Bournemouth University

School of Computing and Engineering

Submission Coursework Brief

Unit: Mathematics for Computing **(**COMP4034**)**		
Unit Contact: Emili Balaguer-Ballester	**Credits:** 20	**Level:** 4

Assessment Title: Polybius	
Assessment Number: 1 of 2	
Assessment Type: Group	**Weighting (%):** 50%
Deadline: 02/12/2025 12:00 PM	**Submission Method**: Brightspace assignment (standard submission box)

Quality Assessor (QA): Dr Hari Pandei	**Other Marker(s):** Dr Botao Fan

Can I use Generative AI tools?

Basic spelling and grammar correction tools are permitted.

Generative AI assisted idea generation and structuring

Generative AI can be used for summarising, creating structures and generating ideas for content. No generative AI content is allowed in the final submission.

Tasks:

No human or AI player has been ever able to complete the Virtual Reality game *Polybius*. You are training your AI player clone, the Generative model *Lightbringer 6.0* (*Li6*) to navigate the Polybius labyrinth.

Thankfully, you have a *Notebook of Clues* (*Notebook CL)* to find the exit of every room (**Tasks 1**, **2**, **3** and **4**). Help Lightbringer to unravel the eerie traps and escape the Polybius maze.

Task 1. *Li6* enters the labyrinth through a cavern (Room 1). A complex number indicates its position in this two-dimensional room, where the real part of the complex number is the horizontal coordinate, and the imaginary is the vertical one (*Figure 1*).

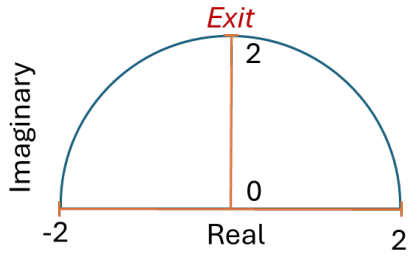

Figure 1. Room 1 coordinates (upper part).

The complex number $z_{initial}$ determines the initial position of *Li6* in the cavern:

$z_{initial} = (-2)^{\alpha} \cdot j^{(4 \cdot \alpha)} \cdot \left| \frac{\sqrt{3}+j}{(\sqrt{3}-j)^{\alpha}} \right|$, where α is your group number. Remember, $j = \sqrt{-1}$ and $|z|$ means the length of a complex number z (its distance from 0 in *Figure 1*).

To avoid obstacles, Li6 moves to the next position by multiplying its current position by the complex number:

$u = \frac{\sqrt{3}+j}{2}$.

In other words: $z_{position\ 1} = u \cdot z_{initial}$, $z_{position\ 2} = u \cdot z_{position\ 1}$, $z_{position\ 3} = u \cdot z_{position\ 2}$, … . There is no other way to move in this room. *Li6* needs to exit the room as quickly as possible before getting trapped.

The Notebook indicates the exit location in the position $z_{exit} = 2j$ (*Figure 1*).

1.1 What is the minimum number of movements to exit the room? Code and plot your solution.

1.2 Briefly explain why, using math.

Task 2. *Li6* can move freely anywhere in the next room of the maze, but this time it has two locked doors. The Notebook indicates that the left door will unlock in $y_{left\ door}$ minutes:

(a) $y_{left\ door} = \lim_{x \to -\alpha} \alpha + (x + \alpha)^{100} \cdot e^{\frac{-1}{(x+\alpha)^2}}$,

while the right door will unlock in $y_{right\ door}$ minutes:

(b) $y_{right\ door} = \lim_{x \to -\alpha} \frac{e^{(x+\alpha)}}{x+\alpha \cdot e^{(x+\alpha)}}$

Li6 must choose the door that will open first to leave room as swiftly as possible. If one of the limits ($\lim_{x \to -\alpha}$) is infinity, a complex number or it does not exist, the door will never open. Remember, α is your group number.

2.1 Which door must *Li6* choose, the left (a) or the right (b) door? Code and plot your solution.

2.2 Briefly explain why, using math.

Task 3. After escaping room 2, *Li6* enters in the middle of a tunnel in the position $x_{initial} = 0$ (*Figure 2*).

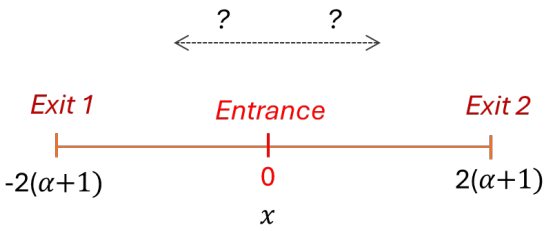

Figure 2. Tunnel coordinates. *Li6* must choose to escape via *Exit 1* or *Exit 2* (not both).

The tunnel is packed with traps, but the notebook knows their location: traps are in all locations where y is *not* a real number according to this equation:

$$x \cdot e^{(y \cdot (x+\alpha+1))} + (\alpha + 1) \cdot e^{(y \cdot (x+\alpha+1))} = x + \alpha$$

In other words, the domain of the function $y(x)$ indicates the *safe* locations. Remember, the domain of $y(x)$ consists of all real values x for which y is also a real number (neither infinity, nor a complex or an inexistent number).

Li6 must choose the route with less traps, starting from $x = 0$ and heading to either the left exit (*Exit 1*) or the right exit (*Exit 2*). See *Figure 2*.

3.1 What is safest to escape: to go left (*Exit 1*) or right (*Exit 2*)? Deduct, code and plot the domain of the function $y(x)$.

3.2 Briefly explain why, using math.

Task 4. The exit of the labyrinth is near, but the final door is controlled by two levers. Only one will open it, while the other will lock the door forever.

Fortunately, the notebook says that the left lever will open the door if the next logic clause is *True*:

(a) $((\mathrm{p} \rightarrow \mathrm{q}) \rightarrow \mathrm{p}) \rightarrow \mathrm{r}$, where:

p: $\wp(\mathrm{S}) \equiv \{\emptyset, \{\alpha\}, \{\infty\}, \{\alpha, \infty\}\}$

q: $\mathrm{S} \cap \mathrm{Q} \cap \{+\infty\} \equiv \{\emptyset\}$

r: $\neg(\neg \mathrm{p})$

The set S is:

$$\mathrm{S} = \{\binom{\alpha}{\alpha-1} \cdot j, \lim_{x \to 0} \frac{1-x}{x^5}\} \cap \{\lim_{x \to 1} \frac{1}{(x-1)} + 1, \sqrt{-\alpha}\},$$

and the set Q is:

$\mathrm{Q} = \{\alpha \cdot e^{lnj}\} \backslash T_{1.1}$, where $T_{1.1}$ is the answer to **Task 1.1**.

Otherwise, if the clause (a) is *False*, the right lever is the one that would open the final door.

Remember: α is your group number, $\binom{n}{m}$ are combinations of n elements taken in groups of size m, $j = \sqrt{-1}$ and $\wp(\mathrm{S})$ is the powerset of the set S (all the possible subsets we can form with the elements of the set S).

4.1 Would *Li6* pull the left or the right lever to exit Polybius? Explain your logic.

4.2 Briefly explain every step of your solution, using math. Use code to plot the limits.

Intended Learning Outcomes (ILOs)

1. Communicate mathematical concepts in the computer science field.

2. Formulate and apply mathematical knowledge in the computer science field.

3. Model and solve real-world computing problems using relevant and appropriate mathematical tools, computer software and programming languages.

4. Demonstrate an understanding on the importance of mathematical approaches to computer science problems.

Submission Format:

Groups

- If you prefer to choose your group members, please self-register in any group of **4 members** you like in **Communications/Groups** in the Brightspace site of Mathematics for Computing **before Friday, the 24th of October**. A group must have 4 members. Group members do not necessarily need to belong to the same lab group.
- After this date, the system will randomly assign you to a group.

Format

- The submission consists of a single PDF document per group uploaded to Brightspace in the corresponding submission box (only one per group).
- The document should contain the answers to **Tasks 1 to 4 in this exact order**. Answers consist of commented code and mathematical derivations.
- You can use Python or Matlab (your choice, this does not influence the mark -see marking criterion below). You can use different languages for distinct tasks.
- For maths, you can use the Word equations editor or LaTeX, or do them manually, but the former two are recommended for readability (it does not influence the mark).
- Remember, you can use generative AI to help you debug code and grammar, but not for generating answers.
- You must help each other. However, we **suggest you start by randomly assigning one task to each group member**. After trying tasks individually, please help each other complete the tasks**.** The entire group should understand all exercises.
- By default, we assume all members contribute equally. Submit the individual Contribution Form (see **APPENDIX**) in the dedicated submission box. Remember to **use a different name from your assignment's name to avoid overwriting it**.
- **If any difficulty arises in your group, do not hesitate to contact Emili** (eb-ballester@bournemouth.ac.uk) **at the earliest opportunity; do not wait.** Thank you very much.

How will this be assessed?

Task 1 [25 marks]

1.1 Numerical answer [10 marks]

- Result correctness [5 marks]
- Coding and figures correctness [5 marks]

1.2 Math explanation [15 marks]

- The correctness of the step-by-step deduction [10 marks]
- The compactness of the deduction [5 marks]

Task 2 [25 marks]

2.1 Numerical answer [10 marks]

- Result correctness [5 marks]
- Coding and figures correctness [5 marks]

2.2 Math explanation [15 marks]

- The correctness of the step-by-step deduction [10 marks]
- The compactness of the deduction [5 marks]

Task 3 [25 marks]

3.1 Answer [10 marks]

- Result correctness [5 marks]
- Coding and figures correctness [5 marks]

3.2 Math explanation [15 marks]

- The correctness of the step-by-step deduction [10 marks]
- The compactness of the deduction [5 marks]

Task 4 [25 marks]

4.1 Logic answer [10 marks]

- Correct logical outcome [5 marks]
- Correctness of the logical deduction [5 marks]

4.2 Sets answer [15 marks]

Expected performance for a pass:

- The assignment demonstrates a working understanding of:
    - the concept of complex numbers (**Task 1**),
    - the notion of infinity and the limit of a mathematical expression (**Task 2**),
    - the difference between an equation and a function and how to implement it (**Task 3**) and,
    - basic concepts in combinatorics, sets and logic computations (**Task 4**).
- This expected level of understanding refers to the capability of addressing computational problems with code and mathematical language. However, this does not require correct answers to Tasks 1-4.
- It also does not mean that the explanations are precise or unflawed. The expectation is that there is a fair understanding of the tasks and that reasoning is sound within the mathematical/coding context.

Expected performance for a 2:1

- The assignment demonstrates, to different degrees, the capacity to:
    - effectively operate with numbers in the complex plane (**Task 1**),
    - compute the limit of a mathematical expression (**Task 2**),
    - implement and plot a function, understanding the plot (**Task 3**),
    - identify similarities between seemingly different sets and use them in logical statements, and reason in combinatorial terms to generate a sound solution (**Task 4**).
- The expectation is to solve mathematical problems with code and mathematical language. However, this does not necessarily require that all answers to Tasks 1-4 are correct.
- Explanations are generally not redundant, short and sound, even though some steps can be flawed and lead to wrong conclusions.

Expected performance for a first-class

- The assignment demonstrates the capability to:
    - correctly operate with numbers in the complex plane using code, and explain why mathematically (**Task 1**),
    - correctly identify the limit of a mathematical expression using code and explain why in mathematical terms (**Task 2**),
    - derive the function mathematically, understand the solvers' solutions, and provide a precise explanation of its domain via the post and mathematical reasoning (**Task 3**)
    - efficiently solve a logical problem involving sets and correctly understand combinatorics in the context of numerical/logical computations (**Task 4**).
- The expectation is that numerical/logical answers to Tasks 1-4 are generally correct, even if some may not be.

- Explanations are as brief as possible , contain code and all relevant maths interacting consistently. Some steps can be mistaken, but the underlying rationale is correct.

Questions about this assessment:

The assignment **relies on laboratory and lecture exercises entirely**. Thus, their attendance is essential to secure a pass.

Drop by the **optional Computational Maths and Modelling Forum on Wednesday afternoons from approximately 13:30-15:30+** in **P203/P201** for ***informal*** support (Emili may not be there all the time).

Alternatively, at the specified times in Brightspace/Content/Tutorial times/Contact details/Unit information & organisation in P303b. There is no need to make an appointment at these times.

Please **note the extras** (**videos, lectures and support sessions**) announced on Brightspace**.**

Academic Integrity

The work you submit must be your own. Any attempt to gain an unfair advantage in your assessment by **cheating**, deception or fraud is considered an academic offence. The 'Assessment help and support' section of the unit (found under 'Assessment' in the content area) provides more guidance on avoiding academic offences, including **any guidance on what will or will not be considered an academic offence in this specific assessment**.

Help and support

The 'Assessment help and support' section of the unit (found under 'Assessment' in the content area) provides information and guidance, including specific information on support for this assessment. It provides help with our policies on deadline extensions and information on support available in the university, including academic skills support and additional learning support for students with disabilities.

Disclaimer: The information provided in this assignment brief is correct at time of publication. In the unlikely event that any changes are deemed necessary, they will be communicated clearly via e-mail and via the VLE and a new version of this coursework brief will be circulated.

Version: 6.7

Updated: 13 October 2025

Issued Date: 13/10/2025

APPENDIX. Group Assessment - Individual Contribution Form.
School of Computing & Engineering

Unit Title: MATHEMATICS FOR COMPUTING (COMP4034)
Element: Coursework 01 - Submission

This is a **mandatory form**, meaning that **ALL members MUST upload** the below form **INDIVIDUALLY** for the Unit Leader to be able to consider individual contributions when marking.
If there were significant issues with engagement or contribution from one or more group members adjustments will be made accordingly, based on the following principles:

- If there is **clear evidence** of engagement or contribution issues, the Unit Leader reserves the right to adjust any member's marks accordingly, based on the evidence **detailed in the form below**.
- If **only part of the group** submits this form:
  a. the Unit Leader reserves the right to adjust any member's marks accordingly, based on the evidence **detailed in the form below**.
  b. the Unit Leader reserves the right to award **zero marks** to any member who **does not** submit the below form.
- Any group where the forms submitted provide **insufficient information** to support Unit Leader to make a judgement, the Unit Leader reserves the right to award every group member an **equal mark**.
- Any group where the forms submitted provide **clear contradictory information**, the marks awarded will be at the discretion of the Unit Leader.

IMPORTANT: Every member of the group takes **full responsibility** to work collaboratively and professionally as a group. The Unit Leader will provide guidance on the next steps if there is a dispute between group members, Unit Leaders would not normally be expected to intervene to resolve disputes between group members.

Your Group Name or Number (According to Brightspace)				
Name and Student Number	**Contribution** (Please Circle)			**Comments** (Required when less than full contribution)
Your Name and Student Number	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	
	None	Partial	Full	

Your role within the group and actions/tasks which you completed or significantly contributed to:

Any other comments you would like to make on your group, particularly anything related to the group work:

Student Signature: _____ **Date:** ____ / ____ / _____