

Introduction to Python

Conditionals

Topics

- 1) Comparison Operators
- 2) Boolean Operations(and, or not)
- 3) Operator Precedence
- 4) Conditionals
 - a) if, if-if, if-elif, if-elif-else
 - b) Ternary operator

Comparison Operators

| Operation | Description |
|------------------------|------------------------------|
| <code>a == b</code> | a equal to b |
| <code>a != b</code> | a not equal to b |
| <code>a < b</code> | a less than b |
| <code>a > b</code> | a greater than b |
| <code>a <= b</code> | a less than or equal to b |
| <code>a >= b</code> | a greater than or equal to b |

Note that `=` is for assignment and `==` is for equals.

These operators return either `True` or `False`.

Comparison Operators

```
a = (10 == 5)    # False
```

```
print(a)         # False
```

```
print(3 <= 7)    # True
```

```
print(3 != 7)    # True
```

```
x = 1
```

```
b = (x > 10)     # False
```

```
print(b)         # False
```

Boolean Operations

Python provides operators to combine the values using the standard concepts of “**and**”, “**or**”, and “**not**”.

These operators are expressed using the words and, or, and not:

| X | Y | X or Y |
|-------|-------|--------|
| True | True | True |
| True | False | True |
| False | True | True |
| False | False | False |

| X | Y | X and Y |
|-------|-------|---------|
| True | True | True |
| True | False | False |
| False | True | False |
| False | False | False |

| X | not X |
|-------|-------|
| True | False |
| False | True |

Or above is "inclusive or".

Boolean Operations

```
x = 4
print((x < 6) and (x > 2))    # True
a = (x > 10) or (x % 2 == 0)
print(a)                      # True

b = not (x < 6)
print(b)                      # False
print(True or False)         # True
print(True and False)        # False
```

Operator Precedence

| Precedence | Operator | Operation |
|------------|----------------------|---------------------------------------------------|
| highest | ** | exponentiation |
| | - | negation |
| | *, /, //, % | multiplication, division, floor division, modulus |
| | +, - | adding, subtraction |
| | ==, !=, <, >, <=, >= | comparisons |
| | not | logical not |
| | and | logical and |
| | or | logical or |
| lowest | = | assignment |

Boolean Operations

Math operators have the highest precedence. Then comparison operators are followed by logical operators. The assignment operator is evaluated last.

```
In[1]: result = 3 + 2 * 4 < 14 or 3 == 5  
      result
```

```
Out[1]: True
```


Conditionals

The reserved word **if** begins an conditional block.

```
if condition:  
    block
```

The condition determines if the block is to be executed.

A block contains one or more statements.

The statements inside of a block must be indented the same number of spaces from the left. The standard is 4 spaces.

If block

What's the output?

```
x = -5
if x > 0:
    print(x)
    print("x is positive")
    print("outside of block")
```

outside of block

If block

What's the output?

```
x = 5
if x > 0:
    print(x)
    print("x is positive")
print("outside of block")
```

5

x is positive

outside of block

Sequence of Ifs

A sequence of consecutive if statements are independent. None, some or all of them can be executed.

```
x = 4
if x % 2 == 0:
    print("x is even")
if x > 0:
    print("x is positive")
```

x is even

x is positive

Sequence of ifs

```
x = -8
if x % 2 == 0:
    print("x is even")
if x > 0:
    print("x is positive")
```

x is even

if-elif

An if block followed by a sequence of elif blocks will execute the **first** block whose condition evaluates to True. No block is executed if all conditions evaluate to False.

```
x = 25
if x < 5:
    print("x is less than 5")
elif x < 10:
    print("x is less than 10")
elif x < 15:
    print("x is less than 15")
```

Note that all of the above conditions are false and thus no block is executed.

if-elif

```
x = 7
if x < 5:
    print("x is less than 5")
elif x < 10:
    print("x is less than 10")
elif x < 15:
    print("x is less than 15")
```

x is less than 10

Note that only the middle elif block is executed!

if-elif

```
x = 1
if x < 5:
    print("x is less than 5")
elif x < 10:
    print("x is less than 10")
elif x < 15:
    print("x is less than 15")
```

x is less than 5

Note that only the first if block is executed, even though all three conditions are true.

if-elif-else

An `if` statement followed by a sequence of `elif` statements and ending in an `else` statement will execute the first block whose condition evaluates to `True`. If all conditions evaluate to `False`, it will execute the default `else` block.

```
x = 0
if x < 0:
    print("x is negative")
elif x > 0:
    print("x is positive")
else:
    print("x is zero")
x is zero
```

if-elif-else

```
x = 10
```

```
if x < 0:
```

```
    print("x is negative")
```

```
elif x > 0:
```

```
    print("x is positive")
```

```
else:
```

```
    print("x is zero")
```

x is positive

and, or, not

Use *and*, *or*, and *not* Boolean operators to simplify conditionals.

The following

```
if x > 0:  
    if x < 10:  
        print(x)
```

is equivalent to

```
if x > 0 and x < 10:  
    print(x)
```

```
if 0 < x < 10:  
    print(x)
```

and, or, not

The following code prints the quadrant of an ordered (x,y) on the Cartesian plane.

```
x = 4
y = 7
if (x > 0) and (y > 0):
    print("first quadrant.")
elif (x < 0) and (y > 0):
    print("second quadrant.")
elif (x < 0) and (y < 0):
    print("third quadrant.")
elif (x > 0) and (y < 0):
    print("fourth quadrant.")
else:
    print("on x or y axis.")
```

Output:
first quadrant

and, or, not

The following code prints the quadrant of an ordered (x,y) on the Cartesian plane.

```
x = -26
y = -31
if (x > 0) and (y > 0):
    print("first quadrant.")
elif (x < 0) and (y > 0):
    print("second quadrant.")
elif (x < 0) and (y < 0):
    print("third quadrant.")
elif (x > 0) and (y < 0):
    print("fourth quadrant.")
else:
    print("on x or y axis.")
```

Output:
third quadrant

Ternary Operators

A *ternary operator* evaluates an expression based on the value of a boolean condition. This is sometimes called *conditional expression* or an *inline if-else* statement.

```
x = 50  
grade = "pass" if x >= 60 else "fail"  
print(grade)
```

fail

Ternary Operators

```
x = 60
```

```
grade = "pass" if x >= 60 else "fail"
```

```
print(grade)
```

```
pass
```

Example 1

Write a segment of code which asks the user to enter a number and prints out whether the number is even.

```
x = int(input('Enter an integer: '))  
if x % 2 == 0:  
    print("x is even")  
else:  
    print("x is odd")
```


Example 2: FizzBuzz

Write a segment of code which asks the user to enter a number. Print "fizz" if the number is a multiple of 3, "buzz" if it is a multiple of 5 and "fizzbuzz" if it is a multiple of both 3 and 5. In all other cases, print the number.

```
x = int(input('Enter an integer: '))  
  
if x % 3 == 0:  
    print("fizz")  
  
elif x % 5 == 0:  
    print("buzz")  
  
elif x % 3 == 0 and x % 5 == 0:  
    print("fizzbuzz")  
  
else:  
    print(x)
```

Does the code work?

No, if $x = 15$, it incorrectly prints "fizz".

Example 2: FizzBuzz

Write a segment of code which asks the user to enter a number. Print "fizz" if the number is a multiple of 3, "buzz" if it is a multiple of 5 and "fizzbuzz" if it is a multiple of both 3 and 5. In all other cases, print the number.

```
x = int(input('Enter an integer: '))
```

```
if x % 3 == 0 and x % 5 == 0:
```

```
    print("fizzbuzz")
```

```
elif x % 3 == 0:
```

```
    print("fizz")
```

```
elif x % 5 == 0:
```

```
    print("buzz")
```

```
else:
```

```
    print(x)
```

Correct!

Example 2: FizzBuzz

Does the following code work?

```
x = int(input('Enter an integer: '))
answer = ""
if x % 3 == 0:
    answer += "fizz"
if x % 5 == 0:
    answer += "buzz"
if answer == "":
    answer += str(x)
print(answer)
```

Yes! Compare this to the previous slide.

Lab 1: Absolute Value

Create a new repl on repl.it. If you wish, you can use this same repl for all of the labs in this lecture.

Write a program which asks for an integer and prints out the absolute value of the number.

Example output 1:

Enter a number: 34

Absolute value of 34 is 34.

Example output 2:

Enter a number: -11

Absolute value of -11 is 11.

Lab 2: Quadratic

Create a new repl on repl.it. Write a program which asks for the coefficients of the quadratic $f(x) = ax^2 + bx + c$ and prints out the number of real roots of $f(x)$.

Enter a: 1

Enter b: -2

Enter c: -15

Two real roots.

Enter a: 1

Enter b: 0

Enter c: 1

No real roots.

Enter a: 1

Enter b: -2

Enter c: 1

One repeated real root.

References

- 1) Vanderplas, Jake, A Whirlwind Tour of Python, O'reilly Media.
- 2) Richard Halterman, Fundamental of Python Programming.