# Problem Statement and Goals
# Drasil Matrix, Vector and Tensor Extension

Christopher W. Schankula

Table 1: Revision History

| Date | Developer(s) | Change |
|------|--------------|--------|
| January 17th, 2025 | Christopher Schankula | Initial version of problem statement |

# 1 Problem Statement

This section describes the problem that will be solved in this project. We start by presenting background information related to matrices, vectors and tensors. We then provide a high-level description of the problem, followed by an overview of the stakeholders and environment in which the resulting software will run.

## 1.1 Background

This section describes background on matrices, vectors, tensors, and the Drasil project.

### 1.1.1 Matrices, Vectors, and Tensors

A matrix is a rectangular table of numbers, symbols or expressions which are used to represent some mathematical object or concept. They are used in linear algebra, physics, and number theory, among other fields [3]. Meanwhile, a vector is a "quantities that cannot be expressed by a single number (a scalar)" [2]. A vector can be seen as a sort of one-dimensional matrix. Similarly to matrices, vectors are used in a wide variety of scientific fields.

A tensor is a type of mathematical objects that describe a relationship between matrices, vectors, or other tensors [4]. The relationship is a multilinear map, meaning it is a function of several linear inputs [1]. Tensors can be used to solve important physics problems, including in mechanics, electrodynamics, and general relativity [4].

## 1.2  Drasil Project

## 1.3  Problem

Currently, vectors and matrices in Drasil are implemented in a way that does not promote the correctness of algorithms using them. For calculations on matrices, vectors and tensors to be correct, it is necessary to ensure certain properties about them, including the sizes of operands. Furthermore, current implementations of matrices and vectors in Drasil support only fixed fixed sizes.

The problem being solved in this project will be to allow the specification of tensors, matrices, and vectors and document and code generation associated with them.

## 1.4  Inputs and Outputs

The inputs to the system will be a representation of operations using tensors (matrices and vectors will be built on top of tensors). The outputs from the system will be documents describing the operations specified in the inputs and code in several supported languages to compute the operations described.

## 1.5  Stakeholders

## 1.6  Environment

# 2  Goals

# 3  Stretch Goals

# 4  Challenge Level and Extras

testing, code walkthroughs, user documentation, formal proof, GenderMag personas, Design Thinking, etc. Normally the maximum number of extras will be two. Approval of the extras will be part of the discussion with the instructor for approving the project. The extras, with the approval (or request) of the instructor, can be modified over the course of the term. —SS]

# 5 References

## References

[1] Wikipedia contributors. Multilinear map, Jan. 2024. URL https://en. wikipedia.org/wiki/Multilinear_map.

[2] Wikipedia contributors. Vector (mathematics and physics), Oct. 2024. URL https://en.wikipedia.org/wiki/Vector_(mathematics_and_physics).

[3] Wikipedia contributors. Matrix (mathematics), Jan. 2025. URL https://en. wikipedia.org/wiki/Matrix_(mathematics).

[4] Wikipedia contributors. Tensor, Jan. 2025. URL https://en.wikipedia.org/ wiki/Tensor.