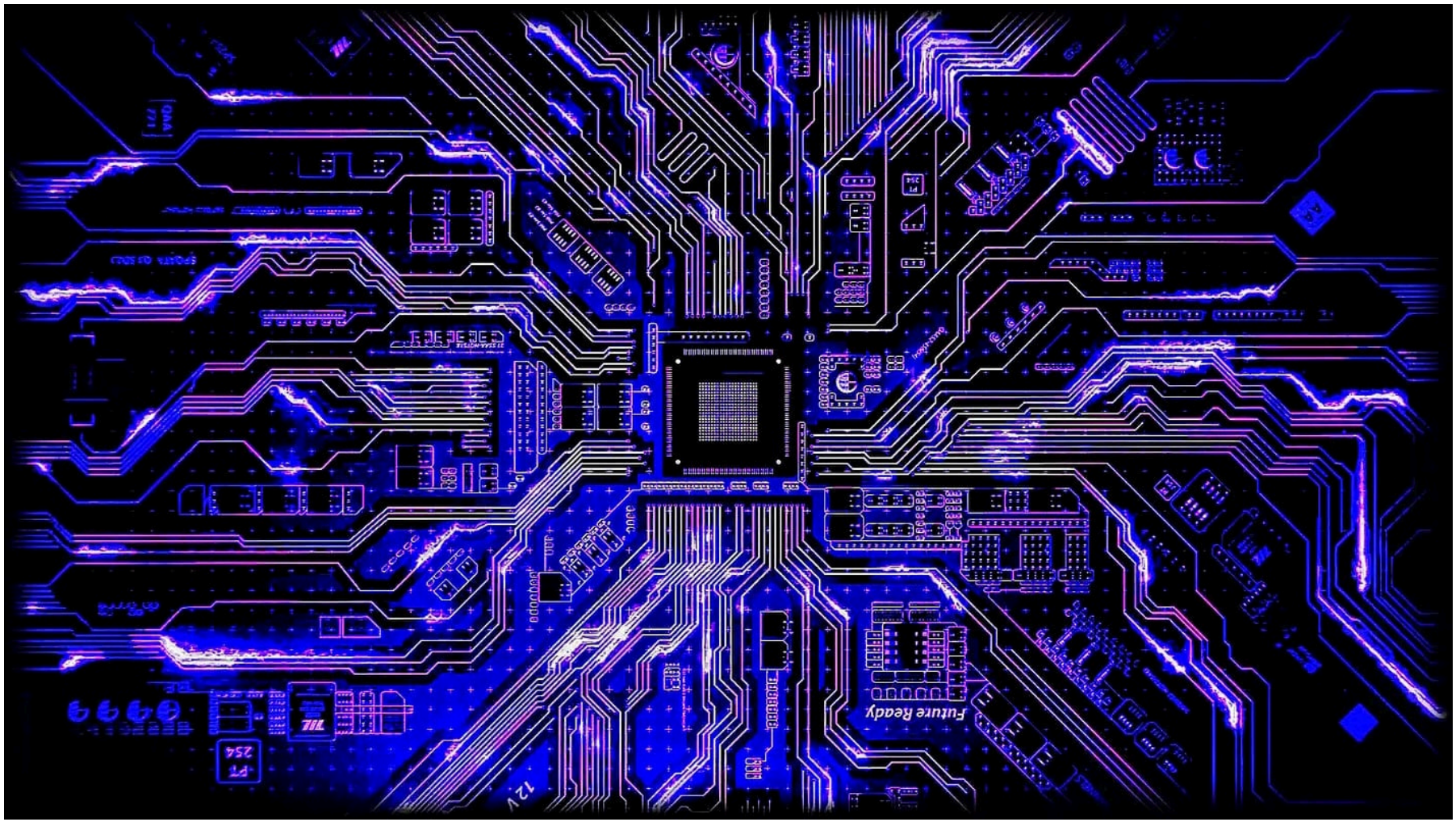
CSci 127: Introduction to Computer Science



hunter.cuny.edu/csci

Frequently Asked Questions

From email and tutoring.

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  Instead of a review sheet, we have:
  - *All previous final exams (and answer keys) on the website.*

Today's Topics

- Design Patterns: Searching
- Python Recap
- Machine Language
- Machine Language: Jumps & Loops
- Binary & Hex Arithmetic
- Final Exam: Format

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Predict what the code will do:

```
def search(nums, locate):
    found = False
    i = 0
    while not found and i < len(nums):
        print(nums[i])
        if locate == nums[i]:
            found = True
        else:
            i = i+1
    return(found)

nums= [1,4,10,6,5,42,9,8,12]
if search(nums,6):
    print('Found it! 6 is in the list!')
else:
    print('Did not find 6 in the list.')
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Python Tutor

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(Demo with pythonTutor)

Design Pattern: Linear Search

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- Example of **linear search**.
- Start at the beginning of the list.
- Look at each item, one-by-one.
- Stopping, when found, or the end of list is reached.

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- Design Patterns: Searching
- **Python Recap**
- Machine Language
- Machine Language: Jumps & Loops

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Python & Circuits Review: 9 Classes in 10 Minutes

A whirlwind tour of the semester, so far...

Class 1: print(), loops, comments, & turtles

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- Introduced comments & print():

```
#Name:  Thomas Hunter                          ← These lines are comments
#Date:  September 1, 2017                      ← (for us, not computer to read)
#This program prints:  Hello, World!           ← (this one also)

print("Hello, World!")                         ← Prints the string "Hello, World!" to the screen
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print("Hello, World!")                         ← Prints the string "Hello, World!" to the screen
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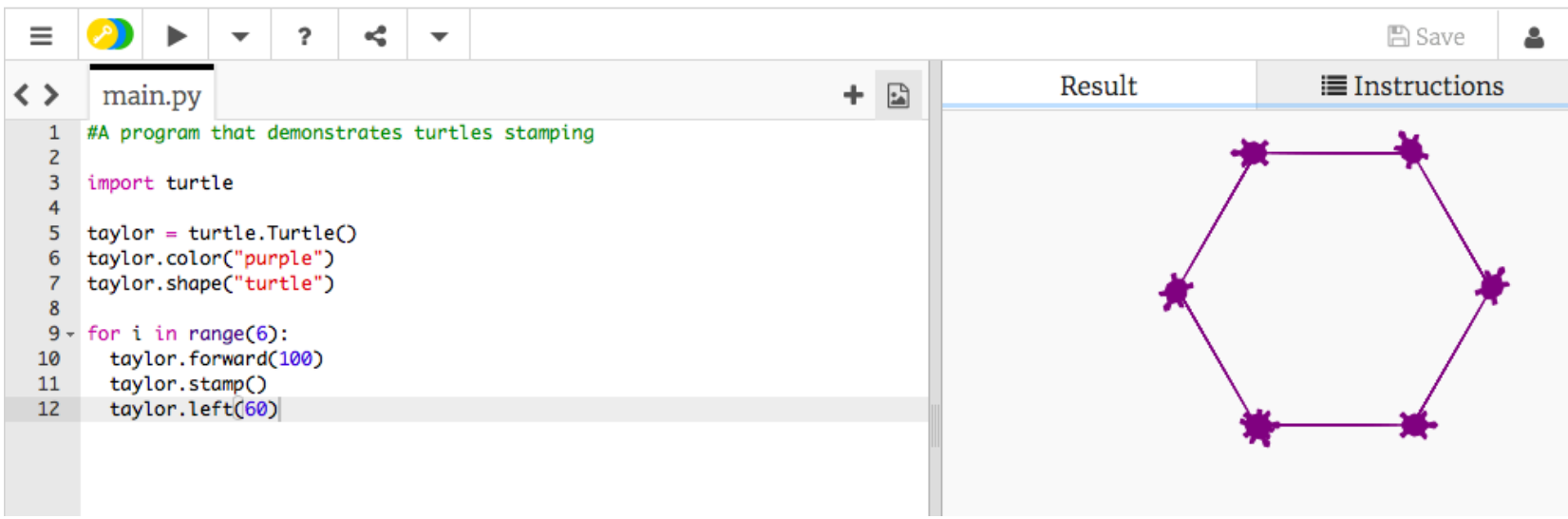
- As well as definite loops & the turtle package:



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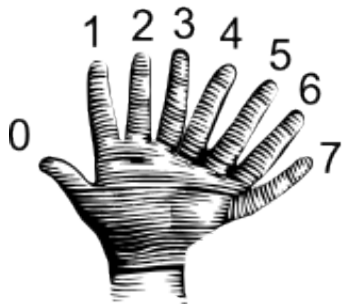
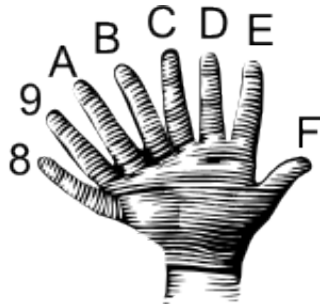
  - **class variables**: for complex objects, like turtles.
- More on loops & ranges:

```
1  #Predict what will be printed:
2
3  for num in [2,4,6,8,10]:
4      print(num)
5
6  sum = 0
7  for x in range(0,12,2):
8      print(x)
9      sum = sum + x
10
11 print(sum)
12
13 for c in "ABCD":
14     print(c)
```

Class 2: colors, hex, slices, numpy & images

Color Name	HEX	Color
Black	#000000	
Navy	#000080	
DarkBlue	#00008B	
MediumBlue	#0000CD	
Blue	#0000FF	





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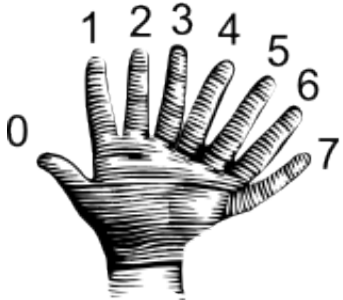

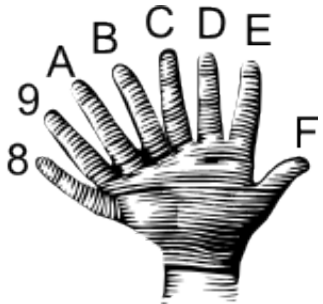

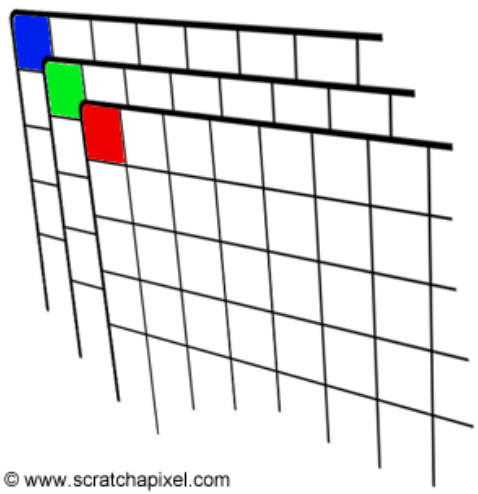

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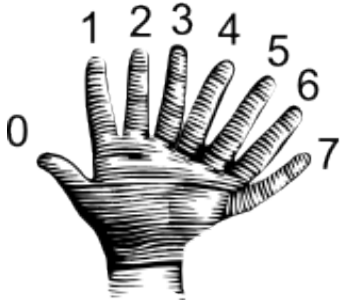
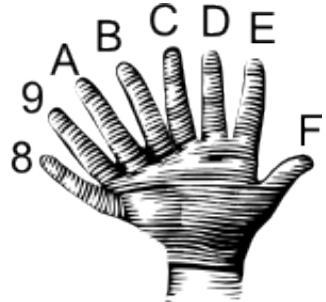
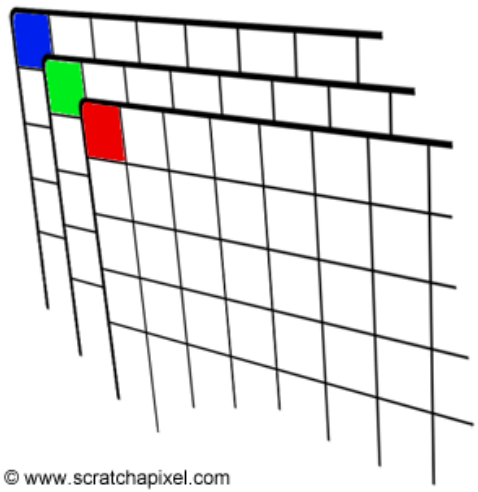
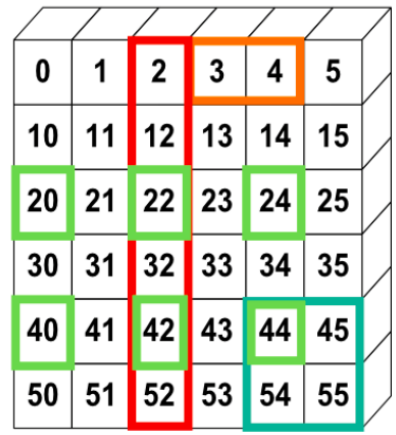


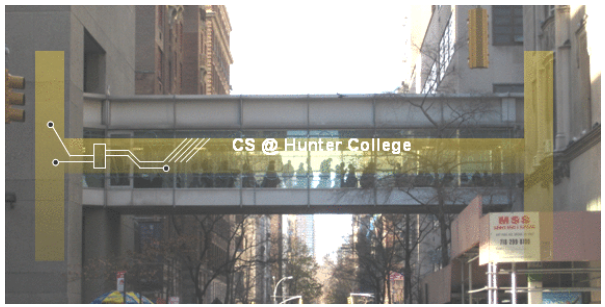





```
>>> a[0,3:5]
array([3,4])

>>> a[4:,4:]
array([[44, 45],
       [54, 55]])

>>> a[:,2]
array([2,12,22,32,42,52])

>>> a[2::2,::2]
array([[20,22,24]
       [40,42,44]])
```



Class 3: design problem (cropping images) & decisions



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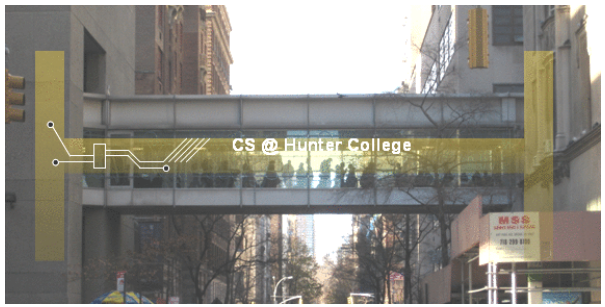

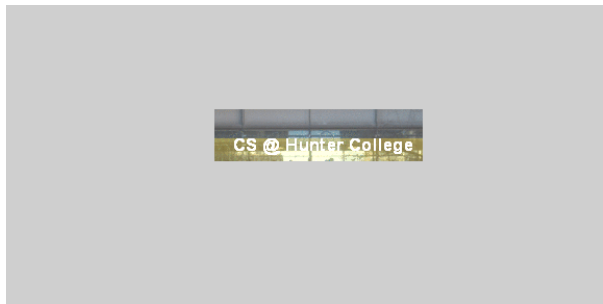

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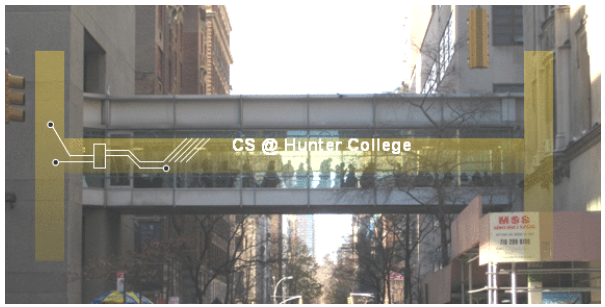

- First: specify inputs/outputs. *Input file name, output file name, upper, lower, left, right ("bounding box")*
- Next: write pseudocode.
  1. Import numpy and pyplot.
  2. Ask user for file names and dimensions for cropping.
  3. Save input file to an array.
  4. Copy the cropped portion to a new array.
  5. Save the new array to the output file.

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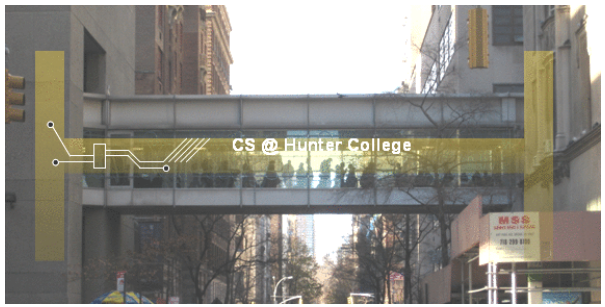

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- Next: translate to Python.

Class 3: design problem (cropping images) & decisions

```
yearBorn = int(input('Enter year born: '))
if yearBorn < 1946:
    print("Greatest Generation")
elif yearBorn <= 1964:
    print("Baby Boomer")
elif yearBorn <= 1984:
    print("Generation X")
elif yearBorn <= 2004:
    print("Millennial")
else:
    print("TBD")

x = int(input('Enter number: '))
if x % 2 == 0:
    print('Even number')
else:
    print('Odd number')
```

Class 4: logical operators, truth tables & logical circuits

```
origin = "Indian Ocean"
winds = 100
if (winds > 74):
    print("Major storm, called a ", end="")
    if origin == "Indian Ocean" or origin == "South Pacific":
        print("cyclone.")
    elif origin == "North Pacific":
        print("typhoon.")
    else:
        print("hurricane.")

visibility = 0.2
winds = 40
conditions = "blowing snow"
if (winds > 35) and (visibility < 0.25) and \
      (conditions == "blowing snow" or conditions == "heavy snow"):
    print("Blizzard!")
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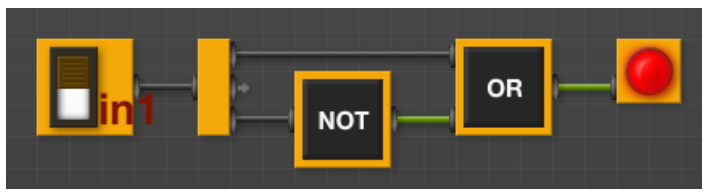
in1		in2	*returns:*
False	and	False	False
False	and	True	False
True	and	False	False
True	and	True	True



Class 5: structured data, pandas, & more design

```
Source:  https://en.wikipedia.org/wiki/Demographics_of_New_York_City,,,,,,
All population figures are consistent with present-day boundaries.,,,,,,
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Year,Manhattan,Brooklyn,Queens,Bronx,Staten Island,Total
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1810,96373,8303,7444,2267,5347,119734
1820,123706,11187,8246,2782,6135,152056
1830,202589,20535,9049,3023,7082,242278
1840,312710,47613,14480,5346,10965,391114
1850,515547,138882,18593,8032,15061,696115
1860,813669,279122,32903,23593,25492,1174779
1870,942292,419921,45468,37393,33029,1478103
1880,1164673,599495,56559,51980,38991,1911698
1890,1441216,838547,87050,88908,51693,2507414
1900,1850093,1166582,152999,200507,67021,3437202
1910,2331542,1634351,284041,430980,85969,4766883
1920,2284103,2018356,469042,732016,116531,5620048
1930,1867312,2560401,1079129,1265258,158346,6930446
1940,1889924,2698285,1297634,1394711,174441,7454995
1950,1960101,2738175,1550849,1451277,191555,7891957
1960,1698281,2627319,1809578,1424815,221991,7781984
1970,1539233,2602012,1986473,1471701,295443,7894862
1980,1428285,2230936,1891325,1168972,352121,7071639
1990,1487536,2300664,1951598,1203789,378977,7322564
2000,1537195,2465326,2229379,1332650,443728,8008278
2010,1585873,2504700,2230722,1385108,468730,8175133
2015,1644518,2636735,2339150,1455444,474558,8550405
```

`nycHistPop.csv`

In Lab 6

Class 5: structured data, pandas, & more design

```
import matplotlib.pyplot as plt
import pandas as pd
```

```
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`nycHistPop.csv`

In Lab 6

Class 5: structured data, pandas, & more design

```
import matplotlib.pyplot as plt
import pandas as pd

pop = pd.read_csv('nycHistPop.csv',skiprows=5)
```

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1800,60515,5740,6642,1755,4563,79215
1810,96373,8303,7444,2267,5347,119734
1820,123706,11187,8246,2782,6135,152056
1830,202589,20535,9049,3023,7082,242278
1840,312710,47613,14480,5346,10965,391114
1850,515547,138882,18593,8032,15061,696115
1860,813669,279122,32903,23593,25492,1174779
1870,942292,419921,45468,37393,33029,1478103
1880,1164673,599495,56559,51980,38991,1911698
1890,1441216,838547,87050,88908,51693,2507414
1900,1850093,1166582,152999,200507,67021,3437202
1910,2331542,1634351,284041,430980,85969,4766883
1920,2284103,2018356,469042,732016,116531,5620048
1930,1867312,2560401,1079129,1265258,158346,6930446
1940,1889924,2698285,1297634,1394711,174441,7454995
1950,1960101,2738175,1550849,1451277,191555,7891957
1960,1698281,2627319,1809578,1424815,221991,7781984
1970,1539233,2602012,1986473,1471701,295443,7894862
1980,1428285,2230936,1891325,1168972,352121,7071639
1990,1487536,2300664,1951598,1203789,378977,7322564
2000,1537195,2465326,2229379,1332650,443728,8008278
2010,1585873,2504700,2230722,1385108,468730,8175133
2015,1644518,2636735,2339150,1455444,474558,8550405
```

nycHistPop.csv

In Lab 6

Class 5: structured data, pandas, & more design

```
import matplotlib.pyplot as plt
import pandas as pd

pop = pd.read_csv('nycHistPop.csv',skiprows=5)

pop.plot(x="Year")
plt.show()
```

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All population figures are consistent with present-day boundaries.,,,,,,
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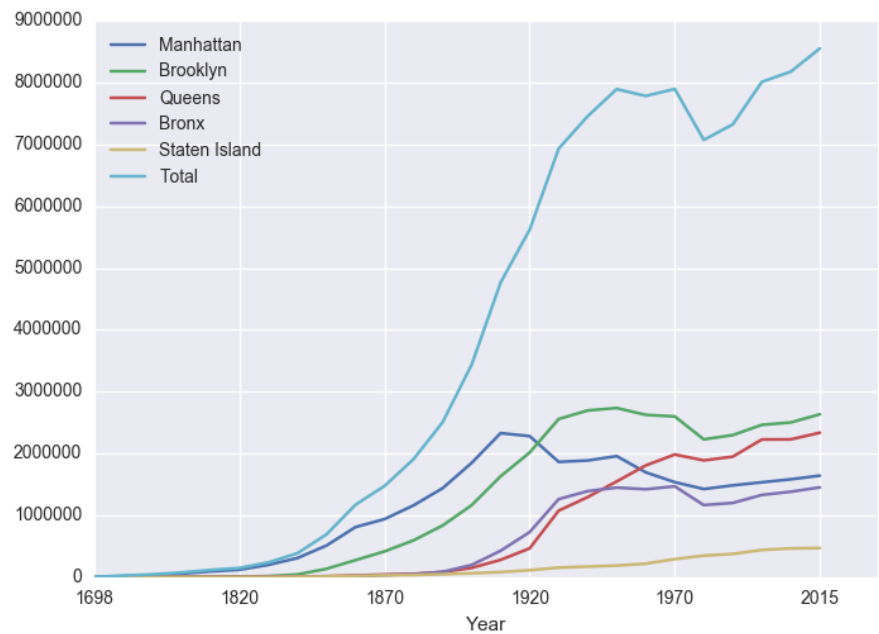
`nycHistPop.csv`

In Lab 6



Class 6: functions

```
#Name:  your name here
#Date:  October 2017
#This program, uses functions,
#     says hello to the world!

def main():
     print("Hello, World!")

if __name__ == "__main__":
     main()
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- Functions are a way to break code into pieces, that can be easily reused.

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- Can write, or **define** your own functions, which are stored, until invoked or called.

Class 7: function parameters, github

- Functions can have **input parameters**.

```
def totalWithTax(food,tip):
    total = 0
    tax = 0.0875
    total = food + food * tax
    total = total + tip
    return(total)

lunch = float(input('Enter lunch total: '))
lTip = float(input('Enter lunch tip:' ))
lTotal = totalWithTax(lunch, lTip)
print('Lunch total is', lTotal)

dinner= float(input('Enter dinner total: '))
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Class 7: function parameters, github

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- Functions can also **return values** to where it was called.

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Formal Parameters

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Class 8: top-down design, folium, loops, and random()


```
def main():
    dataF = getData()
    latColName, lonColName = getColumnNames()
    lat, lon = getLocale()
    cityMap = folium.Map(location = [lat,lon], tiles = 'cartodbpositron',zoom_start=11)
    dotAllPoints(cityMap,dataF,latColName,lonColName)
    markAndFindClosest(cityMap,dataF,latColName,lonColName,lat,lon)
    writeMap(cityMap)
```

Class 9: more on loops, max design pattern, random()

```
dist = int(input('Enter distance: '))
while dist < 0:
    print('Distances cannot be negative.')
    dist = int(input('Enter distance: '))

print('The distance entered is', dist)
```

- Indefinite (while) loops allow you to repeat a block of code as long as a condition holds.

```
import turtle
import random

trey = turtle.Turtle()
trey.speed(10)

for i in range(100):
  trey.forward(10)
  a = random.randrange(0,360,90)
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- Python's built-in random package has useful methods for generating random whole numbers and real numbers.
- To use, must include: `import random`.
- The max design pattern provides a template for finding maximum value from a list.

Python & Circuits Review: 9 Classes in 10 Minutes

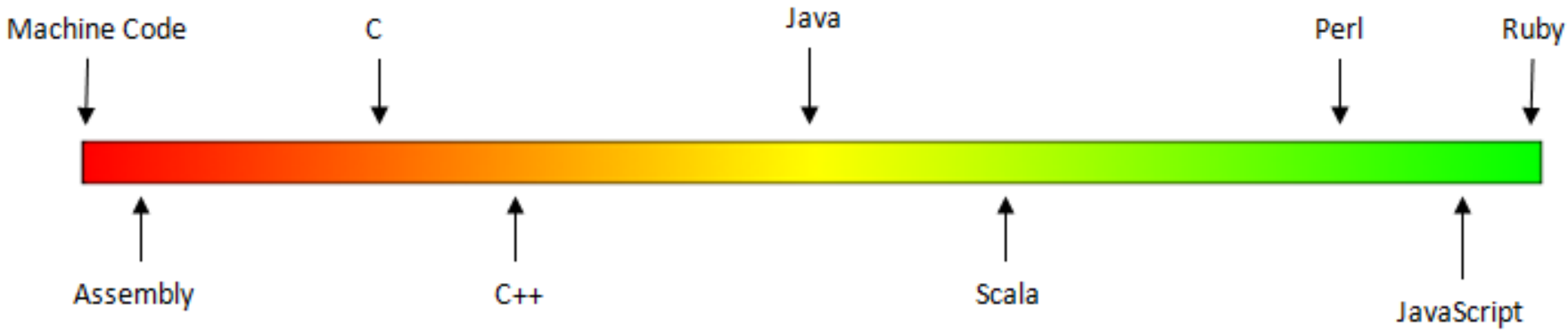
- Input/Output (I/O): `input()` and `print()`; pandas for CSV files
- Types:
  - Primitive: int, float, bool, string;
  - Container: lists (but not dictionaries/hashes or tuples)
- Objects: turtles (used but did not design our own)
- Loops: definite & indefinite
- Conditionals: if-elif-else
- Logical Expressions & Circuits
- Functions: parameters & returns
- Packages:
  - Built-in: turtle, math, random
  - Popular: numpy, matplotlib, pandas, folium

Today's Topics

- Design Patterns: Searching
- Python Recap
- **Machine Language**
- Machine Language: Jumps & Loops

- Final Exam: Format

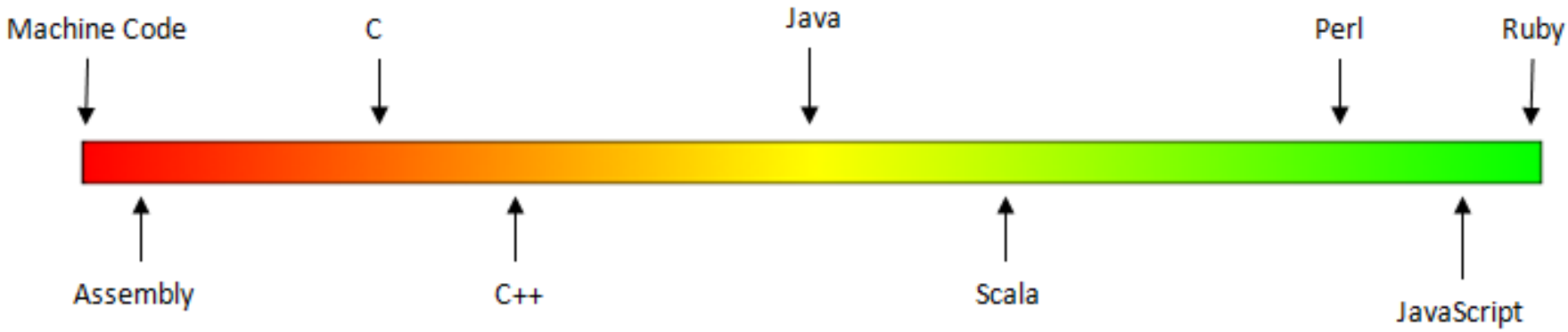
Low-Level vs. High-Level Languages



(codeCommit)

- Can view programming languages on a continuum.

Low-Level vs. High-Level Languages



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- Those that directly access machine instructions & memory and have little abstraction are **low-level languages**

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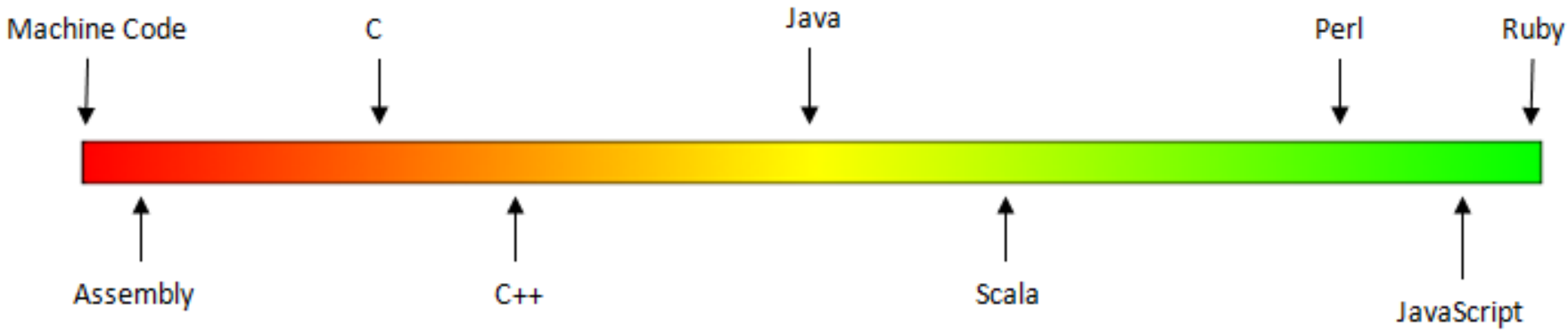

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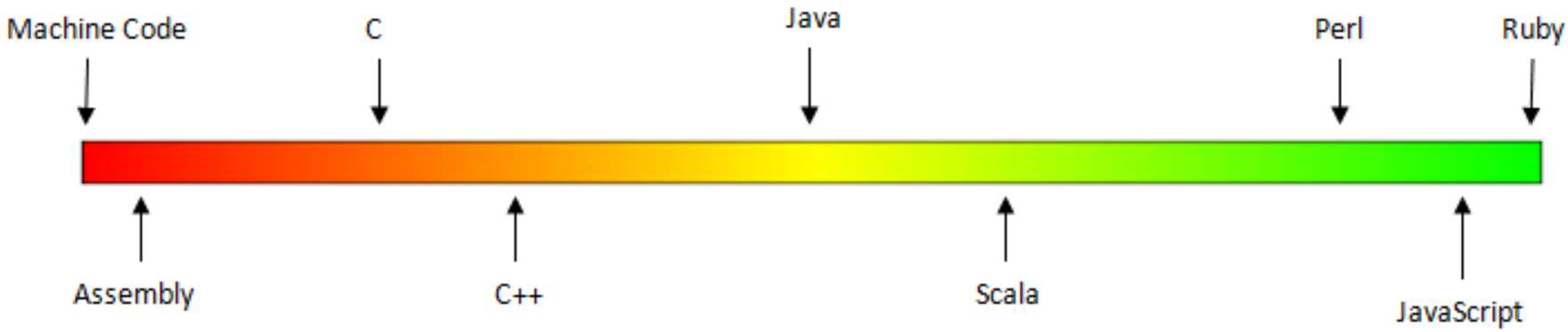

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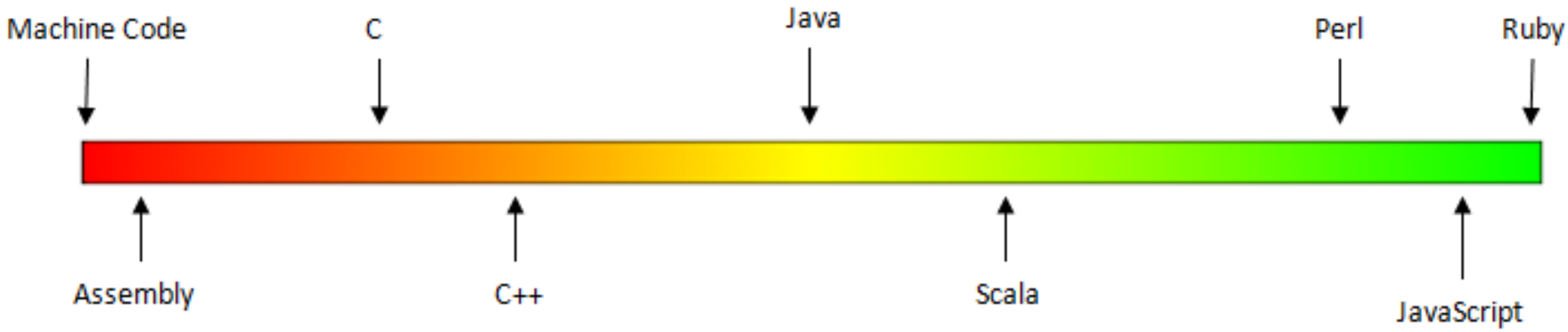

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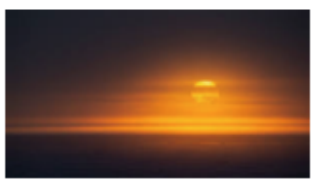
- Some languages, like C, are in between– allowing both low level access and high level data structures.

Processing

Dies ist ein Blindtext. An ihm lässt sich vieles über die Schrift ablesen, in der er gesetzt ist. Auf den ersten Blick wird der Grauwert der Schriftfläche sichtbar. Dann kann man prüfen, wie gut die Schrift zu lesen ist und wie sie auf den Leser wirkt. Dies ist ein Blindtext. An ihm lässt sich



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Data & Instructions

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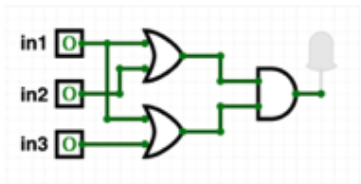
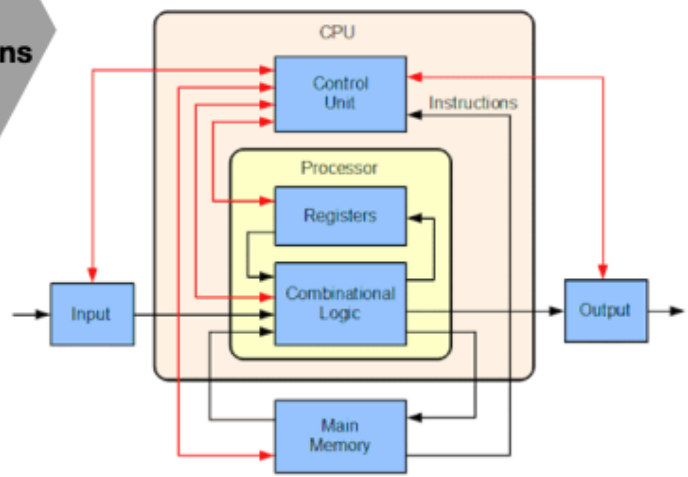
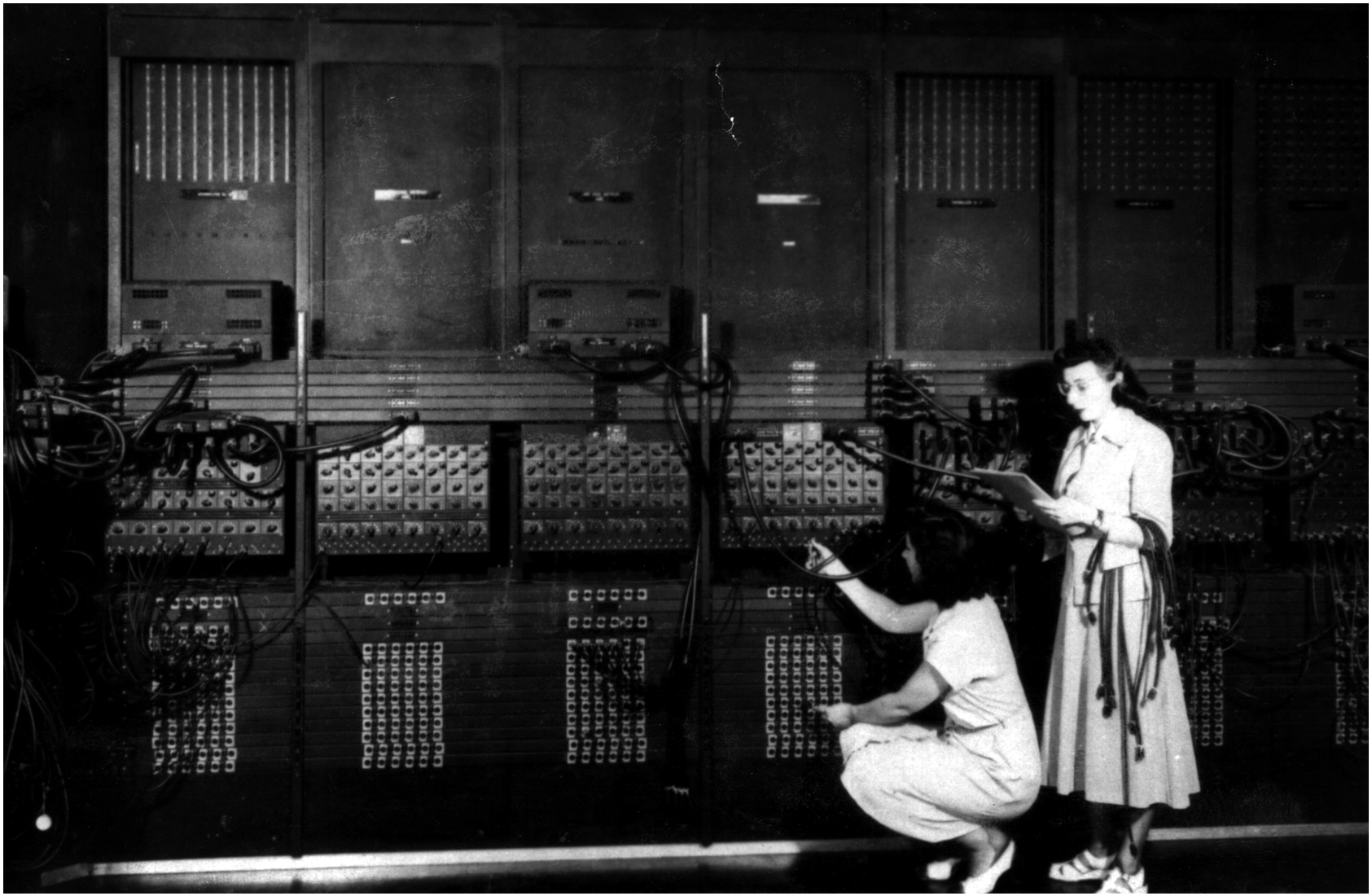


Circuits (switches)
On/Off 1/0 Logic
Billions of switches/bits



Machine Language



(Ruth Gordon & Ester Gerston programming the ENIAC, UPenn)

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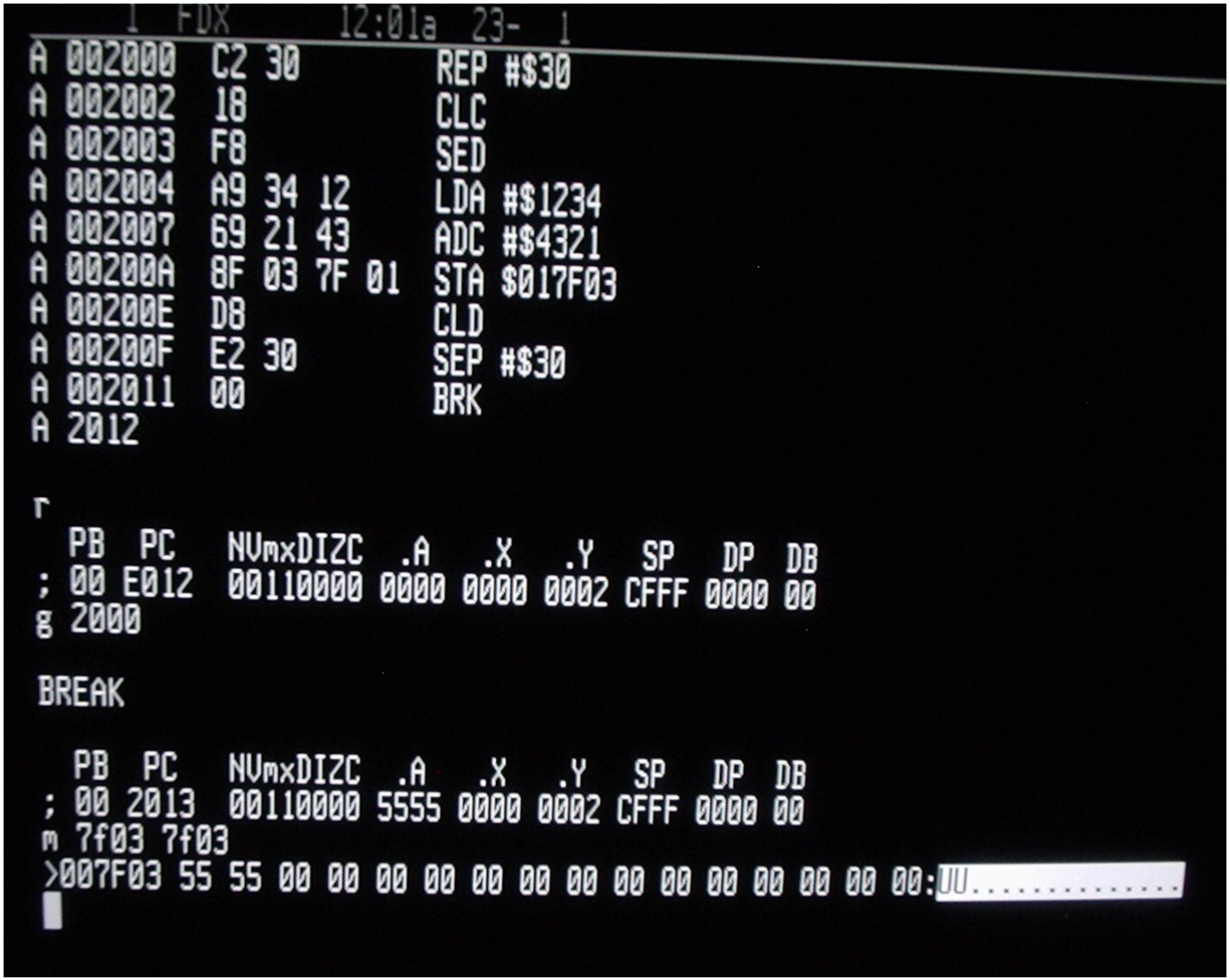

(wiki)

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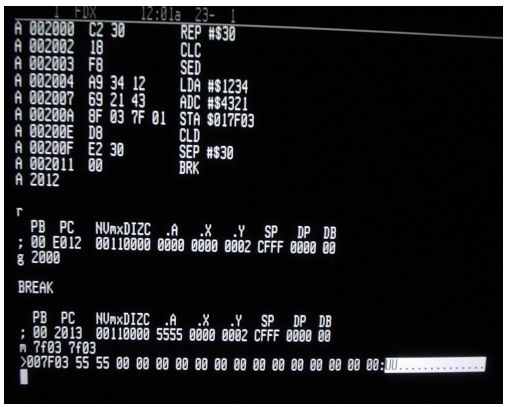

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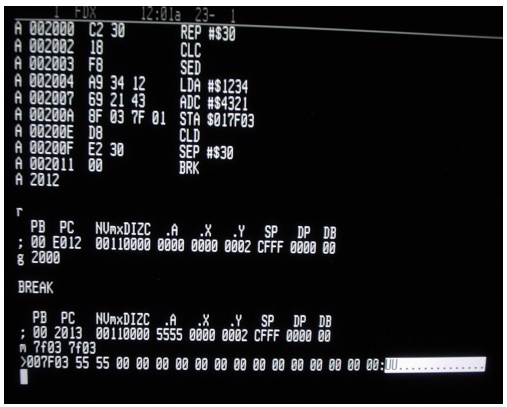

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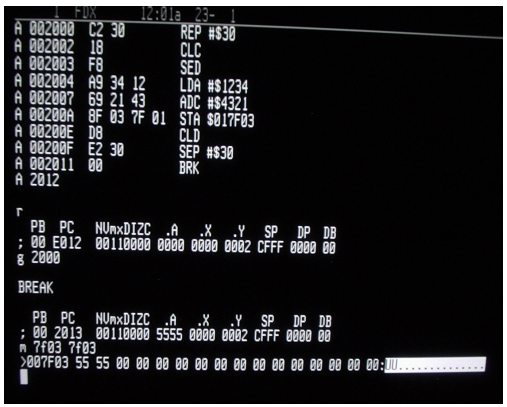

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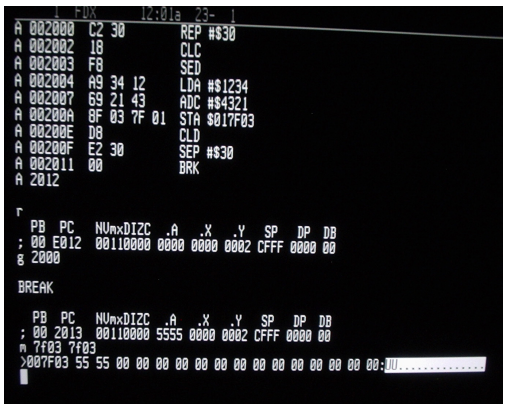

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- More in future architecture classes....

“Hello World!” in Simplified Machine Language

Line: 3 Go!

Show/Hide Demos

User Guide | Unit Tests | Docs

Addition Doubler | Stav | Looper | Stack Test | Hello World

Code Gen Save String | Interactive | Binary2 Decimal | Decimal2 Binary

Debug

```
1  # Store 'Hello world!' at the top of the stack
2  ADDI $sp, $sp, -13
3  ADDI $t0, $zero, 72 # H
4  SB $t0, 0($sp)
5  ADDI $t0, $zero, 101 # e
6  SB $t0, 1($sp)
7  ADDI $t0, $zero, 108 # l
8  SB $t0, 2($sp)
9  ADDI $t0, $zero, 108 # l
10 SB $t0, 3($sp)
11 ADDI $t0, $zero, 111 # o
12 SB $t0, 4($sp)
13 ADDI $t0, $zero, 32 # (space)
14 SB $t0, 5($sp)
15 ADDI $t0, $zero, 119 # w
16 SB $t0, 6($sp)
17 ADDI $t0, $zero, 111 # o
18 SB $t0, 7($sp)
19 ADDI $t0, $zero, 114 # r
20 SB $t0, 8($sp)
21 ADDI $t0, $zero, 108 # l
22 SB $t0, 9($sp)
23 ADDI $t0, $zero, 100 # d
24 SB $t0, 10($sp)
25 ADDI $t0, $zero, 33 # !
26 SB $t0, 11($sp)
27 ADDI $t0, $zero, 0 # (null)
28 SB $t0, 12($sp)
29
30 ADDI $v0, $zero, 4 # 4 is for print string
31 ADDI $a0, $sp, 0
32 syscall             # print to the log
```

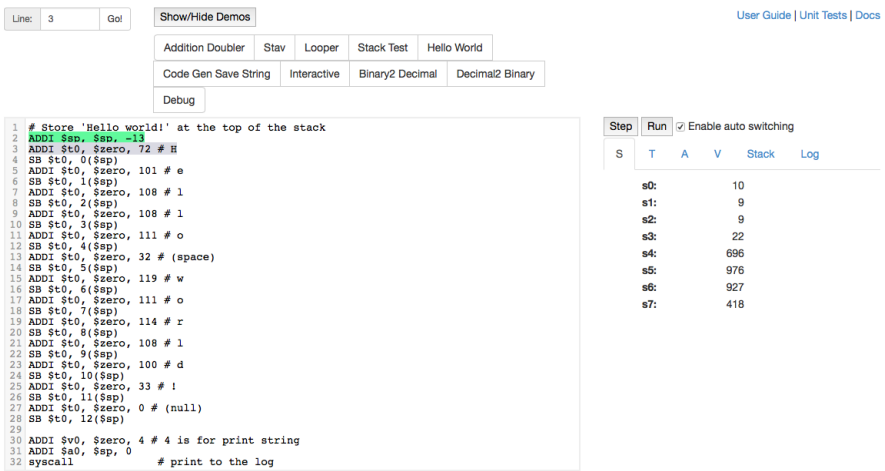
Step | Run | ☑ Enable auto switching

S | T | A | V | Stack | Log

s0:	10
s1:	9
s2:	9
s3:	22
s4:	696
s5:	976
s6:	927
s7:	418

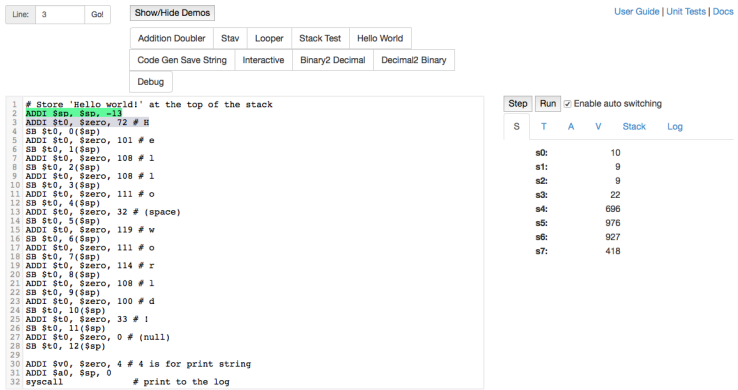
(WeMIPS)

WeMIPS



(Demo with WeMIPS)

MIPS Commands



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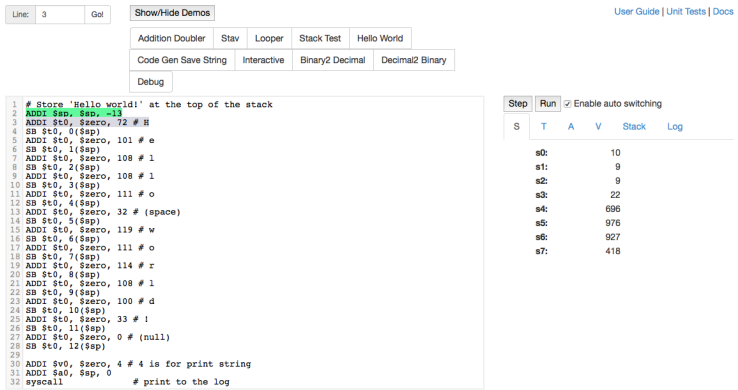

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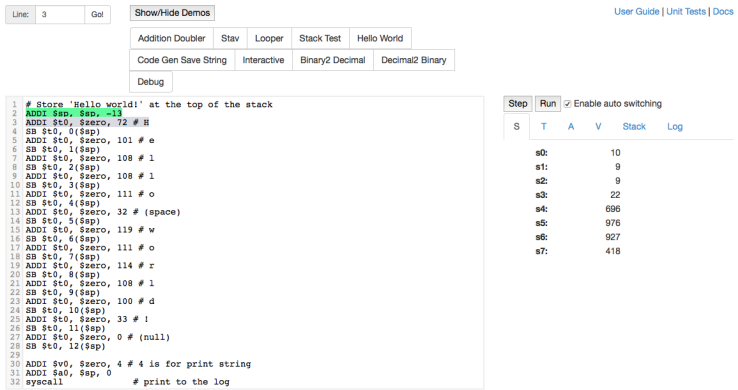

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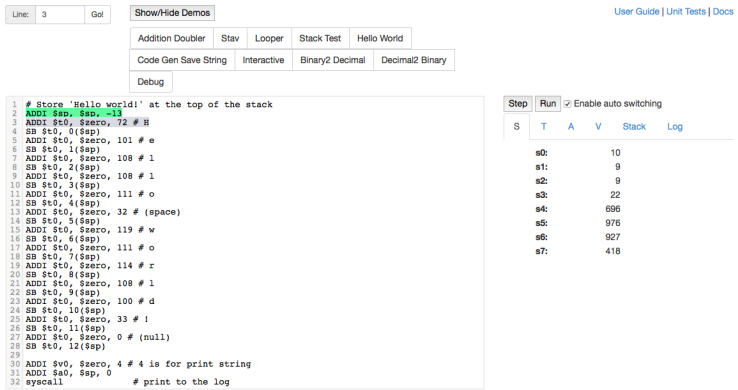

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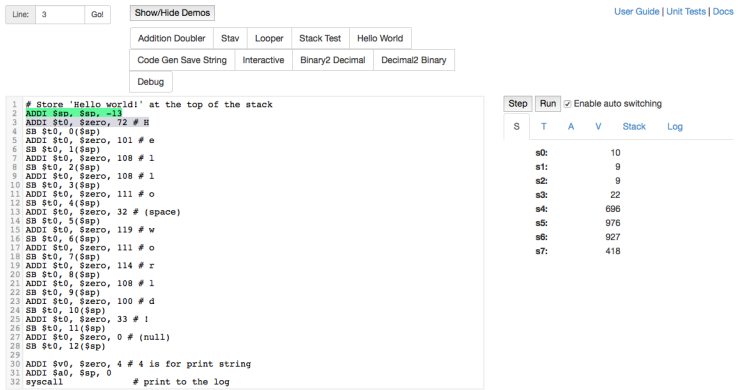

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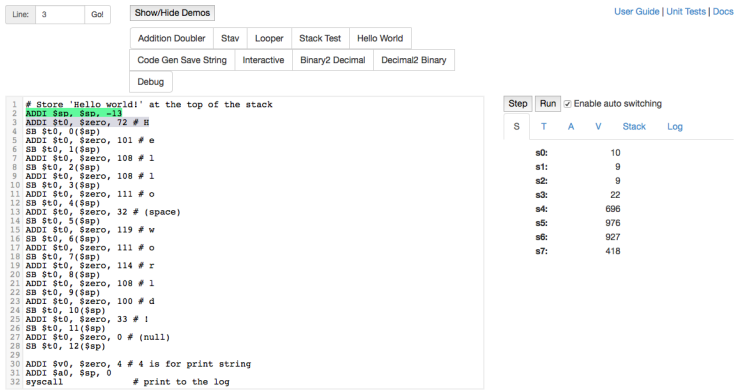

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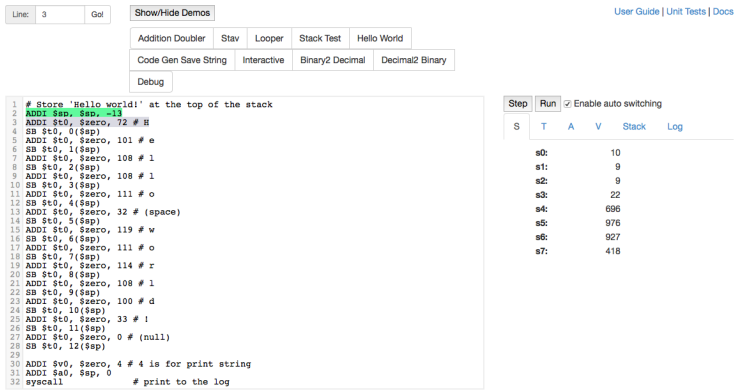

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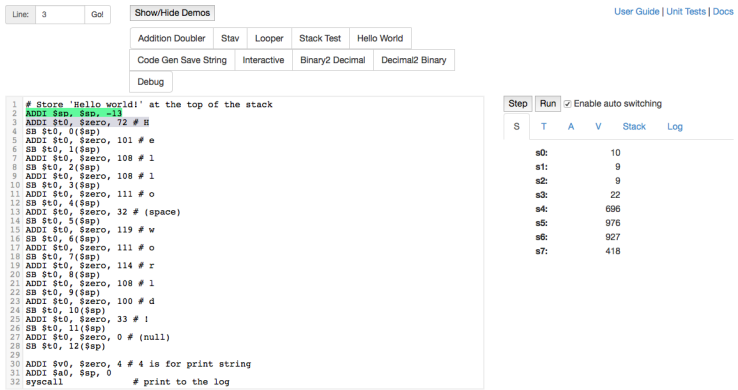

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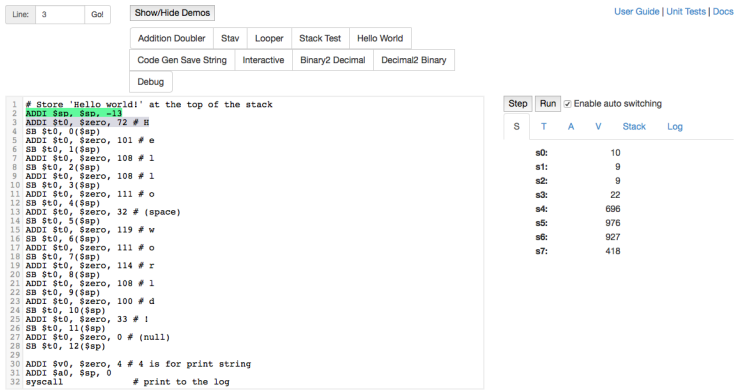

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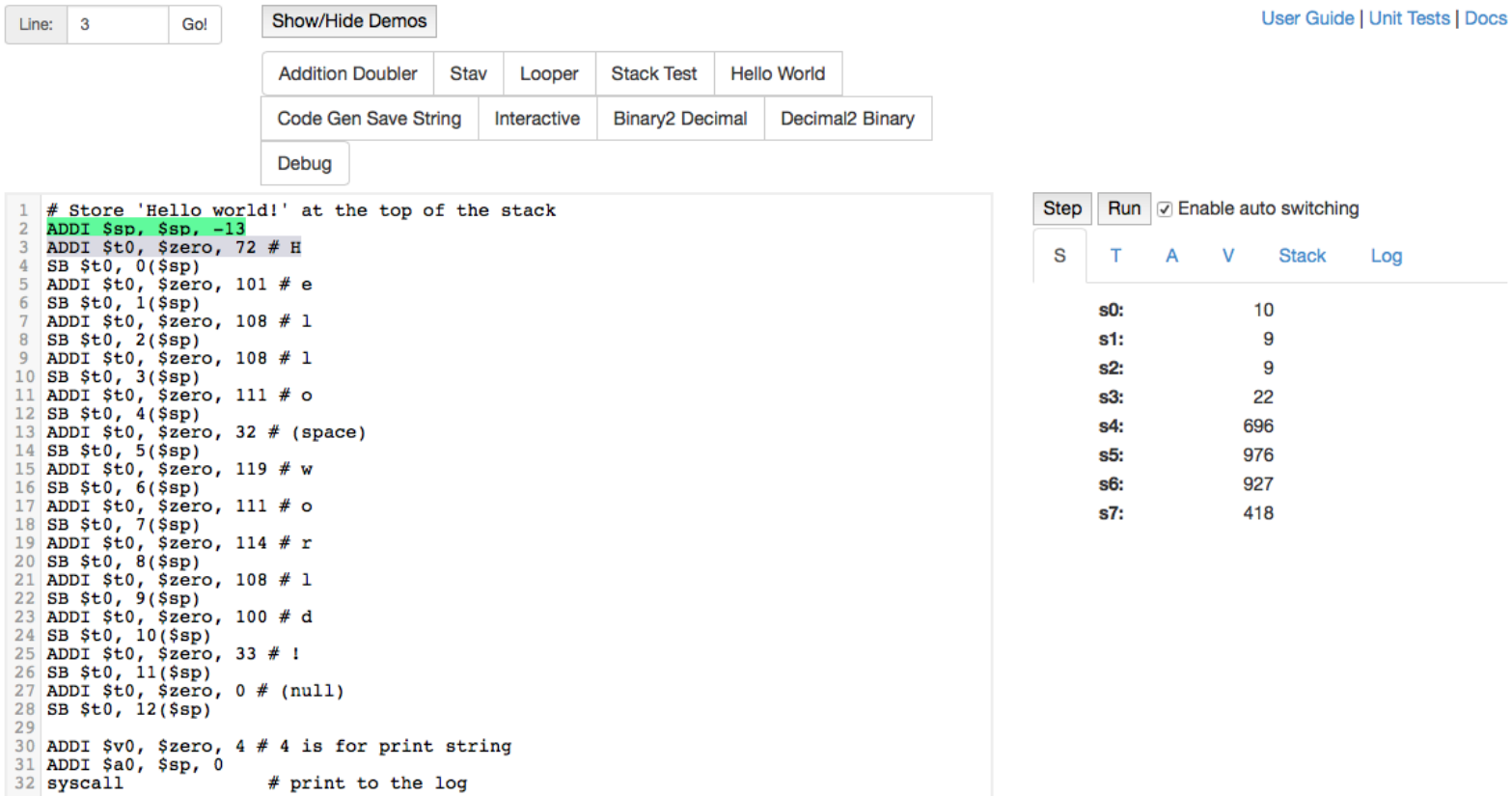
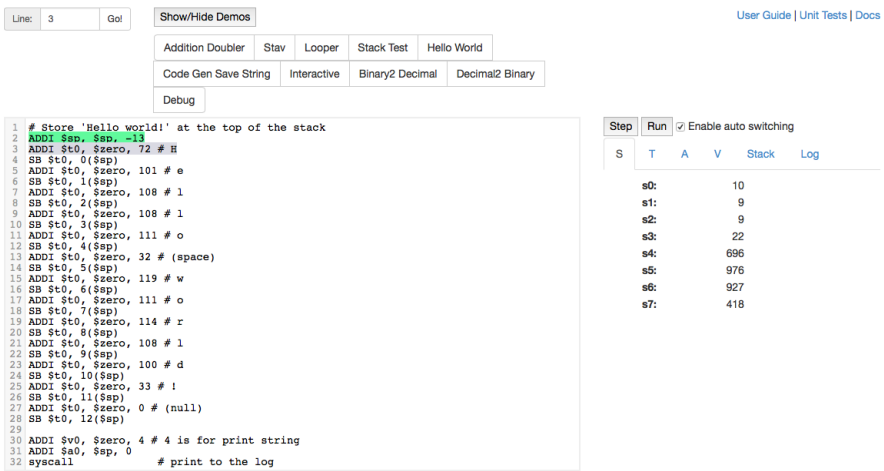
Challenge:



Write a program that prints out the alphabet: `a b c d ... x y z`

WeMIPS



(Demo with `WeMIPS`)

Today's Topics

- Design Patterns: Searching
- Python Recap
- Machine Language
- **Machine Language: Jumps & Loops**

- Final Exam: Format

Loops & Jumps in Machine Language

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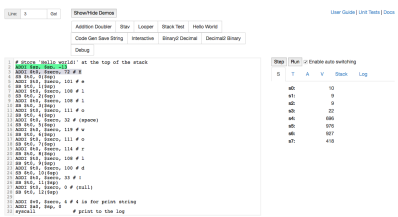

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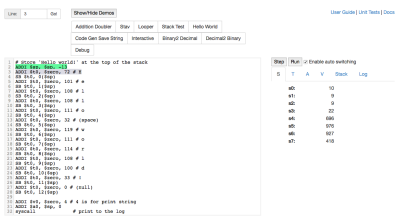

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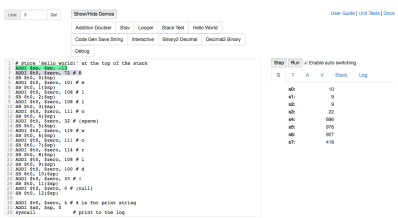

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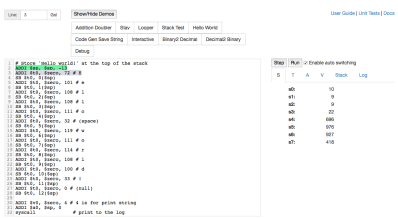

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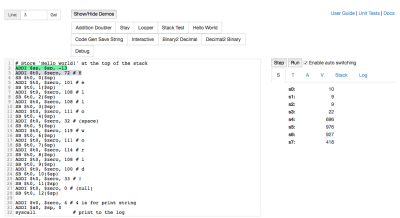

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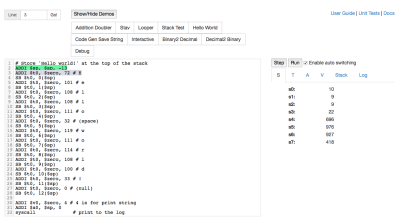

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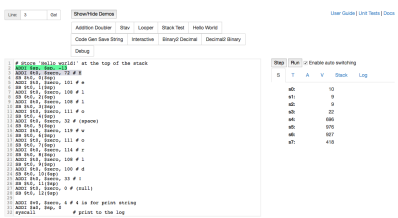

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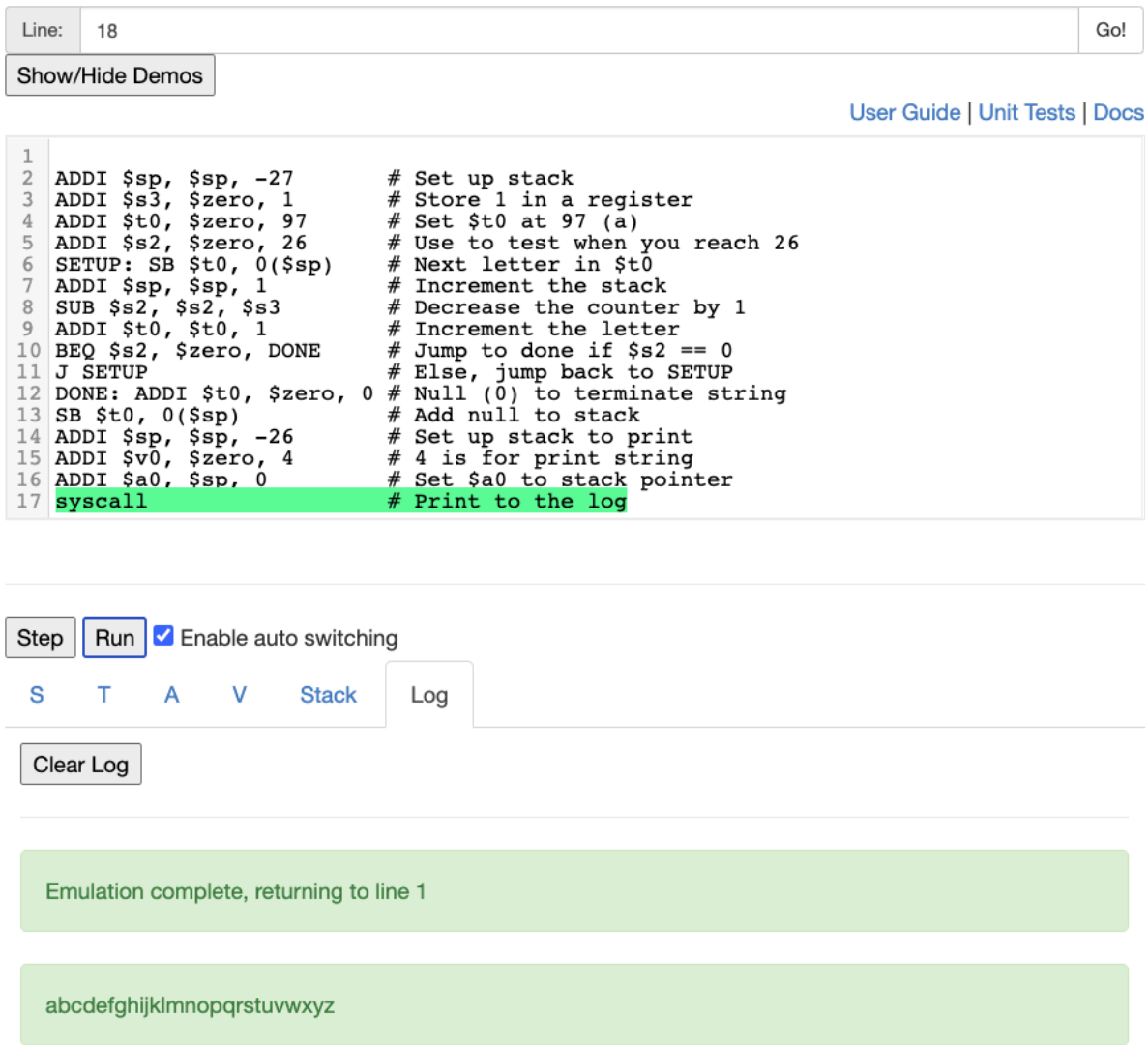
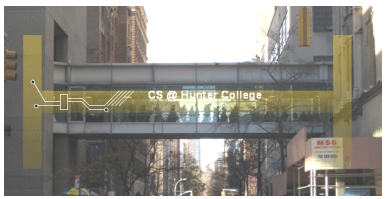
  - See reading for more variations.

Jump Demo



(Demo with `WeMIPS`)

Recap



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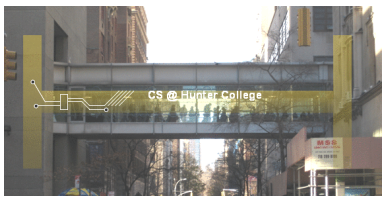

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- Programming languages can be classified by the level of abstraction and direct access to data.

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- Python Recap
- Machine Language
- Machine Language: Jumps & Loops
- Binary & Hex Arithmetic
- **Final Exam: Format**

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Class Reminders!

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