Heat Index (with DO loops)

Worksheet 5
6 February 2023

The purpose of this worksheet is to practice the use of the (nested) `DO` *loop construct.*

The heat index (HI), also know as apparent temperature, is an index that combines air temperature and relative humidity to determine the temperature perceived by a human. (In other words, the heat index is a measure of how hot it feels.) The head index is given by

$$\mathrm{HI(T,R)} = c_1 + c_2\,T + c_3\,R + c_4\,T\,R + c_5\,T^2 + c_6\,R^2 + c_7\,T^2\,R + c_8\,T\,R^2 + c_9\,T^2R^2\,, \tag{1}$$

where HI is the heat index (in degrees Fahrenheit), T the temperature (in degrees Fahrenheit), and R the relative humidity (percentage value between 0 and 100). The constant coefficients c_i ($i = 1, \ldots, 9$) are given by[3]

$$\begin{aligned}
c_1 &= -42.379 \\
c_2 &= 2.049015 \\
c_3 &= 10.14333 \\
c_4 &= -0.224755 \\
c_5 &= -6.83783 \times 10^{-3} \\
c_6 &= -5.481717 \times 10^{-2} \\
c_7 &= 1.22874 \times 10^{-3} \\
c_8 &= 8.5282 \times 10^{-4} \\
c_9 &= -1.99 \times 10^{-6}
\end{aligned}$$

Equation (1) is valid for temperatures of $60 \leq T$ (Fahrenheit) ≤ 90 and relative humidities ranging from 30% to 85%.

Task

Write a structured and well commented Fortran program which uses the nested `DO` loop construct to compute the heat index, HI(T,R), for temperatures $T = 60, 70, 80, 90$ Fahrenheit and relative humidities $R = 30, 40, 50, 60, 70, 80\%$.

Program design

- There is no keyboard input.
- Your code must contain a preamble.
- Use the `PARAMETER` statement to assign numerical values to the coefficients c_i.
- The outer `DO` loop determines the temperature T, the inner `DO` loop determines the relative humidity R.
- The terminal output produced by the program should be as follows:

```
 Temperture=          60 Relative Humidity=          30 HI=   78.6597748
 Temperture=          60 Relative Humidity=          40 HI=   81.9063187
 Temperture=          60 Relative Humidity=          50 HI=   82.9904480
 Temperture=          60 Relative Humidity=          60 HI=   81.9122467
```

[3] See, for instance, `http://en.wikipedia.org/wiki/Heat_index`

```
Temperture=          60 Relative Humidity=          70 HI=   78.6716003
Temperture=          60 Relative Humidity=          80 HI=   73.2685623

Temperture=          70 Relative Humidity=          30 HI=   76.1021652
Temperture=          70 Relative Humidity=          40 HI=   77.0056534
Temperture=          70 Relative Humidity=          50 HI=   76.9349976
Temperture=          70 Relative Humidity=          60 HI=   75.8902588
Temperture=          70 Relative Humidity=          70 HI=   73.8712769
Temperture=          70 Relative Humidity=          80 HI=   70.8781433

Temperture=          80 Relative Humidity=          30 HI=   79.1912613
Temperture=          80 Relative Humidity=          40 HI=   79.9305725
Temperture=          80 Relative Humidity=          50 HI=   80.8044052
Temperture=          80 Relative Humidity=          60 HI=   81.8127441
Temperture=          80 Relative Humidity=          70 HI=   82.9556274
Temperture=          80 Relative Humidity=          80 HI=   84.2328491

Temperture=          90 Relative Humidity=          30 HI=   87.9270325
Temperture=          90 Relative Humidity=          40 HI=   90.6810303
Temperture=          90 Relative Humidity=          50 HI=   94.5986633
Temperture=          90 Relative Humidity=          60 HI=   99.6798782
Temperture=          90 Relative Humidity=          70 HI=   105.924423
Temperture=          90 Relative Humidity=          80 HI=   113.332626
```

Submission Instructions: Rename your Fortran source code to `LastFirst_WS5.f90`. Email a copy of your source code to `ewhart317@gmail.com`. Put `Last First WS 5` in the subject line.