SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

CMPT 120: Introduction to Computing Science and Programming 1

Turtle graphics, and User-defined Functions

python™

Reminders

One-Stop Access To Course Information

- **Course website: One-stop access** to all course information.

  http://www2.cs.sfu.ca/CourseCentral/120/liaqata/WebSite/index.html

- Course Outline
- Exam Schedule
- Python Info
- CourSys/Canvas link
- Learning Outcomes
- Office Hours
- Textbook links
- and more…
- Grading Scheme
- Lab/Tutorial Info
- Assignments

- **Canvas**: Discussions forum - https://canvas.sfu.ca/courses/39187
- **CourSys**: Assignments submission, grades - www.coursys.sfu.ca

How to Learn in This Course?

A **Attend** Lectures & Labs

R **Read** / review Textbook/Slides/Notes

R **Reflect** and ask Questions

O **Organize** – your learning activities on weekly basis,

and finally…

W **Write** Code, Write Code, and Write Code.

Deliverables

1. Deliverables are due by the given date and time.
2. For the course, we are using IDLE to write and run our Python code.
3. You can use the CSIL lab computers outside your lab hours.
4. Plan ahead your assignments and other deliverables. Computer crash, network problems etc. are not acceptable excuses for delays in deliverables.
5. You may use online Python interpreters for running and testing your codes, such as:

   https://repl.it/languages/Python3

Labs

1. Each lab has an assigned TA.
2. Attend your assigned lab and show your work to your TA for the participation marks.
3. Class enrolments and lab swaps are closed now.

Course Topics

1. General introduction
2. Algorithms, flow charts and pseudocode
3. Procedural programming in Python
4. Data types and Control Structures
5. Binary encodings
6. Fundamental algorithms
7. Basics of (Functions and) Recursion (Turtle Graphics)
8. Basics of computability and complexity
9. Subject to time availability:
   - Basics of Data File management

Today's Topics

1. Turtle Graphics: Drawing and Animation
2. Introduction to Functions: User-defined
3. Defining and Calling a Void Function
4. Designing a Program to Use Functions
5. Passing Arguments to Functions

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Graphics: Drawing and Animation Using Turtle

Liaqat Ali, Summer 2018.

Turtle Intro

Turtle is a Python feature that allows you to draw and animate graphic shapes.

```
# Import turtle package
import turtle
# Create our turtle
myTurtle = turtle.Turtle()
# Move forward 50 pixels
myTurtle.forward(50)
# Turn right 90 degrees
myTurtle.right(90)
# Move forward 50 pixels
myTurtle.forward(50)
```

Create a Turtle "object"

Demo and Resources

1. turtle — Turtle Documentation (Methods): graphicshttps://docs.python.org/3.5/library/turtle.html
2. Turtle examples: https://michael0x2a.com/blog/turtle-examples
3. Turtle Programming in Python: https://www.geeksforgeeks.org/turtle-programming-python/
4. https://michael0x2a.com/blog/turtle-examples (squares)
5. https://trinket.io/python/82fe4d3bd0 (interactive)
6. https://www.turtle.ox.ac.uk/downloads/docs/Turtle_Python_Exercises_1-12.pdf
7. http://openbookproject.net/thinkcs/python/english3e/recursion.html

Using turtle in Python

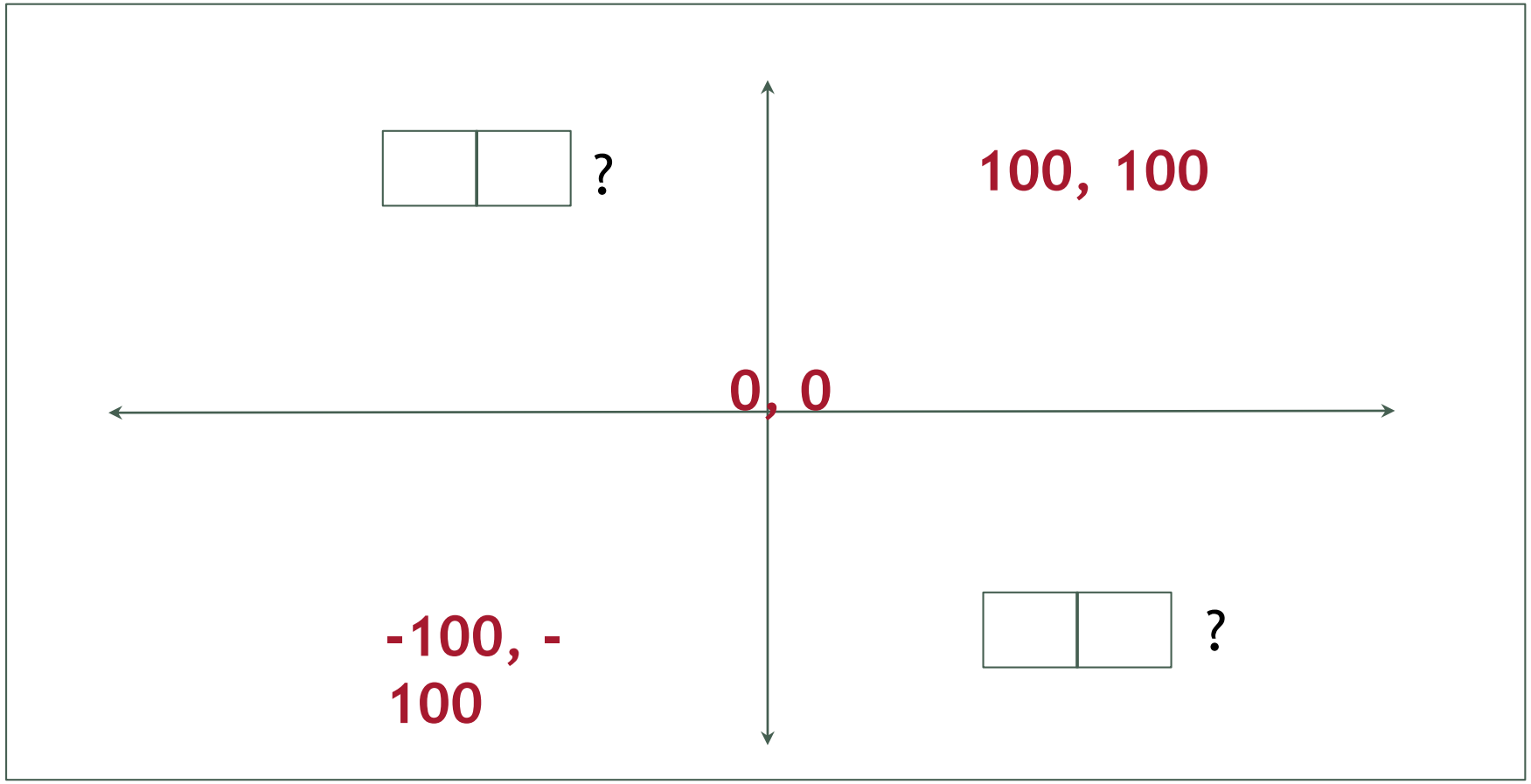
- To make use of the turtle methods and functionalities, we need to import turtle.
- ”turtle” comes packed with the standard Python package and need not be installed externally.
- Four steps for executing a turtle program :
  1. **Import** the turtle module
  2. **Create** a turtle to control (using **Turtle()**)
  3. **Draw** around using the turtle methods.
  4. Run **turtle.done()**.

Common Turtle Methods (See Documentation)

METHOD	PARAMETER	DESCRIPTION
Turtle()	None	Creates and returns a new tutrle object
forward()	amount	Moves the turtle forward by the specified amount
backward()	amount	Moves the turtle backward by the specified amount
right()	angle	Turns the turtle clockwise
left()	angle	Turns the turtle counter clockwise
penup()	None	Picks up the turtle's Pen
up()	None	Picks up the turtle's Pen
down()	None	Puts down the turtle's Pen
color()	Color name	Changes the color of the turtle's pen
fillcolor()	Color name	Changes the color of the turtle will use to fill a polygon

Adapted from: Janice Regan, 2013.

Turtle coordinates



Adapted from: Angelica Lim, 2018.

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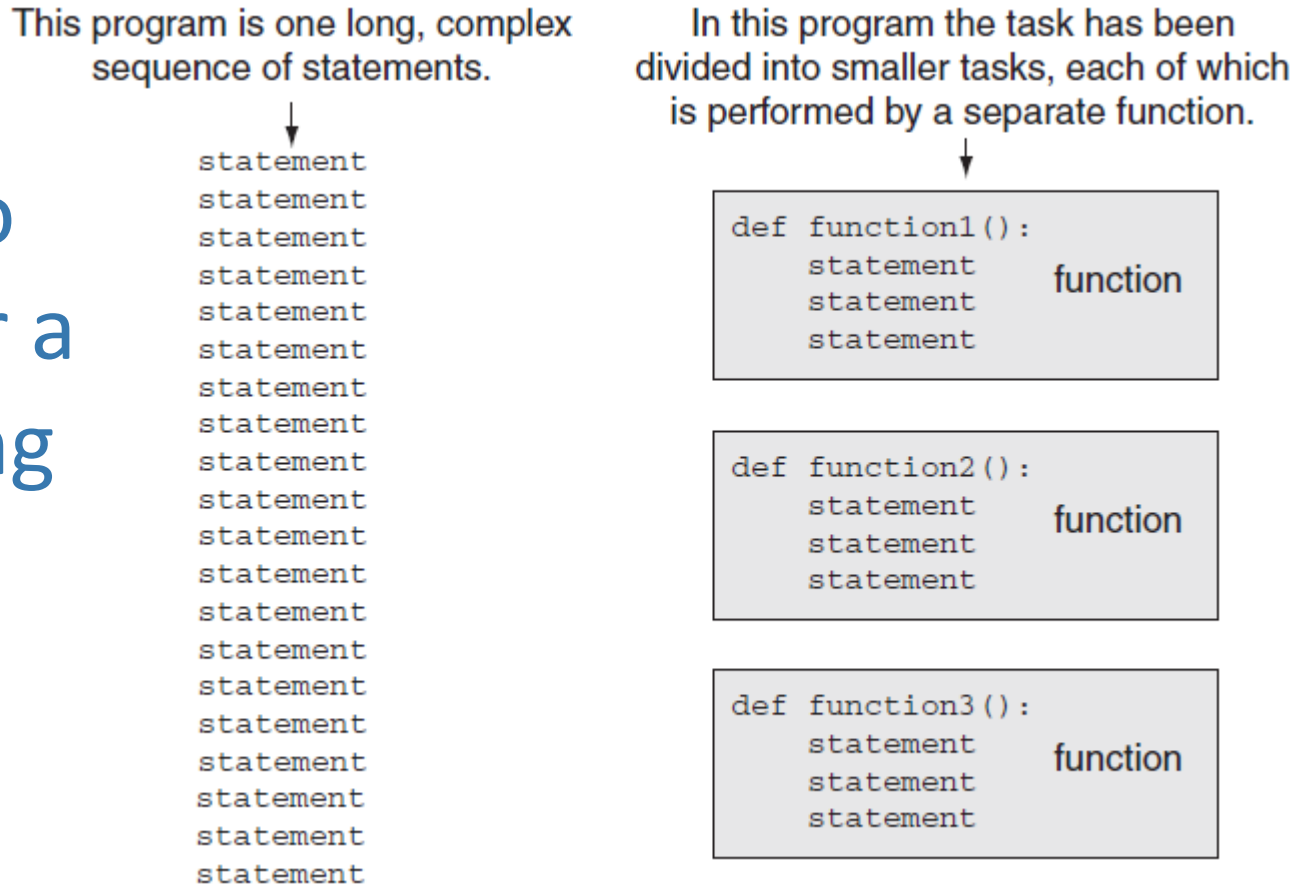
Introduction to Functions

Introduction to Functions

- **Function**: group of statements within a program that perform as specific task.
  - Usually one task of a large program.
    - Functions can be executed in order to perform overall program task.
  - Known as *divide and conquer* approach
- Modularized program: program wherein each task within the program is in its own function.

Functions: A Divide and Conquer Approach

- We use functions to Divide and Conquer a large task by dividing into subtasks.
- We also call it a modular approach.



Function Example

```
# Program to add two numbers.
num1 = 5
num2 = 6
sum = num1 + num2
print(sum)
```

```
# A user-defined function to add
def add_numbers(x, y):
    sum = x + y
    return sum

num1 = 5
num2 = 6
sum = add_numbers(num1, num2)
print(sum)
```

User defined function area

Imaginary dividing line

main function area

Function Example

```
# Calculator.
num1 = 5
num2 = 6
sum = num1 + num2
sub = num1 – num2
mul = num1 * num2
div = num1 / num2
print(sum)
```

```
# A user-defined function to add
def add_numbers(x, y):
        addition = x + y
        return addition
def sub_numbers(a, b):
        sub = a - b
        return sub

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num1 = 5
num2 = 6
sum = add_numbers(num1, num2)
sub = sub_numbers(num1, num2)
print(sum, sub)
```

Imaginary dividing line

Benefits of Modularizing a Program with Functions

- The benefits of using functions include:
  - Simpler code
  - Code reuse
    - write the code once and call it multiple times.
  - Better testing and debugging.
    - Can test and debug each function individually.
  - Faster development.
  - Easier facilitation of teamwork
    - Different team members can write different functions.

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Void Functions and Value-Returning Functions

Void Functions and Value-Returning Functions

- A void function:
  - Simply executes the statements it contains and then terminates.
- A value-returning function:
  - Executes the statements it contains, and then it returns a value back to the statement that called it.
    - The `input`, `int`, and `float` functions are examples of value-returning functions.

Defining and Calling a Function

- **Functions are given names (like we give names to variables).**
  - Function naming rules:
    - Cannot use key words as a function name.
    - Cannot contain spaces.
    - First character must be a letter or underscore.
    - All other characters must be a letter, number or underscore.
    - Uppercase and lowercase characters are distinct.

Defining and Calling a Function (cont'd.)

- Function name should be descriptive of the task carried out by the function.
  - Often includes a verb
- **Function definition**: Specifies what function does.

```
def function_name():
        statement
        statement
```

1. **Function header**: First line of function.
   - Includes keyword `def` and function name, followed by parentheses and colon.
2. **Block**: Set of statements that belong together as a group.
3. **Call** a function to execute it.
   - When a function is called:
     - Interpreter jumps to the function and executes statements in the block.
     - Interpreter jumps back to part of program that called the function.
       - Known as function return

Defining and Calling a Function (cont'd.)

- **`main` function**: Called when the program starts.
  - Calls other functions when they are needed.
  - Defines the *mainline logic* of the program.

Indentation in Python

- Each block **must** be indented
  - Lines in block must begin with the same number of spaces.
    - Use tabs or spaces to indent lines in a block, but not both as this can confuse the Python interpreter
    - IDLE automatically indents the lines in a block
  - Blank lines that appear in a block are ignored

Questions?