AMERICAN UNIVERSITY OF BEIRUT
Faculty of Arts and Sciences
Computer Science Department

CMPS 251
MID TERM EXAMINATION
SUMMER 2003-2004
Closed Book, One hour 15 minutes

SUBMIT THE QUESTION SHEET WITH BOOKLET
(ONLY NON-PROGRAMMABLE AND NON-GRAPHIC CALCULATORS ARE ALLOWED)

STUDENT NAME	
ID NUMBER	

1. Let $x \in \mathbb{F} \equiv \mathbb{F}(b, p, e_{min}, e_{max})$, with $x = \pm m \times b^e$.

   -(5 points) Fill in the bounds on m

   $$\ldots\ldots\ldots\ldots\ldots\ldots \leq m \leq \ldots\ldots\ldots\ldots\ldots\ldots$$

   and if $m_2 = succ(m_1)$, both m_1 and m_2 mantissas in $\mathbb{F}$, find $m_2 - m_1$.

   $$m_2 - m_1 = \ldots\ldots\ldots\ldots\ldots\ldots$$

   -(10 points)Fill in the missing statements in the following `MATLAB` program that generates the positive elements of a floating-point system $\mathbb{F}(b, p, e_{min}, e_{max})$.

```
function x=float(b,p,emin,emax)
x=0;
epsm=b^(-p+1);
%M represents all possible values taken by the mantissa
M=..............................;
E=b^emin;
for ............................
    x=[x M*E];
    E=E*.........;
end
```

   -(5 points) How many floating-point operations (additions and multiplications) would be required to execute the above program.

2. Consider the floating-point system $\mathbb{F} = \mathbb{F}(\ 10, 6, -4, 5)$. This system uses rounding to the closest.

   (a) Fill in the following table. (10 points)

Values of following parameters and elements in IEEE single precision system	
$x_{\min}$	
$x_{\max}$	
ϵ_M (epsilon machine)	
Representation of $\frac{1}{7}$	
succ($\frac{1}{7}$)	

   (b) (10 points) Convert $x = (52.225)_{10}$ into octal form ? Give then the hexadecimal form of the internal IEEE single precision floating point representation of x, using rounding to the closest.

Conversion of $x = (52.225)_{10}$	to octal and IEEE hexadecimal form
Corresponding octal form	
Corresponding IEEE hexadecimal form	

3. Consider the function $f(x) = e^{-x} - 3x$.

   (a) (5 points) Show that this function has one root r on $(-\infty, \infty)$. Graph this function on the interval $[-1, 1]$

(b) (5 points) Find the least number of iterations that provide an approxximation to r within 5 significant figures using the bisection method.

Number of iterations :	

IN WHAT FOLLOWS CARRY ALL YOUR COMPUTATIONS WITH AT LEAST 5 FIGURES

(c) (10 points) Compute the following iterations :
-Give the sequence of 2 approximations obtained by applying 3 iterations of the bisection method.

x_1 :	
x_2 :	

-Give the iteration function $r_n = g(r_{n-1})$ of Newton's method :

Then compute the sequence of 2 approximations obtained by applying 2 iterations of Newton's method with $x_0 = 0.5$.

x_1 :	
x_2 :	

-Give the iteration function $r_n = g(r_{n-1}, r_{n-2})$ of the secant method :

Then give the sequence of 2 approximations obtained by applying 2 iterations of the secant method with $x_0 = 1$ and $x_1 = 0.5$.

x_1 :	
x_2 :	