

# Abu Bakar | Curriculum Vitae

✉ abubakar@gatech.edu    🌐 <http://abubakar.info/>

## Research Interests

My research focuses on exploring new hardware designs, systems, and tools to build **smart, battery-free, ubiquitous sensing devices and wearables** that reliably execute programs with constrained resources under unpredictable energy harvesting conditions that cause frequent power failures. I develop energy-aware adaptive runtime systems for efficient use of harvested energy, explore new energy harvesting techniques for powering battery-free wearables, and reimagine machine learning algorithms to perform on-device, low-latency, and low-energy inferences.

My work has appeared in ACM SenSys, ACM IMWUT, ACM ASPLOS, and ACM BuildSys, has received a **People's Choice Award**, and has been featured in Forbes, Scientific American, ACM Tech News, Daily Mail, The Independent, and many others. I was selected as a **Cyber-Physical Systems (CPS) Rising Star**.

## Education

- 2022 - Present    **Georgia Institute of Technology**  
Ph.D. in Computer Science  
Advisor: Josiah Hester  
Focus: Adaptive and Energy-aware Intermittent Computing Systems
- 2018 - 2022    **Northwestern University**  
M.S. in Computer Science  
Ph.D. in Computer Science [Transferred]  
Advisor: Josiah Hester  
Focus: Adaptive and Energy-aware Intermittent Computing Systems
- 2016    **National University of Computer and Emerging Sciences (NUCES)**  
B.S. in Electrical Engineering

## Awards and Honors

- 2022    **Cyber-Physical Systems (CPS) Rising Star**. Sponsored by National Science Foundation
- 2022    **ACM SIGMOBILE Research Highlight** for “Heuristic Adaptation” work (**GetMobile 2022**)
- 2020    **SIG Travel Award** for attending **ASPLOS 2020**
- 2018    **NSF Travel Award** for attending **ACM SenSys 2018**
- 2017    **People's Choice Award** for “Inverted HVAC” at **ACM BuildSys 2017**
- 2017    **ACM SIGMOBILE Travel Award** for attending **ACM BuildSys 2017**
- 2015    **Dean's Honor List** for outstanding academic performance at **NUCES**
- 2014    **Silver and Bronze medal** for outstanding semester performance at **NUCES**
- 2014    **Best Intern Award** for completing internship tasks and going beyond at **SysNet Lab**

# Publications

## Conference Papers

- C09 **Protean: An Energy-Efficient and Heterogeneous Platform for Adaptive and Hardware-Accelerated Battery-free Computing**  
**Abu Bakar**, Rishabh Goel, Jasper de Winkel, Jason Huang, Saad Ahmed, Bashima Islam, Przemysław Pawełczak, Kasim Sinan Yıldırım, Josiah Hester  
ACM Conference on Embedded Networked Sensor Systems (SenSys 2022) **[To Appear]**
- C08 **Adaptive Intelligence for Batteryless Sensors Using Software-Accelerated Tsetlin Machines**  
**Abu Bakar**, Tousif Rahman, Alessandro Montanari, Rishad Shafik, Fahim Kawsar  
ACM Conference on Embedded Networked Sensor Systems (SenSys 2022) **[To Appear]**
- C07 **FaceBit: Smart Face Masks Platform**  
Alexander Curtiss, Blaine Rothrock, **Abu Bakar**, Nivedita Arora, J. Huang, Zachary Englhardt, Aaron-Patrick Empedrado, Chixiang Wang, Saad Ahmed, Yang Zhang, Nabil Alshurafa, Josiah Hester  
ACM Conference on Pervasive and Ubiquitous Computing (**UbiComp'22**)  
Published in PACM IMMUT, Volume 5, Issue 4  
**Fast Company 2022 Innovation by Design Award—Finalist in the Students category**  
**Featured in Forbes, Scientific American, Gizmodo, TechCrunch, Engadget, Daily Mail and many others**
- C06 **REHASH: A Flexible, Developer Focused, Heuristic Adaptation Platform for Intermittently Powered Computing**  
**Abu Bakar**, Alexander G. Ross, Kasim Sinan Yıldırım, Josiah Hester  
ACM Conference on Pervasive and Ubiquitous Computing (**UbiComp'21**)  
Published in PACM IMMUT, Volume 5, Issue 3  
**SIGMOBILE GetMobile Research Highlight 2022**
- C05 **BFree: Enabling Battery-free Sensor Prototyping with Python**  
Vito Kortbeek, **Abu Bakar**, Stefany L. Cruz, Kasim Sinan Yıldırım, Przemysław Pawełczak, Josiah Hester  
ACM Conference on Pervasive and Ubiquitous Computing (**UbiComp'21**)  
Published in PACM IMMUT, Volume 4, Issue 4  
**Featured in TechTimes, The Independent, Make: Magazine**
- C04 **Time-sensitive Intermittent Computing Meets Legacy Software**  
Vito Kortbeek, Kasim Yildirim, **Abu Bakar**, Jacob Sorber, Josiah Hester, Przemysław Pawełczak  
ACM Conference on Architectural Support for Prog. Languages and Operating Systems (**ASPLOS'20**)
- C03 **The Betrayal of Constant Power × Time: Finding the Missing Joules of Transiently-Powered Computers**  
Saad Ahmed, **Abu Bakar**, Naveed Anwar Bhatti, M. Hamad Alizai, Junaid Haroon Siddiqui, Luca Mottola  
ACM SIGPLAN/SIGBED Conference on Languages, Compilers, and Tools for Embedded Systems (**LCTES'19**)
- C02 **Inverting HVAC for Energy Efficient Thermal Comfort in Populous Emerging Countries**  
Khadija Hafeez, Yasra Chandio, **Abu Bakar**, Ayesha Ali, Affan A. Syed, Tariq M. Jadoon, M. Hamad Alizai  
ACM Conference on Systems for Energy-Efficient Built Environments (**BuildSys'17**)  
**People's Choice Award**
- C01 **Design of a Laser Tracker Using 2-DOF Stepper Controlled Platform**  
**Abu Bakar**, Neelam Nasir, Mukhtar Ullah, Zeashan Hameed Khan  
IEEE Conference on Robotics and Artificial Intelligence (**ICRAI'16**)

## Journal Papers

- J02 **Demystifying Energy Consumption Dynamics in Transiently Powered Computers**  
Saad Ahmed, M. Nawaz **Abu Bakar**, Naveed A. Bhatti, M. Hamad Alizai, Junaid H. Siddiqui, Luca Mottola  
ACM Transactions on Embedded Computing Systems (**TECS**), Volume 19, Issue 6 October 2020

- Jo1 **Inverted HVAC: Greenifying Older Buildings, One Room at a Time**  
Samar Abbas, **Abu Bakar**, Yasra Chandio, Khadija Hafeez, Ayesha Ali, Tariq M. Jadoon, M. Hamad Alizai  
ACM Transactions on Sensor Networks (**TOSN**), Volume 14 , Issue 3-4 December 2018

## Workshop Papers

- Wo2 **Logic-based Intelligence for Batteryless Sensors**  
**Abu Bakar**, Tousif Rahman, Alessandro Montanari, Jie Lei, Rishad Shafik, Fahim Kawsar  
ACM Workshop on Mobile Computing Systems and Applications (**HotMobile'22**)
- Wo1 **Making Sense of Intermittent Energy Harvesting**  
**Abu Bakar**, Josiah Hester  
ACM Workshop on Energy Harvesting & Energy-Neutral Sensing Systems (**ENSsys'18**)

## Posters and Demo Abstracts

- Po2 **Harnessing Power from the Soil: Long-Term, Stable Power Production from Terrestrial Microbial Fuel Cells Integrated into Green Infrastructure**  
Weitao Shuai, Bill Yen, Laura Jaliff, **Abu Bakar**, Jason Huang, Alexander Curtiss, Colleen Josephson, Josiah Hester, Pat Pannuto, George Wells  
Assoc. of Environmental Engineering and Science Professors Research and Education Conference (**AEESP'22**)
- Po1 **The Energy Harvesting Mode Abstraction**  
**Abu Bakar**, Josiah Hester  
ACM Conference on Embedded Networked Sensor Systems (**SenSys'18**)

## Work Experience

- 2022 - Present **Georgia Institute of Technology**  
**Graduate Research Assistant**  
Advisor: Josiah Hester  
Developing battery-free health-sensing wearables that are powered by users' activities.
- 2018 - 2022 **Northwestern University**  
**Graduate Research Assistant**  
Advisor: Josiah Hester  
Developed new hardware designs and runtime systems for adaptive batteryless devices, and explored different energy harvesting sources (soil microbes, breathing, physical activity) for environmental and health-sensing applications.
- Fall 2021 **Nokia Bell Labs—Pervasive Computing Group**  
**Research Intern**  
Advisor: Fahim Kawsar, Alessandro Montanari  
Focus: Machine Learning, Batteryless Computing, Tsetlin Machines  
Designed logic-based machine learning algorithms (differing from arithmetic-based neural networks) for batteryless sensors, introduced new encoding techniques for compressing trained models and reducing inference latency, and developed adaptation techniques for adjusting model complexity at runtime based on available harvested energy on batteryless sensors.

- 2016 - **LUMS School of Science and Engineering—SysNet Lab**  
 2018 **Research Assistant**  
 Advisor: Muhammad Hamad Alizai  
 Focus: Intermittent computing, Embedded systems, Building systems  
 Worked on developing: an energy-efficient inverted HVAC system, a hardware platform for evaluating a runtime system designed for battery-free devices, and a mechanism for estimating dynamic energy consumption of battery-free devices at compile time.
- Summer **NUCES—SysNet Lab**  
 2014 **Undergraduate Research Intern**  
 Advisor: Affan A. Syed  
 Focus: Wireless Sensor Networks, Wireless Power Transfer  
 Worked on wirelessly powering sensor nodes using a 808nm infrared laser.

## Teaching Experience

- Spring **Teaching Assistant—CE465: Internet-of-things Sensors, Systems, and Applications**  
 2022 Northwestern University
- Spring **Teaching Assistant—CE346: Microprocessor System Design**  
 2021 Northwestern University
- Spring **Teaching Assistant—CE346: Microprocessor System Design**  
 2020 Northwestern University
- Spring **Teaching Assistant—CS365: Data Communication & Networks**  
 2017 Information Technology University
- Fall **Teaching Assistant—CS677: Internet of Things**  
 2016 LUMS School of Science and Engineering
- Fall **Teaching Assistant—CS214: Programming Fundamentals**  
 2015 National University of Computer and Emerging Sciences
- Fall **Teaching Assistant—EE112: Programming for Engineers-II**  
 2014 National University of Computer and Emerging Sciences
- Spring **Teaching Assistant—EE110: Programming for Engineers-I**  
 2014 National University of Computer and Emerging Sciences

## Professional Services and Leadership Experience

- 2022- **Paper Reviewer**  
 Present Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (**IMWUT**)  
 2 reviews per quarter
- 2022- **Group Meeting Coordinator — Northwestern University**  
 Present Weekly group meetings for Ka Moamoa Lab

- 2019- Present **Student Mentor**  
 Jason Huang (BS)  
 Alejandra Almonte (BS)  
 Julia Persche (MS)  
 Rishabh Goel (MS), PhD student at **Georgia Institute of Technology**  
 Alexander Ross (BS/MS), Electronics Engineer at **Gerresheimer**  
 Eugene Choe (BS/MS), Firmware Engineer at **Samsung Semiconductor**  
 Jackson Schuster (BS/MS), Software Engineer at **Microsoft**  
 Julian Richey (BS/MS), ASIC Design Engineer at **Amazon**
- 2019 - 2020 **Treasurer Toastmasters International — Northwestern University**  
 Managed finances for the university club including student memberships.
- 2019 **Volunteer for Graduate Student Seminars — Northwestern University**  
 Organized biweekly seminars for Computer Engineering department where students presented recent research papers in their fields.
- 2016 **President IEEE FAST Electrica — NUCES**  
 Organized 26 competitions, workshops and seminars under the umbrella of university's annual 3-day tech event. Supervised a team of 60 students who were a part of operations, logistics, sponsorship, marketing, photography and event management teams.
- 2016 **Finance Secretary of National Solution Convention (NaSCon) — NUCES**  
 Lead a team of 5 students to manage the budget and expenses of 50+ social and technical events that included talks, workshops, seminars, and robotics & coding competitions. Also served as a liaison between the university and external sponsors.
- 2015 - 2016 **Chairperson IEEE Student Branch — NUCES**  
 Managed a team of 10 people and organized competitions, workshops, and seminars for students. All activities were focused on research and technology trends in industry and academia.
- 2015 **President IEEE Robotics Club — NUCES**  
 Organized workshops and maintained a maker space to help students learn, practice, and polish their skills in robotics

## Skills

**General:** System Programming, Firmware Development, PCB Designing, Makefile, Testing/Debugging, Version Control

**Programming:** C, Embedded C, C++, Python, VHDL, Verilog, Assembly, Shell, HTML, GDB

**Hardware Architectures:** ARM Cortex, MSP430, Atmel, FPGA, AI8x Accelerators

**Lab Equipment:** Oscilloscope, Logic Analyzer, Function Generator, Digital Multi Meter, Soldering Iron

**Platforms and Tools:** Mbed, Arduino, MATLAB, Keil, Proteus, Eagle, Modelsim, Microwind, Xilinx Spartan-3

Last Updated: Sep 15, 2022