CS 100: Gates and Drawing and Turtles

Chris Kauffman

Week 3-1

Logistics

HW 2 due Thursday at 11:59pm

- Code.org plus a few additional exercises

HW 3 Python programming

- Make sure you have access to a computer
- Install Python 3
- Will be posted over the weekend
- 2 weeks to work

Mini-Exam 1 Thursday

- Last 30 minutes of class
- 1 page, front and back
- Open notes, book, slides
- Stuff like HW 1 and code.org exercises

Goals Today

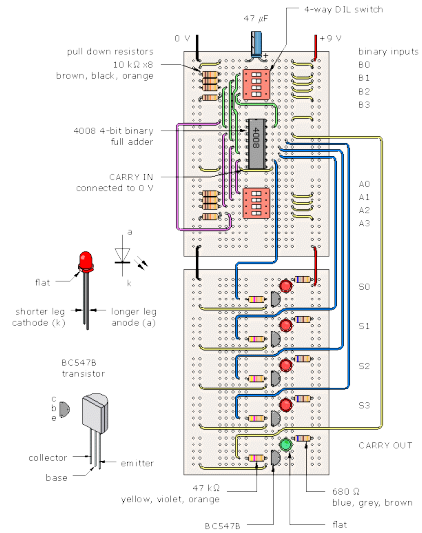
- Gates and Programming
- Drawing with python
- Basic programming elements in python

Gates That "Do" Stuff

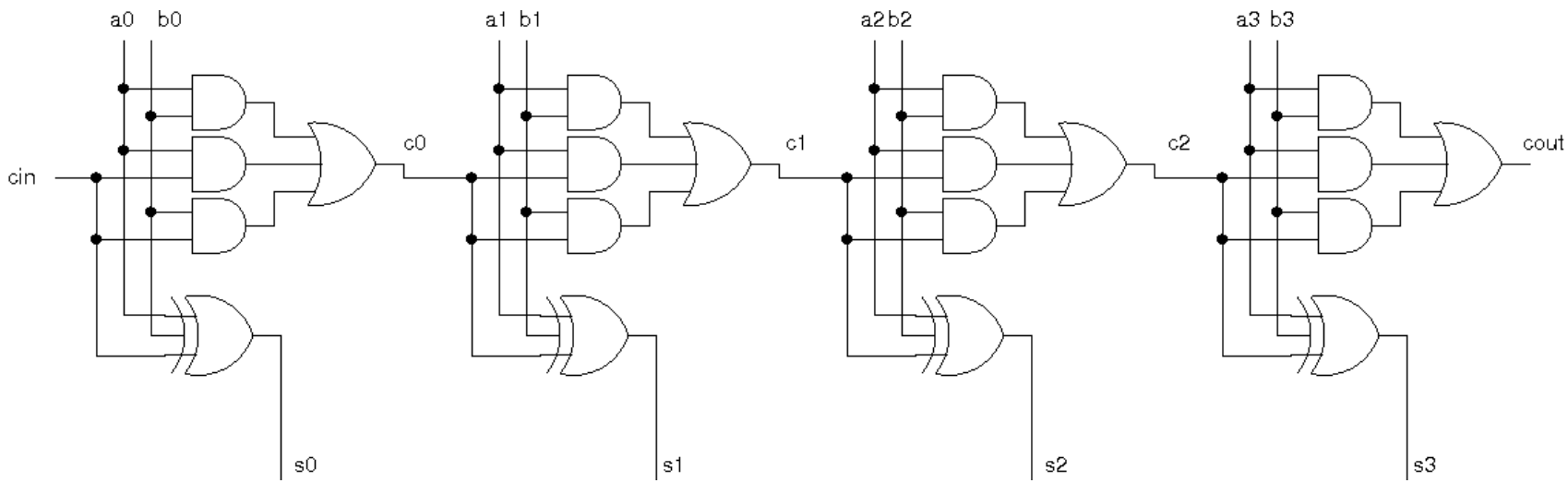
4-Bit Adder

- Two input number a, b (top)
- Each input has 4 bits
- Output s which is the sum of them (bottom)
- Also a carry bit *cout* (right)

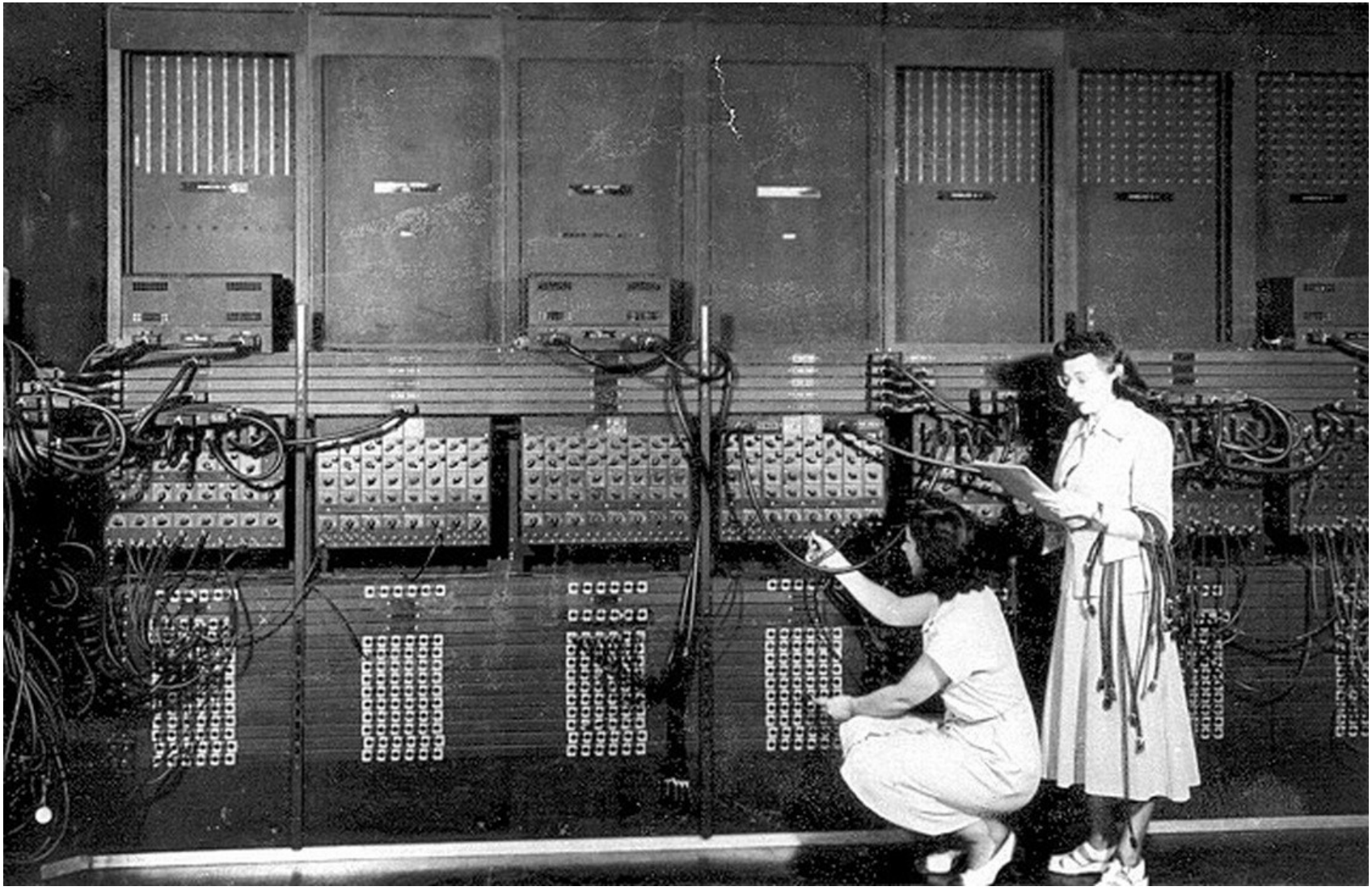
On a Breadboard



Source



Programming the ENIAC = Rewiring



Source: Huffington Post

The Machine Today

Repeat

- Input goes in
- Logic changes registers
- Output goes out

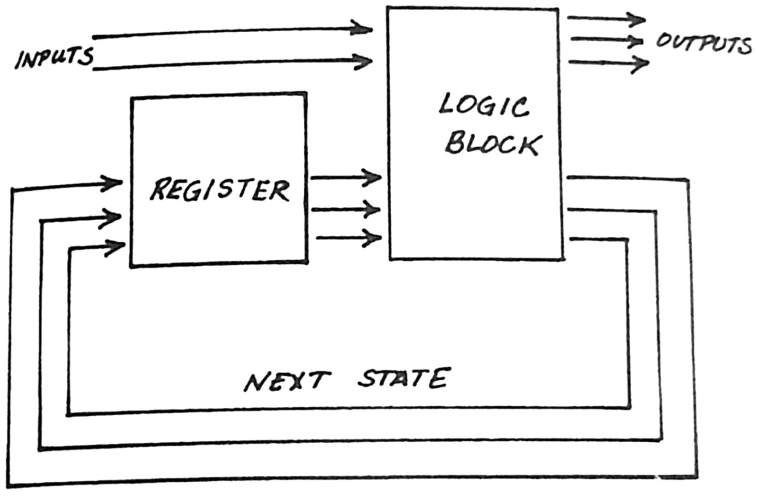


FIGURE 14

Finite-state machine, with logic block feeding register

Codes for Instructions and Data

Primitive Operations

Sequence of bits for each thing device can do

ADD	0001
SUBTRACT	0010
MULTIPLY	0011

Registers

Each place bits can be STORED is assigned a sequence of bits

REGISTER 0	0000
REGISTER 1	0001
REGISTER 2	0010

Machine Instructions

Usually DOING something involves an action and a few locations

```
ADD REGISTER 0 to REGISTER 1, put answer in REGISTER 2

Bits: 0001 0000 0001 0010
       ADD REG0 REG1 REG2

MULTIPLY REG2 by REG4, put answer in REG3
Bits: 0011 0010 0100 0011
      MULT REG2 REG4 REG3
```

Layers on Layers

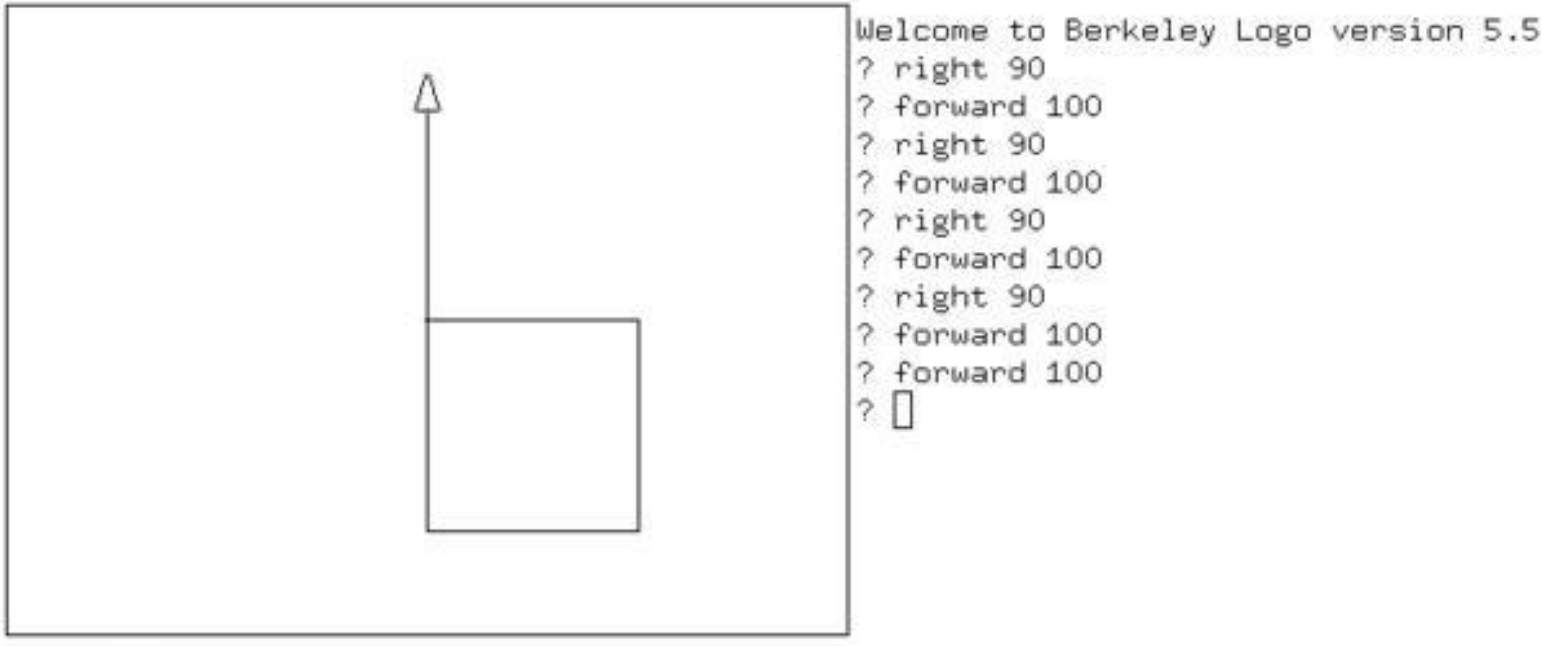
Anyone want to program in binary? Me neither luckily...
This was an early problem that got solved

- View clip from Episode 6 of 1983's Bits and Bytes

Turtles Then

My first experience programming: drawing with a "turtle"

- Didn't tell me it was programming
- Language called *Logo*, still used in some settings today
- Similar to the "Artist" exercises on code.org



Source

Turtles Today

- We will do some programming in Python in this class
- Python comes with the turtle built in
- Used extensively to demonstrate in How to think like a Computer Scientist starting in Chapter 3
- Demonstrations on screen are in order

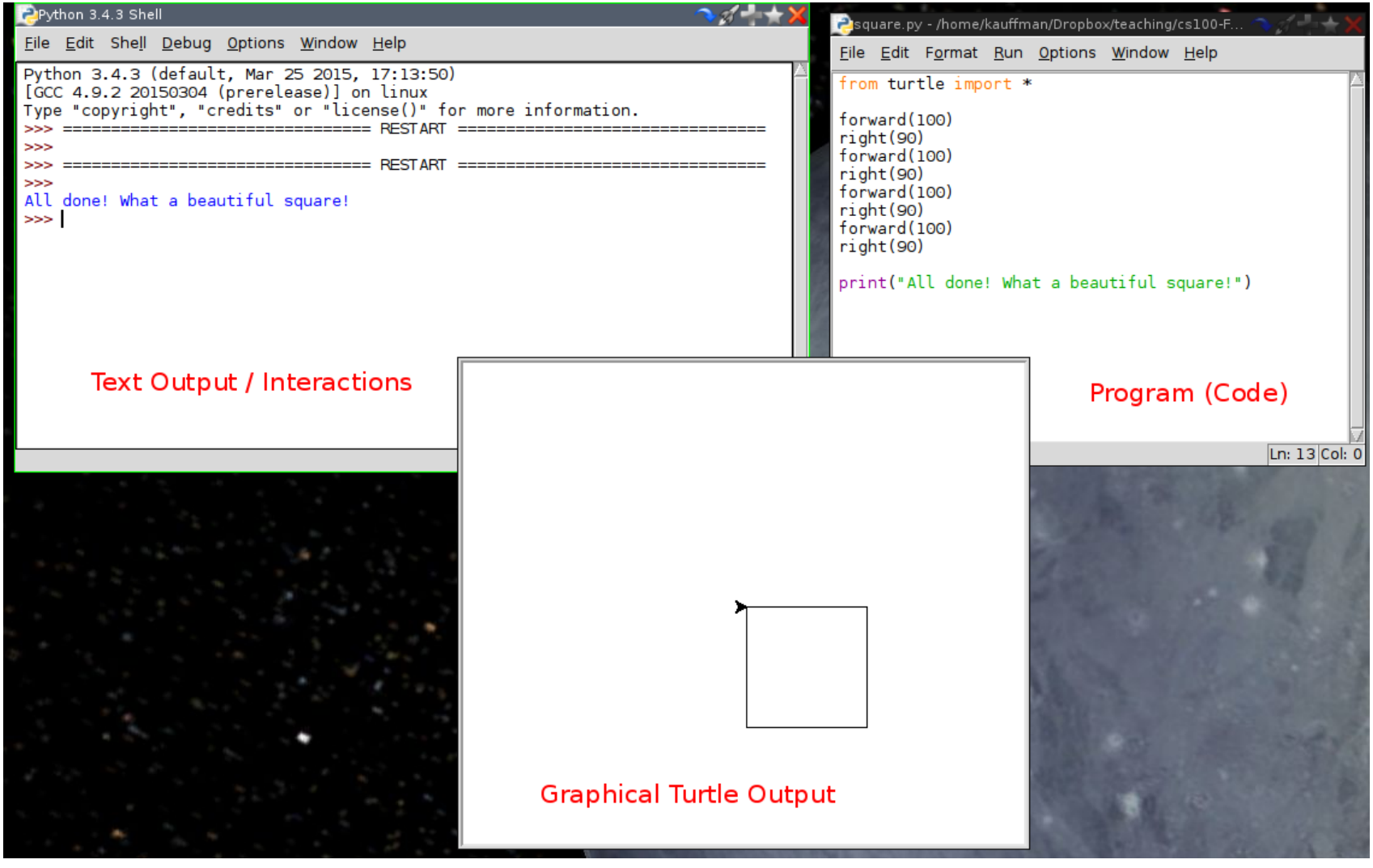
Items TODO

Install Python on your personal system

1. Go to https://www.python.org/
2. Click "Downloads"
3. Click "Download Python 3.5.0"
   - Your Platform (Windows/Mac/Unix) should show up
4. Save the file in a sensible spot (Downloads folder)
5. Install
   - Windows: double click and run installer
   - Mac(?): double click to mount disk image and open, then double click "Python.mkpg" to run installer
6. Look for "IDLE (Python GUI)" program
7. Run it to start a python loop

If you get stuck with install, see me or a TA in office hours

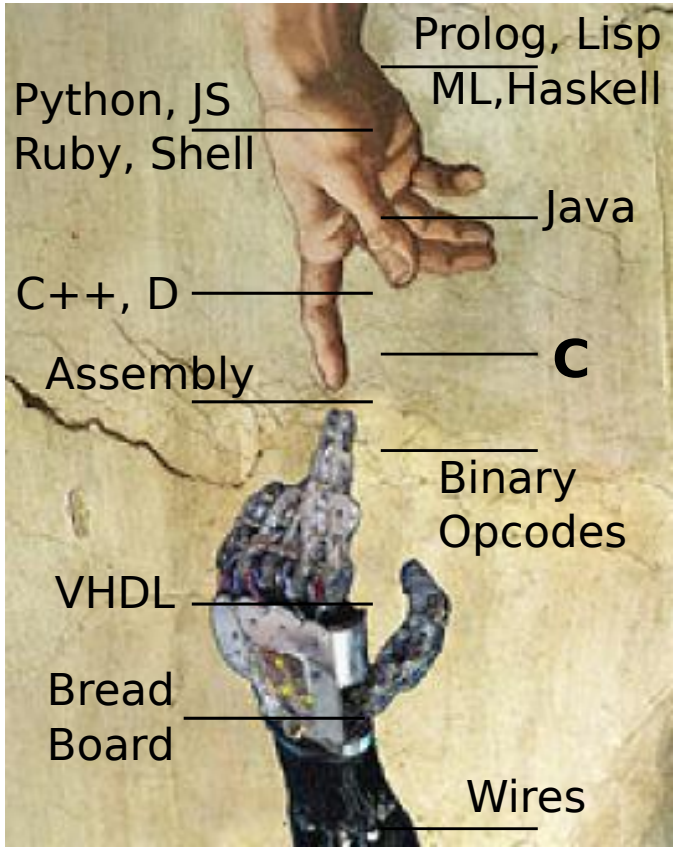
IDLE - A program to write Python Programs



Overview of Python

- A programming language and environment
- A higher-level way of interacting with a computer
- Used by lots of companies to real work (e.g. Google)

Pure Abstraction



Bare Metal

Programming

1. Write down some instructions
2. Ask the computer to execute those instructions
3. Look at the result
4. If happy with result, declare victory
5. Otherwise, change the instructions and go to 2

Tiny Little Turtle Commands

```
from turtle import *                    # Use the turtle module

forward(50)                             # move forward
backward(100)                           # move backward
right(90)                               # turn left
left(120)                               # turn right

circle(30)                              # draw a circle
stamp()                                 # stamp the turtle symbol
shape("turtle")                         # Change shape of pen
                                        # to a turtle
# arrow, turtle, circle, square, triangle, classic

square(100)                             # ERROR: need to teach this
```

Differences from "Think"

```
import turtle                 # Allows us to use turtles
wn = turtle.Screen()          # Creates a playground for turtles
alex = turtle.Turtle()        # Create a turtle, assign to alex

alex.forward(50)              # Tell alex to move forward by 50 units
alex.left(90)                 # Tell alex to turn by 90 degrees
alex.forward(30)              # Complete the second side of a rectangle

wn.mainloop()                 # Wait for user to close window
```

- Can have many turtles around: `alex`, `beth`, `clarence`, `debbie`
- Can tell them each to do things individually with `alex.forward(100)` and `debbie.right(30)`
- We will mostly just tell the global turtle do stuff with `forward(100)`

Python: Repetition and Conditions

```
print("Hello")                          # Print hello

for i in range(4):                      # Repeat, i=0,1,2,3
    print("Number: "+str(i))            # Print the i vals

myVar = 7                               # Assign a variable
if(myVar > 5):                          # Check something
    print("Bigger than five");
else:
    print("Smaller than five");

if(myVar % 2 == 0):                     # % is remainder op
    print("Even")
else:
    print("Odd")
```

Python: Functions

```
def reportOddness(x):                # Define a function
    if(x % 2 == 0):
        print("Even")
    else:
        print("Odd")

reportOddness(2)                     # Use the function
reportOddness(9)

def repeatedGreeting(n):             # Repeats in functions
    print("Saying hello "+str(n)+" times")
    for i in range(n):
        print("Hello!")

repeatedGreeting(3)
someValue = 5
repeatedGreeting(someValue)
```

Next Time

- Finish Code.org exercises and HW 2
- Install Python
- Finish "Pattern" Ch 3
- Read "Think"