Duke University
Edmund T. Pratt, Jr. School of Engineering

EGR 53L Fall 2006

Test I

Rebecca A. Simmons
Michael R. Gustafson II

Name (please print)_____

In keeping with the Community Standard, I have neither provided nor received any assistance on this test. I understand if it is later determined that I gave or received assistance, I will be brought before the Undergraduate Judicial Board and, if found responsible for academic dishonesty or academic contempt, fail the class. I also understand that I am not allowed to speak to anyone except the instructor about any aspect of this test until the instructor announces it is allowed. I understand if it is later determined that I did speak to another person about the test before the instructor said it was allowed, I will be brought before the Undergraduate Judicial Board and, if found responsible for academic dishonesty or academic contempt, fail the class.

Signature:_____

Problem I: [15 pts.] Geometric Analysis

For a right triangle, the Pythagorean Theorem states:

$$a^2 + b^2 = c^2$$

where a and b are the lengths of the 2 short sides of a right triangle and c is the long side of the triangle. Write a script file that asks the user to input values for the 3 sides of a triangle: a, b, and c. First test to see if the length of a plus b is shorter than c; if not, give an error message that says: "Sides do not define a triangle." If that test passes, check to see if both a and b are shorter than c; if not, give an error message that says: "Neither a nor b can be longer than c." Finally, assuming the above two tests pass, check to see if sides a, b, and c form a right triangle. If they do the program should print "Right Triangle" to the screen and if not the program should print "Not a Right Triangle."

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Problem II: [25 pts.] Mortgage Program

The following equation calculates loan payments:

$$m = \left(\frac{\left(1 + \frac{p}{1200}\right)^N}{\left(1 + \frac{p}{1200}\right)^N - 1} \right) \left(\frac{pL}{1200} \right)$$

where L is the dollar amount borrowed, N is the number of months that the loan will be paid back for, p is the annual interest rate percentage, and m is the monthly payment in dollars. Note that in this formula, a 6.25% interest rate would yield a p value of 6.25. Do not divide by 100 - that is part of what the 1200 does in the formula.

(a) Using this equation, write a function you could use to take values for L, N, and p, and then return one output, m. In some instances the user will only want to input 2 values - one input for L and one input for N. Your function should test for this case and in this instance p should be set to a default value equal to the current prime rate of 8.25%. Sometimes, the user will only input one value, in which case your program should assume that the loan is for 30 years with an interest rate of 8.25%. If the user ends up entering no inputs, the function should given an error stating "Not enough information."

(b) Write a script that will ask the user to input values for L, N, and p (you do not need to check if these are valid). Have your script call the function to get the value of the monthly payment, and then report back the information to the user by stating:

```
The monthly payment for a WW month loan of $XXX
with an interest rate of Y.YY percent is $ZZZ.ZZ.
```

where the ALL CAPS symbols above are replaced by the actual values. Note that the number of months and the amount of the loan should be displayed as whole numbers, while the interest rate and monthly payments should have two digits after the decimal point. Notice also that the words are written on two lines. For example, if the user used $L = 22000$, $N = 60$, $p = 4.5$, then the program should state:

```
The monthly payment for a 60 month loan of $22000
with an interest rate of 4.50 percent is $410.15.
```

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Problem III: [20 pts.] Matrix Creation and Manipulation

For each of the following sections, either write the Matlab command required or answer the questions. Given the following Matlab commands:

```
x=[2;1;3]
y=5:-2:0
z=[4;5;6]
A=[1 1 2; 3 4 0; 1 2 5]
B=[1.2 -0.4;3.0 12.6]
```

(a) Evaluate

```
x.*y'
```

(b) Evaluate

```
[A,z]
```

(c) Evaluate

```
A(:,2).^2
```

(d) Evaluate

```
(abs(floor(B)))-1
```

(e) Evaluate

```
A([2 1], [1 3 1])
```

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Problem IV: [15 pts.] I/O Functions

Write the Matlab script that will perform the following tasks. First, ask the user to input a number between 1 and 9, inclusively, and validate the number (i.e. keep asking until the user does it correctly). Then, using that number, produce a formatted table of the first four powers of that number. The table will show the number, the power to which it is raised, and the result. The table must be formatted such that the number is shown with two decimal digits, there are spaces on either side of the equals sign, and the results are shown with four decimal digits of precision, which must line up. As examples, the output below represents what might happen if the user entered the number 6.5. Note that a '␣' represents a space, and that $9^4 = 6561$:

```
6.50^1␣=␣␣␣␣6.5000
6.50^2␣=␣␣␣42.2500
6.50^3␣=␣␣274.6250
6.50^4␣=␣1785.0625
```

As another example, here is the output for 2.345678:

```
2.35^1␣=␣␣␣␣2.3457
2.35^2␣=␣␣␣␣5.5022
2.35^3␣=␣␣␣12.9064
2.35^4␣=␣␣␣30.2743
```

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Problem V: [15 pts.] Piecewise Functions

Write a script that uses logic to help produce a graph of the following function for the height of a rubber-band-launched bowling ball over time given that it was shot onto the roof of a building and then rolled off:

$$y(t) = \begin{cases} t < 0 & 0 \\ 0 \leq t < 4 & -t^2 + 8t \\ 4 \leq t < 9 & 12 \\ 9 \leq t < 12 & -\frac{4}{3}t^2 + 24t - 96 \\ t \geq 12 & 0 \end{cases}$$

over the domain $-2 <= t <= 15$. Add code to properly label and title the graph and also to save it as `TheDude.eps`. In this case, do not worry about units.

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Problem VI: [10 pts.] UNIX and LaTeX Processing

Assuming you have just logged in and opened a terminal window, give the proper UNIX commands needed to:

(a) Change into your EGR53 directory

(b) Create and then change into a `labT` directory

(c) Copy all files ending in `.tex` from user `mje7`'s, `public/EGR53/labT/` directory into your current directory

(d) Assuming there is now a file called `Example.tex` now in your `labT` directory, rename it `TestFile.tex`

(e) Assuming you have renamed the file properly, process `TestFile.tex` to produce a `.dvi` file

(f) Preview the `.dvi` file which results

(g) Create a PostScript file named `FileToPrint.ps` from the `.dvi` file

(h) Preview the `.ps` file