Peer feedback form

Feedback from group:	1
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A. Implementation and experimental design

Obstacle implementation: the assignment was to implement obstacles according to certain criteria: they had to be round(ish), static, roughly half the cell size, and regularly spaced. Please assess if the chosen obstacle implementation meets these criteria:

1	2	3	4	Selection:
There are no obstacles or the implementation is so flawed that it does not allow an answer to the research question.	*Obstacles are implemented but not (fully) satisfy the criteria, which might affect the ability to answer the research question.*	*Obstacles mostly match the criteria. Any issues/bugs/artefacts are minor and have little impact on the answer to the research question.*	*Obstacles are implemented correctly to complete the assignment and answer the research question.*	**3**

Implementation of migrating cells: the assignment was to study collective cell migration where cells keep moving at high densities, using the parameters from self-study exercise 1.3 (the correct choice was max_{act}=80). Please assess to what extent the implementation allows for collective cell migration:

1	2	3	4	Selection:
The implementation is strongly flawed (e.g. cells completely fall apart or do not actively migrate at all).	*The team used somewhat valid parameters, but the chosen max_{act}/λ_{act} do not allow collective motion at high density.*	*The team did not use the correct parameters from ex1.3. Their cells could move at high densities but did not align as in ex1.3.*	*The team chose correct parameters from ex1.3, or equivalent ones allowing migration at high densities and alignment as in ex1.3.*	*2*

Experimental design: to assess the effect of obstacles on collective migration as asked, the simulations should (a) have sufficient cells to exhibit collective migration, (b) be compared against a proper baseline, and (c) ensure that while assessing the effect of a variable of interest, everything else is held constant. Please assess the experiment according to these criteria:

1	2	3	4	Selection:
The # of cells was too low to speak of collective migration; cells mostly did not touch at all.	*There were enough cells that some of them were touching, but not enough to speak of "high densities" per the exercise.*	*The simulation contained an appropriate number of cells to allow for collective migration.*	*There were enough cells for collective migration, and the experiment varied the number of cells to test sensitivity of conclusions.*	***1***
There was no baseline (e.g. only a simulation without obstacles or only a simulation with obstacles), making it impossible to assess the effect of obstacles on collective motion.	*There was a control (e.g. comparing "few" to "many" obstacles), but a no-obstacle baseline was missing making the effect of obstacles on collective motion hard to assess.*	*There was a comparison between a no-obstacle baseline and a run with obstacles, allowing the team to assess how obstacles changed collective motion in this one obstacle setting.*	*Obstacles were varied in a meaningful range (no obstacles to sparse grid to closely packed), allowing a general assessment of the effect of obstacles across various densities.*	*4*

Comparisons between simulations always changed multiple variables at once (e.g. both # cells and # obstacles), preventing meaningful conclusions.	*Some (but not all) comparisons between simulations changed multiple variables at once, limiting meaningful conclusions.*	*[There is no meaningful intermediate here]*	*All comparisons between simulations kept all but one of the variables fixed, allowing a fair assessment of the impact of the changing variable.*	*4*

Other potential problems: there can be other choices in the experimental set-up that might stand in the way of a robust answer to the research question. Check the right column with an X if these problems are present in the report:

Problem	**Explanation**	**Does this apply? (yes/no/maybe)**
Initialization artefacts	In simulations with many cells, you might run into issues where cells fragment into pieces because they are initialized too close together. You are then looking at artefacts, not modelling what real cells might do.	***No***
Stochasticity not considered	The CPM is stochastic, and results may vary between runs. To draw robust conclusions, you should run each simulated condition multiple times – especially in quantitative analyses.	***Yes***
Dynamics not considered	CPM behavior is dynamic and may change over time (e.g. in exercise 1.3: the alignment increased gradually over time). If not considered, you might: - miss important observations (e.g. because you did not wait long enough) - unfairly compare simulations at different time points	***Yes***
Other (please specify):		

Group assessment and feedback: Based on the above, please assess how well the experiment(s) in this report were designed to answer the research question as posited in the assignment. Please write at least 150 words of constructive feedback to help them fix any issues and/or show explicitly which parts were done well. Be specific (which experiment(s) are you talking about?), offer concrete suggestions for improvement and explain why these changes will result in a better report.

Your experimental setup has a clear structure with a good progression of obstacle densities (0, 4, 9, 16, and 25) while keeping the cell count constant. This is a very solid baseline for isolating variables. However, the implementation of the migrating cells prevents you from answering the core research question regarding collective migration. Specifically, you initialized exactly 37 cells on a 200x200 grid. Since each cell has a target volume of 200, they only occupy about 18.5% of the total grid space. At this low density, true collective migration (where cells align their directions and stream together) cannot emerge. Instead, as you correctly noted in your results, the cells just bump into each other, form static clusters, and stop moving. The ideal scenario would be a highly packed environment where cells are forced to interact constantly. To fix this, I strongly suggest increasing the number of cells significantly (e.g., to 150 or more) so they cover the majority of the grid. Additionally, you noted that Max_{act} *was set to 20. For the cells to migrate properly and align at high densities according to exercise 1.3, this parameter should be set to 80. Finally, running the simulations for only 600 Monte Carlo Steps is likely too short to observe stable dynamic behaviors. Consider increasing the duration and running multiple instances (to account for stochasticity) to ensure your results are robust.*

B. Analysis and visualizations

Quantifications: the most robust evidence of any effect of obstacles on collective migration can be provided through some sort of quantification. This does require that your quantification metric(s):

- Is/are measuring the right thing(s)
- Is/are implemented correctly

Please assess the quantitative analysis in this report (if there are none, skip this part):

1	2	3	4	Selection:
There are quantitative analyses in the report, but they do not provide useful information to answer the research question.	*There are quantitative analyses in the report, but their added value is limited.*	*There are quantitative analyses in the report that help answer the research question.*	*There are quantitative analyses in the report that help answer the research question, and they are clearly well-designed and robust (e.g. through proper statistical testing).*	***3***
The implementation seems incorrect, yielding outcomes that make no sense.	*[There is no meaningful intermediate here]*	*[There is no meaningful intermediate here]*	*The implementation seems correct, yielding reasonable outputs.*	*4*

Visualizations: you were asked in the assignment to add visualizations, which can complement quantitative analyses to show effects of interest. This is most effective if your visualizations:

- Are appropriate in relation to what you are showing (i.e. don't provide a link to a video if a simple screenshot would have sufficed)
- Have a clear and self-explanatory message (e.g., compare simulations side by side, not in different figures on different pages, and provide a meaningful caption)
- Draw attention to the points of interest (e.g. by using colors and/or annotations appropriately)

Please assess the quality of visualizations and figures in this report:

1	2	3	4	Selection:
There are no visualizations at all.	*There are visualizations, but they are not showing behaviors that are relevant for the report.*	*Visualizations are present and mostly relevant and appropriately chosen.*	*Visualizations are present, relevant, and well-chosen for the effects they are showing.*	*3*
Visualizations are not very informative (for example: the message is that cells align, but you	*Visualizations are somewhat informative, but some relevant information is missing (e.g. comparing two*	*The visualization shows the relevant behaviors with necessary information, but presentation could be*	*The visualization shows and draws attention to the relevant behaviors, using colors, annotations,*	*2*

cannot see directions in the screenshot).	*screenshots without a timestamp).*	*improved to draw attention where needed.*	*and time stamps appropriately.*	
The figures do not support the message (e.g. the relevant simulations are not shown together).	*The figures somewhat support the message, but it is not clear what the message is without reading the main text.*	*The figures are reasonably self-explanatory, but not well supported by captions.*	*The figures are self-explanatory, supported by captions highlighting the message and any relevant details.*	*2*

Description: Any figures/tables should be coherently described and referenced in the results section of the main text, which provides a narrative around the experiment(s) performed. Please assess the quality of this description:

1	2	3	4	Selection:
There is no or barely any text explaining the figures and tables.	*There is a narrative text explaining the results, but it does not reference the figures/tables appropriately.*	*The narrative text explains the results and references figures/tables appropriately.*	*The narrative text explains the results very clearly and references figures/tables appropriately.*	***2***
The text provides some explanations but many relevant observations in figures/tables are left unexplained.	*The text mostly explains the observations but is at times unclear or contradictory.*	*The text explains the observations in detail and correctly, but this causes the main point to be lost.*	*The text explains the observations correctly and in sufficient detail while also remaining to the point.*	*2*

Group assessment and feedback: Based on the above, please assess the quality of the visualizations and analyses in this report. Please write at least 150 words of constructive feedback to help them fix any issues and/or show explicitly which parts were done well. Be specific (which experiment(s)/figures/text sections are you talking about?), offer concrete suggestions for improvement and explain why these changes will result in a better report.

I really liked that you took the initiative to write a Python script to quantify your results (extracting average speeds and total distance traveled). This adds a great objective layer to your qualitative observations, and presenting the data in clear tables makes it very easy to read. However, there are significant issues with how the visualizations are presented and described. Most notably on page 5, under the "Revised Video & Speed Comparison" section, the image labels are swapped: the image titled "Without obstacles (revised)" clearly shows a grid of 16 grey obstacles, while the image titled "With obstacles (revised)" shows a completely empty grid. This makes interpreting the results very confusing. Furthermore, your screenshots do not show any directionality or alignment (which is the key feature of collective migration in this exercise). I suggest adding color-coding to your cells based on their direction of movement, which would immediately show the reader if the cells are moving coherently or just randomly jiggling in a cluster. Finally, the timestamps on your figures are inconsistent with your methods. The text mentions "End states after 1 hour" and "2 hours", but your Methods section states the simulations only ran for 600 Monte Carlo Steps (which usually corresponds to mere seconds or minutes in biological time, not hours). Please align the terminology in your descriptions with the exact MCS used so the reader can properly follow the timeline.

C. Conclusions and evidence

Validity: Claims and conclusions in the report should be backed-up by evidence (figures/tables/etc); please assess to what extent this is the case:

1	2	3	4	Selection:
The report makes several claims that are not backed up by any evidence.	*Most claims are supported by evidence, but the claims are too strong for the evidence*	*Most claims are supported by evidence, any overclaiming is minor.*	*All claims are thoroughly supported by evidence; there is no doubt that they are valid.*	*2*

	presented (e.g. the results could be due to noise).			

Clarity: Ideally, a report should clearly answer the research question with a main conclusion after presenting the results. Assess how clearly the (main) conclusions are communicated:

1	2	3	4	Selection:
There was no clear conclusion, just a description of results.	*Some conclusions were drawn, but there was unclear which were the major and minor points.*	*The main conclusion was clearly highlighted, but it could be explained better.*	*The main conclusion was clearly highlighted and well explained.*	*3*

In addition, please answer the following with Y/N:

	Yes/No
Does this report answer the research question posed in the assignment (and hopefully in the report introduction)? I.e. are the differences between obstacle simulations and the no-obstacle baseline clearly discussed?	***Yes***
Does the answer mention the alignment of directions in the scenario without obstacles, which is disturbed when obstacles are present?	***No***
Do you otherwise agree with the conclusions made?	***No***
Is it easy to find the main conclusions in the report (e.g. in a separate section) and to distinguish it from other observations made?	***Yes***
Is it clear which statements are factual observations ("the cells did X in context Y") and which are interpretations thereof ("these findings suggest that obstacles do X")?	***Yes***

Group assessment and feedback: Based on the above, assess how well the report answered the research question. Please write at least 150 words of constructive feedback to help the other team fix any issues and/or show explicitly which parts were done well. Be specific (e.g. quote specific claims you disagree with, or specific figures that seem to contradict the conclusion, etc), offer concrete suggestions for improvement, and explain why these will improve the report.

Your main conclusion is that cells move around until they find another cell, form a stable cluster, and then stop migrating, and that obstacles simply reduce the free space, causing them to cluster and stop faster. While this conclusion is completely logically sound and well-supported by the evidence you presented in your specific simulations, it unfortunately misses the core phenomenon of the assignment: collective alignment. Because your simulation used too few cells, the cells never formed a dense tissue, and thus never exhibited the aligned, collective "streaming" behavior seen in exercise 1.3. Your conclusion describes an artifact of low density rather than the actual effect of obstacles on collective migration. The ideal scenario is that in the baseline (no obstacles), highly dense cells align and move together in a specific direction. When obstacles are introduced, this alignment is physically disrupted, reducing the overall collective speed. To improve your report, you need to first fix the cell density (as mentioned in the first section) so that alignment occurs. Once you have true collective migration, you must rewrite your conclusion to discuss how the obstacles disrupt this specific alignment, rather than just stating that obstacles make cells bump into each other faster.

D. Report

Finally, use the questions below to assess if the report is properly structured, clear, and self-contained enough to completely interpret and reproduce the work:

	Yes/No
Does the report clearly state the main research question in the introduction?	***Yes***
Does the report contain ALL the relevant sections: introduction, methods, results, discussion/conclusion?	***Yes***
Are there sections of the report that are difficult to read and/or interpret? (If so, please mention those in the textbox below).	***Yes***
If any literature references are cited: do they seem relevant to the presented work?	***N/A***
Are there any claims where you think a literature reference is missing?	***No***
Are the methods described sufficiently well that you could reproduce the work *without looking at the code*? This means the report should include: • All the relevant parameters used, including the temperature T and boundary conditions • If adhesion values J are given in a matrix, it should be clear which celltypes are in the rows and columns; • Densities of cells and obstacles (or numbers, but then the size of the simulation field should be included)	***No***
Are methods justified?	***Yes***
Is it clear how long simulations were running before outputs (data/screenshots) were generated?	***No***
Are there any other reasons why results may not be reproducible?	***No***

Group assessment and feedback: Based on the above, assess how the report can be improved. Please write at least 150 words of constructive feedback to help the other team fix any unclear sections and/or show explicitly which parts were done well. Be specific (e.g. quote specific parts where you get confused and explain what you find confusing, etc), offer concrete suggestions for improvement, and explain why these will improve the report.

Your report has a solid structure, clearly dividing the content into Introduction, Methods, Results, and Discussion. The Introduction sets up the premise well. However, the Methods section lacks critical details needed for someone else to reproduce your work without looking at your code. First, the Adhesion (J) matrix is incomplete. You explicitly mention the adhesion between obstacles and moving cells ($J_{obstacle\text{-}cell}$ = 1000), but you completely omitted the adhesion values for cell-cell, cell-background, and obstacle-background interactions, which are crucial for cellular behavior. Second, you state Max_{act} was set to 20, which deviates from the parameter (80) needed for the requested collective behavior in exercise 1.3. Lastly, the timeline is highly confusing. The Methods state a run time of 600 Monte Carlo Steps (MCS), taking about "10 minutes in wall-clock time", but the Results sections showcase "End states after 1 hour" and "2 hours". It is unclear if "1 hour" refers to biological time, real-world waiting time, or if the 600 MCS is a typo. To fix these issues and make the report fully reproducible, please provide the entire J matrix, double-check your activity parameters, and clearly define your simulation runtimes purely in Monte Carlo Steps throughout the entire text.

E. Bonus simulations (if any)

Some groups may have chosen to perform additional experiments on top of those requested in the assignment. Please assess their added value using the table below:

1	2	3	4	Selection:
There are additional experiments, but it is unclear what their goal was.	*There are additional experiments answering specific questions, but their relation to the main research question is unclear.*	*There are additional experiments that allow a somewhat better answer to the research question.*	*The additional experiments add substantial value to the report.*	*[choose 1-4]*
Additional experiments are not well-designed (e.g. missing baseline or varying too many variables at once).	*Additional experiments are mostly well-designed; with some minor flaws.*		*Additional experiments are well-designed to answer a specific question.*	*[choose 1,2 or 4]*
Additional experiments are not analyzed or the analysis is flawed.	*Additional experiments are analyzed in a mostly sensible manner, with only minor flaws.*	*Additional experiments are analyzed in a sensible manner.*	*Additional experiments are analyzed thoroughly.*	*[choose 1-4]*
Conclusions of additional experiments are missing or not supported by the data.	*Conclusions of additional experiments are mostly supported by the data, with minor problems.*	*Conclusions of additional experiments are supported by the data.*	*Conclusions of additional experiments are supported by the data and well-explained.*	*[choose 1-4]*

Group assessment and feedback: Based on the above, please offer suggestions to improve any additional experiments that were performed (if there were none, you can leave this empty).

Your feedback goes here.