UNIVERSITY OF CALIFORNIA
COLLEGE OF ENGINEERING

E7: INTRODUCTION TO COMPUTER PROGRAMMING
FOR SCIENTISTS AND ENGINEERS
Professor Raja Sengupta
Spring 2010
First Midterm Exam—March 3, 2010

[37 points ~ 45 minutes]

Question	Points
Part I	9
Part II	8
Part III	11
Part IV	9
TOTAL	**37**

Notes:
1. Your exam should have 16 pages. Check this before you begin.
2. You may use a calculator, your notes, and the textbook on this examination as necessary provided that you do not impede those sitting next to you. No electronic devices are permitted.
3. Use a #2 pencil and green scantron sheet to record your answers. Bubble in your solution to each question on the corresponding space on your scantron. There is one correct answer for each question. Multiple bubbles, incomplete bubbles, or stray marks will cause your solution to be marked incorrect.
4. Please write your **name**, **student ID number**, and **discussion section** on your scantron for identification purposes.
5. You may NOT leave the exam room before the exam ends.

Part I:

Questions 1 – 3: General Matlab operators

1. (1 point) The semicolon operator (;) in Matlab is essential to:
    a. Writing a recursive definition
    b. Programming an if-else statement
    c. Programming a sequence of statements on the same line
    d. None of the above

2. (1 point) The colon operator (:) and the linspace command in Matlab can create the same arrays. Select the true statement below: Typing >> [1:1:5;linspace(1,2,5)]
    a. generates a 2 x 5 matrix
    b. generates a 2 x 4 matrix
    c. generates a 2 x 2 matrix
    d. generates a 1 x 1 matrix

3. (1 point) Typing >> y=1; x=2; y=x+1 assigns y to which value?
    a. 1
    b. 3
    c. 2
    d. none of the above

Questions 4 – 8: Matrix Operations

The following questions refer to the following matrices:

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

4. (1 point) True or False: C = A*B is a defined value
    a. True
    b. False

5. (1 point) Typing >>x = length(B(1,:)) assigns x to which value?
    a. 3
    b. 0
    c. 1
    d. No value. There is a matlab error.

6. (1 point) Typing >> C = A .* A assigns C(2,3) to which value?
    a. 96
    b. 36
    c. 25
    d. A .* A is an invalid Matlab command

7. Typing the command >>A(1,2) = B(1,3) assigns A to which value?
   a. 0
   b. $\begin{bmatrix} 1 & 2 & 2 \\ 4 & 5 & 6 \end{bmatrix}$
   c. $\begin{bmatrix} 1 & 3 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$
   d. Produces a matlab error

8. (1 point) Typing >>y = size(B) assigns y to which value?
   a. [2 3]
   b. 3
   c. 0
   d. 2

9. (1 point) Which of the following will compute correctly?
   a. >> A*B
   b. >> A.*B
   c. >> H = [A B]
   d. >> H = [A B']

Part II:
Questions 10-13: Logical Operators
Consider the following two programs in files myprogram1.m and myprogram2.m respectively:

```
function [y] = myProgram1(x)          function [y] = myProgram2(x)
   if x>4                                 if gt(x,4)
      y=x+2;                                 y=x+2;
   elseif x<=3                            elseif gt(x,3)
      y=x/2;                                 y=x;
   elseif x>3 & x<=4                      else
      y=x;                                   y=x/2;
   end                                   end
end                                   end
```

10. (1 point) The command >> `y = myProgram1(3.5)` will assign y to the value
    a. 5.5
    b. 1.75
    c. 3.5
    d. none of the above

11. (1 point) The command >> `z = myProgram2(3.5)` will assign z to the value
    a. 5.5
    b. 1.75
    c. 3.5
    d. none of the above

12. (1 point) The programs myProgram1.m and myProgram2.m
    a. denote the same mathematical function
    b. each denote a function but the two functions are different
    c. do not both denote a function. Only myProgram1 denotes a function
    d. none of the above

13. (1 point) Which of the following can be a type for myProgram1?
    a. double → char
    b. double → double
    c. char → char
    d. double → logical

Questions 14-17: If-else statements

Suppose you are a construction engineer and you are performing a retrofit of a building. The owner of the facility has asked you to calculate the potential cost savings from changing the existing light bulbs to different types. The types of light bulbs being considered are incandescent, LED, and CFL. LED has the highest initial cost, but the long-term cost is the least due to lower energy consumption, while incandescent has the lowest initial cost, but the highest long-term cost. CFL is in between.

Consider the following function, where the inputs are the hours the bulb is expected to be used, the current style of bulb, which is input in the form ('INC ', 'CFL ', 'LED'), and the proposed retrofit alternative.

```matlab
1    function cost_diff = BulbReplacement(hours, curr_bulb, new_bulb)
2    %BulbReplacement calculates the cost savings of switching out a bulb of type
3    %curr_bulb and replacing it with a bulb of type new_bulb. Hours designates
4    %the amount of time the light will be used. Positive outputs represent
5    %savings and negative represent costs.
6
7    if eq(curr_bulb,new_bulb)
8        cost_diff = 'no cost difference, you have not changed anything';
9
10   elseif curr_bulb == 'INC'
11       if new_bulb == 'CFL'
12           cost_diff = 0.012*hours - (3 + 0.003*hours);
13       elseif new_bulb == 'LED'
14           cost_diff = 0.012*hours - (11 + 0.002*hours);
15       else
16           cost_diff = 'Enter a valid bulb type';
17       end
18
19   elseif curr_bulb == 'CFL'
20       if new_bulb == 'INC'
21           cost_diff = 0.003*hours - (1 + 0.012*hours);
22       elseif new_bulb == 'LED'
23           cost_diff = 0.003*hours - (11 + 0.002*hours);
24       else
25           cost_diff = 'Enter a valid bulb type';
26       end
27
28   elseif curr_bulb == 'LED'
29       if new_bulb == 'INC'
30           cost_diff = 0.002*hours - (1 + 0.012*hours);
31       elseif new_bulb == 'CFL'
32           cost_diff = 0.002*hours - (3 + 0.003*hours);
33       else
34           cost_diff = 'Enter a valid bulb type';
35       end
36
37   else
38       cost_diff = 'Enter a valid bulb type';
39
40   end
```

14. (1 point) Which line number in the file BulbReplacement,m will determine the value of the variable cost_diff in response to the command >>BulbReplacement(1500, 'CFL ','LED')?

     a. 14
     b. 23
     c. 25
     d. None of the above

15. (1 point) Which line number in the file BulbReplacement,m will determine the value of the variable cost_diff in response to the command >>BulbReplacement(1500, 'ABC ', 'LED')?

     a. 1
     b. 12
     c. 23
     d. none of the above

16. (1 point) Which line number in the file BulbReplacement,m will determine the value of the variable cost_diff in response to the command >>BulbReplacement(15, 'LED ','ABC')?

     a. 34
     b. 23
     c. 1
     d. none of the above

17. (1 point) The program BulbReplacement.m has type
     a. double x char x char $\rightarrow$ double $\cup$ char
     b. double x char $\rightarrow$ double x char
     c. double x char x char $\rightarrow$ char
     d. none of the above

Part III:
Questions 18-28: Functions, Nested Functions, Scope, Type

18. (1 point) The contents of myFunc3.m are as follows:

```
function y = myFunc3 (x)
x = 3;
y = x+2;
end
```

The value of x in the workspace after >> `x = 30; y =myFunc3(x);` is:

        a. 3
        b. 30
        c. 32
        d. No value. There will be a Matlab error.

19. (1 point) The value of y in the workspace after >> `x=3; y=3; y=myFunc3(x);` is:

        a. 5
        b. 0
        c. 3
        d. No value. There will be a Matlab error.

20. (1 point) The contents of `myFunc1.m` are as follows

```
function x = myFunc1 (x)
x=x;
end
```

The program myFunc1.m:

        a. Denotes the identity function f(x) = x
        b. Denotes the Matlab value NaN
        c. Denotes nothing because this program will not execute
        d. None of the above

21. (1 point) The contents of myFunc2.m are as follows:

```
function y = myFunc2 (x)
x=2 ;
y = x^2;
disp(x)
end
```

The final value assigned to x in the workspace by >> x = 3; x = myFunc2 (x) is:

     a. 3
     b. 9
     c. 4
     d. No value. There will be a Matlab error.

22. (1 point) The value of x in the workspace after >>x=3; clear; x=myFunc2(3);x will be:

     a. 4
     b. 3
     c. 2
     d. None of the above because this program will produce a matlab error

23 (1 points) The program file myFunc4.m is partially as follows:

```
function y = myFunc4 (x)
y = x + gunc1(x);
end
_____
x= y*2;
end
```

Select which of these should fill in the blank so that myFunc4 will compute correctly regardless of the presence or absence of any other user programmed functions present in the matlab working directory.

        a. function x = gunc1(y)
        b. y= 2;
        c. function gunc1(y)
        d. none of the above

Use the following code for problems 24-26:
The following are the contents of f.m, g.m, and h.m. They are all in the working matlab directory.

```
function y = f(x)
y = x + g(x) + h(x);
end
```

```
function y = g(x)
y = x*h(x);
end
```

```
function y = h(x)
y = x;
end
```

24. (1 point) The value of x in the workspace after >> x= 2; x=g(h(x)) is:
        a. 2
        b. 4
        c. 8
        d. 12

25. (1 point) The value of x in the workspace after `>> x=2; x = f(g(h(x)))` is
    a. 4
    b. 8
    c. 12
    d. 24

26. (1 point) The value of x in the workspace after `>> x=2; x = h(g(x))` is
    a. 2
    b. 3
    c. 4
    d. none of the above because this program will produce an error.

27. (1 point) If func has type A → B and gunc has type C → D, then the program

```
function y = hunc(x)
y = gunc(func(x))
end
```

has type A → D provided

A) C ⊆ B   B) B ⊆ C   C) A = ∅   D) A = C   B

28. (1 point) A type for the **and** operator in matlab is

    a. double → double
    b. double x double → char
    c. double x double → double
    d. logical x logical → logical

Page IV:
Questions 29-32: Recursion
The following is a recursive Matlab function.

```
function [out] =midtermRec(n)
if le(n,2)
    out = 1
elseif eq(n,3)
    out = 2
else
    out = midtermRec(n-1)  + midtermRec(n-3)
end
end
```

29. (1 point) What will be value assigned to out by the command >> `out =` `midtermRec(1)`?
       a. 0
       b. 1
       c. 2
       d. 3

30. (1 point) What will be the value assigned to out by the command >> `out =` `midtermRec(4)`?
       a. 2
       b. 3
       c. 4
       d. 6

31. (1 points) Notice there are no semicolons at the end of any lines in midtermRec.m. This means that as soon as any line is run, it will display the result of that line at the Matlab command prompt.

What will be the sequence of numbers displayed to the screen when the following command is typed into the command prompt? Space is provided below for you to do a function trace if you wish.

```
>> midtermRec(5);
```

      a. 1, 2, 1, 3, 5
      b. 5, 1, 3, 1, 2
      c. 4, 2, 1, 3, 1
      d. 2, 1, 3, 1, 4
      e. 1, 2, 1, 3, 4

32. (1 point) Which of the following Matlab functions will compute y defined as follows? Assume $n \in Naturals$:

$$y(n) = n^2 + (n-1)^2 + (n-2)^2 + \ldots + 2^2 + 1$$

```
a. function y = myFunc (n)
   if n == 1
        y = 1;
   else
        y = myFunc(n-1);
   end
   end
```

```
b. function y = myFunc (n)
   if n == 1
        y = 0;
   else
        y = myFunc(n) + n^2;
   end
   end
```

```
c. function y = myFunc (n)
   if n == 1
        y = 1;
   else
        y= myFunc(n-1) + n^2;
   end
   end
```

```
d. function y = myFunc (n)
   if n == 1;
        y = 1;
   else
        y = myFunc(n+1) + n^2;
   end
   end
```

Questions 33-37: Iteration
Assume that isprime is a Matlab function that takes in a positive whole number, n, and returns 1 if that number is prime and 0 otherwise.

Now consider the following set of commands and the matrix A:

$$A = \begin{bmatrix} 4 & 8 & 12 \\ 5 & 11 & 3 \\ 8 & 2 & 4 \end{bmatrix}$$

```
function out = myPrime(matrix)
[rows,columns] = size(matrix);
out = 0;

for i = 1:rows
    for j = 1:columns

        if isprime(matrix(i,j))

            out = out + matrix(i,j);

        end

    end
end
end
```

33. (1 point) What value will be assigned to the variable out by >> out = myPrime(A) ?

       a. 38
       b. 21
       c. 4
       d. none of the above

34. (1 point) What value will be assigned to the variable out by
      >> out = myPrime(A([1 2],:)) ?

       a. 24
       b. 0
       c. 19
       d. 20

35. (1 point) What value will be assigned to the variable `out` by

```
>>out = myPrime(A(1,1))?
```

    a. 0
    b. 1
    c. 9
    d. none of the above

Consider the following program:

```
function out = g(in)
n = 1;
out = 1;

while n < in
    out = out + n;
    n = n + 1;
end
end
```

36. (1 point) What value will be assigned to the variable out by >> out = g(5)?

        a. 5
        b. 10
        c. 11
        d. 15
        e. 16

37. (1 point) What value will be assigned to the variable out by >> out = g(3)?
        a. 1
        b. 3
        c. 4
        d. 6
        e. 7