Welcome!

We'll get started shortly ...

CS 49 Section

Week 5

Surajit A Bose

Agenda

- Logistics and check-ins
- Review of lecture concepts
  - Expressions
  - Constants
  - The **`random`** module and **`math`** library
- Coding Template
- Section Problem: Mars Weight

Logistics

Section Survey

- Please take the brief, anonymous Section Survey!
- Two required multiple choice questions
- Two optional open-ended questions
- Will take about one minute
- Will help me make section more useful for you
- Not the same as the mid-course survey (which is for the entire class)
- Section survey URL: https://forms.gle/p4Qjd5235H2359vQ9
- Deadline: 11a Friday, February 14

No meeting February 14

- Due to the Presidents' Day holiday, there will be no section next Friday
- Section slides **and solutions** for week 6 will be posted early next week
    - CiP solutions may not be available until Friday
- Feel free to reach out via Pronto or Canvas inbox with any questions regarding the week's material or assignments
- Enjoy your Valentine's Day!

Quick Check-in

Let's quickly go round the room! Pick any one of the following to complete the sentence: As the weeks go by, this class is getting:

- easier, because ...
- more difficult, because ....
- more fun, because ...
- more stressful, because ...

How to get hold of me / get help+

- The class forum. Feel free not only to ask, but also to answer questions!
- Surajit's office hours:
  - Fridays 12 noon–1p, directly after section
  - By appointment on Zoom
- Lane's office hours
- Canvas inbox or Pronto inbox for Lane
- Canvas inbox (preferred) or Pronto for Surajit
- Sina's support section, Fridays 1p–2p on Zoom (note the changed time)
- Email bosesurajit@fhda.edu, 24 hr turnaround
- Online or in-person tutoring via the STEM center (Room 4213)
- The section GitHub repo has lecture and section slides and solutions

Lecture Review: Expressions

Expressions

- A statement that can be evaluated
- We've seen boolean expressions in Karel: `front_is_clear()`, `beepers_present()`, that evaluate to `True` or `False`
- There are also arithmetic expressions: given `x = 9` and `y = 2`,
  - `z = x + y` `# z = 11`
  - `z = x - y` `# z = 7`
  - `z = x * y` `# z = 18`
  - `z = x / y` `# z = 4.5`
  - `z = x // y` `# z = 4`
  - `z = x % y` `# z = 1`
  - `z = x ** y` `# z = 81`
  - `z = -y` `# z = -2`

Expressions

- The symbols **+**, **-**, **/**, etc. are the operators
- The terms operated upon (**x** and **y** in the previous slide) are the operands
- The evaluated result of the expression is typically stored in a variable (**z** in the previous slide) using the assignment operator **=**
- Keep in mind the difference between the two division operators:
  - **/** will always result in a float
  - **//** will always result in an integer, any remainder being discarded
  - **%** is the modulus operator for the remainder of integer division
- Given x = 8 and y = 2, what is the value and type of these expressions?

```
x ** y  # ?        x / y  # ?      x < y  # ?
```

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- Given x = 8 and y = 2, what is the value and type of these expressions?

```
x ** y  # 64      x / y  # 4.0      x < y  # False
```

Expressions

- Watch out for floating point values! They are not stored precisely:

```
x = 1.9
y = 1
z = x - y
print(z)                    # 0.8999999999999
```

- Precision of float results is not reliable beyond the precision determinable by the inputs. Here, the value of **z** is not reliable past one decimal place.
- Can use `round(a, b)` where **a** is the value to round, **b** the number of decimal places:

```
print(round(z, 1))     # 0.9
```

Expressions

- Operators have the following precedence:

( )	parentheses
******	exponentiation
–	unary negation
***, /, //, %**	multiplication, division, integer division, modulus
+, –	addition, subtraction

- Operators with the same precedence (e.g., multiplication, division) are evaluated from left to right

Expressions

- Compound operators: **+=**, **-=**, ***=**, etc. combine the arithmetic and assignment operators in a single command
- Given initial values **x = 3** and **y = 2**, what would the following expressions evaluate to?
  - **x *= y** *# x = x * y*
  - **x += 4** *# x = x + 4*
  - **x /= y** *# x = x / y*
  - **x %= y** *# x = x % y*

Expressions

- Compound operators: `+=`, `-=`, `*=`, etc. combine the arithmetic and assignment operators in a single command
- Given initial values `x = 3` and `y = 2`, what would the following expressions sequentially evaluate to?
  - `x *= y` `# x = x * y, x = 6`
  - `x += 4` `# x = x + 4, x = 10`
  - `x /= y` `# x = x / y, x = 5.0`
  - `x %= y` `# x = x % y, x = 1.0`
- Notice that the types of the results depend variously on the operands, the operators, or the results themselves
- Remember that types can be cast to a different type

Any Questions?

Lecture Review: Constants

Constants

- In Python, a constant is a variable whose value does not change during the execution of the program
- By convention, constants are named in **UPPER_SNAKE_CASE**
- Why use constants?
  - To avoid "magic numbers"
  - To allow easy updates
  - To follow the principle of programming for the general case
- Unlike most other programming languages, Python does not enforce constants; they are a convention

Constants

- Suppose I have a program that calculates various resources needed for running an office building based on its square footage. E.g., how many smoke detectors it needs, what the budget should be for HVAC, etc.
- What constants would I need so I can reuse the program for any building?

Constants

- Suppose I have a program that calculates various resources needed for running an office building based on its square footage. E.g., how many smoke detectors it needs, what the budget should be for HVAC, etc.
- What constants would I need so I can reuse the program for any building?
  - **SMOKE_DETECTOR_FACTOR**

    ```
    # e.g. 1 per 2000 sq.ft. or 0.0005
    ```

  - **HVAC_FACTOR**

    ```
    # how many dollars to budget per sq.ft.
    ```

Any Questions?

Lecture Review: `random` and `math`

The `random` module and `math` library

- A module is a python file (with the extension .py) that contains code that can be reused in a different program.
- The **`random`** module allows generation of pseudo-random numbers
- A library, loosely speaking, is a collection of many modules
- The **`math`** library allows mathematical operations such as calculating square roots
- To use such external modules or libraries, your program needs an **`import`** statement such as **`import math`** or **`import random`**
- We've seen such a statement: **`from karel.stanfordkarel import *`**

The random module and math library

```
from math import sqrt
import random

def main():
    for i in range(4):
        my_num = random.randint(200, 1000)
        my_sqrt = sqrt(my_num)
        print(f'Number is: {my_num}, square root is: {my_sqrt}')

if __name__ == '__main__':
    main()
```

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    main()
```

Any Questions?

Where do all these go?

Flashback to Week 1 . . .

The Anatomy of a Program

- File name, comment, your name, date
- Import statement
- **`main()`** module with further comments. Indentation is important!
- Guard clause and invocation of **`main()`**

```
"""
main.py

Karel moves a beeper from the bottom row to the top row

Programmer: Surajit A Bose, Date: 2025.02.03
"""

from karel.stanfordkarel import *

def main():
    """Move Karel and beeper to top row

    Preconditions:
    - Karel is in the bottom left corner, facing east
    - There is a beeper immediately in front of Karel

    Postconditions:
    - Karel is in the top right corner, facing east
    - Beeper has been moved and is immediately behind Karel
    """
    pass   # Delete this line and write your code here!  :)

# There is no need to edit code beyond this point
if __name__ == '__main__':
    main()
```

The structure of a Python program

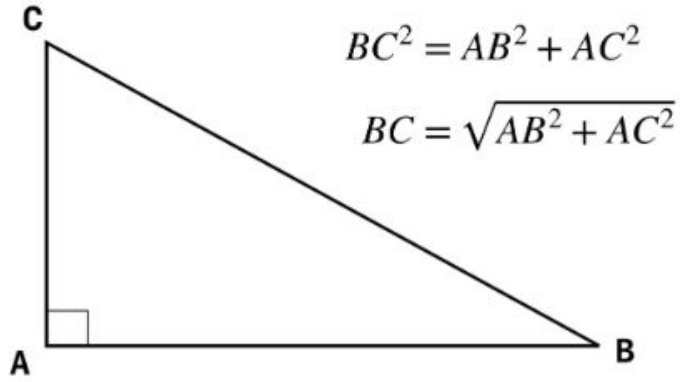
- Python programs have a typical order:
  - Comment with filename, program overview, and programmer name
  - import statements
  - constants
  - `main()` function
  - helper functions
  - guard clause and invocation of `main()`
- A template for your use is here

Sample problem: Pythagorean Theorem

https://codeinplace.stanford.edu/cs49-w24/ide/a/pythagorean

Pythagorean Theorem

Write a program that asks the user for the lengths of the two perpendicular sides of a right triangle and outputs the length of the third side (the hypotenuse) using the Pythagorean theorem! The Pythagorean theorem, named after the ancient Greek thinker, Pythagoras, is a fundamental relation in geometry. It states that in a right triangle, the square of the hypotenuse is equal to the sum of the square of the other two sides.



Steps to solution:

- Get len_AB from user and convert to appropriate type
- Get len_AC from user and convert to appropriate type
- Compute sum of squares
- Compute len_BC
- Display len_BC

Section problem: Mars Weights

https://codeinplace.stanford.edu/cs49-w24/ide/a/marsweight

Mars Weights

Due to the weaker gravity on Mars, an Earthling's weight on Mars is 37.8% of their weight on Earth. Write a Python program that prompts an Earthling to enter their weight on Earth and prints their calculated weight on Mars. The output should be rounded to two decimal places when necessary. Example:

```
Enter a weight on Earth: 120
The equivalent weight on Mars: 45.36
```

- What constant should we use?
- As what type should the input from the user be cast?

Let's get to work!

That's all, folks!

Next up: Control Flow!