# CONTROL AND ITERATION 1

DATA C88C

January 22, 2024

## 1 Control

**Control structures** direct the flow of logic in a program. For example, conditionals (`if-elif-else`) allow a program to skip sections of code, while iteration (`while`), allows a program to repeat a section.

### 1.1 If statements

**Conditional statements** let programs execute different lines of code depending on certain conditions. Let's review the `if- elif-else` syntax:

```
if <conditional expression>:
    <suite of statements>
elif <conditional expression>:
    <suite of statements>
else:
    <suite of statements>
```

Recall the following points:

- The `else` and `elif` clauses are optional, and you can have any number of `elif` clause.

- A **conditional expression** is a expression that evaluates to either a true value (`True`, a non-zero integer, etc.) or a false value (`False`, `0`, `None`, etc.).

- Only the **suite** that is indented under the first `if`/`elif` that has a **conditional expression** that evaluates to `True` will be executed.

- If none of the **conditional expressions** are `True`, then the `else` suite is executed. There can only be one `else` clause in a conditional statement!

## 1.2   Boolean Operators

Python also includes the **boolean operators** `and`, `or`, and `not`. These operators are used to combine and manipulate boolean values.

- `not` returns the opposite truth value of the following expression.

- `and` short-circuits at the first `False` value and returns it. If all values evaluate to `True`, the last value is returned.

- `or` short-circuits at the first `True` value and returns it. If all values evaluate to `False`, the last value is returned.

```
>>> not None
True
>>> not True
False
>>> -1 and 0 and 1
0
>>> False or 9999 or 1/0
9999
```

## 1.3   Questions

1. Determine what the Python interpreter will output given the following lines of code.
   ```
   >>> from operator import add, mul
   >>> mul(add(5, 6), 8)
   ```

   > **Solution:** 88

   ```
   >>> print('x')
   ```

   > **Solution:** x

   ```
   >>> y = print('x')
   ```

   > **Solution:** x

   ```
   >>> print(y)
   ```

   > **Solution:** None

   ```
   >>> print(add(4, 2), print('a'))
   ```

> **Solution:**
>
> ```
> a
> 6 None
> ```

```python
def foo(x):
    print(x)
    return x + 1


def bar(y, x):
    print(x - y)

>>> foo(3)
```

> **Solution:**
>
> ```
> 3
> 4
> ```

```python
>>> bar(3)
```

> **Solution:** Error

```python
>>> bar(6, 1)
```

> **Solution:** -5

```python
>>> bar(foo(10), 11)
```

> **Solution:**
>
> ```
> 10
> 0
> ```

2. Tommy will only wear a jacket outside if it is below 60 degrees or it is raining.

Write a function that takes in the current temperature and a boolean value telling if it is raining and returns `True` if Tommy will wear a jacket and `False` otherwise.

First, try solving this problem using an if statement.

```python
def wears_jacket_with_if(temp, raining):
    """
    >>> wears_jacket_with_if(90, False)
    False
    >>> wears_jacket_with_if(40, False)
    True
    >>> wears_jacket_with_if(100, True)
    True
    """
```

**Solution:**
```python
    if temp < 60 or raining:
        return True
    else:
        return False
```

Note that we'll either return `True` or `False` based on a single condition, whose truthiness value will also be either `True` or `False`. Knowing this, try to write this function using a single line.

```python
def wears_jacket(temp, raining):
```

**Solution:**
```python
    return temp < 60 or raining
```

Video walkthrough

3. To handle discussion section overflow, Matt and other TAs may direct students to a more empty section that is happening at the same time.

Write a function that takes in the number of students in two sections and prints out what to do if either section exceeds 30 students.

**Hint**: You can do **str**(<number>)+ <string> to concatenate a number and a string

```python
def handle_overflow(s1, s2):
    """
    >>> handle_overflow(27, 15)
    No overflow
    >>> handle_overflow(35, 29)
    Move to Section 2: 1
    >>> handle_overflow(20, 32)
    Move to Section 1: 10
    >>> handle_overflow(35, 30)
    No space left in either section
    """
```

**Solution:**
```python
    if s1 <= 30 and s2 <= 30:
        print("No overflow")
    elif s2 > 30 and s1 < 30:
        print("Move to Section 1:" + str(30 - s1))
    elif s1 > 30 and s2 < 30:
        print("Move to Section 2:" + str(30 - s2))
    else:
        print("No space left in either section")
```
Video walkthrough

4. Write a function that returns `True` if a positive integer n is a prime number and `False` otherwise.

A prime number $n$ is a number that is not divisible by any numbers other than 1 and $n$ itself. For example, 13 is prime, since it is only divisible by 1 and 13, but 14 is not, since it is divisible by 1, 2, 7, and 14.

**Hint**: use the `%` operator: `x % y` returns the remainder of x when divided by y.

```python
def is_prime(n):
    """
    >>> is_prime(10)
    False
    >>> is_prime(7)
    True
    """
```

> **Solution:**
> ```python
>     if n == 1:
>         return False
>     k = 2
>     while k < n:
>         if n % k == 0:
>             return False
>         k += 1
>     return True
> ```
> Alternatively, the while loop's conditional expression could ensure that k is less than or equal to the square root of n.
> Video walkthrough