



**UOW  
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Bachelor of Game Development (Hons)  
**Artificial Intelligence for Games**  
**XBGT2104N**

Prepared by Mohamad Faris Zakwan  
Semester January 2024

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**SCHOOL OF  
COMPUTING  
& CREATIVE  
MEDIA**

# ASSIGNMENT 1

Course Title : Artificial Intelligence for Games  
Course Code : XBGT2104N  
Course Lecturer : Mohamad Faris Zakwan  
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## BRIEF

Create a UCS + A\* playground. Use your pathfinding tutorial + exercise02 project as the base.

Your project MUST adhere to these requirements:

- Unity project.
- Includes Windows build of the project.
- PDF Documentation.
- **Logic/programming assets from external sources are NOT ALLOWED.**
  - You cannot use projects (complete or partial) made by another entity (real or artificial) to complete this assignment. Examples:
    - Pathfinding project asset from Unity Asset Store.
    - Projects from GitHub.
  - Work from tutorial/exercise is allowed because it is yours.

**See the next few pages for other requirements.**

# PROJECT OUTPUT

## 1. Unity project with playable Windows build:

Two game state: **Map Editor State** and **Navigator Test State** (default)

- You may choose to merge the two states or make it switchable.
- **The two states MUST exist within the same scene.**

### **Map Editor State**

- Able to select different terrain types for painting.
- Able to paint grid cells with the selected terrain type.

### **Navigator Test State**

- Can change the active navigator type when navigator is standing still.
- Can change the active pathfinding algorithm.
- Can change pathfinding configuration (e.g., allow diagonal movement, switch heuristic functions)
- Can click on any cell to set that cell as the goal.

When a goal is set...

- Trigger pathfinding algorithm, and then move the navigator if path is found. The start coordinate is where the navigator is.
- If the navigator is currently moving, make it move to the new goal instead.
- **Check for coordinate or cell validity!**
- When pathfinding algorithm is executed, show the algorithm results (e.g., time taken, cells processed, path length, algorithm type)

## 2. PDF Documentation:

- Project description.
- Brief descriptions of your approaches.
- Describe challenges faced.
- Provide acknowledgements & attributions.

# REQUIREMENTS

## Map Representation

Your game map **MUST** be represented using a square grid. Minimally, your map is required to:

1. Have a size of 20x20.
2. Supports 4-way cell connection.
3. Grid cells supporting Terrain Cost.

For this assignment, you **WILL** need to provide:

1. At least 6 unique terrain types.

- Avoid similar terrain types! for example, jungle and forest are too similar!
- You may want to use enumeration for this.

2. Support for in-game map editing.

- **Zero marks for map editing using Unity Inspector/Editor.**
- All map editing functionality **MUST** be usable in Editor Play State. This is to ensure that the compiled game is also capable of doing the same.

You can add additional features, such as 8-way cell connection.

## Navigator

Navigator is a steering agent that moves by following a list of waypoints. The navigator seeks each waypoint using the first in, first out rule. For the final waypoint, the navigator will also apply arrival to slow down to a stop.

The navigator is required to support **navigator types** that affect the final cost for cell traversals. For example, traversing through Forest cells:

- **Scout**: discounted cost (-2 cost)
- **Heavy Tank**: overcharged cost (+5 cost)

The navigator types should also support impassable terrain types, For example:

- Fire Golem cannot walk on Water tile.
- Merman avoids Desert tiles at all costs.

You **MUST** implement the navigator using SimpleVehicle and the relevant steering behaviour algorithms from Steering tutorial.

## Pathfinding Algorithms

The required pathfinding algorithms for this assignment are **Dijkstra (UCS)** and **A\***, both implemented in pathfinding tutorial and extended in exercise 2.

### **Penalty applies if:**

- Missing or incomplete algorithm. **(-2.5% each)**
- Algorithm(s) produces unhandled exceptions. **(-1%)**

# DOCUMENTATION

Your documentation should be:

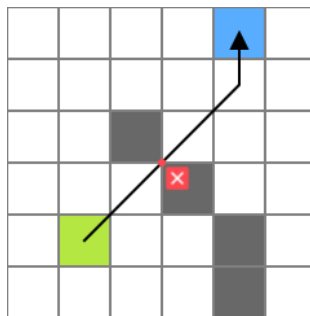
- Brief, concise, and straight to the point.
  - Provide figures if necessary.
- Neatly formatted.

Your documentation MUST:

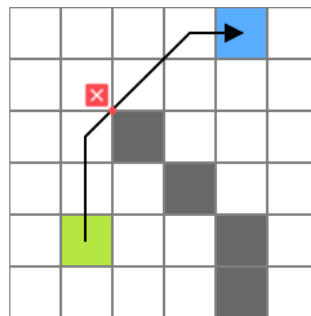
- Have a cover page (Download the cover page in OpenLearning)
- Saved as PDF format.
- Provide acknowledgements to the people that help you.
- Provide attribution (APA style) to external works that you used in your project.
  - e.g., Tutorials, art assets.

# ADDITIONAL NOTES:

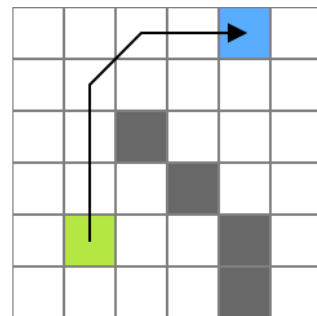
1. Supporting 8-way cell connection may look straightforward, but it is not just about adding the ordinal directions in SquareGridGraph! You will need to solve pathfinding issues like the figure below:



Diagonal Tunneling



Cross Corners



Expected Result

2. If you prefer to combine the two game states as a single state, make sure that the controls do not clash.
3. State switching may require additional work depending on your application flow:
  - If the navigator is currently moving towards goal, can the player switch to map edit state?
  - If so, when the player switches to map edit state, and then paints the cells along the path of navigator, what happens?
  - If not, what happens if the player presses the map edit state button/key?
4. You may add additional functionality to improve UX. Just briefly describe the additional features in your documentation.

# SUBMISSION REQUIREMENTS

**Zip Filename Format:** *StudentID\_XBGT2104\_A1*

e.g., 0120123\_XBGT2104\_A1.zip

Your zip file MUST contain:

1. **A /Build folder, containing playable Windows build.**
2. **A /Project folder, containing project source.**
3. Documentation (**PDF**)

**! [Unity] Only include these files! !**

For Unity project source, only these folders are required:

1. /Assets
2. /ProjectSettings
3. /Packages

Name	Date modified	Type	Size
Assets	7/2/2022 2:57 PM	File folder	
Library	4/2/2022 12:19 PM	File folder	
Logs	4/2/2022 11:22 AM	File folder	
obj	18/1/2022 4:40 PM	File folder	
Packages	18/1/2022 4:26 PM	File folder	
ProjectSettings	3/2/2022 11:22 PM	File folder	
Temp	4/2/2022 12:19 PM	File folder	
UserSettings	3/2/2022 11:22 PM	File folder	
.vsconfig	18/1/2022 4:23 PM	VSCONFIG File	1 KB
Assembly-CSharp.csproj	4/2/2022 11:21 AM	C# Project file	53 KB
GameOfLife.sln	18/1/2022 4:40 PM	Microsoft Visual S...	13 KB
PsdPlugin.csproj	18/1/2022 4:23 PM	C# Project file	57 KB
Unity.2D.Animation.Editor.csproj	18/1/2022 4:23 PM	C# Project file	77 KB

Only the highlighted folders are required. Other files will be regenerated by Unity on project launch.

**Each student is given access to a OneDrive folder for coursework submissions. Check your student email.**

- Only the student and lecturer-in-charge will be able to access the contents inside the folder.
- The same folder is used for all coursework submissions.

**Penalty applies:**

- **If you submit past the deadline: -20% of marks per day late.**
- **If you update your submission past the deadline without receiving permission from the lecturer beforehand.**



# ASSESSMENT CRITERIA

Coursework marks allocated for this assignment is **25%**:

- Map : 10%
- Navigator : 10%
- Documentation : 5%

**No submission or non-working submission is assessed as 0% of the allocated marks.**

**You will be penalized 20% of allocated marks if you do not include a playable Windows build.**

**DUE DATE: 31 MARCH 2024**

# ASSESSMENT RUBRIC

CRITERIA	MARKS					
Map (10)	5	4	3	2	1	0
Map (2)				Meets minimum requirements: <ul style="list-style-type: none"><li>• 20x20 map size.</li><li>• Cells support terrain type/cost.</li></ul> Supports 4-way AND 8-way cell connectivity.	Meets minimum requirements: <ul style="list-style-type: none"><li>• 20x20 map size.</li><li>• Cells support terrain type/cost.</li></ul> Supports 4-way cell connectivity.	One of the following: <ul style="list-style-type: none"><li>• No submission.</li><li>• Does not meet minimum requirements.</li></ul>
Terrain (2)				At least 6 unique terrain types.  A terrain type MUST have: <ul style="list-style-type: none"><li>• Cost value above 0.</li><li>• Unique art asset.</li></ul>	Less than 6 unique terrain types.  A terrain type MUST have: <ul style="list-style-type: none"><li>• Cost value above 0.</li><li>• Unique art asset.</li></ul>	
Map Painting Mechanism (2)				Change the active terrain type for painting using in-game UI with mouse button interaction.	Change the active terrain type for painting using keyboard keys.	
Runtime Map Painting (4)		Brush-style tile painting, fill-mode, and undo step.	Brush-style, and fill-mode.	Brush-style tile painting.	Simple dot-style tile painting.	
		<b>Definitions:</b> <div><b>Dot-style:</b> Mouse left button click on individual tiles to paint the tile.</div> <div><b>Single Brush-style:</b> Mouse left button press on a tile to start painting, dragging the mouse cursor while holding the button paints other tiles.</div> <div><b>Fill mode:</b> Mouse left button click on tile to change the terrain type. All neighbours and their neighbours also change the terrain type if they match.</div> <div><b>Undo Step:</b> Ctrl-Z to undo painting changes. Preferably unlimited undo.</div>				

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CRITERIA	MARKS					
Navigator (10)	5	4	3	2	1	0
Navigator Types (5)	Default navigator type plus an additional:  Six (6) unique navigator types.	Default navigator type plus an additional:  Four (4) unique navigator types.	Default navigator type plus an additional:  Three (3) unique navigator types.	Default navigator type plus an additional:  Two (2) unique navigator types.	Default navigator type plus an additional:  One (1) unique navigator type.	One of the following: <ul style="list-style-type: none"><li>No submission.</li><li>Does not meet minimum requirements.</li></ul>
	Unique: Non-duplicate terrain favour. Unique art asset.					
Navigator Cost Overrides (2)				<ul style="list-style-type: none"><li>Supports terrain cost discount and cost overcharge.</li><li>Supports terrain denial (e.g. Human cannot walk on lava)</li></ul>	<ul style="list-style-type: none"><li>Supports tile cost discount and cost overcharge.</li></ul>	
Pathfinding & Steering (2)				Supports UCS and A* pathfinding (changeable by player)  Steering IS DRIVEN using SimpleVehicle.	Supports UCS and A* pathfinding (changeable by player)  Steering IS NOT DRIVEN using SimpleVehicle.	
Quality (1)					Navigator works as expected without any issues. <ul style="list-style-type: none"><li>Navigator follows path properly.</li><li>Navigator stops at goal properly.</li><li>No errors.</li></ul>	
Document (5)	5	4	3	2	1	
Content (3)			Brief and concise documentation of work done. Acknowledgement and attributions follow latest APA-style.	Elaborate documentation of work done. Acknowledgement and attributions not following APA-style correctly.	Any of the following: <ul style="list-style-type: none"><li>Poor or confusing documentation of work done.</li><li>No acknowledgement or attributions provided.</li></ul>	
Formatting (2)				Consistent formatting.	Inconsistent formatting.	

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PENALTIES		Documentation	Navigator	Project Files	Submission	Late
Infractions		<p>Not using the provided cover page (-1)</p> <p>Documentation generated using text generators, such as LLM solutions (-2)</p>	<p>Missing pathfinding algorithm (-2.5 each, -5 max)</p> <p>Pathfinding algorithms produce error (-1)</p>	<p>Includes non-essential folders or files in the submission. (-3)</p> <p><b>Note:</b> Non-essential files WILL BE REGENERATED by Unity Editor.</p>	<p>Windows Build not provided (-10)</p> <p>Project Source not included (-25)</p>	<p>-20% assessed marks per day late.</p> <p>How days are counted:  <math>x = \text{hours late}</math>  <math>\text{Days} = \text{ceil}(x / 24)</math></p> <p>e.g.            5 minutes late:  <math>x = 5/60 = 0.0833</math>  <math>\text{Days} = \text{ceil}(0.0833/24)</math>  <math>= \text{ceil}(0.003472)</math>  <math>= 1 \text{ day}</math></p> <p>27 hours late:  <math>x = 27</math>  <math>\text{Days} = \text{ceil}(27/24)</math>  <math>= \text{ceil}(1.125)</math>  <math>= 2 \text{ days}</math></p>