CS 134 Lecture 5:
More Conditionals
Announcements & Logistics

• **Homework 2** is due tonight at 10 pm

• **Lab 2** was released on Friday
  • Pre-lab due at the beginning of lab
  • Full Assignment due Wed/Thur 10 pm

• You can work on lab machines any time (when there's not a class)

• Make sure to keep your work consistent with what is on **evolene**
  • Always pull/clone when you start and add, commit and push to evolene when done with a work session

*Do You Have Any Questions?*
Last Time

- Wrapped up functions
  - Discussed return statements and variable scope
- Started learning about conditionals
  - Boolean data type
  - Making decisions in Python using if else statements
Today’s Plan

- Learn more about `if else` statements
- Look at more complex decisions in Python
  - Boolean expressions with `and`, `or`, `not`
- Choosing between many different options in our code
  - `if elif else` “chained” conditionals
- Using `import` for using functions across different `.py` files
- We are going to cover a lot of material in the next 3 lectures
  - Make sure you are keeping up and getting help if needed!
Boolean Expressions and If Statement

• Python expressions that result in a True/False output are called **boolean expressions**

• For example, checking if a user's entered number, `num`, is even

• How do we do this? (What is a property of even numbers that we can use to test this condition?)
  • Even numbers are evenly divisible by 2 (remainder of zero)
  • Thus, `num % 2` should be zero if and only if `num` is even

• Now we have a Boolean expression we can test for: `num % 2 == 0`

• We can implement "conditional statements" in Python using Boolean expressions and an **if-else statement**

```python
is_even.py
```
Python Conditionals (if Statements)

```python
if <boolean expression>:
    statement1
    statement2
    statement3
else:
    statement4
    statement5
```

If it is raining, then bring an umbrella. Else, bring your sunglasses.

Note: (syntax) Indentation and colon after if and else
Optional Else & Simplifying Conditionals

• The else block is **optional**: not a requirement (not always needed!)

• Sometimes we can simplify conditionals

• For example, all three below are equivalent inside the body of a function that returns `True` if num is even, and `False` otherwise

```python
if num % 2 == 0:
    return True
else:
    return False
```

```python
return num % 2 == 0
```
Python Conditionals (if Statements)

- Don't forget proper indentation!

(Credit to u/ufo1udek_ on r/ProgrammerHumor)
Let's See Some Examples
More Decisions

• Sometimes, we need a more complicated conditional structure with more than 2 options but exactly one option is possible.

• Example: Write a function that takes a temp value in Fahrenheit.
  • If temp is above 80, print "It is a hot one out there."
  • If temp is between 60 and 80, print "Nice day out, enjoy!"
  • If temp is below 60, print "Chilly day, don’t forget a jacket."

• Notice that temp can only be in one of those ranges.
  • If we find that temp is greater than 80, no need to check the rest!
Nested Conditionals

if booleanExpression1:
    statement 1
    ...
else:
    if booleanExpression2:
        statement 2
        ...
        ...
    else:
        statement 3
        ...
        ...
Attempt 1: Chained Conditionals

- We can **nest** if-else statements (using indentation to distinguish between matching if-else blocks)
- Works, but this can quickly become unnecessarily complex (and hard to read!) The code below is an example of what **NOT** to do!

```python
def weather1(temp):
    if temp > 80:
        print("It is a hot one out there.")
    else:
        if temp >= 60:
            print("Nice day out, enjoy!")
        else:
            if temp >= 40:
                print("Chilly day, wear a sweater.")
            else:
                print("Its freezing out, bring a winter jacket!")
```
Logical Operators

- Logical operators **and**, **or**, **not** are used to combine Boolean values

- For two Boolean expressions $\text{exp1}$ and $\text{exp2}$
  - **not** $\text{exp1}$ (! in other languages) returns the opposite of $\text{exp1}$
  - $\text{exp1 and exp2}$ ($\&\&$ in other languages) is True iff $\text{exp1 and exp2}$ are True
  - $\text{exp1 or exp2}$ ($||$ in other languages) is True iff either $\text{exp1 or exp2}$ are True

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<th>$\text{exp1}$</th>
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<th>$\text{exp1 or exp2}$</th>
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Attempt 2: Sequence of Ifs

- What if we use a bunch of if statements (w/o else) one after the other to solve this problem?
- What are the advantages/disadvantages of this approach?

```python
def weather2(temp):
    if temp > 80:
        print("It is a hot one out there.")
    if temp >= 60 and temp <= 80:
        print("Nice day out, enjoy!"")
    if temp < 60 and temp >= 40:
        print("Chilly day, wear a sweater")
    if temp < 40:
        print("It's freezing out, bring a winter jacket!")
```
If Elif Else Statements

- Fortunately, there is a simpler way to specify several options by chaining conditionals.

```python
if booleanExpression1:
    statement 1
    ...
elif booleanExpression2:
    statement 2
    ...
else:
    statement 3
    ...
```

A better approach that avoids too many indented blocks and improves code readability.

Can have any number of `elif` conditions, but only one (optional) `else` (at the end).
Attempt 3: Chained Conditionals

- We can chain together any number of `elif` blocks
- The `else` block is **optional** (not a required part of the syntax)

```python
def weather3(temp):
    if temp > 80:
        print("It is a hot one out there."")
    elif temp >= 60:
        print("Nice day out, enjoy!"")
    elif temp >= 40:
        print("Chilly day, wear a sweater."")
    else:
        print("Its freezing out, bring a winter jacket!")
```
IMPORTANT: In the moment one of the tests is True, the associated statements are executed and the chained conditional is exited. Only in the case when tests are False, we continue checking to find a True test.
Takeaways

• Chained conditionals avoid messy nested conditionals
• Chaining reduces complexity and improves readability
• Since at most one branch in a chained `if–elif–else` block can be executed (the first condition that evaluates to `True`, or the `else` if all conditions are false) using them avoids unnecessary checks incurred by chaining if statements one after the other
Exercise: leapYear Function

• Let’s write a function `leapYear` that takes a `year` (int) as input, and returns True if `year` is a leap year, else returns False

• When is a given year a leap year?
  • "Every year that is exactly divisible by four is a leap year, except for years that are exactly divisible by 100, but these centurial years are leap years, if they are exactly divisible by 400."

How do we structure this logic using booleans and conditionals?
Exercise: \texttt{leapYear} Function

- Let's write a function \texttt{leapYear} that takes a \texttt{year} (int) as input, and returns \texttt{True} if \texttt{year} is a leap year; else returns \texttt{False}

- When is a given year a leap year? (\texttt{wikipedia})
  
  - "Every year that is exactly divisible by four is a leap year, except for years that are exactly divisible by 100, but these centurial years are leap years, if they are exactly divisible by 400."
  
  - If year is \texttt{not} divisible by 4: year is not a leap year

  - Else (divisible by 4) and if \texttt{not} divisible by 100: is a leap year

  - Else (divisible by 4 and by 100) and \texttt{not} divisible by 400: not a leap year

  - Else (if we make it to here must be divisible by 400): is a leap year

\texttt{leap.py}
Importing functions
Using functions in different files

Suppose you define a function `is_leap()` in the file `leap.py`

- If you want to use this function in a different file (e.g., `main.py`)
  - You need to tell python about it using an `import` statement
  - `ex:` `from leap import is_leap`

```python
from <filename w/o extension> import <function name>
```