Introduction

17-313 Spring 2024

Foundations of Software Engineering

https://cmu-313.github.io

Michael Hilton and Eduardo Feo Flushing

Introductions

Michael Hilton

Associate Teaching Professor at CMU

- A.S. Grossmont Community College 1999
- B.S. San Diego State University - 2002
- Software Engineer at DoD - 2002 to 2011
- M.S. Cal Poly San Luis Obispo - 2013
- PhD at Oregon State - 2017
- Internship at Microsoft Research - Summer 2017
- Assistant/Associate Teaching Professor at CMU - Fall 2017 to current

Eduardo Feo Flushing

B.Sc. In Computer Eng., Universidad Simon Bolivar, Venezuela - 2007

M.Sc. in Informatics, University of Trento, Italy - 2010

M.Sc. in Software Systems Engineering, RWTH-Aachen, Germany- 2010

Ph.D. in Informatics, University of Lugano - IDSIA, Switzerland - 2017

Postdoc, CMU Qatar - Fall 2018

Visiting Assistant Teaching Professor, CMU Qatar – Fall 2021

Assistant Teaching Professor, CMU Qatar – Fall 2023

Teaching Assistants

Sophia Witt

Alexis Axon

Eyob Dagnachew

Grace Xin

Laura Marinov

Jesse Ding

Jenny Liang

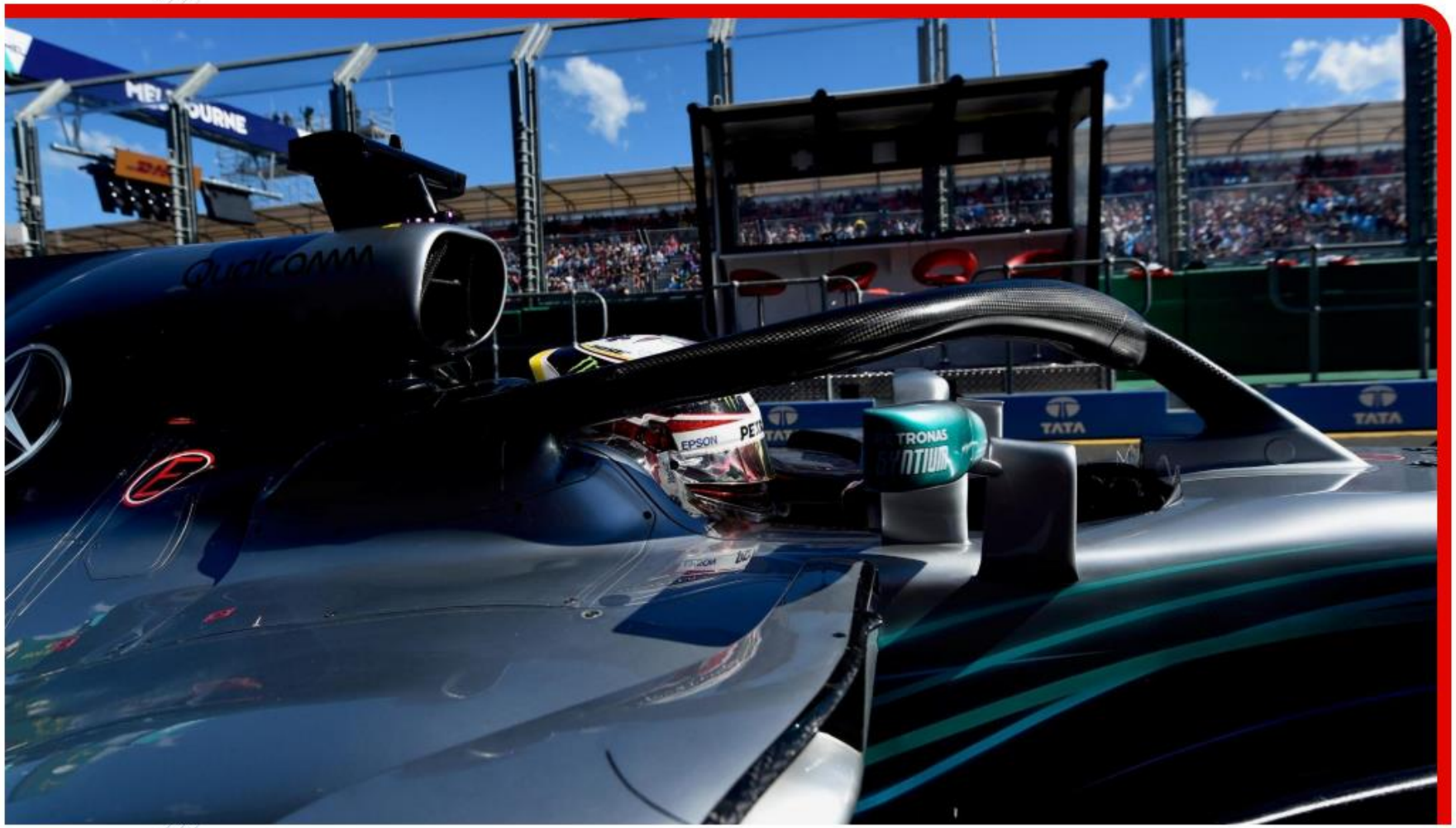
Ao Li

Software is everywhere

Software glitch cost Hamilton victory - Mercedes

25 March 2018

MERCEDES | AUSTRALIA | HAMILTON



Toyota Case: Single Bit Flip That Killed

Junko Yoshida

10/25/2013 03:35 PM EDT

During the trial, embedded systems experts who reviewed Toyota's electronic throttle source code testified that they found Toyota's source code defective, and that it contains bugs -- including bugs that can cause unintended acceleration.

"We did a few things that NASA apparently did not have time to do," Barr said. For one thing, by looking within the real-time operating system, the experts identified "unprotected critical variables." They obtained and reviewed the source code for the "sub-CPU," and they "uncovered gaps and defects in the throttle fail safes."

The experts demonstrated that "the defects we found were linked to unintended acceleration through vehicle testing," Barr said. "We also obtained and reviewed the source code for the black box and found that it can record false information about the driver's actions in the final seconds before a crash."

Stack overflow and software bugs led to memory corruption, he said. And it turns out that the crux of the issue was these memory corruptions, which acted "like ricocheting bullets."

Barr also said more than half the dozens of tasks' deaths studied by the experts in their experiments "were not detected by any fail safe."

Bookout Trial Reporting

http://www.eetimes.com/document.asp?doc_id=1319903&page_number=1
(excerpts)

"Task X death in combination with other task deaths"

HealthCare.gov

Learn | Get Insurance | Log in | Español

Individuals & Families | Small Businesses | All Topics

Search | SEARCH

The System is down at the moment.

We're working to resolve the issue as soon as possible. Please try again later.

Forbes

HealthCare.gov Diagnosis: The Government Broke Every Rule Of Project Management

Loren Thompson Senior Contributor

Aerospace & Defense

I write about national security, especially its business dimensions.

After 400 software fixes and major hardware upgrades, the Obama Administration is claiming to have achieved its goal of transforming HealthCare.gov into a web-site that

The Patient Protection and Affordable Care Act, better known as Obamacare, will probably be remembered as President Obama's most important domestic policy initiative. However, inept federal management of the HealthCare.gov

Obama Speech Today on Tech Problems of HealthCare.gov | The New York Times

The New York Times

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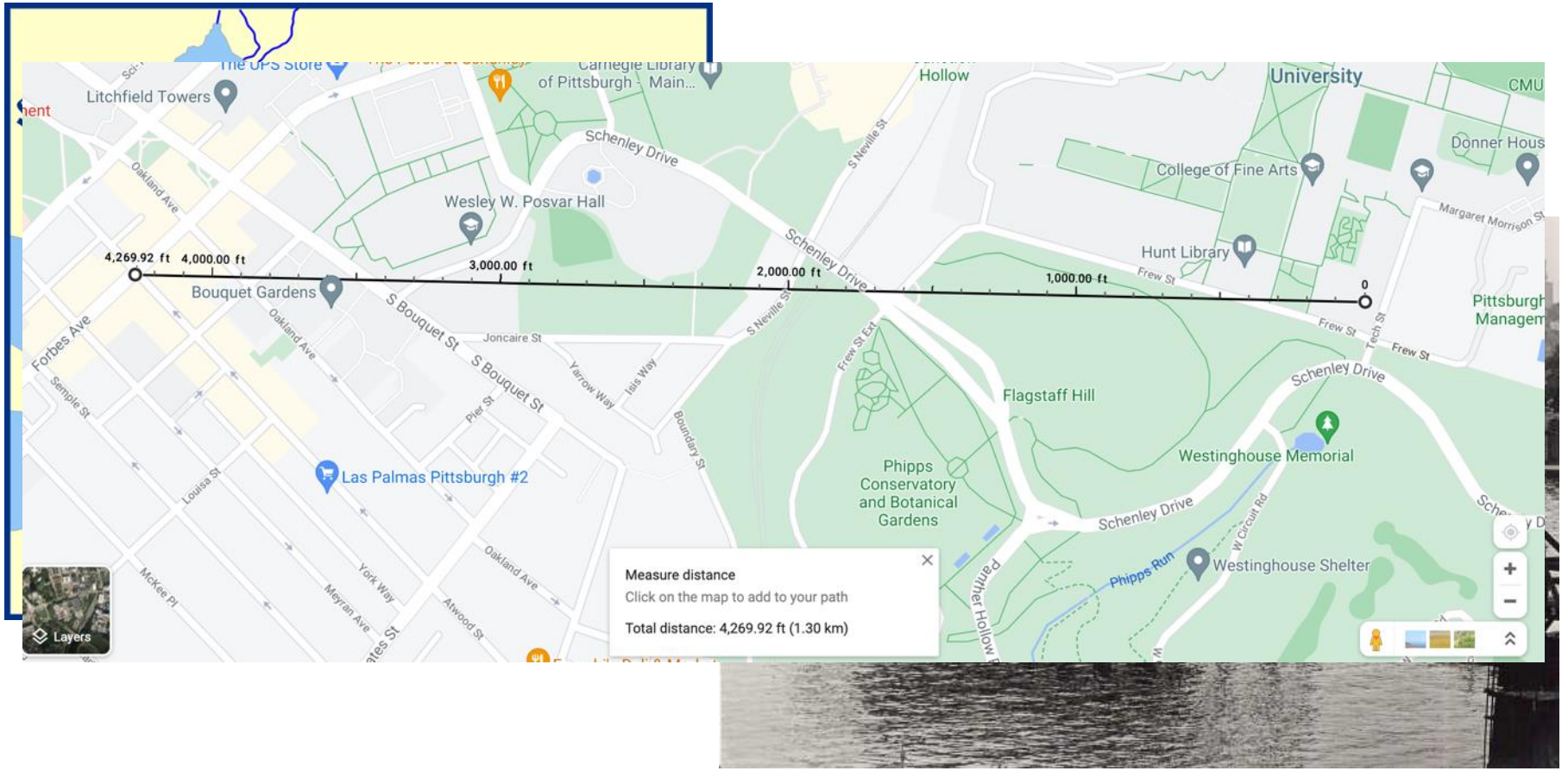
THE VERGE


BOEING
REDLINE
The many human errors that brought down the Boeing 737 Max

Vasa

Vasa


Litchfield Towers
Carnegie Library of Pittsburgh Main...
Schenley Drive
Wesley W. Posvar Hall
Oakland Ave
4,269.92 ft
4,000.00 ft
3,000.00 ft
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1,000.00 ft
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Bouquet Gardens
S Bouquet St
Joncaire St
Forbes Ave
Semple St
Las Palmas Pittsburgh #2
Louisa St
McKee Pl
York Way
Meyran Ave
Atwood St
Pier St
Yarrow Way
Isis Way
Boundary St
S Neville St
Hollow
University
CMU
College of Fine Arts
Donner Hous
Margaret Morrison St
Hunt Library
Frew St
Frew St Ext
Tech St
Pittsburgh Managem
Flagstaff Hill
Schenley Drive
Westinghouse Memorial
Phipps Conservatory and Botanical Gardens
Westinghouse Shelter
Phipps Run
W Circuit Rd
Panther Hollow
Measure distance
Click on the map to add to your path
Total distance: 4,269.92 ft (1.30 km)
Layers

What happened is now called “Vasa syndrome”

- Changing shipbuilding orders
- No specifications for modified keel
- Shifting armaments requirements

Requirements

- Shipwright’s death

Teams

- No way to calculate stability, stiffness, or sailing characteristics

Metrics

- Failed pre-launch stability tests

QA

Software Engineering?

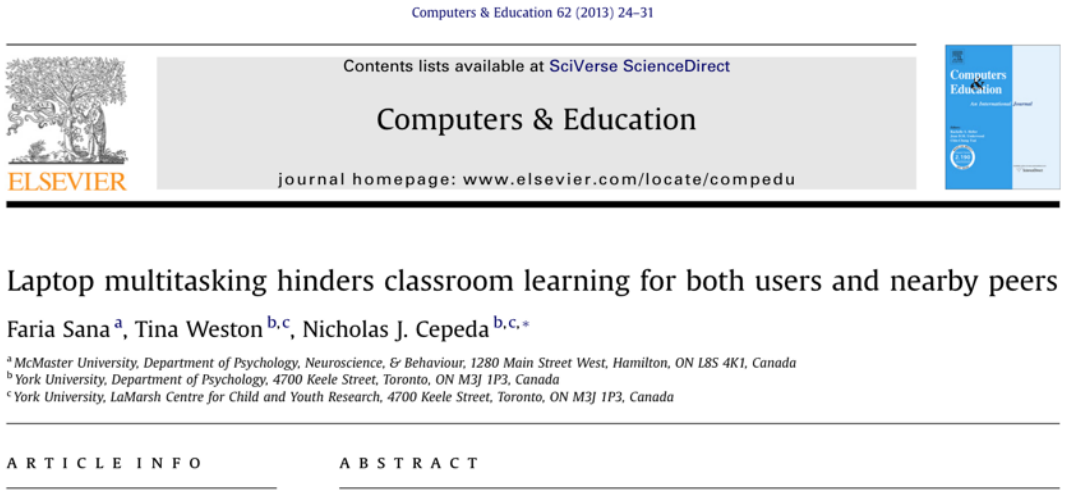
- What is engineering?
- And how is it different from hacking/programming?

1968 NATO Conference on Software Engineering

- Provocative Title
- Call for Action
- “Software crisis”

Margaret Hamilton

This Course



Computers & Education 62 (2013) 24–31

Contents lists available at SciVerse ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

ELSEVIER

Laptop multitasking hinders classroom learning for both users and nearby peers

Faria Sana [a], Tina Weston [b,c], Nicholas J. Cepeda [b,c,*]

[a] McMaster University, Department of Psychology, Neuroscience, & Behaviour, 1280 Main Street West, Hamilton, ON L8S 4K1, Canada
[b] York University, Department of Psychology, 4700 Keele Street, Toronto, ON M3J 1P3, Canada
[c] York University, LaMarsh Centre for Child and Youth Research, 4700 Keele Street, Toronto, ON M3J 1P3, Canada

ARTICLE INFO

ABSTRACT

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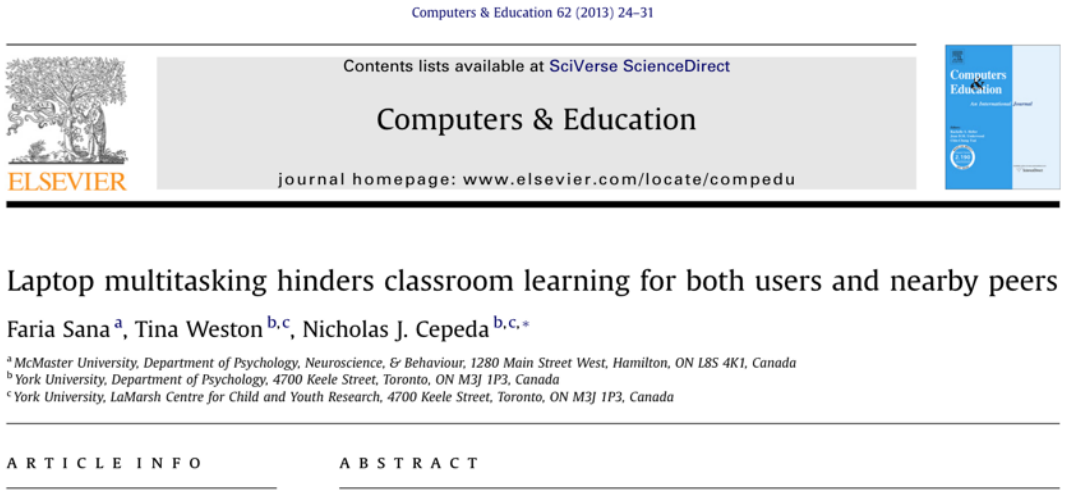
Faria Sana, Tina Weston, and Nicholas J. Cepeda. 2013. Laptop multitasking hinders classroom learning for both users and nearby peers. Computing Education



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Smoking Section

- Last full row

<Name>

What is the most recent software team project you've worked on? (30 Seconds)

and how was your experience? **1 word**

Course infrastructure and logistics

- Infrastructure/source of truth
  - Course website: schedule, slides, syllabus, office hours
  - Canvas (and Gradescope) homework, grades, other material
    Slack for communication and collaboration.
    Git/Github for coding and collaboration
- Logistics
    Lecture in-person only
    All recitations are in-person
- Office Hours are flexible.
- If you want to talk to us, DM/email ALL INSTRUCTORS at once.
  Trust us, it's faster.

Connect with us for the class

- All links on our course website: https://cmu-313.github.io
- Canvas: https://canvas.cmu.edu/courses/39244
- We will send you an invite for Slack, please be on the lookout for it.

Course Themes

- Software engineering as a human process
- Requirements and Specifications
- Metrics and Measurement
- Software Quality: Testing + CI + Security
- Continuous Deployment and DevOps
- Software Project Teams
- Managing Time, Teams, and Risks
- Software Architecture and Design Docs
- Scaling and Performance, Trade-offs
- AI/ML in Software Engineering
- Open-Source Software
- Strategic Thinking about Software

Prerequisites

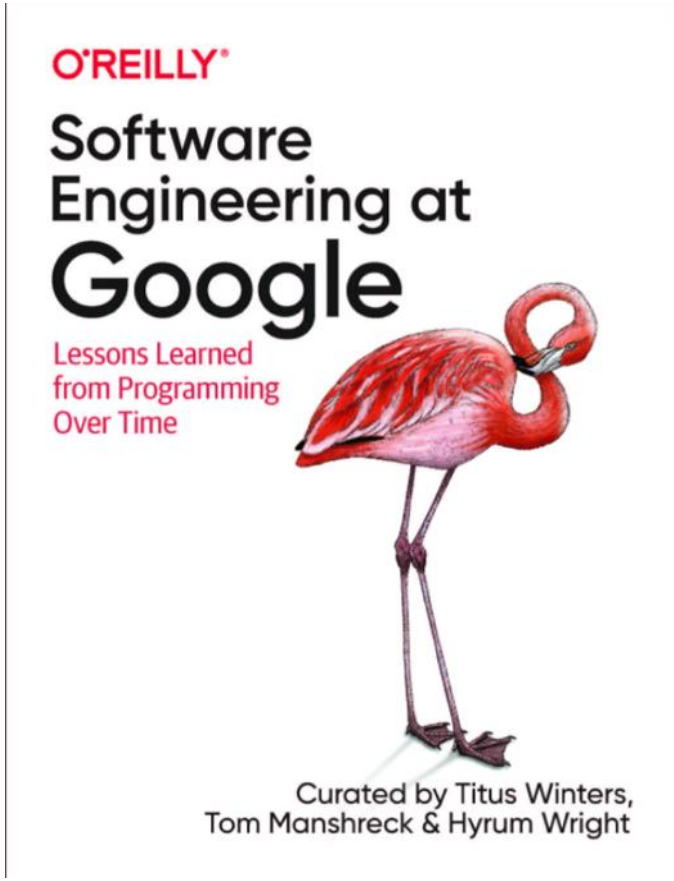
- Assumes working knowledge of popular programming languages (e.g., 15-121, 15-122)
- You will have the best experience if you have already had an internship or been involved in a large-ish software development project (ask us if you have any questions)
- How is it different from 17-214?
  - 17-313 largely focused on human issues and quality beyond functional correctness
  - 17-313 focused on larger scale

Readings, Quizzes, and Participation Activities

- Reading assignments for some lectures
  - Preparing in-class discussions: background material, case descriptions, possibly also podcast, video, Wikipedia
- In-person activities
  - **Lecture**: Active learning exercises every lecture (except this one)
  - **Recitation**: Working sessions, submission on Canvas/Gradescope
- All of the above count as graded "participation activities"
  - You may miss up to 4 participation activities with no grade penalty
    (No need to send emails ahead-of-time)

Textbook

- No single textbook
- Assigned readings from different sources
  - Book chapters (library)
  - News articles
  - Lecture notes
- Recommended supplementary reading: Software Engineering at Google
  - Available for free online (legally!): https://abseil.io/resources/swe-book



Gaining Experience: Central to 313!

- Case study analyses
- Team assignments
- Open-source engagement
- Hands-on experience is key!!!

- No “survivor”-style projects – wait till 17-413 (Capstone)

Evaluation

- Assignments (60 %)
  - Regular homework, mostly in teams with individual component
  - Open-source engagement
- Midterms (20 %)
- Participation activities (20 %)
  - In-class exercises
  - Pre-class reading assignments
  - Recitation exercises

Recitations

- Practical tasks, preparation for homework, extra material, discussions
- Have your GitHub account at the ready.
  - Bring your laptop!
- This week: GitHub (helpful for recitation 1, will be on week 2 due to holiday)
- Teams will all go to the same recitations

“Homework” Assignments / Projects

- P1: Setup and test a large existing software product
  - Get up-to-speed with new technologies quickly and on your own
- P2: Collaborative development on a large software project
  - Add features and follow SE process
- P3: Continuous Integration + Deployment
- P4: Develop a design doc, and deploy an ML-based microservice
- P5: Open-source Excursion
  - Open-ended project: contribute to an OSS project using everything you have learned; get kudos for having PRs merged

Warning! Course & HW structure may be different than what you are used to…

- Lecture topics are on high-level ideas about software engineering; case studies and experiences
- Projects require applying these ideas to technical artifacts
- Projects simulate “real-world” professional SE experience
- Technical aspects of project will not be taught in class
  - Explicit learning goal: learn new tools, languages, etc. on your own
  - Ask for help when needed; recitations provide demos and resources
- Project requirements are often vague or under-specified (intentionally)
  - Feel free to ask for clarifications, but expect subjective responses
  - Focus for assessment is engagement, not absolute correctness

Team Assignments

- Mirror realistic setting
- Assigned teams throughout the semester
  - Fill in team building survey before next lecture
- Teamwork surveys every week
- Conflict resolution process as needed
- Most team assignments have individual components

Professionalism

- Being a professional means, you must work well with others
- The best professionals are those who make those around them better
- If you feel someone is not treating you or someone else in a professional manner, you have two options:
  - If you feel you have the standing to do so, speak up!
  - Reach out to the course staff, and we will meet with you privately to discuss it, as well as preserve your anonymity

Final Projects

- Open-source excursion is the most fun part of the course!
- Very open-ended project. 24% of overall grade.
- Brings together everything you will have learned from lecture and prior assignments
- Teamwork and communication is very important
- In-person presentation in finals week (no exam)
- ***Do NOT book flight tickets for end-of-semester holidays until finals are scheduled.***

Late day policy

- **Assignments**: No late days
  - Simply doesn't work with team assignments
  - Plan for unexpected delays ahead of time (not just before deadline).
- **Participation activities (lecture + recitation)**: Accommodations in case of health issues, travel for interviews, university sports, etc.
  - Everyone gets **4 free absences**. No need to inform us beforehand.
  - Beyond 4 absences, participation grade can be affected.
  - Inform us of extended absences (e.g., hospitalization). We can help you make up some of the lost points in such cases.
- If you have an assignment due after a trip, turn it in *before* you leave.
  - You may not have Internet where you're going.
  - Your return travel may be delayed beyond the assignment deadline!

Academic Honesty

- Standard Collaboration Policy
- In group work, be honest about contribution of group members; do not cover for others
- Unless explicitly prohibited, you may use generative AI (e.g. ChatGPT) to help you write your prose and code. You are responsible for its correctness. Be sure to attribute the content to the service you used.
- HW1 will be done in one public repo. PLEASE reach out if you have concerns.

For next class: survey, scheduling

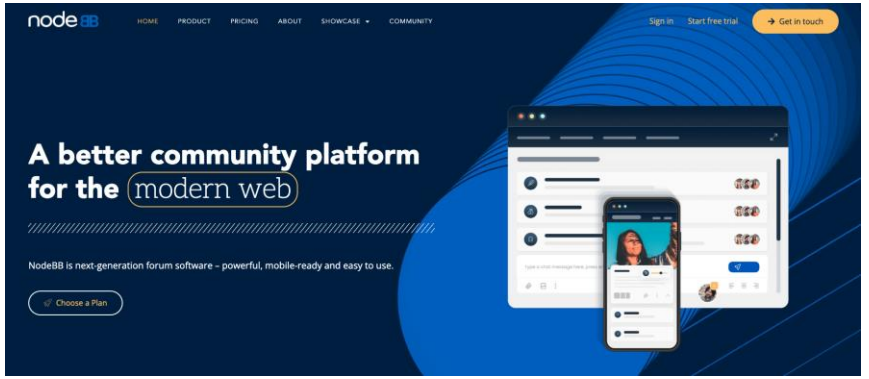
First-week Survey due Thursday

- Form groups based on schedule availability.
  - This is ridiculously important.
  - Identify experience and working styles.
  - Participation point

- Help us shape the course based on
  - your background knowledge
  - your interests

- Posted to canvas, we will also post on slack after inviting you all
- https://forms.gle/XFp8tVruaywAKaSYA

Project P1 posted tonight



- P1A: Checkpoint due this Friday (Jan 19th)
  - Only 5% of total P1 points – meant to ensure you start on time
- P1B: Due Sep 7th
  - Translate a file to TypeScript (**technically challenging** for non-experts; purpose is to learn new things and engage with a large code base)

  OR
  - Reach 100% line coverage for a given file. If you can't get there, explain which lines are not covered and why.