NJIT
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ID Number: ......no solution given   (7 points)

Grade: 1: 50. 2: 40. 3: 40. 4: 30. 5: 40. 6: 40. 7: 30. 8: 30. Total: $300 + 7$..

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

Read the Problems CAREFULLY!

There are 5 (FIVE) pages this page included

In the exam, the following matrices will be used. Do not get puzzled if a reference to matrix X, Y or Z or etc arises! If a problem modifies X and then another problem (not a question in a problem) uses X again, for the latter problem ignore the prior modifications; use/read X as it appears on this page not as modified before.

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.

$$X = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 2 & 1 \\ 2 & 0 & 2 \end{bmatrix}, Y = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}, Z = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 2 \\ 2 & 1 & 1 \end{bmatrix}, R = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}, T = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix},$$

Problem 1. (50 POINTS)
Give short answers to the following questions.

(a) How many bytes in 1KiB? **Answer: 1024**

(b) Are the two variables `TRUE` and `true` the same or not? **Answer: No, they are not**

(c) What is a 1MB? **Answer: 1000000 bytes**

(d) How many bytes is a MATLAB `double`? **Answer: 8 bytes**

(e) How many bytes is a MATLAB `logical`? **Answer: 1 byte**

(f) What is the range of values for an 8-bit integer? (give number of values,lowest and highest value in the range.) **Answer: 256 values, -128 to 127**

(g) What is matrix element $X(2,2)$? **Answer:** $X(2,2) = 2$

(h) What is array element $X(6)$? **Answer:** $X(6) = 0$

(i) What is array element $Y(8)$? **Answer:** $Y(8) = 0$

(j) Represent decimal 74 in hexadecimal. **Answer: 4a or 4A**

Problem 2. (40 POINTS)
Evaluate the following MATLAB expressions. What are the values of a, b, c, d ?

(i) $a = 2\,\hat{}\,2 + 2\,\hat{}\,2\,\hat{}\,2 - 1$. **Answer:** $a = 19$**, since** $a = 4 + 4\,\hat{}\,2 - 1 = 4 + 16 - 1 = 19$

(ii) $b = 1\&\sim 0$ **Answer:** $b = 1$**, since** $b = 1\&1 = 1$

(iii) $c = 1 == 2 \quad - \quad$ `true` **Answer:** $c = 1$**, since** $c = 1 == (2-1) = 1 == 1 = 1$

(iv) $d = 10 < 2 > 0$ **Answer:** $d = 0$**, since** $d = (10 < 2) > 0 = 0 > 0 = 0$

Problem 3. (40 POINTS)
(i) List the elements of X in column-major filin/form.
1, 1, 2, 0, 2, 0, 1, 1, 2
(ii) List the elements of Z in row-major filin/form.
1, 1, 1, 1, 1, 2, 2, 1, 1
(iii) What is $Z(:,:)$?

$$Z = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 2 \\ 2 & 1 & 1 \end{bmatrix}$$

(iv) What is the effect of doing $X([2 \quad 3], [1 \quad 2]) = [100 \quad 200; 300 \quad 400]$?

$$X = \begin{bmatrix} 1 & 0 & 1 \\ 100 & 200 & 1 \\ 300 & 400 & 2 \end{bmatrix}$$

(v) What is the effect of doing $K = [10 \quad 11; 12 \quad 13]$?

$$K = \begin{bmatrix} 10 & 11 \\ 12 & 13 \end{bmatrix}$$

Problem 4. (30 POINTS)

(i) What is the effect of doing $P = ones(3) + eye(3) + 3$?

$$P = \begin{bmatrix} 5 & 4 & 4 \\ 4 & 5 & 4 \\ 4 & 4 & 5 \end{bmatrix}$$

(ii) What is the value of `thisvar` after the second statement is executed below? What is it after the third statement is executed?

```
>>   thisvar = 10;                      % thisvar =10
>>   thisvar = thisvar*thisvar;         % thisvar = 10*10=100
>>   thisvar = thisvar+11;              % thisvar = 100+11 = 111
```

   Answer : 100 and 111 respectively (as shown in the code in the form of comments)

(iii) What are the values of `a,b` at the end (last two lines)?

```
>>   a=100;
>>   b=200;
>>   t=a; a=b; b=t;
>>   a
>>   b
```

   Answer: The values get swapped i.e. $a = 200$ and $b = 100$.

Problem 5. (40 POINTS)

For these calculations the matrices are those of the cover page. (If they have changed in previous problems, disregard those changes as explained in the instructions.)

(i) How much is $X * X$?

   Answer

$$X * X = \begin{bmatrix} 3 & 0 & 3 \\ 5 & 4 & 5 \\ 6 & 0 & 6 \end{bmatrix}$$

(ii) How much is $X./Z$?

   Answer

$$X./Z = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 2 & 0.5 \\ 1 & 0 & 2 \end{bmatrix}$$

(iii) How much is $T * R$?

   Answer 3

(iv) How much is $X + ones(3)$?

$$X + ones(3) = \begin{bmatrix} 2 & 1 & 2 \\ 2 & 3 & 2 \\ 3 & 1 & 3 \end{bmatrix}$$

Problem 6. (40 POINTS)

The 8-bit binary integer `10010101` what decimal integer does it represent if considered: (i) an unsigned integer, (ii) in signed mantissa representation, (iii) one's complement, and (iv) two's complement representations.

(i) As unsigned it is $2^0 + 2^2 + 2^4 + 2^7 = 1 + 4 + 16 + 128 = 149$. Thus the number is **149**.

(ii) In signed mantissa, it is a negative number. Discarding the sign bit the absolute value is $0010101 = 1 + 4 + 16 = 21$. Thus the number is **-21**.

(iii) In one's complement the number is a negative number. To find the absolute value, we flip the bits to get `01101010` and thus we get $2 + 8 + 32 + 64 = 106$, which gives **-106**.

(iv) In two's complement the number is a negative number. To find its absolute value we subtract one and flip the bits that gives `01101011` which is $1 + 2 + 8 + 32 + 64 = 107$, which gives **-107**.

Problem 7. (30 POINTS)

(i) What is the result of $Z(3, :) + T$ in MATLAB?

Isolate the third row of Z and add it to T to get

$$Z(3, :) + T = \begin{bmatrix} 3 & 1 & 2 \end{bmatrix}$$

(ii) What is the result of $2 * X + 3 - Z$ in MATLAB?

$$2 * X + 3 - Z = \begin{bmatrix} 4 & 2 & 4 \\ 4 & 6 & 3 \\ 5 & 2 & 6 \end{bmatrix}$$

(iii) What is the result of $X = X >= 2$?

$$X = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

Problem 8. (30 POINTS)

Evaluate the following MATLAB expressions.

(i) $a = 2 + 2 \,\hat{}\, 2/2 * 2 - 8 > 4 + 2 * 2$

Answer: $a = 0$.

This can be tricky. It requires an evaluation of everything on the left of $>$ and of the right of $>$ before the low priority relational operator gets applied. Thus $a = (2 + (((2\,\hat{}\,2)/2) * 2) - 8) > (4 + 2 * 2) = ((6 - 8) > 8) = -2 > 8$ which is false i.e. $a = 0$.

(ii) $b = -1 - 1 | - 1 + 1 \& - 1$.

Answer: $b = 1$.

We evaluate all arithmetic expressions before the logical operators. $b = -2|0\& - 1 = (-2|0)\& - 1 = 1\& - 1 = 1$ and thus $b = 1$.

(iii) $c = 2 \,|\, true \,|\, false \,||\, (1/0)$

Answer: $c = 1$.

Non short-circuit logical operators have precedence over short-circuit ones $c = (((2|true)|false)||(1/0)) = (1|false)||(1/0) = 1||(1/0) = 1$, and thus $c = 1$.

$$X = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 2 & 1 \\ 2 & 0 & 2 \end{bmatrix}, Y = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 2 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}, Z = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 2 \\ 2 & 1 & 1 \end{bmatrix}, R = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}, T = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix},$$

Intentionally left blank. Copies of front-page matrices included
You can tear-off this last page and use it as scratch paper; do not turn IT in

End of Exam 1