Tips for PhD

Austin Buchanan

Assistant Professor

Industrial Engineering & Management

Oklahoma State University

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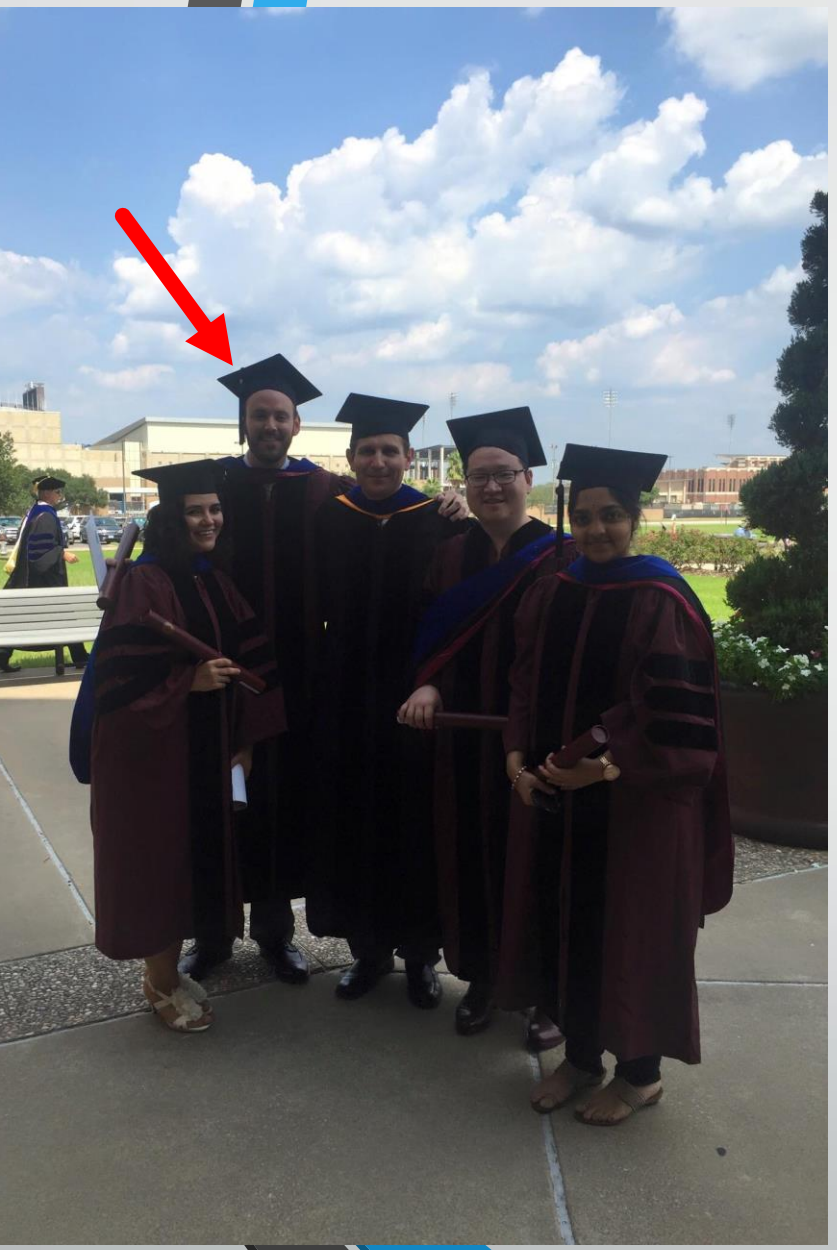
About Me

- PhD (2015), ISE, Texas A&M University
- BS (2011), IE&M, Oklahoma State University

- Research Interests:
  - Combinatorial Optimization
  - Integer Programming
  - Design and Analysis of Networks
  - Operations Research



My Research

Refereed Journal Articles

- S. Kahruman-Anderoglu, A. Buchanan, S. Butenko, O.A. Prokopyev. On provably best construction heuristics for hard combinatorial optimization problems. To appear at *Networks*. (link) (pdf)
- A. Buchanan, J.S. Sung, S. Butenko, E.L. Pasiliao. An integer programming approach for fault-tolerant connected dominating sets. *INFORMS Journal on Computing*, 27(1):178-188, 2015. (link) (pdf)
- A. Verma, A. Buchanan, S. Butenko. Solving the maximum clique and vertex coloring problems on very large sparse networks. *INFORMS Journal on Computing,* 27(1):164-177, 2015. (link) (pdf)
  - Selected by INFORMS President L. Robin Keller as the May 2015 President's Pick article
- A. Buchanan, J.S. Sung, V. Boginski, S. Butenko. On connected dominating sets of restricted diameter. *European Journal of Operational Research*, 236(2):410-418, 2014. (link) (pdf)
- A. Buchanan, J.L. Walteros, S. Butenko, P.M. Pardalos. Solving maximum clique in sparse graphs: an O(nm + n2^{d/4}) algorithm for d-degenerate graphs. *Optimization Letters*, 8(5):1611-1617, 2014. (link) (pdf)

Working Papers

- A. Buchanan. Extended formulations for vertex cover. (pdf)
- Y. Wang, A. Buchanan, S. Butenko. On imposing connectivity constraints in integer programs. (pdf)

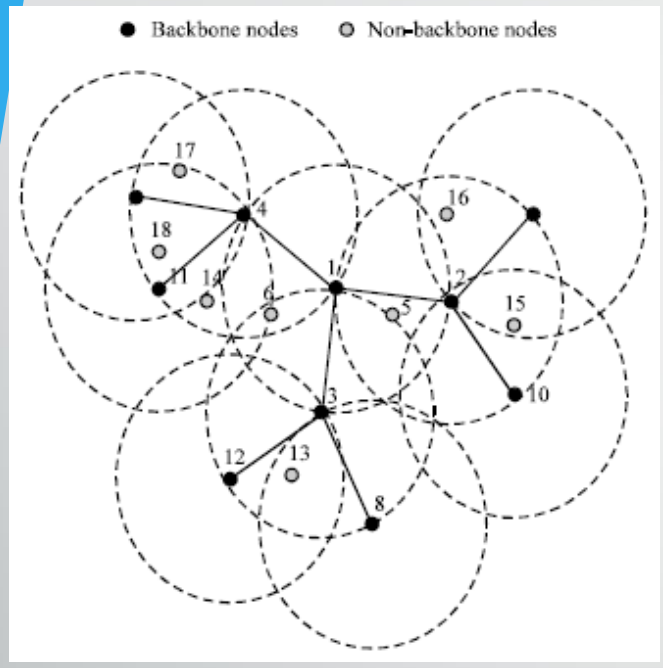
Unpublished Manuscripts

- A. Buchanan, S. Butenko. Tight extended formulations for independent set. (pdf)
  - *A main result of this paper is that there are size O(n2^k) extended formulations for independent set in graphs of treewidth at most k. Unbeknownst to us, the same bound had been obtained by Monique Laurent using different techniques. See page 134 of her paper "Sums of squares, moment matrices and optimization over polynomials."*

Conference Proceedings

- A. Buchanan, N. Chen, X. Ma. Using GRASP for the cover by s-defective independent sets problem. In Examining Robustness and Vulnerability of Critical Infrastructure Networks. Ed. by S. Butenko, E.L. Pasiliao, and V. Shylo. Amsterdam: IOS Press, 2014, pp. 17–25.

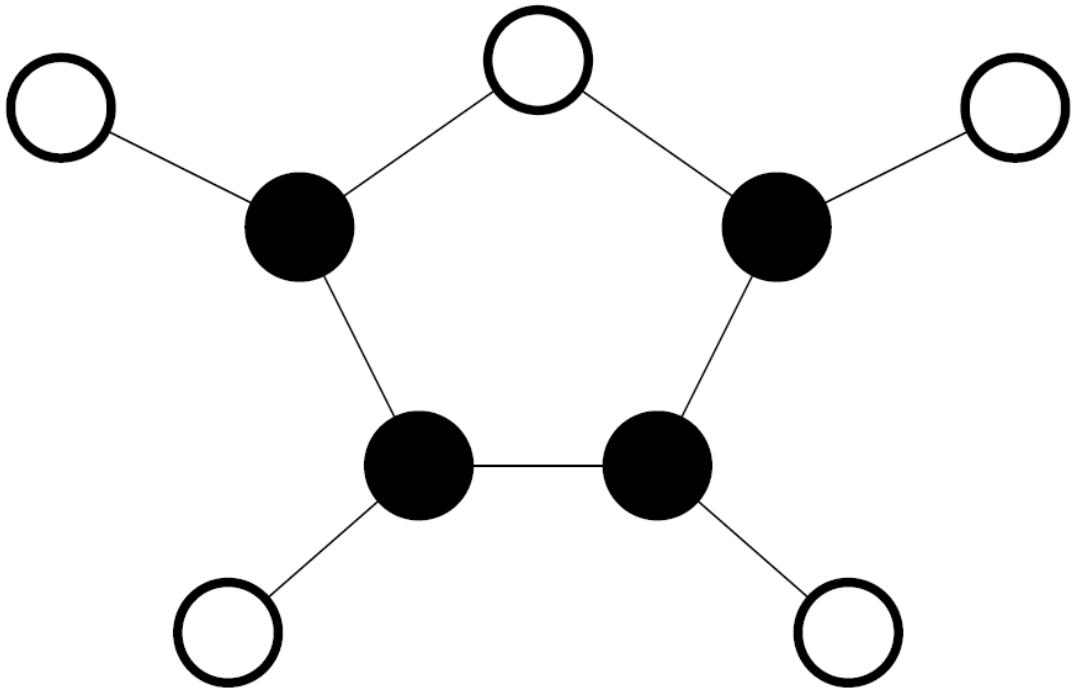
My Research: Connected Dominating Sets



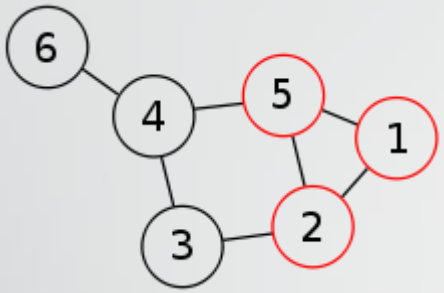
Extensions:

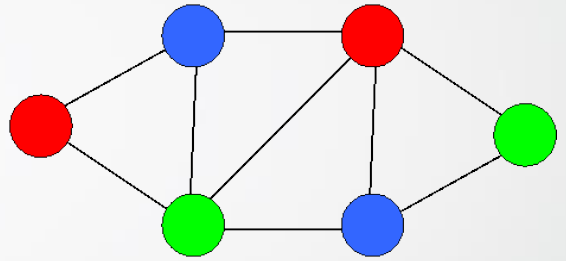
- Latency/diameter-constrained
- Fault-tolerant

Connected dominating set (CDS) = 'virtual backbone'



My Research: Clique and Coloring





Overview

- Classes
- Research
- Writing Papers
- Pitfalls
- Online Tips

Listener beware:

IMO. YMMV.

One take-home message:

"Academics judge you by your **publications.**"

Classes

- Take classes related to your research
  - To prepare you to write good papers
  - Other classes not so important…
- My research requires mathematical and computational skills
  - Take optimization courses from IE&M, proof-based Math courses, algorithms from CS
- Ask your adviser and (strong) classmates
- The goal in PhD is research/publications---not a 100% in every class.
  - See Deirdre McCloskey's "How to be a good graduate student"

  http://www.deirdremccloskey.com/docs/pdf/Article_315.pdf

Research

- Understand your adviser's research area/strengths
  - Read their papers
- Know the 5-10 historically great/important papers/ideas in your field
  - For example, if you're working in optimization, you should know "optimization = separation"
  - You can read other papers as needed
- Generate *many* ideas
  - Almost all will be awful.
  - If the idea passes the *smell test*, record it in an "ideas" notebook.
  - Be curious; try things out. Test if the idea is worth pursuing.
  - Work on several research topics at once.
- Know your strengths; exploit them
  - Collaborate to help with your weaknesses
- Dissertation = 3 papers + staple

“If you don't spend almost all of your time feeling like an idiot, you're not really doing research.”

-Jeff Erickson, CS prof, UIUC

@jefferickson

Research Quality

- (Journal) Quality is important
  - For some business schools, 1 paper in OR or MS = 4 papers in EJOR
  - Know the top journals in your field
  - When academics see your CV, they'll see **where** you published; hard to (quickly) judge what you published
- Book chapters and many conference proceedings are practically worthless on a CV
  - Exceptions: CS-heavy conferences

Research

- Try to finish one paper every semester.
  - If some don't work out, it's ok; you'll have ~8 chances.
  - It's good to collaborate.
    - 4 four-author papers is viewed much more favorably than 1 single-author paper.
- If you get stuck:
  - It's okay to take a break; go for a walk. (grab a cocktail?)
  - Ask your labmates/adviser
  - Set the problem aside for a couple weeks.
  - Can you solve a simpler problem?
    - See George Polya's "How to Solve It"

Writing Papers

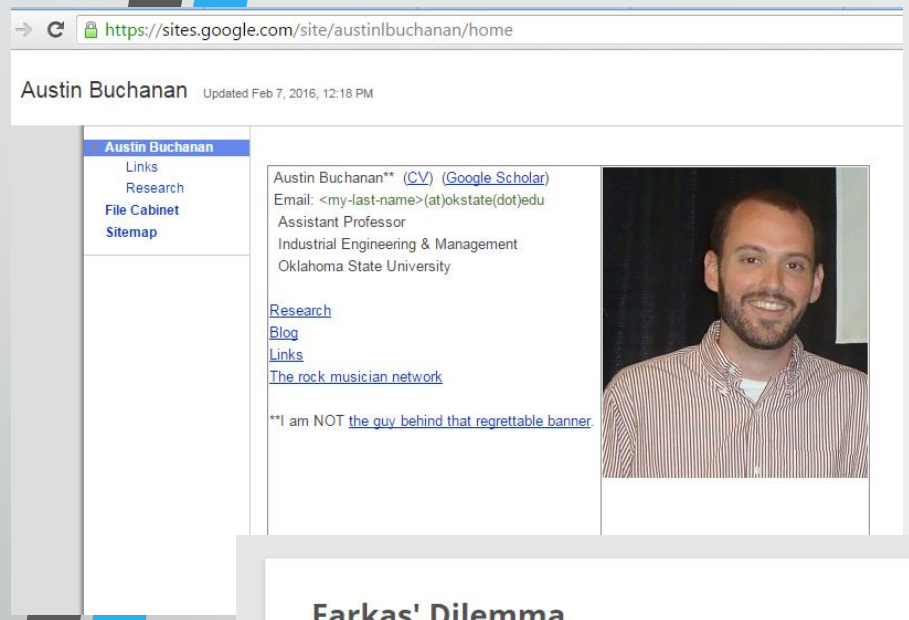
- Start typing very early
  - If you work in OR, use LaTeX and BibTeX.
  - LaTeX >> MS Word for papers, but slides can be easier with PPT
- Write a (stunning, untrue) abstract at the beginning
  - What you **want** the paper to be when you're done
  - Provides vision
- Create an outline; fill it in
- Constantly revise
  - Eventually become a stickler for details
  - Keep old versions
- Follow Cole Smith's writing tips:

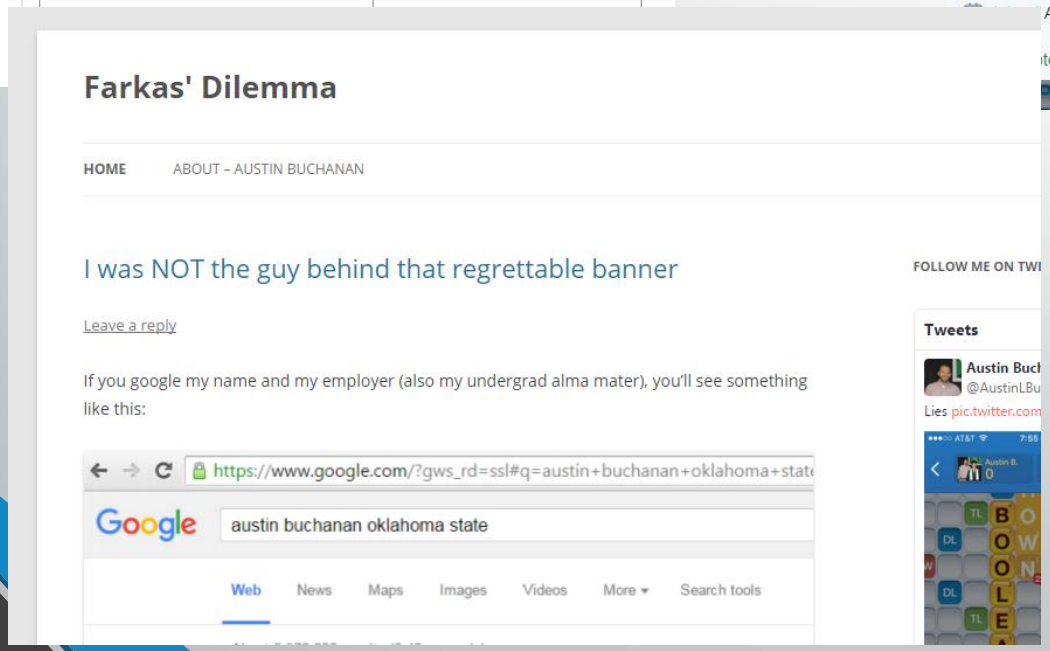
http://people.clemson.edu/~jcsmith/tips/Tips_Home.html

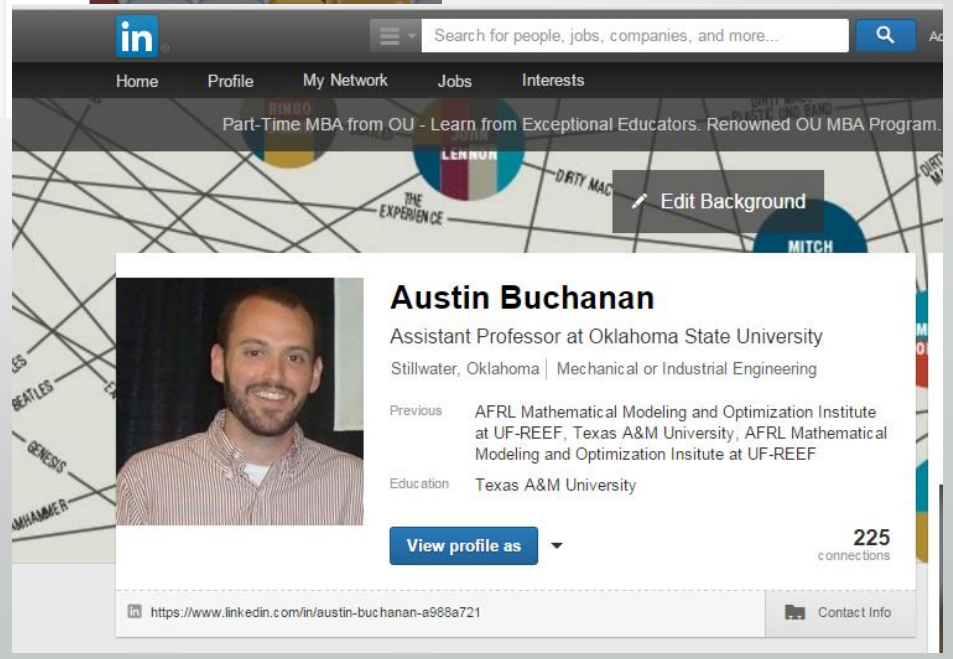
- Read Laura McLay's blog post "just write, damn it":

http://punkrockor.com/2015/05/04/just-write-damn-it/

Maintain an Online Presence

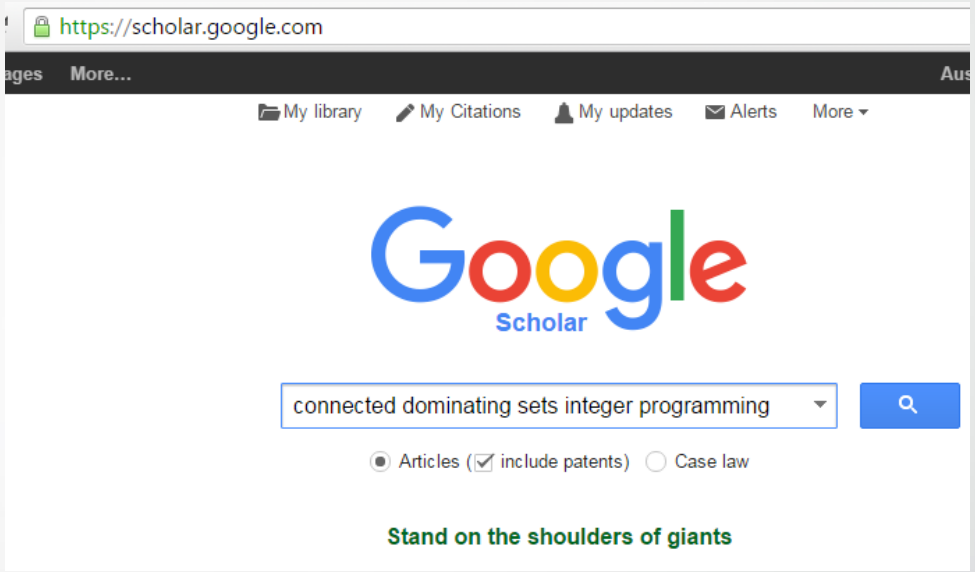






Online Tips

- Use Google Scholar
  - To find articles
    - Free versions + preprints
  - Know Google search tips, like putting something in quotes
  - To get BibTeX entries
  - To find related articles
    - "Cited by…"
  - To subscribe to a researcher
  - To see all papers by a researcher
  - To see which papers cite you



- Use preprint websites
  - Optimization Online, arXiv
  - Subscribe to feeds in your area
  - Post your papers there when you submit
  - Be aware of copyright restrictions

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Solving the **connected dominating set** problem and power dominating set problem by **integer programming**
N Fan, JP Watson - Combinatorial optimization and applications, 2012 - Springer
Abstract In this paper, we propose several **integer programming** approaches with a polynomial number of constraints to formulate and solve the minimum **connected dominating set** problem. Further, we consider both the power dominating set problem–a special ...
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On connected multiple point coverage in wireless sensor networks [PDF] from researchgate.net
S Yang, F Dai, M Cardei, J Wu, F Patterson - International Journal of ..., 2006 - Springer Full-Text @ OSU
... **Integer Programming**: $$ \begin{array}{lll} \hbox{Minimize}&x_1+x_2+\cdots ... Energy efficient area monitoring by sensor networks. IEEE Computer 37(2):40–46. 3. J. Wu and H. Li, On calculating **connected dominating set** for efficient routing in ad hoc wireless networks. Proc. ...
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The minimum **connected dominating set** problem: Formulation, valid inequalities and a branch-and-cut algorithm
L Simonetti, AS Da Cunha, A Lucena - Network Optimization, 2011 - Springer
... Abstract. We consider the minimum **connected dominating set** problem. We present an **integer programming** formulation and new valid inequalities. A branch- and-cut algorithm based on the reinforced formulation is also provided. ...
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Linear kernels for (**connected**) **dominating set** on H-minor-free graphs [PDF] from psu.edu
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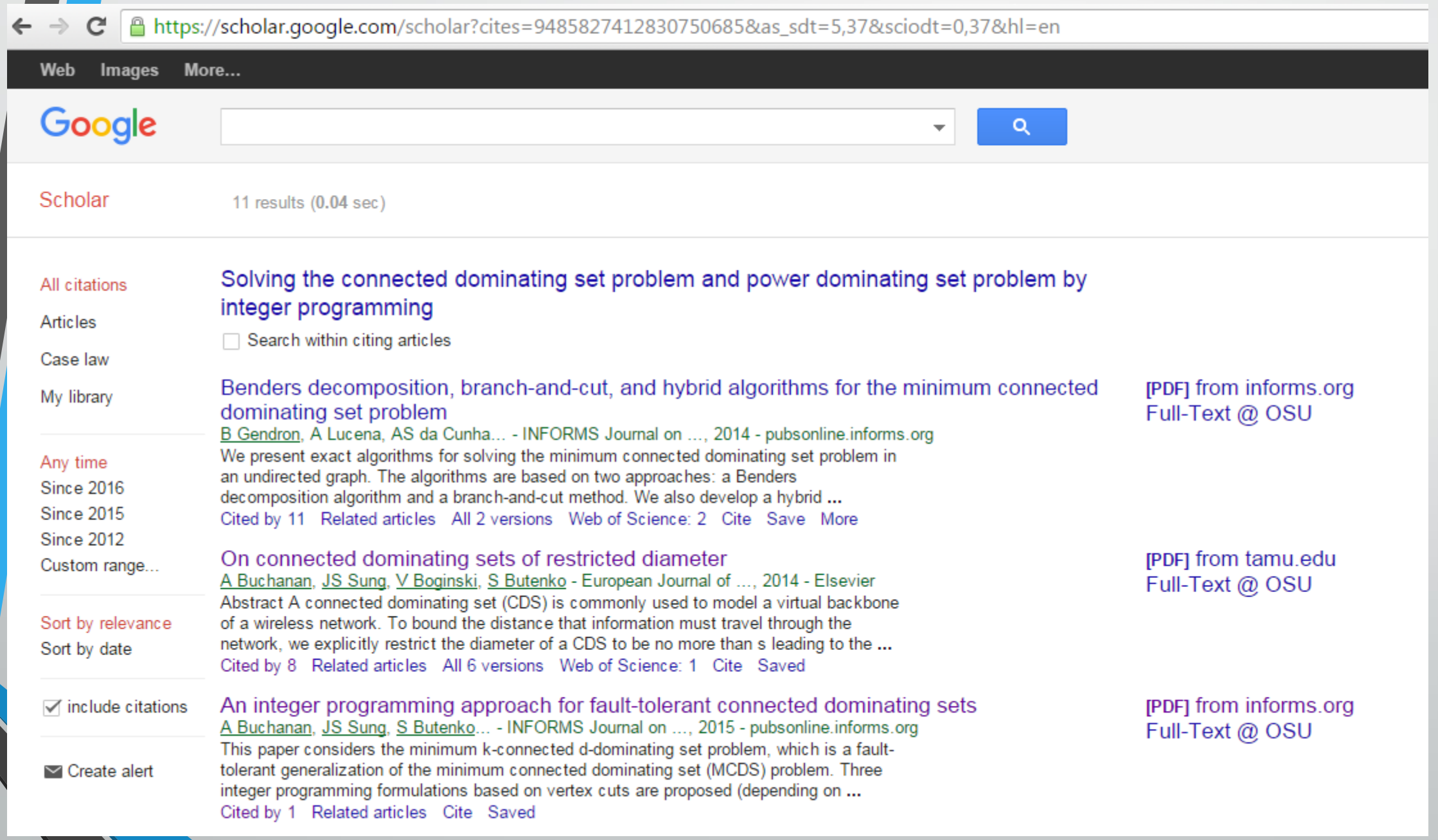
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Solving the connected dominating set problem and power dominating set problem by integer programming
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Benders decomposition, branch-and-cut, and hybrid algorithms for the minimum connected dominating set problem
B Gendron, A Lucena, AS da Cunha... - INFORMS Journal on ..., 2014 - pubsonline.informs.org
We present exact algorithms for solving the minimum connected dominating set problem in an undirected graph. The algorithms are based on two approaches: a Benders decomposition algorithm and a branch-and-cut method. We also develop a hybrid ...
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On connected dominating sets of restricted diameter
A Buchanan, JS Sung, V Boginski, S Butenko - European Journal of ..., 2014 - Elsevier
Abstract A connected dominating set (CDS) is commonly used to model a virtual backbone of a wireless network. To bound the distance that information must travel through the network, we explicitly restrict the diameter of a CDS to be no more than s leading to the ...
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An integer programming approach for fault-tolerant connected dominating sets
A Buchanan, JS Sung, S Butenko... - INFORMS Journal on ..., 2015 - pubsonline.informs.org
This paper considers the minimum k-connected d-dominating set problem, which is a fault-tolerant generalization of the minimum connected dominating set (MCDS) problem. Three integer programming formulations based on vertex cuts are proposed (depending on ...
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Luidi Simonetti

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Professor da Ciência da Computação, Universidade Federal Fluminense
Programação Matemática, Otimização Combinatória
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Title 1–20	Cited by	Year
Modeling hop-constrained and diameter-constrained minimum spanning tree problems as Steiner tree problems over layered graphs L Gouveia, L Simonetti, E Uchoa Mathematical Programming 128 (1-2), 123-148	76	2011
Bilevel optimization applied to strategic pricing in competitive electricity markets M Fampa, LA Barroso, D Candal, L Simonetti Computational Optimization and Applications 39 (2), 121-142	56	2008
Reformulations and solution algorithms for the maximum leaf spanning tree problem A Lucena, N Maculan, L Simonetti Computational Management Science 7 (3), 289-311	23	2010
The minimum connected dominating set problem: Formulation, valid inequalities and a branch-and-cut algorithm L Simonetti, AS Da Cunha, A Lucena Network Optimization, 162-169	14	2011
Hybrid heuristics for a short sea inventory routing problem A Agra, M Christiansen, A Delgado, L Simonetti European Journal of Operational Research 236 (3), 924-935	13	2014
Modelling the hop-constrained minimum spanning tree problem over a layered graph L Gouveia, L Simonetti, E Uchoa International Network Optimization Conference	12	2007
Benders decomposition, branch-and-cut, and hybrid algorithms for the minimum connected dominating set problem B Gendron, A Lucena, AS da Cunha, L Simonetti INFORMS Journal on Computing 26 (4), 645-657	11	2014

Google Scholar

Citation indices	All	Since 2011
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Co-authors View all...

Eduardo Uchoa
Cid Carvalho de Souza
Lúcia Drummond
Fábio Protti
A. Ridha Mahjoub
Yuri Frota
Ana Cristina Bicharra Garcia
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Bernard Gendron
Luiz Augusto Nobrega Barroso
Anand Subramanian
Luiz Satoru Ochi
Breno Piva
Luis Gouveia
Pedro Henrique González
Carlos Alberto Martinhon
Igor Machado Coelho

Pitfalls

- Starting research too late
- Sticking with a topic that's going nowhere
- Waiting on your adviser to push you
  - Push them! (kindly ☺)
- Failing to polish a paper

CV

- Create one now
  - What do you want it to look like when you graduate?
- Learn by reading other academics' CVs
- Have distinct headings/sections for:
  - Published/accepted papers
  - Working/submitted papers (if at all)
    - Some discourage including this. (I think it's fine---especially if you can link to a preprint.)
  - Conference presentations (if at all)
    - I think it's fine---especially as a grad student.
- Keep a current version on your webpage

Questions?