University of Nottingham Ningbo China

CENTRE FOR ENGLISH LANGUAGE EDUCATION

PRELIMINARY YEAR, SEMESTER TWO, 2024-25

INTRODUCTION TO MATHEMATICAL SOFTWARE AND PROGRAMMING
MID-SEMESTER EXAM

Time allowed: ONE Hour

Candidates must write their ID number on this cover page and fill-in their attendance card but must NOT write anything else until the start of the exam is announced.

This paper contains TWENTY questions. The total number of points is 100.
Answer all questions with necessary steps.

Only general bilingual dictionaries are allowed. Subject-specific dictionaries are not permitted.

No electronic devices can be used in this exam.

Do NOT open the examination paper until told to do so.

All answers must be written on this paper.

INFORMATION FOR INVIGILATORS:
A 10-minute warning should be given before the end of the exam.
Please collect the examination paper after the exam.
Please return the examination paper in ID order.

Student ID: _____ **Marks (out of 100):** _____

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Section A: Multiple-Choice Questions (4×15=60 Marks)

Tick (✓) one most appropriate answer for each question.

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1. Which of the following commands can delete all variables saved in MATLAB workspace?

   ☐ help ☐ delete ☐ clear ☐ clc

2. How to concatenate the vector `b = [2,4,6]` to an existing 3×3 matrix `A` to form a 4-by-3 matrix C?

   ☐ `C = [A;b]` ☐ `C = A+b` ☐ `C = [A,b']` ☐ `C = A(end,:)+b`

3. Given a = [1,2,-3] and b = [1,0,1], what is the output of MATLAB statement `a.*b`?

   ☐ `1, 1, -3` ☐ `1, 0, -3` ☐ `-3, 1, 1` ☐ `-2`

4. Which of the following is NOT a pre-defined variable in MATLAB?

   ☐ j ☐ e ☐ inf ☐ pi

5. What vector is generated by the following statement `x = 1:2:5`?

   ☐ `2, 3, 4, 5` ☐ `3`
   ☐ `1, 3, 5` ☐ `1, 1.25, 1.5, 1.75, 2`

6. Which of the following statements will create a row vector of 10 numbers that are randomly generated between 0 and 10?

   ☐ `10*rand(10)` ☐ `10*rand()` ☐ `10*rand(1, 10)` ☐ `randi(0, 10)`

7. Which of the following statements can create a vector that divides the interval $[-4, 4]$ into 80 evenly spaced subintervals?

   ☐ linspace(-4,0.1,4) ☐ linspace(-4,4,79) ☐ linspace(-4,4,80) ☐ linspace(-4,4,81)

8. Which of the following MATLAB commands finds all roots of the polynomial function $f(x) = 2x^3 - 4x - 5$?

   ☐ roots([-5, -4, 2]) ☐ solve([2, 4, 5]) ☐ roots([2, -4, -5]) ☐ roots([2, 0, -4, -5])

9. What is the output of the following MATLAB script?

```
a = 1:9;
b = 9:-1:1;
c = sum(a==b)
```

   ☐ c=1 ☐ c=5 ☐ c=8 ☐ c=45

10. What is the output of the following MATLAB script?

```
list = [];
for i=9:-2:5
    list = [i,list];
end
disp(list)
```

☐ 9, -2, 5 ☐ 5, 7, 9 ☐ 9, 7, 5 ☐ 5, 6, 7, 8, 9

11. To plot the graph of $y = \dfrac{1}{1+e^{-2x}}$ on interval $[-1, 1]$ in MATLAB, one creates an array x representing the given interval using: `x = linspace(-1,1)`. Which of the following statements is correct for creating the corresponding array y?

☐ `y = 1/(1+e^(-2*x))` ☐ `y = 1./(1+exp(-2*x))`
☐ `y = 1/(1+e^{-2*x})` ☐ `y = 1./(1+1/exp(2*x))`

12. The following MATLAB script is designed for generating an overlaying plot with two curves $y = 5x^2$ and $y = \sin x \tan x$ on the interval $[-1, 1]$. Identify the line that contains an error.

```
Line 1:  x = -1:0.1:1;
Line 2:  y1 = 5x.^2;
Line 3:  y2 = sin(x).*tan(x);
Line 4:  plot(x,y1,'r-',x,y2,'b:','LineWidth',2)
Line 5:  legend('curve1','curve2')
```

☐ Line 2 ☐ Line 3 ☐ Line 4 ☐ none of them

13. What is the file extension of MATLAB script files?

☐ .script ☐ .mat ☐ .m ☐ .fig

14. What is the output of the following MATLAB script?

```
i = 1; s = 0;
while s<=25
    s = s+i;
    i = i+1;
end
fprintf("i=%d,s=%d\n",i,s)
```

☐ i=7,s=22 ☐ i=8,s=28 ☐ i=7,s=22 ☐ i=8,s=28

15. In nested loops, the `break` command contained in the inner loop will exit which of the following?

☐ entire loops ☐ inner loop ☐ entire program ☐ none of them

Section B: Short Answer Questions (40 Marks)

Write your answers in the designated box provided for each question.

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16. Let `m = pi/2` (≈ 1.5708) and `n = exp(2)` (≈ 7.3891) be two variables created in MATLAB. Write the output of the following MATLAB statement:

    `fprintf('m=%.2f,n=%.3f\n m+n=%d\n',m,n,floor(m+n))` [5]

```
m=1.57,n=7.389
m+n=8
```

17. Write a MATLAB function **MatrixSum(A)** that finds the sum of all elements in A.

    You may use MATLAB built-in function `size()` for checking the size of the matrix, but do NOT use the built-in function `sum()` here. [10]

```
function y = MatrixSum(A)
[m,n] = size(A);
y = 0;
for i=1:m
        for j=1:n
                y = y+A(i,j);
        end
end
end
```

18. Write a MATLAB script for finding the sum of the first 100 prime numbers:

$$2 + 3 + 5 + 7 + 11 + \cdots = ?$$

You may use MATLAB built-in function `isprime()` in your script. [10]

```
mysum = 0;
n = 1; count = 0;
while count<100
    if isprime(n)
        mysum = mysum+n;
        count = count+1;
    end
    n = n+1;
end
disp(mysum)
```

19. Analyse the MATLAB function **func(array)** given below and answer the questions. [10]

```
Line 01: function m = func(array)
Line 02: % input: an integer array in ascending order (repeated values may exist)
Line 03: n = length(array);
Line 04: rec = 1;
Line 05: m = 1;
Line 06: for i=1:n-1
Line 07:     if array(i)==array(i+1)
Line 08:         rec = rec+1;
Line 09:     else
Line 10:         if rec>m
Line 11:             m = rec;
Line 12:             rec = 1;
Line 13:         else
Line 14:             rec = 1;
Line 15:         end
Line 16:     end
Line 17: end
Line 18: if rec>m
Line 19:     m = rec;
Line 20: end
Line 21: end
```

(i) What is the final output value m when `array = [1, 3, 5, 5, 7, 7, 7, 13]`?

(ii) What information is saved in the two variables: `rec` and `m`, that are used in this function?

(iii) Briefly explain the code segment from Line 10 to Line 15.

(iv) What task does this function attempt to solve?

(v) When will the code segment from Line 18 to Line 20 be used? Give an array example.

(i) m=3

(ii) rec: how many times current value is repeated
m: the maximum repeated time of a value found so far

(iii) if current value has larger frequency (rec) than the one saved in (m), update (m) by (rec);
otherwise keep the value saved in (m).
in both cases, reset the variable (rec) back to 1, for counting the frequency of the next number.

(iv) to find the largest frequency that a number appears in the array

(v) it is need when the last few elements have the highest frequency.
for example, array = [1,3,5,5,7,7,7,13,13,13,13]

20. List THREE differences between MATLAB function file and script file. [5]

Refer to your lecture notes.

Use this page for rough work.