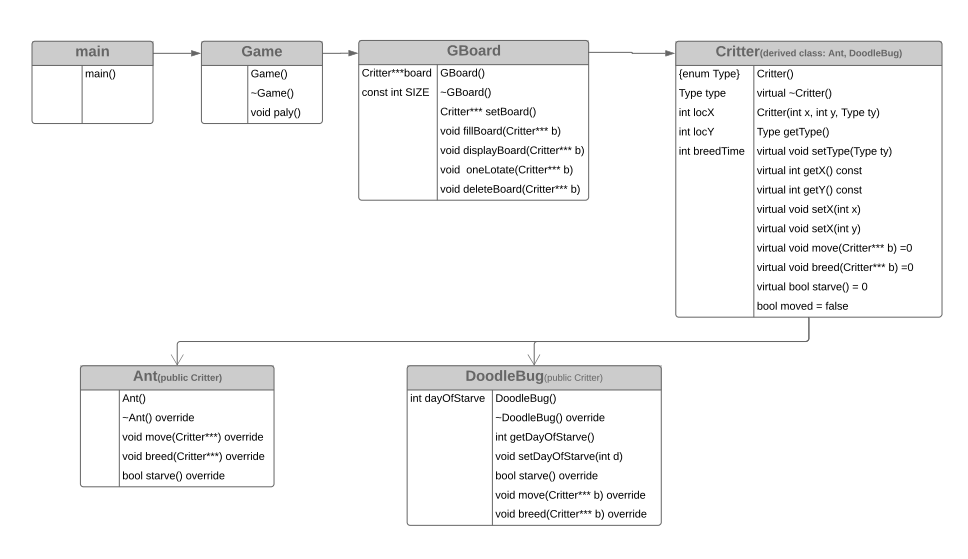
**Design, Reflection, Test Plan for Group Project**

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**DESIGN**

Below is the diagram of our group program.



Main Requirements:

* The board should be 2D array, and the cell of board points to a critter. That means we need to use “\*\*\*” Ant the board size is 20\*20.
* The doodle bugs should first move. Then ant move. After moving, they can breed.
* Critter class should be parent class, and ant and doodlebug classes are derived classes.
* Finding a cell for move and breed should be randomly.
* Doodle bugs are starved to death if they have not eaten for more than three days.
* Ants can breed when they have 3 turns (days), and doodle bugs can breed when 8 days.
* If there are no cells near the critters, they could not move or breed and wait for next turn.

For Critter:

* To detect each critter, the Critter class, parent class has getters and setters of coordinate of row and columns of the board. And also, it has another getter and setter for Type, enum.
* Other functions are all pure abstract so are not implemented in the Critter class.

<The bool moved() function is added later>

For Ant:

* It has two big parts: move and breed. As for the starve(), it does not have that one but still is needed to write on the header function.
* Ants needs to check if the cell is empty or not before moving. Also, it should be randomly. However, if we first pick a random number and that cell is occupied by another critter, it has to pick another random number again and again. So, our design should check the empty cell first then choose randomly one of those empty cells.
* The board cell and row between 0 and 19. So, we should be cautious not to cross the border.
* As for breed, the first work of this is also check if the cells near the ants is empty or not.

For Doodle Bug:

* Other parts are the same, but it must eat ant so the first thing that doodle bugs do is finding a cell that ants stay.
* Also, it has actual starve() function, and it check if the doodle bugs have not eaten ants for 3 days or more and delete the doodle bug.

<This starve() function first was void, but changed to bool later>

For Game Board class:

* We need to create board with 2d array of pointers using \*\*\* because each cell of this board are critters.
* Then, we need to fill this board with ants and doodle bugs using random number generator.
* Also, we need to create a function that prints the board with critters using ASCII characters.
* Inside the oneLotate function, the most important thing is if all events are in the right order. First doodle bugs should move then ant. And after all moving are done, the critters can breed.

For Game class:

* This class should be simple. It only asks the number of days and call the functions from the GBoard class and show them to users then has the feature of each continue and exit.

**REFLECTION**

1. When designing this program, bool moved function was not there. But when write the oneLotate function, we need something to check if critters moved or not. So, we set it in the critter class.
2. As for the starve() function, we first wrote it with void. Then, it was a little troublesome to handle it inside Ant class. So, later we changed it bool and made the return value of Ant’s starve() false.
3. When the program first showed the board, it was so exciting. However, it kept creating error. We tried many things but none of them was not working. Then, finally, we found the most important thing here is if every event is in the right order. We should first check if critters cross the border and then if the cell is empty or not using “nltptr.”
4. To be cautious of Typo!

The silliest mistakes that we made about the program is we input “X” in the place where should have been input “Y”. When we fixed those typos, the program just worked perfectly. Then, when we ran it on the school server, it showed 0 error and no memory leaks.