PHYS3561
Computing project

Organiser: Dr Cristina Zambon

cristina.zambon@durham.ac.uk

Your goal for this module

Apply the computing skills you've acquired to conduct research!

You will create:

- A `milestone' program: the starting point for your work.
- Posters: describe your research to a general physics audience.
- An oral presentation: present your research to a specialist audience.
- A 6-page report: a thorough description of your project in the style of a research article.

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This module will help you…

- Tackle problems that are not mathematically tractable.
- Construct simulation models to derive useful results.
- Utilise the processing and graphic power of modern computers for conducting research.
- Refine your coding skills.
- Enhance your employability skills, such as complex problem-solving, critical thinking and providing feedback.
- Cultivate independence and creativity.

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Projects

- Astrophysics:

  Dimitri Gadotti, Cedric Lacey, Peder Norbert, Russell Smith.

- Particle Physics:

  Jessica Turner, Cristina Zambon.

- Atomic and Optical Physics:

  Simon Gardiner, Robert Potvliege.

- Condensed/Soft Matter:

  Nicholas Bristowe, Aidan Hindmarch.

- Climate Physics:

  Stuart Adams.

The booklet with the project descriptions is on Ultra

What to attend this week

Week 1 : Two lectures on Thursday at 3pm and Friday at 11am delivered by Jeppe Andersen on advance topics in programming e.g.

- Operating systems.
- Languages: compiled vs interpreted.
- Code performance.
- Debugging.
- Version control and git.
- Remote repositories.

Week 1: Two-hour drop-in sessions on Friday at 2pm.

What to attend the following weeks

- One-hour tutorial-style workshops every two weeks (compulsory). During these tutorials you will receive guidance on your project and have the opportunity to discuss your progress. The oral presentation will occur in one of these tutorial sessions.

4 tutorials in Michaelmas term and 3 tutorials in Epiphany term.

- Synchronous Python assistance. Two 1-hour drop-in sessions per week in Ph216 (optional) on Monday and Friday at 12:00 from week 2 and continuing through week 18 except week 10.
- Asynchronous Python help. Talkyard platform via Ultra.

Python support is provided by two PhD students: Sarah Johnston and James Petley.

Important!

It is of utmost importance that you understand that the majority of your project work must be completed in your personal time.

The responsibility for making progress between tutorials lies with you. This is an integral part of the research process. Additionally, keep in mind that this is not a group exercise.

Organisation of the module

You have been assigned to a project/tutorial group (C1, C2, C3,C4).

Look for the information on Ultra (Computing tutorial timetable).

You need to know:

- Which day (Monday/Friday).
- Which weeks (C1, C2 or C3, C4).
- Your tutor's name.

There will be drop-in sessions with your tutor during the first two weeks of the Epiphany term.

Michaelmas Term

Day	Time	Room	Teaching Week									
			1	2	3	4	5	6	7	8	9	10
Tue	1300	Ph8	Intro	-	-	-	-	-	-	-	-	-
Thu	1500	Ph8	L3Comp	-	-	-	-	-	-	-	-	-
Fri	1100	CLC203	L3Comp	-	-	-	-	-	-	-	-	-
Fri	1400–1600	MCS3098	Drop-in[1]	-	-	-	-	-	-	-	-	-
Tutorials[2]												
Mon	1000–1300	Various	-	C1	C3	C1	C3	C1	C3	C1	C3	-
Fri	1000–1300	Various	-	C2	C4	C2	C4	C2	C4	C2	C4	-

[1] Students are advised to attend the Computing Skills lectures in advance of the Computing Drop-in session.

[2] Computing Project tutorials: The allocation of students to groups C1, C2, C3 and C4 is published separately. Each student attends one 1-hour tutorial per fortnight (the same slot each week), during a 3-hour 'practical' block as indicated above. An optional synchronous drop-in programming help session will also operate during each 3-hour block, in addition to asynchronous programming help. Details will be announced.

Epiphany Term

Day	Time	Room	Teaching Week									
			11	12	13	14	15	16	17	18	19	20
Tutorials[1]												
Mon	1000–1300	Various	-	-	C1	C3	C1[3]	C3[3]	C1	C3	-	-
Fri	1000–1300	Various	-	-	C2	C4	C2[3]	C4[3]	C2	C4	-	-

[3] The Computing tutorials in weeks 15 and 16 will include oral presentations. Further details will be announced.

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Level 3 Computing Project 2023/2024

Tutorial will take place in-person, fortnightly. Each tutorial last 50 minutes and attendance is compulsory.

	C1 Monday, starting week 2			C2 Friday, starting week 2			C3 Monday, starting week 3			C4 Friday, starting week 3		
Projects	**Tutor**		**Time**	**Tutor**		**Time**	**Tutor**		**Time**	**Tutor**		**Time**
Solitons										Gardiner	OC304	10:00
Q-optim				Potvliege	PH107	10:00				Potvliege	PH107	10:00
Light-matter							Gardiner	PH157	10:00			
Q-comp	Adams	PH107	10:00				Adams	PH107	10:00			
Q-comp1				Potvliege	PH107	12:00				Potvliege	PH107	12:00
Q-comp2				Gardiner	PH107	11:00				Gardiner	OC304	11:00
Neutron stars	Lacey	PCL059	10:00				Lacey	OC304	10:00			
Rockets				Gadotti	OC304	12:00	Smith	PH157	11:00	Gadotti	OC304	12:00
Rockets1	Smith	MCS1007	10:00									
Rockets2	Norberg	PH157	10:00									
Accretion disk							Norberg	PCL059	10:00			
Accretion disk1	Norberg	PH157	11:00									
Accretion disk2	Norberg	PH157	12:00									
SuperN cosmo	Lacey	PCL059	11:00									
SuperN cosmo1							Gadotti	OC304	11:00			
SuperN cosmo2							Gadotti	OC304	12:00			
Grav collapse	Smith	MCS1007	11:00	Norberg	PCL059	10:00						
Grav collapse1							Smith	PH157	12:00			

What you can find on Ultra

- Project booklet (detailed description of all projects). Data for some projects.
- Lecture materials.
- Python resource: Introduction to Python, Python revision, Python traps and pitfalls (Physics lab webpages). Some help with Scipy functions.
- Posters: tips and previous year winners' posters.
- Link to the Talkyard platform.
- Link to the Computing Project server (Jupyter Notebook).
- Access to peerScholar for peer assessment.
- Contact information.
- Space for comments and suggestions.

What you have to do

- Design and create a `milestone' program. It is a formal requirement to complete it by session 4 – weeks 8/9 in the Michaelmas term.
- A formative poster in Michaelmas term, weeks 5/6. The formative poster include peer-assessment in weeks 6/7.
- A summative poster in Michaelmas term, weeks 9/10.
- A 7 (+3) minute oral presentation in Epiphany term, in session 6 - weeks 15/16.
- A 6-page report to be submitted in Epiphany term, week 20.

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Michaelmas Term

Week*			Mon	Tue	Wed	Thu	Fri
0	(11)		25-Sep	26-Sep	27-Sep	28-Sep	29-Sep
1	(12)	Oct	02-Oct	03-Oct	04-Oct	05-Oct	06-Oct
2	(13)		09-Oct	10-Oct	11-Oct	12-Oct	13-Oct
3	(14)		16-Oct	17-Oct	18-Oct	19-Oct	20-Oct
4	(15)		23-Oct	24-Oct	25-Oct	26-Oct	27-Oct
5	(16)	Nov	30-Oct	31-Oct	01-Nov	02-Nov	$\boxed{\text{03-Nov}}$
6	(17)		06-Nov	07-Nov	08-Nov	09-Nov	$\boxed{\text{10-Nov}}$
7	(18)		13-Nov	14-Nov	15-Nov	16-Nov	$\boxed{\text{17-Nov}}$
8	(19)		20-Nov	21-Nov	22-Nov	23-Nov	24-Nov
9	(20)	Dec	27-Nov	28-Nov	29-Nov	30-Nov	$\boxed{\text{01-Dec}}$
10	(21)		04-Dec	05-Dec	06-Dec	07-Dec	$\boxed{\text{08-Dec}}$

Formative pos
Phase 1: subm
Phase 2: peer
assessment.

Summative pos

Epiphany Term

Week*			Mon	Tue	Wed	Thu	Fri
11	(26)	Jan	08-Jan	09-Jan	10-Jan	11-Jan	12-Jan
12	(27)		15-Jan	16-Jan	17-Jan	18-Jan	19-Jan
13	(28)		22-Jan	23-Jan	24-Jan	25-Jan	26-Jan
14	(29)	Feb	29-Jan	30-Jan	31-Jan	01-Feb	02-Feb
$\boxed{15}$	(30)		05-Feb	06-Feb	07-Feb	08-Feb	09-Feb
$\boxed{16}$	(31)		12-Feb	13-Feb	14-Feb	15-Feb	16-Feb
17	(32)		19-Feb	20-Feb	21-Feb	22-Feb	23-Feb
18	(33)	Mar	26-Feb	27-Feb	28-Feb	29-Feb	01-Mar
19	(34)		04-Mar	05-Mar	06-Mar	07-Mar	08-Mar
20	(35)		11-Mar	12-Mar	13-Mar	14-Mar	$\boxed{\text{15-Mar}}$

Oral presentation

Report

Why bother with Posters?

- If you google `poster’ you will find examples of Educational Posters, Advertising Posters, Political Posters, Corporate Posters and more.
- Posters can be used to promote a product, an event, a service, an idea, a plan and more.
- A possible definition is: *`A poster is a usually large sheet with images and text which aims at conveying certain information and making it noticeable for the target audience*.’ (https://design4users.com)
- Creating an effective poster is a valuable skill to have.
- You will be creating a Research Poster, which is widely used in the academic world. Just take a look at the walls of the physics department!

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Assessment

- Summative poster. Weighting: 15%.

  Prizes for best poster and runner-ups.

- Oral presentation. Weighting: 15%.

- Report. Weighting: 70%.

  Prize for Graphical Excellence (Level 3)

- All assessment components will be assessed by your tutor.

Guidelines for the use of gAI

- Any use of gAI and related technologies to fabricate or misrepresent data will be considered as Academic Misconduct.
- Lecture material (notes, questions and more) are copyrighted. Therefore, they cannot be submitted to gAI without explicit permission.
- You can use gAI for researching a topic or developing a piece of code. However, please keep in mind that you remain fully responsible for the accuracy and validity of the material produced, including the potential for plagiarism.
- If you use gAI to produce a piece of work, you should clarify how AI has been utilise in your project by including a statement in your final report that contains the following details: name of the tool used, how it was employed, which elements of your work were affected.
- You can use gAI in the process of writing your report, presentation or poster ONLY to improve readability and language.
- In references appearing in posters, oral presentation, report you must include DOIs and ISBNs.
- Student Guidance on the use of gAI.

Why use peer-assessment?

- It will help you to become familiar with the assessment criteria.
- You will receive feedback from 3 peers.
- You will learn through the process of assessing your peer's work and by reviewing examples of strong and weaker work.
- By observing the standard achieved by others and the different ways information can be processed and discussed, your own understanding will improve.
- It will encourage self-reflection: through assessing others and by receiving feedback, you should be able to stand back from your own work and evaluate it impartially.
- Scientific evidence strongly suggest that peer-feedback is very effective.
- You will gain practice in assessing the work of others, a skills required in many careers. You need to provide feedback that help others improve their work.

More on feedback

- Giving and receiving feedback can be uncomfortable.
- When providing feedback to others, consider the person receiving feedback: you can be direct but please be kind. The tone you use in your feedback is just as important as the feedback itself.
- Remember that you are giving or receiving feedback on a piece of work. This is not a judgement on the person who produced that work.
- Your feedback is supposed to be helpful, so avoid general statements, be specific and provide constructive suggestions.
- Plan to spend approximately 15-20 minutes assessing a single poster.

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Assessment criteria

Assessment of Poster in module PHYS3561

Name:
Title of poster:
Marker's name:

1st 2:1 2:2 3rd

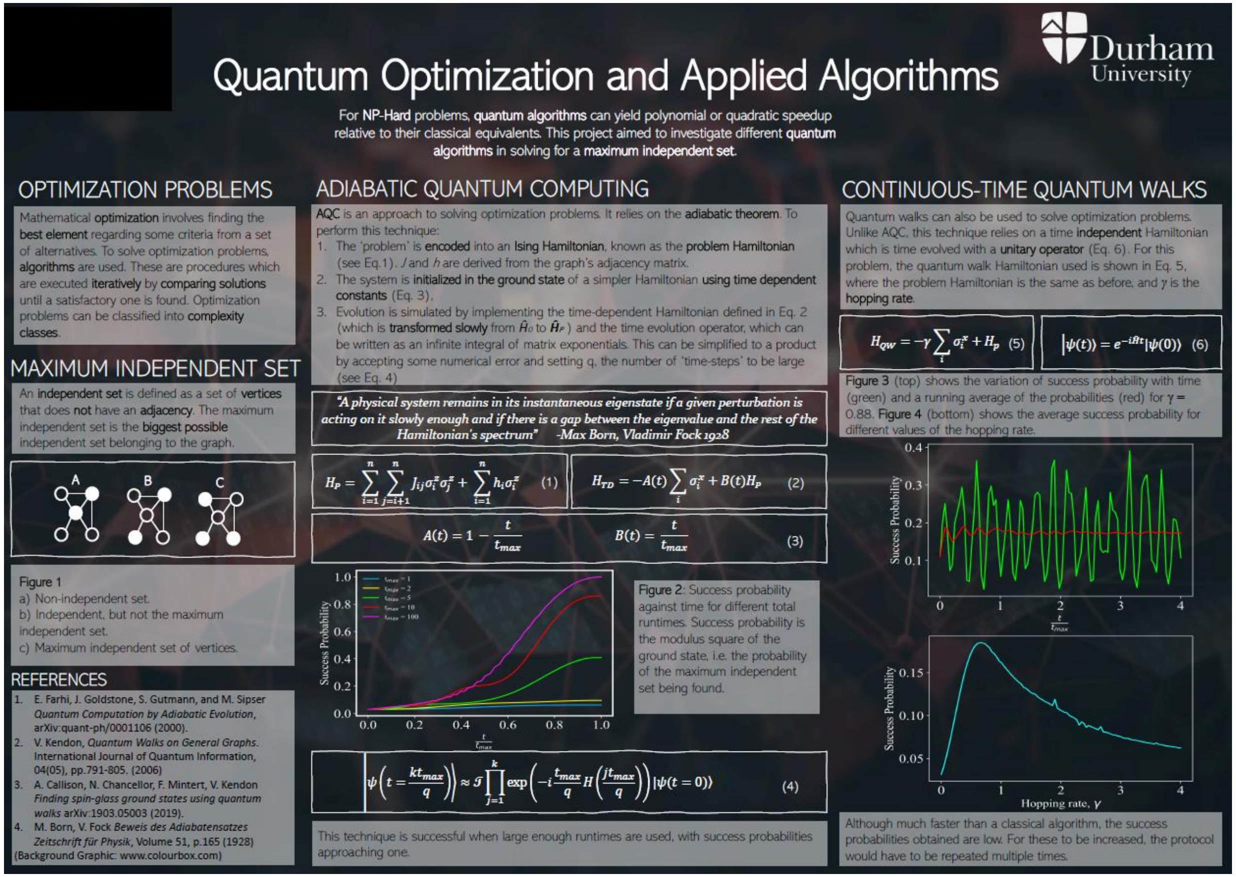
Each element is assessed on the scale: Exemplary – Excellent – Good – Sound – Acceptable – Insufficient – Unacceptable.

Poster: Physics Content
The background of the project is explained
The scientific content is well researched and presented in sufficient depth for a non-specialised physics audience
The scientific content is presented clearly without jargon and unexplained acronyms
The key findings are clearly discernible, compared with the literature and linked to the wider context by means of suitable references

Assessment criteria

Poster: Structure and Presentation
The overall structure, use of the available space and choice of colours make the poster interesting and visually attractive
The poster shows the right balance amongst the different elements (text, figures, formulas)
The material is presented in a logical flow
The text and the formulas are easily legible in terms of colours, font size, spacing and alignment
Figures and tables have the right size and resolution. They are easily readable, strongly support the poster narrative and help the understanding of the scientific content
Captions and legends are informative and used to guide the viewer

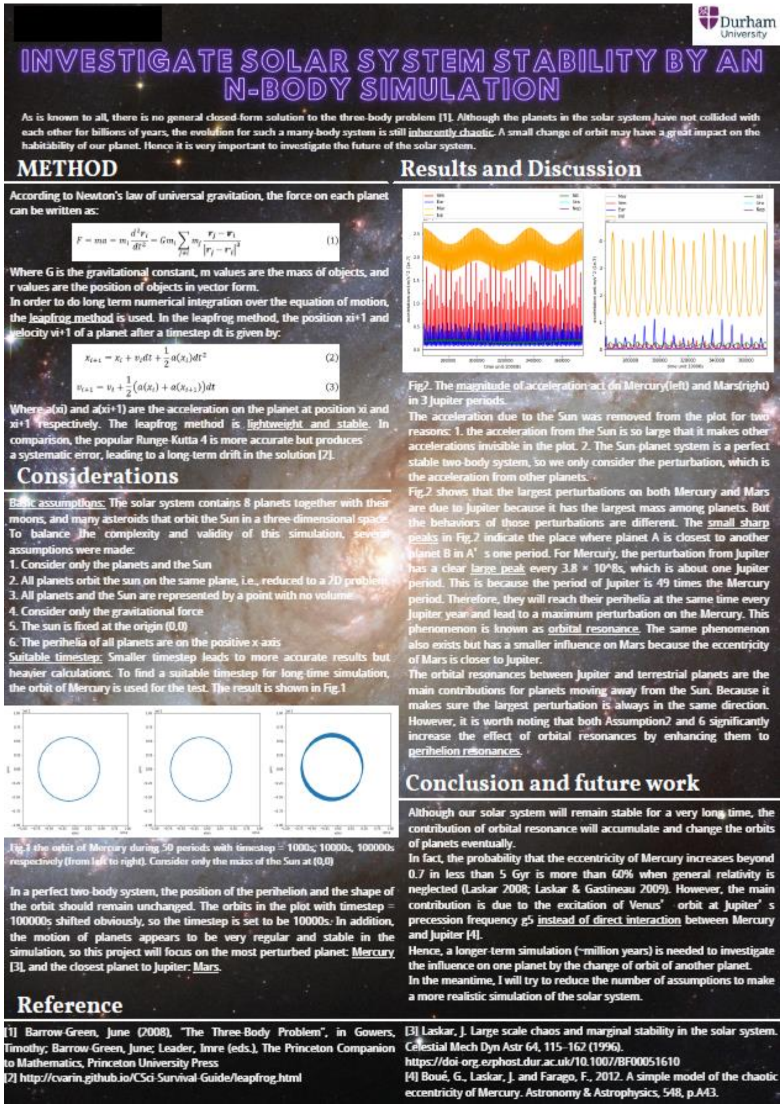
Example 1



Poster: Physics Content	
The background of the project is explained	Sound
The scientific content is well researched and presented in sufficient depth for a non-specialised physics audience	Good
The scientific content is presented clearly without jargon and unexplained acronyms	Good
The key findings are clearly discernible, compared with the literature and linked to the wider context by means of suitable references	Acceptable

Poster: Structure and Presentation	
The overall structure, use of the available space and choice of colours make the poster interesting and visually attractive	Good
The poster shows the right balance amongst the different elements (text, figures, formulas)	Exemplary
The material is presented in a logical flow	Excellent
The text and the formulas are easily legible in terms of colours, font size, spacing and alignment	Excellent
Figures and tables have the right size and resolution. They are easily readable, strongly support the poster narrative and help the understanding of the scientific content	Excellent
Captions and legends are informative and used to guide the viewer	Excellent

Example 2



[redacted]

INVESTIGATE SOLAR SYSTEM STABILITY BY AN N-BODY SIMULATION

As is known to all, there is no general closed-form solution to the three-body problem [1]. Although the planets in the solar system have not collided with each other for billions of years, the evolution for such a many-body system is still inherently chaotic. A small change of orbit may have a great impact on the habitability of our planet. Hence it is very important to investigate the future of the solar system.

METHOD

According to Newton's law of universal gravitation, the force on each planet can be written as:

$$F = ma = m_i \frac{d^2 r_i}{dt^2} = Gm_i \sum_{j \neq i} m_j \frac{r_j - r_i}{|r_j - r_i|^3} \quad (1)$$

Where G is the gravitational constant, m values are the mass of objects, and r values are the position of objects in vector form.
In order to do long term numerical integration over the equation of motion, the leapfrog method is used. In the leapfrog method, the position xi+1 and velocity vi+1 of a planet after a timestep dt is given by:

$$x_{i+1} = x_i + v_i dt + \frac{1}{2} a(x_i) dt^2 \quad (2)$$

$$v_{i+1} = v_i + \frac{1}{2}\left(a(x_i) + a(x_{i+1})\right) dt \quad (3)$$

Where a(xi) and a(xi+1) are the acceleration on the planet at position xi and xi+1 respectively. The leapfrog method is lightweight and stable. In comparison, the popular Runge-Kutta 4 is more accurate but produces a systematic error, leading to a long-term drift in the solution [2].

Considerations

Basic assumptions: The solar system contains 8 planets together with their moons, and many asteroids that orbit the Sun in a three-dimensional space. To balance the complexity and validity of this simulation, several assumptions were made:

1. Consider only the planets and the Sun
2. All planets orbit the sun on the same plane, i.e., reduced to a 2D problem
3. All planets and the Sun are represented by a point with no volume
4. Consider only the gravitational force
5. The sun is fixed at the origin (0,0)
6. The perihelia of all planets are on the positive x-axis

Suitable timestep: Smaller timestep leads to more accurate results but heavier calculations. To find a suitable timestep for long-time simulation, the orbit of Mercury is used for the test. The result is shown in Fig.1

Fig.1 the orbit of Mercury during 50 periods with timestep = 1000s; 10000s, 100000s respectively (from left to right). Consider only the mass of the Sun at (0,0)

In a perfect two-body system, the position of the perihelion and the shape of the orbit should remain unchanged. The orbits in the plot with timestep = 100000s shifted obviously, so the timestep is set to be 10000s. In addition, the motion of planets appears to be very regular and stable in the simulation, so this project will focus on the most perturbed planet: Mercury [3], and the closest planet to Jupiter: Mars.

Results and Discussion

Fig2. The magnitude of acceleration act on Mercury(left) and Mars(right) in 3 Jupiter periods.

The acceleration due to the Sun was removed from the plot for two reasons: 1. the acceleration from the Sun is so large that it makes other accelerations invisible in the plot. 2. The Sun-planet system is a perfect stable two-body system, so we only consider the perturbation, which is the acceleration from other planets.
Fig.2 shows that the largest perturbations on both Mercury and Mars are due to Jupiter because it has the largest mass among planets. But the behaviors of those perturbations are different. The small sharp peaks in Fig.2 indicate the place where planet A is closest to another planet B in A' s one period. For Mercury, the perturbation from Jupiter has a clear large peak every 3.8 × 10^8s, which is about one Jupiter period. This is because the period of Jupiter is 49 times the Mercury period. Therefore, they will reach their perihelia at the same time every Jupiter year and lead to a maximum perturbation on the Mercury. This phenomenon is known as orbital resonance. The same phenomenon also exists but has a smaller influence on Mars because the eccentricity of Mars is closer to Jupiter.
The orbital resonances between Jupiter and terrestrial planets are the main contributions for planets moving away from the Sun. Because it makes sure the largest perturbation is always in the same direction. However, it is worth noting that both Assumption2 and 6 significantly increase the effect of orbital resonances by enhancing them to perihelion resonances.

Conclusion and future work

Although our solar system will remain stable for a very long time, the contribution of orbital resonance will accumulate and change the orbits of planets eventually.
In fact, the probability that the eccentricity of Mercury increases beyond 0.7 in less than 5 Gyr is more than 60% when general relativity is neglected (Laskar 2008; Laskar & Gastineau 2009). However, the main contribution is due to the excitation of Venus' orbit at Jupiter' s precession frequency g5 instead of direct interaction between Mercury and Jupiter [4].
Hence, a longer-term simulation (~million years) is needed to investigate the influence on one planet by the change of orbit of another planet.
In the meantime, I will try to reduce the number of assumptions to make a more realistic simulation of the solar system.

Reference

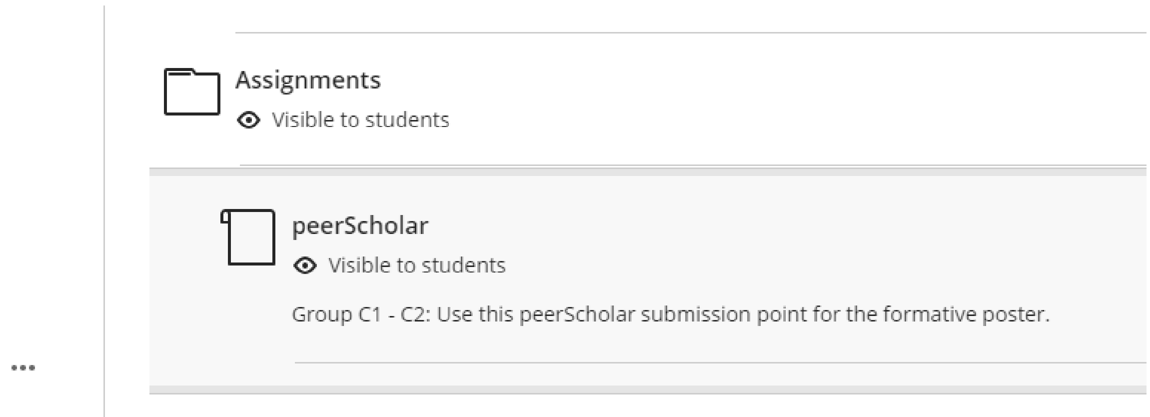
[1] Barrow-Green, June (2008), "The Three-Body Problem", in Gowers, Timothy; Barrow-Green, June; Leader, Imre (eds.), The Princeton Companion to Mathematics, Princeton University Press
[2] http://cvarin.github.io/CSci-Survival-Guide/leapfrog.html
[3] Laskar, J. Large scale chaos and marginal stability in the solar system. Celestial Mech Dyn Astr 64, 115–162 (1996). https://doi-org.ezphost.dur.ac.uk/10.1007/BF00051610
[4] Boué, G., Laskar, J. and Farago, F., 2012. A simple model of the chaotic eccentricity of Mercury. Astronomy & Astrophysics, 548, p.A43.

Poster: Physics Content	
The background of the project is explained	Excellent
The scientific content is well researched and presented in sufficient depth for a non-specialised physics audience	Excellent
The scientific content is presented clearly without jargon and unexplained acronyms	Good
The key findings are clearly discernible, compared with the literature and linked to the wider context by means of suitable references	Good

Poster: Structure and Presentation	
The overall structure, use of the available space and choice of colours make the poster interesting and visually attractive	Acceptable
The poster shows the right balance amongst the different elements (text, figures, formulas)	Good
The material is presented in a logical flow	Excellent
The text and the formulas are easily legible in terms of colours, font size, spacing and alignment	Sound
Figures and tables have the right size and resolution. They are easily readable, strongly support the poster narrative and help the understanding of the scientific content	Sound
Captions and legends are informative and used to guide the viewer	Good

peerScholar

- It enables you to provide anonymous feedback on your peers' work.
- It is easy to use.
- You can access peerScholar via Learn Ultra.



- This is a three-phase task with two deadlines. To ensure success, your engagement is required in all phases! Note that failure to submit your poster by the deadline will result in the absence of feedback on your poster.

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Phase 1: submit

peerScholar

Activities
1 Item

Group c1 - c2: formative poster
Classic Activity

Create	Assess
Due Sep 22nd 2022, 8:00am	Begins Sep 22nd 2022, 9:00am

Activity Instructions

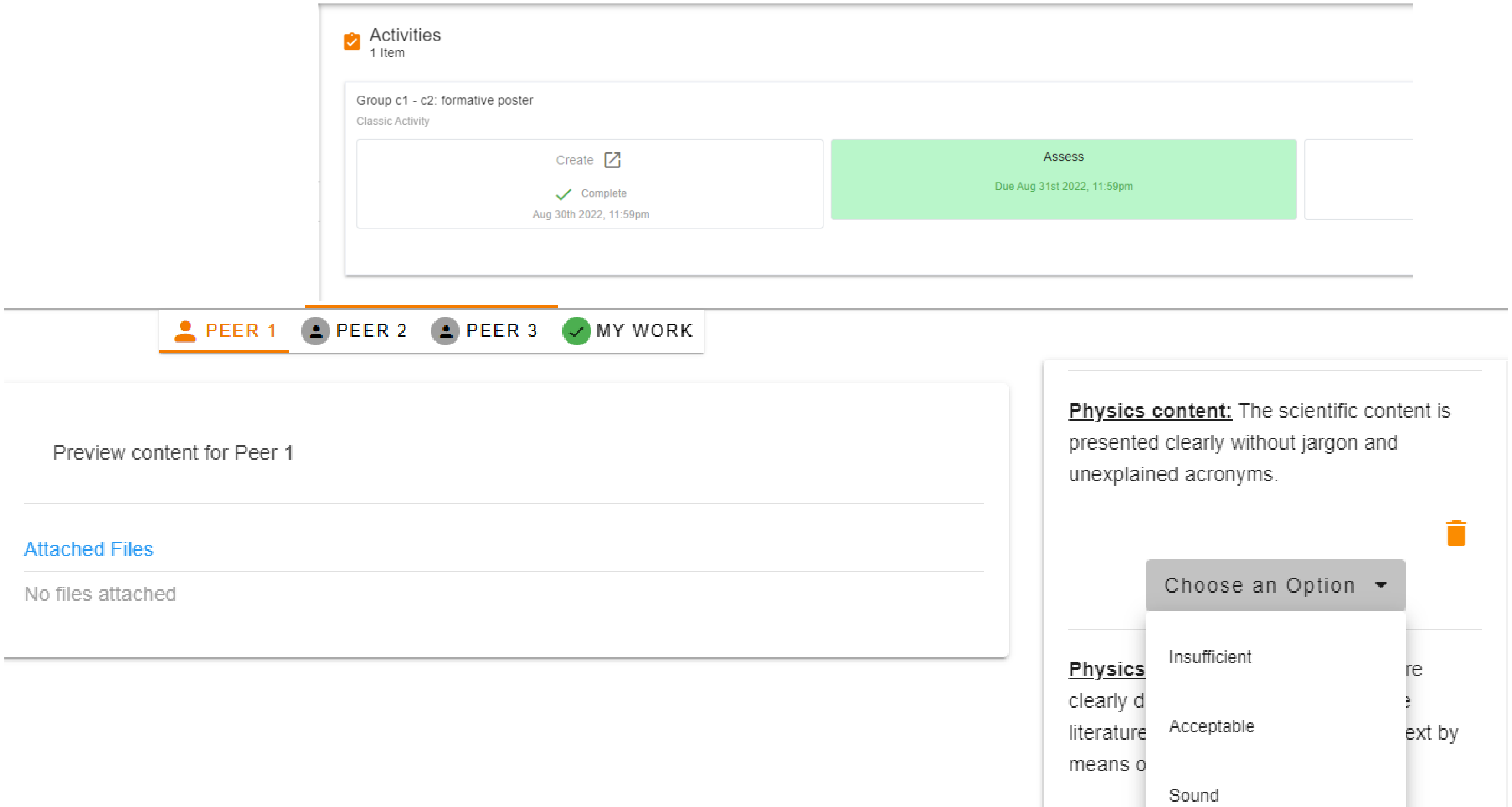
Create Instructions

Please upload your poster as a **pdf file**. Remember that your name should not be included in the poster or in the filename.

Follow instructions and remember to submit!

Submit

Phase 2: assessment

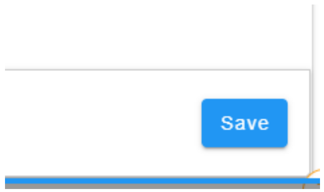


Assessment criteria as a dropdown menu.

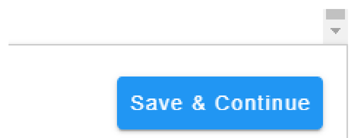
Scale: Insufficient - Acceptable – Sound – Good - Excellent - Exemplary.

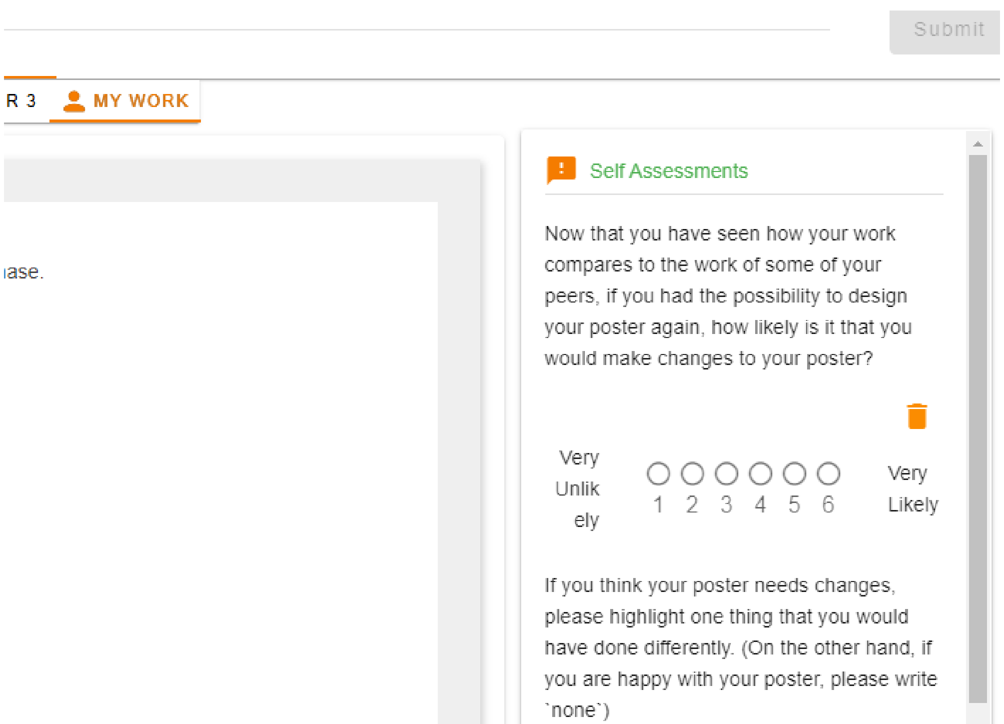
You can and should participate in the assessment phase, even if you didn’t submit your poster!

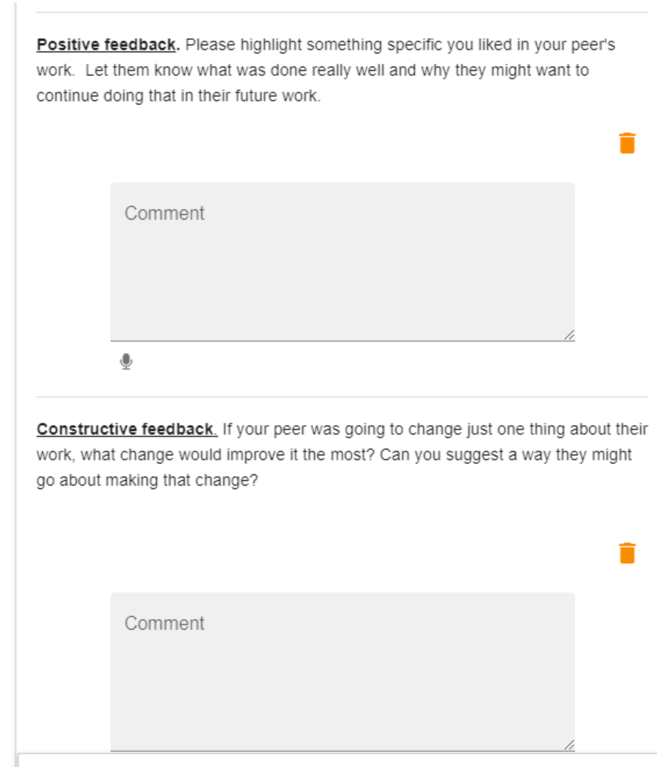
Phase 2: assessment



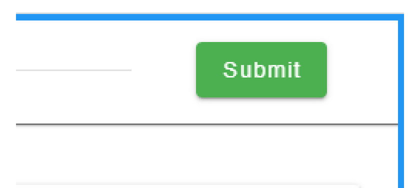
You can pose and continue later. Please save your work.



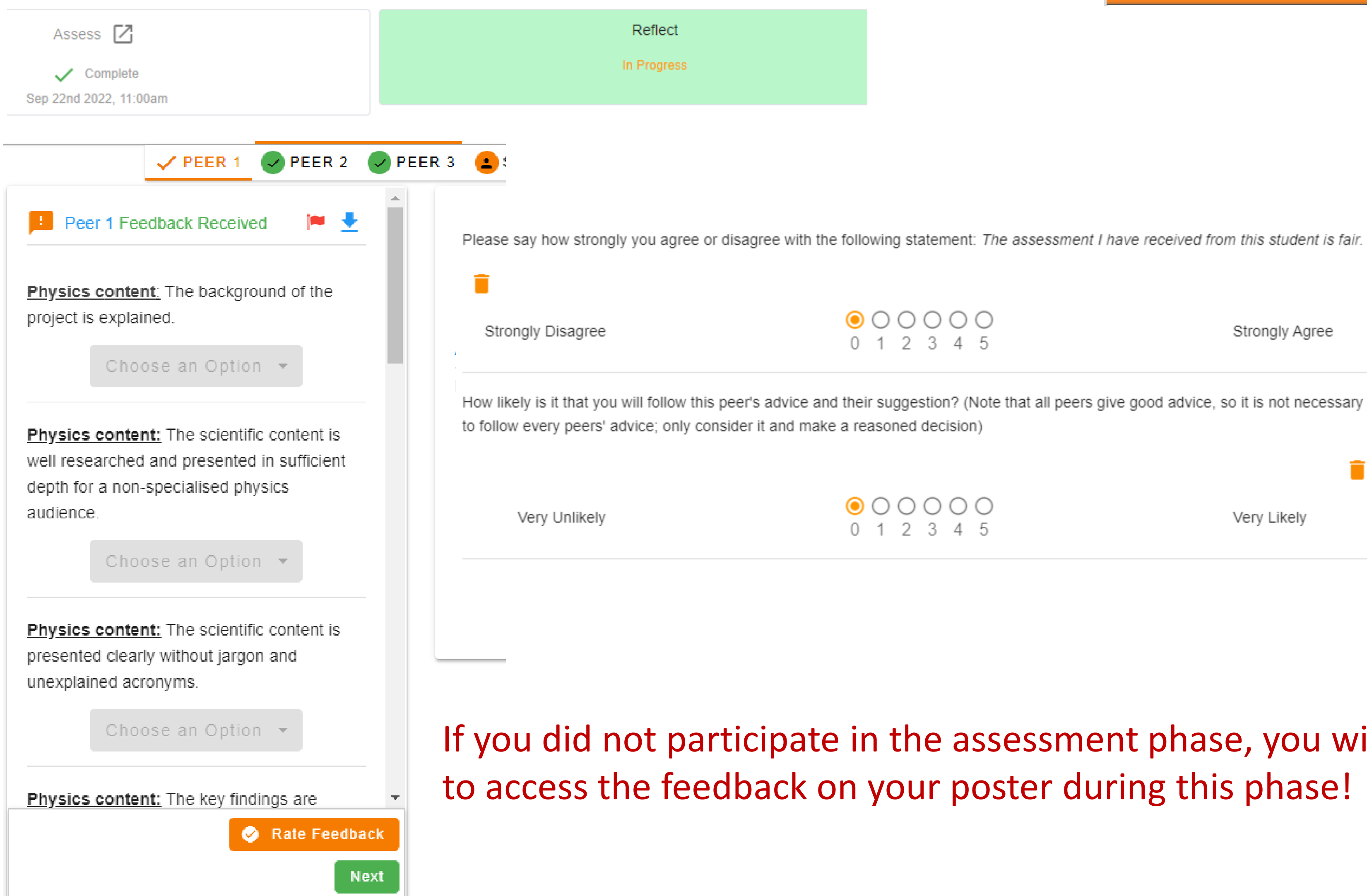




Remember to submit



Phase 3: reflect on the feedback you received



If you did not participate in the assessment phase, you will unable to access the feedback on your poster during this phase!

Designing a Program: a guide

- DO NOT rush into your programming: typing lines of code straight away is not a good approach.
- THINK:
  - How is the program going to work?
  - Sketch out the required functions.
  - How will the data be stored?
- PLAN - you may consider writing `pseudo code':
  - Begin by considering the top-level structure.
  - Fill in the details by defining functions.
    - Elaborate further with lower-level functions.
  - Stop and consider:
    - Are there better ways of doing things?
- WRITE the functions in Python:
  - Start with low-level functions.
  - Test their functionality.
  - Build up the structure using working functions.

Pseudo-Code Example

5 A proper example — projectile motion.

Let's tackle the problem of projectile motion, for example the motion of a cannon shell. We want to plot a graph of the position of the cannon shell as a function of time. If we ignore air resistance, this is a trivial problem, but we want our program to be capable of allowing for air resistance (however, we'll assume the density of air is constant).

We can solve this problem using "Euler's Method" (see "Computational Physics" by Giordiano & Nakanishi for example). In this method, we update the position at time t_i using the velocity at time t_i to get the position at time $t_{i+1} = t_i + \Delta t$.

$$\begin{aligned} x_{i+1} &= x_i + v_{x,i}\Delta t \\ y_{i+1} &= y_i + v_{y,i}\Delta t \end{aligned} \tag{1}$$

We also need to update the velocity allowing for the acceleration due to gravity and the effect of air resistance.

$$\begin{aligned} v_{x,i+1} &= v_{x,i} + \frac{F_{\text{drag}}\cos\theta}{m}\Delta t \\ v_{y,i+1} &= v_{y,i} + \frac{F_{\text{drag}}\sin\theta}{m}\Delta t - g\Delta t \end{aligned} \tag{2}$$

where the drag force is given by $F_{\text{drag}} = -A\rho_{\text{air}}v^2$ (where A is constant and ρ_{air} is the density of air). Since v_x, v_y are the x and y components of v, we have $v_x = v\cos\theta$.

```
program shell_trajectory
   get initial values                                   (function)
   create arrays x,y,vx,vy,t
   initialize variables vx[0] and vy[0]. Set x[0],y[0],t[0] = 0
   choose timestep  delta_t
   loop over time steps:                             (Python: "for i in range(max_steps)")
      compute t[i+1], x[i+1] and y[i+1]
      compute air resistance                            (function)
      compute vx[i+1], vy[i+1]
      if y < 0 exit loop
   plot graph of y vs x                                 (function)
```

```
function get_initial_values
      input none
      output initial values of ...
    #  read from file or from keyboard?
    set initial x,y velocity,
    set density of air, constant A, mass of shell.
    return values

function air_resistance
      input: vx, vy, constant A, density of air
      output: Fx, Fy   (x and y components of drag force)
   compute speed        #   v = sqrt(vx**2 + vy**2)
   compute angle        #   theta = arctan(vy/vx)
   compute x and y components of drag force
   return drag force Fx, Fy

function plot_graph
       input: x, y
       output: none
   open graph window
   plot x, y
   add axis titles/units
   return
```

```
Data structures
   A, rho_air, vx0, vy0:   initial values.  (what units?)
   delta_t, max_steps:     parameter values.
   x,y,t,vx,vy:   arrays of real numbers. Dimensions 0 .. max_steps-1
```

A few points on coding for your project

- DO NOT: write a program and then try to make it work!
- DO: Build up the program from small functions. Test each one thoroughly on its own before moving on to the next: check carefully the logic of the functions you built, make a plot using the function to test it thoroughly, print out intermediate values, check arrays have the expected dimensions, and ensure the calculation is in the correct units.

  For the milestone, it could be a good idea to ask some peers with a working program and have them to print some of the intermediate numbers.

- Take advantage of this week to revise some Python. You are going to use functions extensively in Numpy, Pylab, Scipy.

Where to find support

- Physics (tutors).
- Python (demonstrators).
- Anything else concerning the module (organiser). Please send an email including:
    - Project title and tutor’s name.
- Deadline extension requests via the Physics Student Portal.
- Student support (SSO Carolyn Hammond).
    - Based in Ph117. Email: physics.studentsupport@durham.ac.uk

What to do after attending this lecture

- Check which project you are assigned to and your group (C1, C2, C3, C4).
- Print out the project description and/or download it on your laptop.
- Read it!
- Start thinking of questions for the first tutorial.
- In the meantime, review and revise your Python skills and attend the other lectures in week 1.