# ENGR 1204 Programming Languages in Engineering
MATLAB Lab 5

The objective of this exercise is to use MATLAB to find the minimum value of a function.

A pipe is to supply water to 4 cities forming a unit square (Note: 1 can represent any distance – e.g. 100 miles). The water source is at one of the cities. The goal is to connect the 4 cities with sections of pipe in a way which minimizes the total pipe length. Any number of pipe sections can be joined.

The diagrams below show 4 possible configurations. Clearly solution (c), with a 4 way junction, uses less pipe than (a) or (b). The task will be to determine if solution (d) can further reduce the total pipe length.

| (a) | (b) | (c) | (d) |
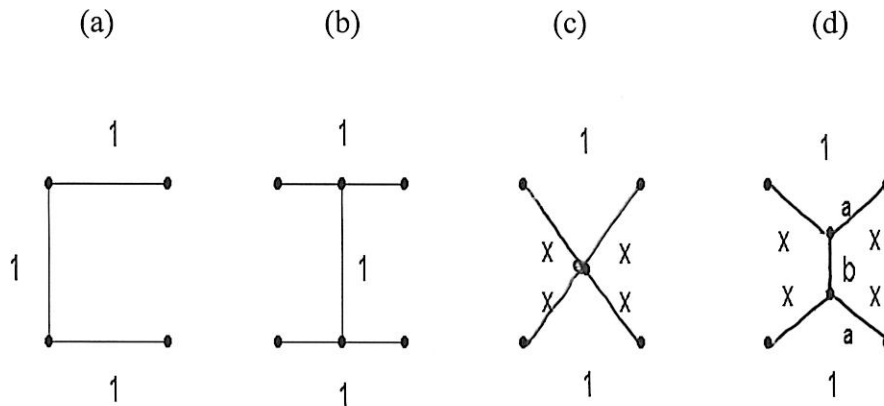
length = 3   length = 3

$x = sqrt(2) / 2 = 0.707$

length = 4 x = 2.828

$2 a + b = 1$

length = 4 x + b

Derive length in terms of b.

length (b) = _____

where $0 <= b <= 1$

Create a MATLAB program (.M script file) to calculate and display the values of b and total pipe length in table form; the range of b should be $0 <= b <= 1$, with a step size of 0.02. The formula for length should be entered as an anonymous function

length = @ (b) _____

(derived formula for function)

(over)

The first few lines of output are shown below:

```
b     length
0.00  2.8284
0.02  2.8203
0.04  2.8124
0.06  2.8049
```

Verify that the lengths for $b = 0$ and $b = 1$ are as expected.

Next, identify the approximate value of b which results in minimum length and modify the program to display the values of b and length over a more limited range. Change the increment for b to 0.001 and display as many digits for length needed to identify the smallest value.

Submit the following:

(1) the modified program and results

(2) the minimum value of length and corresponding value of b (can circle values on the print-out)

(3) the derivation of the formula for length as a function of b (by hand)