NJIT New Jersey's Science & Technology University

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March 2015
Exam 1(250 points)

CS 101
Spring 2015
90 minutes

Name: .....

ID Number: ..... **Exam Number:** .....

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

Solve **ALL the problems** in the space provided

Read the Problems CAREFULLY!

There are 6 (SIX) pages this page included

In the exam, the following matrices MAY be used. Do not get puzzled if a reference to matrix X, Y or Z or etc arises! No problem modifies X, Y, Z, R, S in a way that missing that problem would change the answer of any other problem of the exam.

If you are asked to evaluate a MATLAB expression, and you think the result would generate an ERROR because a variable is undefined you could write `ERROR` instead of giving an answer. For example `five == 5` generates an `ERROR` since variable `five` is never defined anywhere in the exam.

$$X = \begin{bmatrix} 2 & 1 & 2 & 1 \\ 2 & 3 & 3 & 2 \\ 3 & 4 & 4 & 3 \end{bmatrix}, Y = \begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}, Z = \begin{bmatrix} 1 & 2 & 1 & 2 \end{bmatrix}, R = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}, S = \begin{bmatrix} 1 & 2 & 3 \end{bmatrix}.$$

Problem 1. (48 POINTS)
Give short answers to the following questions.

(1) How many bytes in 1KiB?

(2) What is an 1Kb?

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

(4) How many bytes is a MATLAB `uint16`?

(5) How many bytes is a MATLAB `logical`?

(6) What is the range of values for `int8` in MATLAB? (give number of values,lowest and highest value in the range.)

(7) What is array element $Y(end-1, end-1)$?

(8) What is array element $X(end-3)$?

(9) Represent decimal (i.e. base-10) integer 49 in hexadecimal.

(10) How many bits in a byte nowadays?

(11) How much is $j * j$ in MATLAB?

(12) Represent decimal (i.e. base-10) integer 49 in binary.

Problem 2. (30 POINTS)
What is the **value**, **Size** (i.e geometry/shape), number of **Bytes**, and the **Class** (i.e. data type) of variables `p2a,p2b,p2c,p2d,p2e,p2f`, as needed for the MATLAB program below.

```
>>  clear
>> p2a =  5 < 5 < 5;
>>  p2a
>>  whos p2a         %p2a= ............  Size ... x ...  Bytes ......   Class    .........
>> p2b =  int8(5 < 5);
>>  p2b
>>  whos p2b         %p2b= ............  Size ... x ...  Bytes ......   Class    .........
>> p2c =  5 == 5 + 5;
>>  p2c
>>  whos p2c         %p2c= ............  Size ... x ...  Bytes ......   Class    .........
>> p2d = int32(5 * 5 - 10/ 5);
>>  p2d
>>  whos p2d         %p2d= ............  Size ... x ...  Bytes ......   Class    .........
>> p2e = 11:-2:1;
>>  p2e
>>  whos p2e         %p2e= ............  Size ... x ...  Bytes ......   Class    .........
>> p2f =  transpose(R)*R;
>>  p2f
>>  whos p2f         %p2f= ............  Size ... x ...  Bytes ......   Class    .........
```

Problem 3. (60 POINTS)

Evaluate the following MATLAB expressions.

(example) $z = ones(2)$ **Answer** $z = [1 \quad 1; 1 \quad 1]$.

```
>>  clear;
>>  p3a =  2:3:10
>>  p3a

>>  p3b =  size(X);
>>  p3b

>>  p3c =length(X);
>>  p3c

>>  p3d = 2*eye(3)+ones(3)+1;
>>  p3d

>>  p3e = sum(X);
>>  p3e

>>  p3f = diag(X);
>>  p3f

>>  p3g = X(end, 2:end);
>>  p3g

>>  p3h = Y .* transpose(Y);
>>  p3h

>>  p3i = diag(diag(X));
>>  p3i

>>  p3j = sum(X(:));
>>  p3j

>>  p3k = transpose(S) * S:
>>  p3k

>>  p3l = S *R ;
>>  p3l

>>  p3m = S* transpose(S);
>>  p3m

>>  p3n = 2:-1:2;
>>  p3n

>>  p3o = length('1234');
>>  p3o
```

Problem 4. (16 POINTS)

For **p3k**, **p3m** of Problem 3 provide the following information.

```
>> p3k;
>> whos p3k                          Size ... x ...  Bytes ......   Class    .........
>> p3m;
>> whos p3m                          Size ... x ...  Bytes ......   Class    .........
```

Problem 5. (24 POINTS)
(a) List the elements of Y in column-major order/filin/form.

(b) List the elements of Y in row-major order/filin/form.

Problem 6. (24 POINTS)
(a) Write MATLAB code that copies matrix X into matrix B.
Write MATLAB code that uses the colon operator and extracts/prints
(b) the second column of B,
(c) the second row of B, and
(d) deletes from B its second row
(e) prints X in column major form in the form of a column,
(f) that defines row vector $[4, 9, 16, 25, 36, \ldots, 256]$ in as short a way as possible (fewer than 15 characters).

```
(a)   ......................

(b)   ......................

(c)   ......................

(d)   ......................

(e)   ......................

(f)   ......................
```

Problem 7. (24 POINTS)
What is the value of `p7a, p7b, p7c,p7d,p7e,p7f` after the execution of the following code?

```
>>  p7a=10;
>>  p7b=20;
>>  p7c=0;
>>  p7c=p7a;
>>  p7a=p7b;
>>  p7b=p7c;
>>  p7a                                  % p7a =  ................
>>  p7b                                  % p7b =  ................
>>  p7c                                  % p7c =  ................

>>  p7d=10;p7e=5; p7f=5;
>>  p7d= p7d+p7e+p7f;
>>  p7e= p7d+p7f;
>>  p7f= p7d+p7e+p7f;
>>  p7d                                  % p7d =  ................
>>  p7e                                  % p7e =  ................
>>  p7f                                  % p7f =  ................
```

Problem 8. (24 POINTS)
The following code resides in a file named `compute.m`. Apparently it attempts to compute $e = \exp(1.0)$ using the approximation

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \ldots + \frac{1}{n!}$$

implied by the Taylor expansion of $\exp(x)$ for $x = 1$. However the code is incomplete. The code uses function `cumprod()`. This computes the cumulative products of the elements of say vector x. Thus if $x = [\ 2\ \ 3\ \ 4]$, then `cumprod`$(x) = [\ 2\ \ 6\ \ 24]$. We ask you to fill the incomplete lines (Lines 5 and 6) to turn this into a correct MATLAB M-file for this computation/approximation of e. Line 7 prints the approximation of e to the desired precision/order.

```
% Compute e approximation to order n              Comment Line 1
n = input('Order of approximation ' );                 % Line 2
a = [1 1:n ]     ;                                     % Line 3
a = cumprod(a)   ;                                     % Line 4
b =              ;                                     % Line 5
c =              ;                                     % Line 6
disp(c)          ;                                     % Line 7
```

$$X = \begin{bmatrix} 2 & 1 & 2 & 1 \\ 2 & 3 & 3 & 2 \\ 3 & 4 & 4 & 3 \end{bmatrix}, Y = \begin{bmatrix} 1 & 1 & 2 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}, Z = \begin{bmatrix} 1 & 2 & 1 & 2 \end{bmatrix}, R = \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}, S = \begin{bmatrix} 1 & 2 & 3 \end{bmatrix}.$$

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You may tear-off this last page and use it as scratch paper; do not turn IT in

End of Exam 1