HTA Lectures
Cybersecurity
And Why You Should Study It!
Allie :)
What is Cybersecurity?

“The state of being protected against the criminal or unauthorized use of electronic data, or the measures taken to achieve this.”

“CIA Triad”

Basically, security of online data :)
Confidentiality

Shhh...can you keep a secret?

All data should be kept private at all times! You need to be super careful about who has access to what (i.e. who is authorized to see the data).

Most common attack due to weak confidentiality:

Man-in-the-Middle Attacks
Man in the Middle Attacks

Uh oh, someone is eavesdropping on you!

- When a bad guy positions themself in a private conversation between a user and an application.
- Goal: steal personal information (passwords, credit card numbers, social security numbers)
- Tricky because skilled hackers can make it seem like nothing is wrong (they can hide really well)

Basically:
You send some hot gossip in the mail, and your mailman opens the envelope, reads the information, then reseals it and nobody will ever know!
Integrity

Don’t let anyone mess with your data!

In addition to being private, data needs to be trustworthy! Integrity of data is upheld if the data is accurate and reliable (basically, nobody can get in the system and change it without permission).

How to make sure attackers can’t compromise data integrity? Hide your data! Fancy techniques like encryption, hashing, and more can protect your data.
What Can Go Wrong with Data Integrity?

Instead of one specific “main attack,” problems with data integrity arise from:

**Problems with authentication and authorization**

If someone gets into the system but they’re lying about their identity

...very bad :(

I live in a world full of people pretending to do something they’re not.
Ok now my data is super secret and private but wait...now who gets to see it?

Data isn’t much good to a company if nobody can access it; the tricky part of cybersecurity is making sure that people are actually able to access the top secret data.

Systems need to work! If a system is compromised and there is no recovery plan, data can get lost, or at least take a long time to access (making customers very very angry)

What if it’s compromised on purpose... introducing the Denial of Service (DoS) attack
Denial of Service (DoS) Attacks

Uh oh, someone wants to make it hard to get your data!

- Hacker spams a server with traffic
- Special case: **Distributed** DoS attack: hacker uses multiple computers to flood the target
- Overflows the server and interrupts the service being provided

CS15 example: GPTA uses **rate limiting**: you can only enter queries every 15 seconds, so the server doesn’t get overloaded
What can you do about it

Three main pathways:

1. Policy (non-technical)
2. Blue Team (technical defense)
3. Red Team (technical offense)
Non-technical Cybersecurity Roles

- Names like “Policy Writer”, “Governance and Risk”
- **Great for people who care about security but don’t love the technical aspect**
- Security engineers follow rules to secure their systems → you can write the rulebook!
- Skills required: security awareness, writing skills, critical thinking, top-level understanding of technology
Blue Team

- Technical **defensive** role
- Responsible for securing and protecting systems
- **Planning:** design a secure system
- **Threat protection:** always be alert!
- Roles like “Application Security”, “Cloud Security”
- **Great for people interested in coding and how computer systems work**
- High projected salaries (very slay)
Red Team

- Technical **offensive** role
- Blue Team works hard to secure the system...Red Team tries to break it
- (Legal) hacking into company systems to find weak points to fix
- Roles like “Penetration Testing”
- **Great for people interested in coding and who like to break things!**
- High projected salaries
Interested in learning more?

There are some awesome security classes in the Brown CS department!

- **CS22**: learn the math behind encryption (you should all take it :))
- **CS33**: computer systems are super important in security (pre-req for other security classes also)
- **CS1040**: Cryptography (how to secure online communication)
- **CS1650**: Software Security and Exploitation (hacking into the system!)
- **CS1660**: Intro to Computer Systems Security
- **CS1510**: Intro to Cryptography and Computer Security
- **CS1515**: Applied Cryptography
The Battle of Marathon
490 BCE
Athens population: 315,000
(about 0.3% of the world population)

Persian Empire population: 50,000,000
(about 50% of the world population)
Who wins?
Athens
But how??
What is a Shell?

- User interface for operating system commands
- Shells:
  - Graphical User Interface (GUI)
  - Command Line Interface (CLI)
- Goal to create an effective workflow to accomplish certain tasks
CLI (Command Line Interface)

- The main graphical component is a window that allows you to enter text input
- User types text commands the program will run
  - REPL (Read Eval Print Loop)
  - ex. Terminal
- Shell specific scripting languages
  - ex. bash, zsh
## CLI: Good Idea or Bad Idea?

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Faster</td>
<td>● Learning curve</td>
</tr>
<tr>
<td>○ GUI takes a lot to load</td>
<td>● Reduced interaction for user</td>
</tr>
<tr>
<td>○ Practice provides fluidity</td>
<td>○ No clicking or dragging</td>
</tr>
<tr>
<td>● Accessible!</td>
<td>● Aesthetics = whack</td>
</tr>
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<td></td>
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</tbody>
</table>
Common Commands

- **cd** - change directory *(tip: use tabs to autocomplete)*
- **ls** - list directory contents
- **touch** - create a new file or “touches” existing file
- **rm** - remove a file
- **mkdir** - create a directory
- **rmdir** - remove a directory
- **mv** - move one file to another location
- **cp** - copy one file
- **cat** - print the contents of a file
- **chmod** - change file modes/permissions
- **grep** - returns all occurrences of a string in a given text
- **clear** - clear the terminal
Flags

java
  • java -version

ls
  • ls -a

rm
  • rm -rf

open (Mac only but there are Windows equivalents)
  • open -e <text file>

man
  • man <command name>
Chaining Commands

- **Piping**
  - Redirects the output of one command into the input of another
  - `command_1 | command_2 | command_3 | .... | command_N`
  - Ex: `ls -a | wc -l` passes the output of `ls` into `wc`

- **&& (AND)**
  - Chains a sequence of commands together
  - `command_1 && command_2 && command_3 && .... && command_N`
  - Ex: `cd src && ls` will go into src directory and list all contents
Useful Tips and Tricks

- Retyping a recent command?
  ○ Press the up (and down) arrow to navigate history
  ○ Control + R to do a back-history search
  ○ `history`

- Don’t remember the filepath or command?
  ○ Press Tab once for autocomplete, twice for a list of everything in that directory

- Want to stop something you accidentally ran?
  ○ Ctrl-C to interrupt the process
  ○ Ctrl-Z to pause a process
    ■ Can then send to foreground (fg) or background (bg) using the process ID
Useful Tips and Tricks

- Wish you had a shortcut for a long command?
  - Create an alias in `.zshrc` or `.bash_profile`
    - alias compile_run_pong="cd pong && javac *.java && cd .. && java pong.App"
  - open -e ~/.zshrc → type your alias (save file) → refresh your terminal → enjoy
~FUN~ Commands

- date
- yes <text>
- figlet <text>
- sl
- telnet towel.blinkenlights.nl
- trans [-brief]
- fortune
- cowsay <text>
- animal-to

*Note: for some of these commands, download may be required (Google is your friend)*
Text Editors in the Terminal

- nano
- vim
- emacs
Interested?

Introduction to Computer Systems

This course covers the organization of computer systems (in terms of storage units, caches, processors, and I/O controllers) and teaches you assembly and C language programming.
Modern Computer Graphics

When your simulations become more real than reality
Beyond JavaFX

- Raster graphics, used in CS1230, work with a fixed number of colored pixels
  - 2D arrays, anyone?
  - Manually compute the value of each pixel according to what you want to see
  - Used to simulate scenes or draw your own, filter and transform images
Beyond JavaFX

- Raster graphics, used in CS1230, work with a fixed number of colored pixels
  - 2D arrays, anyone?
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  - Used to simulate scenes or draw your own, filter and transform images
Simulating Our World

Let there be light!
How do we simulate our world on a screen?

- **BIG IDEA:** use mathematical / physical laws of motion to describe the movement and appearance of the objects you code

- Using gravity + collision detection in Doodle Jump
  - You didn’t have to hardcode where exactly the doodle would be at every time step
  - That would have made your program crazy long and impossible to play!
Raytracing + Pathtracing

- Describe a scene and have a computer render it “photorealistically.”
- In real life, things appear the way they do because of the way light interacts with them.
- Follow light rays from a light source and figure out how much light hits the spot in the image, and where the lights bounce off the objects.
Which one is real?
Real World Features On Your Screen

- Not everything we want to render is a solid object, we also want real life features (like water) with realistic interactions.
- We’re able to bring these features to life through these simulations, and they’re only improving from here.
- Like earlier, we don’t hard code these features, we use math and clever coding techniques to simulate real life objects digitally.
  - splashes, ripples, reflections, buoyancy of the ball, etc.

Water Simulation made by Evan Wallace, former Brown CS Student and Co-Founder of Figma
https://madebyevan.com/webgl-water/
How can we use AI to optimize creativity?

- **Creation takes time!**
- Animation: a drawing for every frame, ~24 frames/second
- A lot faster to visualize an image mentally than to put “on paper!”
- Right: timelapse of 30 hours of work for 8 comic pages
The good, the bad, and the ugly

- AI trained off of stolen datasets
  - big ethical debate
- On the other hand, creation has been “gatekept”
  - art not known as a lucrative field
  - making some projects requires a huge amount of funding or a big studio
- Not going away anytime soon, so how can we creatives harness it to work for us and not against?
Silly Premise: Andy’s X-Men

- We want to make a cover for comic, Andy’s X-Men
- We have a sketch, but we want to make polished concept art. Can AI help?
  - yes! (to an extent)
Midjourney AI: Powerful, but unwieldy
Infinite Variations!

- Great for brainstorming
- Less great for polishing existing concepts
Infinite Variations!
Render photorealistically
Example use case: In-Betweens ("Tweening") & Rotoscoping

- **Tweening:** Animations are composed of key frames (like specific poses) and in-betweens, which are frames between keyframes to make motion smooth. Tweening is the process of drawing the in-between frames.

- **Rotoscoping:** Drawing over video to make an animation
  - Classic Disney movies like The Little Mermaid were made this way!
- Can be tedious and repetitive
More Graphics!

- Here are some resources:
  - Two minute papers youtube channel (highly highly recommend, even for non-graphics related videos)
  - Pixar graphics library

- Here are some classes you could take!
  - CS1230: Introduction to Computer Graphics (requires CS200)
  - CS1250: Introduction to Computer Animation
  - CS2240: Interactive Computer Graphics (requires CS1230)
Of course we do. That’s why I got into CS in the first place

So you want to get a job?
What even is “industry”? 

Government: 
- NSF
- NASA
- HealthSource.gov
- HealthCare.gov

Non Profit: 
- Khan Academy
- girls who code
- techsoup
- KIVA
- change.org

For Profit: 
- Adobe
- Meta
- Microsoft
- Amazon
- Meta
- Google
- Figma
- mongoDB
What does “industry” look like?

- Education Tech ("EdTech")
- Health Tech
- Financial Tech ("FinTech")
- Consumer Tech
- Animation
- Video Games
- AI Tech
- Bio Tech
- Ad Tech
- Robotics
- Virtual and Augmented Reality
- Security
- Databases
- Communication
- Lots and Lots More...

Coursera, Khan Academy, Duolingo, Canvas
athenaHealth, HealthCare.gov, Clover, Flatiron
Stripe, Jane Street, Square, Bloomberg
Google, Facebook, Apple, DropBox
Pixar, Dreamworks
Activision, Blizzard, Bungie, EA, Valve
OpenAI
Novo Nordisk, Moderna Inc., BioNTech
...
...
...
...
..
Types of Careers: SWE

⚠️ Software Engineer/Developer (often called SWE)
  - Focus on creating and coding the software
  - Variety of specialties: Test/Quality Assurance (QA), etc.
  - Not a code monkey, not coding 10-12 hours a day
    - Often in meetings collaborating on design, setting requirements, and talking to prospective customers
    - Depends on company/job, so research/ask about it during process
  - Can work on different parts of applications:
    - Specialists: Frontend, Backend, Databases
    - Generalist: “Full-Stack”
Types of Careers: PM

- **Project/Program/Product Manager**
  - Some of our best HTAs have gone into Program Management
  - Focus defining what the product should be and what features it should have
  - Includes some level of project management/coordination
  - Work with both prospective users and software developers
  - Technical position
  - Some PMs code and make prototypes
  - Can’t just tell everyone what to do. Have to convince the engineers that your plans are the best for the product
  - Being a PM doesn’t mean you can’t be a SWE after (and vice versa)
Other Types of Careers

- UX (User Experience) Designer
- UI (User Interface) Designer
- UX vs. UI
- Data Scientist
- Systems Programmer
- IT Architect
- And many more!
The Road to Jobs/Internships*

- Research companies
- Apply (online, at Tech Fair, at Career Fair, by email, etc.)
- Online Assessment (usually asynchronous)
- Technical interview (Phone/Zoom/Google Hangouts)
- Onsite Interview
- Offer

*Disclaimer: This may vary by company, some might have more/less steps
Online Coding Assessments

- Many software development jobs & internships nowadays require some form of an online coding challenge/assessment to weed out applications
- You code on an IDE of their choosing, interviewer gives some problem that you have to solve
- In 45 minutes to an hour, you are expected to reason through different ideas and write code or pseudocode for a solution
- If coding, can normally use whatever language you are most comfortable in
- Imagine you are turning in a CS15 Assignment! Make sure to code with style and be efficient.
- Your solution doesn’t necessarily have pass all the tests cases, be totally right, or sometimes even work at all to advance to the next round.
Technical Interviews

- Similar skillset to a Coding Assessment
- On an online coding pad or on whiteboard, interviewer gives some problem that you have to solve
- You are expected to reason through different ideas and write code or pseudocode for a solution
- Expect to talk aloud and show your work
- Most importantly, they just want to see how you think
- Problems are often algorithmic and/or involve some sort of data structure:
  - “How could you reverse a LinkedList?”
  - “How could you build a Queue using two Stacks?”
  - “Imagine <long scenario about some hypothetical game>. How would you account for <specific case or rule>? ”
- Many of the foundational data structures and algorithms needed for technical interviews are covered in lots of depth in CS200 :)
What might an internship look like?

Working at a small company/start up < 50 people
- Typically only designing 1-2 products
- Small user base → take more risks in project features
  - Have a larger say in the direction of the project
- Fast paced → push out features as fast as you can build them (every couple of days)

Working at a mid level - large company > 200 people
- Building many products, can get exposed to multiple different technologies in one company
- Larger user base → take less risks, work is heavily reviewed
  - Might not have as much freedom, but affect many more users
- Slower paced → features pushed out every couple of weeks/once per month
What I Wish I Knew About CS Earlier...

& Why You Belong Here

Sarah
Only Some of the Resources at Brown

● WiCS - Women in Computer Science
  ○ Mentorship program, meetings and events
  ○ Supports the Artemis Project, a free summer camp for rising ninth-grade girls from the Providence area who show interest in science and technology.

● Mosaic+
  ○ Advocate for diversity within Brown's CS community
  ○ Big-little system, workshops, group study

● The UTA Program
  ○ Has changed my life!!
There is more to CS than SWE

In fact, there are jobs out there that you and I have never even heard of...
Random CS Internships I’ve Explored

- Computer Science Teaching
- Product Management/Technical Project Management
- Technical Writing/Documentation Team
- Technical Specialist for Law Firm

And there are so many more! (UX Designer, Systems Architect, Database Administrator, Healthcare AI Developer, Quant Analysts)
“Everyone in this country should learn how to program because it teaches you how to think”
– Steve Jobs.
So... what makes a good programmer?
Exception in Application start method

java.lang.reflect.InvocationTargetException <4 internal calls>
at com.sun.javafx.application.LauncherImpl.launchApplicationWithArgs(LauncherImpl.java:389)
at sun.launcher.LauncherHelper$FXHelper.main(LauncherHelper.java:767)
Caused by: java.lang.RuntimeException <4 internal calls>
at com.sun.javafx.application.LauncherImpl.launchApplication(LauncherImpl.java:328)
at sun.launcher.LauncherHelper$FXHelper.main(LauncherHelper.java:767)

Caused by: java.lang.NullPointerException <1 internal call>
at tetris.tetrisGame setUpBorder(TetrisGame.java:120)
at tetris.tetrisGame.<init>(TetrisGame.java:33)
at tetris.GameOrganizer.setUpGamePanes(GameOrganizer.java:48)
at tetris.GameOrganizer.<init>(GameOrganizer.java:10)
at tetris.App.start(App.java:12)
at com.sun.javafx.application.LauncherImpl.lambda$launchApplication$0(LauncherImpl.java:863)
at com.sun.javafx.application.PlatformImpl.lambda$runLater$6(PlatformImpl.java:326)
at com.sun.javafx.application.PlatformImpl.lambda$null$6(PlatformImpl.java:295) <1 internal call>
at com.sun.javafx.application.PlatformImpl.lambda$runLater$6(PlatformImpl.java:295)
at sun.glass.ui.InvokeLaterDispatcher$Future.run(InvokeLaterDispatcher.java:95)

Exception running application tetris.App

Process finished with exit code 1
The TAs are not better programmers than you. We just have more experience.
Problems become familiar problems.
“I did something wrong…”
“Now it doesn’t work…”

“Where have I seen this before?”
“How can I figure out what happened?”
“Where can I find more information?”
Struggling + Frustration → Learning
package lab0;

public class Main {

    public static void main(String[] args) {
        System.out.println("Hello world!");
    }

}
<table>
<thead>
<tr>
<th>Title</th>
<th>Sales</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minecraft</td>
<td>176,000,000</td>
<td>Multi-platform</td>
</tr>
<tr>
<td>Tetris</td>
<td>170,000,000</td>
<td>Multi-platform</td>
</tr>
</tbody>
</table>
FUNCTIONALITY

For this assignment, you'll navigate a CS15Robot called AndyBot through a maze—surpassing daunting obstacles such as walls and an especially trifling roadblock. Your task is to call move methods on the AndyBot to move it out of the maze (off-screen) so the "Winner!" message appears.

1. Don't try to move your bot into a wall because it will cause AndyBot to get stuck.

2. The red at the end of the maze represents the roadblock. To pass it, AndyBot will have to submit a secret password (it will be a number). Unfortunately, this password will be different every time you run the program. Luckily, the maze will help you if you call the right methods (hint: think about who has this information when calling the method!)

3. Once AndyBot is on the maroon square (the square directly underneath the gray square) it may enter the password. If AndyBot tries to enter the password before it reaches the square, the password will not be accepted as that is too early to input it.

4. Once AndyBot submits the correct password, make sure to move your AndyBot upwards 2 more steps and off-screen to victory. The bottom screen should read "WINNER!"

5. A successful program will match the pattern shown below:
Step 4. Set up the Timeline that will be in charge of updating the doodle's location and displaying the graphical changes. (To test if your Timeline is working, you can start with printlines)

Step 5. Set up the KeyEvent handler so you can use the left and right arrows to get your doodle to move.

Step 6. Add “wrapping” capabilities so the doodle reappears on the other side when it moves offscreen.

Step 7. Add some physics simulation so that your doodle falls.

Step 8. Start with creating one basic platform and add/test collision detection with that platform.

Step 9. Generate a whole screen of semi-randomly positioned platforms so that your doodle can jump its way upwards!

Step 10. Add the vertical scrolling so that when the doodle tries to pass a certain height, it stops moving, and all the platforms move downward. (WARNING! This step is tricky! Really think about the best way to implement this -- careful design and pseudocode will simplify this step greatly.)

Step 11. As platforms scroll down, be sure to delete them and generate new ones both graphically and logically.

Step 12. Add the moving, disappearing, and extra bounce platforms.

Step 13. When the game is over, stop the Timeline, display a “Game Over” label, and make sure the Doodle can no longer be moved with the arrow keys.

Step 14. Add score tracking to the game.

Programming with a Partner
Example Final Design

Containment Diagram

Inheritance Diagram

Collidable

Bird
instanceOf is **bad** because it indicates a poor use of (or lack of) polymorphism!

**do not use instanceOf! 😭 you’ll lose points 😭**
Socially Responsible Computing
Class CS15Paddle

java.lang.Object
cs15.prj.pongSupport

public class CS15Paddle
extends java.lang.Object

A SUPPORT class that models one pong paddle.

Constructor Summary

Constructors

Constructor and Description

CS15Paddle(boolean isLeftPaddle)
Creates a new paddle in the pong game.

Method Summary

All Methods  Instance Methods  Concrete Methods

Modifier and Type  Method and Description

void  checkCollision(CS15Ball ball)
Checks if the paddle instance is colliding with a ball.
Java NullPointerException is an unchecked exception and extends RuntimeException. NullPointerException doesn't force us to use catch block to handle it. This exception is very much like a nightmare for most of java developer community. They usually pop up when we least expect them.

https://howtodojava.com › java › exception-handling

Java NullPointerException - How to effectively handle null ...

People also ask:

- How do I fix null pointer exception?
- What is a null pointer exception?
- Why is NullPointerException bad?
- How do you handle null pointer exception in C++?
cs0150: Introduction to Object-Oriented Programming and Computer Science

Sketchy Debugging Hours!! (Francesca)

About
- 2 people
- CIT 219
- Ends at 4:30 PM

Queue
- C

Manage Queue
- Edit queue

Joined 22 minutes ago
You’re learning how to learn.
The Goal of CS

Know how to code everything

Know how to figure out how to do what you want to do.
Part of that process includes not knowing what to do.

AND THAT’S COMPLETELY FINE.
What makes a good programmer?

- Knows how to write code,
- Learns and masters relevant tools,
- Persistent against stupid computers,
- Always willing to learn,
- And a pro at a little extra googling.
You’re already on your way.

Go get ‘em.
Apply to TA CS15 for next fall!
How do I apply?

- Applications for next fall will come out in early/mid March
- Application is short and non-binding
- We’ll send an email to the whole course when applications are out!
Why should I apply?

- Participate in the skits!
- Make friends for life!
- Master Java and OOP!
- Mentor new CS students!
- Improve the course!
Lastly, we present... the best of the commit messages
You had a way with words...

finished!!! itted 12 days ago

jk it was a bracket mistake itted 12 days ago

cs15 TAs this is beyond me " 12 days ago

poop itted 12 days ago

poop itted 12 days ago

poop 13 days ago

gird your loins committed on Nov 1

me when i chase ball committed on Oct 19

me when i run in a field in circles w my tongue out committed on Oct 19

YAYYYY committed on Oct 19

poo drews508 committed 14 days ago

lkhvkj drews508 committed 14 days ago

lets go drews508 committed 14 days ago

ljhuful drews508 committed 14 days ago

platform makes doodle go poof?? committed on Oct 27
Sometimes GitHub is hard...

please keep code i am begging please dont delete
committed 20 days ago

shapes are moving
git add -A
committed 17 days ago

pieces work
git add -A
committed 18 days ago

trying to MERGE
committed on Nov 1

trying to merge p.3
committed on Nov 1
We’ve seen you at your highest highs…

aaaaand the rows move down
committed 15 days ago

THE LINES CLEAR!!
committed 15 days ago

werking!!
committed 15 days ago

starting to slay
committed 15 days ago

sh*t is working finally
committed on Oct 31

---

done
mmitted on Oct 11

the fruits are ninja’d
mmitted on Oct 11

done
mmitted on Oct 11

slayyyyy
committed 14 days ago

Commits on Nov 13, 2022

TETRIS TIME GAMERSS
committed 16 days ago

Commits on Nov 12, 2022

gamering tetrisness
committed 16 days ago

---

IT WORKS
committed 13 days ago

Tetris is done
committed 13 days ago

p works
committed 14 days ago

AAAAAAA ROW CLEARING WORKS NOW
committed 14 days ago

---

WE ARE CHAMPS
committed 27 days ago
...and your lowest lows

I hate this even more now
committed 26 days ago

I hate this project
committed 26 days ago

fixed?
committed 26 days ago

it won't work?
committed 26 days ago

YAHOOoOO
committed 26 days ago

this is bad.
committed 15 days ago

I don't know if I can do this
committed 15 days ago

it's on Nov 12, 2022

nothing works anymore.
committed 17 days ago

eheifefhehfehfeifehfheihfeihfeihfeihfeihfehf
committed 16 days ago

tetris is the bane of my existence
committed 16 days ago

I couldn't do it, I sat here for 12 hours straight but I still couldn't...
2 weeks ago

I was overdramatic, I got it done
2 weeks ago
We love you too <3

LET'S GO I AM DONE SHOUTOUT TO THE TA(s) READING THIS

committed 13 days ago

i love cs

committed on Sep 29

Sherry's a real one she saved my life tonight

thx workshop 5

committed 20 days ago
Yes ;)

does anyone read this
committed 27 days ago

can the TAs read this??
committed on Sep 15
And finally... some never before seen t-shirt designs
And finally... some never before seen t shirt designs