

# Bachelor thesis

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July 18, 2023

# Contents

<b>1</b>	<b>Framework</b>	<b>2</b>
1.1	Introduction . . . . .	2
1.2	Graphs . . . . .	2
1.3	The semiring . . . . .	3
1.4	Einsums . . . . .	3
1.4.1	Definition . . . . .	3
1.4.2	Common examples . . . . .	3
1.4.3	Properties . . . . .	3
<b>2</b>	<b>Shortest Path Problem</b>	<b>4</b>
2.1	Problem Definition . . . . .	4
2.2	All pairs shortest path with Einsums . . . . .	4

# Chapter 1

## Framework

### 1.1 Introduction

### 1.2 Graphs

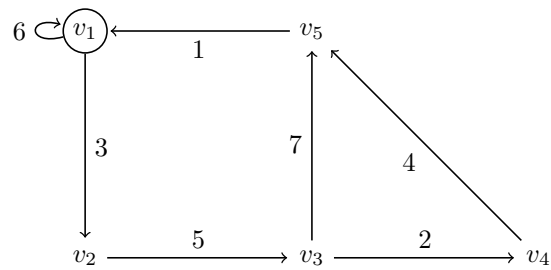


Figure 1.1: Weighted Directed Graph with 5 Nodes

$$A = \begin{bmatrix} 0 & 3 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 \\ 0 & 0 & 0 & 2 & 7 \\ 0 & 0 & 0 & 0 & 4 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

### 1.3 The semiring

### 1.4 Einsums

#### 1.4.1 Definition

#### 1.4.2 Common examples

#### 1.4.3 Properties

## Chapter 2

# Shortest Path Problem

### 2.1 Problem Definition

### 2.2 All pairs shortest path with Einsums

Lets state the problem:

**Problem 2.1** (All pairs shortest path). Given a directed weighted graph and its adjacency matrix  $A$ . Compute the length of the shortest path between every pair of nodes.