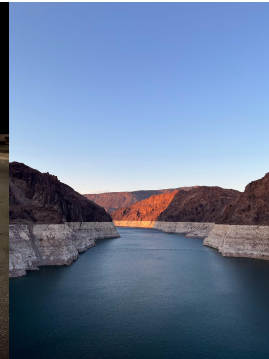
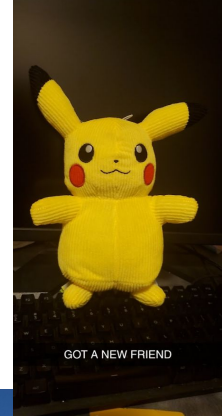
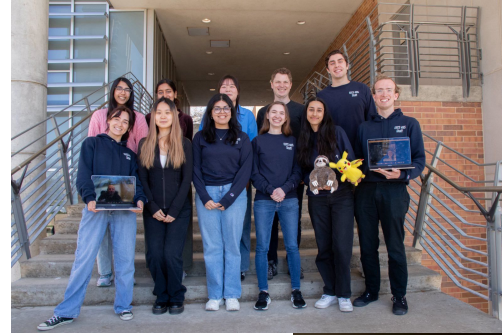


Self Driving Cars, Working in Japan, and SWE!

Henry Beckstein

About Me

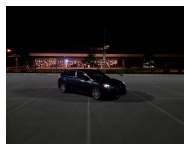
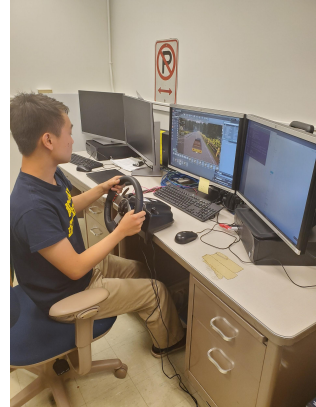
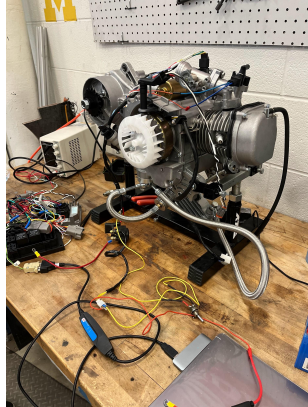
- Just graduated w/ C.S. Degree
 - German and Asian Language Minor
- Columbus, IN 📍
- Moving to Japan in January ✈️🌍
- Freetime?
 - Repairing cars, hiking, road trips, hanging out with friends
- Pikachu Enthusiast 😊😊



About Me (But like professionally)

- 2019: Research Assistant at University of Michigan
 - [Importing real-life roads into an open source driving sim](#)
- 2021: Subaru MDP
 - Building a tool to benchmark competitor cars
- 2022: EECS 481 IA (*hi!*)
 - Every semester except Fall 2023
- 2023: EECS 485 IA (🕸️💻🖨️🖱️💿💿)
 - Fall and Winter
- 2024: Subaru of Japan Research Engineer
 - Developing AI @ [Subaru's Tokyo Satellite office.](#)

- I've also built full-size airplanes(really!) and worked retail



About me (along the way...)

5 Years to graduate....

Almost failed: Math 216 🦴, EECS 376 😞

Switched Majors: MEng ➔ C.S.

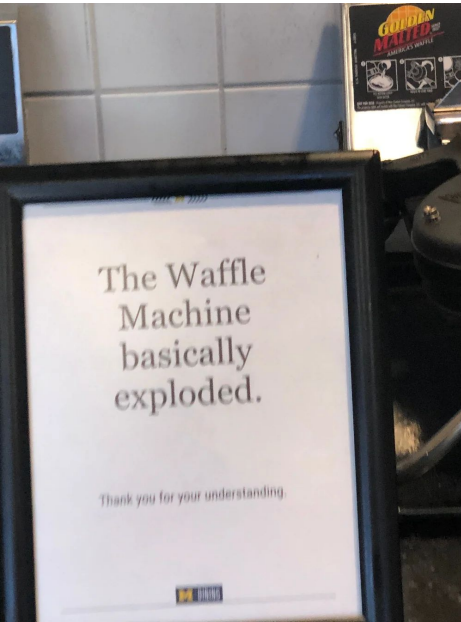
Lost father to cancer in W23

Fulbright Rejection (W24) 🎓🎓🎓

Bricked a car 🦴🦴🦴🦴



Automotive Software Development



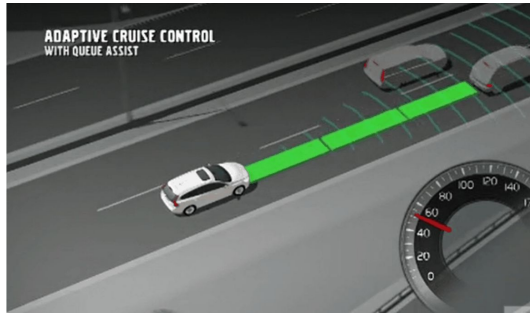
A little bit of background...

- 'Self Driving' Cars aren't exactly new...
 - ~1995: Highway capable prototype cars
 - ~2006: Automatic Emergency Braking in a production car
 - ~2008: Lane Keep Assist System
- But now they are in almost every car
 - Low cost to implement
 - Actually reduce ownership costs (Insurance)
 - Required by government regulations



ADAS (Advanced Driver Assistance)

Adaptive Cruise Control



Car slows down
or speeds up with traffic

Steering Assist



Car steers in the lane

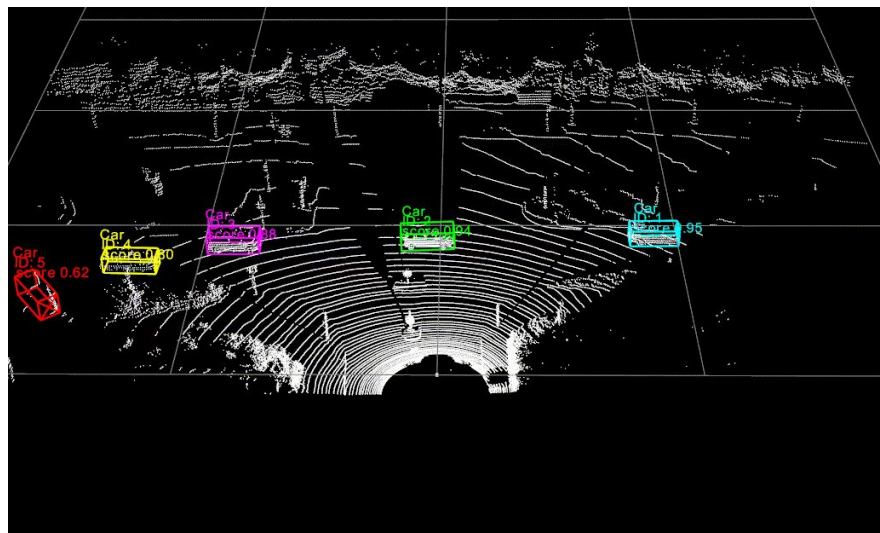
Hardware for Self Driving

- Cameras
 - Generally, very low spec
- Radar
- GPS
- Concept Sensors
 - LiDAR
 - Surround view radar



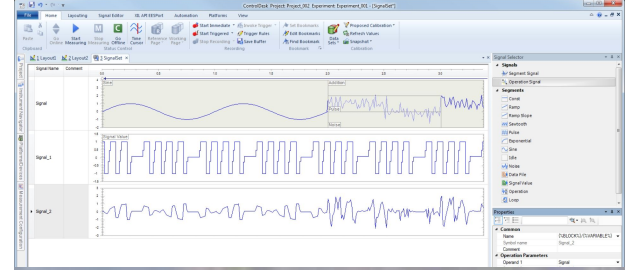
Black and White Cameras until 2013!

LiDAR is great but really expensive



SWE in Automotive

- EVERYTHING IS TESTING
 - ~75% of Software Cost is maintenance and testing 🛠️🔨🔪
- Test for functional correctness
 - Does the car try to kill the driver? 🔪🔪
 - If there is a software fault, does it fail gracefully?
- Test for customer feeling 😊
 - Does the software 'feel good' to the driver? 😄😄😄
 - Is the driver able to understand what the car does?



How do we test?

- Driving!
 - Target routes (specific curves)
 - Duration Testing (coast to coast drives)
 - Scenario Testing (Government Regulation)
- Software Analysis
 - HILS testing (Simulate hardware inputs)
 - Automatic Software Analysis (Static or Dynamic)
- Case Studies
 - Investigate performance of competitor vehicles
 - FARS: Fatal Accident Recording System



**No one:
Bursley Baits bus drivers at 2am:**



Driving!

- Test routes focus on specific areas to tune performance
 - Test and tune at every speed (how hard does the car turn, etc)
 - These tests have the most influence over customer feel
- Duration Testing
 - Test in extreme conditions (Death Valley) to find the breaking point
 - Evaluate in real life conditions
- Most companies use professional drivers to gather data
 - Some companies (Tesla and others) gather customer data as well.
 - Conventional companies can't do this (why?)



Reporting Safety Defects

Contacting Tesla

For detailed information about your Model Y, go to <http://www.tesla.com> and log on to your Tesla account or sign up to get an account.

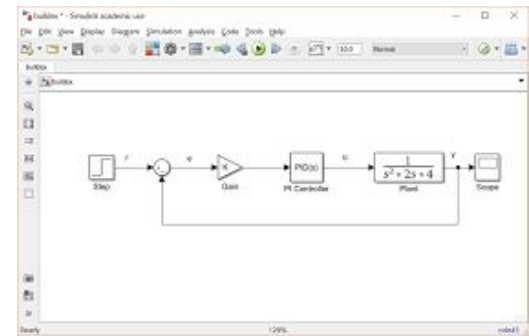
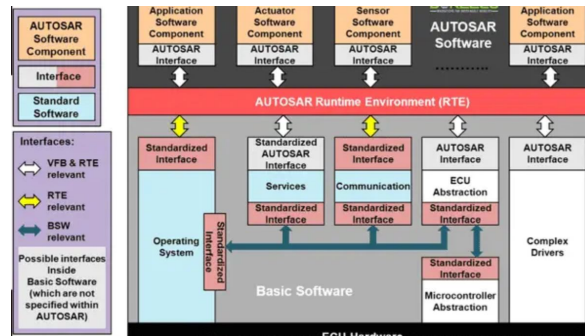
If you have any questions or concerns about your Model Y, in the United States, Canada or Puerto Rico, call 1-877-79TESLA (1-877-798-3752) and in Mexico, call 1-800-228-8145.

Note

You can also use voice commands to provide feedback to Tesla. Say "Report!", "Feedback", or "Bug report" followed by brief comments. Model Y takes a snapshot of its systems, including your current location, vehicle diagnostic data, and screen captures of the touchscreen. Tesla periodically reviews these notes and uses them to continue improving Model Y.

Software Analysis

- HILS Testing is used for basic function testing
 - Bench test hardware (Power Steering, Control Module)
 - Test if supplier hardware meets specs
- Software Analysis tests for safety critical flaws
 - AUTOSAR Specification - Avoids memory leaks, etc
- Both methods fail to effectively test safety
 - HILS testing is too low level and test the entire vehicle
 - Software Analysis can test for memory leaks, but it can't verify if the program is correct



Case Studies (Sometimes it's best to research what's out there...)

- Identify areas of poor performance by researching fatal crashes
 - Nighttime fatalities are an industry-wide issue (FMVSS 127)
- Benchmark Competitor Systems
 - Test for driving feel and comfort
- Gather Industry and Academic Research
 - [2015: Jeep/Dodge Remote Control Exploit](#)
 - Research Conferences at Michigan, etc.



HYUNDAI

United States Department of Transportation

Search

REPORT A PROBLEM

NHTSA

Ratings Recalls Risky Driving Road Safety Equipment Technology & Innovation MORE INFO

RESEARCH & DATA

Fatality Analysis Reporting System (FARS)

Share: [f](#) [t](#) [in](#) [e](#)

Detailing the Factors Behind Traffic Fatalities on our Roads

FARS is a nationwide census providing NHTSA, Congress and the American public yearly data regarding fatal injuries suffered in motor vehicle traffic crashes.

How to Access FARS Data

Create your own fatality data run online by using the FARS Query System. Or download all FARS data from 1975 to present from the FTP Site.

RESEARCH

Speeding Data
Visualization Prototype:
Traffic Fatalities in
Crashes Involving
Speed, 2016

[VIEW THE VISUALIZATION](#)

- [Run a Query Using the FARS Web-Based Encyclopedia](#)
- [2010 FARS/NASS GES Standardization – Posted 12/8/2011](#)
- [FARS and GES Auxiliary Datasets Q & A – Posted 9/9/2010](#) These files will complement

Cross Language Projects (literally!)

Working in an almost entirely Japanese team



Car Manufacturers do most development in their home land

- Satellite offices help with certification and testing
 - But engineering decisions are made at home
 - Sometimes homeland features take years to make it abroad
- Automakers are moving some development to target markets
 - Speeds up development
 - (Sometimes?) lower cost
- Satellite offices are often staffed by expats who support engineering



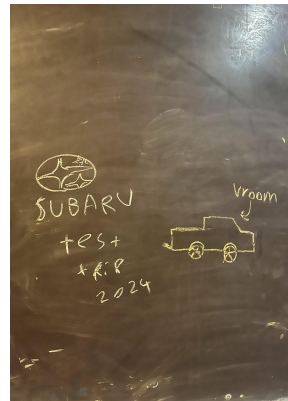
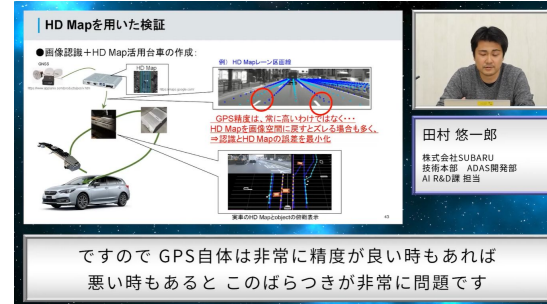
First Experience at Subaru

- When I joined Subaru, ~80% of our office was Japanese expats
 - We spent a lot of time just typing into Google Translate to explain ideas
- Most of the job was software maintenance
 - 'Fix this broken code from ~20 years ago and make it work'
- Sometimes, writing software to support research
 - 'Write code to scrape car reviews off this website'
 - 'Design software to analyze this GPS trace'
- People were really amazed at my (mid) software skills



Current Job experience at Subaru

- Run my own research projects
 - Lead a team of interns to take a far future research idea from concept to reality
- Design and Test improvements for Subaru's next generation AI
- Develop high definition map software for next generation Subarus
- Streamline production vehicle development 🚗🚚🚙🚗
 - Write my own apt repository to install development code onto test vehicles 🗄️🗄️
- Diagnose and repair broken embedded stuff ⚡⚡
 - Hand solder circuits and wiring harnesses 🤖🤖



Impressions about Japanese Software

- In Japan, many developers aren't formally trained in C.S.
 - This makes developing large scale software really hard.
 - C.S. isn't paid any more then regular engineering,
 - There's little financial incentive to elect this major
- Japan's C.S. Education is really poor
 - Cutting edge there is what was cutting edge ~10 years ago.
 - A lot of the websites have security vulnerabilities.
- Japan's Legal and Cultural Structure is really archaic
 - Ethical Hackers are often prosecuted
 - Unwilling to change ANYTHING



Impressions about Japanese Corporate life

- Almost everyone works for the same company their whole life
 - It's very hard to get hired mid-career
- You aren't incentivised to take risks
 - There's no reward for doing so, and it's socially unpopular
- Everyone must agree on the right way forward
 - Achieving consensus takes so long that opportunities are wasted.
- So many arbitrary decisions
 - **“We've already done it this way, so...”**
 - **“It's too risky to try it another way...”**
 - **“It will put too much pressure on HR”**
 - **“We need think about it...”**
- Story Time!



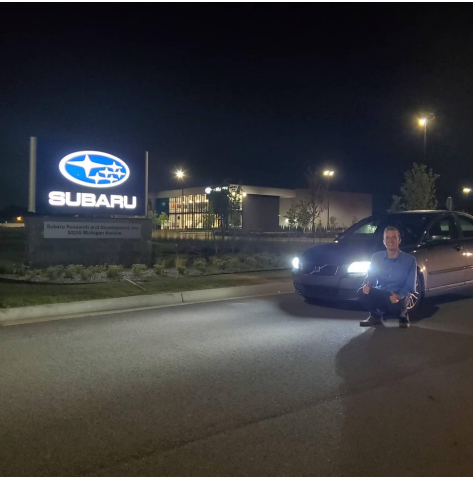
Big Snack

@candyflippin

more like zero-tonin am I right lol

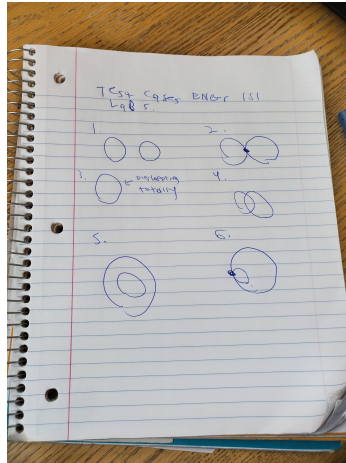
That's not to say it's all bad...

- There's a lot of economic stability for workers. Mass Layoffs are unheard of
- Slow decision making leads to generally better products
 - But these products don't incorporate the latest technology or match the market
- People are really nice. Everyone wants to make a better product
 - People really do want to help, everyone is just unsure of the big picture.



Working on projects in different languages

- Pictures are the best way to explain ANYTHING
 - Paint drawings and a few sentences are really great.
- We spend a lot of time double checking messages
 - There's a lot that gets lost in translation on both sides
- Comments and Documentation in Japanese
 - Occasionally we add english notes and do translations



Classes at UM

Which ones are the most useful?



EECS 481: Software Engineering

- I don't know if there's ever been a time I've explicitly used 481 concepts, but I explain a lot of the concepts to people new to SWE
 - “Why don't we use mocking to test this.....”
 - “This design would be super hard to maintain...”
- 481 builds a lot of ‘Soft Skills’ that are really useful.
 - Michigan (and most schools) are really weak about teaching this.
 - Super useful on the job, and a nice flex to have 🤓🤓🤓
- 481 is great at teaching how corporations actually work
 - It's not about writing the fastest code or the most lines.
 - It's all about talking to people and making decisions with little info..



EECS 485, Web Development

- Even cars run on the web!!!
 - Automotive ethernet runs inside of the car
 - Remote start/unlock/updates all runs over the web
- P4: Distributed Systems is really useful
 - A car is literally a distributed system of computers
- This course develops great GIT skills 🥰



Other Advice

- Join a club!
 - The smaller clubs often have a lot of freedom
- Should I do MDP?
 - MDP is great because it oftentimes leads to a guaranteed job/internship offer
 - MDP is really painful because there's a lot of arbitrary paperwork
- Take classes that actually interest you
 - There's something to be said for just exploring, especially if you don't think it leads to a career

The screenshot shows a Stack Overflow question page. At the top, the title is "cash" and the question text is "dr paoletti mentions cash a lot in lecture, what does that mean?". Below the question, there is a "lecture" tag. The question has 6 "good question" votes. The answer section shows "the students' answer" with a green "S" icon, containing the text "Basically its when you have my kind of money, and people will say things like 'wow.. look at him, he has a lot of cash'". Below this, it says "(instructor's answer is also correct)". The answer is endorsed by an instructor, indicated by a green bar with the text "- An instructor () endorsed this answer -". The answer has 9 "thank!" votes. Below the answer, there is an "instructors' answer" section with an orange "i" icon, containing the text "Do you mean cache? The cache is something that holds recently used data inside the processor rather than in main memory to access them more quickly".

Thank You!

Questions??

HenryBe@umich.edu

<https://www.linkedin.com/in/henry-beckstein/>