



School of Computing Final Year Research Project
Project Initiation Document

Can machine learning improve geoscience
prediction models

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1 Basic Details

Student Name: Kane Swartz

Draft Project Title: Can machine learning improve geoscience prediction models

Course Year: Software Engineering year 3

Project Supervisor: Dr Rich Boakes

Client Organisation: University of Portsmouth School of the Environment, Geography Geosciences (SEGG)

Client Contact Name: Dr. Mohammad A Hoque

2 Degree Suitability

When I enrolled onto the Portsmouth Software Engineering course it was to develop the skills that would empower me to make impactful software. This project demonstrates a range of both software development and academic skills including problem identification, appropriate choice of software tools and the ability to do appropriate research in order to understand a specific real world problem sufficiently to specify and develop a solution. This project shows my ability to develop impactful software demonstrating that I have realised the quintessential purpose of this degree by having garnered skills to this effect.

3 Outline of the project environment and problem to be solved

3.1 Who is the client

Dr. Mohammad A Hoque is a senior lecturer in the SEGG whose ambition lies in reducing human consumption of contaminants. After procuring a BSc and MSc in Dhaka University he then went on to complete a PhD in University College London.

3.2 What is their problem

Dr. Mohammad A Hoque is a contributor to an interdisciplinary project between the SEGG and the School of Computing (SoC), iArsenic. iArsenic is a tool which predicts a data point's classification based on its features.

3.3 Why does it need to be solved

At its core the purpose of iArsenic is to contribute to the scientific effort to improve access to safe drinking water by aiding the identification of unsafe drinking water.

The need for integration between the disciplines of environmental science and machine learning has been detailed (Fleming, Watson, Ellenson, Cannon, Vesselinov, 2021, pp. 878-880).

This dissertation will work toward the goal of integrating these fields by introducing machine learning techniques to an already existing environmental science project in order to compare the accuracy of predictive models developed from an environmental science perspective to models developed from a software engineering / machine learning perspective.

4 Project aim and objectives

This is an exploratory project with the aim of comparing existing predictive models developed within the University of Portsmouth SEGG with a geoscience discipline with models developed from within a software engineering / data science discipline using machine learning techniques, which are not leveraged in the existing models.

The objective of the project will be to develop a model or multiple models, leveraging machine learning. These models will then be evaluated and their error will be compared to the existing models.

5 Project constraints

The models developed will be constrained by the objective of comparing their error to the existing models. This means the new models will need the same source data-set and produce the same format of outputs.

Time constraints and the need to produce a deliverable also come together as another fundamental constraint, meaning the research, development and review areas of the project will likely benefit from more time, almost indefinitely, requiring time to be provisioned accordingly.

6 Facilities and resources

As this project will be leveraging supervised machine learning techniques on a data-set approximately 1.3 million rows in size, a regular computer without sophisticated graphics capabilities will be suitable.

If the data-set was significantly larger or deep learning techniques were being considered, cloud computing technologies would likely be considered though this is not anticipated.

- Personal laptop
- Meetings with the client
- Occasional meeting with machine learning experts will be beneficial

7 Log of risks

7.1 Risk 1

7.1.1 Description

Time constraint

7.1.2 Impact

Almost all aspects of this project, from problem identification to algorithm research and design to execution could take more time on their own than is available for the entire project

7.1.3 Mitigation / Avoidance

The project will be split into stages and each stage will have a deadline after which the project will move on to the next stage. It is anticipated there may be temptation not to move on when the time comes, so planning ahead of time will help keep time allocation realistic.

7.2 Risk 2

7.2.1 Description

Burnout / stress related health deterioration

7.2.2 Impact

A final year dissertation is well associated with student stress. This could negatively impact not only the quality of output from myself with regards to the dissertation but could lead to more profound negative personal impact.

7.2.3 Mitigation / Avoidance

At all times I aim to prioritise my well-being and if the strain appears significant enough my strategy is to remain aware that abandoning the project for the sake of my well-being is always an option and perhaps a sensible choice as my well-being is foundational to the dissertation itself.

While I don't expect to abandon the project, maintaining this frank and honest perspective will hopefully allow me to make sensible decisions with regards to my well-being and thus my productivity too.

7.3 Risk 3

7.3.1 Description

Data loss or corruption

7.3.2 Impact

This would require work to be done again which will be time inefficient. As a time sensitive project the ramifications of this would range from minor to so severe the the project cannot be delivered.

7.3.3 Mitigation / Avoidance

Work will be stored on GitHub and google drive and backed up frequently.

8 Project Deliverables

The primary deliverable will be a written comparison and analysis of the error of all of the existing models and the models to be developed.

To produce this deliverable a machine learning model will need to be developed and will also be delivered as an artefact.

9 Project Plan Approach

The primary strategy in executing this project is to break it into distinct stages. Broadly these will be:

1. Problem research / problem identification (what should the deliverable look like)
2. Solution development (developing the solution outlined by problem research)
3. Solution evaluation (reflecting on the suitability of the solution)

Stage one is already underway and formed the basis of this PID, this stage will be concluded by the end of November 2022.

Stage two will involve developing a machine learning model and a suitable evaluation method, common to the new model and the previous models, to be concluded by the middle of February 2023 with a soft deadline to have a demonstrable machine learning based model for the demo on the 3rd February 2023. Stage three will be the write up of the project and should be concluded one week before the submission deadline on 5th May 2023 allowing for at least 1 week to review and make amendments.

10 Supervisor Meetings

Regular communication with the project supervisor will be over Discord and in person meetings subject to availability.

Having worked with Dr Rich Boakes for a number of years we have developed effective though ad-hoc communication methods such as attending a first or second year lecture to borrow his time in the last 15 minutes of the class. I have confidence that the supervisor will be available for support when required in a timely fashion on a suitably regular basis.

11 Legal, ethical, professional, social issues (mandatory)

Any interpretation of the output or results of these models has to be taken in the context of experimental or research tools. This project is not intended to provide advice or guidance on whether any source of drinking water is safe and accepts no liability for the use of these models output for this purpose or any other purpose outside of academia. Drinking water pollution is a sensitive and current topic and this project will be conducted with consideration to the human impact associated with this ongoing phenomena.

12 Appendix A: Ethics Certificate



Certificate of Ethics Review

Project title: Can machine learning improve geoscience prediction models

Name:	Kane Swartz	User ID:	941226	Application date:	21/10/2022 13:58:59	ER Number:	TETHIC-2022-104051
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You must download your referral certificate, print a copy and keep it as a record of this review.

The FEC representative(s) for the **School of Computing** is/are [Haythem Nakkas](#), [Dalin Zhou](#)

It is your responsibility to follow the University Code of Practice on Ethical Standards and any Department/School or professional guidelines in the conduct of your study including relevant guidelines regarding health and safety of researchers including the following:

- [University Policy](#)
- [Safety on Geological Fieldwork](#)

It is also your responsibility to follow University guidance on Data Protection Policy:

- [General guidance for all data protection issues](#)
- [University Data Protection Policy](#)

Which school/department do you belong to?: **School of Computing**

What is your primary role at the University?: **Undergraduate Student**

What is the name of the member of staff who is responsible for supervising your project?: **Dr Rich Boakes**

Is the study likely to involve human subjects (observation) or participants?: No

Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?: No

Are there risks of significant damage to physical and/or ecological environmental features?: No

Are there risks of significant damage to features of historical or cultural heritage (e.g. impacts of study techniques, taking of samples)?: No

Does the project involve animals in any way?: No

Could the research outputs potentially be harmful to third parties?: No

Could your research/artefact be adapted and be misused?: No

Will your project or project deliverables be relevant to defence, the military, police or other security organisations and/or in addition, could it be used by others to threaten UK security?: No

Please read and confirm that you agree with the following statements: I confirm that I have considered the implications for data collection and use, taking into consideration legal requirements (UK GDPR, Data Protection Act 2018 etc.), I confirm that I have considered the impact of this work and and taken any reasonable action to mitigate potential misuse of the project outputs, I confirm that I will act ethically and honestly throughout this project

Supervisor Review

As supervisor, I will ensure that this work will be conducted in an ethical manner in line with the University Ethics Policy.

Supervisor comments:

Supervisor's Digital Signature: **rich.boakes@port.ac.uk**

Date: **21/10/2022**

13 Appendix B: Gannt Chart

- primary focus
- secondary focus
- tertiary focus
- deadline

Date	02/09/2022	07/09/2022	16/09/2022	23/09/2022	30/09/2022	07/10/2022	14/10/2022	21/10/2022	28/10/2022	04/11/2022	11/11/2022	18/11/2022	25/11/2022	02/12/2022	09/12/2022	16/12/2022	23/12/2022	30/12/2022	06/01/2023	13/01/2023	20/01/2023	27/01/2023	03/02/2023	10/02/2023	17/02/2023	24/02/2023	03/03/2023	10/03/2023	17/03/2023	24/03/2023	31/03/2023	07/04/2023	14/04/2023	21/04/2023	28/04/2023	05/05/2023	12/05/2023	19/05/2023	26/05/2023	02/06/2023	09/06/2023	16/06/2023	23/06/2023	30/06/2023	07/07/2023	14/07/2023	21/07/2023	28/07/2023	04/08/2023	11/08/2023	18/08/2023	25/08/2023	01/09/2023	08/09/2023	15/09/2023	22/09/2023	29/09/2023	06/10/2023	13/10/2023	20/10/2023	27/10/2023	03/11/2023	10/11/2023	17/11/2023	24/11/2023	01/12/2023	08/12/2023	15/12/2023	22/12/2023	29/12/2023	05/01/2024	12/01/2024	19/01/2024	26/01/2024	02/02/2024	09/02/2024	16/02/2024	23/02/2024	01/03/2024	08/03/2024	15/03/2024	22/03/2024	29/03/2024	05/04/2024	12/04/2024	19/04/2024	26/04/2024	03/05/2024	10/05/2024	17/05/2024	24/05/2024	31/05/2024	06/06/2024	13/06/2024	20/06/2024	27/06/2024	04/07/2024	11/07/2024	18/07/2024	25/07/2024	01/08/2024	08/08/2024	15/08/2024	22/08/2024	29/08/2024	05/09/2024	12/09/2024	19/09/2024	26/09/2024	03/10/2024	10/10/2024	17/10/2024	24/10/2024	31/10/2024	06/11/2024	13/11/2024	20/11/2024	27/11/2024	04/12/2024	11/12/2024	18/12/2024	25/12/2024	01/01/2025	08/01/2025	15/01/2025	22/01/2025	29/01/2025	05/02/2025	12/02/2025	19/02/2025	26/02/2025	03/03/2025	10/03/2025	17/03/2025	24/03/2025	31/03/2025	06/04/2025	13/04/2025	20/04/2025	27/04/2025	04/05/2025	11/05/2025	18/05/2025	25/05/2025	01/06/2025	08/06/2025	15/06/2025	22/06/2025	29/06/2025	05/07/2025	12/07/2025	19/07/2025	26/07/2025	02/08/2025	09/08/2025	16/08/2025	23/08/2025	30/08/2025	06/09/2025	13/09/2025	20/09/2025	27/09/2025	04/10/2025	11/10/2025	18/10/2025	25/10/2025	01/11/2025	08/11/2025	15/11/2025	22/11/2025	29/11/2025	05/12/2025	12/12/2025	19/12/2025	26/12/2025	02/01/2026	09/01/2026	16/01/2026	23/01/2026	30/01/2026	06/02/2026	13/02/2026	20/02/2026	27/02/2026	04/03/2026	11/03/2026	18/03/2026	25/03/2026	01/04/2026	08/04/2026	15/04/2026	22/04/2026	29/04/2026	05/05/2026	12/05/2026	19/05/2026	26/05/2026	02/06/2026	09/06/2026	16/06/2026	23/06/2026	30/06/2026	06/07/2026	13/07/2026	20/07/2026	27/07/2026	03/08/2026	10/08/2026	17/08/2026	24/08/2026	31/08/2026	06/09/2026	13/09/2026	20/09/2026	27/09/2026	04/10/2026	11/10/2026	18/10/2026	25/10/2026	01/11/2026	08/11/2026	15/11/2026	22/11/2026	29/11/2026	05/12/2026	12/12/2026	19/12/2026	26/12/2026	02/01/2027	09/01/2027	16/01/2027	23/01/2027	30/01/2027	06/02/2027	13/02/2027	20/02/2027	27/02/2027	04/03/2027	11/03/2027	18/03/2027	25/03/2027	01/04/2027	08/04/2027	15/04/2027	22/04/2027	29/04/2027	05/05/2027	12/05/2027	19/05/2027	26/05/2027	02/06/2027	09/06/2027	16/06/2027	23/06/2027	30/06/2027	06/07/2027	13/07/2027	20/07/2027	27/07/2027	03/08/2027	10/08/2027	17/08/2027	24/08/2027	31/08/2027	06/09/2027	13/09/2027	20/09/2027	27/09/2027	04/10/2027	11/10/2027	18/10/2027	25/10/2027	01/11/2027	08/11/2027	15/11/2027	22/11/2027	29/11/2027	05/12/2027	12/12/2027	19/12/2027	26/12/2027	02/01/2028	09/01/2028	16/01/2028	23/01/2028	30/01/2028	06/02/2028	13/02/2028	20/02/2028	27/02/2028	04/03/2028	11/03/2028	18/03/2028	25/03/2028	01/04/2028	08/04/2028	15/04/2028	22/04/2028	29/04/2028	05/05/2028	12/05/2028	19/05/2028	26/05/2028	02/06/2028	09/06/2028	16/06/2028	23/06/2028	30/06/2028	06/07/2028	13/07/2028	20/07/2028	27/07/2028	03/08/2028	10/08/2028	17/08/2028	24/08/2028	31/08/2028	06/09/2028	13/09/2028	20/09/2028	27/09/2028	04/10/2028	11/10/2028	18/10/2028	25/10/2028	01/11/2028	08/11/2028	15/11/2028	22/11/2028	29/11/2028	05/12/2028	12/12/2028	19/12/2028	26/12/2028	02/01/2029	09/01/2029	16/01/2029	23/01/2029	30/01/2029	06/02/2029	13/02/2029	20/02/2029	27/02/2029	04/03/2029	11/03/2029	18/03/2029	25/03/2029	01/04/2029	08/04/2029	15/04/2029	22/04/2029	29/04/2029	05/05/2029	12/05/2029	19/05/2029	26/05/2029	02/06/2029	09/06/2029	16/06/2029	23/06/2029	30/06/2029	06/07/2029	13/07/2029	20/07/2029	27/07/2029	03/08/2029	10/08/2029	17/08/2029	24/08/2029	31/08/2029	06/09/2029	13/09/2029	20/09/2029	27/09/2029	04/10/2029	11/10/2029	18/10/2029	25/10/2029	01/11/2029	08/11/2029	15/11/2029	22/11/2029	29/11/2029	05/12/2029	12/12/2029	19/12/2029	26/12/2029	02/01/2030	09/01/2030	16/01/2030	23/01/2030	30/01/2030	06/02/2030	13/02/2030	20/02/2030	27/02/2030	04/03/2030	11/03/2030	18/03/2030	25/03/2030	01/04/2030	08/04/2030	15/04/2030	22/04/2030	29/04/2030	05/05/2030	12/05/2030	19/05/2030	26/05/2030	02/06/2030	09/06/2030	16/06/2030	23/06/2030	30/06/2030	06/07/2030	13/07/2030	20/07/2030	27/07/2030	03/08/2030	10/08/2030	17/08/2030	24/08/2030	31/08/2030	06/09/2030	13/09/2030	20/09/2030	27/09/2030	04/10/2030	11/10/2030	18/10/2030	25/10/2030	01/11/2030	08/11/2030	15/11/2030	22/11/2030	29/11/2030	05/12/2030	12/12/2030	19/12/2030	26/12/2030	02/01/2031	09/01/2031	16/01/2031	23/01/2031	30/01/2031	06/02/2031	13/02/2031	20/02/2031	27/02/2031	04/03/2031	11/03/2031	18/03/2031	25/03/2031	01/04/2031	0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14 References

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