CS2.201: Computer Systems Organization
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Lab Exam Questions Bank

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Note: Read the given information below carefully.

- There are 12 problems in this question bank.
- Assume all the integer variables to be long long int. In case of an invalid input return '-1'.
- Overflow cases to be handled
- Make suitable assumptions wherever necessary.
- Tentative marks problem 1 to 6: 15 marks for each question; from problem 7 to 12: 25 marks for each.

Problem 1: Given two numbers(N and M) perform basic arithmetic operations, i.e. add, subtract, divide, exponentiation, modulus- using switch case(S).
Input/Output Format

- Input: M N S
- Output: Result of chosen operation in integer format
- Switch case: '1' for addition(M+N), '2' for subtract(M-N), '3' for divide(M/N), '4' for exponentiation(M^N), and '5' for modulus(M%N)

Sample Test Case
Input: 7 5 2
Output: 2

Explanation- Second switch case is subtraction. $7 - 5 = 2$. Hence the output.

Problem 2: Check if a given 64-bit number contains odd number of 1s in its bit representation.
Input/Output Format

- Function format: $int\ parityCheck(int\ N)$
- Input: N
- Output: **TRUE**, if the input has odd number of 1s, **FALSE** otherwise.

Sample Test Case
Input: 5
Output: FALSE
Input: 7

Output: TRUE

Explanation- Bit representation of 5 is 101, i.e. even number of 1s. Hence, output is FALSE. Similarly, bit representation of 7 is 111, i.e. odd number of 1s. Hence, output is TRUE.

Problem 3: Find the sum of even numbers in a matrix.
Input/Output Format

- Function format: $int\ sum(int\ array[][],\ int\ m,\ int\ n)$
- Input: M N <List of M*N elements of matrix row wise>
- Output: Integral value of the sum
- Note: M- number of rows and N- number of columns

Sample Test Case
Input: 3 4 1 1 2 5 2 3 3 7 4 5 3 1
Output: 8

Explanation- Number of rows is 3, number of columns is 4. Sum of even elements of matrix is 2+2+4 = 8
Matrix visualised- $\begin{bmatrix} 1 & 1 & 2 & 5 \\ 2 & 3 & 3 & 7 \\ 4 & 5 & 3 & 1 \end{bmatrix}$

Problem 4: Given integers N and M. Find modulus of sum of all prime numbers less than N with respect to M
Input/Output Format

- Input: N M
- Output: Integral value of the modulus

Sample Test Case
Input: 13 3
Output: 1

Explanation- Modular addition of prime numbers less than 13 is to be done. $(2+3+5+7+11)\%3 = 1$

Problem 5: Given a number X, find the first natural number i whose factorial is divisible by X.
Input/Output Format

- Input: X
- Output: Integral value of the number whose factorial is to be taken

Sample Test Case
Input: 16
Output: 6

Explanation- 6 is the smallest natural number such that $(6!)\%16 = 0$

Problem 6: Given two numbers M and N, find GCD(M,N)
Input/Output Format

- Input: M N
- Output: Integral value of the GCD
- Note: $0 < M, N < LONG\_MAX$

Sample Test Case
Input: 24 39
Output: 3

Explanation- GCD is Greatest Common Divisor. Divisor of 24 are 1, 2, 3, 4, 6, 8, 12, 24 and 39 are 1, 3, 13, 39. Hence, GCD of 24 and 39 is 3, since both the numbers can be divided by 3.

Problem 7: Perform binary search for the position of an element in a sorted array.
Input/Output Format

- Function format: *int binarySearch*(*int list*[], *intsize*, *intelement*)
- Input: M <List of elements> N; M is the length of list; N is the element to be searched for
- Output: Integral value of the position of element in zero-based indexing.

Sample Test Case
Input:
10
10, 20, 30, 50, 60, 80, 110, 130, 140, 170
110
Output: 6

Explanation- the index value for 110 is 6. It's a zero based indexing

Problem 8: Matrix multiplication. Given two matrices perform matrix multiplication
Input/Output Format

- Input: M N P<List of M*N and N*P elements of matrix row wise>
- Output: Print the resultant Matrix of size M*P

Sample Test Case
Input:
2 1 5
3 1
2 3 4 5 1
Output:
6 9 12 15 3
2 3 4 5 1

Explanation- First matrix is of size 2*1 and second matrix is of size 1*5

Problem 9: Given a number N ,check if the sum of the factorial of digits is equal to N (special number).
Input/Output Format

- Input: N
- Output:**TRUE**, if the input is special number, **FALSE** otherwise.

Sample Test Case
Input: 145
Output: TRUE

Explanation- $1! + 4! + 5! = 145$

Problem 10: Bubble sort. Given an array of integers of size N perform bubble sort on it.
Input/Output Format

- Input: N <elements of array>; N is the size of array
- Output: Sorted array

Sample Test Case
Input:
5
4 1 3 9 7
Output: 1 3 4 7 9

Problem 11: Partition an array (as in quick sort). Use the first element of the array as a pivot.
Input/Output Format

- Function format: *void partition*(*int array*[], *int size*)
- Input: N <List of elements in array>
- Output: Print pivot separated array

Sample Test Case
Input:
5
4 1 3 9 7
Output: 3 1 4 9 7

Explanation- Notice in above output 1st element 4 is considered as pivot and all elements left of pivot are less than pivot and all the elements right of pivot are greater. However, the relative ordering between numbers (example between) 3 and 1 is preserved as it is. This is what you are expected to do i.e. you can NOT use a bubble sort to partition the array and claim that the basic definition of pivoting is still satisfied. You are supposed to pivot it like the way it is done in quick sort

Problem 12: Compute the sum of first N numbers recursively and return the modulus of sum with respect to K.

Input/Output Format

- Input: N K
- Output: Integral value of the modulus

Sample Test Case
Input: 13 3
Output: 1

Explanation- Sum of natural number till 13 is 91. $(91)\%3 = 1$