UNIVERSITY OF CALIFORNIA
COLLEGE OF ENGINEERING

E7: INTRODUCTION TO COMPUTER PROGRAMMING
FOR SCIENTISTS AND ENGINEERS
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[30 points ~ 40 minutes]

Question	Points
Part I	7
Part II	5
Part III	7
Part IV	6
Part V	5
TOTAL	**30**

Notes:
1. Your exam should have 11 pages. Check this before you begin.
2. Before you leave the exam hall, make sure your name has been cross-verified and marked on the class list by atleast one of the GSIs while you are submitting your exam. If not, your exam will not be graded.
3. You may use your notes or laptop on this examination as necessary provided that you do not impede those sitting next to you. No other electronic devices are permitted.
4. Use a #2 pencil and a green scantron sheet to record your answers. Mark your solution to each question on the corresponding space on your scantron. There is one correct answer for each question. Multiple markings, incomplete markings, or stray marks will cause your solution to be marked incorrect.
5. Please write your **name, subject, date, test number, student ID number**, and **discussion and lab section** on your scantron for identification purposes.
6. You may NOT leave the exam room before the exam ends.

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Part I:
Questions 1 – 4: Matlab and Programming Basics
1. The semicolon operator (;) in Matlab can NOT be used to:
   A. Suppress automatic output display
   B. Separate a sequence of instructions
   C. Separate rows in a matrix
   D. None of the above

2. Which of the following is true?
   A. Every function can be computed by a Turing Machine
   B. If a function can be computed by a Turing Machine it can also be computed by a Von Neumann machine and vice versa
   C. Some functions computed by Turing machines cannot be computed by Von Neumann Machines
   D. Every function can be computed by a Von Neumann Machine

3. Which of the following variable name is allowed in Matlab ?
   A. `else`
   B. `x/y-`
   C. `x`
   D. none of the above

4. We want to store 128 in Matlab. Pick the data type that would minimize the memory used.
   A. uint8
   B. int8
   C. int16
   D. double

Questions 5 – 7: Matrix Operations

5. For any matrix P, P.^2 – P^2 is equal to 0 in Matlab -
   A. For every matrix P
   B. Sometimes
   C. Never
   D. Only if P is a 2 X 2 matrix

6. If we have two row vectors, a = [1 2 3] and b = [3 4 5], which of the following is WRONG?

   A. $a' * b = \begin{bmatrix} 3 & 4 & 5 \\ 6 & 8 & 10 \\ 9 & 12 & 15 \end{bmatrix}$

   B. $a * b' = 26$

   C. $(a * b)' = \begin{bmatrix} 3 \\ 8 \\ 15 \end{bmatrix}$

   D. $a .* b = \begin{bmatrix} 3 & 8 & 15 \end{bmatrix}$

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7. Which of the following commands defines the matrix
   P = [2 1 1 1; 9 4 2 8; 13 7 7 7]

   A. P = [[2 9 13], [ones(1,3); 4:2:8; ones(1,3)*7]]
   B. P = [[2 9 13]';[ones(1,3), 4:2:8, ones(1,3)*7]]
   C. P = [[2 9 13]',[ones(1,3); 4:2:8; ones(1,3)*7]]
   D. P = [[2 9 13];ones(1,3); 4:2:8; ones(1,3)*7]

Part II:
Questions 8-12: Matlab Functions

8. Which of the following statements is correct ?
   A. Function "clear" clears only the scalar variables, but does not clear arrays.
   B. Function "clc" clears only the command window.
   C. Function "clear a" clears all variables of type "array".
   D. Function "clc" clears all variables.

9. We define the following function and save under display.m

   ```
   function [] = myDisp()
           disp('I love E7')
   end
   ```

   We write the following code at the command prompt:
   >> myDisp()
   and we get the error message : "Undefined function or variable 'myDisp'.
   Which of the following statements explains the error?
   A. The error is due to the absence of output
   B. The error is due to the absence of input
   C. There is a syntax error in the function definition
   D. The error is due to the name of the m-file

10. This is a Matlab function that returns the sum and product of two numbers.
    ```
    function [total, product] = SumProd(x,y)
        total = x+y;
        product = x*y;
    end
    ```
    Given the function is saved in your working directory, which of the following two commands
    will give an error?
    >> [total, product] = SumProd(2,3)
    >> [t, p] = SumProd(2,3)
    A. The first command.
    B. The second command
    C. Neither of the commands
    D. Both the commands

11. Pick the expression that computes the function $f(a,b,c) = a - (b*c)$. The functions subtract and multiply in the expressions are as defined below.

```
function [z] = multiply(x,y)
        z = x * y;
end
```

```
function [z] = subtract(x,y)
        z = x- y;
end
```

A. `subtract(a) - multiply(b,c)`

B. `subtract(a, multiply(b,c))`

C. `multiply(a, subtract(b,c))`

D. `subtract(multiply(b,c), a)`

12. Consider the following Matlab function myMultiply.m :

```
                          myMultiply.m
function out = myMultiply(A,B)
 out(1,1)=A(:,1)'*B(:,1);
 out(1,2)=A(:,1)'*B(:,2);
 out(2,1)=A(:,2)'*B(:,1);
 out(2,2)=A(:,2)'*B(:,2);
end
```

Which of the mathematical functions below does the program above compute? The arguments of the functions are matrices. Assume the matrix elements are modeled by Matlab doubles.

A. $f(A,B) = A'*B$ for all A & B

B. $f(A,B) = A*B$ for all A & B

C. $f(A,B) = A*B'$ for all A & B

D. None of the above

Part III:
Questions 13-19: Logical Operations, If Else

13. For the following code, what should the value of y_2 be so that $z = 1$:

```
>> x='aa';
>> y1='bb';
>> y2=_____;
>> z=eq(strcmp(x,y2) , (strcmp(x,y1)));
```

A. There is only one unique value of y2 for which z = 1

B. There are many values of y2 for which z = 1

C. There are no values of y2 for which z = 1

D. None of the above

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14. a and b both have logical values. Which of the following commands returns the same result as **or (a,b)** ?

   A. a+b
   B. logical(a*b)
   C. logical(a+b)
   D. none of the above

15. Which of the following expressions assigns x the logical value 1?

   A. clear; x = isa (y,'double'); y=1;
   B. x = isa(1, 'logical')
   C. clear; x = isa(y, 'logical') ; y = logical(1) ;
   D. x = isa(1, 'double')

16. If x = 1, which of the following expressions evaluates to 0?

   A. isreal(exp(-log(x)))
   B. isreal(log(exp(x)))
   C. log(exp(-x))
   D. isreal(exp(log(-x)))

17. The content of myTest.m is as follows:

```
myTest.m

function [h] = myTest(T)
      if T < 30
            h = 2*T +1;
      elseif T<20
            h = T-2;
      else
            h = 0;
      end
end
```

Typing
>> a = myTest(5)
returns

   A. a = 11
   B. a = 3
   C. h = 0
   D. Undefined function or variable 'a'

A teacher enters the grades of students into a function that categorizes their grades according to the following: $[0,20] \rightarrow$ F ; $(20,40] \rightarrow$ D ; $(40,60] \rightarrow$ C ; $(60,80] \rightarrow$ B; $(80,100] \rightarrow$ A. Assuming the teacher will only input grades between 0 and 100, for the next two problems consider the two programs below (Note: '[ ]' mean the number is included, '( )' mean the number is excluded)

```
function [grade] = myFun1(x)
  if x<20
    grade = 'F';
  elseif x<=40
    grade = 'D';
  elseif x<=60
    grade = 'C';
  elseif x<=80
    grade = 'B';
  else
    grade = 'A';
  end
end
```

```
function [grade] = myFun2(x)
  if x<20
    grade = 'F';
  end
  if x<=40
    grade = 'D';
  end
  if x<=60
    grade = 'C';
  end
  if x<=80
    grade = 'B';
  else
    grade = 'A';
  end
end
```

18. Which of the two programs on the previous page will correctly compute?

    A. Neither myFun1 nor myFun2
    B. Both myFun1 and myFun2
    C. myFun1
    D. myFun2

19. If I type the following command, what will be the output?
    >> myFun2(40)

    A. A
    B. B
    C. C
    D. D

Part IV:

Questions 20-25: Matlab Types, Function Scope

Consider the following function `SimpleTest.m`:

```
function Result = SimpleTest(x,y,z)
if isa([x y z], 'double')
    if and(ge(x,z),lt(y,z)) == 1
        Result = 'The inputs are valid';
    else if ge(z,x) == 1
            Result = 'The third input is not valid';
    else
            disp('The inputs are not valid, try again');
    end
else
    disp('Wrong input format. x, y, z must be numbers');
end
end
```

20. What relation between x, y and z is the above function checking?

    A. $y < z <= x$
    B. $x < y < z$
    C. $y <= x <= z$
    D. None of the above

21. What is the type of the Matlab function SimpleTest?

    A. Logical x Logical x Logical → Char
    B. Double x Double x Double → Double
    C. Logical x Logical x Logical → Logical
    D. Double x Double x Double → Char

22. Which of the following changes would make SimpleTest return a value of type `logical`?

    A. Change the expression `'The inputs are valid'` to `logical(1)`
    B. Change the expression `'The third input is not valid'` to `logical(0)`
    C. Both option A and option B
    D. Neither Option A nor Option B

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For Problems 23-25, use the following three Matlab functions:

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

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

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

23. If all three functions are defined in the Matlab file f.m, what will be the value of x after the following commands?

    `>> x = 2; x = h(g(f(x)))`

    A. 32
    B. 8
    C. 4
    D. None of the above

24. If the three functions are defined in three different Matlab files f.m, g.m and h.m respectively all located in your working directory, what will be the value of x after the following commands?

    `>> x = 2; x = h(g(f(x)))`

    A. 64
    B. 16
    C. 2
    D. None of the above

25. On execution of the program >> `clear;x=2;h(g(f(x)));clear`, the whos command in f.m will show there is:

    A. 2 double in memory
    B. 1 doubles in memory
    C. No doubles in memory
    D. None of the above

Part V:

Questions 26-30: Turing Machine, Iteration and Recursion

26. You are given the following Turing Machine that evaluates a particular unary (Base 1) operation.
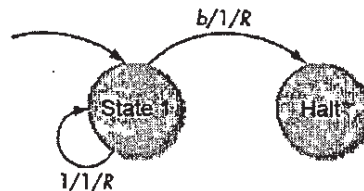
Remember that the notation I/O/M means that the symbol I is read at the current head position, symbol O is written there and then the head moves in the direction M (R-> Right, L-> Left). This Turing Machine starts at State 1 and halts at state Halt. The tape head is always positioned to read the first input.

If the input to this machine is the unary representation of 3 (1111b), what is the output?

A. The unary representation of 5.
B. The unary representation of 4.
C. The unary representation of 2.
D. The output cannot be uniquely determined.

27. Function *y:Naturals → Reals* is defined as follows:
$$y(n) = \log(n) + \log(n - 1) + \cdots + \log(1)$$

What is the recursive mathematical definition of the above function?

A. $y(n) = \log(n) + y(n - 1)$,   if $n > 1$
   $y(n) = 0$,   if $n = 1$

B. $y(n) = \log(n) + y(n - 1)$,   if $n > 1$
   $y(n) = 1$,   if $n = 1$

C. $y(n) = \log(n) + \log(n - 1) + \cdots + \log(1)$

D. None of the above

28. Now which of the following Matlab functions will correctly compute the recursive definition on the previous page?

    A.

    ```
    function y=myFunc (n)
        y = myFunc(n-1) + log(n);
    end
    ```

    B.

    ```
    function y=myFunc (n)
    if n == 1
        y = log(1);
    else
        y = log(n);
    end
    end
    ```

    C.

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

    D.

    ```
    function y=myFunc (n)
    if n == 1
        y = log(1);
    else
        y = myFunc(n-1) + log(n);
    end
    end
    ```

29. Which of the following is true?
    A. In Matlab, the number of times a for loop will execute can depend on the code in the loop.
    B. The number of times a while loop will execute can depend on the code in the loop.
    C. For and While loops can always be used interchangeably in Matlab.
    D. None of the above is true.

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30. The matlab function rem (x,y) returns the remainder after dividing x by y. Given, N stores values of class double, which of the following functions will NOT terminate when called?

A.

```
function [] = myFunc ()
  N=2;
  while N>0
    .  N=N/2;
  end
end
```

B.

```
function []= myFunc()
 N=2;
 for i = 1:N
     if rem(N,2)==0
         N=N+1;
     else
         N=N-1;
     end
 end
end
```

C.

```
function []= myFunc()
 N=2;
 while N>0
     if rem(N,2)==0
         N=N+1;
     else
         N=N-1;
     end
 end
end
```

D. Come on! This last one is of course a trick question. All of the above will terminate!