Final Lab Aphids Vs Insects

By

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Week 9&10 lab

Milwaukee School of Engineering

Submitted to:

Professor: Joshua D. Carl, Ph.D

EECS Department

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Objective

The objective of this lab is to create a simulated game that is like predator vs. prey. Using at least 2 of the 3 advance OOP ideas, operator overloading, composition, and inheritance/polymorphism.

Description

In my program I created 4 classes: Game, Insect(abstract), Aphids, and Ladybugs. In which the bugs live in a 20 X 20 grid of cells. Only 1 bug can occupy a cell at a time, and the adges are closed so the bugs cannot move off the edges. Time is simulated in time steps. Each bug performs 1 or more actions each time step. And the user can also pick a specific number of steps in between printing results. The Game function has a grid of Insect pointers and has the functions. To populate the grid with Insect* set to nullptr. And then inserting the aphids and ladybugs. It also has a start function and timestep function as well. In which where breed, movement, and death occurs.

Conclusions

The lab was successful and was able to execute all the functions for Ladybugs and Aphids. Specifically, for the movement function which is what I had the most trouble with. For some reason when executing the code lags and stop and returns 00000c5 instead of 0. I believe the reason for this must be because some of the logic in my is going in a loop. Instead of doing it once. The biggest challenge for me during this lab was working out how this would be implemented and how to make it as proficient as possible. Specifically, the 2-d array without using global variables. This is where I created my game class for. Uses a class game that inputs Insect* I was able to implement the necessary movement functions and keep track of them in my class instead of doing it in my main code. This allows all the methods and functions be done under the hood. But what I love about this lab was forcing to use pointers and the challenge of thinking how to create the hierarchy for all the classes. I also created a check function that returns a value if an aphid/insect was present. This was very useful when trying to implement the movement and breed functions. Something I would have done differently would be how I did the logic for my movement function and breed. I believe the breed function for both aphid and ladybugs are identical so I could have just implemented that function as a virtual instead of a pure virtual and call it once. This would reduce the amount of copy and paste I had to do and make the code shorter and cleaner. I also wish that I had for time to implement the food class for my aphids. For the food class I was thinking of deriving from Insect class and only have a generic constructor, int getInsect function, and death function.

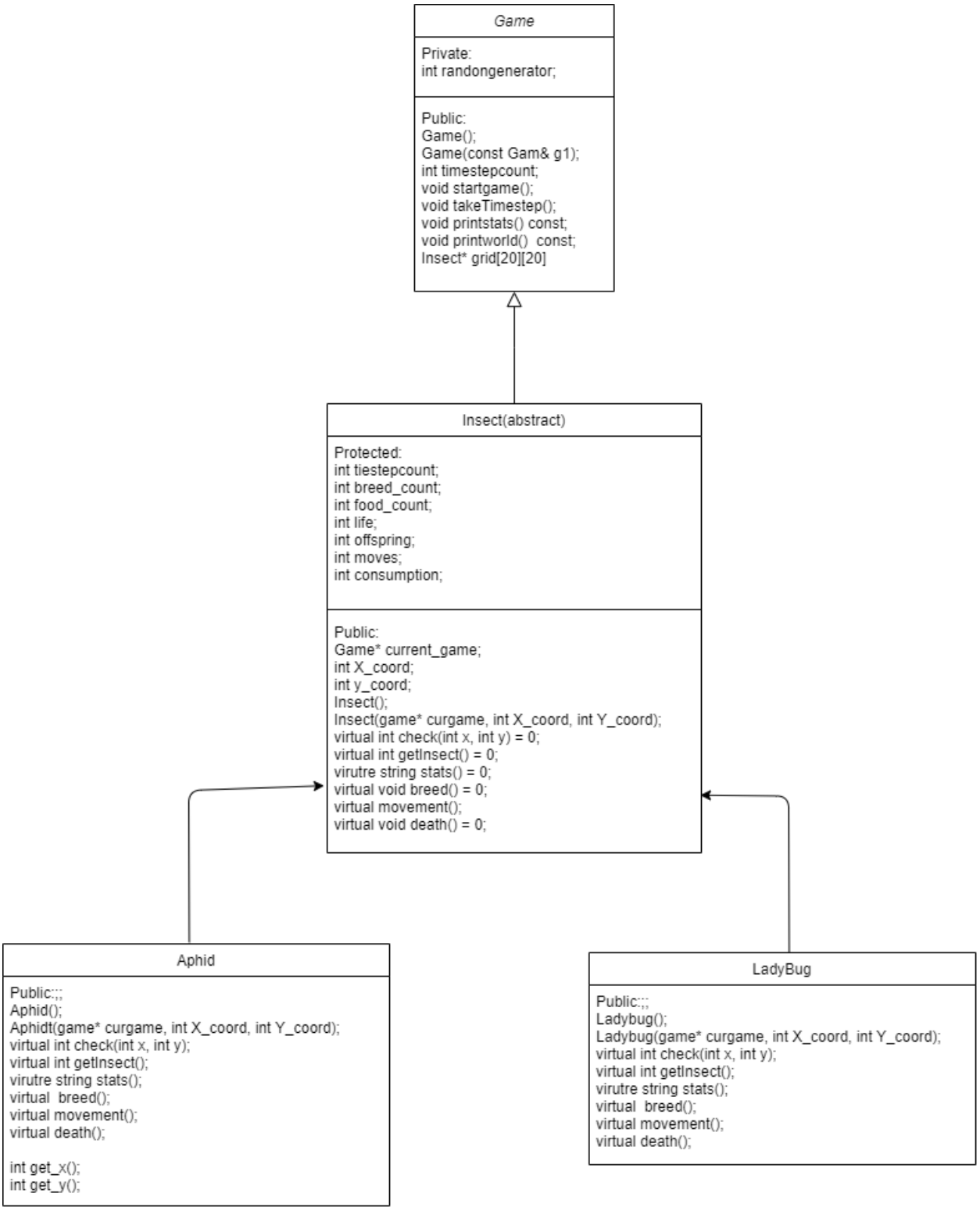
Preliminary Text:

Game Class: This class is to map my abstract class pointers onto the grid and be able to move items in me from my grid class and if the object in my grid class is picked it can then move it onto another place. I am thinking of adding a function in which you can insert an insect* pointer to a selected index [m][n] in my grid path. For Insect abstract class I created three variables called name. X coordinate, and Y coordinate. Were the insect path having two variables with virtual functions and pure virtual functions all point for this class is just to make the code easier to digest and to understand.

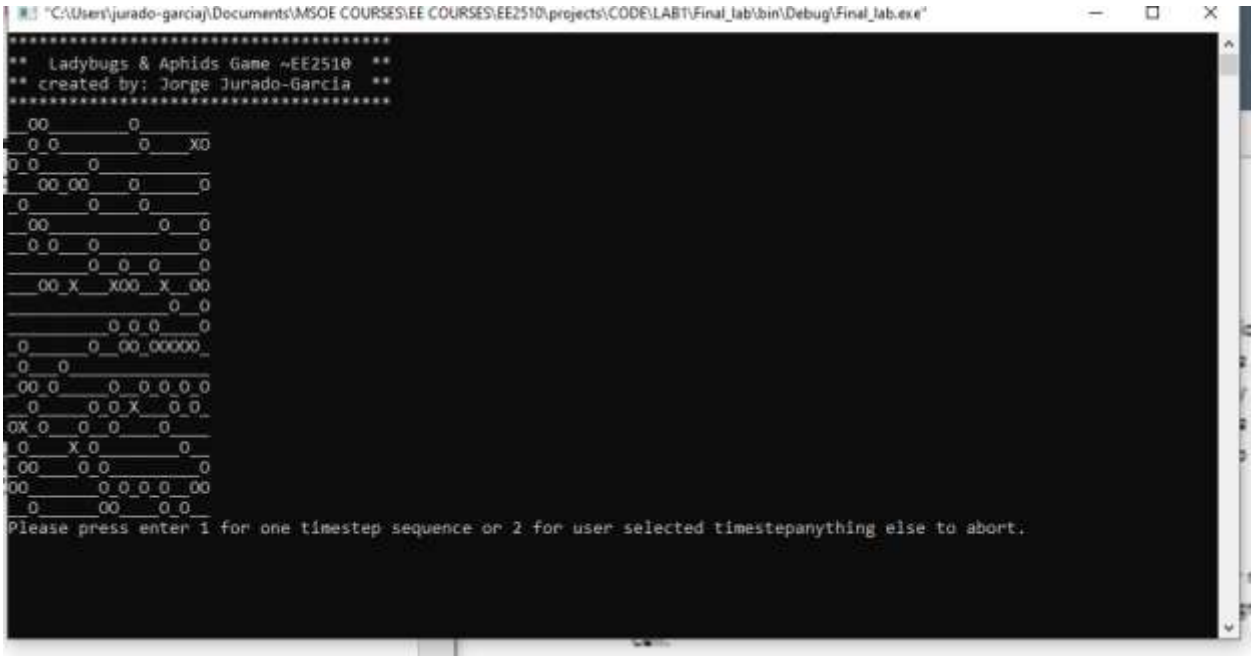
For Aphid class is it my prey it holds the proper constructors and have some operator handlers namely for food. My Ladybug class has an operator handling that takes in aphids and delete that aphid and increases its food tank variable by one. It also has different stats for it but other than that it mostly the same to aphids.

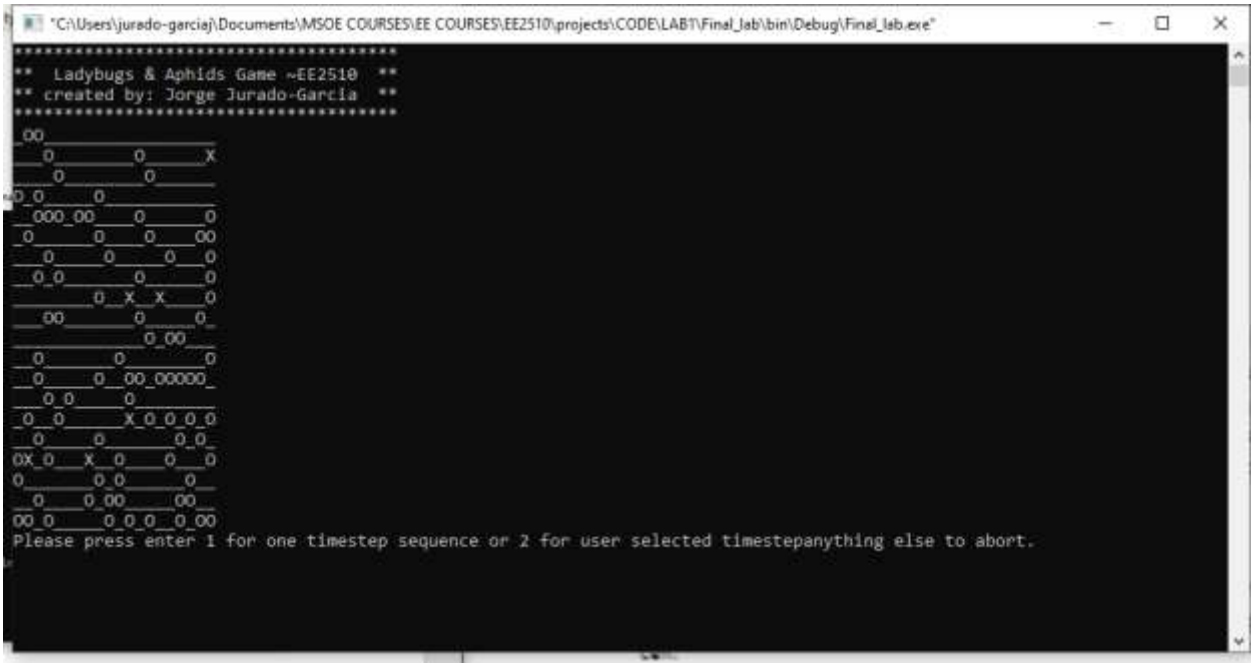
Aphids and Insects inherits form Insect abstract class. And Game class is base class for Insect abstract class.

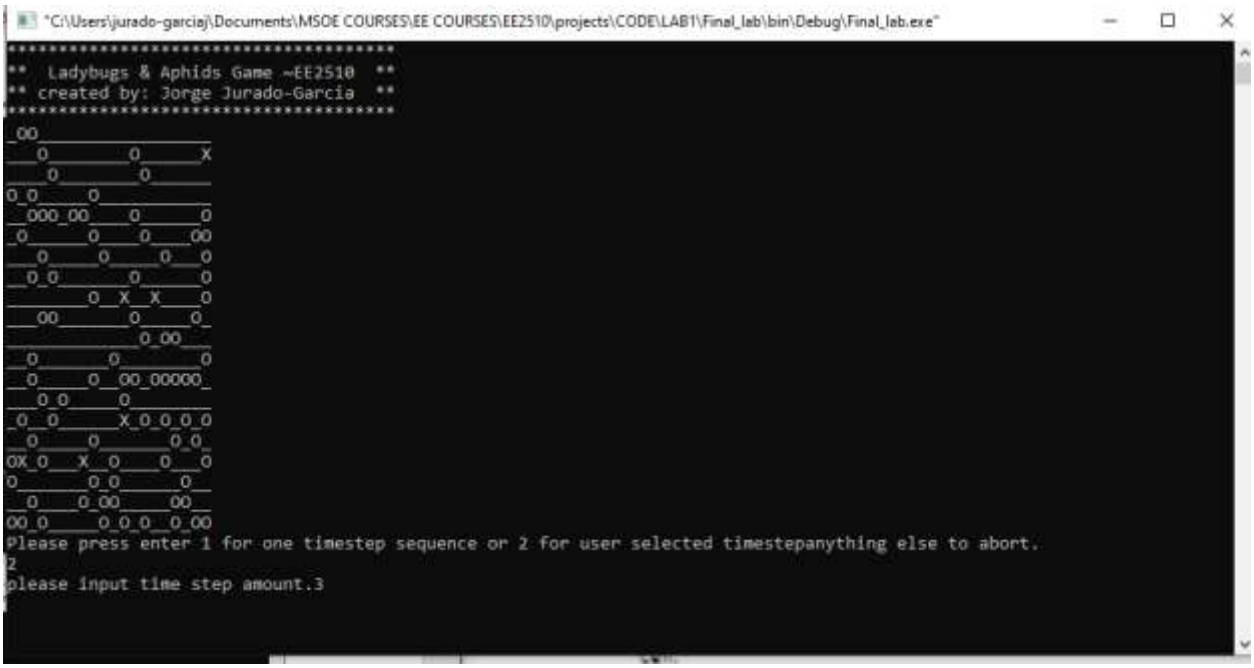
UML Diagram:

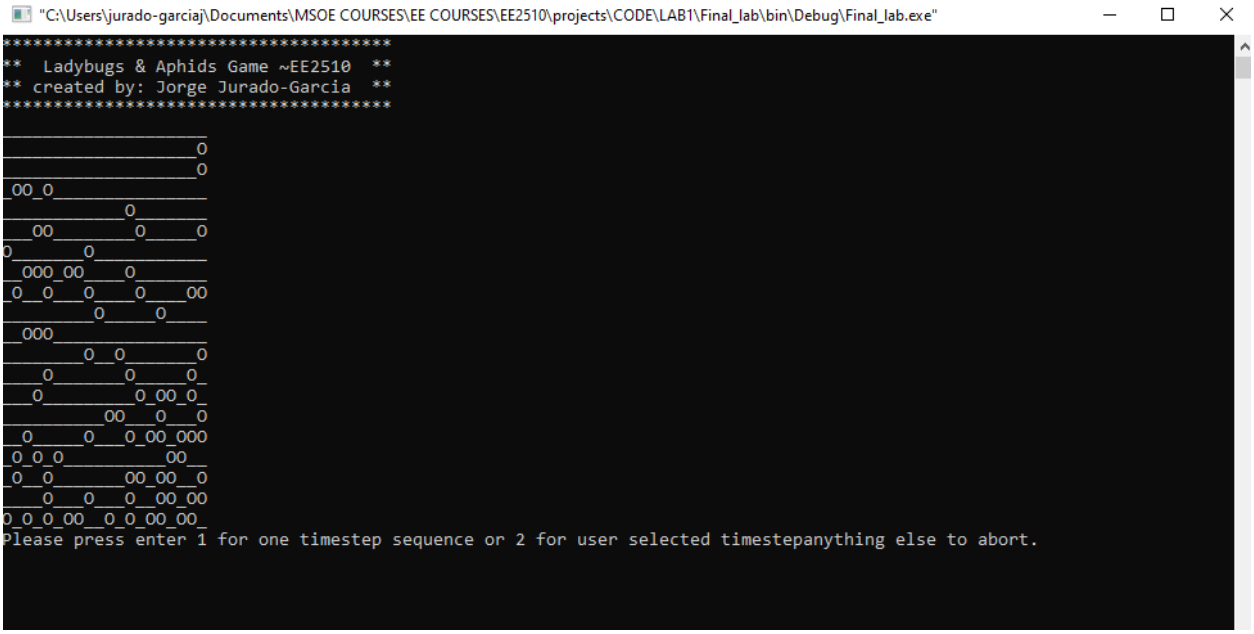

Game
Private:
int randongenerator;
Public:
Game();
Game(const Gam& g1);
int timestepcount;
void startgame();
void takeTimestep();
void printstats() const;
void printworld() const;
Insect* grid[20][20]
Insect(abstract)
Protected:
int tiestepcount;
int breed_count;
int food_count;
int life;
int offspring;
int moves;
int consumption;
Public:
Game* current_game;
int X_coord;
int y_coord;
Insect();
Insect(game* curgame, int X_coord, int Y_coord);
virtual int check(int x, int y) = 0;
virtual int getInsect() = 0;
virutre string stats() = 0;
virtual void breed() = 0;
virtual movement();
virtual void death() = 0;
Aphid
Public:;;
Aphid();
Aphidt(game* curgame, int X_coord, int Y_coord);
virtual int check(int x, int y);
virtual int getInsect();
virutre string stats();
virtual breed();
virtual movement();
virtual death();
int get_x();
int get_y();
LadyBug
Public:;;
Ladybug();
Ladybug(game* curgame, int X_coord, int Y_coord);
virtual int check(int x, int y);
virtual int getInsect();
virutre string stats();
virtual breed();
virtual movement();
virtual death();

Console Result:

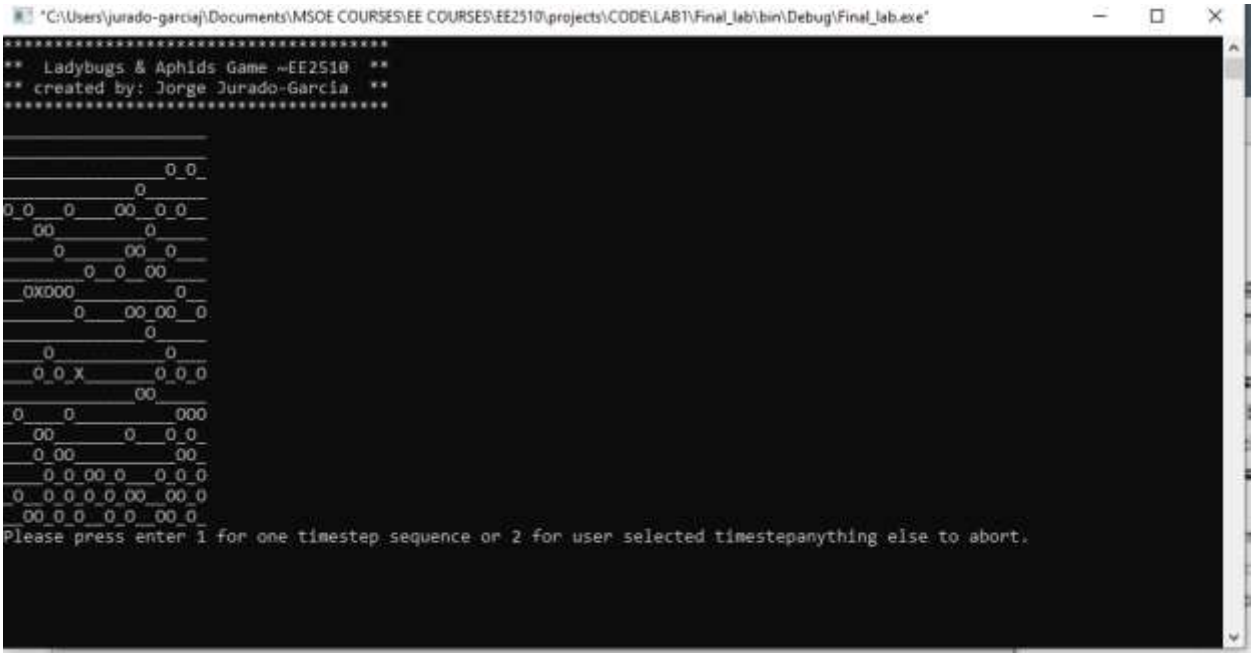


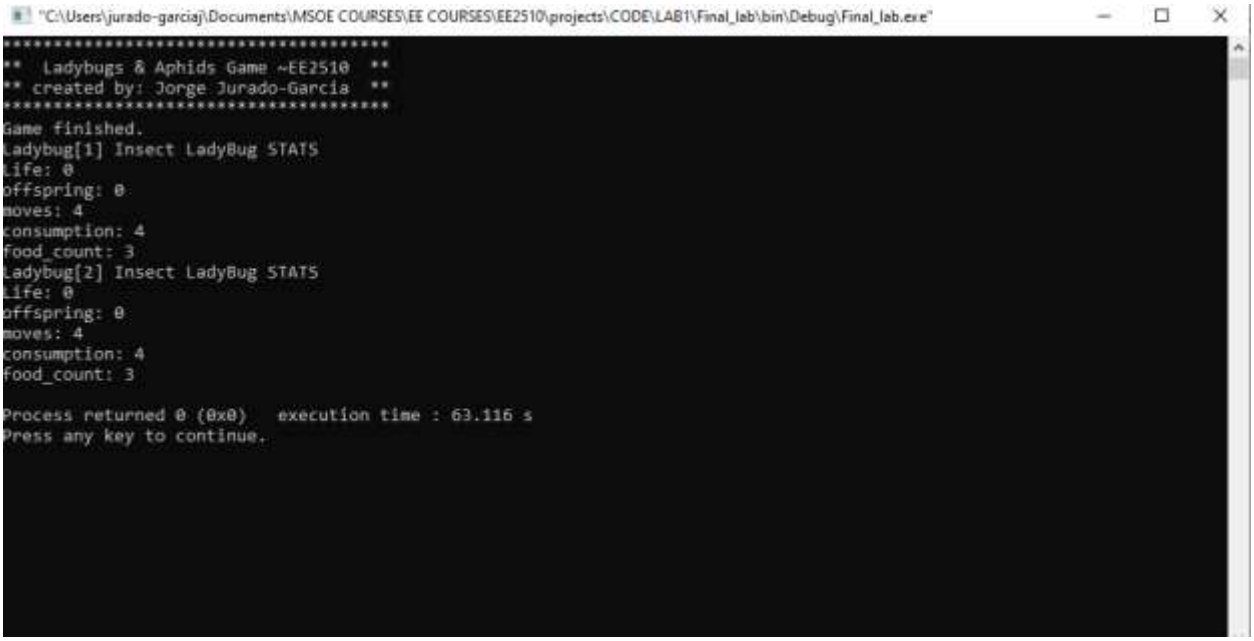



"C:\Users\jurado-garciaj\Documents\MSOE COURSES\EE COURSES\EE2510\projects\CODE\LAB1\Final_lab\bin\Debug\Final_lab.exe"
** Ladybugs & Aphids Game ~EE2510 **
** created by: Jorge Jurado-Garcia **
Please press enter 1 for one timestep sequence or 2 for user selected timestepanything else to abort.
2
please input time step amount.3


"C:\Users\jurado-garciaj\Documents\MSOE COURSES\EE COURSES\EE2510\projects\CODE\LAB1\Final_lab\bin\Debug\Final_lab.exe"
** Ladybugs & Aphids Game ~EE2510 **
** created by: Jorge Jurado-Garcia **
Please press enter 1 for one timestep sequence or 2 for user selected timestepanything else to abort.

Abort function and stats of ladybug after four time steps.





Main File

```
#include <string>
#include <stdlib.h>
#include "Game.h"
#include "iostream"
using namespace std;
void intro(){
std::cout<<"****************************************"<<std::endl;
std::cout<<"**  Ladybugs & Aphids Game ~EE2510  **"<<std::endl;
std::cout<<"** created by: Jorge Jurado-Garcia  **"<<std::endl;
std::cout<<"****************************************"<<std::endl;
}
int main()
{
    intro();
    Game g1;
    g1.startGame();
    g1.printWorld();
    while(1){
    cout<<"Please press enter 1 for one timestep sequence or 2 for user
selected timestep";
    cout<<"anything else to abort."<<endl;
    int user_input;
    cin>>user_input;
    if(user_input == 1)
    {
        g1.takeTimeStep();
       system("CLS");
       intro();
       g1.printWorld();
    }
    else if(user_input == 2)
    {
      int num;
      cout<<"please input time step amount.";
      cin>>num;
      cout<<endl;
      cout<<"timestep amount: "<<num<<endl;
      for(int i=0; i<num; i++)
      {
            g1.takeTimeStep();
      }
      system("CLS");
      intro();
      g1.printWorld();
    }
    else
    {
        system("CLS");
        intro();
        cout<<"Game finished."<<endl;
        g1.printstats();
        return 0;
    } //end elss
    } //end while
} //end main
```

Game Header File

```
#ifndef GAME_H_INCLUDED

#define GAME_H_INCLUDED

#include "Insect.h"

class Insect;

class Game

{

private:

  int generateRandomNumber(int startRange, int endRange) const; //random
number generator

public:

  Game();  //generic

  Game(const Game& g1); //copy constructor

//  ~Game(); //desctructor

  int timeStepCount;  //counts for my time step in my public function
startgame

  void startGame(); //starts and populates my grid

  void takeTimeStep();  //next game

  void printstats() const;

  void printWorld() const;  //prints the grid

  //insector pointer from main that creates a grid of 20 x 20;

  Insect* grid[20][20];

};

#endif // GAME_H_INCLUDED
```

Game source file

```
#include <iostream>
#include <sstream>
#include <time.h> //time
#include <stdlib.h> //srand and rand
#include <string>

#include "Game.h"
#include "Insect.h"
#include "Ladybug.h"
#include "Aphids.h"

Game::Game(){
  srand(time(NULL)); //random seed genrator
  timeStepCount = 0;  //game is started so rimestep is 0
  //creates a 20 by 20 array of null pointers
  for (int x = 0; x < 20; x++)
    for (int y = 0; y < 20; y++)
      grid[x][y] = nullptr;
}

Game::Game(const Game& g1)
{
    timeStepCount = g1.timeStepCount;
    for (int x = 0; x < 20; x++){
    for (int y = 0; y < 20; y++){
      grid[x][y] = g1.grid[x][y];
    }
    }
}

void Game::startGame(){
  int x,y;  //x and y coordiniates for grid
  int aphidcount = 0;
  int ladybugcount = 0;

  //while function ladybug_count is set to 20
  while (ladybugcount < 10){
    //uses game genrate function to create a random number
    x = generateRandomNumber(0, 20 - 1);
    y = generateRandomNumber(0, 20 - 1);
    //example: grid[1][1] = ladybug or aphid then thats it
    //if not populate it with a ladybug
    if (grid[x][y] == nullptr)
    {
    grid[x][y] = new Ladybug(this, x, y);
    ladybugcount++;
    }
  }

  while (aphidcount < 100){
    x = generateRandomNumber(0, 20 - 1);
    y = generateRandomNumber(0, 20 - 1);
    if (grid[x][y] == nullptr){
```

```
    //example: grid[1][1] = ladybug or aphid then thats it
    //if not populate it with a aphid
    grid[x][y] = new Aphid(this, x, y);
    aphidcount++;
    }
  }
}

void Game::takeTimeStep(){
  timeStepCount++;

  for (int x = 0; x < 20; x++){
    for (int y = 0; y < 20; y++){
      if( grid[x][y] == nullptr)
      {

      }//end if
      else if (grid[x][y]->getInsect() == 2) //ladybug
      {
           grid[x][y]->movement();
            std::cout<<"ladybug movement function done\n";
      }//end else if
      else if(grid[x][y]->getInsect() == 1)
      {
           grid[x][y]->movement();
            std::cout<<"Aphid movement function done\n";
      } //end else if
      else{
          std::cout<<"N";
      } //end else
      }//end for
  }

 std::cout<<"lady bug done";

  for (int x = 0; x < 20; x++){
    for (int y = 0; y < 20; y++){
      if( grid[x][y] == nullptr)
      {

      }//end if
      else if (grid[x][y]->getInsect() == 2) //ladybug
      {
             grid[x][y]->breed(); //this function works
             std::cout<<"ladybug breed done\n";
             grid[x][y]->death(); //this function works
              std::cout<<"ladybug death done\n";
      }//end else if
      else if(grid[x][y]->getInsect() == 1)
      {
           grid[x][y]->breed(); //this function worls
           std::cout<<"aphid breed done\n";
           grid[x][y]->death(); //this function works
           std::cout<<"aphid death done\n";
      } //end else if
      else{
          std::cout<<"N";
```

```
      } //end else
      }//end for
  }
   std::cout<<"aphid done";

 }//end program

void Game::printWorld() const
{
  for (int x = 0; x < 20; x++){
    for (int y = 0; y < 20; y++){
      if (grid[x][y] == nullptr)
        std::cout << '_';
      else if (grid[x][y]->getInsect() == 1)
        std::cout << 'O';
      else  //world[x][y]->getType() == LADYBUG
       std:: cout << 'X';
    }
    std::cout << std::endl;
  }
}

void Game:: printstats() const
{
int num=1;
for (int x = 0; x < 20; x++){
    for (int y = 0; y < 20; y++){
        //grid is a insect* so in order to check what inside
        // i used getInsect and if its object of ladybug then
        //it will return a value of 2;
        if( (grid[x][y] == nullptr) )
           {
           }
        else
        {
        if( (grid[x][y]->getInsect()) == 2)
        {
            std::string result;
            result = grid[x][y]->stats();
            std::cout<<"Ladybug["<<num<<"]"<<result;
            num++;
        }
        }
    }
    }
}

int Game::generateRandomNumber(int startRange, int endRange) const
{
  return rand() % (endRange - startRange + 1) + startRange;
}
```

Insect Header File

```
/*
File created by: Jorge Jurado-Garcia
Name: insect.h file
Abstract class
Date: 4/30/21
Modifications:
5/9 changing pure virtual functions to virtual
    and deleting get/set function and creating data mememberss
    as protected instead of private
All rights reserved
Educational purposes
*/
#ifndef INSECT_H_INCLUDED
#define INSECT_H_INCLUDED
#include "Game.h"
class Game;
class Insect
{
public:
    //generic
    Insect();
    //parameter constructor
    Insect(Game* curgame, int X_coord, int Y_coord);
    //THIS IS WILL BE NAME, X-LOCATION, AND Y-LOCATION
    //pure virtual functions makes insects abstract base class
    virtual int check(int x, int y)=0;  //pure virtual
    virtual int getInsect() = 0 ; //pure virtual
    virtual std::string stats(); //pure virtual;
    virtual void breed()=0;
    virtual void movement();
    virtual void death()=0;
```

```
    Game* current_game;
    //game* for current_game address of the address of gameptr
    int X_coord;
    int Y_coord;

    protected:
    int timestepcount;
    int breed_count;
    int food_count;
    int life; //life expedency
    int offspring; //production
    int moves; //moves
    int consumption; //ladybugs eaten
//end of class
};
#endif // INSECT_H_INCLUDED
```

Insect Source File

```
/*
File created by: Jorge Jurado-Garcia
Name: insect.ccp file
Abstract class
Date: 4/30/21
Modifications:
All rights reserved
Educational purposes
*/
#include <sstream>
#include <iostream>
#include "Insect.h"
//generic constructor
Insect:: Insect()
{
    current_game = nullptr;
    X_coord = 0;
    Y_coord = 0;
    timestepcount = 0;
    breed_count = 0;
    food_count = 0;
    life = 0; //life expedency
    offspring = 0; //production
    moves = 0; //moves
    consumption = 0; //ladybugs eaten
}
Insect:: Insect(Game* curgame, int X_coord, int Y_coord)
{
    this->current_game = curgame;
    this->X_coord = X_coord;
    this->Y_coord = Y_coord;
    //timestepcount copies the timestepcount from class game
    //since current_game is a ptr to game game*
     breed_count = 0;
    food_count = 0;
    life = 0; //life expedency
    offspring = 0; //production
    moves = 0; //moves
    consumption = 0; //ladybugs eaten
    timestepcount = curgame->timeStepCount;
}
std::string Insect:: stats()
{
    std::string ret;
    ret = " Insect ";
    return ret;
}
void Insect:: movement()
{
    if(timestepcount==current_game->timeStepCount)
  {
      return;
  }
  timestepcount++;
}
```

Aphid Header file

```
/*
File created by: Jorge Jurado-Garcia
Name: Aphids.h file
Abstract class
Date: 4/30/21
Modifications:
All rights reserved
Educational purposes
*/
#ifndef APHIDS_H_INCLUDED
#define APHIDS_H_INCLUDED

#include "Insect.h"

class Aphid:
    public Insect
{
    public:
    //generic constructor
    Aphid();

    //parameter constructor
    Aphid(Game* curgame, int X_coord, int Y_coord);

    int get_x();
    int get_y();

    //virtual functions to override
    virtual void death();
    virtual int check(int x, int y);
    virtual void movement();
    virtual void breed(); //breeds and returns a insect
    virtual int getInsect(); //return an aphid
    virtual std::string stats();
};

#endif // APHIDS_H_INCLUDED
```

Aphid Source File

```
/*
File created by: Jorge Jurado-Garcia
Name: Aphids.ccp file
Abstract class
Date: 4/30/21
Modifications:
All rights reserved
Educational purposes
*/

#include <iostream>
#include <sstream>
#include <time.h>
#include <stdlib.h>
#include <string>

#include "Aphids.h"

//generic constructor
Aphid:: Aphid()
{
   food_count = 3;
   breed_count = 3;
}

//parameter constructor
Aphid::Aphid(Game* curgame, int X_coord, int Y_coord)
  :Insect(curgame, X_coord, Y_coord)
{
    breed_count = 3;
    food_count = 3;
}

 //death of aphid
 void Aphid:: death()
 {
   if(food_count==0){
        current_game->grid[X_coord][Y_coord] = nullptr;
    }
   return;
 }

 //breed function
void Aphid:: breed()
{
    std::cout<<"in breed function\n";
     if(breed_count != 0){
        std::cout<<"breed count is not zero\n";
        return;
    }
    std::cout<<"breed count is zero";
    int ar[4];
    ar[0] = check(X_coord+1,Y_coord);  //down
    ar[1] = check(X_coord,Y_coord+1);  //right
    ar[2] = check(X_coord-1,Y_coord);  //up
```

```
    ar[3] = check(X_coord,Y_coord-1);  //left

    int New_X_coord;
    int New_Y_coord;

    for(int j = 0; j<4;j++)
    {
     int sum = ar[j]+ sum;
     std::cout<<ar[j];
     if(sum==0){
        return;
     }
    }

    for(int i=0;i<4;i++){
     if(i==0){
         New_X_coord = X_coord+1;
         New_Y_coord = Y_coord;
     }
     else if(i==1){
         New_X_coord = X_coord;
         New_Y_coord = Y_coord+1;
     }
     else if(i==2){
         New_X_coord = X_coord-1;
         New_Y_coord = Y_coord;
     }
     else{
        New_X_coord = X_coord;
        New_Y_coord = Y_coord-1;
     }
     if( ar[i] == 1 ){
        //make the current position to a null ptr
        offspring++;
        current_game->grid[X_coord][Y_coord] = this;
        current_game->grid[New_X_coord][New_Y_coord] = nullptr;
          std::cout<<"passed this\n";
        current_game->grid[New_X_coord][New_Y_coord] = new
Aphid(current_game,New_X_coord,New_Y_coord);
        std::cout<<"beed count accomplushed";
     i = 5;
     }
}//end for

} //end function

//getInsect function
int Aphid:: getInsect()
{
    return 1;
}

int Aphid:: get_x()
{
    return X_coord;
}
```

```
int Aphid:: get_y()
{
    return Y_coord;
}

//stats function
std::string Aphid:: stats()
{
    std::string num;
    num = " ";
    return num;
}

//movement function
void Aphid:: movement()
{
  if(timestepcount==current_game->timeStepCount)
  {
      return;
  }
  timestepcount++;
  std::cout<<X_coord<<" "<<Y_coord<<"\n";
int ar[4];
    ar[0] = check(X_coord+1,Y_coord);  //down
    ar[1] = check(X_coord,Y_coord+1);  //right
    ar[2] = check(X_coord-1,Y_coord);  //up
    ar[3] = check(X_coord,Y_coord-1);  //left

    int New_X_coord;
    int New_Y_coord;
    int sum=0;
    for(int i = 0; i<4;i++)
    {
    for(int j=0;j<4;j++){
     sum = ar[j]+ sum;
     std::cout<<"ar["<<j<<"]"<<ar[j]<<"\n";
    }
    std::cout<<"sum: "<<sum<<"\n";
    if(sum==0){
        return;
     }
     if(i==0){
         New_X_coord = X_coord+1;
         New_Y_coord = Y_coord;
         std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
     }
     else if(i==1){
         New_X_coord = X_coord;
         New_Y_coord = Y_coord+1;
         std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
     }
     else if(i==2){
         New_X_coord = X_coord-1;
         New_Y_coord = Y_coord;
         std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
     }
     else{
```

```
        New_X_coord = X_coord;
        New_Y_coord = Y_coord-1;
        std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
     }
      if( ar[i] == 1 ){
        std::cout<<New_X_coord<<" " <<New_Y_coord<<"\n";
        current_game->grid[New_X_coord][New_Y_coord] = nullptr;
        current_game->grid[X_coord][Y_coord] = nullptr;
        std::cout<<"passed all info\n";
        X_coord = New_X_coord;
        Y_coord = New_Y_coord;
        current_game->grid[New_X_coord][New_Y_coord] = this;
        std::cout<<"passed all info\n";
        i = 4; //stop the for loop
        std::cout<<"j is:"<<i<<"\n";
}//end if statement
}//end for
std::cout<<"done\n";
} //end movement

//check function
int Aphid:: check(int x, int y)
{

    //this is to check if the user who imported x value between 0-20
    //bool out is a way to check what will happen if if its outofscope
    //then the check function is null
    int out;
   if( (x<0 || (y<0)) )
   {
        out = 0;
        return out;
   }
   if( (x>19) || (y>19) )
   {
       out = 0;
       return out;
   }
    if(current_game->grid[x][y] == nullptr)
    {
        out = 1;
    }
    else if(current_game->grid[x][y]->getInsect() == 2) //ladybug
    {
         out = 0;
    }
    else //aphid
    {
         out = 0;
    }
    return out;

}
```

Ladybug header file

```
/*
File created by: Jorge Jurado-Garcia
Name: LadyBugs.h file
Abstract class
Date: 5/02/21
Modifications:
All rights reserved
Educational purposes
*/
#ifndef LADYBUG_H_INCLUDED
#define LADYBUG_H_INCLUDED

#include "Insect.h"
#include "Aphids.h"

class Ladybug:
    public Insect
{
    public:
    //generic constructor
    Ladybug();

    //parameter constructor
    Ladybug(Game* current_game, int X_coord, int Y_coord);

    //stats function
    virtual std:: string stats();

    //virtual bool check(int x, int y);
    //virtual functions to override
    virtual void movement();
    virtual int check(int x, int y);
    virtual void  death();
    virtual void breed(); //breeds and returns a insect
    virtual int getInsect(); //return an insect
};

#endif // LADYBUG_H_INCLUDED
```

Ladybug Source File

```
/*
File created by: Jorge Jurado-Garcia
Name: ladybug.ccp file
Date: 5/02/21
Modifications:
All rights reserved
Educational purposes
*/

#include <iostream>
#include <sstream>
#include <string>

#include "Ladybug.h"

//generic constructor
Ladybug:: Ladybug()
{

  food_count = 3;
  life = 0;
  offspring = 0;
  moves = 0;
  consumption = 0;
  breed_count = 8;
}

//parameter constructor
Ladybug::Ladybug(Game* current_game, int X_coord, int Y_coord)
 :Insect(current_game,X_coord,Y_coord)
{
```

```
    breed_count = 8;
    food_count = 3;
    life = 0;
    offspring = 0;
    moves = 0;
    consumption = 0;
}

  //death of aphid
void Ladybug:: death()
 {
    if(food_count<=0){
        current_game->grid[X_coord][Y_coord] = nullptr;
    }
   return;
 }

 //breed function
void Ladybug:: breed()
{
    std::cout<<"in breed function\n";
     if(breed_count != 0){
        std::cout<<"breed count is not zero\n";
        return;
    }

    if(breed_count != 0){
        return;
    }
    int ar[4];
    ar[0] = check(X_coord+1,Y_coord);  //down
    ar[1] = check(X_coord,Y_coord+1);  //right
```

```
ar[2] = check(X_coord-1,Y_coord);  //up
ar[3] = check(X_coord,Y_coord-1);  //left

int New_X_coord;
int New_Y_coord;

for(int j = 0; j<4;j++)
{
 int sum = ar[j]+ sum;
 if(sum==0){
    return;
 }
}
for(int i=0;i<4;i++){
 if(i==0){
     New_X_coord = X_coord+1;
     New_Y_coord = Y_coord;
 }
 else if(i==1){
     New_X_coord = X_coord;
     New_Y_coord = Y_coord+1;
 }
 else if(i==2){
     New_X_coord = X_coord-1;
     New_Y_coord = Y_coord;
 }
 else{
    New_X_coord = X_coord;
    New_Y_coord = Y_coord-1;
 }
if( ar[i] == 1 ){
    //make the current position to a null ptr
```

```
        offspring++;
        current_game->grid[X_coord][Y_coord] = this;
        current_game->grid[New_X_coord][New_Y_coord] = nullptr;
          std::cout<<"passed this\n";
        current_game->grid[New_X_coord][New_Y_coord] = new
Ladybug(current_game,New_X_coord,New_Y_coord);
        std::cout<<"beed count accomplushed";
     i = 5;
     }
}//end for
}

int Ladybug:: getInsect()
{
    return 2;
}

//stats function
std:: string Ladybug:: stats()
{
    std::string ret;
    std::ostringstream out1;
    std::ostringstream out2;
    std::ostringstream out3;
    std::ostringstream out4;
    std::ostringstream out5;
    out1<<life;
    out2<<offspring;
    out3<<moves;
    out4<<consumption;
    out5<<food_count;
    ret = Insect::stats();
```

```
    ret = ret + "LadyBug STATS\n";
    ret = ret + "Life: " + out1.str() + "\n";
    ret = ret + "offspring: " + out2.str() + "\n";
    ret = ret + "moves: " + out3.str() + "\n";
    ret = ret + "consumption: " + out4.str() + "\n";
    ret = ret + "food_count: " + out5.str() + "\n";
    return ret;
}

void Ladybug:: movement()
{
    if(timestepcount == current_game->timeStepCount)
    {
        return;
    }
    timestepcount++;
    std::cout<<X_coord<<" "<<Y_coord<<std::endl;
   int ar[4];
    ar[0] = check(X_coord+1,Y_coord);  //down
    ar[1] = check(X_coord,Y_coord+1);  //right
    ar[2] = check(X_coord-1,Y_coord);  //up
    ar[3] = check(X_coord,Y_coord-1);  //left

    int New_X_coord;
    int New_Y_coord;
    int sum=0;
    int pp=0; //best choice of action

     for(int j=0;j<4;j++){
     sum = ar[j]+ sum;

     if(ar[j] == 2){
```

```
    if( j == 0 ){
        j = 4;
    }
        pp = j;
 }
 std::cout<<"ar["<<j<<"]"<<ar[j]<<"\n";
} //end for
std::cout<<"sum: "<<sum<<"\n";

if(sum==0){
    return;
 }

if(pp == 0)
{

for(int i = 0; i<4;i++)
{

 if(i==0){
     New_X_coord = X_coord+1;
     New_Y_coord = Y_coord;
     std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
 }
 else if(i==1){
     New_X_coord = X_coord;
     New_Y_coord = Y_coord+1;
     std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
 }
 else if(i==2){
     New_X_coord = X_coord-1;
     New_Y_coord = Y_coord;
```

```
     std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
 }
 else{
    New_X_coord = X_coord;
    New_Y_coord = Y_coord-1;
    std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
 }

 if( ar[i] == 1 ){  //aphid in its place
    //make the current position to a null ptr
    std::cout<<X_coord<<" "<<Y_coord<<std::endl;
    current_game->grid[New_X_coord][New_Y_coord] = nullptr;
    current_game->grid[X_coord][Y_coord] = nullptr;
    current_game->grid[New_X_coord][New_Y_coord] = this;
    X_coord = New_X_coord;
    Y_coord = New_Y_coord;
    moves++;
    food_count--;
    i == 4; //stop for loop
 }//end if

}// end for

}//end if
else
{
    if(pp==4){
     New_X_coord = X_coord+1;
     New_Y_coord = Y_coord;
     std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
 }
    else if(pp==1){
```

```
            New_X_coord = X_coord;
            New_Y_coord = Y_coord+1;
            std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
        }
           else if(pp==2){
            New_X_coord = X_coord-1;
            New_Y_coord = Y_coord;
            std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
           }
           else{
           New_X_coord = X_coord;
           New_Y_coord = Y_coord-1;
           std::cout<<New_X_coord<<" "<<New_Y_coord<<"\n";
           }//end of else statement

           //make the current position to a null ptr
           std::cout<<X_coord<<" "<<Y_coord<<std::endl;
           current_game->grid[New_X_coord][New_Y_coord] = nullptr;
           current_game->grid[X_coord][Y_coord] = nullptr;
           current_game->grid[New_X_coord][New_Y_coord] = this;
           X_coord = New_X_coord;
           Y_coord = New_Y_coord;
           moves++;
           consumption++;

       }//end else
}//end function

//check function
int Ladybug:: check(int x, int y)
{
int out;
```

```
    //this is to check if the user who imported x value between 0-20
    //bool out is a way to check what will happen if if its outofscope
    //then the check function is null
   if( (x<0 || (y<0)) )
   {
        out = 0;
        return out;
   }
   if( (x>19) || (y>19) )
   {
       out = 0;
       return out;
   }
    if(current_game->grid[x][y] == nullptr)
    {
        std::cout<<"null pointer\n";
        out = 1;
    }
    else if(current_game->grid[x][y]->getInsect() == 2)
    {
        std::cout<<"ladbug found\n";
         out = 0;
    }
    else{
        std::cout<<"aphid found pointer\n";
         out = 2;
    }
    return out;
}
```