The University of Melbourne
School of Computing & Information Systems

COMP90083 Computational Modelling & Simulation

Assignment 2

Released: Monday 26 August, 2024
Proposal due: 23:59, Sunday 15 September, 2024
Report due: 23:59, Sunday 20 October, 2024

Overview

In this assignment, you will create an agent-based model (ABM) of a complex phenomenon, working as part of a group (of two people). This assignment gives you greater freedom to apply the knowledge and skills you are acquiring in this subject to a domain of interest to you.

The objectives of this assignment are to gain experience in:

- identifying problem of broad scientific or policy interest;
- designing an appropriate ABM and experiments to address a more research specific question;
- communicating the design of your model and the results of your investigation; and
- collaborating over an extended period of time to execute a substantial piece of work.

Background

Agent-based models can be used to model a broad range of systems in the real world. You are free to choose a topic of interest for this assignment. While the work you submit (proposal, report and model code) must be that of your group, we are happy for topics and questions to be discussed with us, with each other, in class, in tutorials, and on the Discussion Board.

To get you started, a list of possible topics is provided at the end of this specification. You may use one of these for your project or a different topic entirely. Note that any of these example topics could each be used as the basis for *many* possible questions and could potentially lead to very complex models. However, bear in mind the time constraint on this project: You should start by aiming for a *single* question that can be addressed using a relatively *simple* model. It is far more important to address a simple question *well* than to address a complex question (or many questions) *poorly*. If your initial question and model go well, you can always elaborate on your question and extend your model. For the same reason, we recommend choosing a topic early and sticking to it; don't spend too much time looking into multiple topics.

In terms of model complexity: as a baseline, your model should involve some form of non-trivial agent behaviour and interaction between agents, such that you can identify and measure some interesting emergent behaviour of the system.

Your tasks

1. Identify a question and review relevant literature and existing models;
2. Write a proposal describing your question and proposed approach (first deadline);
3. Design and implement your model (in NetLogo or a general-purpose language);
4. Design and execute a series of experiments using your model;
5. Write a report describing your model and findings (second deadline).

Procedure and assessment

- This assignment is to be completed *in groups of two*.
- This project has two deadlines: a proposal and a final report (plus model code). The suggested structure for each submission is outlined below.
- Late submissions will incur a penalty of 2 marks for every day (or part thereof) after the deadline. If there is a valid reason that you require an extension, email Andres well before the due date to discuss this.
- You should submit both your proposal and your report via Canvas LMS. All files should contain the names and student numbers of all group members. Please upload these as separate files (rather than a single archive).
- We encourage the use of the Discussion Board to discuss and ask questions about this project; however, all submitted work must be your group's own work.
- This project counts for 40% of your total marks in this subject. Marks will be awarded according to the criteria described below.

Proposal

Your proposal should be up to 2 pages outlining:

1. Context: The scientific or policy problem providing context for your research;
2. Research Question: The specific research question you've identified for your project;
3. Background: A brief summary of previous research relevant to this question;
4. Proposed Methods: Your proposed approach to addressing this question; e.g., in the form of a draft ODD description (this may be partial, or subject to change, but should summarise your thinking at this stage).

Your proposal does **not** count toward your Project 2 mark (it is for feedback only); however, if your group does **not** submit a proposal, there we will **deduct 5 marks** (out of 40) from your Project 2 mark. (That is, you should submit a proposal!)

Report

Your report should be 9–12 pages (at least 11pt font size and 2cm margins), incorporating the following components:

- *Introduction:* Motivate and describe your question and summarise relevant research on this topic.
- *Model design:* Describe your model using the ODD framework; this should be sufficiently detailed to enable someone else to implement your model.
- *Methods:* Describe the experiments used to analyse your model's behaviour and address your question; this should be sufficiently detailed to enable someone else to recreate your analysis.
- *Results:* Provide a qualitative and quantitative summary of your model's behaviour, including tables or figures as appropriate.
- *Discussion:* Interpret your results: how do they answer the question that motivated your project? Put your results in a broader context: what are the implications of your findings? Describe the strengths, limitations and potential future directions of this work. This is also the place to reflect on things that may have gone well or less well in carrying out the assignment and briefly summarise what you have learned from the experience.

Your report counts for 40% of your total marks in this subject. Note that you can reuse any content from your proposal in your report.

Code

You may implement your model in NetLogo or a general-purpose language (e.g., Python, Java, or C++). If you choose to use a general-purpose language, you are welcome to use an agent-based modelling library/framework such as Mesa, Repast, or MASON (though note that the teaching team may only be able to provide limited support for these libraries).

Your model code will not contribute to your mark for this assignment, but it is a hurdle requirement in that it **must** be submitted (in a well-structured and documented form) to obtain a passing mark for the assignment. If it consists of multiple files, your code may be uploaded as a ZIP archive.

Academic misconduct

The University misconduct policy (https://academicintegrity.unimelb.edu.au/) applies. Students are encouraged to discuss the assignment, but all submitted work must represent the group's understanding, implementation and writing. You may use short sections of code from existing models where appropriate, but these should be commented on as such and include a reference to the original source of the code. TurnItIn will be used on submitted work to detect high levels of similarity with other material. While you must refer to existing material in your background review, the words used should be your own and original sources must be acknowledged. See the policy link for guidelines about good scholarship.

Marking criteria

Criterion	Description	Marks
Proposal	The research question proposed is clearly articulated. Relevant background information is well summarised. The draft model description clearly outlines a model suitable for addressing the proposed question. Note: you will receive feedback on your proposal; **not** submitting a proposal will result in a deduction of 5 marks from your total.	
Introduction	The introduction motivates the study, reviewing appropriate literature and outlining the gap in knowledge and question you will address	8 marks
Model design	The model is comprehensively described, making appropriate use of the ODD protocol. The design of the model matches the research question well. The model incorporates non-trivial agent behaviour and interaction and reflects an understanding of the concepts covered throughout the subject.	8 marks
Methods	The experiments are appropriate to the question and well justified, and all relevant information is provided.	8 marks
Results	The results are summarised and communicated, including appropriate use of figures and tables and sensitivity or uncertainty analysis appropriate to the question.	8 marks
Discussion	The results are interpreted, and an answer to the question is provided. The implications of the research and the strengths and limitations of the approach taken are discussed. The discussion and reflection demonstrate an understanding of the concepts covered throughout the subject.	8 marks
Model implementation	The code is well structured, readable, and well commented and explained. Note: your code will not marked but must be provided as part of your submission to obtain a passing mark for this assessment item.	(hurdle)
Total		40 marks

Example topics

We encourage you to choose a topic that interests you in this project. The following list of possible topics will help spark your imagination.

- Natural attractions are geographical or biological features of broad tourist appeal, such as coral reefs, mountain ranges, and other wilderness areas. However, such attractions can become victims of their own success as increasing popularity can lead to overcrowding and degradation of the tourist experience. Models can be used to explore these phenomena and potentially identify solutions that would benefit tourists, service providers, and environmental protection.
- Critical minerals are high-demand resources but have easily disrupted supply chains. For example, neodymium is essential for the manufacturing of permanent magnets, which are required in electric motors and generators. Neodymium has an almost monopolistic supplier, which has used its position to significantly increase neodymium's price. Models can be used to understand the complex and dynamic interactions between suppliers and consumers of critical minerals. (hint: there are existing investment models that can serve as starting points)
- We often wait in queues (physically or virtually) in settings such as airports, supermarkets, and call centres. Depending on context, customers may differ (i.e., in terms of serving times, priority, behaviour, and other characteristics), but there is a common goal of ensuring that all customers are served as efficiently as possible. Queuing systems can be designed in various ways (i.e., number of servers, number of queues, and other strategies), and models can be used to evaluate the impact of customer waiting times and satisfaction in different settings.
- Some bacteria live in communities that adhere to a surface and exude a polymeric film that can protect them against threats such as antibiotics. These biofilms have been referred to as "cities for bacteria". While biofilms have some practical uses (e.g., in sewage treatment), they are often a cause of infection and contamination. Models can be used to explore how biofilm forms and potentially also strategies for removing biofilms.
- An invasive species is one that is non-native to a particular environment and can cause substantial economic or environmental harm, For example, rabbits (which eat agricultural crops), foxes (which prey upon native species), and cane toads (which compete for the same habitats as native species) are notable invasive species in Australia. Control of invasive species can be very challenging, and models can be used to evaluate the potential impact of control strategies such as trapping, baiting (i.e., using poison), or barriers (i.e., fences).
- Nightlife districts of large cities are important social and economic hubs but can also be violent settings —often associated with the consumption of alcohol. Some cities have attempted to reduce alcohol-related violence via strategies such as limited trading hours for nightlife venues, increased policing, provision of free public transport and other measures. Models can be used to explore which environmental and regulatory factors encourage or discourage violent behaviour.
- Melbourne and other cities have recently experienced demonstrations (public gatherings of people to protest for or against a particular idea or action). While such events are usually peaceful, they can result in violent behaviour and confrontation with police. How could a model be used to explore the situations in which an otherwise peaceful

protest may become violent, and what are the strategies to prevent this from occurring? (hint: there are existing models of protest that may be useful as a starting point)

- While social media services such as Twitter, Facebook and WeChat support many positive social interactions, they can also be platforms for the spread of misinformation. How could a model of information spread (e.g., on a network) be used to understand how misinformation is spread and what strategies could be used to limit the spread of misinformation? (hint: there are existing models of information spread that may be useful as a starting point)
- As Earth's climate changes, the geographic range of habitats that particular species occupy can change, enabling species to expand into new areas or forcing them to migrate. How could a model be used to explore the dynamics of this process and anticipate potential impacts in terms of interactions with other species or human activities such as agriculture? (hint: there are existing models of animal migration that could be used as a starting point)
- Historically, the discovery of new regions of the globe or of new economic resources in known regions has prompted a rush to exploit these resources, often to the detriment of the environment and local populations. How could a model be used to explore this phenomenon and suggest sustainable approaches to using future resources? (hint: there are existing models of managing common resources that could be used as a starting point)