E7 Midterm Examination 1

September 30, 2011

NAME : _____

SID : _____

SECTION : **1** or **2** (please circle your lecture section)

LAB :

#11: TuTh 8-10	#12: TuTh 10-12	#13: TuTh 12-2	#14: TuTh 2-4
#15: TuTh 4-6	#16: MW 8-10	#17: MW 10-12	#18: MW 2-4
#19: MW 4-6	#20: TuTh 10-12	#21: MW 3-5	#22: TuTh 4-6

(please circle your lab section)

Part	Points	Grade
A	10	
B	6	
C	8	
D	11	
E	5	
F	5	
TOTAL	**45**	

Notes: 1. Write your name on the top right corner of each page.

2. Record your answers only in the spaces provided.

3. You may <u>not</u> ask questions during the exam.

4. You may <u>not</u> leave the exam room before the exam ends.

Part A (10 points)

Let two MATLAB arrays A and B be defined as

```
>> A = [1 3 5]
>> B = [0 5 1; 2 4 3]
```

Record the output of the following MATLAB commands:

A.1 (1 point)

```
>> A

    A = 1   3   5
```

A.2 (1 point)

```
>> A+B(2,:)

    ans = 3   7   8
```

A.3 (1 point)

```
>> [A B(:,1)']

    ans = 1   3   5   0   2
```

A.4 (1 point)

```
>> A./A

    ans = 1   1   1
```

A.5 (1 point)

```
>> 2*A

    ans = 2   6   10
```

A.6 (1 point)

```
>> A.^2

    ans = 1   9   25
```

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A.7 (1 point)

```
>> B([1 2],[1 3])

              0   1
    ans =   2   3
```

A.8 (1 point)

```
>> B(1,end:-1:1)

    ans = 1   5   0
```

A.9 (1 point)

```
>> size([A;B])

    ans = 3   3
```

A.10 (1 point)

```
>> max(min(B))

    ans = 4
```

Part B (6 points)

The following code is entered in the command window:

```
>> cars = {{'Ford'}    '2008 Focus'  'blue'    '$5,000'; ...
           {'VW'}      '2009 Jetta'  'gold'    '$11,000'; ...
           {'Toyota'} '2007 Prius'   'sliver'  '$9,000'}
```

In parts B.1-4, record the output of the following MATLAB commands:

B.1 (1 point)

```
>> cars{1,1}{1}

    ans = Ford
```

B.2 (1 point)

```
>> cars{2,1}{1}(2)

    ans = W
```

B.3 (1 point)

```
>> cars{5}(6)

    ans = J
```

B.4 (1 point)

```
>> [cars{1:2,3}]

    ans = bluegold
```

B.5 (1 point)
Write a one-line MATLAB command to correct the typographical error "sliver" to "silver" in the description of the Toyota Prius.

```
>> cars{3, 3} = 'silver';
```

B.6 (1 point)
Write a one-line MATLAB command to reduce the price of the VW Jetta to $10,500.

```
>> cars{2,4} = '$10,500';
```

Part C (8 points)

The following table contains the scores of the Cal football team to date in the 2011 season.

Opponent	Home	CalScore	OppScore
Fresno State	true	36	21
Colorado	false	36	33
Presbyterian	true	63	12
Washington	false	23	31

A 1-by-4 structure array is created to store the preceding information. The array should be called R, with fieldnames Opponent, Home, CalScore and OppScore. The contents of the fields should be char, logical, double and double, respectively.

C.1 (4 points)

Write the MATLAB commands to create the (1,1) entry of the array R (this is associated with the game against Fresno State).

```
>> R(1).Opponent = 'Fresno State';

>> R(1).Home = true;

>> R(1).CalScore = 36;

>> R(1).OppScore = 21;
```

C.2 (2 points)

Using comma-separated lists, create two 1-by-4 double arrays, CS, and OS, which contain the points scored by California (in CS) and the points scored by the opponents (in OS) for each game.

```
>>  CS = [R.CalScore];

>>  OS = [R.OppScore];
```

C.3 (2 points)

Write a MATLAB command that operates on CS and OS, which calculates the total number of wins by California.

```
>>  numel(find(CS>OS))
```

Part D (11 points)

The amortization formula

$$m = \frac{i(1+i)^n}{(1+i)^n - 1}p$$

relates the monthly payment m to the principal borrowed p, the interest rate i, and the total number of monthly payments n. For instance, a $10,000$ loan for 5 years at 4% interest corresponds to $P = 10,000$, $n = 5 \times 12 = 60$ and $i = 0.04$.

A function M-file called `payment.m` is written to calculate the monthly payment.

D.1 (2 points)

Complete the function. Assume that p and n are scalars, but i is, in general, an array.

```
function m = payment(p,n,i)

% Calculate monthly payment by the amortization
% formula
% p: principal (scalar)
% n: total number of monthly payments (scalar)
% i: interest rate (array)
% m: monthly payment (array)


m =   i.*(1+i).^n*p./((1+i).^n-1);
```

Suppose now that the function `payment` is completed correctly and it is visible to the MATLAB workspace.

D.2 (1 point)

Write a MATLAB command that would calculate the monthly payment for a principal of $10,000$ borrowed at 4% for a period of 5 years.

```
>> payment(10000, 60, 0.04)
```

D.3 (3 point)

For the purpose of testing the function, you execute the commands

```
>> m1 = payment(10000,36,0.06)
>> m2 = payment(20000,36,0.06)
>> m3 = payment(20000,48,0.06)
>> m4 = payment(20000,48,0.09)
```

Describe in a few words how you expect m1 and m2 to be related if the function is correctly implemented.

```
m2 would be twice m1.
```

Describe in a few words how you expect m2 and m3 to be related if the function is correctly implemented.

```
m3 is slightly less than m2.
```

Describe in a few words how you expect m3 and m4 to be related if the function is correctly implemented.

```
m4 is 1.5 times m3.
```

D.4 (1 point)

Do you expect the command

```
>> payment(10000,24,0)
```

to yield the correct answer? Explain why (or why not).

```
No, with an interest rate of 0 the formula evaluates
to 0/0, therefore MATLAB will return NaN.
```

D.5 (1 point)

Create an anonymous function loan10 that calculates the monthly payment for a 10 year loan. The input arguments to loan10 are (in order) interest and principal.

```
>> loan10 = @(i, p) payment(p, 120, i)
```

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D.6 (1 point)

Invoke the anonymous function of part D.5 to calculate the monthly payment for a $10,000$, 10-year loan at 4% interest.

```
>> m5 = loan10(0.04, 10000);
```

D.7 (2 point)

Complete the following two MATLAB commands that would plot the monthly payment of a $10,000$ 5-year loan as a function of the interest rate, when the latter varies from 1% to 10% with increments of 1%.

```
>> m = payment(10000, 60, 0.01:0.01:0.1)
```

```
>> plot(0.01:0.01:0.1, m)
```

Part E (5 points)

Assume that the array variables A and B have been defined from the MATLAB command window as follows:

```
>> A = [1 1 0];
>> B = [1 0 0];
```

Indicate the output of the following commands, which are executed in sequence from the MATLAB command window (if a command produces a MATLAB error, write ERROR):

E.1 (1 point)

```
>> C=A&B

        C = 1 0 0
```

E.2 (1 point)

```
>> D=~(A|B)

        D = 0 0 1
```

E.3 (1 point)

```
>> E=~(A&B)|B

        E = 1 1 1
```

Suppose next that the scalar variables a and b have been defined from the MATLAB command window as follows:

```
>> a=1; b=2;
```

Indicate again the output of the following commands:

E.4 (1 point)

```
>> b<=b+a==1

        ans = 1
```

E.5 (1 point)

```
>> (b<=b)+a==1

        ans = 0
```

Part F (1+1+1+2 points)

The function `fun` takes as input a string `A` and a positive integer `n` and outputs a string `B`. The rule for generating `B` is as follows: If `A` is `n` or more characters long, then `B` is equal to the first `n` characters of `A`. Alternatively, if `A` is less than `n` characters long, then `B` is equal to `A`, padded from the right by enough blank characters to be again `n` characters long.

The function `fun` accepts a subfunction `subfun` which performs the "padding", if necessary. Complete the code in `fun` and `subfun`, as necessary.

```
function B=fun(A,n)
% Replace the string A by its first n characters.
% If A has less than n characters, then pad it by
% enough characters for the output to be n characters long.



if (length(A) >= n)


    B = A(1:n);


else


    B = subfun(A, n - length(A))


end



function C = subfun(A,k)
% This is a subfunction of func that pads a string by
% k blank characters from the right


C = [A repmat([' '], 1, k)]
```