# ASSIGNMENT 1

**Due February 3, 2005 (before start of class)**

## Problem 1

Which of these familiar rectangles is closest to a golden rectangle whose aspect ratio is given by $\phi = (1 + \sqrt{5})/2$?

1. 3-by-5 inch index card
2. 8.5-by-11 inch US letter paper
3. 8.5-by-14 inch US legal paper
4. 9-by-12 foot rug
5. 9:16 "letterbox" TV picture
6. 768-by-1024 pixel computer monitor

For a rectangle, we let the height to be the smaller dimension and the width to be the larger dimension. The aspect ratio of a rectangle is then given by the ratio of its width to its height.

For this problem, you *must* use Matlab to do the calculations with an element-by-element vector division. You are *not allowed* to use a `for` or a `while` loop. Instead use the Matlab functions `abs` and `min` to find the geometry that is closest to a golden rectangle. Use

```
help min
```

to find how to use the `min` function in Matlab.

Your program *must automatically* display the following result on the screen:

```
The w by h geometry is the closest to a golden rectangle.
```

where `w` and `h` are the numerical values for the width and height, respectively, of the geometry from the above list that is closest to a golden rectangle. Also do not use any `if-else if` or `switch` statement.

Turn in your solution including a hard-copy of your Matlab program. Submit also an electronic copy of the program as an e-mail attachment.

**Problem 2**

Matrix $\mathbf{M}$ can be partitioned into a 2 by 2 block matrix:

$$\mathbf{M} = \begin{bmatrix} \mathbf{A} & \mathbf{B} \\ \mathbf{C} & \mathbf{D} \end{bmatrix},$$

where each submatrices, $\mathbf{A}$, $\mathbf{B}$, $\mathbf{C}$ and $\mathbf{D}$ are all $n$ by $n$ square matrices. The $ij$ element of $\mathbf{A}$ is given by $i * (j + 2)$. The elements of $\mathbf{B}$ are all equal to 7 except that from the second element all the way to the next-to-the-last element of the first row should all be ones. Matrix $\mathbf{C}$ is the transpose of $\mathbf{B}$, and $\mathbf{D}$ is the $n$ by $n$ identity matrix. You also need to use the Matlab function `det` to compute $d = \det(\mathbf{I} + \mathbf{M})$, where $\mathbf{I}$ is the $2n$ by $2n$ identity matrix.

For example, if the format is set to `short` and $n = 5$ then

```
MM =

     3     4     5     6     7     1     1     7
     6     8    10    12     7     7     7     7
     9    12    15    18     7     7     7     7
    12    16    20    24     7     7     7     7
     7     7     7     7     1     0     0     0
     1     7     7     7     0     1     0     0
     1     7     7     7     0     0     1     0
     7     7     7     7     0     0     0     1

d =
     1881488
```

and if $n = 6$ then

```
MM =
```

```
     3     4     5     6     7     7     1     1     1     7
     6     8    10    12    14     7     7     7     7     7
     9    12    15    18    21     7     7     7     7     7
    12    16    20    24    28     7     7     7     7     7
    15    20    25    30    35     7     7     7     7     7
     7     7     7     7     7     1     0     0     0     0
     1     7     7     7     7     0     1     0     0     0
     1     7     7     7     7     0     0     1     0     0
     1     7     7     7     7     0     0     0     1     0
     7     7     7     7     7     0     0     0     0     1
d =
     11703872
```

In this problem you *must* write a Matlab function to create matrix $\mathbf{M}$ and compute the determinant of $\mathbf{I}+\mathbf{M}$. The function *must* have a single input argument $n$ and *must* return both matrix $\mathbf{M}$ and $\det(\mathbf{I}+\mathbf{M})$.

You *must* also need to write a script file to use a loop to run the function 4 times for $n = 4, 5, 6,$ and 7. The statement containing the function call should be terminated with a comma so that the output of the function is automatically displayed on the screen when the script file is run.

Write whatever else you need to write as comments in those two separate files. Submit a hardcopy of the two files. Also submit them electronically as attachments to an e-mail.

Note: The name of your script file must begin with a lowercase 'm' followed by your student ID number, a lowercase 'a', and the assignment number (e.g. 01 for the first assignment), then a lowercase 'p', and the problem number (e.g. 02 for problem 2) and the dot and the extension 'm'. For example the script file for the second problem of assignment 1 by a student whose ID number is 0234567 should be: `m0234567a01p02.m`. Your function file should have exactly the same name followed by the underscore and extension 'm'.