GARTS: Game Design Document

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Contents

[Preface 2](#_Toc468830633)

[Version Breakdown 2](#_Toc468830634)

[Game Concept 2](#_Toc468830635)

[Key features 2](#_Toc468830636)

[Gameplay 2](#_Toc468830637)

[Opponents 3](#_Toc468830638)

[Rules-based AI 3](#_Toc468830639)

[Learning AI 3](#_Toc468830640)

[Map 3](#_Toc468830641)

[Buildings 3](#_Toc468830642)

[Town Centre 3](#_Toc468830643)

[Barracks 3](#_Toc468830644)

[Stables 3](#_Toc468830645)

[Archery Range 4](#_Toc468830646)

[Farm 4](#_Toc468830647)

[House 4](#_Toc468830648)

[Units 4](#_Toc468830649)

[Farmer 4](#_Toc468830650)

[Archer 5](#_Toc468830651)

[Knight 5](#_Toc468830652)

[Spearman 5](#_Toc468830653)

[Combat 5](#_Toc468830654)

[Countering 5](#_Toc468830655)

[Resources 5](#_Toc468830656)

[Food 5](#_Toc468830657)

[Wood 6](#_Toc468830658)

[Stone 6](#_Toc468830659)

[Gold 6](#_Toc468830660)

[Graphics 6](#_Toc468830661)

[Input 6](#_Toc468830662)

[Audio 7](#_Toc468830663)

[Document Changelog 7](#_Toc468830664)

# Preface

Genetic Algorithm Real-Time Strategy (GARTS) is an application designed to test whether or not emergent, dynamic artificial intelligences can be more engaging than traditional rules-based AIs in real-time strategy games, resulting in enhancing a game’s replayability.

GARTS comes packaged with, and is built with, the lightweight development framework ‘Appollo’, which was designed specifically for this project. The ‘Appollo’ framework is open-source, and may be used by anyone for developing applications. Currently the framework exists only to support the development of GARTS, and uses SDL2.0 as a backend, programmed in C++.

The following document details the high-level concepts required in designing GARTS, and will be updated regularly with changes in the project’s design as they are encountered. This document is intended to be kept up to date and to show project progression as problems are encountered and solutions found. Critical changes will be highlighted to aid in comparison with previous versions of this document. The details laid out in this document are all subject to change as the project progresses and is tweaked.

## Version Breakdown

On the front of this document, a version number is presented (format: #a.#b.#c).

* #a: The release version number. Reflects the current public release. Will be incremented on each major public release of the project.
* #b: Major version number. Reflects the current state of the project in terms of major updates. Will be incremented when a major feature has been implemented.
* #c: Minor version number. Reflects current state of the project in terms of minor updates. Will be incremented when tweaks or bug-fixes are committed to the project.

# Game Concept

GARTS is a real-time strategy game, pitting multiple players against each other. One player will be controlled by a human, the others controlled by one of two AI types. The gameplay is modelled on Ensemble Studio’s ‘Age of Empires’, with the game’s complexity kept at a minimum so as not to interfere (i.e annoy, frustrate or confuse) with the participant’s experience.

Each player will manage a small economy which they will use to produce military units and the structures that build them. Each unit will have a specific unit that it ‘hard counters’, and will deal additional damage to that unit. Each unit will have a health pool where damage will accumulate until the unit is destroyed.

The game will end when either player loses all of their military units and construction buildings.

## Key features

* Classic RTS gameplay, based on ‘Age of Empires’.
* Rock-paper-scissors gameplay for an easy to learn game.
* Two different types of AI to play against. Emergent and rules-based.
* Short, fast-paced 15 minute rounds.

# Gameplay

The following section will dictate gameplay and unit design, as well as costs for building each unit. Combat and resource management is also discussed.

## Opponents

The game will have multiple players to battle against. Each opponent will either be controlled by a static, rules-based AI, or will be controlled by an emergent, learning AI which uses a genetic algorithm to dictate its decisions.

### Rules-based AI

The rules-based AI opponent will follow a set strategy dictated by milestones. It will check to see if a particular milestone is reached and act accordingly. This AI is designed to train the player and allow them some time to learn how to play the game before facing against learning AIs.

### Learning AI

The learning AI will use a genetic algorithm to process its actions. Depending on how well each AI performs, it will be assigned a fitness value and merged with other AIs, resulting in a (hopefully) more powerful, more efficient AI. The challenge comes in trying to outsmart the AI before it outsmarts you.

## Map

The map will be symmetrical on both the x and y axis to allow players a fair experience regardless of where they spawn. The map will be a grassy plain with very little features other than resources. Again, the focus is on the AI, not the graphics of the game. Each cardinal direction will have a spawn point for a player to place their town centre at the beginning of the game.

## Buildings

Each building placed will unlock a new type of unit or generate additional resources. Each building takes a short construction period before it can be used. Each building may hold a build queue of 10 units, and will automatically build units that remain in the queue. Buildings that are capable of spawning units may also have a rally point associated with them where newly spawned units will gather.

### Town Centre

Centre ‘capital’ building. The only building present for each player at the beginning of the game.

#### Details

Spawns: Farmer, Barracks, Stables, Archery Range, Farm, House.

Cost: N/A.

### Barracks

Military building. Allows player to spawn Spearmen.

#### Details

Spawns: Spearmen.

Cost: 100 wood.

Build time: 15 seconds.

### Stables

Military building. Allows player to spawn Knights.

#### Details

Spawns: Knights.

Cost: 200 stone, 100 wood.

Build Time: 15 seconds.

### Archery Range

Military building. Allows player to spawn Archers.

#### Details

Spawns: Archers.

Cost: 100 wood.

Build time: 15 seconds.

### Farm

Economy building. Generates the Food resource.

#### Details

Generates: 10 food per second.

Cost: 100 wood, 100 gold.

Build time: 15 seconds.

### House

Economy building. Increases the population cap.

#### Details

Increases population cap by 10.

Cost: 200 wood, 200 stone.

Build time: 15 seconds.

## Units

GARTS main area of gameplay is how units interact with each other. Farmers are economic units, however are capable of attacking if necessary, while military units are incapable of performing core Farmer functions and instead function as purely military, dealing damage to enemy units and buildings. When a unit is destroyed, the player will no longer be able to interact with it, and it will be despawned.

### Farmer

Builds buildings and collects resources. Farmers can be assigned to resources to collect them. Once the Farmer is full, they will have to carry their payload back to the Town Centre, where it will be added to the player’s resource pool.

#### Details

Builds: Barracks, Stables, Archery Range, Farm and House.

Additional farmers constructing the same building will increase its build speed.

Cost: 50 food.

Damage: 5 per second.

HP: 20.

Payload: 50 of any item.

### Archer

Ranged attack unit.

#### Details

Cost: 50 food, 100 wood.

Damage: 20 per second, 30 to Spearmen (Hard-Counter).

HP: 40.

Range: 30.

### Knight

Mounted Heavy Cavalry. Fast movement speed.

#### Details

Cost: 100 food, 100 wood, 100 gold.

Damage: 20 per second, 30 to Archers (Hard-Counter).

HP: 80.

### Spearman

Basic infantryman.

#### Details

Cost: 50 food, 100 stone.

Damage: 20 per second, 30 to Knight (Hard-Counter).

HP: 60.

## Combat

Combat is how the majority of units will interact. Each unit is capable of targeting and attacking hostile units. A player may direct a unit to attack enemy units. Units will react to incoming damage and retaliate without player direction. Once the targeted unit is destroyed, the unit will search for other units in a local vicinity and move to engage them.

### Countering

To help balance the game, each unit has a ‘hard-counter’. This means that each unit is guaranteed to be more effective against its ‘hard-counter’. Units will deal additional damage per second (DPS) to its ‘hard-counter’ unit, destroying it quicker than other units.

## Resources

The player requires resources to purchase buildings and units, and the control of resources can be critical to a player’s success. Each resource present in the map has a maximum resource cap, after which the resource will become depleted for the rest of the game.

### Food

Required to spawn units only. Can be harvested or generated using a Farm.

#### Details

Berry bushes: Placed in level.

500 food per instance.

### Wood

Required for all buildings and most units, wood can be collected by assigning farmers to trees throughout the map. A tree will hold a set number of resources before depleting.

#### Details

Trees: Placed in level.

100 wood per instance.

### Stone

Required for most buildings and some units. Harvest only.

#### Details

Rocks: Placed in level.

200 stone per instance.

### Gold

Required for constructing Knights. Harvest only.

#### Details:

Rocks: Placed in level.

100 gold per instance.

# Graphics

Each game object will be represented by an appropriately sized and designed sprite. The sprites will offer a visual representation that must be indicative of a building/units/resource’s function. Each sprite will have a background colour of the player it belongs to for easy recognition.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Archer | Spearman | Knight | Farmer | Wood | Gold | Stone | Archery Range | Stables |
| Man with bow and quiver | Main with tall spear | Horse with man on top | Man with pitchfork | Tree, deciduous | Stone with gold streak | Large Boulder | L-shaped building with archery targets | Rectangular building with horse stables/hoof marks |

|  |  |  |  |
| --- | --- | --- | --- |
| Town Centre | Farm | Barracks | House |
| Large L shaped building with central tower | Windmill with small crops | H shaped building with swords and shields on walls | Small square building with thatch roof. |

# Input

The game will be controlled primarily through mouse-movement. This is a minimum requirement, and if time allows hotkeys will be introduced (since they are the staple control method of RTS games). The mouse will be used to select individual units, or can be dragged to ‘box’ select a group of units. The game’s menus will function through mouse clicks. When the user mouses over a gameobject, the gameobject’s name will be displayed near the cursor.

# Audio

Audio is not necessary for the project since it will not impact gameplay, however it would be desired for a complete game. Audio to be used in the game will be .wav or .mp3, with wav being used for sound effects and mp3 used for music.

# Document Changelog

(05/12/2016): Initial document draft completed.