Intelligent Procedural Level Generation

# Research Project:

Procedural generation can and is used in many aspects of asset creation for electronic software such as creating textures, sound, and even entire worlds. However, procedural generation systems are limited by the algorithms used to generate them. By using algorithms and an initial seed generated randomly or by a user, vast amount of unique content be generated on a per user basis. Even really large numbers of assets, with Hello Games’s *No Man’s Sky* generating a maximum of 264 planets procedurally as a result of 264 seeds, only a smaller subset of those differences will be meaningful or noticeable to players. Essentially, these systems always create new content to impress users by means of scale but rather than adapting to the users themselves. Pseudo-AI system such as the Director in the *Left 4 Dead* series can react to variables player conditions and status to change levels and content within them dynamically, but those reactions are simply conditional algorithms.

The goal is to create an artificially intelligent system that learns from the players and in real time procedurally generates levels of scaling difficulty for the player to interact with. In the tutorial level or level 0, the player will be taught how to play the game while the AI learns about the player simultaneously and uses that as well as the ruleset to create the levels of subsequent difficulty.

**This project explores procedural generation directed by a learning artificial intelligence rather than pre-defined user algorithms.**

# Personnel:

Principal investigator: Oluwaseun Ogedengbe

Research Advisor: Professor John Reppy

Possible Testers: TBD

# Research Method:

Primary game made using a light 2D engine.

* The game consists of a single player 2D platformer where the player is constantly moving in a single direction, similar to other running game, and must maintain their speed by avoiding or correctly vaulting off of presented obstacles.
* Win condition: Since the levels are procedurally generated, they have no definite end. Instead, the player must maintain speed above an increasing speed limit until that speed limit reaches a cap. The game becomes more difficult at increasing speed but the AI only directly makes the level more challenge in response to skill level and charter progression in the game.
* Loss condition: Player movement speed decreases under a threshold for a certain amount of time.

AI

* Gauges player skill level and adjusts to player skill level dynamically.
* Scales difficulty to player accordingly
* Uses player information to procedurally generate a level and its paths in real-time.Pri

Rating

* Player statistics such as completion, incompletion, # of obstacles avoided, etc will be used to create a heuristic on every level played.
* Players will also be given a survey to fill out.

Addendum:

Changed from 2D game to 3D map/terrain with a ruleset to make it a game

AI: Genetic Algorithm that learns to generate intelligent guesses

Uses nearest neighbor and markov models to grow set

Heuristic: Simply the goal set that would attempt to be replicated.

# Similar projects

http://www.northeastern.edu/games/grace/

http://en.wikipedia.org/wiki/Procedural\_generation

http://www.gamasutra.com/view/feature/3098/a\_realtime\_procedural\_universe\_.php

http://tinysubversions.com/spelunkyGen/

http://en.wikipedia.org/wiki/Darwinia\_(video\_game)

http://en.wikipedia.org/wiki/Synth\_(video\_game)

http://www.ign.com/articles/2014/08/15/gamescom-2014-the-sun-will-burn-out-before-you-see-all-of-no-mans-sky?watch

https://github.com/gamesbyangelina

http://www.gamesbyangelina.org/brought-to-you-by/

http://hermitgames.com/leavehome.php