

Indian Institute of Technology (IIT-Kharagpur)

AUTUMN Semester, 2023

COMPUTER SCIENCE AND ENGINEERING

Computer Organization and Architecture Laboratory

MIPS Assignment 4

August 16, 2023

AIM: To get acquainted with MIPS assembly language and the system calls. Partial marks will be awarded for incorporating interactive interface as specified, appropriate use of system calls for printing and taking inputs, suitable commenting and correct implementation of the logic.

INSTRUCTIONS: Make one submission per group in the form of a single zipped folder containing your source code(s). Name your submitted zipped folder as Assgn.1_Grp_GroupNo.zip and (e.g. Assgn.1_Grp.25.zip). Inside each submitted source files, there should be a clear header describing the assignment no., problem no., semester, group no., and names of group members. The file name should be of the format QuestionNo_Grp_GroupNo.s (e.g. Q1_Grp.25.s). Liberally comment your code to improve its comprehensibility.

Question 1: Sum of the series

1. Write a MIPS program that takes a positive integer n as input (include proper sanity check) and find the sum of the series $1^1 + 2^2 + 3^3 + \dots + n^n$ using recursion.
2. Examples:
Input: $n = 2$
Output: 5
 $1^1 + 2^2 = 1 + 4 = 5$
Input: $n = 3$
Output: 32
 $1^1 + 2^2 + 3^3 = 1 + 4 + 27 = 32$

Question 2: Collatz Conjecture

1. Starting with any positive integer N , we define the Collatz sequence corresponding to N as the numbers formed by the following operations:

- (a) If N is even, $N \leftarrow \frac{N}{2}$
- (b) if N is odd, $N \leftarrow 3N + 1$

It is conjectured but not yet proven that no matter which positive integer we start with; we always end up with 1. For example, $10 \rightarrow 5 \rightarrow 16 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$.

2. Write a MIPS program that takes a positive integer N as input (include proper sanity check) and outputs the number of steps required to reach 1 from N in the Collatz sequence corresponding to N .
3. For the example, $10 \rightarrow 5 \rightarrow 16 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$, the output should be 6.