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# Welcome!

We'll get started shortly ...



# CS 49 Section


## Week 6

Surajit A Bose





# Agenda


- Logistics and check-ins
  - Review of lecture concepts
    - Boolean expressions
    - Control flow
  - Section Problems:
    - [Dog Year Calculator](#)
    - [Finding Factors](#)
    - [Rock, Paper, Scissors](#)
- 

# Logistics





# 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](#) (not available 2/14)
  - Email [bozesurajit@fhda.edu](mailto:bozesurajit@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: Booleans





# Boolean Expressions

- Reminder: an expression is a statement that can be evaluated
  - A boolean expression evaluates to one of two values: **True** or **False**
  - Like arithmetic expressions:
    - Boolean expressions are built using operators
    - The result is typically stored in a variable
    - For example, given a whole number greater than 1, we could set a variable **is\_prime** to the value **True** or **False** for that number
  - Boolean operators are of two types:
    - Comparison
    - Logical
- 

# Boolean Operators: Comparison +

- The boolean comparators are similar to the ones in math
- Given  $x = 3$  and  $y = 4$ :
  - $x == y - 1$       # *x equals y minus 1*
  - $x + 1 != y$       # *x plus 1 not equal to y*
  - $x < y$       # *x less than y*
  - $x <= y$       # *x less than or equal to y*
  - $x > y$       # *x greater than y*
  - $x >= y$       # *x greater than or equal to y*



# Boolean Operators: Comparison +

- The boolean comparators are similar to the ones in math
- Given  $x = 3$  and  $y = 4$ :

○ $x == y - 1$	# <i>x equals y minus 1</i>	True
○ $x + 1 != y$	# <i>x plus 1 not equal to y</i>	False
○ $x < y$	# <i>x less than y</i>	True
○ $x <= y$	# <i>x less than or equal to y</i>	True
○ $x > y$	# <i>x greater than y</i>	False
○ $x >= y$	# <i>x greater than or equal to y</i>	False



# Boolean Operators: Comparison +

- Note that `==` and `=` are very different beasts!
  - `x == y - 1` is not the same as `x = y - 1`
  - One is an expression: it checks whether the operands on the left and right sides of the operator are equal
  - The other is an assignment: it evaluates the expression on the RHS and stores the resulting value into the variable on the LHS
- Comparison operators can be chained:
  - `x < y` and `y < z` can be expressed as `x < y < z`, to check whether the value of `y` is between the values of `x` and `z`



# Any Questions?

# Boolean Operators: Logical

- The logical operators are **not**, **and**, and **or**
- **not** simply reverses the truth value of its operand:
  - **3 > 4** is **False**, so **not (3 > 4)** is **True**
  - if **x < y** is **True**, then **not (x < y)** is **False**
  - if **x < y** is **True**, then **not (x >= y)** is **True**
- Note the opposites:
  - The opposite of **==** is **!=**
  - The opposite of **<** is **>=**
  - The opposite of **>** is **<=**
- So if **x < 5** is **False**, then **not (x < 5)** is **True** and **x >= 5** is **True**

# Boolean Operators: Logical

+

- The logical operators are **not**, **and**, and **or**
- **and** is **True** only when both of its operands are **True**:
  - $3 < 5$  and  $5 \geq 4$  are both **True**, so  $(3 < 5)$  **and**  $(5 \geq 4)$  is **True**
  - $3 < 5$  is **True** but  $5 < 4$  is **False**, so  $(3 < 5)$  **and**  $(5 < 4)$  is **False**
- **or** is **True** when at least one of the operands is **True**:
  - $3 < 5$  and  $5 \geq 4$  are both **True**, so  $(3 < 5)$  **or**  $(5 \geq 4)$  is **True**
  - $3 < 5$  is **True** and  $5 < 4$  is **False**, but  $(3 < 5)$  **or**  $(5 < 4)$  is **True**
  - $3 > 5$  is **False** and  $5 < 4$  is **False**, so  $(3 > 5)$  **or**  $(5 < 4)$  is **False**
- Short circuiting evaluation: operands are evaluated from left to right, so
  - for **and**, if the left operand is **False**, the right operand is never evaluated
  - for **or**, if the left operand is **True**, the right operand is never evaluated



# Boolean Operators: Logical

+



- Given short circuiting, what will this code print to the screen?

```
def main():  
    print(True or 'Hello')  
    print(False or 'Hello')  
    print(True and 'Hello')  
    print(False and 'Hello')
```

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



# Boolean Operators: Logical

- Given short circuiting, what will this code print to the screen?

```
def main():  
    print(True or 'Hello')           # True  
    print(False or 'Hello')          # Hello  
    print(True and 'Hello')          # Hello  
    print(False and 'Hello')         # False
```

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

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**Any Questions?**






# Operator Precedence



From highest to lowest:

- Parentheses
  - Arithmetic operators:
    - Exponentiation
    - Unary negation
    - Multiplication, division, integer division, modulus
    - Addition, subtraction
  - Comparison operators: equals, less than, etc, all identical in precedence
  - Logical not
  - Logical and, or
- 

# Operator Precedence

- Use parentheses rather than relying on implicit precedence
  - $x + (y / z)$  is clearer than  $x + y / z$ , even though they are equivalent
- Watch out for the higher precedence of logical **not**!
- If **x** and **y** are both **False**, what is the value of:
  - **not** **x** **and** **y**
  - **not** (**x** **and** **y**)
  - **not** **x** **or** **y**
  - **not** (**x** **or** **y**)

# Operator Precedence

+

- Use parentheses rather than relying on implicit precedence
  - $x + (y / z)$  is clearer than  $x + y / z$ , even though they are equivalent
- Watch out for the higher precedence of logical **not**!
- If **x** and **y** are both **False**, what is the value of:
  - **not** **x** **and** **y**                   # *(not False) and False*   **False**
  - **not** (**x** **and** **y**)               # *not (False and False)*   **True**
  - **not** **x** **or** **y**                   # *(not False) or False*   **True**
  - **not** (**x** **or** **y**)               # *not (False or False)*   **True**

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**Any Questions?**



# Lecture Review: Control Flow

# Flashback to Week 2 ...



# Control Flow Overview





- **while** loop: Continuously performs a block of code until a given boolean expression (aka the loop condition) is evaluated to **False**
- **if** statement: Performs a block of code only when a boolean expression (aka the **if** condition) is **True**, and only once
- **if-else** statement: Performs a block of code when a boolean expression is **True**, or a different block (aka the **else** condition) when the expression is **False**. Either block is performed only once
- **if-elif-else** statement: Performs one of three or more blocks of code depending on which boolean expression is **True**. Only one block of code is performed, and only once
- **for** loop: Performs some block of code a specific number of times



# while Loop




- The **while** loop is governed by a boolean expression
  - If the expression evaluates to **False**, the loop is never entered and any code inside the loop is ignored
  - If the expression evaluates to **True**, the loop is entered and the block of code inside it is executed
  - At the end of the code block, the boolean is re-evaluated. If the expression is still **True**, then the loop is re-entered.
  - This continues until the boolean evaluates to **False**.
  - This loop is also called an *indefinite loop* because it will run until the associated condition becomes **False**.
- 
- 




# while Loop




- Beware of infinite loops, where the boolean will never be False!
  - Something inside the loop body must eventually alter the loop condition.
  - The following code fragment is intended to allow employee lookups based on employee ID numbers. The user enters employee ID numbers one after another, entering '-1' when all lookups are done:
- 

```
employee_id = input("Enter employee ID number: ")  
while int(employee_id) != -1 :  
    # Some code here to process employee in some way  
    next_id = input("Enter employee ID number: ")
```




# while Loop




- Beware of infinite loops, where the boolean will never be False!
  - Something inside the loop body must eventually alter the loop condition.
  - The following code fragment is intended to allow employee lookups based on employee ID numbers. The user enters employee ID numbers one after another, entering '-1' when all lookups are done:
- 

```
employee_id = input("Enter employee ID number: ")  
while int(employee_id) != -1 :  
    # Some code here to process employee in some way  
    employee_id = input("Enter employee ID number: ")
```



# while Loop



- In this example, the loop continues until the user enters -1.
  - This value is called a sentinel, as it guards against the loop going on forever by signalling that the loop should terminate
  - Sentinels are often declared as constants
- 

```
SENTINEL = -1
```

```
def main():
```

```
    employee_id = input("Enter employee ID number: ")
```

```
    while int(employee_id) != SENTINEL :
```

```
        # Some code here to process employee in some way
```

```
        employee_id = input("Enter employee ID number: ")
```



# Any Questions?



# if-elif-else Statement



- The **if-elif-else** construction allows us to check multiple conditions
- For example, to determine whether a given year is a leap year:

```
if year % 4 :  
    is_leap = False  
elif (year % 100 == 0) and (year % 400) :  
    is_leap = False  
else :  
    is_leap = True
```

- Note: **if year % 4** is equivalent to **if (year % 4) != 0**
- 

# if-elif-else Statement

- What is wrong with this code?

```
x = 5
y = 12
if x = y:
    print("They're equal")
elif x < y:
    print("x is smaller!")
else:
    print("y is smaller!")
```

# if-elif-else Statement

- What is wrong with this code?

```
x = 5
y = 12
if x == y:
    print("They're equal")
elif x < y:
    print("x is smaller!")
else:
    print("y is smaller!")
```


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**Any Questions?**





# for Loop

- The **for** loop performs its block of code a specified number of times
  - It is controlled by a loop variable, usually **i** (for index)
  - **i** is often specified as a **range**
  - Syntax: **for i in range(start, stop, step)**
    - Default start is 0
    - A specified stop is always required
    - Default step is 1; if a different one is needed, must specify start too
  - **i** enters the **for** loop with value 0 or the specified start, increments by 1 or the specified step, and terminates the loop when **i == stop**
  - Note that the loop does not execute when **i** has the value of **stop**.
- 




# for Loop

- Example: First 10 odd numbers

```
for i in range(1, 21, 2):  
    print(i)
```



- Example: Countdown

```
for i in range(10, 0, -1):  
    print(i)  
print("Blast off!")
```



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**Any Questions?**



# Section problem: Dog Year Calculator

<https://codeinplace.stanford.edu/cs49-w24/ide/a/dogyearssection>






# Dog Year Calculator

- One dog year is the equivalent of seven human years. Write a Python program that prompts the user to enter an age in human years. Output the equivalent age in dog years:

**Enter an age in human years: 12**

**The age in dog years is 84**

- Check that the user enters a positive integer
  - Continue prompting for a human age until the user enters zero
  - What constants should we use?
  - As what type should the input from the user be cast?
- 

# Dog Year Calculator

Here is an example of what one run of your program should look like (user input is *italicized*):

Enter an age in human years: *-12*

Sorry, please enter a positive number or 0 to exit

Enter an age in human years: *13*

The age in dog years is 91

Enter an age in human years: *0*



# Section problem: Finding Factors

<https://codeinplace.stanford.edu/cs49-w24/ide/a/findingfactors>



# Finding Factors

- Ask the user to enter an integer
- Check that the number is greater than zero
- Print all the factors of the given number one by one
- Ask for another number and repeat until the user enters zero
- What constant should we use?
- How do we obtain the factors?

Here is an example of what one run of your program should look like (user input is *italicized*):

```
Your number: -10
Please input a positive number
Your number: 42
1
2
3
6
7
14
21
42
Your number: 53
1
53
Your number: 0
```



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# That's all, folks!

Next up: Graphics!