Bharathan Balaji

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Research Experience

- **Research Scientist: Amazon Artificial Intelligence Lab**   Feb 2018 – Present
  Research in machine learning, internet of things and cloud services
  Manager: Dr. Balakrishnan Narayanaswamy
- **Postdoctoral Scholar: Network and Embedded Systems Laboratory, UCLA**   Jan 2016 – Feb 2018
  Research in internet of things, smart cities and large scale ocean monitoring
  Advisor: Prof. Mani Srivastava
  - Created and hosted the 1st ACM International Workshop on the Internet of Safe Things
  - Published 2 journal papers, 2 conference papers, 4 workshop papers, 2 demos, 3 posters
  - Acted as the local chair for ACM SIGCOMM 2017
  - Mentored 5 PhD students, 12 Masters students, 4 undergrad students
  - Reviewed 9 papers for IEEE, ACM, Elsevier and MDPI journals and conferences
  - Gave guest lectures in ubiquitous computing, cyber-physical systems and introduction to programming
  - Developed an automated grading system for embedded system courses
  - Created a defense mechanism for acoustic attacks on smart speakers
  - Proposed a language to capture smartphone app notifcation requirements
  - Created a lightweight, low power sensor tag for tracking underwater animals
  - Created a web service to ingest, manage and query smart city data
- **Graduate Student: Systems, Networking and Energy Efficiency Lab, UCSD**   Apr 2010 – Jan 2016
  Research in smart buildings, sensor networks and processor variability
  Advisors: Prof. Yuvraj Agarwal and Prof. Rajesh Gupta.
  - Published 6 conference papers, 4 workshop papers, 3 demos and 1 poster
  - Reviewed 10 papers for IEEE, ACM and Elsevier conferences and journals
  - Mentored 2 PhD students, 7 Masters students and 9 undergrad students
  - Created a software thermostat interface for office buildings
  - Develop a active learning approach to normalize building metadata
  - Developed algorithms and web service for fault diagnosis in buildings
  - Created a web service system for building monitoring and control
  - Proposed HVAC energy disaggregation approaches for a building
  - Characterized the power variability in modern CPUs
  - Developed low power, wireless occupancy sensors and plug meters
  - I was the teaching assistant for Computer Architecture and Embedded Systems courses
  - Gave a guest lecture for ubiquitous computing course
- **Summer Research Intern: Ericsson Research**   Jul 2012 – Sep 2012
  Research in building energy analysis and WiFi based occupancy detection
  Mentor: Dr. Du Li.
  - Created an occupancy sensing solution for HVAC control using WiFi
  - Showcased a demo of occupancy solution at BuildSys 2012
- **Research Intern: Qualcomm Institute, UCSD**   Sep 2009 – Mar 2010
  Research in WiFi client energy efficiency
  Mentors: Dr. B.S.Manoj and Prof. Ramesh Rao.
  - Created a novel power saving scheme for WiFi clients in 802.11b
  - Published in Globecom 2010

Education

- **University of California, San Diego (UCSD)**
  Ph.D. in Computer Science and Engineering,   Jun 2011 – Jan 2016
  Thesis – Software Augmented Buildings: Exploiting Existing Infrastructure to Improve Energy Efficiency and Comfort in Commercial Buildings
  M.S. in Electrical and Computer Engineering,   Sep 2009 – Jun 2011
  Thesis – Using Occupancy to Reduce Energy Consumption of Buildings
- **Visvesvaraya National Institute of Technology (VNIT), Nagpur, India**
  B.Tech. in Electronics and Communication Engineering,   Jun 2005 – Jun 2009

Journal Papers

- **BuildingRules: A Trigger-Action Based System To Manage Complex Commercial Building**
  Alessandro A. Nacci, Vincenzo Rana, Bharathan Balaji, Paola Spoletini, Rajesh Gupta, Donatella Sciuto, Yuvraj Agarwal
  ACM Transactions on Cyber-Physical Systems, 2018
- **Brick: Metadata schema for portable smart building applications**
  Bharathan Balaji, Arka Bhattacharya, Gabriel Fierro, Jingkun Gao, Joshua Gluck, Dezhi Hong, Aslak Johansen, Jason Koh, Joern Ploennigs, Yuvraj Agarwal, Mario Berges, David Culler, Rajesh Gupta, Mikkel Baun Kjaergaard, Mani Srivastava, Kamin Whitehouse
  Applied Energy, 2018

Conference Papers

- **Brick: Towards a Unified Metadata Schema For Buildings**
  Bharathan Balaji, Arka Bhattacharya, Gabriel Fierro, Jingkun Gao, Joshua Gluck, Dezhi Hong, Aslak Johansen, Jason Koh, Joern Ploennigs, Yuvraj Agarwal, Mario Berges, David Culler, Rajesh Gupta, Mikkel Baun Kjaergaard, Mani Srivastava, Kamin Whitehouse
  ACM Conference on Embedded Systems For Energy-Efficient Built Environments (BuildSys), 2016
  Audience Choice Award, Nominated for Best Paper Award
- **Genie: A Longitudinal Study Comparing Physical and Software Thermostats in Office Buildings**
  Bharathan Balaji, Jason Koh, Nadir Weibel, Yuvraj Agarwal
  ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp), 2016
- **Zodiac: Organizing Large Deployment of Sensors to Create Reusable Applications for Buildings**
  Bharathan Balaji, Chetan Verma, Balakrishnan Narayanaswamy, Yuvraj Agarwal
  ACM Conference on Embedded Systems For Energy-Efficient Built Environments (BuildSys), 2015
  Nominated for Best Paper Award
- **Data Driven Investigation of Faults in HVAC Systems with Model, Cluster and Compare (MCC)**
  Balakrishnan Narayanaswamy, Bharathan Balaji, Rajesh Gupta, Yuvraj Agarwal
  ACM Conference on Embedded Systems for Energy-Efficient Buildings (BuildSys), 2014
- **Sentinel: An Occupancy Based HVAC Actuation System using existing WiFi Infrastructure in Commercial Buildings**
  Bharathan Balaji, Jian Xu, Rajesh Gupta, Yuvraj Agarwal
  ACM Conference on Embedded Networked Sensor Systems (SenSys), 2013
  Citations:100+
- **Duty-Cycling Buildings Aggressively: The Next Frontier in HVAC Control**
  Yuvraj Agarwal, Bharathan Balaji, Seemanta Dutta, Rajesh Gupta, Thomas Weng
  ACM Conference on Information Processing in Sensor Networks (IPSN), 2011
  Citations: 150+
- **A Novel Power Saving Strategy for Greening IEEE 802.11 based Wireless Networks**
  Bharathan Balaji, Bheemarjuna Tamma, B.S.Manoj, Ramesh Rao
  IEEE Global Telecommunications Conference (Globecom), 2010

Invited Papers

- **Models, Abstractions, and Architectures: The Missing Links in Cyber-Physical Systems**
  Bharathan Balaji, Mohammad Abdullah Al Faruque, Nikil Dutt, Rajesh Gupta, Yuvraj Agarwal
  ACM Annual Design Automation Conference (DAC), 2015

Workshop Papers

- **Enabling Edge Devices that Learn from Each Other: Cross Modal Training for Activity Recognition**
  Tianwei Xing, Sandeep Singh Sandha, Bharathan Balaji, Supriyo Chakraborty, Mani Srivastava
  ACM 1st International Workshop on Edge Systems, Analytics and Networking (EdgeSys), co-located with MobiSys, 2018
- **Did you hear that? Adversarial Examples Against Automatic Speech Recognition**
  Moustafa Alzantot, Bharathan Balaji and Mani Srivastava
  NIPS Workshop on Machine Deception, 2017

- **EchoSafe: Sonar-based Verifiable Interaction with Intelligent Digital Agents**
  Amr Alanwar, Bharathan Balaji, Yuan Tian, Shuo Yang, Mani Srivastava
  ACM International Workshop on the Internet of Safe Things (SafeThings), co-located with ACM SenSys, 2017
- **Emu: Engagement Modeling for User Studies**
  Bo-Jhang Ho, Nima Nikzad, Bharathan Balaji, Mani Srivastava
  ACM International Workshop on Smart & Ambient Notification and Attention Management (Ubittention), co-located with Ubicomp, 2017
- **ZonePAC: Zonal Power Estimation and Control via HVAC Metering and Occupant Feedback**
  Bharathan Balaji, Hidetoshi Teraoka, Rajesh Gupta, Yuvraj Agarwal
  ACM Workshop on Embedded Systems For Energy-Efficient Buildings (BuildSys), 2013
- **Accurate Characterization of Variability in Power Consumption in Modern Computing Platforms**
  Bharathan Balaji, John McCullough, Rajesh Gupta, Yuvraj Agarwal
  USENIX Conference on Power-Aware Computing and Systems (HotPower), 2012
- **Managing Plug-Loads for Demand Response within Buildings**
  Thomas Weng, Bharathan Balaji, Seemanta Dutta, Rajesh Gupta, Yuvraj Agarwal
  ACM Workshop on Embedded Sensing Systems for Energy-Efficiency in Buildings (BuildSys), 2011
  Citations: 50+
- **Occupancy-Driven Energy Management for Smart Building Automation**
  Yuvraj Agarwal, Bharathan Balaji, Rajesh Gupta, Jacob Lyles, Michael Wei, Thomas Weng
  ACM Workshop on Embedded Sensing Systems for Energy-Efficiency in Building (BuildSys), 2010
  Citations: 350+

Demo Papers

- **PrOLoc: resilient localization with private observers using partial homomorphic encryption**
  Amr Alanwar, Yasser Shoukry, Supriyo Chakraborty, Bharathan Balaji, Paul Martin, Paulo Tabuada, Mani Srivastava
  ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN), 2017
  Best Demo Award
- **Portable Queries Using the Brick Schema for Building Applications**
  Bharathan Balaji, Arka Bhattacharya, Gabriel Fierro, Jingkun Gao, Joshua Gluck, Dezhi Hong, Aslak Johansen, Jason Koh, Joern Ploennigs, Yuvraj Agarwal, Mario Berges, David Culler, Rajesh Gupta, Mikkel Baun Kjaergaard, Mani Srivastava, Kamin Whitehouse
  ACM Conference on Embedded Systems For Energy-Efficient Built Environments (BuildSys), 2016
  Best Demo Award
- **BuildingRules: A Trigger-Action Based System To Manage Complex Commercial Buildings**
  Alessandro A. Nacci, Bharathan Balaji, Paola Spoletini, Vincenzo Rana, Rajesh Gupta, Donatella Sciuto, Yuvraj Agarwal
  ACM International Joint Conference on Pervasive and Ubiquitous Computing (Ubicomp), 2015
- **BuildingSherlock: Fault Management Framework for HVAC Systems**
  Rizhen Zhang, Bharathan Balaji, Yan Zhang, Balakrishnan Narayanaswamy, Yuvraj Agarwal
  ACM Conference on Embedded Systems for Energy-Efficient Buildings (BuildSys), 2014
- **A WiFi Based Occupancy Sensing Approach to Smart Energy in Commercial Office Buildings**
  Du Li, Bharathan Balaji, Yifei Jiang, Kshitij Singh
  ACM Workshop on Embedded Sensing Systems for Energy-Efficiency in Buildings (BuildSys), 2012

Posters

- **Scrabble: Converting Unstructured Metadata into Brick for Many Buildings**
  Jason Koh, Bharathan Balaji, Dhiman Sengupta, Julian McAuley, Yuvraj Agarwal, Rajesh Gupta
  ACM Conference on Embedded Systems For Energy-Efficient Built Environments (BuildSys), 2017

- **Data Hub Architecture for City Data**
  Sandeep Singh Sandha, Jason Koh, Bharathan Balaji, Daniel Crawl, Ilkay Altintas, Rajesh Gupta, Mani Srivastava
  ACM Conference on Embedded Networked Sensor Systems (SenSys), 2017

- **AquaMote: Ultra Low Power Sensor Tag for Localization and Fine Motion Tracking**
  Eun Sun Lee, Jeya Vikranth Jeyakumar, Bharathan Balaji, Rory P Wilson, Mani Srivastava
  ACM Conference on Embedded Networked Sensor Systems (SenSys), 2017

- **Controlling Actuation in Central HVAC Systems in Buildings**
  Jason Koh, Bharathan Balaji, Rajesh Gupta, Yuvraj Agarwal
  ACM Conference on Embedded Systems For Energy-Efficient Built Environments (BuildSys), 2015
  Best Poster Award

Technical Reports

- **EmbedInsight: Automated Grading of Embedded Systems Assignments**
  Hao Li, Bo-Jhang Ho, Bharathan Balaji, Yue Xin, Paul Martin, Mani Srivastava
  arXiv:1703.04514 [cs.CY], arXiv.org, 2017
- **Modeling Actuation Constraints for IoT Applications**
  Bharathan Balaji, Brad Campbell, Amit Levy, Xiaozhou Li, Addison Mayberry, Nirupam Roy, Vasuki
  Narasimha Swamy, Longqi Yang, Victor Bahl, Ranveer Chandra, Ratul Mahajan
  arXiv:1701.01894[cs.SY], arXiv.org, 2017
- **Managing Commercial HVAC Systems: What do Building Operators Really Need?**
  Bharathan Balaji, Nadir Weibel, Yuvraj Agarwal
  arXiv:1612.06025 [cs.HC], arXiv.org, 2017
- **Quiver: Using Control Perturbations to Increase the Observability of Sensor Data in Smart Buildings**
  Jason Koh, Bharathan Balaji, Vahideh Akhlaghi, Yuvraj Agarwal, Rajesh Gupta
  arXiv:1601.07260 [cs.SY], arXiv.org, 2016
- **HVACMeter: Apportionment of HVAC Power to Thermal Zones and Air Handler Units**
  Jason Koh, Bharathan Balaji, Rajesh Gupta, Yuvraj Agarwal
  arXiv:1509.05421 [cs.SY], arXiv.org, 2015
- **BuildingSherlock: Fault Management Framework for HVAC Systems in Commercial Buildings**
  Hidetoshi Teraoka, Bharathan Balaji, Rizhen Zhang, Anthony Nwokafor, Balakrishnan Narayanaswamy,
  Yuvraj Agarwal
  CSE, UCSD, 2014
- **BuildingRules: A Trigger-Action Based System To Manage Complex Commercial Buildings**
  Alessandro Nacci, Bharathan Balaji, Paola Spoletini, Vincenzo Rana, Rajesh Gupta, Donatella Sciuto,
  Yuvraj Agarwal
  CSE, UCSD, 2014

Technical Skills

- **Programming Intermediate:** Python, C
- **Programming Basic:** Bash, Java, LATEX, MySQL, Cassandra, HTML/CSS
- **Machine Learning:** Python Scikit Learn
- **Hardware:** Circuit Design, PCB Design, PCB Assembly
- **RESTful Web Services:** Flask, Django
- **User Study:** Contextual Interviews
- **Building Energy and HVAC Management**

Teaching Experience

- Lecture on Introduction to Programming, Los Angeles Computing Circle (High School Level), UCLA   2017
- Guest Lecture, Principles of Embedded Systems (Graduate Level), UCLA   Fall 2016
- Guest Lecture, Ubiquitous Computing (Graduate Level), UCSD   Fall 2016
- Guest Lecture, Ubiquitous Computing, UCSD   Fall 2015, Fall 2016
- Teaching Assistant, Software for Embedded Systems (Graduate Level), UCSD   Spring 2013
- Teaching Assistant, Computer Architecture, UCSD   Winter 2011
- Teaching Assistant, Computer Architecture Lab, UCSD   Fall 2010

Student Advising

- *PhD Students:* Jason Koh, Francesco Fraternali, Bo-Jhang Ho, Sandeep Sandha, Amr Alanwar
- *MS Students:* Rizhen Zhang, Yan Zhang, Eugene Kolinko, Huaipeng Zhang, Charlie Chen, Xiaoxiao Zheng,
  Qi Li, Eun Sun Lee, Yue Xin, Vikranth Jeyakumar
- *Undergraduate Students:* Xueyang Li, Kevin Chavez, Andrew Yi, Macklin Lee, Danny Zhang, Watson Yim,
  Jayon Huh, Michelle Tang, Yung Nguyen, Hao Li, Yikai Wang, Corrine Farley, Justin Kuo
- Mentor for Jacobs Undergrad Mentorship Program for 2014, 2015

Service to Research Community

Organizer

- Steering Committee Member for ACM Workshop on Internet of Safe Things (SafeThings)   2018
- Technical Program Committee Member for ACM BuildSys   2018
- General Chair for ACM Workshop on the Internet of Safe Things (SafeThings)   2017
- Organizer for Brick Tutorial in ACM Conference on Systems for Energy-Efficient Built Environments   2017
- Local Arrangement Chair for SIGCOMM   2017
- Session Chair for Data Aware Energy Use Workshop as part of Mathematics for Planet Earth (MPE)   2014

Reviewer

- IEEE Transactions on Industrial Informatics   2018
- Elsevier Computer Communications   2017
- MDPI Sensors   2017
- IEEE Transactions on Industrial Informatics   2017
- IEEE Transactions on Mobile Computing   2016
- IEEE Transactions on Industrial Informatics   2016
- ACM Conference on Pervasive and Ubiquitous Computing (UbiComp)   2016
- IEEE Pervasive Computing   2016
- Elsevier Energy and Buildings   2016
- Elsevier Future Generation Computer Systems   2016
- Elsevier Energy and Buildings   2015
- IEEE Embedded Systems Letters (ESL)   2015
- IEEE/ACM Transaction on Networking   2014
- ACM Conference on Pervasive and Ubiquitous Computing (Ubicomp)   2014
- IEEE Micro   2014
- Elsevier Sustainable Computing, Informatics and Systems   2014
- IEEE Embedded System Letters   2013
- IEEE Transactions on Industrial Informatics   2013

Awards

- Best Demo Award, IPSN 2017
- Audience Choice Award, Nominated for Best Paper Award, BuildSys 2016
- Best Demo Award, BuildSys 2016
- Best Poster Award, BuildSys 2015
- Nominated for Best Paper Award, BuildSys 2015
- Most Innovative Solution for proposal on Picking up the PACE: Expanding PACE financing programs for Commercial Owned Buildings in Better Buildings Case Competition, 2014
- Highest grade (valedictorian) in my High School, 15th in the state of Maharashtra, India. Ranked in top 0.02% in all India entrance exam.

Professional Memberships

- ACM Professional Member   2016 – Present
- IEEE Professional Member   2016 – Present
- ACM Student Member   2011 – 2015
- IEEE Student Member   2012 – 2015
- UCSD Energy Club   2015
- Engineers for a Sustainable World Student Member   2012
- Association of Energy Engineers Student Member   2013

References

- Mani Srivastava, Professor, University of California, Los Angeles
- Yuvraj Agarwal, Assistant Professor, Carnegie Mellon University
- Rajesh Gupta, Professor, University of California, San Diego
- Yuan Tian, Assistant Professor, University of Virginia
- Balakrishnan Narayanaswamy, Amazon Research