

# CS 312: Artificial Intelligence Laboratory

## Lab 6 Report

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### 1 Introduction

The objective of this task is to solve the Optimal Matrix Multiplication Problem. Given a set of  $N$  matrices (coordinates) and their dimensions, find the least cost of multiplying the matrices. For the given problem, the input is a  $N \times 1$  list of dimensions of the  $N$  matrices. The output is the least cost for the order of multiplying the matrices.

### 2 Heuristic Functions Considered

The following functions are appropriately designed to satisfy the constraints as shown below. Here  $d$  is the list of dimensions of the  $N$  matrices.

#### 2.1 Over-Estimate

$$h_1(d) = (d_0 * d_1 * d_2 \dots * d_{N+1}) * N \quad (1)$$

#### 2.2 Under-Estimate

$$h_2(d) = (d_0 * d_1 * d_2 \dots * d_{N+1}) / N \quad (2)$$

### 3 Observations and Analysis

The results obtained using AO\* algorithm with various heuristics are summarized in the below table -

Input	Least Cost Found	
	$h_1(u)$	$h_2(u)$
input <sub>1</sub>	18	18
input <sub>2</sub>	328	101
input <sub>3</sub>	600	300
input <sub>4</sub>	59938	10881

We see least cost is always found when the underestimating heuristic( $h_2(u)$ ) is used. As expected, overestimating( $h_1(u)$ ) does not always guarantee optimal cost as AO\* isn't guaranteed to be admissible in this case.