

# [COMP 4501]

## Final Project Report

### March of the Mandibles

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**Theme:** Ant colony sim

**Setting:** Garden/wilderness

**Goals:** Destroy the enemy palace

In March of the Mandibles, you take control of an ant colony, competing with other colonies for land, resources, and ultimate victory. The player must control their ant units to collect various resources throughout the garden to feed their queen and grow their colony. On top of this, players must defend their palace while also preparing to kill the enemy Ant Queen (destroy the enemy palace). The death of an Ant Queen will cause the affected colony to “lose” the game. The last colony standing is the victor.

### How to Play

#### [Controls]

**WASD/Arrow keys** - Pan the camera

**B** - Enter/exit building mode

**Left Mouse Button (LMB)** - Select units

**Right Mouse Button (RMB)** - Command selected units

**Left Shift** - Combines with LMB to select additional units OR combines with RMB to make a selected unit start *patrolling*

**In building mode:**

**LMB** - Build at mouse location

**RMB** - Exit building mode

#### [Actions]

**Unit selection** - To select a unit, place the cursor over their model and use LMB. Selected units will have a coloured ring below their model. To **select multiple** units, hold LMB and drag the mouse over an area containing the units. Additionally, holding left-shift while performing either of these actions will allow you to add more units to the selected group while maintaining your previously chosen units.

**Movement** - With at least one ant unit selected, using RMB anywhere on the map will command the selected units to move to that location. The cursor icon will briefly change if the command was successful. If the cursor does not update, no movement command is issued.

**Harvesting** - Similarly to movement, if at least one ant unit is selected, using RMB on any resource will command the selected units to start harvesting that resource. The units will travel to the resource, harvest, and then automatically travel to the Palace to drop off their collected items. Once the resource is depleted (the model despawns), the units will drop off the last resources and become idle until another action is issued.

**Changing Actions** - To cancel or change a unit's current action, select them and simply issue the desired action. For example, if a unit is harvesting a resource and I want them to attack, I would select the unit and use RMB to select the enemy I want them to attack. My unit will stop what they're doing and will immediately begin the next action.

**Attacking** - With at least one ant unit selected, using RMB on an enemy unit (ants or buildings) will command the selected units to attack. The selected units will move into attack range and begin attacking the enemy until the target is dead. If the target flees, your units will pursue them to continue the attack.

**Patrolling** - With at least one ant unit selected, holding left-shift and clicking RMB will command the selected units to 'patrol' to the clicked location. They will move toward the location, attacking any enemy units they encounter on the way.

**Building** - To build a new building, enter building mode by pressing **B**. A building will appear by your cursor, indicating you are in building mode. Press LMB at a location to construct a new building. A building can only be made if 1) the building is in a valid location and 2) the colony has sufficient resources to construct the chosen building.

### **[Basic Strategy/Starting Off]**

You play as the **blue** colony, and your goal is to eliminate the **red** colony by destroying their palace. Both colonies start off with two buildings and three ants, placed in opposite corners of the map. Your **Palace** is your most crucial building; protect it at all costs. Your other building is a **house** which provides more capacity for your colony. The maximum number of ants in a colony depends on the number of homes you possess. Spawning ants and building houses both cost some **resources**, namely **food**, **protein**, and **foliage**. These resources spawn periodically on the map. The main pipeline to victory is to collect enough resources to build enough houses to amass a large army of ants. With enough ants, you can lay siege to the enemy Palace and claim victory. The challenge is collecting resources faster than your enemy, which may require you to pick fights and kill their ants while they are harvesting/exploring. They may do the same to you, so keep an eye on units doing automated tasks.

### **Game Objects & Design Choices**

The player (human) and the enemy (AI) have access to the same units, buildings, and resources. They function identically, and neither side has an explicit advantage. Colonies are distinguishable by their "team color", with the player being blue and the enemy being red. A

colony's units/buildings are only controllable by their associated actor (i.e. the AI or human controlling the colony).

### **Mobile Unit**

**[Worker]** - The main “grunt” of the colony; this unit is responsible for gathering resources and transporting them to the palace. When needed, workers may also engage in combat. Workers have poor combat stats but are strong in numbers.

### **Buildings (aka Stationary Units)**

**[Palace]** - Each colony starts with this building. It is supposed to house the **Ant Queen**. As the Queen is not an actual unit, the Palace building represents the Queen's status. If the palace is destroyed, it is implied that the Queen has died. If new ants spawn near the palace, it implies that the Queen was responsible. In short, the palace is the only building that spawns new units, and thus, it must be protected at all costs.

**[House]** - Each colony starts with one house. The number of houses in a colony dictates the total number of mobile units they may possess (i.e. the maximum number of ants). Currently, every house increases total ant capacity by 10 units. Houses require no upkeep, but they may be damaged. Destruction of a house will decrease the total unit capacity, but will not despawn any units. Colonies which exceed their capacity will not be able to build new units until they build more houses.

### **Resources**

Throughout the game, many resources will be spawned on the map. These resources may be harvested by **worker** units and brought back to the **Palace** to be added to the colony's stockpile. Each resource type is collected in the same fashion.

**[Food]** - These are the berries that appear throughout the map. They provide a certain quantity of the “food” resource when harvested. Food is the limiting factor in creating any unit.

**[Protein]** - Protein functions similarly to food but is a less abundant resource. It is used along with foliage to construct new buildings.

**[Foliage]** - These are harvestable plants that appear on the map. Foliage will be used to create **buildings** and are not involved in the creation of ants.

## **Implementing Unit Actions**

### **Spawning Ants:**

Spawning ants is an automatic action of the palace. Given sufficient resources, currently set to 50 food, a new worker ant will automatically spawn from the palace every 15 seconds. How it works is the colony keeps track of the palace and the spawn timer, and it calls its palace's spawning capability every time the timer is up. This capability is the Spawning node with the attached script Spawning.gd, which is a child node to the Palace scene object. It is this Spawning capability that creates an instance of the worker ant. So if the timer is up and there is enough capacity for another ant, the **Spawning node** will try to consume resources for a new ant, and if there are enough resources, a new ant will spawn.

### **Selecting Units:**

Selecting units is controlled in Camera3D.gd. Player can select either a single unit or a group of units with left-click, either with one click, or with a selection box by dragging the mouse while holding left-click. Selected units will be put in a group, and the selection beneath them will be visible to show which units are selected. One of the selected units will also be displayed in the HUD. Player can also left-click units while holding shift to add more units to the selected group. Left clicking again on an empty part of the terrain while not holding shift will deselect all units.

### **Move:**

After selecting units, right-clicking anywhere will have the mobile units move to that location, either just to move there or to perform an action depending on where it was clicked. Only ants can move, as they have a **Movement node** with Movement.gd attached.

Player right-clicks empty terrain on the map:

- The Movement Node on the ant will set the position of that click as the destination, and the ant will automatically move there since it has Godot's NavAgent as a child node of the ant

### **Carrying/Harvesting:**

Harvestables is a class that includes 3 types: food, protein, and foliage. These three types have their own scene, and are respawned on the map in world.gd when one is depleted. Only worker ants can carry/harvest resources. Their **Carrying node** with Carrying.gd attached is responsible for harvesting resources.

Player right-clicks on a harvestable after selecting ants:

- Carrying capability sets that resource as a target, and uses the ant's Movement capability to move closer to that resource
- When within a certain range, it'll collect 10 of that resource, before automatically moving back to base (palace) to place it into the player's inventory
  - When reaching the palace, carrying capability has the ant's inventory emptied and added to the corresponding colony's inventory
- The ant will continue moving back and forth between the base and the resource to harvest it until the resource is completely depleted

### Attack:

Only the mobile (worker) units can attack, and they can attack both enemy buildings (Houses and Palace) and worker ants. Worker ants have an **Attack node** with Attack.gd attached to it, controlling its attacking. Ants will move to attack after they have initially been selected.

Player right-clicks an enemy unit on the map after selecting own ants:

- Camera3D.gd will call every selected unit's **Attack node** to set the enemy unit as an attack target
- Attack.gd will use Movement to head towards the enemy unit if not near it, and attack it when it gets within a certain distance. Units will deal damage every 3 seconds if in range
  - Workers have an attack stat of 10, so they deal 10 damage every 3 seconds
  - Console will print an attacking statement with each attack
  - The unit has a function that will decrease its HP
- Ant will keep attacking unless it is selected to do something else
- When the targeted unit's HP reaches 0, the unit will call their colony's function to remove either the ants or the buildings from the colony's total number of existing ants/buildings
  - If the enemy's palace is destroyed, a win is printed in the console

### Building:

Currently, the only building the player can build is a House, which requires 20 protein and 100 foliage in-game to build. Houses are built by entering build mode which is entered by pressing the 'B' button on the keyboard. When entering build mode, it activates a boolean that prevents other units on the screen from being selected until build mode is exited. It is controlled by the Building node attached to PlayerColony, which has a Building.gd script attached to it. All the following functionality is contained in Building.gd.

Player presses 'B':

- When in build mode, an Area3D model of the original House (house\_area.tscn) is used to determine positioning and collision with other objects before it can be placed.
- Using raycasting, the position where the mouse collides with the world space is used to determine where the user wants to place their house. The Area3D model moves with the mouse so the player can see where it would drop
- The building will visually be either red or green to tell the player if they can build:
  - It'll be red when a building cannot be placed on the map, either due to colliding areas, the location being too far from the palace, or having insufficient resources
  - It'll be green if a house can be built there, as it's in an empty area, within a certain range of the palace, and there's enough resources

Player left-clicks to try and place building:

- If the model collides with objects other than the terrain or is too far from the palace, a house cannot be built there. Additionally, if the player doesn't have enough resources, a house cannot be built either
  - The console prints statements if this occurs
- Otherwise, if the terrain is empty and the player has sufficient resources, an instance of the actual house (house.tscn) is created in the place where the player clicked.
  - It adds to the number of houses the colony owns, and more ants can be spawned as well. In this case, with each new house, 10 additional ants can be spawned.

- Build mode is automatically exited when a building is placed

Player presses 'B' again or right-clicks while in build mode:

- Build mode is exited, no buildings are placed

### **AI Behaviors:**

The enemy colony is managed by AI\_Manager.gd. The AI Manager has a few different behaviors:

- The `_physics_process()` function tracks timers and calls functions that handle each specific behavior.
- It keeps track of which three harvestables of each type are nearest its palace. Every so often it re-checks the locations of harvestables and updates the list accordingly.
- Once per second, it checks for any idle workers. Any idle workers found are given commands to harvest nearby resources from nearby harvestables.
- When the colony has enough ants, it will attempt to launch an attack on the player's base. It loops over all its ants, with a 50% chance for each to determine if they should be sent to attack. Ants that are sent to attack are given a patrol command to patrol toward the player's base.

Individual ants also have some AI behaviors built into some of their actions, making them a bit autonomous. The player also gets access to those behaviors.

- Ants told to harvest will automatically drop off resources after picking them up, and then return to collect more after dropping off.
- Ants told to patrol will check for nearby targets as they move, and attack if an enemy gets close enough. If their target dies they will continue onward to their original patrol spot.