MATH 426 - Assignment 3

June 9, 2008

1 Using For Loops:

Write a Matlab function that given a number n computes $n!$. The function header should be as follows

```
function F = fact(n)
```

Note that there is already a Matlab function `factorial` which does this. Obviously you can't use that function in your code, but you can use it to check your answers.
After writing the function `fact` write a script file, `test_fact.m`, that calls `fact` for several values of n. In each case output n and $n!$.

Remark: Computing factorial using a `for` loop is not efficient when using Matlab; later in the course we will see more efficient ways of doing such computations in Matlab.

2 Using if - elseif - else:

Write a Matlab function `compvec` which given two vectors $\mathbf{x}$ and $\mathbf{y}$ determines whether or not they are linearely independent. The function must have the following interface:

```
compvec(x,y)
```

To determine whether $\{\mathbf{x}, \mathbf{y}\}$ is linearely independent you may use the following approach:

- if $\mathbf{x} = 0$ or $\mathbf{y} = 0$ then $\{\mathbf{x}, \mathbf{y}\}$ is a linearely dependent set.
- otherwise, check the angle θ between $\mathbf{x}$ and $\mathbf{y}$: if $\theta = 0$ or $\theta = \pi$ (the vectors are parallel) then they are linearely dependent, else they are linearely independent. Moreover, if $\mathbf{x}$ and $\mathbf{y}$ happen to be orthogonal, you program should point that out. The possible output messages from you function should be the following:
  1. Linearly dependent vectors (one of them is zero).
  2. Linearly dependent vectors (both non-zero).
  3. Linearly independent vectors (orthogonal).
  4. Linearly independent vectors.
- Note that given two vectors $\mathbf{x}$ and $\mathbf{y}$ in $\mathbb{R}^n$ the angle θ between them is specified by the following:
$$\cos(\theta) = \frac{\mathbf{x} \cdot \mathbf{y}}{||\mathbf{x}||||\mathbf{y}||}$$

Another (maybe easier way) to solve this problem would be to just check the cosine of the angle between $\mathbf{x}$ and $\mathbf{y}$. Let $c = \cos(\theta)$. Note that:

- $c = 0$ corresponds to $\theta = \frac{\pi}{2}$ (orthogonal vectors),
- $c = 1$ or $c = -1$ corresponds to case of parallel vectors (linearely dependent).

Once you are done with programming `compvec`, write a script file, `test_compvec`, that calls the function `compvec` using the following test cases:

$$\mathbf{x} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad \mathbf{y} = \begin{bmatrix} 0 \\ 0 \end{bmatrix},$$

$$\mathbf{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \mathbf{y} = \begin{bmatrix} 2 \\ 4 \end{bmatrix},$$

$$\mathbf{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \mathbf{y} = \begin{bmatrix} 1 \\ 0 \end{bmatrix},$$

$$\mathbf{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \mathbf{y} = \begin{bmatrix} -2 \\ 1 \end{bmatrix}.$$

Note that the test cases above are vectors in $\mathbb{R}^2$, but your program should work for vectors in $\mathbb{R}^n$ for all $n \geq 2$.