**Vision Document**

For Multiagent Control of Traffic Signals

Version 1.0

Submitted in partial fulfillment of the requirements of the degree of MSE

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# Introduction

The intent of this project is to create an efficient, scalable, modular Multiagent System (MAS) that controls traffic signals given sensor data. A white paper from the THALES group discusses at a high level using genetic algorithms with a MAS to improve traffic flow. That paper also provides a sample road network with traffic flow data that can be used for comparison.

The purpose of this project is to show a Multiagent System can be used to create a more positive experience for the driver and benefit the environment at the same time.

Show improvements over a baseline typical timing based network with the following metrics: travel time, loss time (# of stops), fuel consumption, hydrocarbon production. To show these improvements I will model timing based behavior with a standard SUMO model. Then I will model a simple reactive MAS, a more intelligent reactive MAS, a MAS that uses genetic algorithms and finally a goal-oriented MAS that uses mesh network based collaboration.

## Motivation

Adf

## Terms and Definitions

Agent

Multi-Agent System

SUMO

TraCI

RabbitMQ

MongoDB

## References

Asdf

# Project Overview

Asdf

## Project Goal

Asdf

## System Context

asdf

# Project Requirements

Driving requirements of project

Use case diagrams and data flow diagrams

The requirements will describe all key functionality required of the resulting system. At a minimum, the requirements will include the valid range of inputs and the expected outputs associated with those inputs. Each requirement will also be given a unique identifier. This document will continue to evolve at least until the architecture presentation and will be continually updated.

## Critical Use Cases

### Displays Simulation

**Description:** The Simulation for Urban Mobility will be used to display the active simulation.

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Provides current simulation state data

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Produces individual intersection state data

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Executes traffic light signal plan

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Information about current intersection status is shared

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Produce data to share with neighboring intersections

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Create traffic light signal plan

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

#### Incorporate data that was shared into planning

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Verify plan is safe

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Submit plan to be executed

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

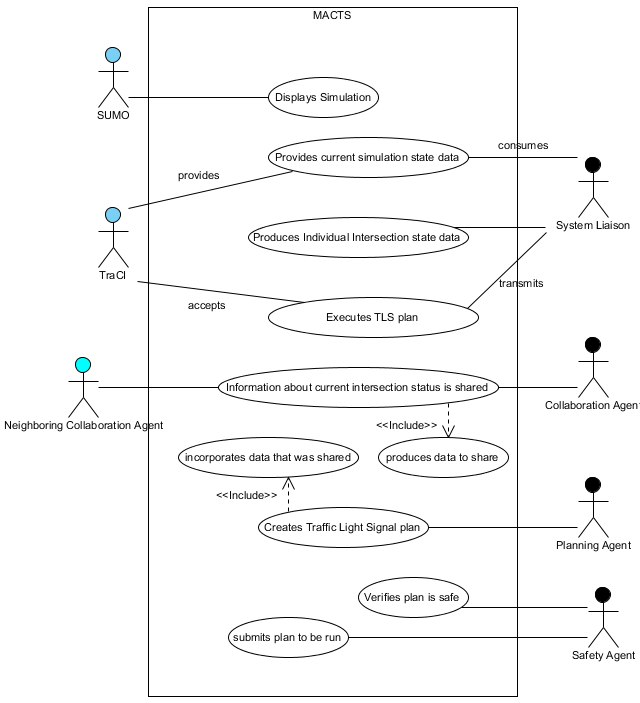


Figure 1Critical Use Cases

## System Activity

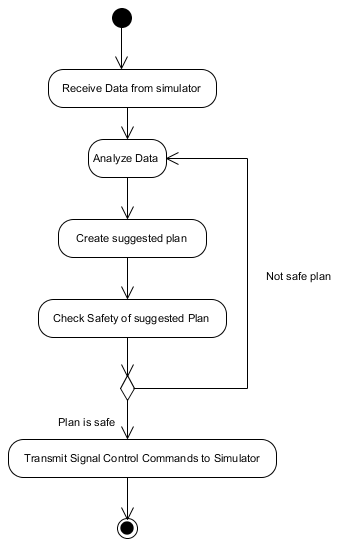


Figure 2UML Activity Diagram for a single simulation iteration

# Assumptions

Like has specific version of SUMO and Python, etc.

# Constraints

This system will not attempt to model the behavior of individual cars nor to visualize system behavior. Those aspects are left to the simulation engine SUMO.

# Environment

## Purpose

The purpose of this section is to describe the development platform, tools, environment practices and processes that will be employed for the Multi-Agent Control of Traffic Signals project.

## Hardware

I will use a Sony laptop as the prime development station. The laptop has an Intel core I7 processor and sufficient RAM to run the simulations. The computer can support the development environment as well as running the simulation. Additional machines may be used to show the distributed nature of the MACTS system. An External Hard Drive will be used for local but off computer repository. A flash drive will be used for OneNote file sync.

## Tools

This section describes tools (software) that will be used for the project and supporting activities.

### Process Support

Google docs will be used for maintaining the engineering notebook, for capturing information about references and for storage of guides, research & reference documents. Swift-Kanban is an electronic Kanban board which will be used for project management. Google Calendar will be used for scheduling work. OneNote is used for collecting project notes and for putting together working documents. Visual Paradigm for UML will be used for creating UML diagrams and when possible for generation or reverse engineering of application source code. MS Word 2010 will be used to create the documentation. Draft documents will be exported in PDF format.

### Development

The Simulation for Urban Mobility or SUMO will be the simulation engine that I interface with.

PyCharm is an integrated development environment that will be used for Python 2.7 coding. Python 2.7 was chosen since Python 3 is still new enough that I was having difficulty gathering the necessary interface modules.

RabbitMQ is a message queuing server which I will use for inter-agent communication. The Python module pika will be used to work with RabbitMQ.

MongoDB is a document store and will be used for persisting agent configuration information and for any knowledge base needs. The Python module pymongo is used to work with MongoDB.

### Testing

For unit testing, PyUnit the unittest module will be used. If mock objects are needed, mockito-python will be used. However, if mockito-python proves to not be suitable, I’ll switch to Michael Foord’s Mock. PyChecker will be used for checking for typical errors, similar to C’s lint. To see code coverage of unit tests, Ned Batchelder’s Coverage.py module will be used. PyMetrics will be used for code analysis, particularly cyclomatic complexity.

### Version Control

The distributed version control system git will be used for all project documents. That is, code and supporting portfolio documents will all be included in to the repository. I will update the git repository on the KSU CIS server, a local on machine repository as well as an external on hard drive repository during development.

## Process

### Development

I will create UML diagrams, unit tests and code to meet requirement acceptance criteria. Before committing code to the repository I will run coverage tests and code metrics. I will seek to have 100% coverage of non-trivial code. I will also strive for a low cyclomatic complexity. As features/requirements are completed, they will be committed.

### Releases

There will be a weekly commit to external hard drive and to the KSU CIS server of all current work. Any Microsoft Word documents that were updated will also have their last modified date time stamp updated and a PDF version generated.

A weekly progress report will be made to my advisor in the form of an email.