MATH3024 PROJECT

TASK

Create a model for a complex system inspired by one of the following lyrics:

“Despite all my rage, I am still just a rat in a cage”

“I, am thinking it's a sign, that the freckles in our eyes, are mirror images and when we kiss they're perfectly aligned”

“I was carried to Ohio on a swarm of bees”

“Brosandi, Hendumst í hringi, Höldumst í hendur, Allur heimurinn óskýr, nema þú stendur” (Smiling, Spinning round and round, Holding hands, The whole world a blur, But you are standing)

The purpose, implementation analysis of your model are all up to you! The project description is intentionally ill-defined so as to provide you with freedom and autonomy to take the project in a direction that is interesting and relevant to you. Obviously, you should use the tools and techniques we cover in this unit, though not everything will be relevant for your chosen application. If at any stage you are unsure then *please* speak with me about your ideas.

Totally uninspired? Have your own idea you want to explore? Let’s talk about it! All projects are to be approved by the study week (i.e. prior to submitting the Interim report).

What exactly does it mean to ‘create a model’?

- Motivate it: give context about why your model matters and what others have done that is relevant
- Define it: sufficient detail needs to be given for your model to be reproduced
- Simulate it: code up your model and run it.
- Analyse it: qualitative depiction of model output, parameter sweeps, ensemble simulations for statistics
- Communicate results: via a Jupyter Notebook and Report

CODE

Code is to be written in Python.

This course is not about coding but coding is essential for modelling. Embrace it, get excited… at the end of this unit you will have ‘Python’ on your CV and will be equipped to code out in the real world. You are welcome to use any AI that is helpful.

SUBMISSION DETAILS

See LMS.

Interim report

This is simply a brief summary of your progress on, and plans for, the project task. The purpose is to ensure you are on track and will allow me to identify any concerns early and discuss them with you. State what you are modelling. Discuss how you are going to approach your implementation. Perhaps, discuss how you plan to summarise the system behaviour.

Final report

There are two options for your submission.

1. Entirely via a Jupyter Notebook (100%), which allows blending code, text and multimedia for communication and interactive aspects.
2. A more traditional approach of a research paper + python code. With this option the Project Report and the Jupyter Notebook will still need to be well-integrated and complement each other where appropriate.

I should be able to review the code and run it in a Jupyter Notebook. Code must be documented, clear, and readable with version of python and versions of any packages you use included.

ASSESSMENT

See Rubric on LMS for a guide. A reminder: rubrics are a guide for markers, they are not checklists specifying exactly what tasks you should do.

There are no constraints on length in either direction so long as you fully cover the standard components required for communicating research, namely: introduction, methods, results, discussion and conclusion. Having said that, effective communication should be concise and the tone should be scientific. **Marks will be lost for waffling on like ChatGPT.**

Some suggested inclusions:

- *Introduction:* Provide an overview of the problem and a literature review. You should address the gap or question that your work addresses and outline what has been done in this space before.
- *Methods:*
  - Model description. Describe how your model works in terms of the components, interactions, environment, model schedule/timing of events etc. Your description should be specific and comprehensive enough for someone else to implement your model.
  - Model analysis. Detail parameter settings that were systematically explored and the analyses you ran. If your model is stochastic, you will need to run multiple trials at the same parameter settings and provide statistics. Your description should be specific and comprehensive enough for someone else to replicate your analyses accurately.
- *Results:* Qualitative and quantitative summaries of the model behaviour, illustrating outcomes with appropriate visualisation such as graphs and animations for different settings as needed.
- *Discussion:* revisit the initial question or problem and analyse how your results shed light on this issue. If you suspect there are still some bugs driving your model's behaviour, this is the place to discuss this. It is also an opportunity to discuss how you might verify, validate, or extend the model in the future.

- *Conclusion:* Summarise the key findings and main takeaways. Put your results in a broader context. Discuss the broader implications of your findings, how they contribute to the field, and what potential applications or practical implications they might have. Describe the strengths, limitations, and potential future directions of your work. Note that what is considered 'Discussion' vs what is considered 'Conclusion' is a grey area.