

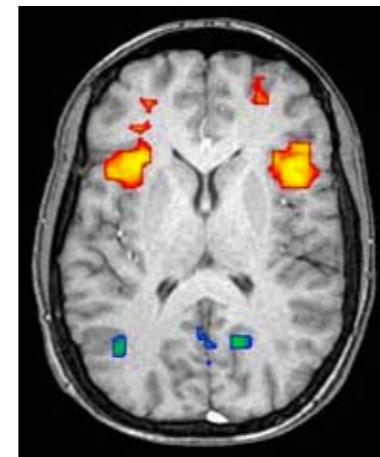
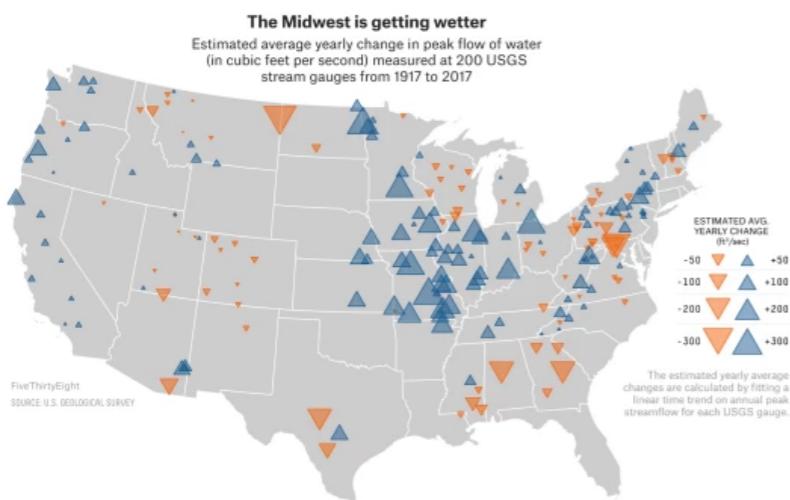
[301] Introduction

Tyler Caraza-Harter

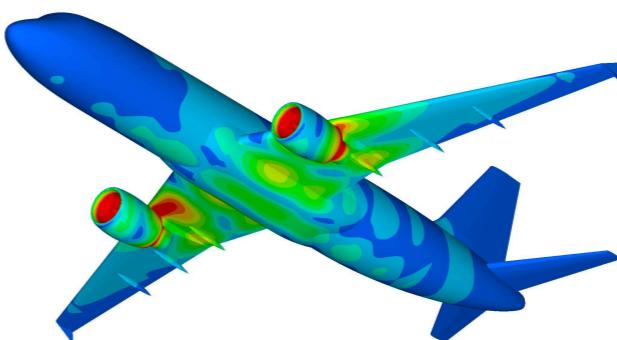
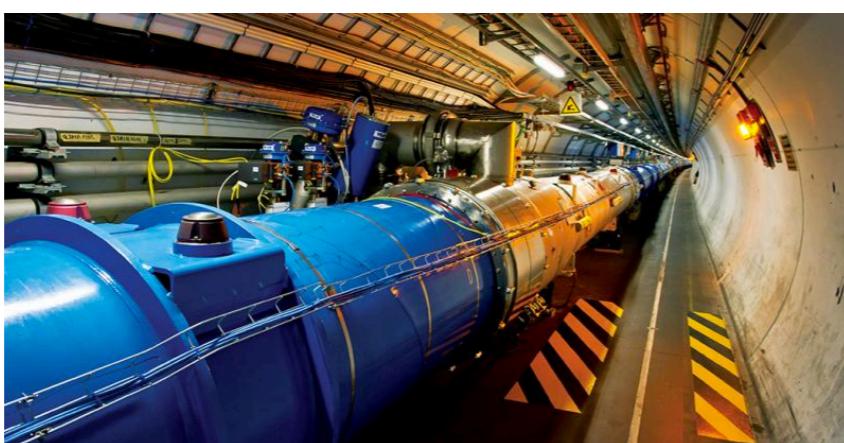
Welcome to Data Programming I!

Data is exploding in many fields

- Journalism
- Biology, physics, chemistry
- Psychology, sociology, economics, business
- Engineering (mechanical, electrical, industrial, etc)



<https://fivethirtyeight.com/features/the-midwest-is-getting-drenched-and-its-causing-big-problems/>



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How can we gain insights from that data?

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- With computation

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Approach I: human computation



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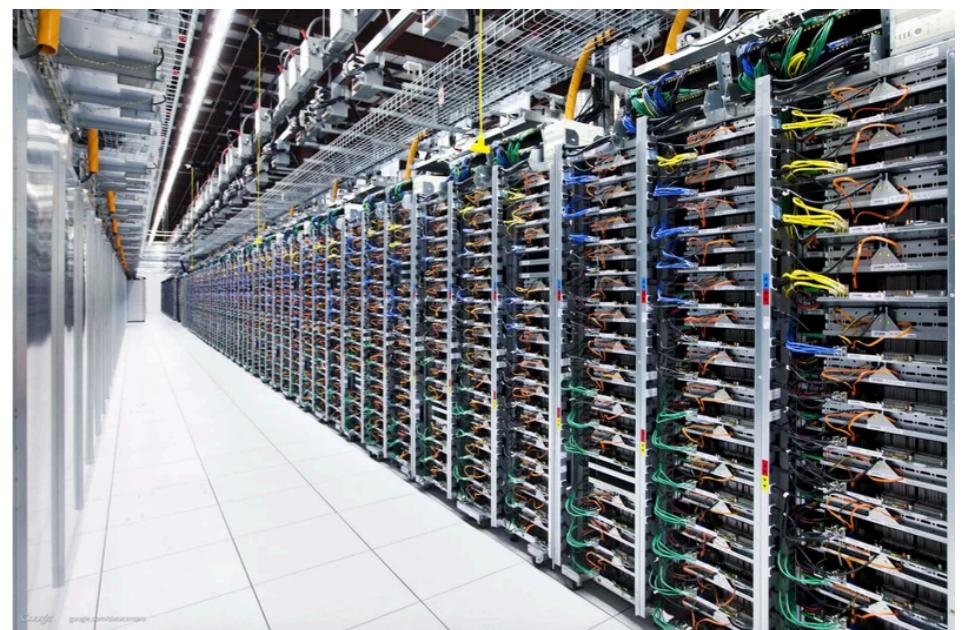
- With computation

Approach 1: human computation



https://en.wikipedia.org/wiki/Human_computer

Approach 2: machine computation



<http://fortune.com/2015/11/15/intel-super-7/>

Welcome to Data Programming I!

CS 301 is about approach 2

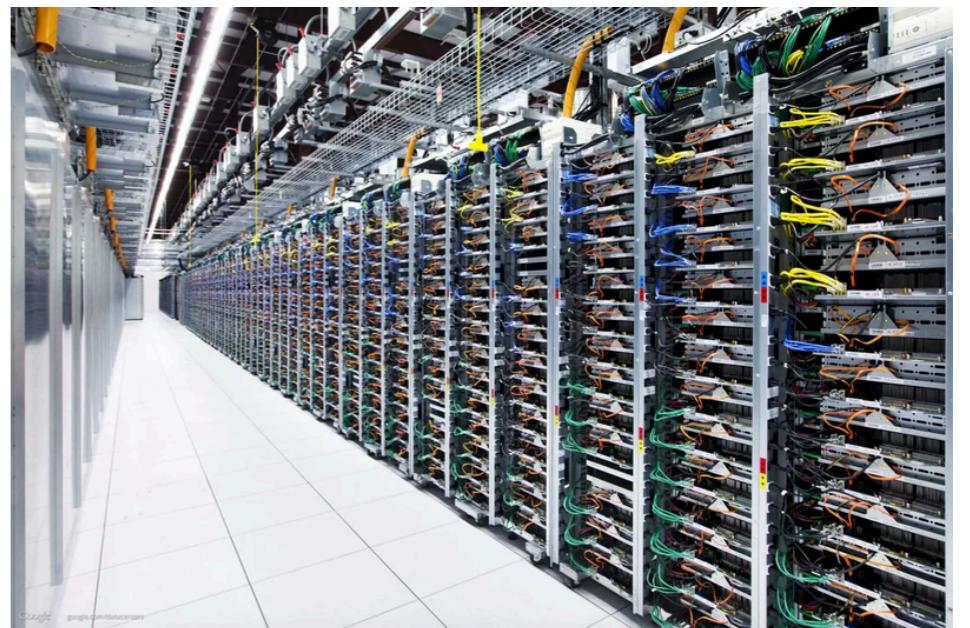
- Faster, more reliable, can churn through more data

Approach 1: human computation



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Approach 2: machine computation



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- Faster, more reliable, can churn through more data
- Automate to save human effort

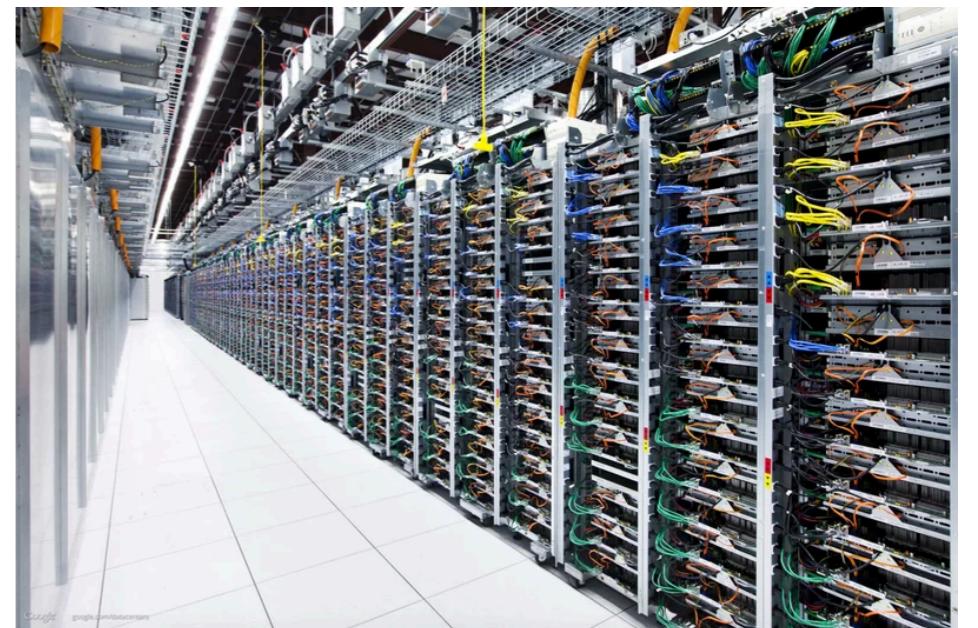
*“Find the leverage in the world, so you can **be more lazy!**”*

~ Larry Page

Approach 1: human computation



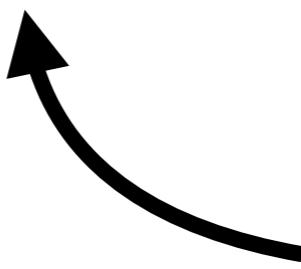
Approach 2: machine computation



Welcome to Data Programming I!

CS 301 is about approach 2

- Faster, more reliable, can churn through more data
- Automate to save human effort
- Requires being able to tell computers what to do!

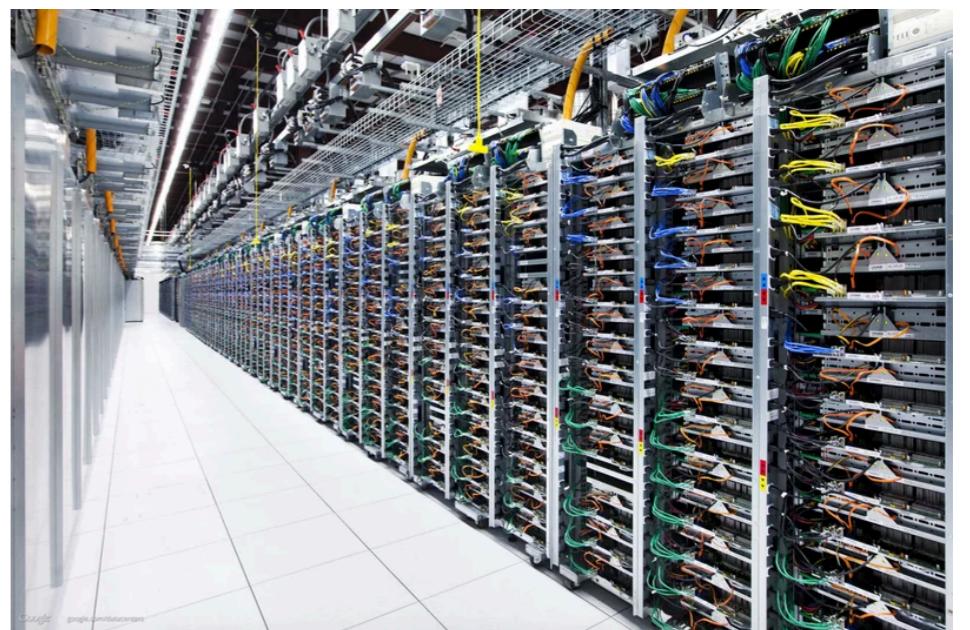


**society needs more domain experts
in specific fields who can write code**

Approach 1: human computation



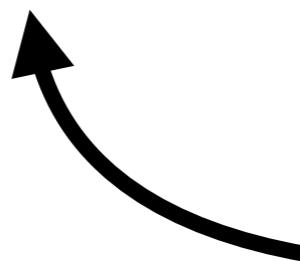
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CS 301 is about approach 2

- Faster, more reliable, can churn through more data
- Automate to save human effort
- Requires being able to tell computers what to do!



**society needs more domain experts
in specific fields who can write code**

Goal: become "bilingual"

- Speak the language of **biology**, mech eng, journalism, etc)
- Speak the language of **computing**

Why CS 301?

Typical intro CS

- Challenging language (e.g., C++ or Java)
- CS students and other majors together
- Heavy on theory, light on data

vs

CS 301 approach

- Python (powerful but easier to learn)
- Bring more coding into other fields
- Light on theory, heavy on data
- Emphasize questions and communication

50 Best Jobs in America for 2019

Job Title	Median Base Salary	Job Satisfaction	Job Openings	
#1 Data Scientist	\$108,000	4.3/5	6,510	View Jobs
#2 Nursing Manager	\$83,000	4/5	13,931	View Jobs
#3 Marketing Manager	\$82,000	4.2/5	7,395	View Jobs
#4 Occupational Therapist	\$74,000	4/5	17,701	View Jobs

https://www.glassdoor.com/List/Best-Jobs-in-America-LST_KQ0,20.htm

Today's Topics

Introductions

- Who am I? Who are you?

Course overview

Computer hardware basics

Website

Who am I?

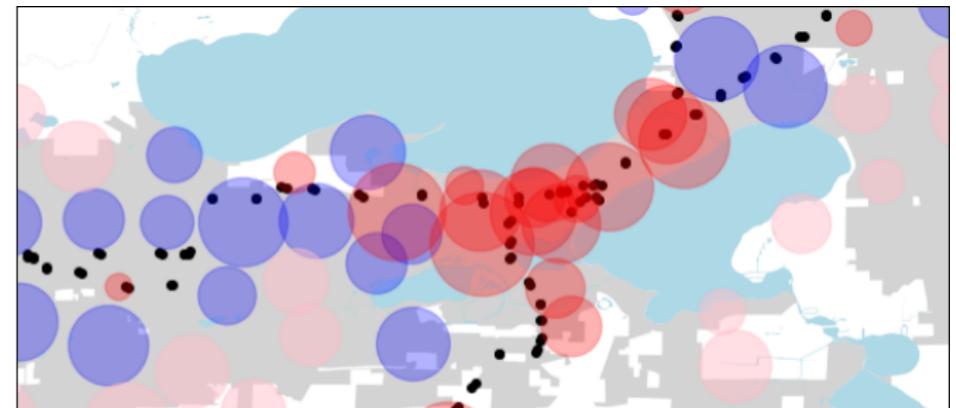
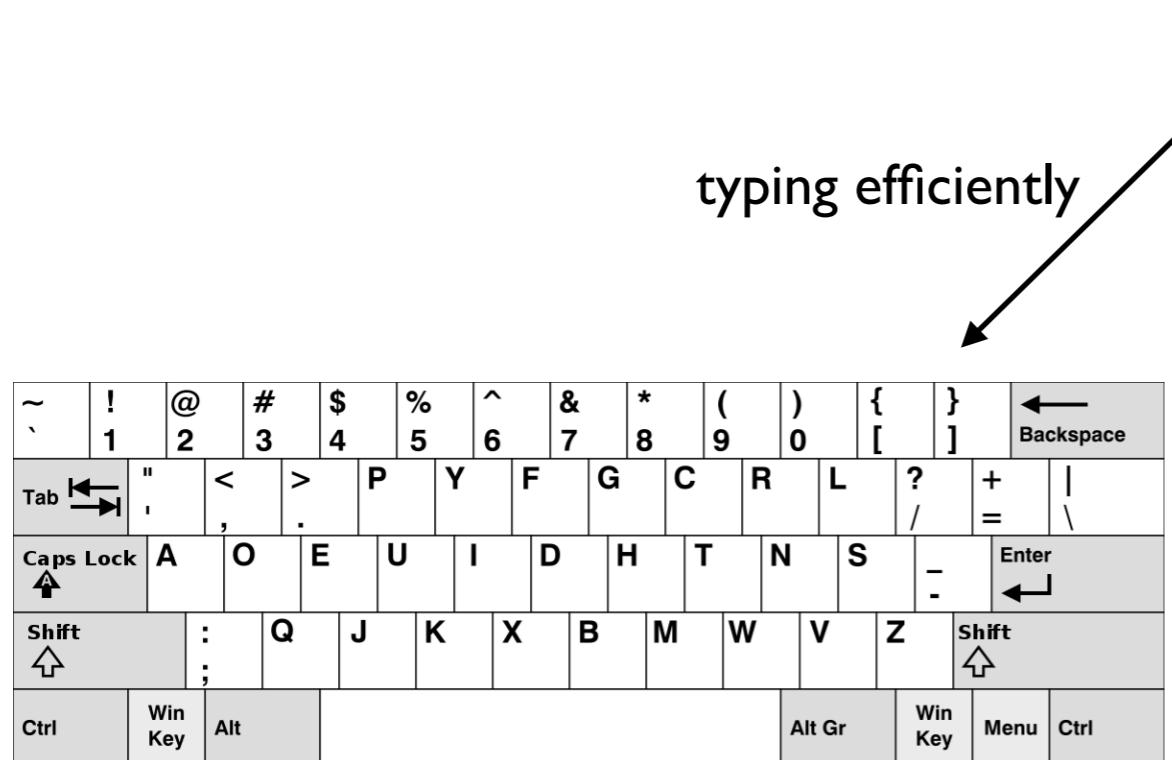
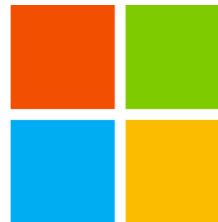
Tyler Caraza-Harter

- Long time Badger
- Email: tylerharter@gmail.com
- Just call me “Tyler”



Industry experience

- Worked at Microsoft on SQL Server and Cloud
- Other internships/collaborations:
Qualcomm, Google, Facebook, Tintri



Plot by [Jin Woo Lee](#) (previous CS 301 student)

More: <https://wisc-ds-projects.github.io/f19/>

Who are You?

Year in school?

- 1st year? 2nd? Junior/senior? Grad student?

Area of study

- Natural science, social science, engineering, other?

How many have programmed before?

- Any language? Python? Taken a class?

Survey (counts for participation)

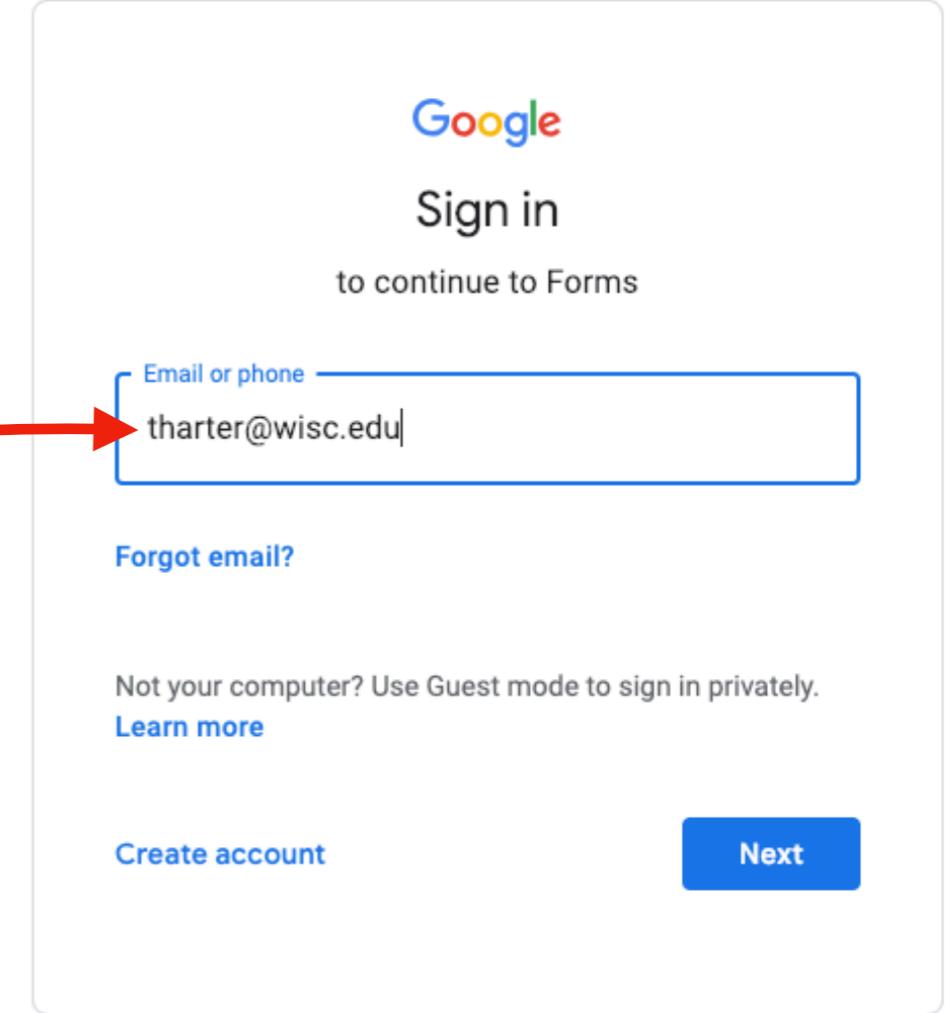
Please help us get to know you (not anonymous):

<https://forms.gle/eobVbkoHzKWjTjoYA>

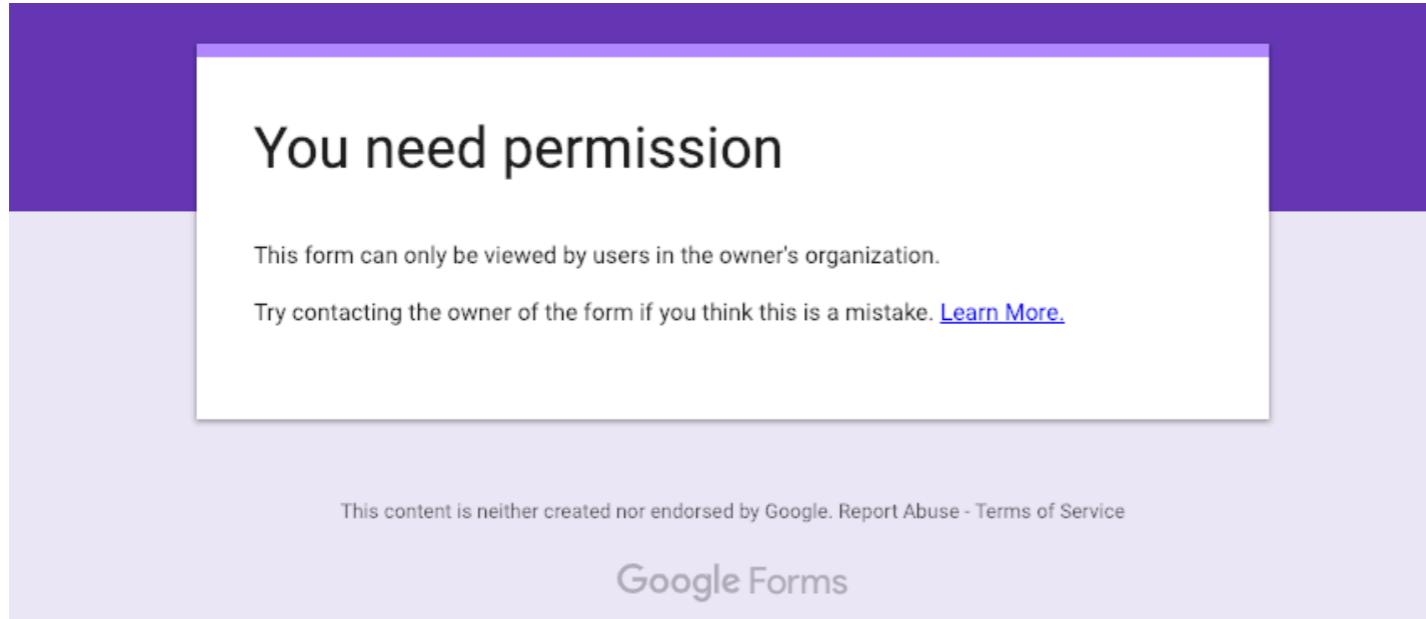
Purposes:

- gauge class interest/experience
- determine who on **waitlist** is attending
(please finish by 4pm today!)
- correlate experience with later scores

be sure to use your
campus email!

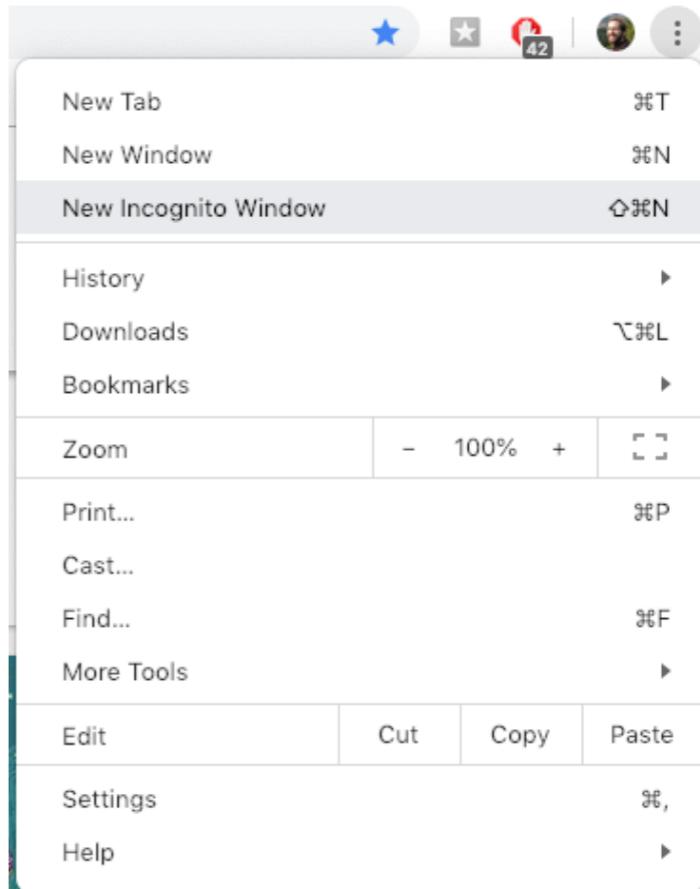


Survey: Common Technical Issues

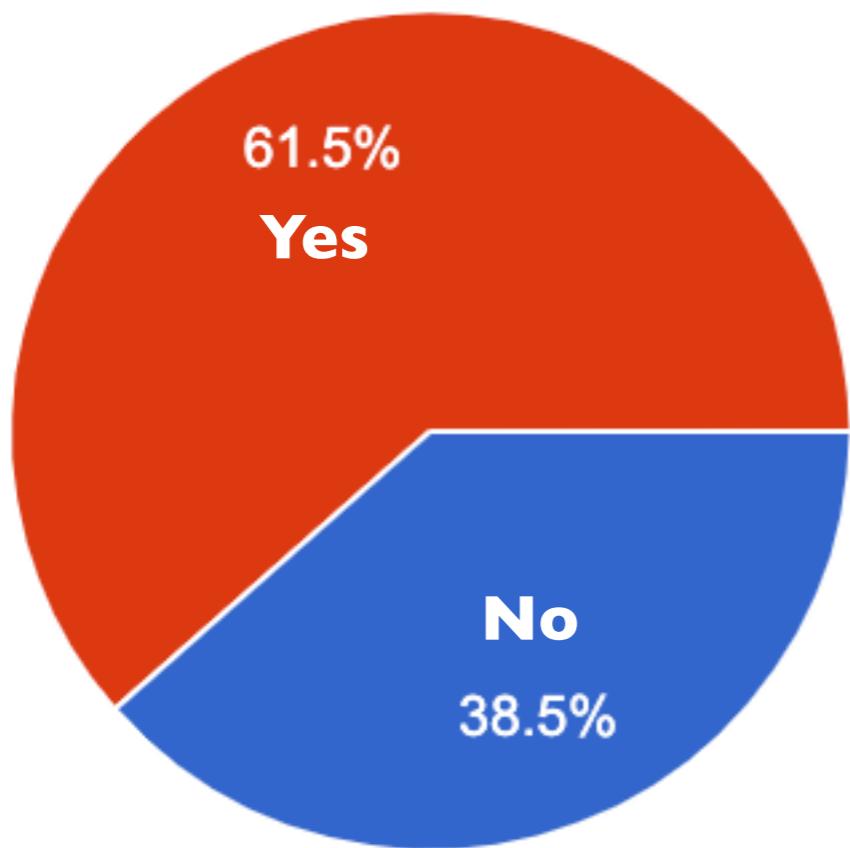


if you were automatically signed into gmail without being asked, consider clearing cookies or using an Incognito Window (in Chrome)

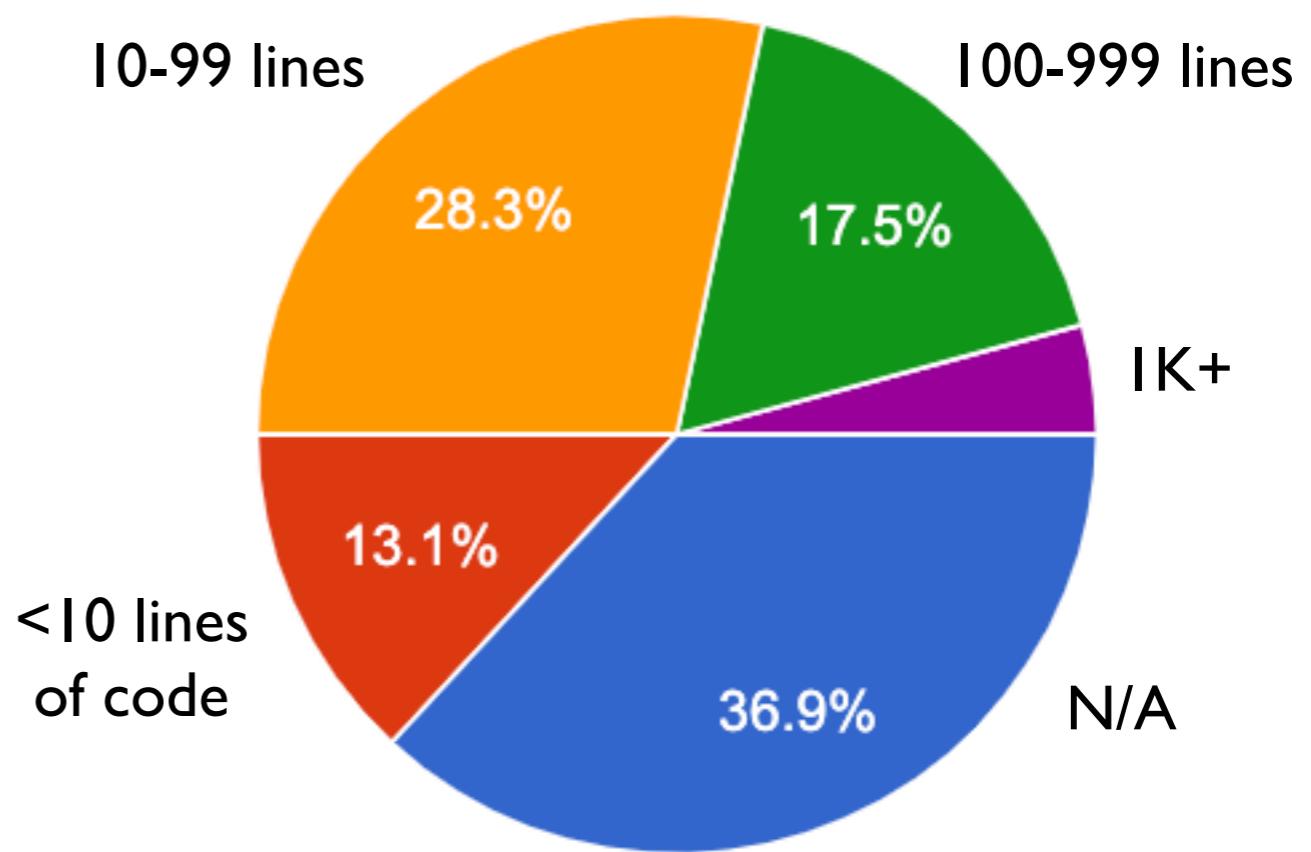
if you see this, it means you're signed in via Gmail instead of your campus email



Some results from Spring 2019...



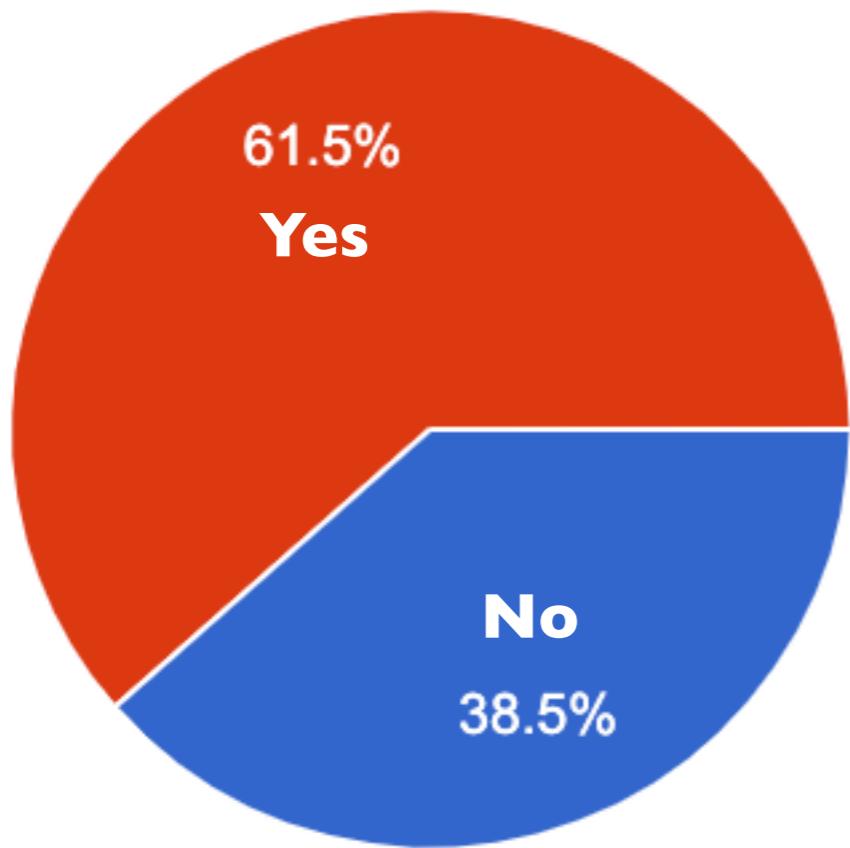
First time taking a CS course?



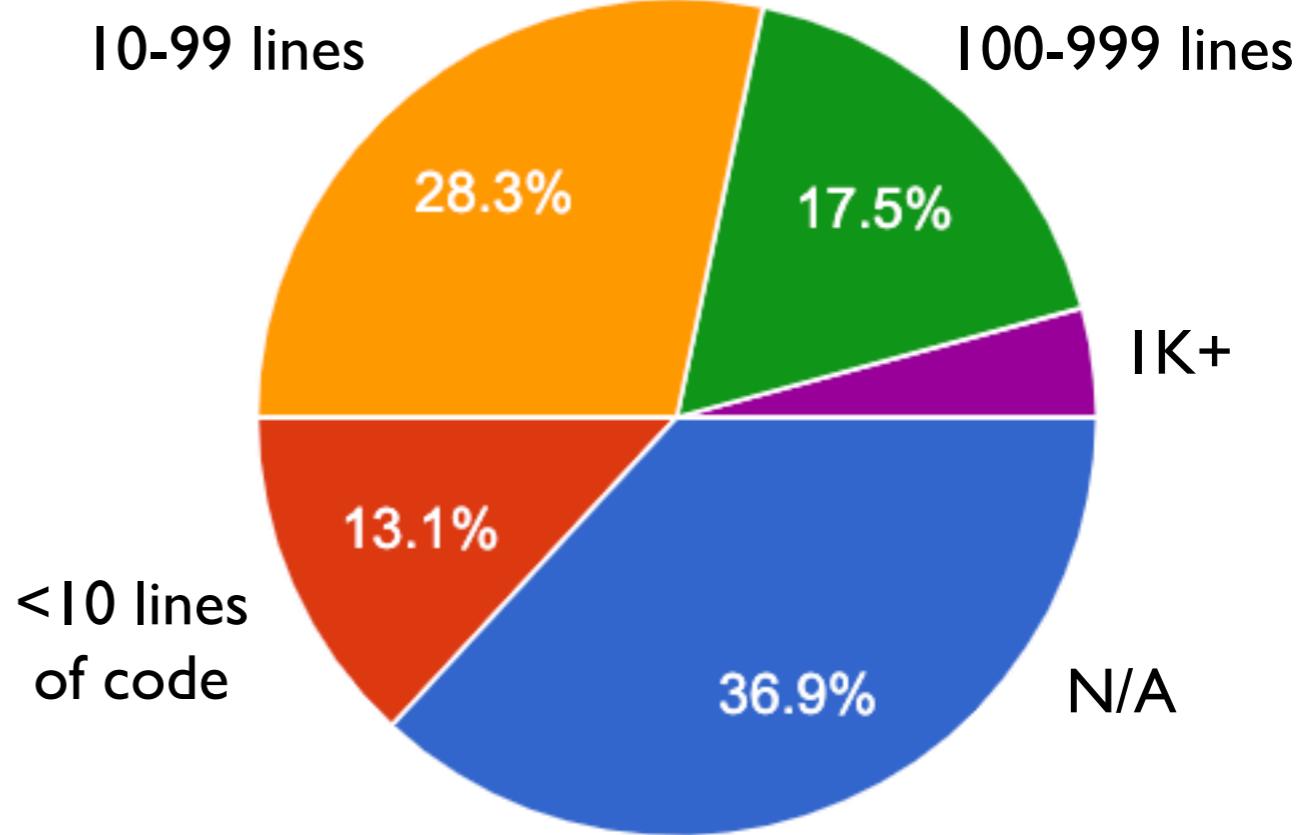
Largest program written prior?

from 548 students

Some results from Spring 2019...



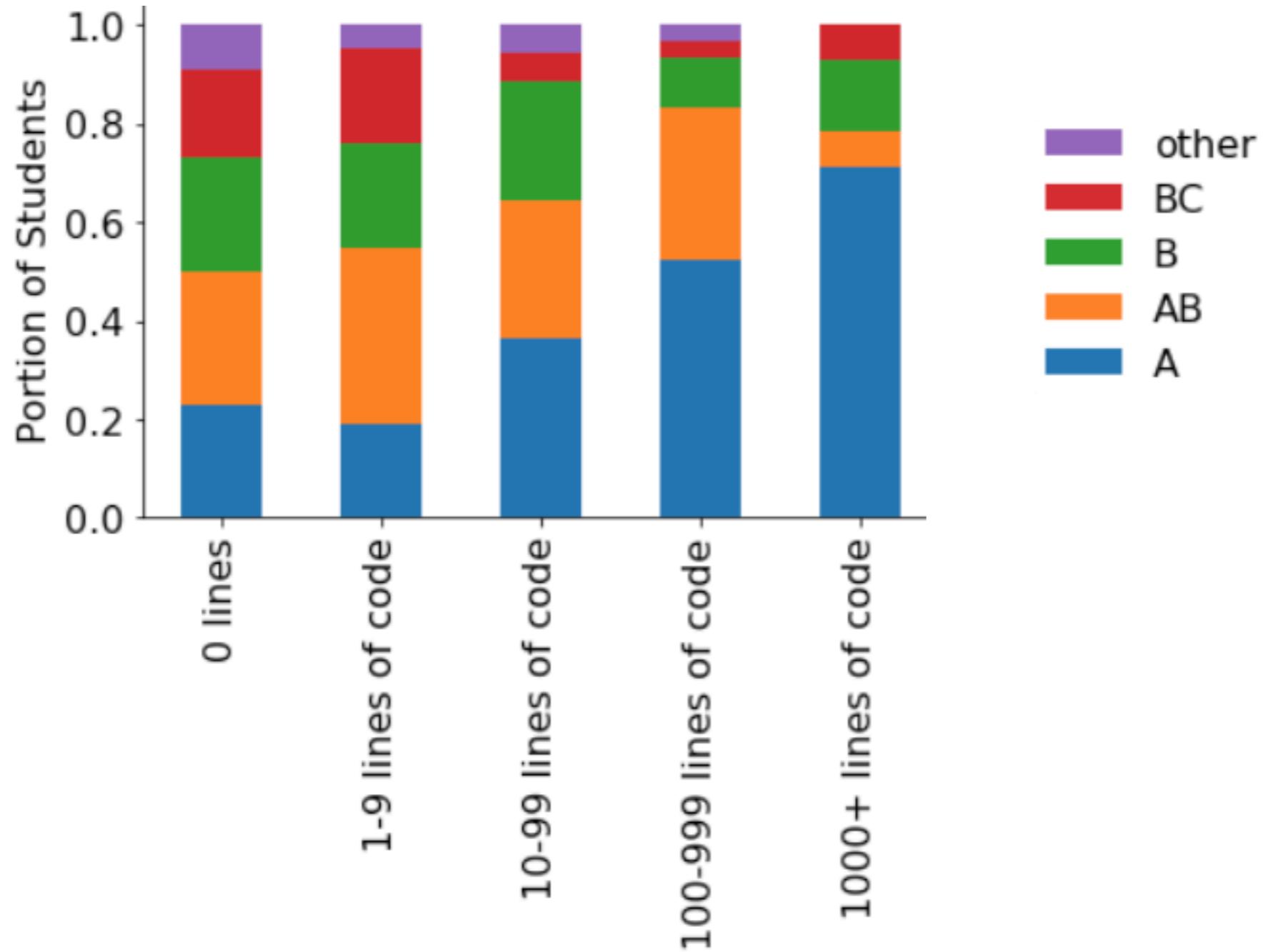
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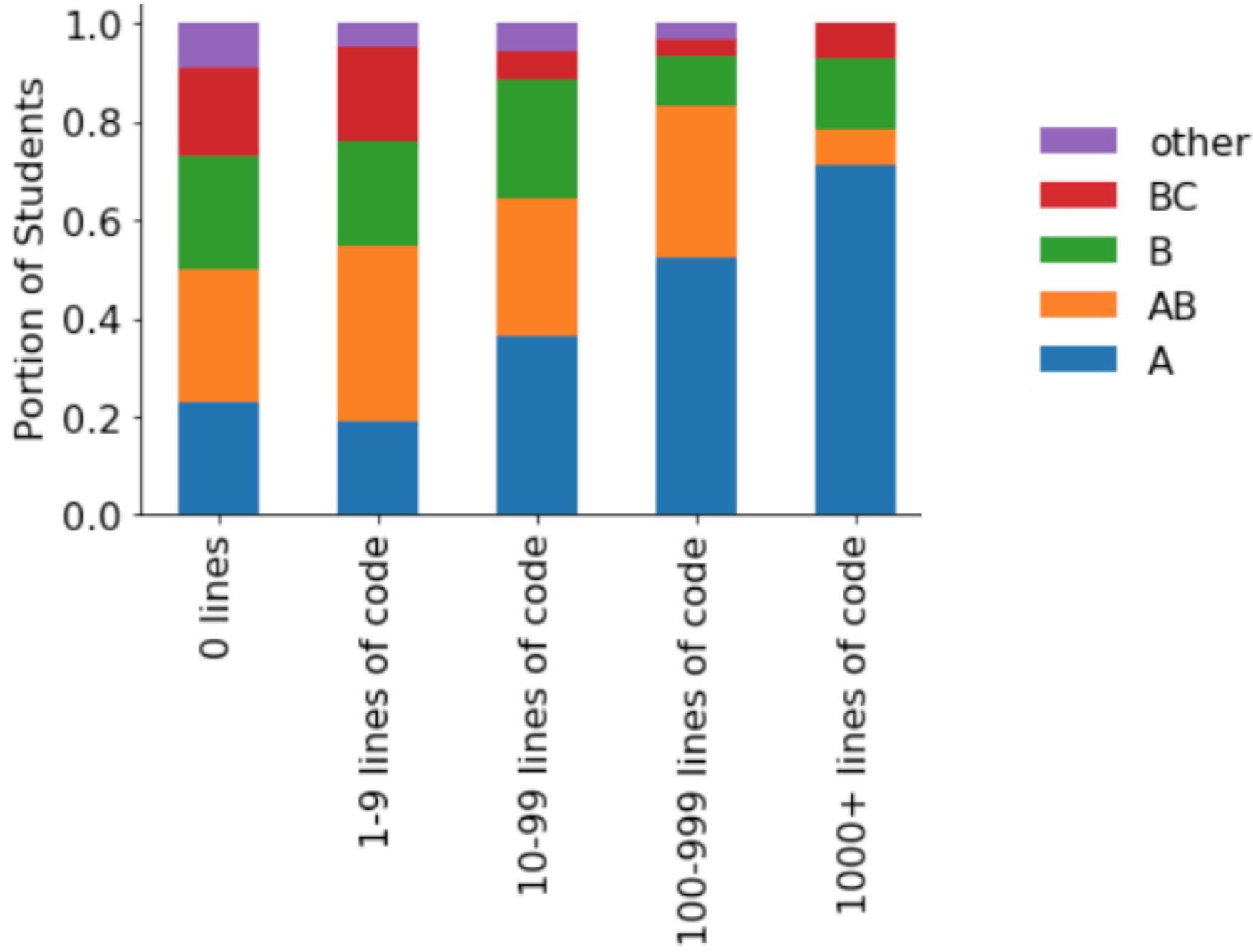
Largest program written prior?

how did students in each group do?

from 548 students



Experience and grades



Some comments on Fall 2018 course evals:

- *I am a senior CS student, this class was very easy for me*
- *Make it significantly easier. None of [us] will ever code again...*
- *Good course, I think there is a good pace for this course, speaking as someone with zero programming experience coming into the class.*

Today's Topics

Introductions

Course overview

- Topics
- Lecture
- Lab
- Readings
- Class communication
- Grades
- Projects
- Exams

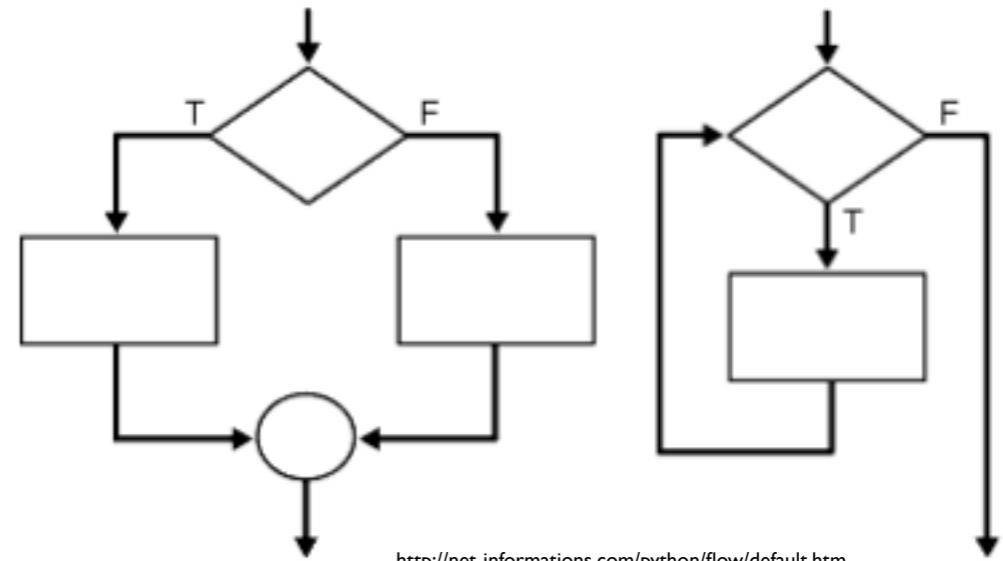
Computer hardware basics

Website

30 | Topics

Part I: Control Flow

- What step is currently executing?
- How to write functions?
- How to conditionally do something?
- How to repeat steps?



<http://net-informations.com/python/flow/default.htm>

Part 2: State

- How to structure lots of data?
- How to save data in files?



Part 3: Data Science

- Tabular data
- Internet
- Databases
- Plotting



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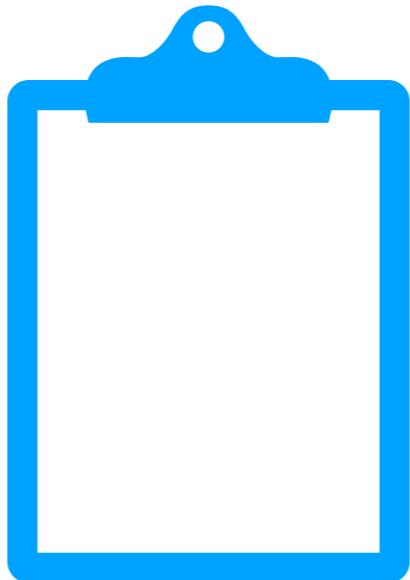
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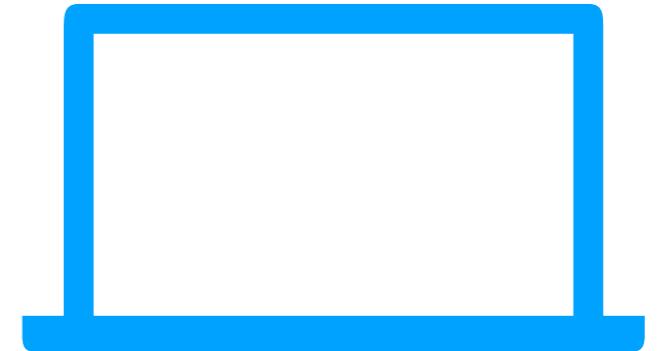
Lecture Style



general concepts



worksheet practice



live coding

Your role

- do **readings** before or after
- feel free to bring your **laptop** along!
(but avoid the temptation to get distracted)
- I love to get **questions**



Thoughts on Attendance...

Suggestions from Course Eval:

*I think one MAJOR thing to do is make lecture **mandatory** [student from F19]*

*Make labs semi **mandatory** [student from S19]*



Feedback Form:

*There was someone in front of me today just **watching movies and buying things** online today in the very front row and it was incredibly distracting as their screen is right in front of the screen you are working on, so I had to be looking at it. I didn't really feel comfortable asking him not to do it again as just another student [student from S19]*



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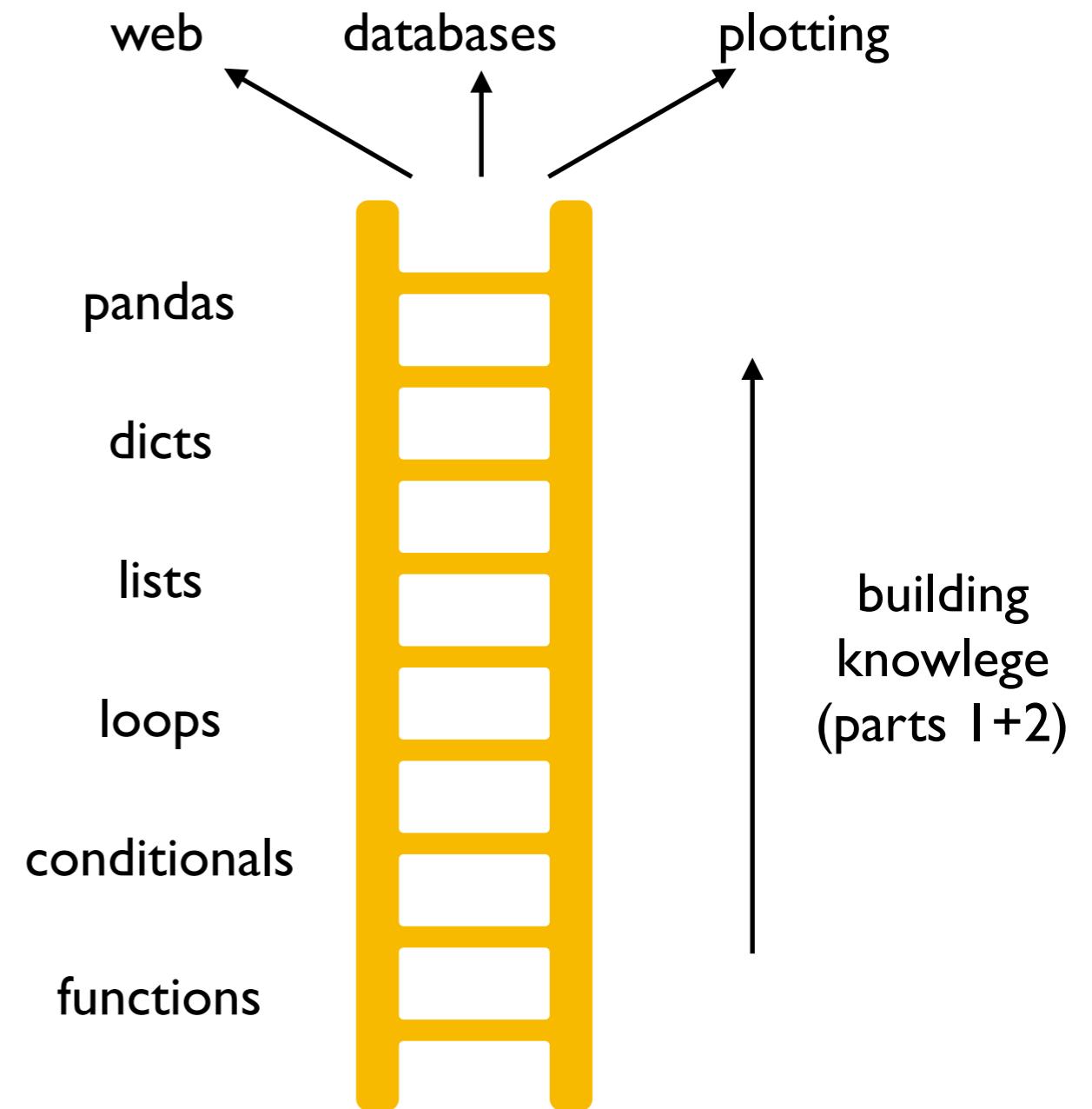
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Lecture rule: *anything you do on your laptop in class must be less interesting than my lectures*

Especially Avoid Holes in Understanding in Parts 1+2 of the course



see Salman Kahn...



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Labs

Format

- 75 minutes on Thu or Fri, leave when you're done
- **self guided**, not graded
- lab document will be posted each week
- **do the lab before starting the project!**
- get help with projects+content too! (just ask a TA/mentor)

People

- best to do lab docs with a partner
- 1-2 TAs will be there to answer questions

Computers

- bring your laptop!
- use backup lab computers if necessary

we will have labs this first week

(also, get any help needed installing Python during this one)

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Computer hardware basics

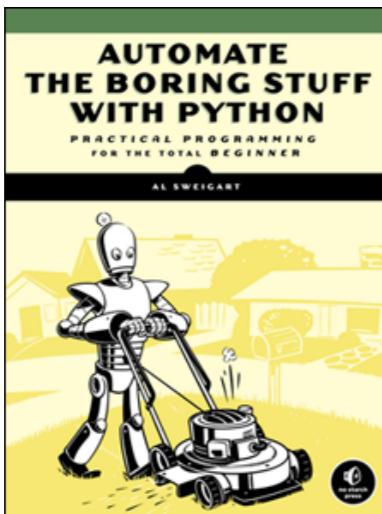
Website

Readings (all free!)



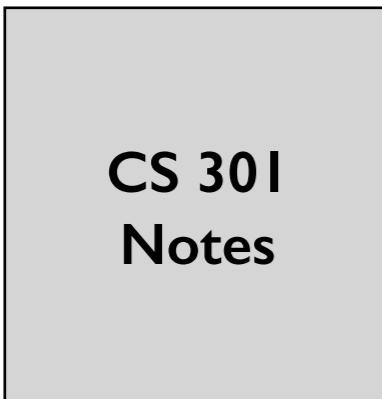
Think Python, 2nd Edition

- Allen B. Downey
- Assumes no programming background
- It's very concise
- Get the 2nd edition, which is for **Python 3!**



Automate the Boring Stuff

- Al Sweigart
- Useful for some more advanced topics related to using data



Course Notes

- 301 instructors
- Mostly for data science part of class

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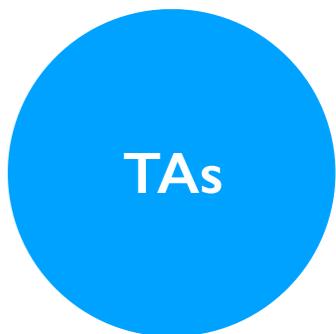
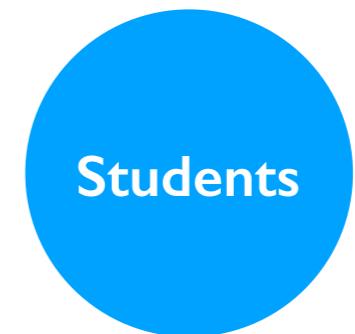
Communication is CS 301

Good communication is critical for a class of this size

- Who needs to communicate: students, TAs (+mentors!), instructors

Besides direct email, we'll use five communication tools

- Piazza
- Email
- Feedback Forms
- Project Submission
- Canvas



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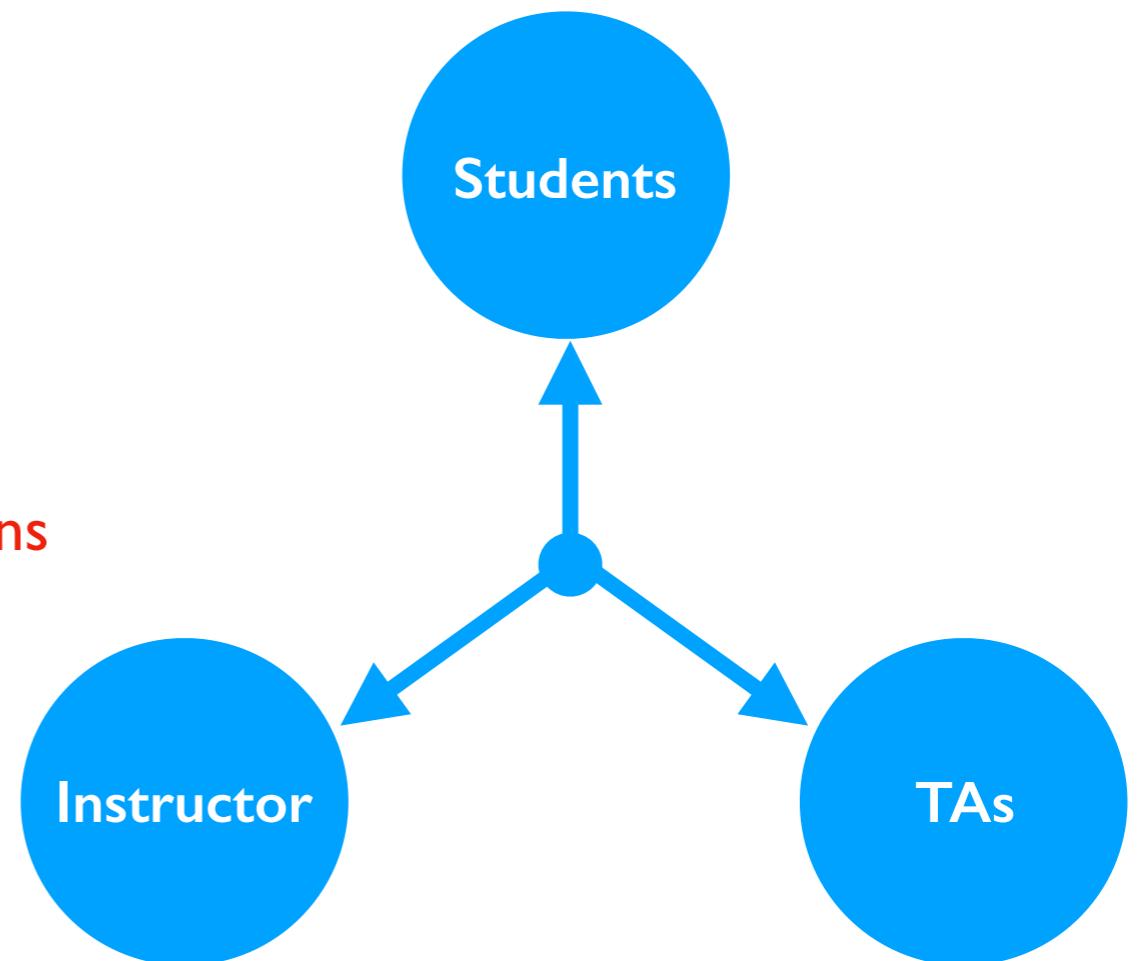
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Rule 1: don't post more than 5 lines of code

Rule 2: check other posts and project corrections
to avoid repeat questions

Note: we'll keep a pinned post of current
office hours here



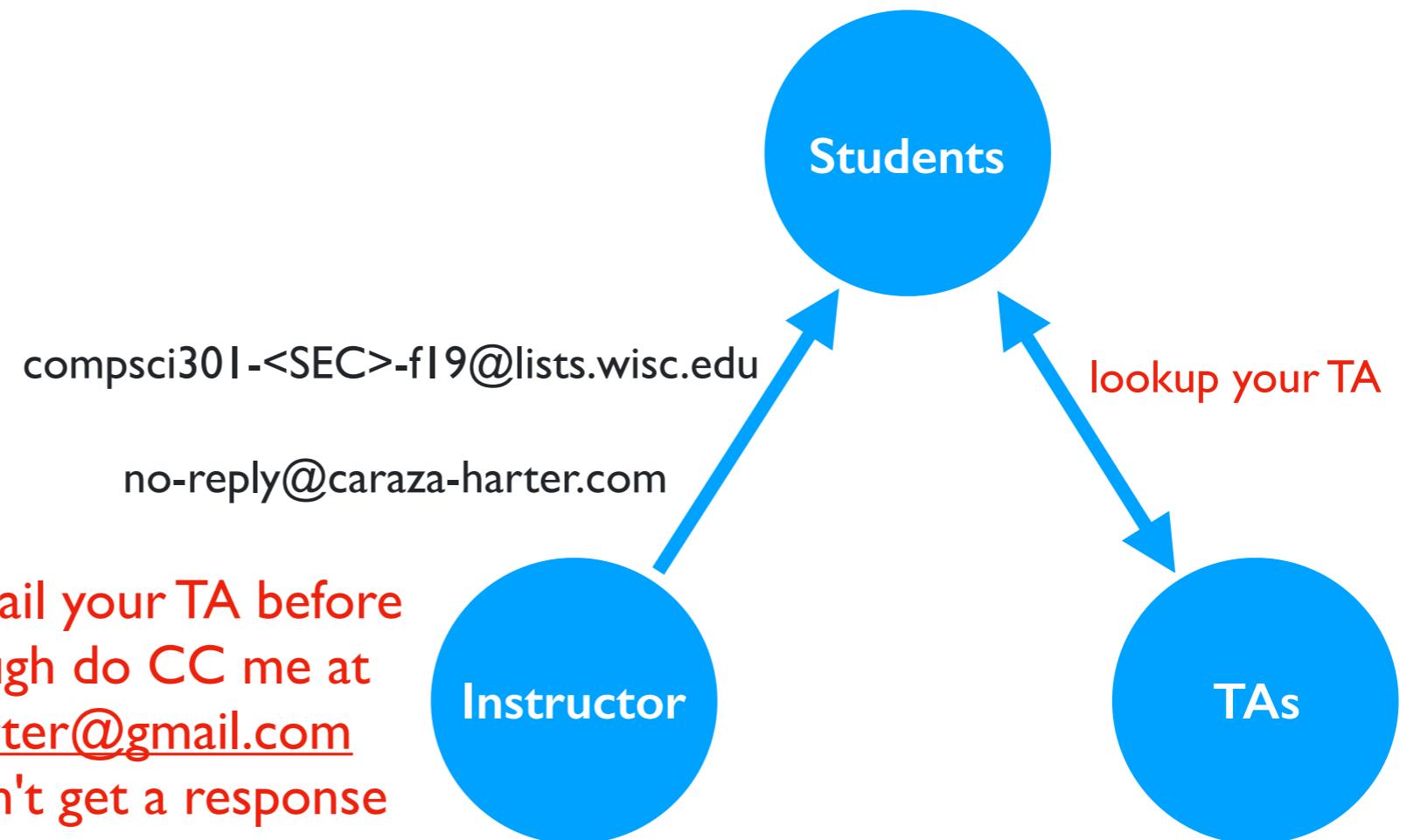
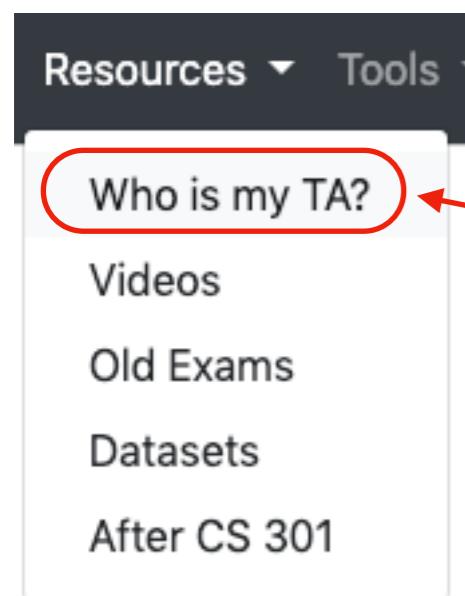
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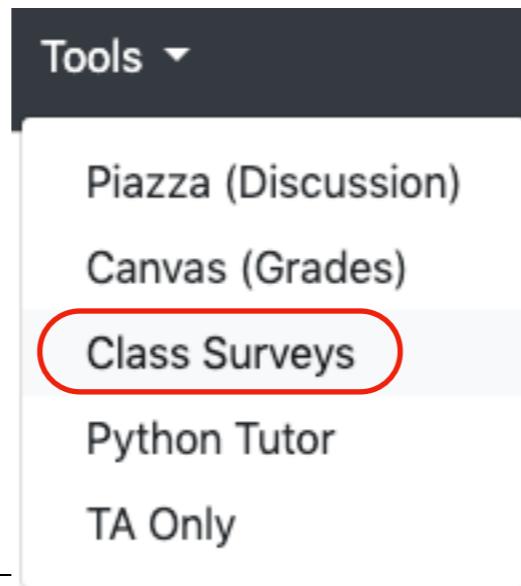
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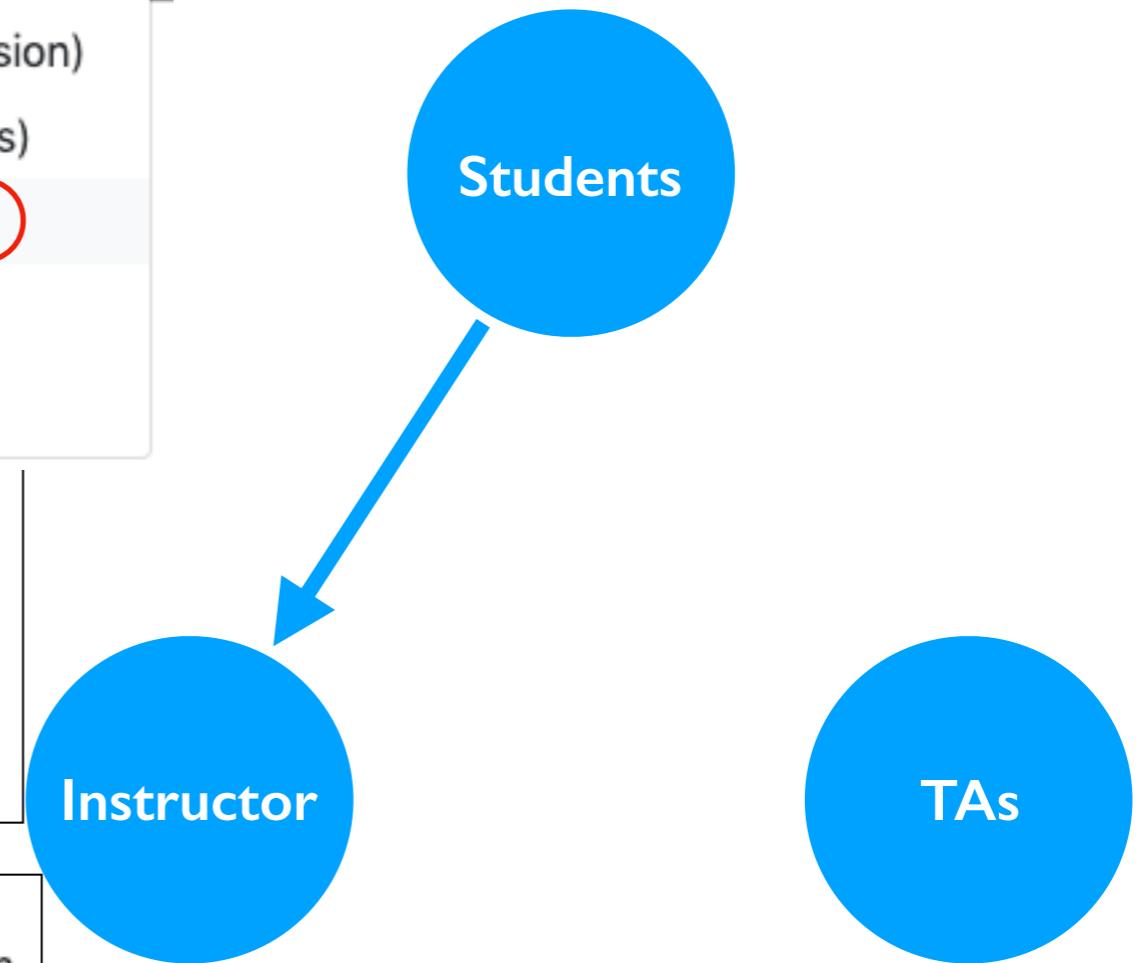
Besides direct email, we'll use five communication tools

- Piazza
- Email
- **Feedback Forms**
- Project Submission
- Canvas



2. Feedback Form. If you have any issues with the class or suggestions for improvement, please let us know sooner rather than later; we may be able to make changes more rapidly than you might imagine. This is optionally anonymous, but it's always nice to know who you are (sometimes it makes sense to have followup conversations).

4. Thank You! Has a TA or mentor provided exceptional help, during office hours, Shelf hours, lab, etc? Thank them by filling out this form, and I'll pass along the feedback.



Communication is CS 301

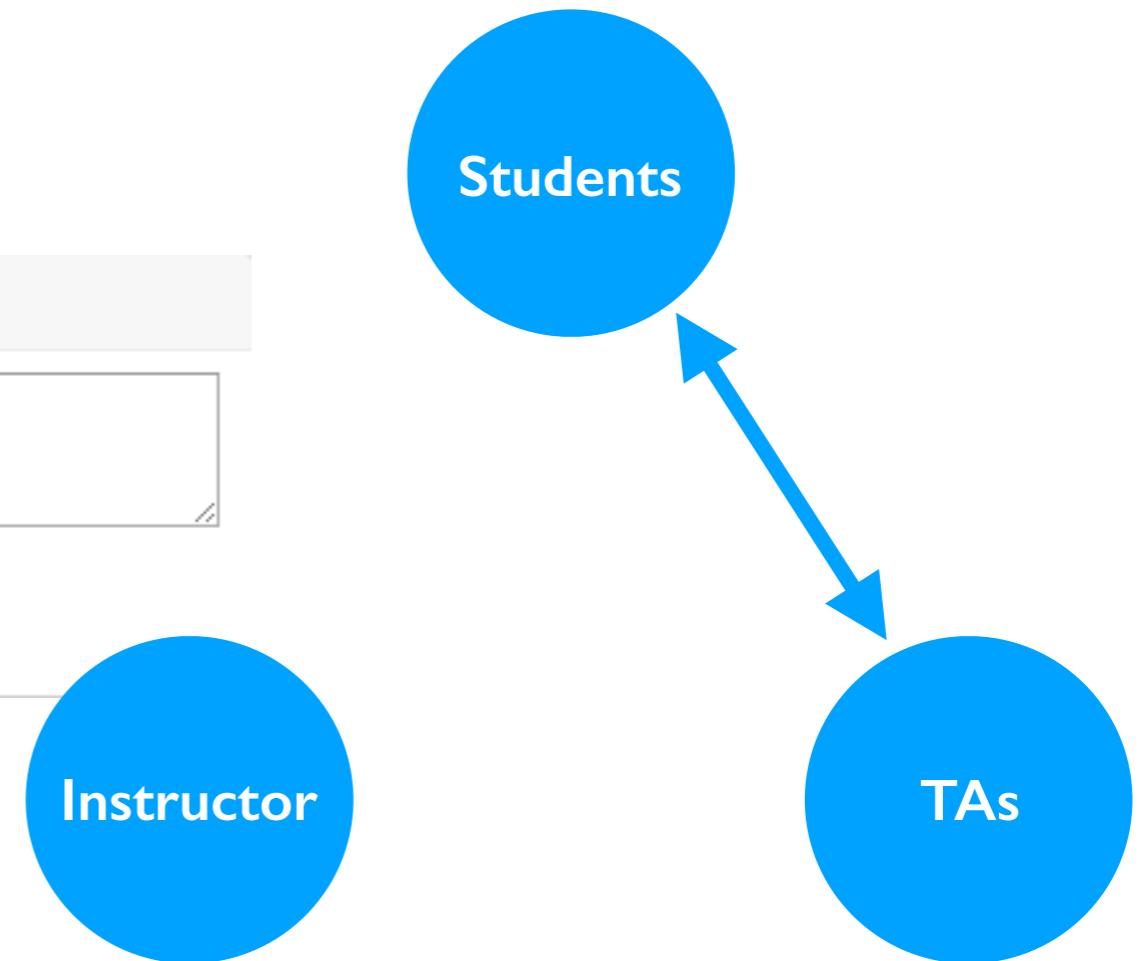
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Besides direct email, we'll use five communication tools

- Piazza
- Email
- Feedback Forms
- Project Submission
- Canvas

The screenshot shows a user interface for submitting feedback. At the top, there's a navigation bar with 'Syllabus', 'Projects' (which is highlighted with a red oval), and 'Resources'. Below the navigation is a 'Comment' input field containing 'Good work'. Underneath the comment field are three buttons: 'OK', '👎', and '👍'. Further down, there's a 'Choose File' button with 'No file chosen' next to it. A question at the bottom asks 'is any specific kind of feedback you're interested in?'. The entire interface is set against a light gray background.



Communication is CS 301

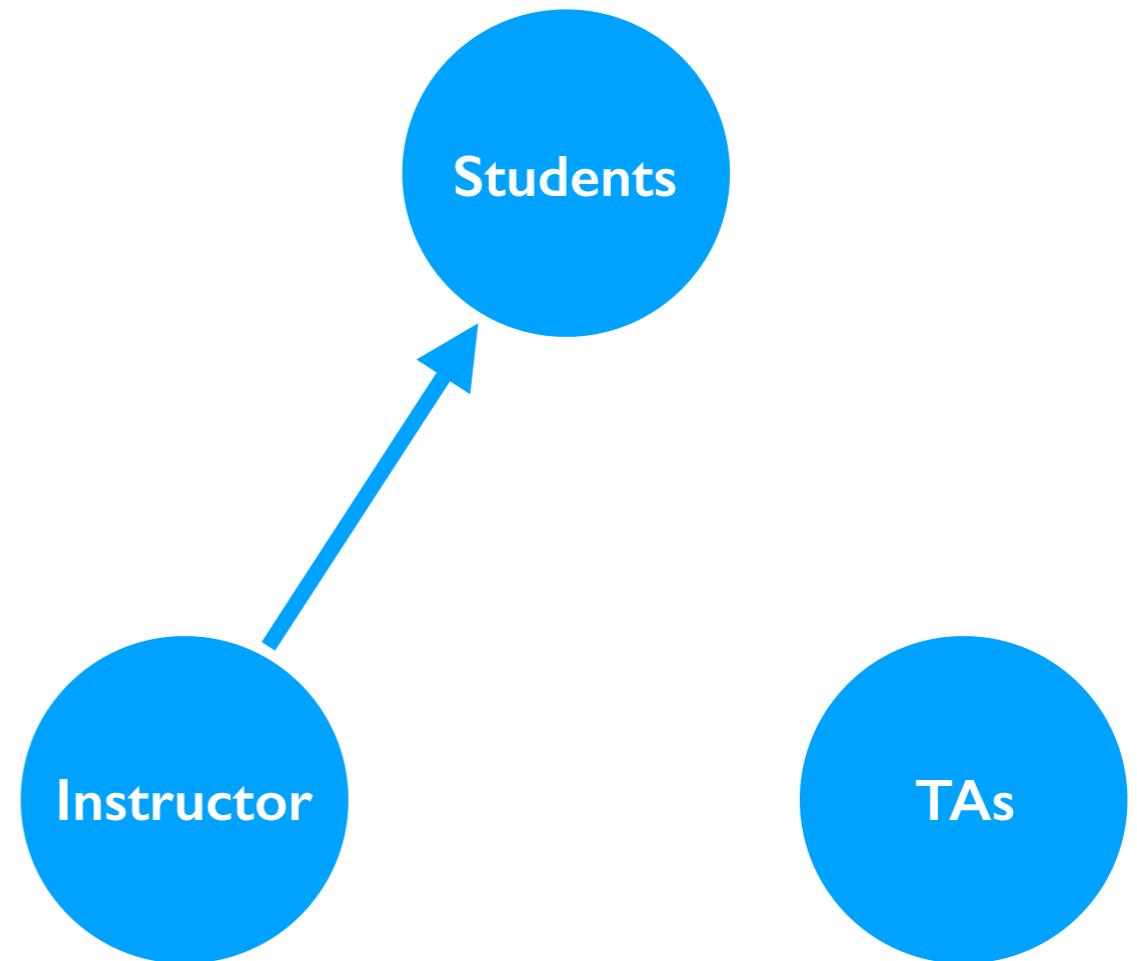
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- **Canvas**

our Canvas is
ONLY for grades



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- **Grades**
- Projects
- Exams

Computer hardware basics

Website

Grades

49% - programming projects

- **10 projects**, not evenly weighted
- we'll share grading tests with you - **avoid surprise**
- learning to program is the most import part of the course

50% - exams

- 15% midterm 1 (evening)
- 15% midterm 2 (evening)
- 20% final
- finalized times coming soon

1% - participation

- filling surveys, following directions, other

The Final Curve

The curve will be set at the end of the semester, based on sum of all points earned.

I try to keep the grade distribution similar across semesters:
<https://registrar.wisc.edu/grade-reports/>

I'll tweak to minimize students on the margin.

Guarantees:

- at least 95% guarantees an **A**
- at least 85% guarantees a **B** (or better)
- at least 70% guarantees a **C** (or better)
- at least 60% guarantees a **D** (or better)

Grades

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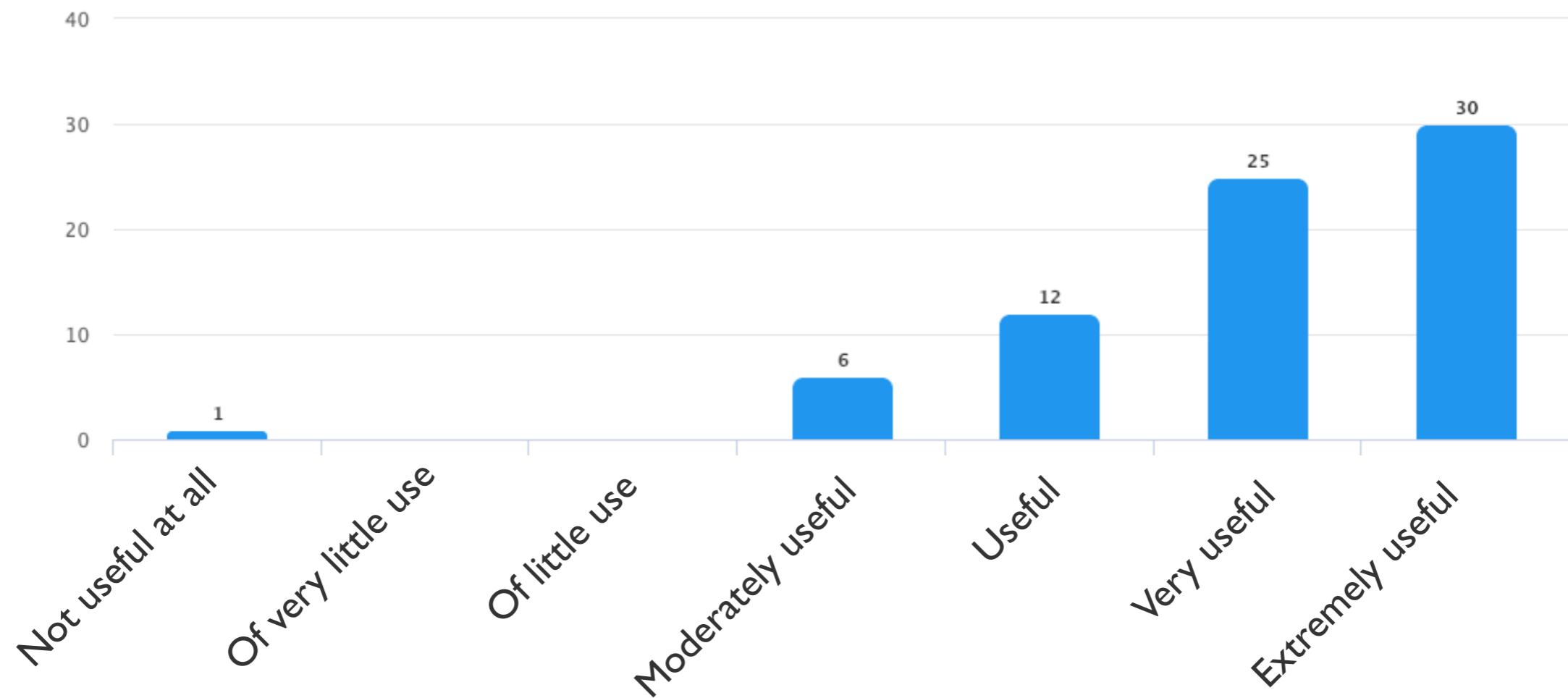
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Prior student reaction to projects

Projects: How useful were projects to your learning?



Projects are the heart and soul of CS 301

Project Overview

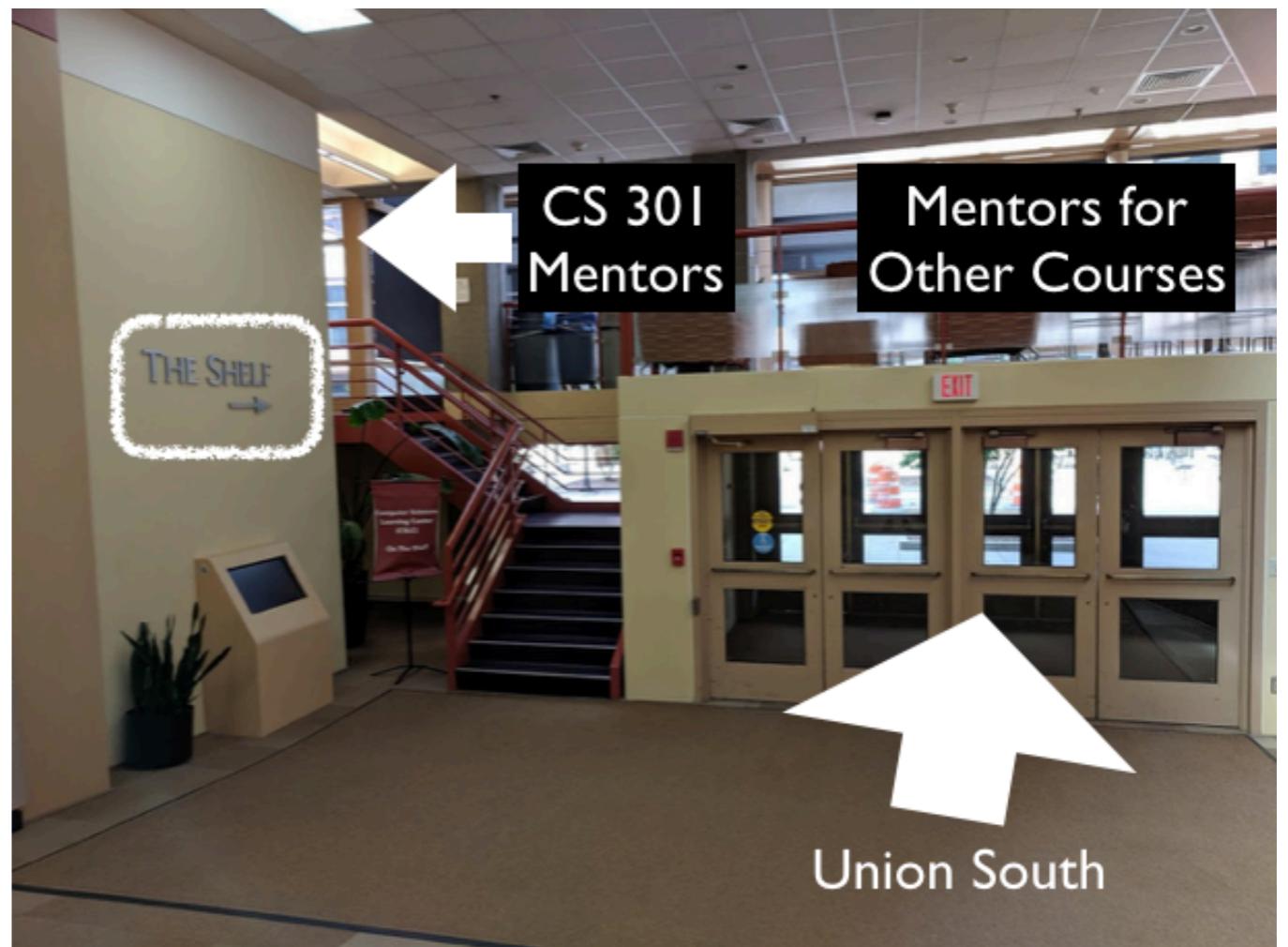
Nearly all projects will relate to some dataset

Timeline

- Projects will be due most weeks, on **Wed, at midnight**
- You get 7 late days, use them wisely!
- Contact us about any issues

Getting help

- Piazza/email
- Lab sessions
- Instructor or TA office hours
- **Shelf Hours**
 - Sun (2-8pm)
 - Mon-Wed (3-9pm)



Pair Programming

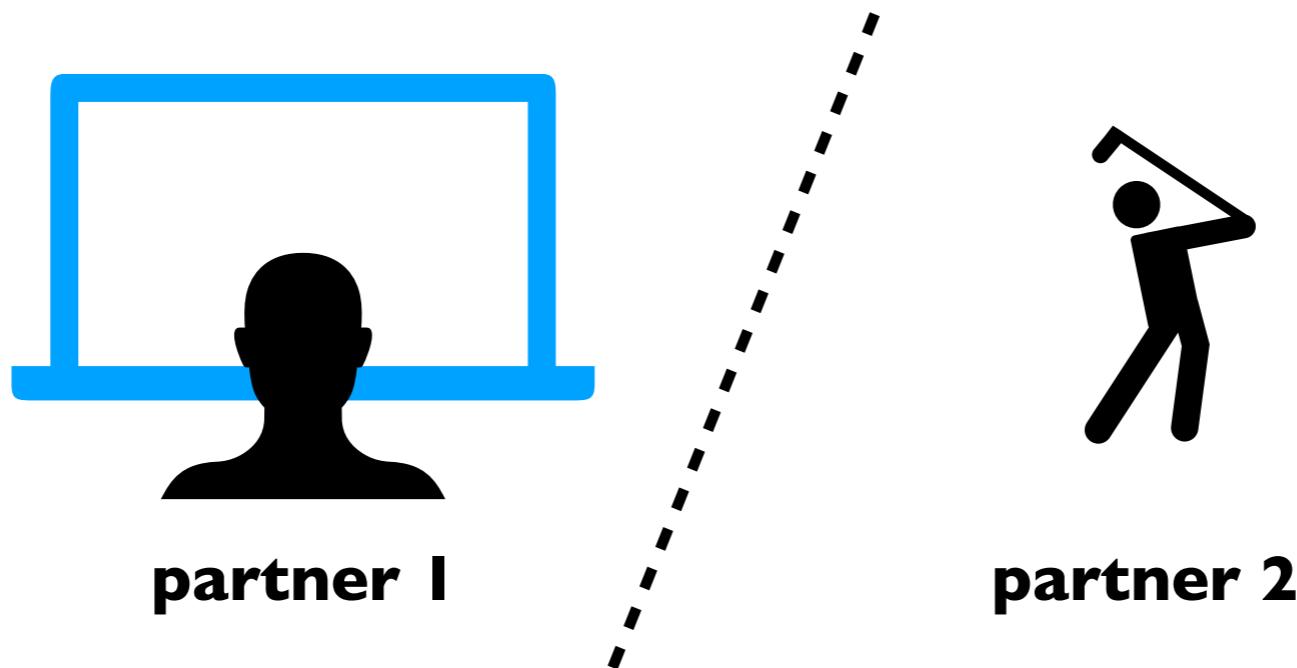
You can optionally work in pairs of two

- Partnerships across sections allowed
- Switch partners between projects (or keep with same partner)

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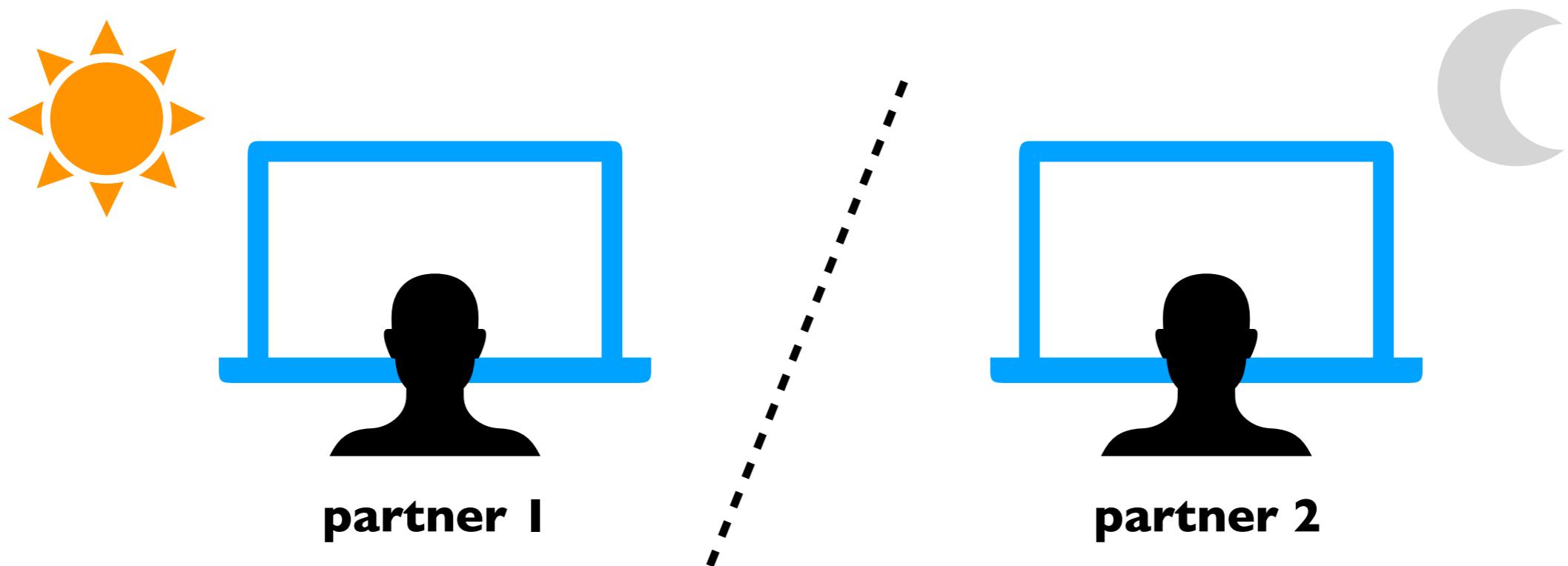


bad: partners don't share work

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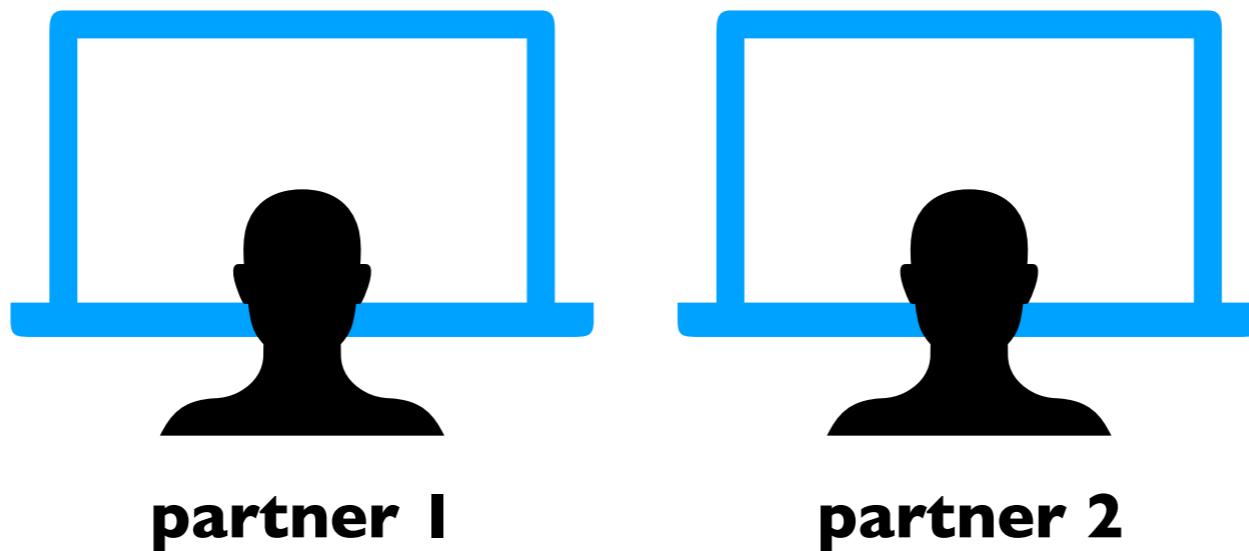


bad: working on different parts at different times

Pair Programming

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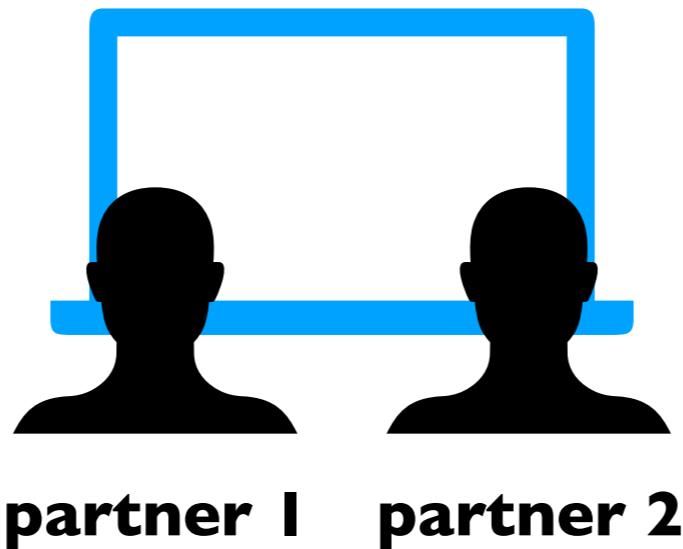


better: working alongside each other

Pair Programming

You can optionally work in pairs of two

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- Switch partners between projects (or keep with same partner)



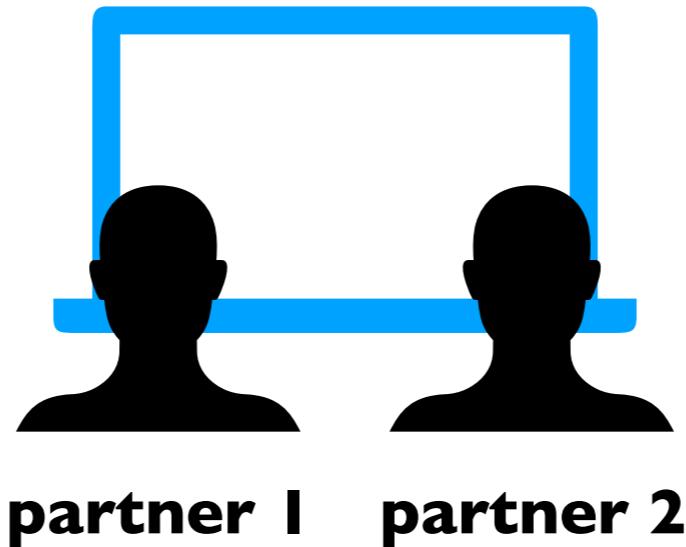
partner 1 partner 2

best: working on same computer

Pair Programming

You can optionally work in pairs of two

- Partnerships across sections allowed
- Switch partners between projects (or keep with same partner)



partner 1 partner 2

Suggestions

- Take turns coding (don't be greedy/aggressive!)
- One person types, other makes suggestions and thinks about design

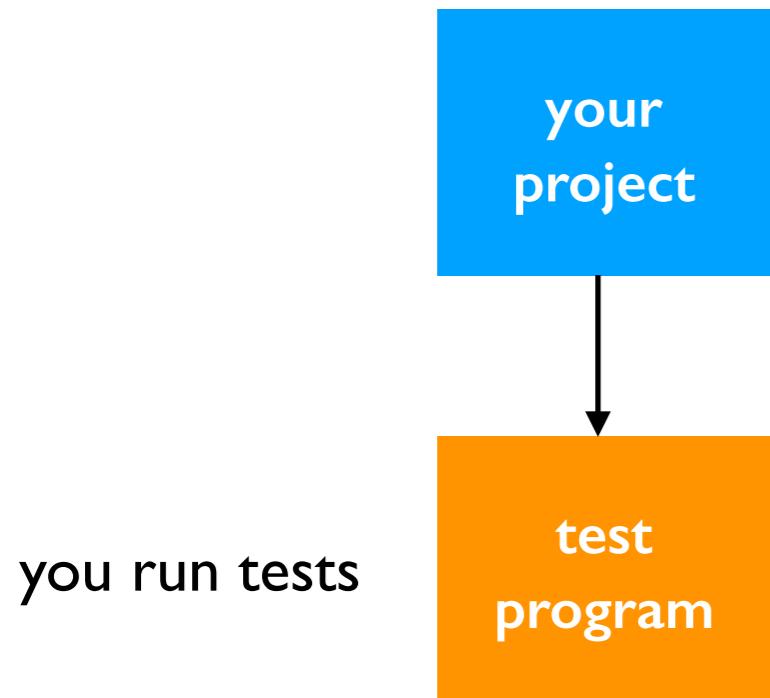
Project Grading

YOU

your
project

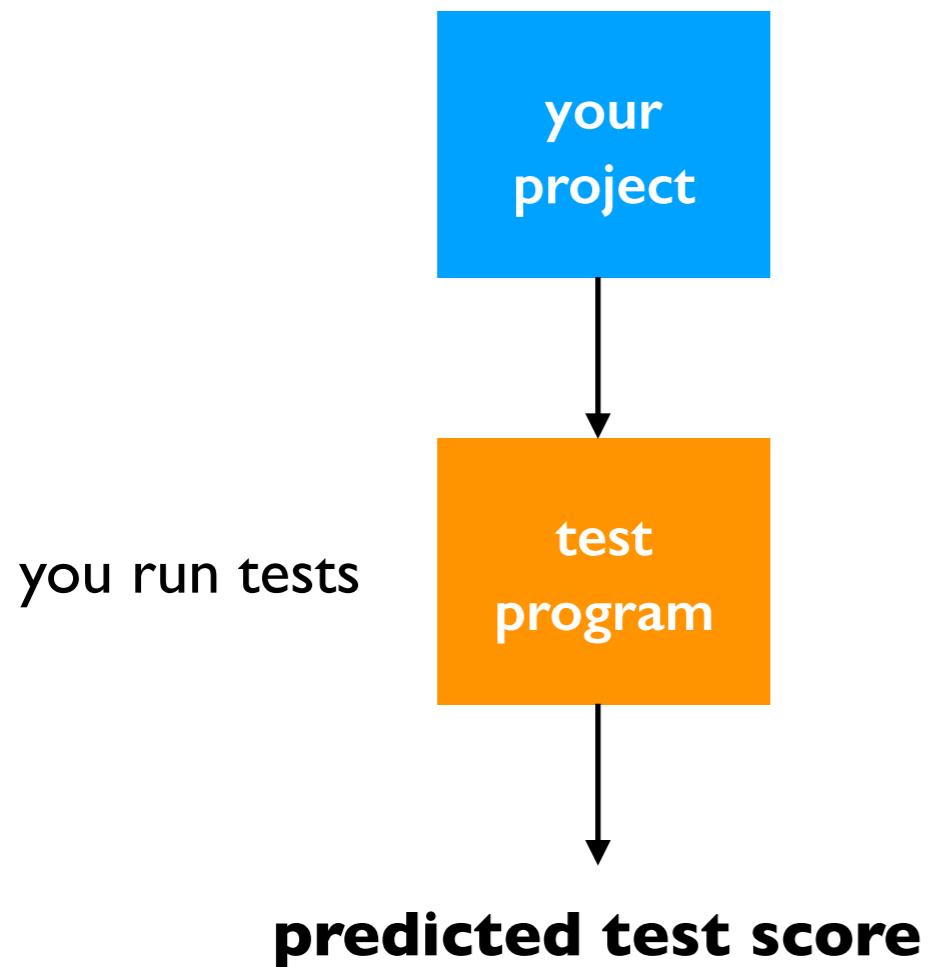
Project Grading

YOU

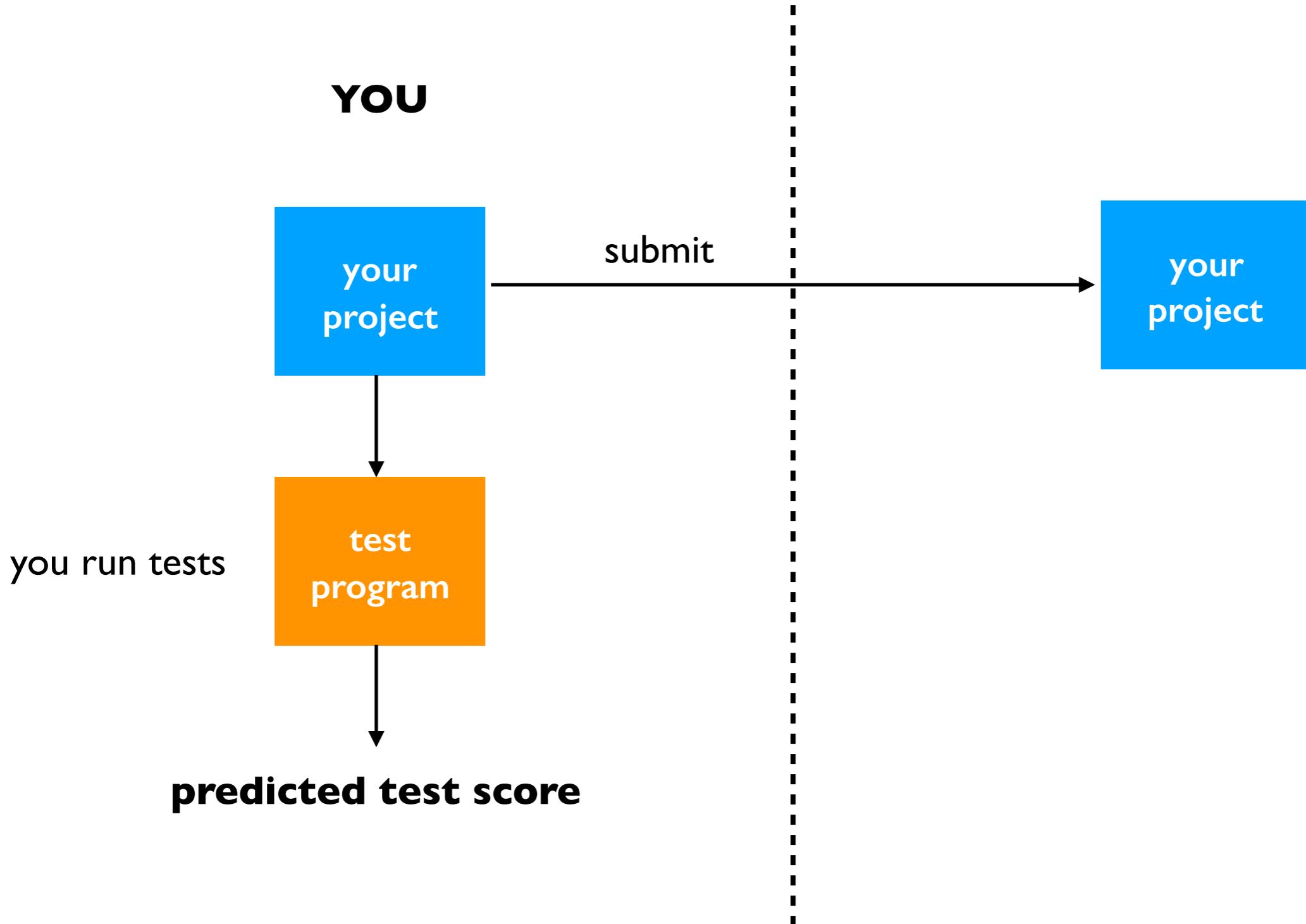


Project Grading

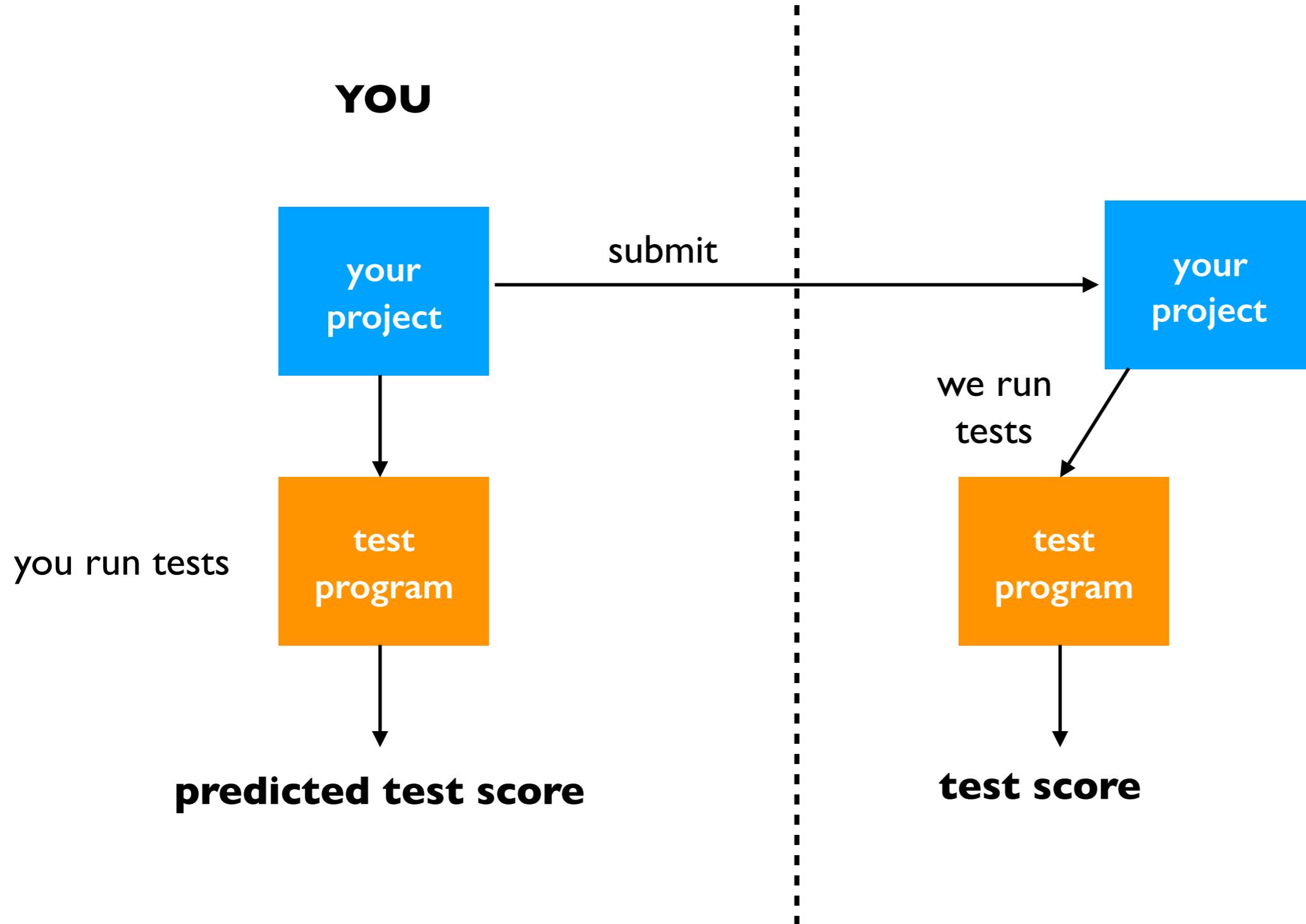
YOU



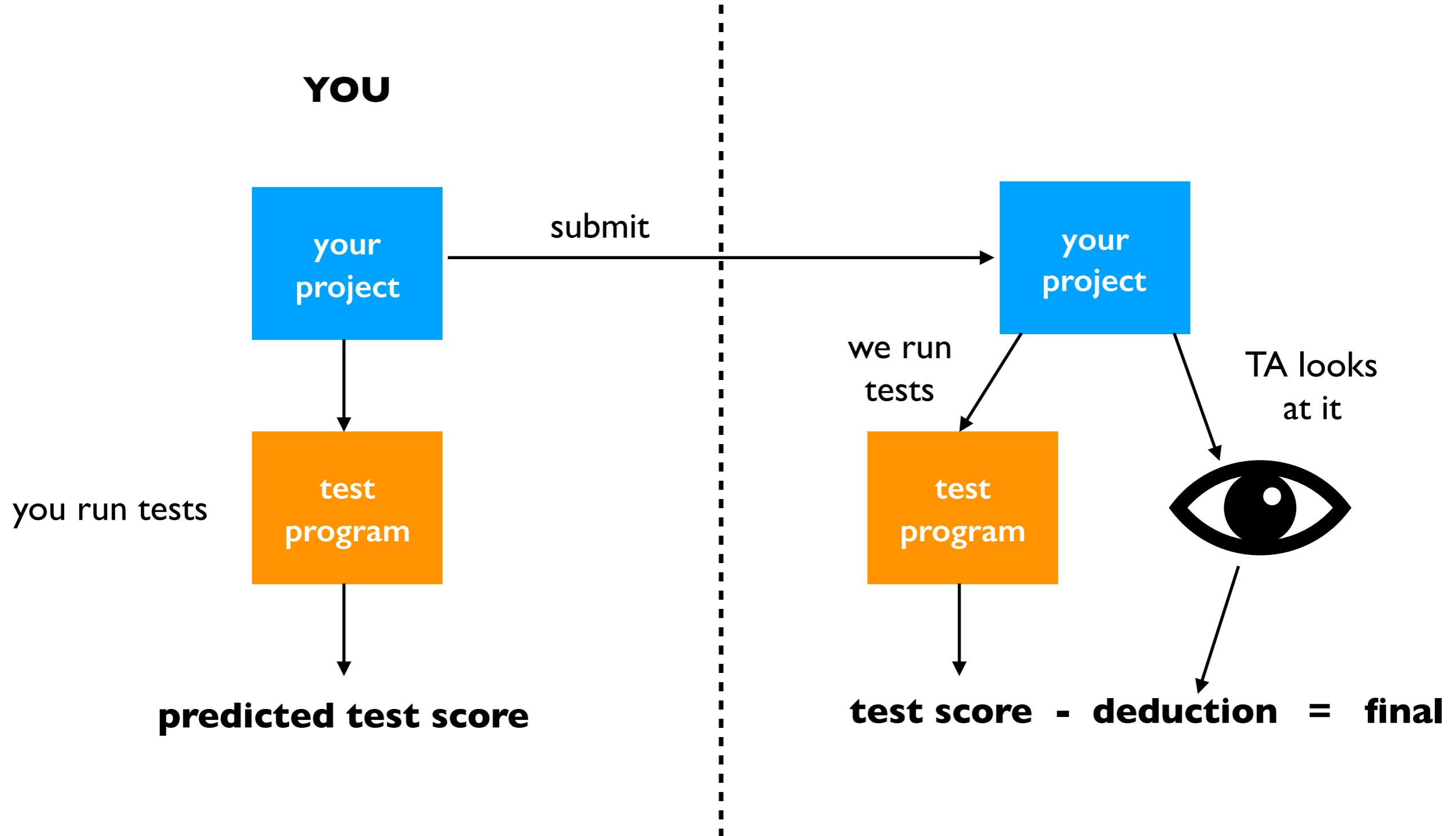
Project Grading



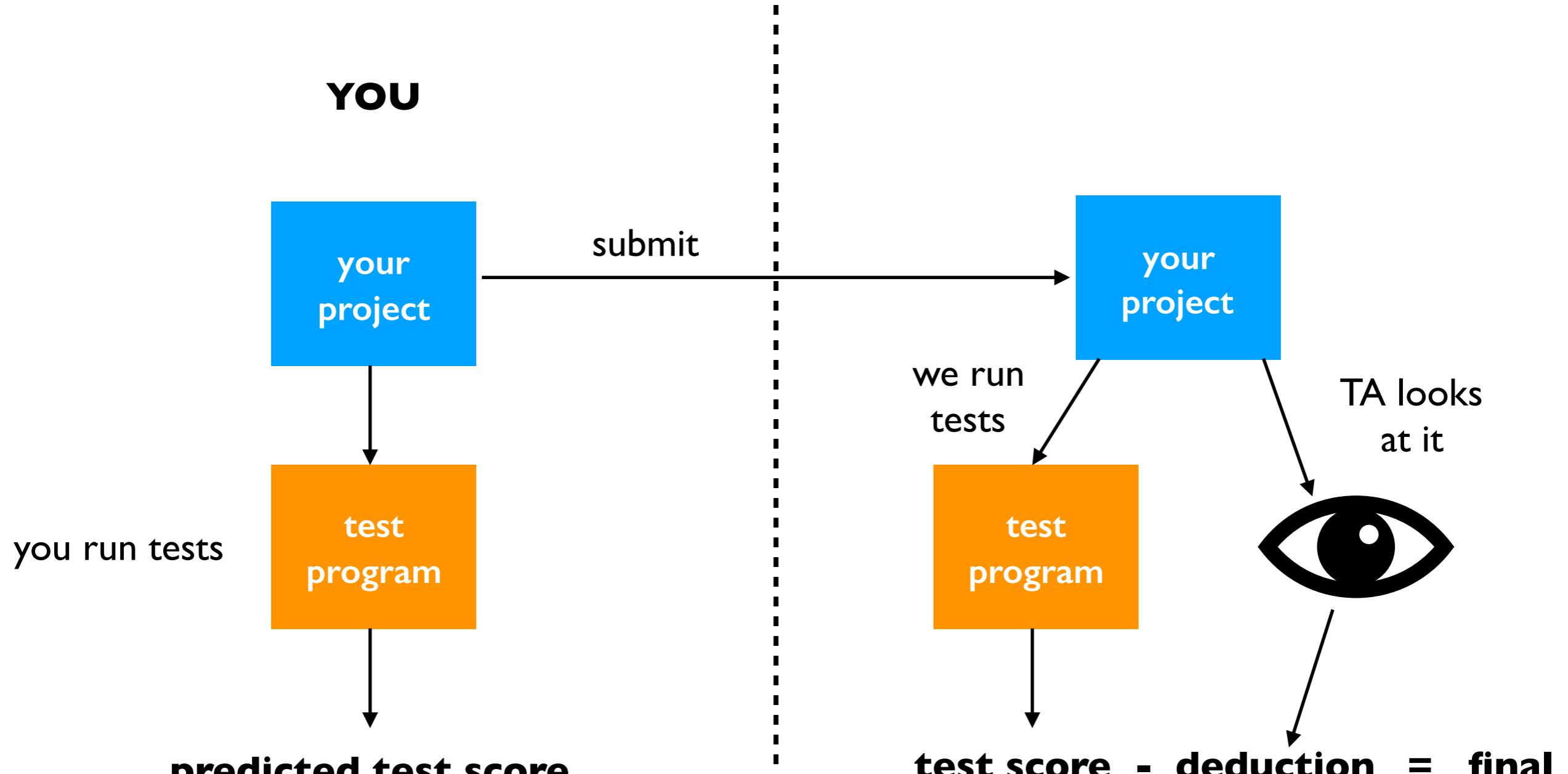
Project Grading



Project Grading



Project Grading

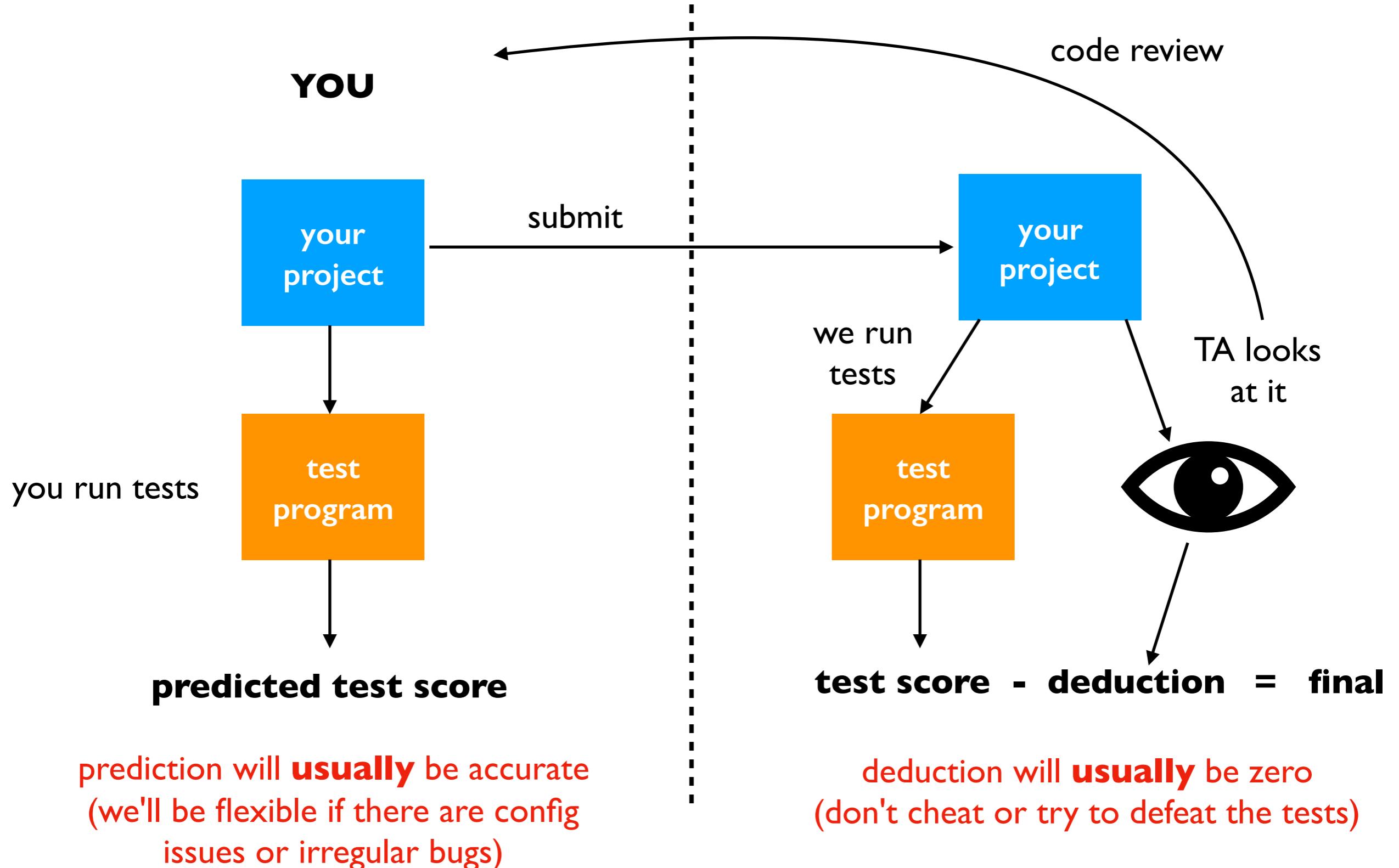


prediction will **usually** be accurate
(we'll be flexible if there are config
issues or irregular bugs)

deduction will **usually** be zero
(don't cheat or try to defeat the tests)

Project Grading

feedback is mostly about how to do things better or more simply (valuable even if you score 100%)



Today's Topics

Introductions

Course overview

- Topics
- Lecture
- Lab
- Readings
- Class communication
- Grades
- Projects
- Exams

Computer hardware basics

Website

Exams

There will be two midterms and one final

- Check website for tentative dates/locations
- One 8.5x11 inch notesheet (both sides, printed or written) only
- Exams will be multiple choice scantron

Contents

- cumulative
- ideally not much time pressure
- one goal: reward project partners doing more work over those slacking

projects ≈ writing code

exams ≈ reading code

Today's Topics

Introductions

Course overview

Computer hardware basics

- Input/Output
- CPU
- Memory
- Storage
- Networking

Website

Today's Topics

Introductions

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Computer hardware basics

- **Input/Output**
- CPU
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Input/Output

I/O (stands for input/output)

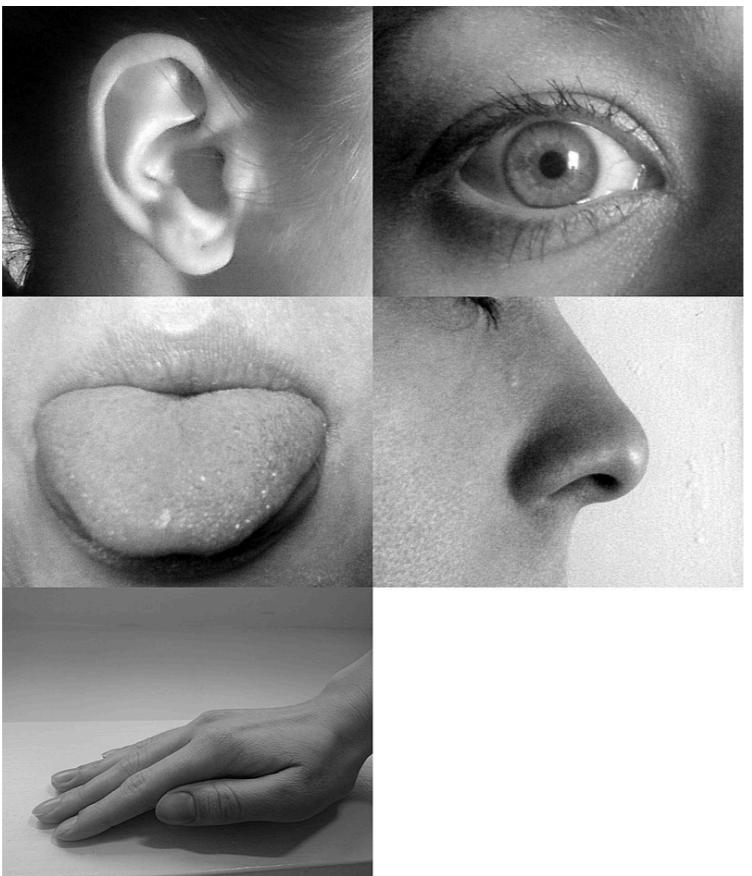
- What are examples for human?

Input/Output

I/O (stands for input/output)

- What are examples for human?

input: senses

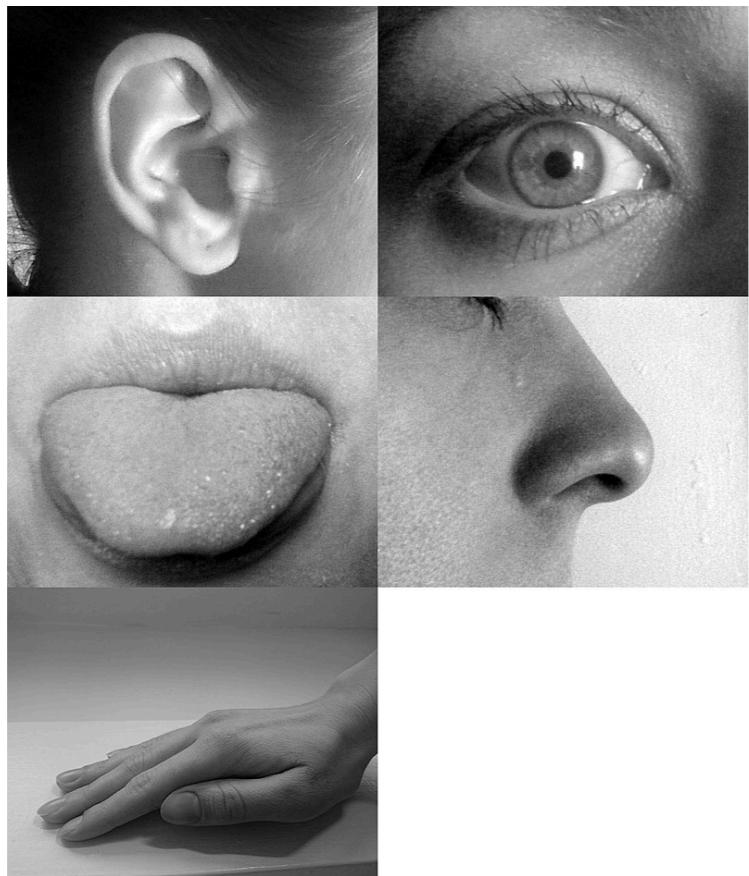


Input/Output

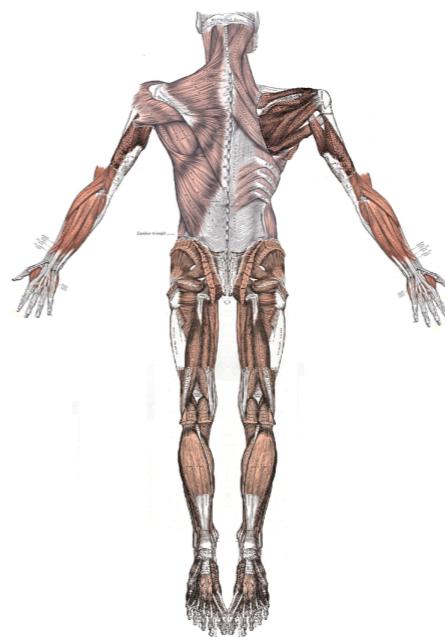
I/O (stands for input/output)

- What are examples for human?

input: senses



output: muscles, voice



<https://jasperproject.github.io/>

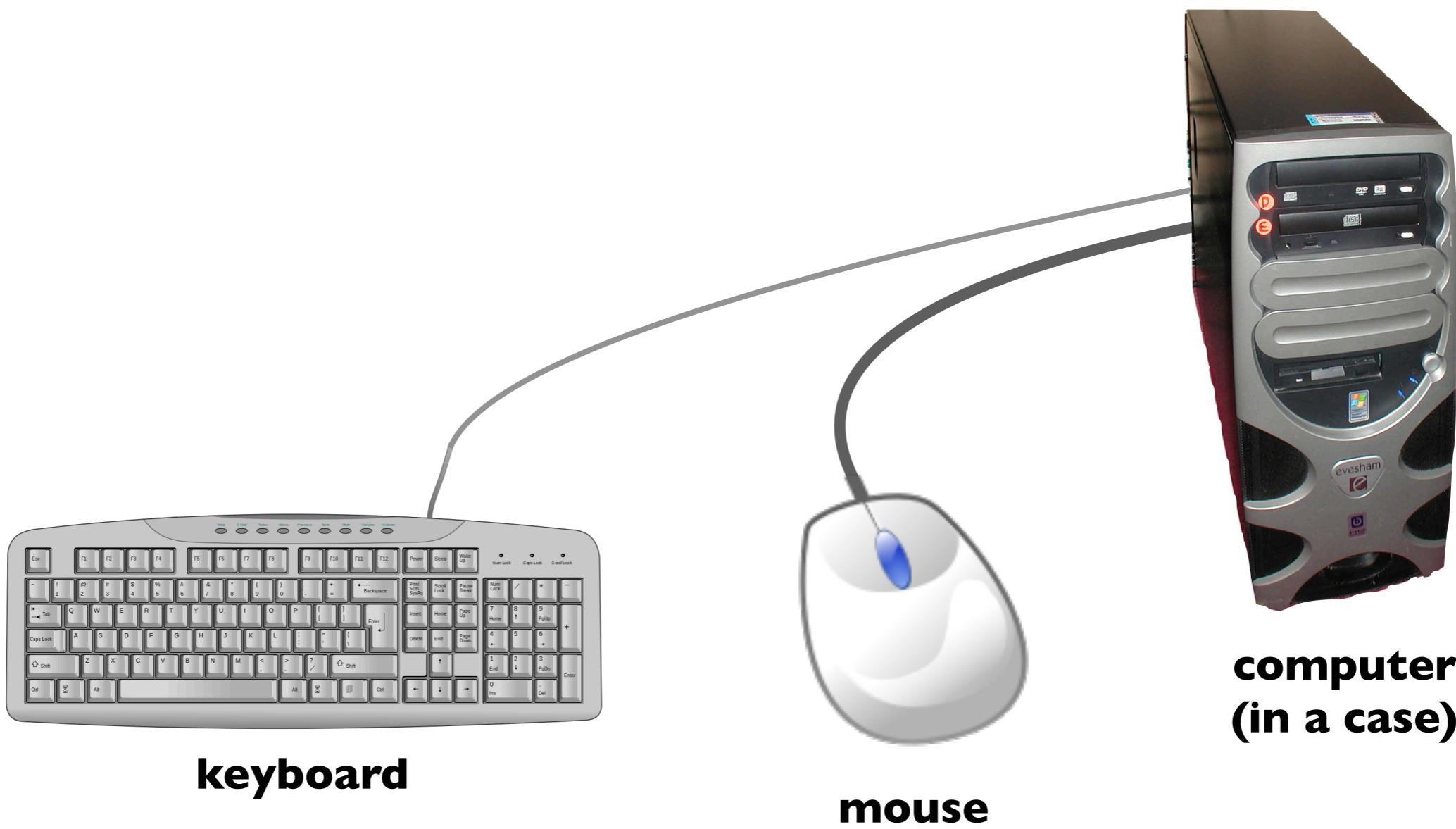
Computer Input/Output

what are some common computer inputs?



**computer
(in a case)**

Computer Input/Output

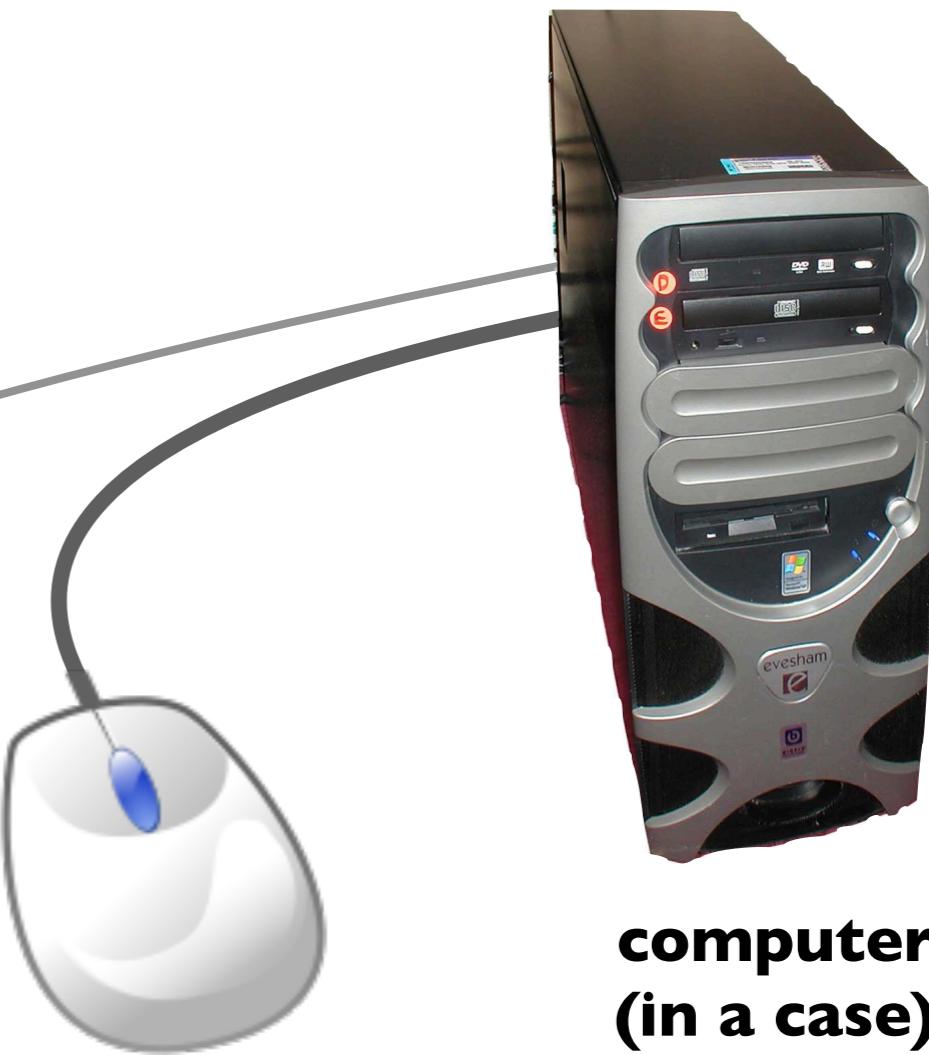


Computer Input/Output

what are some common compute outputs?



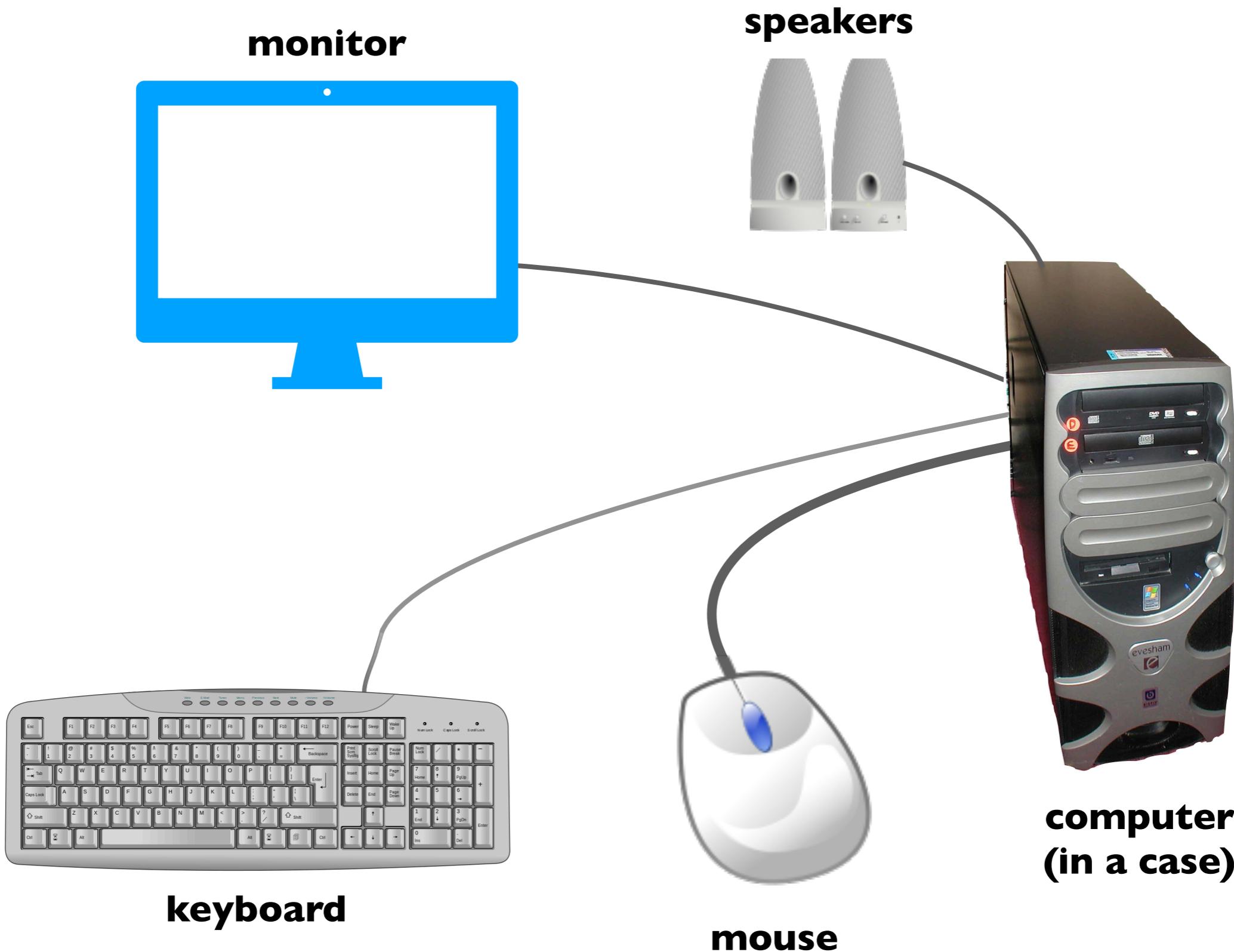
keyboard



mouse

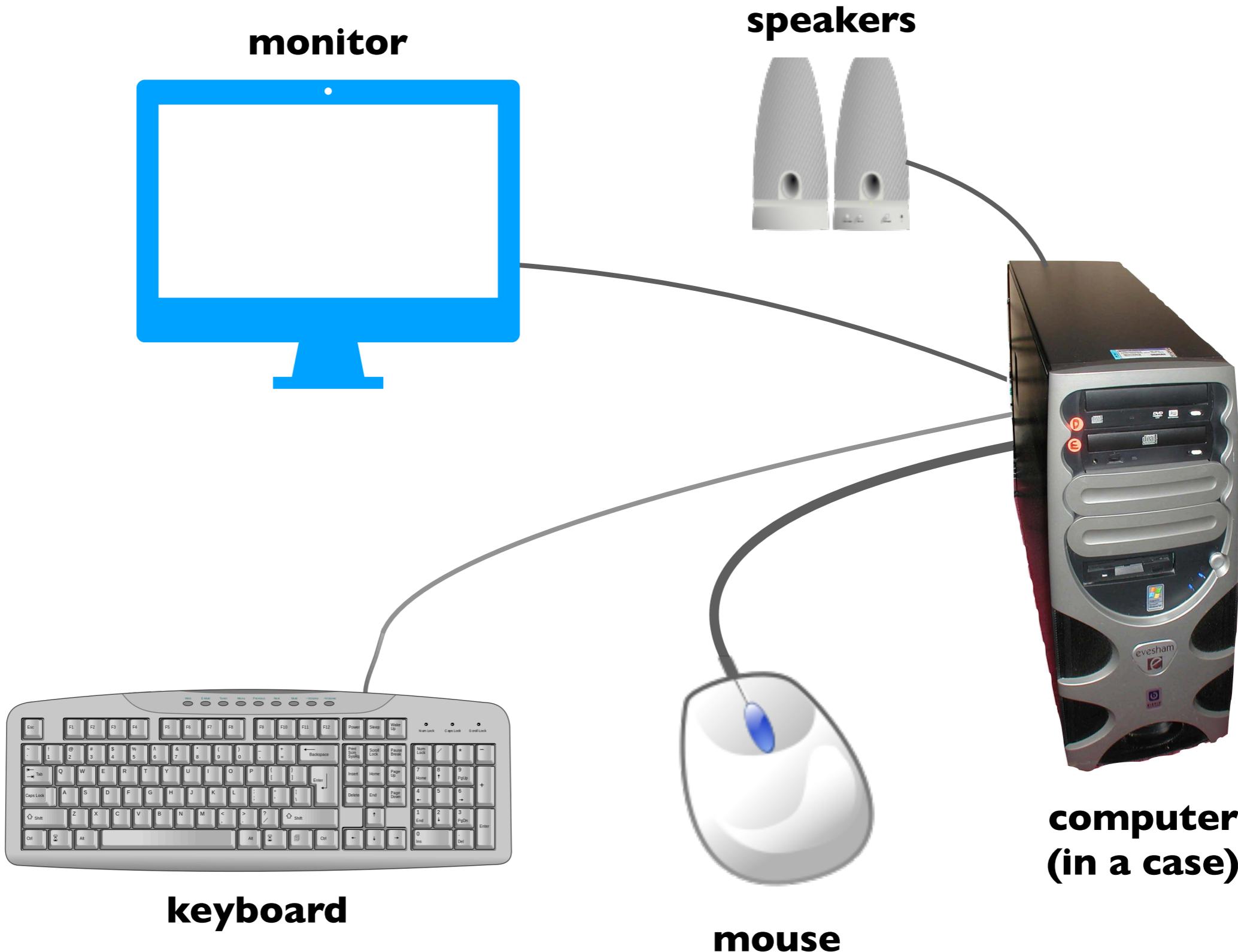
**computer
(in a case)**

Computer Input/Output



Computer Input/Output

I/O devices attach via “ports” (e.g. USB) in back of computer



Computer Input/Output

monitor



speakers



**What's inside a
computer case?**



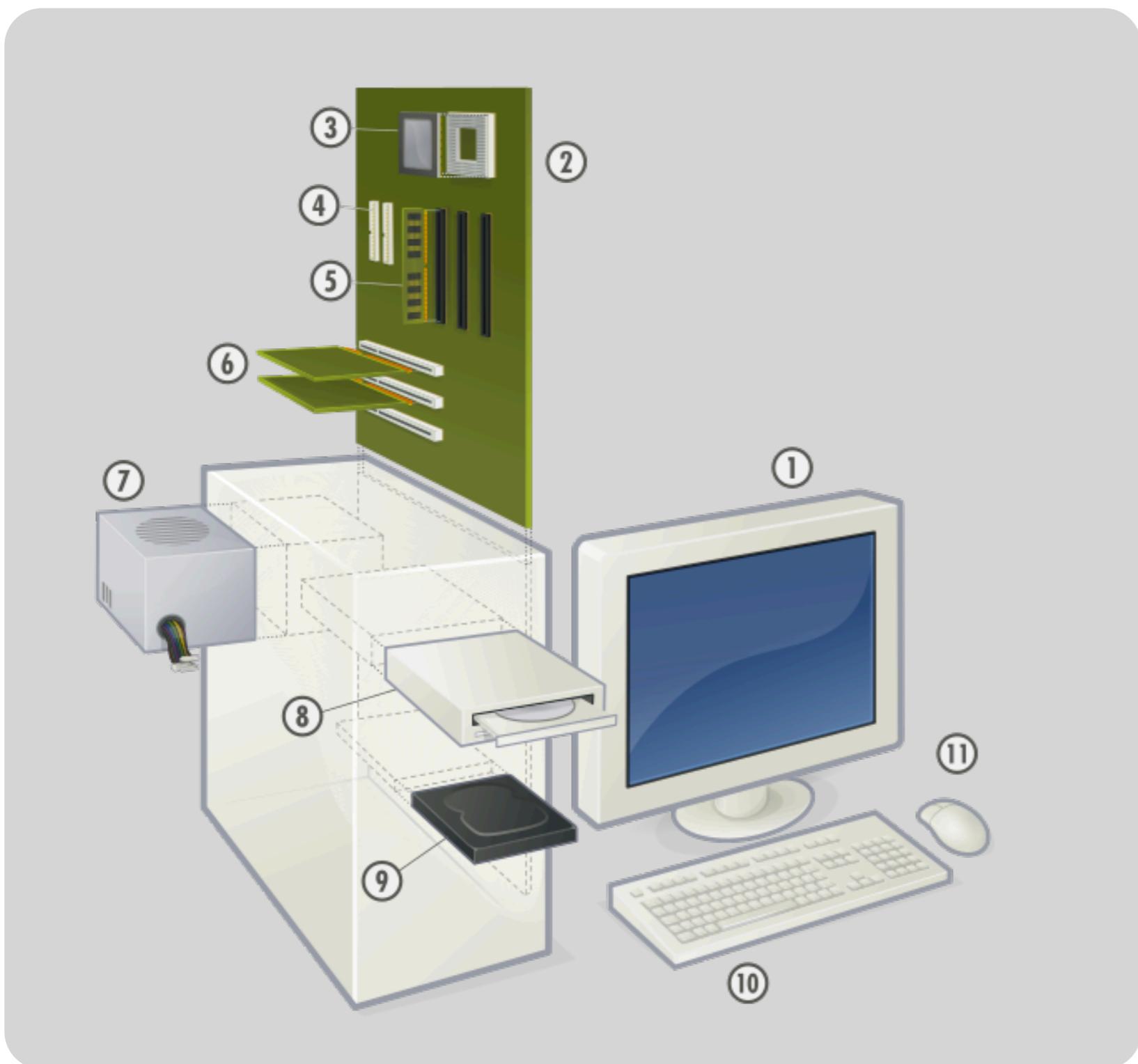
keyboard

mouse

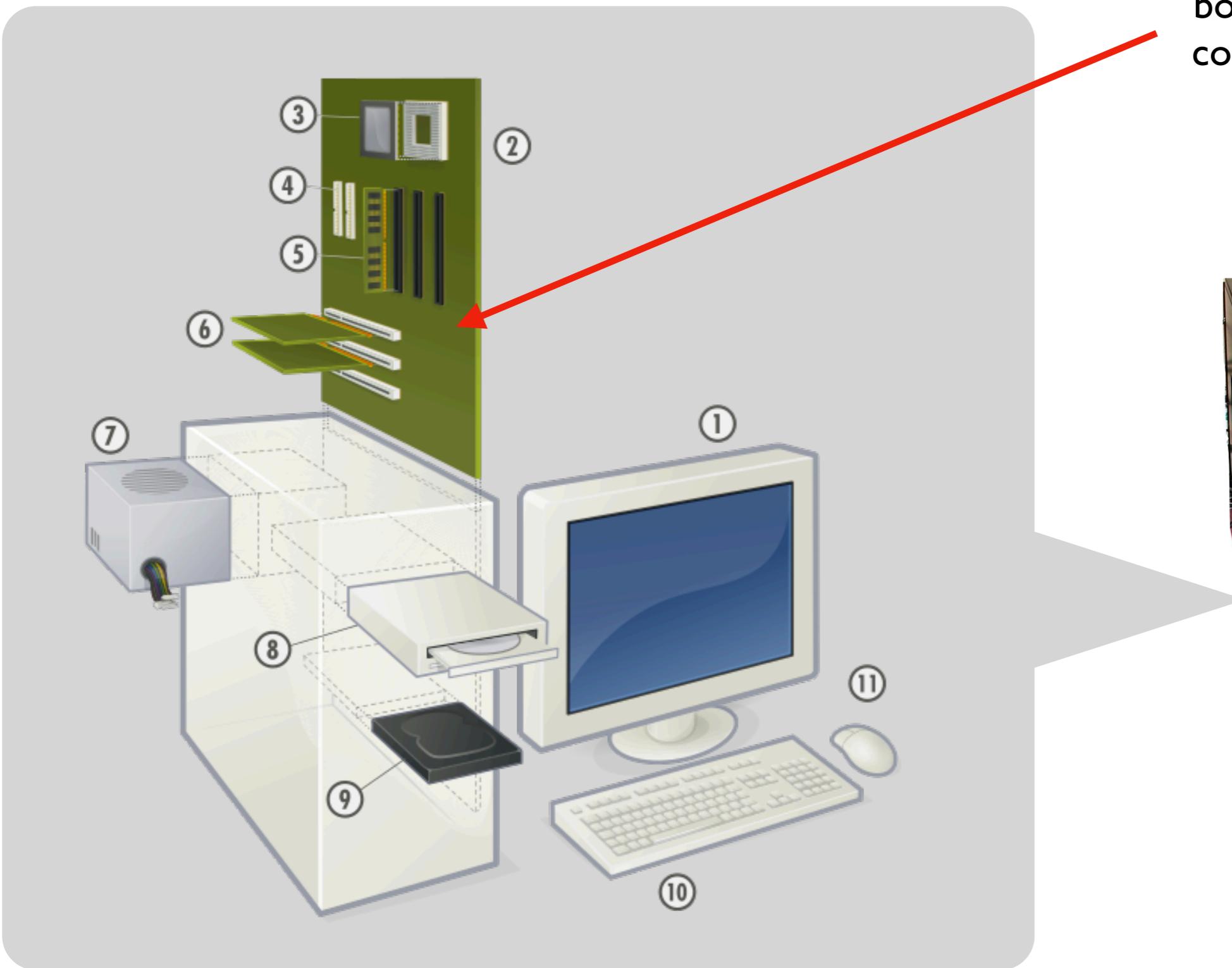


**computer
(in a case)**

Computer Internals



Computer Internals



Motherboard: main circuit board to which other components connect, via sockets/slots



Today's Topics

Introductions

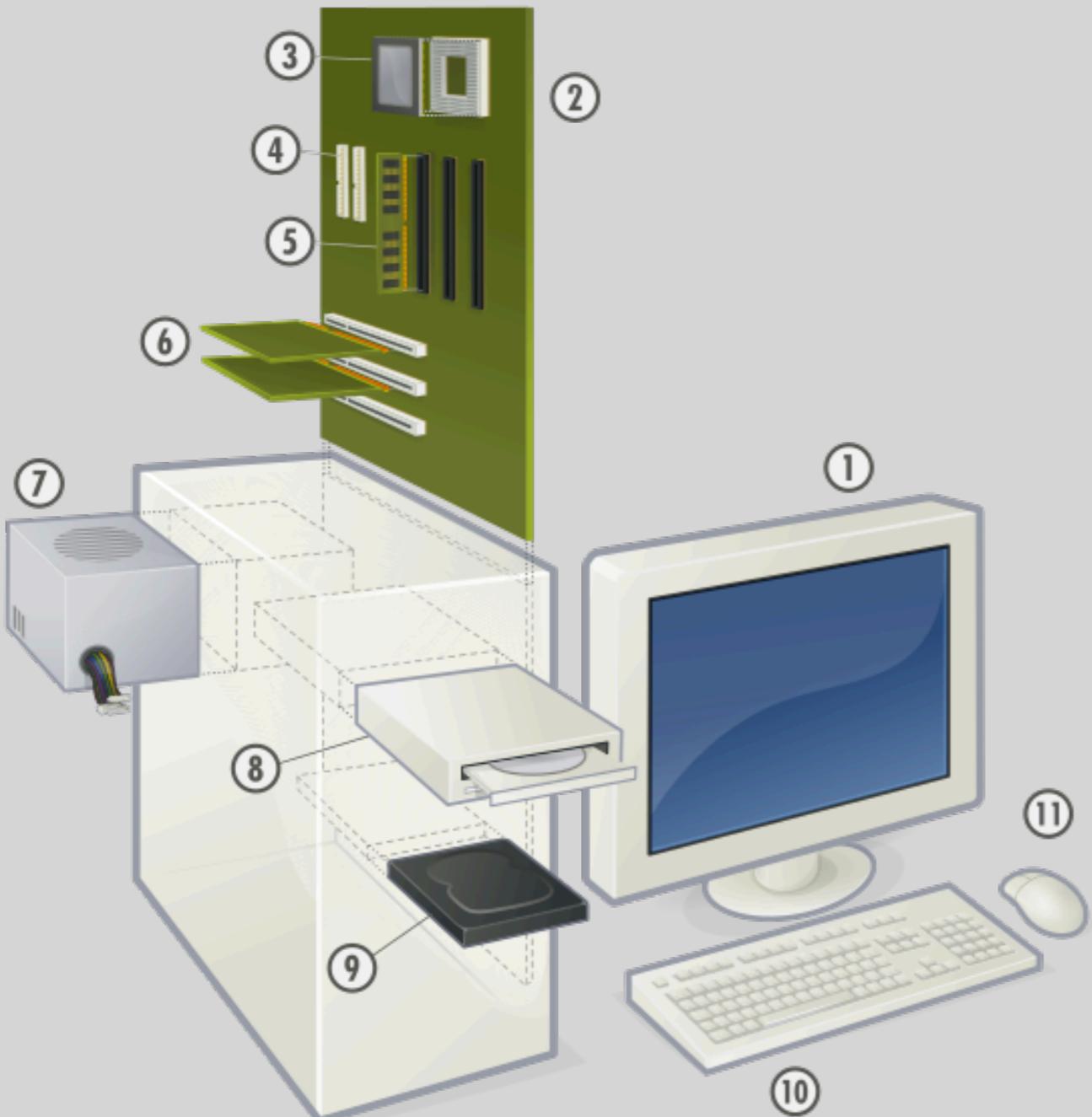
Course overview

Computer hardware basics

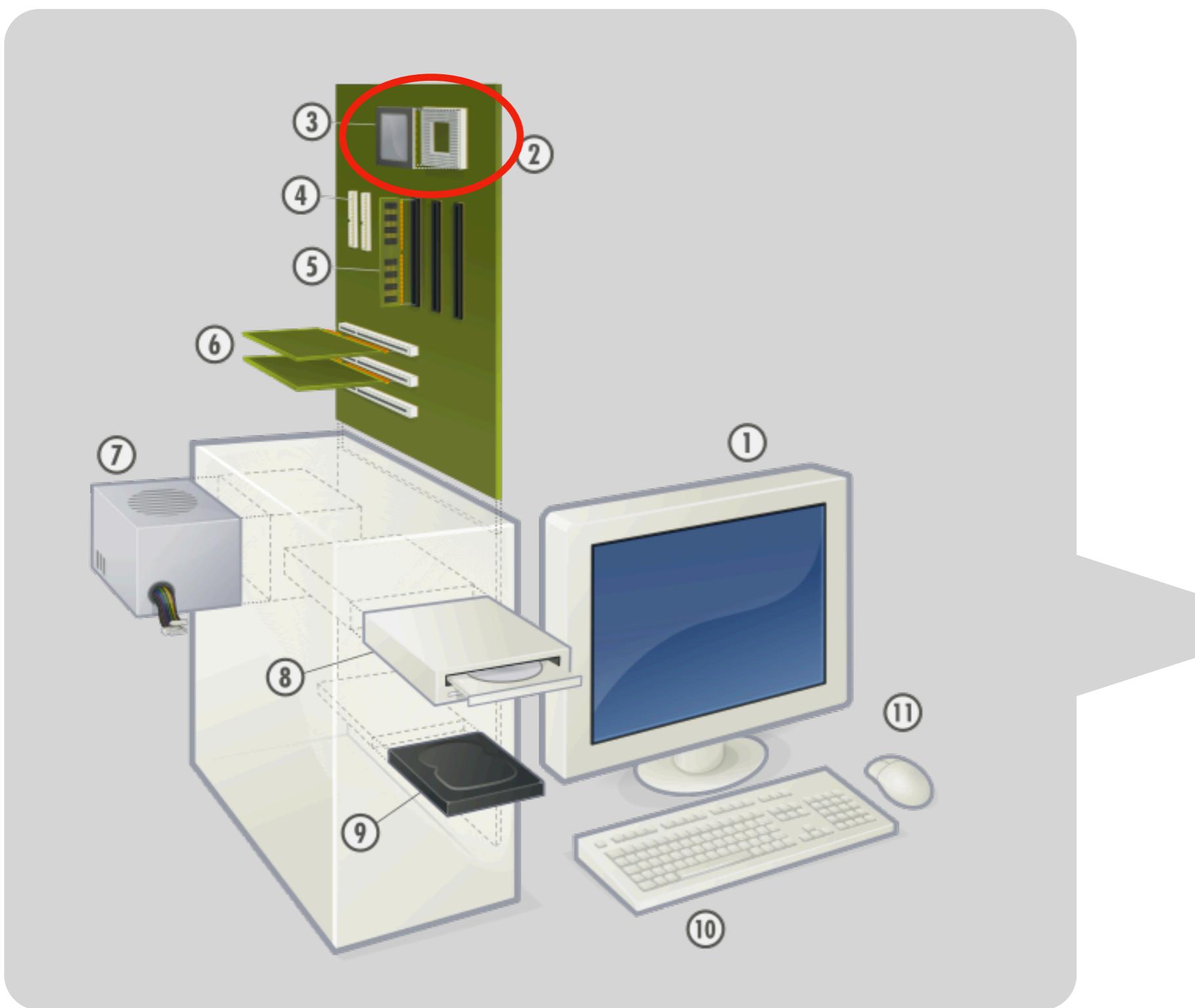
- Input/Output
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Website

Central Processing Unit (CPU)



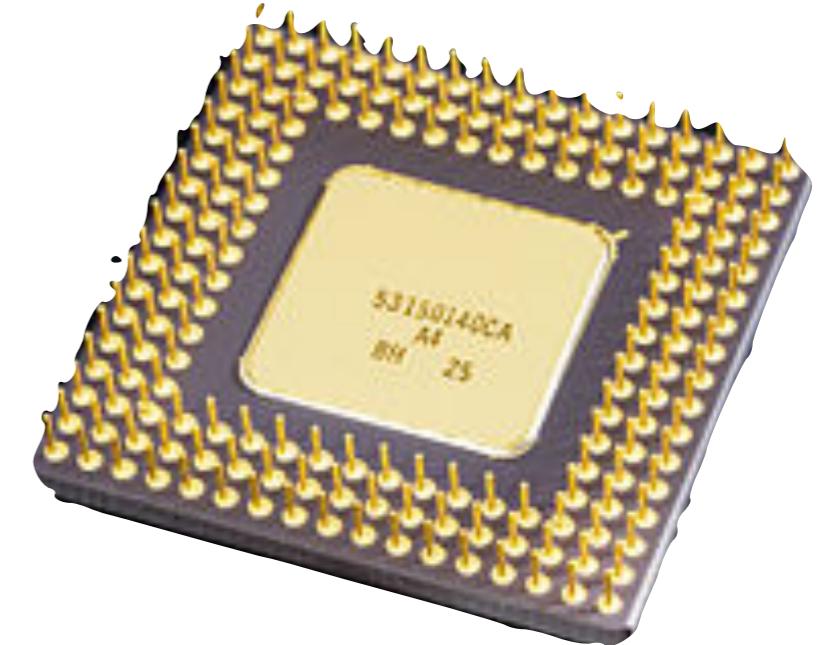
Central Processing Unit (CPU)



CPU

Responsible for computation

- Runs code
- Performs addition, other math
- Compares numbers, text
- Receives input, sends output
- Some compare it to a “brain”



Runs on a clock

- Typically a couple GHz (i.e., billions of ticks per second)
- High-speed makes CPUs hot, require fans/cooling

Computers often have multiple CPUs

- Motherboard may have multiple sockets
- Single chip may contain multiple CPUs
- Allows computers to do more things simultaneously

Today's Topics

Introductions

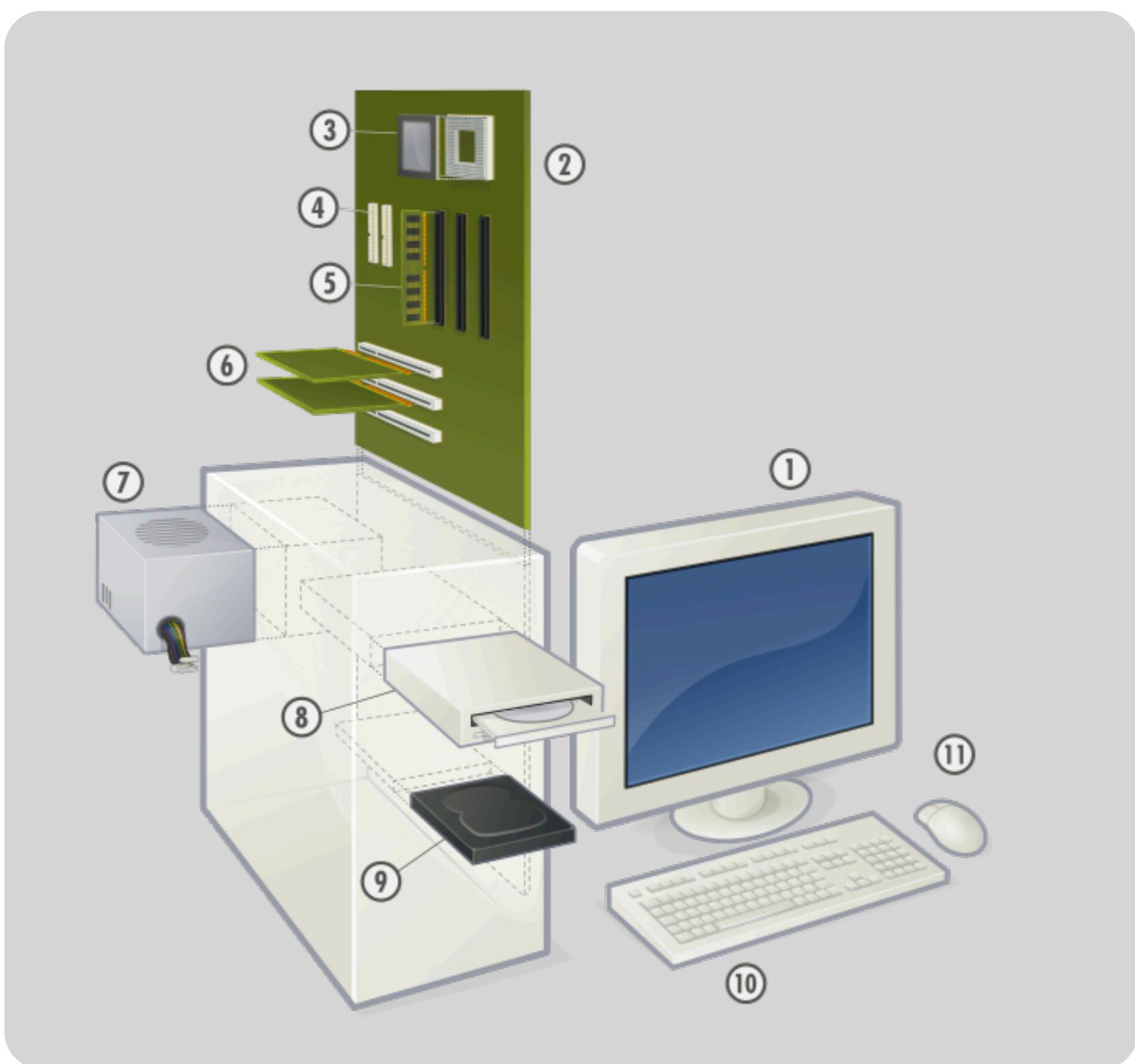
Course overview

Computer hardware basics

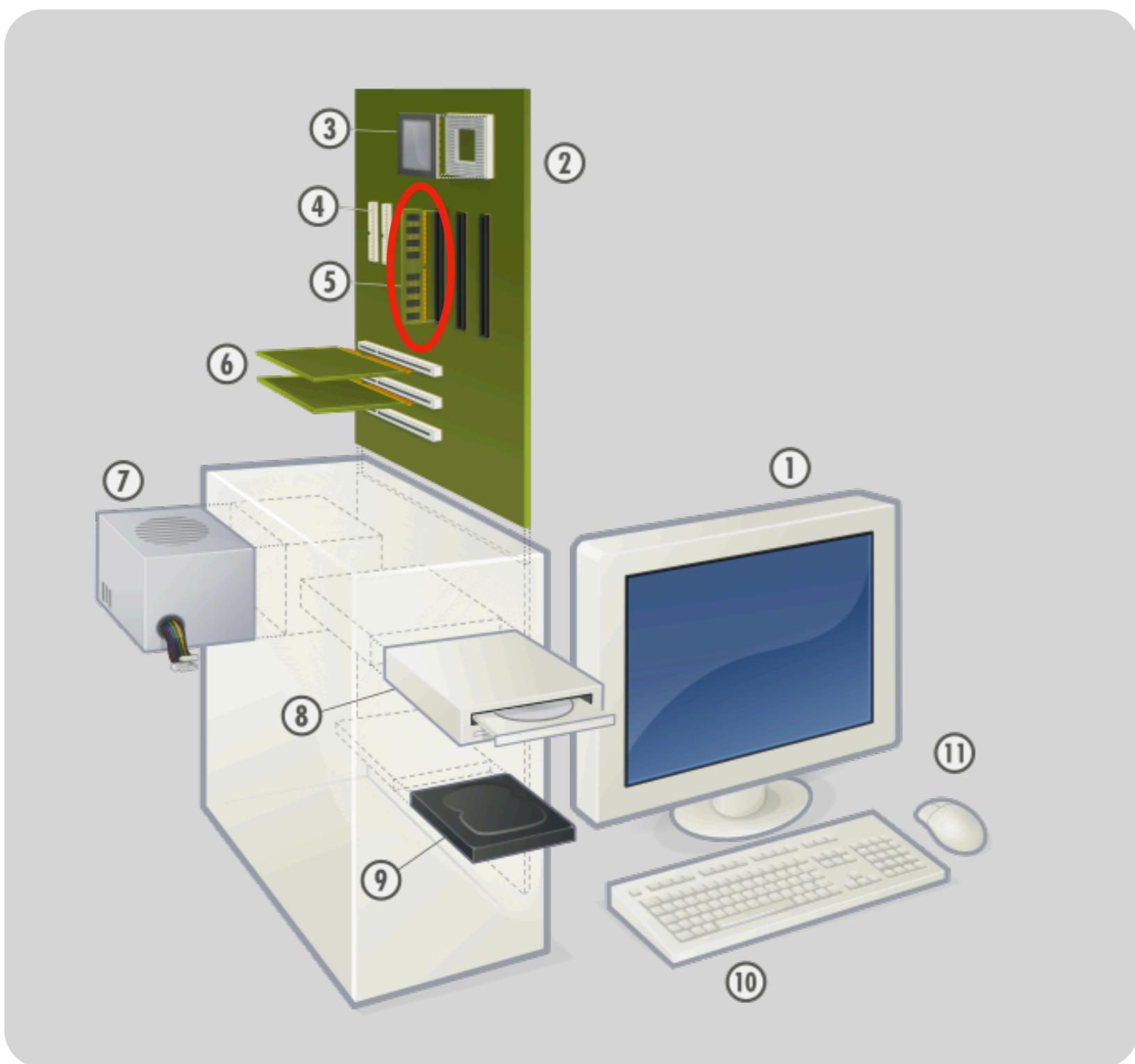
- Input/Output
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Website

Random Access Memory (RAM)



Random Access Memory (RAM)



Memory

Memory stores data for short term

- RAM is most common form today (don't worry about specifics)
- CPU sends data to/from memory
- Accessing it is very fast
- It is “volatile” — meaning you lose this data when you power off your computer
- You don't save “files” in memory, otherwise they would be gone!

Stores bytes of data

- One byte ≈ one letter
- The text “hello” requires 5 bytes
- Typical personal computer has few to tens of gigabytes (billion bytes) of memory



Today's Topics

Introductions

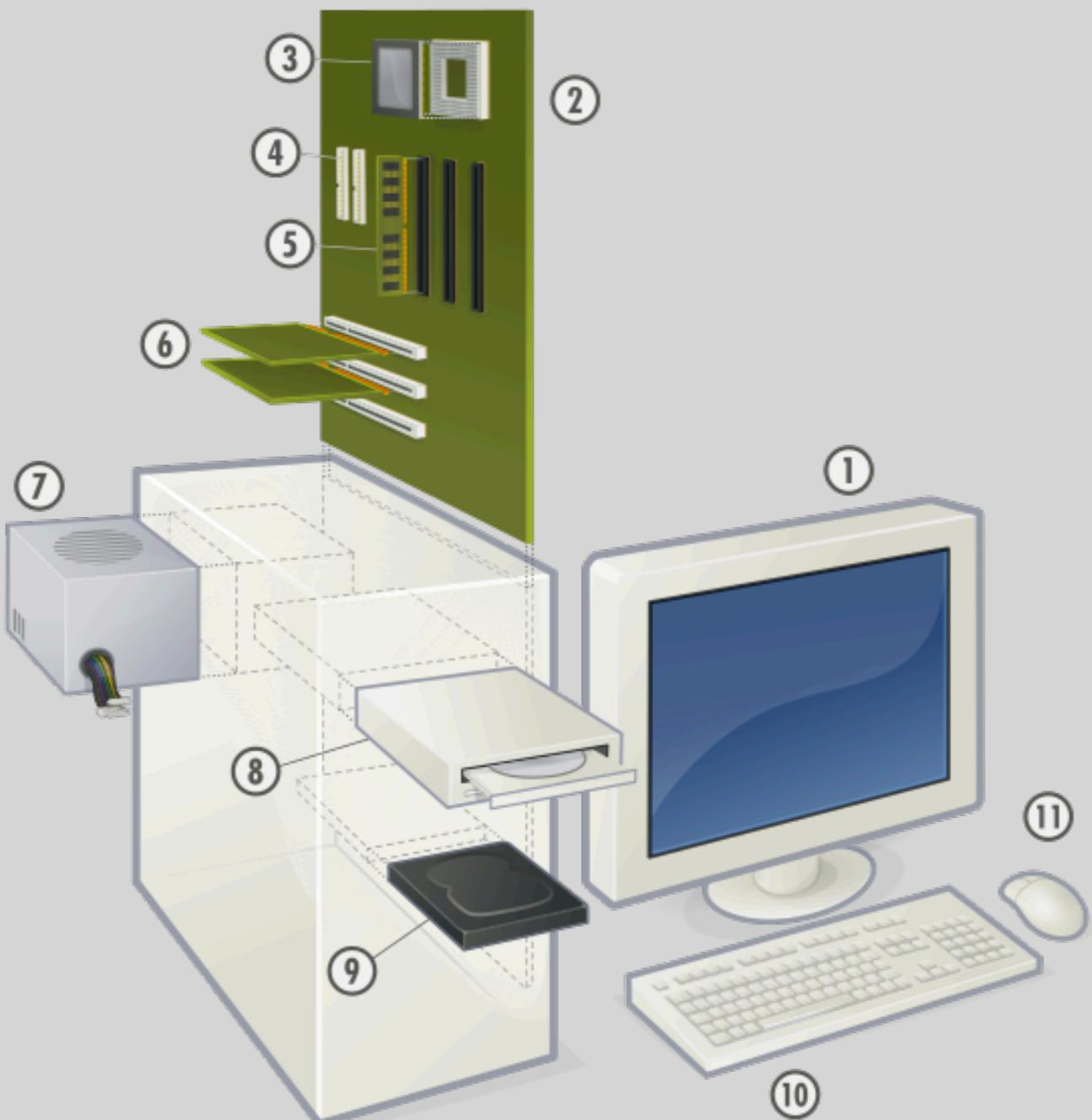
Course overview

Computer hardware basics

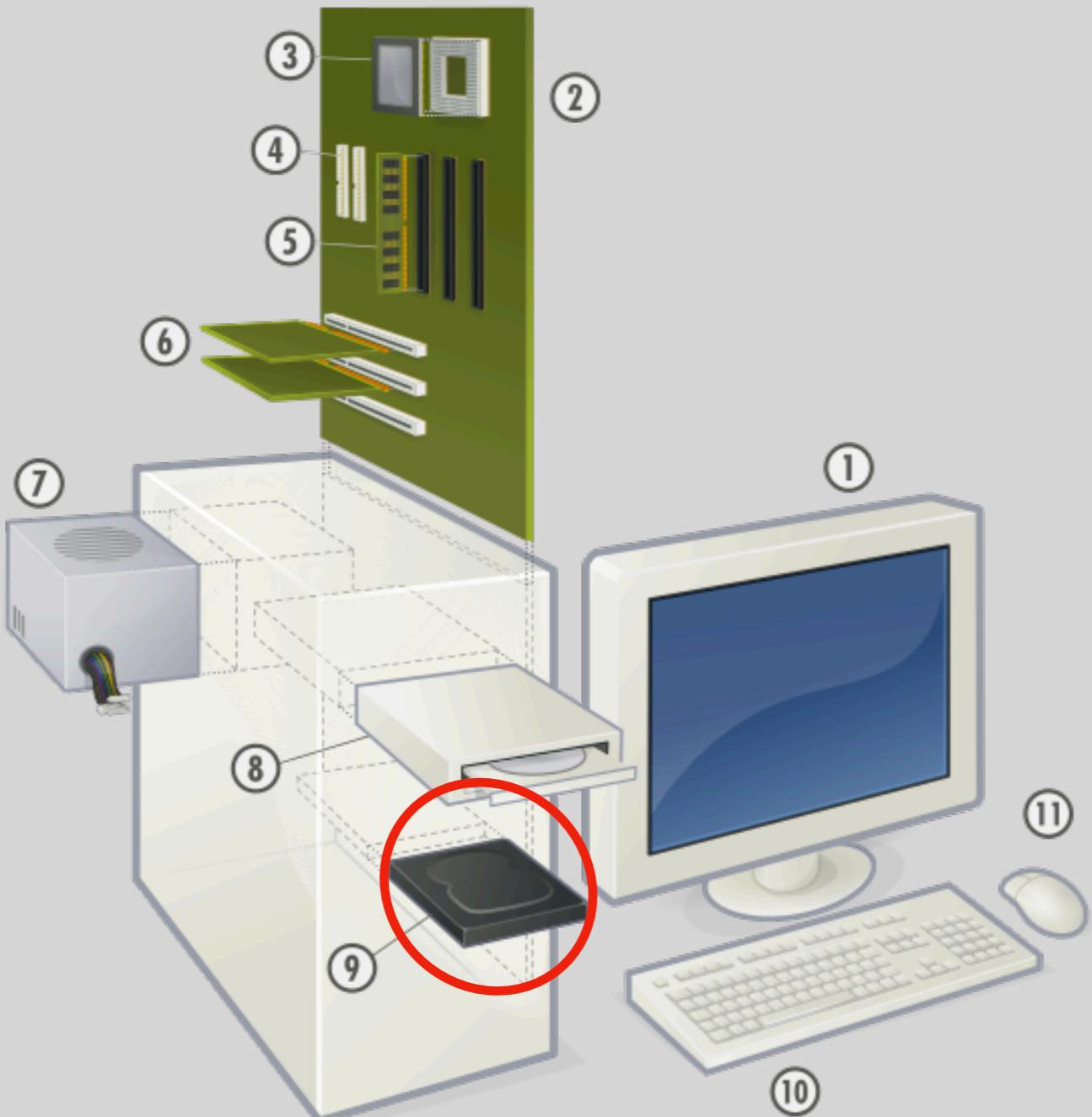
- Input/Output
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Website

Storage Drives



Storage Drives



Storage Drives

Two common devices

- HDD (hard disk drive), has moving parts, cheap, slow
- SSD (solid state drive), no moving parts, expensive, fast
- Both much slower than RAM...

Storage devices used to save data after power down

- **Persistent** medium, in contrast to **volatile** RAM
- Typical capacity: hundreds of gigabytes

When you make a directory/folder or **save a file**, that data is ultimately getting recorded to your storage device

- **Sometimes computers save to RAM first, and only to the device later; power down cleanly to avoid losing your data!!!**

Today's Topics

Introductions

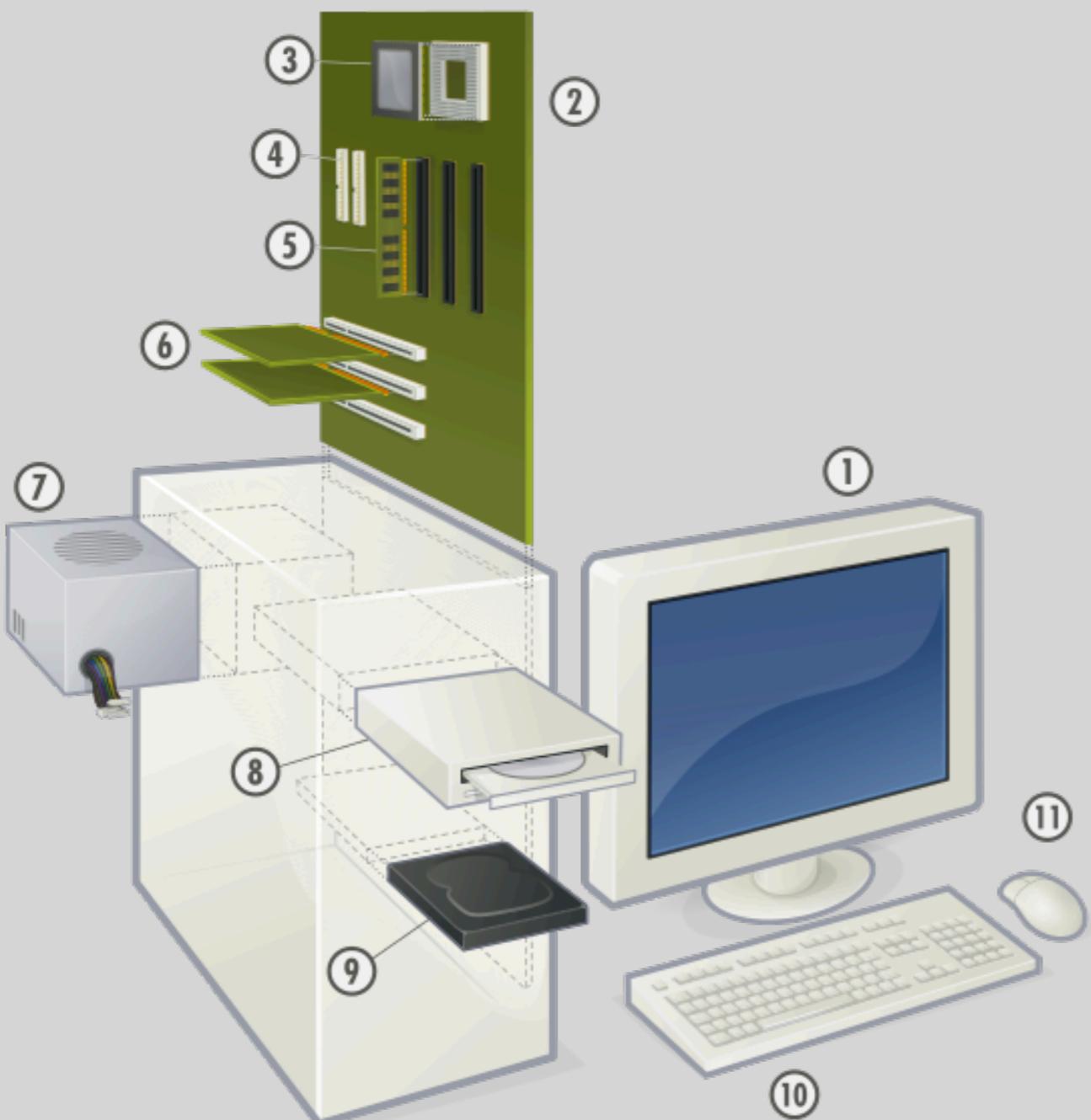
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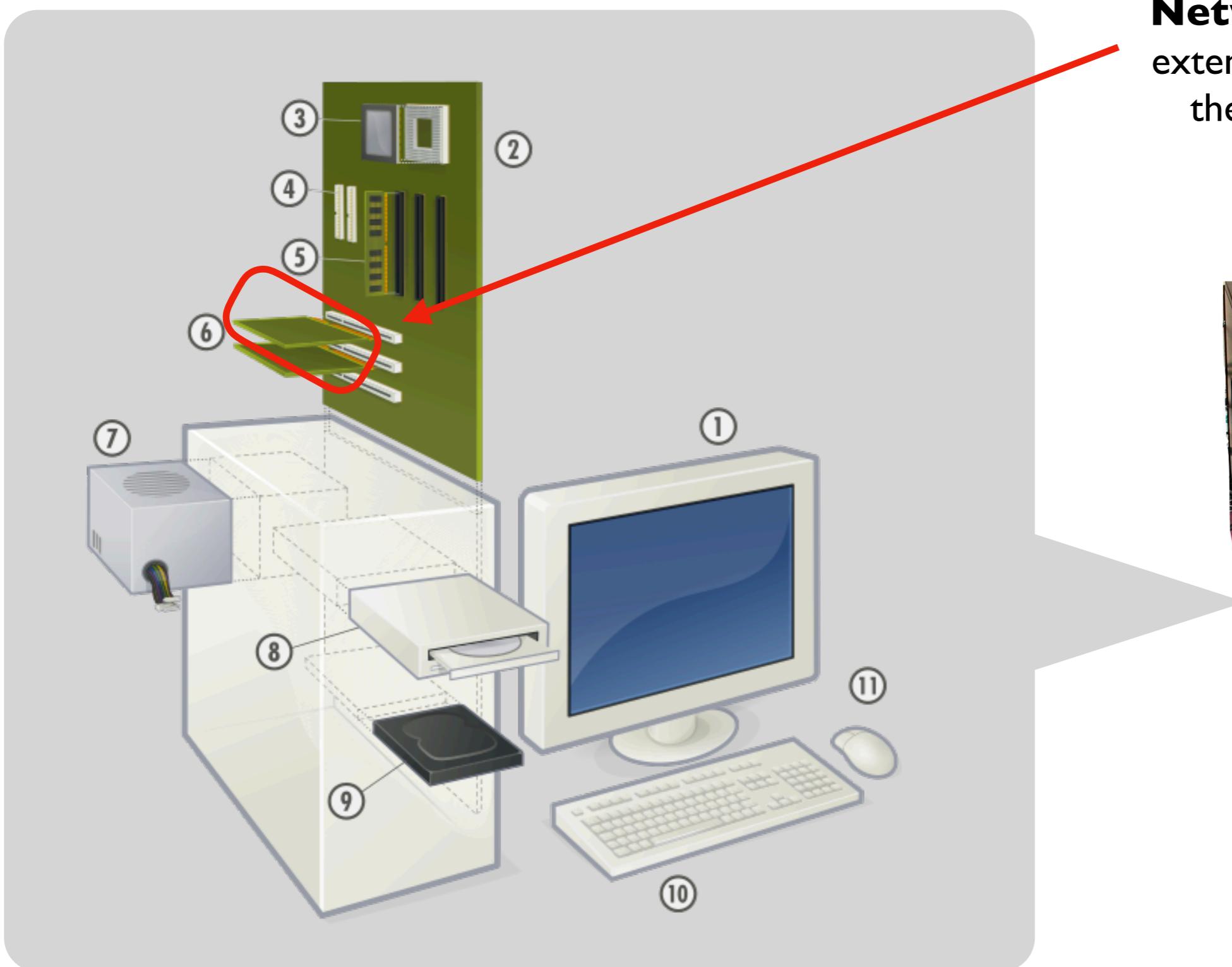
- Input/Output
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Network Interfaces



Network Interfaces



Network: often based on extension card or built into the motherboard itself



Networking

NIC (Network Interface Controller)

- Provides computer communication to other computers, and the Internet



Wired vs. Wireless

- Wired ethernet is common for cable-based connection
- Wi-Fi is common for radio-based wireless connection



Terminology

- **Server**: program/computer that runs, waiting for incoming requests, to which it responds
- **Client**: program/computer that sends requests to a server

Today's Topics

Introductions

Course overview

Computer hardware basics

Website

Course Website

Shared website (sections 1+2):

<https://tyler.caraza-harter.com/cs301/fall19/schedule.html>

Walk through...

Next steps...

- take the "Who are You?" survey:
<https://tyler.caraza-harter.com/cs301/fall19/surveys.html>
- read syllabus carefully:
<https://tyler.caraza-harter.com/cs301/fall19/syllabus.html>
- setup Python on your computer (with videos) and do Lab-PI:
<https://github.com/tylerharter/cs301-projects/tree/master/fall19/lab-pi>
- start PI (Project I), due next Wed:
<https://github.com/tylerharter/cs301-projects/tree/master/fall19/pi>