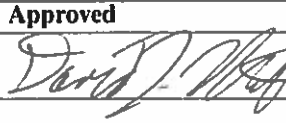
University of Colorado
Department of Computer Science
CSCI 4308

Project Charter

(PYTMH)

Monday 16th September, 2019

Approvals

Role	Name	Affiliation	Approved	Date
Customer	David Motta	Northrop Grumman		10/11/19
Course Coordinator	Alan Paradise	CU-Boulder		

Project Customers

Name: David Motta Email: David.Motta@ngc.com
Name: Christian Butterfield Email: Christian.Butterfield@ngc.com

Team Members

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1. Revision History

Date	Notes	Approval

2. Description and Scope

Northrop Grumman is a "leading global security company providing innovative systems, products and solutions in autonomous systems, cyber, C4ISR, space, strike, and logistics and modernization to customers worldwide. Their vision is to be the most trusted provider of systems and technologies that ensure the security and freedom of our nation and its allies. As the technology leader, they will define the future of defense - from undersea to outer space, and in cyberspace."

The goal of Northrop Grumman's project this year is to create a time dependent model to classify and track vehicles in video for use in real-time applications. Last year, students tested a variety of algorithms to perform this task, and were able to achieve a tracking accuracy of 56.9% and a classification accuracy of approximately 80%. The algorithms they tested treated each frame of video independently and thus had temporal instabilities in classification. This year's task is to test a variety of methods that are time dependent to see if we can improve the classification accuracy. At a minimum, Northrop Grumman would like us to investigate attention, long short-term memory (LSTM), recurrent neural networks (RNN), and temporal convolutional neural networks (TCNN), but they are also open to other methods we may find in the course of our research.

The ability to classify and track objects in videos is unbelievably useful in the real world. One of the fundamental problems in creating autonomous vehicles, like self-driving cars, is the ability to make sense of video in real time. Other applications of object tracking and classification include augmented reality, surveillance, and defense.

3. Specific Objectives

1. Determine collection of models to analyze, at least Attention, LSTMs, RNNs, and TCNNs
2. Treat classification dependently in video data
3. Test all models and present statistical analysis
4. Improve upon previous team's accuracy on vehicle classification
5. Present sponsor empirically derived solution to which model best performs in terms of accuracy and time

4. Approach

4.1. Major milestones or events schedule

Task	Start date	End date
Northrup Grumman Project	9/30/2019	4/26/2020
Project Charter	9/30/2019	10/14/2019
Decide technologies	10/14/2019	10/21/2019
Go over previous team's models and datasets	10/14/2019	10/28/2019
Find better datasets	10/21/2019	11/4/2019
Data cleaning	11/4/19	11/25/2019
Find candidate algorithms	10/21/2019	11/11/2019
Research Attention, LSTMs, RNNs, and TCNNs	10/21/2019	11/11/2019
Analyze and select algorithms	11/11/2019	11/25/2019
Fall Break	11/25/2019	12/2/2019
Setup cloud service/Northrop machine	10/21/2019	12/19/2019
Create architecture/interface for model testing	12/2/2019	12/19/2019
Winter Break	12/19/2019	1/13/2020
Implement models	12/2/2019	2/24/2020
Testing and data analysis	1/13/2020	3/23/2020
Spring Break	3/23/2020	3/30/2020
Compile data and create presentations	3/30/2020	4/26/2020
Burndown		

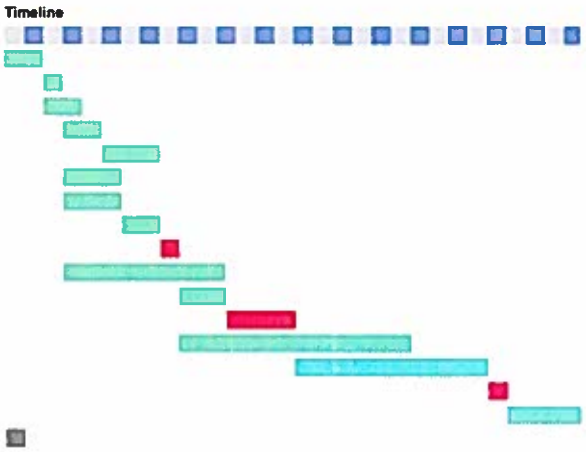

Figure 1. Project Schedule

4.2. Impact on other projects or systems

On successful completion, this vehicle detection and classification model may be implemented within one of many Northrop Grumman's services. Using satellite data, Northrop Grumman may use this model to identify and classify vehicles within their technology.

4.3. Critical assumptions, and constraints

The assumption we are making through this project is that applying these different algorithms to data that we are able to find available publicly will be an accurate representation of their actual performance and value. However, it is not necessarily true that the data we find and the performance of the different models when tested and trained on this data will directly translate to the data which Northrop Grumman handles.

4.4. Major known risks and risk mitigation plans

Risks

1. Data is not cleansed/standardized
2. Models don't perform as well as we expect
3. Model training/testing takes longer than expected

Mitigation Plans

1. We will do an appropriate amount of data exploration at the beginning of the project to understand the way the data is formatted and attempt to remove any discrepancies.
2. The way to mitigate this risk is to focus on tuning the models and hyperparameters.
3. We plan to start training/testing as soon as we can. We will probably start training as soon as a model is implemented and we have an appropriate dataset, to at least get a better idea of how long training will take.

4.5. Process for change control

1. Draft change proposal as a team
2. Submit change request to Lakshya Sharma (TA)
3. Review and resubmit if needed
4. Submit change request to David Motta and Christian Butterfield
5. Review and resubmit if needed
6. Submit final change proposal to Alan Paradise and Northrop Grumman
7. Log revision

5. Resources

5.1. Stakeholders

1. Alan Paradise - University of Colorado, Boulder
2. David Motta - Northrop Grumman
3. Christian Butterfield - Northrop Grumman

5.2. Roles & Responsibilities

Team Member	Role	Responsibilities
Justin Davis	Communications Lead	Contact between professor, TA, sponsor contacts, and team.
Zhengwu Yuan	Source Code Control Lead	Maintenance and error resolution for source code repositories.
Valliappan Chidambaram	Requirements Lead	Make sure the project meets all the requirements, and manage changes to the scope of the project.
Paris Dinh	Implementation Lead	Training and application of models and algorithms to data sets.
Amari Hoogland	Architectural Lead	Manage libraries and technology used.
Sofia Lange	Documentation Lead	Write ups, explanation of code, analysis of differences between algorithms.
Lei Teng	Testing/Analysis Lead	Monitoring testing and leading analysis and interpretation of results.
Kamen Shah	Deployment Lead	Deployment of necessary resources.

5.3. Other material resource needs

As of now, we do not require any additional material resources to complete the project, because Northrop Grumman is providing us with a machine to aid in training our models and storing data.

6. Team Skills and Interests

Critical Project Elements	Team member(s) and associated skills/interests
Setup Cloud infrastructure	Kamen Shah- Knowledge on setting up cloud infrastructure systems on GCE and Azure
Previous work	Lei Teng- Data previous work experience
Data set exploration and preparation	Justin Davis - Data Science Team Valliappan Chidambaram - Machine Learning class
Model Creation	Amari Hoogland - Machine Learning class Valliappan Chidambaram - Written a neural network before Kamen Shah - Experience from ML projects and class
Model Tuning	Paris Dinh - Machine Learning class
Model Testing	Lei Teng - Machine Learning class Zhengwu Yuan - Machine Learning class
Model Comparison and Analysis	Sofia Lange - knowledge of comparing different performance measures
Realtime Model Prediction	Paris Dinh - Machine Learning class
Sponsor Outreach	Justin Davis

7. Time and Cost - Budget

Critical Project Elements	Resource/Source
On Premises Storage	standard storage on provided machine
Azure cloud instances	standard S1 instance