What do you call a computer super hero?

A screen saver!!!

Source: https://www.scarymommy.com/computer-jokes

Thank you April!

CMPT 120

Lecture 18 – Graphics and Animation
Python – Turtle and Functions and Recursion
Last Lecture

• Continued learning about **turtle**
• Continued creating animation programs using
  • **Turtle**
  • **Functions**
• Introduced **tuples**

A **tuple**, like a list, is a sequence of items of any type. Unlike lists, however, tuples are immutable. Syntactically, a tuple is a comma-separated sequence of values. Although it is not necessary, it is conventional to enclose tuples in parentheses:

```
```
Today’s Menu

• Solve the **chocolate chip cookie problem** using **Turtle + Loops + Functions**

• Summarize topics related to function using a demo
  • [OperationsOnList.py](#) posted on our course website
  • And the Python Visualizer

• Introduce a new kind of algorithm: **Recursion**
From last lecture!

• **Step 1 - Problem statement:**
  • Write a program that draws a chocolate chip cookie with our Turtle

• **Step 2 – Design**
  • Let’s have a look at a possible algorithm

• **Step 3 – Implementation**
  • Let’s transform this algorithm into Python code

• **Step 4 – Testing**
  • Does our program work i.e., solve the problem?

We started implementing our Cookie program incrementally: implement some code, test, repeat!

Let’s get to the chocolate chips now! 😊
Step 2 – Design

Turtle Canvas

# Tell tt to draw a chocolate chip cookie
# Draw the contour of the cookie
tt.penup()
tt.goto(-140,-120)
tt.pendown()
tt.circle(30)
tt.penup()

# Draw a chocolate chip in the middle of the cookie
# Draw a chocolate chip in the top left area of the cookie
# Draw a chocolate chip in the bottom left area of the cookie
# Draw a chocolate chip in the bottom right area of the cookie
# Draw a chocolate chip in the top right area of the cookie
# Click on the canvas to exit
canvas.exitonclick()
How to draw the chocolate chips?

• Solution:
  • Could we copy and modify the code many times, each instance of the code would be drawing a chocolate chip?

• Hum… This solution would lead to a lot of repeating code, which is not a good idea!

Why? Let’s have a look!
Function Demo

• Demo using Python Visualizer and OperationsOnList.py posted on our course website:

  1. Arguments and parameters
  2. Default parameters
  3. Differentiate between variables local to a function (which has local scope) versus variables used outside of a function
     • Shadowing
  4. Lists are mutable
     • Passing lists as argument(s) to a function
       • What happens when function modifies a list?
  5. Strings and tuples are immutable:
     • Passing strings and tuples as arguments to a function
       • What happens when function modifies a string, a tuple?
Recursion

Functions that call themselves
Recursion - Definition

From our Readings (16.1)

- **Recursion** is a method of solving problems that involves breaking a problem down into smaller and smaller subproblems until you get to a small enough problem that it can be solved trivially.
Recursion in the real world

- Russian dolls
Recursion in the real world

- Searching for the word “guffaw” in a dictionary

Source: http://www.eslstation.net/ESL310L/310L_dict.htm
Recursion in the real world

- Droste Effect

The picture is in the picture which is in the picture...
Next Lecture

- Our midterm is coming up soon!
- Let’s have practice exam #5!
  - Please, bring paper, pens/pencils and all your questions to our lecture on Wednesday!

- We shall continue investigating the topic of **Recursion** on Friday!