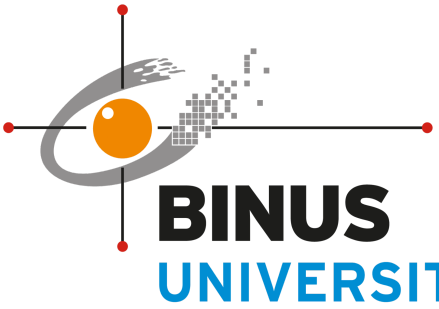

Combat Robot
Data Structures's L2AC's Group 5's Final Project Report

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Problem Description

This project is a crude adaptation of Hero of Robots, a Taiwanese arcade trading game. It simulates where upon starting the game, the user acquires a new card which allows them to play with it or any other cards the user owns against enemies. This iteration is the best possible impression coded in C++, and the prototype has been proven to be partially successful, with some subsequent errors occurring occasionally.

Data Structures Analysis

- Vector

  The ParseCommaDelimitedString function separates a string via commas and places the separated strings into a vector. Using vectors as the data structure in this scenario seems to be the common practice in C++.

  First, A vector's size is dynamic, allowing worry-free amounts of insertion and deletion, unlike arrays, whose sizes are fixed. Second, when compared to List, the space of each element in a vector is only half of an element in a List because List traverses using nodes. And since the insertion of the substring is done at the end of the data structure, both Vector and List have the same cost in terms of time. Thus, in overall performance, vector is the better choice. Vectors have a random access iterator, allowing the values to be accessed by index and then used to create objects of the type Robot that are later on ushered into the vector. Using an iterator would be too bothersome. A vector of the type Robot is initialized with the aforementioned function, which is later accessed by a random index.

```
// Seperate a string by commas and put the seperated strings into vector
vector<string> parseCommaDelimitedString(string line){
vector<string> result;
stringstream s_stream(line);
while(s_stream.good()){
string substr;
getline(s_stream,substr,',');
result.push_back(substr);
}
return result;
```

- Queue

  The data structure that is often used to store game objects are array, queue and list. Here in our game, we want the data structure to be able to represent the order of the enemies encountered by the player and are placed in a queue to ramp up the difficulty of the simulation. It seems to make much more logical sense with 'First In First Out', where the first enemy to be faced and defeated is removed first. Using a queue, removing the element at the front will only cost O(1) time, which may be of significant difference in large amounts of data, when compared to List, which costs O(n) time.

  The table below provides an insight on the execution time for the enemies setup, which covers the following: 3x push, 1x front, and 1x pop. According to the result, there is really not much difference, which may be due to the small amount of data. However, it can still be seen that the queue is the winner.

	Queue	List
Best Time	0.57 ms	0.54 ms
Average Time	1.03 ms	1.05 ms
Worst Time	1.57 ms	1.66 ms

Table 1.1 Execution Time of Enemies Initial Setup

```
298       enemies.push(e1);enemies.push(e2);enemies.push(e3);
299           currentEnemy = enemies.front(); //Challenge the first one in the queue
300           enemies.pop(); //To prevent being called again
```

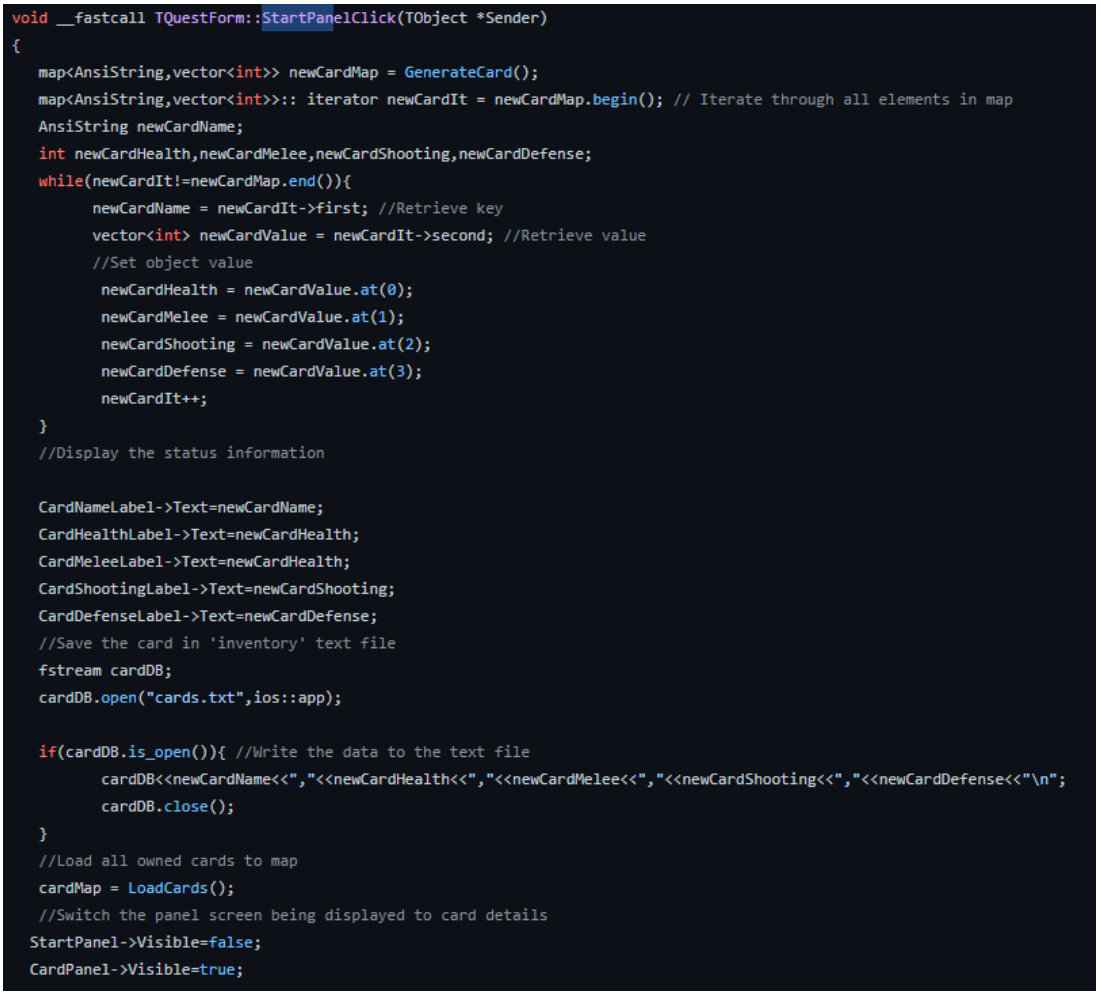
Image 2.1 Queue Insertion and Deletion

```
294   //      enemyList.push_back(e1); enemyList.push_back(e2); enemyList.push_back(e3);
295   //      currentEnemy = enemyList.front();
296   //      enemyList.pop_front();
```

Image 2.2 List Insertion and Deletion

- Map

  A Dictionary-Esque data structure that prevents the occurrences of identical keys. Not only would it be used for differentiating between robot names, but reducing the amount of iteration as well. Unlike vectors, Map will have an easier time to find specific keys. With other data structures using a type of class, one would have to use the getter method during each iteration to check for confirmation. Unfortunately, C++ Builder does not seem to support .contains() function, which was added in C++ 20. Thus, in our case, the find algorithm was used to check whether the key existed in the text file in the first place to prevent unwanted errors.



```
void __fastcall TQuestForm::StartPanelClick(TObject *Sender)
{
   map<AnsiString,vector<int>> newCardMap = GenerateCard();
   map<AnsiString,vector<int>>:: iterator newCardIt = newCardMap.begin(); // Iterate through all elements in map
   AnsiString newCardName;
   int newCardHealth,newCardMelee,newCardShooting,newCardDefense;
   while(newCardIt!=newCardMap.end()){
         newCardName = newCardIt->first; //Retrieve key
         vector<int> newCardValue = newCardIt->second; //Retrieve value
         //Set object value
          newCardHealth = newCardValue.at(0);
          newCardMelee = newCardValue.at(1);
          newCardShooting = newCardValue.at(2);
          newCardDefense = newCardValue.at(3);
          newCardIt++;
   }
   //Display the status information

   CardNameLabel->Text=newCardName;
   CardHealthLabel->Text=newCardHealth;
   CardMeleeLabel->Text=newCardHealth;
   CardShootingLabel->Text=newCardShooting;
   CardDefenseLabel->Text=newCardDefense;
   //Save the card in 'inventory' text file
   fstream cardDB;
   cardDB.open("cards.txt",ios::app);

   if(cardDB.is_open()){ //Write the data to the text file
          cardDB<<newCardName<<","<<newCardHealth<<","<<newCardMelee<<","<<newCardShooting<<","<<newCardDefense<<"\n";
          cardDB.close();
   }
   //Load all owned cards to map
   cardMap = LoadCards();
   //Switch the panel screen being displayed to card details
  StartPanel->Visible=false;
  CardPanel->Visible=true;
```

Image 3.1 Map Iteration

```
 void __fastcall TQuestForm:: StartRobot(){
// auto start = std::chrono::high_resolution_clock::now();
//std::this_thread::sleep_for(std::chrono::seconds (3));
         AnsiString rawName= CardEdit->Text; //Get user input from editable text fiel

         cardIt = cardMap.find(rawName);
         //Find reference: https://thispointer.com/how-check-if-a-given-key-exists-in

          // Find the element with key [cardName]
         // Check whether it exists in the cardMap or not
         if(cardIt!= cardMap.end()){
         //Element is found
         vector<int> cardValue = cardMap.at(rawName);  //Access the value from iterat
     //Retrieve the data
         int health = cardValue[0];
         int melee = cardValue[1];
         int shooting = cardValue[2];
         int defense = cardValue[3];
         //Set player's status value
         player.setName(rawName);
         player.setHealth(health);
     player.setMaxHealth(health);
         player.setMAtk(melee);
         player.setSAtk(shooting);
         player.setDefense(defense);
         //Display the status on text labels
     PlayerNameLabel->Text = player.getName();
         PlayerHealthLabel->Text = player.getHealth();
         PlayerMATKLabel->Text = player.getMAtk();
         PlayerSATKLabel->Text = player.getSAtk();
         PlayerMeleeDefenseLabel->Text = player.getDefense();
     PlayerRangeDefenseLabel->Text = player.getDefense();
     //Change displayed panel screen to Combat
         SetupPanel->Visible=false;
         CombatPanel->Visible=true;
         }
```

Image 3.2 Map Find Algorithm

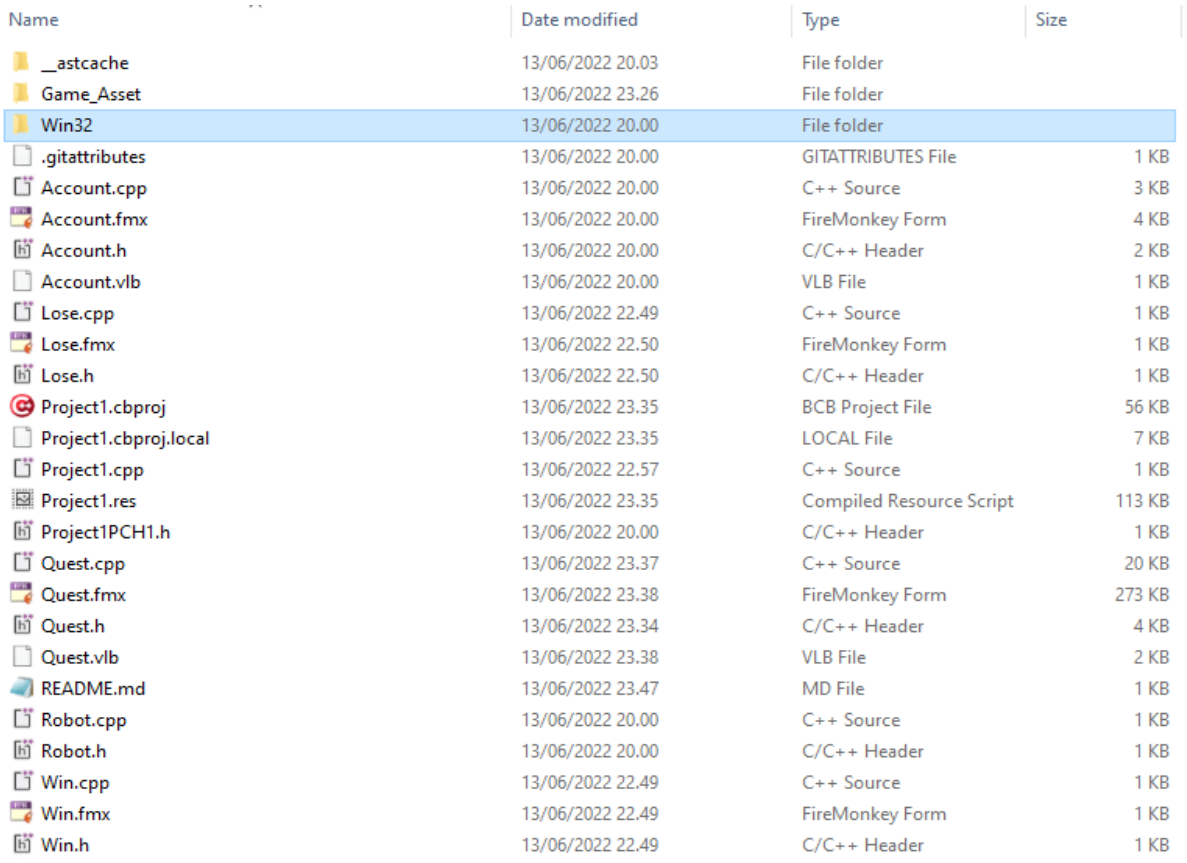
Game Description

The game initiates with the player starting at the login interface, where the player logs into the game. The game will then transition with the player placed into battle and facing waves of AI enemies. The player will be granted an interface and will be able to select between a melee attack or a ranged attack. The enemy will initiate self-defense via an anti-melee or an anti-range. The enemy uses random number generation to determine which defense they will do.

Upon being executed, the decisions made by the player and the enemy will result in numerous cycles of attacking and defending. If the player achieves victory, they will transition to the next stage and recover all lost health points. If the player loses then the game will conclude.

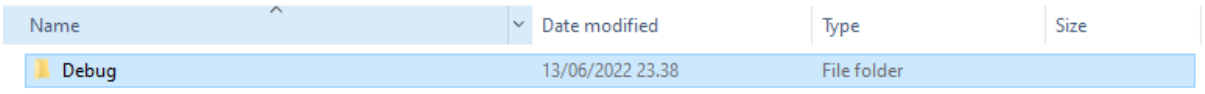
Program manual

The .exe file is available in the Win32/Debug folder. The code/script responsible for the program can be found in the 'Quest' and 'Project1' files.
Step 1: Open the 'Win32' Folder



Name	Date modified	Type	Size
__astcache	13/06/2022 20.03	File folder	
Game_Asset	13/06/2022 23.26	File folder	
Win32	13/06/2022 20.00	File folder	
.gitattributes	13/06/2022 20.00	GITATTRIBUTES File	1 KB
Account.cpp	13/06/2022 20.00	C++ Source	3 KB
Account.fmx	13/06/2022 20.00	FireMonkey Form	4 KB
Account.h	13/06/2022 20.00	C/C++ Header	2 KB
Account.vlb	13/06/2022 20.00	VLB File	1 KB
Lose.cpp	13/06/2022 22.49	C++ Source	1 KB
Lose.fmx	13/06/2022 22.50	FireMonkey Form	1 KB
Lose.h	13/06/2022 22.50	C/C++ Header	1 KB
Project1.cbproj	13/06/2022 23.35	BCB Project File	56 KB
Project1.cbproj.local	13/06/2022 23.35	LOCAL File	7 KB
Project1.cpp	13/06/2022 22.57	C++ Source	1 KB
Project1.res	13/06/2022 23.35	Compiled Resource Script	113 KB
Project1PCH1.h	13/06/2022 20.00	C/C++ Header	1 KB
Quest.cpp	13/06/2022 23.37	C++ Source	20 KB
Quest.fmx	13/06/2022 23.38	FireMonkey Form	273 KB
Quest.h	13/06/2022 23.34	C/C++ Header	4 KB
Quest.vlb	13/06/2022 23.38	VLB File	2 KB
README.md	13/06/2022 23.47	MD File	1 KB
Robot.cpp	13/06/2022 20.00	C++ Source	1 KB
Robot.h	13/06/2022 20.00	C/C++ Header	1 KB
Win.cpp	13/06/2022 22.49	C++ Source	1 KB
Win.fmx	13/06/2022 22.49	FireMonkey Form	1 KB
Win.h	13/06/2022 22.49	C/C++ Header	1 KB

Step 2: Open the 'Debug' Folder



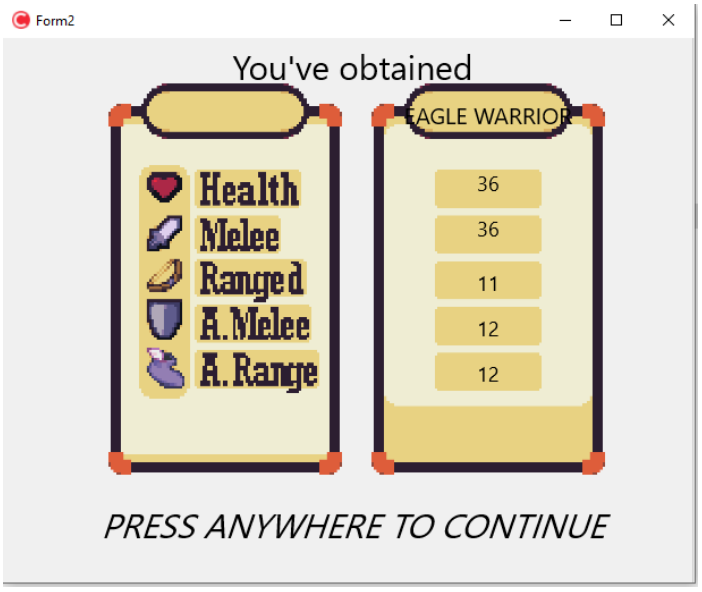
Name	Date modified	Type	Size
Debug	13/06/2022 23.38	File folder	

Step 3: Open Project1.exe

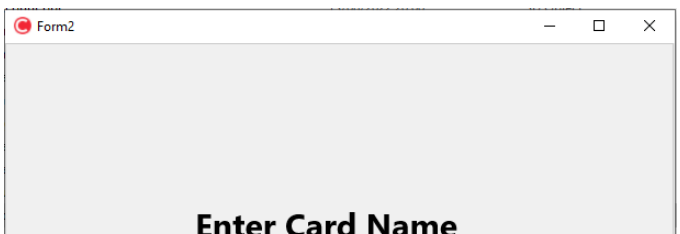
Name	Date modified	Type	Size
Account.obj	13/06/2022 20.00	3D Object	989 KB
cards.txt	13/06/2022 23.38	Text Document	2 KB
CharacterForm.obj	13/06/2022 20.00	3D Object	566 KB
Classes.obj	13/06/2022 20.00	3D Object	41 KB
GameOver.obj	13/06/2022 20.00	3D Object	538 KB
LoginForm.obj	13/06/2022 20.00	3D Object	978 KB
MainForm.obj	13/06/2022 20.00	3D Object	628 KB
Menu.obj	13/06/2022 20.00	3D Object	538 KB
NumberWizard.obj	13/06/2022 20.00	3D Object	631 KB
Project1.exe	13/06/2022 23.38	Application	600 KB
Project1.ilc	13/06/2022 23.38	ILC File	1.472 KB
Project1.ild	13/06/2022 23.38	ILD File	192 KB
Project1.ilf	13/06/2022 23.38	ILF File	5.632 KB
Project1.ils	13/06/2022 23.38	ILS File	18.560 KB
Project1.map	13/06/2022 23.38	Linker Address Map	1 KB
Project1.obj	13/06/2022 23.09	3D Object	525 KB
Project1.pdi	13/06/2022 23.38	PDI File	1 KB
Project1.tds	13/06/2022 23.38	TDS File	13.248 KB
Project1PCH1.pch	13/06/2022 20.00	Precompiled Header File	30.297 KB
Quest.obj	13/06/2022 23.38	3D Object	1.566 KB
RegistrationForm.obj	13/06/2022 20.00	3D Object	848 KB
robots.txt	13/06/2022 20.00	Text Document	1 KB
Unit3.obj	13/06/2022 20.00	3D Object	538 KB

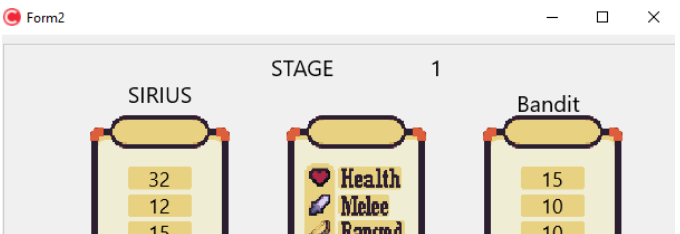
Execution of The Program

Step 1: Receive a random robot card.

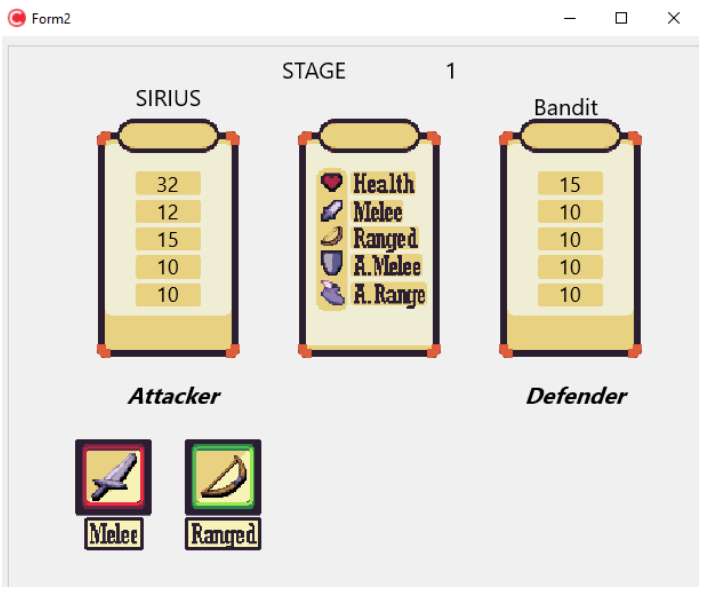


Step 2: Enter owned Card name.





Step 3: Try to win in a combat system that depends on RNG.



Step 4: Either win or lose.

Resources

https://www.youtube.com/watch?v=nxHnnQToy5o&list=PL43pGnjiVwgQakzRxpt2amqN9f7-tRtc_&index=3
https://www.youtube.com/watch?v=EGCuStJyuVE&list=PL43pGnjiVwgQakzRxpt2amqN9f7-tRtc_&index=2
https://www.youtube.com/watch?v=UJI_SdxAtzk
https://thispointer.com/how-check-if-a-given-key-exists-in-a-map-c/
https://www.geeksforgeeks.org/difference-between-vector-and-list/
https://stackoverflow.com/questions/2074970/stack-and-queue-why
https://www.delftstack.com/howto/cpp/cpp-timing/#use-stdchronohigh_resolution_clocknow-and-stdchronoduration_cast-to-measure-execution-time-of-a-function