CCE2301—MATLAB: Practical 1

Trevor Spiteri
trevor.spiteri@um.edu.mt
http://staff.um.edu.mt/trevor.spiteri

Department of Communications and Computer Engineering
Faculty of Information and Communications
University of Malta

22 February, 2008

Programming in MATLAB

Objective

The objective of this practical is to use basic MATLAB features such as scripts, functions, and arrays.

Procedure

At the bottom of a pond, there are several temperature sensors. The sensors are at different depths and at different distances from the shore. At some specified times, we need to read the temperature from each sensor and store the results in an array.

1. Create a structure array to hold information about the different sensors in the pond. The information about the locations of the sensors is given in the Table 1. You can write the structure using the MATLAB `struct` command as follows:

```
distances = { 0.5, 1.1, 1.2, 4.1, 4.7, 5.0, 5.9, 8.2 };
depths = { 0.21, 0.25, 0.37, 1.42, 2.35, 1.60, 2.15, 3.02 };
sensors = struct('distance', distances, 'depth', depths);
```

Table 1: Sensor locations

Sensor	Distance (m)	Depth (m)
1	0.5	0.21
2	1.1	0.25
3	1.2	0.37
4	4.1	1.42
5	4.7	2.35
6	5.0	1.60
7	5.9	2.15
8	8.2	3.02

You should create a script file and write all your commands in the file, so that you can update them as you go along.

2. For this practical, we will simulate the temperature values. The temperature T will be dependant on the distance from the shore and the depth. It will also be dependant on the time, and will have a random component.

$$T = r(10 + 5e^{-s/30} + 10e^{-d/10})(0.9 + 0.1\cos(1.8 + \pi t/12))$$

where T is the temperature,
s is the distance from the shore in m,
d is the depth in m,
t is the time of day in hours (from 0 to 24),
r is a random variable.

The random variable r is calulated as follows:

```
r = 0.95 + 0.1 * rand;
```

To seed the random number generator, add the following line to the start of the script:

```
rand('state', sum(100 * clock))
```

Write a function to model the pond temperature. The function should have the following definition:

```
function temp = sim_temp(sensor, time)
```

The `sensor` parameter is an element of the structure array. For example, to get the temperature of sensor 3 at 06:00, you would call

```
sim_temp(sensors(3), 6)
```

3. Create a row vector `time` with the times at which the readings are to be taken. This vector should have values from 0 to 24 inclusive, with a spacing of 2.

4. Find the temperature for each sensor at each time, storing your results in an array `temp`. The `temp` array should have 13 rows, one for each time instant; and eight columns, one for each sensor.

5. Find the minimum temperatures and the times at which they are occurring. To do this, use the `min` function with two return values:

   ```
   [min_temp index] = min(temp);
   ```

   `min_temp` will be a row vector containing the minimum temperatures. `index` will be a row vector containing the indices of the minimum values. Using the `index` vector and the `time` vector, get a new row vector `min_time` containing the times at which the minimum temperature is occurring at each sensor.

6. Use the `max` function to create two row vectors `max_temp` and `max_time` containing the maximum temperatures and the times at which they are occurring.

7. Use the `mean` function to create a row vector `mean_temp` containing the mean temperatures.

8. Write a function with the following definition:

   ```
   function mean_temp = get_mean(all_temp, sensor_index)
   ```

   - The first parameter `all_temp` should be the `temp` array.
   - The second parameter `sensor_index` is the sensor number from 1 to 8.
   - The function returns the mean temperature for the given sensor index.
   - Use the `nargin` function so that if the second parameter is not passed to the function, a row vector containing the mean for each sensor is returned. That is, `get_mean(temp)` should return a row vector identical to `mean_temp` in 7 above.

Report

Your report should include the MATLAB script and functions that you wrote, the results, and any observations and comments.