CMSC201
Computer Science I for Majors

Lecture 03 – Variables

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Last Class We Covered

- Algorithms
- Program Development
- Control Structures
  - Sequential
  - Decision Making
  - Loops
- Types of Errors
  - Syntax
  - Logic

Any Questions from Last Time?

Exercise

- What will each of the following do?

1. `print("Hello')`

   Error – Need to have matching ' and "

2. `Print('Hello')`

   Error – Need to have lowercase print

3. `print('Hello World')`

   Hello World

Today's Objectives

- To start learning Python
- To learn more about variables
  - How to use them
  - Different types
- To learn how to use input and output
  - To do interesting things with our program
- To play a party game

"Cowboy Coding"

- Jumping right in to writing code
- Disadvantages
  - No formal management of project
  - No standard way of coding
  - Not planning things out
    - Forgetting to include important things
    - Having to make big changes later

Software Development Process

1. Analyze the problem
   - Determine specifications (requirements)
2. Create a design
3. Implement the design
4. Test and debug the program
5. Maintain the program

Example: Temperature Converter

You have been invited to live in Europe during a semester abroad. You aren't sure how to dress because the temperature is given in Celsius.

- Problem:
  - Temperature is given in Celsius
- Solution:
  - Write a program to convert Celsius to Fahrenheit

Input/Process/Output

- Input
  - What information do you need for your converter?
- Process
  - What formulas do you need for your converter?
- Output
  - What is the output from your converter?

Introduction to Python (Variables)

Python

- Python is a widely used language
  - General purpose
  - High-level language
- Emphasizes code readability
  - More streamlined than some other languages

"Hello World!"

- In Python:

```
print("Hello World!")
```

- In the C++ programming language:

```
#include <iostream>
int main() {
    std::cout << "Hello, world!\n";
}
```

Elements of a Program

- Identifiers
  - Variables
  - Modules (later in the semester)
  - Functions (later in the semester)
- Expressions
  - Code that manipulates or evaluates identifiers

We Start Python Today!

- Two ways to use python

We will write programs

  - You can write a program as a series of instructions in a file and then execute it

  - You can also test simple Python commands in the Python interpreter

What Is a Variable?

- Something that holds a value
  - Can change (unlimited number of times)
- Similar to variables in math
- In simple terms, a variable is a "box" that you can put stuff in

Rules for Naming Variables

- Variables can contain:
  - Uppercase letters (**`A-Z`**)
  - Lowercase letters (**`a-z`**)
  - Numbers (**`0-9`**)
  - Underscores (**`_`**)
- Variables can't contain:
  - Special characters like **`$`**, **`#`**, **`&`**, **`^`**, **`)`**, **`(`**, **`@`**

More Rules for Naming Variables

- Variables can be any length
  - `x`
  - `IsKanyeRunningForPresidentIn2020`
  - `myName`

- Variables cannot **start** with a digit
  - `2cool4school` is not a valid variable
  - `cool4school` is a valid variable

Variables and Keywords

- Keywords are the reserved words in Python

`False`	`class`	`finally`	`is`	`return`
`None`	`continue`	`for`	`lambda`	`try`
`True`	`def`	`from`	`nonlocal`	`while`
`and`	`del`	`global`	`not`	`with`
`as`	`elif`	`if`	`or`	`yield`
`assert`	`else`	`import`	`pass`	
`break`	`except`	`in`	`raise`	

- Variables cannot be keywords
  - **`or`** is not a valid variable name
  - **`orange`** is an acceptable variable name

Exercise: Variables

- Are the following legal or illegal in Python?

`1spam`	**No – Illegal!**
`raise1`	**Yes – legal!**
`Spam_And_Eggs`	**Yes – legal!**
	But it doesn't follow our coding standards! **spamAndEggs or spam_and_eggs**

Using Variables in Python

- Create a variable by declaring it
- Also need to initialize it
  - Use the assignment operator (=)

assignment operator

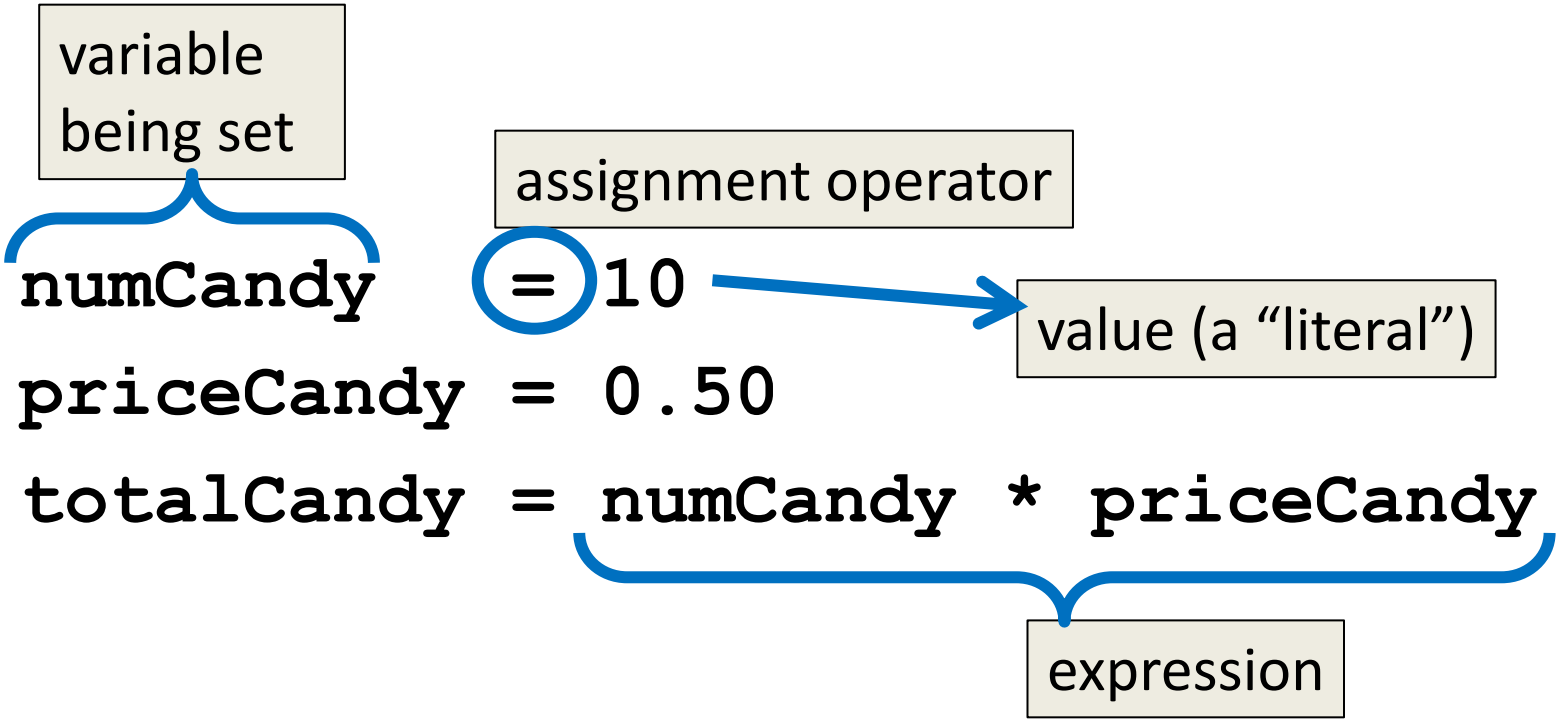
```
richFiddy  = 50000000
poorFiddy  = 0.50
brokeFiddy = 0
```

Introduction to Python (Expressions)

Expressions

- Programs manipulate data
  - Allows us to do interesting things
- Expressions calculate new data values
- Use assignment operator to set new value

Expressions Example



Common Mistake

- Many new programmers mix up the left and right hand sides of the assignment operator

- Variable being set is on the ***left***
- Expression is on the ***right***

```
numCandy = 10
```

```
10 = numCandy
```

Variable Types

- There are many different kinds of variables!
  - Numbers
    - Integers
    - Floats (decimals)
  - Booleans (**`True`** and **`False`**)
  - Strings (collections of characters)

Variables Types: Examples

```
aString   = "Hello class"
float_1   = 1.12
myBool    = True
anInteger = 7

dogName   = "Mrs. Wuffington"
classCode = 201
```

Variable Usage

- Variables are designed for storing information
- Any piece of information your program uses or records must be stored in a variable

Introduction to Python (Input and Output)

Output

- Output is text printed to the screen
  - So the user can see it and respond

- The command for this is **`print`**
  - Use the keyword "**`print`**" and put what you want to be displayed in parentheses after it

Output Example

```
print (3 + 4)
print (3, 4, 3 + 4)
print()
print("The answer is", 3 + 4)
```

```
7
3 4 7

The answer is 7
```

Output Exercise 1

- What will the following code snippet print?

```
a = 10
b = a * 5
c = "Your result is: "
print(c, b)
```

```
Your result is:  50
```

Output Exercise 2

- What will the following code snippet print?

```
a = 10
b = a
a = 3
print(b)
```

There are two possible options for what this could do! Any guesses?

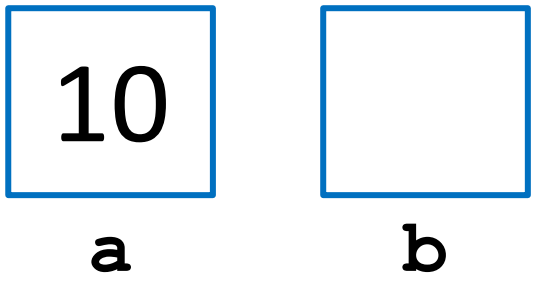
10

Output Exercise 2 Explanation

- Why does it print out 10?
- When you set one variable equal to another, they don't become linked!
- After **`b`** is set to 10, it no longer has anything else to do with **`a`**

Output Exercise 2 Explanation

```
a = 10
b = a
a = 3
print(b)
```



Output Exercise 2 Explanation

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b = a
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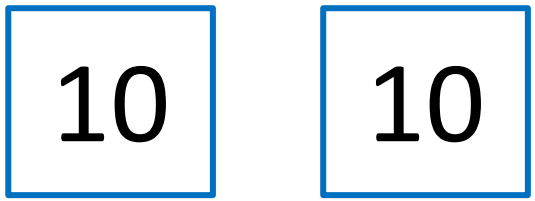
print(b)
```



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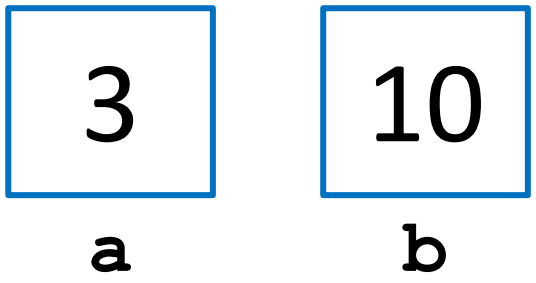

Output Exercise 2 Explanation

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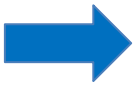

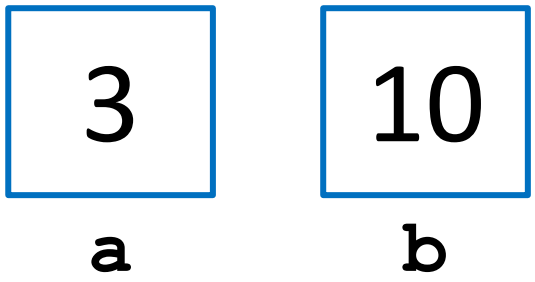

output: 10

Input

- Input is text we get from the user
  - We must tell them what we want first

```
userNum = input("Please enter a number: ")
print(userNum)
```

- The output will look like this: `10`

```
Please enter a number:
10
```

How Input Works

```
userNum = input("Please enter a number: ")
```

- Takes the text the user entered and stores it
  - In the variable named **`userNum`**

- You can do this as many times as you like!

```
userNum  = input("Enter another number: ")
userNum2 = input("Enter a new number: ")
userAge  = input("Please enter your age: ")
```

Input as a String

- Everything that comes through **`input()`** will come in the form of a string

- There is a difference between **`"10"`** and **`10`**
  - **`"10"`** is a two character long string
  - **`10`** is understood by Python as a number

Converting from String

- To turn an input string into a number, you can do the following:

```
aNum = input("Enter a number: ")
aNum = int(aNum)
```

- **`int`** stands for integer (a whole number)
- You can also do it in one line:

```
aNum = int(input("Enter a number: "))
```

Class Exercise: Mad Libs

- Mad Libs is a phrasal template word game where one player prompts others for a list of words to substitute for blanks in a story, before reading the – often comical or nonsensical – story aloud

- The game is frequently played as a party game or as a pastime

Exercise: Calculating Averages

- Write, on paper or on your computer, a program that asks the user for two numbers and prints out the average.

- Make sure to use variables, and to get the input from the user!
- Does the order of operations come into play for this exercise?

Exercise: Assignment Weighting

- Pretend you're writing a program to compute someone's weight grade. You have so far:

```
hwWeight         = 0.4
examWeight       = 0.5
discussionWeight = 0.1
```

- Write a program that then asks the user for their homework grade, exam grade, and discussion grade and prints out their total grade in the class.

Announcements

- Your Lab 0 is in class this week!
  - Go to your scheduled location and time
- Homework 1 is out (on Blackboard)
  - Due by next Monday (Feb 8th) at 8:59:59 PM
  - You must have completed the Syllabus Quiz to see it
- Academic Integrity Quiz on Blackboard
  - Must complete to see Homework 2 next week

Practice Problem

- You recently accepted a new job in Philadelphia, PA and you are trying to figure out if you should take the train or drive.
  - Taking the train costs $4.90 each way
  - It is 75 miles round trip, your car averages 28 mpg, and gas is $2.03 per gallon plus $0.06 per mile in maintenance. Your new work has free parking, so you don't need to pay.
- Write a program that can calculate the total cost to drive to work, and print out if it is cheaper to drive to work, or to take the train. By how much?