CS410P
ASSIGNMENT 4P

The purpose of this assignment is to give you practice with repetition using for nested loops, lists, tuples, functions.

You are required to write a program to print 2 tables of temperature values converting Celsius to Fahrenheit.

The first table should display the following columns: Temperature in Celsius, Temperature in Fahrenheit, several columns of Temperature in Fahrenheit which include Wind Chill factor (one column for each wind speed starting 5mph up to 40mph in increments of 5mph).

The second table should display the following columns: Temperature in Celsius, Temperature in Fahrenheit, several columns of Temperature in Fahrenheit which include Head Index factor (one column for each relative humidity percentage starting at 40% up to 100% in increments of 10).

The headings for each column must also be printed i.e. Celsius, Fahrenheit, Wind speed (or Heat index) value. For any temperature value that's not valid for either Wind Chill calculation or Heat Index calculation print a "X" in that column.

Scenario

Wind chill is the perceived decrease in air temperature felt by the body on exposed skin due to the flow of air.

Wind chill numbers are always lower than the air temperature for values where the formula is valid. When the apparent temperature is higher than the air temperature, the heat index is used instead.

In 2001 there were corrections made to the wind chill calculations and the formula for computing this in U.S customary units are:

$$T_{wc} = 35.74 + 0.6215T_a - 35.75V^{+0.16} + 0.4275T_aV^{+0.16}$$

where T_{wc} is the wind chill index, based on the Fahrenheit scale, T_a is the air temperature, measured in °F, and V is the wind speed, in mph.

Wind chill temperatures are valid for temperatures upto 50 deg Fahrenheit only and when the wind speed is 5 miles or more.

The heat index is an index that combines air temperature and relative humidity in an attempt to determine the human-perceived equivalent temperature—how hot it feels. Like the wind chill index, the heat index contains assumptions about the human body mass and height, clothing, amount of physical activity, thickness of blood, sunlight and ultraviolet radiation exposure, and the wind speed.

In the late 1970s there was a formula developed to calculate the heat index and this formula below approximates the heat index in degrees Fahrenheit, to within ±1.3 °F

$$HI = c_1 + c_2 T + c_3 R + c_4 T R + c_5 T^2 + c_6 R^2 + c_7 T^2 R + c_8 T R^2 + c_9 T^2 R^2$$

where

HI = heat index (in degrees Fahrenheit)

T = ambient dry-bulb temperature (in degrees Fahrenheit)

R = relative humidity (percentage value between 0 and 100)

$c_1 = -42.379, c_2 = 2.04901523, c_3 = 10.14333127, c_4 = -0.22475541, c_5 = -6.83783 \times 10^{-3}, c_6 = -5.481717 \times 10^{-2},$
$c_7 = 1.22874 \times 10^{-3}, c_8 = 8.5282 \times 10^{-4}, c_9 = -1.99 \times 10^{-6}.$

Heat index formula is valid only when the temperature is 80 deg Fahrenheit or above and when the relative humidity is 40% or more.

Requirements

Two files need to be submitted: main.py (should contain code only for main function); functions.py (should contain the functions outlined below in 1 & 2).

The main program prompts the user to enter 2 integers which is the range of values to be computed:
- Only numbers in the range 20 to 50 (both inclusive) are accepted
- First number should be less than second
- Any non-integer input will stop the program, otherwise program continues to accept a pair of values and processes them (exception handler is needed)
- Both numbers are accepted on the same line (i.e. no new line or carriage return after first number)

(1) First table should display the original Celsius and the computed Fahrenheit temperature as the first 2 columns, additional columns for Wind Speeds from 5mph to 40 mph in increments of 5. The Fahrenheit temperature for each wind speed with Wind Chill factor must be printed under the particular Wind Speed column. *Wind Chill temperatures must be computed in a function of its own called compute_wind_chill()*

(2) Second table should display original Celsius and the computed Fahrenheit temperature as the first 2 columns, additional columns for Relative Humidity from 40% to 100% in increments of 10. The Fahrenheit temperature for each relative humidity with Heat Index factor must be printed under the particular Relative Humidity column. *Heat Index temperatures must be computed in a function of its own called compute_head_index()*

For both (1) and (2) irrelevant columns should contain a "X" (i.e. for starting Fahrenheit temperatures that are greater than 50 for Wind Speed and less than 80 for Heat Index)

You need to use a nested for statement to compute the values for both tables. As you iterate through the loops you can print the computed values as you go along. Each function also returns a count of extreme temperatures. Extreme cold temperatures are those are below zero Fahrenheit (with or without wind chill), extreme hot temperatures are those above 100 (with or without heat index).

For extra credit you should store each computed value in a list (so one row in the table will be a list of values for a particular value of Celsius/Fahrenheit). Since we have multiple rows in each table you will end up storing the entire table of values in a list of several lists (it's a nested list). If you store values in a list you must return the list to the caller (main function) which prints each table (just saving the values in a list will not get you any extra credit). Printing must not be done in the functions compute_wind_chill() or compute_heat_index().

Sample Outputs

```
Enter 2 numbers between -20 and 50: -10 5
Wind Chill Temperatures
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Celsius	Fahr	5mph	10mph	15mph	20mph	25mph	30mph	35mph	40mph
-10	14.0	5.93	1.42	-1.47	-3.63	-5.38	-6.85	-8.13	-9.27
-9	15.8	8.05	3.65	0.84	-1.27	-2.97	-4.41	-5.65	-6.76
-8	17.6	10.16	5.88	3.14	1.09	-0.56	-1.96	-3.18	-4.25
-7	19.4	12.28	8.11	5.45	3.46	1.84	0.48	-0.7	-1.75
-6	21.2	14.39	10.34	7.76	5.82	4.25	2.93	1.78	0.76
-5	23.0	16.5	12.57	10.06	8.18	6.66	5.37	4.26	3.27
-4	24.8	18.62	14.8	12.37	10.54	9.06	7.82	6.74	5.78
-3	26.6	20.73	17.03	14.67	12.9	11.47	10.26	9.21	8.28
-2	28.4	22.85	19.27	16.98	15.26	13.88	12.71	11.69	10.79
-1	30.2	24.96	21.5	19.28	17.62	16.28	15.15	14.17	13.3
0	32.0	27.08	23.73	21.59	19.99	18.69	17.6	16.65	15.81
1	33.8	29.19	25.96	23.89	22.35	21.1	20.04	19.12	18.31
2	35.6	31.3	28.19	26.2	24.71	23.5	22.49	21.6	20.82
3	37.4	33.42	30.42	28.51	27.07	25.91	24.93	24.08	23.33
4	39.2	35.53	32.65	30.81	29.43	28.32	27.38	26.56	25.83
5	41.0	37.65	34.88	33.12	31.79	30.72	29.82	29.04	28.34

```
Extreme cold:  17

Heat Index Temperatures
```

Celsius	Fahr	40%	50%	60%	8%	80%	90%	100%
-10	14.0	X	X	X	X	X	X	X
-9	15.8	X	X	X	X	X	X	X
-8	17.6	X	X	X	X	X	X	X
-7	19.4	X	X	X	X	X	X	X
-6	21.2	X	X	X	X	X	X	X
-5	23.0	X	X	X	X	X	X	X
-4	24.8	X	X	X	X	X	X	X
-3	26.6	X	X	X	X	X	X	X
-2	28.4	X	X	X	X	X	X	X
-1	30.2	X	X	X	X	X	X	X
0	32.0	X	X	X	X	X	X	X
1	33.8	X	X	X	X	X	X	X
2	35.6	X	X	X	X	X	X	X
3	37.4	X	X	X	X	X	X	X
4	39.2	X	X	X	X	X	X	X
5	41.0	X	X	X	X	X	X	X

```
Extreme heat: 0
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Enter 2 numbers between -20 and 50: 0 12
Wind Chill Temperatures

Celsius	Fahr	5mph	10mph	15mph	20mph	25mph	30mph	35mph	40mph
0	32.0	27.08	23.73	21.59	19.99	18.69	17.6	16.65	15.81
1	33.8	29.19	25.96	23.89	22.35	21.1	20.04	19.12	18.31
2	35.6	31.3	28.19	26.2	24.71	23.5	22.49	21.6	20.82
3	37.4	33.42	30.42	28.51	27.07	25.91	24.93	24.08	23.33
4	39.2	35.53	32.65	30.81	29.43	28.32	27.38	26.56	25.83
5	41.0	37.65	34.88	33.12	31.79	30.72	29.82	29.04	28.34
6	42.8	39.76	37.11	35.42	34.15	33.13	32.26	31.51	30.85
7	44.6	41.88	39.34	37.73	36.52	35.54	34.71	33.99	33.36
8	46.4	43.99	41.57	40.03	38.88	37.94	37.15	36.47	35.86
9	48.2	46.1	43.81	42.34	41.24	40.35	39.6	38.95	38.37
10	50.0	48.22	46.04	44.64	43.6	42.76	42.04	41.43	40.88
11	51.8	X	X	X	X	X	X	X	X
12	53.6	X	X	X	X	X	X	X	X

Extreme cold: 0

Heat Index Temperatures

Celsius	Fahr	40%	50%	60%	8%	80%	90%	100%
0	32.0	X	X	X	X	X	X	X
1	33.8	X	X	X	X	X	X	X
2	35.6	X	X	X	X	X	X	X
3	37.4	X	X	X	X	X	X	X
4	39.2	X	X	X	X	X	X	X
5	41.0	X	X	X	X	X	X	X
6	42.8	X	X	X	X	X	X	X
7	44.6	X	X	X	X	X	X	X
8	46.4	X	X	X	X	X	X	X
9	48.2	X	X	X	X	X	X	X
10	50.0	X	X	X	X	X	X	X
11	51.8	X	X	X	X	X	X	X
12	53.6	X	X	X	X	X	X	X

Extreme heat: 0

```
Enter 2 numbers between -20 and 50: 25 38
Wind Chill Temperatures
Celsius Fahr    5mph    10mph   15mph   20mph   25mph   30mph   35mph   40mph
25      77.0    X       X       X       X       X       X       X       X
26      78.8    X       X       X       X       X       X       X       X
27      80.6    X       X       X       X       X       X       X       X
28      82.4    X       X       X       X       X       X       X       X
29      84.2    X       X       X       X       X       X       X       X
30      86.0    X       X       X       X       X       X       X       X
31      87.8    X       X       X       X       X       X       X       X
32      89.6    X       X       X       X       X       X       X       X
33      91.4    X       X       X       X       X       X       X       X
34      93.2    X       X       X       X       X       X       X       X
35      95.0    X       X       X       X       X       X       X       X
36      96.8    X       X       X       X       X       X       X       X
37      98.6    X       X       X       X       X       X       X       X
38      100.4   X       X       X       X       X       X       X       X

Extreme cold:  0

Heat Index Temperatures
Celsius Fahr    40%     50%     60%     8%      80%     90%     100%
25      77.0    X       X       X       X       X       X       X
26      78.8    X       X       X       X       X       X       X
27      80.6    80.36   81.36   82.56   83.95   85.55   87.35   89.34
28      82.4    81.8    83.22   85.02   87.21   89.8    92.77   96.13
29      84.2    83.5    85.4    87.87   90.92   94.55   98.76   103.54
30      86.0    85.45   87.9    91.11   95.08   99.82   105.32  111.58
31      87.8    87.65   90.72   94.73   99.69   105.6   112.44  120.24
32      89.6    90.1    93.86   98.74   104.75  111.88  120.14  129.52
33      91.4    92.81   97.33   103.14  110.26  118.68  128.4   139.42
34      93.2    95.78   101.11  107.93  116.22  125.99  137.23  149.95
35      95.0    98.99   105.22  113.1   122.63  133.8   146.63  161.1
36      96.8    102.46  109.65  118.66  129.49  142.13  156.59  172.87
37      98.6    106.19  114.41  124.61  136.79  150.97  167.13  185.27
38      100.4   110.17  119.48  130.94  144.55  160.31  178.23  198.29

Extreme heat: 49
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Grade Key:

A	Input validation (range) - 7, exception handler (non-numeric) - 3	10
B	Accuracy of wind chill values (20), extreme cold count (5)	25
C	Accuracy of heat index values (20), extreme heat count (5)	25
D	Nested For Loop used accurately, Functions created accurately, Constants defined, Program structure and modularity	20
E	Output format	20
F	Extra credit – Lists are used to store computed values for both temperature tables, returned to the caller and printed in caller (caller is in the main function). No printing occurs in the functions	10