

Robert Xiao

CURRICULUM VITAE

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Last Updated: January 2, 2018

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EDUCATION

PhD in Human-Computer Interaction **2011 – Present**

Carnegie Mellon University, Pittsburgh, PA

Thesis Proposed: March 29, 2017

On-World Computing: Unleashing Computation on the World Around Us

Estimated Graduation April 2018

Bachelor of Mathematics **2007 – 2011**

University of Waterloo, Waterloo, ON

Double Honours in Computer Science and Combinatorics & Optimization

HONOURS AND AWARDS

SCHOLARSHIPS & FELLOWSHIPS

NSERC Postgraduate Scholarship **2013 – 2015**

\$63,000 award for three years, awarded to top Canadian graduates in their third year of a graduate program of study

Qualcomm Innovation Fellowship **2012**

\$100,000 award for one year for a team of two students

NSERC Julie Payette Postgraduate Scholarship **2011**

\$25,000 award for one year awarded to top Canadian students in their first year of a graduate program of study

NSERC Undergraduate Student Research Award **2008 – 2010**

Canadian federal fellowships to support academic research as an undergraduate student

Rene Descartes Scholarship **2007 – 2011**

Awarded to students with strong performance on Canadian national mathematics competitions

SELECTED HONOURS AND AWARDS

Fast Company Innovation by Design Student Award	2016
Awarded for EM-Sense, recognizing an outstanding work of innovation. A total of 15 awards were given out from a pool of 1700 nominations	
Allen Newell Award for Research Excellence	2015
Awarded w/ Scott Hudson to recognize outstanding body of work within the School of Computer Science at Carnegie Mellon University	
Governor General's Silver Medal	2011
Awarded to the individual with the highest academic average over all graduating students	
Rising Stars of Research Honourable Mention	2010
Awarded to outstanding posters in the national Rising Stars of Research Poster Competition	
NSERC USRA Poster Competition First Prize	2009, 2010
Awarded to the top poster presented at the University of Saskatchewan USRA Poster Fair	
Putnam Mathematics Competition	2008
110th place in North America (4th in U of Waterloo)	
President's Scholarship of Distinction	2007
Awarded to students with a 95% entrance average or higher	

PUBLICATIONS

27. **Xiao, R.**, Cao, T., Guo, N., Zhuo, J., Zhang, Y. and Harrison, C. (2018). ProjectionWatch: A Wearable Projector with On-Arm Projection and Finger Input. To appear in *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (CHI '18). 11 pages.
26. **Xiao, R.**, Schwarz, J., Throm, N., Wilson, A. and Benko, H. (2018). MRTouch: Adding Touch Input to Head-Mounted Mixed Reality. To appear in *IEEE Transactions on Visualization and Computer Graphics* (TVCG), Special Issue. 8 pages.
25. **Xiao, R.**, Hudson, S.E. and Harrison, C. (2017). Supporting Responsive Cohabitation Between Virtual Interfaces and Physical Objects on Everyday Surfaces. In *Proceedings of the ACM on Human-Computer Interaction, Engineering Interactive Computing Systems* (EICS '17). ACM, New York, NY, USA. Article 12. 17 pages.
DOI: <https://doi.org/10.1145/3095814>

24. **Xiao, R.**, Laput, G., Zhang, Y. and Harrison, C. (2017). Deus EM Machina: On-Touch Contextual Functionality for Smart IoT Appliances. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 4000-4008. DOI: <https://doi.org/10.1145/3025453.3025828>
23. **Xiao, R.**, Hudson, S.E. and Harrison, C. (2016). CapCam: Enabling Quick, Ad-Hoc, Position-Tracked Interactions Between Devices. In *Proceedings of the 2016 International Conference on Interactive Surfaces & Spaces (ISS '16)*. ACM, New York, NY, USA, 169-178. DOI: <https://doi.org/10.1145/2992154.2992182>
22. **Xiao, R.**, Hudson, S.E. and Harrison, C. (2016). DIRECT: Making Touch Tracking on Ordinary Surfaces Practical with Hybrid Depth-Infrared Sensing. In *Proceedings of the 2016 International Conference on Interactive Surfaces & Spaces (ISS '16)*. ACM, New York, NY, USA, 85-94. DOI: <https://doi.org/10.1145/2992154.2992173>
21. Laput, G., **Xiao, R.** and Harrison, C. (2016). ViBand: High-Fidelity Bio-Acoustic Sensing Using Commodity Smartwatch Accelerometers. In *Proceedings of the 29th Annual Symposium on User Interface Software & Technology (UIST '16)*. ACM, New York, NY, USA, 321-333. DOI: <https://doi.org/10.1145/2984511.2984582>.
Best Paper Award
20. Zhang, Y., **Xiao, R.** and Harrison, C. (2016). Advancing Hand Gesture Recognition with High Resolution Electrical Impedance Tomography. In *Proceedings of the 29th Annual Symposium on User Interface Software & Technology (UIST '16)*. ACM, New York, NY, USA, 843-850. DOI: <https://doi.org/10.1145/2984511.2984574>
19. **Xiao, R.**, Benko, H. Augmenting the Field-of-View of Head-Mounted Displays with Sparse Peripheral Displays. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 1221-1232. DOI: <https://doi.org/10.1145/2858036.2858212>. **Honorable Mention Award**
18. **Xiao, R.**, Schwarz, J. and Harrison, C. (2015). Estimating 3D Finger Angle on Commodity Touchscreens. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces (ITS '15)*. ACM, New York, NY, USA, 47-50. DOI: <https://doi.org/10.1145/2817721.2817737>
17. Guo, A., **Xiao, R.** and Harrison, C. (2015). CapAuth: Identifying and Differentiating User Handprints on Commodity Capacitive Touchscreens. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces (ITS '15)*. ACM, New York, NY, USA, 59-62. DOI: <https://doi.org/10.1145/2817721.2817722>

16. Chatterjee, I., **Xiao, R.** and Harrison, C. (2015). Gaze+Gesture: Expressive, Precise and Targeted Free-Space Interactions. In *Proceedings of the 2015 International Conference on Multimodal Interaction (ICMI '15)*. ACM, New York, NY, USA, 131-138. DOI: <http://dx.doi.org/10.1145/2818346.2820752>. **Best Paper Award**
15. Laput, G., Yang, C., **Xiao, R.**, Sample, A. and Harrison, C. (2015). EM-Sense: Touch Recognition of Uninstrumented, Electrical and Electromechanical Objects. In *Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology (UIST '15)*. ACM, New York, NY, USA, 157-166. DOI: <https://doi.org/10.1145/2807442.2807481>. **Best Talk Award**
14. Laput, G., Lasecki, W.S., Wiese, J., **Xiao, R.**, Bigham, J.P. and Harrison, C. (2015). Sensors: Adaptive, Rapidly Deployable, Human-Intelligent Sensor Feeds. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, USA. 1935-1944. DOI: <https://doi.org/10.1145/2702123.2702416>
13. Laput, G., **Xiao, R.**, Chen, X., Hudson, S.E., Harrison, C. (2014). Skin Buttons: Cheap, Small, Low-Powered and Clickable Fixed-Icon Laser Projectors. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology (UIST '14)*. ACM, New York, NY, USA. 389-394. DOI: <https://doi.org/10.1145/2642918.2647356>
12. **Xiao, R.**, Lew, G., Marsanico, J., Hariharan, D., Hudson, S.E., Harrison, C. (2014). Toffee: Enabling Ad Hoc, Around-Device Interaction with Acoustic Time-of-Arrival Correlation. In *Proceedings of the 16th International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '14)*. ACM, New York, NY, USA. 67-76. DOI: <http://dx.doi.org/10.1145/2628363.2628383>
11. **Xiao, R.**, Laput, G., Harrison, C. (2014). Expanding the Input Expressivity of Smartwatches with Physical Pan, Twist, Tilt and Click. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2014 (CHI '14)*. ACM, New York, NY, USA. 193-196. DOI: <https://doi.org/10.1145/2556288.2557017>
10. Schwarz, J., **Xiao, R.**, Mankoff, J., Hudson, S.E., Harrison, C. (2014). Probabilistic Palm Rejection Using Spatiotemporal Touch Features and Iterative Classification. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2014 (CHI '14)*. ACM, New York, NY, USA. 2009-2012. DOI: <https://doi.org/10.1145/2556288.2557056>

9. Harrison, C., **Xiao, R.**, Schwarz, J., Hudson, S.E. (2014). TouchTools: Leveraging Familiarity and Skill with Physical Tools to Augment Touch Interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2014 (CHI '14)*. ACM, New York, NY, USA. 2913-2916.
DOI: <https://doi.org/10.1145/2556288.2557012>
8. **Xiao, R.**, Harrison, C., Hudson, S.E. (2013). Lumitrack: High Speed, High Precision, Low-Cost Tracking with Projected m-Sequences. In *Proceedings of the 26th Annual ACM Symposium on User Interface Software and Technology (UIST '13)*. ACM, New York, NY, USA. 3-12. DOI: <http://dx.doi.org/10.1145/2501988.2502022>
7. **Xiao, R.**, Harrison, C., Hudson, S.E. (2013). WorldKit: Rapid and Easy Creation of Ad-hoc Interactive Applications on Everyday Surfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2013 (CHI '13)*. ACM, New York, NY, USA. 879-888. DOI: <https://doi.org/10.1145/2470654.2466113>
6. Tang, J., **Xiao, R.**, Hoff, A., Venolia, G., Therien, P., Roseway, A. (2013). HomeProxy: Exploring a Physical Proxy for Video Communication in the Home. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2013 (CHI '13)*. ACM, New York, NY, USA. 1339-1342.
DOI: <https://doi.org/10.1145/2470654.2466175>
5. Bateman, S., Mandryk, R.L., Gutwin, C., **Xiao, R.** (2013). Analysis and Comparison of Target Assistance Techniques for Relative Ray-Cast Pointing. In *International Journal of Human-Computer Studies (IJHCS)*, Volume 71, Issue 5, 511-532.
DOI: <http://dx.doi.org/10.1016/j.ijhcs.2012.12.006>
4. Harrison, C., **Xiao, R.**, Hudson, S.E. (2012). Acoustic Barcodes: Passive, Durable and Inexpensive Notched Identification Tags. In *Proceedings of the 25th Annual ACM Symposium on User Interface Software and Technology (UIST '12)*. ACM, New York, NY, USA, 563-568. DOI: <https://doi.org/10.1145/2380116.2380187>
3. **Xiao, R.**, Nacenta, M., Mandryk, R.L., Cockburn, A., Gutwin, C. (2011). Ubiquitous Cursor: A Comparison of Direct and Indirect Pointing Feedback in Multi-Display Environments. In *Proceedings of Graphics Interface 2011 (GI '11)*. Canadian Human-Computer Communications Society, Waterloo, Ontario, Canada, 135-142.
Best Student Paper Award
2. Bateman, S., Doucette, A., **Xiao, R.**, Gutwin, C., Mandryk, R.L., Cockburn, A. (2011). Effects of view, input device, and track width on video game driving. In *Proceedings of Graphics Interface 2011 (GI '11)*. Canadian Human-Computer Communications Society, Waterloo, Ontario, Canada, 207-214.

1. Gutwin, C., Schneider, O., and **Xiao, R.** (2011). Chalk Sounds: Using Synthesized Audio to Improve Workspace Awareness in Distributed Groupware. In *Proceedings of the 2011 Conference on Computer Supported Cooperative Work (CSCW '11)*. ACM, New York, NY, USA, 85-94. DOI: <https://doi.org/10.1145/1958824.1958838>

POSTERS

3. **Xiao, R.**, Bateman, S., Mandryk, R., Gutwin, C. (2009). Enhancing the Effectiveness of Remote Pointing. Presented at the University of Saskatchewan USRA Poster Fair, August 2009.
2. **Xiao, R.**, Nacenta, M., Cockburn, A., Mandryk, R., Gutwin, C. (2010). Ubiquitous Cursor: Filling in the Space Between Displays. Presented at the University of Saskatchewan USRA Poster Fair, August 2010.
1. **Xiao, R.**, Harrison, C. (2012). Synthetic Sensors and Displays. Presented at the Qualcomm Innovation Winner's Day, September 2012.

INVITED PRESENTATIONS

2. "CapCam: Enabling Quick, Ad-Hoc, Position-Tracked Interactions Between Devices." Engadget Live. New York City, USA, Oct 29, 2015.
1. "Evolving the Human-Computer Interface." Co-Keynote presentation with Sir Tim Berners Lee. "WE: Way to Evolve" summit. Tencent. Shenzhen, China, Nov 10, 2013.

SELECTED PRESS COVERAGE

Desktopography, 2017

<http://www.dailymail.co.uk/sciencetech/article-4650346/Fancy-turning-DESK-touchscreen.html>
<http://www.popularmechanics.com/technology/gadgets/a27124/desk-touchscreen-projector/>

Deus EM Machina, 2017

<https://www.engadget.com/2017/05/09/deus-em-machina-electromagnetic-emissions-sensing/>
<https://techcrunch.com/2017/05/09/how-a-tap-could-tame-the-smart-home/>

ViBand, 2016

<https://techcrunch.com/2016/11/21/overclocked-smartwatch-sensor-uses-vibrations-to-sense-gestures-objects-and-locations/>
<https://www.theverge.com/circuitbreaker/2016/11/2/13463312/carnegie-mellon-lg-smartwatch-hack-gesture-accelerometer-viband-project>

SparseLight, 2016

<https://www.theverge.com/2016/4/26/11512820/sparselight-ar-vr-led-hack-microsoft-hololens>
<https://arstechnica.com/gaming/2016/05/how-side-mounted-leds-can-help-fix-vrs-tunnel-vision-and-nausea-problems/>

EM-Sense, 2015

<http://www.wired.com/2015/11/em-sense-enabled-smartwatch-can-detect-when-you-touch-a-doorknob/>

<http://www.nbcnews.com/tech/innovation/disney-smartwatch-knows-what-youre-touching-tells-you-what-do-n461741>

<https://www.fastcodesign.com/product/em-sense>

Zensors, 2015

<http://www.pcworld.com/article/2914552/zensors-app-lets-you-crowdsource-live.html>

<http://gizmodo.com/one-old-android-phone-could-make-all-your-dumb-things-s-1699362305>

3D Finger Angle, 2015

<http://gizmodo.com/a-touchscreen-that-knows-the-angle-of-your-finger-is-wa-1742667522>

<http://www.digitaltrends.com/mobile/qeexo-fingerangle-news/>

Skin Buttons, 2014

<http://phys.org/news/2014-10-skin-icons-smartwatch.html>

<http://www.fastcodesign.com/3036985/this-smartwatch-projects-laser-buttons-onto-your-skin>

TouchTools, 2014

<http://gizmodo.com/what-life-would-be-like-if-skeuomorphism-ruled-our-ipad-1570806039>

<http://www.engadget.com/2014/05/01/touchtools-user-interface-manipulating-objects/>

6DOF Physical Smartwatch, 2014

<http://www.newscientist.com/article/dn25482-tilting-smartwatch>

<http://www.engadget.com/2014/04/30/concept-smartwatch-joystick/>

WorldKit, 2013

Work featured as segment on “Stephen Hawking’s Science of the Future”, Episode 4.

<http://www.reuters.com/video/2013/06/12/researcher-gives-new-meaning?videoid=243310701>

<http://www.foxnews.com/tech/2013/07/08/projector-turns-everything-into-touchscreen/>

TEACHING EXPERIENCE

Lab Instructor

2014

Lab Instructor for the Programming Usable Interfaces Prototype Lab, in the Human-Computer Interaction Institute at Carnegie Mellon University, during the September-December 2014 academic term.

Teaching Assistant

2014

Teaching Assistant for an introductory course on Applied Gadgets, Sensors and Activity Recognition, taught by Scott E. Hudson, in the Human-Computer Interaction Institute at Carnegie Mellon University, during the January-April 2014 academic term.

Tutoring and TAing	2008-2010
Various tutoring and TA positions with the Tutorial Center and Tutoring in Residence programs (four semester-long appointments total), Faculty of Mathematics, University of Waterloo	
MATH 227 TA (Calculus 3 for Honours Physics)	2009
Received outstanding evaluation from MATH 227 professor for TA work	
MATH 146 TA (Advanced Linear Algebra)	2009
Received outstanding evaluation from MATH 146 professor for TA work	
CS 116 Tutor (Intro to Computer Science 2)	2009
Developed and maintained entirely new version of the automatic grading system (used by nearly 1000 students per semester). Department of Computer Science, University of Waterloo, Waterloo, ON, Canada.	

POSITIONS AND APPOINTMENTS HELD

Research Consultant, Microsoft Research	2017
Mentored by Julia Schwarz and Hrvoje Benko. Work focused on advancing interactions in augmented reality. Redmond, WA, USA	
Research Intern, Microsoft Research	2016
Mentored by Andy Wilson and Hrvoje Benko. Work focused on advancing interactions in augmented reality. Redmond, WA, USA	
Research Intern, Microsoft Research	2015
Mentored by Andy Wilson. Work focused on expanding the FoV of VR systems using sparse peripheral displays. Work resulted in the Sparse Peripheral Displays paper, which earned an honorable mention at CHI 2016. Redmond, WA, USA	
Software Architect, Qeexo, Co.	2013
Summer internship with CMU spinoff. Work focused on engineering rich multitouch solutions for mobile devices. Pittsburgh, PA, USA	
Research Intern, Microsoft Research	2012
Mentored by John Tang. Work focused on in-home physical proxies for video communication. HomeProxy publication resulted from this internship. Redmond, WA, USA	

Embedded Software Developer, Research in Motion	2011
Development and validation of embedded radio firmware for 3G modems. Waterloo, ON, Canada	
Summer Research Student, University of Saskatchewan	2010
Summer research with the Interaction Lab, Department of Computer Science, mentored by Carl Gutwin. Research funded by NSERC under the Undergraduate Student Research Award program. Saskatoon, SK, Canada	
Summer Research Student, University of Saskatchewan	2009
Summer research with the Interaction Lab, Department of Computer Science, mentored by Regan Mandryk and Carl Gutwin. Research funded by NSERC under the Undergraduate Student Research Award program. Saskatoon, SK, Canada	
Summer Research Student, University of Saskatchewan	2008
Summer research with the Imaging, Multimedia and Graphics Lab, Department of Computer Science, mentored by Mark Eramian. Research funded by NSERC under the Undergraduate Student Research Award program. Saskatoon, SK, Canada	
Database Analyst, University of Saskatchewan	2007
Database analyst with the Centre for Continuing and Distance Education at the University of Saskatchewan. Minimum qualifications required 3rd year Computer Science undergraduates; I took the job while in high school. Saskatoon, SK, Canada	

COMMUNITY SERVICE

Program Committee Member, CHI 2018	2017
Invited program committee member for the 36th Annual ACM Conference on Human Factors in Computing Systems (CHI 2018) conference held in Montreal, Canada.	
Contributing Writer, Crash Course Computer Science	2017
Invited contributing writer for 19 episodes of the Complexly & PBS Digital Studios “Crash Course Computer Science” educational video series.	
Program Committee Member, IUI 2018	2017
Invited program committee member for the 22nd ACM International Conference on Intelligent User Interfaces (IUI 2018).	

Student Volunteer, UIST 2017 2017
Student volunteer at the program committee meeting and main conference for the 30th Annual ACM Symposium on User Interface Software & Technology (UIST 2017).

Session Chair, UIST 2015 2015
Chair of the “Hands and Fingers” papers session at the 28th Annual ACM Symposium on User Interface Software & Technology (UIST 2015).

Regular Conference Paper Reviewer
Reviewer for over 50 submitted papers across several conferences, including CHI, UIST, UbiComp, DIS, CSCW, ITS/ISS and MobileHCI. Annual reviewer for CHI and UIST since 2013.
3 “*Excellent Reviewer*” distinctions received at CHI (2016, 2017, 2017).

Journal Paper Reviewer
Reviewer for over 10 journal articles, including articles submitted to IJHCS, IEEE Computer and IEEE Photonics.

ADDITIONAL HONORS AND AWARDS

First place, DEFCON 25 CTF July 2017
Competed with the CMU PPP team at annual DEFCON CTF in Las Vegas.

First place individual, Cambridge 2 Cambridge Challenge July 2017
In-person computer security competition held in Cambridge, UK, among over 100 prequalified contestants. £3000 prize for first place individual.

First place team, Cambridge 2 Cambridge Challenge July 2017
In-person computer security competition held in Cambridge, UK, among 22 teams of 5 prequalified people each. £9000 prize for first place team.

First place, DEFCON Quals CTF May 2017
Online team computer security competition; qualified to final competition in Las Vegas, NV.

First place, NSA Codebreaker Challenge 2016 December 2016
Individual cryptography/reverse engineering competition held online.

First place, DEFCON 24 CTF August 2016
Competed with the CMU PPP team at annual DEFCON CTF in Las Vegas.

First place, Codegate CTF May 2016
Four-person team, computer security competition held in Seoul, S. Korea. 50,000,000 KRW (\$45000 USD) prize.

Second place, 0CTF Finals Four-person team, attack-defense style computer security competition held in Shanghai, China. 20000 RMB (\$3000 USD) prize.	April 2016
Fifth place, Microsoft College Puzzle Challenge Four-person team, ranked fifth nationally and first at CMU.	April 2016
First place, Microsoft Build the Shield Competition Four-person team computer security competition held in Seattle, Washington with over 40 participating teams.	March 2016
First place, Codegate Quals CTF Online team computer security competition; qualified to final round in Seoul, S. Korea.	March 2016
First place, Tsinghua University BCTF Online team computer security and cryptography competition, over 500 participating teams.	March 2016
Fourth place, 0CTF Qualification Round Online team computer security competition with over 800 participating teams; qualified to final round in Shanghai, China.	March 2016
Third place, Boston Key Party CTF Online team computer security and cryptography competition, over 750 participating teams.	March 2016
Top 25, NSA Codebreaker Challenge 2015 Individual cryptography/reverse engineering competition held online.	December 2015
Fifth place, HITCON 2015 Final CTF Four-person team computer security competition held in Taipei, Taiwan.	December 2015
First place, HITCON 2015 Quals CTF Online team computer security competition, qualification for final round.	October 2015
Second place, DEFCON 23 CTF Participated in this team computer security competition in Las Vegas.	August 2015
First place, Microsoft Code Hunt Individual programming competition held on the Microsoft campus and open to all employees.	August 2015
Third place, SECCON 2014 Final CTF Four-person team computer security competition held in Tokyo, Japan.	February 2015
First place, CMU-Citadel Programming Challenge Individual competition hosted by Citadel LLC.	January 2015

Third place, Microsoft College Puzzle Challenge
Four-person team, ranked third in national standings.

April 2014

Invited participant of the USA Mathematics Olympiad

2007

Pythagoras Contest Canadian Champion

2001

REFERENCES

DR. CHRIS HARRISON

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Carnegie Mellon University
5000 Forbes Ave
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DR. HRVOJE BENKO

Oculus VR
8747 148th Ave NE
Redmond, WA 98052-3483
Email: hrvoje.benko@oculus.com

DR. ANDREW D. WILSON

Microsoft Research
Bldg. 99
One Microsoft Way
Redmond, WA 98052-6399
Email: awilson@microsoft.com

DR. SCOTT HUDSON

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Carnegie Mellon University
5000 Forbes Ave
Pittsburgh, PA 15213-3891
Email: scott.hudson@cs.cmu.edu

DR. CARL GUTWIN

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110 Science Place Drive
The University of Saskatchewan
Saskatoon, SK S7N 5C9

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