University of California, Berkeley
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Department of Mechanical Engineering
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E7 Midterm Examination 2

November 2, 2018

NAME : _____

SID : _____

Part	Points	Grade
A	6	
B	2	
C	9	
D	4	
E	6	
F	3	
G	8	
H	8	
TOTAL	**46**	

Notes:
1. Write your full name and SID in the spaces provided above.
2. Write your name on the top right corner of each page.
3. Record your answers *only in the spaces provided.*
4. This is a closed-book exam.
4. You may *not* ask questions during the exam.
5. You may *not* leave the exam room before the exam ends.
6. You may *not* use any electronic devices (cell phones, computers) during the exam.

 Name: _____

Part A - Problem 1 (2 points)

Consider the following code:

```
a=[ 2     8     8     2     3     0     7     0     6
    6     5     8     1     5     9     3     2     4
    6     9     0     1     4     9     2     3     5
    7     0     3     8     0     4     4     8     2
    4     4     2     5     2     4     0     0     7
    0     1     8     5     1     3     1     0     1
    2     9     4     2     1     9     9     1     6
    9     0     9     8     2     3     9     6     1
    1     7     1     6     4     1     5     7     3];
b = 0;
n = size(a,2);
while b < 15
    b = b + a(4,n);
    n = n - 1;
end
```

After execution of the above code, fill out in the spaces provided the results of the following statements:

A.1 (1 point)

```
>> b

   ans =
```

_____

A.2 (1 point)

```
>> n

   ans =
```

_____

 Name: _____

Part A - Problem 2 (4 points)

Consider the following code:

```
a = zeros(1,100);
for n = 1:100
    for m = 2:sqrt(n)
        if mod(n,m)==0
            a(n) = a(n) + 1;
        end
    end
end
```

After execution of the above code, fill out in the spaces provided the results of the following statements:

A.3 (1 point)

```
>> a(2)

   ans =
```

_____

A.4 (1 point)

```
>> a(24)

   ans =
```

_____

A.5 (2 point)

```
>> sum(a(10:20)==0)

   ans =
```

_____

 Name: _____

Part B (2 points) Consider the following code:

```
n = 0;
count = 0;
while n < 1e3
    count = count + 1;
    n = 2^n;
    if n >= 4
        n = n - 1;
        break
    end
end
```

After running the above code, fill out in the spaces provided the results of the following statements:

B.1 (1 point)

```
>> count

   ans =
```

_____

B.2 (1 point)

```
>> n

   ans =
```

_____

 Name: _____

Part C (9 points)

Consider a function called `convert`, which is intended to convert letter grades to grade points, such that:

- `convert('A')` returns 4.0
- `convert('B')` returns 3.0
- `convert('C')` returns 2.0
- `convert('D')` returns 1.0
- `convert('F')` returns 0.0

The function presently reads as follows:

```
1  function point = convert(letterGrade)
2
3     if letterGrade == 'A'
4
5             point = 4.0;
6
7     elseif  letterGrade = 'B'
8
9             point = 3.0;
10
11    elseif  lettergrade == 'C'
12
13            point = 2.0;
14
15    else    letterGrade == 'D'
16
17            point = 1.0;
18
19    elseif letterGrade == F
20
21            point = 1.0;
22
23    end
24
25 end
```

 Name: _____

C.1 (5 points) Trying out this function, it is observed that it does not work properly. Identify and fix all the errors in the function, by writing below the line numbers (using the enumeration of the code lines as above) and the corresponding corrections.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

C.2 (4 points) Below, you are given the function `convertArray` that changes an array of letter grades `letterArray` to an array of gradepoints `pointArray` using the above `convert` function. The `letterArray` function has incomplete parts. Fill them out in the spaces provided.

```
function pointArray = convertArray(letterArray)
    % letterArray: an input array of letter grades
    % pointArray: an output array of point grades
    %       corresponding to the input letterArray
    % e.g., calling
    %       >> convertArray(['A','B','C','D'])
    % returns
    %       >> ans =
    %                [4.0, 3.0, 2.0, 1.0]
    %

    pointArray = [];

    while _____

        pointArray = [pointArray, convert(_____)];

        letterArray(1) = [];

    end

end
```

 Name: _____

Part D (4 points) Consider the following function `functionD`:

```
function [output] = functionD(input, count)
    if count < 10 && input >= 2
        output = functionD(input/2, count + 1);
        count = count + 1;
    else
        output = count + input;
    end
end
```

Answer the following questions:

D.1 (1 point) What is the output of the following call?

```
>> functionD(32, 3)

   ans =
```

_____

D.2 (1 point) How many times is `functionD` called in part D.1?

_____

D.3 (1 point) What is the output of the following call?

```
>> functionD(256, 8)

   ans =
```

_____

D.4 (1 point) How many times is `functionD` called in part D.3?

_____

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Part E (6 points)

We want to find the minimum in a given `double` array of numbers recursively. We have written the following code:

E.1 (4 points) Fill in the blank lines in the code below.

```
function num = findmin(array)

    if length(array) == 1

        num =  array;

    elseif array(1) < findmin(array(2:end))

        num = _____

    else

        num = _____

end
```

E.2 (1 point) What does this function return if we type the following command:

```
>> findmin([2,1,3,1,5])

          ans = _____
```

E.3 (1 point) How many times the `findmin` function is called in part E.2?

_____

 Name: _____

Part F (3 points)

F.1 (1 point) What is the output of the following code (true/ false)?

```
>> (4 + eps)/4 == 1

   ans =
```

_____

F.2 (1 point) Given

```
>> realmax

ans =

  1.7977e+308
```

What is the output of the following code?

```
>> [10,2].^10000

   ans =
```

_____

F.3 (1 point) Convert the number 121 in the base-3 system to a number in the decimal (base-10) system. The answer is:

```
   ans =
```

_____

 Name: _____

Part G (8 points) Consider a quadratic polynomial of the form

$$y(x) = c_2 x^2 + c_1 x + c_0 \, .$$

Assume that the polynomial $y(x)$ satisfies the following equations:

$$y(0) = 4$$
$$y(1) = 1$$
$$y(2) = 0$$

The coefficients c_2, c_1, c_0 are determined by solving the system of linear algebraic equations

$$Ac \; = \; b \, .$$

Complete the matrix A and the vector b in the spaces provided below (note that the vector c has coefficients stored in the order $[c_2; c_1; c_0]$):

```
>> A = [

                                                    ];

>> b = [                                            ];

>> c = A\b ;
```

 Name: _____

Part H (8 points)

H.1 (6 point)

Consider the nonlinear function

$$f(x) = 1 + \sin(x) - x \, .$$

We want to use fixed-point iteration method to find a root of $f(x)$. Complete the code below, in the four designated lines, to accomplish this.

```
% fixed-point iteration to find the root
% of function f = 1 + sin(x) - x

tol = 1e-3;      % tolerance (relative)

xprev = pi;

xnext = _____

while _____

   xprev = _____

   xnext = _____

end
```

H.2 (2 points)

Given a nonlinear function

$$f = 2x^{11} + 3x^4 + 2x + 8 \, ,$$

we want to use the bisection method to find a root with an initial search range [-2, 2]. After one iteration, what is the new search range?

```
ans = _____
```