

Name:

Answer the following questions using the MATLAB programming language. Try to be as exact as possible. Your answers should be such that if typed into MATLAB they will produce the correct result. Exactly correct answers will receive full credit. Note that there may be more than one way to answer the question and so any correct answer will be accepted. Check your solutions with simple examples to make sure they are correct.

1. Solve the following system of equations using MATLAB commands.

$$\begin{aligned} 2x + 7y - 12z &= 4 \\ 4x + 8y + 67z &= 4.8 \\ 3x + 2y - 4z &= 6.9 \end{aligned}$$

2. Write a function called `sum_range` that takes two numbers, computes their sum, and outputs

- *greater than or equal to 0* if the sum is greater than or equal to 0
- *less than 0* if the sum is strictly less than 0

The syntax for the `if else end` block is

```
if <conditional expression>
<matlab commands>
elseif <conditional expression>
<matlab commands>
else
<matlab commands>
end
```

The syntax for a function definition is

```
function <return_value> = <function_name>(<arg1>, <arg2>, ...,
<argn>).
```

3. Write a function called `average` that takes in two numbers  $x$  and  $y$  and returns their average.

4. Write a function called `randint` that takes two numbers  $x$  and  $y$  and generates a random number between them. Use the `rand` function which generates a random number between 0 and 1.

5. Write a function called `student_grade` that takes as input student scores from two mid-terms, one final, and five homework assignments and outputs the student's final grade as a percentage. The midterms are graded on a scale from 0 to 100 and are each 20% of the final grade. The final exam is graded on a scale from 0 to 100 and is 40% of the final grade. Each of the five homework assignments is graded on a scale from 0 to 10 and together are worth 20% of the final grade. You can assume the input scores are in the form of an array  $A$  where  $A(1)$  and  $A(2)$  are the midterm scores,  $A(3)$  is the final, and  $A(4)$ ,  $A(5)$ ,  $A(6)$ ,  $A(7)$ , and  $A(8)$  are the homework grades.

6. Write a program that creates a matrix of dimension  $m \times n$  in which the value of each element of the matrix is the sum of the indices for that cell. So for example the value of  $A(1,1)$  is 2,  $A(1,2)$  is 3 and  $A(3,6)$  is 9. The program should first ask the user for dimensions  $m$  and  $n$ .

7. Write a function that takes an array  $A$  as input and outputs all the even numbers. Use the remainder function  $rem(x,y)$  to check if a number is divisible by 2.  $rem(x,y)$  produces the remainder after dividing  $x$  by  $y$ . You can assume all numbers in  $A$  are positive integers. The syntax for a for loop is

```
for i = f : s : t
<matlab commands>
end
```

where  $f$  is the value of  $i$  in the first pass,  $s$  is the increment in  $i$  after each pass, and  $t$  is the value of  $i$  in the last pass.

The command to get the length of an array  $A$  (i.e. the number of elements in the array) is `length(A)`.

8. Write a function called `mysum` that returns the sum of the first  $n$  terms of the series given below:

$$\sum_{k=1}^n \frac{-1^k k}{2^k} (k = 1, 2, 3, \dots, n)$$

9. Write a program that swaps two numbers  $x$  and  $y$ . For example, if  $x = 5$  and  $y = 20$  then after the program is executed the new values of  $x$  and  $y$  should be  $x = 20$  and  $y = 5$ .
10. Write a function called `sort_student_scores` that takes two arrays as input. The first is a set of student names called *names* and the second is a set of student scores called *scores* such that the name and score of student  $i$  is given by  $names(i)$  and  $scores(i)$  respectively. Your function should sort the scores of the students and their names in decreasing order of score.
11. Write a function called `rank` that takes an array of numbers  $A$  and a number  $x$  as input. Your function should search the array  $A$  for  $x$  and return the rank of  $x$  in  $A$ . The rank of  $x$  is the cell number in  $A$  it belongs to. For example if you have an array  $A = [ 4 30 5 ]$  then the rank of 4 is 1, rank of 30 is 2, and the rank of 5 is 3.

12. Write a function called `strcmp` that takes in two strings and outputs 1 if they are equal and 0 otherwise.

13. Write a program that asks for student names and scores until the student name "END" is entered. Use the `strcmp` function you wrote in the last problem to check for string comparison. Your program should then call the function called `sort_student_scores` that you wrote in the previous problem and output the names of the top three scoring students.

The syntax for the while loop is  
`while <conditional expression>`  
`<matlab commands>`  
`end`

14. Write a function called `matrixsort` that takes as input a matrix  $A$  and number of rows  $m$  and columns  $n$ . Your program should sort the elements

of the matrix in ascending order row after row where the smallest number is in  $A(1,1)$  and the largest is in  $A(m,n)$ .

15. (EXTRA CREDIT) Write a function that takes a sorted array of positive integers  $A$  and a number  $x$ . Your program should then perform a binary search on the array  $A$  to find  $x$ . The number of comparisons your program makes should be less than half the total length of the array under all circumstances.