Python

A quickstart into the key concepts of programming

Control structures

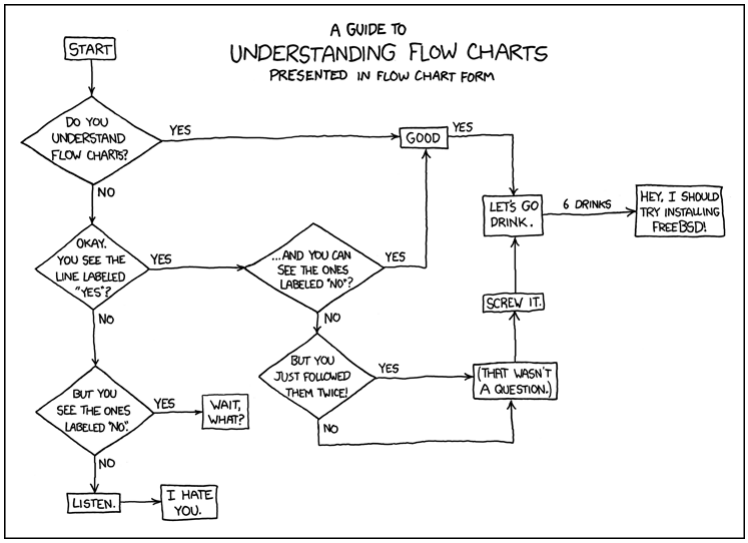
1

Control flow

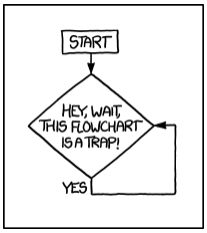
4

Control flow

- Computer programs can't do that many things, they can:
  - Assign values to variables (memory locations).
  - Make decisions based on comparisons.
  - Repeat a sequence of instructions over and over.
  - Call subprograms.



https://xkcd.com/518/



https://xkcd.com/1195/

conditionals

control_flow_conditionals.ipynb

Conditional Statements: if

- Syntax:

```
if condition :
    indentedStatementBlock
```

- A group of individual statements, which make a single code block are called *suites*
- If the condition is true, then do the indented statements.
  If the condition is not true, then skip the indented statements.

```
if (a<100):
    print('a is less than 100')
```

- *File: if_1.py*

Conditional Statements: if else

- Syntax:

```
if condition :
    indentedStatementBlockForTrueCondition
else:
    indentedStatementBlockForFalseCondition

a = 88
if (a<10):
    print('a smaller than 10')
else:
    print('a larger than 10')
```

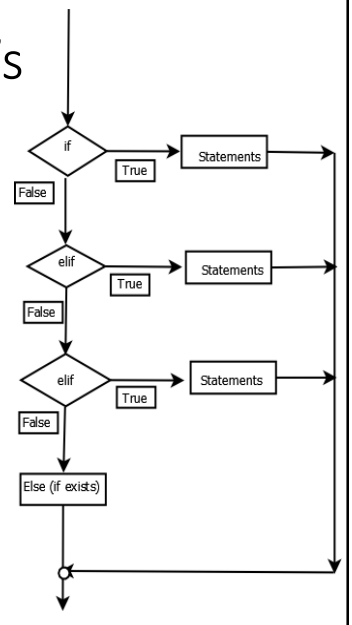
- *File: if_else_1.py*

Conditional Statements: chaining if's

- Combine several if statements into one statement using **elif**
- **else** block at the very end is not required

```
if x < 0:
     print("negative")
else:
      if x > 10:
          print("large")
      else:
          print("small")
```

```
if x < 0:
    print("negative")
elif x > 10:
    print("large")
else:
    print("small")
```



cs.uky.edu/~keen/115

Conditional Statements: chaining if's

- There can be zero or more `elif` parts, and the `else` part is optional.
- The keyword '`elif`' is short for '`else if`', and is useful to avoid excessive indentation.
- An `if … elif … elif …` sequence can be seen as a substitute for the `switch/case` statements found in other languages.

Catching Exceptions

- Catching Exceptions: `try` and `except`
- https://cvw.cac.cornell.edu/python-intro/control-flow/exception-handling
- Syntax

```
try:
    some statements here
except:
    exception handling
```

- *File: try_except_1.py*
- *File: try_except_2.py*

Catching Exceptions

- Specific error conditions can then be tested for and responded to, using one or more except statements.
- First, the code block between the `try` and `except` keywords is executed.
- If no exception occurs, any except statements and their code blocks are skipped, and execution continues.
- If an exception occurs during execution of the try, the rest of the statements in its code block are skipped. Then the except statements are checked one at a time, in order, to see if one matches the specific exception. If there is a match to the exception named after one of the except keywords, the code block following that except is executed, and then execution returns to the try statement and continues from there.
- Many of Python's built-in exceptions are self-explanatory, some of the more commonly encountered ones.
  - NameError - You probably misspelled a variable or function name, or you otherwise referenced a name that was never defined.
  - IOError - I/O operation failed.
  - SystemError - Internal error in the Python interpreter.
  - ZeroDivisionError - Second argument to a division or modulo operation was zero.

loops

control_flow_loops.ipynb

Loops

- **for** loops are executed a fixed number of iterations. It is possible to exit early but this must be added to the code.
- **while** loops do not have a predetermined number of iterations. They terminate when some condition becomes False.

for loop (basic)

- **`for`** iterates over the items of any **sequence** (a list, tuple, string), in the order they appear in the sequence.
- The general Python syntax:

```
for <item> in <iterable object>:
    blockToRepeat
```

- *File: for_loop_1.py*
- *File: for_loop_change_content.py*

for loop

- If you need to modify the sequence you are iterating over while inside the loop, it is recommended that you first make a copy.
- Iterating over a sequence does not implicitly make a copy.
  The slice notation makes this especially convenient.
- *File: for_loop_vanrossum_1.py*

iterator

- An iterator is a special object that gives values in succession, it implements the `next` protocol and raises `StopIteration` when exhausted.
- Iterator
  - `range()`
  - `enumerate()`
  - `zip()`
- The `for` loop automatically constructs an `iterator` from an `interator object`, then repeatedly calls `next` until a `StopIteration` is raised.

iterator

- The benefit of the iterator indirection is that *the full list is never explicitly created!*

```
N = 10 ** 12
for i in range(N):
    if i >= 10: break
    print(i, end=', ')
```


range

- `range(start,end,stride)` function gives an iterable that enables counting.
- As with indexing, `range()` inclusively starts at zero by default, and the ending is exclusive.
- It is often useful to make a list or tuple that has the same entries that a corresponding range object would have, with a type conversion:
  - `list(range(10)`
  - use the `range()` function along with the `len()` function

range

- What if we need indexes?
  - Simulate a counter
  - use `range(len(our_list))` and lookup the index:

```
fruitslist = ['banana', 'apple',  'mango']
for i in range(len(fruitslist)):
    print(fruitslist[i])
```

- Source: http://treyhunner.com/2016/04/how-to-loop-with-indexes-in-python/

enumerate

- `enumerate` returns an iterable where each element is a tuple that contains the index of the item and the original item value.

```
fruitslist = ['banana', 'apple',  'mango']
for num, color in enumerate(fruitslist):
    print(num, color)
```

- *File: for_loop_index*
- Source: http://treyhunner.com/2016/04/how-to-loop-with-indexes-in-python/

zip

- What if we need to loop over multiple things?
- `zip`: allows to loop over multiple lists at the same time
- The zip function takes multiple lists and returns an iterable that provides a tuple of the corresponding elements of each list as we loop over it.

```
fruitslist = ['banana', 'apple',  'mango']
ratios = [0.2, 0.3, 0.1, 0.4]
for fruit, ratio in zip(fruitslist, ratios):
    print("{}% {}".format(ratio * 100, fruit))
```

- Source: http://treyhunner.com/2016/04/how-to-loop-with-indexes-in-python/

reversed

- `reversed`: for giving an iterator that goes in the reverse direction.

```
count_up = (1, 2, 3, 4, 5, 6, 7, 8 ,9, 10)
for count in reversed(count_up):
    print(count)
```

iter

- `iter` object is a container that gives you access to the `next` object for as long as it's valid

```
I = iter([2, 4, 6, 8, 10])
print(next(I))
2
print(next(I))
4
print(next(I))
6
```


Comprehension

- Comprehension: powerful functionality within a single line of code; provides a compact way to create lists, dictionaries, sets
- `new_list = [`*`expression`* `for` *`member`* `in` *`iterable`*`]`
  - expression is the member itself, a call to a method, or any other valid expression that returns a value.
  - member is the object or value in the list or iterable.
  - iterable is a list, set, sequence, generator, or any other object that can return its elements one at a time.
- `squares = [i * i for i in range(10)]`

for loop: summary

- Loop over a single sequence with a regular `for-in`
- Loop over a list while keeping track of indexes with `enumerate`
- Loop over multiple lists at the same time with `zip`

while loop

- while loops use a condition to determine when to stop the loop.
- The general Python syntax:

```
while <boolean expression>:
    blockToRepeat
else:  # optional
    blockElse
```

- *File: while_loop_1.py*

Fine-Tuning Your Loops: break, continue, else

- The `break` statement breaks out of the loop entirely, any `else` clause will not be executed.
- The `continue` statement skips the remainder of the current loop, and goes to the next iteration
- *File: while_loop_break_continue.py*

for loop: else part

- use case: implement search loops, searching for an item meeting a particular condition, and need to perform additional processing or raise warning if no acceptable value is found
  - Loop should contain `break` statement.
  - The statements in the else block will be executed after all iterations are completed (normal termination).

```
numbers =[1,2,3,4]
for i in numbers:
    print(i)
    if i > 2.5:
       break
else: # Not executed as there is a break
    print("No Break")
```

- *File: for_loop_else.py*