A. V. Gerbessiotis

May 2011

Exam 2(333 points)

CS 101-008

Spring 2011

120 minutes

NJIT
New Jersey's Science &
Technology University

Name: ....

ID Number: ....

Exam Number: ....

Grade: 1: ... 2: ... 3: ... 4: ... 5: ... 6: ... 7: ... 8: ... 9: ... 10: ... Total: ....

Solve **ALL the problems** in the space provided
Read the Problems **CAREFULLY!**

There are 7 (SEVEN) pages; This is Page 1 and Page 7 is SCRATCH page
You can carefully tear Page 7 off and work on it; Do not return it then.
Read and Sign the statement below at the end of the exam
Unsigned exams will be marked with grade 0 (zero).

STATEMENT

On my honor, I pledge that I have not violated the provision of the NJIT Student Honor Code.

Sign below at the end of the exam

Signature ....

In the exam, the following matrices will be used. Do not get puzzled if a reference to matrix X, Y Z, R, S, T or W arises! If you are asked to evaluate a MATLAB expression, and you think the result is undefined you could write UNDEFINED instead of giving an answer. For example `five == 5` is UNDEFINED since variable `five` has not been defined.

$$X = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}, Y = \begin{bmatrix} 2 & 0 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \\ 2 & 2 & 2 \end{bmatrix}, Z = \begin{bmatrix} 2 & 2 & 2 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}, S = [1; \quad 1; \quad 1 \quad], R = [1 \quad 2 \quad 2 \quad],$$

$$T = ['Computer' \quad 'Science*'], \qquad W = ['COMPUTER' \quad ; \quad 'SCIENCES'],$$

Problem 1. (63 POINTS)
Give short answers to the following questions. If you think an answer does not exist, you can write UNDEFINED next to it.

(1) (5pt) How many bytes in 1KiB?

(2) (5pt) How many bytes is a MATLAB `char`?

(3) (5pt) How many bytes is a MATLAB `double`?

(4) (5pt) Write decimal (base-10) 52 as an unsigned 8-bit binary number.

(5) (5pt) What is the value of $X(1,2)$?

(6) (5pt) What is the value of $X(2,1)$?

(7) (5pt) What is the value of $T(2)$?

(8) (5pt) Unsigned `0x12` is what unsigned integer base-10?

(9) (5pt) What is the value of $W(1,:)$?

(10) (5pt) What is the value of $W(2,8)$?

(11) (5pt) What is the value of $X(7)$?

(12) (5pt) What is the value of $W(3)$?

(13) (3pt) How much is $i * i$ in MATLAB?

Problem 2. (30 POINTS)
What are the values of $p2a, p2b, p2c, p2d$?

  (a) $p2a = 2 \char`^ 1 \char`^ 2 + 2 \char`^ 2 \char`^ 1$

  (b) $p2b = -5 - \sim 5 + 5$

  (c) $p2c = 1 == 3 - 2 == 1$

  (d) $p2d = 0 >= 0 >= 0$

Problem 3. (30 POINTS)
What are the values of $p3a, p3b, p3c, p3d$? What are their dimensions? Which of the four is/are scalar?

(example) $z = ones(2)$ **Answer** $z = [1 \quad 1; 1 \quad 1]$, z **is a** 2×2 **matrix**.

(a) $p3a = 1 : 3 : 7$

(b) $p3b = X(2 : end, 1 : end)$

(c) $p3c = size(W)$

(d) $p3d = length(R)$

Problem 4. (30 POINTS)

With reference to the following MATLAB code, answer the following questions.

```
function s=exam2p4(n)
  if(n==0)
    s='0';
  elseif(n==1)
    s='1';
  else
    s=[exam2p4(mod(n,2)), exam2p4(floor(n/2))];
  end
end
```

(a) What is the effect of `p4a= exam2p4(2)`? What is the value of $p4a$ returned?

(b) What is the effect of `p4b= exam2p4(7)`? What is the value of $p4b$ returned?

(c) What is the effect of `p4c= exam2p4(10)`? What is the value of $p4c$ returned?

(d) What does function `exam2p4` compute for an input that is a non-negative integer? Explain.

Problem 5. (30 POINTS)

(a) How many types of functions have we encountered in MATLAB? List them also.

(b) List three types of variables available in MATLAB .

Problem 6. (30 POINTS)

(a) We would like to print the numbers from 1 to 10 one such number per line. Give a method that does so using a `for` loop.

(b) We would like to print the numbers from 1 to 10 one such number per line. Give a method that does so using a `while` loop.

(c) We would like to print the numbers from 1 to 10 one such number per line. Give a method that does so WITHOUT using a `for` or a `while` loop.

(d) Is selection sort stable? Does it sort in-place?

(e) Is odd-even transposition sort stable? Does it sort in-place?

End of Page 4/Turn Page

Problem 7. (30 POINTS)

How efficient is the following function `inefficient`? Comment on it. Then, give a transformation that can make it faster by an order of magnitude or so. Show your transformed code next to the original on the far right below, where we decided to call the new function `efficient`

```
%Original                          Transformed
function y=inefficient(n)          % function y= efficient(n)
 for jj=1:n                        %
   x(jj) = jj  ^ 3;                %
 end                               %
 y=x;                              %
end                                % end
```

Problem 8. (30 POINTS)

You are given below the listings of M-file `exam2p8.m`. We then issue the two calls `[c d]` = `exam2p8(40,10)` and `[a b]=exam2p8(20,10)` shown below. What are the values of c, d, a, b?

```
function [c d]= exam2p8(a,b)

  c= a+b;
  d= a*b;
  temp=c;
  c=d;
  d=temp;
end
>>  [c d]= exam2p8(40, 10);
>>  c
    c =
>>  d
    d =
>>  [a b]= exam2p8(20, 10);
>>  a
    a  =
>>  b
    b  =
```

End of Page 5/Turn Page

Problem 9. (30 POINTS)

Implement function `aven(n)` that computes and returns the average of the first n integers $1, 2, \ldots, n$, i.e. the sum $(1 + 2 + \ldots + n)/n$. Thus a call to `aven(10);` will print

`The average from 1 to 10 is = 5.500000`

and the call `aven(100);` will print

`The average from 1 to 100 is = 50.500000.`

It is imperative that you not only implement the function that computes correctly the average, but you also include in the function's body, code that prints the relevant information as shown in the examples above. (You can use for that an `fprintf` or a `disp` function.)

Problem 10. (30 POINTS)

You are given below the listing of M-file `exam2p10.m`.
    (a) Identify and classify all functions in this file. Do the same for all variables.
    (b) What is the value returned for f for `f= exam2p10(1)`.

```
% exam2p10                    This is line 1
function y= exam2p10(z)       %        line 2
  function z= fun1 (x)        %        line 3
    z= 2*x;                   %        line 4
  end                         %        line 5
  function z= fun2 (x)        %        line 6
    persistent zorro;         %        line 7
    z= 2*x;                   %        line 8
  end                         %        line 9
                              %        line 10
  y= fun1(z)+ fun3(z);        %        line 11
  return;                     %        line 12
end                           %        line 13
function z=fun3(x)            %        line 14
  function z=fun1(x);         %        line 15
    z= 10*x;                  %        line 16
  end                         %        line 17
  z= 10*fun1(x);              %        line 18
end                           %        line 19
```

End of Page 6/Turn Page

$$X = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}, Y = \begin{bmatrix} 2 & 0 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \\ 2 & 2 & 2 \end{bmatrix}, Z = \begin{bmatrix} 2 & 2 & 2 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}, S = [1; \quad 1; \quad 1 \quad], R = [1 \quad 2 \quad 2 \quad],$$

$$T = \begin{bmatrix} 'Computer' & 'Science*' \end{bmatrix}, \qquad W = \begin{bmatrix} 'COMPUTER' & ; & 'SCIENCES' \end{bmatrix},$$

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End of Exam 2/ You may tear off this page carefully