Introduction to Python

Conditionals

Topics

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

Comparison Operators

Operation	Description
a == b	a equal to b
a != b	a not equal to b
a < b	a less than b
a > b	a greater than b
a <= b	a less than or equal to b
a >= b	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)     # value of a is False
print(a)          # False is printed
print(3 <= 7)     # True
print(3 != 7)     # True
x = 1
b = (x > 10)      # value of b is 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

Note: The above Or is also know as the "inclusive or". The conversational "or" may sometime be used as the "exclusive or"(one or the other but not both).

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.

```
result = 3 + 2 * 4 < 14 or 3 == 5
print(result)          # True
```

Although the above expression is correct, often for the sake of readability, and clarity it is often good practice to include parenthesis.

```
result = (3 + 2 * 4 < 14) or (3 == 5)
print(result)          # True
```

Conditionals

Selection determines which parts of an algorithm are executed based on a condition being true or false.

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

Note: Since the conditional is false, the entire block is skipped. The print statement outside the block, however, is executed.

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

Note:The above conditional block is executed.

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

Note: Both of the above blocks are executed.

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

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

Here's the correct way to implement FizzBuzz.

```
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)
```

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.

AP Exam

The AP exam only uses two types of if blocks:

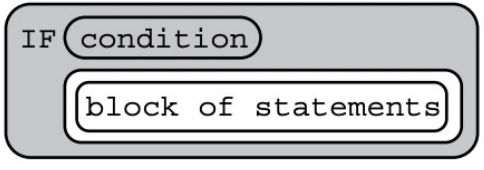
1) If
2) If – Else

To cover more complex logic, nesting of conditionals are used.

Text:

```
IF(condition)
{
 <block of statements>
}
```

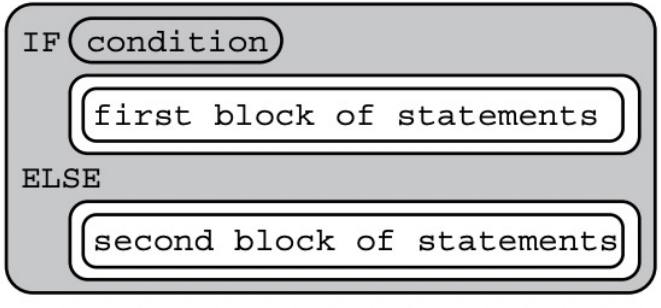
Block:



Text:

```
IF(condition)
{
 <first block of statements>
}
ELSE
{
 <second block of statements>
}
```

Block:



Example

Write a program that asks the user to enter their gpa. Print out "With Distinction" if the gpa is at least 3.8 and "With Honor" if it's between 3.3 and 3.8(not including end points) and "No distinction" otherwise.

Since the AP exam only uses if, and if-else. DO NOT use elif in the code.

```
gpa = float(input('Enter gpa: '))
if gpa >= 3.8:
    print("With Distinction")
else:
      if gpa > 3.3:
            print("With Honor")
      else:
            print("No distinction")
```

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).

Hint: Compute the discriminant b^2 – 4ac. If the discriminant is > 0, it has two real roots. If it is < 0 , it has no real roots and if it is = 0, it has one repeated root.

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.