Engineering Models I
Homework Assignment #7

Problem 1:

(a) Work through the following loop by hand to complete the table below and determine the output of the program. OK to check results using MATLAB but you need to understand how to do this by hand also.

```
x = 0.25; total = 1;
for k = 1:4
    total = total + (-1)^k*x^k;
end
fprintf('The value of total is:  %0.4f \n',total);
```

	Total
Initial (Before Loop)	
k = 1	
k = 2	
k = 3	
k = 4	

Program Output: _____

(b) Work through the following loop by hand to complete the table on the next page and determine the program output. OK to check results using MATLAB but you need to understand how to do this by hand also. **Assume the number that the user enters is 95.**

```
x = input('Enter a positive integer  ');
product = 1;
N = 1;
while product <= x
    product = product*2;
    N = N + 1;
end
fprintf('The binary representation of %i requires %i bits
\n',x,N-1);
```

	Product	N
Initial		

Program Output: _____

Problem 2: Cube Root of a Number

In Lab 8, you wrote a script to find the square root of a number. The following algorithm can be used to find the cube root of a number:

$$Estimate = {}^{1}/_{3}\,(2 * Estimate + Number/Estimate^{2})$$

$$Error = abs(Number - Estimate^{3})$$

(a) Write a script that will find the cube root of a number using the algorithm shown above with the following specifications:

- Use input statements to prompt the user for the number he/she would like to find the cube root of and for an initial estimate of the cube root.
- Iterate through the algorithm until the Error <= 1e-9
- Use an fprintf statement to display the original number and the estimate for cube root of the number with 3 places behind the decimal point.
- Use an fprintf statement to display the total number of iterations required.

(b) Now run your script to complete the table on the next page.

Number	Estimate	Actual Cube Root	Program Output	Number of Iterations
29.85	**1**			
–216	**1**			
2000000	**1**			
2000000	**20**			

Turn in your script file along with the homework assignment

Problem 3: Natural Log

In Lab 8, you wrote a script to find the ln(x) for any x in the range $0 < x \leq 2$ using the Taylor series:

$$\ln(x) = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n}(x-1)^n = (x-1) - \frac{(x-1)^2}{2} + \frac{(x-1)^3}{3} - \frac{(x-1)^4}{4} + \cdots$$

In this problem, you will modify that script to allow for x values larger than 2 by using the relationship:

$$\ln(x) = -\ln\left({}^{1}/_{x}\right)$$

(a) Modify your script from Lab 8 as follows:

- You will still prompt the user for a number and for the desired number of iterations
- Modify your check for invalid inputs – now the only invalid inputs are x values that are less than or equal to 0.
- Modify your code to handle x values that are greater than 2 using the relationship described above.
- Modify your fprintf statement to display the original number, x, entered by the user and the estimate of the ln(x) with 8 places behind the decimal point.

(b) Now run your script to complete the following table.

x	Number of Terms	Actual ln(x)	Program Output ln(x)
4	**4**		
4	**8**		
4	**12**		
0.4	**4**		
0.4	**8**		
0.4	**12**		

100	**100**		
100	**200**		
100	**300**		
100	**400**		

Comment: This particular algorithm requires a lot of terms to get accurate estimates for x-values close to zero and larger x-values.

Turn in your script file along with the homework assignment