CL04 - Boolean Operators and Conditional Control Flow

Announcements

Re: Quiz 00

- Median grade was 90% – great job!!
- Graded quizzes available on Gradescope
  - *Please review what you missed ASAP*; we will build on the topics covered in Quiz 00 throughout the course, and these foundational concepts are vital!
  - Don't understand a particular question/part of a memory diagram? Please come see us in Office Hours! Full list of hours on the site's support page
- *Regrade requests will be open till Thursday at 11:59pm*. Please submit a regrade request if you believe your quiz was not graded correctly according to the rubric

LS05 and LS06 (multiple choice questions) – due tonight at 11:59pm

EX01 – Tea Party Planner – due Saturday, May 24th at 11:59pm

Note: only boxed rubric items with check marks were applied to your quiz

Question 5

(no title) 4 / 4.5 pts

Output

✔ + 1 pt Output is `5.0` with no quotes OR the RV for the `crunch` function call frame

– 0.5 pts Extra lines of output in addition to `5.0` OR the RV for the `crunch` function call frame. (Only select if student got points for Q)

Stack: Globals

✔ + 0.5 pts `crunch`'s `id` reference bound to a `fn lines 3-5` in the heap (e.g. `id:0`)

+ 0.5 pts `measure`'s `id` reference bound to a `fn lines 8-10` in the heap (e.g. `id:1`)

Stack: `crunch` function call frame

✔ + 0.5 pts Frame is labeled "crunch" and has its own defined box/separation from the rest of the stack

✔ + 0.5 pts RA of `13`

✔ + 0.5 pts RV of `5.0` (written as a float)

✔ + 0.5 pts a has a value of `6`

✔ + 0.5 pts b has a value of `9`

– 0.5 pts Extraneous frames on Stack (e.g. `measure` frame, or more than one `crunch` frame)

+ 0 pts Incorrect or blank

Warm-up Questions

Given these two function definitions, reason through the questions below with your neighbors!

```
"""Warmup question"""


def is_21(age: int) -> bool:
    """Return whether age is at least 21."""
    print("in is_21's function body")
    return age == 21 or age > 21


def birthday(age: int) -> int:
    """Increases age by 1."""
    print("in birthday's function body")
    return age + 1
```

1. Which expression is valid, based on parameter and return type declarations?
   - **a.** `is_21(age=birthday(age=21))`
   - **b.** `birthday(age=is_21(age=21))`
2. For the selected expression above, which function call expression evaluates first?
   a. Inner-most function call based on parentheses
   b. Outer-most function call based on parentheses
   c. First function call encountered, reading from left to right, ignoring parentheses

3. What is the *printed output* of evaluating the following? `is_21(age=21)`
4. What is the *returned value* of evaluating the following? `is_21(age=21)`

Relational Operators (Review)

These operators are placed between expressions of the same type* to compare them.
Relational operators evaluate to *boolean values*.

Operator Symbol	Verbalization	`True` Ex.	`False` Ex.
`==`	Is equal to?	`1 == 1`	`1 == 2`
`!=`	Is NOT equal to?	`1 != 2`	`1 != 1`
`>`	Is greater than?	`1 > 0`	`0 > 1`
`>=`	Is at least?	`1 >= 0` or `1 >= 1`	`0 >= 1`
`<`	Is less than?	`0 < 1`	`1 < 0`
`<=`	Is at most?	`0 <= 1` or `1 <= 1`	`1 <= 0`

*Comparisons between int and float values will automatically convert (“type coerce”) the ints to floats.

Relational Operator Practice

1. 1 + 2 < 3 + 4

Which operator must have higher precedence? < or +?

2. 110.0 != 110

3. “UNC” == “Unc”

4. “UNC” > “DUKE”

Be careful using relational operators to compare strings!

- Python is a case-sensitive programming language (e.g., “U” != “u”)
- Every character has a numerical (“ASCII”) value associated with it. Strings are compared based on each character of the string’s ASCII values, in order

(Read an explanation here.)

Reasoning through the logical `or` operator

Recall the warm-up question…

```
4   def is_21(age: int) -> bool:
5       """Return whether age is at least 21."""
6       print("in is_21's function body")
7       return age == 21 or age > 21
```

`is_21` returns `True` if age is at least 21, and `False` otherwise. How must the `or` operator work?

How could we rewrite line 7 to simplify it using a different relational operator?

Expression	Evaluated Result
False **or** False	
True **or** False	
False **or** True	
True **or** True	

Reasoning through the logical `and` operator

Consider the function…

```
16    def can_enter(age: int, has_id: bool) -> bool:
17        """Can you enter the 21+ event?"""
18        return age >= 21 and has_id
```

`can_enter` returns `True` if `age` is at least 21 and `has_id` is `True`, and `False` otherwise. How does the `and` operator work?

Expression	Evaluated Result
False **and** False	
True **and** False	
False **and** True	
True **and** True	

What must have higher precedence:
>= (relational operator), or
and (logical/boolean operator)?

Reasoning through the logical `not` operator

Consider the function…

```
21    def can_eat(temp: int, allergic: bool) -> bool:
22        """Is it safe to eat this food?"""
23        return temp >= 165 and not allergic
```

`can_eat` returns **`True`** if **`temp`** is at least 165 and **`allergic`** is **`False`**, and **`False`** otherwise. How does the **`not`** operator work?

Expression	Evaluated Result
not False	
not True	

For this to be sensible, what must be the precedence of **`not`**, **`and`**, and **`or`**?

Logical / Boolean Operators

Expression	Evaluation
False **or** False	**False**
True **or** False	**True**
False **or** True	**True**
True **or** True	**True**

Expression	Evaluation
False **and** False	**False**
True **and** False	**False**
False **and** True	**False**
True **and** True	**True**

Expression	Evaluation
not False	**True**
not True	**False**

Precedence (highest to lowest):

0. Arithmetic operators (PEMDAS)
1. Relational Operators
2. Not
3. And
4. Or

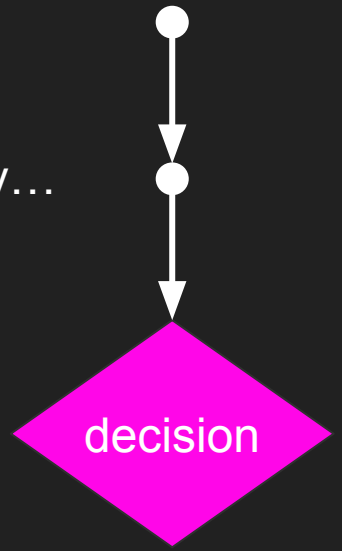
Conditionals

Control flow is *linear*

Going about your day…

Control flow is *linear*

Going about your day…

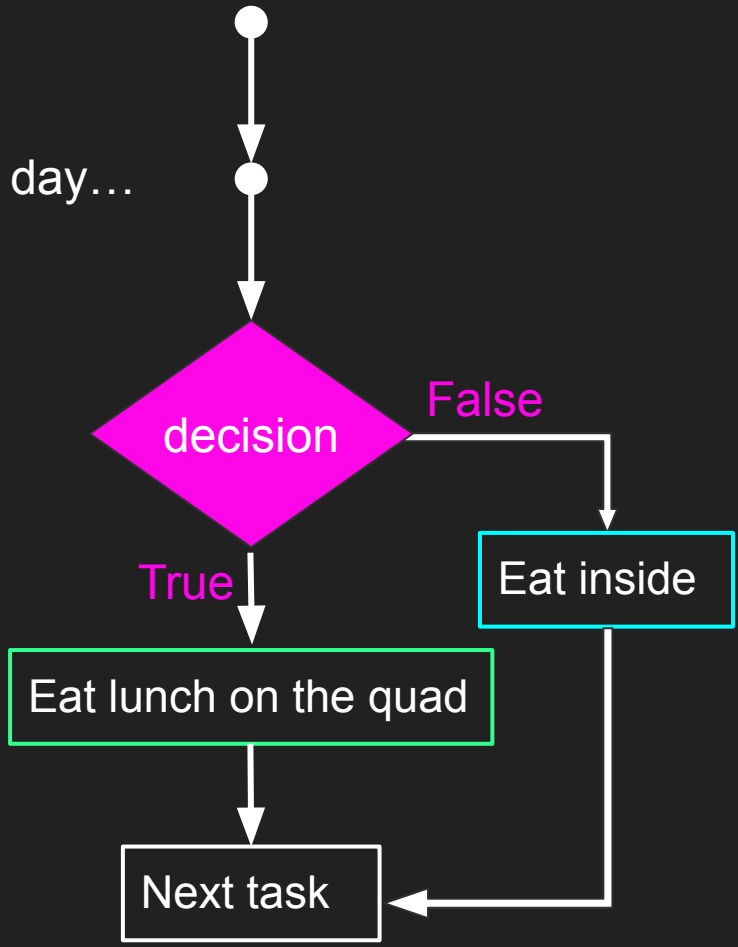


Is the weather nice?

Control flow is *linear*

Going about your day…

Is the weather nice?



If-then / *Conditional* Statements

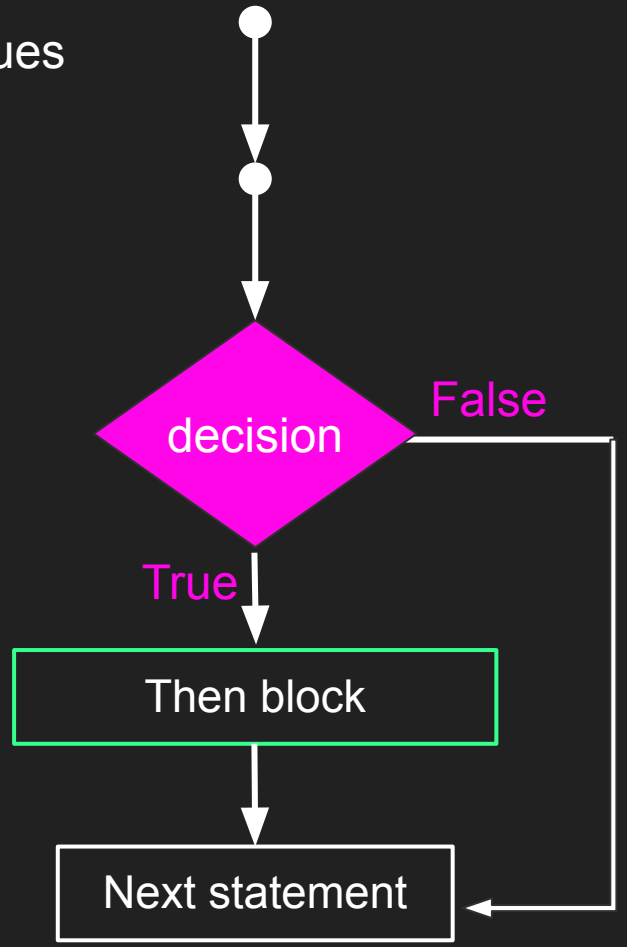
Code that behaves conditionally based on input values

if <condition>: ← bool

    <then, execute these statements>

<rest of program>

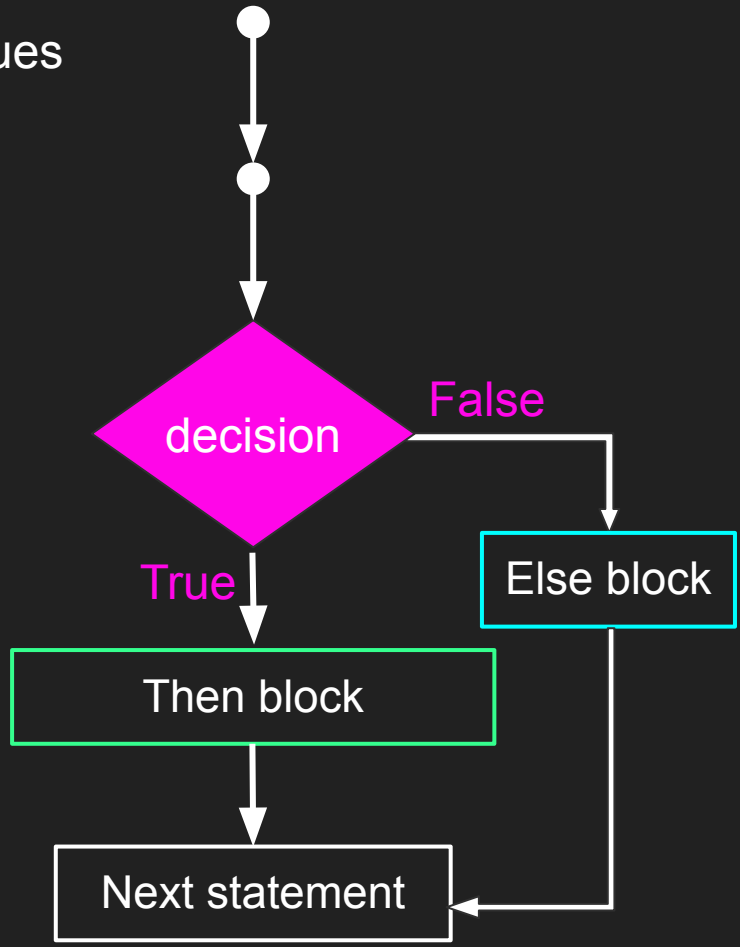
```
def weather_info(temperature: int) -> None:
    """Function to make sense of the weather."""
    if temperature < 65:
        print("Don't forget a jacket!")
    print("Moving on...")
```



If-then-else / *Conditional* Statements

Code that behaves conditionally based on input values

```
if <condition>:
    <then, execute these statements>
else:
    <execute these other statements>
<rest of program>
```



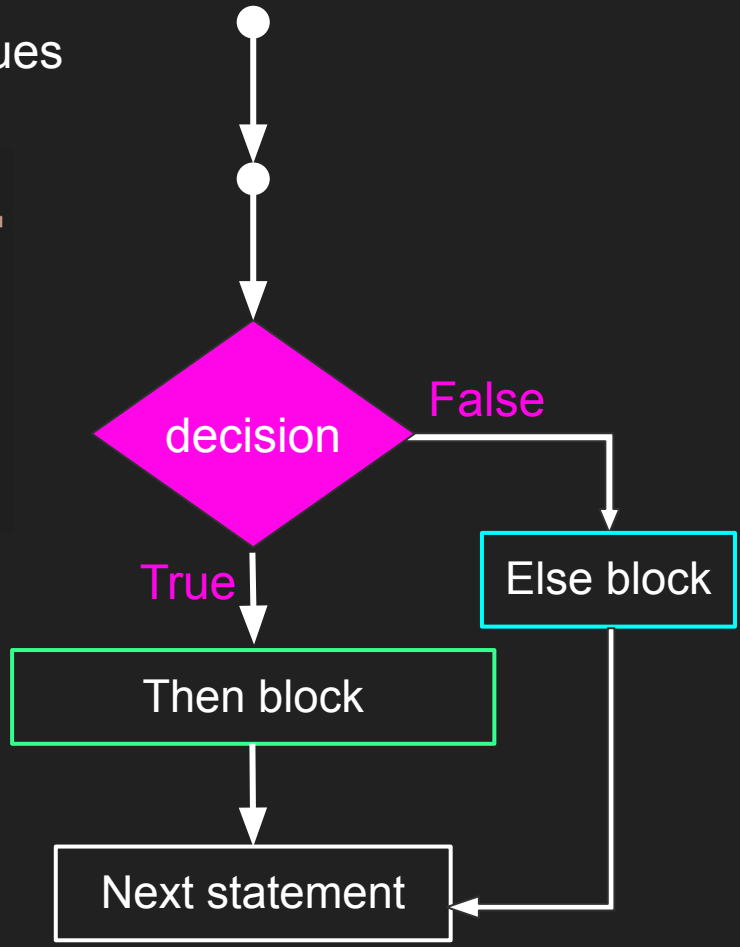
If-then-else / *Conditional* Statements

Code that behaves conditionally based on input values

```
4   def weather_info(temperature: int) -> None:
5       """Function to make sense of the weather."""
6       if temperature < 65:
7           print("Don't forget a jacket!")
8       else:
9           print("That's a comfortable temp!")
10      print("Moving on...")
```

Determine which lines would execute as a result of this function call: **`weather_info(temperature=63)`**

And this one:
`weather_info(temperature=75)`

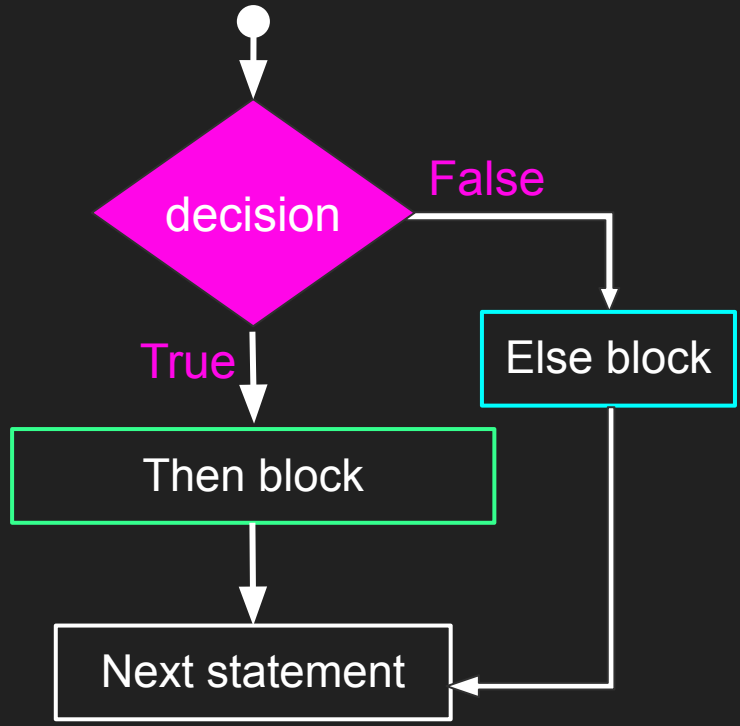


General syntax and semantics

```
if <condition>:
    <then block>
else:
    <else block>
<rest of program>
```

Semantics:

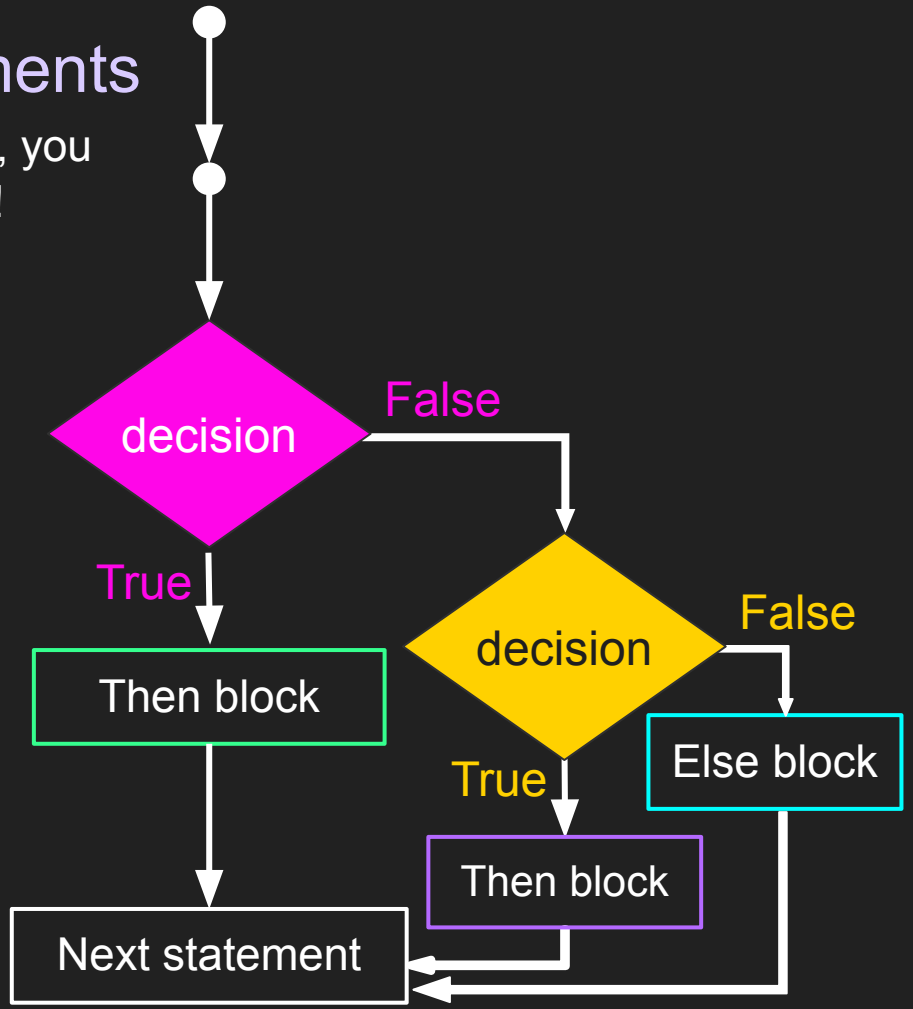
1. When evaluation reaches an **if statement**, the **boolean test expression** is evaluated.
2. If the expression evaluates to `True`, control continues into the **then statement block**. If the then statement block completes without a return, control continues by moving on to the next statement after the if statement.
3. Otherwise, if the test expression evaluates to `False`, control *jumps over the then block* and continues to the next line, whether it is an **else statement block** (if there is one) or the next statement in the program.



If-elif-else / *Conditional* Statements

If you want to test multiple different conditions, you can use one or more “else if” (elif) statements!

```
if <condition>:
    <then, execute these statements>
elif <different condition>:
    <then, execute these statements>
else:
    <execute these other statements>
<rest of program>
```



```python
"""Examples of conditionals."""


def number_report(x: int) -> None:
    """Print some numerical properties of x"""
    if x % 2 == 0:
        print("Even")
    else:
        print("Odd")

    if x % 3 == 0:
        print("Divisible by 3")

    if x == 0:
        print("Zero")
    else:
        if x > 0:
            print("Positive")
        else:
            print("Negative")

    print("x is " + str(x))


number_report(x=110)
```

Practice

Write a function called check_first_letter that takes a input two strs: word and letter

It should return “match!” if the first character of word is letter

Otherwise, it should return “no match!”

Examples:

- check_first_letter(word=”happy”, letter=”h”) would return “match!”
- check_first_letter(word=”happy”, letter=”s”) would return “no match!”

```python
"""Calling to and fro..."""


def ping(i: int) -> int:
    print("ping: " + str(i))
    if i <= 0:
        return i
    else:
        return pong(i=i - 1)


def pong(i: int) -> int:
    print("pong: " + str(i))
    return ping(i=i - 1)


print(ping(i=2))
```

```python
"""Mysterious 'rev' from source (src) to destination (dest)!"""


def rev(src: str, i: int, dest: str) -> str:
    """You happen upon a magical lil function..."""
    if i >= len(src):
        return dest
    else:
        return rev(src=src, i=i + 1, dest=src[i] + dest)


print(rev(src="lwo", i=0, dest=""))
```