Review

- How can I convert one primitive type to another primitive type?
- How do we make our programs interact with a user?

Objectives

- Another trick
- Definite Loops

Trick: Arithmetic Shorthands

- Called **extended assignment operators**
- Increment Operator
  - `x = x + 1` can be written as `x += 1`
- Decrement Operator
  - `x = x - 1` can be written as `x -= 1`
- Shorthands are similar for `*, /, //` :
  - `amount *= 1.055`
  - `x //= 2`

FOR LOOPS

Parts of an Algorithm

- Input, Output
- Primitive operations
  - What data you have, what you can do to the data
- Naming
  - Identify things we're using
- Sequence of operations
- Conditionals
  - Handle special cases
- Repetition/Loops
- Subroutines
  - Call, reuse similar techniques

Super Power:
Superhuman Speed

Looping/Repetition

We know how to make a PB&J Sandwich:

Make PB&J sandwich

Make 10 PB&J sandwiches

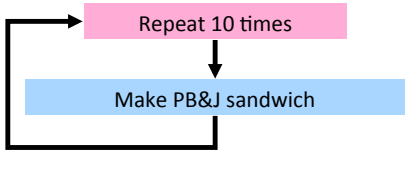
Make PB&J sandwich
Make PB&J sandwich
Make PB&J sandwich
Make PB&J sandwich
Make PB&J sandwich
M
M
M
Make PB&J sandwich
Make PB&J sandwich

Repetition is common in programming. Is there some simpler way to say that we want to repeat something?

Looping/Repetition

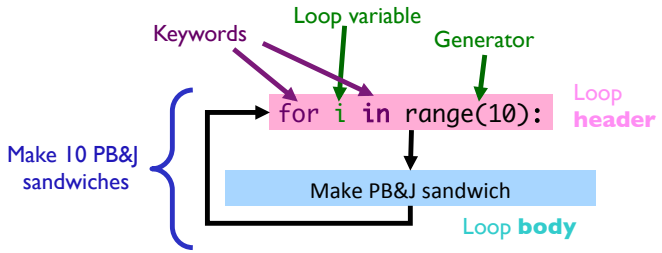
Make PB&J sandwich

Make 10 PB&J sandwiches



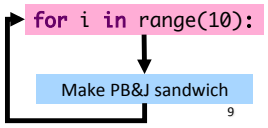
The `for` Loop

- Use when know how many times loop will execute
  - Repeat N times



What Goes in the Loop Body?

- Make PB&J Sandwich
  1. Gather materials (bread, PB, J, knives, plate)
  2. Open bread
  3. Put 2 pieces of bread on plate
  4. Spread PB on one side of one slice
  5. Spread Jelly on one side of other slice
  6. Place PB-side facedown on Jelly-side of bread
  7. Close bread
  8. Clean knife
  9. Put away materials



What Goes in the Loop Body?

- Make PB&J Sandwich

Initialization
1. Gather materials (bread, PB, J, knives, plate)
2. Open bread

Loop Body
3. Put 2 pieces of bread on plate
4. Spread PB on one side of one slice
5. Spread Jelly on one side of other slice
6. Place PB-side facedown on Jelly-side of bread

Finalization
7. Close bread
8. Clean knife
9. Put away materials

`for` Loop Syntax and Semantics

- Use when know how many times loop will execute
  - Repeat N times

Times to repeat

```
for x in range(10):
    statement_1

    statement_2
    …
    statement_n
```

"Body" of `for` loop
- Gets repeated
- Note indentation

Using the `for` Loop

- If only ***one*** statement to repeat

```
for variable in range(5): print("Hello!")
```

Analyzing range()

- **range** is a *generator*
- What does **range** do, exactly, with respect to the loop variable i?

```
for i in range(5):
    print(i)

print("After the loop:", i)
```

range_analysis.py

for loop analysis

```
for i in range(5):
    # like assigning i values(0,1,2,3,4)
    # consecutively, each time through loop

    # rest of loop body …
```

- Note: when have range(5),
  - i gets values (0, 1, 2, 3, 4)
  - Which means that loop executes 5 times
- Optional: start and step parameters

range([start,] stop[, step])

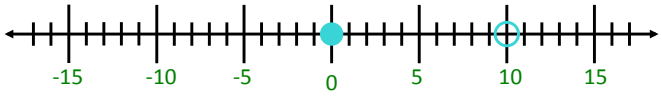
- [xxx] means that xxx is optional
- 1 argument: range(stop)
- 2 arguments: range(start, stop)
- 3 arguments: range(start, stop, step)

range([start,] stop[, step])

- 1 argument: range(stop)
  - Defaults: start = 0, step = 1
  - Iterates from 0 to stop-1 with step size=1
- 2 arguments: range(start, stop)
  - Default: step = 1
  - Iterates from start to stop-1 with step size=1
- 3 arguments: range(start, stop, step)
  - Iterates from start to stop-1 with step size=step

range

- range is a number generator
  - 1 argument: range(stop)
  - 2 arguments: range(start, stop)
  - 3 arguments: range(start, stop, step)

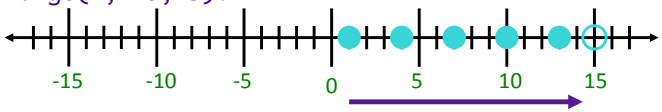


range(10)
range(0,10)
range(0,10,1)

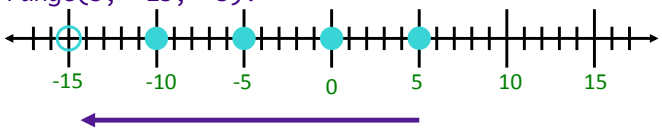
[start, stop)

Sequence generated by range

range(1, 15, 3):



range(5, -15, -5):



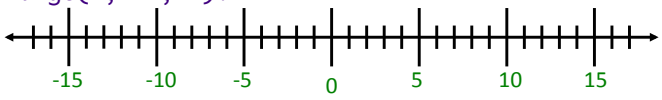
more_range_examples.py

Practice

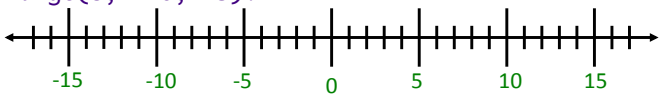
Place these: ● ○

Which direction?

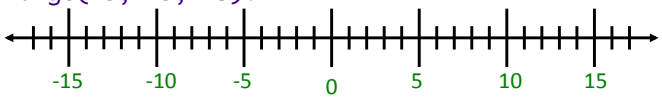
range(2, 14, 2):



range(8, -10, -3):

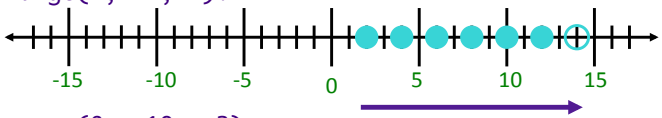


range(-5, 15, -3):

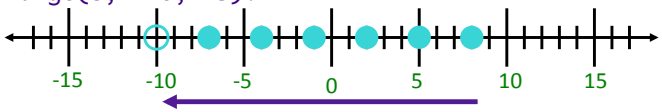


Practice Solution

range(2, 14, 2):

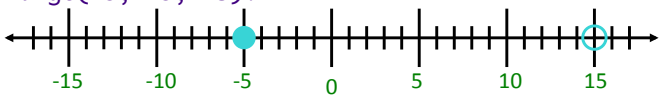


range(8, -10, -3):



range(-5, 15, -3):

Won't generate any



Practicing for Loops

- Write the Python code to print the following:
  - A)
    ```
    1
    2
    3
    4
    5
    ```
  - B)
    ```
    2
    5
    8
    11
    ```
  - C)
    ```
    ****
    ****
    ****
    ```

What is getting repeated? How many times?

Programming Practice

- Add 5 numbers, inputted by the user
  - After implementing, simulate running on computer

Generalizing Solution: Accumulator Design Pattern

1. Initialize accumulator variable
2. Loop until done
   - Update the value of the accumulator
3. Display result

Programming Practice

- Average 5 numbers inputted by the user

Programming Practice

- Average 5 numbers inputted by the user
- Good example of how to build up to a solution
  - Break down into smaller pieces

average5.py

This Week

- Lab 2
- Broader Issue