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.

If statements

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

Recall the following points:

- The else and elif clauses are optional, and you can have any number of elif clauses.
- 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 with a conditional expression evaluating to a true value will be executed.
- If none of the conditional expressions evaluate to a true value, then the else suite is executed. There can only be one else clause in a conditional statement!

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 stops evaluating any more expressions (short-circuits) once it reaches the first false value and returns it. If all values evaluate to a true value, the last value is returned.
- or short-circuits at the first true value and returns it. If all values evaluate to a false value, the last value is returned.
Questions

1.1 Alfonso will only wear a jacket outside if it is below 60 degrees or it is raining. Fill in the function `wears_jacket` which takes in the current temperature and a Boolean value telling if it is raining and returns `True` if Alfonso will wear a jacket and `False` otherwise.

This should only take one line of code!

```python
def wears_jacket(temp, raining):
    return temp < 60 or raining
```

1.2 To handle discussion section overflow, TAs may direct students to a more empty section that is happening at the same time. Write the function `handle_overflow`, which takes in the number of students at two sections and prints out what to do if either section exceeds 30 students. **Note:** Don’t worry about printing “spot” for singular values and “spots” for multiple values.

```python
def handle_overflow(s1, s2):
    if s1 <= 30 and s2 <= 30:
        print("No overflow.")
    elif s2 > 30 and s1 < 30:
        print(str(30 - s1) + " spots left in Section 1.")
    elif s1 > 30 and s2 < 30:
        print(str(30 - s2) + " spots left in Section 2.")
    else:
        print("No space left in either section.")
```
While loops

Iteration lets a program repeat statements multiple times. A common iterative block of code is the **while loop**.

As long as `<conditional clause>` evaluates to a true value, `<body of statements>` will continue to be executed. The conditional clause gets evaluated each time the body finishes executing.

Questions

1.1 What is the result of evaluating the following code?

```python
def square(x):
    return x * x

def so_slow(num):
    x = num
    while x > 0:
        x = x + 1
    return x / 0

square(so_slow(5))
```

Infinite loop because `x` will always be greater than 0; the `num / 0` is never executed.

1.2 Fill in the `is_prime` function, which returns `True` if `n` is a prime number and `False` otherwise. After you have a working solution, think about potential ways to make your solution more efficient.

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

```python
def is_prime(n):
    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 the square root of `n`. 
# 2 Environment Diagrams

An environment diagram keeps track of all the variables that have been defined and the values they are bound to.

```python
x = 3
def square(x):
    return x ** 2
square(2)
```

When you execute assignment statements in an environment diagram (like `x = 3`), you need to record the variable name and the value:

1. Evaluate the expression on the right side of the `=` sign
2. Write the variable name and the expression's value in the current frame.

When you execute `def` statements, you need to record the function name and bind the function object to the name.

1. Write the function name (e.g., `square`) in the frame and point it to a function object (e.g., `func square(x) [parent=Global]`). The `[parent=Global]` denotes the frame in which the function was defined.

When you execute a call expression (like `square(2)`), you need to create a new frame to keep track of local variables.

1. Draw a new frame. Label it with
   - a unique index (f1, f2, f3 and so on)
   - the intrinsic name of the function (`square`), which is the name of the function object itself. For example, if the function object is `func square(x) [parent=Global]`, the intrinsic name is `square`.
   - the parent frame ([parent=Global])
2. Bind the formal parameters to the arguments passed in (e.g. bind `x` to 3).
3. Evaluate the body of the function.

If a function does not have a return value, it implicitly returns `None`. Thus, the "Return value" box should contain `None`.

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Since we do not know how built-in functions like `add(...)` or `min(...)` are implemented, we do not draw a new frame when we call built-in functions.
Questions

2.1 Draw the environment diagram that results from running the following code.

```python
a = 1
def b(b):
    return a + b
a = b(a)
a = b(a)
```

![Environment Diagram](image)
2.2 Draw the environment diagram so we can visualize exactly how Python evaluates the code. What is the output of running this code in the interpreter?

```python
>>> from operator import add
>>> def sub(a, b):
...     sub = add
...     return a - b
>>> add = sub
>>> sub = min

>>> print(add(2, sub(2, 3)))
```

Output:

```
0
```