Software Requirements Specification for SE 4G06: subtitle describing software

Team 3, Tangle
Calvyn Siong
Cyruss Allen Amante
Edward Gao
Richard Li
Mark Angelo Cruz

October 6, 2024

Contents

Revision History

Date	Version	Notes
Date 1	1.0	Notes
Date 2	1.1	Notes

1 Purpose of the Project

1.1 User Business

The Tangled Program Graphs (TPG) framework is an alternative approach to reinforcement learning (RL) that leverages evolution-based techniques instead of the widely used deep neural networks (DNN). In traditional RL, agents learn through trial and error by generating actions and receiving rewards. The DNN approach requires extensive computational resources, often involving thousands of GPUs, which can be expensive and inefficient. In contrast, TPG aims to provide a more cost-effective and resource-efficient solution, with the long-term goal of embedding this evolution-based learning directly into hardware, reducing dependency on large-scale computational infrastructure.

Currently, TPG has been tested primarily in fully observable, stationary mini-game environments, which are not representative of the dynamic and partially observable nature of real-world scenarios. This limitation presents a challenge, as the real-world problems TPG is meant to address are much more complex and constantly changing. To safely and effectively evolve TPG's capabilities, it is crucial to test the framework in advanced simulation environments, like MuJoCo, which can better mimic real-life dynamics in a controlled and risk-free manner.

Additionally, TPG's codebase has been developed by graduate students primarily focused on research output, often neglecting the software engineering practices necessary for creating a robust and maintainable open-source framework. Without standardized practices such as unit testing, continuous integration/continuous deployment (CI/CD), and architectural guidelines, TPG's long-term goal of becoming a widely adopted, open-source framework could be hindered. This project seeks to address these gaps, ensuring that TPG can scale, evolve, and attract contributions from other researchers and reinforcement learning enthusiasts in a standardized and efficient manner.

1.2 Goals of the Project

1. **Enabling Software Engineering Standards**: We aim to create a seamless and standardized process for all contributors to the Tangled Program Graphs (TPG) framework. This includes simplifying the onboarding process, establishing clear contribution guidelines, and build-

ing a robust, scalable architecture that is open for extension but closed for modification. By doing so, we ensure that future development is both collaborative and sustainable, allowing for a consistent quality of contributions while maintaining the integrity of the core framework.

2. **Physics Engine Integration**: We also seek to enhance TPG's ability to handle more complex, real-world-like scenarios. This will be achieved by integrating TPG with the MuJoCo physics engine, which allows for experimentation in dynamic and partially observable environments. By expanding the testing environments, we can evolve TPG's capabilities beyond its current limits, ensuring it is better suited for real-world applications.

2 Stakeholders

2.1 Client

Insert your content here.

2.2 Customer

Insert your content here.

2.3 Other Stakeholders

Insert your content here.

2.4 Hands-On Users of the Project

Insert your content here.

2.5 Personas

Insert your content here.

2.6 Priorities Assigned to Users

Insert your content here.

2.7 User Participation

Insert your content here.

2.8 Maintenance Users and Service Technicians

Insert your content here.

3 Mandated Constraints

3.1 Solution Constraints

Insert your content here.

3.2 Implementation Environment of the Current System

Insert your content here.

3.3 Partner or Collaborative Applications

Insert your content here.

3.4 Off-the-Shelf Software

Insert your content here.

3.5 Anticipated Workplace Environment

Insert your content here.

3.6 Schedule Constraints

Insert your content here.

3.7 Budget Constraints

Insert your content here.

3.8 Enterprise Constraints

Insert your content here.

4 Naming Conventions and Terminology

4.1 Glossary of All Terms, Including Acronyms, Used by Stakeholders involved in the Project

Insert your content here.

5 Relevant Facts And Assumptions

5.1 Relevant Facts

Insert your content here.

5.2 Business Rules

Insert your content here.

5.3 Assumptions

Insert your content here.

6 The Scope of the Work

6.1 The Current Situation

Insert your content here.

6.2 The Context of the Work

Insert your content here.

6.3 Work Partitioning

Insert your content here.

6.4 Specifying a Business Use Case (BUC)

Insert your content here.

7 Business Data Model and Data Dictionary

7.1 Business Data Model

Insert your content here.

7.2 Data Dictionary

Insert your content here.

8 The Scope of the Product

8.1 Product Boundary

Insert your content here.

8.2 Product Use Case Table

Insert your content here.

8.3 Individual Product Use Cases (PUC's)

Insert your content here.

9 Functional Requirements

9.1 Functional Requirements

Insert your content here.

10 Look and Feel Requirements

10.1 Appearance Requirements

Insert your content here.

10.2 Style Requirements

Insert your content here.

11 Usability and Humanity Requirements

11.1 Ease of Use Requirements

Insert your content here.

11.2 Personalization and Internationalization Requirements

Insert your content here.

11.3 Learning Requirements

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11.4 Understandability and Politeness Requirements

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11.5 Accessibility Requirements

Insert your content here.

12 Performance Requirements

12.1 Speed and Latency Requirements

Insert your content here.

12.2 Safety-Critical Requirements

Insert your content here.

12.3 Precision or Accuracy Requirements

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12.4 Robustness or Fault-Tolerance Requirements

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12.5 Capacity Requirements

Insert your content here.

12.6 Scalability or Extensibility Requirements

Insert your content here.

12.7 Longevity Requirements

Insert your content here.

13 Operational and Environmental Requirements

13.1 Expected Physical Environment

Insert your content here.

13.2 Wider Environment Requirements

Insert your content here.

13.3 Requirements for Interfacing with Adjacent Systems

Insert your content here.

13.4 Productization Requirements

Insert your content here.

13.5 Release Requirements

Insert your content here.

14 Maintainability and Support Requirements

14.1 Maintenance Requirements

Insert your content here.

14.2 Supportability Requirements

Insert your content here.

14.3 Adaptability Requirements

Insert your content here.

15 Security Requirements

15.1 Access Requirements

Insert your content here.

15.2 Integrity Requirements

Insert your content here.

15.3 Privacy Requirements

Insert your content here.

15.4 Audit Requirements

Insert your content here.

15.5 Immunity Requirements

Insert your content here.

16 Cultural Requirements

16.1 Cultural Requirements

Insert your content here.

17 Compliance Requirements

17.1 Legal Requirements

Insert your content here.

17.2 Standards Compliance Requirements

Insert your content here.

18 Open Issues

Insert your content here.

19 Off-the-Shelf Solutions

19.1 Ready-Made Products

Insert your content here.

19.2 Reusable Components

Insert your content here.

19.3 Products That Can Be Copied

Insert your content here.

20 New Problems

20.1 Effects on the Current Environment

Insert your content here.

20.2 Effects on the Installed Systems

Insert your content here.

20.3 Potential User Problems

Insert your content here.

20.4 Limitations in the Anticipated Implementation Environment That May Inhibit the New Product

Insert your content here.

20.5 Follow-Up Problems

Insert your content here.

21 Tasks

21.1 Project Planning

Insert your content here.

21.2 Planning of the Development Phases

Insert your content here.

22 Migration to the New Product

22.1 Requirements for Migration to the New Product

Insert your content here.

22.2 Data That Has to be Modified or Translated for the New System

Insert your content here.

23 Costs

Insert your content here.

24 User Documentation and Training

24.1 User Documentation Requirements

Insert your content here.

24.2 Training Requirements

Insert your content here.

25 Waiting Room

Insert your content here.

26 Ideas for Solution

Insert your content here.

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Lifelong Learning. Please answer the following questions:

1. What knowledge and skills will the team collectively need to acquire to successfully complete this capstone project? Examples of possible knowledge to acquire include domain specific knowledge from the domain of your application, or software engineering knowledge, mechatronics knowledge or computer science knowledge. Skills may be related to technology, or writing, or presentation, or team management, etc. You should look to identify at least one item for each team member.

2. For each of the knowledge areas and skills identified in the previous question, what are at least two approaches to acquiring the knowledge or mastering the skill? Of the identified approaches, which will each team member pursue, and why did they make this choice?