MA305 – Lab #5
Indexing and Searching Lists (Arrays)

Due on: 11/01/2023

Reading data into arrays enables extraction of information that would be difficult otherwise. As an example, consider some Temperature-Humidity data, recorded in a data file as follows:

```
----- Date, Temperature, Humidity data ---------
 660219  -13  38
 790711   53  88
 841108   -6  11
 881227   57  12
   ...    ... ...
```

Each data line contains 3 numbers (integers in this case): Date (as YYMMDD), Temperature and Humidity. We want to figure out interesting information such as: hottest/coldest date, most/least humid date, the number of days the temperature is below freezing or above 70, etc.

1. Figure out the logic and basic steps (algorithm) to do the following:

a. Read the data `lab5.txt` and store the columns into three (integer) lists: `D, T, H`

b. Search through the data and find the dates of highest and lowest temperature, and highest and lowest humidity.

One way of doing this would be to first find `Tmax` and then compare each `T[i]` with `Tmax` to pick out the index `i` at which `T[i] = Tmax`. If we call this index `idx`, then the hottest date is `D[idx]`.

c. Find the average temperature, and average humidity level.

d. Find the number of days that the temperature is:
- below freezing
- above the average temperature

e. Print out dates in the usual format of MM/DD/YY.

This requires decoding the date information, which can be done as follows: if `Date` is the variable containing the date as an integer of the form YYMMDD, then

```
day = mod( Date, 100 )
month = mod( Date/100, 100 )
year = Date/10000
```

where `mod(m,n)` = remainder of the integer division `m/n`. Do you see why this works?

Note: In Python: integer division `a/b` is `a//b` and `mod(a,b)` is `a%b` !

2. Create a new directory 'Lab5' and write a Python program `lab5.py` to implement the steps (a-e) as described in **1**. You need a data file for this lab, get the file `lab5.txt` from your course Canvas and keep it in the same directory.

3. The data file 'lab5.txt' contains Date (YYMMDD), Temperature and Humidity data. From the temperature, `T`, and the (relative) humidity, `H`, we can compute the Heat Index (approximately) using the formula:

```
HI =  -42.379 + 2.04901523*T + 10.14333127*H -
     0.22475541*T*H - 6.83783e-3*T*T - 5.481717e-2*H*H +
     1.22874e-3*T*T*H + 8.5282e-4*T*H*H - 1.99e-6*T*T*H*H , for T > 55,
HI = T , for T <= 55.
```

a. Write a function `heat_index()` to compute Heat Index using the above formula.

b. For each Temperature, Humidity pair, compute the corresponding Heat Index, and print out the results (Date, Temperature, Humidity, Heat Index, nicely lined up in columns). This is for you to see that you read in the data. Do NOT submit this output!

c. Find the dates of lowest temperature, and of highest heat index. For each day found, your code should print the date, temperature, humidity, and heat index, with date in the common format of MM/DD/YY.

d. Find and report the average temperature, the average humidity level and the average heat index of the data.

e. Count and report the number of days that the temperature is in the following ranges (i) Temp > 50 (ii) $0 \leq$ Temp < 32

4. Make a log of your work using Unix command `script`. Save the typescript file as `lab5_script.txt`, edit it showing the python code and the results from **3**c.,d.,e. separated by lines. ==========

5. Submit your code `lab5.py` and `lab5_script.txt` through Canvas.

Some suggestions:

- Do it step by step, one small thing at a time, till that part works.
- To help debugging, insert `print()` statements to see what values are produced. Once debugged, comment those out (or delete them).
- Note that all the data values are integers. You may choose to treat them either as integers or as reals. Just be careful...