

## Purpose

The purpose of this assignment is to give you practice with writing functions and Nested FOR loops.

## Problem

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 Heat 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  $\pm 1.3$  °F

$$HI = c_1 + c_2T + c_3R + c_4TR + c_5T^2 + c_6R^2 + c_7T^2R + c_8TR^2 + c_9T^2R^2$$

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.

Function compute\_Wind\_Chill ()

Input arguments: Integers for range of Celsius temperature values (1 Input argument for starting Celsius value, 1 Input argument for ending Celsius value)

Output arguments: None

Function Return value: Integer containing number of Fahrenheit values below 20 degrees.

- Converts temperature from Celsius to Fahrenheit for the range of temperatures provided in steps of 1 degree increments.
- Table shows 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.
- Returns count of temperature values less than 20 (extreme values)

Function compute\_Heat\_Index ()

Input arguments: Integers for range of Celsius temperature values (1 Input argument for starting Celsius value, 1 Input argument for ending Celsius value)

Output arguments: None

Function Return value: Integer containing number of Fahrenheit values above 100 degrees.

- Converts temperature from Celsius to Fahrenheit for the range of temperatures provided in steps of 1 degree increments.
- Table shows the 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.
- Returns count of temperature values greater than 100 (extreme values)

For both computations irrelevant columns should contain a “X” (i.e. if the initial Fahrenheit temperatures are greater than 50 for Wind Chill and less than 80 for Heat Index)

You need to use a Nested FOR statement to calculate and print values for each table.

The main() function should display some information to the user as to how the program works. It should take input from the user for specifying the range of values, if the range is outside of -20 to 50 an error message should be displayed and the user must be prompted to enter new values. You do not need a loop to keep getting new inputs from the user if a correct range of values are entered. If a valid range is input by the user, it calls the functions compute\_Wind\_Chill() and compute\_Heat\_Index() to compute and print the two tables of values. After returning from each function, the main() function prints information about the total number of “extreme” temperature values (i.e. totals of wind chill less than 20 and totals of heat index above 100).

## Input

Input should be taken from the user only in the main() function. The input will come from standard input, that is, from a user at the keyboard.

## Output

Output will be sent to standard output (the screen). The initial message about the program to the user and any error messages about the input should be output in the main() function. Your output for all the temperature conversions may not match mine exactly due to truncate/rounding issues but they have to be close. However, your extreme cold and extreme heat counts should match with mine.

Here is mandatory output needed for comparing your extreme count results on Mimir:  
(the variable indicate in each printf statement would be the corresponding one that holds the extreme value, these should be printed in the main() function).

```
printf(“Extreme Cold: %d\n”, count_cold);  
printf(“Extreme Heat: %d\n”, count_heat);
```

## Compiling your program

```
gcc main.c ctof.c -lm -o main
```

## Submission

Submit three files: main.c (contains only main() function), ctof.c (contains other functions), ctof.h (header file with prototype declarations, constants, include statements for libraries)

## Sample Output

This program converts temperature values from Celsius to Fahrenheit  
and also factors in Wind Chill and Heat Index at the appropriate temperatures

Please enter the range of temperature values (in Celsius between -20 and 50) to be converted

Celsius to Fahrenheit with Wind Chill factor

Celsius	Fahrenheit	5mph	10mph	15mph	20mph	25mph	30mph	35mph	40mph
0	32.00	27.08	23.73	21.59	19.99	18.69	17.60	16.65	15.81
1	33.80	29.19	25.96	23.89	22.35	21.10	20.04	19.12	18.31
2	35.60	31.30	28.19	26.20	24.71	23.50	22.49	21.60	20.82
3	37.40	33.42	30.42	28.51	27.07	25.91	24.93	24.08	23.33
4	39.20	35.53	32.65	30.81	29.43	28.32	27.38	26.56	25.83
5	41.00	37.65	34.88	33.12	31.79	30.72	29.82	29.04	28.34
6	42.80	39.76	37.11	35.42	34.15	33.13	32.26	31.51	30.85
7	44.60	41.88	39.34	37.73	36.52	35.54	34.71	33.99	33.36
8	46.40	43.99	41.57	40.03	38.88	37.94	37.15	36.47	35.86
9	48.20	46.10	43.81	42.34	41.24	40.35	39.60	38.95	38.37
10	50.00	X	X	X	X	X	X	X	X
11	51.80	X	X	X	X	X	X	X	X
12	53.60	X	X	X	X	X	X	X	X

## Celsius to Fahrenheit with Heat Index factor

Celsius	Fahrenheit	40%	50%	60%	70%	80%	90%	100%
0	32.00	X	X	X	X	X	X	X
1	33.80	X	X	X	X	X	X	X
2	35.60	X	X	X	X	X	X	X
3	37.40	X	X	X	X	X	X	X
4	39.20	X	X	X	X	X	X	X
5	41.00	X	X	X	X	X	X	X
6	42.80	X	X	X	X	X	X	X
7	44.60	X	X	X	X	X	X	X
8	46.40	X	X	X	X	X	X	X
9	48.20	X	X	X	X	X	X	X
10	50.00	X	X	X	X	X	X	X
11	51.80	X	X	X	X	X	X	X
12	53.60	X	X	X	X	X	X	X
13	55.40	X	X	X	X	X	X	X
14	57.20	X	X	X	X	X	X	X
15	59.00	X	X	X	X	X	X	X
16	60.80	X	X	X	X	X	X	X
17	62.60	X	X	X	X	X	X	X
18	64.40	X	X	X	X	X	X	X
19	66.20	X	X	X	X	X	X	X
20	68.00	X	X	X	X	X	X	X
21	69.80	X	X	X	X	X	X	X
22	71.60	X	X	X	X	X	X	X
23	73.40	X	X	X	X	X	X	X
24	75.20	X	X	X	X	X	X	X
25	77.00	X	X	X	X	X	X	X
26	78.80	X	X	X	X	X	X	X
27	80.60	80.35	81.35	82.54	83.94	85.53	87.32	89.31
28	82.40	81.80	83.21	85.01	87.20	89.78	92.74	96.10
29	84.20	83.40	85.30	87.86	90.91	94.53	98.73	103.51