FACULTY OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

DEPARTMENT TECHNOLOGY AND COMMUNICATION NETWORK

SEMESTER 2 2023/2024

CSC4202-5: DESIGN AND ANALYSIS OF ALGORITHMS

LECTURER NAME:

DR. NUR ARZILAWATI BINTI MD YUNUS

GROUP PROJECT

STUDENT NAME	MATRIC NUMBER
HASRINAH BINTI KURONG	213110
ANIS NADIRA BINTI NOOR MAISAM	210423
MOONNA BINTI ZULKAFLY	212137

Link to your online portfolio

https://sites.google.com/student.upm.edu.my/portfolio-project-csc4202/home

Initial Project Plan (week 10, submission date: 31 May 2024)

<table>
<tr><td>Group Name</td><td>HaNiMoon</td></tr>
<tr><td>Members</td><td>
<table>
<tr><td>Name</td><td>Email</td><td>Phone number</td></tr>
<tr><td>HASRINAH KURONG</td><td>213110@student.upm.edu.my</td><td>013-6258438</td></tr>
<tr><td>ANIS NADIRA</td><td>210423@student.upm.edu.my</td><td>010-7140570</td></tr>
<tr><td>MOONNA ZULKAFLY</td><td>212137@student.upm.edu.my</td><td>012-9779927</td></tr>
</table>
</td></tr>
<tr><td>Problem scenario description</td><td>Geographical Setting:
The scenario is set in a region characterized by steep slopes, hilly terrain, and unstable geological formations, making it prone to landslides. The region is home to several communities, with infrastructure such as roads, homes, and agricultural lands scattered throughout the area.

Type of Disaster:
The region faces the constant threat of landslides, which can be triggered by heavy rainfall, seismic activity, or human activities such as deforestation and construction. Landslides in this area can result in the sudden movement of rock, soil, and debris down slopes, causing extensive damage to infrastructure, homes, and natural habitats.

Damage Impact:
Landslides have the potential to cause significant damage, including the loss of life, displacement of communities, and disruption of transportation networks. They can also lead to the destruction of homes, agricultural</td></tr>
</table>

	lands, and natural ecosystems, further exacerbating the impact on local communities and the environment.
Why it is important	Managing landslide risk in hilly terrains is crucial for: 1. **Protecting Lives and Infrastructure:** Hilly regions are prone to landslides that can threaten human lives and disrupt essential infrastructure such as roads and utilities. 2. **Preserving the Environment:** Effective risk management helps mitigate environmental damage caused by landslides, preserving natural habitats and biodiversity. 3. **Enhancing Community Resilience:** Implementing preventive measures like slope stabilisation and early warning systems improves community preparedness and resilience against natural disasters.
Problem specification	The problem involves reducing landslide risk in hilly terrains by assessing terrain characteristics, implementing mitigation strategies like slope stabilisation and early warning systems, and enhancing community resilience through education and emergency preparedness. These efforts aim to protect lives, infrastructure, and the environment from the impacts of landslides while promoting sustainable development practices.
Potential solutions	A potential solution to manage landslide risk in hilly terrains involves leveraging algorithms for effective risk assessment and mitigation strategies. Algorithms such as dynamic programming can be utilised to analyse terrain data and compute the minimum risk path through a grid representation of the terrain. This helps in identifying vulnerable areas prone to landslides and optimising the placement of mitigation measures like slope stabilisation or early warning systems. Additionally, graph algorithms are useful for modelling connectivity and flow of information, aiding in infrastructure planning and emergency response strategies. By integrating these algorithmic approaches, stakeholders can develop

	comprehensive solutions to reduce landslide risks, protect communities, and sustainably manage hilly terrains prone to natural hazards.
Sketch (framework, flow, interface)	framework for managing landslide risk in hilly terrains involves several key components: 1. **Risk Assessment:** Utilize algorithms and data analysis techniques to assess terrain characteristics such as slope steepness, soil stability, vegetation cover, and historical landslide data. Algorithms like machine learning models or statistical analysis can help identify high-risk areas prone to landslides. 2. **Mitigation Strategies:** Implement effective mitigation measures based on the risk assessment findings. This includes engineering solutions like slope stabilization, drainage improvement, and vegetation management. Algorithms such as dynamic programming can optimize the placement of these measures to maximize effectiveness and minimize costs. 3. **Early Warning Systems:** Develop and deploy algorithms for early warning systems that monitor key indicators such as rainfall intensity, soil moisture levels, and ground movement. These systems can provide timely alerts to communities and authorities, enabling proactive evacuation and emergency response planning. 4. **Community Engagement and Education:** Use algorithms for data-driven decision-making in community engagement and education initiatives. Algorithms can help analyze demographic data, communication patterns, and behavioral insights to tailor educational campaigns and enhance community awareness about landslide risks and safety measures. 5. **Environmental Monitoring:** Algorithms can be employed for continuous environmental monitoring post-mitigation to assess the effectiveness of implemented measures. This includes monitoring changes in terrain stability, vegetation growth, and erosion rates to ensure long-term resilience and sustainability.

Project Proposal Refinement (week 11, submission date: 7 June 2023)

<table>
<tr><td>Group Name</td><td>HaNiMoon</td></tr>
<tr><td>Members</td><td>
<table>
<tr><th>Name</th><th>Role</th></tr>
<tr><td>HASRINAH KURONG</td><td>Find the problem statement that is related with the scenario.</td></tr>
<tr><td>ANIS NADIRA</td><td>Find the expected output and potential solution by using algorithms.</td></tr>
<tr><td>MOONNA ZULKAFLY</td><td>Find problem specification and make a framework.</td></tr>
</table>
</td></tr>
<tr><td>Problem statement</td><td>The region is characterized by steep slopes and unstable geological formations, making it prone to frequent landslides. This poses a significant threat to communities, infrastructure, and natural habitats. Triggered by heavy rainfall, seismic activity, or human activities like deforestation, landslides involve sudden movements of rock, soil, and debris down slopes, causing extensive damage and endangering lives. They disrupt transportation networks, destroy homes and agricultural lands, and threaten local ecosystems, highlighting the urgent need for effective risk mitigation strategies in this vulnerable area.</td></tr>
<tr><td>Objectives</td><td>1. The objective of the scenario is to develop a comprehensive landslide risk reduction plan that minimizes the occurrence and impact of landslides, protects vulnerable populations, and ensures the sustainable development of the region. The plan should aim to enhance the resilience of the region to landslides and promote safe and sustainable development practices in hilly terrains.</td></tr>
</table>

Expected output	• Reduce the complexity of finding the minimum risk path in a grid by breaking it down into simpler subproblems and combining their solutions.
Problem scenario description	Geographical Setting: The scenario is set in a region characterized by steep slopes, hilly terrain, and unstable geological formations, making it prone to landslides. The region is home to several communities, with infrastructure such as roads, homes, and agricultural lands scattered throughout the area. Type of Disaster: The region faces the constant threat of landslides, which can be triggered by heavy rainfall, seismic activity, or human activities such as deforestation and construction. Landslides in this area can result in the sudden movement of rock, soil, and debris down slopes, causing extensive damage to infrastructure, homes, and natural habitats. Damage Impact: Landslides have the potential to cause significant damage, including the loss of life, displacement of communities, and disruption of transportation networks. They can also lead to the destruction of homes, agricultural lands, and natural ecosystems, further exacerbating the impact on local communities and the environment.
Why it is important	Managing landslide risk in hilly terrains is crucial for: 1. **Protecting Lives and Infrastructure:** Hilly regions are prone to landslides that can threaten human lives and disrupt essential infrastructure such as roads and utilities. 2. **Preserving the Environment:** Effective risk management helps mitigate environmental damage caused by landslides, preserving natural habitats and biodiversity. 3. **Enhancing Community Resilience:** Implementing preventive measures like slope stabilisation and early

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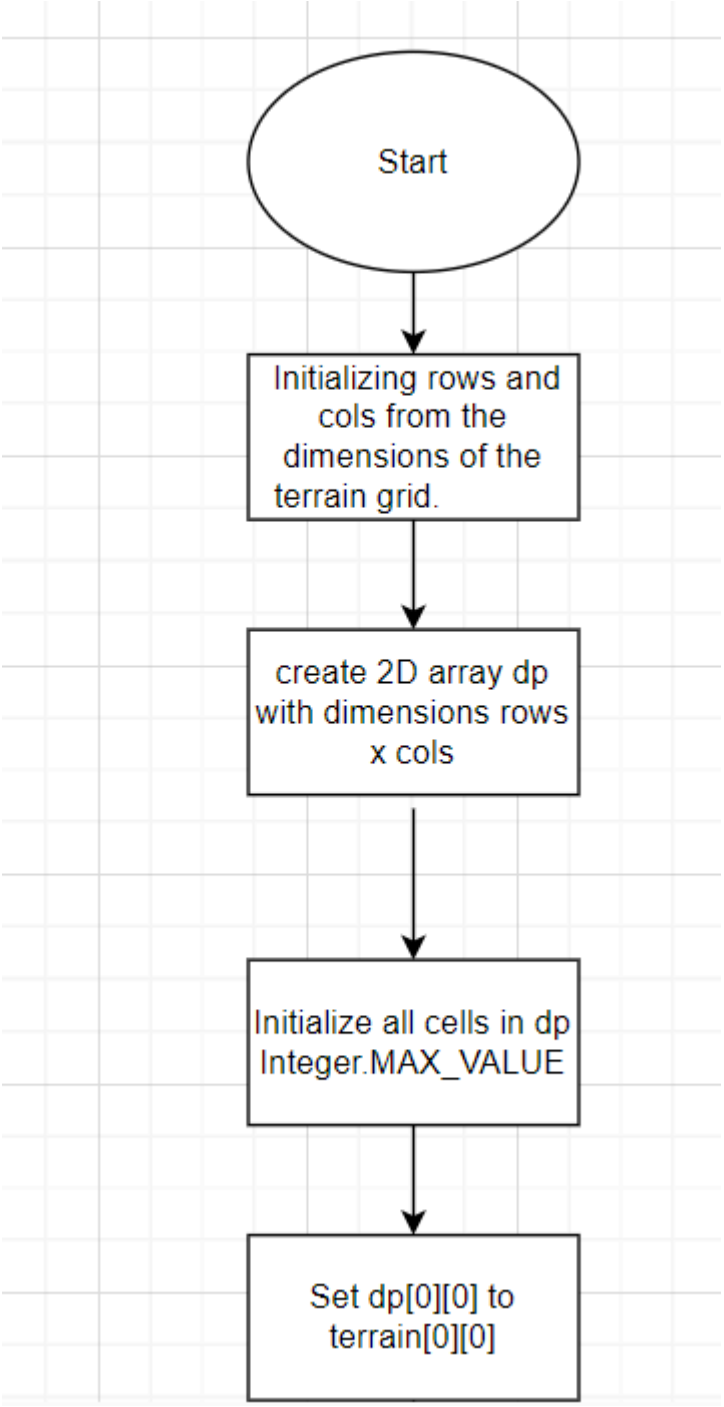
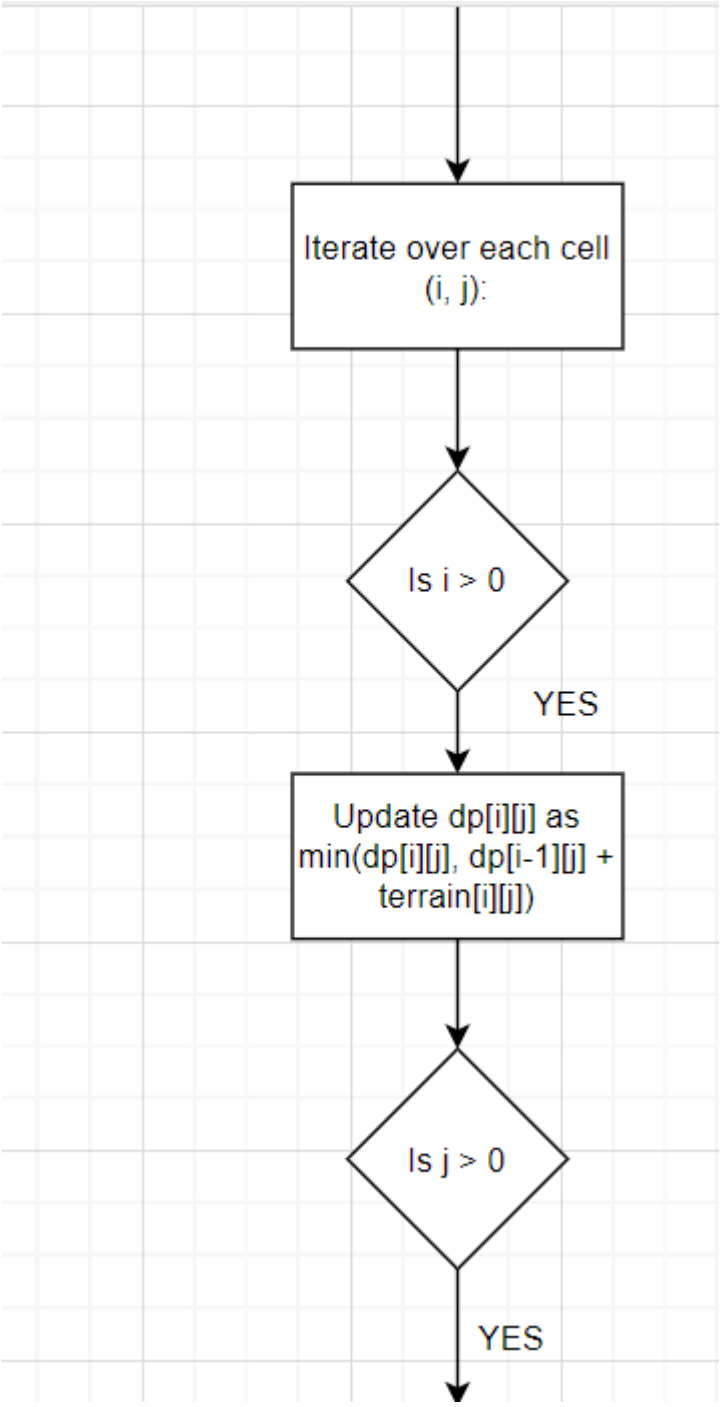
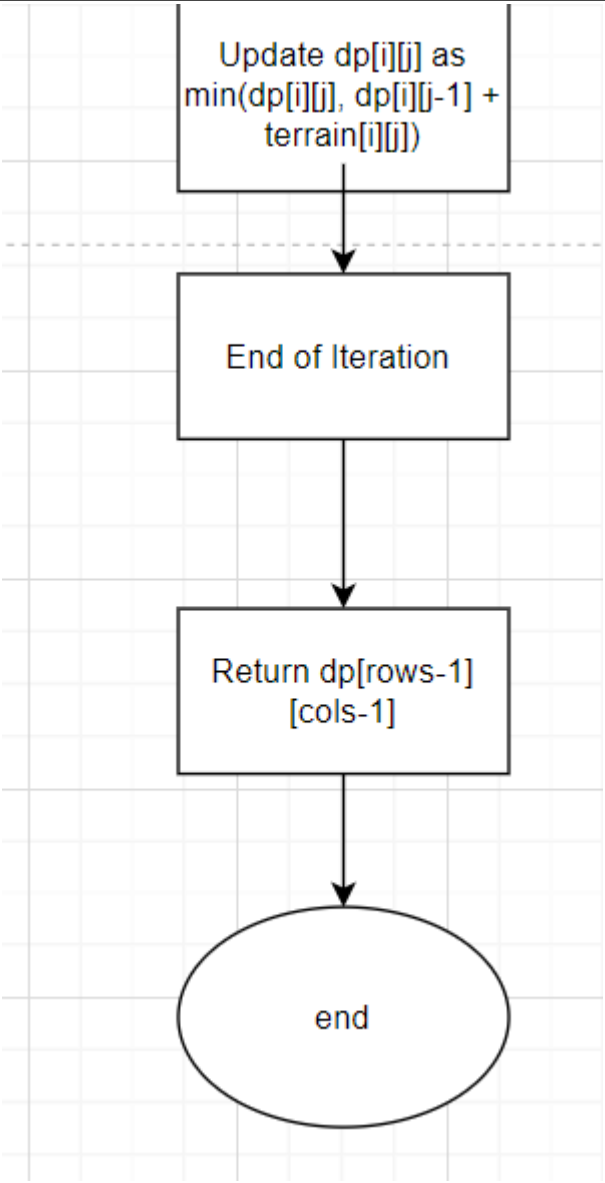
Sketch (framework, flow, interface)	


Iterate over each cell (i, j):
Is i > 0
YES
Update dp[i][j] as min(dp[i][j], dp[i-1][j] + terrain[i][j])
Is j > 0
YES



Methodology

Milestone	Time
<eg: scenario refinement>	Week10
<eg: find example solutions and suitable algorithm. Discuss in group why that solution and the example problems relate to the problem in the project>	Week 11

	<eg: edit the coding of the chosen problem and complete the coding. Debug>	Week 12
	<eg: conduct analysis of correctness and time complexity >	Week 13
	<prepare online portfolio and presentation>	Week 14

Project Progress (Week 10 – Week 14)

<table>
<tr><td>Milestone 1</td><td>Scenario refinement</td></tr>
<tr><td>Date (wk)</td><td>Week-11 (3/6/2024)</td></tr>
<tr><td>Description / sketch</td><td>● Refine the scenario for landslide risk reduction in hilly terrains.
● Ensure the scenario is relevant to algorithmic approaches.
● Define the problem clearly, identifying the types of data involved and the expected outputs.
● Determine the objectives of the project, focusing on the practical applications of the algorithms.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Hasrinah kurong</td><td>Anis Nadira</td><td>Moonna zulkafly</td></tr>
<tr><td>Research and identify real-world scenarios related to landslide risk reduction and ensure the scenario is detailed and applicable to algorithmic solutions.</td><td>Evaluate the strengths and weaknesses of each algorithm in the context of landslide risk reduction.</td><td>Outline the primary objectives, including improving safety, minimizing damage, and enhancing emergency response strategies. Besides , define the expected outputs from the scenario, such as minimum risk paths,</td></tr>
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			risk assessment reports, or evacuation routes.

Milestone 2	find example solutions and suitable algorithm. Discuss in group why that solution and the example problems relate to the problem in the project
Date (Wk)	**Week-11 (6/6/2024)**
Description / sketch	Outline the dynamic programming algorithm specification, which involves several key components that ensure efficient and optimal problem-solving. The first step is to break down a complex problem into smaller, manageable subproblems. This decomposition is crucial because it allows the algorithm to focus on solving each subproblem independently, which is essential for efficient computation. Also, define input, output and constraints.
Role	

Hasrinah kurong	Anis Nadira	Moonna zulkafly
Evaluate together the strength and weakness of each algo, and come up with own opinions. Outline the algorithm.	Evaluate together the strength and weakness of each algo, and come up with own opinions. Find example solutions.	Evaluate together the strength and weakness of each algo, and come up with own opinions. Implement the algo in Java.

Milestone 3	Edit the coding of the chosen problem and complete the coding. Debug
Date (Wk)	**Week-12 (14/6/2024)**
Description / sketch	The *LandslideRiskReduction* Java program calculates the minimum risk path through a grid representing hilly terrain. The findMinRisk function initializes a 2D dp array with maximum values, setting the top-left cell to the terrain's starting risk. It then iterates through each grid cell, updating dp values based

<table>
<tr><td></td><td>on adjacent cells above or to the left, ensuring dp reflects the minimum risk path. The function returns the minimum risk to reach the bottom-right corner, demonstrated in the main method with a sample grid.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Hasrinah kurong</td><td>Anis Nadira</td><td>Moonna zulkafly</td></tr>
<tr><td>Implement the coding related to the scenario and write and refine the Java code to solve the landslide risk problem.</td><td>Develop the pseudocode based on Hasrinah's coding and ensure the pseudocode is clear, comprehensive, and accurately reflects the logic of the Java code.</td><td>Analyse the output of the code and identify any errors and debug and test the code to ensure it works correctly and efficiently.</td></tr>
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Milestone 4	conduct analysis of correctness and time complexity
Date (Wk)	**Week-13 (17/62024)**
Description/ sketch	The algorithm correctly computes the minimum risk path by ensuring that at each step, the minimum cumulative risk is propagated through the grid. The correctness is maintained by the principle of dynamic programming, where the optimal solution to the problem is built from the optimal solutions to its subproblems. The algorithm ensures that the minimum risk path is found, which is crucial for safe evacuation during a landslide. Also, determine the best case, average case and worst case scenario time complexity as well as space complexity.

<table>
<tr><td>Role</td><td>
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<tr><td>Hasrinah kurong</td><td>Anis Nadira</td><td>Moonna zulkafly</td></tr>
<tr><td>Analyse the algo correctness based on the Java code and output shown.</td><td>Analyse the time complexity of best case, average case and worst case scenario, and come up with possibilities of each case.</td><td>Analyse space complexity and relate with the problem scenario.</td></tr>
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<tr><td>Milestone 5</td><td>prepare online portfolio and presentation</td></tr>
<tr><td>Date (Wk)</td><td>Week 14 (25/6/2024)</td></tr>
<tr><td>Description/ sketch</td><td>Utilized online tools (Google sites) to develop an online platform. Listed information in the Project docs proposed by lecturer is inserted in the online platform, such as problem illustration, algo paradigm,pseudocode, code and output as well as the algo analysis. Drafted version has been published, however, any changes may be needed.</td></tr>
<tr><td>Role</td><td>
<table>
<tr><td>Hasrinah kurong</td><td>Anis Nadira</td><td>Moonna zulkafly</td></tr>
<tr><td>Prepare the slide and do the respective parts.</td><td>Prepare the slide and fix the code , also make the analysis the output</td><td>Make an online portfolio using google sites and transfer all information from google doc to the google sites.</td></tr>
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