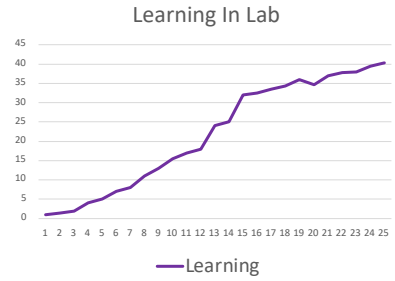
Objectives

- Conditionals
- Exam review

1

Your Learning Journey

- You're learning a lot
  - Struggle is part of the learning



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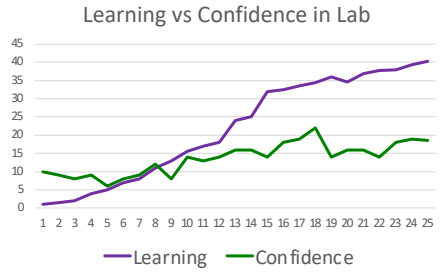
Your Learning Journey

- But struggle affects your confidence
  - Confidence != Learning



Lab ends and … ???

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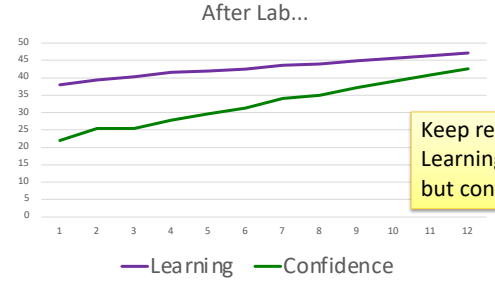
Your Learning Journey

- But struggle affects your confidence
  - Confidence != Learning



Keep reviewing, practicing
Learning may not increase as much, but confidence should

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Review

- What makes a "good" function?
- What are benefits of functions?
- What does the `return` statement do?
- What does it mean to "programmatically test" a function?
  - What are the benefits of programmatic testing?
- What development approaches did we discuss?
  - What are their steps?

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Review: 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

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Review: Why Write Functions?

- Allows you to break up a problem into *smaller*, more *manageable* parts
- Makes your code easier to *understand*
- Hides implementation details (*abstraction*)
  - Provides interface (input, output)
- Makes part of the code *reusable* so that you:
  - Only have to write function code once
  - Can debug it all at once
    - Isolates errors
  - Can make changes in one function (*maintainability*)

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Review: 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
   - Comment out the other code temporarily
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

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Why Refactoring?

- Common practice: write code, then realize it would be better (more readable, reusable, easier to test, …) if it were in a function

Review: Testing Functions

- Functions make it easier for us to test our code
- We can write code to test the functions
  - Test Case:
    - Input: parameters
    - Expected Output: what we expect to be returned
      - Or if state changed as we expected
  - We can verify the function *programmatically*
    - "programmatically" – automatically execute test cases and verify that the actual returned result is what we expected
    - No user input required!

Review: `test` Module

- Not a standard module
  - Included with our textbook
  - More sophisticated testing modules but this is sufficient for us
- Function:
  - `testEqual(actual, expected[, places=5])`
    - Parameters: actual and expected results for a function.
    - Displays "Pass" and returns True if the test case passes.
    - Displays error message, with expected and actual results, and returns False if test case fails.

`test` module's `testEqual` function

```
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

```
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`.

Another Example of Programmatic Testing

- Testing a constructor/function/method that affects state:

```
def testGraphWin():
    window = GraphWin("Title", 300, 200)
    test.testEqual( window.getWidth(), 300 )
    test.testEquals( window.getHeight(), 200 )
    …
```

  - Call the constructor/function/method under test
  - Check the resulting state

 More on this later…

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

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Making Decisions

- Sometimes, we do things only if some condition holds (i.e., "is true")
- Examples
  - If the PB is new (has a safety seal)
    - Then, I will take off the safety seal
  - If it is raining and it is cold
    - Then, I will wear a raincoat
  - If it is Saturday or it is Sunday
    - Then, I will wake up at 9 a.m.
    - Otherwise, I wake up at 7 a.m.
  - If the shirt is purple or the shirt is on sale and blue
    - Then, I will buy the shirt

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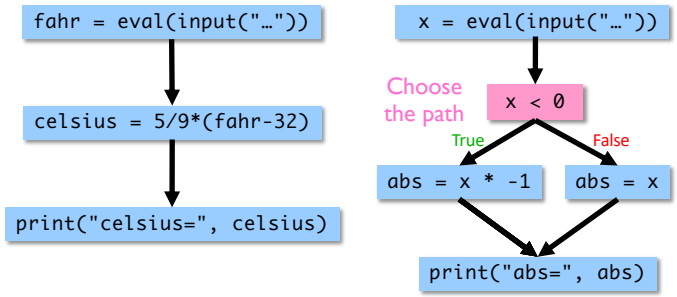
Conditionals

- Sometimes, we only want to execute a statement in certain cases
- Example: Finding the absolute value of a number
  - |4| = 4
  - |-10| = 10
  - ➢To get the answer, we multiply the number by -1 *only if it's a negative number*
  - ➢Code:

```
if x < 0 :
    abs = x*-1
```


`if` Statements

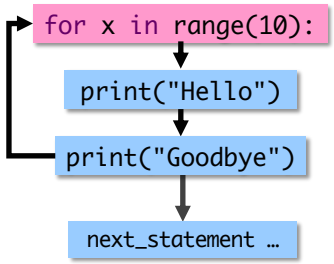
- Change the ***control flow*** of the program



Other Constructs That Change Control Flow

- **for** loops
  - Repeats a loop body a fixed number of times before going to the next statement after the **for** loop

```
for x in range(10):
        print("Hello")
        print("Goodbye")
next_statement …
```



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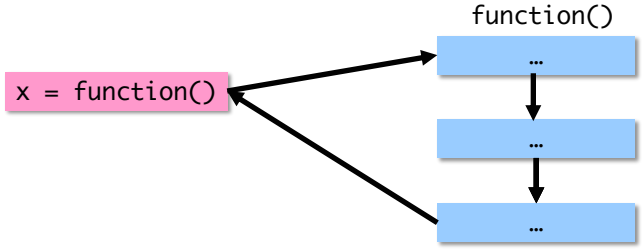
Other Constructs That Change Control Flow

- Function calls
  - "Go execute some other code and then come back with the result"



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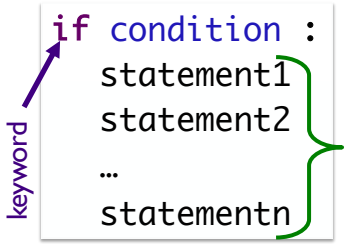
Syntax of `if` statement: Simple Decision



"then" Body
- Note indentation

English Examples:

```
if it is raining :
    I will wear a raincoat
if the PB is new :
    Remove the seal
```


Conditions

- Syntax (typical, others later):
  - `<expr> <relational_operator> <expr>`
- Evaluates to either `True` or `False`
  - Boolean type

Relational Operators

- Syntax: `<expr> <relational_operator> <expr>`
- Evaluates to either `True` or `False`
  - Boolean type

Low precedence
After arithmetic operators

Relational Operator	Meaning
<	Less than?
<=	Less than or equal to?
>	Greater than?
>=	Greater than or equal to?
==	Equals?
!=	Not equals?

Example: Using Conditionals

- Determine if a number is even or odd

```
x = eval(input("Enter a number: "))
remainder = x % 2
if remainder == 0 :
    print(x, "is even")
if remainder == 1:
    print(x, "is odd")
```

Common Mistake:

Assignment Operator vs. Equality Operator

- Assignment operator: =
- Equality operator: ==

```
x = eval(input("Enter a number: "))
remainder = x%2
if remainder = 0 :
      print(x, "is even.")
```

Syntax error

Syntax of `if` statement: Two-Way Decision

```
if condition :
    statement1
    statement2
    …
    statementn
else :
    statement1
    statement2
    …
    statementn
```

keywords

"then" Body

"else" Body

English Example:

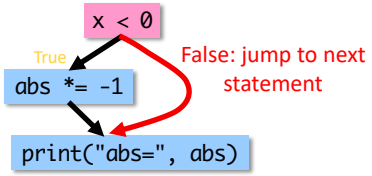
```
if it is Saturday or it is Sunday :
        I wake up at 9 a.m.
else :
        I wake up at 7 a.m.
```

If-Else statements (absolute values)

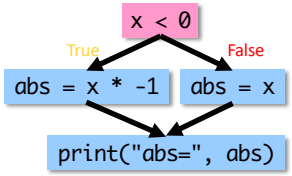
```
abs = x
if x < 0 :
    abs *= -1
print("abs=", abs)
```

```
if x < 0 :
    abs = x * -1
else:
    abs = x
print("abs=", abs)
```

If statement



If-else statement



Example: Using Conditionals

- Determine if a number is even or odd
- More efficient implementation
  - Don't need to check if remainder is 1 because if it's not 0, it *must* be 1

```
x = eval(input("Enter a number: "))
remainder = x % 2
if remainder == 0:
      print(x, "is even")
else:
      print(x, "is odd")
```

Practice: Draw the Flow Chart

```
print("This program determines your birth year")
print("given your age and current year")
print()
age = eval(input("Enter your age: "))

if age > 120:
    print("Don't be ridiculous, you can't be that old.")
else:
    currentYear = eval(input("Enter the current year: "))
    birthyear = currentYear - age
    print()
    print("You were either born in", birthyear, end=' ')
    print("or", birthyear-1)
print("Thank you.  Come again.")
```

What does this code do?

Flow of Control

- max: Given two numbers, returns the greater number

Is this implementation of the function correct?

```
def max(num1, num2):
    if num1 >= num2:
        theMax = num1
    else:
        theMax = num2
    return theMax
```

Flow of Control

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def max(num1, num2):
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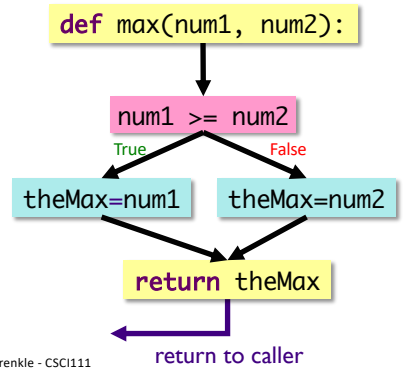

Flow of Control: Using `return`

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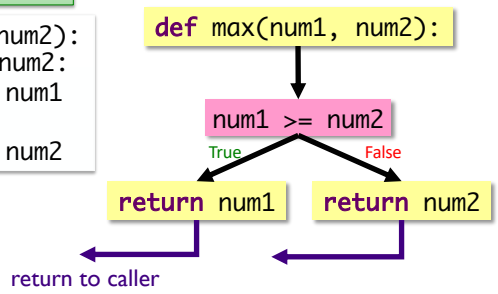

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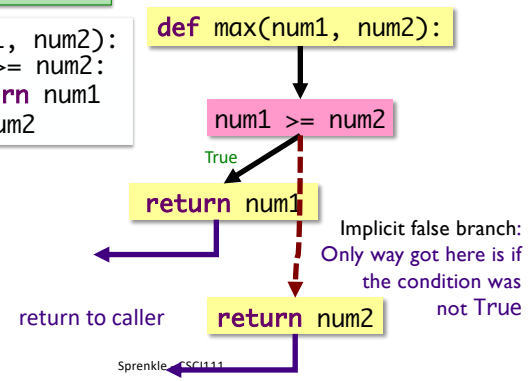

Practice: Speeding Ticket Fines

- Any speed clocked over the limit results in a fine of at least $50, plus $5 for each mph over the limit, plus a penalty of $200 for any speed over 90mph.
- Our function
  - Input: speed limit and the clocked speed
  - Output: the appropriate fine
    - What should the appropriate fine be if the user is not speeding?
- Write test cases first!

Exam Friday

- In-class, on paper
  - Emphasis on critical thinking
- Exam Preparation Document is on course web page
- Similar problems to class and lab
  - Review questions
  - Worksheets
  - Problems
- Content: up through Lab 4
- No broader issue this week

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Looking Ahead

- Lab 4
  - Practicing ***functions***
  - Due Friday
- Exam Friday
- No broader issue this week

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