Research Plan

Artificial Intelligence and Machine Learning

Generating music using AI

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VERSION HISTORY

Version	Date	Author(s)	Changes	Status
0.1	03-02-2022	Mickey Krekels	Added the main structure of the document.	In progress
0.2	05-02-2022	Mickey Krekels	Finished the chapter research description	In progress
0.3	09-02-2020	Mickey Krekels	Finished the chapter research questions	In progress
0.4	10-03-2020	Mickey Krekels	Added feedback from the teacher Leon	In progress
0.5	11-03-2020	Mickey Krekels	Fixed grammar-related issues	Finished

1 TABLE OF CONTENT

1 RESEARCH DESCRIPTION

1.1 CONTEXT

This document will describe the plan of the research topic “Artificial Intelligence and Machine Learning”. The project plan document will also contain the topic description, what problems and opportunities are available and what the research questions are.

1.2 WHAT IS ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING?

As described in the article “what is Machine Learning?” on IBM Cloud Learn Hub, *Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.* (1)

Tasks that are difficult to structurally program such as predictions and imitating human behaviour are issues where machine learning is used the most. Examples of AI(Artificial Intelligence) and ML(Machine Learning) are the self-driving cars developed by Tesla, these cars use convolutional neural networks (2) such as YOLO (3) to recognize cars within a certain distance.

The chess computer “Deep Blue” (4) also used a machine-learning algorithm to predict the best possible move. In 1997 this chess computer defeated Garry Kasparov who was widely considered the greatest chess player of all time, this achievement is for a lot of researchers what marked the start of the machine learning era.

Therefore researching this interesting topic can offer a lot of theory and skills.

1.3 THE PROBLEM/OPPORTUNITY

There are a lot of topics within Artificial Intelligence and Machine Learning that can be researched. From simple classification such as Decision Tree algorithms to more advanced neural network projects.

From my previous specialization semester in Artificial Intelligence, I learned the basics of working with neural networks. For this research, I would like to continue working on this skill. Therefore the main goal is to make a demo project that **generates music** using a **trained neural network**.

This technology could provide the music industry with an opportunity with a cheap and fast alternative to writing music.

1.4 End delivery of this Research

The delivery of this research will be a demo project, where the network is able to generate a musical sound file. For documentation purposes, I am going to use Jupyter Notebook (5), which is a python framework for documenting code. This notebook delivery will explain all the training steps, optimization techniques and the end result.

1.5 What research methods are going to be used?

With the experience learned from previous projects, the best way to research a new AI network/technique is by learning the basics of the theory and starting a demo project. If we look at the ICT research methods from the Dot Framework research methodology (6) in figure 1. The Categories **Lab**, **Library** and **Workshop** are most suited for this research.

Library	Field	Lab	Showroom	Workshop	Extra
Available product analysis	Document analysis	A/B testing	Benchmark test	Brainstorm	Joker
Best good and bad practices	Domain modelling	Component test	Ethical check	Business case exploration	
Community research	Explore user requirements	Computer simulation	Guidline conformity analysis	Code review	
Competitive analysis	Focus group	Data analytics	Peer review	Decomposition	
Design pattern research	Interview	Hardware validation	Pitch	Gap analyisis	
Expert interview	Observation	Non-functional test	Product review	IT architecture sketching	
Literature study	Problem analysis	Security test	Static program analyis	Multi-criteria decision making	
SWOT analysis	Stakeholder analysis	System test		Prototyping	
	Survey	Unit test		Requirements prioritization	
	Task analysis	Usability testing		Root cause analysis	

Figure 1 research methods https://ictresearchmethods.nl/Methods

2 Research Questions

In this part of the document, I will describe the most relevant research questions. This will be done by using the Dot Framework research methodology (6).

2.1 Main Research Question

2.1.1 How is it possible to generate music with machine learning and neural networks?

2.2 Sub Questions

To provide an answer to the main question these sub-questions are required.

2.2.1 How to create a training set for the network?

2.2.2 How to create a validation set for the network?

2.2.3 How is the data structured?

2.2.4 What public datasets are available?

2.2.5 What are the common techniques/algorithms used for this type of network?

2.2.6 What is the theory behind music generation with neural networks?

2.2.7 How to create a music generation network demo?

2.2.8 How to test the quality of the generated result?

See the table below for the linked category and methods for each of the sub-questions.

Dot Framework research methodology		
Sub Question	**Method**	**Category**
2.2.1	Data analytics	**Lab**
2.2.2	Data analytics	**Lab**
2.2.3	Available product analysis	**Library**
2.2.4	Available product analysis	**Library**
2.2.5	Literature study	**Library**
2.2.6	Literature study	**Library**
2.2.7	Prototyping	**Workshop**
2.2.8	A/B testing	**Lab**

3 BIBLIOGRAPHY

1. **IBM Cloud Education.** What is Machine Learning? *ibm.* [Online] 15 7 2020. https://www.ibm.com/cloud/learn/machine-learning.

2. **Convolutional neural network. *wikipedia.* [Online] https://en.wikipedia.org/wiki/Convolutional_neural_network.**

3. Manishgupta. YOLO — You Only Look Once. *towardsdatascience.* [Online] 30 5 2020. https://towardsdatascience.com/yolo-you-only-look-once-3dbdbb608ec4.

4. Deep Blue. *wikipedia.* [Online] https://nl.wikipedia.org/wiki/Deep_Blue.

5. Ingargiola, Antonino. What is the Jupyter Notebook? *jupyter-notebook-beginner-guide.* [Online] 2015. https://jupyter-notebook-beginner-guide.readthedocs.io/en/latest/what_is_jupyter.html.

6. The DOT Framework. *ictresearchmethods.* [Online] https://ictresearchmethods.nl/The_DOT_Framework.