

BRANCHING, ITERATION

(download slides and .py files ••• follow along!)

6.0001 LECTURE 2

LAST TIME

- syntax and semantics
- scalar objects
- simple operations
- expressions, variables and values

TODAY

- string object type
- branching and conditionals
- indentation
- iteration and loops

STRINGS

- letters, special characters, spaces, digits
- enclose in **quotation marks or single quotes**

```
hi = "hello there"
```

- **concatenate** strings

```
name = "ana"
```

```
greet = hi + name
```

```
greeting = hi + " " + name
```

space

- do some **operations** on a string as defined in Python docs

```
silly = hi + " " + name * 3
```

INPUT/OUTPUT: `print`

- used to **output** stuff to console
- keyword is `print`

define

```
x = 1
```

```
print(x)
```

```
x_str = str(x)
```

```
print("my fav num is", x, ".", str "x =", int, 1 (x))
```

```
print("my fav num is " + x_str + ". " + "x = " + x_str)
```

INPUT/OUTPUT: `input ("")`

- prints whatever is in the quotes
- user types in something and hits enter
- binds that value to a variable

on
string

```
( text = input("Type anything... ")  
  print(5*text)
```

if) input : hi

⇒ hihihihihi

string

- `input` **gives you a string** so must cast if working with numbers

on
int

```
( num = int(input("Type a number... "))  
  print(5*num)
```

if) input : 5

⇒ 5 x 5 = 25

int

COMPARISON OPERATORS ON `int, float, string`

- `i` and `j` are variable names
- comparisons below evaluate to a Boolean

`i > j`

`i >= j`

`i < j`

`i <= j`

`i == j` → **equality** test, `True` if `i` is the same as `j`

`i != j` → **inequality** test, `True` if `i` not the same as `j`

LOGIC OPERATORS ON bools

- `a` and `b` are variable names (with Boolean values)

`not a` \rightarrow True if `a` is False
 False if `a` is True

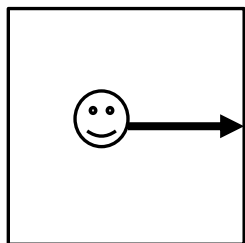
`a and b` \rightarrow True if both are True

`a or b` \rightarrow True if either or both are True

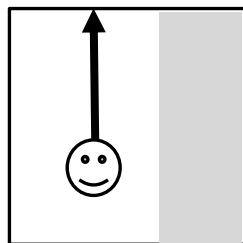
A	B	A and B	A or B
True	True	True	True
True	False	False	True
False	True	False	True
False	False	False	False

COMPARISON EXAMPLE

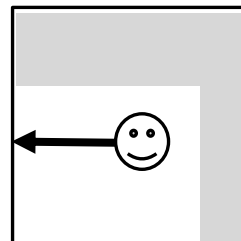
```
pset_time = 15  
sleep_time = 8  
print(sleep_time > pset_time)  
derive = True  
drink = False  
both = drink and derive  
print(both)
```



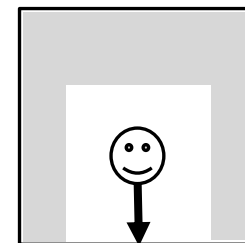
If right clear,
go right



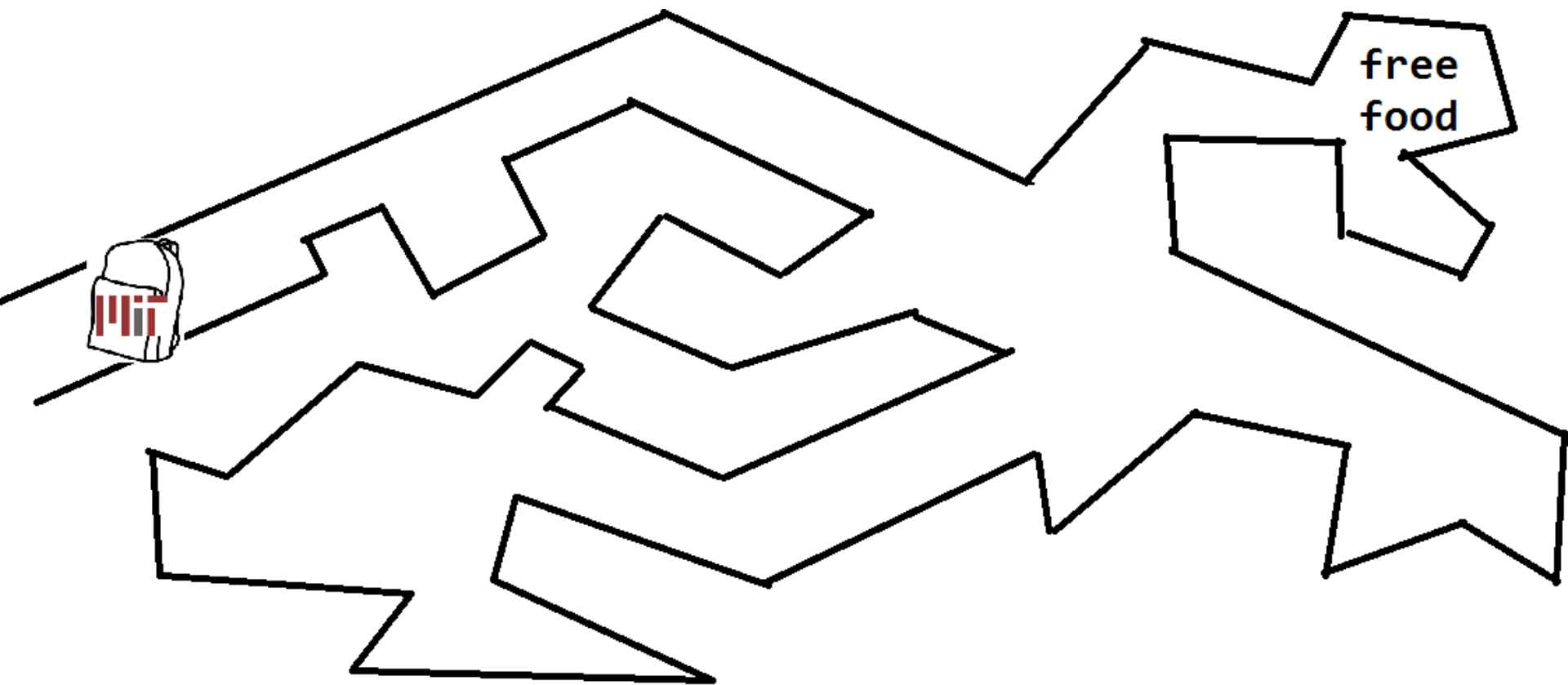
If right blocked,
go forward



If right and
front blocked,
go left



If right , front,
left blocked,
go back



CONTROL FLOW - BRANCHING

```
if <condition>:  
    <expression>  
    <expression>  
    ...
```

```
if <condition>:  
    <expression>  
    <expression>  
    ...
```

```
else:  
    <expression>  
    <expression>  
    ...
```

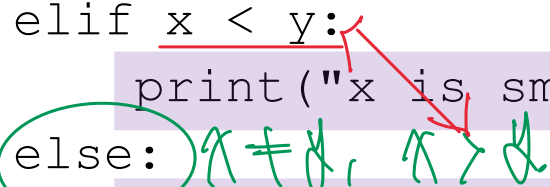
```
if <condition>:  
    <expression>  
    <expression>  
    ...  
elif <condition>:  
    <expression>  
    <expression>  
    ...  
else:  
    <expression>  
    <expression>  
    ...
```

- `<condition>` has a value `True` or `False`
- evaluate expressions in that block if `<condition>` is `True`

INDENTATION

- matters in Python
- how you denote blocks of code

```
x = float(input("Enter a number for x: "))
y = float(input("Enter a number for y: "))
if x == y:
    print("x and y are equal")
    if y != 0:
        print("therefore, x / y is", x/y)
elif x < y:
    print("x is smaller")
else:
    print("y is smaller")
print("thanks!")
```



= VS ==

```
x = float(input("Enter a number for x: "))
y = float(input("Enter a number for y: "))
if x == y:
    print("x and y are equal")
    if y != 0:
        print("therefore, x / y is", x/y)
elif x < y:
    print("x is smaller")
else:
    print("y is smaller")
print("thanks!")
```

What if $x = y$ here?
get a `SyntaxError`



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- Legend of Zelda – Lost Woods
- keep going right, takes you back to this same screen, stuck in a loop

```
if <exit right>:
```

```
    <set background to woods_background>
```

```
    if <exit right>:
```

```
        <set background to woods_background>
```

```
        if <exit right>:
```

```
            <set background to woods_background>
```

```
            and so on and on and on...
```

```
        else:
```

```
            <set background to exit_background>
```

```
    else:
```

```
        <set background to exit_background>
```

```
else:
```

```
    <set background to exit_background>
```



- Legend of Zelda – Lost Woods
- keep going right, takes you back to this same screen, stuck in a loop

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```
while <exit right>:  
    <set background to woods_background>  
<set background to exit_background>
```

CONTROL FLOW:

while LOOPS

```
while <condition>:  
    <expression>  
    <expression>  
    ...
```

- <condition> evaluates to a Boolean
- if <condition> is True, do all the steps inside the while code block
- check <condition> again
- repeat until <condition> is False

while LOOP EXAMPLE

You are in the Lost Forest.



Go left or right?

PROGRAM:

```
n = input("You're in the Lost Forest. Go left or right? ")
while n == "right":
    n = input("You're in the Lost Forest. Go left or right? ")
print("You got out of the Lost Forest!")
```

CONTROL FLOW:

while and for LOOPS

- iterate through numbers in a sequence

```
# more complicated with while loop
n = 0
while n < 5:
    print(n)
    n = n+1
```

```
# shortcut with for loop
for n in range(5):
    print(n)
```

CONTROL FLOW: `for` LOOPS

```
for <variable> in range(<some_num>):  
    <expression>  
    <expression>  
    ...
```

- each time through the loop, `<variable>` takes a value
- first time, `<variable>` starts at the smallest value
- next time, `<variable>` gets the prev value + 1
- etc.

range(start, stop, step)

- default values are `start = 0` and `step = 1` and optional
- loop until value is `stop - 1`

```
mysum = 0
for i in range(7, 10):
    mysum += i
print(mysum)
```

Handwritten calculation for the first example:

$$\begin{aligned} \text{mysum} &= 0 + 7 \\ // &= 7 + 8 \\ // &= 15 + 9 \end{aligned}$$

⇒ if float: error.

```
mysum = 0
for i in range(5, 11, 2):
    mysum += i
print(mysum)
```


Handwritten calculation for the second example:

⇒ 5, 7, 9, ~~11~~

break STATEMENT

- immediately exits whatever loop it is in
- skips remaining expressions in code block
- exits only innermost loop!

```
while <condition_1>:  
    while <condition_2>:  
        <expression_a>  
        break  
        <expression_b>  
    <expression_c>
```



break STATEMENT

```
mysum = 0
for i in range(5, 11, 2):
    mysum += i
    if mysum == 5:
        break
    mysum += 1
print(mysum)
```

- what happens in this program?

for

VS while LOOPS



for loops

- **know** number of iterations
- can **end early** via `break`
- uses a **counter**
- **can rewrite** a `for` loop using a `while` loop

while loops

- **unbounded** number of iterations
- can **end early** via `break`
- can use a **counter but must initialize** before loop and increment it inside loop
- **may not be able to rewrite** a `while` loop using a `for` loop

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6.0001 Introduction to Computer Science and Programming in Python

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