Flow Control, Functions, and Scientific Computing

INF1005/6 - Social Data Analytics

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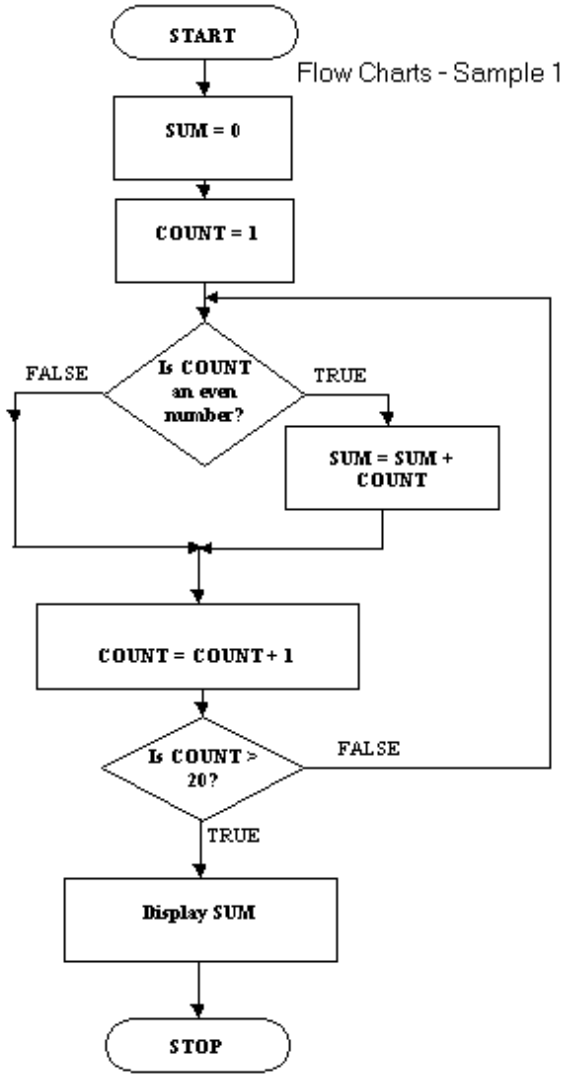
Flow Control

Flow control refers which parts of the program are executed, in what order.

Types of flow control

- Loops
- Conditional statements
- Functions



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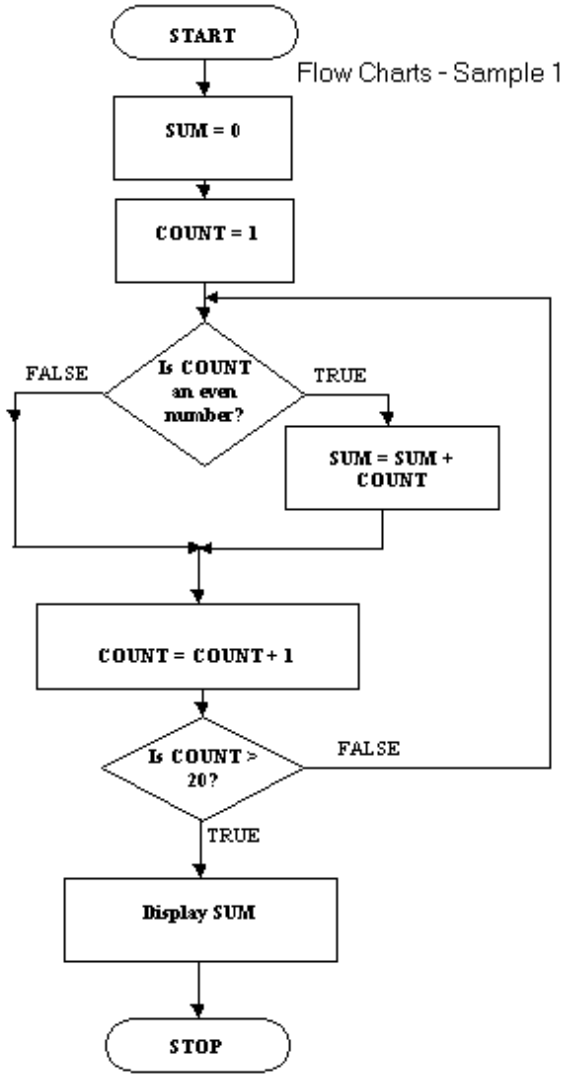

Loops

`for` loop

```
for i in range(100):
    print(i)
```

Loops

`while` loop

```
i = 0
while i < 100:
    print(i)
    i = i + 1
```

Conditional statements

if it is raining then
the sky is cloudy
else if it is snowing then
the sky is cloudy
else
the sky is clear

```
sky = None
is_raining = True
is_snowing = False
if is_raining:
    sky = "cloudy"
elif is_snowing:
    sky = "cloudy"
else:
    sky = "clear"
```

Conditional statements

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Conditional statements

if it is raining then
the sky is cloudy
else if it is snowing then
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else
the sky is clear

`is_raining` and
`is_snowing` are booleans

```
sky = None
is_raining = True
is_snowing = False
if is_raining == True:
    sky = "cloudy"
elif is_snowing == True:
    sky = "cloudy"
else:
    sky = "clear"
```

Comparison Operators

Numerical operators

- ==
- !=
- >
- >=
- <
- <=

Examples

```
3 == 4 # False
3 != 4 # True
3 > 4  # False
3 < 4  # True
```

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- `!=`
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Examples

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3 != 4 # True
3 > 4  # False
3 < 4  # True
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Logical Operators

Logical operators tie various logical statements together

- `and`
- `or`

```
True and True
True and False
False and False
True or True
True or False
False or False
```

Logical Operators

Logical operators tie various logical statements together

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```
True and True    # True
True and False   # False
False and False  # False
True or True     # True
True or False    # True
False or False   # False
```

Logical Operators

You can combine logical operations with operators

```
(4 > 3) and (8 > 5)                # True
True or (0.2 < -2)                 # True
(-3 == 2) and (3 == 3)             # False
("hello" == "kitty") and True      # False
```

You can also assign them to variables

```
is_4gt3 = 4 > 3
is_8gt5 = 8 > 5
is_4gt3 and is_8gt5 # True
```

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is_4gt3 and is_8gt5 # True
```

Using Conditional Statements

`if`, `elif`, and `while` all work with a conditional statement

```
import random
count = random.randint(-10, 10)
if count < 0:
    print("count is negative.")
elif count == 0:
    print("count is zero.")
else:
    print("count is positive.")
```

```
count = -10
while count < 0:
    print("count is negative")
    print(count)
    count = random.randint(-10, 10)
```

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count = -10
while count < 0:
    print("count is negative")
    print(count)
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```

Exercises

1. Write code which goes through each number from 0 to 20 and prints the number if it is divisible by 5.
2. Write code which begins with a number equal to 1000. Print the number, then subtract 1 from the variable until the number equals zero.

Functions

- A *function* is a piece of code which can be written once and run many times
- Examples of built-in functions: `range`, `print`, `randint`
- Two most important parts of a function
  - *arguments* - what goes between the parentheses
  - *return value* - what comes back
  - Both are optional

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Built-in Functions

List functions

- `len` - length of list
- `sorted` - sorts a list
- `list` - converts to list

```
len([1, 2, 3])
# 3
```

```
sorted([3, 2, 1])
# [1, 2, 3]
```

```
list( (1, 2, 3) )
# [1, 2, 3]
```

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# 3
```

```
sorted([3, 2, 1])
# [1, 2, 3]
```

```
list( (1, 2, 3) )
# [1, 2, 3]
```

Built-in Functions

Type functions

- `type` - get type of object
- `int` - convert to integer
- `float` - convert to float
- `str` - convert to string

```
type([1, 2, 3])
# list

type(1.3)
# float

int("10")
# 10

float(1000)
# 1000.0

str(100)
Out[]: '100'
```

Built-in Functions

Type functions

- `type` - get type of object
- `int` - convert to integer
- `float` - convert to float
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type([1, 2, 3])
# list

type(1.3)
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int("10")
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float(1000)
# 1000.0

str(100)
Out[]: '100'
```

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type([1, 2, 3])
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type(1.3)
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int("10")
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float(1000)
# 1000.0

str(100)
Out[]: '100'
```

Built-in Functions

Type functions

- `type` - get type of object
- `int` - convert to integer
- `float` - convert to float
- `str` - convert to string

```
type([1, 2, 3])
# list

type(1.3)
# float

int("10")
# 10

float(1000)
# 1000.0

str(100)
Out[]: '100'
```

User-defined functions

Define your own functions if you plan using the same piece of code over and over.

```
def my_mean(my_list):
    sum = 0
    for i in my_list:
        sum += i
    return sum / len(my_list)

my_mean([1, 2, 4, 8, 10])
# 5.0
```

User-defined functions

`def` says that this will be a user-defined function.

```
def my_mean(my_list):
    sum = 0
    for i in my_list:
        sum += i
    return sum / len(my_list)

my_mean([1, 2, 4, 8, 10])
# 5.0
```

User-defined functions

What comes after `def` is the function name.

```
def my_mean(my_list):
    sum = 0
    for i in my_list:
        sum += i
    return sum / len(my_list)

my_mean([1, 2, 4, 8, 10])
# 5.0
```

User-defined functions

In between the parentheses are the arguments. You use them as variables within the function.

```
def my_mean(my_list):
    sum = 0
    for i in my_list:
        sum += i
    return sum / len(my_list)

my_mean([1, 2, 4, 8, 10])
# 5.0
```

User-defined functions

`return` is a special function which gives a value back from the function.

```
def my_mean(my_list):
    sum = 0
    for i in my_list:
        sum += i
    return sum / len(my_list)

my_mean([1, 2, 4, 8, 10])
5.0
```

Methods

A *method* is a function which is associated with an object. The big difference is the syntax, which is

```
object.method(args)
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
```

List methods

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my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]

my_list.count(4)
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]

my_list.count(4)
# 2
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]

my_list.count(4)
# 2

my_list.remove(1)
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]

my_list.count(4)
# 2

my_list.remove(1)
# [2, 3, 4, 1, 2, 4]
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]

my_list.count(4)
# 2

my_list.remove(1)
# [2, 3, 4, 1, 2, 4]

my_list.clear()
```

List methods

```
my_list = [1, 2, 3]
my_list.append(4)
# [1, 2, 3, 4]

my_list.extend([1, 2, 4])
# [1, 2, 3, 4, 1, 2, 4]

my_list.count(4)
# 2

my_list.remove(1)
# [2, 3, 4, 1, 2, 4]

my_list.clear()
# []
```

String methods

```
my_string = "this is a string. it is a good string"
my_string.capitalize()
```

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my_string = "this is a string. it is a good string"
my_string.capitalize()
# 'This is a string. it is a good string'
```

String methods

```
my_string = "this is a string. it is a good string"
my_string.capitalize()
# 'This is a string. it is a good string'

my_string.find("it")
```

String methods

```
my_string = "this is a string. it is a good string"
my_string.capitalize()
# 'This is a string. it is a good string'

my_string.find("it")
# 18
```

String methods

```
my_string = "this is a string. it is a good string"
my_string.capitalize()
# 'This is a string. it is a good string'

my_string.find("it")
# 18

my_string.count("is")
```

String methods

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my_string = "this is a string. it is a good string"
my_string.capitalize()
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my_string.replace("string", "bit of text")
```

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# 'this is a bit of text. it is a good bit of text'
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# 'This is a string. it is a good string'

my_string.find("it")
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my_string.replace("string", "bit of text")
# 'this is a bit of text. it is a good bit of text'

my_string.split()
```

String methods

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my_string.capitalize()
# 'This is a string. it is a good string'

my_string.find("it")
# 18

my_string.count("is")
# 2

my_string.replace("string", "bit of text")
# 'this is a bit of text. it is a good bit of text'

my_string.split()
# ['this', 'is', 'a', 'string.', 'it', 'is',
    'a', 'good', 'string']
```

Exercises

1. Write a function which checks if a string is in another string. If so, return True. If not, return False.
2. Write a function which takes two numbers x and y, raises x to the y power, and subtracts one, i.e. $f(x, y) = x^y - 1$. Return the result.

Modules

Modules are prewritten libraries of objects and functions.

Three ways of importing modules

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import random
random.randint(-1, 1)
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import random as ra
ra.randint(-1, 1)
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Three ways of importing modules

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import random
random.randint(-1, 1)
```

```
import random as ra
ra.randint(-1, 1)
```

```
from random import randint
randint(-1, 1)
```

SciPy and pandas

SciPy is a module for scientific and technical computing.

pandas is a module for data manipulation and analysis.

We will usually import these two modules like so:

```
import numpy as np
import pandas as pd
```