

# JAYLEN WANG

Carnegie Mellon University

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Department of Electrical and Computer Engineering

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## BRIEF BIOGRAPHY

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*My work bridges computer architecture and software systems, demonstrating the importance of that bridge in enabling sustainable data center systems via solutions that span the compute stack.*

As the demand for web services continues to grow, data centers are scaling up to meet the demand, consuming a massive amount of energy and producing significant carbon emissions. **My research focuses on addressing the growing carbon emissions, produced both by running and manufacturing hardware, of data centers by analyzing inefficiencies across computer architecture and software systems and designing solutions to make these systems more energy and carbon efficient.**

My work is one of the first to examine the environmental impact of hyperscale web systems and to provide actionable insights to reduce it. My work integrates carbon efficiency into computer system design, as it is crucial for sustainable growth and access to critical web services in both developed and developing nations. My work is a step towards curbing computing's contributions towards climate change and promoting sustainable computing practices.

My research has been recognized with the NSF Graduate Research Fellowship Program (GRFP) Award, the 2023 Benjamin Garver Lamme/Westinghouse Graduate Fellowship, a Ford Foundation 2023 Predoctoral Fellowship Competition Honorable Mention, and the Jack and Mildred Bowers Scholarship in Engineering.

## EDUCATION

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### **Ph.D., Electrical and Computer Engineering**

Advisor: Prof. Akshitha Sriraman

*NSF GRFP Fellow*

*Dissertation Title: Enabling Sustainable Web Systems*

*Carnegie Mellon University*

*Aug 2022 - Present*

### **B.Sc., Electrical Engineering**

PIs: Profs. David Brooks & Gu-Yeon Wei

Minor in Computer Science

Graduated *Summa Cum Laude* (GPA: 4.0/4.0); *Member of Phi Beta Kappa*

*Harvard University*

*Aug 2018 - May 2022*

## AWARDS AND HONORS

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### **Jack and Mildred Bowers Scholarship in Engineering**

Full tuition support for third year of PhD

*2024*

### **NSF Graduate Research Fellowship Program (GRFP) Award Winner**

Awarded \$171,000 as part of prestigious fellowship supporting exceptional graduate students in STEM

*2023*

### **Ford Foundation 2023 Predoctoral Fellowship Competition Honorable Mention**

Honorable mention given to top Ford Fellowship candidates

*2023*

### **Benjamin Garver Lamme/Westinghouse Graduate Fellowship**

Full tuition support for second year of PhD

*2023*

### **Carnegie Institute of Technology Dean's Fellow**

Awarded \$83,000 towards tuition, stipend, and travel

*2022*

### **Harvard SEAS Dean's Engineering Design Award**

Awarded \$500 for having one of the top 7 (out of 43) best Senior engineering design projects

*2022*

### **Sophia Freund Prize**

Awarded \$1000 as highest ranking undergraduate in the Electrical Engineering department

*2022*

### **Phi Beta Kappa Member**

Admitted into Harvard's chapter, one of 146 out of 1962 (7.4%) students

*2022*

**Derek Bok Center Distinction in Teaching**

2020, 2021

Awarded to most highly rated (by students) TAs; received distinction in three semesters

**John Harvard Scholar**

2020

Award given to top 5% (4.0 GPA) of students in respective class

**Harvard College Research Program Funding Recipient**

2019

Awarded \$3,500 to perform independent research during the summer


**Detur Prize Winner**

2019

Recognizes students with top academic standing in their first year at Harvard



**PEER-REVIEWED CONFERENCE AND JOURNAL PUBLICATIONS**

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- **Jaylen Wang**, Daniel S. Berger, Fiodar Kazhamiaka, Celine Irvine, Chaojie Zhang, Esha Choukse, Kali Frost, Rodrigo Fonseca, Brijesh Warriar, Chetan Bansal, Jonathan Stern, Ricardo Bianchini, and Akshitha Sriraman. *Designing Cloud Servers for Lower Carbon*. 51st International Symposium on Computer Architecture (**ISCA 2024**). June 2024. 


**PEER-REVIEWED WORKSHOP PUBLICATIONS**


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- **Jaylen Wang**, Melissa Pan, Udit Gupta, and Akshitha Sriraman. *Giving Old Servers New Life at Hyper-scale*. 6th Young Architect Workshop (**YArch 2024**) held in conjunction with **ASPLOS**. June 2024.
- **Jaylen Wang**, Udit Gupta, and Akshitha Sriraman. *Peeling Back the Carbon Curtain: Carbon Optimization Challenges in Cloud Computing*. 2nd Workshop on Sustainable Computer Systems (**HotCarbon 2023**). July 2023.  

*Performs the first ever characterization of server generations for microservice-based web services to enable hardware lifetime extension*


- Jialun Lyu, **Jaylen Wang**, Kali Frost, Chaojie Zhang, Celine Irvine, Esha Choukse, Rodrigo Fonseca, Ricardo Bianchini, Fiodar Kazhamiaka, and Daniel S. Berger. *Myths and Misconceptions Around Reducing Embedded Carbon for Cloud Platforms*. 2nd Workshop on Sustainable Computer Systems (**HotCarbon 2023**). July 2023.  

- **Jaylen Wang**, Udit Gupta, and Akshitha Sriraman. *Giving Old Servers New Life at Hyperscale*. 1st Workshop on Hot Topics in System Infrastructure (**HotInfra 2023**) held in conjunction with **ISCA**. June 2023. 

- **Jaylen Wang**, Udit Gupta, and Akshitha Sriraman. *Characterizing Datacenter Server Generations for Lifetime Extension and Carbon Reduction*. 1st Workshop on NetZero Carbon Computing (**NetZero 2023**) held in conjunction with **HPCA**. Feb 2023. 

- Sahana Rangarajan, **Jaylen Wang**, Sara Mahdizadeh Shahri, Pratyush Patel, and Akshitha Sriraman. *Designing Equitable Data Center Scheduling Systems*. Career Workshop for Inclusion and Diversity in Computer Architecture (**CWIDCA 2022**) held in conjunction with **MICRO**. Oct 2022. 

*Introduces equity as a first-order design metric in modern data center scheduling systems*

- **Jaylen Wang**, Abdulrahman Mahmoud, Gu-Yeon Wei, and David Brooks. *A Dataflow-Aware Fault Resilience Analysis Framework for Deep Neural Network Accelerators*. 4th Young Architect Workshop (**YArch 2021**) held in conjunction with **ASPLOS**. March 2022. 

*Introduces a new framework and tool to quickly and accurately assess the reliability of deep neural network accelerator designs to random bit flips, providing insights for resilient accelerator design*

**INVITED SEMINAR TALKS**

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**Designing Cloud Servers for Lower Carbon**

 *Intel Labs*, Host: Dr. Shankar Balachandran Oct 2024


 *Princeton University (CS)*, Host: Prof. Margaret Martonosi Oct 2024

 *Rutgers University (CS)*, Host: Prof. Santosh Nagarakatte Oct 2024

 *Google SystemsResearch@Google (SRG) Group*, Host: Dr. David Culler Sep 2024

	ISCA, Buenos Aires	Jun 2024
	University of California San Diego (CSE), Host: Prof. Jishen Zhao	Apr 2024
	University of California Riverside (ECE), Host: Prof. Shaolei Ren	Apr 2024
	University of Southern California (ECE), Host: Prof. Murali Annavaram	Apr 2024

## SELECTED PRESS



- *TechXplore* “New methodology enables design of cloud servers for lower carbon”  Oct 2024
- *Carnegie Mellon University News* “Designing Cloud Servers for Lower Carbon Emissions”  Oct 2024

## AWARDED GRANT PROPOSALS COLLABORATED ON


- *AWS Cloud Credit for Research*, “Carbon-Aware Scheduling to Reduce Hyperscale Carbon Emissions”, Award: \$76,000, Award period: 2024-25

## PROFESSIONAL SERVICE/IMPACT

### Co-organizer/founder of workshop or panel

- *Workshop Co-Founder* for 1st Workshop on Hot Topics in Ethical Computer Systems (**HotEthics 2024**) held in conjunction with ASPLOS  Apr 2024
- *Panel Co-Organizer* for Panel on Sustainable Systems at The 19th Workshop on Hot Topics in Operating Systems (**HotOS 2023**)  Feb 2023

### Invited contributor, speaker, or panelist

- *Graduate Student Panelist* for Undergrad Architecture Mentoring Workshop (**uArch**) held in conjunction with ISCA Jun 2024
- *Co-Author* in ACM SIGARCH Computer Architecture Today blog article *Reducing Embodied Carbon is Important* (**ACM SIGARCH 2023**)  Aug 2023

### Artifact evaluation committee member

- Architectural Support for Programming Languages and Operating Systems (**ASPLOS 2024**) Oct 2023
- International Symposium on Microarchitecture (**MICRO 2024**) Sep 2024

## PROFESSIONAL EXPERIENCE

**IBM Research Intern**, IBM Research, Yorktown Heights, NY May 2024 - August 2024  
Mentor: Asser Tantawi

*Developing new frameworks and strategies for more sustainable cross-cluster batch job scheduling.*

**Azure Systems Research Intern**, Microsoft Research, Redmond, WA May 2023 - August 2023  
Mentor: Fiodar Kazhamiaka

*Developing a framework based on an understanding of server design’s data center-scale impact to improve Azure’s resource and carbon efficiency.*

**Graduate Research Assistant**, Carnegie Mellon University Aug 2022 - Present  
Advisor: Prof. Akshitha Sriraman

*Introducing sustainability as a first-order hardware/software system design metric for hyperscale systems and redesigning data center systems to promote hardware reuse*

**Undergraduate Research Assistant**, Harvard University March 2021 - Aug 2022  
Lab: Harvard Architecture, Circuits, and Compilers Group  
Advisors: Dr. Abdulrahman Mahmoud, Profs. Gu-Yeon Wei and David Brooks

*Developing a hardware-aware framework for analyzing the resilience of deep neural network accelerators to soft errors, considering the reuse of values in an accelerator's dataflow propagation*

**Engineering Development Group Intern**, MathWorks

May 2021 - Aug 2021

Team: Deep Learning HDL Toolbox

Supervisors: Wang Chen, Siyuan Xu

*Enabling efficient mapping of non-square convolution kernels onto square processing-element arrays, allowing users to deploy models using non-square kernels onto FPGAs*

**Undergraduate Research Assistant**, Harvard University

May 2020 - Aug 2020

Lab: Harvard Edge Computing Lab

Advisor: Prof. Vijay Janapa Reddi

*Analyzing how using SLAM for localization affects efficiency and power usage within autonomous drone applications by integrating SLAM algorithms into an open-sourced drone benchmarking framework*

**Undergraduate Research Assistant**, Harvard University

May 2019 - Aug 2019

Lab: Hoffman Physics Lab

Advisor: Prof. Jenny Hoffman

*Developing a tensioning system for an XY-walker system to extend the range of a scanning tunneling microscope used to research the proximity effect of superconductivity*

## TEACHING EXPERIENCE

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### Invited guest lecture on sustainable computing

- *Computer Systems & the Hardware-Software Interface (18-344)*; Profs. Akshitha Sriraman & Brandon Lucia Fall 2024

### Undergraduate teaching assistant, Harvard University

- *Systems Programming and Machine Organization (CS 61)*; Prof. Eddie Kohler Fall 2020, 2021
- *Circuits, Devices, and Transduction (ES 152)*; Profs. Gage Hills & Woodward Yang Fall 2021
- *Systems and Control (ES 150)*; Profs. Li Na & Yue Lu Fall 2021
- *Introduction to Electrical Engineering (ES 50)*; Profs. Chris Lombardo & Marko Loncar Spring 2021
- *Integration, Series and Differential Equations (MATH 1B)*; Dr. Hakim Walker Fall 2019

## LEADERSHIP & VOLUNTEERING

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- CMU Institute of Technology K-12 Outreach, STEM Volunteer 2023-Present
- President of Harvard Club Tennis 2019-2022
- President of Harvard College Engineering Society 2020-2021
- Co-President of Harvard Engineering Peer Concentration Advisors 2020-2021

## TECHNICAL SKILLS

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<b>Programming Languages</b>	C/C++, Python, Shell, Verilog, x86 Assembly
<b>System Skills</b>	Low-level Systems Programming, Performance Characterization, Scripting, Docker
<b>Tools and Frameworks</b>	Pin, gem5, Linux perf, Intel PMU tools, PyTorch, Catapult HLS, Git

## REFERENCES

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1. Prof. Akshitha Sriraman (akshitha@cmu.edu)  
Assistant Professor, Carnegie Mellon University
2. Daniel S. Berger (daberg@microsoft.com)  
Researcher in Azure Systems Research Group, Microsoft

3. Fiodar Kazhamiaka (fkazhamiaka@microsoft.com)  
Researcher in Azure Systems Research Group, Microsoft
4. Prof. David Brooks (dbrooks@g.harvard.edu)  
Haley Family Professor of Computer Science, Harvard University
5. Prof. Udit Gupta (ugupta@cornell.edu)  
Assistant Professor, Cornell University