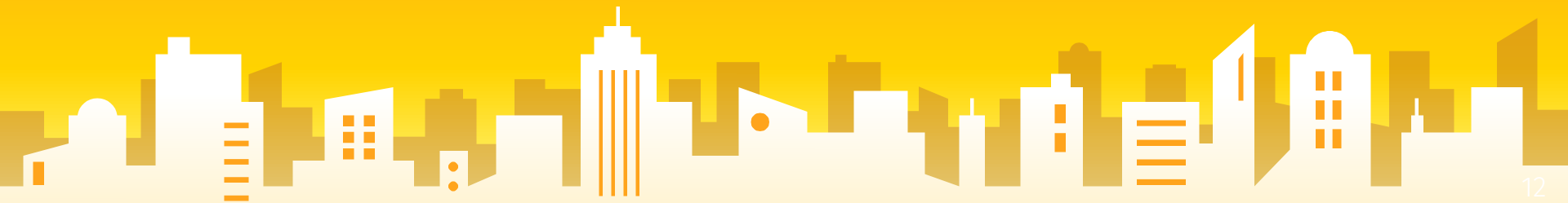
Interactive vs Script

- Interactive Mode
  - You type directly to Python one line at a time and it responds.

- Script Mode
  - You enter a sequence of statements (lines) into a file using a text editor and tell Python to execute the statements in the file.

Variables, Expressions and Statements.

Second Lesson.



Constants

- Fixed values such as numbers, letters, and strings, are called “constants” because their value does not change
- Numeric constants are as you expect
- String constants use single quotes (') or double quotes (")

```
>>> print(123)
123
>>> print(98.6)
98.6
>>> print('Hello world')
Hello world
```

Reserved Words

False	class	return	is		finally
None	if	for	lambda		continue
True	def	from	while		nonlocal
and	del	global	not		with
as	elif	try	or		yield
assert	else	import	pass		
break	except	in	raise		

You cannot use reserved words as variable names / identifiers.

Variables

- A variable is a named place in the memory where a programmer can store data and later retrieve the data using the variable “name”
- Programmers get to choose the names of the variables
- You can change the contents of a variable in a later statement

x = 12.2
y = 14

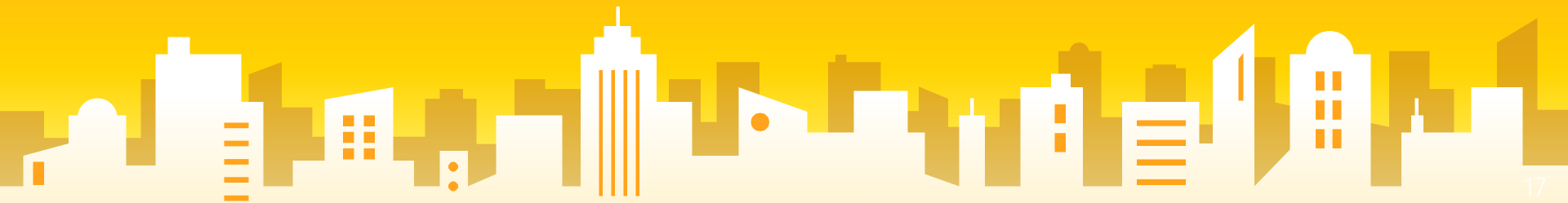
Python Variable Name Rules

- Must start with a letter or underscore _
- Must consist of letters, numbers, and underscores
- Case Sensitive

Good: spam eggs spam23 _speed
Bad: 23spam #sign var.12
Different: spam Spam SPAM

Expressions

Third Lesson.



Numeric Expressions

- Because of the lack of mathematical symbols on computer keyboards - we use “computer-speak” to express the classic math operations
- Asterisk is multiplication
- Exponentiation (raise to a power) looks different than in math

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Power
%	Remainder

Operator Precedence Rules

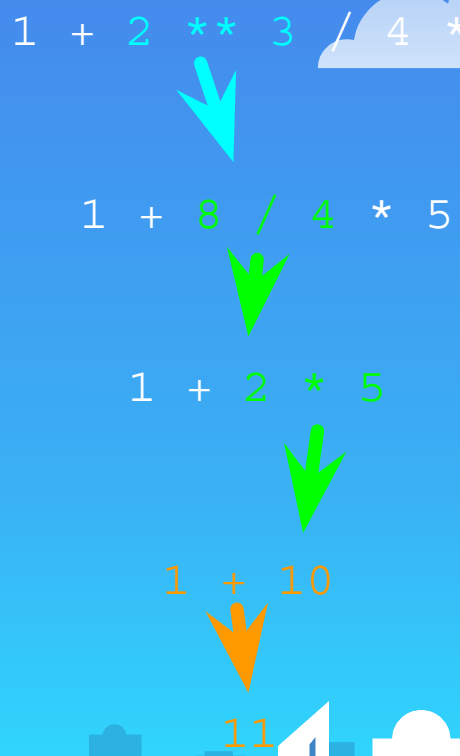
Highest precedence rule to lowest precedence rule:

- Parentheses are always respected
- Exponentiation (raise to a power)
- Multiplication, Division, and Remainder
- Addition and Subtraction
- Left to right

Parenthesis
Power
Multiplication
Addition
Left to Right

```
>>> x = 1 + 2 ** 3 / 4 * 5
>>> print(x)
11.0
>>>
```

Parenthesis
Power
Multiplication
Addition
Left to Right



What Does “Type” Mean?

- In Python variables, literals, and constants have a “type”
- Python knows the difference between an integer number and a string
- For example “+” means “addition” if something is a number and “concatenate” if something is a string

```
>>> ddd = 1 + 4
>>> print(ddd)
5
>>> eee = 'hello ' + 'there'
>>> print(eee)
hello there
```

concatenate = put together

Several Types of Numbers

- Numbers have two main types
  - Integers are whole numbers: -14, -2, 0, 1, 100, 401233
  - Floating Point Numbers have decimal parts: -2.5 , 0.0, 98.6, 14.0
- There are other number types - they are variations on float and integer

```
>>> xx = 1
>>> type (xx)
<class 'int'>
>>> temp = 98.6
>>> type(temp)
<class'float'>
>>> type(1)
<class 'int'>
>>> type(1.0)
<class'float'>
>>>
```

Type Conversions

- When you put an integer and floating point in an expression, the integer is implicitly converted to a float

- You can control this with the built-in functions int() and float()

```
>>> print(float(99) + 100)
199.0
>>> i = 42
>>> type(i)
<class'int'>
>>> f = float(i)
>>> print(f)
42.0
>>> type(f)
<class'float'>
>>>
```

Integer Division

Integer division produces a floating point result

```
>>> print(10 / 2)
5.0
>>> print(9 / 2)
4.5
>>> print(99 / 100)
0.99
>>> print(10.0 / 2.0)
5.0
>>> print(99.0 / 100.0)
0.99
```

This was different in Python 2.x

String Conversions

- You can also use int() and float() to convert between strings and integers
- You will get an error if the string does not contain numeric characters

```
>>> sval = '123'
>>> type(sval)
<class 'str'>
>>> print(sval + 1)
Traceback (most recent call last):
File "<stdin>", line 1, in <module>
TypeError: Can't convert 'int' object
to str implicitly
>>> ival = int(sval)
>>> type(ival)
<class 'int'>
>>> print(ival + 1)
124
>>> nsv = 'hello bob'
>>> niv = int(nsv)
Traceback (most recent call last):
File "<stdin>", line 1, in <module>
ValueError: invalid literal for int()
with base 10: 'x'
```

User Input

- We can instruct Python to pause and read data from the user using the input() function
- The input() function returns a string

```
nam = input('Who are you? ')
print('Welcome', nam)
```

```
Who are you? Chuck
Welcome Chuck
```

Converting User Input

- If we want to read a number from the user, we must convert it from a string to a number using a type conversion function

```
inp = input('Europe floor?')
usf = int(inp) + 1
print('US floor', usf)
```

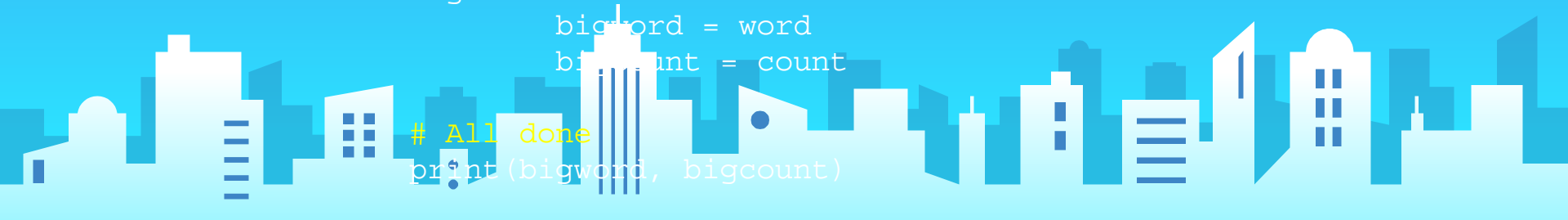
- Later we will deal with bad input data

Europe floor? 0
US floor 1

Comments in Python

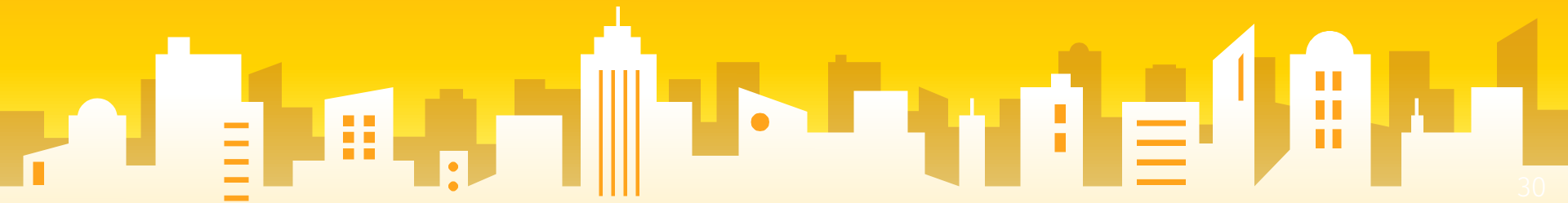
- Anything after a # is ignored by Python
- Why comment?
  - Describe what is going to happen in a sequence of code
  - Document who wrote the code or other ancillary information
  - Turn off a line of code - perhaps temporarily

```
# Get the name of the file and open it
name = input('Enter file:')
handle = open(name, 'r')

# Count word frequency
counts = dict()
for line in handle:
    words = line.split()
    for word in words:
        counts[word] = counts.get(word,0) +
1

# Find the most common word
bigcount = None
bigword = None
for word,count in counts.items():
    if bigcount is None or count >
bigcount:
        bigword = word
        bigcount = count

# All done
print(bigword, bigcount)
```

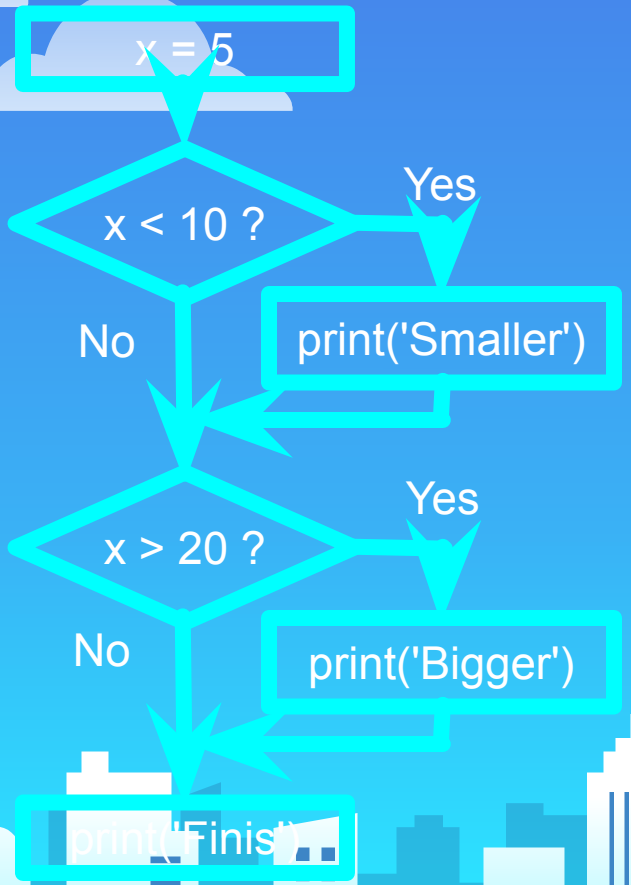


Conditional Execution

Fourth Lesson.



Conditional Steps



Program:

```
x = 5
if x < 10:
    print('Smaller')
if x > 20:
    print('Bigger')

print('Finis')
```

Output:

```
Smaller
Finis
```

Comparison Operators

- Boolean expressions ask a question and produce a Yes or No result which we use to control program flow
- Boolean expressions using comparison operators evaluate to True / False or Yes / No
- Comparison operators look at variables but do not change the variables

Python	Meaning
<	Less than
<=	Less than or Equal to
==	Equal to
>=	Greater than or Equal to
>	Greater than
!=	Not equal

Remember: “=” is used for assignment.

Comparison Operators

```
x = 5
if x == 5 :
    print('Equals 5')
if x > 4 :
   print('Greater than 4')
if  x >= 5 :
    print('Greater than or Equals 5')
if x < 6 : print('Less than 6')
if x <= 5 :
    print('Less than or Equals 5')
if x != 6 :
    print('Not equal 6')
```

Equals 5

Greater than 4

Greater than or Equals 5

Less than 6

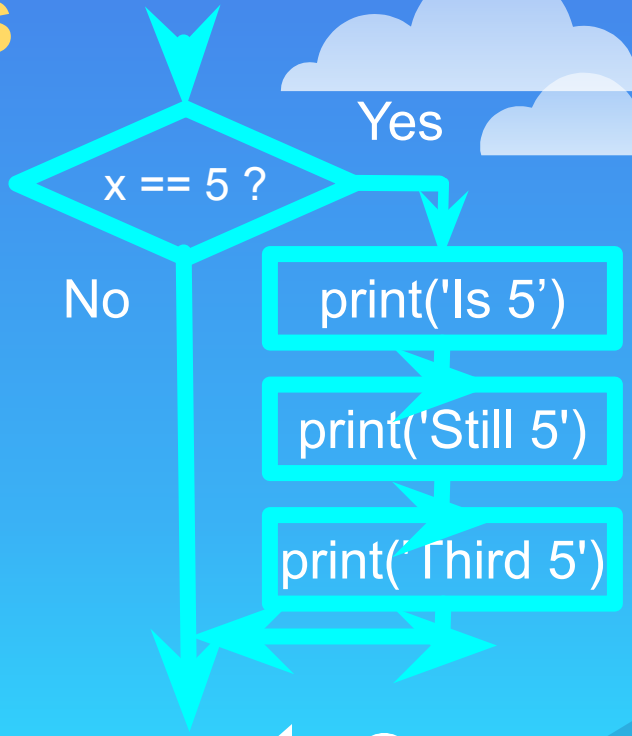
Less than or Equals 5

Not equal 6

One-Way Decisions

```
x = 5
print('Before 5')
if  x == 5 :
    print('Is 5')
    print('Is Still 5')
    print('Third 5')
print('Afterwards 5')
print('Before 6')
if x == 6 :
    print('Is 6')
    print('Is Still 6')
    print('Third 6')
print('Afterwards 6')
```

```
Before 5
Is 5
Is Still 5
Third 5
Afterwards 5
Before 6
Afterwards 6
```



Indentation

- Increase indent indent after an if statement or for statement (after :)
- Maintain indent to indicate the scope of the block (which lines are affected by the if/for)
- Reduce indent back to the level of the if statement or for statement to indicate the end of the block
- Blank lines are ignored - they do not affect indentation
- Comments on a line by themselves are ignored with regard to indentation

increase / maintain after if or for

decrease to indicate end of block

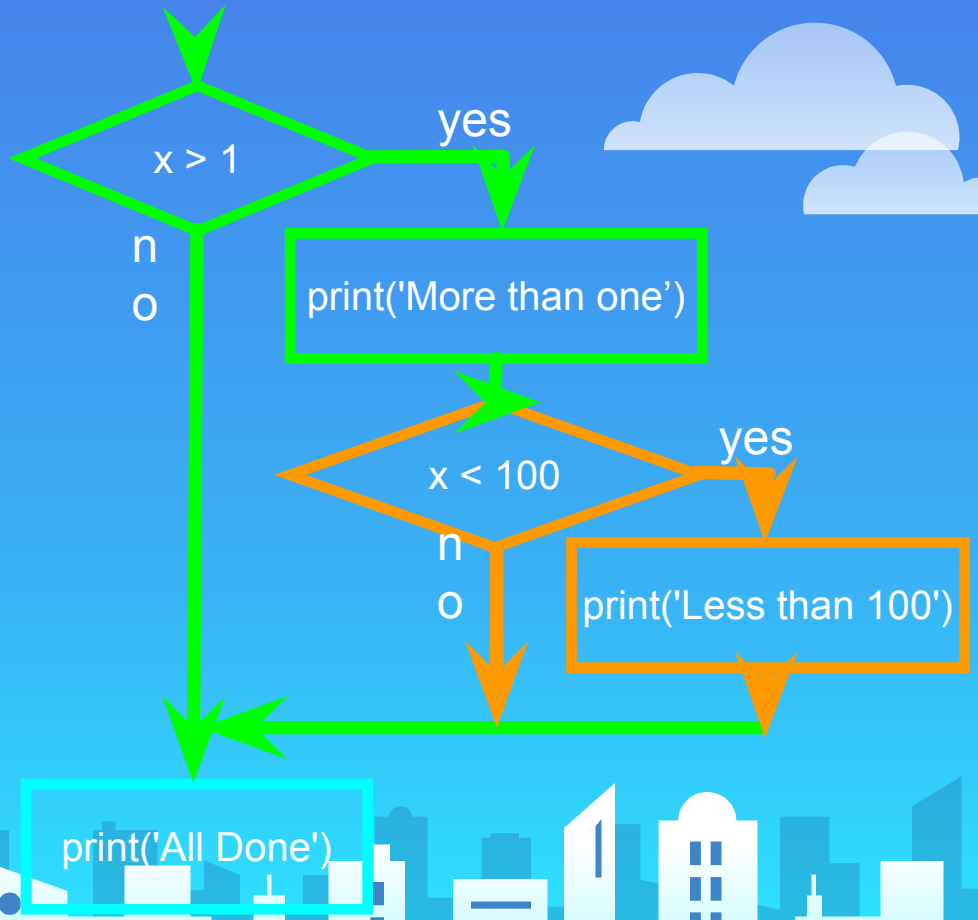
```
x = 5
if x > 2 :
    print('Bigger than 2')
    print('Still bigger')
print('Done with 2')

for i in range(5) :
    print(i)
    if i > 2 :
        print('Bigger than 2')
    print('Done with i', i)
print('All Done')
```

Think About begin/end Blocks

```
x = 5
if x > 2 :
    print('Bigger than 2')
    print('Still bigger')
print('Done with 2')

for i in range(5) :
    print(i)
    if i > 2 :
        print('Bigger than 2')
    print('Done with i', i)
print('All Done')
```

Nested Decisions

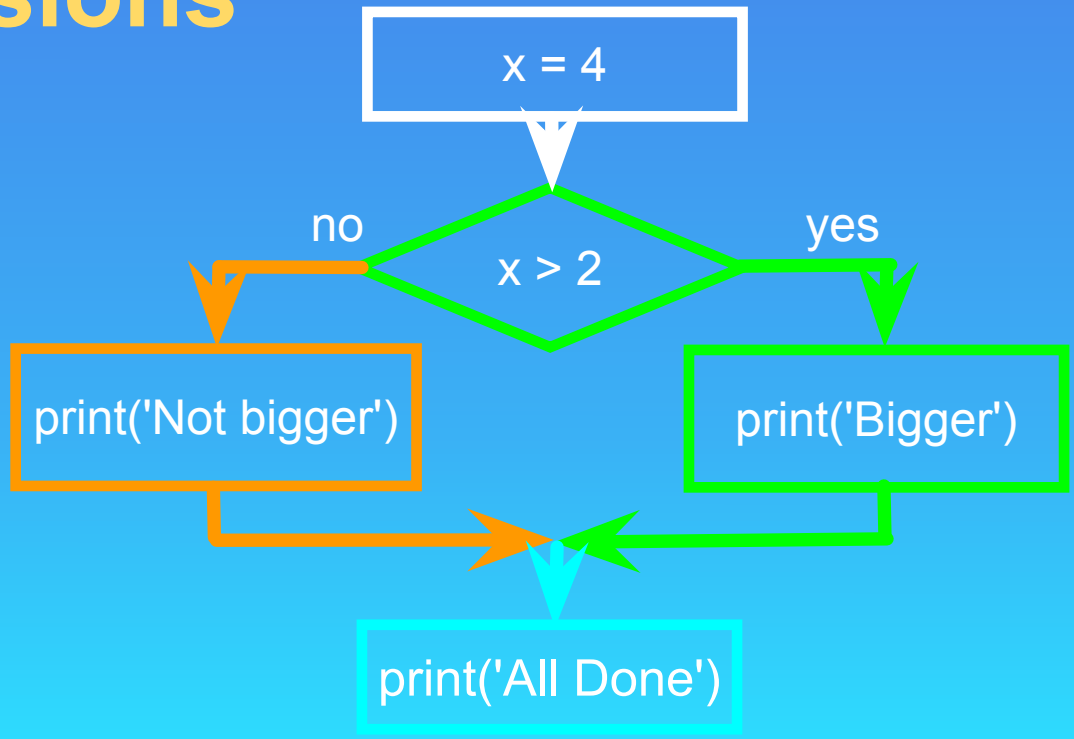
```
x = 42
if x > 1 :
    print('More than one')
    if x < 100 :
        print('Less than 100')
print('All done')
```



Two-way Decisions

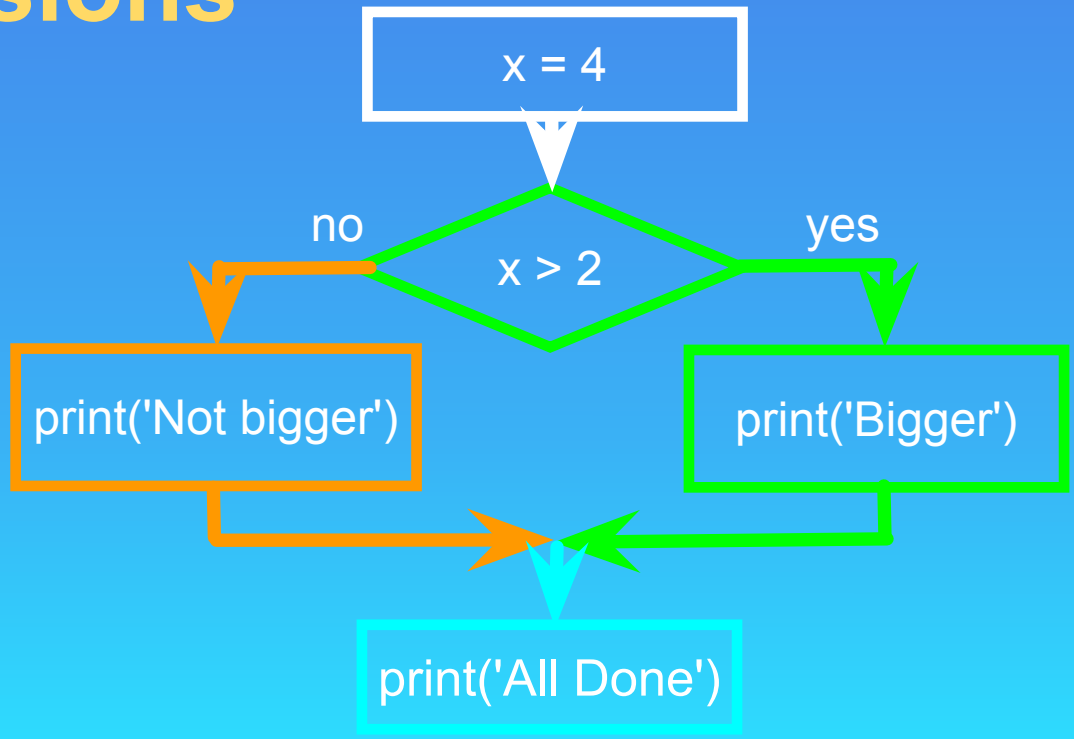
- Sometimes we want to do one thing if a logical expression is true and something else if the expression is false

- It is like a fork in the road - we must choose one or the other path but not both



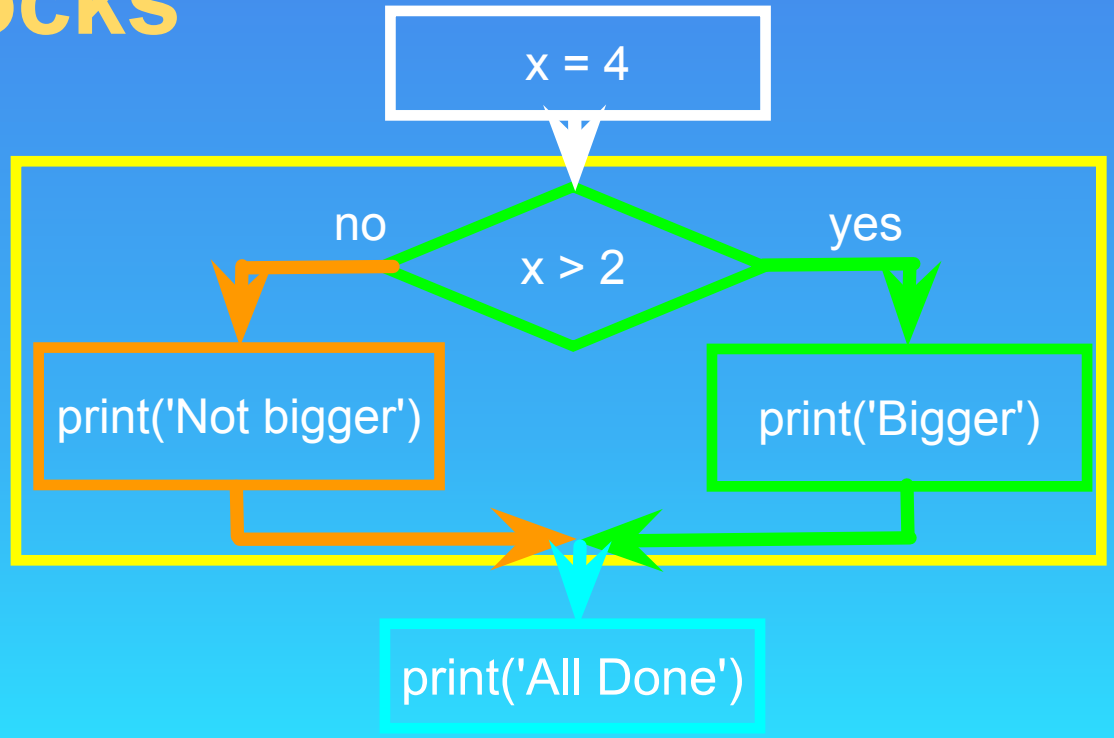
Two-way Decisions with else:

```
x = 4

if x > 2 :
    print('Bigger')
else :
    print('Smaller')

print('All done')
```



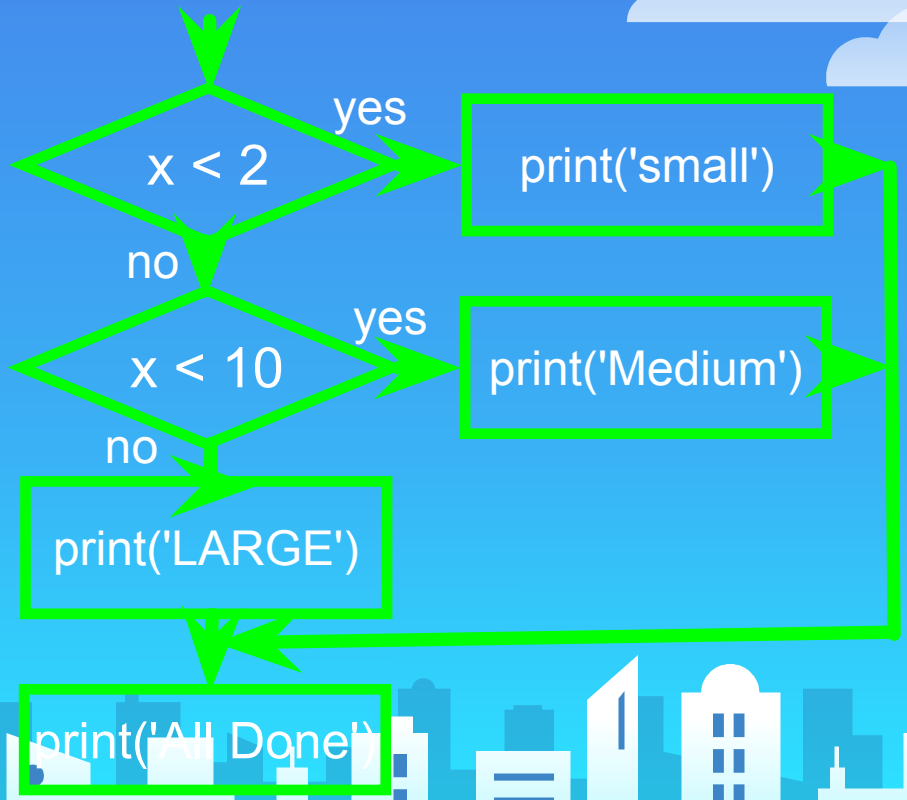
Visualize Blocks

```
x = 4

if x > 2 :
    print('Bigger')
else :
    print('Smaller')

print('All done')
```



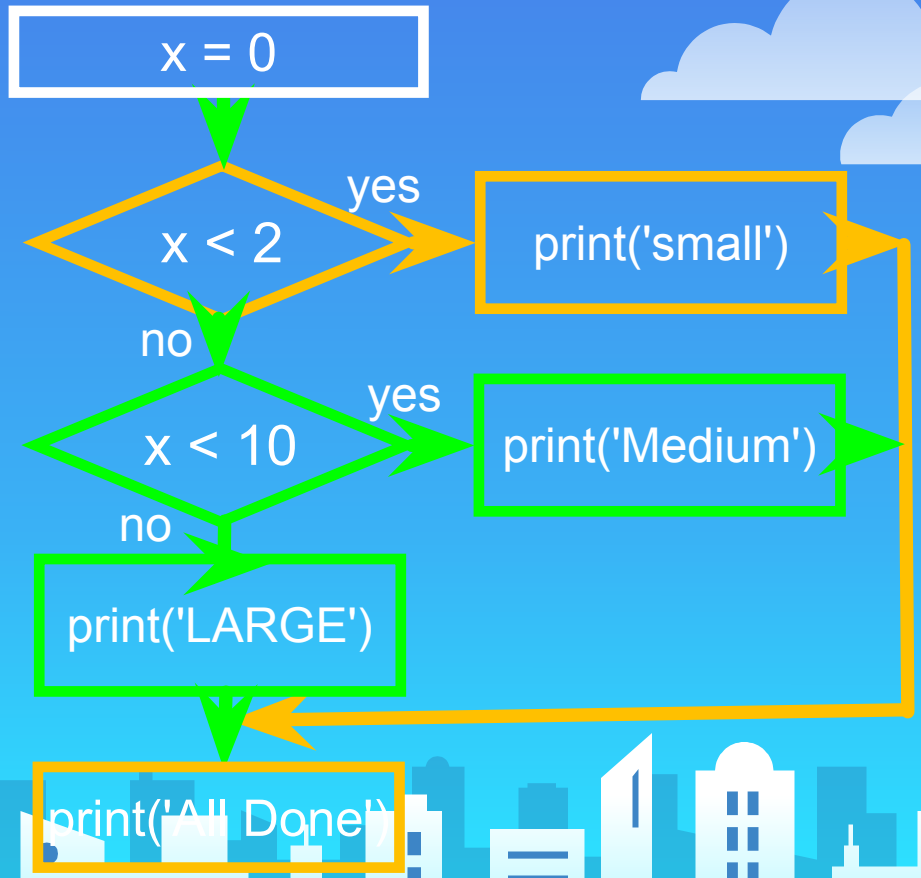
Multi-way

```
if x < 2 :
    print('small')
elif x < 10 :
    print('Medium')
else :
    print('LARGE')
print('All done')
```



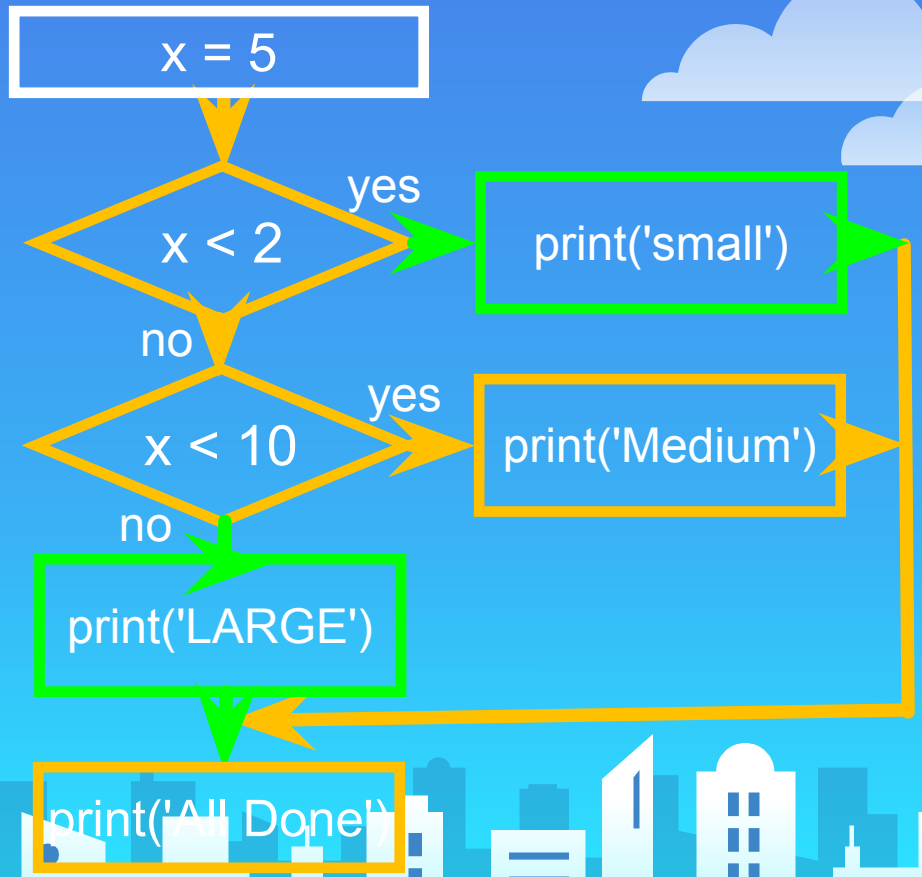
Multi-way

```
x = 0
if x < 2 :
    print('small')
elif x < 10 :
    print('Medium')
else :
    print('LARGE')
print('All done')
```



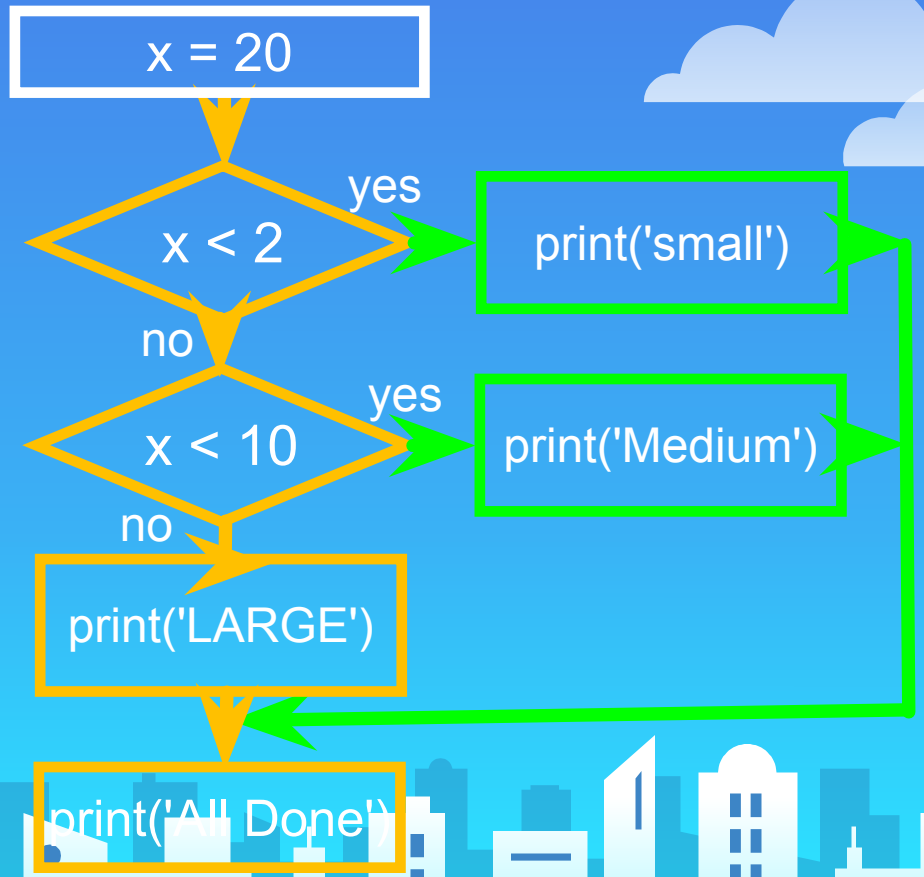
Multi-way

```
x = 5
if x < 2 :
    print('small')
elif x < 10 :
    print('Medium')
else :
    print('LARGE')
print('All done')
```



Multi-way

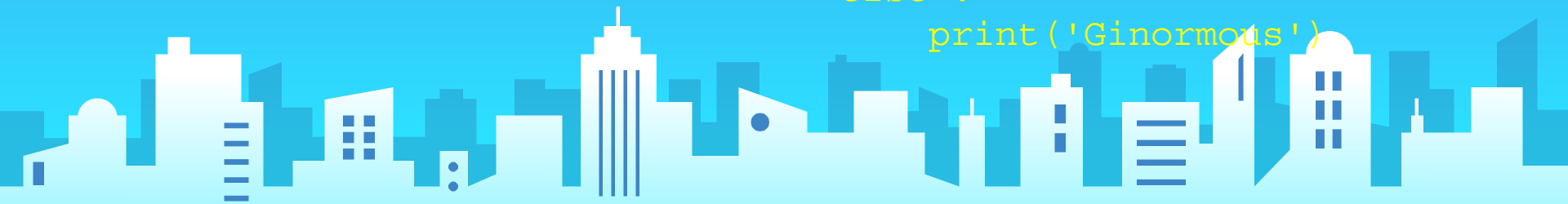
```
x = 20
if x < 2 :
    print('small')
elif x < 10 :
    print('Medium')
else :
    print('LARGE')
print('All done')
```



Multi-way

```
# No Else
x = 5
if x < 2 :
    print('Small')
elif x < 10 :
    print('Medium')

print('All done')
```

```
if x < 2 :
    print('Small')
elif x < 10 :
    print('Medium')
elif x < 20 :
    print('Big')
elif x < 40 :
    print('Large')
elif x < 100:
    print('Huge')
else :
    print('Ginormous')
```

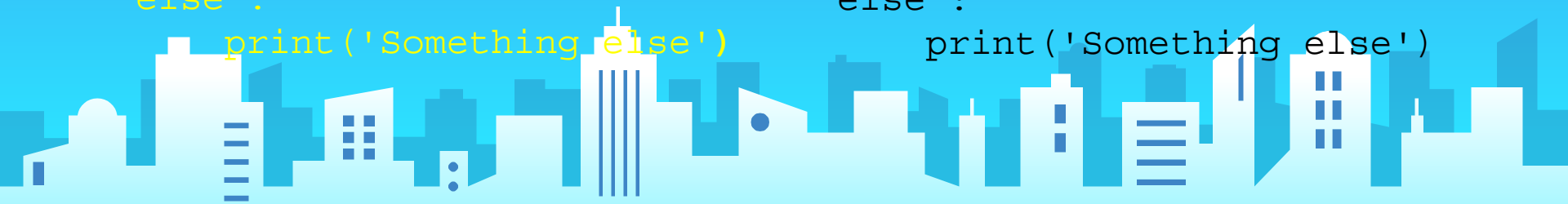


Multi-way Puzzles

Which will never print regardless of the value for x?

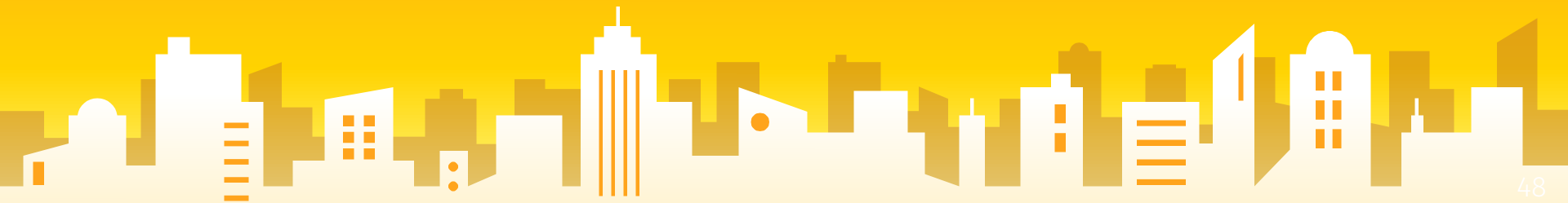
```
if x < 2 :
    print('Below 2')
elif x >= 2 :
    print('Two or more')
else :
    print('Something else')
```

```
if x < 2 :
    print('Below 2')
elif x < 20 :
    print('Below 20')
elif x < 10 :
    print('Below 10')
else :
    print('Something else')
```



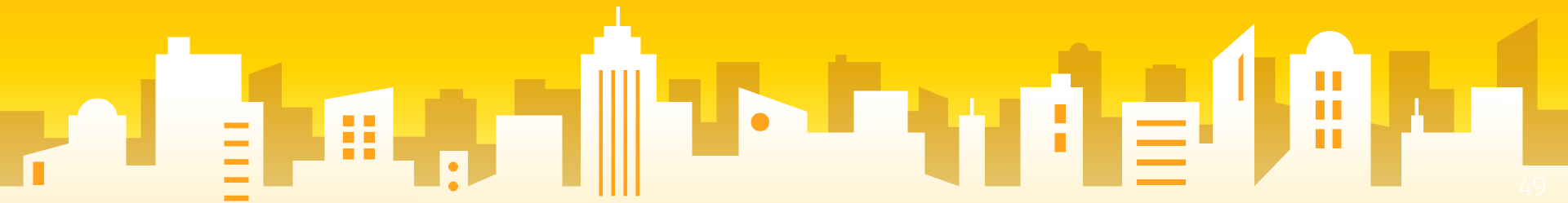
How many days in march?

Assignment



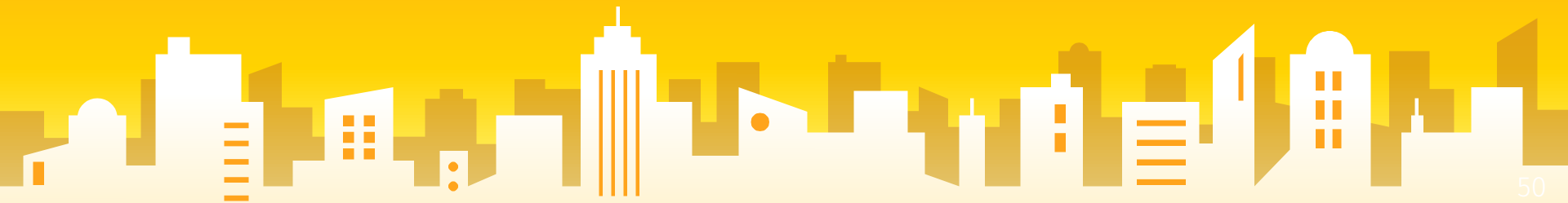
What is the 3 letter state code of India?

Assignment



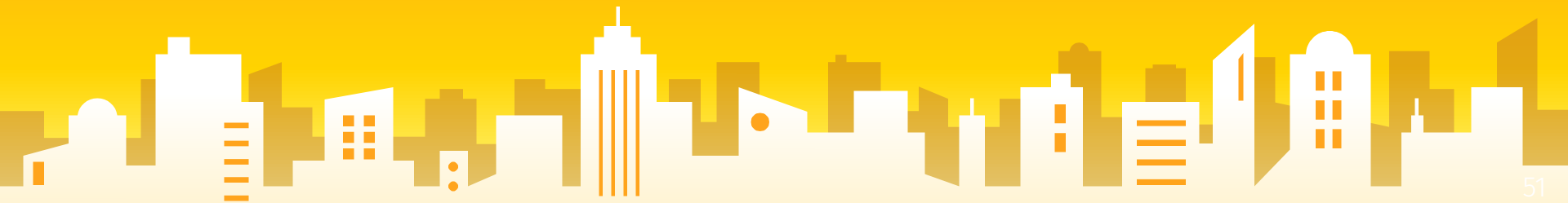
3 inputs

A < B < C



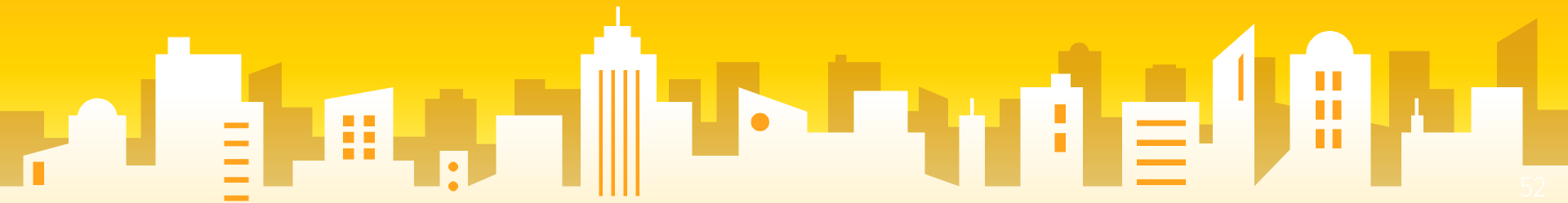
Positive or Negative

1 or -1



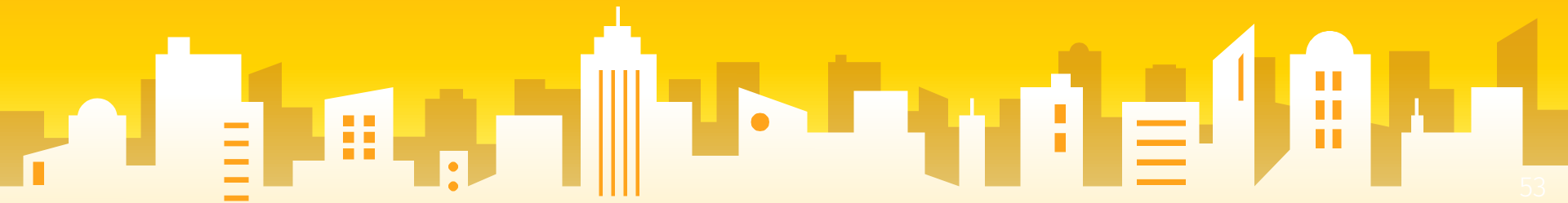
Guess the number?

Less than or Greater than

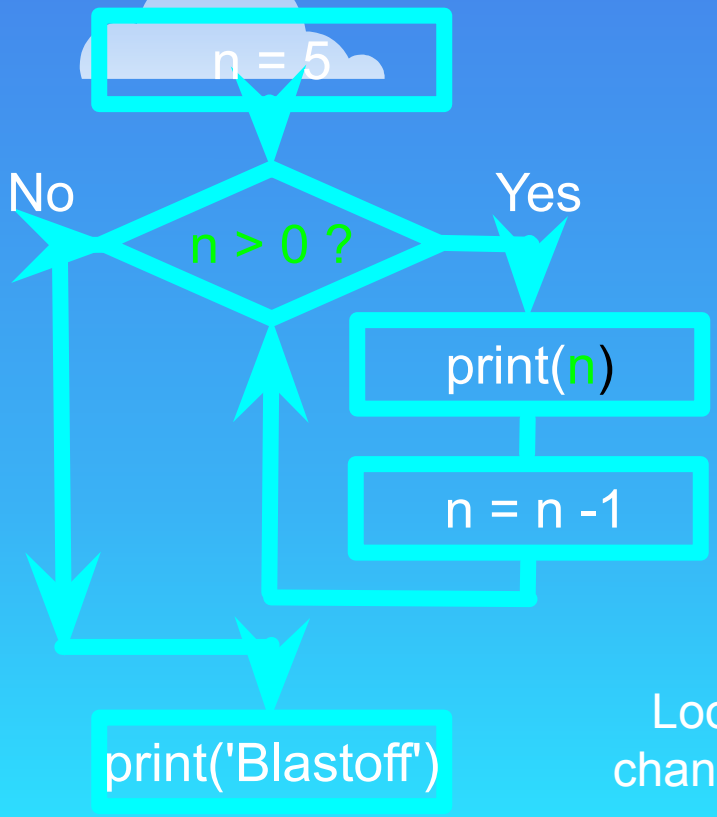


Loops & Iteration

Fifth Lesson



Repeated Steps



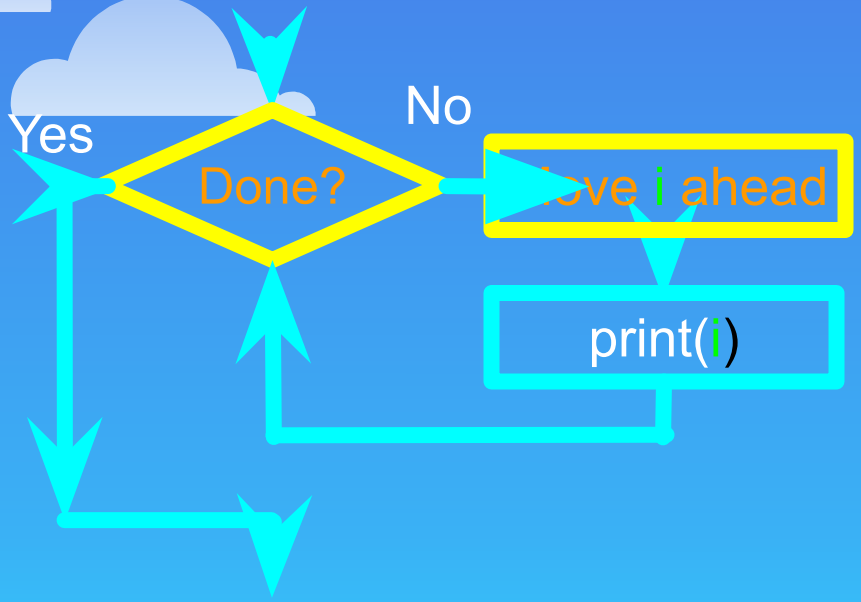
Program:

```
n = 5
while n > 0 :
    print(n)
    n = n - 1
print('Blastoff!')
print(n)
```

Output:

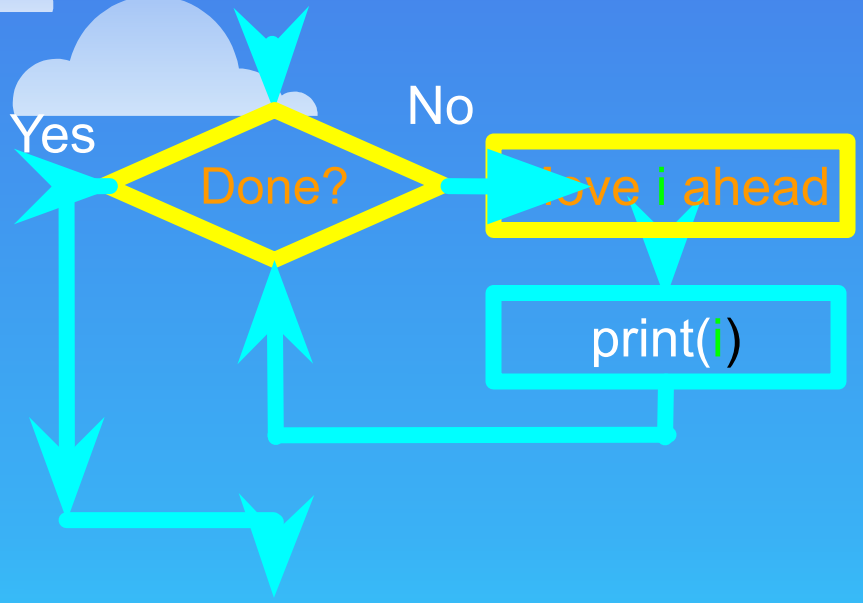
```
5
4
3
2
1
Blastoff!
0
```

Loops (repeated steps) have iteration variables that change each time through a loop. Often these iteration variables go through a sequence of numbers.

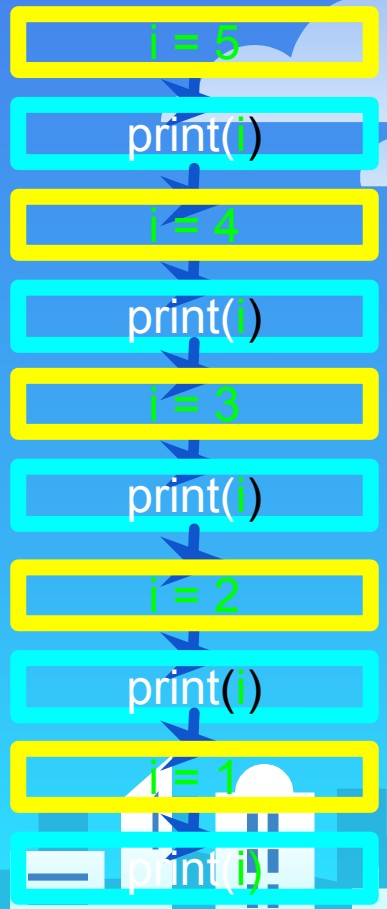


- The iteration variable “iterates” through the sequence (ordered set)
- The block (body) of code is executed once for each value in the sequence
- The iteration variable moves through all of the values in the sequence

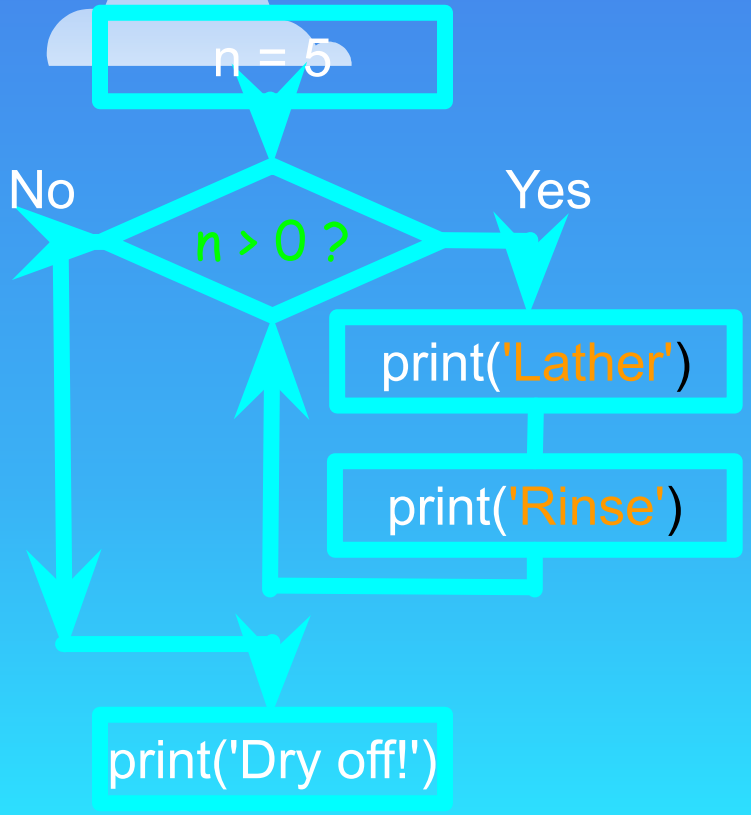
```
for i in [5, 4, 3, 2, 1] :
    print(i)
```




```
for i in [5, 4, 3, 2, 1] :
    print(i)
```



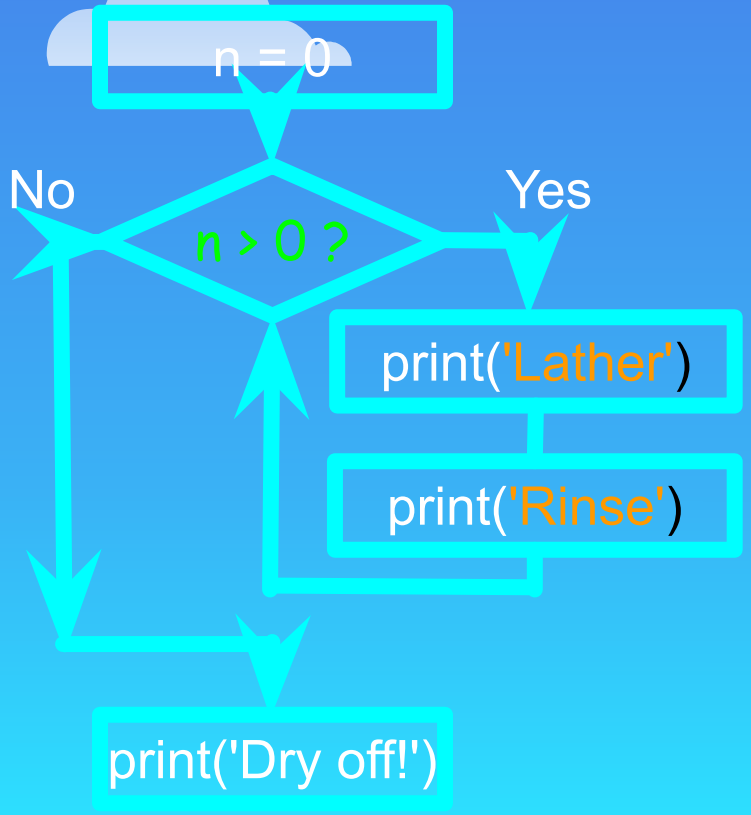
An Infinite Loop




```
n = 5
while n > 0 :
    print('Lather')
    print('Rinse')
print('Dry off!')
```

What is wrong with this loop?

Another Loop




```
n = 0
while n > 0 :
    print('Lather')
    print('Rinse')
print('Dry off!')
```

What is this loop doing?

Breaking Out of a Loop

- The break statement ends the current loop and jumps to the statement immediately following the loop

- It is like a loop test that can happen anywhere in the body of the loop

```
while True:
    line = input('> ')
    if line == 'done' :
        break
    print(line)
print('Done!')
```

```
> hello there
hello there
> finished
finished
> done
Done!
```

Breaking Out of a Loop

- The break statement ends the current loop and jumps to the statement immediately following the loop

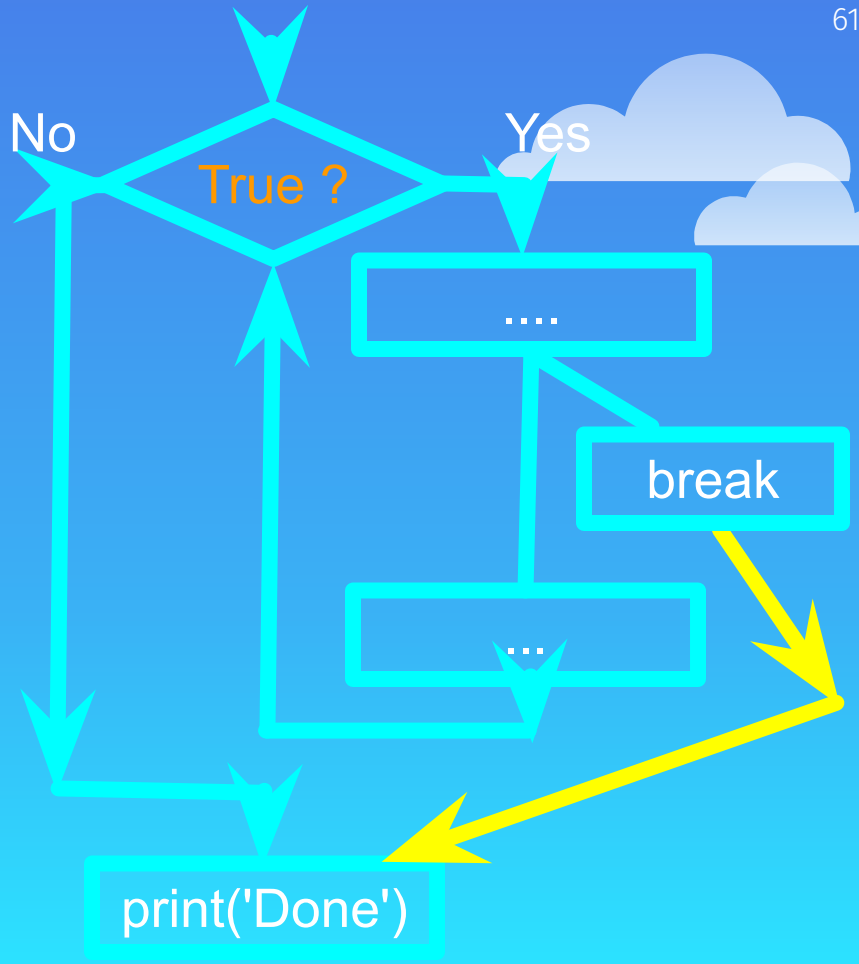
- It is like a loop test that can happen anywhere in the body of the loop

```
while True:
    line = input('> ')
    if line == 'done' :
        break
    print(line)
print('Done!')
```

```
> hello there
hello there
> finished
finished
> done
Done!
```

```
while True:
    line = input('> ')
    if line == 'done' :
        break
    print(line)
print('Done!')
```

http://en.wikipedia.org/wiki/Transporter_(Star_Trek)



Finishing an Iteration with continue

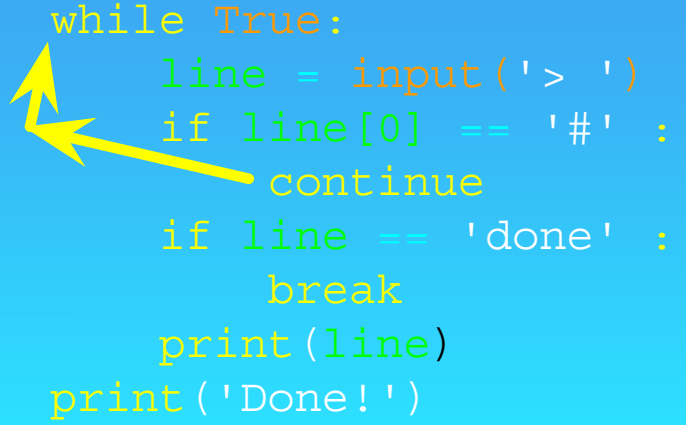
The continue statement ends the current iteration and jumps to the top of the loop and starts the next iteration

```
while True:
    line = input('> ')
    if line[0] == '#' :
        continue
    if line == 'done' :
        break
    print(line)
print('Done!')
```

```
> hello there
hello there
> # don't print this
> print this!
print this!
> done
Done!
```

Finishing an Iteration with continue

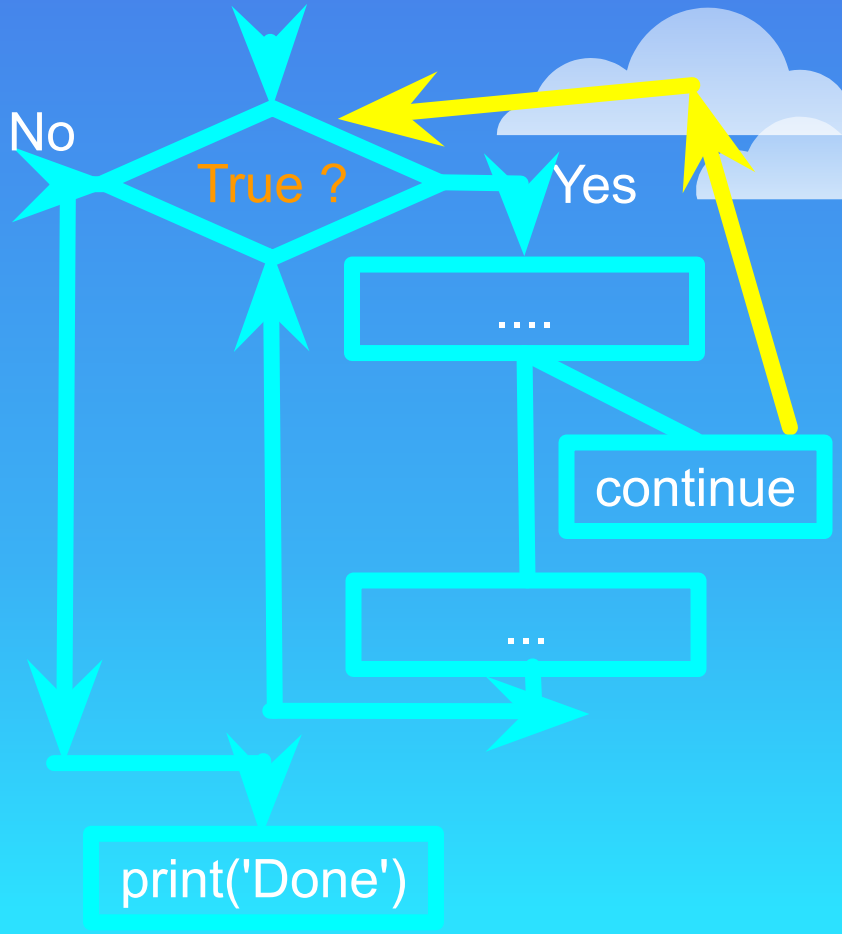
The continue statement ends the current iteration and jumps to the top of the loop and starts the next iteration



```
while True:
    line = input('> ')
    if line[0] == '#' :
        continue
    if line == 'done' :
        break
    print(line)
print('Done!')
```

```
> hello there
hello there
> # don't print this
> print this!
print this!
> done
Done!
```

```
while True:
    line = raw_input('> ')
    if line[0] == '#' :
        continue
    if line == 'done' :
        break
    print(line)
print('Done!')
```



Indefinite Loops

- While loops are called “indefinite loops” because they keep going until a logical condition becomes False
- The loops we have seen so far are pretty easy to examine to see if they will terminate or if they will be “infinite loops”
- Sometimes it is a little harder to be sure if a loop will terminate

Definite Loops

- Quite often we have a list of items of the lines in a file - effectively a finite set of things
- We can write a loop to run the loop once for each of the items in a set using the Python for construct
- These loops are called “definite loops” because they execute an exact number of times
- We say that “definite loops iterate through the members of a set”

A Simple Definite Loop

```
for i in [5, 4, 3, 2, 1] :
    print(i)
print('Blastoff!')
```

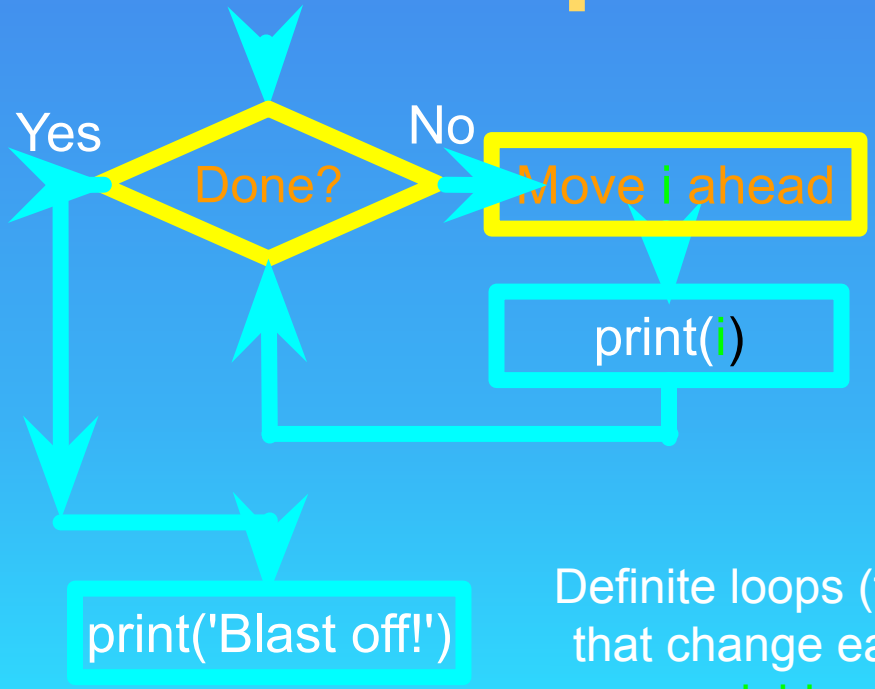
```
5
4
3
2
1
Blastoff!
```

A Definite Loop with Strings

```
friends = ['Joseph', 'Glenn', 'Sally']
for friend in friends :
   print('Happy New Year:', friend)
print('Done!')
```

```
Happy New Year: Joseph
Happy New Year: Glenn
Happy New Year: Sally

Done!
```

A Simple Definite Loop




```
for i in [5, 4, 3, 2, 1] :
    print(i)
print('Blastoff!')
```

```
5
4
3
2
1
Blastoff!
```

Definite loops (for loops) have explicit iteration variables that change each time through a loop. These iteration variables move through the sequence or set.

Looking at in...

- The iteration variable "iterates" through the sequence (ordered set)
- The block (body) of code is executed once for each value in the sequence
- The iteration variable moves through all of the values in the sequence

Iteration variable

Five-element sequence

```
for i in [5, 4, 3, 2, 1] :
    print(i)
```

Loop Idioms: What We Do in Loops

Note: Even though these examples are simple, the patterns apply to all kinds of loops

Looping Through a Set

```
print('Before')
for thing in [9, 41, 12, 3, 74, 15] :
     print(thing)
print('After')
```

```
$ python basicloop.py
Before
9
41
12
3
74
15
After
```

What is the Largest Number?

What is the Largest Number?

3

What is the Largest Number?

41

What is the Largest Number?

12

What is the Largest Number?

9

What is the Largest Number?

74

What is the Largest Number?

15

What is the Largest Number?

What is the Largest Number?

3 41 12 9 74 15

What is the Largest Number?

largest_so_far -1

What is the Largest Number?

3

largest_so_far 3

What is the Largest Number?

41

largest_so_far 41

What is the Largest Number?

12

largest_so_far 41

What is the Largest Number?

9

largest_so_far 41

What is the Largest Number?

74

largest_so_far 74

What is the Largest Number?

15

74

What is the Largest Number?

3 41 12 9 74 15

74

Finding the Largest Value

```
largest_so_far = -1
print('Before', largest_so_far)
for the_num in [9, 41, 12, 3, 74, 15] :
    if the_num > largest_so_far :
        largest_so_far = the_num
    print(largest_so_far, the_num)

print('After', largest_so_far)
```

```
$ python largest.py
Before -1
9 9
41 41
41 12
41 3
74 74
74 15
After 74
```

We make a variable that contains the largest value we have seen so far. If the current number we are looking at is larger, it is the new largest value we have seen so far.

More Loop Patterns...

Counting in a Loop

```
zork = 0
print('Before', zork)
for thing in [9, 41, 12, 3, 74, 15] :
    zork = zork + 1
    print(zork, thing)
print('After', zork)
```

```
$ python countloop.py
Before 0
1 9
2 41
3 12
4 3
5 74
6 15
After 6
```

To count how many times we execute a loop, we introduce a counter variable that starts at 0 and we add one to it each time through the loop.

Summing in a Loop

```
zork = 0
print('Before', zork)
for thing in [9, 41, 12, 3, 74, 15]
:
    zork = zork + thing
    print(zork, thing)
print('After', zork)
```

```
$ python countloop.py
Before 0
9 9
50 41
62 12
65 3
139 74
154 15
After 154
```

To add up a value we encounter in a loop, we introduce a sum variable that starts at 0 and we add the value to the sum each time through the loop.

Finding the Average in a Loop

```
count = 0
sum = 0
print('Before', count, sum)
for value in [9, 41, 12, 3, 74, 15] :
    count = count + 1
    sum = sum + value
    print(count, sum, value)
print('After', count, sum, sum / count)
```

```
$ python averageloop.py
Before 0 0
1 9 9
2 50 41
3 62 12
4 65 3
5 139 74
6 154 15
After 6 154 25.666
```

An average just combines the counting and sum patterns and divides when the loop is done.

Filtering in a Loop

```
print('Before')
for value in [9, 41, 12, 3, 74, 15] :
    if value > 20:
        print('Large number',value)
print('After')
```

```
$ python search1.py
Before
Large number 41
Large number 74
After
```

We use an if statement in the loop to catch / filter the values we are looking for.

Search Using a Boolean Variable

```
found = False
print('Before', found)
for value in [9, 41, 12, 3, 74, 15] :
    if value == 3 :
        found = True
    print(found, value)
print('After', found)
```

```
$ python search1.py
Before False
False 9
False 41
False 12
True 3
True 74
True 15
After True
```

If we just want to search and know if a value was found, we use a variable that starts at False and is set to True as soon as we find what we are looking for.

How to Find the Smallest Value

```
largest_so_far = -1
print('Before', largest_so_far)
for the_num in [9, 41, 12, 3, 74, 15] :
    if the_num > largest_so_far :
        largest_so_far = the_num
    print(largest_so_far, the_num)

print('After', largest_so_far)
```

```
$ python largest.py
Before -1
9 9
41 41
41 12
41 3
74 74
74 15
After 74
```

How would we change this to make it find the smallest value in the list?

Finding the Smallest Value

```
smallest_so_far = -1
print('Before', smallest_so_far)
for the_num in [9, 41, 12, 3, 74, 15] :
    if the_num < smallest_so_far :
        smallest_so_far = the_num
    print(smallest_so_far, the_num)

print('After', smallest_so_far)
```

We switched the variable name to smallest_so_far and switched the > to <

Finding the Smallest Value

```
smallest_so_far = -1
print('Before', smallest_so_far)
for the_num in [9, 41, 12, 3, 74, 15] :
    if the_num < smallest_so_far :
        smallest_so_far = the_num
    print(smallest_so_far, the_num)

print('After', smallest_so_far)
```

```
$ python smallbad.py
Before -1
-1 9
-1 41
-1 12
-1 3
-1 74
-1 15
After -1
```

We switched the variable name to smallest_so_far and switched the > to <

Finding the Smallest Value

```
smallest = None
print('Before')
for value in [9, 41, 12, 3, 74, 15] :
    if smallest is None :
        smallest = value
    elif value < smallest :
        smallest = value
    print(smallest, value)
print('After', smallest)
```

```
$ python smallest.py
Before
9 9
9 41
9 12
3 3
3 74
3 15
After 3
```

We still have a variable that is the smallest so far. The first time through the loop smallest is None, so we take the first value to be the smallest.

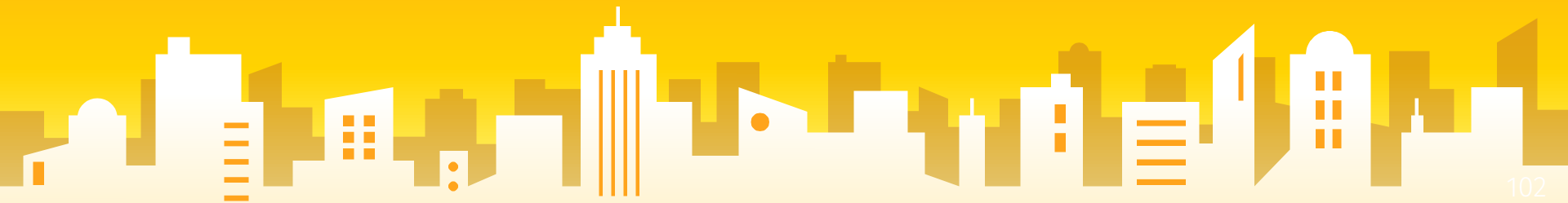
The is and is not Operators

```
smallest = None
print('Before')
for value in [3, 41, 12, 9, 74, 15] :
    if smallest is None :
        smallest = value
    elif value < smallest :
        smallest = value
    print(smallest, value)

print('After', smallest)
```

- Python has an is operator that can be used in logical expressions
- Implies “is the same as”
- Similar to, but stronger than ==
- is not also is a logical operator

Program to add natural numbers.

Sum = 1+2+3+4.....n (For and While)



Single Line Statements

```
flag = 1
while (flag): print 'Given flag is really true!'

print "Good bye!"
```

Thank you

Miss You...