cs304
Software Engineering

TAN, Shin Hwei

陈馨慧

Southern University of Science and Technology
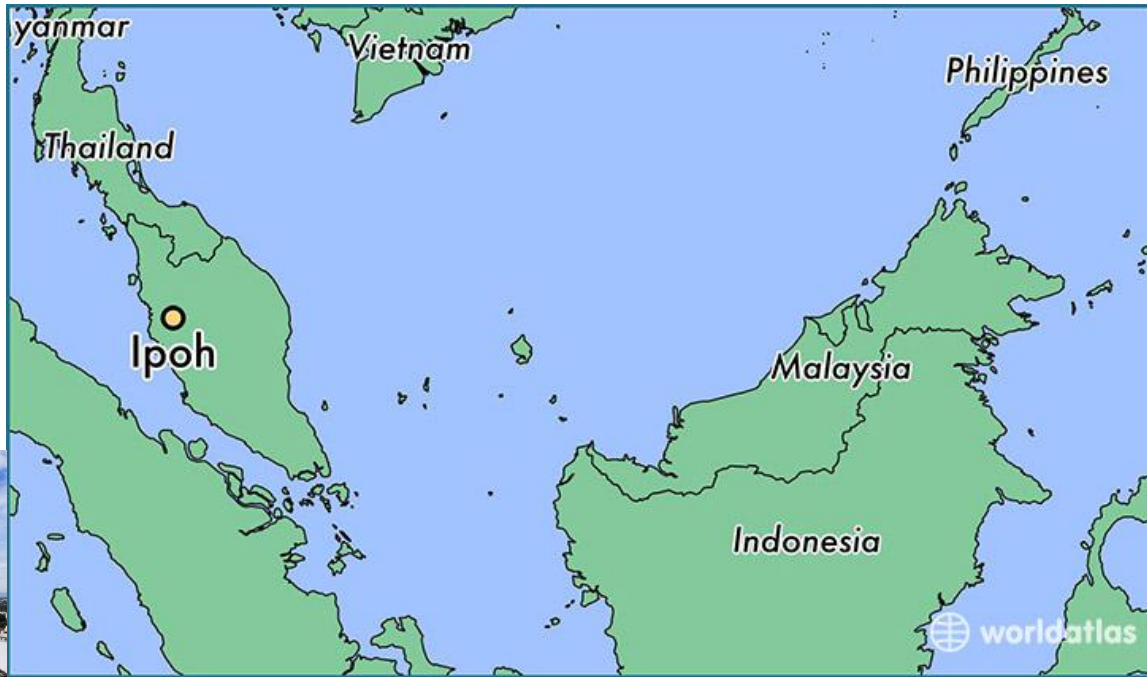
Slides adapted from cs427 (UIUC) and cs304(SUSTech)

About me

- I am a Chinese Malaysian
  - Born in Ipoh

Famous Food

Famous celebrity

City Surrounded by Mountains

Famous Drink

Teaching Background

Have experience in teaching:

- Software Engineering (SE)
  - Software Testing (ST)
    - …

B.S.(Hons): 2006-2010
M.S: 2010-2012
Teaching Assistant for SE

PhD
2012-2018
Teaching Assistant for ST

Assistant Professor
June 2018
Proposed first ST class

Darko Marinov

Ralph Johnson

Gang of four

Some of the slides will be adapted from UIUC/NUS!

My Research

Research Interest:
Automated Software Maintenance

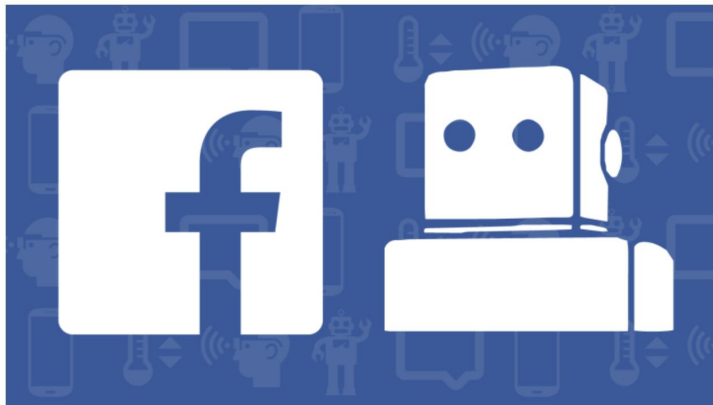| **Maintain Documentation**	**Maintain Test**	**Maintain Code**
Detect outdated documentation	Fix broken Tests	Fix buggy code
	Generate Tests	• Mobile Apps • C programs • Student Assignments

How much time you spent in

- Writing code
- Debugging (Find why it is wrong?) your code
- Fixing your bugs

What if a robot could debug & fix your code automatically?

Facebook's new 'SapFix' AI automatically debugs your code

Josh Constine @joshconstine / 5 months ago

Comm

Facebook is building an AI tool to help devs fix buggy code

by IVAN MEHTA — 5 months ago in ARTIFICIAL INTELLIGENCE

Facebook ⓘ has quietly built and deployed an artificial intelligence programming tool called SapFix that scans code, automatically identifies bugs, tests different the best ones that engineers can choose to implement.
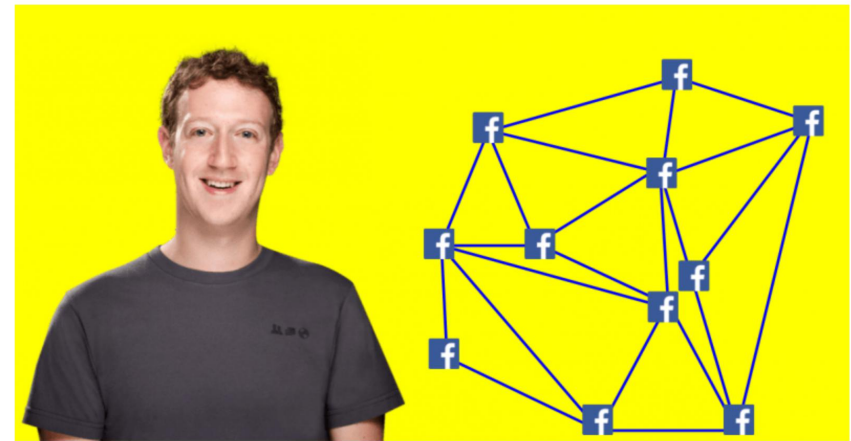
- Yes!

Research Impact

Repairing Crashes in Android Apps

Who	Shin Hwei Tan, Zhen Dong, Xiang Gao, Abhik Roychoudhury
Track	* ICSE 2018 * Technical Papers
When	Wed 30 May 2018 15:00 - 15:20 at H2 room - Apps and App Stores II Chair(s): Patrick Maeder
Link to Preprint	http://www.shinhwei.com/droixicse_camera.pdf

ICSE 2019 (series) / Software Engineering in Practice /

SapFix: Automated End-to-End Repair at Scale

- We propose first repair tool for Android apps

- They admit using similar approach as our tool

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Do you want to build the next generation tool?

- Revolutionize how programmer write code
- Improve programmers' productivity
- Automate boring tasks

Be part of SUSTech Intelligent Software Group

Xin Yao (Head of Department)
Research Interest: Search-based Software Engineering, Genetic Algorithm

Yuqun Zhang
Research Interest: Software Engineering, Service Computing

Yepang Liu
Research Interest: Mobile App analysis, Cyberphysical system

Shin Hwei Tan
Research Interest: Automated program repair, Software Testing, Mobile app analysis

Talk to me after class or send me email if you are interested in joining my group! We are looking for students!

Teaching Staff

- Instructor:陈馨慧Tan Shin Hwei

- Teaching Assistant:
  - 胡春风Hu Chun Feng, hucf@sustc.edu.cn
  - 王大兴Wang Daxing, wangdx3@mail.sustech.edu.cn

- Student Helpers/ Lab Assistant:
  - 张晓文
  - 李子强
  - 周颖
  - 汪至圆
  - 胡玉斌
  - 陈宇恒
  - 彭一明
  - 闫璐
  - 李盈
  - 林源樟

Course Logistics

- Course Description
  - This course focuses on providing **hands-on experience in designing and developing large-scale software systems** with an emphasis on the use of automated tools and techniques
  - Recommended prior course
    - CS309: OOD

Textbooks

- Ian Sommerville, *Software Engineering*
- Freeman et al., *Head First Design Patterns*
- Block, *Effective Java*
- Zeller and Krinke, *Essential Open Source Toolset: Programming with Eclipse, JUnit, CVS, Bugzilla, Ant, Tcl/TX and More*
- McConnell, *Code Complete: A Practical Handbook of Software Construction*
- Barrett, *Linux Pocket Guide*
- Pilone, *UML 2.0 Pocket Reference*

Evaluation and Grading

- Weekly Lab Tutorials– 20%
  - >=10
- Project – 35%
  - Fixing GitHub Issues of Java Open-Source Projects
  - Group of 5
  - 3 presentations (proposal, progress, final)
  - 2 written reports
  - Peer evaluations
- Exams – 35%
  - Final:
    - What's on an exam? Anything from any aspect of class, including lab sections.
- In-Class Exercises/Attendance – 10%
  - Spontaneous (Need to attend project presentation during lecture)

Systems Used

Sakai

- Lecture/lab notes
- Gradebook

Wechat Work

- Lecture/Lab Q/A
- Live teaching

GitHub Classroom

- Homework/Project submissions
- Ask questions about homework
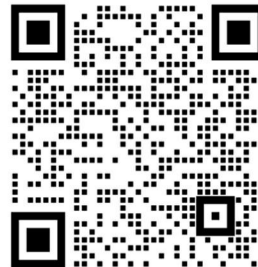
Wechat work 企业微信

- Join the group chat

Software Engineering CS304-2021

This is an internal group chat of the company. Only the company members can join it by scanning QR

QR code valid for 7 days (before 01/15). Re-entering will update QR code.

Award-winning Project

- Won the World Teacher Day Challenge!
- Paper Accepted in ICSE-JSEET (Education track)
- Project Proposal uploaded
  - Start choosing your project early!

GitHub-OSS Fixit: Fixing bugs at scale in a Software Engineering Course

Shin Hwei Tan, Chunfeng Hu, Ziqiang Li, Xiaowen Zhang, Ying Zhou

Many studies have shown the benefits of introducing open-source projects into teaching Software Engineering (SE) courses. However, there studies that limit the wide adaptation of open-source projects in a classroom setting, including (1) the selected project is limited to one par only investigated on its effect on teaching a specific SE concept, and (3) students may make mistakes in their contribution which leads to po software companies have successfully launched programs like Google Summer of Code (GSoC) and FindBugs "fixit" to contribute to open-so success of these programs, we propose GitHub-OSS Fixit, a course project where students are taught to contribute to open-source Java pro GitHub. We described our course outline to teach students SE concepts by encouraging the usages of several automated program analysis t carefully designed instructions that we gave to students for participating in GitHub-OSS Fixit. As all lectures and labs are conducted online, could help in guiding future online SE courses. Overall, our survey results show that students think that GitHub-OSS Fixit could help them t the knowledge taught in class. In total, 154 students have submitted 214 pull requests to 24 different Java projects, in which 59 of them ha been closed by developers.

- https://github-fixit.github.io/

Build the future of communications. Start today with Twilio's APIs and services.

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POSTS BY STACK

JAVA .NET RUBY PHP
PYTHON SWIFT ARDUINO
JAVASCRIPT

POSTS BY PRODUCT

SMS AUTHY VOICE
TWILIO CLIENT MMS VIDEO
TASK ROUTER FLEX SIP
IOT PROGRAMMABLE CHAT
STUDIO

CATEGORIES

Code, Tutorials and Hacks
Customer Highlights
Developers Drawing The Owl
News
Stories From The Road
The Owl's Nest: Inside Twilio

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NEW!

Tutorials

Sample applications that cover common use cases in a variety of languages. Download, test drive, and tweak them yourself.

Get started

Computer Science lessons from around the world

TwilioQuest FOR EDUCATION

Introducing the winners of the World Teacher Day Challenge

An opportunity to say thank you

With 2020 bringing a host of challenges to us all, World Teacher Day presented itself as an opportunity to pause and celebrate the hard work of Computer Science teachers around the world. Not only have they had to continue finding engaging ways to teach their students, but in a world where everything is done virtually, some extra creativity was required.

The challenge

We asked teachers at all levels of education to submit their most creative lesson plans for computer science. The key criteria we looked at was:

- Distance Learning: lesson is compatible with distance learning
- Accessibility: lesson plan was created to be inclusive and equitable for all students.
- Fun / Engagement Factor: We want to hear why this lesson is particularly fun for students!

The results

We were blown away by the creativity displayed by the educators in bringing Computer Science to life! From across the world, we saw educators that teach at different levels of education share their insights. From HTML, to algorithms, hardware and Git, you can get all sorts of inspiration from our winning submissions. Congratulations to Rahul, Shin Hwei, Juan Alberto, Shivangi and Kimberly!

You can check out the full lesson plans in TwilioQuest's **Awesome-CS repository** on GitHub.

The GitHub Fixit Project

This 6-week lesson plan, aimed at **higher-ed** students, helps students boost their employability by contributing to well-known open source projects. The course covers core software engineering concepts including static analysis, coding standards, unit testing, and the very important skill of making pull requests.

Project

- Develop some real software
  - Groups of 5 students
- Deliverables
  - Proposal (due in the 4th week)
  - Progress report (around mid of semester)
  - Final presentation and report (end of semester)
- Process should start with XP
- Must document process you use
- Must convince us you follow the process you documented

Project lifecycle

- Propose project
- Form team
- Develop
- Deliver code, tests, documentation
- Graded on process during development + quality of what you deliver =
 PROCESS + PRODUCT

Collaboration

- You must individually solve homework assignments
- No Cheating!
  - Do **NOT** use any resources without citation
  - One student got caught cheating in final exam of my class last semester!

A →cheating→ No grade!

Course Communication

- GitHub Classroom
  - Share the bugs that your find! (Remember to document when you find a bug through knowledge shared in GitHub discussion!)
  - Helps each other with tools installation
- Instructor: Shin Hwei Tan
- Email: tansh3@sustc.edu.cn
  - Please include **se-sustech** in the title of the email
  - Write your email in **English**!
- Office: 创园(Innovation park) Building 10, Room 605
- Office hours: after lecture or by appointment

Other Communication: GitHub Classroom
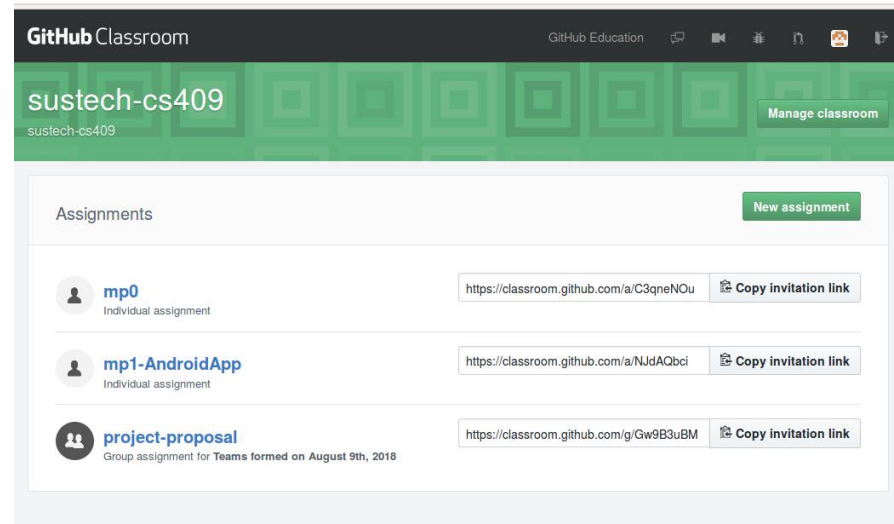
- Automates repository creation and access control
  - Easy to distribute starter code and collect assignments on GitHub.

Have you used GitHub before?

Y
N

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Discussion through GitHub

Expectations

- You are responsible for your own class
  - You will fail if you have many late submissions
  - You need to pass this class to graduate
- Independent student
  - Google online if you have any problem installing a tool
    - Everyone may be using a different O.S so we can't answer specific problem
  - If you have problem understanding a concept, ask this in class
    - Good chance to practice your English!
- But…
  - Expect that I may not be able to give you an immediate answer (I'm alright if my response to your question is "I don't know," so you're going to have to be alright with that, too)
  - I (or the TAs) WILL always find you the answers you need in a timely fashion. Be patient.

Why learn Software Engineering?

Well-Prepared in Their Own Eyes

Employers give college graduates low scores for preparedness across learning outcomes; students think they are better prepared.

Proportions saying they/recent college graduates are well prepared in each area*

■ Employers ■ Students

Area	Employers	Students
Working with others in teams	37%	64%
Staying current on technologies	37%	46%
Ethical judgment and decisionmaking	30%	62%
Locating, organizing, evaluating information	29%	64%
Oral communication	28%	62%
Working with numbers/statistics	28%	55%
Written communication	27%	65%
Critical/analytical thinking	26%	66%
Being innovative/creative	25%	57%
Analyzing/solving complex problems	24%	59%
Applying knowledge/skills to real world	23%	59%
Awareness/experience of diverse cultures in US	21%	48%
Staying current on developments in science	21%	44%
Working with people from diff. backgrounds	18%	55%
Staying current on global developments	18%	43%
Proficient in other language	16%	34%
Awareness/experience of diverse cultures outside US	15%	42%

*8-10 ratings on zero-to-ten scale

AI Software Engineer

Top AI Jobs Open in the U.S.

Occupation (Job Category)	Open AI Jobs on Glassdoor	Percentage of Open AI Jobs on Glassdoor
AI Software Engineer	56	11%
AI Data Scientist	23	4%
AI Software Development Engineer	21	4%
AI Research Scientist	18	4%
AI Product Manager	9	2%
AI Technical Program Manager	9	2%
AI Business Development Manager	7	1%
AI Solutions Architect	7	1%
AI Learning And Development Specialist	6	1%
AI Research Engineer	6	1%
AI Research Staff Member	6	1%
AI Technical Sales	5	1%
AI Back End Engineer	4	1%
AI Computer Scientist	4	1%
AI Financial Services	4	1%
All Others	327	64%
Total	512	100%

Source: Glassdoor Economic Research. Active unique job listings on Glassdoor with "artificial intelligence" or "deep learning" job titles as of October 20, 2017. Job titles are normalized into broad occupational groups using Glassdoor's proprietary algorithm that groups similar jobs.

From: https://www.forbes.com/sites/louiscolumbus/2017/11/26/the-best-ai-companies-to-work-for-in-2018-based-on-glassdoor/#246233053d78

What is AI Software Engineer

Business Analysts/Scrum Master

Data Scientists

Data Architects

- Manage project
- Manage meetings and updates
- Make sure all targets are being met

- Data analysis and exploration
- Build predictive models
- etc...

- Develop, construct, test and maintain architectures such as databases and large-scale data processing systems
- etc...

AI Engineer
Collaborate with Data Scientists, Data Architects and Business Analysts/Scrum Master to ensure alignment between the business objectives and the analytics back end as well as ensure the scalability and security of the final product.

AI Engineer

- Infrastructure as Code
- Continuous Integration
- Automated Testing
- API and MVP application integration and development

Most concepts will be thought in this class !

From: https://towardsdatascience.com/what-is-the-role-of-an-ai-software-engineer-in-a-data-science-team-eec987203ceb

Why is this class important?

- What kind of career paths do you envision for yourself?
  - Developer/Engineer
  - Graduate school
  - Overseas studies

Some topics studied in S.E.

- Process
- Tools
- Techniques
- Models (of software development)
- Modeling (of developed systems)

Software process

- IEEE 1074: "A set of activities performed towards a specific purpose"

- Johnson: "The steps a particular group follows to develop software"

- All teams followed the same process: (academic) XP (Extreme Programming)

Many software processes

- Agile
  - eXtreme Programming (XP), Scrum…
- Theoretical
  - Waterfall…
- Formal
  - Rational Unified Process (RUP), Cleanroom…
- Distributed, open-source
  - Bazaar…
- …

The fable of the Chicken & the Pig

- A Pig and a Chicken are walking down the road.
- The Chicken says: "Hey Pig, I was thinking we should open a restaurant!"
- Pig replies: "Hm, maybe, what would we call it?"
- The Chicken responds: "How about 'ham-n-eggs'?"
- The Pig thinks for a moment and says: "No thanks. I'd be committed, but you'd only be involved."
  - ➢ The Chicken is involved, but the Pig is committed

From: http://en.wikipedia.org/wiki/The_Chicken_and_the_Pig

Default process: XP

- Roles
  - XP: Customer, Developer, Coach
  - Scrum: Pigs (product owner, dev team [3-9 ppl], Scrum master), Chicken (customers and executive management) (http://en.wikipedia.org/wiki/The_Chicken_and_the_Pig)
- Activities
  - XP: Write stories, planning game, test-first, pair programming, continuous integration, refactoring
- Work products
  - XP: User stories, tests, code

Activities in IEEE 1074 (1)

- Project Management
  - Project initiation
  - Project monitoring and control
  - Software quality management
- Development
  - Requirements
  - Design
  - Implementation

Activities in IEEE 1074 (2)

- Post-development
  - Installation
  - Operation and support
  - Maintenance
  - Retirement
- Integral processes
  - Verification and validation
  - Software configuration management
  - Documentation development

What is (not) S.E.?
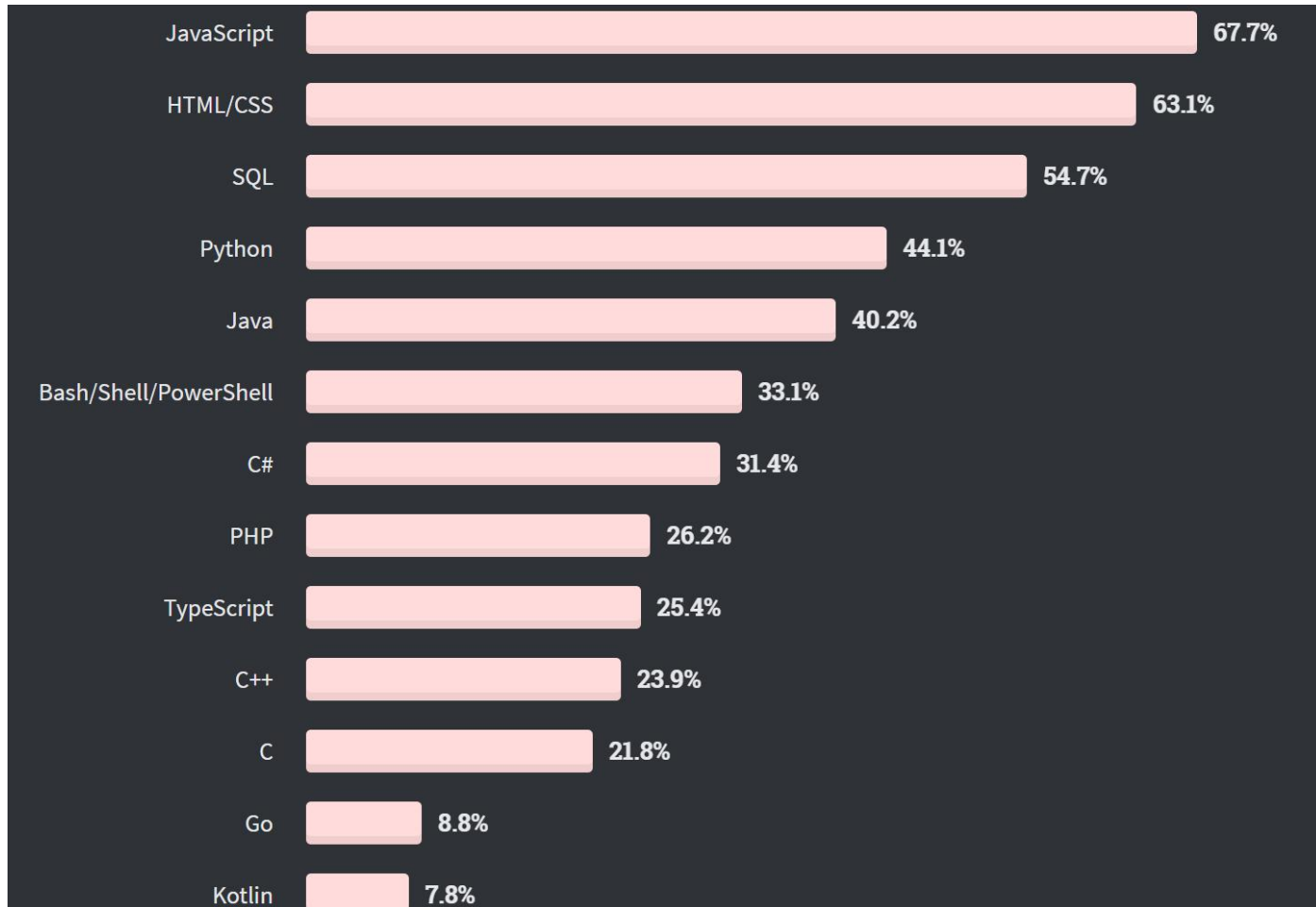
- Not just software programming
  - Individual vs. team
- Not just a process
  - Field that studies several different processes
- IEEE 610: "The application of a <u>systematic</u>, <u>disciplined</u>, <u>quantifiable</u> approach to the <u>development</u>, <u>operation</u>, and <u>maintenance</u> of software."

A Little Something About You
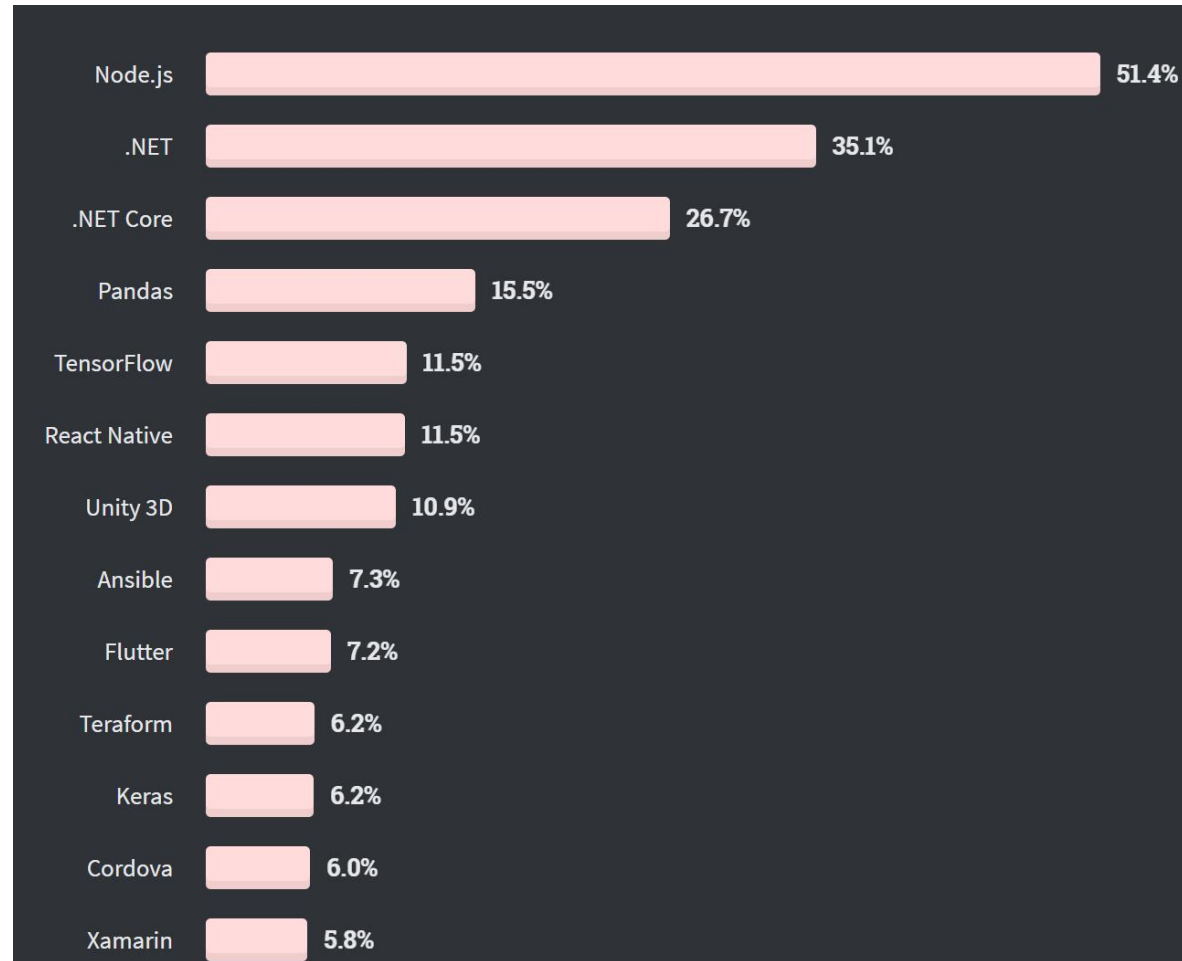
What programming languages do you know?

Popular Programming Language According to StackOverflow

From: https://insights.stackoverflow.com/survey/2020/#most-popular-technologies

What framework do you know?

Popular Frameworks, Libraries, & Tools According to StackOverflow

Node.js	51.4%
.NET	35.1%
.NET Core	26.7%
Pandas	15.5%
TensorFlow	11.5%
React Native	11.5%
Unity 3D	10.9%
Ansible	7.3%
Flutter	7.2%
Teraform	6.2%
Keras	6.2%
Cordova	6.0%
Xamarin	5.8%

From: https://insights.stackoverflow.com/survey/2018/#most-popular-technologies

Which text editor do you use?

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Popular Development Evironments

Most Popular Development Environments

| All Respondents | Web Developers | Mobile Developers | SRE/DevOps |

Visual Studio Code	**50.7%**
Visual Studio	**31.5%**
Notepad++	**30.5%**
IntelliJ	**25.4%**
Vim	**25.4%**
Sublime Text	**23.4%**
Android Studio	**16.9%**
Eclipse	**14.4%**
PyCharm	**13.4%**
Atom	**13.3%**
IPython / Jupyter	**9.5%**
Xcode	**9.4%**
PHPStorm	**7.6%**
NetBeans	**5.9%**
Emacs	**4.5%**

From: https://insights.stackoverflow.com/survey/2019#technology
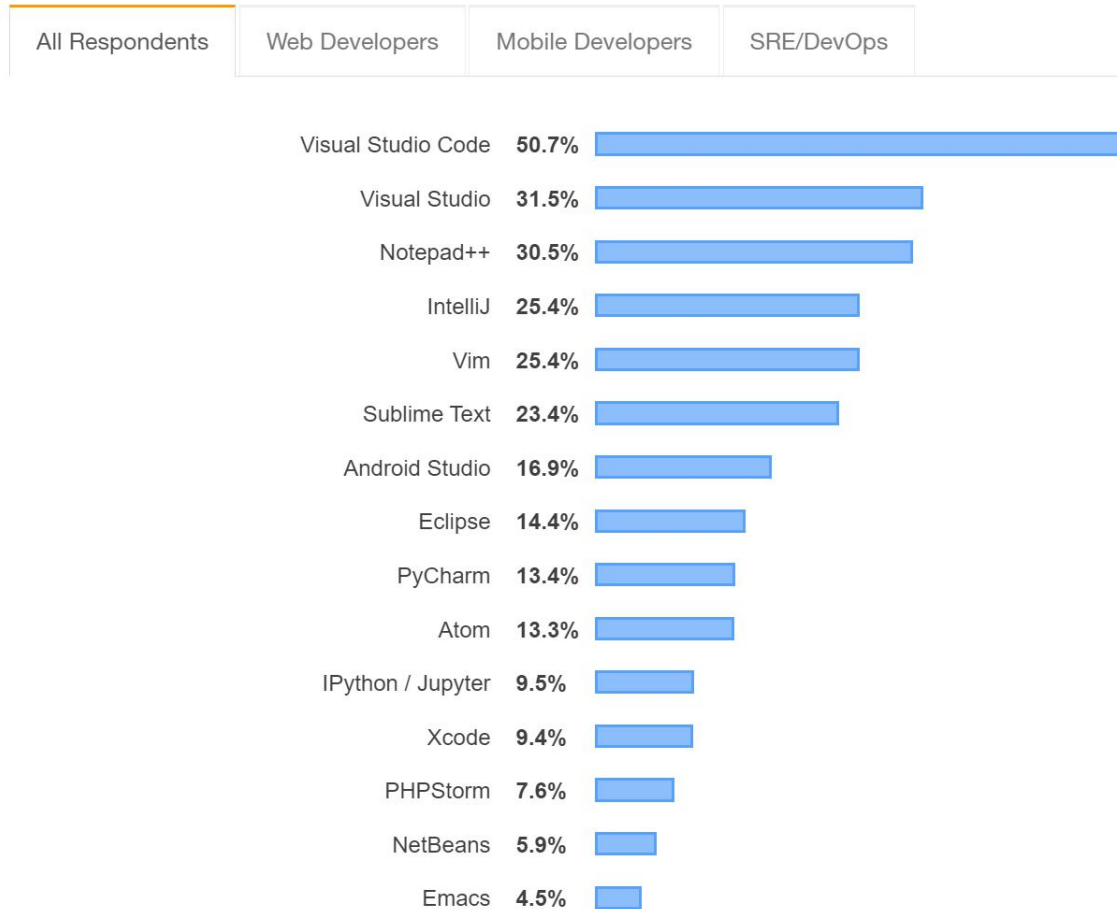
Lab Session

- Lab Sections this week
  - Meet "your" TA
  - Get familiar with GitHub
- Be ready for class
  - Come with your own machine if at all possible. With Eclipse/IntelliJ (recommended)

Todos

- Sign up for a new GitHub account if you don't have one