

## Detailed Project Proposal

First Name:	Darie-Dragos
Last Name:	Mitoiu
Student Number:	1905367
Supervisor:	Ian Harris

### Defining your Project

#### 1.1 Project title

Title: A Desktop Application for Maintenance of Computer Systems.

The maintenance of computer systems implies the collection and analysis of hardware and software data using networking programming techniques for collection and the use of machine learning techniques to analyse the data collected from the computer systems, the collected data could be the Central Processing Unit (CPU) Temperature, Utilization, Response Time, Memory Utilization, Hard-Disk S.M.A.R.T (Self-Monitoring, Analysis and Reporting Technology) System and Operating System Log Files.

This being said, the desktop application will allow the computer systems to be monitored in near real-time by analysing the current state of the machines and provide predictive analysis based on past data being the ultimate goal of the application in the limitation of information found and skill acquired during research, design and development process.

#### 1.2 Background

As computer systems are used for problem solving, the software element it is the main factor that creates computer systems failure events (Salfner 2006). In 2006, the downtime of computer systems was represented largely by the software element comparing to the hardware element as Salfner (2006) suggests. Naturally this problem brings into discussion the term “Maintenance of Computer Systems”, as this term becomes relevant for enterprises, institutions, organisations and individuals that need to monitor the performance and state of their computer systems in order to prevent, mitigate and evaluate the impact of events such as slow response of the computer systems, the computer systems not responding when specific operations are performed or worst the failure of the systems which would result in the transition of the system from a working state to a non-working state accompanied with the loss of essential data.

The applications, services and resources of the desktop type of computer systems could be organized and scheduled in such a fashion which would reduce the impact of the system’s failure whenever predicted by making use of machine learning techniques which would classify specific events that would occur in computer systems as events that would require maintenance or just as informative events if the severity of the events is low in order to secure the normal functionality of the machines.

Numerous approaches have been performed in order to provide a solution to the maintenance of computer systems problem. Some of the most common approaches would be the ones that make use of machine learning techniques such as classification and regression models in order to analyse system log files which could contain data from simple system log in information to more relevant information when it comes to maintaining a machine such as software failure or hardware failure.

The prediction models that have been used would be some of the standard machine learning models such as the Bayes Networks Model, the Hidden Markov Model, Partially Observable Markov Decision Process and the Support Vector Machines as Fulp, Fink and Haack (2008) indicate in order to analyse operating systems events logged and stored on the computer's hard-disk in order to be able to signal any occurring failure of the system in real-time and also make predictions based on past data.

Analysing the state of the storage component of the computer system in order to identify any decrease in the response time or failure of the machine is another approach undertaken in order to identify any maintenance event for a system based on storage component state, the storage system being a hard-disk in most cases as Hamerly and Elkan (2003) indicate, the hard-disk state, response time and utilization are the main factors that have been used when making use of machine learning models.

This being said, the project is important because it could prevent and mitigate the impact of possible technical problems related to computer systems which may require maintenance and with this it could also reduce the possible downtime of the machines and reducing or even eliminating the cost required in order to investigate the problems that occur in computer systems.

### **1.3 Motivation**

The desktop application will be of use to any enterprise, institution or individual that needs to have an insight about the state of one or more computer systems.

The enterprises and institutions that would benefit from this desktop application are any enterprises or institutions that use computer system for problem solving and wish to reduce the cost, time and labour investment into investigating technical problems related to computer systems. The enterprises and institutions will benefit from using this desktop application by being able to receive near real-time information about the state of one or more computer systems (this project focus being on desktop type of computer systems and not servers), accompanied with a prediction feature which will try to predict any hardware or software events that could occur in computer systems based on past data that may require maintenance.

The individuals that may be concerned using this type of desktop application would be professionals working as computer technicians or systems administrators which are usually assigned with tasks of ensuring the normal functionality of specific computer systems it is present. The professionals working as technicians or system administrators would benefit the most from this type of desktop application, as the time invested into the investigation of hardware or software technical problems could be reduced or even eliminated by providing near real-time information about the state of one or more monitored computer systems and the prevention of events that may require maintenance such as the failure of the computer systems which could vary from the event of a non-responding machine to the transition of the machine from a working state to a non-working state could be possible if a prediction of hardware or software technical problems is provided based on past data collected from the computer systems.

## 1.4 Aim & Objectives

**Aim:** To create a functional desktop application that efficiently provides information about the hardware and software state of computer systems in real-time and in a predictive manner.

### Functional Requirements:

#### Must Have:

- Implement the graphical user interface for the authentication system of the application using the chosen graphical user interface library,
- Implement the graphical user interface for the core features of the application using the chosen graphical user interface library,
- Implement the controller of the main application using the libraries that have been evaluated,
- Implement the client controller of the application using the libraries that have been evaluated,
- A feature for the main application (server side) to allow the near real-time information to be retrieved from the machines which are monitored.

#### Should Have:

- Implement a notification system for near real-time events that occur in the machines which are monitored,
- Implement a calendar system for near real-time events which have occurred in computer systems,

#### Could Have:

- Implement the predictive feature for the desktop application by making use of the machine learning techniques,
- Implement a calendar system for predicted maintenance events,

#### Wont' Have (this time):

- Not Applicable.

### Non-Functional Requirements:

#### Must Have:

- Identify and study similar applications that provide solutions to the maintenance or failure of computer systems problem,
- Identify and evaluate possible candidate programming languages that are categorised as general-purpose programming languages in order to ensure the application can be scaled accordingly as more features need to be implemented,
- Research, identify and evaluate existing libraries that will allow the relevant information from computer systems to be acquired in order to provide a solution to the maintenance of computer systems problem, considering the programming language in cause,
- Research, identify and evaluate existing libraries that will allow the data transfer to be performed in a reliable and secure manner in order to prepare the data for analysis, considering the programming language in cause,
- Research, identify and evaluate possible candidate machine learning techniques which could provide a solution to the predictive part of the desktop application,

- Research, identify and evaluate existing libraries that will allow the data analysis to be performed in order to try and make predictions based on past data and the current state by making use of the machine learning techniques,
- Research, identify and evaluate existing graphical user interface libraries suited for a modern type of desktop application which can provide a significant and relevant number of layouts and widgets, considering the programming language chosen for the controller of the application if possible,
- Perform manual and automated testing of the application.

#### **Should Have:**

- Apply a modern approach in term of layout when it comes to the design once the limitations of the graphical user interface API have been evaluated.
- The application must comply with the General Data Protection Regulation 2018.

#### **Could Have:**

- Allow trials of the application in order to collect feedback from users,
- Analyse the feedback from users and adjust the application based on the needs of the users.

#### **Won't Have (this time):**

- Not Applicable.

### **1.5 Key Techniques**

- Predicting maintenance using Support Vector Machine based on log files stored on the system (Errin W. Fulp, Glenn A. Fink and Jereme N. Haack),

The Support Vector Machine Model, it is a classification and regression model that allows the prediction of possible events that may require maintenance based on both log files stored on the system and failure signals of the hard-disk.

- Predicting maintenance using the Hidden Markov Model based on log files stored on the system (Felix Salfner),

The Hidden Markov Model it is a model that uses probability as a way of predicting possible events that may require maintenance, just as the previous technique, this technique is using the logs stored on the system, though minimal work has been done in the source found.

- Predicting failure of the Hard-Disk using Bayesian approach based on the internal state of the hard-disk (Greg Hamerly and Charles Elkan).

As the Hidden Markov Model, the Bayesian approach it is a probability-based technique used in order to allow the prediction of possible events that may require maintenance based on the hard-disk component.

## **1.6 Legal, Social, Ethical, Professional and Security issues**

The desktop application will present an authentication system which will require the user to register, the registration presenting a security code as a constraint, this authentication system it is present in order to restrict the access to the application from unauthorised persons, because of this, the users data must be kept in a secure place in order to comply with the General Data Protection Regulation 2018 (GDPR) and to prevent any unauthorised access by complying with the Computer Misuse Act 1998, for the storage of users data an Amazon Cognito database will be considered.

The desktop application will collect technical data from computer systems by making use of networking programming techniques to make that possible, alongside the technical data, the identification of the machine will also be collected, the computer name represents a possible candidate for the identification of the machine despite a hash calculated using the machine's hardware, the rest of the collected data being technical, the data will not present any security issues as virtual machines will be used for testing.

The desktop application will not present any social issues when considering the professionals working in the field of maintaining computer systems such as technicians or system administrators, as the desktop application it is not designed to solve the problems that occur in computer systems, the desktop application it is designed to provide help to the technicians and systems administrators by providing near real-time information and try to predict future problems that could occur in computer systems.

This being said, the desktop application in cause should not present any significant legal, social, ethical or security issues because the application will comply with the General Data Protection Regulation 2018, the Computer Misuse Act 1998 and last but not the least the application it is not designed to replace the human working in the maintenance of computer systems field, but to provide help in solving the problems that occur in computer systems.

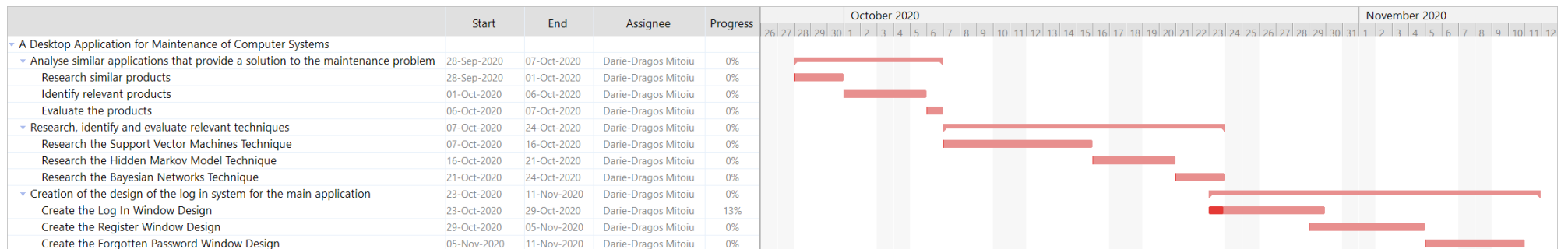
## **1.7 Project Plan**

High Level Project Plan:

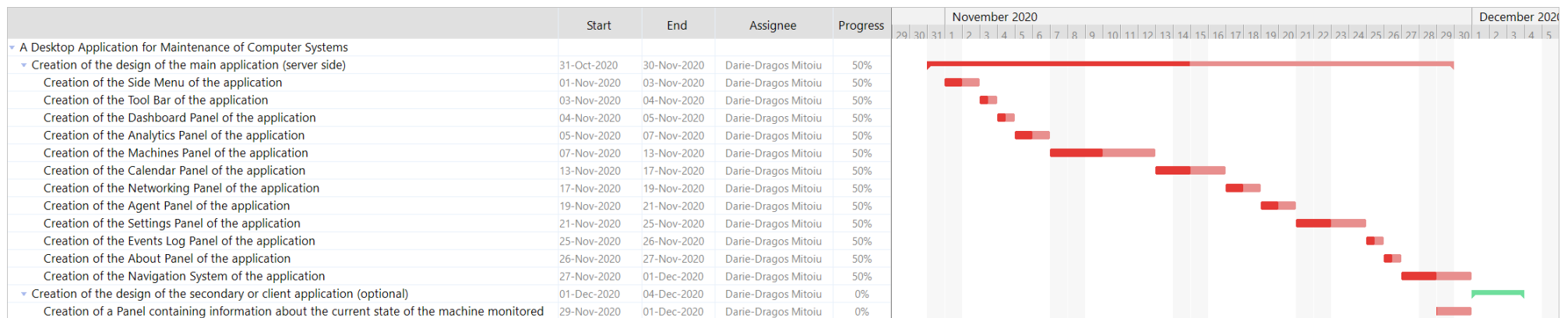
- Analyse similar systems that provide a solution to the maintenance of computer systems problem,
- Research, identify and evaluate techniques that could result in a solution to the problem of maintenance of computer systems,
- Creation of the design of the main application Authentication System,
- Creation of the design of the main application (server side),
- Creation of the design of the client application (optional – as the client does not require an interface, the client application will be responsible of sending relevant data to the server),
- Implementing the core features of the main application (server side),
- Implementing the core features of the client application,
- Perform Manual and Automated Testing on the main application (server side),
- Perform Manual and Automated Testing on the client application,
- Deploying the main application and client application to virtual machines as required,
- Evaluate the real-time data results and the prediction accuracy or probability,
- Build and Obfuscate the main application.

## 1.7. Schedule:

### 28.09.2020 – 01.10.2020 (October work)



### 01.09.2020 – 01.12.2020: (November work)



**01.01.2021 – 02.02.2021: (January work)**

					January 2021																															February				
	Start	End	Assignee	Progress	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3
▼ A Desktop Application for Maintenance of Computer Systems																																								
▼ Implementing the features of the main application (server side)	01-Jan-2021	31-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Authentication System Functionality (Log In, Register, Recover Account)	01-Jan-2021	02-Jan-2021	Darie-Dragos Mitoiu	50%	<div></div>																																			
Creation of the Dashboard Panel Functionality (general information)	02-Jan-2021	05-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Analytics Panel Functionality (Overview of current data)	05-Jan-2021	08-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Mahines Panel Functionality (Retrieve clients information)	08-Jan-2021	09-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Calendar Panel Functionality (Show Events)	09-Jan-2021	13-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Networking Panel Functionality (Allow clients to connect to server)	13-Jan-2021	15-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Agent Panel Functionality (creation of the client as a Java Archive)	15-Jan-2021	19-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Settings Panel Functionality (Themes Options)	19-Jan-2021	21-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the Events Log Panel Functionality (Application Logs information)	21-Jan-2021	23-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the About Panel (Application Information)	23-Jan-2021	26-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Create the real-time data monitoring feature	26-Jan-2021	28-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the predictive feature based on log files (optional)	28-Jan-2021	30-Jan-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
▼ Implementing the features of the client application	30-Jan-2021	02-Feb-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			
Creation of the data transfer feature between client and server	30-Jan-2021	02-Feb-2021	Darie-Dragos Mitoiu	0%	<div></div>																																			

**02.02.2021 – 27.02.2021 (February work)**

[illegible]

## References

1. Bastos, P., Lopes, I. and Pires, L.C.M., 2014. Application of data mining in a maintenance system for failure prediction. *Safety, Reliability and Risk Analysis: Beyond the Horizon: 22nd European Safety and Reliability, 1*, pp.933-940,
2. Salfner, F., Schieschke, M. and Malek, M., 2006, April. Predicting failures of computer systems: A case study for a telecommunication system. In *Proceedings 20th IEEE International Parallel & Distributed Processing Symposium* (pp. 8-pp). IEEE,
3. Salfner, F., 2005, April. Predicting failures with hidden Markov models. In *Proceedings of 5th European Dependable Computing Conference (EDCC-5)* (pp. 41-46),
4. Fulp, E.W., Fink, G.A. and Haack, J.N., 2008. Predicting Computer System Failures Using Support Vector Machines. *WASL*, 8, pp.5-5,
5. Hamerly, G. and Elkan, C., 2001, June. Bayesian approaches to failure prediction for disk drives. In *ICML* (Vol. 1, pp. 202-209).



### **1.8 Ethics Form**

**You must include in your signed ethics form in this submission or you will not be able to continue the project.**