**Select Project Overview.**

The selective project will be undertaken by Philip Crispin and Aaron Fletcher. It will be implemented with the MCEEdit platform.

The projects inspiration is taken from the GDMC competition, which aims to iteratively generate a Minecraft village. Our implementation of this will use genetic algorithm to determine the best location and

**Definitions**

**Search Space:** The area which the bounding box has selected. It has a width, and height.

**GridLocation:** an x,y coordinate within the search space.

**tile:** Information regarding the highest surface cube in the search space. It contains an X, Y and Z axis, along with information regarding the block type. *Note that Z axis and Y axis are switched to “conventual” thinking.*

**TileMap:** A list of lists containing information about each tile. It contains information in the following format TileMap[y][x], with y referring to the y axis, and x referring to the x axis.

**graph:** An object which contains information derived from the TileMap, allowing graph search functions such as A star, BFS etc to occur, Manhattan distance etc. This object will be passed to other functions, and acts as the search space state. Each tile represents a vertex, and each tile traversable ‘N’ ‘E’ ‘S’ ‘W’ within the search space represents an edge

**building location:** A building location is the x, y coordinate where a building has been built.

**proposed building location:** A proposed building location for a building that has not yet been built. It can have a fitness score associated with it.

**wall:** A vertex in which no building can occur. A wall is typically water surfaces, trees or building locations.

**saturated:** The search space cannot support another proposed building location.

**paint:** Replacing blocks on the real world

**Overview.**

1. A bounding area is selected by the filter function in MCEdit, returning a **TileMap**.
2. The **TileMap** produces a **graph** object.
3. **Proposed building locations** will then be determined from the **search space** using GA until the area is **saturated.** All proposed building locations will be appended to a dictionary in the following format [order] = GridLocation

**Genome**

The genomes genetic code are X and Y coordinates. When initialised randomly these X and Y coordinates could be any vertex which is not a wall.

Each genome has a Total Fitness value which is initialised to zero.

Fitness for each genome will be determined by:

* Closeness to water, as calculated by **Manhattan Distance.**
* Closeness to other building locations, as calculated by **Manhattan Distance.**
* Flatness of the land, as calculated by determining the absolute value of traversing Z index within the building location divided by the total number of tiles used.

For all these fitness metrics, closer to zero is better. Each fitness metric scaled to unit variance will contribute to the Total Fitness value as per

Total Fitness Value = Closeness to water + closeness to other buildings + Flatness of the land

An Ideal Total Fitness value is Zero.

**Crossover**

* Crossover is only allowed to occur if the generated offspring would exist within the search space only.

**Process:**

* Firstly, crossover possibly is determined by calculating the Cartesian products of the parent genes.
* i.e.

|  |  |
| --- | --- |
| **Parent Genome** | **Potential Offspring Permutations** |
| Grid Location (X1, Y1) | Grid Location (X1, Y2) |
| Grid Location (X2, Y2) | Grid Location (X1, Y1) |
|  | Grid Location (X2, Y1) |
|  | Grid Location (X2, Y2) |

* Finally, a check to see if all these potential offspring can exist within the map occurs.
* If crossover can occur, a random number generator determines if crossover should occur.
* Finally, a random number generator determines if X or Y should be switched in the offspring.

**Mutation**

* Mutations cannot occur outside the search space.
* Mutations can only occur in in a ‘N’, ‘E’, ‘S’ ‘W’ direction
* Mutations cannot occur where it would put a proposed building on a walled vertex.

**Process:**