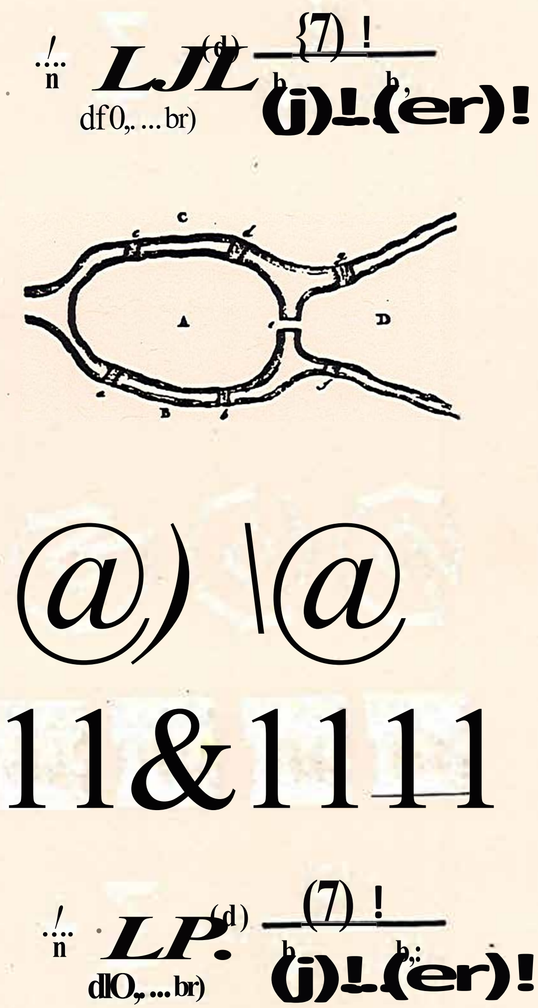

Fortieth Southeastern International Conference on

Combinatorics, Graph Theory & Computing

Florida Atlantic University

March 2-6, 2009

Program and Abstracts

Invited Talks

Monday, March 2, 2009
Ralph Stanton
Butterfly Factorization (9:30 AM)

Ron Mullin
A Framework for Factoring and Counting Certain Polynomials over Finite Fields
(2:00 PM)

Tuesday, March 3, 2009
Ron Graham
(9:30 AM)

Fan Chung
New Directions in Graph Theory (2:00 PM)

Wednesday, March 4, 2009
Heiko Harborth
Some Graph Drawing Problems (10:30 AM)

Stephen Milne
Sums of Squares, Jacobi Elliptic Functions, Continued Fractions, and new Formulas for Ramanujan's tau Function and other Classical Cusp Forms
(2:00 PM)

Thursday, March 5, 2009
Fred Roberts
(9:30 AM),

Friday, March 6, 2009
Donald Kreher
(9:30 AM)

Monday, March 2, 2009 (9:30 AM)

Butterfly Factorization
Ralph G. Stanton, University of Manitoba

Butterfly factorizations are defined, and a constructive method is given for creating them.

Monday, March 3, 2008 (2:00 PM)

A Framework for Factoring and Counting Certain Polynomials over Finite Fields
RC. Mullin* FAU, J.L. Yucas SIU, G. L Mullen, PSU

Finite fields have applications in several areas of mathematics such as combinatorics, coding theory and cryptography. In turn, these often lead to new questions about finite fields. This talk involves such a situation. It leads to a combinatorial counting problem. The method used to solve this problem can be generalized to a method of a wider class of such problems.
This method involves a transform on the set of rational functions over the finite field F_q. For a subclass of these functions, the transform yields a polynomial and its factorization as a product of the set of monic irreducible polynomials all of which share a common property P that depends on the choice of rational function. We derive a formula from the factorization for the number of monic irreducible polynomials of degree n having property P. However it is also possible in some instances to exploit the properties of the factorization to obtain a "closed" form of the answer more directly. We illustrate this with examples.

Tuesday, March 3, 2009 (2:00 PM)

New directions in graph theory
Fan Chung, University of California, San Diego

Nowadays we are surrounded by numerous large information networks, such as the WWW graph, the telephone graph and various social networks. Many new questions arise. How are these graphs formed? What are basic structures of such large networks? How do they evolve? What are the underlying principles that dictate their behavior? How are subgraphs related to the large host graph? What are the main graph invariants that capture the myriad properties of such large sparse graphs and subgraphs.
In this talk, we discuss some recent developments in the study of large sparse graphs and speculate about future directions in graph theory.

Wednesday, March 4, 2009 (10:30 AM)

Some Graph Drawing Problems
Heiko Harborth, Techn. University Braunschweig, Germany

For realizations of graphs in the plane there arise many combinatorial problems. How many different drawings are there? What are minimum and maximum numb ers of crossings? Which numbers of crossings in between are possible? Can all edges have the same number of crossings? How many edges can occur without crossings? Also rectilinear drawings and such drawings with edges of integer lengths are of interest. Partial results and several open pro blems are presented.

Wednesday, March 4, 2009 (2:00 PM)

Sums of squares, Jacobi elliptic functions, continued fractions, and new formulas for Ramanujan's tau function and other classical cusp forms

Stephen C. Milne, The Ohio State University

We first recall the "'tyoach" from his epic "Fundamenta Nova" of 1829. We then discuss our infinite families of explicit exact formulas involving either squares or triangular numbers, two of which generalize Jacobi's (1829) 4 and 8 squares identities to $4n^2$ or $4n(n+1)$ squares, respectively, without using cusp forms such as those of Glaisher or Ramanujan for 16 and 24 squares. We derive our formulas by utilizing combinatorics to combine a variety of methods and observations from the theory of Jacobi elliptic functions, continued fractions, Hankel or Turanian determinants, Lie algebras, Schur functions, and multiple basic hypergeometric series related to the classical groups. We also note our derivation proof of the two Kac and Wakimoto (1994) conjectured identities concerning representations of a positive integer by sums of $4n^2$ or $4n(n+1)$ triangular numbers, respectively. These conjectures arose in the study of Lie algebras and have also recently been proved by Zagier using modular forms. Related and subsequent work of Don Zagier, Ken Ono, Getz and Mahlburg, Rosengren, Imamo\=glu and Kohnen, H.-H. Chan and K. S. Chua, and, H.-H. Chan and C. Krattenthaler is very briefly reviewed.

We conclude with a short discussion of our new formulas for Ramanujan's tau function, including one in terms of the Leech lattice. If time allows, we then present analogous new formulas for several other classical cusp forms that appear in

Monday, March 2, 2009

8:00am	Registration in Grand Palm Room			
9:00am	Conference Opening Session: President Frank Brogan, Provost John Pritchett, Dean Gary Perry			
9:30am	**Ralph Stanton**			
10:30am	COFFEE			
	Sessions for Contributed papers in Live Oak Pavilion			
		B	C	D
11:00am		Gra	13 Emert	@Duncan
11:20am		16 Okamoto	17 Mihnea	18 Schiennever
11:40am		110 Rockney	111 Kemnitz	112 Renz m
12:00pm	LUNCH (on your own)			
2:00pm	**Ron Mullin**			
3:00	COFFEE			
3:20pm	113 Phinezy	Santana	5 Molina	116 McKeon
3:40p		118 Melcher	9 Grimaldi	120 P. Zhang
4:00pm	lliehgal	2 Isaak	Q3 Tanny.	4 Rasmussen
4:20pm	12s Tiemeyer	126 Buelow	Q7 Beeler	8 Hook
4:40pm	129 Voiirt	130 Beaslev	13J Chen!!	132 Everhardt
5:00pm	133 Allagan	134 R. Jamison	135 Froncek	136 Meadows
5:30pm	**Reception at Sean Stein Pavilion**			

Tuesday, March 3, 2009

8:00am	Registration in Grand Palm Room			
	Sessions for Contributed papers in Live Oak Pavilion			
	A	B	C	D
		38 Bahamanian		
8:40am	141 Dufour	42 lninaham	43 M. Lioman	144 Feder
9:00am	145 Sano	46 Raychaudhuri	47 Suffel	48 Garber
/9:30am	**Ron Graham**			
10:30am	COFFEE			
10:50am	149 Park	50 Walsh	51 F. Zhan2:	52 EP-P-}eton
11:10am	53 Roberts	54 Leach	155 Wilson	56 Meszka
11:30am	57 Bohm	58 Prier	59 Li2:ht	60 Abay-Asmerom
11:50am	61 Reiher	62 Pfaltz	163 Levit	64 Lambert
12:10pm	65 Sternfeld	66 Lyle	167 JY Lee	68 Toma
12:30pm	LUNCH (on your own)			
t2:00pm	**Fan Chun**			
13:00pm	COFFEE			
[3:20pm	69 Narayan	70 Fowler	71 Nussbaum	72 Tonchev
13:40pm	r73 Hsiao	74 K. Oiu	75 Finbow	76 Seneveratne
4:00pm	77 Kwon2:	78 Shiu	79 Zemke	80 Fuii-Hara
j4:20pm	81 S-M Lee	82 Kikas	83 SoraP1le	84 Ilic
14:40pm	85 Lo	86 D. Linman	87 Jacob	88 Cummin2:s
15:00pm	89 Locke	90 Lintak	91 Deleado	92 Markenzon
5:20pm	93 Myrvold	94 Sherman	95 Lewinter	96 Slater
16:00pm	**Reception at the Live Oak Patio**			

Wednesday, March 4, 2009

18:00am	Registration in Grand Palm Room			
	Sessions for Contributed papers in Live Oak Pavilion			
	A	**B**	C	D
l8:20am	7	98 McGuire	99 A. C. Jamieson	100 Hachimori
8:40am	101	102 Abbott	103 Bartha	104 Kubicka
19:00am	105	106 Wei	107 Hicks	108 Nkwanta
9:20am	109	110 Duncan	i11	112 Grolmusz
:):40am	113	114 Jaroma	115 Yi	116 Pike
10:00am	COFFEE			
10:30am	**Heiko Harborth**			
11:30am	TICA Meeting and Awards Session			
12:05pm	**Conference Photo**			
12:15pm	LUNCH (on your own)			
12:00pm	**Steuben Milne**			
13:00pm	COFFEE			
13:20pm	117	118 Ferrero	119 Hochberg	120 Steinbenrer
13:40pm	121	122 Factor	123 P. Johnson	124 McKee
4:00pm	125	126 DeLaVina	127 Kingan	128 Salehi
4:20pm	129	130 Bowie	131 G. Gordon	132 P. Chuni!
4:40pm	133	134 Jum	135 Florez	136 Hansen
:00pm	137	138 Laskar	139 Chun	140 H. Su
5:20pm	141	142 Koessler	143 Exoo	144 McQuillan
6:30pm	**Conference Banguet at Deerfield Beach Hilton**			

Thursday, March 5, 2009

8:00am !	Registration in Grand Palm Room			
	Sessions for Contributed papers in Live Oak Pavilion			
	A	B	C	D
&:30am	**Fred Roberts**			
10:30am	COFFEE			
10:50am	145 Soifer	146 Novick	147 Wan!!	148 Kubicki
11:10am	149 Radziszowski	150 Sewell	151 Won!!	152 Vautaw
11:30am	153 Over	154 Sinko	155 A. Lee	156 Oda
111:50am	157 Hilton	158 Seo	159 Kon!!	160 Chen
12:10pm	161	162	163 Choora	164
12:30pm	LUNCH (on your own)			
12:00pm	.165 Arnavut	166 Kaneko	167 Chinn	168
t2:20pm	169 L. H. Jamieson	170 K. Gochev	171 Chan	172 Matheis
2:40pm	173 Starling	174 Tennenhouse	175 Gronau	176 Gao
:00pm	COFFEE			
:20pm	177 Cloteaux	178 Heubach	179 Kaski	180 Finizio
3:40pm	181 Adachi	182 Hartnell	183 Vau2:han	184 Shaoiro
j4:00pm	185 Altman	186 Pinciu	187 Bever)	188 E2:ecio2:lu
1,4:20pm	189 Shawash	190 Servatius	191 Kille:rove	192 McMahon
j4:40pm		194 Dios	195 Beavers	196 Gardner
15:00pm	197 Shahrokhi		199R. M. Low	200 Lant
i5:20pm				
l5:45pm	**Informal Party at Coyote Jack's**			

Friday, March 6, 2009

[8:00am	Registration in Grand Palm Room			
!	Sessions for Contributed papers in Live Oak Pavilion			
	A	B	C	D
18:40am	201	1202	203	1204
j9:00am	205	1206	07	1208
:30am	**Nathaniel Dean**			
10:30am	COFFEE			
10:50am	1209	1210 Tran	1211 Burchett	1212 Pavcevic
11:10am	213	1214 Vasudevan	1215 D. Johnson	216 S. Holliday
,11:30am	1217	1218 Worlev	219 V. Gochev	1220 Lefmann
11:50am	1221	1222 Vinh	1223 Latour	1224 Stevens
12:10pm	225	1226	227 Guan	

l\Ionday. l\Iarch 2, 2009, 11 :00 Al\I

2) Randie Index an<l Extremal Cacti

DLmid Gray•: Hua \Vang. Georgia Southern llniver:,;ity

A c·adll is H c<>rmt-ctc<l graph with each block bdug; an edge or a cycle. The Randit iucl,•x ,, f a graph G is the siml ol ((d(-u.\)(d{,;)\J" O\'er all ,•dg,,s U: cf C, wh rP ti(,,) dl,not<.-; tl,e dq,r,,• of tlw vr-rt(•x ·l; o E [- 1, l] is not. Z<lro. A cuct.tts is c,,,l:rcm'T if it achieves the maxilml111 lmiuimmn} vnllll• f,)r th1? Randie; Index m1dcr <xrtail1 n striction. . Tht: <:xtrcmal (-l1<ti nf thr- llandif. index huve h<ll fXtf'TL ivfly studied lwforr-. \V., will pnwidc a ;;implc t('(•hniq1w fur finding t:xt.n:mal ca.cti il tli'-- ca-5c α = l (the weight vf a graph). A form11lu for tl11' ,i.:l'ight of the graph ca."ily follow:,,. \Vt• will tilso explore variotL') ca-K of i•xtn•rnal nwti with given IJmubcr ,,f vcJ-t ir.cs 1 pendant <<ig<s aud <'yclcs.

K,•yw,mb: n.,u,di(: index, Cacru,. Extremal

3) Guideposts in the Cyclic Towers of Hanoi Problem

.Joh!, W. Em,•rt. llogcr B :\"clsoH", F 'a rk W. OwNt, (Ball State University)

Tll<' multipl<• tOW<l8 <f Hunoi p11zz< 1 with a llircctt."<l cyd<' t ron.-,itiou graph b a va.rill.tiou of t.h" dassk :l-post t.,,wcrs of Hanoi pmzk• to a puzzl,· with p posts, wl1crc p > 2. umber Liu posts so that 0.1,2.....p - 1 , 0 is a dircct,,l cycle called the tnuisit.ion graph of the puz,lc. Dcsiguau' onf post as sonrce. post S and anotlwr p,,st as rlt-,;tination po,;t. D. TherP aTc n di8ks. no two of which ha'-'(the 8amc cliw-nt t.cr: 111,unh.—nd 1: . . . , 11 iu or<ler of incn.:asing diarnct.cr. Eacli disk has a ho!,• in the ccnt,•r so thut it will tit c,v,;r a prn;t. lnitiull,v. ull 11 disk, arc ou post S. A disk may be moV<d f 'om the top of post i to till' top of post *j* if und ,,11ly if thr mov,, will not re.snit in thc disk being phwed on top of li di:-k wil11 smalk·r diameter and post i is the pred..-'<:cssor of post J il the t.nmsition grttph. Tlw problem i:; to dctcru1lll< the ruinimmn munbcr of moves H<]Hn'Cl to tra.w,fer all the disk to post *D.* Eqttlvi1leutl:v. oue Sl ks a :-,hortcst path (gco<l, ic) bdwt'<'II vertices in the t--tatc g 'aph of the prc,blcm corn-;;ponding to *5* aud *D.* This ,tat,, gmpl1 <on.sists of p" Vl'rti,'c., reprr;,<'llting slat. tog.,t.her with dirN'te,d edg n presenting lt•gal moves l)('t\vecn xtl.1tPS. The li•db1k stat graph is a fibrati,,n over the (n - 1)-disk state graph. This structure and rclat<:xl s_ynu1wtric:; ar. exploited to id<'utify <lbting11i:illt.'d p'>ints (b'llid.,•p'>:-tr;) such that ut len,,t Vil<' (O(h-:-ir. lwtwt-c11 so11rcc and .k-stirn-Jti<JJJ :-.ttit• <'Om,bts vf a 1mion of .-•o<lics bl'twcc11 tlic• g;uidept,sts. 1'-eyi.vords: nmltiplc. towc-r:». l-JaJ1oi: transition graph. tihration. symmetry.

4) An Extension oft.he Bell Numbm· to Graph Theory

Dr_vn\ Duncan: Auhurn Un.i\'(•niity

FG a finite sd.. th• rnunbn nf pf1rtit.ioniu or tlw Cl<-tnrJ'tts into non-cJnpty sd.:; is kll<wl1 a., tl ie Bell nnmhc,r. Ext.,•nding this to grnphs, the Bell nnmhcr ,11'" :;rnph is th,· 11umlwr ,,f panit,iunings of the vcrtt'x :;et iuto no11-t-mpty indcpr•udt-nt S<t. Th<: Oell number fur C<'rtaii1 cln;,<s of grnpl1 i known. thCJugh tcdmiqm·s for (\ntUHcratilm \·ary by d a. i

l\c_v,\·or<.b: blIHph theory. d part it.ions l\fouday. March 2, 200!), 11 :20 A?\I

6) Powers of Paths and Planarity

Gm-y Chart.nwd. \V('st<rn).,fichigan Uuivcrsit.y, Flit aha Okamoto•, University of \Vbcou in - La Cross<', Ping Zha.11g, Wt-'">tt-rn -Iid1igan Uniwr,ity.

Variotl.'> mca.•mres of uoupla.uarity of certain powers of paths art'; inve::-:tigatcd. Some rcs1dts and c1l)OJ proble1ns arc prt sc11tcd.

Kq rw ord : powc.:rs of paths, uonplanarity.

7) Image and Video Compression Based on Permutations

Amy '.\!ihnrn. Florida .-\tlruitic University

PPrmut.ations nm lw applied to compn-s."'i fairly :-,tatic: vidtX> S{'<1m•uc 11<h us thos<.' ust•d in vidcoconfor,mcing, llrVl'illanrc vid,•o monitoring and medic,,! nmlt.inwdiu videos. An effidr:nt way to reprt'S\mt H pcrmutn.tiou resulting from an image is iutrodure<I. hHs>d on th€ pllttern.s found in suc-h permutations. \Ve rompar<' somP. types of regression 10 see which giw-s the best approximation of tlw inverse pcrmutativH. llt'<-Xk-d to recover un image f 'om ibi sort<-d Vl'rsiou and we disr.11ss the po ibility of u.,;ing :-,omc: rc trkt("'() p<'rmuta.tio1L-;1 which a.'e d1cap to represent. We r-xt.cnd an 11lgorithm by D. SoC<k N, al. 1,2006) tlwt u cs permut11ti{)]1S (,ft.he pixds of ..ruh franw to triltlsmit a video S{'(tllC]lrt•.

Keyword : }.H.'rn,1u1tio11: vidt'<> <:on1prcssion

8) Approxhn.ation algoritbrus ror the ruiuhnurn rainbow subgraph proble1n

St<'phan \la to. C:u11ad10, lngo Sdii,•rrn<•yer•. Zsol t T1t1/a T<'<-lmi,;clic Univ<'rsitiit !3crgakad<'mic Fn•ibcrg. G(•rt1ia11y

\Ve con id<r tlw \Ciniwmn Ha.inhow Snbgraph problem p.lHS): Givf?n n rapli G. wh(,SC edg,-s are c-ol,,um.1 with p ct>lonrs. Fiu<l a ,mbi,'I'a.ph F - G of G of mininnuu order a11d with 1J c<lt''S s11dl that each colour occ:ur exnctly OUC('. Il1 lhb talk wP will pr<(mt IIPIH'r aud lowt•r homuh, for th(• ordt?r of t.ht mi11J111H1 r11inbow ubg'aph F': F)r graphs with nwx:im11m degree- Ll(G) there is a fl•udy po}ynmnial-t.ime approximat.ion a11)rith111 for tlu: :\JRS problem will, "" 11ppruximatio11 rntio of (G): W,- will prc-;c11t a p,)!·11omial-tiu1<· apprt>ximation algoritl1111 with an <l.pprt)Ximati<Jfl rati() uf .

KC'ywor<ls: Colouring. iinimurn rainbow s11bgraph: approximati<,11 itlgurit.hm

I\fonday, March 2. 2009. :J:20 PM

13) Graphs \,Vith Neighbor-Distinf,'l.tishiug Sets of Vertices

F\1ta.ba Okamoto. Uuiv(;rsity of Wisc(Jr, in - La Cross<', Bryan Phinezy· 1lnd Ping Zlwng. \V(:skrn):lid1i 1tn lJniver it.y.

Sets of v<•rtice:; in a comll'<'t('(] gnl-ph an• studied thilt us1: dbtr'Ul<;: t≤ distin&ltbh every t,w„ adja<:ent wrtir,!s in the graph. W(• prr-s;-nt som,• results ill this urea of res ard1.

I\cyword: dit-.u1tc:, <lhitingui hin::; vcrti<;e:-.

14) Cyclically Simple Tournaments

1k"h>k-l Santnna · : I<. B. Rdd 1 Cnlifornî11 Sta.t,l' U11ivt!r:–i1y S,w -fa.1Tos

\Ve gh.-t a n.:vi xl proof of Z.liukm, \'hu.radcrization of t·ydic;a.lly imple t,mrwirncuts. Tht.,e an:' orieutati()us of <;omµk:k gn-iph:-: in which tlw intersection of a n-y twn cydt..., is t.!it'hcr r•mpty or a path. Thi• uwln result diarndt."!riz tournnmc:ut thnt Mr both strong nnd <ydi("1dl y simple, und it is ns,x:I to complete the full ("huracteri>.»tion. We d c'fnee that there is tho•n\ is a uuiquc strong rydically simple tournament of ead1 order.

I\eywor,l: tvllman1<>J1ts. eydically s1n1>h- tourn1)m('nts. tran.-,itivc to1irnarncnt 1 strong tournm11ent

15) On the Couverg,mce of Roots of Generalized Fibonacci Polynomials

RuL>N t \foliu,,· (Alirm College), Akliht Zl'il"k(• (Lym11n Brigi,-i; C >llcgc. \Jid1igan St11t<' Uni–vcr!'>ity)

Pork_:: 1 dcfinP th" gen rnliw>d FibonAc-d polynomi11! s.-p,c-nce (C } hy Gf;(x) = - J , Gt"(:.') = .t - 1 MHI for 11 2: . G(:.r) = .c';G,.M1 (:,·) + 0,1--2(.c). Lcl 9; d<?1olt.' tit<' 111n<l11wl1 root. of C n. \V:• will prove that for each k 1 there ,:xist J umnb<•r 01, with the pr(J1]l rfy **thc1t the odd-iudc."{c:d** .9!'H converge **rnonot.mkull.v to** 01; **from bcl„w and the** cvcn-indcx(>i.l *gf;'s* convt.rg-i= monot onicilll y to tt;. from above'.

K1•ywonJs: Fihonuc;ci pol ,i 10mial rt)(Jt. <\n1vert1<t·

16) Generalized Chromatic Numbers of Graphs with Bipartite Complements

r,ut!Mm A. \-Ic-K„1n. (<1111K·ticu1. Coll<•g„

Tlw cm,d,tional dm,11i.atic rnunb,•r c(G, H) of a graph C: with rcspt'Ct to" snhgrnph H is tht mininmm nnmbc.r or r.olors nc•(Klcd to color thP ver1ir.PS of(: snd1 thut uo r(,lor cl,1ss c,11tai1L'< a subgraph of C i,ornorphic lo H. i.e., H is a fo-'biddm .;ubg,upl, i1l <11-l, <ulur dnss. W< itW(.">tigll<• the par11m•U:r l"(G. l/) wl,r-r<: th 1:omplc11wnt of th,· graph G is a bipartite grnph ,ind th,, ubgraph H is ,t 1m,mber of varions famili(..-, of graphs ind11ding patlis and cycles.

Keyv:unls: v(•Itl'X <:0k,rittK ge11cn1lizcd d1n,rnatic wuulwr. hipartitt.' gmph:–

1vlonday.]\,Jareb 2, 2009, 11 :40 A'l

10) The Infiuigon aud Its Properties

R,,lwrt A. Bed,•r, Alb.,a A. Rockn<'y•, Cassi<' E. Yl'urwood. Ea.st Tcmlcs.s<'<' Stat,, Uni,wsii.y

Tlu• i11fi11i$_g$ o1t is a).!raph Ct)IL',trndr•d by ir1scribing i, triangle into a drrlc$_t$ follow<–<l by a !,Cjlla'C: follow(.'d. by ;i circlt·. and &) on. In ca.di ih!rM.ioJ1$_1$ we iucrca..,c t.lw nnmlwr of !'lidl' (Jf t,h(' polyg:ou by u1c. A grnph can h< ohtniucd hy pladng n vertex nt each poiut nf inter!'l<'d,ion. \\·, n>toV· pvl vhom; wlwn 1w<c–st1ry t> avoid O\'Prlnpping \'PrtirC'.''i [n this t<1lk, we will <lbc11.ss prup<.•rri, of tlw infinigou: indtu.li11g vertex iu1d edge counts. n•rh·x degree., Euler aud Hamilton t·yd(::-,. V'.:rtt!..'(and (:d{l; cliromat.h m1mhers: and pr<Jpertics related tc, di:--tmet.' a11,t cc,nncctivity.

11) d-Strong Edge Colorings of Graphs

Arnfried k(•nmitz., llfossirniliano !llarnngio, Tcdrn. Univ. 13ra.m1,d1wcig. GrrmaJl,Y

If < : *E* --• {1, 2, ..., *k*) is " proper r,,Jgc <:olorin!(of n ;ruph G = (F. £) then the palette S(u) of a vc11ex c E V is thr set of Nk,rs of the incident ,•<lg'8: 5(1') = {c(c) : e =uw E E}. An <lg coloring c distinguishes V<'rtic,-s u and v if *S(u.)* ;f S(,•). A d-st.rong c'<lge coloring ur G is a pro1wr edg,· coloring tl,at, distinguis.lll'S all pairs of vcrtic,-,; u an<l 1• with distance *d(u.* ·1) =5 d. The mini1mun munlwr of culors of n d•strong <<lge <;o)orittg is callc:d ,l-strong diromnti<.: i11<k'X *X:/C)* of *C*.

\Ve will prcsn1t !0111l' gt,mcraJ results on d·s1 rong c·dg·f^1 coloring.-. as \\·ell as spC'r.itk results for paths and cycle ;uu.l a gcr1Prnl conjcctur<.'.

hc•ywords: edge c-oloring.-s: 8t.ron!{ d1romatie indt-x

12) Hamiltonian Labcliugs of Graphs

\Villein Rt'ni'.c111a* a11d Piug Zhang. \V(-::it•·ru Hcliiga.u UniwJr:-,ity.

A Hamiltonian lnbt ling; <•f fl graph G of ,xd0r n ii: a vertex hd1,:-:liu;; c for whkh thP smu of !c(uj - c(vil an<l th(• l ngth of I lon"st u - v p11th in G is at le-ast n 1;,- every pair " ," of two db;tind. vc-rtkc:, in(;. \Ve inv<'::itig;1.tt\ the· minim.um k for which G has a llarniltoniu11 labding. all labds of wl1ieh lwlong; to tlw sd f1, 2, .. , k}. Sc,rne re,ult, and c,p<:u qtt,:stic,ns invoh:i11g this concept ar dcsnibcd.

Keywords: dPtonr distarH'<": Hamilt<,r1i,u1 lahding.

Mond a y, !vlarch 2. 2009. :3:40 Pl\·!

18) Reachability in Arc-Colored Tournaments

:Vli<:had \k·lchcr*. Ii:. 13 R,,id. California State University Sarl \'larcos

A monodirornatic :-ink in nn arr--evlorcd tc,umainent h; \ v,•rt(•x that. <al1 be r<;wht:<l Uy every oth·N vertex in the tournament. by a mo110<:hrom1ttic puth. A raiubow k-t'yc:.le iu an arc-,·olorc<l tournruncnt is a cycil' with k arc-; sud1 that 110 t,vo ar in the cyck· huvc the scLinc color. :Vlotivatc<l by a conj'x tnn· of P. Enlo''s aud t\ (-,mj<'r:turc hy Si:inds, Sauer, and \Voodrow, we investigate the <'.Xistf'Jlct of monoduomatic ink-:; in CC'rta.in tournaments without ra.iubow 3-cycl ; the tournaments considcn·d urc tournaments obtain(;-d from spt'<'itLI ;11c r<;vcr:mls of tra.rn,itivc tourna.nH•ut:,. Among the tOlU'IUl,mPnb inn-stigat,<.'<J u·t• ups<'t t:un rnai nr·nt:;1 tourna.rflC'.llts that mp oht ai1wd by rcvcr:-;ing the nrc;,, in a p:u.h f 'om the so111ce to tlw sink in a tr;mi;itivt> tonmam1,,::nt,. Hesult.:; from the likrat.un:· and 01J1c- open probl(•ms will al,o be <li:;-,u:,,L-<l.

Ecyword : t.oi1rnanwnt 1 arc- olorinbrs. n1onodH"orm1tir path.;;. upset tourniu11ents

19) Arrangements of l\•farked Dominoes

Ral1>l1 Grimaldi. Rosf'•-H1LJma11 [n:-;titut<.• cif Tl<lmolug,v

\V0 considn tW•l t.vpc of mark e l domino : (1) Tho ·· with two dot:-; un ,:ad1 fact•: a1id. (2) Thos{\ with me dot on one fl·Ht• aJld two dr,ts on d1P vther. Th<· Sf.ond type can hnvr. th,, fac,, wit!, one <lot on it.her the· 1,ft fan, or tl1<, right fa<'c (and one ,u d, do1niuo can be rotti..t<,l er:al-to-cud to prodnn• the other).

For ca.di posit.iv,, integer n wP eount the munbcr of ways W(cnn am&11gc 11 1f tl1c:-;, two typ1:-. of dominoes in a line so ttrnt tJw number of d<ils on the rir,ht face- 1f t";Kh domino (,•xccpt for Lh,, lust) is th<' s,w1e a,; thl' numl, r of dots uu 1he l d l face of the dorniuo tltat. folkJWS it. Thi:-. providc:i a.not.her :-,itnation where th{' Fihouac:ei rnuuhcr:,, tu·b(•.

Th cn, co1L-;i<lering all tJl<' p<J.Ssiblc ways ,vc can arnutg<' th c u domi11t><' 1mder thl t• coHdit.i<Jn: W(tonnt (i} the total munlwrs of face:; ,vith one: dot and thP t<,U.tl rnunbcr with two dc,t.s: (iiJ thP. number of k•vr,b, that. oc<'ur thl1t i;;; the 1111mb•r of times we have a co1ci<'u1ivl\ pair of fac, with the san1e nmnber of dots; (iii) the nnmber of ri s r.hut oc:cur that is: the rnunbcr of timt-:,, we hw<' t Cl)HS<.'-llf.ivc pair uf fa<:(with oni dot Of tla first foce and two <lots on tl·c s1,·ortd face; (ivi th,• mm,h,,r ,,f descents that c,ccnr tlrnt is. t.h,, llUlllhN uf timc-;s t:1,Ne H n con:--ecutive pair uf foecs with two rk,ts on tlu· fin,t and vm· on the s<'f•(m,l: fmd (v) tlu numbt:r of nms t.hat ocrnr tiv1t i th<' numl:)('r tim1-:, wt· ha.ve eon.-.e-cutivc lists of fuct>:- with Olll' dot (two dot:,;) wht'rc each such list i pn"-·cdt,I by nothing or t fact' with two <lots (c,m' dor.) and is followNJ h, uothin or a fa(:<' with t,i·l) <k'Jb, lOH<' dot).

Palindromii-: arrungC'TnC'Jlt/'i <Jf thPsc dl>tnilllH.'S ar. i:Jso c·n1L;;idt·n:d.

Keywords: Fib,,ruwd nurnhcrs. dominVl'8. arnmgcnwnts. l<:vd:-, 1 ri ('S, <ll>sccut.

20) From Checkerboards to Graph Colorings

Gary Ch»rt.rnnd, \1\-su•rn 'lidii1s,1.n Univ<•rsit.v. Fntaha Okamoto. Universit,v of Wisrnn.sin - La Cr°'";;_•: Ebra.hilJl Sald i i, Univer:-:ity of \"evada Lns V<'ga,. Pil1 Zhang·. \Vcstcrn \[idtignn UJ1iV('f'Sily.

A dw\'knh(Hl.rd probk1n is introduccxJ. Frum tl1is, a '-L'rt.. x coloring of gra1)hs is s11ggf-sthl whid1 rc.••mlt; in ;om(• c-vloring probl<•ms.

I<r•ywords: dieekerhoard. vertecx coloring.

l\fond$_{ay}$, March 2. 2009, ,1:00 P\-J

21) 4-cycle systems of the line graphs of completl• multipartite graphs

Dr. C.A.Ro<li;cr, !\i<lhi Schi;al*. Auhurn Uuivcrsit.y

In our la t talk W(bridiy r<'vicwed the neces."iary and suffici<'nt couditions for 1hc c-xbtC11<e of •l-r.ydc yst,•rrL-; of Uw line r,n\phs of (X)rnplctc multipartitt' grupll.'). \Ve ht1d con<;t•ntrate<l on th" Ct>< where ,ach part of th,: omplctc rnultipartil<' grapli had r,vcn siZ('. ln this t,alk the cvcJ1 ca',(' is r<•vh•wcd. thCJl w-. will introd11c1.· omc c-o11.')truction-; for thc ettse whr,n each part has odd size.

Keyword::-: ryde ;,::,y!,tCtn. line graph

22) Monotone Reachability with Short Paths

.Jone-Ile Hook, Gnrth baa.k•·. L hi!(h Uniwr,,it.v

If we { color the arcs of i:LlI)' nitc.· tonrmmwnt cnn wend a sink i:e>t of 3 vcrtic sud1 tha.t therc i: a mono<-hn;,1 nat-ic path from every vert PX into the sf>t'! rrhis b a sp(-cia.l rase of tlw monotone reachability problem. A :;ink &'t, of,;,., I can be fowul if only 2 colors are 11s;d on lV('ry triangle. \Vt: UsC a simple reductiou to sho\\. thut n ink set of size 3 cxi:-,ts if the trn.nsitive dn,11rc for om of th<: color!; ha nll p1 th-, of length .J or no inc.kpc-n<leut set of size 4.

Keyword: t011nrnments

23) Graphs and .l'vleta-Fibonacci Recnrsious

Abra.barn h guri David Reiss iv1d Stcp}wu Tanuy*. Dcpartrm:ut of :\1utlu.·mntic . lluiw·r::.ity uf Torouto

for l: > I 1111d nonncg11tiv0 paramctns a_0. b_μ, p = 1../;, rl"fin<, Lhe recmsion C(u) = I::(n - a,C(11 - $b\mu$)). dmot<'d i1l short by (u1,h 1, a, . bt, . . . , a,. bl). -hwy well-k11ow11 mela· Fibonacd rt.'<'llrnion: with nppropriatc iuitial C(Jndit iow;, are :·,pl·<:ial cH'-(.'s. iududing the HofstmlU'r Q-rcemsion (0,1.0.2) and tbl! C,111olly r,x·nrsi<>n ((1,1,1.2). w., fonLs on part.ic11lar choic,,; for the p11rameters and initin.l conditions that le<ld w solations (,eqnc11r<'S) tliat arc l o\\; ::v·o\ving: that is. the st'<Jlll'UC(;ut:- rnonotonc uon-<lcnr·asing nnd s11fx·cssivt:: tPrm:-. diffrr by (or 1. \V< discov<'r u d1ar:tc:t<..:rization of :i(1mc families 1)f pariillll'H't'h for \vliid1 \\C CdUl dcmou rrotl' a fasdrll\ting COJUI\X:tion lH'twr•cu the,<.' low growi11g metu-Fihonucci scq11mccs and iufinit• u-0cs with special lahcling sdwmcs for the nod,-s: in (•11(h ('lo<' the SCi"llll'UCC connt.s tht! 1111mlxr of la.h,.b ou the lcav<-s in particular sub trf\'!:, of the trCPS. This work ext<•n1ls u11J w1itics so111p recent contributions by Rtt'-ikt\y and D1.·ugau cuid Balarnuhan. Zhiqiang <Ud TiU1ny.

Key \Vord.;: l ı'tt1-F ibona('<i rcc11rsio11; Conully rec11rsi,,1,; slow growingst<1111-11c<; info1ite l,inory tr:"<.

24) The Set Chromatic Number

Crai. R1.tsmnsscn. f\a\-a1 P(l:-itgradnatc Sd1ool

Gin'n ı nontrivial gn1ph C = (l/ı E L bt < , V -• 1V be a Cl)loriug in which ndj;h:<;nt vi:rticcs arc aJl<;we<J to hav,· tlw :,rune <0101: For cad1 vcrt<'-X n (• F . define th(• nr-i!d1horlH,<,d color set NC('F) to be the :-tt v(<t>lhr:- \Lil<l in th,, ncighhorh1)1J,l oft!. Thf• coloring,; is u sPL colorini; if 111> E £ implies NC(,,) /, NC(·,:). The 111iJ1inllm n11mhcr of r-olvrs n•qnircd of a set. C\Jloriug b \•(0). th set chromatic uurnl,n of G. Thb talk will pr<(•ut •,rm' ha,-;ic n-snlts.

Keywords: Graph culoriug. et eoloring: ndghbor--dbtiug1 Lishing d ,luriug;.

lvlond$_{a\,y}$, Mardi 2. 2009, 4:20 Pl'vl

25) C-4 FactorizatiorLs with Two Associate Classes

C. A. Ro<l11cr, L A. Ti<'Ilicycr*. Auburn University

Let. ,l', = l,(a.p: 1 $_1$ >j 1„ tbc multigraph with: the number of vcrtic,-s in t'ach part equal to u; r.he umnlwr of p,u·ts equa.l to p: the nmnlwr >f ("(lgcs joining any two vertil:<!-i of the Slim{' part ('qtwl to ,\ $_1$:-ind the numhc:r of <.'flgl' j1Ji11ing any two vcrtir.r:s of differ<:nt parts C<Jllal to ,\. Tbi grnph was of int(;n.:t t.> Bo• and Shimmnoto in thdr study of group divbiblc dffiign-, \Vith two as."oc.iate dasses. cC(,;a y and sutficir-nt condit.ions for tl1<' existence of ,:-cycle· d<\.'Omposition!) vf thi:; gJaph havl\ lHx·n found wht•u.: E {3. 4}. The exi kuc<.' of n-;olvubl<• -1-cydc de<;ompo,'itions of /(lws bx<l1 ·,(•ttled wh<n ,tis t.:vcn. }mt thl' odd ca!,{' i: rnud1 111ori diffknlt. In this papcr$_1$ m'ccs.-;ary Hild sufficient conditions for th<' exist enc of,, C4-fa(·toriz„tion of A'(a.,p: >.,: ,\,) ure found when a ≡ 1 (mod -I] and > $_1$ is even, u1ld suhslautial µrugrcs, is made in the case where > $_1$ is odd.

l,rywords: factorie>1tion. grapli th ory . .J-c ·des

26) Equal Full {O, I}-Matrix Ranks of Local Out-Tournaments with Tournament Strong Components

Zachary C. Iluclow' and Kirn A. S. Fuctor, ::V!arquctle U11ivcrsily

Find dassc"!-. of <litl.phs whoM· ndji1ccnry m,1trirf-s have ('qtml {0 $_1$ l}-ma.trix r nks hns h:;-(H approa<"h(:d from several diffl'r<.'nt augle'j. In this t.alk, \V(look at the real. 3c,1Jk•tu1, r, mncgutive intl'gc•r uuld t<rm rimk:-, l)f adjac<_:ncy mat.ril'{:-i of local ou.t-tum,wmerd-'i. A local ont-tourm.u1wnt is a dip,Taph where tllf• 011t:;ct uf <VC!',Y Vt!rtcx bu. to11r11unr.nt Hl'rc $_1$w< limit the ron t rur.t.ion of t.hc out.-tournuml:'nt:-. tf, tl.tCN wh<]Se strong cornponf•1us ar{' tonrname11t's. \Ve explort.• corLstruccions where 1\I ranks ar(• ('<Juul arid the matrix b uonsingular.

E,•,-words: {0.1)-matrix runks. Boolenn rank. nnnnPgatiw integer rank. tern, ra.nk, local tu11ma111ent out-tourr11untut

27) Valuations on Graphs and Their Direct Products

Rob(rt A. B,-eler, East Tc1u1,-:;s,·c Stale University

A dcco111position of a i(rnph H liy a grapl1 G is a partiti„11 of LliP „l1;c ,et of H snd1 that, th snb aph indll<'Ni hy the 1-•d{S in cad\ p. rt of the pl1rt.iti{Jn is isomorphic· to(;. It is well known that (graceful h.1l,<·lling of a graph O i11d11ct> (cydi<: G-<lPcurnpositioll of a rornpl ı rc graph. B<lt•1'r ,md .Jamison cxt<'f1dcd thi:– notiou of grncl'ful lahcl1int h> that of 11 gcnl-r,il vuhttition iu a cyclic ;roup. Thtc\ yidd cydi<' lilCCJJJ1positi0!.1<; of cirC'u};mt r11ph-,]n thb, taJk, we will 1.xamine tlw pr1.1bk·m of Vt)hu,1.lious il all arhitrHr,v group. Thb, will .Vif'ld a d("<:ompo:;it.ion oft\ Cuylc.v grnplL ns wdl us tl1e structure· of the a.sst.,datC'd iutersr"<:tiun graph. \: (' will ttlso cxrunirw the problem of <:onstruc:t.iug: raw valuation::- fnun ol<l 11:-ing din=t produ<;ts of th(;ir ussoci11.tc<l groups. Ju tbis way. W(will c.kfiHe new prodttd on ,raph::-.

28) Star Avoiding Ramsey Numbers

Jv11rIl<! Hook·\ Garth bititk, Colt.on f\l11gwu:1t. Ld·1igh Univer,-.ity

Th (grnphJ Rnms(\Y numhr-r $R(C.\ H)$ is tlH' ::-malle-;t i11h\1.r H sndt that every 2-cnloriJJ .)f tlu· (ds1. of 1(, ('ontains cithr•r a red eopy of Gor a him: ,·opy <}f H imd t,herc exist:,; a 2-coloring of J<,l-l that docs not rontnin a red copy of G0r n blue <\1py of fl. \Vha.t is thr- larg;est :-;tar A' $_{1k}$ that (:au 0e n1novt'<l from K$_{n}$:;o Lhat thl' uu<lcrlying graµh is .still forn'(.l t<] havt• eith<:r n red coµ:v Of Gor n bhw <{)>Y of H? Tlmt hi: determine the laqt-:-.t iut<:gcr /, such tli;.1t ('Vl"ry 2-,·oloring of A·„ - h·u: has l'ithcr n rd<l Gori\ him· Ha.ad tl1r.rc exist:– a 2-f't>loring of $J(_{.} - J($li,+1 wit.hont a rt (:(Jr a blue H. \Vt l1av(• detC'rmined thi:-. iut cgcr for some dns. es of graphs Gand /-/ wl1crr· U(G,H) is kuown.

Kc,vwor<ls: Ha.m<:y umnbcr, r.dgc-C'Ol\)t'f:d grnph

Monday, March 2, 2009, 4:10 PM

29) A special list coloring problem

:Vlargit Voigt. Uniwrsil.)' of Applied Sci(:nccs Drc,dm. Gcrmauy

A *list* w;,igmnenl. f. of C is a ftmction that assigns to <vt' ry vertex,: of G • s d (list) L(vj of <:olor,. Tlw grnph G is m11<d L-list t:0lornble if there is • <:oloring,; of the ,wticcs of C sud1 th>1t ,(,:) E L(v) for nil o E *V(G)* aml p(11) Cf ,:*(w)* for "II 1w E *E(G)*.

.Jonn H11td1inson mentioned th,· followini; qn,-sti,m a,k<'<l by 13mcr- ltichtcr whrn• d(v) denotc-s the degree of v in *G*.

Let G he o plu1u;1·1 ?wc01inc'ctcd g,-aph which is not a comvlek graph. ls G L•li.sl colmnhlc Jo,· <vc,y /i,t assig,wH,nl L vt/1 jl(t•JI = min{,i(t·),6} fur „111, E V ?

-fore g:cnt:nJ we may a-;kcd for \vhid1 pairx (r. k) tlu follvwing qncstion is ;u1,-;wr-n11 in the «ffirmative. l\otc that a Gallai tree is a graph C sur-h that. <vPry block 0f C is Pitlwr a compll'k gTaph or an od<l cyclt\.

let r nnd k be i,deger, a11d let G be a }'lmmr ,. -cu,mected yrnph which is not a Callai tn•,·. /; G L-li.,t c:ulrm;ble fm· rvc171 l •t assiy1!111ent L with IL(,,)i = min{d(v), k} l

The talk !-inmmuri%c:: some n ent r<ults arid op<•n problcrn<, C:(JBC<:min t,his qm:!,tion.

I(cyworc.b: list coloring. plaua.r tr;\phs

30) Imbedding Partial Tournaments

L•:Roy B. Ben.slPy. Utah State University

Lf•t, D o 1,-oplPSs dighu frec dirc('ted grnph on 11 vurticcs. I3ttsed on row and/or colnmn :,mus: what. is thc smalk':'5t, N such that D can be imhcd<le<l i11 a rpgular tuuma.:nwnt on N vcrtie;(...., Th.is qm•stilm is auswcrt"<1 in sonw SJ)('f:ific <:ascs.

Key wonh,: 'lo11n1a.u1cnt. :-t1br.onn.1i1111ent imbc<tcling of <ligrn.phs.

31) A kind of conditional vertex conuectivity of Cayley graphs generated by transposition trelS

E<ldi,' Cheng·. L;\,zlo Liptak, Oakland lfniwrsit.y

Ld G Ill' t flph. Tlien T (; F(G) b <'fllkd an U²-1t;1t c:c-n1l if G - T i s disctm1w<:tt•d **and** eacn v,·nex in **I'(G)** - *T* ha., iit lcat '"'" uei hbor,; in **G** - *T*. T11< size of **I** s111all<'St **R2-vurt(•x-cut b** tLH' fi':!•v<·11.n;-(;vun,;,:lit'1ty of C: **and is dcuohd** hy **ri² (C). \V, determiuc** this number fo r C a, ley t,rnplu, g:c•ncrated by t.nmspositiou trCf-.

I<eyw1.)rd:,: C i\le y gnjph!->: t":u11ditional \"Prtc:x cotuH\'ti\·it,

32) The Distinguishing Chromatic Number for the Product of GraplL'.i

Robrrr. A. B"dcr. .Jackie L. Ewrh11Plt Ill'. E>1st 'fmnesse<:., Stat.(• Uniwrsit.y

Tlw disti n gui,1hi 1g chromr:,tir; numlx:-r of n a raph C i:; tht' ininimum munhcr i)f color:i re411i r c d to la b,-l th e vcrtice:,, of *G* in nd1 ,t waY that JiC) two adja<«•nt \'Pttid':-- :-lutn• t.ltc same colo r anti no aut.ornorphism t1f t.hc graph pre;< rves aJl thr· colors. Thb t1otiu11 was intro<lnc<:'<l bv C o l1il 1s and TreJ1k wliC'rc th1:y gan• t)H' disti11gubhi11g cllnJinittit· nurnlwr f0r st'Y<'ral cla!-ISCl of simple b'Taphs. 111 this tdlk: wt' c-xpau<l t11b lo tlie Curtcsiall prodttd ..:r nw, i;rnphs. Tl i<sc graphs will inrludc tlw path, tit(• eydc, tlH' ,tar. ,md th,• c,m1pk•t<, gmph.

33) Choice numbers of some complete multipartite graphs

A.J. Allagall" and P.DJoluts<Jn .Jr., Auburn Uuivcr,ity

E t.imak:--. ,u,d ill some ca'il.':', (;xa<t. values. ;up 11htai11cd oft.he choice numbers of some <:omµl<'h' multipartit<· grnplis in which all parts ex cpt on,' arc ,,!' sizes l or 2. Th;>s<' n,...,ults also , tima.t<:, nud MJJHPtim(:– 1J,•k rm i 11c. tlu· Ol1b;1 111111h(r of tlwsc:? graph:-:. Tlic Ohha n11mlwr ,,f IJ. (finite simple) graph is the srnnll,-st order of a cliqul' sud, tluit the choice m1111ber a1ld the d1rom1Hk number of the- join nf the graph with a cliqnc of thut ord(?r arc l'<tllul.

l<0y wordH aud phrasC:->: rhoi<t." number. rhromatie nnmb(•.r: lbt coloring

34) Small Chords in Mix Graphs

Rob<>rt E. Jami.son. Ckm.,on Univ,·rsit)'

hmy :;-riiph d,'l,i;,,_-s ran }){' flcsrri11-1<l u::,;in roughly t]1e following paradigm: f'11ch vPr-t:"< b as:;igni::<l s1Jtn<'thiug n1eatiuring its Sl:.e a1ld som1.thing: rnu•:c,11ring it-. *tolenmcc.* ff the <;ombinc>tl sizl' cxc;<C<l the C()mbin<>t-1 to lcm.nee:; 1th<'n tltl'n' b u c,mfH<;t un<l the corr<-spow.1-ing vr.rtic:c lue 11dj11tcnt in a *conflict* !J1Ylph. In tbi:,; paper tlw fnnetiom, rombiniJJ sizes a1ld tolerances are 111ic fnnction. 1 which intcq)<•la.t,(' hnw('t'.l 111ju and nwx. Thb work is an <-xtc-nivn or ,vork by .Jacobson. Lehcl, flncl Lt.-sniak on ¢-tolPrancc graphs. Strnc·t.ttnil prop('rtit'S. <'SJ)(.•cially th'.! existence of dttJr<l-: nnd ronn(•(·tions with othvr graph dt cs will h< dbc11sc-d.

l<c•yw(,rlb: iutcrscctiun graph. interval grapl1, tl1r<>Shok-l grapl1, tol<:ranc:c grapl1, .:p-toleraucc<' graph: lwrcditary gnlph da . gT1p1 rnpn'S<'nh1tion.

35) Cyclic decoruposit.ion of cornplct< g:raphs into 1,·,n,,1+ „ :the rnissing case

Dalibor Frol1cck, UniV<'rsity of :\Jirm,,sotu Duluth

A 1smph Gis cnllcd alrrwst hiprutitf· ii' thcr exists"" Nlge e E E(G) sud1 11mt C - t is hipartitc. In 2004. A. Bline,,. S. EI-Zan,iti. ,ind C. v,.nd,·n Eyndcn dc•fin,·d a rww typ<' "f lal>!'ling. c,111,xl , - l ,,hd ing. wl o;c (o<isto.lC<' t;,,. a graph Cwit.h) '<lge,; gnuraut•·cs a cydic 0-decomp,)sition of I<·,µx+1 for a.ny positive int<'gl•r x.

In" m,cnt prr:print, S. EI-Znnnti. W. ()'Hanlon. ann E. Spicer """I tbc lalwliu to sh,lw th;1t if 1n > 2 and](",," +,. ;uisrs from *A'*,,,,, hy addin,; a1l C<J|((' i11to thc p rtite s<t of sb:e ml then K,,„ + e has a')' - lubcliug und tht:·n.Jore c-y<:lical,v 1.lt.'Comµos, K11.r+I •,vJ1<'re k = nm-!- l. fur ;u1y po.'-itiv<' intc·g<'r .c. Thc·y also bowc'tl th11t for 1l = 2 H> -;- l11.ht•ling ,;xist:-.. How,;vcr. ill the coudw,;ion of tl<ir pap(:r thc c•xpr:-rl a b<.'lil'f that. a c:ydir dccnmpt):-,it.iou exists. Gn thih t,,lk. we n n going to confiru1 thdr h,·lid.

36} A Survoy of Mixed Decompositions

Robert A. 13,,el(,r. Adam \L \'leadow,· East Tcnw-,,sc'€ Sta.tc lJ11iversit;y

'Iripl(' l,ystcnu, hav(' hr.en stmJi1•d for more than n l1u1tdr01l ,vrari-. in both ()i i!(n th ·ory nucl in graph d<'Comp<,-;it.i,)ns. It is wel1 known that tl1c :,,;olution to l<irkrn:u1's Sdu,olgirl Pn,lilt'Hl b cquival<•r1t to exisklIC<' uf a A·:s-<lccornpositiou of J\-,;. 'This n nlt. was later g<.:ncralizf'd to d<'COlllJ.)Ositiom; of Du hy orit.l1tntiu11:-, of Ks hy r.1e11dd:mhn in 1971. Thi:-. wa'; further P,c.ucraliz'-d to dC(·dmpo itions of th<' mixed c:ornpl,:t<' g1·apl1 iuuJ part i;il orieHtlLti1.ms cif I(, hy G11rdn,•r in J!lO!l. [1 this t;alk. w will give a short snrvcy ,,f t,ripl,o sy,t,·ms an,l their relation to ckr.0111pr,ition.. \:vl' will also g,ivc new re,,mlts for the d e\>mpo iti,,n of a mixed cu111ph't(• gr:1ph ir1to panial orient.ations uf vario1 simpl<' gT;\phs.

TUebday, March :3, 2009, 8:20 AM

38) Graph Amalgamation and Hamiltonian Decomposition of Multigraphs

:vlohumrrwd Amin Bahmanian*. Chris A. Rodger, Aubttrn UrJ\'l'rsity

A Hamiltonian d(,-compo;,ition is a dc-compo:-,ition of a rpgula.r graph into spanning eyd<.s. Ama.lgamatiug a graph H can b• thought of a; ta.king H: purtition.iug it:; v<•rtk&s. then for arh dc•m<]lt of th< partition squashing th1· vcrtkr-s t<; form a !)ing<• vertex iu the >lmnlga-matcd gmph C. Any <l|<• incidmt with th,; origiual wrticcs in H arc thr 9h inci<lr•nt with the ('Orresp\lnding lww vertex ill C, and any ed e joining two v(•rtkes that. mP sqna.slw,.i. together in f1 bdComu=" a loop on the new \'t'rkx in G. Graph mnnlgan1atiun has bl<rt provf<l very []<)w<•rful in cm1.,t,ructing Hamiltonian decompositions of varivtts class(-,; of graphs.

Jn thi:; Utlk we describe this tcdutlqnc Hnd wt· giv,? H g,mcra.lization 'Jf tl1f' pr(?vion resnh_f· in graph a.m"-1.ga.mation. Then wP give a necf'Ssary 1lnd sufficient cx,ndition for 1,·(a ,.... a,.,). 1•A2) to bl' Hamilt.onin.n <lt,,.ompooahk• using thb gf•ncrali¼ation. and 1inally we giv(.' some lX.tlU- sions for almost-regular graphs.

Kt>ywords: Graph homomorphism. 1;hu11ilton ('yclcs, Amalgamutiun, Edge coloring

Th<' dr,y, :tlfarch :3, 2009. 8:40 A M

41) Circular (n, k) games

)fo,thi<-•11 D11fo11r;1, Univcr!,ity of QuCLeq at _)-Jo11tri:al: Silviu Htul.>ach. Californill Srat<• Univcr:,;ity L\lS Angel,-:,;

\Ve (kscribe a game coH ist.ing ()f r; pil< of t<>kPns pla<<'tl 11 a drdc.•. A 111ov• com;ists of <hoo:•dng k ('On<;<-cntivc ih : and tnkinp; at ll'ast one token f'om th,, k pil('S. ion• prC'i dy if t; is th,• mnubr,r of t->kms in pile *j*. au<l Q; is th,• nnmb<·r ,if t0kc11s tlw playN sdc<:ts from pile J. then the mlr-s arc M follows: Pick pilE-s i, i + l, . . . i + *k* - 1 (mud 1t) and s<lect O::; ,i $ l rvkcus from pil<' j = 1: i + 1, ···: i + k - 1 will1 I: ...−1 aj ?. l. \Ve 11an\ cxpk,nxl this g1unc for mall case and ckt<>rmined the •t of losing stat.f's. \\\• pn•sr-ut tll<'se result an\l some conj0.<t11n.

Kl')l'\vorcb: **Combinatorial** guru.•s.

42) Coloriug of Distm,ce Graphs

:vrcga.n lngrnha.m*. Hirf'J1 \Jaharnj. Clctnh'Jll llnivCl'!iity

It h,1 pn•viow;i? Leen provm: A distance grnph *C: (D)* with distanc,, ,ct *D* = {,J,, *d* . . . } has the set Z -lf intcgr:rs a," th4! v<•rt-•x S\f 1 with t,vo V<:ttit(• r: y E Z a.'e adjacent if aud ouly if lx - 111 E *D* Thm the d1romntic nnmber of G(JJ) is finit.c whm<?wr inf ,f-' > l. W,. will genernlir.e t.his rf'Snlt to a distance !';l'll.Ph C(D) with dist>1nce set D = {d,.d2 . . . .} which ha,; tht' set Z" as t.hc vPrlt'x sd. Let D = {d1, de, . . .} 1,,, an infinite dist,u1eP set such that there exist intt•1cn, r, E *Z* for all 1 i n :--lltbfying L; 1; < ¦1 then *G(D)* hit:, a prop<•r coloring usiug at HtO:it J,=11; c·olors.

Kcyw,,rds: distance- grnph. proper coloring

43) J.uduced sub-di raphs wit;h large girth of influence di raphs of t,ime-stamp<:d raphs

\fare J. Livrna11•, Judiaua ll-Purdur l' Fvrt \Vaync, Dn•w .J. Lip111an, Oakland

A Timi---St:unpf-<l G h i; a grnpb with nmlt iplc cd f•s hut no loops, J,'J i, ·ri· ead1 .-di• is lab<'i,-d with" t.im(..-,tamp. A timcstamp du1 be thouglit. of as the tim,' whm a cc,llahorntirn, or intc•ractiou \W<un; hctw(:cn tlH: v<•rti,-, joiucd b the ed e. Givt•11 a tim('-t.cu·np(·d gropli H. tb n sod tcrl i11ft11r•ncc dip;rmph c,f H i t1,- digraph Ofl tJw \'t•rt,,x set >f H witL a11 mT from vertex Q to vertex I(if and onl if tht•r(! i- n path from Q to R with 11on-dt.'<:rca;-;in tirn strtrnp:;. We say that *q* i11flumcPs R. 0111• questiou that can be 11skod is: Giv<'ll a digraph G. what b tltl' smalk,-,t tinl!·st,unp d gri.tph H so that G is 1111 incluc<\l snbgrnph ()f th ; a.-;sodatP<l inti1WHCl' digraph nf H'.' In tliis pap<:r w< providt• a <:orn:trtt(·tiun of--11<h au H for auy giv,,n ,ligraph G, 11nd show tha.t if the uud,,rl,viug graph of C ha., 1,irt I, great<•r thru, -t. thi constru<·t.ion is b(!-;t p,Js.-;ilJI<'.

IC,Y't\'Onh,: timc-1--tmnpcd graph. iufl11cu(•(' digraph: lt1.rge girth

44) The J\,faximum Rectilinear Crossing Number of the n Dimensional Cube Graph, Q,,

:).Jultbcw Alpo•rt (Harvard University). Eli,• F,-dcr' (Ki11gsbon,ugl1 Go1m111111ily Colle!(t•Cl.il\'Y), Hriko Ha.rborth (Tt-clmisrb,, Uniw:rsit.al't) and Shddon Kldn' (RmnLam .\lesivtn High Sd1ool)

In Ihis n!::i<:trd we find and prove t1l(• max.irnurn rc:etilirn•a.r crussiug number vf t1l(• t.tm:c dimensional ,:i,hc 9mph (Q:,). WP <lPmonstrah, a rn thod of drawing tlll' n-cuh,· b'rnph. Q,,, with mauy cr->ssings: aml thw, find 1 low(•r hound for the mnximmn rectilim.•rH <"r-.hsing lt1J11he·r ,,f *Q*.,,\We conjcdm<· that thi hound is sharp. \We ,ilso prove ,m 11pp,•r ht>11nd for thr: maximum rcc-tilinc:u- cros.-;ing m1111pr of *0*,,.

Keywords: 111axim11m n•ct iliucar r-ros-;inc: 11mnlwr, c11hc graJ>h, 11-('ube raph

45) The Competition Numbers of Regular Polyhedra

Yoshio SA:'\O. Kyoto lluivcrsity

Tiu' (:ompt'tition grnph ,,f u digraph D is u (simpl<' undirnct<<l) graph whi<h ha:; thl· sam(• vertex set a D mid ba:; ,w e'tl¸< h1.tveen two distiJ1ct vcrticr•!- c and I if and only if th1.rc 1-xists a vcrt.cx v in D swh tlnll (.c, v) au<l (y. ·.;) arc arcs of D. F,,r nny i;raph G, G together with snflicientl,v many isol11t,,I wrt.irc,; is the compctiti,,n grnph ,,f som,• a,,ydic <lii;raph. The competition numhN k(G) of a l(raph C is defined to be thc smallest number of such isol a ted veJ·t·i<;es. lt. is au NP-l}ard pr o bk:r1 to <o mµute the eurnpctition u1lmbcr k(G) for a graph C aud it has been om: of important rt's!'urch problems in tlw study of 1-ompct.it.ion graphs to chnractcrizc.• a gl·npl by itfi competition nnmher. [t is well known that there cxi:•t 5 kinds of n'f\Ular pol,vhedra in the three dirnmsional space: a t t.rn.hcdwn, a hexahedron. an o<'tah<'<lron, a dodc'<:ahedron. an ico;;a.lwdron. \Ve rrgM<l a polylwdron as a graph. The compPtition nmnb,•rs of a t<•trahcdrou, a hr;xahc'l.lrort. an octal,edrou, and a dodecahedron aC lu.-;il;v computed b, known r<;Sult; on C<)mpdition tnunbcr. In thi:, talk \\(' fo<'ll on au i<'ilsa hc-lron aud give thc t':xnct vulue• of the comp, t.i1ion 11mnbtr of au iro;;aht. 'dron.

Key_w o nh•: compl'tition graph compl..'tition munbt•r. edge diquc <ov<•r: n·gular pol y lw-dron: icohahcdron

46) Dist,ance-2 Labeling of Threshold

Aruncl·hati l'layd111udhuri. Dept of '.\-J,.t.liematir-,, College of Stat.,,i Isla.u<l, cc:,.-y

In thiH rmpcr. w• prc-;cnt, some r, nlt llll dbrnJ1Ct'-2 labding of grapb:- with di;-imetl'r t'wo. lll <list,mce–2 lahdinp; of a gn:;ph. each vPrtCx of G is as,,.ign,-d Hnon-nC'gative inte t•r /(x) such that if the dist.,uwc bctwL-en two vcrtii'c:, c and I/ is l. th<n !J(,') - /(vii 2, if this dis!UJl(< is '. th,cu If(,:''! - J(y)! 2: l and if this distuncc is !,'Teater tlwu 2 tlwr,! is no <:ou:;traint on their h1bcls. The pHn p2(/) of a distauc<. 2 labeling f b the maxium111 value ,,f /(.c) ov,,r "II th< vertices x of G. The minimum span of ,i distance- lal>ding, l2(C) i, the minimum value of sp2(/J owr all distan<-e-2 labeling:; of 0. In this talk, we will provide" polynomial algorithm for finding /2(C). wlit'r<' G is "spLx-i,,I cla.ss of di11rn,'t.·r-2 graphs, the d,c-s of tlm-,,hold grnplLs.

47) On the Relationship Between Node and Edge Component Order Cormectiv-it,ics

C.L. Snffcl', L. J,uzmicrc,-uk. St(•\'t'n:, lnstiLute ol'Trchnolog,v. D. Gross..1 Saccoma.ti, Sctun Hall Univt•n;ity

\Ve d<St'rib two vu.1.nt'rubiliLy paranlctt'r!S whid1 inodcl rH;twork:, t.hat are vnlneral>lf: TJ IH)de or (tlg<' foilun• bnt an.' c011:-;idt•n-il to be opernl,le provided the urviving riet,w<,rk luv H:mffid iutl, hngc (:Onttr-h!Cl pi,X'!!. \\\ discuss somc GOJUl(\lhlL'i and ditl'fl!'JICX•t; behvc(•u them.

48) The Orchard crossing uun1ber of complete bipart.ite graphs

Eli,• Fcdn (Kini,o;liorough Comnrunit,v Coll<'g,-C:U:'\Y, USA). .,nd Dll-vid Garb,,r* /lfolu11 lu,t.ittJtc ,,r Trdmology. Israel)

\:\i' continue our rc=R'tlrch rcg.:,rding the Ord1n.rd cr ing nur1llwr. which is <letine<l in a :-iimilar way to th(; wcll-kuo,-.·n rc<:tilim•cff cros.-ing: munbt•r. \V,: c_omputl' tlw Ord1,ud uossirig numb<r for <<,mpl<tc bipmtitr: grnphs. To a,;e@iplish this, we first. illust.rnfr un upper liom,d b, prc1.:ntinf{ a configuration of $1;_{n,1}$ with n Mnll mmlh<r ,,f Ordund c-rossiug.. \Ve th,:n pr<!'<llt a rigorous proof tl1.1t Uiis h>lmd is sh1.1rp. In th,;, la.st p11rl of th,· tn.lk. w,, will pr•s<nt Sum< drawing-s of $I<_{,,n}$, graphs that shvw thc cornplicat.io.ns iu tl<• compnlatious of Ord1ar<l <ro ing m1mbcr in the gcn,;ral <H)l of $K_{m,u}$ g.mphs when• m ¥5 1l.

K,•ywords: crossing number, l'omplete bipartil<• graph

-i9) Cycles and 71-cornpetition b'l"aphs

Bonuo PARJ(• (S,-,111 l\atioual llnivcrsity). Yr,:,hi,, SAKO {hyot.o Univ<'rsity)

Tlu• not.ion of a 7J-c::ornpetitiou graph and 1l1< p--t:-ornpctitiou nur11ber of a graph w(•rf' iltt,rc,\l ι H;c'<l by S. -R. J-(in1, T. A. 1<:Ktt, F. R. -[c forrb: and F. S. Robert:,, as a gt.t1trt1lizHtiou of u c,,rnp<'lition graph Hnd tl.ir. r:ou1p,titiH1 nurnbcr of a g:rnph. rt':--ipN:tivdy. Let 1) he a pnsitiw integer. Th1: p-compct,tion graph C,,{D) of" <li!(raph D = (V. A) is ,, (simple 11ndirc,'.tcd) [\TAph which ha,; the same vertex set V and has ;,n ,-dg,· lctw1¥•n distinct vertices :candy if and only if thf'n: exist. JJ distinct vcrtic{· vl •••• :l!$_1$, E \/ ;,ud1 tl1at (.c. t,'.). (y. L,) arc ,u-cs of dll' digrnph D for <'ach i = L ... ,/>.

\Ve ('Hil r:;,,sily t>hs')rvc thnt. for any graph G. G tog;ethPr with :-11ffi<it'ł1u.ly many isolHtt,l ve-rti<es is thP 11-r:ompf'titi0n nu_mb('r of some a.cydk digraph. Tiu• 1,-r:.omprlition mnnbr:r k_{v} (G,') of a g'taph G is ddiu(•<l to be th.-, miuitrnun number k ;ud1 tl1at G with k isolated vcrt ice:, is the J>-Compl.>titiou number of a a.cyclic dlgn:tph.

ln this pript-r. we giv<' a rwc<>ssm')· mul su.fficicut condition for a e:yde and for th<' ('Orn-pk1mci1t of a cyd(tn he a J>-cornpr•tition grliph. V\'t ,ilw giv,· a d1an1cr.erization of gra,plt'i whosr· Jrcompc·titkm numbers are nt most m. wlu•re m il n givr.n nonn<•gtttive integer. Then. W' cornputl the p-comp('titivH numbers vi' a cycle al!d the cornplcmc11t of' a c-yd<..

!<eywc,rds: J>-C-Ompetition gT11ph. p-eompetihon m1mher. J>-edg<· rliqne cov,,r

50) The paranoid watchlnan: a search probletn on graphs

Jur1<r Dalzell, Ivy Tl'<'h Cornmuuit.y Culll'gt•: Davi<l Leach, Univcr:,ily of \ 'c;l Gi.-orgia: :\.·lcttthP,v \·\\tl:;;h·. lrnliuua.-Purdtte Univcr iry Fort \Vay11(•

A wa1<:hmau is touring a graph tu c11sun• that it ii frc of intn.td('rs; lw is aware of auy iut,rnd rs within his i,nrnediah' ncii;hbourhood ii.c. wit.bin di,tanc:c I c,f his positi,m) and wi,lws to find a rout<• t.hat will mrantec that any iutrud<'rs will br: dl'ICctl\l. \V,, 1iivc Ul\'CS.•mry and uftici(•nt c:m1diti,,u for such a route to <·xht iu a given graph. aud C.'XiWlinc ;m11e g<11cralization.,;; of thP. problcJ-n. \VC ttlso compare- thb with <,f'hcr sea'ch problem ,1n grapILL.., such as cops & rubbers and durninutiou St'.ilrd1

Keywords: p11rs11it-eva.sion. graph s0a.rd1ing, inkrwU groph.-;

51) On Some Properties and Algorithms of the Hyper-Star

Fan Zltang*. J.c Qiu. Brock llniv('r:sit_v

Tlw Hypcr St nr graph b a rwwly propzy,,1:-d intcrr;-Hrnr-c:·t ion 1wtwf,rk in ordt.ff to improve tlJC nc-tw<,rk crn,t dl'fiued as th product of it:, t.k·grf'• 11rd dia.mr-h'r. \VP study tl1e Hamil-touicily probl,:•rn and d,•vdop 11 rtdghborh.,od lir..,adca".ing ..lgorithm for the Hyper-St11r S1,t-cifica.Jly: wt 1-how r.hat thl' Hypcr Sta.r graph H Hurniltoniau if ond only if middk cnht'S .ll'C H ιuniltonh1n by (tnhlbhin nn isomorphism bdwccn the l\\-o. \Ve th1:n <l<'vd<,p a ucig11-borh.1od bl't.)adc:ast.ing a.lgorithm by fin<lin tht'! nodc--di oint. pttths of <YH1stanr ll·n th hc-twP(:11 tl1e neighbor:; of the broudca.sting nod-:. ln wt\W of tk• lower bom1<l impo:icd by the siug:le-p<,rt rnodd: our a.lgorithm b ll.') 'mptor.kally optimal.

Keywords: Hyp<'r-Star. Jforniltc,uicit_v. l\'dghborhvod Broad<"astiug.

52) Graphs as Linked Cycles

Roger Eg:&h:ton*. Illinois Stutc Univt.r it.Vj Pctt•r Admri::-. Uuiv<:r ity {lf Q11<<•nshu1tL. JaJllt'N :\.l:1c.:Dougall: Uuiversity of t:wcd.')tlc.

Giv<;n a tinitc graph C: kt $1\backslash_{0}$ and I\' 1 ht· isomorplik ind11cr"() µroper subgraphs (,f G, ndt nt'<<.'h:-f1rily <lbtiuct. ChoosP an bomorphism fl : 1\o -• A" 1 Ext<•11d :, tn al1 i OBh)rpl1brn ,r: Co-> C,, wl,en" G_{0} = G and C0 n G, =K,. Tlw 11mph 1I = Go U C, is a linkc·d poi,·. \Vith i11ilu1l l 1k G, krnu:l K_{1}, pre/.:er,icl $1<_{0}$. ond f>hift <J. Iteration tlf thb (•orn;tn ιr·t·i,J 11yit!-ł-; n linked dwin $G_{()}$ U G_{1} U G_{1} u ... U G,1 fur any ,, ? l. with G;-1 n G, K1 f(,r l .·is; 11 For :initablc n w• CUB require that G_{II} = C_{II}: producing ciu nlinkcd f.-yde. Ia.ny grnplL' tr<' actually linko:I c:ycks. and thi!, vi?\\i->oint gives ,1 foctori;, 1tio11 of tlicm.

K(•ywortb: graph. isornoivhism, fo1;torization. liuke<l duiin. linked cycll'.

Tuc8day. March 3, 2009, 11:10 AM

53) Rungc-Kutta-Fehlbcrg Integration Methods of the Newton-Cot<-':> Type

Charle-,; E. Rob,,rt.,. Jr.. [udia.ua State Uuivcrsity

\Ve dtvt·lop a fourth-ord'-r :md a fifth-ordc-r Rungc-Kutta-Fehlbt'rg nwnpri<·al int.cgralion prowdur,•of th< :-.i,,\Vt.on-Cotc;, typ(' whid1 have small nmncrical factors as:;odat<•d with the trmu.-.ation errors. The umnt•rirul foctors of thc **trurication** 1•rrors of th c mpth<Xi."i of int"gration arc compared with thc nmncric;J factors of th• trnnc,Jtion „rro1-s of the corresponding ITI<'thods derived by Fehlhcrg. For the fourth-orrll"r method. the absolute valnrs <,fall of the **nurn<?rical factors arc mailer than those of the corresponding Fc-hlbcrg methods.** Fur **tlte** fifth-orckr rMthod, ,;ix of the tw<'llt)' murt<'rical factors of trw tnmca.t,ion errors ar< zero and th1 absolute valnc::• of fonrt<-'<H of tlw twenty muucri<:al fo.–tors 11rc smnlk-r tlu1.0 tliosc <i tlw com:-spondinr; lm,t Fchlberg meth(Kl. l\ltmerical results are presE·nted.

I(<')'Words: initiul vnln.,, prohlcirn;: m1mc:rical inwgration, Rnng<"-Kut1H•nlct11ods

·54) Some results on the watchman nwnber of trees

David Jj:,;,eh*, I)ni\'l'rsity of \VCSt Georgia. ;\fatt Walsh, lndia.na-PnrdlW University Fort \Vayuc, Jmwt Dal,-\'11. Ivy Tech Couunmiity Coll<'ge

W< 11s' a r,rnph as a mc><lel of a sealed facility that n"',,Js to h• semrhed for intruders. A ivat.d1man at vertex 1· elm obs('rvf' All vf'rti<' in 1V[t-']. lnt.rnders are a,c;um.-<l to have pcrfr,,1 informat.ion about tlw location of ull wat.cluucn, and tlw ability lo P•'rfoctly predict their mov<•meut. \Ve <.kfinc the watchman rmrnbcr of a graph ***C*** to b< rhe minimum 1nu11ber of watchn1cn n'qnired to ,•nsnr<' that ther 11rc no i11trndcrs in G. Ill thb talk w,, lo,ik at th<' ca-f' where Ci:; a tnx-. Sp w.ific8lly. we dlara.<·h.·ri'l.e the trees with **f** watdtman numhC'r of 1 ancl give some upper bounds for other catiCS.

55) Subdivision of the Cube

R»bcn. A. [kckr. ,...!khael fl. 0(,rcn. '.\lathunid \:I.E. Wilson·. Eust Tciu,r-ss,_._, Stat.•· Univcr:-:.ity

Th1" cube is a grapl, that apµ<•ar-, vft<>n as in <'Xillltf>lt. of computer uctworkiug structures. In this t·aJ.k wt· CXJJISidf'r subdividing of the c11h(• and c·onnt."X!ting t11t· new points when tlw ir associiilt.'1.J (.'ligc"i sharl' a **common endpoint.** \Vt· will lw <lbcussiug j1< properties of thrsc gr;;phs. W(' will also be disclL"ing lhhsibk applicatio11s of these gYaplis to the lidd **of quantum** cornpnting.

56) k-cycle free one-factorizations of complete g'aphs

\fori1t:-.:z :vicszk'1.. AGH LJnivf•rsit.y of SC'lencc and Te<-hnol<1!,!;y. Krak1>W, Pt)lttrnl

A 0111;-factorizi\.tiHI of a regular g'apL ***G*** is nuiforrn if the: union of any t-> onc-foc:tors **is isomorphic** t<, **the** **am,•** two-far.tor H. **whid1 is a** disjoint nuion of P.vcn cydt--s. There are only S()\•tral infinite c!,l,.,,;(of k11ow11 uniform ont"-fa<;torizativrn> of complete• graphs. Au oppO:-iitt.: prop'.:rty m1iy be d<•alt ,vith: 01w (UU ask ubtmt the cxbt<:ncc of 011<'-f actorization such that the un.ion of any two or.w–facror:-, doc:; rit.)t includP c,vde <lf giv<'H l<•ngth:-. A <Jm foC'torizati<JH F = [F1: 121.... F,) of G is si-tid k-crJ<:le Jr<< if thc tmion of any 1\\'0 011(.- fact,<,r:; does nvL includ the cycl"" C1. as a component,. CotN'<]lWnt-ly, F is k;-cyclc ***f*** if tlw union of any two ow..-fodvn; **does** not i11dndc **all** cyc1('8 of l<•ugtlis . k. lt is prov(:<l t11:1t for ew:ry n ;:: J and <'very <•vcn k ?: 4 where k # 2t,: there cxist, <l k•cydc f'e(' 01H.:-focu,riza.tiou of the complete graph ***I(21***. lorcovcr, sm1w i11finite cla-:::-cs o·f ***k*** <-<:yd<• frr't.' ,mo-factorizntiou:-; of Kin arc const.n1cted.

Keyword-,:: onc-.f H·toriz,1tion: k-cyd<·. two-factvr

TuC's<lay, J\farch 3, 2009, 11:30 AM

57) R ,gular antichains

vfo.tthias Di)lun. Uuh·crsit.iit Rustock

L<t. 6 be a :;uh,cl of P([w)). the power , d of [m] := {l. 2. . . . . m}. The sir.c uf L, i:; n := i61. \Ye call B m aHticha..in if then' arc ac, two sc:r:, iu L wliiclt arc comparable uu<lcr set indusiou. An ,mtidia.in B i , called k-rci;ular l,k E N), if for cad, i E [m] th,,re arc t•x;u:tly l: blr><k'i B i , . B h . . . . : Bh· E 6 r.ontaiuing i. Ill thi caSi.' we say that.Bi .1. (k: m. n)-1.1nticha.iu. \\Vc, analy1–c if for a givr-n pttramctn-pair {'m. n) an (m, 1n, u)-antidmin <'xi:-t (H not. Oar mtth1 r._-;ult is a sutlici(•nt condition: Let 1Il: n E N arhitra.ry with m. G and with

$$\begin{cases} m+:l:,;n:c; \text{l}G) - mJ & \text{if } Il l= 0, 1, 3, 4 \pmod 5, \\ '' + :l \$ n S \text{l}G) - mJ - l & \text{if } ,n::= 2 \pmod 5. \end{cases}$$

Then t.hcrc exists an (m. m, n)-aut.icl1riin 6.

K<•ywon.b: (R(-:gnlnr) antid1ain, Compll:'kly :;cparating system. Extr<:rnaJ S<t theory

58) Graphs in which each indepencfont dominating set intersects c,ach minimum dominating set

P<.tcr John or1 !Jld Davi<l Prier'': Auhtlfn Univ<•rsity

Every graph with an isolatt'CI vertex has th1· propl•rty givc11 in the title. Let s11eh a graph with no bohtt;xl wrtic,-s b›s calhl DI-pat.lu,luj\ical, for sh"rt. Pr<'violLsly it w;,., dis-·c'-•Vl'rcd thii-t the only Dl-pad1ologi<;ij(graphs with dominHti<>n umnl>l'r 110 gn•ot,-•r thnn 2 are the complete hip rtitP p;rnphs A-(11, 11) with m. n > 2. Her<' wP describe" larg<' cla»s of Dl.-pathol,,gical coun,x·t<'d graphs, ,u1<l prove that thP sm11Jk-st D1-pat.hological grapl1 with dorninatiou rnuti!Jer 3 t'Onsi:-;t:, of two 4-cyd<•s jui1wd by a path of l<·ugth 2.

r<:y words and phrases: durnina.tion. duiniraation munb(•r. rninimnm <.h,mi11utiug s<t

59} Low-dimensional Cross Comparison GraptLs

:-l'til J. Calkin; Robert E. .fomi:;,\,11, .J. Bowl11c1n Light.'". Ch:uisorl Univt.rit,v

A eros. rompar,5011 gnLph mvdcl is onP in whid1 cad1 vcrt C< v is as,,i,u;ned a rank r,. and a tolenmee t,, (bot.h from !'.i(lllt(' partially ordi:-n-<l f;O: P). 1Hd tw<, vtirt.i n a11d v ilt.- in confiict; if r-, 2: tu an<l r, l v - .lambon :;how1:<l thut tht: r-r11:j:rL'OHIJJ(1risou rnodd is wdvcr al. using u-dirncnsiorwl reul vcctor imd coor<liuat<..:,i.·isc cornµarist.)ll to rt'pn::-;t•ut a gra.pb on n n:rti<:t•s. Tl i is talk will fo<'IL" <J t>]fir-ic1,t:;J of rcprt'!,t'tlt.nti(JliS - the srnulk:,t vnlm.' ti !>neh t11at a mph r1m lw t(•presented using d-climensional v(,ctors. and will aLt empt. tc, cl•ssi(v those grnphs for which d S 2.

J<(•y,-.-ords: conHicl-t(,lern.11c<' hrnphs, c<rTT graph::-. ,·c'('tor rr-pn'hentutiM1s

60) Irnbcddint,"S of Graph Products where one of the Factors is Q,,: a Survey

Ghickw<,n Abay-Asmcrom: Virginia Conunouwcalth Univer;;ity

Th tl i is talk \\l' will survey rninirnum imbcddings of gravh products wht.It" one of the factors is Q n . tll<' n-t1tbe. Thf' prodncb we will cow,;idcr iud11dc: c·artcia11. t·urnpositiu11, t<•nsor. mid ::;trung tensor µr0d11('ts.

l,cywnrd,;: 1>Taph products, gmu.s irnbt'<lding,;

61) Zero-Sum-Theory in affine plam.-s over finite fields

Christia11 Reill<'<. UuivNsity of Rostock

Suppose• that. p iHdkatc•s a prime n1unbcr. We urc interested in qtwstions falling 11wkr the followir',\ general srhm1c: A.-;sw,1c· t,hat a ,cc1m•ncc P = (P,, P₀, . . . , Pn) of points in the atti n f! pl n ll.(·' ov,·r tlw fir:ld cont.1:1ining]J d<'mcnt.s is given. \Vhat <an be inf, rn"<l from its lm!(th ahom the existence >f a n(-U empty snb;<'qnenr·,• of P whos,• tPrJJLs sum np to zero? Provided that. 11 is s11ffidm1tly larg(•. one might: also think of adding some con,traint.s on the :::;izc of :;u<b a sub-qucnc0.

F<r iW,tiUl<:C. it ll be<n conj<'(;turc<l tweuty year ago by KEMNITZ that in ca-;c n = 4.p-3 ,m<' r,l11 gd. s11d1 i, :-:11b-<qucncc of l<mgth 7; n.•centl y . this h<ls bP.(!ll provr·n.

Anotlwr line of r = a r c h is roncemed with extl'llSion., oi' ,u1 old re,;nlt: dne to OLSEN about thc DAVENPOR T cou:;ttu1l of v-b'I"oup:-;. implying in particular t.hitt if you tak(' 11 = '2 p - 1 in th c ab o ve situ.at.ion. tlu.'n the <.:xi':itt'nce of some n o n empty z:cro SIU1 subsc'<11.1encc follO\vs. This. h<>w<>v<>r, docs uot remain true if we attempt to rqJ/i\rc 2p — l b,, 21' - 2. But some intcrr ting things rt•g,ndiug th<· <;ltts."\itlf:atiou ')f comit<.'H?x,unplcs cun bt' s.ti<l.

Kc_ywor<b.: C o mbiuatoria] ZNo SlUn -Tli('CJry. Kemuit;,-,' Conjectun-. Da.vc'uport eom.;tunt: Property B

62) Neighborhood Homomorphisms

.John Pfahz*. Univ. of Vir ini:i, JQS('f Sb,pa.l, Brno Univ. of Tc<-h.

A ncighhorhnod homomorphism is 11natural <'Xt,•n ion of the familiar graph lwruomorphism. \V,• P.xpl o re th> ways SH<h mappings in1cra<·t with d,1mimtting Sf'ts. In pnrt'ir.11lt.r. w „:-;t;tbli s h crit.(:ri,t t'll'".turiug that a n<.•ighborlioo<l homomorphism will 1r1k< rninim,tl do1ninutiug sets outo minimal domirmting: st'ts. Con...;idcring invariml<'t' tu1dc'r tnu:.isformatiou provide:-; a :,;<nncwlwt diffon•nt wtfY of looking at 1m old <>:;tabhCll probl<:m .

J\.eywonl : h o momorphis1n. domiuatiug set

63) Greedoids on Vertex Sct:s of Unicycle Graphs

Vadim E. Levit•. Arid Uuiv. C.,nter, lsnu-1: Eugen Ma.udrcsrn. llolon [nst. of T<xfo,.. lsrad

A mari11mm :;tabl e set in o graph C i a stHhk· :-ct of m;D.:immn :-,ize. S' is a local 111,u;imum st11ble s!'t of G. and w,, wriw S E >1'1'\(G). if S i s a rnaximum st.tthlc' s d oft.he snbgrapl, im/11,ed by S U N(S), wh<'l',' N(S) is th< neighborhood of S. G is a ti1l'iq1<-f<· yrnph if it owns ouly on<' cyde. It is lmnw11 that ti11· family w(T) of a forc,;t T limns a g-rec,loid on its vertex s<t. In this ptiper we c()mplP.tPl y d la rnu:terizC m1kyde p;rnphs whose fa111ili(' nf local m11xim11m stuhk• s..t.s form gmxloid,;. In particular. 1j/((i) is u grccdoid for e\'l'ry graph G will, the uili q ne cyd<· of i;izc 3.

k<'ywords : 1111icyde graph. I.me, bip 1.rtitl' bTa,uh. l\Onig-Egerv<.iry graph. lvn1-I maxinmm tal,k• :,,t1 gn.xxloi,l. 1uii q ud y rc-;lrict<'ll maxim1tm rnaldting

64) Finding a Biplru1c.u· ln1beddiug of C,. x C'₁₁ ≥ C, x I'ₘ

.Josh 1 1ll J,,:. Lambert. 1'<,rth Dakota Stat<; University

DclC'rlltining ti)(' bipl:urnr \'r(i.ssing 11mnlwr or th(• graph(\ X C" X ell/P,, WtlS 1 probk:lll propos<:d in a paper l:, y C z ah.u·kl,. SYkorn: SzCkdy. aud Vrt\). \V, fiud as a t'(UOllary to the m;iin tlw·on·m of thi talk thnt th{· hipl<rntir cro i11g nnmher of tlH• afon•rucut:ioned grnph i s t>rO. Thi s n"Snlt follow fr o m the ck<'ompoiti,,111 of C,1 / C,, x C t x f,1 into (HW F.p,v or e1 x Pi,,,. / - 2 copi<S of C7r: J(, P m , and a <opy of C,,2 P2m-

I<c•y\\'Ords: 11 1irk nFSs, biplanar r.ro.·,sing numb0.r, dccc;1111hJSition

Tuc·day, Ivlarch :J. 200!J. 12:10 PM

65) Local Motions a.ud More

H. Sternfdd*. !SU; D. host<'r, UWLC: R. Killi;n:.ve, r,,tiwd

A quadr:mglc- is four p•)ints. no thrr·c colin<'ar. L<t $ABCD$ 1,,, a quadrangh• in a proj,>ctive pl,uw. The diai;onal points ,,f Al3CD nn• $E = ABnCD$. $F = ACnBD$. $G = ADnBC$. If thn diaJ{onnl point arc not colin<-•u-. we <an perform a),)rul motiou hy moving from A B CD .to any of four n,•w rp1adran1;l0s: $AEFG$, $13EFG$, $CEFG$. $DEFG$. A proj•'<'tiV<' plane is s'1.id tv he I)(111 motion conner.tKI if ir is possiblP to read1 any quadrangle frc,m a given <Jlla<lranglt hv a st•rh: of !>Cal motivn . IJt (•arlif•r work we :-;howf'<l that. the plane of i,rdN 3 is ,·mm,x·t.,,,]. lfo,t.er proved that the plane of order 127 i, not loc;;J c,wtiou c'<>mw<tcd. We• continu<' to study lo..-al m<Aion e1JmHx-h•d11cs.''i.

66) On the Domination of Kings

.Jolie Bam1um111 Xortheastern University :'\cil Calkin. Clemson Univrrsity Jt:rerny Lylt:-*. The llniwr,ir.y of Southern Jississippi

In this pnper. wf' f'onsidt:.r connting lhc numlwr of r-ontigur:.,t.ions vf kings on an k x n ch1;-:;;-board. sueh tla1.l every sq,uuP is dumirrntcd hy a king. L('t. f(k: 1I) he the 11w11lwr of tk,111inuting configurat.ions. \We cor ider tlw asymptotics of th<- fundion $J(k; 1I)$ 11iug t l1y-hrid of tit<• tran for matrix method and 1 pn,l,ul,ilistic pprouch.

I<<•ywurds: du111inatii1g :;<'ts, c:hcsslx,{u·d problems, trn.n.sfor 1natrix 111ethud

67) The corupetition munber of a graph G with exactly one 1naxitna] cliquo of size J

JungYcu11 Lt•)· (Seoul >lat.ional Unin'rsit,vJ. Scog-.Jin I<irn(Konkuk U11ivcrsity) Sult-Hyurrg Ki111(S1'0Ul ·:-Jatiowtl Univ('rsity). Yo;;l1io S: uo(I<,voto Ur1iVI'I':-.ity)

Givc.n a <ligruph D. it!:- <·omµctiliou graph C(D) 11as the :;arw: vvrtex :1t as D uml ul1 <>tl0 bdw<'<'fl two vc;rti<<'S .c 1md y if tlicl'(: b a V<'rtt•x 1f <, dwt. (T: u) rmd (r; 1v.) an: ar<s of D. Roberts !Ul78) observed that. if C i,; HtlY g:raph, C toget.hc-r with ;11fficic11t ly mnn,v i,olnt,,I \'Prtir<>S is the r·ornpetition graph of 0H acycli<" digraph. Tlwn he dr·fined tlu ;:0111pt:litiltJn number k(G) of 11graph G to lw t.hc srnall<'st rnunlwr k sueh that G tog thcr with k bolat<'i.l \.\'rticc-; addl'"I ii, ttu, cornpf:tit.i,m gntph of un acyclic <ligrnph.

Rolwrb, [19i8j gav<' a fonrmla for tlie compt.'titiuu umulwr of G<11meckd grnphs witl1 Ho trinngk and Kirn and Robert:-: !!fJ97j romput<'<l the c<>mpt·titio11 1111111lr of C:<Jfllli:<'tc.'<l !{raphs with <Xa<t;ly OJIC: tria11g1e. In rhb U:ilk, we \\/ll give the rompdit.ion munhnr of n gn.1.ph witl1 cxaetly 1JIIP maxima.I diqw.: of ;i½c ?: 3. which cxlc'11tls their rr nlrs.

Keywords: comtl\:tit.itm graph. comp<\titic,n numhc1\ m;.ixima.1 cliq1w

68) On the system of multiple alL.different predicates

Scrg Kruk, Susan Tvn,a•, Oakland llniv rsir.y

Jn this pa.pt:r. wr r:xpl<>rf• tht.' propert ics oft he r·otnh st.ructiirr- 1-f thi: rnnlt iplc rtll. di.JJr!rent predicates by pn-st\nting t\vo cla s<'s of foect-indndng iucqualit.i(.-=; uf t1le euuvcx hnll vi feit-sihlt• i11tcgpr i,olution:s. Siucc the munb,r of fac:ets is <.:xpouC'ntial: we giv<' 1 pc1lyr'llllllial-tirnc scparnthm tlg<,rithrn that <1dds (.ht' fo<'t't.-indndng i1H'<)tUJ!itk-i, L, they be<om(• viol;itnt\.

Keyworlls: Simnltancou 1nard1i11gs: Polyh<."(lral !')truc:turC'; Fa<:et

Tuesday, i\farch 3, 2009, 3:20 Pi\J

69) **Optimal Rankings** and **Labeling,,** of **Graphs**

Roh< rt .Jami:iou. Ck•msou Uuivrrsit)' Darn r.i A. arayan*: Roclu-su•r ltbt.it.11tc ofT<'<:hnolog_v

Given u g:rnph G, u fw1ttion f : 1:(G) {1. 2...., k} i ,i k-ra.nking; of G if J(v.) = f('II) impli<':– every u - · v p,1th c-ontain:– a v1.rt.1x w such that /(wj > /(1.r). A k-rankinµ; i– mi1,i11wl if the rcxhwtion of noy l1lbcl greater than l violat,· th< dl'hCrib<XI nmking prop(•rty. \Ve <'Onsider two norms for rninimnl rankin&- ln the tirl'it norm \w· minimize thl" lari;cst label of a rninimal ranking and in the sce011d norm we minimize the :;Um ov,-r all labd:s. The 11111:c-optimal norm IIJ(G)!I,., i the sm,t!lcst k for whith C lw.,;, minimal k.-ranking. This vitluc is abo n•fonc<l to as rlw rnnk number x,(G) in previous work,. The sm11-optimal norm !!flGJII, is th minimum s1un of all luh{'b over all mi11im1tl rankini;,,. We will invcstig,atE' similaritit-"i-i and diffcrPnt-<,;, bctwt'<'ll thc two 11orms. In particular we shO\v that patl1s m1<l cyclt that. an.: sLun-optirnal are abo max-•optimaL

Finally w,• will present new results an<l qu,,stiuns involving other wrt<•x labclin1; prolMrrL,.

l\<:ywords: k-rankillg. vertex lab<:liug: verl('X coloring.

70) **Graph** theory of single-molccult> conductors

Patri<:k W. Fowler. Dcpartrucut of Chemistry, UnivNsity of Shcffil'i<I, UK

Conrluction ,)r an dc'Ctron through a n,.,J,x·ular ,•kctronic device· i modelled by an <x-!ff<"ion iuvolving chttra<:tcristic polynomials of Hu' rnole<:nlar gnJpb :md thrce w..:rt,;x-dcl<;tt,(i suh-gTflph<;. Two l'JSJ)<'Cts when.! gnipli tht-vry <'lll'l g-ive insight an· ""<}1ti1:onduction and dl:c-tivr· 01n-1dty.

Equicou<l11rtors are non-isomorphk f-ontluctors with rnodd trnnsrni iOH ftmf-tio11s that arc idt•uticu} ut ull ek'<-tron <•Hcrgic-. Their ,,xistcm<'<' follows from that of isosp<>etral graphs: i-i'>:-pcctral vPrticc:- <m<l pairs. IufinitP fomilie of c.-quiclm<lucting mok'<-ular g:rnµh arP pr<'-sr:nt<I.

Opacity of I rnok :ule to pa.,s1,gc of cl,ect.rons ht spc ·ifk mergi,.,,_ is !(,1vemC<J by th eigm-Villit1.: spectr<l of the four charul·t(•rb.th.: polyr,ornials. K<•ees-or.v and sutfic-i<nt condition for opacity of molecular grnplLs 1m• gi\'l'll. aml **cmcstrudiotLS** for comp,>sitc i;rnphs ,u·• ,,xhibitcd.

"'f1is hllk is b,1M'ti 011 joint. work witl Barry T. Pickup, Ts:wk;.i z. Todorov<L: Sam lling (SheffiPld). 'Ihm" Pi,;,n.,ki (Ljubljana), Wendy :\-Jyrvold (Victoria).

l(<.·ywonb: c.hcmin1I grapli.s: udjarcnr-y matrin ; ci!(<'nva.lucs: is,>S}lt'Ctrnl gn:1ph

'il) **Twin Graphs**

ll.c,nul<l :--.iussbami,*, Dr. Abdol-Hossc-in P.stiil,mii«u, Michigan State U11iversily

This pap<'r inlroducps a m•\l; t,VPf' c,f Tnph!-i knO\vn 1k uvin graphx. Givf'n a gra.plt proprrt.y .P. a sitnple non-!--elf:.r.ompl<'m(•ntary raph G is called a twiu l!:mph with rr-spect lo P, if G and il, ('Omplcnwut satb(y prop,,rty P. For ,1,.. purpose-,, of this paper, we focus on the \l'\S(' where P il; tlc•fincd as the wnnb<•r of s1mn11ing tr<'E:-i <f G. Tlwsc graphs: whidt we refer to a-; sp-twin graphs. are dd:incd Hh th 0 simpl,, 1101!-M-lf-eompl<'lllf',ntary gri-:tph C v.·l,o complcrn€'nt. hos th<' same nurnb,,r of s1nwning; trCN a;; 0 . :'\o !-if>-t,viu rHph with f ewer titan S vertices exist. However. mi:lny p-twin graphs (•xi:;t 8 or more vPrtiet·:;;. In this paper, we provid<• an c x ha u,t iv< kn)k ,it aJl sp-twiu g:ruphs on 11 or fewer vcrticPs, and for <:t:rtaiu '-Yl"--:, of grnphs uv t> 17 vertices. Sp('<:itkully. we con:-,id(•r sr,edal of :-,p-twin graphs whid1 arc also trianglo-f'cc. qnadril»tcral-frcc, hip,utitc. Eulcriru,, rcgulitr. \Ve al.o <"Xamine th<' number (,f '-'lge;:; for sp-twin graphs 011 a particular 11111111r of w•rt.ice..;, which vari·-; rt•laUvel.v litt.J...·. dS well as the nwBber of spt,uuling tr(-c,; for :-ip-twin grapl1"4 uu a pmti('uhu rnunbcr \)f vcrt,k,,......: ,vliich va.ric:,, considerably. Finally. we cor1.,i<l<r uthcr graph ffi(1ft.un•s :md1 a rm.lhti;, diarnctl'r. u1<l girt.It in relation to sp-twin gruph.

Kcy,\\nds: b'Tnph. twiu graph. <:omplcttl('tlt. spanniug tn,'{'

72) Quantum **co<les** from **caps**

Vladimir D. Tond1cv, :di<'higan Tr·hnological l'nivcrsity

Caps iu a finite projective· gr'<)ml'lry ov<•r GF{4) are u:,<xl tiw th(' c-orn,trudiou <f :<HH' quMt,um ,,rror-c,>1-re<:ting codes, including 1n optimal [[27. 1:J, :.Jj code.

l\e,ywords: crr<,r-c;orrN:tiug <0-1<\ qwult11111 C<>tk: finite i(t"t>m<•try.

Tucsrlay, l'v!arch 3, 2009, 3:40 Plvl

73) On Edgt'-Balance Iuckx Sets of Cubic Trees

Piug-Tsui Chlmg. Long Island univcr,ity, Sin-:\fo1 L"· Sau Jose State uaivcr,ity. H,in-Hua H!-b1u*. SUJ\Y Dow11statc· Icdicnl Ccntr:r

Let, G = (V, E) b a simpl ;;raph. ,md kt A = {O, 1}. Auy t1l;<• labeling/ : E -• A in-dnt',!S" partial vr·rt,·x lahding r :V -> A that "s.sii;ns Oor 1 tr, /"(1;). <lq><IHlilli\ on wl,cthcr th(•n.' uro tnlHC 0- or 1-r-<lg•h incident to 1.1, and lilVCS J·(1.i) nnlaht'lc<l othcrwist·. For <a(h i E .4. 1,l f.J/i) = llw E E : f(uv) = ii and t,,{i) = iv E V : /"(1•) = ,1. Th,, NigE,halancc index s,•t G isdd'in(.-d a,; Efll(C:) = 1"1(0) - •1(1)1: the cxlg• labeling f satblics 1<1(0) - "r(l)I < 1. A tnP i called cubic; if all internal vl'rtices arc of dc•gnx [1]3. Tir thi pap(:r: <Xurt val1c-i of the e<lc-btila.11<:I' il.ldcx set5 of ('uhi<; tnxH nn· obtaiued. ull (>f t,h\!JJl forru arit hructic progres....;ions.

K<•y \Vvr<b: Ed.c;c-fricndly labeling, t"-lgt'-halttnc:c iwk•x st:t. 011t-poi11t tU1ion. ring of ring:-:.

74) On the Spectrum of Middle-Cubes

Y..Jiirng. Univ(•r5ity of SciPncc :tn<l Technology of China, K. Qiu*. Br,k-k University. Carrndfl, R. Qiu, Ut1ivcrsily of Science and T,>chnology .-r China, J. Sll('n. Ttxas Stat,• lfuivcraity

A mid<llc-Cubf is m ind11ft s11bgraph consisting of nod at, the middl(" two layr•r.,, of it h_vp<'rcnbc. The mi<ldlc-mbes or0 relat,,l to rh,, well-known [h·volving Door (Middl<" L<'v<'lsl ('Onjc-cturc. \V(' :study tht." middk.-...l'ubc graph by completf•ly cha'nrt<riziug ib :sfH:x.tnffn. Spc,·ifically, we first prcs<:nt. a simpl1; proof of its sptd.nun utilizing th<, fact that tll(' gr<>ph is rdated to .Johw;on gn1ph.., wLid1 M' distnnCc-r<•J;(Hl11r graphs 1uld whose dgcnvnhw::- cttn b0 cc,mp11tNI 11sing th(? fs:-isocia.tion scl1Pntes. \-\e tlu:n give a se<ond proof f'om a pun:. grupli tht-.1r.v point of view \viH.1out u ing its distai1ce r('gular property and thc tedmiqne of 1:1'!1o,Ociation :-d.1Pm(i. Iutl'r«.·tingly. tlH' multiplidtir.z.; of the cig,nvn1ta•::- coirn..-idc with the s<xJU<lU<Xs A05(llti6 <lnd A0J9598 from Sloan<'s ,m-li1w <;nrydopcdia of iutcgcr "'l'"'u<:c,-,.

l\cywords: middlt'- cuh<: liy!Jt.r(:UL('. sp('<:trum, int<.'gt'r s<XJU(flC<

75) \Vcll Covered Circulant Graphs

Art Finbow· and flania \lo11ssi. Saint \1arv·s U11ivt'rsity, Halifax :-JS

A graph C is said to he lJ:eL/-rovnY:d if r:vN.V 111a-xiulal indc•p\ J klent sct of vcrt icfS ln:'i thf same <-n.rdinality.]n thb papn the lllth<,rs discuss what is known uhnut wtll-cuverM circubrnt grupl1::;.

['\eywonb: wc:11-r.ovt'n.,d. m;i_:dmal indPpt.ndc11t sr·t.. drr·ulnnt graphs.

76) An optimal class of binary codes for permutation decoding

Pani Scnt'viratnl', Arnt\ricau Univc·rsity of Sl1arjah.

13inary codr:s dt'filHxl t.hrongh tht- row-spa.n of inddenf'e matric of desil2;ils (1r adjac01wy matric1.":i of n g:nlar graph hnvc 111a11y properti(,..., that <an be Jrxhld'<_I from the combiuatorial propcrt.ie:; 1)f tht: design or Tttph. au<l <,fku have a great. d(•al of s'rnm<•I ry cuid lar;,!;c automorphbm gronps. In thi!-) pa.per \\.'\? <'\mstrnc;t n class of bin,Hy rodcn; from t.hc row span c,f an adjn((-m<y matrix of t.lte complctf rnulti-pnrtitc graph and show that these (:odes co11ta.in 1ninimnl PD-set:,, for pcrrnulation <letodiug:.

[\.c,vwords: codC's. gn,plls. perm11tation df<.odin.

Tuesday, l\farch 3, 200!), 4:00 PI\I

77) On Edgec Balance Index Sets of Generalized Theta GraptLs

Hurri:i l\wong*. SUXY Fn't.lonitij Sin-J·'li.n L<'(. Stui Jo:-,(' Stutc Uuiversit.y; and Diuc."'jh G. Sarvatc, Collc,c;e 1f Clla.rlcston

Let. G = (1,', £) b,: a simple graph. Any edge lubcliug / : E ..., Z2 ,lf G indnccs a vertex IHbd ing lnh,clin!(JT : V -• Z_e dcfin, l by j+(,·) = tj if / is inci<knt to more• 0-cxlge, tl,nn 1-,-dges. uik-l j+(,') = 1 if a is incident tv more 1-, lges th/i11 0-e<lgcs. \,·c le,we j+(:r) 1mlabel1"<l if a is inrideJlt to an equal nnmhN ..r (). and 1-t"dges. We '"Y f is <-<lg,,frim<lly if le,(0) - e1(l)I rı 1. and ddiuc the ,-<lg,-1,ala.ncc ind,•x sci or G a, the S<t {\t:J(O)- ,·1(l)i: the •xlge labeling f b edge-friendly}. \Ve study the eclg,-bal,u1c1; index sPts of ctu·ralit:<-d theta b,'"aph .

K<•ywords: t•dg,,fri('tldly lalwling. cxlg,-balane<; indc:x sc•t, th<;ta graphs

78) Unicyclic and Bicyclic Graphs of fumk 5

Wai Cbro Shin*, .Jianxi Li and \V,1i H,mg Ch,u1. Hong l<onf\ Baptist Uni vcrsity

TL,• sp<'<'tmm of a 1,'mph C i , tlw colltx·tion of cigcnvuhws of its adjacmcy matrix A(G). Tht? ra.uk of 0 , dcuotccl h_y r l G J. is tl1c number of non-zero ('ig{'uvalt1<=-, iu it sp<'Ctrnm: or <'<lt1i,·alm1tly, th.- rnnk of A(G). The nullity of a grnph G is the mnltipliciLy of the dg,'nvalue z(•ro in it– :,;,;pc<'tn1m. lt is known that the rank is <<]naJ to the different<.' frOJn tl1e ;ff<ler to the nullity of the graph. I-ln el 1l/ in [On the nullity <f bi<:yclic graph,, Lin. Alycbm App l.. -129 (2<)08). 1387-1301.J c·lwrnctcriz,'<l bicydic grnphs ,,f onkr II with nullity n .. 4. That b. tliP:v <h nrm h•rizcd hiryclic ra.phs of ra.uk 4. nut thPy mi .,ed ome <<l:ies In this paper: we ·will C<JmplPtc• 1heir pronf nnd dluractf:·ri1,e nnicyclic nn<l hieydic gn:1ph-; of rank 5. rc:-,p<.x·tivdy.

h ywor,Ls: Spr..:·trnm. nullity.

79) Minimal k-rankiugs and the Rauk Numb<« of a Prism Graph

Andrew z,•rnk,•" arnl Darr@ A. :-;aray11.11. H"dico;t,·r Jrn,tit11t,, of Tcx·hn11lo!c(y, Juan Ortiz, Lehigh University Hula Ki11g. California L11therM1 Uniwrsity

A k-ranki11g of a ra.ph is " eol.-.ring /(\/ (C:)) - {1, , ... k} whr·rr· ,my p>ith bel ween ti\·,, vertices of t.hc ;am(• ra11k coura.ins a vertex of :,;trkt.l larger rank. A k-ranking is minirfl(r/ if the r<'<lttc tio1l of uny la be l gn•a.t(:r than 1 violutc tlu• de:,;,;rilwd riu1king prop<•rty. Th(' mnk 1111111h1· of a graph \ ,.! G) is the: 111i11immn k s11d1 that. C ha., a minirm1l k-rnnkiug. \V1• invN>tigat.e the ra11k nm11h(r or the prism i;raph P_l x C_n, lu p11rtir·nlnr w.· provP ,vlicn r, ?: t ;_,(P, x C.,) = [.log,(j- J)J + llog0 (j - 1 - (2l'º-. . . 2j- 1)JJ -, 3 wl1<•rej = 2 l-" / j .

K•·ywords: k-r:u1king, prisrn graph. vntf'x coloring

80) Perfect Hash Families of Strength Three with Three Rows

Ryoh Fuji-Ham. Univ<'rsity of Tsukul>a

A perfc'<'t lw:,;h fnmil PHF(N;k:v:lj is nn N A k arrn,v on ıi ymh..:>ls wirh ti ?. t: i11 whieh in ('\'('tY ;V x t sub a rmy (tis calk-d, strcngth) i at, Icaa om: row i; C(1J11prisrl of dbliuct symbol,. Perfr·c t has h funiilito:, have many applications in t-ryptt,gn:iphy. S('Cllrc fram<·proof codcsi da tul,a:c mana.gemc:nt and software t< ting. The m<,st ba:ii<; non-trivial ca-;,; i:, the strr,ngth tlue,· with t.lm,' rows. N = t = :l. H. A. Walk,,r lJ all() C. ,J. Coll1m1rt1 (Pcrfi<·t. Hash Families: Const.rnc·tiorn, and Exist,·!lc . .J. M»th. Crypt. l (2007).]237) lwvc shown a tubl1• of <•xisting PHF in tlw ca.sc f<I N = t "' 3. \Ve shvw con,trnctimLs of PHF(3; I:.. v, 3) whil'h exce'Cd some vah1<s of thl' tahl<,.

Keywords: P<'rfoct ha8h famil;v. iutcraction tcstiug: th1'((.•tcrin arithrru:tie prugn-;,-;ion

81) On (1, 1)-Strongly In<lexablc Gr;,phs Associated with Sequences of Positive Integers

Alexander :\im-T,1·1 Le<•, Gra.,,,, ln.,titntr, of Pcrfllm<'ry and Siu-lin Le<·', San Jo;,,• State Univ1.-rity

F>r HllY integr·r k d;:: 1, 11 (p.q)-graph G with wrwx set V1.G) and ,,lg(• set $E(G)$, JJ = [l,'(G)j and q = iE(G)i, is :11id to be (k,tl)-strongly indmrnhle (in short (k,d)-Sl) if there Pxb:its I fnndioJJ pair (/, j+) whir·h a&signs intf'gr-r l1.1bcb to the vertic.cs nnd cdgei, i.ti., f \/(G) {0.1. .. , p - 1} and j'T: E(G) - {k.k + d, k + d, ..., k + (q - l)d} ar< 01\t0, where l•1U, v) = /(11) + /(v) for any (-,;, ,:) -; E(G). Given uny S{'(jllCllCl' (n,, 11e, ..., ur-) of posit.iv,. i11tcg-rs w• eonst.mctc<l a (1, 1)-Sl graph Z(a1.n2 ••.• ,a.,.). We include !he rr-,,nlt of S.\L Hc;;de aml Shctty a., a special ease.

l\(')'\VOHh,: graceful: inch.Xllhi.?1 l:lritl1mmic pr,,p;n-ssi1Jll1 odd nnmber. spidt•r.

82) Disjoint. pat.hs in (n, /,;)-arrangement l,'l'aphs.

Jeff Boats. Viz1.1ros Kik,is', .JcJu1 OIPksik and :>:art Shaw1.1sh, University of Dc·troit: 1,,rry

The study of intcrco11.nC'<'tion network" ha< at.tractc.,l a great, ckal \f r ca.rd1 in the rmht n'w decades. Exist('ncc of K-disjoint pat.hs lwui":ecn r: sourcf'S and /i destinations guara11t et r-onC'ltrf(•Ot con1111m1iC;1tion \\'ithin the net\\'Ork. Thb problem ha-; bef'n addrc-"iscd ill hypt'.r-enbcs I,· Gon1.ales and Serena in 2001. 111 1998 Gu and Pmg show'(! that star graphs -S,, on n! wrtircs- have thP, rl!!.;:!l-l-disjoiut puth pl'l)perty. In 1990 Cheng 11nd Lipm,m show«! th11t t.h" splii.-st11r S luc, the (n - !)-disjoint. path prop-,rt.y. l<ik,c, in 2(K)4 t'Stahlish,,I that the Altf--.rnating group grnph A,, hi1.; the (n - 2)-disjoint parh property. The (n. k)-aJTangt'ment graphs vr :1,.;.. \\Wt' proposC'd by Day and Tripahi ill 1992 tu address th,, gruwth pruhlNn of the umnbt'r of wrtiet."> in the star grnph. The Star uud 11ltcrnating group grnplLs are both spedal ea.scs of am111gcmmt !(rnphs. Wt• extend the n'f;nlt.s of Kik,,s '2l)(J to show that A,,,k bu,, tlw [':':'.!ci!J-di,;joint path propt'rty.

Keywords: <li:-joi11t path: ioterconn('(;tiou fll'twork-i. arnwgc•mcut Taph

83) J\foltit.hreshold Graptcs

Rubert E. Juui;-;on. Clemsull lh1ivi.'n;.ity anJ Uuivcn,ity \)fHuifn Ala11 P. SpntgU<'. llniv,·r ity of Alabami'\ at 13irrningharu

\Yr. ay that !,;rapl 1G is an <,cld-nmltit.hrcshold hri1ph witl1 regard to thrr-:,,hold 01 < 0 < ... < 0- if it is pos.-:ihl t· to as,ig:n a ntnk r(l') to f•ach n\rt-•x 1• such that V(:rti<:t v am1 w arc· adjac:<'ut itf the nmnlwr of tlu,=-,hold:; that CXCl!(,<l r(v) + r(w) i:, ,,dd. Au 1uiulog(,U.'i ddinition yidds thı' r;v(:n threshold !(rnphs, which a.n' msily se<n to b,, complernr:nts of th•· ildd threshold P,Tnph.-, For example, tlw sf'¦tlNlCP ,1f run ks 0, t1 - 1 : 2 -'2: : :-a.. .. :-:howi- that every pa.ti t is u mnltit,hre,;hold)!;raph wit!1 two tlrn>sholds 0 1 =0 - .5 und 0 =0 1.5. Thr d a.":·ical thrc,,;ho l< grn.plli:i introduced hv Chvatnl aud Ha.rmn{'r urc tht• ca'< of Oil< thn hold. \Ve will show: (1) for ('Wry grnph on" wrtic<a,, r,(r, - 1)/'.! thrc;,;holds suffic,, for C to l,e rq.m:s<·ntahle as n mnlt.it.lu·eshold graph. (2) Tlicr,, t•xist grnpl,s on" wrtkc,;, such that " - '! thr hokb are nf1 :;,uftfri ent for G to be a 1n11ltithrcshr,ld graph. A f1111<la111Pntal q110,titm fi>r whid1 we haw•no ar1swl'r arises fu111 tl< gap l,ct\Vt"Cll ll<<' twu n ults: in urder to n.::pn<11t <V('ry gru,uh on n vcrti<:{'S as a rrutltitliH•bold grnph. i the m1mhcr ,)f thrc:-,lwlds r<X<ted of order 0(11). or O(ri"), or in bctwcm{:

Keyw,>rd:,;: tl1n-shold graph:-,

84) Relations in finite non-abelian groups and in1portance of short relations in the context of cryptography

Ivana nic": Spyro,. ;\,[agliveras Florida Atlantic Ul iversity: B<>(a Ha.ton

Finite ,:ydic groups, in pa.rticular r<•prcscutnt.iorn,, arc wir\dy w;ed in cryptography. f,,t.i-vttc<l hy thP al:.;d>rn. of cxpouents in finiu• cydic gro11ps: we dcfiw:' th1: <,r,cratiou ,,f rnh;ing a tnplo:• r,f gencrat.1.)r of a finite (11t111-1-1belian) g,roup t< a1 il te }r. \\• (h-i11e thc opt>ruti<;11 of I>S<Udo addit.ion of cxpuneuts oft.he gencrnti11g tupit' an<l show tha1 ll<• s<l of ull i11t,,gt'rs to;;ethcr ,,·itlt tlLis or><'ra.tiou form.'i 1, gT<,ttp. Dy rai1>i11g tlw !'.:ll<'rnting tnph• t(, diff('n•nt intel(r:r. g<j11p relation."' '1l'C ohtn.iJJ<XI whid1 i11d11r< a gruup pr,:ntat ion m tlH' Kiven •t of generators. \\• explon• relations in the sp1"ria] linf:w· gronp $SL(2.p^n)$. 1J a prirnP, and prove thc ,,xisu,uce of short rda.tio11s in the gcneralcH'S. \Ve furthcr determine h,·mist.ie,Jly particular sl ort n:la.tions in th< gcu<.'rato given in the coust.ru<:tion of the: Z,·u1or-T illif-h cryptographic ba,h funr:tiou. for ,111,Jl v,titu', ,,f th< parameters. Th<: Z<':mor-Tillich h, ,h fnrn:tion i: still nnhrokr.11 if thi; pan.unet.('rs .tn' d1osc11 \\•isdy. \Ve al:-:o cvrnuHmt m1 the lengtl, of the relation., whi,·h are ,1htai1m.l by solving 111)nt.rnditional ge,wra.liz<'!l dis,'rcte log:arith1n problem iu th{' finite :,iroup SL('2, JJ) witl1 rt'spoct to g('n(•rntor:; of ::,pedal furrn. whcn:.: we .:,sWll<' that th< g<'ncralizcd <li:;<;rck logarithm is defintxl as in [lJ.

Keywords: nou alwlian finitt• groups, r<'lutiorL<: sl1ort n•lutions, gron,µ µn•scntat.iu11s, crypt,,- grnphil' hash f1111<tiolLS, Zernor-Tillich ha,h fm1ctio11

Tuesday, March 3, 2000, 4:40 PM

85} On (1, 2)-Strongly Indexable Spiders with Few Legs

Sin-:'.1-lin Lee, S,tn .Josi' State Uuivcrsit.y, au<l Sh,mg-Ping Bill Lo*. Cisco SystcnLs, Inc.

For auy integer f:.:d 2 I. a (p.<J)-graph G with vertex set F(GJ 01ld e<lgc set E(G), 1J = W(C)I ,u,d q = iE(C}I. is s1.id to lw (k,tl}-stroni;ly iud,x11hl<' (iu short (l.:,dJ-SI) if there exists"· fun<;tion pi<ir (J,J+1 whirh as.igiL integ"r lnhcb to th< vertices on<l edges, i.e., f V(G) ... {Cl.1 . . . . p - J} nnd J+: E(G) -- {J.:.k+ d.k + 2d. . . . ,!.: + (q - l)d} ,,re om,,, where J+(u,1:j = J(u) +/(11) for any (u.,,) E E(G). Wr dct;,rminP here rim,,,,,,_ <f spidPrs tl,at ore (1. 2)-SI grnphs.

r<eywr,rds: gra('efol. indexable. arithmetic progression, odd munher. spider.

86) Diameter of Star Graphs with many Faults

Eddie **Cl,mg,** Dn•w Lipman•, Oakland lluivcrsit.y.

An important issue in compntf'r <-ommunicat.ion networks is fault-tolerant rout in. Cive=n it 1,'l'tiph l-f 1111d a set of faults F £; V(H) suclt 1hat H - F is comwctcd, a routing bctwe,11 two vcnict:h in H - F is callc'<I a fault **tolcnwt routiug. A popular grnph topology** for intcrcomwction networks & the stnr graph. It is known t,hijt when :ln - 8 vcrtin•s 11JC deleted, thr resnl!.ini,; graph has a sinp;le large component and at mc,,t two other cvrnponc-nts of size at mo-t two.]n thi trdk, ,vc give a l·h)tlJld on t.h diarnetc;r oft he larg-c romptment HS wdl a:, ruuling in tl,is faultt.:d raph. This will also provide 1t1 a.lt.cruak proof of tlJC abov<' rl'sult.

K<•ywor<ls: lutcrconm.'<-tion uctworks, :.;tar graphs: ,xt(•n<lLxl fault-tolcrant ro11ting

87) 1'-linimal Rankings of Certain Classes of Graphs

Jobby Jucvh* an<l Rt'Ull Laskl1r, Clcrnsou Univprsit,v. Dau Pillu11<'. Pu.turnwan SdtutJI a11d Gillwrt Eyahi. Audorson Uuin•rsity

f ora !(raph G, (V. C). 11function/ : V(G) ... {l. 2. . . . . k) is a k-ranking if /(u) = /(1•) i1nplic,; that every u.-v paih contains a V<'rl<'- w s1ld1 t.ltat /(u,) > /(11). TIH' rank rnnnbcr Xr(G') and th<' arnnk ntuuher ibr (G) of Gan• **rnspcdivdy,** the minimum an<l **thP muxhmu11** value of k 11d1 that G has a mi11i111al k•ra11ki11µ;. In thi ta1k \\'C will e t.nhlbh mon prop1•rti<>s of minimal ranking. give h01md,; for tlw rank m1mb r of tl1e rooks grn.ph of un 11> 1l,d.1esshoar,l and <ll'tl'rmin th,· arnnk munb<•r of tlm rooks graph.

l<eywords: minimal ranking:-;, rank mnnher. arnnk mmihf'r nnd rooks graph.

88) Il-iangular Numbers and Difference Syst(,rus of Sct.s

Larry Curnrnings: University of \;Vatcr1oo

A differcnre systems of ,wts is a rollcdion of subsets of Z,. with th(• property that cad, 11011-rnro clcrnt\nt of Z_{11} apJx'ar::, at lea-t once a; the <litfi-r<:ncc of p}crneuts fu111 different set:-, Diffrn•n<.:c systenL-; of sets ttris<' na111mlly in th1· study of sy::;tcrnatk comrna-fo.-c <o<k'"i \\'e US(' tri,u1 ular umnbers mo<l sttituhlt- n tc, toustntt'":t iulinitl' fa.miliPs (Jf differcnct> systems of st'ts and study t.hdr prr,pNtir-,,.

Keywords: diff(;r<:ncc c-t. triung;ular numl)('rs. comma-frt'<: rode

Tuesday, !\larch 3, 2009, 5:00 PM

89) Infinite FamiliL-s of Super Edg<. Graceful 'frees

S.C.Lockc" and \.V.Wd. Florida Atlantic Univcrsit)'

\V(• (•i.-pan,l tlw collcr:tiou of snpcr <lgc-gra<;eful tree,; prodn<<'11 by Le,·. Wd. \\!en and Liu (C'GTC 200S) an.J provi<k 11 lower bound on th,· nmHh<'r ,,f snpcr edg<>-1,'Tacefnl lalwlinb.-,; for I snbclass of t.hcsc tl'<'CI'

I{c,ywords: ft:lg:::,r>1('c'f11I, upcr IX"lg<•-gracr:f11L tre<. p;ra,µh ln.hdi11gs

90) On the diameter of the Unidirectional Hyper-Stars

Eddie C'h,'ll!;. Laszlo Liptak·. Oakland UnivPrsity. and Sa.rnh AndPrson. Presbyteri,in College. ,u,d i,;,,Uy Christl>rLS<'ll, A.-;bury College, and Jcuuil'c-r Dicrnunsch, University of Dayton

Star g 'aphs w,·re int r<s:luced 1Is a compel'it i,·c modPI 10 the l,ypPrr-ubes. Recently. hypt'r-st111, were im.roduc<.'CI to lw a competitive model to holh hypcrcub<.-; and star gruph. The vertex sd of t]l(' lqrprr-star HS(n. k) is the S<t of all {O, I }-strings of lcn1,<th n with exactly k 1is: and two \'('rtk<!S arc t1djHrcmt if tmd cn1y if one (O.ll b< ()htnin<•d by cxclianging the first symbol with a ditfrrc·nt symbol (l with O. or O with 1) in another pr,sit.ion. These aph.s have nice com1<x·tivity and structural propcrtic...-;: and t]wir edges can be oric·nte<l 10 obttlhl uni<lir,·ctioual hyper-stars UHS(u.k). 111 this paper we pn's<;llt com1mtat.ional rt-suits ,,n finding t,b,; dirc<;te,xl path hPtw<'cu two v<.:rtke in ***UH***S(n: k). nnd prov(' an upper botmd on ifs diruHct<·r.

l(eywt)rd)'): lnkrcoum•c-tion ndwork:;, 1.u1i<lin:tiorui.} h_1>er-stars. routing. <liamr:t<•r

91) k-long Graphs

A. Ddgadu•. Purd,a.-;c Coll<-g<'. SUl\Y. I. L,•wiutcr, L.Qniutas. Pac<' Uuivcrsity, \'cw Y.,rk

A po:-it.iw· int<:g1.r is k-1<,u if it r.an hl' writtc11 11(1 + L:) for 11 ?: 1 tUHf k n. A nontrivial :,;mph is /,-long if: (l) the v,'rticc,; a.r labeled bv distiurt k-!,,11g inu•g(:rs. (2) cad, e<l11;c is labelro by thc product of its l'[ldvc-rr k•.:s, an<l (3) CHCh edge lalwl is a distinct. k-lo11g tmmber. Vario 11 thc orcui:; 1ue prn:-,cutt't.l. iudt1ding t.h,.: n.'->hl'ttiou tl.wt ull trc(:,; ur<; 1-lmig.

Keywords: J.:-lor1g, k-long graph. lal,t•liug

92) Priifor Code for Chordal Graphs

Liliun l'a rk<•nzou*: Univ(•rsichick• Ft:dl'ral do Rio th .hwdro. Piml1.l Rcuato dd Ct:r.,ta. P<:n:ini: lnst.ii.nto Slilita,· d< Engcnlwria

Tlw idea of ,t'isodatiug <:od<'wortls to t11(lahC'ilcd grupl t'i of a ,p, ;itk family is not n·ent.: iu Prll.f.r's <1rtiele frorn 1918, n om'-ttHJJJC corn-:,..r,ondc1we bd\VtX'.Jl the !')t{ of (n - 2)-tuplc.-; of the inte ers {1. 2. . . . . n} and tht! set ,")f i1ll labr.lh'<l lr(•t>; ,,n n ver!"icr-s \VIL; a)r('ndy proved to hold. Du< to several applirutiot1, of tltis ki.ud of cod<' in m11thm1ati..s and comput<•r science. 8Cvc:1·1J Priifcr- like codes wen• stuclh·d aft.er 1970. Jn this pap(•r. we <Xt<•nd the original PriifPr code to d1ordaJ g-rapl!-io. A littl'1u- t'nc:odiug ;,Jgorithm is prc;1•11tt:d. Two inwn-:-.r.ing pn>bl<m> arc solvt, i iu onh.•r to cn:-mr: thlA 1inl'1trity (Jf 1.ln al nritlun: t!H· dy rwmic mttinte.nanf'e of the max:irnul dique-:-;. under thf' dd tion of impli,ia.l vertices; and rh(: sPkction of tht: ll'a:st simplicial vertex 11ing a moditit'<l priorit.v q11t-uc. Fiuall.v. Wt' how how tlH: frn.mewo rk d(;vdopl'<i <;an be u cful in the codifkc\tilm l)f ,Jthcr Pri1f'r-likt• Ct)dt.' for d1ordal :;-mph'>.

Kt'ywo rd;: <:hordaJ grnph. co<lc. algoritluns

Tuesday, Mardl 3, 200!), 5:20 PM

93) Graceful Fore,;ts

Wendy lyrv0ld •. Aaron Willi.uns and Lucus Panj,•r. UniV<'rsity of Victoria

A graph on 11 v(•rtiet•s and 111 c,-dgcs is _qmcef11l if there Is a labeling of it. vt•rtirt:' with <li;ti.uct l«l,cLs sd,-ct.(.1.l f 'om the set (l, 1, 2, ... m such that when •1ld1 odgc is labd,'<l by tl1(! ahsolut.c vnJn< of th<; differctH·c. of its Pndpoints, thC (•d1s' lnbtJs on• distinct". By this ddinit.ion, :i forest is not graceful nnkss it b a tr<!C (there is uot. e•nm1gh l,ib,•L, for all the vcrticf-sL H<J\\'ever: <-.:msidPring f11n."'•ls is an nbviom ttpproarl1 for seard1inp; for r.itlwr an indu<:ti.w· proof for 1hc graceful tr(.' conject.urc or an t1Jgorithm for gracefully labeling a trex-. A forct is /1vtto11,-up gr,,ccful if its vcn.ic,-s c,u, he lalwlc<l with unique lab0ls from 0. 1. 2..... n - l so that it indnces a labding of the ,-<lges with distinct. value; from I, 2...., m. \Ve d1arnct.crize au infinite family of forests whid1 arc. not bottom-up gracC'ful due l(J Hpnrity coudition.

I\,<y wor,ls: Grap h labeling pn)bl<'ITL"i, grf1d-11l grt1phs, gracf'ftll tret· conj(-c111re.

94) !Vlatching preclusion for the (n, k)-huhble-sort graphs

Eddie· Ch,,ng. L,cszl,, Liptak, Oakland Univcr:;ity and David Sherman·, Groves High Sd,_01

The mtttching pr(iclusion n11mb1."r of a graph is the minimum m1mhi?r of r-..ig;;s "-"hf,sC de-let ion results in" i,;raph that l1as n ither p<·rfect matd1ings nor almost-1x·rfcn milt<·hings. We• find this nwnb,•r for the (11, k)-bubbhsort graphs and cla..ssify all tlw opUmal solutious.

Keyw,,rd:-,: CHyk'y graphs: conditional n\rtt\x com1Pct.ivir_v

95) l\1inimum Color Set.s of T!'ipartite Graphs

A. Ddg,adu, Purd,asc Colk,gc·, SUXY, \'I. Lwintc•r•, L.Qui11tas, P.te<' UJ1iwrsity, \'ew Y-,rk

A mph C is tripart.il•'" if it;; d1romilti<- 1111mh•\r r:(G) ·:· :J. Let f(G} hC tjH? c11rdirw.lity vf a 111inimum color S.t of 0. Vn.ri<ns extrcrnal pt.:>blf'm."i i11w>lving /(G) •ff' st.ndied, including t1le spL'<'ial ca.,c for which .f(G) " I.

Key"vords: minim11m color set. maximum planm·, tripartiU·

96) Defining Parameters for Countably Infinite Grap)Ls

Pt'l,Cr J. Slutt•r. Urtiv<'rsity uf Alabama in Huntsville

Because on0 r11n til0 the infinite sqnar• grid Z x Z that is r,•ular of degre<' fom with :,tars A-1,-l, it :seems rca:,onubh: to d•:fiue the dor.niuativn pt:rcentag._ parnm<'tt.•r of Z x Z tv lr· r%(Z x Z) = 1/5. llsing a difkrmt tilini(of ZxZone <an ,u-g1l(' that tll<' loc1Jti.ng-d,>rninatiug pN<·entt1gc v11lU<' is LD%(Z x ZJ = 3/10. lt also s,•rns ohvi,,us t.hat for indcpmclcm·,, we haw ::!(Z x Z) = 1/2.

Howev<'r. a.,. ,vill be <liscus,'lr,J lirrc-. it b l<-5i t.lMn obvimt-; how to ddinc pt'ITl'Uf age parameters for ciHmtahly infinite graph:-,, <;vcn wlH.'fl tlwy are 1<<;ally finitt.•. are of bouu<le<l lkgrt•c, or (Vt.'lJ arc n•guhu of degTcx· thrce!

Keyword : percentage panuncr.crs: countably infiaitc (raphs

\Vcd11esday, March -1, 2009, 8:20 Alvl

98) The Annihilator Graph of a Ring

Trevor 1-kGuin<)kw Coll<';<! of Florida

Jn recent y<'ars: t1le tuols of graph t1<VI')' havt.' bec-u nt•d ts stud ' r-ornrnutativc ring;;. In an <'Vl'f incn·a ing munUt•r ,Jf fJHpcr:s. w warchcrs are sccking n<iv graphi<:al l'<'pn,-,(:ut n.tiou:-i of rings based c,lJ tht! zero divi!-.or tructnre of tlw rlngs. Some of thc:sc grnph.-, arc foiit.c if and only if tlw m,mb<:r of zcrc, divisor;, 0f th• ring is finite. The A-nmhiJator (;,up!, of a Ring se<'k to lift this, rt1ld other re,;trictions. Succinet.ly, thcs<' graphs have vcrticc-s d,,fined by antichaius of monurnials with rt-spcct to le..xicographif• wru1 ord<'r. and edge-; <ldinN by a 111011,mjul 8d pmd-11d ,if 0 bdwtx•n two antidrnins. ThL-;c graph;, arc finit.c for all rings. and uniquely define ring,, with Krull dim,•nsion 0. 1H this paper, we will lay the futmdatic,n, of th• annihilator graph, and discuss the proof of their u.niqnene.ss \'ia run.idiains. As mot ivat:ion for tht-s< graphs, WP will brieHy pn•vit:w thc futurP of a.1111ihilittor grnphs. which arc the A/0110111-wl Am11h1/ator Graph and the Grobr,er· Ar/.1/ihila.tor Groph. aml M<' the topics of c:nrn:ot ncarch.

h,,ywords: Am1ihilat-or, Pulynomiol Rings, Grohncr Bast'S. Zero Divisor Graph, An-tichaitL,

99) A Variety of Algorithms for Matchings on Trees

Alru1 C. .Jarnicsou. St. M.r_ys Coll<w• nf).laryland

In 200G: S. T. He,ktni(:mi pr('sc•utt'<l a t.Lorongh 11rv<Y of many :mh,;d JKlft\H1ctcr <n t,n'\S that did not have a.lgoritluui<..: :-.olntion.. Thh, papc:r spc'<'ifir.i'Ul n,)tod three mah":hing: variants, first introdnr•xl b Goddard et al. in 2005, rvnnc :tcd, isollJt.,,f'ce and disro11-11cdt'<l matd1ings. In t-hi:i paper we :-;ettlP thn"(; un:;o)ved algorithmic problems over tlwe t-n><-i of rnatd1ing hy providing al,Hitluns utilizi11g the \Vim('r (\lg(' viu-iaut. \Ve will also ·,krnonstrate a new tf•dm.iquc required for tlw development of our alg:orit.hm for di:-;comH\'t.cd ma.trJting.

K<;_yword: disc:onncdf\l matching. com1pf:tcd matd1iug:. mnkhing:,. al oritlun-;: \Vim<:r style alf\Orithms, cdg<: subset prohk•ms

100) Obstructions to shellability and related properties in dimension 2

\.1a aJiiro Hadtimori ... Univ(•n,;ity of Tsukuba
l\cnji l{a.shiwabara. Uuivvr ity of Tokyo

for a property P c,f sirnplicial complexe,, nn \)hstructic,n to P b 1t sirnplid11l compk<-"= whid1 does nor satbf_v P but all vf its prop<•r r,,;triclions satisfy 'P. W,1.d1s(2000) showed tha t 2-<litn('rt iou(ll oh tructi,ms t:) :,}wlht.l,ility ii;L,; at m<JSt 7 vcrti<:t-:-,: t.hns th('rt.' t,r'.' only finitt.? number of2-di1ncn_ional ohhtn1etit.ms to sht-llubilit.y. (Thcrr· arc only 011c 1-dimcusicmul obstruction, and no O-<limPnsio11al 1..lhstrndk,u.)]n lhi:-. talk \\e :,pecify t1le cc,wplf t1 list >r 2-<limcnsional ob t1 d i 1s to sl.icllability. F11rtl1('r. wP sl10\V that the !'id of ob:-;tr1t1·tion:-. to hcll hilityi to portitionability and to Cohcn-;v[acauhiyu(::;:, ore the same• in dimeu.:;i"n 2.

1<'}'Words: si nplici l cv111pl x. shdla.bility: pa.rtitional,ility. C,l1t\11-\:fit<aiLay11c'S.S. (1lr st ruction

Wednesday, March 4, 2009, 8:40 AM

102) Some Generalizations on Counting Binary Strings

·Jo.sh Ahhc,tt. ,-w Colleg<' of Florida

Ext.ending R Grimaldi's work on Binary Strill!,'> and Jacobsthal numbers for th•· lnnguagc A = {u,01.11}, we will cxa.i1lim• some gml<'ral properties for l'<ltmtiug binary languag<'s. We cmtmerntP thr,mgh srnall lanKtUJgcs and fonts ,m e,mnts for the ntnnb,•r of strings of length u in.sid<' the l<Je<'Jle closure of u ven langiwge. We will di><1tss how th<'St' com1ts an, afft-ctcd when ridding additional clemf'nts to a longuag(•. \Ve also pr<'Sent c-ounts for t}1(munber of 0's and 1 :s and tlH.' uumbcr of nms im;idc thc:-;e binary ::.trings of length H.

Keywords: binary strings, Jacol:,,;tb,,I nurnbPrs, symbol cod,-s

103) l\-faximurn matchings in vertex-weighted graphs

Yliklos 13artha\ :vkrnorial U11ivcrsity of l\'ewfonndlaud

The vertke; of a grnph an• nssigrnxl a nonneg11tivP intf'ger ,veight. and a rnau·hiug i songl,t that. co,·t•rs ,i S<t of vcrt.iccs with maximum total w,•ight. The simp!C'St- spcx'i,d cas<' of t,his proble1n t"'>,:<ntiall, different f'om the tUlw(•ightcd <me b whcr('by all weight:-: are U or 1. The rorr0;pondin mockl. mllcxi. soliton gTaph hll!i hr:<U studkd hcforn in e<nn c<tion with el,,ctronic swit<'hing at the mol&ttlar Jew!. As part of that study, thP Gallai-Edmo11ds (G-E) dc'('omposit.ion ha-; bf('n <>xtenrlNI t<1 solit•m g.mptt.;;, pr()viding a solution to tlw ma:dtr1t1m mttlcl1ing prvhl<'m for ud1 t)'Taph!5.

Jt is i-hown that 1he problem of ti.tiding a ma.·•drnmn-weight. rnat.d1ing in a general vertex-weighted grnpl, G can be solved b· a rcp<:ar,-<l a.r,plkittiun of rhe G-E dc-c0111p;,sitiou for a S(X}U('UCc $G_0 = G_1 G_1$: ... of :-olit1.m uhgrapli:-i >f G. 1n <'ach soliton graph G_1: thl) :;t,'t.'011dary verticc.,; (i.e., wrtic-cs with weight()) •re d10.scn as tlw ones with sm ll<-st weight in C,, atH] $G_{:+1}$ hi sett.'-> A(GJ U DtG,) ft<'Cordiug t<J tlw G-E dC<'01npm,itio11 of C_1. ThP- proc<"ss stops when this gi·a.ph bcx·om,·s <'mpty.

Kc_yvmrd:-: vcrtc:x-w(•ighwd. grHph, pnrfect/ma.·•dmum 111atclJinp;. Gn.llui-Edn1onds <ICCOm-p\1.-;ition: rm1xim11m mat.ching alg'1ritl11n.

104) Optimal Stopping Time on a l\•1inorit;y Color in a 2-color Urn Scheme

Ewa I<ul,i,·ka·, Gr,<'gorn I<uhi<-ki. Univ<'rsity of Lvnisvillt'

C:)ns ider an urn (·ontaining an odd nuruhcr of boll!) in 1wo ,·..:,lon.;. \\'her<' tlJC n11ml,..r nf ba ll:, in a spedfk <olor is p;iv•n bv a hinvmial distribution with p = k. \Ve pi,·k t.h balls rando ml, om' b' On e witl 10 ut r<:pl crrl('ut r<'VPH.iing tbcir colo. \Ve wa(1t to stop the pro cess maximi r,in,: the probability that the <<>lr of th<' sd"-t,•d \,all is t,he rninorit.)' ,·ol,)I'. \\(' fi11d tlw optimal st<,ppiug ti1nt·. the prob,ihility of suc<·,-s.s. and its 11s,vmptoti<: behavior.

Keyword:;: urn d1<:In<'. opt.inud :-,topping timc

Wcduesd a y, [\:[arch 4, 2009, 9:00 AM

106) On Jacobsthal Binary Sequences

S. Mai;livem, ,u1d W. W<'i', Fl<,ridu Atlantic Univ,•rsit.v

Ld. I: = {O. J} be tlit' bi11ary alpl,ab<'l, ,wd .4 = {O. 01. l I} tlw s<t t,f IJm-c stri11g„ l).(Jl. 11 >,-er *L*. Let ..i· dmot<' the Kh,uc do.sure of A. ,uni z+ the s<t of po,itin' int<,g<,rs. A sc<1uc•nrP i11 A" is <;nlk'tl a .Jar.ohsthal binary S<<JHCIIC<:. Tll(' munlwr of J11,·.)bthal birwry SC(l1ll'l1CCS of lcng.th n E **Z**$^+$ b tbt. n.'" .Jacobstlrn J number. L(.'t k E **Z**$^+$! 1 5 k 'fl. The nnmh<'l· of .Jacoh,r.hal bi Mt)· scq11enC'c, with 1 /lt the 1.1 positir,n f rom tlw left is drnot:ed bv "•u,k· A formula for this munber ha-; b<'Nl dcdvc<l r<Y-cntly. I11 lhis paper we cousidl'r th(' general ct1,t' uf a(n; k$_1$, k, ... k,,.). the munhcr of Jaeobst.hal binary s Jut·ue<,s with I at ·(ad1 vf the k!h (1::; i m) positi<JtL"- from the 1:ft wlu·rr.- m, k; E Z; 1 :; m < n; 1 $ k$_1$ < k$_2$ < . . . < k u. \Ve prt"€ llt, 11 t'>rm1la for r1(11;k$_1$, k, · · . . k,.,,l. and study s.1m• otlwr sp 'l'ial types of .Jac·obstloal binary scqu<s1ct':l. Some icJ„1nitic-s involving th<."" nwnb,•rs arc also giv<'n.

l\t•ywor,L..,: ,JHC-1•hsthal mnnl>('fl". r-01nhinatori11I id<'nt.iti(!-; 1 comhinatori:U. cm11m<mtio11

107) Decompositions of Prisms into l\•fatchings

IlraJ1dy Hieb'. nobcrt E. .Jamison. Clm,son UnivNsity

If G is any graph. a G-decompo,ition of a hast mph H = (V. E) is n part it ion of th<' edge sCt of If into subgn,phs of !-I wltich arc isomorphic to G. The subgniphs induecd by r.hc parts l)f th< ('<lge de<:omposit.i<,tt art" cn11((1 block1;, The dfCompo:iition .'Jf'llJ'h i)f a G-df•<:ompo:-.ir ion i tlw vertex int<'rM'<:tion graph of the hlockx. In this talk wt' will !-itml y the ca."c of regular <l< omp1.Jsition graph:-: whtire the pro1otyp(• C is r1 mat<:hiJ1g and tlw· host H is n prism.

1<t>y\vonb: dccompositiOl1: prism. reg11lar, rnatrLiug

108} A class of generalized RNA arrays that are psendo involntions in the Riordan group

Asnm1,ah \"kwantu: ::vtorgHn Stah· lfr_llver:-;ity

\Ve pn cnt i das; ,,l' µ;eneralizf'tl HJ\'A army!-i that }wvc c"·ombin11lt,riaJ m(•11ning ;ind are of p:-;NH.lo-or<lcr iu th<' Riurdtm gronp.

Wcdlll'U,L,Y, Mardi 4, 2009, 9:20 Al\I

112) On I.he Dclaunay Tessellation of Proteins

Vine,,, Crohnu,,-·, R;,fad ()rdiig.
Eotviis tJniv,,rsity, :\'yirc-g_yh.lz,,. Hungary

Tiu• c-xrun.inatiou of struigh1.forw11.rdly ddinahlc <liscrctt• ,tmcttu'<'l> in nucleic a<·ith, and pn,tcins turm,i ont ro hc- J><'rb>1ps th<· mo.t imp,,rtallt dcvdopJHcnt. in c,ur prcscnr kur,wlc,Jgc and undcr"t.1111din the thdr form and fnuctic,11 in c,,111,•mpornr.v biology. These di,crctc structure,,, II'<' Sf'<ltt,·nces <f nudmtidc,; and amino acid m,idue:-, rc,;p,-ctively. [3i,1informaties was burn a., the ;ei<•nc-c of anal$_y$"iug tht..-;c M.'T}Ucncc-t. Thf' ,liscrcti;,..ution of th•· I,iologicul inforrnution into ,•1ty-to-l11u,dlc s,x111mcc-; ,,I' 4 0r 20 symb,ib mad,• po,..,iblc- the 11pplicarion of dc,r•p rnntht. m:it.ic-Al. cumhi11atori1:tl awl !-itatistical tool with ,·normons s11cccs;;. The tools. rc-snh in!': fw,n tl,is pr0<.'cs,s, d1ang<>d ,111r p1'rcption of gPrwtic:s. mol,-cnlar bi,llc,gy, and th<' lift• itself.

Straightforward discrl'te srr11ctttr<-s can ulso II(' ddincd in the svatial dc-;cripriv11s of pro-tciI, and nudcic tu:ids. The dcfiuiti<,u aud <·xm11iru,tion of dil'iC'rt>tc objc'<:t.s lt"iiug the• :–pntial structmc of prot<'ins i11stc-\d of a111ino acid M'<Jll<IIC<l< wonld intcrcl'pt. sp11tiaJ drnractcristic:s, that arc mor<' cc,nscrv•tivc evolutionary th:\ll lhe pc,lyJ><'Ptidc " lll('llCl'S.

[n th<' pr(!)C11(. w,-,rk we anttly1,-: tJw D<'launay t ·llatiom• of more tha11 5700 prutciu stmrtum, f 'om th,• Prc,tc-in Oma D,u,k. Th<: D,•latmuy tc,:,cllations of th,• lwuvy atoms of these protein 8trnnnn.-s give.' r.,:rtainl$_y$ a IIICJfC c:,)mph.·x ::–tructurr than tl1e pol$_y$mer so-qu,•nc,,- th,,m.,dws. hut th,,;;c tcs.,dlation, arc- still m.,ily rnuna cahlc mathematically ilDd t.ttiblirall ·- an<l 1,hry nM> \\,ell <h.rihr· tJ1f' 1opolog:ir.:tl simplidal r,111ph•x: of th,· prott in.

J(c.·ywonh,: di crctization nf prot<··in stntrtttrc:,;. D•·lmmH$_y$ tr<,f•llntioJ1

\Vcdnes<lay, March 4, 2009, 9:40 AI'd

u,i) Primes, Lucas Pscudoprimes and Generalized Repuuits

J<lut H. .laroma, Ave l\faria Uuiwrsit.y

A r-pmlit R_{II} is an intt'g<'r tha.l Ian be writt.t:n as a string of // Ol(',>. Almost thirty .Years ago. \V. L Suy<ll•r lXhUdt'd the notion of a n'H-Lmir Rn t t) tlmt which for auy Jh ;-itive integer b R(b) hus u fi-ndic ('AT,ami m tluu. <xmsh;ts bf (,nly ond-H He <;allcd sueb muubr:rs i.c1 leraliz('<l rcplutits. Int.his t11lk we shall pr<S<llt divisibility properties , ssociated with the QH-nllzc"d rr-pnnits. a" v(l1 a; pay pa.rtknln.r ath'nt.ion lo primc-s and Lurl:ls p.-<?udoprimes distrihut,'(l among 1hc,n.

115) Graphs 2-cell embedded in non-orientable surfaces and their coding sequences

Cvllf\ X. l{a.ug. Ennj<'cing Yi'. T,xl1s AM U11ivcrsity-G11lvcst.c,n

Coding seqm•nccs arc a sirnplc and uatuml mu\luls of rcpr< cuting gTaphs. In appl.vinJ c,Jding seq11r•nccs to grapllii in 111.m-ori(ntabl,- s11rfa<xs. \V(clarify on whnt it nHan for a ra.pl1 to hr 2-u·ll embedded in thc fobi11s band and in th,' pWjN·tivc pl,u,c; in p1t1tic11la1, rxa.mplcs arc g\(_U of tlw degeucrat.(: situation wlwn· the complcnumt of ; face in the proje<-r.ive plnJ1l' is nut a tru<' :\fobiu band. Tttking the matr1.r of dPgc.-neraty intv accowit. via Lodiug s<'<tlllllC('S, we give rigort>lt."i prt>t>S of Euler <:hamct(•ristk formula.; for uou-(1rie11tahlc surftH!!S. Th<' m1Ltter of d<gmcnl<y had not bc,-n prcviom,dy <on-;idc•nxl in this cont••xt.

I<<')\Vt)Itb: -n ll cwlwddi11g: codint !'}qmuc<. dg<•1lera<_y. :\lobitt'i hand: nou-oritttutbk snrfoces

116) .Pl,ylogenetic Networks for Human mtD.NA Haplogroup T

David A. Pik,•, k-mvrial liuivcrsit.y of :\cwf,111ndlu11d

Ph.vlogr•nel ic networkc; arr graphs (preferably tr-t-s) that ;how thr· f•,Ml11tit,11ary hnmd1ing and thc r-nrre-;p<,nding hist.oricul development of pt-ll<'tic divnsity within a pt,p11la1 ion. Using data from an oulinc r(•posit.rJf)' \P develop phylogc;11<'tic uC!works for mrD:\fA hnpl1lbTo1lp T. which h ow: of M'VIral known part!- within a pa.rtithm llf h1uwmity lw.sf.d upuu mat<•m;il luwp;l ry By lU1Hlysing the st rncl 1hc oft he rcs11lti11g networks forthi- hnpl .>Aronp \\(i1r.· rlH 1- r\) learn abont t)lP order in which (in0.tif' m11lations oer.urrc-d witldu sorn4• vf il s11hc_ronps. \\!(: ;tr(. abo able to i<lenti(y unstal,k· IIU(•looti<lcs and prcviottsly ul!id<•ntifi('(I gt-uelic du:-.t<-r:,

K,,ywords: mit.od10ndriul D>:A. µl,ylog<'ndic networks

118) Power Domination in Cylinders and Tori

R\>b,•rto D,uT('ra: Daniela Fcrr<;n>·. T<;xas Statt· llnivcrsit.y

A crucial task for dcctric power cornpanic-; consist, of thP con1ini1011s 111onitoring of t.hcir power ra•t,i.·i>rk. Thi mcmitoring lan bl! {'fficier1tl,,· a<'<:>mplished by pladu µh;L"e m<•as111·,m,ut. units (P).llls) ut s,kctcd n<•twork loc11tions. Jfowcver. cJ,w t,, the high cost vf tht' P·1Us, their munbcr mm"t b(• minimized. The power domination problr:m c:ousist of finding thP rniuimnm munl'>l'r (>f PMUs n<edfCI to monit.or a given power n('twork, as well as to det<:rrniuc th": location.-; whtrD tlit'Y :;honld bt' placc't"I. In terms of graphs. ltt(' probkin ('()rtsists of finding miuirnal seb of vcrtic<,s tlliit dominate tlw entire l,'ntph ae<:ordius to some given prop 1gation rule:,; impo,.;ed by the nflture of the power n(t work.

Tlw power rk,1nina1ing proble}-11 b P-c:omplPte. However. dot-<l formula"i for the pmv.-r dominati1Jn number of {'CI1aiu families of graphs. such as re:cta.ugular grid haw.! b(•cn fonud. \Ve ext cud the n•,ults for grids to otl,er families of graµh proclucts: the cyliu<lcr, $P_n \times C$,. for integer, 11 ? 2, m 2 J, ,u,d the tvri C., x C,r. for integers n. m 2 J.

E<:ywords: pmvcr dorninaliou: grid: <·yliudcr. torus

119) Discrep,Uicy of Homogeneous Arithrrwtic Progressions

Rohut Hodiberg, Ea,t C,u·olirn, University

lu t.hc H):JOs. Paul Erdl>ti :lli-k<xl if lll<r<' wa.:, •m1r rornstrult. 13 and t 2-cokiriug uflhc natural ntUJlhcr o that tV('ty finite a.ritlimt•tic: prugressiou <:onti\iui11g Z('to (ZAP) IHHL „·ithi11 B , th(• smn<• m1mb<r of term of ,:-H:h col>r. 11ii q111,tiou n;main.-, op('n. In this talk ···· will bridiy mcnt.ion sumf' rf:f•ent. results on qunsi•nrithm1..•tic progrcs.-;ion. ,vhcre 110 snch B P.xists , and then :-.om partial n-sults along thc;sc lin<'s: For a set X of positive int<•gcrs, define $disc(X)$ to lw tit(; f4•ct<t B so that for ornc coloring of tlw uat11rol mmtbt::rs: all ZAPs with tliffcrcucc in the set .Y haV('. withiu D: th<' :-;atnt;: n11mht:r of (;a.ch color. Sum<• thclm.:ms in<:.ludP:

- For auy set X = {o.b.c} with a < b < c and gc<l(a..b,c) =-1, disc(X) = I if and only if a + b = c or c is odd.
- d-isc((1,2..., 12}) = 2
- di c({l.'.! .... 28}j 2 3.

K<')"'-">rcb: tlbcrcµa11ey. bom<,gc`nd'Jlt arithmctie progn!-iions

120) A new proof of the four-color theorem

John Stdnbcrger. Uuiw,rsi1y of llritisli Columbia

\Ve givP a new proof of tl1 • four-color 1heorern hy r-x.hibit.in1; nt 1mavoidttbk· sf't of 28a:! D-reduf'ible configurations. This provfS a 1970 cc,uj<'>\,tnrc or Stromqnb,t also m•it.:n,1:1, I by Rulx•nsu11, Sau<lers: Seymour awl Thurru1:;.

Keywords: 1i.1ur-('ok,r tlt,-on·m. rcd11dhility

Wcdnc day, March 4. 2009. :3:40 Pl'vl

122) Secondary Domination Graphs: An Introduction

I,im A. S. Factor•. '.\forqu,-t.te Univ,•rsity ,md Larry J. Langley, University of th,, P:,cifi<"

Using Ih,· graph dl'finit-ion of secondar_v domin11tion by Ifrdctnim,i ct al., wc ext.cm! th,· <:onc,•pt to <lir,rnphs. In partit:ular. we consider tllr' (1.2)-dmnination flrtlJih of a tourna.ut(;ltt T. dcm 1J (T). Given v<.•ttkl· x)jnd y in a digraph D ,c .uid y m< a i 1.2)-dMn.i11ati.n9 pt.1ir if and only if for IUJY (Jthcr v<•ru•x ::: z i-, at m(>St ont? !-SUP ,1;1way from r or y1 1md is at mCY:t two :tC)!-i away from th(' at.her of x or y. A (1.2)-dmuinati011 _qroph of a di rnph D is ddinec-1 to b;;, tlw grnph G = i\'. E) wh<r< F(G) = V(D). and &y i, an roi(c of G whenever r and y nrc a (1.2)-domi1 ati1 1y pai1· iu D. \V< <•xumitlt' th<· :-,tructun· of (1.2)-domi11otion !jr'l ph,; of t.UllfllaJllf'lll:-i.

K•ywun_b: tlorninntion graph: st"(ond1uy <fomination. (1:.:n-d,)m.ination

123) A Fl·obenius problem in the Gaussian integers

Peter Jolmson*. Auburn liniwrsity. Christ.oplwr M11r_•r; Univer,,ity of 'frxas, Da.11:i,. all(! .Jordon Pasc-hkr·. Un.iw·r!'.:iity of R(J(·h,-st.--r

It is wdl lmown th»t if a(] J•...• o(k) an' pooitiw· intcgr,rs with gTcatc,;t comrnon di,·isor l tht?n N1rh sntlkit'ntly lart,t· pnsitivc lnt,•g.Pr <an br. exprP"iSN.I as a nonnPgat ive intr,g.rr r,)mbina.tion of tlw a(ij. The problPm of fin.Jin/(the lar(E-81. positive illtcger not so xpm,;.,iblr, as a fun,'t.ion of t.hc a(i). is c,lk'<'.I tbc Frol,enius problem in honor of th,, rnathcrnatician who solv<x.l it iu tlu.: case k = 2. \\:c sl n)w that in that case. k = 2 1 al1 ruml q, m ts prohk·m ('Hn be f ormulated il1 th1' Gaus.<,bm iuteger:--. and •lve it in thr- sp{'cin1 casr. when oru· of tlu.· twv rdari\'Ply prime Gnm,siall intl·ger:,, i: pnn\ly real amJ othc·r ii purdy irnaginnry.

k.t'Y word:,; aud pl,rnM'h: C,1w,sia.11 intr•gc-rs. Enclideun dorwtin. Frolx·nim: problem

124) Hercditarily Equivalent Graph Properties

Terry '.\kI<t,'. \\'right Stat(• lluin·rsit.y

Fur any gr.1-ph property P. define a grnph t•; b,, hertdilanly P if every il1- dncC1l nh-p;ntph satishcs P. Defi-n hvo graph properties P :Uld Q to he hnrd- itoril11 ,•qlfivatcnl if hr'ing hcn.,Jitarily-P is cq11ivakm l> hd11g hcr<'llitarily-Q. For insta.ite<'- the propcrtic'S I' = '-:very Vt:rtcx has cvt;ll degn•,, ,u1d Q = ·1thc m1.mh<r of cdg<'S is evl'11 • are hcn.:ditar-ily e<l11iwdc'IJt il1< kod: in this <HS' hcr(-..lit,nril.v-P 11nd lu•n lit.;irily-Q an" ,-m·h cqnivalcut. to being nn f'(lgcks>g:n1ph. This talk ,vill txmnint1 tlw g 'aph mt*1 1ltlwo ry l>f hPr,'<litary CiJliiv-alPn<:c, indud- ing it$ iutimatt.· relationship to 'lll'mirno.l 1'q-ui-uule11ce and LIH' n.-:,ultiug 11c;1ion of <:om71lemrntar!J p1·v11c1t1Cs in the corr<.pondiug lh)l)ll'an algd>rn.

k.t•y words: hereditary property. minimal pn:,p(•rt;v. graph nwta.theory

Wcdnc day, March 4. 2009. 4:00 Pl\,f

126) **Graffiti.pc on the total domination number of a tree**

Ermclind1 1 **DeLaVina***, Ry11J1 Pcpp<•r ,md nill Walkr, Uuivcr,ity of Hou ton - D,l\\1ltown

Tl 1f' rotal **domiuatiun** number **of** a gra_pl.t G is the minimum cardinality **of** a sub,,;et **of vcrtic:cs S :-,urL that every vertex of die graph Ch; adjac<•nt to omc vertex in S. GrnJ-fiti.pc.** a program t!mt mak t graph t,heor<'t.ical <"<mj,'Ctnrcs (utilizing t,w,, conject.un• making strategics, one of wh.id1 is similnr to S. Fajtl o wi,-z·s Grnffiti): wns qtll'rit'O for conj,_:f:tnrcs i) n the tou11 domination nurnhc;r of <'onnPCtcd graph . ln 2007: sc•vernJ of Gra.ffiti.p<"s Nmj(>(':tnr on tl 1P **total domiuatiuu we-re** 1wnoun<·<:<l **aud rcsolv,.:<l. In this talk.** w< n:vi:'iit so111< uf **thvsc** conjc-ctun>s ,uid iww on,-s. made m<in' rccrnt.Iy, sp1-cifically for t.rc,,.-,.

127) **A computational approach to inequivalence, isomorphism, and excluded n1inors iu n1atroids**

Sandra h:ingan. Brooklyn C,)l!Pge, C U N Y

Although us **of c ompntr-r in proviu_!!;** t.lF,nc1m; **is** widel y ac<·<:ptcd **iu** comhint1toric;s, matroid theorists hilve b,'('Jl some what. slow to th,,nge wit,h the timffi. We pr"S,·Dt a computational approadt to rnatroids th11t rnd11,·e,; some lengthy pnblisl1t•d proofs to straightforward cornputC'r cukulations thut c;ut b• c•a:,ily urvler:;tood. while k<"'-'Ping and (•1.tl1 wciug tJ1t' geo**rnct.rie irisight** thDt **is o** impt)l't.tUtt **in wotroid theory intact.**

I<eyw1.Wlb: rnatroid:-:.. graph!->. ill('(Jlli\'a.lcnt·P. isomorph.ism: cornhirifl.torial catak,g:-i

128) PC-Labeling **of** a **Graph and** its PC-Set

8hrahi111 S n l<•hi: lJuiv, rsit.y of :'\evnda La..; V<•gas

F<,r 11 graph C = (V, £) and a binary w•rt<'X oloring (labeling) J : V I G) {O, l} let v1U) = lJ-1(i)I. fissaid lo bf'conli11I ifl·v1(1)-1•1(CJ)! :,'. l. TheC'oloring.f: V(C) (0.1} i l1d 1 1c<s all ,-..lgl' l,tlicling r. E(G) (0.1} ddi1wd by J'(.C!J) = I f (,) - f(y)I V,cy E £(G1. Let ,: 1{iJ = l r - 1 (;) 1- A graph G is said to lw <:or<lial if it admits a <',mli;,J la.bding such that lr.1(1) - r1(0)i :S l. [n this talk tlw ,·onccpts of PC-labdin!(aud PG-s<•t.s ,,f **1,•raphs** will lw introd 11r<·d am.I the PC-sPts of r.-rt,J.in das<;<s ,,f graphs will be d;,tennin0,L

J<,-yw,irds: cordial labcliug, Mrdial g;raphs, PC-lahdiui,;. PC-sets

Wcdnc day, March 4. 2009. 4:20 Pl\!

130) Set-siz<.'CI (1,3)-Domination for Trees

:,,iirnnd!l R. 13,,wk·. University of :'\orth Alabama
Pct,:r J. Slater: 1Jniver ity of Ahl-mmr1 in H1111tsvilk

Tlw dumin.J.tion continuum p.1r..u1tt;tl'r ./r\r, :'..3, ..(G) arc d<fiH(t l under th<' r('(uir<•mcuts that Path :-:ubsct S cJ V(G) t)f siz(• i lw dominated i\t lca.,t c, tjl11r. A :-:nbct D V(C) b a set-sized (r,. "> r, ...)(G)-dominating s d if for (•adl snbsct S of l'(G) nfsizc i, tlw dosed nPi!(hborhood of S inwrsi,-t.s D <l least r; times, IN[S] n DI 2 c,. for cach i E 1. Then 7x(•, .ci ,.:1... J(G) is the minimum t·ardinn.lity of a sct-sizt-d k1,Vi:C3 . . . .)(Gj-dornirwling sPt.

}:'or trc,· T. 'rr(:;, ,.i ;(T) is dl.fill<d if and onl y if c1 2 and r2 3. Ju thi- pap<'r we ,·on,id r sct-siwd (J 3)-domin:it ion for tree,;. We show, for t tr;;c T of order 11, that (3/4)u + (1/2) 5 "Y,rt.:ii(T) 5 u. aml we dwractcri,-,, 1lll' trws that uchi<W thl'st' bou.uds.

hc."yword:;: tr<-es. domin.i:.1tion •:ontin1111.m

131) Fixing uu111bers **for rnatroi<ls**

Gary Gordon•, Jmuifrr '.\k?llult·. :'san('y :\t•ndau"r. Lafoyl'ttt• College

Given , matrnid *Al* th fixing numlwr *f(M)* is the size of thP smallc,t subset *S* ,,l' elements Jl' the mnt.roid so that the onl,v uut.ornorphism fixing eadl l'lernmt of S is the it-hutit_v. (Fixiug nmnhPrs hav<' bt,:n studic-d ror grupl1s.) We dt•t.c:rmim· tile fixing numlwrs d som(' matroids with large a11h)rnvrphi,rn groups, including pr,,j,:etiv(; and affiue plum•. In 11dditi,m. w,· COmpnk *f(M)* for lar!(<' rlL'<><; of t,rnn.w,rsal rwu.wids arising from hip:irtit,· grapl1 .

132) On Computing Edge-Magic Grap}L and tlwir applicat;ious in Cryptography

Pi11g-T:.a i Chung*. Long bla nd llniw•n;ity, Sin ·fin Lt'<. Rid1ard Lvw, Sau Jose Stat<' Univcr;ity

F',r a l: y• d1.notc

$$Q(u) = \begin{cases} \{\pm a, \ldots, \pm(a-J+q/2J)\} & \text{if,1isev<'J1} \\ \{0,\pm a, \ldots, \pm(u-1+(q-1)/2)\} & \text{if,1isodd} \end{cases}$$

A ip, ,1)-i;rnph Gin wliid, the ,,J c-s art• lalwk<l by (J(a) s,, tlu1t tlll' wru•x sl1ms mod pis a cnustn.nt, i- calt'CI q(a) Balnncc Edgl. lCngk ff C b n (J,.'J)-graplt in which the <dt> arc lnbcl<d 1,2::3, ... J 5 thnt the vertex slmls l\l(\Onscant: mod p, tlwn G is C;all,d a]1 Ed f \.fogir (E'.\·l) graph. [n this paper. we first inv,tigaw 1le rPlat.iousl,ip between 1he tJ11ir_y of 8\.1 graphs and the th(•ory of Q(u)-IlE f grapILs. Several c..uj.-,tun,.., al'(: propos ,l \.\',· thcn aJ1uly zc tht <'t>mpntationnl <:omplcxity for computing £j.•J gmph-i und db<Usti tlH'ir poteutinl 1tpplicl1ti011s in Cr.vptognJ}>lt_y.

I<cyw,)l'ds: Q(a) Ilalnnre t'<lg.•-magic, <'<lg.rrwgic. Q(a)-,otnp11tational compk•xity. <ryp-togrnphy.

Wednesday, March 4. 2009, 4:4.0 P M

134.) Independent Domination in Complementary Prisms

Erm,–,t .hun*: J o d A. COngora, Tcr,.-sa \V. H_a yne:, **Ea.-;t** Tcnlll'S.")l't State University **Johrn,ou** City

Let G be a graph and G he the Cornplcm<>nt of G'. The c:omplcHll'ntury prism 0 C of ***G*** is the grnph formed from the disj,iint tmio11 of C ,md C by adding tl,c «l!(es of a p,•rfcct matduug b<'tw<Xu tlw <:orrcspomJing vcrtin-,; of *C* aHd *G*. We consider th inckpmdr:nt domination nnmh<-rs of romplemcntary prisms ,:,nd present upp r and lower bounds. Among other rc.-sults we dtaracteri7,<• tlw grnplcs C G nttaiuinf; tlw lower bound mn:r{i(G),i{C)} Ω *i(GG).*

l<cywvr<ls: Cartcsia.u Produ<·t.. Cornph:mcnta.ry Prbm: I11<lPpCJ1dmt D1,rninatio11.

135) **A** representation **of** the bias matroid in **a** projective **phu,e.**

Rigob(•rto Florez. Univ('rsity of South Carolina Smntcr.

A qna.sig·roup e:i.1xzn·ion 9mph of /($_3$ consists uf a :g-aph that. 1,a,; a po.ra.lld edge to each edge of K , for each clcmmt ill the quasigro1.1µ. Each t,li;c La a label in the qnasigrnup. This g:ruph giw-s rise to t,wo nu1k-3 ma.troids: th<• full bia1, •lilil the completF t1ft matroii.l.

In thi,, tttlk we discuss the 11lgebraic diaractni,ation for 1he r pr,>sentability of these ma.troidi– in t project.ivf' plane in tPrms of q11asibr•mps and ternary ri11g.

136} Zero-Surn !Vlagic and Null Sets of Planar Graphs

Eh r aliim S n lt•hi uud Sarnw•l HHH:;t:U¥. Uuiv,·rsity uf l\\·vada. Lu, Vega

For any h E N a grapl, G = (\', B l is said w he /,-magic if th,·n· r·xi;ts a labeling 1: E(G) ***Z,*** - {O} s11d1 that the ind11cP<i vertex 111.h,lin /+ : V(G') ***Z,,*** ,kfined hy

/, .t{i,'::=. L , _ l,(11.I')

uvEr',.((·'.:)

is a <,ontu11l uwp. \-\1 r<H **tl:;b** <:on ta.nt is **Owe call** C: a zt.'r&-um It-magic **grapl1. Thi: uull** ct of G is Hr' f't c,f all 1w1.nra1 numbers h E N for which G a.dmit:-; a zcrcr:-run It-magic labeling. A g:ra.ph G i:- said to be uniformly null **if** t'VPry magic labeling c,f G induces z,::rn s111H ln this paper we will ideuli(y tll(' 1111! sets ,,f <'Crtain plaJ1ar grnph.,.

K l!ywords: magic: zero-sum: nnll set of a grnph

Wednesday, March 4. 2009, G:00 Pi'd

138) Role Assib'T1ments and Domination in Graphs

Ik1111 Ltski,r*, Cle;rnson University and J,•n•my Lyh·. Uriivcrsity ,,f Southern :\lississippi

In this p.apcr we il1v4;;;t iga.tc the coucPpt. of rolP as.-.;igunwnb as a tool for \011::,i({pring vt:rtex partiti\)W, of a g:ruph whcr<..: (.'Udh part.it i<,n is cir.her an indcpf'ndcnt or <\ total \k,rniulltiug sf:t.

I{eywords: graph lwmomorphism: role .issigmm.!nt: iudep<'Il(lcnt. and total dvmiuutin{ s d nd <loruatil' partitiorn;.

139) *A* Deletion-Contraction Theorem for Internally 4-connected Graphs

Car")lyn Clnm*. Lonii-:imu1 State Univr:rsity, Dillon '1a.yhcw. Victoria Uuivt rsity of \Vclling:- t.(m. **James Oxley.** Louisiana **State** University

1\1tte[1] \,Vhff•l:-. Theorem H'>]Prts that. for a 3-ccJI.tllC'U'ti i{raph *C* t.lwrc i an <.tlg-• *f* in G such that tht• rlelr.tic,11 or ront.ract.ion of e fron, G i:. ;)-<·onnecl er! and simple uni(.., G is a whc,,l'I.]n thi talk, w:: present a similar r(..••mlt t(>r internally 4-comilx·te<l graphs. This th(.,-orcm i n :,,p{'<;ial cu:,,l' of a rnon' geu<..rt.11 n-sult. for binary inutroids.

J..:cywords: chain tl1turl'rn. **internally** -1-corinectcxl. **<ldt'tio11-contrndion, whcx•ls tlworcm**

140) Ou *Z*, 'l! Z_0-magic Graphs

Yihni **Wcu, Suzhou** Scil'nc:c **aud** Tcd1.Mlogy College, Sil1-'.\Ji11 **L,,.,, San** .JoS<· **Stat<'** UuivNsity. :wd Hsin-Ha.o Su', Stoncl,ill Colk•g<.

Let G be a simpk µ,mph with wrt,·x set F(GJ **a1ld ,!•:-** set **E((!).** For any a.hcliru, 1,croup A writt.cu additively w<' denote **A · = A \ {O}. Any** mapping **l : E(G)** **A'** is callcxl a **lah1'iing. Civ('U u labeling on 1.:dgc s,;t. of G Wt tau indu<x a Vl'rtl'x set h.1lwling: t[t] : V(G) _.. A n; foll1.1ws:**

1+ (u) = I) l (u. u)I (11.1) E E(G))

A graph C is knO\vU as A-mt1gic ift.herc is a labeling l : £(0) A" ud1 rlH1t for ear.It vertex V: t.he sum of t.lw lubd:-. vf the (,'Ugcs incid<•11t with v arc all equal to the ;;arn<· constant.. lu t1tb paper, w illV(..",ti! Htl· grupfL', which a.re z.· ,f) z-ma.g:ic or ar'-: [1(Jt z''i a Zt-lfiH–KiC.

l cywor<ls: vertex labC'ling. edg<' la.bcling, magi<' gruph. Kk:iu fonr group

Wednesday, tvfarch 4. 2009. :,:20 Pi\!

1'12) Locating-Domination iu Complementary Prisms

E r istin R.S. Ho lm(• . 0(•nbc R. KoC:-i-;le;r . T1.'r;\ \V. Hayne. Dl·partrncut of :\latlwma.tic
Ea.,t TcJutcs..,_i State University

Let, C = (V. E) he u graph and C lw the ,·omplrm<mt of G. The comrMmcntary prism of . G, d,•notc-d CG. is the gruph form,•d from th" di,jc,iut nnion of G ,md C by udding 1lw edges ,,f „ perf<'<'t m1<td ing lwtw<>cn the c.·om:sponding V<'rti,·c,; of G and C. A ,,.t D.:;; V(C) is• IO<'aLing-dominati11g Sf't of G if for every 11 E V(G) \ D. its neighborhood N(t,J intcrsecti,m with D i s nonm1pty aud distinct from N(v) n D for all " E V(C) \ D wl1t•re „ f- u. TI,c hwntiug-dornin,ttion number of C is t!,p minirniun cardin,ility of u locating-dominating sN of C. W,• stncly locating-dominati,111 iu r<>mpl-,mmtary prisms. W„ dl't.ermiuc the locating-do mination nnmb e r of G(; for spP<·itic graphs G and rharactcrize the cornpl<'rn ntary prisms wilh small J,,rating-dvrnina.tion number:,. \VC also 1>tC>c'11t bounds on t1l<' lol'atiou-1J,n1inatiou muubt•rs vf complt·ment ,u , prism::;.

1'1?ywords: C-omplementt.1r.v Prism . 1,)('nting-Domiliation. Domim1tion

143) Variants of the Moore Graph Problem

GL'Offrcy Exou. lndia11a Stat,, Uni\'l'rsity

Some va.ria.nts of th Muorc graph prohkm will he discussed. The 1„r1ts will he on vnri„11s rnf'l:l:-illff':S of h w d u s e w< c.ui oome to cmt<;;trn(·ting a '.\"loon· graph i11 the n,.:;t where Od \foore l,"faplL c..xist,. Cartoons will))(' ,;hown.

Keyword : '.\-loon· mph. r.a (\ dc.•gn:C: rliumf'tt.:•r: <ut•1-oon

1.1,1) Vertex-magic 2-regular graphs

Dun :vll'Quillan*, 1\orwich University and .Jumps M. :\'lcQniUan, Wr-stl'rn Illinois lluiw·rsit.l'

lt is well-known that each cyrlc has at IPu,t one vut.c.x-mui;i total lnl,l'iui; {V\'TT L). Huwr:ver, not mud, is known n•garding other 2-rc•gular gTaphs. 'lnd)ougall ha., c<111jtd,11n•d tha1. ea<h rc·gnlar grnph ,)f ,1,,grPe at !,•,isl. 2 has a V ITL cxcc·pt for tlw disjoint 11nHl1 2C:,. lu tl ib ta.lk w\ <lb.cuss n)cent prOb'T(•;; ou this pruhl<'IIL In part.icula.r W :.hov,: that the: disjoint m,i,,n 6Ca ha., a V:\iTL for every., otlwr than'.!. WP sh<,w that. for s = (2)/3"1 (with k > 0) tb,• graph.,(', bus u V:\1TL with n magic con,t.ant of h if ,rnd oul:,· if (li2)(15.; + -1) :Sh S (1/2)(21.s + 2).

K e y ,\l)rds: v<.:rtcx•mngk. t'<ig<'-magk. 2-r<'gllhH

Thursday. 1\-la.rdt 5. 2009, 10:50 Ai\f

145) How Docs One Record Mathematics and Its History?

Ob:;en1)tio1L; au<l 1l-:-:ou-; frl)]n Tlw ·fatlH.•rnatii.al Coloring Book.
Alcxn,n<l ı r S,tifer. Uuiv<.•rsity of C-0lorado or]ifl•r(t1lf.cd11

What is ma.thematic,? Will it exist. will it be pass<;d Ol withont. It writt0n t,,xt"! lsnt nHlth r matic , in i s1.iJJsc, wLat is rtXXJr<lcd ahout it? And how docs mlc rt'<or,l m11thi.'Iffl\.tit's?

I\Iath, natics b ohjt•cti\.,?. lorcovr-r. in the Plat,l)lli t vh:lw (shin-tLi by mol-)t mathcmat.i-d t ns), it exist:.; vut there, and h)Y.ly Ils ltlf'rdy dis.rover it. Tims it mnkcs scnsf' to nforcr. ohj(:ctivily in matlki111-1tical writ.iug. Thi:; obj(.:ctivity ı c11forcf' f aud pr88<<l on by editors or j<,uroal and book. u1wrvisors and advbor. au effix-t of ndentlPs tlH;orem-pr\)Of-t hcorem-proof book. rd) if writt<'.Jl by rohot:; for rohot-,. It t.hcrcforc com< m lit.lll' urprisc that majority of hum,u1 kind dislikes rnatlwmatics.

If one were to a8SUlll' th,1t ma.thernati<:s is <lom: h ᵛ rnatlu.'matkifllS, and furtlwr il&illrtt· t.hat rnathcrnaticians an' human beini,o. one wonder$ whether mathnnatic.--; B (SS(•ut.iully a hnrnau <l1<lv<lvor; in<:vitably !'.-lll>jf<;tivc. If <>. why should W< not n'or<l it is a Hv;. vital hnrna11 tH'tivit.y? \Vh.y uot writ<l mathcma.tibi it, if it were ereatcd ruid r(C<)rdcd hy hmnan hdn rvr human beings?

Su. tuc we williug and t•?ady to give rna.t)l('mutir-s a human faec ruld human aml scientific hbtory? L<l us :-lart thi convcr:;athm in Boen iuid eoutinue hcyor.11.l It i; too ilnporta.nt t<; ncglc,·t!

146) Independent Sets in Edge Closures of Bondy-Chvatal Type

Robert E. Ja.misvn, 13rdl1 t\ovick" Cl<lmsr,11 University

Let All he thr. C>mphtc WllPh of order n a]td 0 ll pt>sitivc intcgrnl tlttt;'-1/told. Suppose 8 is , Sd (>f cdg.,., of J(, ar,d Id dcy;(") dmol<" the umnlwr <l cdlscs in S inridm1t with v An •>di:<,,, Ol /{,. is /1-dep,md<nt. Ol S it" de9s(11) + dr9s(,:) ? 0. S i s 0-clt,scd provide,! S conlaiu:-; ,di cdge:i that art· 0-dtf)Cll<h,\nt l'll S. Si:-. O-ill1.kp(:1H.lent iff no edge ut =uf S i s in tlic d,Jsuw l)f S \ lll. fu thi:-, paj)(:r ı we will i11vc__tigate rnwxima1 1tnd maximum 0-ind<'p,;nd{·nt s d., ,,f <<l/;- The now dnssi<:al c,w' fl = n wa, stndi"i by Bondy and Chv,,tal who pn,V('d t.hat if th(• H-dosurt• of,·, graph is BELmilt(,11ian: tl1cn the original raph mw,t lw HawilLonian.

l{eywon.b: closun\ independenc;r•. Hnmilt011icity

147) On Balance Index Sets of Disjoint Union Graphs

Sin-!Vlill L-c. San Jose State University. Hsin-Hao Su. Stonchill College. ,u1d Y,u1g-Chi11 \Vaug*, T:i 1l-H1li lust.itllf(• of T{'<lmology. Tn.iwun.

Let(,' ht· a simple graph with wrt.('X SPt \/(G) and c<lw:c ,ct $B((:)$. nnd 1,t $Z_2 = \{0, 1\}$. A labeling f : $\backslash l(G)$ - Z_2 inducl's all ,-dgc partin! labdillg f' : $E(G)$ - , Z_0 ci<'fincd by j'(1w) = j(u} if and c,nly if J(-u) = f(-1') for <>1th tlg•: 1w E E(Gj. For i E Z2, let 1,,(i) = i{v E l'(C:) : /(-,;) = i}I ,ind •1(i) = l{e E E(G) : r1,-) = i}i. \\p call/ is a friendly lab•lin!: if lo,(0} - ;:J! 1J : 1. Tim b,dancc· index sPt of C, d,•uot<l 13[(G). i, d<'tinPd as {11<(0} - 1!1(1)1: the vl'rll'X labeling f is f'icmlly}. [n 1hi, paper, we ,1.udy tilt' bnlm,c,· ind<x ('r of th{' tfo,joiut union gnipbs.

](ₚywordb: vertf•x lab<ling, fricudly labeling: ba.lam'{· il1tPx set: a.ritlrnu•rit: progn ion

148) Graph-theoretic generalization of the secretary problem; selecting a best twin

Grzcgorz Kul,il'ki". Ullivt•rsity of Lb>Uiwik•
:\·1id ua.l :\lurayw.•. \\.r<,da.w University (Jf T(-1.hnol\>g)"

C<;mi tl<'r a post't P con btiug of two diail1:-, cl Hl{ ;amt• lcnbith; the (Jliiy lUC<JUlflwahc de1w.nts arc lcli'n cnts from the l-}allH: h."Vll: rcfr•m'<l a" t.\vius. Tht· dcml'IJt;,, of P nr,· oh1,nw:d on,- ily<•lW in some rttnd ᵣmi pP.rmnta.tion. At a]V fill ᴴ Wf obs;J-vr- the pnrtial (,rd<\r iudur.rl by the <lemcHls t.h,it c,unc up to that "'"'n<llt. \Ve w,mt to d1uosc the prcs(•t1tl_v obs-•rvi, I d<m<ut maximizin th prol,a.hility that this d('mcut. i, orll' t)f thc hM) max.imaJ t.wiu:,. V'e fiud tlic optimal st,Jppin time nntl t-:-,tablish tbe l\...ymptot,ic hphnvior \lf th,; pn,bnbilit.y <f ,tl(:("(S..".

Keyword:;:; c<;n'tary problem. optimal stopping. partial ord\r

Thur day, l\farch ;i, 2009, 11:10 AM

1-I!J) Bounds ou Some Ramsey Numbers Involving; Quadrilateral

Xiuodong Xu, Gua11gxi A<:ildcmy of Scicnc,s, :\'i1m1iug, China
Zdmi Shao, Huazl10ng Univt.!rsity of Sdcn(·c iuHi Technology, \:ähan, Chinn.. StnnbJa.w
Rnd iszowski', [tocheslfJ' lns1i1me of Tedmology. .\/Y, USA

For graphs G1, G2, · • .G,,,, th(• rlamst-y nurnh"r R(G1,G2,· • .C,,,) is <l•fine<l to lw the smallc,,t int,·w•r n su h that any m-coloring of the <dgcs oft.he c,,mpl<•t,, b'ntph / ,,. mtlt in-dude ;, monochromfl ti<' G; in color *i* for some *i* Int.his talk w• report on several low(•r and up-per bow1ds for sonw Rant>(.Y nurnlwrs involving qua<lrilut,•ra.l C 1• including R(Cl• J,9) :,; 32, 19 S R(C.1, C,·A5) $ 22, 31 S R(C1.C4.C.,,I,,) $ 5U, 52 $ R(C./, 1, /. I, .,) S: 72, ,12 $ RtC.,,C.,.I(.,Ki) $ 7G, and 87:,; R(C,,,C.,.h·,,1<.i) $179.

k<ywor d-,: R:un:scy munbcrs. quadrilateral.

150) The D-independence Number of a Graph

.J. Louis S,•wcW, P<t<,r J. Slut.,·r. University of Alallamn in Hnntsvillc

For a set D of positiv<' intcg,,r,,, we dd-inc ,, v,,rtex set S;;; V(G) O be D-iU<kpm<lmt if 11,v E S impli<•s the dista.ne,• d(11,v) ¢ D. The D-indcpmd,·nrc munlwr ;io(C:) is the ma."<imum cardirndit_v of a D-ind1.p<'ndei1ct· set. ln partkul[lf. tht· indCpcndt°nce mm1her /i(C) , fipi(C). fl,,rc. we forns on t.he odd-ind,,pcmdmce nnmber 3o o o (G) where ODD= {1,3,5, ...}.

I<eyw,,rd:-;: indvJ>C'ndenc<' muulwr, distance sd.

151) Extreme Friendly Indices of $C_0 \times P_n$

Wai Chc-c Shiu a1ld Fook S,lll Wong', Hout hong Il,iptist University

Let G = (\'.£) 1w" ronn<Y1,'<l simpl,• grnph. A lnhdinl!; / : V(G) - Z, indttc<'S ilfl edge lalwling f ' : £'(G) Z, ddi111sl hy f"V!!) , f(.r) + /(y) for each cry E E. For i E Z2 let ·v1(i) = IJ-'(i)I ilnd r1U) = Ir'(i)i. If lv1(0) - v1(l)I 5 1, W(call it;\ fri<:udl· labeling u1ukr /. For a fri t:ndl;, labcliu / of a i;rnph G we define the f 'i('Jldly iud<:x of G ,md,•r f by i1iG) = c1(1) - "J(O), "11,c set {i1(G)l f is u fri ndly Int.ding: ,,f G} is caJlc,l tl< fnll friendly ind r·x • of G. [n this pap<'r. wt' will prcsrnt thf t>xtn-mc f 'iPt1lUy indiC('·-, 1.1 th(' CarU-;i a 11 product of a eyd<: alld a path.

k<Py,,·ord:-;: Fri(Hdl,y lahCling 1 f 'imidl,y index S<t, C;,rtf-siuJ1 prc,d11ct. of a cycl<· and a path,

152) Tour Sets aud Tour Vertices of a Graph

Garry L. JohrLs. \Villiarn R. Vantaw", Saginaw Valky Stat,• Uniwrsity

Let (; be a connectCd. simpl(" graph. and let u and ti be vertiCe:-;. \V(detin,· a u - v to11r to b<'" u - ,, I.rail of muxi11lum length. and for any subsd S <; \'((.'). w" denote hy h[S] the set of all vcrtic c lying on auy tour bitwce11 ully pair of vc-rr.i(,cs in ;J. \Ve say tl1at S is a rvur S('t if Ir [S) = V(GL and that a vertex ti is a t<,ttr V(fi<X if v li;!– withiu every miuirnum tour hPt of C. ln thh, talk. we present, sonu• bHsi,· r ult <011c(•ming to11r sds aH tonr vcrt,ic,. ind lu li1lg some cvmrwrison:-; of thPSP. <on('cpl; to gt:'1.>detk S€ts. gr,-,detic vcrt icns, deto11r •t.. itnd detour vertices.

J<eywords: trail, tour. dctonr. geod tic

Thursday, l\farch 5, 2009, J1 :30 Al\-I

153) Cyclic perfect T(P2 U P2 U P2) triple systems

Danny D·er'!'·. h!ffi\)rii-il llniver ity of l\'(:wfrnu1dlluh.l. .foi:;h :fmLz<r 1 University of Vidoria

A T(G) triple is fi,rnwd by taking a gravlt G and replaci11g every edge with a >-c 'clc: wh n' ,1ll of th mw vertie,.::-, arc dhitiue:t from ,Ul uthcr:-, in G. A11 (·tl t· di:;j ,)int <lccumpm,itiou ,,f :l1,. into T(Gi t.riplc,; is called u T(C) triple sy,u•m of oHkr n. If we cru, 1kcomposc Kn into <;1Lpic-s of H s•i-aph G. sud1 that ,vc r,u1 f\Hm 1l T(G') tripl0 from tl1d1 grnph in the d,'<'ompoRit,io n and produce a pa.rt·ition of the cdg of 3 K, , th,:m the rnsult.ing T\G) triple s.vstc111 is calhl perf<'ct. \Ve show that the spel'tnu-r, of pcrkct T(P2 u P2 u P'2j triple ')'y:-}<lfL'i for ,, at ll'a:-it U i ,, 1 3 (mod 6): uud iv(• cyrlit constrndi\nb for all admb ibk· orik•n,,.

I<eywunl-,: gn.,ph d('(:ornposit i<,us. trip!,.: yskrn:--

154) Colored-Independence

Anne C. Sinko, Ob,,rliu Colleg,,

Gi\'ert a partition $\mathcal{S} = \{S,.S_z, \ldots, S,\}$ of the wortlcx set V(G) for g;raph C wh,·n· S, is ,:ol<,r "1 i, nn S-indcp<'ndcut M\t is uny H(t R V(C) whcr R is ind('JWnllent and cit,hcr R n S, = S; or //11 S; = 0 for e;1h S; with "I:,'. i _<;_I.The 6-indPpcmd,·ncc number ;t(C: 6) is th ma.'<iumm cardirn,lit_y of an S-indcpmdem·•' set. Both tlw indq,cndenc(• partiti,rn nwnlh.:r,

$$;f_1, 1r(G) = \min\{,i(G; 15)! \mathcal{S} \text{ is } I \text{ partition of } V(C)\}$$

nncl

$$i_p,;r_{(C)} = \max\{i(C: 6)1\ 6 \text{ is a p11.rlition of } V(G)\}$$

will lw discm:i.'k'tl in dcta.il.

l,ey words: lndq>,•ndCJicl'. Colorcd-indcp,·n<lcnce

155) On Balance Index Sets of Gcucralizc,d Friendship Graphs

A_udrcw Clnmg-Y<'11ng Lr1·\ S_vra<HS<' l.J11ivcrity: Sl11<Vji11 Lee. Sau JoSt· Slate Unin:r:-:iry and H,iu-Hao Su. St.orwhill Colk·gp.

Let C:-=(V(G). £(G)) be" finite simple i;rap!,, A (0, 1} ;,nd f b a vertex IHI)(•liu 1,f G via .4. The lalwliug fu1,cti«11 f is ,aid to be a friend/11 lalielwy if 1>•1(0)- <1(1)1 l, where 1:1(-i) <lmotc-,, the qnantit,y i{,, : f(v) = i}[ii=D, 1).
Given o vr-rh•x hi helling/ of C: <JliC cau i1tt,:mpt to h1bi'l th< ed.;cs ()f G' hv tlw followi11g rnk 1,r <•Hh cd:,;e {u. ,,} E G, if u and,: hnve the sanw lalwl I (i.e. /('!t) ". f(-o) "' lj, tlim rhc cdg,• {11.v} will be lab<'lc-d l-y l. Otl1r·rwis<!, no lal,t-I will be a,sigrw<l. The rl'sulting <'<lg,, labeling for G is a partial tirn(:tion ,md it is d<:notc<l by r. We are iut,::i·c-,,tcxl in rI:r<:bl'li,\Vior for J · wh(;ll / is a friN ıdly lnhding. [n particular. w< ('Xmnim.' tlu.: bafo.ncc i.ndc:i: ,-;ct (c\hhrtV. as Bl(GJ) of a grnph C:

$$nTtG) = \{ie1(0) - e1(1J[: f \text{ is a fricndl\_1' labding}\}$$

where c1(i) = i{{u,v} E E(G): f"({1t,v}) = i}I (i = fl, 1). lu tl1b t"lk. we will pr<-,<'llt, n ult8 rcgnrdin thc b_ila11e<• indl'X sets for a mm1l,cr t>f gcm:rali?.1.'tl fri<•ncb.Lip l;Tl\pl1s.

J{cywonb: vertex ln bd illg: frii udly labding: balan<:e index d. a.rithmdie pr<>n-:-;,iou

l.5<i) Demidenko Conditions and the Vehicle Routing Problem

Yoshiuki 0<111, l<<'i0 UniV('rsit_v, .!,,pan

Tite' Tra.vding Sak nnwu Prt>blcm (TSP) b om: of the mot f<1m(llb PMhard prnbleul!-i. Sc}. much \Vorks hnvc)(t'n dmw tcJ study p-'l,YIll)I11ia1ly ,olv;ih}<' <H!>'h that b,. t> find g<J<d c:oncliti ons for distan<:<-::i lwtW('<J1 <-ith. sud1 that an optimal tour caJ1 h, fom.1d in polynornial tinw. Tl n·st· good runditiow, give ,ml' restriction 0l1 the uptirnal tour: for <:xarn,ulc. .\lunge prop<\rty aud Demidt nkc, conditions. :vrorf•ovr.:r: it is :-;igniticaut t.,, fiu<l aJg<,ritluns wltid1 \'Offif)llh' tlw sh rt('st tonr with thc r triction. A p_yrrunidal tour app<•nrs f', -qn('lltly in th\>!-<' con<-C'pts. For a given rompl te wdghtf;'<l digraph(;, a ver1cx 1; of G. jr1tl a rh.>sitive int(•1\r k. 1;1-, Vchid,, !louting Probl,·m (VRP) is to fi11d a rninirmrm wcigl,t r-,innect('(J snbp;n,;ph F of G sud.1 that P b a union of k <-y<lc sharing 0l11v the vPrtex & Ju thL; tulk. we apply good (:ontlition for the TSP to t.h,, VHJ'. The 11nthor pri,v"i th,tt if a giwn wcii\ht,-.I dib•mph sa.ti fi l- several coBdition: whid1 ls kn\)Wll for rhe TSP. thPn an opt.iuutl ::-olnt.im \f Hll VHP can a.lso be compntcd in pr,lynominl time. In this t.•.lk, we shall focus ,m DcmidPnk,1 ('vnditions and prove 1hat th• VRP restri<'t<'d to Demid<'nko condition, is abo polyn,11nial tirnl' ulva.ble.

Keyword:: tht· Tra.vding Salcsrnan Problem, th(: Vd1idc Ruuti11g Problem. µynunidul tol1r:. cwd Dctriidcmko condition.;

157) Embedding partial 4-cycle systems

A.J.W. Hilton•, Quc,•u '.\fary University of L,mdon, und C.C. Litt<lm•r, Auburn University

A parti l 4-cycl systcrn *S* or ortkr is a tict of f'<lg<'-disjoi11t •l-cyck wl10 m1iou (µo_;sibl with om<• udditional bolukd vcrtic('8) form:-, a Jp:aph ,vith n vcrtic:c-s. If thc union i; the c;>mpi<-1<' graph h·,, i.h,•n 5 is a 4-cyd<• system; in th"t ca,;c it is kw,wt that r, =1(mod 8). \Ve :how that if n parti ill 4-c::rk• sy:,;tcm S of 1)l'ntr n =1(irn,d 8) ha-; a mh•sin -cd c graph (or le,w,•) G with at lea,1. one isolnt('(I vntr-x 11ml >lt most one component wiLh l lgt,;, thel1 8 <\f be f.'mb d in a 4-cyd<" systPm of order at most 11 + 2 + 12. where D i; the rnaxhmun ,kgr<-c of *G*.

L,;r. A(ll} be tlw last int gN ,. =1(mod SJ s11d1 that any p,u·tinl 4-<;yd,• syste111 of ord,•r n can br- ,•mbeddf'\l in" J..cycle system ()f order I for r.ad, I 2 r r =1(mod 8).

Tiu• n ult abuv(: (-an V(, used to s11ow that

$$r, + n^1/:: Mn)'.:'. r, + i2n." 1^1 +:18.$$

r..: ywords: 4-<'yde systems. emb(xlding. designs

158) Competition-Independence Number of Special Cl, sses of Graphs

S11k .Jai S,'<,*, :vliddlc Tcm1('S.'i'" State Univ<'rsity P,·tcr J. Slat<•r. llnivcrsit,y of Alabama in Hm1tsvillc

Con:--idcr it g1uJ1(! t1.-,odatt-d with a µ;raph (; = (F, £) involving T\V0 pla.y('rs (maxiu1i7,<'r md miu..imizcr} who altcr11atdy sck,--t. vc!rtics to go int.o a set S, which is rcq11iro:J to hav<' a certain prop<."rty. Play stops whe1 1he 1,ddition of any vcrt x nm. already in S de,t ro.vs the property. The maxirniier a.tt,.mpt.f; to r11aximize the siz(> of 8, while the mi11imizer at.tt"mpts to ntiuirnb (' it. If botli plitycrs play opt.imall : tlteu the siz(• of tlil' r(."·tUJting set is fix1-d. The p:lra'netcrs that as:-;igu a va11le to each graph in thi:-, 1uanncr urc ca.llo..l <;omp.,•titiv<' pa.rnm-ci Ns. For the Com1wtiti<,n-l11dcp, •d"n;'C G,,mc the r(.-sulting s"t S must lw independent. The cnrnp1:tit.ion purru:nnters ;1;,,11tm and iJ.; denote the siz•?. of thf' resulting set S i n th< Comp<>titiun-Ind1.:pcndcucP Car11e when t.bc nwxirniz1.:r and rni11imizcr n pc-cLivcl,v. play first. \\\• dPtcrmin<; /Jr.,n(Cl and Jm(C) for PP<'ial clu.,,;s,;-, uf grnphs.

[(<'Y""on.l:;: Irn.lepen<knt :-et: (Om pct it iv._ parameters

159) Ou Edge-Balance Index Sets of Some Complei.e k-partite Graphs

\[n l<ong"', Univ<'rsity of K nsas. Sin-Mi11 il'e: San Jo c· State UnivPrsity, and Yung-Chiu Wa11,;. Tzu-Hui Institute uf Tl:cl111ology.

Let C: hP a simple graph with wrr.«x s<t V(CJ aml cdi;<- set *E(G)*. nn,l kt. *Z*, (0, 1}. Any edge l lwliug f induce,; a partial vcrl<'X lt1.lwliug J : V(C:) - , *Z* a.s.signiug 0 ,,r 1 to j+(,1). u being au d 'mcut of V(C). dp<'11<li11g 011 \1.·hcther tlwre an• mort <'tlgt• <r 1-,>dg., inc-idcnt with o. a.wi no lnhd is p;ivcn to r•·1,•J otlwrwisc. for (>1ch i E Z2• kt. ,,J(i) = 1(1,= V(G): J+('i:) ,c i}I mid let e1ti) . 1(,, E E(GJ: !(rJ = i}I. An ,-<lp;c-lah,-linp; J of G i,; Mid to b L-<lgL-frimdly if !cJ(O) - CJ(l)I S I. Th(' (,lg,-h;,.lar1cc index set of the graph C is dcfirn>d as *EIJl(G)* = {!·uf(O) - vf/l)j : *f* is Ls:lgl•f'icraily). In thi., paper. we iuvpstiga.tc amt pr<,"l(Ut n•:•mlts ro11rcmi11! tlw t'(.lge-ballUtt'C iud, x Sl'ts of som<' compl.,•fl• k-p,wtitc graplc,.

Keywords: V<'rt<'x l lw liug. c-dgc lalwling. friendly lab<'ling. e<,nliulity. c'<lhe-baL1.ncc index sct complete k-partitc

160) Condit.ions on The Distillation for Determining Optimal Chain Lengths of A Graph

A dr<w Clt(:J1, '.\lirtn(.-;ota St,itc Uniwr,;ity \!ourhc,ad

A d1ain is n path wh se int<1rnU Vf'rtk-<·s a.re uf degrcP two nnd who• · did v1 rticcs an• not uf degr1.'C two: and the lt·ng:th of a d1uin h thc 11unhf• of cdgC') in it. Tu ('1.)lllract a <:hain is to contn\<:t togcthc-r all tlw ,•<lgcs in a <'hain int,) onc Cd •. Tlw distillation of n graph *C* is dmot,'Cl by D(G). The distillalion b thi: H,11lt ,,f c,,utrncting every dtnin ro h",om,, a single cd . In pn_•vion.'i work it \HS rncuti011ed tlmt. tbcrc i: a formuln for t.h,· 1111111hr <f spruming tree, r,f a grnph in terms of the l('llgths of the dMins of tlw graph. That formul,i has a nu111wr of term, that is equal to t.ltc mnnbcr of spanning tree,; of D(C). If w; wunt to tind an optimal a.-,;signmcnt of i<•nln, to chain for a particular <lbtilh1tiun nud partkuhu size (m = JE(C)I) and ,ml1•r (n = JV(G)!). thm) first intuition would l,·nd 11, to r,msi<l<r th ;Jpplica.tion of optimi¼ntif]D Le hni nes (sudl as th(La.c;rnnge mnltiplicr uwthrnl ffit"t,hod) to thi µarticular formula. \Ve pri.'st:nt conditions 011 D(*G*) that ar1: Jt<'CC'i,'ary and suf'lki(:Jlt. for the applicc:ttion of t.hcsc tt:•tlmiques tu converge. v, will t1bv pr1-;c11t <11 o,-,-n·lt·W 1f how this fits in with tlw laq;er pitl,ttrc <f lindit1g t-c,ptimul graph,.

l(py,vords: graph, panning tr("(S: tnx• mw1her. optimixution

Thursday, 1\-Iardi 5, :2000, 12: IO Pl\I

163) On Edge-Ba!.u,c ' Index Sets of Fans and Broken Faw;

Dl ım w 1 Choprn·, Wid,ita Stat<' Uniwrsity. Siu-:\·lin L,,,,, San .Jose State llnivcrsity. and Hsin-H"" Sl1. St<>uehill College.

Let. *G* h< a sirnpk graph 1,·ith vcrt<'x o<t V(G) ,md cd!;r. set *E(G)*, ,u,d let = {O. !}. Auy e<Jp;c lh ıdi1lg *J* induec ıı pnrtial vertex labding: J-t : V(C} -, Z2 a-÷iLin 0 or 1 to j + (1l), 1 heing an dσme1lt of V(C). dc'JJCtuling on whr:thPr tlierc aH· morC 0-rxlgr vr J--'1ip1.''f; incid(•nt. with F. and no h1lwl is given to J + \' i) otlwnvise. For each i E Z:!. let v1U) ''' ll.., € V(G): j+(u) = i}I and let. 11(i) = I{< E E(G): J(e) = i}J. Ar, Pdg,,-labl'iing f of G i, s,lid to lw ,-dg,-frimdly if {1"J(0) - 1·:(i)J ;, I. Tlw , Jg bulai,n' ind,·x ,ct of th,, !(raph G is dcfim I ,ls *EBI(G)* = {i'-'1(0) - ;1(1)1 : f is cdgo-fricndly.}. h, this paper. w,, investiga1e anci present re:,nlts (·0n('cn1ing the c,lg(·· halance ind x sets of frms :wd hroken faus.

1'<•ywords: v rt,•x labeling. edge labPling, fri JHll.1· lalwling, Nrdialit.y, ,,·!gc halance index sci: fnn

Thursday, l'vlarch 5, 2009, 2:00 Plvl

165) Effects of Exchanging Sub-l>lock of Sorting Permutations over E11tropy

Ziya Aruavut. SU Y Fn.'<iouia.ı ziyu.a.rnavufO·fn,'<ionia..(;du

Siucp l9U7. pcrrnuta.t.ions and invcrsiom, havt• been tlSf'tl for genu..ml dala comprcssiou. In th.b; work: W(trt at the <lat.a as a um• diuwHsional ;u:rav and ('XJ>l()n' sortir1 pcrmutcttiom, of <luta and th<' df<-ct nf ,•xduutl(ing snb-blo1;k of t.h,, sortin!(pcrmntat.ions over <'ntrupy. Ex p <•rimeutul r11lt;s h o w t.hut there m..iy he &)UH' improv<•mc11t in C<Jmpr si(Jn.

Kcywonb: Data cornpressiou. Lo:-;;k'h-.., A.pplica.tion:-i of Permut.atitJn:-;.

166) The Single Sink Location at Periphery for Min-J\fax Betweenness in WSN

Y\1:,hihiro Ka11ckc/". Gifn University. kancko linfo.gitit-u.nc.

In wirl'i,'Sl' selLsor nctwork(WS!'(). data informn.tion is colb::t<,<l by M'nsor n<,dcs 011d is transmitted to th(• ink nock• via scn.-,or nod<. Kod<:; dose to inks nrt ea y to dcpk·k enPrgy bcnmsC' of so many tnuLsmissic,n times of dnta infom1ation. Shortest: pmhs arc usually ch o s e n us data. tn1J1smiS-':iion route. The: rHJ(k• bctwc<•nnes..., ba::;ed o n <lbtaU<:<' is rcg:a.rdf•d a:; the rate that the uodc appears ou shortest p ,th nmtcs. which forces that node tb tra.u:;1Hit datn informn.t.ion. 1l1('r,,forC' the h1rgcr tlw b<>twt'C1w,,_, of the node is. th,, <'nrli,,r t.h,,t. uoclc ck•plet·es merf{_v. In this t1l k, , w consider the pr, ,blcm of locating tlw sin!(le sink at periphery fJf \VS\' 10 **n1inimizc** the rnaxirnurn of tht3 hf•1wt'cmu:-ss of all nod('s. lJndl·r **some** r·,.1rnlithJns, we sho,v the b1'':;t location. whid1 lfti g, ht k·ad to µrolong ndwork lifctirru..

I<r.ywnrds: sN1:-vr network. !,inglc· sink h.x•;,tir,n, network lifr. di t;\ll.l¨f, bctwC'C'nncs!'!.

167) A new class of functions and their rc,latioushlp to compositions and n-Fibonacci numl>ers

Pliylli, Chim,•, Hurnboldt Stale U.. Gn'g Sirnay, 13nrbHnk PowN "'"' Liglit

Thi5 papr.r givO.S :-omt· rr.h11lts on

- pat t.,,m:– ru:1loug thP numl><•r of or.cnrrf'n(·{:; ;>f st ring of :ls in c.ornp, ;-;it ion." of n:
- pnttcrn:; mnong rompru,itiOllS i.lf n r.untnining a :-u11u11a11d that i:i gn•ut,,r tlHu1 n/2;
- form11l1 for t(r. N), tlu· 1111mb;r of comµ<)siti<m:. tlu1t rt,'!,lllt wht•n r idt•utical .c are appcnd(-d to thP c:ollll)tbitit,JJs of JV. wh,n:• r i greahir tha11 N.

Thursday, ?\-larch 5, 2009, 2:20 Pl\·f

169) Alg;orithnL for Secondary Domination

Lin.Is.,;,,· H. Jmni,,;011•, Ahn C. Jami<..-;on, St. :Vlarys Colk$_{g<}$ of la.rylnml

At tht• 3'Jth So 1th 1stt•m Intl'r11ational Conferenc on Corubiuatorks, Caml' Theory. and Compntiug: H<x.lt•tnil·llli introdu<·(-d the idea of ;<•c>rhh\r.v domination dPnot<-d !J(:r: y) wl'wrc r and y ttn: p<J;;itivC' integers and 1 < = y. Thh, coIJccpt concr·rns the lo(·ntion of th(! :-e<;0nd mt•mhcr of th- h'{ frotu the p<;rsiwctivc of v, rti<x not i1 t.h, :-.et. l\hmy subset puraJ11(:tl'r <al1 be <k•scrihC'd utilihinh set'"ondary dominat.ion. For instance, distance-two do11bl0 domination is OH' suhs,•t pllrametl'r that cau be d,'scribed as a g(2,2) parnmetcr. \V(' rm>sut a 'vVimer-st:vlc ulgorithrn for 9(2. 2) as well a) obS<•rvtltions m tde during the l:xploraticJn of tlw rclation-,hip bctwcm .?(1.:ll and 9(2.2).

l<$_{ey}$ $_{w}$ords: doubk• domi1mtior1. d(,mir111ti,m. alg,iritluns. s(x·ondary d<,rninat.iou, Wimcr-t,vle algoritl1111s

170) Some Results on the Labeling of the r-Path with a Condition at Dist:ance Two

John Gt'vrgL-s, Kali11 Gc·hf•v•, D«vid :\fouro (T'inity Col.), Yan W1tng (Millsaps Col.)

For non-nc-gative real numhc.r :r, th« .\.-number of graph G is the mininrnrn span over all real-v11lued v(irt(•x l;1bt lings of G' for whic-h l;ibds of 1:1dj)('(mf \'(•rtiet diffrr by at IN1.t r. and labels of vertices at distallC<' two differ h· at least 1. For r ?: 2. tlw r-path on ,., Vl'Itices. <1':11ord P$_{n}$(r), is thr graph of ord,:r n ·with vertex :;d {1: 1, 1: v3: ..., 1} uud ('(ig<' set f11,-i:;1 li - jl S. r - I). (:-lotc that P$_{r}$(2) is P,,.) He,.ently, Gri ;u,d Jin dctcnnir1<,i thc behavior ,if ,\,(.P,,) for;· G 0, and Gc'<>rg<s. lamo and WaJJg obtain.ed partial rc,;ults on ,\,.(P$_{r}$(r l) for;·?: 1. Thb paper pr<>s<nts mC'tl10,b that lead to ucw rc,;11lts ou this topi(: i11dttdi11 th<: c:ontplr.tr· dct<'rminatio11 1f the bd1avior of .\$_{r}$(P, (:J)).

Keywords: labdiug with a distance two ,·oudition, Jl,-numhcr of G, .\,-lnbcling of C, -r-path

171) Ou a Coin-flipping Problem

\V.l-I. Chan•, W.C. Shiu. K.Y. Wan. Hu11g .I,ong i11ptisl lluiv rsit.y. Cl,ina, fl. !. l.,.,w". Sm, Jo,e State U11iver,ity, USA.

A c:ollca ue uf tlv· third author pv:-cd th1• followin prohlcin: S11ppohl:· t11at y111 h11ve au k x n squan• array of t·oins. wl)('f(• all ,·,f the coiu-. }1avr HEADS fa<ing up. A m,,vc c-onsbt:s (If ttippiug 0l1 (;Utire row or 1m <•ntin· <;oluum of coius. Fur wlwt vil1H'> <,fr, i:; it possibl,: to hove •x1lc•tly one HEAD fod11g lP; nft.t•r a finik 111111111(•r of m1)V:s'? This part ic:nlar prohl,!m h, an c!Xitmple of a switch-set tin,µ; prohh.•m. The-.c typ< vf 1m:ihlrms m• of mathf•matieal intl'J"(,st as tl Py havl' com1<'ttiv11s to Fibonacci pulynvmials over ***OF(2).*** and <:omplexity theory. Herc. w<: give ,i :;0l 1tion to this parti<:ular qu,,;tion a, wi:1111, provid<' an analysis of t.lu; morl' g,eucral k-stH,te coin-ftippiu{ problcui.

K1.\ywords: witch-sPrting prol>h_•m.

172) Some Remarks m1d Problems on Matrix Enumeration

Sl:anzhcu Cao. I{,;mwth l\lahtt•i:;~, Floridu Atlant.lt' U11ivl•rity.

The <.'mLmcration of Int.q;:cr-mntric(• hHs tx!(:n th• 11bj('<;l of c(m;idPrah11• study: and il is nnlikdy that silnpk• formul s t.:'Xbt exc pt for :i<Jmc ver.v trivicil r.ctst'. \Vt: will prl (;llt some n•mnrks llll :-oml! existing results, sonic ucw rt:sults. a11d !-ivnw Jl('W }H'r>lil(:m i1 thi:, ltn.•a.

l(cyword.,: l:U{orithm. matrix <:onut.iug. irwt.rix l'Olllfl('l'Htion

Thursday, J\:(arch 5, 2009, '.UO PM

173) The Time-Complexity of Shear Sort

Greg Starling*. Gordon D<•avcr. Univcr ity of Arkan.-,as

Sl,ear Sort is a paralll'I algorithm for sorting nl x n numbers. \Vit hont loss of ger'Crnl ity we appl$_y$ it to dt•mcnt- of S_{mn}. Shl'ur Sort i\.'ra ugt!i a permutation of S_{mn} into a matrix of m rows by n COlnmns. Them rows urr sort.] in S<'rpcntinc order (t1lt<:rnntingly s,irtcd up and then sort,-d down) and tl,cn the, n <olmnn.s arc sort,xl np. This scqnmcc of nl.'f ions is repeat.ro [l$_{);}$(m)l times. and Ihm them rows arc sorte<I in sc1r,entine order one final time. **The rows an' then read** altcrna.tingl$_y$ **right** tht.11 !(•ft. **The result. b the** it.kntit:v permutation >f S,m,· This paper cxpauds tlw ,1lgorithm r t,nrsivcly by fot·t,iring mn = **n:=,** m,. Th,• time-complexity of th,, resulting algorithm is shown to be

$$T(IJm,) = T(IJ rn,)(flg(rn,)l + l) + T(11<i)flg(mi)l$$

$$= T(md IJ([ig(m;)l + l) + 2)T(m,)flg(m;)"J IJ([ii((m,)l + 1)\}+ T(m,)flg(rn)l$$

Kc_ywc,rds: Sh('ar Sort.. pcrmut.at ion. sorting network

174) Oriented Graph Saturation

Michad Jacoh-.;on. Craig Tcn.nenhonsc••. Univ<;rsit.y of C11lorado Dt•nvPr

For aplcs G and H, H is s;,i,l to b0 G-saturated if it does not c@t:ain a snhgraph isornorphk to G, but for any edge ɛ E J/^{C} the complement o[H. H+<contains a subgraph isomorphk to G. Th(• ruininnun 11umb(r uf t-dg('8 in a G-saturat.<.-d bm1ph on ll w'r.tkc, i; denoted ,,;at(n. G). V• <xtc•rul the- concept. of saturu.tiou t> oriN1tr•d graphs$_i$ that is, simple grnphs with orient<'(i edges. Fir t we prove thut for any oricmtcd gTaph D$_i$ tlwn.• <•xist D-satnr»t<'<-1 orient.ed grnplcs. and hence show thar .•at(n, D). the minimum nnmber of arcs in a D-,aturau,d ori,'nhxl graph on ll V('rti<:cs, is well ddint-d. Additionally, we' det.cnnil1c <iit(n: D) for sc,mc orient(..'() graph-, D: 4H examine soml' issnc_., tmiq11c to ,wkutcd grnplu,.

Ke_vwurc.b: oricnt(•d graphs, saturation. graph avoidance

175) Orthogonal Latin Squar<>- of Sudoku-t.ype

Hn rt;-Di<t.rk h Growtll. Univt n;ity uf Ro:..tod;:. Gcnnany

We consid,·r ort:hoi('ll1al L•tin Squares of Smk,ku-t.ypc-; i.e., every sqnare of the \IOLS lla_ thr- addit.iona.l Sudok11 property. \Ve will pr ent. remlt:s on rnaximal 11111nh(•r .-f l\lOLS of Su do ku-typc aud vcn.l1 fnrttwr <-ontrac:1ions. not for urder ll !Jnr. also f,r otht.·r ur<lcrs. \Ve ;h< gc.-ueralizc thc n ults t0 c<.'rtain orthogo11al Latin Rccta.uglcs of S11<lok11-typc.

Keywords: Latin ,;quare,;. ,IOLS, Sndoku

176) New proofs for J\/{n,) = S(11, 2) and a bijection

Shanzhl'rt Gao. Florida Atlcmtic Univ<•rsity

Ll't 1\f(n. s) lw tla\ n11mb"r cl ll x ll (0, 1)-marri<·c-i witl1 row sum al1d coln111n sn11 ._ arul whOM rows an· iu l<•xk vgr:q>hical ordc•l-, rutd let S(n.) bf: tl(_: mlmh<r of :-;yttunl'tric arnl trace 0. r, x r, (0. 1. 2)-ml:ttri<:r-:, with row i,nm 2. P. A. ?\·lac>·lahon ,.,btllined a t>rn1lhl. fur 8(2). J.E. J;u1,iski and .\",J. Calkin prS<'nk?d a formula for M\n.8) and notiCL<I rh»t: M(n,2) = S(n). And They conj<'Cturc-d that th!'re is a hijeclion l>l't\\W'll the two st'ts vn CCTC39. The$_y$ tJbtuin<"tl a hijec:tiou aft<·r thit r-oufcrc11ce.

\Ve will [Jf<'S<'lll twu straightforwarcl proofs for M(n,) and S(1t), u bijection, awl rdHt<,l n nlt:,.

Thursday, March 5, 2009, 3:20 PM

li7) Au Approximation Algorithm For The Coefficients Of The Reliability Polynomial

lsnbd !Jrid1l (C\IST), Bri,rn Cl<>tcaux' (.KIST). Fbu,cis SnllivaJ1 (IDA/CCSJ

Tl,,' r<'linbility pol, nomial giv{,-; th• probuhility ttwt a graph n•mctiu-. conm•ct<d gh'('n Unit rw·h ,,l!(<' in it mn fail indcp('!Jdcur.ly with a prohnbilit_y p While in !((Hem! dcten11i11ing tlH: <:odfidcnt; ,)f this pol, nomiul is #P-complN.t\ we giv(' a randorniz('<i algorithm fm approximnting it:, c6cfficiex1ts. \\!hen com pared to the known approximation met.hod of Colb,,um. Debruni and : ly rvold, onr method has l'tnpirically shown a much faster rate of l'Unvcrgencc.

Kcyv:0nls: rPlia.bilit.v polynomial, rando.1niz(,<l algorithm

178) Pattern avoidance of type (2, I) multi-permutation patterrLs in compositions

Silvia H1,,ulmch*: Ca.liforuia State Uuivcrsity Lo> Ang<•l•s Tonfik la.u;;our. lluiv<:rsit.y of Hnifo

Two p,1tt,,rn:-, T and r' dH: \iVilf-quivaknt if the nnml>cr of comµo it.ion a.v0iding the pattern r G<Jl1ab t.l!c wunl)('r •lf composir.i01L-; avoiding thc pat.tern T. A grn<•mli1,cd type (2, 1) patt.,rn T = T,l2T, has an adjar.mcy rcq11iremeut for tlie parts in the ('Omposition that. <orTcspnnd to 1, Hjld T, hnt. tl1r. part correspondi1lg to i3 ma· hP adjacent or not. 1cr <>iunpl:. the eomf>t,sitiou a = = ulul · · · ai = 1212235 hai two orcurrc1lc(-:-. vr thl· pattern r = 11 -- 2 ua.mdy a, aria; = 22J and a,1a;,a7 = 25: ,m the oht•r hiwd. a1a3a-, = 112 is uot m occnrrr-ncc o f, a- tht: two l on: not, adjacent. Hcubach, la.nsour and -1mlagi han' determinf'(l thE' \Vilf-equivalt>ncc class mid gf'nen,t- ing fnnrti()ns for th€ ix permutation p,-rt,,rris of t,v1w (2, !). \\ > cornpll'te tlw pidur<' by investigating the type (2, l j m1lti-p<rm11tation pat.tcnL,. namdy 11 - I, II - 2, 12 – I, I.? - 2, 21 - I. 21 - l ,md 21 - 1. \Ve will show tl1at. th' y fall into fiw Wilf-cquivakncc dass<'s. aud will tivc ,ur <>-1lk·it. lijC<:tion for th,· cq_uivak-ncc of th• pattt?rn:– 12 - 2 nnd 2 1 - . \v]1id1 <till br. vi&tmlb(•d very ui,·t·ly. lu addition: W(l1ave derived g<-nt>rnting function:– for cach of lhe five \Vilf-N111ivalcncc· cla-,.,es.

Kcyv:ord: Patt<•rn avoid:u1<l-. gc.ur:raJizc.-,i m1t.lti-pcn11utatitm [Ja.ttmH. <0111pitioni–.

179) The uumbnr of Latin squares of order 1l

Alc'<at1dcr Hnlµkc, Pd.f<•ri Kaski·. Patric R. J. Os1crgMd . lluiv.-rsity of Hd,h,ki

W0 cs1ablish hy nwl1ns of a cr,lnp11tr-r S<ard1 that there 1lri 20:Jfi0'.?%::i2c,8288:;J:_ HICO(!!) mai11 da';-e"t of Lat.in qnarcs or ord0r U. Tlw fmtmerMion is r.oni-t.rnetiw- for Llw l tr, l66G04 t 11laiu d ,si witlt an autopa.rat.opism gruup of order at lct 3.

l c,vwords: Cntltnt•rnt.ion, Latin sq11arc\ nHlin da s

180) Z-cyclic DTWh(p)/OTWh(p) - The Empirical St.udy Continued

St.(,phal.lie Costa, :-lormau J. Finizio", Chri,t.ophcr Tcixdra, University of flhodc lslaud

Exist.l'nce of Z-cyr.lic DTWh(p) aml OTWh(p) will h• dis<n;sc-d for pri11<, "ft.he form 'J)=,51211+251.

Thurs<l a y, l\fard1 5, 2009, 3:4.0 PM

181) Methods for placing data and parity in disk arrays using the complete bipartite graph

Tomokc, Adachi. Toho UniVl'rsity. Ji.ip,m

Tiu.· <lein• to ::,pfX'<l up t'<:ondnry storag(' ::ystems ha,; k•ud to the d(•vdl>prn('Ut uf n.-dun-dant ,irrays of indcpc11ckmt disks (n}dD;. To minimuze the ac:cc;;; cost in RAID. Cohen, C,,lbonrn 1md Froncek (001) introduced (<1,/J-dnttere,i ordcriug., c-f v,iriotLS sd. syst<H for po dtivc lntcgcrs r],≠ Jn ca.e of a graph this am<1111ts to an ordf'ring of the edgf' set ;11<h tliat the munber of poiut.i, <;ontailwd in any d cor1:>C<utivc edges is l>01md<<l by the nwnber /. For the complete• grnph. Cohm l't al. gm·c some' cyclic c:onstmcr.ions of cluttcr'<.l ordcringo hns."1 on wrnppcd 1>-lahclling:;.

Miil!r.l', Adochi and ,Jimbo (2005) investigated dntten>d ord rings for thP eomple1e bi-partite• grnph. lvliill,•r et a l adapt'<.l the eoncept of wmpJK-<l -labdliugs tu the bipart.it<, ca.,;.; inst<a<l of wrapped [>-labellings, and ga.vc t.h,, c.xplicitt' constnictiou of several infinit" fanuli-s of wrapiwd .C,.-lal><'lling,. Herc, W' investigate mon• gmcrnl ,-ust•s of the complete hipartitc graph. In this tn.lk we ,viii give some <.'on.,trnc:tions of wrapped .C,.-lah•-llin s for su<h ca-.e.s.

1.82) Uniformly !.:-limited packings

B('rt Hartn,-ll: Saint).-lary's Uuivi•r ity. Cunada

A k-lirnit;cd pi1r·king in a n.1ph. whir.h genC'rnlize:s a pi1f•king in a grnph. i n •t 1F vf'rtir--. S :mcll t.hat 110 w·rtt:x iu thi· graph ht1.'i more t1an k mc111b(•rs of Sin its cloe<l ucighhourhood. This might mod(') thl' sit.nation wlll'r(' no onl' wauts too many olm1>xi<m• fodlities (gnrlmgc dumps. for instru1cc) u0arhy. \Ve first e011sidcr gniph<", whl.'rc cv1.ry mHximnl 2-limit<xl r.m<'king is a mavJmmn 2-limit,'ll pa{'ki.ng. **tlnd** chflractt:rizl' those of girth 14 or morr· (joint with R. C:all11nt. G. Gunther and D. Hall). Thm son,f' prelimirn,ry obscrv,.tic,ns for hii;hcr I: will be inrlic:att:>,l

[{e:ywords: parking:-.. ma.-xin1a]

183) Halls condition for p:u·tial latiu **squares**

A. J. W. Hilton and E. R. Vaug;lwn". Queen -fury. University of London

A p1uth1I lat.in square cornpl<'tion problem can h• nut11rally c-xprs('(.l ils n mph li1-t-cvloring probl tJL A llP(·css try condition for n li:-:t.-c-◄,loring probl\·nt 10 ha.ve 1 S1ll11tir,u i that. it utisfir Jlo11s condition. This c·u11dition is an ,·xtl'llsion of tlw wdl-knuw11 11ce4:.-;ar) [1] au<l sultic:icnt conditi()n for a bipt11tit,; graph to lwvc: l tH:rf<Y:t matc.hi11l· 1-1<\V<V<l; it h not in g(•neral H suffid,·nt condition. Crnppcr 1L,kcd whether it might 11et1111ly he suftici,•nt in th r·a."e thflt tl : lh,t-coloring: pr,1hlem ari;<-S fu111 1 partial lalin qnarc. A n •1tivc 11nM1/(r was rt•c-<.ntly given by J. CoJ<lwass<.::r \vho fonnd an ir1(-orr1µldable partial briu squnrc l11at suti fic Hnlls cou<lition. \Ve l'xtend this ueg;ativ, result by showiug that it i; XP-complctc to determine **if** a partial la.tiu square i; completable n e11 1J it .,rtisffo. HalLi comlitim1. For some spC'dnl d a s s<, of partial latin squ,m'. it is known that Halls condition is both Hcc,•ss,Jl')' anrl sufficient. HthP filled cells form u rf'l':tanglf' then Halls c.on<lition is f111ivnlcn1 lo H:vser,; cundition. !3obga and J<>lm,on have shown that Hall,; l'undition **b** also s1tfiici<'llt in the case where the filled <"di form a r<'Ct;1utglP rniuu:; nt empty cdl. \Ve extend tlti n ult by liowin}!; th,Jt Hall condition is :it1fficim11 in th> ca;,;c that till' filled cdl:-i form n ctru1 ll• mi.nus 01w• ('n1pty cPlls, no hvo of whid1 an· in th\ same c·olnmn. Thi:' aim c,f this work is to explore t'lw hmmdnry whf'fr• l-litll condition fajls to he :mftir.i(nt for curnplPtahility.

K<•y\\'Or<ls: Halls c,mdit.i1u1, h1tin qu:,rr·. pa.'ti, 11 lat.in sq11arc li:-.t-coloring

184) Trees, Logs, and the Riordan group

Lou Sktpiro. Howar,l University. lshapiro'1.ihowa.'d.ed11

Th•.,ni itn:. milll)' das."-es of i)rckrr·d trPt. ,,-here t,linr· arn 11nif1mt1 c<,nditions on tlw •lilt d ·ce for v,•rti!'cs. Tlwre indndc: ,,rdercd tr<"'cs, binary Irecs, <V<n tree,s, **0 - J - 2** (l,,1zki11j tref'. and k-ury trt't'S. For th,-:-;c dus.c of trecs thl' t'<JHaliou V ‼ TL hoh ls. F b the gc1wrating fom:tion t)r the munlwr of trci•s. while V and L art' tlH: gc•ncrati11g fm1ctiom, for th' same tr'X's, bnt \Vt h a disting11is]wd vl ru.•x or leaf n-spe<;tivcly. O f'c11F nnd T nrf: ca.,y to find while· List.h kcy b11ilding block. Compn.ri11g two d.ilfert·nt 111c-thod fl,r c":omputing: V leads to tl1t• logurithrni.. dcrivativP.

1{,•y\,rords: c'U(>rating fu11cti()n ordnf.'<i trc1–s. vertex: k;if. niorda11 group

Thursd$_{a\,y}$, March 5, 2009, -1.00 Pl\-1

185) Temporal Orderings in Asynchronous Distributed Environments

Tom Altman*. ll11iw.:rity of C<Jloni.do Denver; Yo:-:hihi<ll' Igiu·ashi 1 Gnnma U11ivc•rity 1 Kiry11 1 .Japan: Iid1iko Omori. l\EC Corp., .Japan

\\'c ccmsidı•r 1\dywunk set of U.'']]':-,/pro<t>:-,<S \,·b:hiug ro n''cciv(; a ervict.• in ;m asyn-du-onc,m• di&trilmt<''\i/01wrnti11g syt,•m. mm•ro11:, alt\>rithms bn.1.xl on tinv`·stnmr,+ or in-t<rpr<)C(S'i c,mun1u1ic'ution via. multi-wriu-r/rcad1••r :,hnred meru()ry had bC(:n pr<Jpo.,cd U- address thc "b,we pr,,blem. Sudi 11pproad1es Hllow each process w cc sily ck·cidc if it is the lu.l OHl' to e11tcr th(' systcrn. making it trivial to solve problems concerning their r!'Sp<,'t'tivc t<'mpornl order and implmient vi,rious nmtual (or 1.:-) <c'<dlİsion alg(lrithms. \\'• propos<' u dist,ribnu·d algoritlun for the ordering of tt<4,•rs/proc:'Sc,<•s which can lw impl<'mcutcd in the nsynrhronous singJ.,..writer/multi-re,,der &hior<'-I memory model. SubS<'<JH<'ntly, this ap-proad 1 may th,,n b,, usc-d to implement mutuul <'xch1siou algorithms in various (dist.ribtiwd) cuvironmcnts. It b mud, simpler tha.n the general method tlu.it sirnul,itt-s the operatiorLs on umlti-wrih!r/n-a<kr !;hared varia.bl(:, hy using a bounded concurn.•nt ti111t..!'-tump :•,dtt:'mc in the inglt'-Writ.Pr/mnlti-rcad.cr bared rn mory tnd(k•L

\\';; shmv th< cc,rrcct1wss of <mr aJgoritl1m an<l diM'IL% its dtidf'nc·y and fonlt tolenntf'C.

Keywords: tfo,trihnted algoritluns. l,)ckout fn-cdom mutu<1I t..xdnsion: haro..l memory

186) A Note on the Yao Graph); for Points in Convex Position

:-1in°h 1 Da.wiruL \''11war 101! 1, Villanova University, Val Pind11*. Sonthc-rn Counc('t.icut State Univc_•rsity

GiV(•n n S(•t of points in the plane, !:he Yn.r, graph }'_ is df'fincd Io follows. At cad1 uode tt. -my k l-<111alst-paratcxl rays originat(-<l at u defi1 ip k mnt:-s. In <'ach <one: c-hovsc the shorte-,;t <dl,e u1: among ull L,lg,-s from u, if th<'rc an' lilly. ,md add a dircct''i 1''1p;' iw to Y. The Yao-Y\0 graph Y Y_t tarts \Vith tlw din:tc<l Yao graph. ud n:ducc:; the maxlrmun dc•gn-c f1f nrnks IN follow5. At each nodt· \t all int()ming <<lg(S f 'c]m cad1 c\mP nrP discarded, l''XCCpt 1w the shortest onr. riL The re,,nlt. is trca.tcd ,., an undirected graph. A gc'Ometrie graph is a t-spannl'r if: for 1.'vcry pair of node. thc sltortc..t distance bdw('<'H the nodc-; following the 1.'dS''!- of the gntph i nt most *t* time, the Eudidcan distall<'l' lwtwN:n them.

It is known th;.t) b is sp,llln<'r for k > 6. Ir: is still op,,n wh tlwr YY, is a spunner. In t.hi pa.per wl' :,h,)w th:'l.t is spanneJ· in the special (HM' of points in ronvex position. \\/• 1 ls1 :,how tl1at Yl' 4 b 11ot a spanner.

1(r')'\\on b: Ym1 graph. :-,pa.nnPr

187) Generation in the Bingo Closure

J. D<y<rl*. Rvh(rt E. Jamison: J. nowllHlrl Li ht, Ckrnsult Univ(•r ily

Bin o is playr''l <ma 5 > 5 grid.. cohmu1s la.lwlf-..i A, *IJ*. C. D: E anci mv:-. label0<I 11 21 3, •l :. from t,1p tl) bot.tum. Tr;kc the 25 squares tn he the ground s.-.t. A squnrv:, is dcpPndtint (t11 a st't. 5 of squares iff s c,;rnpk·h.::'i a linl' d nJw. cvlurnn. or dittgoual with .,q11ar<· tl1at arc already in *S*. For th(' 7 x u Bi11go board. W(:,hall a.ddn.'')'i qn<.'!')tiom; rl:g1t'diug Hu· g,'t'llf;rathm of dosed S(1.L-i th(• miniumIH si1/t' of a g,;nt rtiting M'L nn<l tlw UHL'Ximum sizl.' of a fr(\! (d)S1:4l And indPp,,11dent) ,,,,1..

]{,·ywords: 13iug0, r.Jo..,nm system:,,. pucra.t hm of r-lo!-inn•. ind''pcnd,·ncc

188) A Catalan-Hankel Determinant Evaluation

Omer Egedoglu. Uni\'c>rsity of California, Sru1t1 1 Barbara

L<t:

$$C_r = \frac{1}{k+'i}\binom{k}{k}$$

be th<? A-LI, Cat 1 1an munbn and pm akfx) = I:•-•, C,_p ;_ Dehn<' H,.(.r) = dct:[0.;+,1(.r.)]05,, s n· First fow of tlws,- dnerminants arr• as fullows:

$$H_1(x) = 1;\ H_2(x) = 1 - 1{:}H_3(x) = 1 - 3x + x^2:\ H_4(x) = 1 - 1;x + ;{,}r2 - ,"$$

$$H_4(x) = 1 - 10x + 15x - 7x' + x^{"}1:\ H_5(x) = 1 - 151 \cdot + :1,,.r. - 28x^3 + 9x^1 - ,,;^0$$

Even t.hongli ff,(.c) docs not admit a product cvuhwtion for arbitrnry .c. w(sliuw t.hat the I'('(:''Cntly iutrodnccd tcd..u1iqu(' vf '')'-op,.:ratur:-, is 11pplieabl<:. \Ve i111;r rut<: thi!') tecl111iquc by (•valuntinf;!; this Hank<•! fkWrmiwmt m,

$$H_{,,}(.r) = \sum_{I:::0} t(-1t(\_'\ _{J1,-1}^{+}\ ')\,/$$

Keywords: Catalan 11uwl•<'r. Hankel dclcr1.11inant: p,Jlynvntial: altrh,st tJrt•<l11l'f.

Thursday, March 5, 2009, -1:20 PM

189) Fault Hamiltonicity aud Fault Hamiltonian Connectivity of the (n,k)-bubble-sort Graphs

Eddie Cheng and :'-Irurt Shaw,1,h·. O,ikla.nd University, University of Dctrnit 1m.:_v

Tlw (11, 1.:)--bubhl,-sort graph is a gcm•ralization ofth,• bubbk-sort graph in a way ,iinilar to th,• gcn1•rnlization of the st,u· grnph into (n.k)-star graph. Monxivcr (n.2)-hnhhlc sort grnph is is„111orphic to (11, 2)-star graph. Hamiltonian con11e<:tivity m•11ns cxisteuc<' of Hamilt.onian path b twccn any two vertices of" !\Tnph. and is a highly desired propcrt.y in int<.'r<'Ollfl.t\ction net\vorks. In this work we titudv Hamiltouicity nnd Hamiltonin.n corn1Pctivit.v of (n. k)-bubblc--sort. grnph with faulty edg<>s '.uul foi ty v1;rtic1•s. We cxh•ud the results 01 **fault. Hnmiltonii:t.lt r.MJJle<·tivity of Ht.mg-Cl11m Hn ct al rcgurding (n: k,)-star gmph.<; to** (n, k)-huhbl,-sort graphs.

1\t•ywon.b: i1.1tcr<;onn0.Ction nd\\'Orloi. buhblr.--:c;;.wt p;rnph. 1t1r gn\ph. Hmnilto1tia.11 cm1-nectivity

190) Polarity and rigidity in the plane

Drigiltc Servatius, WP!, vVorc<>stN , :\1A, USA

If the c,iges of a grnph. G. are interpretlii os rigid bodies and vrrtic<"S of G are int.crpret:e<l as pin joints: then the rigidity of a g0n(•ri(rr-nli:t.ation is a (·ombinat<irhl pr<1pert_v, which is well studied. \V(• t•xa1r1ine th(: behavior of tlw rigidity propertic-:, under the polar ,·onstruction in tt1,; pl a m.• whid1 takr-:,; lines to points t 'Id poiuts t< lines. To PVPl')' graph i11 t,hc pl1U1(\V(Pl, **a c-orr0.-ipondinj!; line** nrraJ1g:c.uwnt **and** W(c!'Jn now vil'W thl· **lint.** as **rigid b<,dit. which** an· pinnt-d at c·<rtain intersection point:-;. namel_y the which arc polar imag1. of the edgffi of G. \Ve give a l·Ormula. for the <lcgT<-l-S of f'eedom of this 1i11e arriHtgPnu.:nt derived from **th<;** rigidity **prnp<'rtie,;** of **tb<'** !,'Taph *G.*

T\t:ywords: g<·ncric rigit.lit'- linP arra11gcrru."nt. **polarity**

191) Three surprises

R. Stcrntdd. ISll: D. Ko,t,·r. llWLC; 11. Killgrow·, n,tirc'<I. I... "foylor. CSUD: H. l<al/., CSULA: E. .Jona,, nv U.

I. A rn;st of sq11,r1•s yii:ld, all odd ririrn,,,,_ and 1wfort,mat,•ly more.

2. CDnc('rtlS in £,. G P:(0.0). Q:(J.0). R:(11.v). 0 < 11 < 1, v > 0 wit!, P' Oil Qn, q' OJ RP, R' on f>Q with coordinates r,-sp<'<'tivdy (t+(l-t)11,(l-t.)v). (lt1.tv),(l-t.U) ,o tlrnt. rolli m•iti,m x'=Ax+By+£.)1= Cx+ Dy+ G (F, Field) wlicn A=u-1, 13=(n-l-n")/v

   E=l. Cc=V. n.,=-u, GacU _yi!'IJs p--,Q-,n r and

   likcwist- for P', Q', H'. AD-BC=l, am! t.hc tlworem

   auy collirwatiou with AD-IIC=-..:1 prt('r\'t'S are,i e..'"<plain our surprbt·.

:l. Thm: p;iWJl primr· pow r q. q:e mr,d :l, <r/2. GF(q) plane is ordere<I b_v:: while GF(1J) is tlot. ordered by <.

192) Derangements of the Facets of th<' >t-cuhe

Elizalwth :Vlc:\fohon·. Gary Gor,lon. Lafa_vcltc Colleg<:

Th e munb•·r of automorphi:-;ru:-i of 011 u-cnbe b 2",d. Of t110:;e ant.0111orplis111s. wl: <an **ask how rnony arc d,:rangem(:nt on the** fac,:1 **of the cuhr. t.hat b: on the fmt.s of** dimt-u ion n -· l. Th e an:-iw<r b a :,{'([lll nt<' tlia.t hn-, hecll :--tudi<<l in sr:vf:ral t)lh<•r context.:--. \Ve giYt e,m1bi1.1atori aJ proo6; ()f the rt:1111vnlI'.11c; of two of th<,St.' formulHs ;mrl hwk 1\t other n:,pc<;t,s of th" sit:uat ion.

Ke:vwor<ls: h.nwrc-ttbc , dcran1?:t•rncnt

Thursday, M[arch 5, 2009, 4:40 PM

194) Some Inequalities on the Exbtence of Some Balanced Arrays

D.V. Chopra. Widlit,, St.ate Unin•rsity, Wichita. R.'1-1. Low, San Jo,,(' Stat!' Univ,\rsity. San J(JS(', fl. Di(.s*, ;\<w J<:rsi-y Institnt.(• c,f Tr,dmolor,:y

Dalan<<d arrays (D-a.rr.uys) a.re g<'ncralizatiorL'i of orthoi;,lnal ,u-rays (O-arrnys}. ulld ar< rt"' lated to other combinatorial strncture,;. A B-array T with s symbols (0, 1, ... , s - 1), strc:np,th t. In rows (e;onsl n.1ints). and N cohmms b merely a matrix T of izr: (m x N) wit,h e ()(:m nts (U.1.2..... s - 1) such th1lt in (vr•ry (Ix N.t :. m) snbmatrix T· of T, the following r-onditiou is sat.is!ic<l: ,\(Q.:T"J = >.(Plrr):T") where rr is any (t 1) vc-ctor of Y-, P(Q) is u (t x 1) vce;tor obt.aiu"I by permuting the dcnwnts (If g , au<l ,\(Q: T") (il'not,•s th,, frcq111,n('y of Q iu ,.hf' snbmatrix T·. In this pap,•r. we n trict onn;clvcs to the cnsl' wh(m s = 2 ti.c. 7' bils (,nl.Y two d1m)nt,8, 0 and lJ. ln this case, one can dt?fine tl1e above rnndition ill t.enm: of tlw wl'ight of t.hc vector Q dcnotl'd b· w(Q) a.ud defined to J,,, tlw uwnlwr of ls in Q It is quil:< ob\'ious that w(Q) = w[Pw_)]. Thu, 0 S w(rr) S t , where n is any (t x 1) v ctor. If ,•(,:r) = ;, then ,\(Q: T·) =)(P(,:r): T") = ,,,, say J ; i ; t. Th(' vc,<'tor (;,., ,,,, ... /-•) an<l the umnht;r of rn.v m an• cfi\k<ti the Jnin-uneu•rH of T. Herc. w< obtain some ine<111alitiC ; on thP r_dstcn<•(• c,f some 0-arrayi--. and disfus.-; thr ir applica1 ioru;.

[{cyw<)rd : vrthogvna.l array:-. balarH:r'<i arrnys. :-;trcngth l)f i\ll arn.1y, <:<,ust.raints.

195) Counting the 2-disarrangt.. ments in S'l"

Gorc!.m 13c-aw•rs", Gn•g Starling, U11ivPrsity tif Arka.nsas

A pernmtati(m O t s..!.i i: 2-diH1lI'ang(•nc1lt if (ln<l ,mly ;r u,, = ou < rtl < {,! ; ··· < On-l •ll'u = fn < on-1 < n tl < ··· < rti - 1 n1vl mor(•ovrff, uny int.t•rt•hangt· of n,- and (Ju+k will IH('tll'h the order of n,. and/or or Ou This notioll: iut.rudn<;cd ill a pap(•r pn-sc.utt.-d at thb conf(reJH< in 2f){lS: i; iustnnn<.•ntal in C(11u,ting tlw da:--sr- of pt•n1mtati<1[1x in S?.,, as tlwy arc sorte<l hy th• Slt.r,irSort tilgorithm.]n that pap, r. a n('-11rrl.•11<t' rdatic111 wHs iv,m thttl. c:ounted tlw 2dix..''arnu1g<'Hh:nts

B,. = { 0 for n =Oorn-:..-=-1; 1 for ll =2; B,,_, + B,,_,-,- L, C,IJ,,_,_" for u > 2

,.·here C. b thP Cahlbl.11 numbt!f. [ll this pap('r, we k,-td1 thl. proof of t'OHPCt.nes, of thr• n<111-rc11c f,,r B,, and thon go on to olf••r au iC>rathl.• sulution for thl:" rr-cm-rcnr.P. rdation.

IJ,, = { 0 for ll = 0 vr ll = 1; ;pll-2 r;-1 ... 'fl 2

\\'lwr· T; = (1f.'21: I -v'2{ b, th. k"; Pdl lllllllhr:r.

f{eywords: Slh ar Sort. p(;rmutatio11, 2-disarnutg<.'Inf;llt,. n•trnTcrn-e rdat.it)ll. Cutaliu1 mun-h,-r. Pell munbcr

196) An Excel-Ba ed Graph Drawing Package

L0-ilh.· Gardncr. Or.tavinJ1 :\'icoli<,. U11ivrrsity of I11dia.napolis

\Vt pn•sr.11t a 2-dimr:tt'ii<Jnal graph vi:-ualizat.i.,m pa<k1gr: with varit•lh .t;rnph ;dgorithrw, in Excel writ,t<.'ll in Vi.u;il Ba!)i(- for n-e in DisrrrtP ?\IHIJ1 and <)fhcr i111rodur.tory (01lr;t•,; thnt, trar:h g.raph theory awl c01np11trr alhorithm . DPm1)rn,tratin graph algoriU1n1s wit.h ;in uppruprint.<: layout of llw graph aud h'Taphic.; for tlH algoritl11n fa.<'iliU1ks ;tudcut. lcaruiug 'of how Hlgorithm W(Jrk Ce1wrntiug su<:tl:;iv<· graph.-; for l'cll'L sl(•p lf all algorithm call lw tiuh' <)011-rn1ning arni c11111hrn,omt "'lir:n douc bv haud on I dia.lkhoanl (Jr r:vr.u whl.11 ,•urrat.-d with a raph drawin rw('kag<'. Thi:-; package present <Jltl]mt for the algorithms in a visual tvrmat 0ll tlw !,'f•lflh.

Keyword,: gritph vb11alizati.lll t;Taph nlgorithrns

Thursday, l\farch 5, 2009, 5:00 PM

197) A new look at the tree decomposition

Farlm<l Shahrokhi, UJ\T. farua<l 5c,;.11ut.,!du

Lt.t $G = (V: E)$ be a graph. \V(• pn:sc11t new algorithms for r-ornputing 11 maximum iudı'pcnd◂flt s<;t uf G bu:-icd on a variati1.>n ,,f tlw tr<:<' decomrmHition method. The cla sical al oritlun has O(IVi'.?'-J tim,• compk_'<ity, where IV! is the numlwr of vcrl"icc,, a11d /. is the trc<, width, ,,r tlw si7,1• of lar/!;<'St hag in a tH,· dc('omposition of C \Ve pn-:;cnt ,in nlgoritluu with thi nm11ing time of O(j\/j,1+2J: wh('.re s the si;.e of a 1naxin1mn i11rlepcndent S(·t G which in:skk· of a11y ba of the tl'(-C dccomp ition. Hf'llCl'. wliL·n .'j is a c-onstain.. one di.fl compute th<' rnaximwn indq>endem s t in polyrl()mial time. Combining chis remit with th,! shifting; mcth qd. w <,htn.in more gcnt·nil y ·t improved version of sornc W('ll knnwn approximation algorithm, for solving J\P l,ad problf'ms. In ru:l,lition. we dt"riv(' upper bounds ◁1 the ratio of the cliqnc- cov<·r tu tl1<' maxirrmrn iudep,·ndcnt 3d (d1romat.ic 111u11wr to rnaxinnun diquc) in(; 11,;ing ,;ucl1 ratios insi<l,• of hags. Th,• hotu,ds show tllc,t rati,l of the diquc c:ovcr to the maximum indppr_:rnh•nt ⋈t (chroinutic number to the maximum clique) is small. in rm.my intcr e<·t.ion grHph'; arising from ('()tn•t ric ohjed.s. Finally we diseu more gcnr•ral ch.-;c-; 1 ""hC'Jl non-adjac.<'nt vcrtPx pairs of G mP C'Ovcrcd by small numb,·r of pa.rt ial ordC'rs and relate tl1<(• ca c to 1hc pruhll'mS discuss abovt'.

I<ywr,rds: Graph Theory, Tr<'f' Width. Alg,,rithrns, Chordal Grnphs

199) On a Coin-flipping Problem

W.H. Clllrn. W.C. Shiu. ICY. \Va11, Hong Kong Baptist Uni\-ersity, China, R.:l'L Low*. San Ju;,• Stat<' llnivcrsity, llSA.

A colk:ag11<> of the third author posed tlH• following problm1: Suppose that you have an n x n squar array of ,·oircs, when• all of the coi11s uav,• HEADS fudng up. A movr con.,ists of flipping au <'ntin• row t)r an (;lltirc column of coius. FcJr what values of n b it po&;:ihlc to haw cxact.ly our HEAD facing up, after 11 finite number ,,f 111ov<'S: This pnnkulnr prohlm11 is an Pxainple of a \\.·itch-&•tting pn:iblnm. Tht-=-se types of problems arf' of m11thPmt.1ti<·al inLt•rt-st as the."· have <·onnections to Fibonm"('i pulynomia.ls ovc-r GF(2). aud curnplcxit.y dl('OJ'_y. H<•rt• wt· g,ivc a Sl)lutiou to this partlt.'ula.r qu(-.,tion as well a-; provide uu annly:,b of tht• tnllH: t•ncra.l k-st.alc C(.>i11-flippiu:; pr<Jblcm.

k<')'\\'t)r<l!'): :-;witd1- l'ttiug prvhl<'rn.

200) *A* Method for calcnlat;ing the knights tot,ll tour count

L< k·y Lam,, Institute vf :lnthl'rru,ti<. ⋟ and it') Ap1>lications

Th: au<licnc(• will l,p given a brief ontlin(' (,fa. method for tin<ling the total nmnhc:r (,f romplf't(• toun-. 11 kni ht. nm IHAke r mnd ;1 dwssh,,ard of si.xty-li,11r sq11an visiti11g cad, :'>quan: OllC<' ;\ml only on,:e. lt involves the use of a recursive algorithm. whir:h could he irnplcmc·utl.'tl on a computl?r u.ing an appropria.t,<.: pri)gituorniug: l;u1g1t,tgc ru tiud it..

Friday, 1\-la.rclt 6. 2009, 10:50 .AI\I

210} l'v1ulti-User Detection: au Algorithmic Approach

H",a. Tran . Fordham Uni\'Prsity

f\.f.ult.iplc af•<:ess kd1uiques an' empl o y ed in (·(:Uular c,1inrn11nicati(,n networks wht'rt! Sl'V-craJ 11,,er:; :-;hare thf:: amc bandwidth. Dirr•ct- C()ll('JlG(.' CD}LA i nsc<] to tnubmit :,evcral <;"><'hi-tmwl UM'rs at th<' rune time. A focns on a mult i:–t.Mgc nr('hit.<>etm·c of Suce<: iv,: [nfl r-f<•rtn<:(• C,u1c<'k'r \SIC) b; observt'<i to rccoYc:-r CD1v1A signals. Bit Error Ha.tc expn·s..,i1.ms arc dcrh·"I to cvaltv,t<' pprforn11u1c of the SIC and its 1,lgorithm.

Key words: CD:1-IA. BER, SIC, Optimm11 Dctectnr, Linear Det,'Ctor. Signature Wav, form, Err,·)r Probahility

211} I<-domiuation and k-tuple domination on the rooks graph

Paul Burchett•, Dr. David Lam'. Jason Lud,ni,•t.

Considpr0d ill this J)flpcr arc k i'nd k-tnplc rlornina.t:ion on thf' rook"s graph. [='(r a graph G = (V. £) a s<'t 8 is a k-tupl<' dominating set if t'vcry vertex in V is dornin11t,xl at il'ast k tirn. Giv<'n tll<' :-,arm g:rnµh C. a set S is a k-domirwting ct if <'V<'ry vertex iu F \ 5' i:; dominated at least, k times. Upp,·r a11d kiwcr b,nmd >HC given for both "tdR,.) and "1,dR,.). Thcse hotmds arc nscd r,J solve the k-tnplP domi11ation numl:><'r on tliP rook·s graph for the (·ilSC8 wh(•re k H odd. a11d when k = 2 and k ::: 2n - 2. [n u similar fashion. thl' prr,vidcrl bound aw abv nsc<l lo solve t,l 1e k-<lominarivn number on th(" rook'::-. graph \Vhl·U n 1;ZA and k b ,wcu. and the cases where k = 2. k = 3 and k '!.o. - :1.
Last'ly, 2-t11ple domination. als<) known a.., donhlP thunirmti<JB. i C'm_i<l(1rtx1 on thP. qw1.•n's graph an<l solw•d. on t.h rook's gn1ph. ThP bound fi(1t - 1) dd(Q,1) ti H orriv<id at ,dung witlt d,l(Q,i-valuc:; for 2 s n :', JO.

l\t'ywords: ro1•k's gr::1.ph: q11N-n 1s grnph. 1.:-domination. k-tuple <lomin,;1tion, doubl(i d1111-inariun

212) VVheu constraiJ1ts in BIBO constructions are 1.1ton1orphisrus

\·[ario Osvi11 Pavh•vi<': lTuivc..:rsity of Zagreb. Croatia

As nming an antorni..►rphi:-,,m gronp t•l act on n balanced im·o111pl(1k block design (,x.. 1111,rc generally, t,o a t-◄lesi_f!;n) b a nat.nrnl but- i"lt.rdng additional c.onditiou on tlw d :-,,ign structure. \:Vl' want to find out. huw :-;trung this ;,ts11mµ1-ion i:i iwd whidt rn"(·C.snry cou<lilious arc th<' c:on:-iequeotial vutc<Jrra: l)f it. \-'/pan: d<;vdopiug u1 ttlt orithrn fur (;01L,tr11ct.inf f•dP i ns in a r•ncn\l sctti11g: arcording tc, the c;o1L'itraint!, giv1'n by tlie m1tn111orphi:,,w !Q·,mp m·t ion. h11ving iii 111ind rhc· exec-lieut DISCHETA writtPn hy a ro11p of nrntht-m;1tidnn in Bayrp1lf h. G t·rmany. and trying to h11prove it ifju t n littlP bit. Thf• algorit.hm b ha:,;cd ou tit<']{rauwr-k• ncr method. iri which we want tO include <Jl uumy nt•<:,:,:iry coudition," a-. Wt' •1r<l ..iw;u t • <.lat. the mom(:nt.. T1 1e al t>rithm iuvolv<.'s the ki1mvk·dgc)f ta.ctitlll dt.'<:omposition mat.rin. lu·ing on<• w<\ll-k110wn to(;} in thii:- ctting:. bt.:<Jllliug: IWH' a c:011strnint ,vhidi n'<h1e,-:, the rn1rnl,c·r of roh1mm, of tlu linr-a.r equatio11 :,,yst<m for quite 11largP fac.Lor. Tiu\ ruain tool for our alg;oritl11n is GAP.

Keyword-: t-dcsign: Bll3D, aul.omorphbm group. Enwwr-rvl1.>:-:ner 11111trix tactical <Jr.. Ct)IIIJ>vsilion

214) Community Discovery Algorithms: An Overview

H(•nant Bulakri h m m. ?\ıtrsingh D<o. -Jaha.deviul Va.•m<lev,ul . Cl.)lleg<' tJf EngiuL'<'ring a.nd C,uupnkr Scie.'uce. University of C,·ntra1 Fl,,rid 1

R,,al-world cornpl,-x nctw<,rk, (q ; . Soe:ial ndwork.s, Biol<,gical networks, Internet. WvV\V. j;(<'.). whirh arc m l:itly I.»lf\ organizP du.iu1sclvcs into dc)sdy-knit group ()0<'1.1lly '-knsc :•mt)-grapl);). Such d,)sc--knit g:roups an• termed <1.)mm1mit,it-s. :'Jod within n <01run1mity .share c rtain com.'non propcrti , which bind thein togC't,hcr. Oftf'n C'omrmmity sfrnct11res re.ft,.ct 11atural divit-ion.s within complex. networks. The ntunlH.'r uf such co1mnwliti<. in a l:iv,,11 net.work i, wmallv not known. Various methods haw b'<'n propo&-d for C..'<trnct.iug 1.x,nummitics ill a m.t\1,·ork. ln this pAp4'.r. W< m1lkP a c(,mpnr tivc 1 udy of the· nlgorithms for comnnmity df't('(:tion and provide a taxonomy. \\"e also di:scus..-; th pt·rfornu.1.ru-e of tJH'S<. methods vn wcll-kuowu real-\vorld uctworks and ct rtain bendnnitrk { yntll('tic) graphs.

I<eyword : Community StructurP. C.1nntn111ity Discov ry: [lcal-world Nftwt:.,rk

215) Cent:ral and Local Limit Theorems for Generalized Rook Polynomials

Laue Clark, Durin Johnson : Southcn1 Illinois University

\We prove central an<l lorul liluit th<<)!P.T.TL", for cr•rtain clm,S(-S of generalized rook pol_yno-mi,i.ls intrr,d11,·,,cl by J. Goldman and J. Ha lund (2000).

Kcyworcb: Ht)\)k Pnly11omial. Centrnl Limit Thhu(;ms

21G) .Edge Chromatic Villainy

Atif Abuicda, {.lnivcrsity of Dayton,
Sarah Hullida.y'. Soutlwr11 F\1lyt<'cltnii· State U11ivcrsity:
David Leach. Univer ity c,f \Vct Ct'orgia

A simple gniph (; i prop4:rly l<igo• <:ol<)tlrPfl. An c.11cmy penn.utc:, tlu• label un tlit· edge:, o tha.t tlH; graph ha tlw siuru• lab1.'I set. liut is no l>n:;l.'r prop,;rly l''llg{' ,:ol,,1irP<l. Tlw Edw· ChrornHtfr· Villainy is th(•wiuimmn 1111111bcr of h\Vtip:-, tlrnt m·cd to lw made lo tli1• p<:rm11t1:(l lul>ds :-,u tl m t thP gri:Lph b rro:--tf)r(('l 10 a prnp1.:r "dge- Colo11rinJ:1:. Some n mh s will be givNi. and cxll'l'l8iuns tt, tlu: vcrtc.x \·illai n will be show11.

218) Finding an Approximate Minimum Defensive Alliance

G Gord<,n \Vorlt y III". Uuiven ity of CentnLl Florida

Givpn a simpJ„ graph G = (V E) , a dcfrnsiv,• alli1111fc :i <; V is a set of V<'rtin-„ will, the pr<>p<orty that for cv<:ry " E 5. IN['„j - S! ;;: IN(v) n ii-' - 8)1- Tlw mininnu11 cai·diualit.y of a ,!eforLsiv,• alliance in C is r:alh! th (ckfmsivc) 1J!liance nnmbcr „f C, dmoted «(G). and a dC'fonsivc },llliaJ1c<' with cardi11ality o(G) b caJlcd a minimum defl'.!m,i\'f: llllinnrc. Herein we will look nt the prohlcm of ti11ding <In 11ppro,dm11tc· minimum dcfr•n.sin• allianct' in a graph since fiudiHg a miuimurn c.kfe.nsivc alliitrl('t.: b known to be in ;\P. eomplctc. \Ve will give a lowc•r boun<l on the a.pproimatit>u fact<,r of ul a,µproxfrn te minimmn lkfrnsi\'P allim1<f: and con.,idcr algoritlun:; for finding i-1ldl mi i1pproximate.

l((•ywon.h,: npproximation ttlgorit!un: dt•fcu.')ivc alli t1lli'e

219) Path coverings with prescribed end in faulty hypercubes, I

:S Cn.,r.nu„!,i [1] L Cot('hcv [1]• F.Latour. C,;ntral Connecticut Sr.ate University. V. Gr>ch<'v", Trinity C.,llpgc. C'onnec·t.icut

A path <;ovi•ring of a grnph is a s d bf Y<•rtPx-disjoint sirn})ii• paths that cov<•r all rhc vcrtic,:„, of the £Tl.lph. We cousider the graph Q_n, then-dimensional hypcrcnbc. The vertices of Q„ ar< '11-t,ttplCS <f Os find ls: we say that a \'ert(•x is ewn if it bns an e,·m rnunb,·r of ls aucl odd othcrwis('.

Ill Q„, let :F !Jc a ct, of / 1 odd und h even verr kt . cwd k-t P 1,e a set of 1ntir of vcrtie('8, cc,ntaining $p_{/}$ even f)Hin,. JJ odd pairs imd Jb mixed p.11irs. ln :.Pa.t.h r.ovt•rings ,vith proscrihr,! ends in faulty hyperc·uh„s'·, Cnstruieda ond Gotdiev ttddmss the question: Snppos.- /1. /,.))1, bl nild 7\, arc fix d. How l,irge does II have to be in ordN to gn„rant'<' that, regardless bf the choic<• of :F and 'P. tht•r• •xi t a path covering of Q_n - :F ud1 tliut t'hc pa.ir t)f l'Udpoint.s (1 f the paths ll'c pn•dsr.ly the pairs in 'P? Cl t•arly. the answ,:r depends ul dw values of /:. Jl, Pi. bi .uid Jb• Some of tlu.' kn>WU HWiVrs. t,, thb qucstir1n ,vill he pr!'S('nt<'d and so11w open questions will lw p,;,sed.

Kc_vwords: Path covering. pre„c,rih<'d ends. h$_y$p('rc-1lbr•, H.·uniltoninn p Jth$_1$ Hnmilt.oniaJ1 <)TIC.

220) .Edge Colorings of Hypergraphs \.Vithout l\·1onochrornatic Snbhypergraphs

Hnru1v I<>fmanu FnklllUit fiir lnforrrmtik, Chernnirz llnh\·r:-.it_v of Tcd1n1.11ogy. Gcrmm1_.

Fork-uniform hypcrp;n,ph, F ,md H and intC(\CIS r let cc.1,(HJ dm,11.P u,., nnmhN of r-c-,0lorings vr thP set of hypr·tt'.igt:-; of f1 with n 1.11onodnornuti.< <opy nf F and hl r_r v ln) ;-: mu.c11 f: 11pc,. ,.(H). wlwrC tlw IIHt.xim11m ruus over all k-unifon11 h$_y$Jwrgraph on H veni<:es. L d ;,r.(lt $_1$F) be th,; IL'itwl "71.tr6.1,fmzdion fur F. Ev('ry Pdg<• eoloriug. t•f dl(V Pxtremul Tnr.i11-h.:q1cr raph H for F ("Ontains no monodirorrnu.ic r:opy of F aJl() $_1$ corn-•cq11cntly $_1$ r_r.F(n) r,·dri.F) for r ; 2 For k = 2 nnd tht triungle F ,;; £"$_1$ Y1 n;tf r shnwNl, that o,,l<,$_{,11,}$ = 2t-rin,^{K}, J. wliid, wa., cu11j,:ctured by Erdi; and H..tbcliild. Alon. rlalogh. I<t'<:vasli. and S11dako" extend,.! this by provi111, that c„A-,(11) = „„,r... A) for r = 2,:3 and any fix,xl L 011 th<' otb,·r haud. they obs<:rvcd that <r.K,(n.)),> ;··i(„·h,^{i} for r J. Hen.: We givt• a firsr l'.Xt.(;ni,m of thr:se f: mlts t() hypcr ruph . i.r:., for F hr•in t.lic unifonu l1yperg,ruph „f thli Fnno pla.ne. This is joint work with Y. P0rson, V. Hiidl and :-L ScharJ,t.

keywords: hypcrgrnplLs, rcgularit.y l,111na, >,tahility.

222) Permancut of matrices with restrictt•d entries over finite fields

L„ Anh **Viuh.** '.\foth(•uu,tics DcpMtm<l1t. Hurvnr<l University

For a prime power q. W(study the distribution of pc>rmmwnts of d x d matric('S with (:ntric, in a subsd A of F. More precbcly. 1,t PiA) <lmote the set of p<,nnm1c11t, uf d>. d matrices with entries in A. \',' c show that if 1 C F,, and !Al ≫ J$^{(d+1)}$i2J tlwn 1'(.A) covers F;,. '.\for"wcr. s11ppm,<' that !Al>> ,/! i²d- t),„ for s,mw , > 0. tlicu IP(A)I 2: (J -o(l))IJ. We als o stud y simil iH prohl••ms in ;1 more g0nenil ..;..,uinp;.

Keyword:.,;: pPrmt1n<•ut. matrices 1.wcr finitt fiCld

223) Path coverings with prescribed ends in faulty hypercubes, II

" · c staii,,da [1], I. G"tdwv [1]. F.Lat.om, CeJ1trnl ConnC'Ctirut State Univ rsity. V. God1cv". Trinity College, Conncctient

L·'t. Qn he th e n-diJHensiona.1 hypcrc11b(": let u1, ll2 nnd 1B be ev<'n vPrt'ir.es ,.f Gn and let „, , u2 and v, b<' odd wrtic:e; ul' Qn . W„ will prove that if ll ?. 4. the" there cxitit thn'<: µath.s in ' one joining: ul uud v1. ◊Ill! joining v2 aud u3 and cr1t! joining ·vi luul v3 1 uch that <:very v(•rtex c l Q„ l- on ,-•xtl.cll y om.' oft.ht.• pa.tits.
Thi:. is n contimu).tion of the talk · I'n th <Werings with pn:.'SCribcd ends in fnulty hy1:wreuhcs, [". prc;;mt<'<i hy Vasil GodH•,·.

Keywords: Path **rovcriug,** prc,;<:rilwd ends, h,'p<rrn hc, Harniltoniun puth, Hmnilt@ia.n <·ydc.

224) How Many ·ways Can You Color Your Turkey?

Ga ry E. St..•vt;•ris. Hurtwiek Col.lcg<i: ()11c•onta: y

A str ightforw 1rd couuting prohlt.m a.,-.i l('li to a <lisrrct<· nrn.th(rnatics das; la;t fall ht'Camc m1l<h le , s sirnpl wlv·n en e ralizrkl. In 1hir- paper \V.• dCVf\),)p a rr-c:ursion thnt ;1llmv.-; us to cutt1 1l tl ie umnbcr of pro1wr <:olurings of 3 *An* grid graph w)H-ll k 1:ok,rs arc available. \V1' ,vill al s o indicatt;1 the cornplicati<,ris that arisP wh,!11 attempting h> do th<: :-iaf!H for •l x lr grid graph:--.

Keywords: prop('r coloriug. grid mph

Friday, March 6, 2009, 12:10 PM

227) Critical Squarefree Subgraphs of a Five Dimensional Hypercube

Sul-Young Choi, Le Moyne College, NY, Puhua Guan*, University of Puerto Rico, Rio Piedras, Puerto Rico.

A squarefree graph is a graph without a 4-cycle. A subgraph is called a critical squarefree subgraph if the subgraph itself is squarefree, however when an edge is added, it is no longer squarefree. It has been proved that the size (i.e., the number of edges) of a critical squarefree subgraph of a five dimensional hypercube is at most 56. The known smallest size of such subgraph is 42. In this talk we present critical squarefree subgraphs of a five dimensional hypercube with size k for each k between 42 and 56.

Keywords: Squarefree subgraph; Five dimensional hypercube