**300/303COM Detailed Project Proposal**

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## Section one: Defining your research Project

**1.1 Detailed research question**

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| Does reducing the amount of errors in a tile based procedural generation video game, caused by the overlapping of the tile geometry equate to a better generated world for the player to enjoy? |

**1.2 Keywords**

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| Procedural Level Generation; Games; Graphics; Geometry; Clipping; Culling; |

**1.3 Project title**

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| Reducing overlapping errors when dealing with a tile based procedurally generated 3D video game |

**1.4 Client, Audience and Motivation:**

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| Currently Tile based generation has both positives and negatives. In terms of positives in sandbox games like Minecraft the world generated is random dependent on a given world seed that helps to generate the terrain features and Third person games like Warframe where the level played is random every time but is made of various tiles put together in a meaningful way.  However these have their drawbacks in that the worlds generated can have problems such as continuity errors where the terrain does not make viable sense or where world tiles overlap cause terrain to clip through itself making unwanted geometry and possible world holes for the player to fall through breaking their immersion in the world presented to them.  The project is aimed at trying to find a way in which to reduce the amount of errors that are caused by tile based procedural generation in games when said tiles overlap horizontally and if possible vertically. This project will help both level designers and players. Designers will be helped by identifying a way of reducing the amount of errors that are caused from overlapping tiles and the player by helping to create a more immersive environment for them. |

**1.5 Primary Research Plan**

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| 1) Look Into Research papers and Games that use tiles as a form of level design and identify what techniques they are using and how they are applied.  *Looking at various resources will help to identify what I can do in terms of level design and identify the limit as to what can be created with tile based procedural generation*  2) Create two environments by which one is generated using tiles and the other by hand.  *Making the environments will take the most time as it will require the construction of a tiling system for the game within a pre-built engine in this case I will use Unity*  3) Analyze the load time variation of the worlds and attempt to optimize where necessary as to help with the user experience.  *Improving this will help to refine what can be done as to help with loading a randomly generated world*  4) Identify any errors that occur during said testing in relation to the generated environment and attempt to reduce this.  *The purpose of the project. Reducing the errors beforehand is the goal however if there are still errors present it will help to identify where the problem lies be it the size of the tiles or detail.*  5) Analyzing data gathered from experiments where people view the different environments and how they react to each one.  *Having A group of people go through the world to experience it will be beneficial as it will help to identify errors that I would not have picked up through my own testing. It will also be a chance to see which “world” they find more “interesting/immersive”.*  6) Analyze data and summarize findings. |

This is the end of section one.

## Section Two: abstract and Literature review

**2.1 Abstract**

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| In Modern Games such as Minecraft, Dungeons of the endless and other Tile based games, Procedural generation is used to the effect of creating vast sprawling dungeons and large open expanses as well as being used to create challenging 2D platform games. However, in the 3D space, one thing that tile based generation does not as well is what to do when tiles seemingly overlap when they are generated due to how they have been put together.  The aim of this project is to try and minimize to errors that can occur from this happening and build a solution to the errors that allows for the world being generated to make sense/ feel believable. This is done through an algorithm to check to see if the tiles are overlapping and then try to remedy the situation by either using a different tile in place of the one currently in use or to alter the geometry of the tiles that are overlapping in a way that makes sense during runtime. I hope that through this I will find a method by which will help to reduce these errors and improve the user experience. |

**2.2 Initial/Mini Literature Review (500 words – 750 words)**

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| In *Procedural Level Generation Using Occupancy-Regulated Extension* (ORE) *(Mawhorther and Mateas, 2010),* the authors describe a method which uses a library of “chunks”, a section of data, to then build the world as the player moves around it whenever they reach “anchors”, a position in the world. This algorithm has a lot of strengths however the main downside here is that while this works it requires the use of a library of tiles for the game which can be memory intensive and it also requires maintenance. Another aspect is that does not provide much variety in the level design due to the constraints of the anchors being predictions where the player will be.  *“Another weakness of ORE is that by prioritizing variety, it fails to guarantee playability. Given only the constraints that arise from the anchor points, it's possible to build an unplayable level, because interactions between chunks placed can violate global playability” (Mawhorther and Mateas, 2010).*  This inherently only really lands the system working for 2D game design compared to 3D design where the player can be in multiple places on multiple axis. However This can be applied to the project that I am undertaking by using the idea of predicting where the player is to build the world around them at the same time storing what has been built efficiently so that it can be recalled to be displayed again when the player moves back there.  *Procedural Feature Generation For Volumetric Terrains (Dey et al, 2017)* details a way to generate natural phenomenon such as caves, overhangs and arches in 3D space over using height maps to create “static”/not varied terrain. It does this by applying a “delta value” to construct the phenomenon from a set of volumetric data (Terrain Data).  *“Generates a set of local delta values that can be applied directly to the volumetric data” (Dey et al, 2017)*  The downside to this method is that the generation of such instances is on procedural in a defined area. This can be applied to my project as it will help to add variation to the world that is going to be generated as well as helping to add character to both of the worlds  In *Deterministic Procedural Generation of Mesh Detail Through Gradient Tiling (Bangay, 2017)* procedural generation is applied to a gradient or sloped terrain to simulate flooding and generate virtual environments for the user to experience. It Does this by taking a plane and then tiling a “world” onto that plane. This paper is the most similar to what I would like to accomplish as it generates a world by using tiles and then attempting to smooth this out.  *“Some artefacts do still manifest as “tenting" near isolated boundary points as shown in Figure 11. These anomalies tend to be small compared to the variation provided by the tile.”(Bangay, 2017)*  However as displayed in the paper it details the fact that while this functions there will still be artifacts where vertices are stretched out from the terrain in places. It also is constrained to an existing plane that is user made for the world to be built on top of.  To compare these papers is difficult as they attack different sectors of procedural generation however they do not exactly go into the problem that has been presented. For example while the second paper details how to modify terrain procedurally it does not describe how this could be applied to a larger terrain and how to counteract errors that can come from this whereas in the third paper it again focuses on a small predefined area and then generates the terrain through tilling. The issue here being it can cause unwanted artifacts that while do not affect the world as a whole it could potentially break a players immersion. |

**2.3 Bibliography (key texts for your literature review)**

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| [1]Mawhorther, P. and Mateas, M. (2010) *Procedural Level Generation Using Occupancy-Regulated Extension* [online] Copenhagen: IEEE. available from <http://ieeexplore.ieee.org/abstract/document/5593333/> [1 February 2018]  [2]Dey, R., Doig, J. and Gatzids, C. (2017) *Procedural Feature Generation For Volumetric Terrains* [online] New York: ACM. available from <https://dl.acm.org/citation.cfm?id=3102216> [27 January 2018]  [3]Bangay, S. (2017) *Deterministic Procedural Generation Of Mesh Detail Through Gradient Tiling* [online] New York: ACM. available from <https://dl.acm.org/citation.cfm?id=3014828> [30 January 2018]  Used for references:  [4]Van der Linden, R. and Bibarra, R. (2014) *Procedural Generation Of Dungeons* [online] IEEE. available from <http://ieeexplore.ieee.org/document/6661386/> [9 February 2018] |

This is the end of SECTION TWO

Detailed Project Proposal Grading Form

**The grade sheets for marking the 300COM / 303COM Detailed project proposal are attached on the next page.**

**Grading Notes:**

The proposal is marked out of 20 divided into 10 marks for the quality***, achievability and level of challenge demonstrated by the student's research question and proposed primary method* of solution generation** and 10 marks for the ***thoroughness of the proposa***l.

Modal grading: In awarding marks please consider the following modal template:

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|  | **Research question and primary research method in relation to learning outcomes** | **Thoroughness of the proposal.** |
| **>70%** | A well-considered project proposal that fully satisfies the Learning outcomes for which there is a succinct and focused aim with an associated project  A question or hypothesis that is well above norm for final-year undergraduate project level (approaching Masters level for >80%);  The project involves improving or developing a complex programme, tool, application or the enhancement of a theory or methodology or their application in a new context.  The project demonstrates a high degree of innovation and creativity | All fields completed demonstrating a clear blueprint for the research process and includes the necessary information with respect to the research question.  Research methods are well-considered with clear reasoning for choice of those methods over others;  A clear justification of the need for the project in relation to client or audience.  Projects proposals involving 'business case' reports clearly identify the organisation involved and consider how the case will be evaluated.  A sound grasp of the means of evidence by which the conduct and management of the project may be judged. |
| **Threshold (40%)** | A proposal that identifies an activity with some consideration of a broader context.  A research question which lacks enough substance, context and scope to allow for depth of analysis, but which is marginally acceptable against a threshold for final year undergraduate projects;  A primary method(s) which only just relates to the production of an appropriate solution to the research question. | Completion of sections is cursory or minimal with some cohesiveness and contextualisation.  Sections demonstrate some understanding of the research process involved which loosely links with idea outlined (key question, method, audience);  Research methods are discussed but demonstrate little consideration as to whether they are the most appropriate and lack refinement and further detail.  Identification of some methods of evidence for conduct and management of the project but unclear thinking about planning for reflection or accounting for conduct. |