Patrick M. Virtue

pvirtue@cs.cmu.edu (412) 268-2569

EDUCATION

University of California, Berkeley, Berkeley, California, U.S.A. August 2019
Ph.D. Electrical Engineering & Computer Sciences
Advisors: Michael Lustig and Stella X. Yu

University of Notre Dame, Notre Dame, Indiana, U.S.A. May 2002
B.S. Computer Science Engineering, Summa Cum Laude
Advisor: Jesus Izaguirre

PROFESSIONAL APPOINTMENTS

Carnegie Mellon University
Assistant Teaching Professor, Computer Science and Machine Learning 2018 – Present

GE Healthcare
Senior Software Engineer, Clinical Software Engineering 2007 – 2010
Software Engineer, Surgical Navigation 2007
Software Engineer, Global Software Platforms 2004 – 2007
Engineer, Edison Engineering Development Program 2002 – 2004

TEACHING EXPERIENCE

Carnegie Mellon University

Instructor, *Generative AI* (10-423/10623)
- 160 students, 12 TAs, with co-instructor Matt Gormley — Spring 2025

Instructor, *Introduction to Machine Learning (Undergrad SCS Majors)* (10-315)
- 60 students, 7 TAs — Spring 2025
- 120 students, 10 TAs — Spring 2024
- 160 students, 10 TAs — Spring 2023
- 140 students, 8 TAs — Spring 2020

Instructor, *AI: Representation and Problem Solving* (15-281)
- 120 students, 9 TAs — Fall 2024
- 110 students, 8 TAs — Spring 2021
- 85 students, 9 TAs, with co-instructor Stephanie Rosenthal — Spring 2020
- 115 students, 8 TAs, with co-instructor Fei Fang — Fall 2019
- 100 students, 8 TAs, with co-instructor Stephanie Rosenthal — Spring 2019

Instructor, *Fundamentals of Programming and Computer Science* (15-112)
- 510 students, 51 TAs, with co-instructor Mike Taylor — Fall 2023
- 475 students, 41 TAs, with co-instructor Mike Taylor — Fall 2022

Instructor, *Demystifying AI* (15-181)
- Pilot version, 8 students — Spring 2022

Instructor, *Practical Data Science* (15-388/15-688)
- 30 students — Spring 2022

Instructor, *Mathematical Foundations for Machine Learning* (10-606)
- 20 students, 2 TAs — Fall 2021

Instructor, *Computational Foundations for Machine Learning* (10-606)
- 40 students, 2 TAs — Fall 2021

Instructor, *Introduction to Machine Learning (PhD)* (10-701)
- 140 students, 8 TAs, with co-instructor Ziv Bar-Joseph — Fall 2021

Instructor, *Machine Learning: Fundamentals and Algorithms*
- Online Executive Education, with co-instructor Matt Gormley — Summer 2021

Instructor, *Introduction to Machine Learning (Undergrad/Master's)* (10-301/10-601)
- 320 students, 16 TAs — Fall 2020
- 35 students, 4 TAs — Summer 2020

Instructor & Curriculum Developer, *AI Scholars (previously AI4ALL) Pre-College Program*
- 30 students — Summer 2024
- 30 students — Summer 2023
- 27 students — Summer 2022
- 30 students — Summer 2021
- 39 students — Summer 2019

Instructor, *Principles of Imperative Programming* (15-122)
- 450 students, 39 TAs, with co-instructor Iliano Cervesato — Fall 2018

University of California, Berkeley

Instructor, *Introduction to Artificial Intelligence* (CS 188)
- 400 students, 9 TAs, with co-instructor Stuart Russell — Fall 2015
- 70 students, 3 TAs — Summer 2015

Head Teaching Assistant, *Introduction to Machine Learning* (CS 189/289) — Spring 2015
- 380 students, 8 TAs, with instructors Peter Bartlett and Alexei Efros

Teaching Assistant, *Introduction to Artificial Intelligence* (CS 188) — Fall 2014
- Instructor Stuart Russell

Guest Lecturer, *The Beauty and Joy of Computing* (CS 10) — 2015 – 2017
- Topic: Artificial Intelligence, 6 terms

Guest Lecturer, *Teaching Techniques for Computer Science* (CS 375) — Summer 2016, Summer 2017
- Topic: Peer Instruction

Tutor, *The Structure and Interpretation of Computer Programs* (CS 61A) — Summer 2017

Marquette University & GE Healthcare

Instructor, *Advanced Course In Engineering* — 2004 – 2010
Graduate-level certified, multidisciplinary course for leadership-tracked engineers at GE Healthcare
- Defined curriculum for all image processing and image reconstruction related classes
- Taught 2D & 3D medical image processing, visualization, and post-processing classes

University of Notre Dame

Teaching Assistant, *Data Structures* (CSE 30331) — Fall 2001
- Instructor Jesus Izaguirre

Tutor, Minority Engineering Program 2001 - 2002

Tutor, Academic Services for Student Athletes 1999 - 2002

PUBLICATIONS

Journal Publications

M. Demant, P. Virtue, A. Kovvali, S. X. Yu, S. Rein. Learning quality rating of as-cut mc-Si wafers via convolutional regression networks, *Journal of Photovoltaics*, Volume 9, Issue 4, 1064-1072, 2019.

M. Demant, P. Virtue, A. Kovvali, S. X. Yu, S. Rein. Visualizing material quality and similarity of mc-Si wafers learned by convolutional regression networks, *Journal of Photovoltaics*, Volume 9, Issue 4, 1073-1080, 2019.

P. Virtue, M. Lustig. On the Empirical Effect of Gaussian Noise in Undersampled MRI Reconstruction, *Tomography*, Volume 3, Issue 4, 2017, 211-221.

M. Uecker, P. Lai, M. J. Murphy, P. Virtue, M. Elad, J. M. Pauly, M. Lustig. ESPIRiT—an Eigenvalue Approach to Autocalibrating Parallel MRI: Where SENSE Meets GRAPPA. *Magnetic Resonance in Medicine*, *71*(3), 990-1001, 2014.

L. Barber, M. Koff, P. Virtue, J. Lipman, R. Hotchkiss, H. Potter. The Use of MRI Modeling to Enhance Osteochondral Transfer in Segmental Kienböck's Disease. *Cartilage*, Volume 3, Issue 2, 188-193, 2012.

M. Koff, L. Chong, P. Virtue, L. Ying, L. Foo, H. Potter. Correlation of MRI and Histological Examination of Physeal Bars in a Rabbit Model. *Journal of Pediatric Orthopaedics*, Volume 30, Issue 8, 928-935, 2010.

M. Koff, L. Chong, P. Virtue, D. Chen, T. Wright, H. Potter. Validation of Cartilage Thickness Calculations Using Indentation Analysis. *Journal of Biomechanical Engineering*, Volume 132, Issue 4, 041007, 2010.

R. Chaturvedi, J.A. Izaguirre, C. Huang, T. Cickovski, P. Virtue, G. Thomas, G. Forgacs, M. Alber, G. Hentschel, S.A. Newman, J.A. Glazier. Multi-model simulations of chicken limb morphogenesis, *Lecture Notes in Computer Science*, Volume 2659, Springer-Verlag, New York, 39-49, 2003.

Refereed Conference Proceedings

P. Virtue. GANs Unplugged, *Proceedings of the 11th Symposium on Educational Advances in Artificial Intelligence (EAAI)*, 75, 2021.

P. Virtue, J. I. Tamir, M. Doneva, S. X. Yu, M. Lustig. Learning Contrast Synthesis from MR Fingerprinting, *Proceedings of the 26th Scientific Meeting, International Society for Magnetic Resonance in Medicine (ISMRM)*, Paris, 2018.

J. P. Dougherty, P. Virtue, and S. A. Wolfman. SIGCSE Filk Circle: CS Parody Songs for Learning, Engagement, and Fun, *Proceedings of the 2018 ACM SIGCSE Technical Symposium on Computer Science Education*, Baltimore, Maryland, 2018.

P. Virtue, S. X. Yu, M. Lustig. Better than Real: Complex-valued Neural Networks for MRI Fingerprinting, *International Conference on Image Processing*, Beijing, 3953-3957, 2017.

M. Uecker, F. Ong, J. I. Tamir, D. Bahri, P. Virtue, J. Y. Cheng, T. Zhang, and M. Lustig. Berkeley Advanced Reconstruction Toolbox, *Proceedings of the 23rd Scientific Meeting, International Society for Magnetic Resonance in Medicine (ISMRM)*, Toronto, 2015.

P. Virtue, M. Uecker, M. Elad, M. Lustig. Predicting Image Quality of Under-Sampled Data Reconstruction in the Presence of Noise. *Proceedings of the 21st Scientific Meeting, International Society for Magnetic Resonance in Medicine (ISMRM)*, Salt Lake City, Utah, 2013.

M. Koff, L. Chong, P. Virtue, D. Chen, T. Wright, H. Potter. Validation of Cartilage Thickness Calculations Using Indentation Analysis. *Proceedings of the 17th Scientific Meeting, International Society for Magnetic Resonance in Medicine (ISMRM)*, Honolulu, Hawaii, 2009.

M. Koff, L. Chong, P. Virtue, L. Ying, L. Foo, H. Potter. Correlation of MRI and Histological Examination of Physeal Bars in a Rabbit Model. *Proceedings of the 55th Annual Meeting, Orthopaedic Research Society*, Las Vegas, 2009.

Refereed Workshop Proceedings

P. Virtue, J. I. Tamir, M. Doneva, S. X. Yu, M. Lustig. Direct Contrast Synthesis for Magnetic Resonance Fingerprinting, *Proceedings of the ISMRM Workshop on Machine Learning*, Pacific Grove, California, 2018.

M. Uecker, P. Virtue, F. Ong, M. J. Murphy, M. T. Alley, S. Vasanawala, M. Lustig. Software Toolbox and Programming Library for Compressed Sensing and Parallel Imaging. *Proceedings of the ISMRM Workshop on Data Sampling and Reconstruction*, Sedona, Arizona, 2013.

PATENTS

M. Profio, S. W. Lee, D. Littlejohn, S. Zimmerman, H. McDaniel, S. Stuebe, P. Virtue, S. Robinson, A. C. Hole, C. Proctor. Diagnostic Imaging Simplified User Interface Methods and Apparatus. US Patent 9,514,275, issued 2016.

Z. Lin, G. Avinash, and P. Virtue. Method for Navigating, Segmenting, and Extracting a 3-D Image. US Patent 8,907,944, issued 2014.

P. Virtue, G. Avinash, and A. Budde. Systems and Methods for Segmenting Three Dimensional Image Volumes. US Patent 8,754,888, issued 2014.

P. Virtue, G. Avinash, and Z. Lin. Apparatus and Method for Isolating a Region in an Image. US Patent 8,588,486, issued 2013.

Z. Lin, G. Avinash, and P. Virtue. Method for Navigating, Segmenting, and Extracting a 3-D Image. US Patent 8,477,153, issued 2013.

P. Virtue. 3D Graphical Prescription of a Medical Imaging Volume. US Patent 8,199,168, issued 2012.

G. Avinash and P. Virtue. Semi-Automated Registration of Data Based on a Hierarchical Mesh. US Patent 8,068,652, issued 2011.

P. Virtue, K. Littlejohn, K. Phillips, D. Littlejohn, D. Miesbauer, and A. Van Nuffel. Real-time Volume Fusion in Diagnostic Imaging. US Patent 7,991,450, issued 2011.

INVITED TALKS

Plenary Talk, Musculoskeletal Image Analysis and Measurement Validation, *33rd Annual Great Lakes Biomedical Conference*, Milwaukee, Wisconsin, April 2010.

SELECT RESEARCH PROJECTS

Deep Learning for Magnetic Resonance Fingerprinting 2016 – 2019
UC Berkeley and International Computer Science Institute

- Magnetic resonance fingerprinting is a revolutionary means to produce quantitative medical images from a single pseudorandom magnetic resonance imaging (MRI) scan
- Researching deep learning techniques to make MR fingerprinting more accurate, efficient, and versatile

Complex-valued Neural Networks 2015 – 2019
UC Berkeley and International Computer Science Institute
- Enabling deep learning for applications with complex-valued data by researching novel complex-valued components for neural network architectures
- Extended deep learning software toolkits by implementing complex-valued neural network components and optimization calculus on CPU and GPU

Reconstruction Methods for Fast MRI 2010 - 2019
UC Berkeley, Stanford University, Technion – Israeli Institute of Technology, and GE Healthcare
- Developed reconstruction algorithms and analysis for compressed sensing and parallel imaging algorithms
- Enabled widespread research and development of advanced MRI reconstruction by creating an open source toolkit with efficient implementations of image reconstruction and optimization algorithms

MRI Cartilage Analysis 2007 –2010
GE Healthcare and Hospital for Special Surgery
- Designed algorithms to analyze MRI images to characterize the health of a patient's cartilage
- Produced clinically viable orthopedic software application by decreasing processing time 75% and increasing accuracy 30% over previous image analysis method
- Validated orthopedic software measurements against animal models as part of research collaboration with Hospital for Special Surgery in New York City

HONORS & AWARDS

EECS Outstanding Graduate Student Instructor Award, University of California, Berkeley 2015
UC Berkeley Outstanding Graduate Student Instructor Award, University of California, Berkeley 2014
National Defense Science and Engineering Graduate (NDSEG) Fellowship 2010

SERVICE

To the Professional Community

Co-Chair, Educational Advances in Artificial Intelligence 2023
Authors Chair, Consortium for Computer Science in Colleges, Southwest Region Conference 2018
Participant, CS Education Summit: Addressing the Challenges of Increasing Interest in Computing at the Undergraduate Level through Institutional Transformation, Pittsburgh, Pennsylvania 2017

To the University

SCS Undergraduate Review Committee 2023 – Present
Undergraduate AI Major Advisor 2021 – Present
Artificial Intelligence Curriculum Review Committee 2018 – Present
CS Department DEI Committee 2023 – 2024
SCS Teaching Continuity Committee 2020 – 2023
Teaching & Learning Summit Advisory Board 2020
Faculty Senator 2019 – 2021
Workshop Lead, UC Berkeley Conference for New Student Instructors 2016 – 2018
Mentor, Machine Learning at Berkeley Student Organization 2016 – 2017
Peer Counselor, UC Berkeley EECS Peers Program 2014 – 2016
Student Reviewer, UC Berkeley EECS Department Graduate Admissions Committee 2013 – 2014

To the Community

Co-Curriculum Developer, Mouse.org AI Design League 2023 – Present
Co-Curriculum Developer and Instructor, CMU AI Crash Course for High School Teachers 2021 – Present
Curriculum Developer and Instructor, CMU AI Scholars (previously AI4ALL) Summer Camp 2019 – Present

Co-Curriculum Developer and Instructor, CMU SCS Executive Education	2020 – Present
Curriculum Consultant, CMU TechNights	2019 – Present
Curriculum Consultant, CMU CS Academy	2020 – 2024
Co-Curriculum Developer, AI Programs, Boys & Girls Club	2019 – 2023