Python

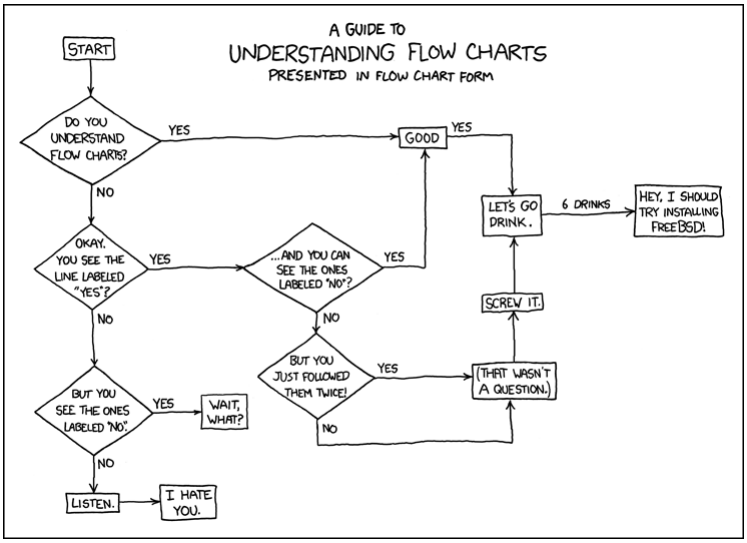
A quickstart into the key concepts of programming

Control structures

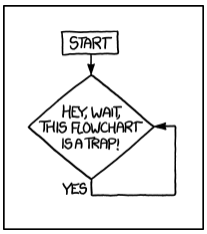
Control flow

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')
```

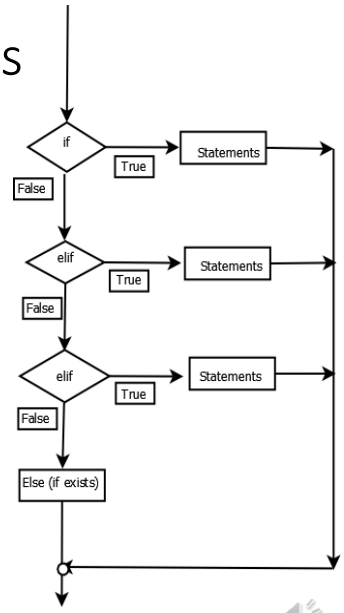
- *File: if_else_1.py*

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

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

- **`for-in`**: loop over the sequence. for loops in Python require an array-like object (such as a list or a tuple) to iterate over.
- The general Python syntax:

```
for <item> in <iterable object>:
    blockToRepeat
else:  # optional
    blockElse
```

- *File: for_loop_1.py*

for loop

```
sum=0
numbers =[1,2,3,4]
for num in numbers:
    print(num)
    sum=sum+num  # check the indentation
avg=sum/len(numbers)
print ('Average:', avg)
```

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*

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 and continue

- 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*

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=', ')
```

for loop: 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/

for loop: enumerate

- What if we need indexes?
- `enumerate` allows to loop over a list and retrieve both the index and the value of each item in the list:
- enumerate function 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/

for loop: 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/

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`

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.

Accumulator pattern

- Common programming pattern:
  - walk through a sequence,
  - accumulate a value as you go,
  - at the end of the traversal, have single value accumulated
- The anatomy of the accumulation pattern includes:
  - initializing an "acccumulator" variable to an initial value (such as 0 if accumulating a sum)
  - iterating (e.g., traversing the items in a sequence)
  - updating the accumulator variable on each iteration (i.e., when processing each item in the sequence)

http://ice-web.cc.gatech.edu/ce21/1/static/audio/static/pip/Iteration/iteration.html

Accumulator pattern

```
nums = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
accum = 0
for w in nums:
    accum = accum + w
print(accum)
```

File: accum_pattern_single.py

File: accum_pattern_single_text.py