COM3001, COM6003 Assignment 1

You will carry this out in teams – mostly of three.

The principle purpose is to take an existing FLAME model and top use it as the basis for some virtual experiments and to write this up as a scientific report. You will receive the FLAME code and some brief remarks about the background of the model and the sort of research questions being investigated.

You then have to do some background research into the scientific area involved, the sort of modelling that has been done before in this area and what discoveries – if any – that have been made using previous models.

There will be systems of the following types:

1) Molecular system – e.g. Oxygen in E. Coli; NFkappa-B system

2) Cellular and tissues systems – keratinocyte colonies etc.

3) Social insects – Pharaoh's ants

4) Economic systems – a Mall system.

Each group will be allowed to choose their preferred model.

The format of the report will be as follows:

Name of group – name of group's members.

Title of investigation/model

Tissue Agent-Based Model

Background

Closely coupled in vitro and in virtuo models have been used to explore the self-organization of normal human keratinocytes (NHK). Although it can be observed experimentally, we lack the tools to explore many biological rules that govern NHK self-organization. An agent-based computational model was developed, based on rules derived from literature, which predicts the dynamic multicellular morphogenesis of NHK and of a keratinocyte cell line (HaCat cells) under varying extracellular Ca^{++} concentrations. The model enables in virtuo exploration of the relative importance of biological rules and was used to test hypotheses in virtuo which were subsequently examined in vitro. Results indicated that cell–cell and cell–substrate adhesions were critically important to NHK self-organization. In contrast, cell cycle length and the number of divisions that transit-amplifying cells could undergo proved non-critical to the

final organization. Two further hypotheses, to explain the growth behaviour of HaCat cells, were explored in virtuo—an inability to differentiate and a differing sensitivity to extracellular calcium. In vitro experimentation provided some support for both hypotheses. For NHKs, the prediction was made that the position of stem cells would influence the pattern of cell migration post-wounding. This was then confirmed experimentally using a scratch wound model.

Contacts

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Section 1

Introduction to the subject area, the sort of modelling done previously – a brief literature survey, the sort of research questions examined and a defensible judgment on whether this modelling led to any new insights.

Section 2

An explanation of the main aspects of the supplied model – e.g. the agents involved, their messages and other key factors. The key parameters, distribution of agent types and so on.

Section 3

A new research question that could be explored using the model or a suitable adaptation of it. This could include questions relating to what happens if some parameters are changed, if the number of agents in the simulation is changed – how does that affect things, or any other new agents that might be brought into the model. This should include a clear methods description – what has been changed and why.

Tasks:

i. Creating different 0.xmls for different oxygen availability based on values in the following tables.

Agent Name	Type	Number
keratinocyte	0	5
keratinocyte	1	10
keratinocyte	2	15
keratinocyte	3	20
keratinocyte	4	25

ii: Changing parameters in **functions.c** file**.**

- **line 612: prob = num_corn_neighbours * num_corn_neighbours * 0.01;**

```
/*
 * cell cycle lengths
 * order in array is K_TYPE_STEM, K_TYPE_TA, K_TYPE_COMM, K_TYPE_CORN, K_TYPE_HACAT
 */
```

- **line 52: const int CYCLE_LENGTH[5] = {120, 60, 0, 0, 120};**

- **line 26: #define PI 3.142857143**

Write your own research questions for exploring the model.

Section 4

Results of the simulation. A number of simulations should be run for each experiment – at least 10. the length of the simulation should be suitable – if it is too short interesting behaviour might be limited.

Section 5

Analysis of the results. Here simple statistics should be used – for example you could measure some parameters – e.g. relating to attributes of individual agents, or characteristics/properties of a population of agents etc. Express the results as graphs with error bars or other means to display the spread of results.

Section 6

Conclusions. The best way to do this is to define some hypotheses and to test them – can you accept or reject them to some suitable level of significance. Again a well argued statistical analysis is needed.

References

Group performance

A list of the contributions of each member of the group – their role – e.g. group leader (if there was one), statistical boffin, programmer, project planning, scientific literature research etc.

A signed statement as to how many hours each member contributed to the project.

Mark scheme. Out of 50.

Section	Marks
1	3
2	3
3	10
4	10
5	10
6	3
References	1
Group performance	10