John R. Emmons

Curriculum vitae
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Education

PhD	**Computer Science** (focus: machine learning + systems)	Stanford University	2016 -
MS	**Computer Science** (with certificate in machine learning)	Washington University	2014 - 2016
BS	**Computer Engineering**	Washington University	2014 - 2016
BS	**Electrical Engineering**	Washington University	2014 - 2016
BS	**Computer Science, Physics, and Math** (triple major)	Drake University	2011 - 2014

Current Research

Stanford University 2016 -
Advisors: Keith Winstein and Silvio Savarese

- Topic area: computer vision and networked systems.
- Goal: change the way people interact with visual data by building systems that either: provide order of magnitude performance improvements or enable previously impossible questions to be answered.
- Keywords: TensorFlow, Keras, SIMD and GPU parallelization, machine learning, computer vision, nonlinear optimization, video compression, serverless computing, distributed systems.

Ongoing and Recent Projects

Feedback Neural Networks for Video: the state-of-the-art computer vision techniques are based on training feedforward multilayer neural networks, e.g. ConvNets. Each layer forms one of several successive representations that terminate with a decision layer. However, recent work has shown that alternative architectures, namely feedback networks, can perform the same tasks but confer additional benefits: early prediction, computational efficiency, and taxonomic classification. In this work, I study the performance implications of this new neural network architecture for video action recognition.

AWSLambdaFace (blog, code): serverless compute platforms such as Amazon Web Services (AWS) Lambda were intended to be used for web microservices and to handle asynchronous events generated by other Amazon web services (DynamoDB, S3, SNS, etc.). However, AWS Lambda also allows users to upload arbitrary linux binaries along with their lambda functions. In this project, I deployed a full-blown deep convolutional neural network based face recognition tool on AWS Lambda and used the system to query for faces in videos in a massively parallel way.

NoScope (blog, code): video data is exploding – the UK alone has over 4 million CCTVs, and YouTube users upload over 300 hours of video every minute. Recent advances in deep learning enable automated analysis of this growing amount of video data, allowing us to query for objects of interest, detect unusual and abnormal events, and sift through lifetimes of video that no human would ever want to watch. However, these deep learning methods are extremely computationally expensive: state-of-the-art methods (as of 2017) for object detection run at 100 frames per second on a state-of-the-art NVIDIA P100 GPU. This is tolerable for a small numbers of videos, but it is infeasible for real deployments at scale. In this project, I helped build a system that accelerates the computation of deep CNN based visual queries using ideas borrowed from the database community.

Past Research Experience

Washington University 2015 - 2016
Advisor: Jeremy Buhler

- Implemented an expectation maximization (EM) based DNA motif finding algorithm.
- Used Nvidia GPUs to accelerate the computation (CUDA, C/C++, Cub).

California Institute of Technology 2015
Advisor: Oscar Bruno

- Used numerical partial differential equation (PDE) methods from computational physics to simulate EM-fields propagating along an open dielectric waveguide with ultra high precision.
- Implemented a high order sovler for these simulations (C++, Fortran, Matlab).

Carnegie Mellon University 2014
Advisor: Onur Mutlu

- Implemented a generic, SMID-parallel DNA sequence alignment filter using Intel SSE3.
- Achieved a 3x speedup over the best previous algorithm using bit-vector approach (C, SSE3).

Drake University 2013 - 2014
Advisor: Klaus Bartschat

- Simulated ultrafast, high-intensity UV laser pulses (attosecond timescale) on hydrogen atoms.
- Parallelized simulations to run on the TACC Stampede supercomputer (Fortran, MPI, OpenMP).

University of California, Berkeley 2013
Advisor: Allison Andrews

- Implemented a massively scalable file system backup algorithm at NERSC.
- Used Hadoop to perform distributed computing in a cluster environment (Hadoop, Python).

Professional Experience

Summer research and development intern, Honeywell 2016
Advisor: Soumitri Kolavennu

- Developed voice recognition engine for detecting phrases from a grammar.
- Deployed an AWS cloud infrastructure to connect voice engine to IOT devices.
- Used IFTTT to trigger actions for commands spoken to the system (AWS, C#, .NET, MongoDB).

Teaching Experience

Teaching Assistant, Signals and Systems (ESE 351), Washington University 2015
Teaching Assistant, Parallel and Sequential Algorithms (CSE 341), Washington University 2014

Grants and Fellowships

NSF Graduate Student Research Fellowship (GRSF) 2016
Washington University Harold Brown Fellowship (full-tuition scholarship) 2014
Drake University Physics Prize (full-tuition scholarship) 2011

Awards and Honors

Washington University Ernest Weiss top senior award for computer science/engineering ($500)	2016
Washington University David Levy top senior award for electrical engineering ($500)	2016
Upsilon Pi Epsilon Executive Scholarship ($2,500)	2015
Drake Outstanding Mathematics Student	2014
Drake DUCURS Best Oral Presentation	2014
ACM Richard Tapia Scholarship ($1,000)	2013
Barry Goldwater Scholarship ($15,000)	2013
Drake STAR Award ($2,000)	2012

Professional Memberships/Affiliations

Tau Beta Pi (TBP)	2015
Eta Kappa Nu (HKN)	2015
Upsilon Pi Epsilon (UPE)	2014
Institute of Electrical and Electronics Engineers (IEEE)	2014
Association for Computing Machinery (ACM)	2013
American Physical Society (APS)	2013

Conference Activity/Participation

Very Large Data Bases (VLDB)	2017
Special Interest Group on Data Communications (SIGCOMM)	2017
ServerlessConf, Austin	2017
Networked Systems Design and Implementation (NSDI)	2017
ACM Richard Tapia Celebration of Diversity in Computing Conference	2014
Midwest Instruction and Computing Symposium (MICS)	2013
Drake University Conference on Undergraduate Research in the Sciences (DUCURS)	2014
Frontiers in Optics: 97th OSA/APS Annual Meeting	2013
Midwest Instruction and Computing Symposium (MICS)	2013
Drake University Conference on Undergraduate Research in the Sciences (DUCURS)	2013
Great Plains Regional Annual Symposium On Protein & Biomolecular NMR (GRASP)	2012

Publications

[1] D. Kang, J. Emmons, F. Abuzaid, P. Bailis, and M. Zaharia, "Optimizing Deep CNN-Based Queries over Video Streams at Scale," *Vldb*, Aug. 2017, [pdf].

[2] H. Xin, S. Nahar, R. Zhu, J. Emmons, G. Pekhimenko, C. Kingsford, C. Alkan, and O. Mutlu, "Optimal Seed Solver: Optimizing Seed Selection in Read Mapping," *Oxford bioinformatics*, Nov. 2015, [pdf].

[3] H. Xin, J. Greth, J. Emmons, G. Pekhimenko, C. Kingsford, C. Alkan, and O. Mutlu, "Shifted Hamming Distance: A Fast and Accurate SIMD-Friendly Filter for Local Alignment in Read Mapping," *Oxford bioinformatics*, Dec. 2014, [pdf].

[4] I. A. Ivanov, A. S. Kheifets, K. Bartschat, J. Emmons, S. M. Buczek, E. V. Gryzlova, and A. N. Grum-Grzhimailo, "Displacement effect in strong-field atomic ionization by an XUV pulse," *Physical review a*, Oct. 2014, [pdf].

[5] J. Venzke, P. Johnson, R. Davis, J. Emmons, K. Roth, D. Mascharka, L. Robinson, T. Urness, and A. Kilpatrick, "Accelerating Biomolecular Nuclear Magnetic Resonance Assignment with A*," Apr. 2014.

[6] J. Emmons, K. Powell, M. Andrews, and J. Hick, "Parallel Graph Reduce Algorithm for Scalable File System Structure Determination," Feb. 2014.

[7] J. Emmons, A. Howes, A. Kramer, K. Bartschat, and J. Grout, "Parallelizable Algorithms for Describing the Effects of Strong Time-Dependent Electromagnetic Fields on the Hydrogen Atom," Oct. 2013.

[8] J. Emmons, S. Johnson, T. Urness, and A. Kilpatrick, "Automated Assignment of Backbone NMR Data using Artificial Intelligence," Apr. 2013.

[9] J. Emmons and A. Kilpatrick, "Structural Studies of a Calmodulin Mutant with Defective Regulation of Muscle Contraction," Nov. 2012.