Welcome to CS 106S!

Introduction to CS for Social Good, our map for the quarter, and JavaScript!

cs106s.stanford.edu, Autumn 2024

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Welcome to the First Day of Class!

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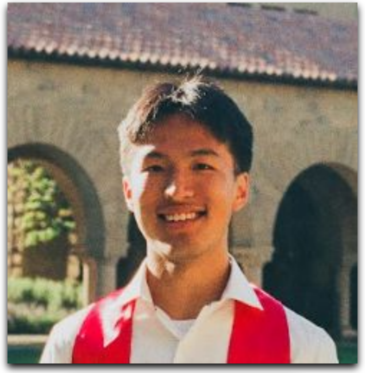
🎨 Hi! I'm Ben

- ❑ Stanford MS CS coterm '25
- ❑ Stanford grad, BS double major in CS & Math '24
- ❑ Minored in Creative Writing ❤️; took 11 English classes in undergrad + Oxford CW abroad
- ❑ Prev. SWE @ NVIDIA; now more teaching-oriented

- ❑ Taught CS 106S last year Aut. & Spr.; also head TA of CS 106AX this Aut.; TA MATH 51 this Win.
- ❑ Interests: fiction/novel writing, anime (*JJK, Demon Slayer, My Hero Academia, Blue Period*), outdoors, boygenius music, bubble tea 🧋



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Intros!

- ❑ Name & pronouns if you're comfortable sharing!
- ❑ What you're studying / thinking about studying
- ❑ Year
- ❑ Fun fact 😨😱 or **any one of the following!**
    - ❑ What are you looking forward this autumn / year? 🌲
    - ❑ Something you did over the summer 🟩
    - ❑ Music / book recommendations? 🎶📚
    - ❑ Anything else you'd like to share! :)

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Course Staff

Teaching Team

Ben Yan

Sarah Chen

Cooper de Nicola

Aditya Saligrama

Faculty Sponsor

Prof. Jerry Cain

📬 **Contact:** cs106s-aut2425-staff@lists.stanford.edu
or bbyan@stanford.edu

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🗺️ The Map For Today

1. syllabus & logistics
2. getting set up for the class
3. HTML/CSS/javascript basics
4. caesar ciphers!

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⛵ Course Logistics

- ❑ 1 unit, S/NC
- ❑ **Attendance (8/9*)**
  - ❑ Relaxed, workshop-style environment
  - ❑ **Brief check-off forms**
- ❑ Canvas for announcements
- ❑ Questions welcome!

***Please do reach out to us if difficult circumstances arise! We understand life can be very stressful and challenging, and will always create a path for you to pass 106S.**

🌐 Course Website!

cs106s.stanford.edu

📬 Contact Email

cs106s-aut2425-staff@lists.stanford.edu; bbyan@stanford.edu is equally fine!

🧭 Place & Time

Lathrop 190

Thurs, 4:30 - 6:20 PM; usually try to keep class to 90 minutes ish

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Course Schedule

Week 1	Sep 26	Intro, JavaScript, Ciphers
Week 2	Oct 3	Sentiment Analysis & Refugee Tweets
Week 3	Oct 10	CS for Climate Change
Week 4	Oct 17	KNN for Cancer Detection
Week 5	Oct 24	Cybersecurity and Ethical Hacking
Week 6	Oct 31	Web Deployment & Open Source
Tuesday, Nov 5, Election Day – Go Vote! 🗳️		
Week 7	Nov 7	Mental Health & Chatbots
Week 8	Nov 14	Trust & Safety
Week 9	Nov 21	What's Next – Beyond 106S, End-Term Boba Party 🧋
	Nov 28	**Thanksgiving Recess**
Week 10	Dec 5	**No class; good luck on your finals!** 🍀

Subject to change – please let me know if you have any feedback or suggestions at any point!

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Overview of Classes!

Coding for Social Good

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Overview of Classes!

What **technologies** (machine learning, sentiment analysis, etc.) can be used to **positively impact the world?**

Coding for **Social Good**

How can we use **JavaScript** to materialize ideas into **real-world applications?**

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Overview of Classes!

What **technologies** (machine learning, sentiment analysis, etc.) can be used to **positively impact the world?**

In **what areas & industries** can we use technology + CS for positive impact?

Coding for **Social Good**

How can we use **JavaScript** to materialize ideas into **real-world applications?**

For what current problems is programming **NOT the answer?**

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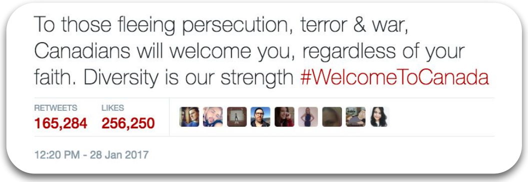
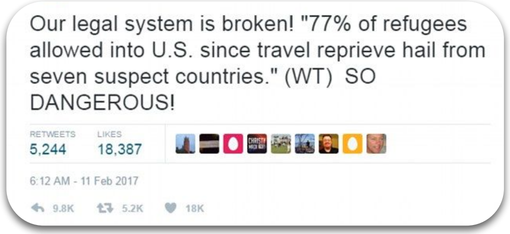
Overview of Classes!


To those fleeing persecution, terror & war, Canadians will welcome you, regardless of your faith. Diversity is our strength #WelcomeToCanada

RETWEETS 165,284 LIKES 256,250

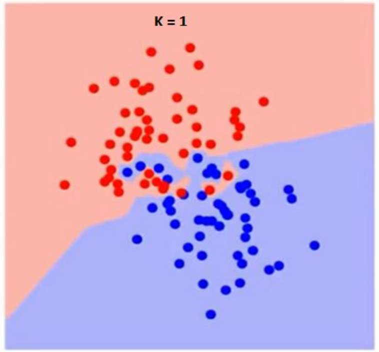
12:20 PM - 28 Jan 2017


Our legal system is broken! "77% of refugees allowed into U.S. since travel reprieve hail from seven suspect countries." (WT) SO DANGEROUS!

RETWEETS 5,244 LIKES 18,387

6:12 AM - 11 Feb 2017

9.8K 5.2K 18K



Cancerous

NOT cancerous

Sentiment Analysis for Detecting Hate Speech on Twitter

Cancer Diagnosis with K-Nearest Neighbors

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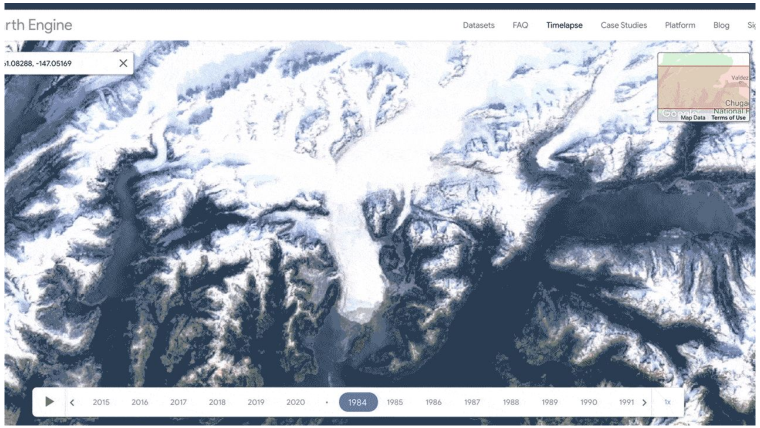
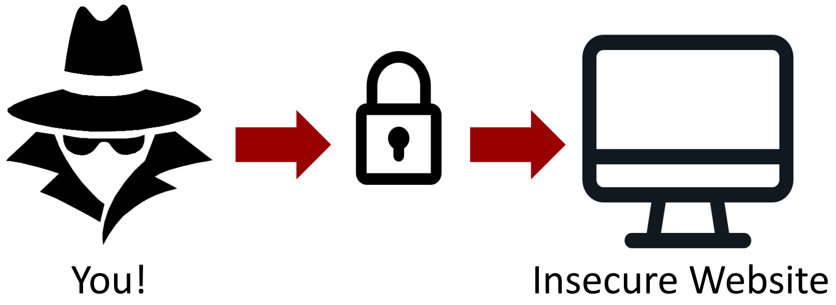
Overview of Classes!



Mapping + Quantifying the Impacts of Climate Change with Google Earth Engine



Ethical Cybersecurity: Hacking an Insecure Website—to Discover Vulnerabilities to Patch

And more!

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Let’s Dive In!

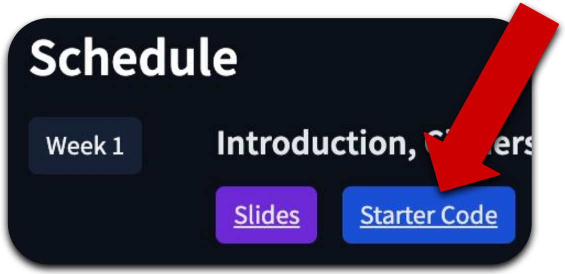
Getting Set Up

<u>install Chrome</u>

<u>install VS Code</u>

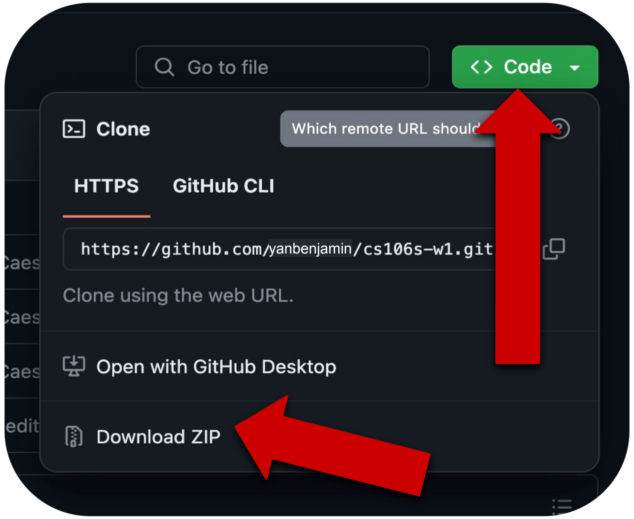
(or an editor of your choice)

Opening the Starter Code



1 Navigate to Week 1 of the Schedule section of **cs106s.stanford.edu**

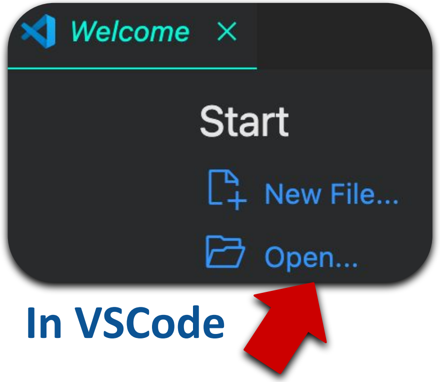
Also, at this link: **https://github.com/yanbenjamin/cs106s-w1**



```
https://github.com/yanbenjamin/cs106s-w1.git
```

Clone using the web URL.

2 Click the bright **"Code"** button, then click "Download ZIP"



In VSCode

3 Unzip the download (clicking .zip file should do the trick) and open the folder / files in your editor

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HTML, CSS, JS Overview

.html	Hypertext Markup Language
.css	Cascading Style Sheets
.js	JavaScript

- HTML for defining the **webpage content and basic structure**
- CSS for **regulating style and formatting**
- JavaScript for **enabling the HTML/CSS page to be interactive**
    - "Language of the Web"
    - 99% of websites use JavaScript on the client side, making it essential for building browser applications

HTML/CSS

Note: CS 106S isn't a dedicated web development course — but I think it's helpful to at least cover the basics.

index.html

```html
<!doctype html>
<html>
   <head>
       <link rel="stylesheet" href="style.css">
   </head>
   <body>
       <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
       <img src = "obiwan.jpg" width = 400>
       <p>Hello there. Open the JavaScript console to continue 
onward!</p>
   </body>
</html>
```

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HTML/CSS

The <html> and </html> tags enclose all the content.

index.html

```
<!doctype html>
<html>
   <head>
       <link rel="stylesheet" href="style.css">
   </head>
   <body>
       <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
       <img src = "obiwan.jpg" width = 400>
       <p>Hello there. Open the JavaScript console to continue
onward!</p>
   </body>
</html>
```

HTML/CSS

HEAD contains info not displayed on webpage (e.g., browser title, any JavaScript or CSS style files to load)

index.html

```
<!doctype html>
<html>
   <head>
       <link rel="stylesheet" href="style.css">
   </head>
   <body>
       <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
       <img src = "obiwan.jpg" width = 400>
       <p>Hello there. Open the JavaScript console to continue
onward!</p>
   </body>
</html>
```

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HTML/CSS

BODY contains everything displayed on the webpage (e.g., text, images, GIFs, etc)

index.html

```
<!doctype html>
<html>
   <head>
       <link rel="stylesheet" href="style.css">
   </head>
   <body>
       <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
       <img src = "obiwan.jpg" width = 400>
       <p>Hello there. Open the JavaScript console to continue
onward!</p>
   </body>
</html>
```

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HTML/CSS

Tags such as <h2> enclose each of the HTML elements. Typically have end tag (</h2>), but not always (<img>)

index.html

```
<!doctype html>
<html>
   <head>
       <link rel="stylesheet" href="style.css">
   </head>
   <body>
       <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
       <img src = "obiwan.jpg" width = 400>
       <p>Hello there. Open the JavaScript console to continue
onward!</p>
   </body>
</html>
```

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HTML/CSS

Question: How can we stylize each of these webpage elements embedded in tags?

index.html

```
<!doctype html>
<html>
    <head>
        <link rel="stylesheet" href="style.css">
    </head>
    <body>
        <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
        <img src = "obiwan.jpg" width = 400>
        <p>Hello there. Open the JavaScript console to continue
onward!</p>
    </body>
</html>
```

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HTML/CSS

Strategy: We use a separate CSS file to specify stylization, colors, etc.

index.html

```html
<!doctype html>
<html>
   <head>
      <link rel="stylesheet" href="style.css">
   </head>
   <body>
      <h2>CS 106S Week 1: JavaScript and Cryptography</h2>
      <img src = "obiwan.jpg" width = 400>
      <p>Hello there. Open the JavaScript console to continue
onward!</p>
   </body>
</html>
```

HTML/CSS

style.css

```
*{
    font-family: 'Courier New', monospace !important;
} /* sets everything (*) on page to Courier New font */

h2{
    color: darkred;
} /* sets section heading to a dark red color */
```

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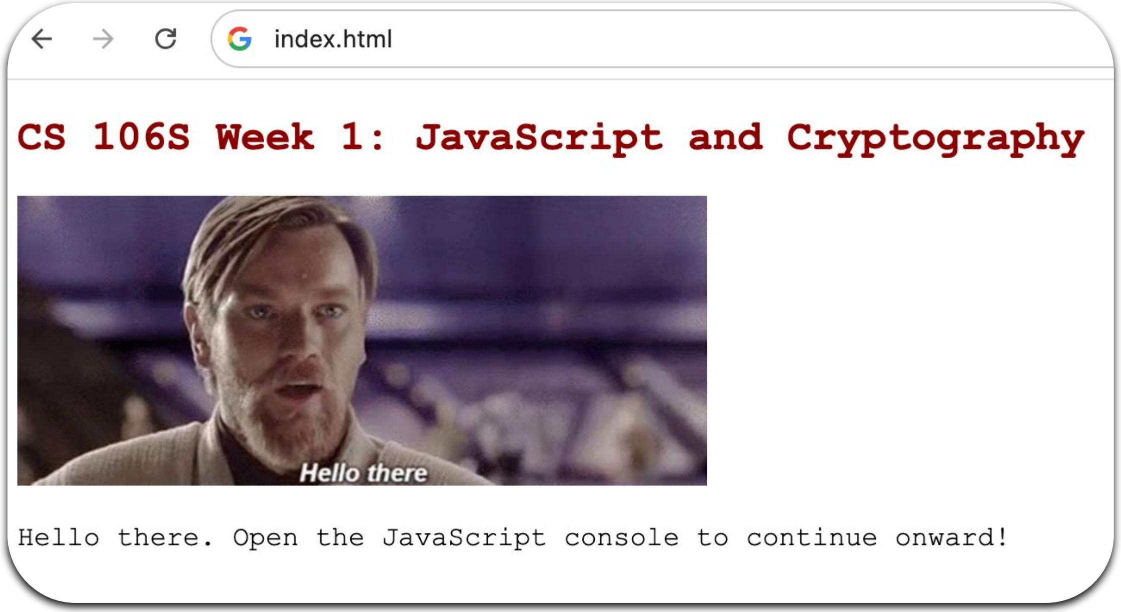
HTML/CSS – Browser Rendering

Resulting webpage from **index.html** and **style.css**



CS 106S Week 1: JavaScript and Cryptography

Hello there. Open the JavaScript console to continue onward!

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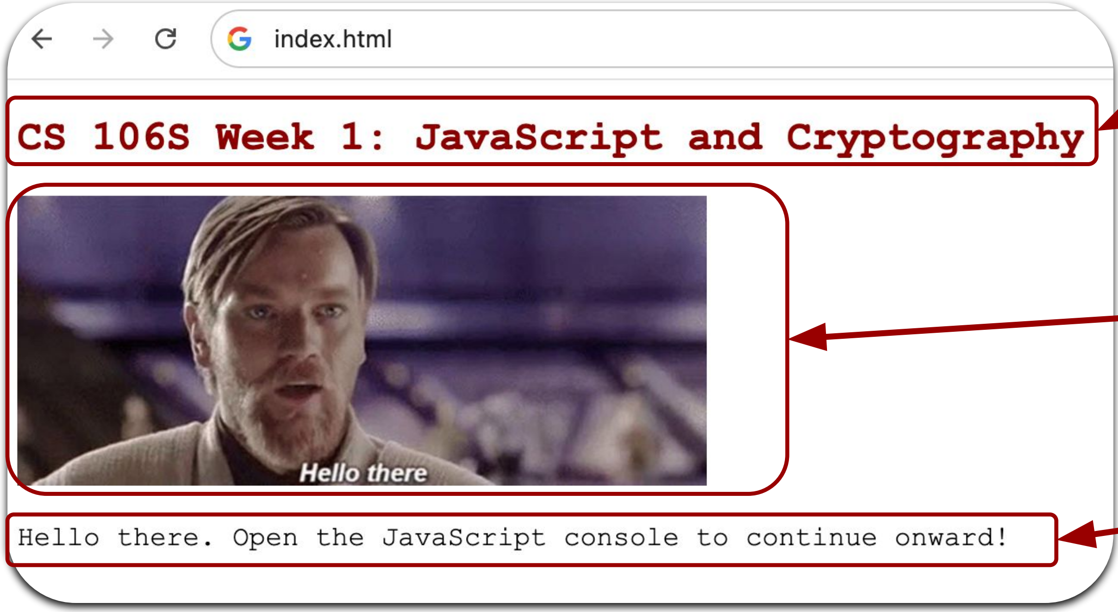
HTML/CSS – Browser Rendering

Resulting webpage from **index.html** and **style.css**



index.html

CS 106S Week 1: JavaScript and Cryptography

Hello there. Open the JavaScript console to continue onward!

Heading **<h2>** tag, with dark red color from CSS

<img> tag, loading in image obiwan.jpg

Text in paragraph tag **<p>**

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Any questions so far?

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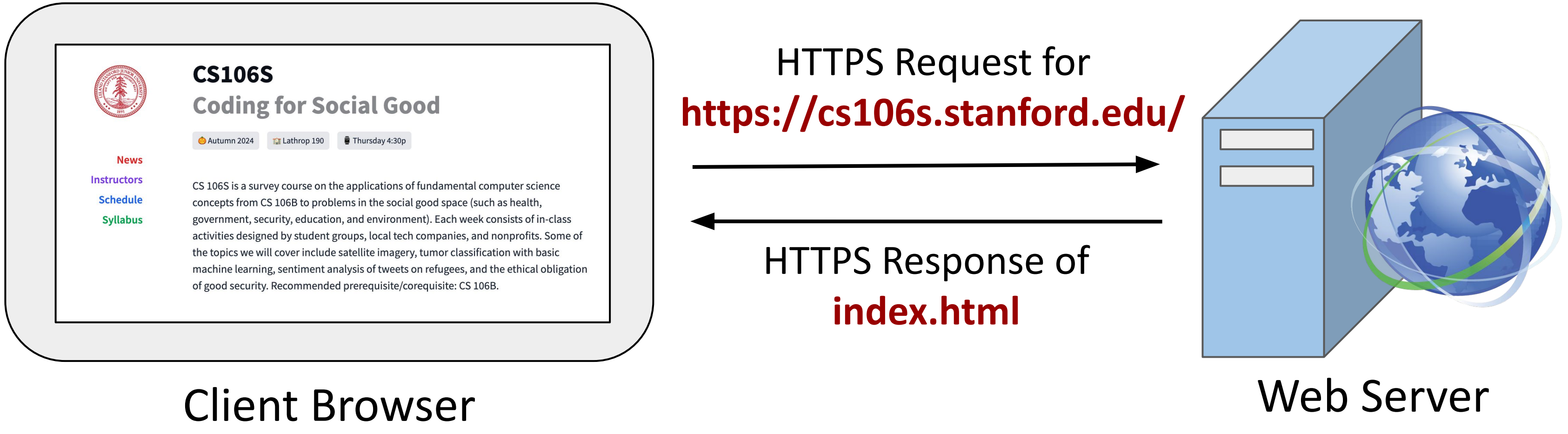
What is index.html?

- In the starter code, you'll find a file named **index.html**; using Finder or your OS equivalent, **open it in Google Chrome**
- This is the **homepage** of a website.

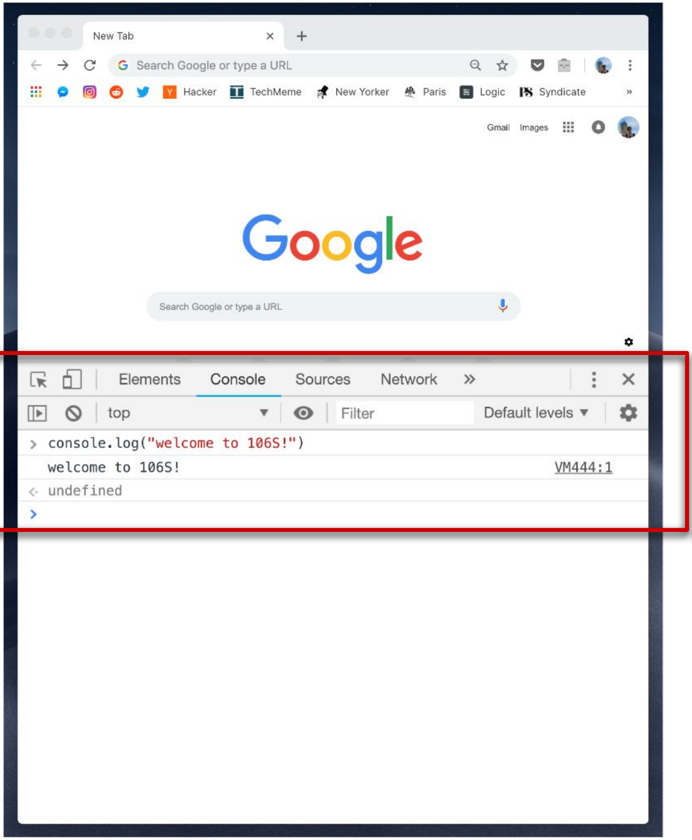


CS106S

Coding for Social Good

CS 106S is a survey course on the applications of fundamental computer science concepts from CS 106B to problems in the social good space (such as health, government, security, education, and environment). Each week consists of in-class activities designed by student groups, local tech companies, and nonprofits. Some of the topics we will cover include satellite imagery, tumor classification with basic machine learning, sentiment analysis of tweets on refugees, and the ethical obligation of good security. Recommended prerequisite/corequisite: CS 106B.

JavaScript in Chrome



```
> console.log("welcome to 106S!")
  welcome to 106S!                                  VM444:1
<· undefined
>
```

1. Open **index.html** in Chrome
2. On Mac: Press **cmd** – **option** – **j**

   On Windows: Press **ctrl** – **shift** – **j**

   Don't let go of the previous key while pressing the next.

Here, **in the console that pops up**, we can input and run JavaScript code!

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Onto the JavaScript Tutorial!

To follow along, inspect the file **tut.js** in your code editor; we'll be running the JavaScript commands inside on the Chrome console!

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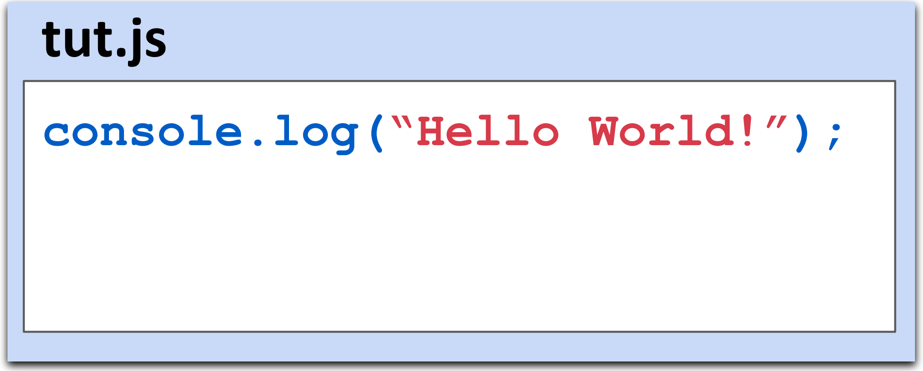
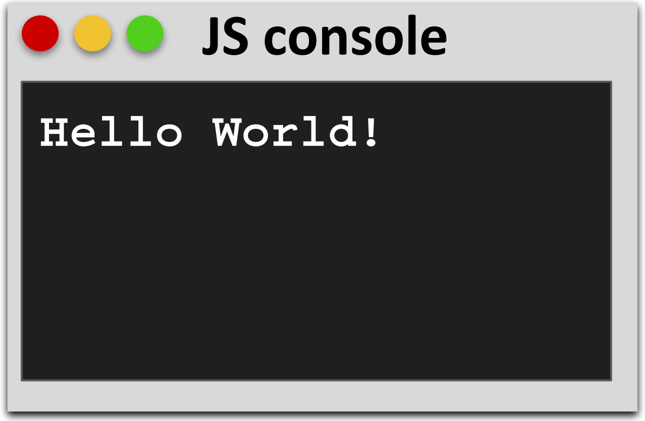
JavaScript – Hello World

- Unlike Python, **do not use print()** for outputting to console; it will try printing … to a physical printer lol



tut.js

```
console.log("Hello World!");
```



JS console

```
Hello World!
```

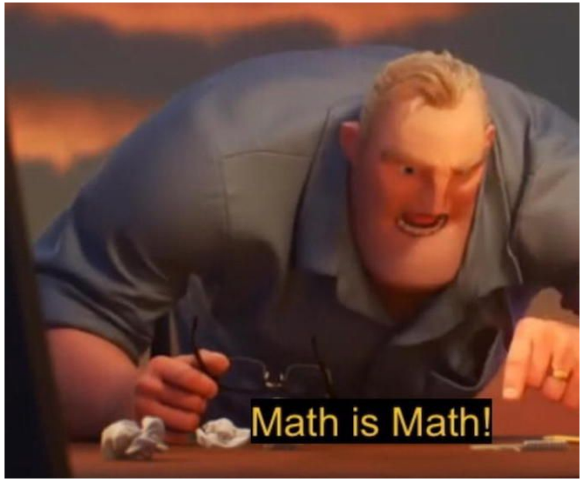
JavaScript – Math Operations

- Works similarly to Python; note the (optional) semi-colon

tut.js

```
1 + 1; // => 2
10 - 4; // => 6
2 * 7; // => 14
3 / 2; // => 1.5

/* mod: remainder function */
4 % 2; // => 0
5 % 2; // => 1
6 % 2; // => 0
10 % 26; // => 10
```



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JavaScript – Variables

- Use let keyword to define **variables of any type** (int, string, array, etc.), and const instead for variables with fixed values

```
let variableName = expression;
```

tut.js

```
let num_classes = 4;
num_classes += 1; // modified
num_classes = num_classes - 2;

const CS106S_UNITS = 1;
var total_units = 17;
```

Note: var (in the place of let) is often seen in older JS code; as a general principle, **avoid using it**. **tut.js** has an explanation of the key difference (var scoping)

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JavaScript – Functions & Calls

```
// general structure
function functionName(arg list){
    statements in function body
}
```

```
// calling function
functionName(args)
```

tut.js

```
function add(x,y) {
    let answer = x+y;
    return answer;
    // Just like Python!
}
```

JS console

```
> add(3,5)
< 8

> add(add(1,2), 3)
> 6
```

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JavaScript – Conditionals (if, else if, else)

tut.js

```
function getMax(x,y,z){
    if (x >= y && x >= z){
        return x;
    }
    //either y or z is max
    else if (y >= z){
        return y;
    }
    else{
        return z;
    }
}
```

`===` Equality `==!` Non-equality

`&&` Logical AND `||` Logical OR

`<` `<=` `>` `>=`

Operate as mathematically expected

Note: A **return** statement exits out of the function immediately i.e. the following lines are not run.

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JavaScript – Objects

JS objects are akin to Python **dictionaries i.e. key-value pairs** enclosed in {}. Entries can be of different type!

Use [] bracket notation to get values!

tut.js

```
let menuPrices = {
    "hotdog": 5,
    "soda": 3,
    "pretzel": 4.50,
    "funnelcake": 9,
}
```

JS console

```
> menuPrices[“soda”]
< 3

> menuPrices[“pretzel”]
> 4.50
```

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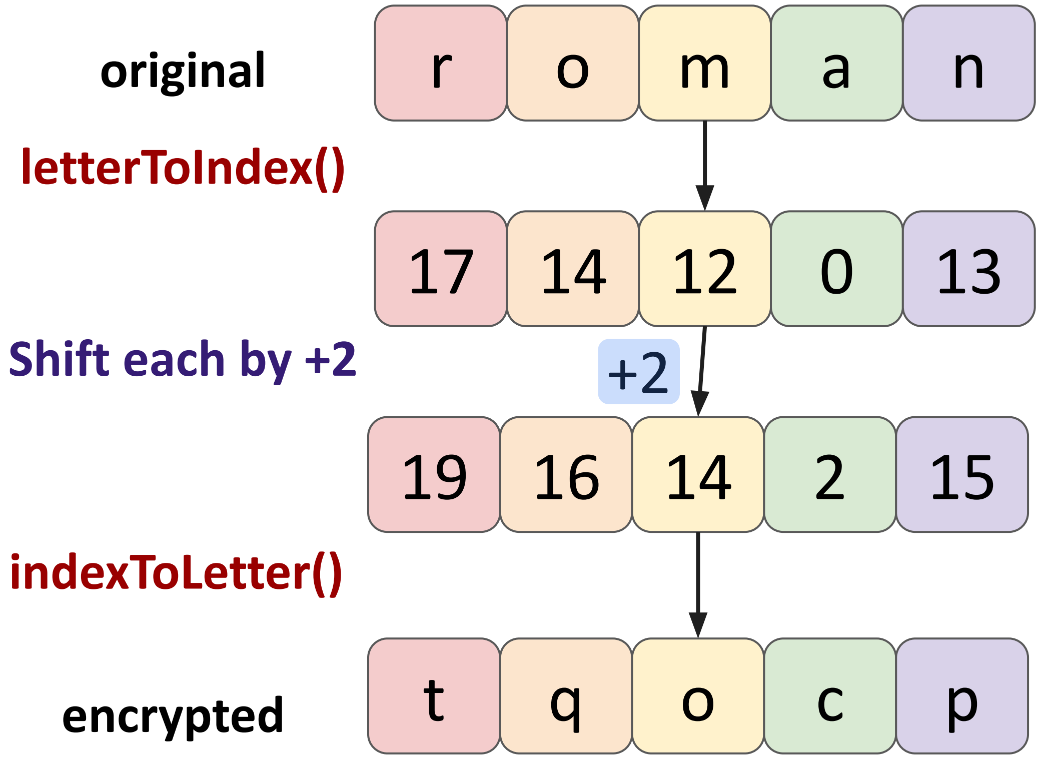
Today's Coding – Caesar Ciphers



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Checkpoint #1

- Traverse over to **assignment.js** on your code editor.

Task

```
Implement the function letterToIndex()
Input: A lowercase letter (a-z)
Output: Index in alphabet (a=0,b=1,c=2,...,z=25)

Tip - You may find the key-value object mapping in the
file useful.
```

Note: After editing the JS file, make sure to click **File -> Save in VSCode,** and **refresh the Chrome page**, for the edits to manifest in the console.

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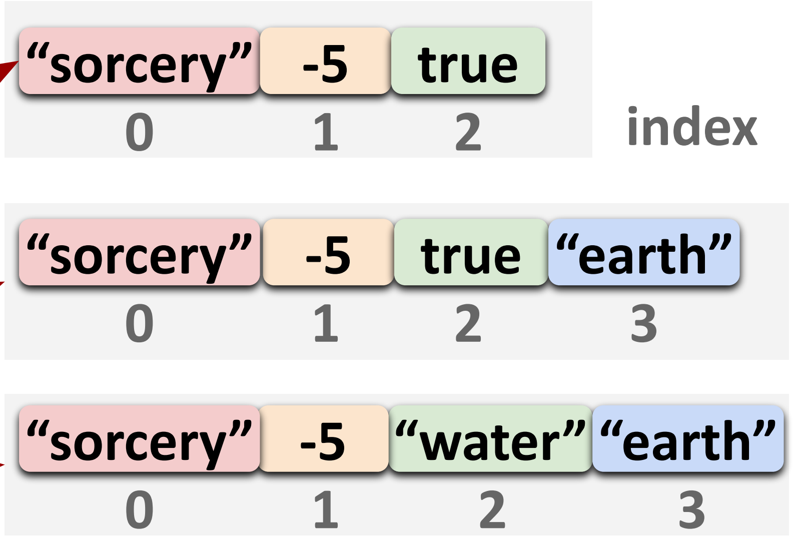
JavaScript – Arrays

- **Ordered lists of any / heterogeneous data type**, 0-indexed in JS.
- Mutable and of variable length.

tut.js

```
let myArray = ["sorcery", -5,
true];
myArray[0]; // => "sorcery"
myArray[1]; // => -5

myArray.push("earth");
myArray.length; // => 4
myArray[2] = "water";
```



Benjamin Yan, CS106S 2024

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Checkpoint #2

Task in assignment.js

```
Implement the function indexToLetter()
Input: Non-negative index of a letter, can be >25
Output: Corresponding lowercase letter; numbers above
25 wrap around i.e. 0=a,1=b,..,25=z,26=a,27=b,...

Tip – The array alphabet=['a','b',..,'z'] may come in
handy. For dealing with overflow, take any letter,
say 'a'; how are all its possible indices related?
```

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Checkpoint #3

Task in assignment.js

Implement the function **shiftLetter()**

Inputs: **original** (letter to shift), **shift** (length to transpose letters by)
Output: shifted letter

Tip - Use letterToIndex() and indexToLetter()!

Example Functionality

JS Console

```
> shiftLetter('a',1)
< 'b'

> shiftLetter('a',4)
< 'e'

> shiftLetter('z',3)
< 'c'
```

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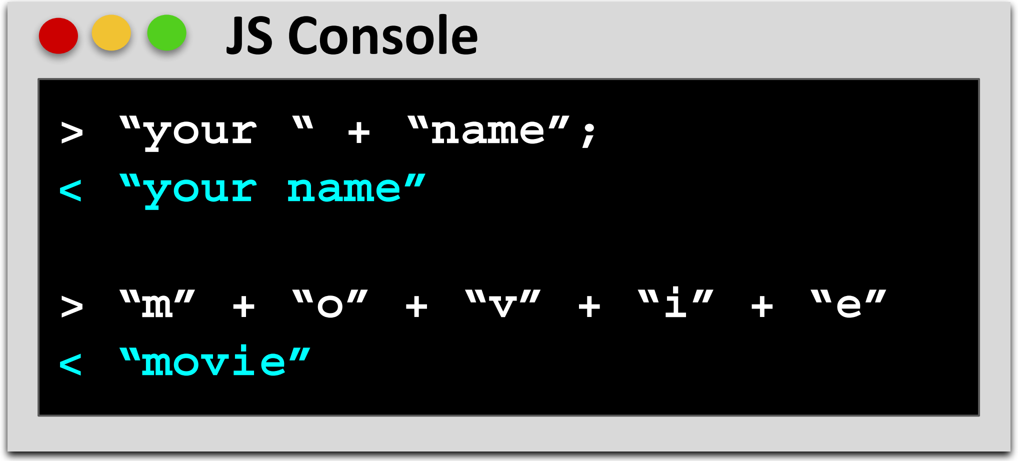
JavaScript – Strings

- **Text or sequence of characters**, wrapped in quotation marks.
- Like Python/C++, strings can be concatenated using + operator


JS Console

```
> "your " + "name";
< "your name"

> "m" + "o" + "v" + "i" + "e"
< "movie"
```

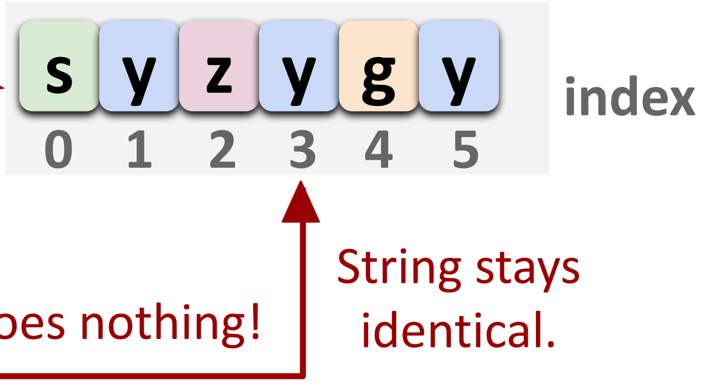
JavaScript – Strings

- Indexing similar to arrays, though unlike arrays, strings are immutable i.e. **its contents cannot be changed once declared**.

tut.js

```
let myString = "syzygy";
myString[1]; // => y
myString[2]; // => z
myString.length; // => 6

//attempt to change a letter
myString[0] = "a";
```



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JavaScript – String Methods

- **However, strings can be replaced.**
- String methods (like +) actually create an **entirely new string**, then re-assign the variable name to that string!

myString
You have freed us!
syzygy!!
myString
Oh, I wouldn't say "freed", more like "under new management."

tut.js

```
let myString = "syzygy";
myString += "!";
myString = myString + "!";
```

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JavaScript – Loops!

- ‘For’ loops for executing a block of code a fixed number of times; JS **syntax is similar to C++/Java**

tut.js

```
function sayHelloThereNTimes(N){
    //loop runs N times
    //(i = 0,1,2,...,N-1)
    for (let i = 0; i < N; i++){
        console.log("Hello There!");
    }
}
```

JavaScript – Loops!

- 'For' loops for executing a block of code a fixed number of times; JS **syntax is similar to C++/Java**

tut.js

```
function sayHelloThereNTimes(N){
    //loop runs N times
    //(i = 0,1,2,...,N-1)
    for (let i = 0; i < N; i++){
        console.log("Hello There!");
    }
}
```

Each time this runs, the value of **i** is incremented by 1, starting from **i = 0**.

The block will be executed **until condition i < N is broken**, i.e. i reaches N, which occurs after **N runs**.

Please do not run sayHelloThereNTimes(1000000);

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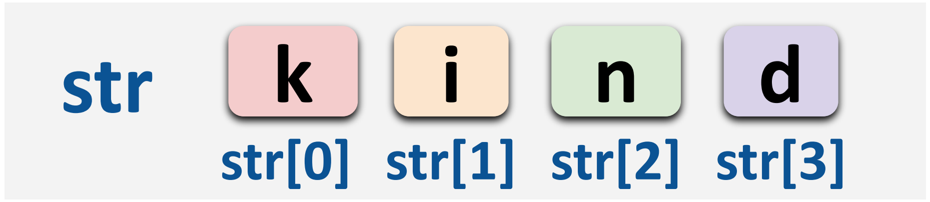
JavaScript – Iterating Over String

tut.js

```
function printAllLetters(str){
    for (let i = 0; i < str.length; i++){
        //get ith letter of string
        let letter = str[i];
        console.log(letter);
    }
}
```

JS Console

```
> printAllLett
ers("kind")
 k
 i
 n
 d
```



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Final Checkpoint – The Full Pipeline

Task in assignment.js

Implement `encrpytCaesar()`

<u>Inputs:</u> `original` (string to encrypt), `shift` (how many places to move each letter down the alphabet)

<u>Output:</u> The encrypted string

Tip – Loops! And take advantage of functions you've already written!

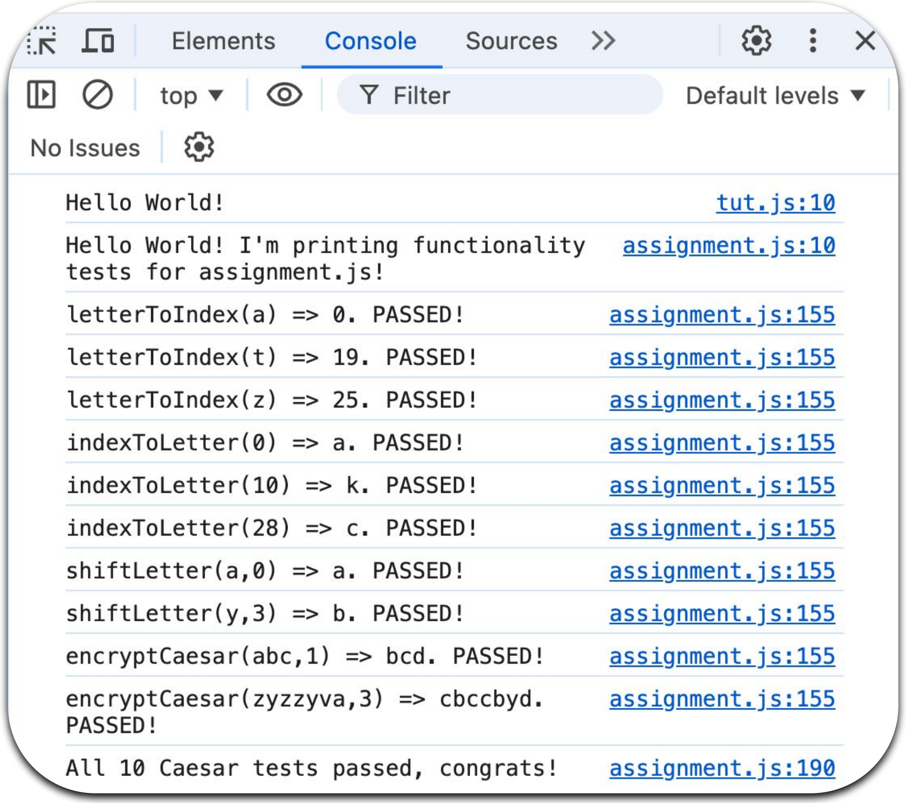
Sample Functionality

JS Console

```
> encrpytCaesar
('abc',1)
< 'bcd'

> encryptCeasar
('zyzzyva',3)
< 'cbccbyd'
```

Sanity Testing



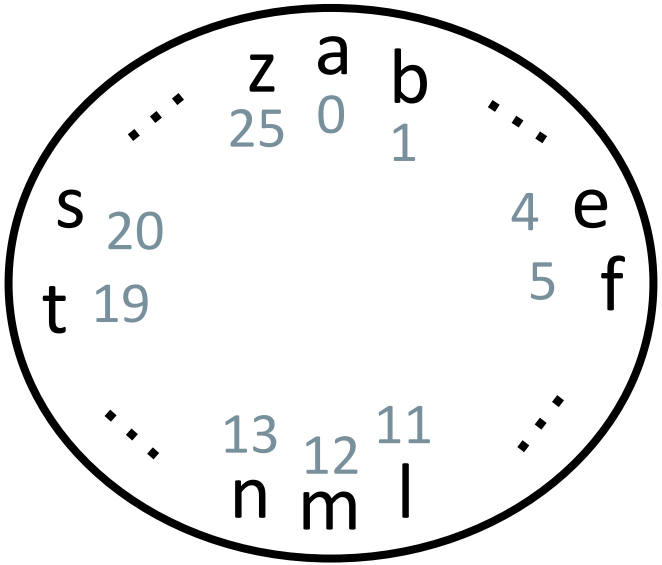
```
Hello World!                                          tut.js:10
Hello World! I'm printing functionality         assignment.js:10
tests for assignment.js!
letterToIndex(a) => 0. PASSED!                 assignment.js:155
letterToIndex(t) => 19. PASSED!                assignment.js:155
letterToIndex(z) => 25. PASSED!                assignment.js:155
indexToLetter(0) => a. PASSED!                 assignment.js:155
indexToLetter(10) => k. PASSED!                assignment.js:155
indexToLetter(28) => c. PASSED!                assignment.js:155
shiftLetter(a,0) => a. PASSED!                 assignment.js:155
shiftLetter(y,3) => b. PASSED!                 assignment.js:155
encryptCaesar(abc,1) => bcd. PASSED!           assignment.js:155
encryptCaesar(zyzzyva,3) => cbccbyd.           assignment.js:155
PASSED!
All 10 Caesar tests passed, congrats!          assignment.js:190
```

All tests should pass after **encryptCaesar()** is successfully implemented!

Solution code available on website right after class :)

(Optional) Caesar Decryption

- Great, we now have encrypted strings! **How do we decode them?**



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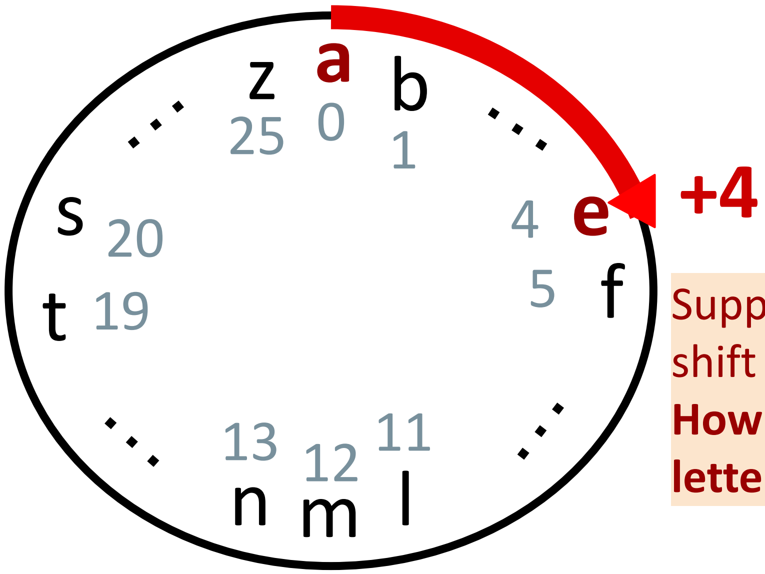
(Optional) Caesar Decryption

- Great, we now have encrypted strings! **How do we decode them?**



Suppose our cipher has a shift of **+4**, e.g., a => e. **How might we go back to letter 'a'**?

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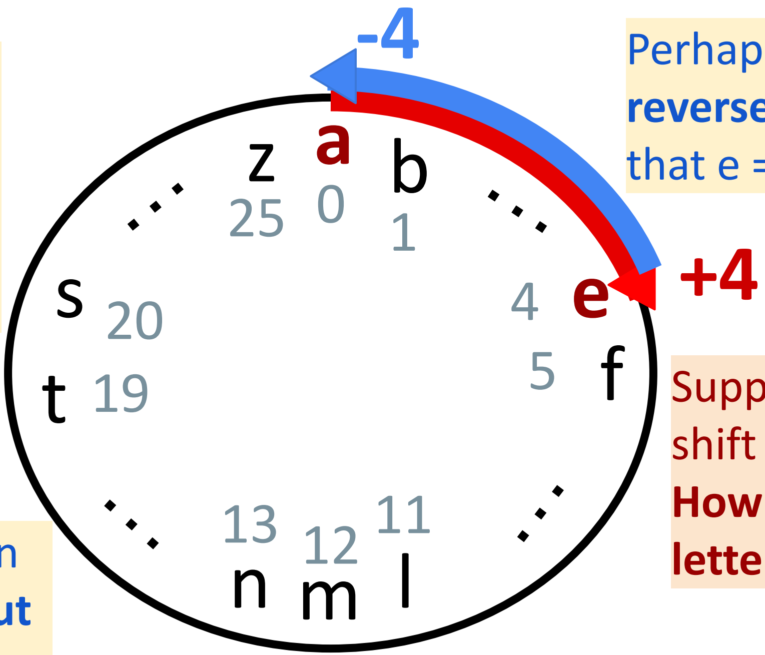
(Optional) Caesar Decryption

- Great, we now have encrypted strings! **How do we decode them?**

This decodes 'e' **but has a problem.** If the negative shift is too large, the index will go negative.



Perhaps, we can do a **reverse shift of -4!** So that e => a.

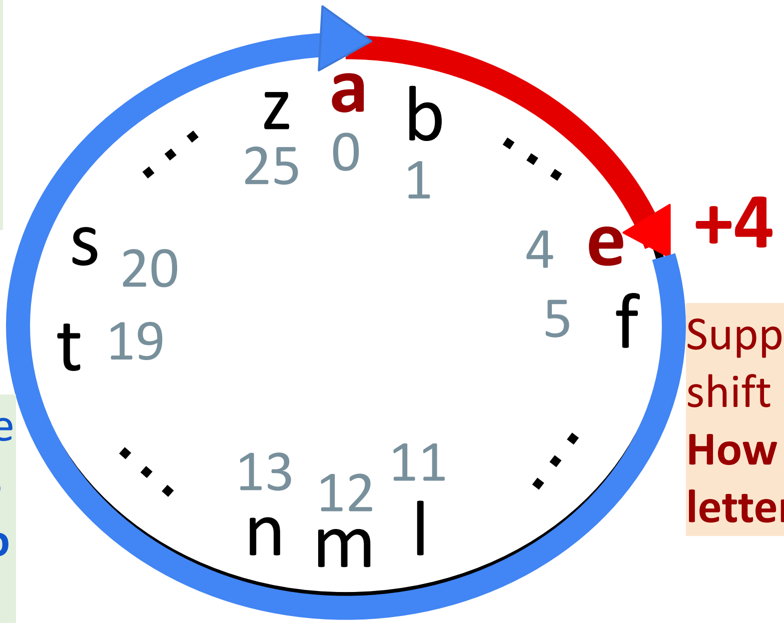
Suppose our cipher has a shift of **+4**, e.g., a => e. **How might we go back to letter 'a'**?

So how might we attain the same effect **without a negative shift?**

(Optional) Caesar Decryption

- Great, we now have encrypted strings! **How do we decode them?**

How large should this shift be? Keep in mind, alphabet / circle length is 26.



Suppose our cipher has a shift of **+4**, e.g., a => e. **How might we go back to letter 'a'**?

Positive shift! Since we can handle indices >25 (Checkpoint #2), **we go this way around the circle instead.**

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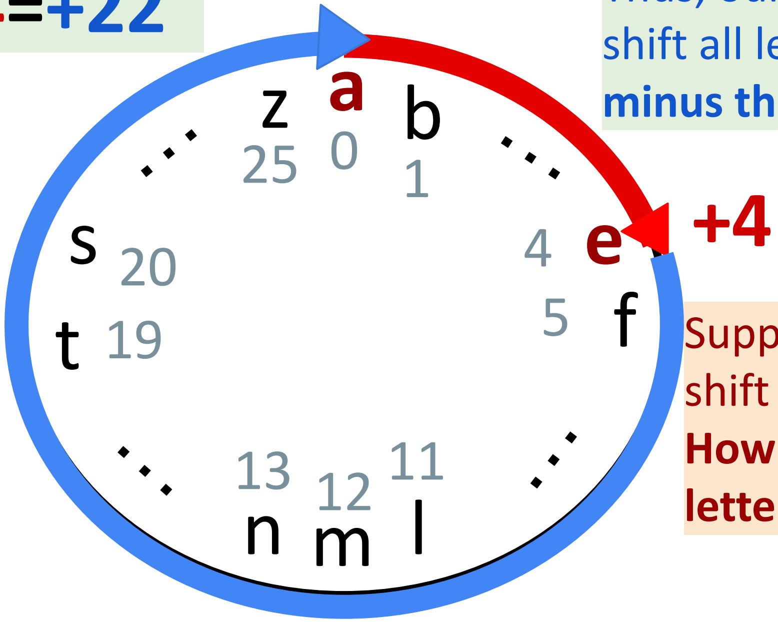
(Optional) Caesar Decryption

- Great, we now have encrypted strings! **How do we decode them?**

26-4=+22



Thus, our decryption scheme will shift all letters by +22, or **26 minus the encryption shift.**

Suppose our cipher has a shift of **+4**, e.g., a => e. **How might we go back to letter 'a'**?

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(Optional) Caesar Decryption

assignment.js

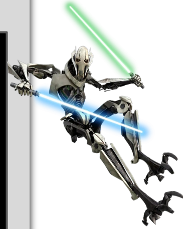
```
/* Decrypts the given string from Caesar
cipher with a given shift length.*/
function decryptCaesar(ciphertext, shift){
    let reverse_shift = 26 – shift;
    return encryptCaesar(
            ciphertext,reverse_shift);
}
```

Obi-Wan

```
> encrpytCaesar
('hellothere',4)
< mjqqtymjwj
```

Gen. Grevious

```
> decryptCaesar
('mjqqtymjwj',4)
< hellothere
```



We observe that decryption **reverses** each letter shift in the encryption—thus recovering the original message.

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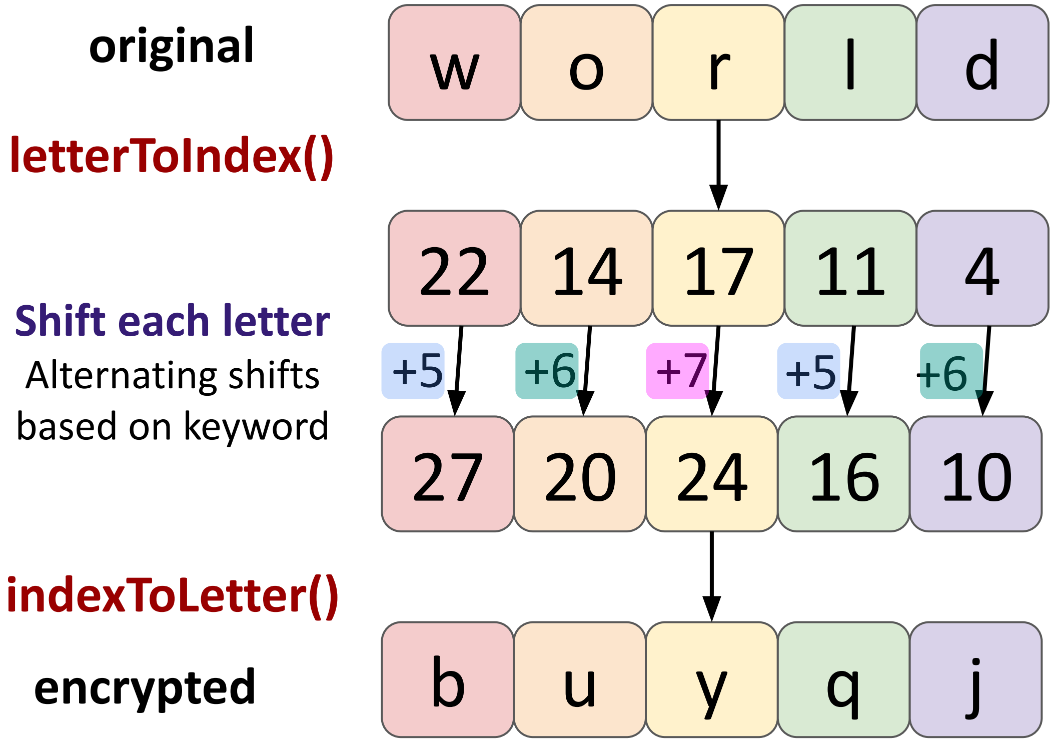
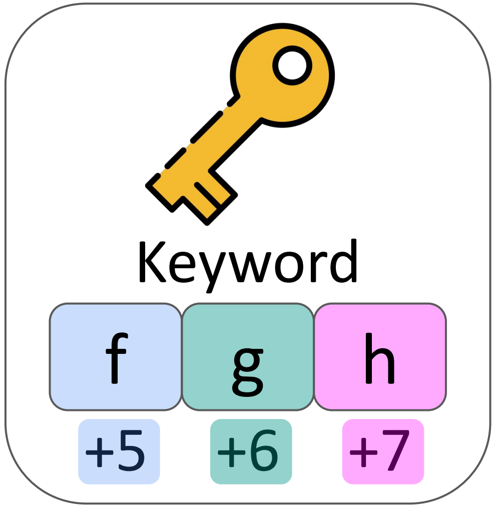
(Optional Extension) Vigenère Ciphers

We won't get to this in class, but feel free to try it out on your own!





Remark: It's like having multiple Caesar ciphers in one encryption!

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Benjamin Yan, CS106S 2024

Check-Off Form!

To get attendance credit each class, you'll fill out a **brief check-off form** (~2 – 5 min to complete).

For today, click the "Check-Off Form" link in the Week 1 section of cs106s.stanford.edu!

https://tinyurl.com/cs106s-aut24-w1-checkoff (case sensitive!)

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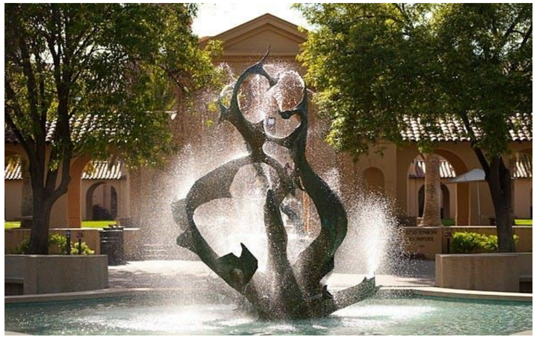
Looking Forward to this Autumn 🍁

Teaching this 1-unit wonder has been a truly wonderful privilege for me.

Thank you for being here to learn with us, and I hope this will be, for you, a fun, rewarding adventure.



Have an awesome first week of classes! :)

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