Joe Breda

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My research focuses on **human-centric sensing** and **applied artificial intelligence** to enhance **health**, **sustainability**, and **societal well-being**. I develop AI-driven systems that leverage ubiquitous technologies—such as **wearable sensors**, **AI agents**, and **environmental smart devices**—for real-world applications in health monitoring, context-awareness, and sustainability. My work bridges fundamental AI and systems research with translational science, advancing commodity and ubiquitous technology for societal impact.

Education

2019 - 2025 Ph.D.	**University of Washington** Paul G. Allen School of Computer Science & Engineering Advisor: *Shwetak Patel*	
2015 - 2019 B.S.	**University of Massachusetts Amherst** Electrical & Computer Engineering Advisor: Jay Taneja	

Current Academic Research Projects

Flu Prediction with Smartwatch Biomarkers in Challenge Study   *Preparing for Nature*

- Running 35 person flu challenge study at the NIH where Fitbit users are infected with the flu and continuously monitored for digital health biomarkers as the disease progresses.
- Analyzing digital health biomarkers relative to PCR tests, symptoms, cytokines, and immune receptors using both statistical analysis and AI models for passive early detection.
- Follow-up proposal to continue flu study awarded $150,000 through Samsung GRO Grant [A8].

LLM DDx   *Working Paper*

- Developing agent based workflow to and benchmark dataset for conducting accurate differential diagnosis across case studies of varying complexity.

Operator: Cross-Device AI Agent for Adaptive Smart Environments   *Working Paper*

- Developing an AI agent architecture to automatically manage smart home devices based on environmental sensors which iteratively learns new policies through reinforcement learning on both explicit and implicit human feedback.

PolicyLiaison: AI Agent for Capturing Public Comment on Urban Subreddits   *Working Paper*

- Developing LLM agents for extracting and analyze public sentiment towards local policy and urban design from 20 years of urban subreddits data (i.e., r/Seattle, r/NYC, etc.) as a supplement to existing public comment sessions.

Passively Crowd Sensing Bicycle Safety with Custom Smart Handlebars   *Accepted to CHI'25*

- Developed and deployed 15 smart bicycle handlebars which measure the proximity of passing cars and modeled safety across the road network from the crowd sensed geospatial data.
- Recently accepted for publication at CHI 2025 [P14] and patent submitted [PT1].

Industry Experience

Google Student Researcher Seattle, WA   May 2021-Oct.2022
- Developed computer vision model and modular data generation pipeline to predict road safety from satellite images using Tensorflow, C++, and Google EarthEngine.

- Lead to Google Gift Grant [A5].

Google Student Researcher Seattle, WA   May 2020 – Sept. 2020
- Developed MapReduce pipeline for generating synthetic population datasets for urban simulation used for modeling traffic and disease monitoring.

Publications

P14   ProxiCycle: Passively Mapping Cyclist Safety Using Smart Handlebars for Near-Miss Detection
      Joseph Breda, Keyu Chen, Thomas Ploetz, Shwetak Patel
      CHI 2025

P13   NightLight: Passively Mapping Nighttime Sidewalk Light Data for Improved Pedestrian Routing
      Joseph Breda*, Daniel Campos Zamora*, Shwetak Patel, Jon Froehlich
      CHI 2025

P12   Exploring and Characterizing Large Language Models for Embedded System Development and Debugging
      Zachary Englhardt, Richard Li, Dilini Nissanka, Zhihan Zhang, Girish Narayanswamy, **Joseph Breda**, Xin Liu, Shwetak Patel, Vikram Iyer
      CHI Late Breaking Work 2024

P11   'I will just have to keep driving': A Mixed-methods Investigation of Lack of Agency within the Thai Motorcycle Rideshare Driver Community
      *Nussara Tieanklin, ***Joseph Breda**, Tim Althoff, Kurtis Heimerl
      CSCW 2024

P10   Thermal Earring: Low-power Wireless Earring for Longitudinal Earlobe Temperature
      Qiuyue Shirley Xue, Yujia Liu, **Joseph Breda**, Mastafa Springston, Vikram Iyer, Shwetak Patel
      IMWUT 2024

P9   Understanding People's Concerns and Attitudes Toward Smart Cities
      Pardis Emami-Naeini, **Joseph Breda**, Wei Dai, Tadayoshi Kohno, Kim Laine, Shwetak Patel, Franziska Roesner
      CHI 2024

P8   Feverphone: Accessible Core-Body Temperature Sensing for Fever Monitoring Using Commodity Smartphones
      Joseph Breda, Mastafa Springston, Alex Mariakakis, Shwetak Patel
      IMWUT 2023 **Won Distinguished Paper Award**

P7   SpiroMask: Measuring Lung Function Using Consumer-Grade Masks
      Rishiraj Adhikary, Dhruvi Lodhavia, Chris Francis, Rohit Patil, Tanmay Srivastava, Prerna Khanna, Nipun Batra, **Joseph Breda**, Jacob Peplinski, Shwetak Patel
      ACM Transactions on Computing for Health 2023

P6   Passively Sensing SARS-CoV-2 RNA in Public Transit Buses
      Jason Hoffman, Matthew Hirano, Nuttada Panpradist, **Joseph Breda**, Parker Ruth, Yuanyi Xu, Jonathan Lester, Bichlien H. Nguyen, Luis Ceze, Shwetak Patel
      Science of the Total Environment 2022

P5   Phone-based Ambient Temperature Sensing Using Opportunistic Crowdsensing and Machine Learning
      Amee Trivedi, Phuthipong Bovornkeeratiroj, **Joseph Breda**, Prashant Shenoy, Jay Taneja
      Sustainable Computing 2021

P4   Hanging Gardens of Babylon: Reframing Urban Agriculture as an Opportunity for Social Engagement
Joseph Breda, Esther Jang, Kurtis Heimerl, Shwetak Patel
Self-Sustainable CHI 2020

P3   Hot or Not: Leveraging Mobile Devices for Ubiquitous Temperature Sensing.
Joseph Breda, Amee Trivedi, Chulabhaya Wijesundara, Phuthipong Bovornkeeratiroj, David Irwin, Prashant Shenoy, Jay Taneja
BuildSys 2019

P2   Staring at the Sun: A Physical Black-box Solar Performance Model
Dong Chen, **Joseph Breda**, David Irwin
BuildSys 2018

P1   Fancy That: Measuring Electricity Grid Voltage Using a Phone and a Fan.
Joseph Breda and Jay Taneja
COMPASS 2018

Patents

PT2   **NightLight: Passively Mapping Night-time Sidewalk Light Data for Improved Pedestrian Routing**   Filed March 31, 2025
Patent derived from [P13].

PT1   **SMART HANDLEBAR CAP FOR SENSING BICYCLE SAFETY**   filed May 24, 2024
Patent derived from [P14].

Organizing Experience

O2   **Founded and President of the Allen School Graduate Entrepreneurship Club**   2024-Present
Organizing quarterly panels and event connecting academic start up founders with current PhD students interested entrepreneurship.

O1   **Founding member of CS4Env cross-department collaborative initiative.**   2022-2023
Assisted with early organize and developed website during first year launch.

Teaching Experience

T4   **Instructor for Mobile Applications for Sensing and Control**   Spring 2025
Developed course curriculum, taught lectures, and lead project based professional masters course.

T3   **Embedded Systems Capstone Teaching Assistant**   Winter 2024
See [TA2].

T2   **Embedded Systems Capstone Teaching Assistant**   Spring 2024
Mentored teams of students on end-to-end capstone projects and lead lectures on embedded ML and Android BLE.

T1	**Embedded Systems Teaching Assistant**	Fall 2023

Tutored embedded systems during office hours and graded assignments

Academic Service

A7	**UW CSE PhD Area Chair**	2025

Triaged over 30 PhD Applications and served as area chair in support of Ubicomp and HCI faculty decisions on PhD Admissions

A6	**Paper Reviewer**	2025

Reviewed for ACM IMWUT, ACM CHI, & ACM COMPASS

A5	**Paper Reviewer**	2024

Reviewed for ACM IMWUT & ACM CHI

A4	**High school Intern Outreach and Mentor**	2024

Interviewed and mentored 1 teams of 5 high school summer lab interns who built a cognitive testing game.

A3	**Paper Reviewer**	2023

Reviewed for ACM CSCW

A2	**High school Intern Outreach and Mentor**	2023

Interviewed and mentored 2 teams of 4 high school summer lab interns who built a zoom-call AI summarization platform.

A1	**UW CSE PhD Admission Reader**	2022

Triaged over 60 PhD Applications

Awards

A8	**Samsung Global Research Outreach (GRO) Grant**	November 2024

Primary author on **$150,000** grant proposal extending my prior work collaborating with the NIH for flu monitoring and early detection.

A7	**Distinguished Paper Award at Ubicomp 2024**	October 2024

For work on my first author paper [P8].

A6	**Computing for the Environment Initiative Grant**	June 2022

Primary author on 2 project proposals totaling **$100,000** of funding ($50,000 each) for developing computer systems for sustainability.

A5	**Google Gift Grant**	October 2021

Primary author of **$60,000** grant to study human mobility patterns.

A4	**Weil Family Endowed Fellowship in Computer Science & Engineering**	September 2019

Selected for award upon PhD admission.

A3	**Graduated from Commonwealth Honors College**	May 2019

For completing honors undergraduate thesis, later published as [P3].

A2	**Graduated Magna Cum Laude**	May 2019

Top 10% of graduating class within the ECE department.

A1 **Commonwealth Honors College: Honors Research Grant** December 2018
Awarded research funding for proposed honors thesis.

Skills ——————————————————————————————

Technical & Research Skills: Empirical Study, Signal Processing, Artificial Intelligence Training & Evaluation, Fine-Tuning Large Models, Deployment & User Study, Embedded Systems Prototyping, Applied Large Language Models, Computer Vision, Prompt Tuning, Audio Processing, 3D modeling, Grant Writing, Statistical Analysis, Survey Methods, Crowdsourcing, Semi-Structured Interviews.