# Bachelor thesis

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# Chapter 1

# Framework

## 1.1 Introduction

## 1.2 Graphs

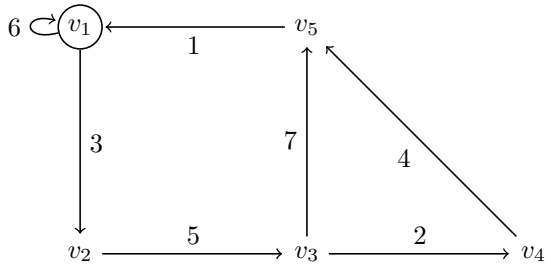


Figure 1.1: Weighted Directed Graph with 5 Nodes

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

## 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.