CIS 122

Turtles all the way down

Logistics

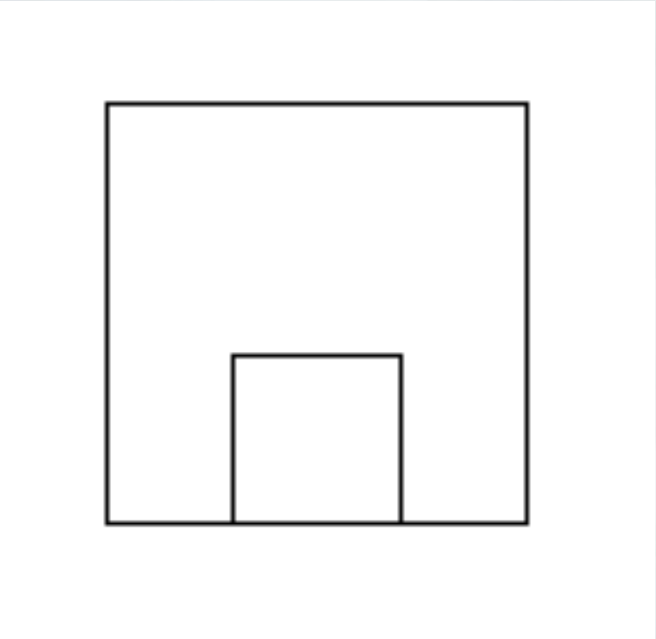
- No class Thursday
  - I'll post review slides instead
- There will still be a midterm review on Friday
  - Come with questions
- Midterm topics have been posted
  - Resources page of website

Turtle Graphics

- Open IDLE in "No Subprocess mode"
  - idle2.7 -n (mac)
  - <IDLE location> -n (windows)
- Import turtle module
  - import turtle
- Start drawing
  - turtle.forward(dist)
  - turtle.backward(dist)
  - turtle.left(angle)
  - turtle.right(angle)
  - turtle.reset()

All Squared Away

- Yesterday, we tried to draw this image
  - Here's one way to do it



```
turtle.forward(100)
turtle.left(90)
turtle.forward(100)
turtle.left(90)
turtle.forward(100)
turtle.left(90)
turtle.forward(100)
turtle.left(90)
turtle.forward(70)
...
```

All Squared Away

- We don't need that much code
- Let's write a square function instead
  - Then we can call it when needed

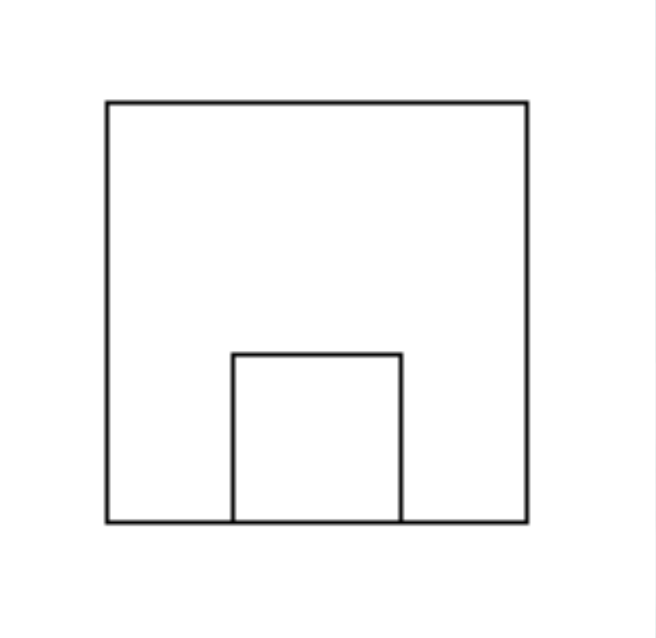
All Squared Away

- We don't need that much code
- Let's write a square function instead

```
def square(length):
    turtle.forward(length)
    turtle.left(90)
    turtle.forward(length)
    turtle.left(90)
    turtle.forward(length)
    turtle.left(90)
    turtle.forward(length)
    turtle.left(90)
```

All Squared Away

- Now we can rewrite our drawing code



```
square(100)
turtle.forward(20)
square(60)
```

- Much cleaner
  - But our square code feels overly complicated

All Squared Away

- Our square function does the same stuff repeatedly
  - Go Forward
  - Turn Left
- Let's write write square recursively
  - But what is there to recurse on?
  - What gets smaller as we draw our square?

All Squared Away

- Recurse on the number of sides left to draw
  - square(length, sidesLeft)
- Base Case
- Recursive Step

All Squared Away

- Recurse on the number of sides left to draw
  - square(length, sidesLeft)
- Base Case
  - No sides left to draw
- Recursive Step

All Squared Away

- Recurse on the number of sides left to draw
  - square(length, sidesLeft)

- Base Case
  - No sides left to draw

- Recursive Step
  - To draw a square with x sides left
  - Draw one side
  - Then draw a square with x-1 sides left

All Squared Away

```
def square(length, sidesLeft):
    if sidesLeft == 0:
        return
    else:
        turtle.forward(length)
        turtle.left(90)
        square(length, sidesLeft - 1)
```

All Squared Away

```
def square(length, sidesLeft):
    if sidesLeft == 0:
        return
    else:
        turtle.forward(length)
        turtle.left(90)
        square(length, sidesLeft - 1)
```

- This function takes two arguments
  - What if we want a square function with only one?
- Outsiders shouldn't care how our function is implemented
  - Want to call square(50), not square(50, 4)

All Squared Away

```
def square(length, sidesLeft = 4):
    if sidesLeft == 0:
        return
    else:
        turtle.forward(length)
        turtle.left(90)
        square(length, sidesLeft - 1)
```

- Default arguments
  - If you don't specify a value, default to the given one
- Now, we can call square(50)
  - and sidesLeft will default to 4

More Cool Turtle Functions

- turtle.width(size)
  - Sets the width of your lines in pixels
  - Minimum 1 pixel
  - No maximum
  - What happens if you set width to...
    - 50?
    - 100?
    - 1000?

More Cool Turtle Functions

- turtle.setpos(pos)
  - Moves turtle to given coordinate position
  - Only takes one argument
  - But we need two coordinates...

- How can we store two coordinates in only one variable?
  - Use a tuple

Tuple Aside

- Tuples are another type of values
  - Store multiple values together
    - (1, 2, 3)
    - (1, "b", True)
  - We'll see them more in the future

More Cool Turtle Functions

- turtle.setpos(pos)
  - Moves turtle to given coordinate position
  - Only takes one argument
  - But we need two coordinates...
- How can we store two coordinates in only one variable?
  - Use a tuple
  - turtle.setpos((25, 50))
- NOT the same as calling setpos with two arguments
  - turtle.setpos(25, 50)
  - This code will not run

A Turtle of a Different Color

- turtle.color(color)
  - Sets the color of your turtle
  - And the lines it draws
- Color can be a string
  - turtle.color("red")
  - turtle.color("blue")
- But what if you want finer color control?
  - Only so many color names...

A Turtle of a Different Color

- Display colors are made by combining primary colors
  - Red
  - Green
  - Blue
- We can describe a color with these components
  - (Red Intensity, Green Intensity, Blue Intensity)
  - More tuples...
- A few common colors
  - Red = (1, 0, 0)
  - Yellow = (1, 1, 0)
  - White = (1, 1, 1)

A Turtle of a Different Color

- Color intensities range from 0 to 1
  - (0.0, 0.0, 0.0) - Black
  - (0.3, 0.3, 0.3) - Dark Gray
  - (0.6, 0.6, 0.6) - Light Gray
  - (1.0, 1.0, 1.0) - White

A Turtle of a Different Color

- Let's draw a line that blends from one color into another

A Turtle of a Different Color

- Let's draw a line that blends from one color into another

```
def blend(greenValue, redValue):
    if redValue >= 1:
        return
    else:
        myColor = (redValue, greenValue, 0)
        turtle.color(myColor)
        turtle.forward(15)
        blend(greenValue + 0.5, redValue - 0.5)

>>> blend(1, 0)
```