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## CMSC 201 Fall 2017

### Lab 04 – While Loops

**Assignment:** Lab 04 – While Loops

**Due Date:** **During discussion**, September 24th through September 28th

**Value:** 10 points (8 points during lab, 2 points for Pre Lab quiz)

In Lab 3, you used conditionals and simple decisions structures to control the “flow” of a program. This week’s lab will put into practice some of the material learned in class, including while loops and nesting decision structures. (Having concepts explained in a new and different way can often lead to a better understanding, so make sure to pay attention.)

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## Part 1A: Review – While Loops

A **while** loop statement in the Python programming language repeatedly executes a target statement as long as a given Boolean condition is **True**.

The syntax of a **while** loop in the Python programming language is:

```
while <condition>:
    <statement(s)>
```

Here, **<statement(s)>** may be a single statement or a **block** of statements. The **<condition>** can be any expression, as long as it evaluates to either **True** or **False**. (Remember, any non-zero value is seen as "**True**" by Python.) The **while** loop continues to run as long as the condition is still **True**. In other words, it runs while the condition is **True**.

As soon as the condition evaluates to **False**, program control passes to the line of code immediately following the statements inside the **while** loop. This is the first line of code after the **while** loop and its statements. It is indented to the same depth as the "**while <condition>:**" line of code.

Remember that in Python, all the statements indented by the same number of character spaces after **while** (or **if**, etc.) statements are considered to be part of a single **block** of code. Python uses indentation as its method of grouping statements.

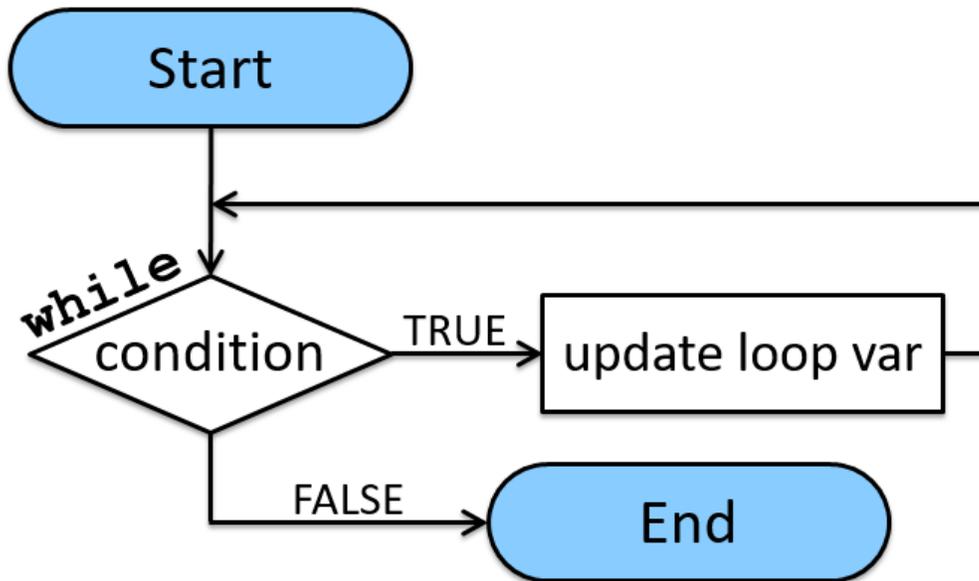


Figure1. A `while` loop in Python

```

while <condition>:
    <statement(s)>
  
```

Each time Python finishes executing the "`<statement(s)>`" inside the `while` loop, it returns to and reevaluates the "`<condition>`". This helps it decide: if the condition evaluates to `True`, it will execute the statements again; if the condition evaluates to `False`, it will stop running the `while` loop.

It's as if Python is asking itself "OK, I'm done – should I go again?" If the condition always evaluates to `True`, the program gets stuck in an *infinite loop*.

It is possible that a `while` loop might not ever run the "`<statement(s)>`" inside the `while` loop. If the condition is tested and the result is `False`, the loop body (the statements) will be skipped and the first line of code after the `while` loop will be executed.

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## Part 1B: Review – Interactive Loops

One of the major uses of a `while` loop is to interact with the user of the program. Users are unpredictable, and we can't always rely on them to act in the correct way, or to follow the rules or directions we give.

Our program may need to ask a user for something over and over and over (and over and over) before it is satisfied. The user may be entering multiple pieces of information, or they may be putting in invalid data (such as a negative score on a quiz, or an email address with no "@" symbol in it).

Since we don't know how many times we'll have to reprompt the user, it makes the most sense to use a `while` loop when interacting with the user in this way.

The first type of interactive loop is one that verifies input from the user. In this case, we continually reject the user's answer while it is unsatisfactory (in other words, until it is satisfactory). The pseudocode for one of these loops might look like this:

```

Ask the user for their input
While the input is not valid:
    Print out what sort of input IS valid
    Reprompt the user for new input
    
```

In an input-verifying loop, it is very important that you tell the user what is unacceptable about their input, and how to fix it.

```

def main():
    age = int(input("How old are you?"))

    while age < 0:
        print("Please enter a positive age.")
        age = int(input("How old are you?"))

    print("Happy", age, "th birthday!")
    
```

```
main()
```

## Part 2: Exercise

In this lab, you'll be creating one file, `temps.py`, but you'll be creating it in three steps. That way, you can focus on each of the steps needed one by one.

By the time the `temps.py` program is complete, it will ask the user to enter temperatures, and will keep track of the minimum and maximum values entered.

### Tasks

- Create a `temps.py` file
- Write the code to get a positive number from the user
- Run and test your `temps.py` file
- Write the code to get all the temperatures from the user
- Run and test your `temps.py` file
- Modify the code to store the minimum and maximum temperatures
- Run and test your `temps.py` file
- Show your work to your TA

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## Part 3A: Creating Your File

First, create the `lab04` folder using the `mkdir` command -- the folder needs to be inside your `Labs` folder as well. *(If you need a reminder of how to create and navigate folders, try asking a classmate next to you for help. If you're both stuck, ask the TA or refer to the instructions for Lab 1.)*

Next, create a Python file called `temps.py` using the “touch” command in GL.

**The “touch” command creates a new blank file, but doesn't open it.**

Once a file has been “touched”, you can open and edit it using emacs.

```
touch temps.py
emacs temps.py
```

The first thing you should do with any new Python file is create and fill out the comment header block at the top of your file. Here is a template:

```
# File:          FILENAME.py
# Author:       YOUR NAME
# Date:        2/TODAY/2017
# Section:     YOUR SECTION NUMBER
# E-mail:     USERNAME@umbc.edu
# Description: YOUR DESCRIPTION GOES HERE AND HERE
#            YOUR DESCRIPTION CONTINUED SOME MORE
```

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## Part 3B: Getting a Positive Number

**This is the first of three steps that must be written for this lab.**

This first step uses a simple `while` loop to get a positive number from the user. If they enter a non-positive number (negative or zero), the program must reprompt them until they enter a positive number.

The program you are writing will be used to find the minimum and maximum in a list of temperatures. The first question we are asking the user is how many temperatures they would like to enter.

Here is some sample output, with the user input in **blue**.

(Yours does not have to match this word for word, but it should be similar.)

```
bash-4.1$ python temps.py
How many temperatures would you like to enter? 0
You must enter a number greater than zero.
How many temperatures would you like to enter? -9
You must enter a number greater than zero.
How many temperatures would you like to enter? 4
```

Once this part of the program works correctly, move on to the next step.

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## Part 3C: Getting the Temperatures

**This is the second of three steps that must be written for this lab.**

This second step will use another `while` loop to get the temperatures from the user, and will keep asking for another temperature until the user enters as many temperatures as they previously indicated. In other words, if the user answered that they wanted to enter “4” temperatures, the program must ask for four temperatures.

**The program does not need to worry about the user entering negative temperatures. It is perfectly valid to enter a negative temperature.**

Here is some sample output, with the user input in **blue**.

(Yours does not have to match this word for word, but it should be similar.)

```
bash-4.1$ python temps.py
How many temperatures would you like to enter? 4
Enter a temperature: -273.15
Enter a temperature: 32.0
Enter a temperature: 98.6
Enter a temperature: 105.2
```

Once this part of the program works correctly, move on to the next step.

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## Part 3D: Find the Minimum and Maximum

**This is the last of three steps that must be written for this lab.**

This last step requires that you use decision structures to determine the minimum and maximum values that the user entered.

The best way to do this is to compare each new temperature as your program receives it, to see if it is smaller than the minimum so far (or larger than the maximum).

Think carefully about how and when to initialize your variables that will store the minimum and maximum. If you set minimum to a starting value like 10000000, it's still possible for the user to only enter numbers larger than that, which means your minimum would be wrong!

*(HINT: If you ask for the first temperature before the while loop starts, you can use that value to initialize the minimum and maximum variables. Don't initialize them inside the while loop, since they'll just get overwritten!)*

Here is some sample output, with the user input in **blue**.  
(Yours does not have to match this word for word, but it should be similar.)

```
bash-4.1$ python temps.py
How many temperatures would you like to enter? 6
Enter a temperature: -12.5
Enter a temperature: 98.6
Enter a temperature: 100.1
Enter a temperature: 72
Enter a temperature: 32
Enter a temperature: 88.3
The minimum temperature entered was -12.5
The maximum temperature entered was 100.1
```

## Part 4: Completing Your Lab

Since this is an in-person lab, you do not need to use the `submit` command to complete your lab. Instead, raise your hand to let your TA know that you are finished.

They will come over and check your work – they may ask you to run your program for them, and they may also want to see your code. Once they've checked your work, they'll give you a score for the lab, and you are free to leave.

### Tasks

- Create a `temps.py` file
- Write the code to get a positive number from the user
- Run and test your `temps.py` file
- Write the code to get all the temperatures from the user
- Run and test your `temps.py` file
- Modify the code to store the minimum and maximum temperatures
- Run and test your `temps.py` file
- Show your work to your TA

**IMPORTANT:** If you leave the lab without the TA checking your work, you will receive a **zero** for this week's lab. Make sure you have been given a grade before you leave!