NJIT

New Jersey's Science & Technology University

Name: ....SOLUTIONS...............................

ID 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.

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

$$T = [' computer' \quad ' science \,'], \qquad W = ['COMPUTER' \quad ; \quad 'SCIENCES'],$$

Problem 1. (60 POINTS)
Give short answers to the following questions. If you think an answer does not exist, you can write `UNDEFINED` next to it.

(a) (5pt) How many bytes in 2KiB? **2048 bytes**

(c) (5pt) How many bytes is a MATLAB `double`? **8 bytes**

(d) (5pt) Write decimal (base-10) 11 as an unsigned 8-bit binary number. `00001011`

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

(f) (5pt) What is the value of $X(3,2)$? **2**

(g) (10pt) What is the value of $T(2)$? What is the value of $T(1)$? **o , c**

(h) (10pt) What is the value of $W(2,8)$? What is $W(1,:)$? **S, COMPUTER**

(i) (10pt) What is the value of $X(7)$? What is the value of $W(3)$? **0 , O**

(j) (5pt) How much is $i*i$ in MATLAB? **-1**

Problem 2. (30 POINTS)
Evaluate the following MATLAB expressions by providing the values of the variables a, b, c, d.

(a) $a = 10/2*4/2 + 2\,\hat{}\,1\,\hat{}\,2$. **14**

(b) $b = 1\&\sim 5 - 5$. **1**

(c) $c = 2 == 3 - 2$. **0**

(d) $d = 1 > 2 < 3$. **1**

Problem 3. (30 POINTS)
Evaluate the following MATLAB expressions by providing the values of the variables a, b, c, d. Also indicate whether a, b, c, d is a scalar (1×1 matrix) or not; in the latter case identify the dimension(s) of the result.

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

(a) $a = 1 : 2 : 8$. **Array a= [1 3 5 7] is a 1x4 matrix**

(b) $b = X(1 : end, 2 : 3)$. **Array b = [1 0 ; 1 1; 2 1] is a 3x2 matrix**

(c) $c = size(X)$. **Array c=[3 3] is a 1x2 matrix**

(d) $d = length(T)$. **Scalar d=16, is a 1x1 matrix (not needed)**

End of Page 2/Turn Page

Problem 4. (30 POINTS)
With reference to the following MATLAB code, answer the following questions.

```
function b=exam2p4(s)
  n=length(s);
  if (n<=1)
    b=1;
    return;
  end
  if (s(1)==s(n))
    b = exam2p4(s(2:n-1));
  else
    b = 0;
  end
end
```

(a) What is the effect of a= exam2p4('abc')? What is the value of a returned? **a=0**

(b) What is the effect of b= exam2p4('aba')? What is the value of b returned? **b=1**

(c) What is the effect of b= exam2p4('abccba')? What is the value of b returned? **b=1**

(d) What is the effect of b= exam2p4('abcabc')? What is the value of b returned? **b=0**

(e) What does function exam2p4 compute for an input that is a string of characters? Explain.

The code determines recursively whether the input string is a palindrome, i.e it reads the same left-to-right or right to left. In line 1 we retrieve its length. In lines 2-5 we check whether its length is 0 (empty) or 1. Any such string of length 0 or 1 is a palindrome by default. In any other case we compare its first charactter $s(1)$ to its last character $s(n)$. If they match s might be a palindrome if the remainder, after dropping the first and last characters is a palindrome. For this we issue the call exam2p4(s(2:n-1)) that checks this remainder string for the palindrome property. If $s(1)$ is not equal to $s(n)$ line 9 sets $b = 0$. Thus a $b = 0$ means s is not a palindrome, and $b = 1$ means s is a palindrome. Note that chopping off characters from s removes 2 characters at a time. If the string has even length at the end we are left with an empty string of length 0, whereas if it has odd length we are left with a string of length 1: both boundary/base cases are handled by lines 2-5.

Problem 5. (30 POINTS)

(a) How many types of functions have we encountered in MATLAB? List them also.
   6 : (primary) functions, subfunctions, nested functions, private functions, anonymous functions, function functions.

(b) List three types of variables in MATLAB .
   3: local,global persistent

Problem 6. (30 POINTS)
For the following sorting algorithms write a `YES` or `NO` in the second column to indicate whether the algorithm sorts in-place or NOT, write a `YES` or `NO` in the third column to indicate whether the algorithm is stable or not, write a `LINEAR`, `LOG-LINEAR`, or `QUADRATIC` to indicate whether the worst-case running time is linear (n), log-linear $(n \lg n)$ or quadratic (n^2) respectively to the number of keys n to be sorted.

```
    Column 1                         Column 2      Column 3     Column 4
    Algorithm                     |  in-place  |   stable  |   running-time
|-------------------------------|------------|-----------|------------------------|
|  BubbleSort/Odd-even transposition |  YES      |   YES     |   QUADRATIC            |
|-------------------------------------------------------------------------------|
|  SelectionSort                 |   YES      |   YES     |   QUADRATIC            |
|-------------------------------------------------------------------------------|
|  InsertionSort                 |   YES      |   YES     |   QUADRATIC            |
|-------------------------------------------------------------------------------|
```

Problem 7. (30 POINTS)
You are given the following MATLAB code residing in file with filename `exam2p7.m`. What does it get printed when we call it with `a= exam2p7(5);`. What is the value of a?

```
function s=exam2p7(n)
 k=1;
 s=0;
 while (k<n)
   s= s+1;
   k= k+1;
 end
 fprintf('s= %2d \n',s);
 exam2p7b(n);
end


function s=exam2p7b(n)
 k=1;
 s=1;
 while (k<=n)
   s=s*2;
   k=k+1;
 end
 fprintf('s= %2d \n',s);
end
```

    s= **4**
    s= **32**
    The value of a **is** $a = 4$.

Problem 8. (30 POINTS)

    You are given the following MATLAB code residing in file with filename `exam2p8.m`. What does it get printed when we call it with `exam2p8();`.

```
function exam2p8()
p8 = 20;
for ii=1:3:10
  p8 = p8 - 2;
end

fprintf('p8 = %2d \n',p8)

p8 = 20;
for ii=1:3:10
  p8 = p8 - ii;
end
fprintf('p8 = %2d \n',p8)
end


p8 = 12
p8 = -2
```

Problem 9. (30 POINTS)

    You are given the following MATLAB code residing in file with filename `exam2p9.m`. We then issue the two calls [c d] = `exam2p9(40,10)` and [a b]=`exam2p9(20,10)` shown below. What are the values of c, d, a, b?

```
function [c d]= exam2p9(a,b)
  c= a-b;
  d= a+b;
end

>>  [c d]= exam2p9(40, 10);
>>  c
    c =   30
>>  d
    d =   50
>>  [a b]= exam2p9(20, 10);
>>  a
    a  =  10
>>  b
    b  =  30
```

Problem 10. (33 POINTS)

Implement a function `sumton (n)` that computes the sum $1 + 2 + \ldots + n$. Thus a call `sumton (10);` will print

`The sum from 1 to 10 is = 55`

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

`The sum from 1 to 100 is = 5050.`

It is imperative that you not only implement the function that computes correctly the sum, 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.)

```
function z= sumton (n)
 z=sum(1:n);
 fprintf('The sum from 1 to %d is = %d \n',n,z);
end
```