Lab 4

- Review Lab 3
  - Run Animations!
- Function review

Lab 3

- Iterative Fibonacci Sequence was a question on several students' interviews

Lab 3 Feedback

- Continuing to get tougher in grading
  - Paying more attention to style (e.g., variable names), efficiency, readability, good output
  - High-level descriptions
  - More strict on adhering to problem specification
  - Constants
  - Demonstrate program **more than once** if gets ***input*** from user or ***outcome changes*** when run again
    - Find errors before I do!

Program Organization

```
# high-level description
# author name

import statements

CONSTANT_DEFNS = …

program_statements ...
program_statements ...
program_statements …
```

Program Organization

```
# high-level description
# author name

import statements

CONSTANT_DEFNS = …

def main():
    statements…
    statements...

def otherfunction():
    statement...
```


Lab 3 Feedback: Common Issues

Which solution is more efficient (does less "work")?

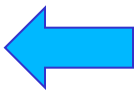
```
operand1=12
for operand2 in range(1, 15):
   result = operand1 % operand2
   print(operand1, "%", operand2, "=", result)
```

vs

```
for operand2 in range(1, 15):
   operand1=12
   result = operand1 % operand2
   print(operand1, "%", operand2, "=", result)
```

Lab 3 Feedback: Common Issues

Which solution is more efficient (does less "work")?



```
operand1=12
for operand2 in range(1, 15):
   result = operand1 % operand2
   print(operand1, "%", operand2, "=", result)
```

vs

```
for operand2 in range(1, 15):
   operand1=12  ← Additional assignment each time through loop
   result = operand1 % operand2
   print(operand1, "%", operand2, "=", result)
```


Lab 3 Feedback: Common Issues

Which solution is simpler?

```
operand1=12
for operand2 in range(1, 15):
    result = operand1 % operand2
    print(operand1, "%", operand2, "=", result)
```

vs

```
operand1=12
operand2=0
for x in range(14):
    operand2 = x + 1
    result = operand1 % operand2
    print(operand1, "%", operand2, "=", result)
```

Lab 3 Feedback: Common Issues

Which solution is simpler?

```
operand1=12
for operand2 in range(1, 15):
    result = operand1 % operand2
    print(operand1, "%", operand2, "=", result)
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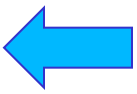


vs

```
operand1=12
operand2=0
for x in range(14):
    operand2 = x + 1
    result = operand1 % operand2
    print(operand1, "%", operand2, "=", result)
```

More code makes solution more difficult to understand

Animation Feedback

- If moving multiple objects together
  - Move *all* the objects, then sleep
  - Otherwise, animation looks choppy
- Could use a list with the `for` loop, as discussed in several sections in the textbook
  - Simplifies and reduces code

```
for object in [ myObj1, myObj2, myObj3 ]:
    object.move()
sleep(.001)
```

Run Animations

Review

- What are characteristics of a good function?
- How can we programmatically test functions?
- What are two development processes we have discussed?

Writing a "Good" Function

- Should be an "intuitive chunk"
  - Doesn't do too much or too little
  - If does too much, try to break into more functions
- Should be reusable
- Should have an "action" name
- Should have a comment that tells what the function does

Writing Comments for Functions

- Good style: Each function ***must*** have a comment
  - Describes functionality at a high-level
  - Include the *precondition*, *postcondition*
  - Describe the parameters (their types) and the result of calling the function (precondition and postcondition may cover this)

Writing Comments for Functions

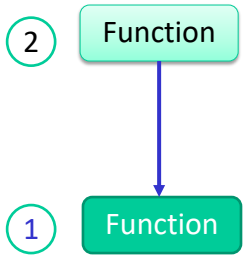
- Include the function's pre- and post- conditions
- **Precondition**: Things that must be true for function to work correctly
  - E.g., num must be even
- **Postcondition**: Things that will be true when function finishes (if precondition is true)
  - E.g., the returned value is the max

Refactoring:
Converting Functionality into Functions

1. Identify functionality that should be put into a function
   - What should the function do?
   - What is the function's input?
   - What is the function's output (i.e., what is returned)?
2. Define the function
   - Write comments
3. Test the function programmatically
4. Call the function where appropriate
5. Create a `main` function that contains the "driver" for your program
   - Put at top of program
6. Call `main` at bottom of program

Review: Bottom-Up Development

- Use the function in context/ call the function
- Define a function
  - Document
  - Test the function



`test` module's `testEqual` function

- Example from yesterday

```
def testWinPercentage():
    test.testEqual( calculateWinPercentage(0, 1), 0 )
    test.testEqual( calculateWinPercentage(2, 2), .5 )
    test.testEqual( calculateWinPercentage(3, 7), .3 )
    test.testEqual( calculateWinPercentage(1, 0), 1 )

testWinPercentage()
```

Could add a parameter for the number of decimal places of precision

After confirming that the function works…

`test` module's `testEqual` function

- Example from yesterday

```
def testWinPercentage():
    test.testEqual( calculateWinPercentage(0, 1), 0 )
    test.testEqual( calculateWinPercentage(2, 2), .5 )
    test.testEqual( calculateWinPercentage(3, 7), .3 )
    test.testEqual( calculateWinPercentage(1, 0), 1 )

# testWinPercentage()
main()
```

Comment out call to test function.
Call `main`.

Docstring on Function

```
def calculateWinPercentage(wins, losses):
    """
    Calculates and returns a win percentage, based on the given wins
    and losses.
    Parameters:
    - wins: a non-negative integer representing the number of wins
    - losses: a non-negative integer representing the number of losses
    Pre: either wins or losses must be greater than 1 or will throw a
    divide by zero error
    Post: returns the win percentage (between 0 and 1, inclusive)
    """
    …
```

Good docstring because
- Describes parameters
- Describes what is return (is it a %?)
- Describes error cases

Development approach:

TOP-DOWN DEVELOPMENT

Top-Down Development

- I have a problem
- But, that problem can be broken into smaller problems

- Solution:
  - Problems → functions!
  - Divide and Conquer!

Example: Top-Down Development

- I want to calculate and then display a team's win/loss percentage based on user input

Example: Top-Down Development

- I want to calculate and then display a team's win/loss percentage based on user input
- Algorithm:
  - Get user input for number of wins and losses
  - Calculate the win percentage
  - Display the results

Example: Top-Down Development – Design: Identify Functions

- I want to calculate and then display a team's win/loss percentage based on user input
- Algorithm:

`main`

- Get user input for number of wins and losses

`calculateWinPercentage`

- Calculate the win percentage
- Display the results

Think about how the function will be used first→ API!

Example: Top-Down Development – Starting Implementation…

```
def main():
    # get user input

    winPct = calculateWinPercentage(wins, losses)

    # display results

def calculateWinPercentage( numWins, numLosses ):
    """
    Given the number of wins and losses,
    calculates and returns the win percentage
    …
    """
    …


main()
```

Think about how the function will be used first→ API!

Summary: Development Approaches

- There are several development approaches
- Not mutually exclusive
- Often will switch between them, depending on circumstances
- As programs grow in size, there is no "one way" to write code
  - But there may be better ways to make progress
  - If you're stuck, step back and reassess your approach

Lab 4 Overview

Note change in naming scheme: lab4_1.py

- Calling functions defined in the same program
- Refactoring code
- Modifying function definitions
- Testing functions
- Creating a module
- Writing a program with a function from scratch