Review of MATLAB

In the fifth and last part of the course, nine lectures introduces us to MATLAB. Below is a list of questions to review for the final exam. Consider also the quizzes, homework assignments, and project.

1. Explain the difference between the `*` and `.*` operators.
   Give an example where the `*` must be used instead of the `.*` operator.
   Give an example where the `.*` must be used instead of the `*` operator.

2. Fermat's spiral is defined in polar coordinates by $r = \sqrt{t}$.
   Give the MATLAB commands to make a plot for t from 0 to 25.

3. Give the MATLAB commands to make a plot of the surface $z = y^2 \cos(x + y)$,
   for x and y ranging between $-\pi$ and $+\pi$.

4. The twisted cubic is a space curve, which can be defined in two ways:

   (a) as (t, t^2, t^3) in parametric representation, with parameter t; and

   (b) as the intersection of two surfaces: $y - x^2 = 0$ and $z - x^3 = 0$.

   Give all MATLAB commands to make a figure of the twisted cubic, with two subplots in the same figure window. The first subplot must use the first parametric definition, while the second subplot should show the two surfaces whose intersection defines the twisted cubic. The region of interest in which we wish to see the twisted cubic is the unit cube $[-1, 1] \times [-1, 1] \times [-1, 1]$.

5. In MATLAB we have seen three different situations where we encountered approximate data. For each such different situation, we processed the data differently. Describe briefly each situation and list the most important MATLAB command that was used in processing the approximate data.

6. We encountered the commands `polyfit` and `spline` in MATLAB.

   (a) Explain the difference between the commands `polyfit` and `spline`.

   (b) Describe a problem for which you should use `polyfit` rather than `spline`.

   (c) Describe a problem for which you should use `spline` rather than `polyfit`.

7. Simpson's rule to approximate the definite integral of $f(x)$ over $[a, b]$ is defined as

$$\int_a^b f(x)dx \approx \frac{b-a}{3}\left(f(a) + 4f\left(\frac{a+b}{2}\right) + f(b)\right).$$

   (a) Write an m-file to implement the function

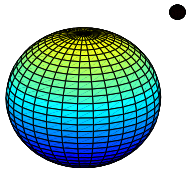
```
function y = simpson(f,a,b)
% returns an approximation for the integral of f(x) over [a,b]
% using Simpson's rule
```

   (b) Use simpson to approximate the integral of $\cos(x)$ for x between $\pi/4$ and $\pi/2$.

8. Suppose we want to sample $f(t) = \sin(2\pi 10t)$. How many samples of $f(t)$ should we take in the interval $[0, 3]$ for a good plot of $f(t)$? What if instead of 10 we have any positive number k?

9. How would you in MATLAB define a permutation matrix P so that `P * [1 2 3 .. n]'` returns `[n .. 3 2 1]'`, for some number `n`? (*Hint*: take `n` = 3 and generalize.)

10. Give all MATLAB commands to make the following plot:



Start with a unit sphere as the big planet. The small sphere is ten times smaller as the big planet. Lift the satellite two units up and shift the second coordinate with negative two.

FINAL EXAM is on Tuesday, May 5, 2009, 10:30 AM - 12:30 PM