# CS3113, Fall 2008, Assignment 2

## Due October 1, 2008 (before start of class)

For this assignment, you cannot discuss any part with anyone else. You need to work all by yourself. Each problem should be done in a separate script file. Key results must be displayed. Any comments must also be displayed as a message.

For example, if your last name is Bush, then you must name the file for homework 1 problem 3 as `BushHW01P01.m`. Submit them using the electronic dropbox in Blackboard.

**Problem 1**

Write a script to accomplish the following task.

Set the state of the random number generator to a value of 7. For any given integer values of $n$ and $m$, create a matrix `MTX` so that the first column contains the numbers $1, 2, \ldots, n+1$, the first row, starting with the second element to the $m+1$-th element, are given by linearly spaced values starting with 0.1 and ends with $\pi$, and if we ignore the first column and the first row from `MTX`, the resulting submatrix contains uniformly distributed random numbers from the interval 0 to 1.

You script program must work for any given integer values of $n$ and $m$. For example, in the case of $n = 5$ and $m = 4$, with the state of the random number generator set to 7, you should get the following result

$$
\text{MTX1} = \begin{bmatrix}
1.0000 & 0.1000 & 1.1139 & 2.1277 & 3.1416 \\
2.0000 & 0.8147 & 0.0975 & 0.1576 & 0.1419 \\
3.0000 & 0.9058 & 0.2785 & 0.9706 & 0.4218 \\
4.0000 & 0.1270 & 0.5469 & 0.9572 & 0.9157 \\
5.0000 & 0.9134 & 0.9575 & 0.4854 & 0.7922 \\
6.0000 & 0.6324 & 0.9649 & 0.8003 & 0.9595
\end{bmatrix}
$$

Display the content of `MTX`. Make sure that you are using the `short` format to display the results.

If you don't know how to do this part of the problem you need to input the matrix by entering the elements one at a time to so that it looks like the one shown above. The rest of the problem requires this matrix.

Create a matrix `MTX2` having exactly the same elements as `MTX` except that the $2, 2$ element is given by adding the $2, 4$ element to its original value.

Create a matrix `MTX3` having exactly the same elements as `MTX` except that the last element on the 4th row is replaced by the mean of all the elements on the 3rd column.

Create a matrix `MTX4` having exactly the same elements as `MTX` except that the last element on the last column of the last row is replaced by the sum of all the elements of the `MTX`.

Create a matrix `MTX5` given by `MTX` by ignoring elements on the first row, the last row, the first column and the last column. Thus `MTX5` is a submatrix of `MTX`.

Create a matrix `MTX6` given by deleting the next-to-the-last column from `MTX`.

Create a matrix `MTX7` given by deleting the first, third and fourth row from `MTX`.

## Problem 2

The last names of a list of baseball players are stored in a two dimensional array of strings `NAMES` with each name appearing in a separate row according to the player's batting-order in the game. As required in MATLAB, each name is padded by trailing spaces so that all the names have exactly the same number of characters). Their ages are stored in a column vector `Ages`, and their handiness is stored in a column vector `Handiness`, with 'L' for a left-hander and 'R' for a right-hander.

Find and list the names of the players who is either older than 30 or younger than 25, and is a right-hander. List their batting-order as well.

MATLAB can actually read and write data in Excel spreadsheet form. We may do that if we have time later in the semester.
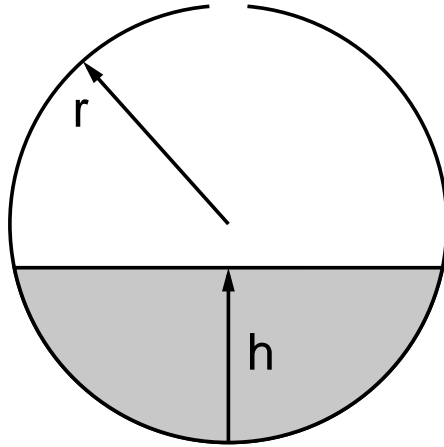
Figure 1: A spherical tank of radius r filled with water to a depth of h.

**Problem 3**

A spherical tank of radius $r$ is filled with water to a depth of $h$ (Fig. 1). We want to find the total volume of water in the tank. Instead of performing an integral, we will find the volume by performing a Monte Carlo simulation.

For this problem we actually know the exact answer for the volume of the water:

$$V(h) = \frac{\pi h^2}{3}(3r - h).$$

We will use this result to help us find the relative error in our computation. But remember, in general of course we don't know the exact answer, otherwise why do we need to do the calculation!

We should use dimensionless quantities by measuring all lengths in units of the radius $r$. It is convenient to use a coordinate system with the center of the spherical tank as the origin. Compute the volume of water filled to a dimensionless depth of $h$ by repeating the simulation 10 times. Find the volumes and the relative error for $h = 0.2, 0.4, 0.6, 0.8$. Comment on your results.

Use close to the maximum number of points that you have on your computer. If you want to, you can increase the amount of memory allocated to MATLAB. If you use more memory than the amount MATLAB is allowed to use, MATLAB uses virtual memory (i.e. your hard-disk), and your calculation may take a long time. You can stop the execution by pressing Control-c on the command line.

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