

# This is CS50

Harvard College (<https://www.college.harvard.edu/>)

Spring 2021

## Lecture 10

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- The End
- Ethics
- Looking Forward
- Quiz Show

## The End

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- Big thanks to the [American Repertory Theater](https://americanrepertorytheater.org/) for hosting lectures this term, providing amazing props, lighting, and sounds to our stage.
- CS50's team, too, has been making everything possible off-stage, including our teaching fellows and course assistants, at both Harvard and Yale.
- And even David makes mistakes and can be unsure about answers for some questions, so rest assured that learning will continue well beyond this course.
- Don't forget that, ultimately:
  - what ultimately matters in this course is not so much where you end up relative to your classmates but where you end up relative to yourself when you began
- We've learned some first principles:
  - computational thinking
  - using algorithms to solve problems, given some inputs from which to produce outputs
  - axes of correctness, design, and style to evaluate our code
  - abstraction, using layering to simplify problems, as with functions in code
  - precision, as by considering all the possible edge cases in our instructions
- With these basic building blocks, we can learn to use tools in the future, beyond C and Python, to solve even more problems.
- We ask a volunteer to give a series of instructions for how to draw a cube and a snowman, and since everyone else interpreted each instruction slightly differently, the final drawings all ended up very different.

## Ethics

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- We might think of ethics as whether we *should* do something, or *how* we go about doing it, even when we have the ability to.
- For example, we can now use code to send lots of emails, creating more spam. We can collect passwords for our website with a form, and if a user uses that same password for another site, we end up with access to their account unless we store the passwords securely.
- JavaScript, too, can be used to log users' actions on our sites, like items they've added to their cart. But logging all actions, over time, can cause worry for users' privacy.
- Before Facebook, the website, there was another website, [Facemash](https://www.thecrimson.com/article/2003/11/19/facemash-creator-survives-ad-board-the/) (<https://www.thecrimson.com/article/2003/11/19/facemash-creator-survives-ad-board-the/>), where code was used to scrape, or download, images of Harvard students and use them without prior permission.
- With some colleagues from the Department of Philosophy, Meica Magnani and Susan Kennedy, we discuss some frameworks for making decisions more rigorously.
- The [Embedded EthiCS](https://embeddedethics.seas.harvard.edu/) (<https://embeddedethics.seas.harvard.edu/>) program at Harvard integrates tools for ethical reasoning into computer science courses, to help ensure that future computer scientists will be creating and using technology ethically.
- The [transcript](#) for this section of lecture, as well as readings for the related [lab](#), have been posted separately.

## Looking Forward

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- Even without additional courses in computer science, we hope that you're now equipped to use technology to solve problems in your own domain.
- When we face new problems, we can rely on one or more of these skills:
  - asking questions
  - finding answers
  - reading documentation
  - teaching yourself new languages
- CS50 IDE, too, can be used for future projects, but it comes with tools for the course.
- More industry-standard tools, for our own Mac or PC, include a terminal and other command-line tools:
  - <https://developer.apple.com/xcode/> (<https://developer.apple.com/xcode/>)
  - <https://docs.microsoft.com/en-us/windows/wsl/about> (<https://docs.microsoft.com/en-us/windows/wsl/about>)
  - ...
- Brian has a [workshop](https://www.youtube.com/watch?v=MJUJ4wbFm_A) ([https://www.youtube.com/watch?v=MJUJ4wbFm\\_A](https://www.youtube.com/watch?v=MJUJ4wbFm_A)) on Git, a version-control

software used to manage different versions of code and enable collaboration with others.

- One of the most popular IDEs, [VS Code \(https://code.visualstudio.com/\)](https://code.visualstudio.com/) is open-source and freely available, with a text editor at its core and lots of other features that can be added. There are many alternatives as well.
- Web hosts include:
  - <https://pages.github.com/> (<https://pages.github.com/>)
  - <https://www.netlify.com/> (<https://www.netlify.com/>)
  - ...
- Web app hosts include:
  - <https://www.heroku.com/platform> (<https://www.heroku.com/platform>)
  - <https://aws.amazon.com/education/awseducate/> (<https://aws.amazon.com/education/awseducate/>)
  - <https://azure.microsoft.com/en-us/free/students/> (<https://azure.microsoft.com/en-us/free/students/>)
  - <https://edu.google.com/programs/students/> (<https://edu.google.com/programs/students/>)
  - ...
- And news sources for technology and programming include:
  - <https://www.reddit.com/r/learnprogramming/> (<https://www.reddit.com/r/learnprogramming/>)
  - <https://www.reddit.com/r/programming/> (<https://www.reddit.com/r/programming/>)
  - <https://stackoverflow.com/> (<https://stackoverflow.com/>)
  - <https://serverfault.com/> (<https://serverfault.com/>)
  - <https://techcrunch.com/> (<https://techcrunch.com/>)
  - <https://news.ycombinator.com/> (<https://news.ycombinator.com/>)
  - ...
- CS50 has many communities as well:
  - <https://discord.gg/cs50> (<https://discord.gg/cs50>)
  - <https://www.facebook.com/groups/cs50> (<https://www.facebook.com/groups/cs50>)
  - <https://www.facebook.com/cs50> (<https://www.facebook.com/cs50>)
  - <https://gitter.im/cs50/x> (<https://gitter.im/cs50/x>)
  - <https://github.com/cs50> (<https://github.com/cs50>)
  - <https://www.instagram.com/cs50/> (<https://www.instagram.com/cs50/>)
  - <https://www.linkedin.com/groups/7437240/> (<https://www.linkedin.com/groups/7437240/>)
  - <https://www.linkedin.com/school/CS50/> (<https://www.linkedin.com/school/CS50/>)
  - <https://www.quora.com/topic/CS50> (<https://www.quora.com/topic/CS50>)
  - <https://www.reddit.com/r/cs50> (<https://www.reddit.com/r/cs50>)
  - <https://cs50x.slack.com/> (<https://cs50x.slack.com/>)
  - <https://www.snapchat.com/add/cs50> (<https://www.snapchat.com/add/cs50>)
  - <https://soundcloud.com/cs50> (<https://soundcloud.com/cs50>)
  - <https://cs50.stackexchange.com/> (<https://cs50.stackexchange.com/>)

- <http://cs50.stackexchange.com/> (<http://cs50.stackexchange.com/>)
- <https://twitter.com/cs50> (<https://twitter.com/cs50>)
- <http://www.youtube.com/cs50> (<http://www.youtube.com/cs50>)

## Quiz Show

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- We host a quiz show with the audience, with the following questions:
  - What are the steps for compiling source code into machine code?
    - Preprocessing, compiling, assembling, linking
  - What is the runtime of binary search?
    - $O(\log n)$
  - Which of these animals was the first to be mentioned in a CS50 lecture?
    - Cat
  - Every time you `malloc` memory, you should also be sure to...
    - `free`
  - What is a race condition?
    - When two things happen at the same time and produce an unexpected result
  - Does zooming in on a photo let you “enhance” it to generate more detail?
    - No, a photo only has a certain amount of detail
  - Which of the following is not a characteristic of a good hash function?
    - Randomness
  - What does FIFO stand for?
    - First in, first out
  - Which of the following would represent pink using RGB values?
    - `#ffd0e0`
  - In C, which of the following lines of code allocates enough memory for a copy of the string `s`?
    - `malloc(strlen(s) + 1)`
  - How should you organize your clothes to be cool?
    - queue
  - What is a segmentation fault?
    - When a program tries to access memory that it shouldn't
  - Which of the following types of overflow can result from recursion without a base case?
    - stack overflow
  - In the town of Fiftyville, what were the names of the three people who witnessed the rubber duck robbery?
    - Ruth, Eugene, and Raymond
  - Which of these command-line programs check your code for memory leaks?
    - `valgrind`

- Which of the following exists in C, but not Python?
  - do-while loops
- What HTTP request method should you use when sending private information, like a password?
  - POST
- What data structure allows for constant-time lookup for words in a dictionary?
  - trie
- What is a cookie?
  - both of the above
- What's your comfort level now?
  - I'm among those more comfortable
- Thanks for joining us at CS50!