15-112 Fundamentals of Programming

Lecture 3 – Language basics

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Announcements

- First assignment has been posted. Due date is Tuesday Sept 1 at 10:00pm
- Please get on Piazza and start contributing

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Recap of last class

- What do we know so far?
  - Draw shapes using Turtle library
  - Repeat a set of statements
  - Define functions that perform specific tasks

Let's practice these skills

- Draw the following image:

What do computers do?

- Get input
- Process the input
- Generate output

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What do we need to learn?

- We will learn instructions in Python for:
  - Asking the user for input
  - Reading input
    - What can be sources of this input?
  - Processing input – What kind of operations we can do on this input and how to do it
  - Printing output
    - What could be possible destinations for this output

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Printing in Python

- Print a word or sentence

```
print (“what ever you want to print”)
print (‘I want to print this statement’)
print (‘I want to print “quotes” here’)
```

- Print multiple sentences on same line

```
print (“This is a line”   , “ on same line”)
```


Comments

- Any text in python with a # symbol is ignored until the end of that line

```
# I will print my name
print (“Saquib Razak”)   # this line prints my name
```

- Comments are used to document your code
- Puts lots of comments that explain what you are doing

Getting input from keyboard

- Getting input

  a = input()
- Using input with a message

  a = input("Please Enter your name")
- Reading Integers

  a = int(input("Enter your age"))

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Variables

- We saw the following code:

  a = input()
- In this example what is -- a?
  - a is a variable
  - You store a value in a variable

    a = 5
  - You read the value stored in it

    print (a)

    print (a + 6)

    b = a - 3

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So what exactly are variables?

- All information in computers is stored in memory.
  - What is memory?
- Variables are ways of accessing memory

Variables

- Rules for variable names
  - Must begin with a letter or underscore
  - May include letters, digits, and underscores
  - Sin(x) is not a valid variable name

Operations

- Following are some of the operations
  - +, -, *, /,//, %
  - **
  - =
  - <, >, <=, >=, ==, !=
  - and, or, not
  - <<, >>

Examples

- **print (3 * 2)**
- **print (3 + 2)**
- **print ("abc" + "def «)**
- **print (3 + "def «)**
- **print (2+3*4)**
- **print (9**1/2)**
- **print (9**(1//2))**
- **print ("20/3 =", (20//3))**
- **print (" 6/3 =", (6/3))**

More Examples

- a = 5
  print (a)
- print (5 < 8)
- print (8 < 5)
- print (8 == 8)

More Examples

- print (8 != 8)
- a = 5
  b = 6
  print (a < b)
- print (5 / 0)
- print (0 / 5)

Variables in Expressions

- Assign value to a variable
  - age = 21
- Change a variables value

```
age = 21
print ("You are "  , age * 12 , " months old")
age = age + 1
print ("You will be ", age * 12, "months after 1 year")
```


Variables in Expressions

```
radius = 3.1
pi = 22/7
area = pi * radius**2
print (area)
```

Bitwise Operators

- Bits and Bytes – What are these?
  - Read handout given at the end of class
- Binary Numbers
- Bitwise Operators
  - & (Bitwise AND)
  - | (Bitwise OR)
  - ^ (Bitwise XOR)
  - <<
  - >>

Bitwise Operators: Examples

- **6 & 5**
- **6 | 5**
- **6 ^ 5**
- **6 << 1**
- **6 << 2**
- **6 >> 1**

Operator Precedence

- Operator precedence (highest to lowest):
  - **
  - Positive, negative, NOT (+x, -x, ~x)
  - *, /, %,//
  - +,-
  - >>, <<
  - & (Bitwise AND)
  - ^ (Bitwise XOR)
  - | (Bitwise OR)
- Operators with same precedence are processed left to right

Operator Precedence Examples

- print (3 + 4 * 2 + 5)
- print (3 * 2 + 2 / 5)
- print (-2 ** 4 + 8 >> 2)

Let's work out a problem

- Write a program that reads current temperature from the user in Fahrenheit and prints the equivalent Celsius value.

Another Example

- Write a program that reads an integer from the user and prints the sum of its digits.

Strings

- Any sequence of characters enclosed within " " or ' ' is a string
  - "This is a string"
  - 'this is also a string'
  - "this is not a string – can you guess why?'
  - '7his 1s a $tring'
  - "%^%$#@!*(*&^& - what did you say?"

Indexing and Slicing

- Used to manipulate information in a string

name = "Chris Myers"

0	1	2	3	4	5	6	7	8	9	10
C	h	r	i	s		M	y	e	r	s

```
print (name[2:4])
print (name[:4])
print (name [3:])
print (name[:])
```

Some String Functions

- len(s) – gives us the length of string s
- s.capitalize( ) - change to upper case
- s.lower() - change to lower case
- s.count(sub)
- s.find(sub)
- s.index(sub)
- s. strip()

Approximating Floats

What is the output of the following code?

```
d1 = 0.1 + 0.1 + 0.1
d2 = 0.3
print (d1 == d2)
```

Short Circuit Evaluation

- Let's try the following code:

```
x = 0
y = 0
print ((y == 0) or ((x/y) == 0))
print (((x/y) == 0) or (y == 0))
```


Short Circuit Evaluation

- How about:

```
x = 0
y = 0
print ((y > 0) and ((x/y) == 0))
print ((y == 0) and ((x/y) == 0))
```

Math functions

- print (math.sqrt(5)) **Does not work**
- import math
  print (math.sqrt(5))
- math.log(x[, base])
- math.cos(x)
- math.sin(x)
- math.tan(x)
- math.pi
- math.e

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