MAE-10 : Winter Quarter 2011

Final Examination

Instructions: You have until the end of the class period to complete the exam. Notes on both sides of an 8.5”x11” sheet of paper are allowed. Closed book. No calculators.

Section 1: Short Answer. (2 points each)

(1.1) Name one positive and one negative aspect of **cloud computing**?

(1.2) How many data lines will be plotted on the figure generated by the following code?

```
t = [-1:100];
x = t.^2;     y = x.^2;     w = y.^2;     z = w.^2;
G = [ t ; x ; y ; w ; z ];
plot(t,G)
```

(1.3) How many elements are in `w`?

```
y = [ 1:3:10 ; 2:3:11 ; 3:3:12 ];
w = y( 1:2:3 , end );
```

(1.4) What value(s) are stored in `t`?

```
x = [1 2 3 4];   y = [4 3 2 1];
w = (x >= y);
t = find(w)
```

(1.5) What fraction (0% to 100%) of the plotting window will be occupied by subplot(s)?

```
x = [1:10];   y = x.^2;
subplot(2,2,3)
plot(x,y)
```

(1.6) Convert the following binary (base-2) numbers to decimal (base-10) numbers. The decimal number system is what we use every day to count (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, …).

```
0101011                    1010101
```

<u>Section 2</u>: Identify all errors in the following segments of code, if any exist, and give an explanation of the error. If you believe that there are no errors write "No errors." (2 points each)

(2.1)
```
A = [1 2 3 4 5 6 7 8 9 10 15 16 17 18 19 20];
B = [1 3 5 7 9 0];
C = A(1:5) .+ B(2:6);
D = C .+ A(11:2:15);
```

(2.2)
```
X = (100:200);
Y = (1000:2000);
tablexy = [ X(3:end) , Y(4:end).^2 ];
tablexy = tablexy(1:2)
```

(2.3)
```
X = [ 1:2:11 ];
Y = [ 1:3:10 ];
if( X > Y )
   disp(X)
elseif( (X(1) > Y(2)) | (X(1) < Y(2)) )
   if( Y(3) > Y(3) )
      disp( X(4) )
   end
elseif( ~(X(2) < X(3)) )
   disp( X(5) )
else
   disp( X(4) > X(3) )
end
```

(2.4)
```
A = [ 1:3 ];
B = [ -2:3 ];
for k = A
   i = 2;
   while( i<5 )
      C(k) = C(k) + A(k);
      i = i + 1;
   end
end
fprintf( '%7i\n' , A,B,C )
```

(2.5)
```
Y = [34.5, 65.22, 89.09, -12.34];
X = [43.2, 76.5, -90, 0];
fprintf('%8.4f\n' , X, Y)
fprintf('%g %g %e\n' , [X, Y])
fprintf('%i %g %9.1f\n' , [X ; Y])
```

(2.6)
```
A = '51152ABC';  B = 'Y1111X';  C = '15119012';
switch ( C(3:4) )
   case{ A(1:3), A(1:2) }
      disp('hi')
   case{ B(2:3), B(3:4) }
      disp( 'bye' )
   case{ A(6:7), '11321' }
      disp('pickles')
end
```

(2.7)
```
X = [ 0:10:100 ];
Y = X.^3;
T = Y .- X;
subplot(4,2,5)
plot(X,X)
subplot(4,2,9)
plot(T,X)
title('My fun figure')
subplot(4,2,1)
plot(X,Y)
```

For problems (2.8) through (2.10), I provide a function program and the "main" program that calls the function, each stored in a different m-file. Assume both m-files are in the same directory. Errors may exist in both programs.

(2.8)

In the "main" program:

```
X = [ 2:2:10 ];
Y = [ 3:3:1200 ];
[ X,Y ] = pizza( X , Y );
fprintf('%i', [X , Y])
```

In the m-file containing the function `pizza`:

```
function [ W,T ] = pizza(W, T)
W = T' ;
endfunction
```

(2.9)

In the "main" program:

```
X = [ 1:10 ];
Y = [ 2:11 ];
W = [ 3:12 ];
output = f1( X(2:4) , Y(9:10) , W(5:7) )
fprintf('%7.2f' , output)
```

In the m-file containing the function `f1`:

```
function [ result ] = f1( A,B,C )
A = A .+ 2;
B = B .+ 2;
C = C .- 2;
result = A .+ B .- C;
endfunction
```

(2.10)
In the "main" program:
```
     X = 3;  Y = 4;  A = 10;  B = 20;
     W = f1(X,Y) + f2( A, f1(B,B) );
     fprintf('W = %f' , W)
```

In the program containing the function `f1`:
```
     function [ Y ] = f1( A,B )
     Y = A+B;
     for i = A:B
        Y = Y + i;
     end
     endfunction
```

In the program containing the function `f2`:
```
     function [ Y ] = f2(X,Y)
     X = X .^ 2;
     Y = X .+ 2;
     endfunction
```

Section 3: Write the output from the following segments of code exactly as it would appear it is executed in Matlab or Octave. Indicate blank spaces with an underscore. Assume that there are no errors. (4 points each)

(3.1)
```
     a = 2^4 / 4+4 * 2-2;
     b = 2^(4/4+4)*2-2;
     c = 27/9+64/4/4^2;
     fprintf( '%3i\n' , a,b,c )
```

(3.2)
```
a = [ 1:4 ; 3:6 ; 2,2,2,2 ];
b = a(end:end);
c = a( a(1,2) , a(1,3) );
d = a( : , 2 );
fprintf( '%3i %3i' , b, c, d )
% Note: there is 1 space between %3i and %3i
```

(3.3)
```
x = [ 100 : 2 : 10000 ];
j = x(200) - x(198);
for i = 1:j
   fprintf( '%4i\n' , x(i) )
end
```

(3.4)
```
i = 10;  j = 3;
while(j < i)
   fprintf('%3i%3i', i,j)
% Note: there are no spaces between %3i and %3i
   i = i - 7;
   j = j - 1;
end
```

(3.5)
```
hour = 'ten';  ten = 'hour';   one = 'clock';
x = [3 5 8 2 4];
switch hour
   case{'one', ten}
      if( x(2) > x(1) )
         disp('koo koo')
      elseif( x(3) > x(2) )
         disp('ding dong')
      end
   case{'ten', one}
      if( x(4) == 2 )
         disp('bing bong')
      elseif( x(5) == 4)
         disp('tik tok')
      end
   otherwise
      disp('wristwatch')
end
```

(3.6)
```
     a = [7.2, 4.3, 0.1, 9.9, 100.1, 70.0];
     for i=1:2
        j = 1;
        while( i < a(j) )
           fprintf('%5.2f%6.1f\n', i,a(j) )
           j = j+1;
        end
     end
% Note: there are no spaces between %5.2f and %6.1f
```

For problems (3.7) through (3.10), I provide a function program and the "main" program that calls the function. Assume both programs are in the same directory.

(3.7)
In the "main" program:
```
     x = [ 2:2:8 ];
     y = [ 3:3:12 ];
     fprintf( '%2i\n' , y(3:4) )
     [ x , y ] = f1( x(1:2) , x(3:4) );
     fprintf( '%2i%2i\n' , x, y )
% Note: there are no spaces between %2i and %2i
```

In the m-file containing the function `f1`:
```
     function [ a , b ] = f1( a , b )
     a = b;
     b = a;
     endfunction
```

(3.8)

In the “main” program:

```
     a = 2;
     b = 4;
     x = 10;
     y = 12;
     fprintf( '%3i%3i\n' , a, b )
% Note: there are no spaces between %3i and %3i
     [ a,b ] = f2( a , b ,x,y );
     fprintf( '%2i%2i\n' , a,b )
% Note: there are no spaces between %2i and %2i
```

In the m-file containing the function `f2`:

```
     function [ x , y ] = f2 ( y,x,a,b )
     for i = 1:5
        x = x + 1;
        y = y + 1;
        if(i==3)
           fprintf( '%2i%2i\n' , a,b )
           return
        end
        a = a - 1;
        b = b - 1;
     end
     endfunction
```

(3.9)

In the “main” program:

```
Y = @(X) X.^2 + 1;
PIG = 2;
COW = [3 , 4 , 5];
HORSE = DOG(PIG) - CAT(COW);
GOAT = DOG(COW) - CAT(PIG);
fprintf('%3i' , HORSE , GOAT , Y(PIG.^2) )
```

In the m-file containing the function `DOG`:

```
function [ output ] = DOG (X)
if(numel(X)>1)
   output = X(end);
   return
else
   output = X - 1;
   return
end
endfunction
```

In the m-file containing the function `CAT`:

```
function [ output ] = CAT ( Y )
output = 0;
for i=1:numel(Y)
   output = output + Y(i);
end
endfunction
```

(3.10)

In the "main" program:

```
x = 5;
y = (1:3);
w = f5( f6(x) , y ) + f6(y);
fprintf('%3i\n' , w)
```

In the m-file containing the function `f5`:

```
function [y] = f5(w,t)
y = f6(w) + f6(t);
fprintf('%3i\n' , y)
endfunction
```

In the m-file containing the function `f6`:

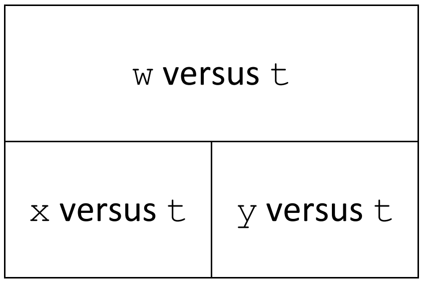
```
function [w] = f6(x)
for i=1:numel(x);
   x(1) = x(1) + x(i);
end
w = x(1);
fprintf('%3i\n' , w)
endfunction
```

<u>Section 4</u>: Write a program to complete the following tasks. Do not write the output of the code.

(4.1) (5 points) A program calls a function called `plotty`:

```
    plotty(x,y,w,t)
```

Write the function `plotty` that takes as input the arrays `t, x, y, and w` (there is no output). The function `plotty` displays the following information on three separate subplots.
(1) In the upper half of the plotting window, plot `w` versus `t`.
(2) In the lower left corner of the plotting window, plot `x` versus `t`.
(3) In the lower right corner of the plotting window, plot `y` versus `t`.



(4.2) (5 points) A program calls a function called `trans`:

```
    AT = trans(A)
```

Write the function named `trans` that takes as input an array `A` and returns as output the transpose of `A` (called `AT`). For example,

if `A` contains

```
1 4 7
8 9 0
0 0 0
1 4 6
```

`AT` would contain

```
1 8 0 1
4 9 0 4
7 0 0 6
```

Your function must be general for any sized `A` array. You <u>cannot</u> use any of Matlab and Octave's built-in functions for this problem except functions that determine the number of elements, rows, or columns in an array. <u>You cannot use the transpose operator in this problem</u>.

(4.3) (5 points) A program calls a function named `coinflip`:

```
    results = coinflip(numflip)
```

Write the function named `coinflip` that takes as input the number of times (`numflip`) the user will flip a trick coin, and returns as output the result from each flip (`results`). The trick coin is weighted so that there is a 75% chance of heads and 25% of tails. If the coin lands on heads, the result for that flip is "`H`". If the coin lands on tails, the result for that flip is "`T`".

For example, if `numflip` is 5, three possible values for `results` are `HHTHT`, `TTHHH`, and `HHHHH` (there are many more possible outcomes). The actual values stored in `results` will depend on how the coinflips turn out.

Your function must be general for any value of `numflip`.

(4.4) (6 points) A restaurant only sells two items, hamburgers and sodas. Each time a customer places an order, the number of hamburgers and sodas each customer orders is saved in a file called “`customers.txt`”. Yesterday, 157 customers visited the restaurant and the following data were recorded:

In “`customers.txt`”

```
1       1
2       0
… <rows 3-156 not shown> …
1       4
```

The first column contains the number of hamburgers ordered by each customer. The second column contains the number of sodas ordered by each customer. For example, customer #157 ordered 1 hamburger and 4 sodas.

Create a program that will read the data from “`customers.txt`” and store it in an array. Then find out the following information and display the answers to the screen:

(1) How many hamburgers were ordered that day?
(2) Which customer (1-157) ordered the most sodas?
(3) How many customers ordered more sodas than hamburgers?

You <u>cannot</u> use any of Matlab and Octave’s built-in functions for this problem except functions that determine the number of elements, rows, or columns in an array.