INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
DEPARTMENT OF MATHEMATICS AND STATISTICS

MA522M-Data Science Programming Laboratory

Exercise-4 Duration: 120 Minutes P1 Slot 15:00-17:00

27 January 2025 Practical 3 Marks

Answer All Questions. Usage of Internet is not Allowed

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1. Get a rectangular matrix using lists and using the function `GetMatrix()`. Get two matrices. Store them in files A.txt and B.txt using Python file processing. Read these two matrices again and store them in A and B. Add two matrices using a function `AddMatrix(A,B)` if dimensions match. [1]

2. Create a function `Isprime(n)` to check whether given number is a prime or not. Find all prime numbers between n_1 and n_2 using the function `AllPrime(n1,n2)`. [0.5]

3. Calculate the factorial of a number using recursion and compute the Taylor series expansion for e^x. [0.5]

4. Generate a random integer x_1 between 1 and 100. Use the `import␣random` library. Generate another random number x_2 between 1 and 100. Check whether x_2 divides x_1. If so, append this to the dictionary `divisors`of x_1. If not, append this to the dictionary `nondivisors` and generate again another x_2 and repeat this process until all divisors are found. Note, this may take a long time. Finally store all divisors and nondivisors in a file divisors.txt and nondivisors.txt [1]

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1. Get a vector using lists and using the function `GetVector()`. Get two vectors. Store them in files x.txt and y.txt using Python file processing. Read these two vectors again and store them in x and y. Add two vectors using a function `AddVectors(x,y)`. Compute their dot product `dotproduct(x,y)`. Compute their cross product if dimension is 3 `crossproduct(x,y)`. [1]

2. Create a function `Isprime(n)` to check whether given number is a prime or not. Find all prime numbers between n_1 and n_2 using the function `AllPrime(n1,n2)`. [0.5]

3. Calculate the LCM and GCD of five numbers using recursion. [0.5]

4. $2^{15} = 32768$ and the sum of its digits is $3+2+7+6+8 = 26$. Find the sum of digits of the number 2^0 to 2^{25}. Use the library `import␣sys` and set `␣sys.set_int_max_str_digits(320000)` [1]

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1. Get a square matrix using lists and using the function `GetMatrix()`. Get two matrices. Store them in files A.txt and B.txt using Python file processing. Read these two matrices again and store them in A and B. Multiply two matrices using a function `MultiplyMatrix(A,B)` if dimensions match. Find its trace. If the dimension is 3, find it determinant [1.5]

2. Let n be a positive integer. Let D be the list of its proper divisors. Let $\sigma(n) = \sum_{k \in D} k$. Two numbers a and b are said to be amicable if $\sigma(a) = b$ and $\sigma(b) = a$ where $a \neq b$. For example $\sigma(220) = 284$ and $\sigma(284) = 220$. Find all amicable numbers under 1000. Create a functions `divisors(n)`, `IsAmicable(a,b)` and `AllAmicables(n)`. Store them in a file Amicable.txt [1]

3. Calculate the Fibonacci of a number using recursion and compute the Fibonacci series. Use efficient recursion with dictionaries [0.5]

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1. Get a square matrix using lists and using the function `GetMatrix()`. Check whether they are upper triangular matrix. If so, store them in files UpperA.txt using Python file processing. Read these two matrices again and store them in A. Find its trace. Find its determinant and all eigenvalues [1.5]

2. Let n be a positive integer. Check whether it is a prime or not. A prime number is said to truncatable prime if you continuously remove digits from left to right, they remain prime. For example 3797 is a prime and it is a truncatable prime as 379, 37 and 3 are primes. Find all truncatable primes between 11 and 10000. [1]

3. Calculate the factorial of a number using recursion and compute the their digit sum using recursion. For example, $10! = 3628800$ and their digit sum is $3+6+2+8+8+0+0 = 27$. Find the digit sum of all factorials between 1 and 20, store them in a file [0.5]