# ECE 218

## Fall 2022

## Exam 2 – Take Home

**(open book / open notes)**
**This is an individual exam. You must complete it on your own. Any questions should be directed to the course instructor.**

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**Honor Code: On my honor, I have neither given nor received any aid on this exam**

(Please sign)

Problem Description:
For this system, you are going to use C++ Standard Template Library implementations of ‘vector’, ‘stack’, and ‘map’ to implement a simple game of Blackjack You will then use that to test if the player or dealer has any advantage if the deck of cards is randomly shuffled.

Function Design:
Comments in the code.

Sample Execution:
Below

```
=Start Hand 1=====================
=Player==============
H10 H5  --> 15
=Dealer==============
C4 SK HA H9  --> 24
Dealer Bust, Player Wins!!
=End Hand 1=====================

=Start Hand 2=====================
=Player==============
S8 H6 D7  --> 21
=Dealer==============
C10 CJ  --> 20
Player Wins!!
=End Hand 2=====================

=Start Hand 3=====================
=Player==============
DK C5  --> 15
=Dealer==============
CK DJ  --> 20
Dealer Wins!!
=End Hand 3=====================

=Start Hand 4=====================
=Player==============
H7 CA S5 SA S9  --> 23
=Dealer==============
H8 DQ  --> 18
Player Bust, Dealer Wins!!
=End Hand 4=====================

=Start Hand 5=====================
=Player==============
D10 HJ  --> 20
=Dealer==============
D3 D8 C7 DA H2  --> 21
Dealer Wins!!
=End Hand 5=====================

=Start Hand 6=====================
=Player==============
H4 D6 C8  --> 18
=Dealer==============
SJ D4 C6 C3  --> 23
Dealer Bust, Player Wins!!
=End Hand 6=====================

=Start Hand 7=====================
=Player==============
C9 S6  --> 15
=Dealer==============
SQ CQ  --> 20
Dealer Wins!!
=End Hand 7=====================

=Start Hand 8=====================
=Player==============
C2 HQ S3 D2 D5  --> 22
=Dealer==============
HK D9  --> 19
Player Bust, Dealer Wins!!
=End Hand 8=====================

====Deck Empty===Game Over====
2
Player won 3 hands
Dealer won 5 hands
```

Conclusion:
I was able to successfully create a game resembling Blackjack. I created an algorithm that generated not only the game's outcome, as well as the probability of a player and dealer winning for a singular deck of cards. I attempted extra credit as well.

Code:

```
#include <iostream>
#include <fstream>
#include <map>
#include <stack>
#include <vector>
#include "support.h"
using namespace std;
int playerwon =0;       //global to count how many times the player won
int player2won =0;      //global to count how many times the player2 won
int dealerwon =0;       //global to count how many times the dealer won
int runnum=1;       //global to count how many times the game ran: hand number

struct card{
   char suit;
   string value;
};

map<string,int> cvalue;
void mapinput(){
//==========INSERT VALUES INTO MAP==========
cvalue.insert(make_pair("A",1));
cvalue.insert(make_pair("2",2));
cvalue.insert(make_pair("3",3));
cvalue.insert(make_pair("4",4));
cvalue.insert(make_pair("5",5));
cvalue.insert(make_pair("6",6));
cvalue.insert(make_pair("7",7));
cvalue.insert(make_pair("8",8));
cvalue.insert(make_pair("9",9));
cvalue.insert(make_pair("10",10));
cvalue.insert(make_pair("J",10));
cvalue.insert(make_pair("Q",10));
cvalue.insert(make_pair("K",10));
}

ostream& operator<<(ostream &out,card &c){
```

```
    return out <<c.suit<<c.value;     //operator to print out the card suite and values
}

void readData(string filename, card* cardsarr, int size){
ifstream fin;
fin.open(filename);
card c;
    for(int i=0; i<size; i++){      //read in suite and value
        fin>>c.suit>>c.value;
        cardsarr[i] = c;        //fill the array from the file
        }
 fin.close();
}

void readData2(string filename, card* cardsarr, int size){
ifstream fin;
fin.open(filename);
card c;
    for(int i=0; i<size; i++){      //read in suite and value
        fin>>c.suit>>c.value;
        cardsarr[i] = c;        //fill the array from the file
        }

 fin.close();
}

void printArray(card* cardsarr, int size){
    for(int i=0; i<size; i++){
        cout<<cardsarr[i]<<" ";     //print out the values of array
    }
}

void printVector(vector<card> cardsvec)
{
    for (int i = 0; i < cardsvec.size(); i++) {     //loop to print out the values of the vector
        cout << cardsvec[i]<<" ";
    }
}

int scoreHand(vector<card> cardsvec){
    int sum =0;     //variable to continure a summation of different values of a card
```

```
    for(int i=0; i<cardsvec.size(); i++){
        sum= sum+ cvalue[cardsvec[i].value];        //summation of the card values
    }
    return sum;
}

 void shuffle(card* cardsarr, int size) {
        int cardsstruck=0;      //variable to count the amount of cards extracted from original
        card cardsshuffled[size];       //new array to insert the extracted cards into

     for (int i = size - 1; i > 0; i--) { // for loop to shuffle
         int j = randomInRange(0, size-1);      //variable that randomly chooses a value to take out of the array
         cardsshuffled[cardsstruck] = cardsarr[j];      //inserting the extracted card into new array
         cardsarr[j] = cardsarr[i];                     //inserting all values of my original vector into the same vector of random values
         cardsarr[i] = cardsshuffled[cardsstruck] ;     //inserting the shuffled cards from new array into original array
     }
}
void dealplayer(stack<card> &deck, vector<card> &player, vector<card> &dealer){     //deal 2 cards to player at the beginning of
each hand
    player.push_back(deck.top());       //adding value to player vector from deck
    deck.pop();     //removing card from top of deck

}

void dealdealer(stack<card> &deck, vector<card> &player, vector<card> &dealer){     //deal 2 cards to dealer at the beginning of
each hand
    dealer.push_back(deck.top());       //adding value to player vector from deck
    deck.pop();     //removing card from top of deck

}

void dealplayer2(stack<card> &deck, vector<card> &player2, vector<card> &dealer){     //deal 2 cards to dealer at the beginning of
each hand
    player2.push_back(deck.top());       //adding value to player vector from deck
    deck.pop();     //removing card from top of deck

}
void play(stack<card> &deck, vector<card> &player, vector<card> &dealer){
    dealplayer(deck, player, dealer);       //deal the player
    dealdealer(deck, player, dealer);       //deal the dealer
    dealplayer(deck, player, dealer);       //deal the player
```

```
dealdealer(deck, player, dealer);       //deal the dealer
while(deck.size()>4){       //while loop for as long as the deck has atleast 4 cards to deal out
if(scoreHand(player)==21 && scoreHand(dealer)!=21){     //player has 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player=============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Dealer=============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Player Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    playerwon++;        //increment the amount of times the player won
    runnum++;       //increment the amount of hands played
    player.clear();     //clear the hand of the player
    dealer.clear();     //clear the hand of the dealer
    player.push_back(deck.top());               //deal out the cards again for next hand
    deck.pop();     //remove the top element or card of the deck
    dealer.push_back(deck.top());               //deal out the cards again for next hand
    deck.pop();
    player.push_back(deck.top());               //deal out the cards again for next hand
    deck.pop();
    dealer.push_back(deck.top());               //deal out the cards again for next hand
    deck.pop();
    continue;       //run through the while loop again from the top
}

//below is practically the same code but with different if statements for each case

if(scoreHand(player)>21 && scoreHand(dealer)<=21){       //player over 21 and dealer is not
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player=============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Dealer=============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Player Bust, Dealer Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    dealerwon ++;       //increment the amount of times the dealer won
    runnum++;
```

```
    player.clear();
    dealer.clear();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    continue;
}

if(scoreHand(player)>=18){};        //player between 18 and 21... do nothing

if(scoreHand(player)<=12){      //player has less than 13 so draw until 17 or more
    while(scoreHand(player)<=17 ){
        if(deck.size()==0) break;       //if there are no cards left... end the hand
        player.push_back(deck.top());       //player hits
        deck.pop();
    }
}

 if(scoreHand(player)>=13 && scoreHand(player)<=17){        //player between 13 and 17
    int hitstand = randomInRange(0,1);      //number generator between 0 and 1 to see if the player will hit or stand
    if(hitstand){
        if(deck.size()==0) break;
        player.push_back(deck.top());
        deck.pop();
    }
}

if(scoreHand(dealer)==21){      //dealer has 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Dealer Wins!!"<<endl;
```

```
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    dealerwon++;
    runnum++;
    player.clear();
    dealer.clear();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    continue;
}

if(scoreHand(dealer)>21 && scoreHand(player)<=21){       //dealer over 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Dealer Bust, Player Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    playerwon ++;
    runnum++;
    player.clear();
    dealer.clear();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    continue;
}
```

```
if(scoreHand(dealer)>=17 && scoreHand(dealer)<=21){};       //dealer is betwen 17 and 21

if(scoreHand(dealer)<17){       //dealer below 17
    while(scoreHand(dealer)<17 ||scoreHand(dealer)<21){
    if(deck.size()==0) break;
    dealer.push_back(deck.top());
    deck.pop();
    if(scoreHand(dealer)>=21) break;
    }
}

if(scoreHand(player)==scoreHand(dealer) && scoreHand(player)!=21 &&scoreHand(player)<21){      //scores are equal but not 21
     cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Player Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    playerwon++;
    runnum++;
    player.clear();
    dealer.clear();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    continue;
}

if(scoreHand(player)<=scoreHand(dealer) && scoreHand(player)>21){      //both bust but the player has less... player wins
     cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
```

```
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Player Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    playerwon++;
    runnum++;
    player.clear();
    dealer.clear();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    continue;
}

if(scoreHand(dealer)<=scoreHand(player) && scoreHand(dealer)>21){      //scores are equal but not 21
     cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Dealer Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    dealerwon++;
    runnum++;
    player.clear();
    dealer.clear();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
    deck.pop();
    player.push_back(deck.top());
    deck.pop();
    dealer.push_back(deck.top());
```

```
        deck.pop();
        continue;
    }

    if(scoreHand(dealer)<scoreHand(player) && scoreHand(dealer)<21&& scoreHand(player)<21){    //player has higher score than
dealer below 21
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        playerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player.push_back(deck.top());
        deck.pop();
        dealer.push_back(deck.top());
        deck.pop();
        player.push_back(deck.top());
        deck.pop();
        dealer.push_back(deck.top());
        deck.pop();
        continue;
    }

    if(scoreHand(dealer)>scoreHand(player) && scoreHand(dealer)<21&& scoreHand(player)<21){    //dealer has higher score than
player
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
```

```
        dealerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player.push_back(deck.top());
        deck.pop();
        dealer.push_back(deck.top());
        deck.pop();
        player.push_back(deck.top());
        deck.pop();
        dealer.push_back(deck.top());
        deck.pop();
        continue;
    }

}
    cout<<"====Deck Empty===Game Over===="<<endl;
    cout<<endl<<endl<<"Player won "<<playerwon<<" hands"<<endl<<"Dealer won "<<dealerwon<<" hands"<<endl;
}

void play2(stack<card> &deck, vector<card> &player, vector<card> &player2, vector<card> &dealer){
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    while(deck.size()>4){
    if(scoreHand(player)==21 && scoreHand(dealer)!=21 && scoreHand(player2)!=21){       //player1 has 21, wins
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
```

```
    playerwon++;
    runnum++;
    player.clear();
    dealer.clear();
    player2.clear();
    dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
continue;
}

if(scoreHand(player)!=21 && scoreHand(dealer)!=21 && scoreHand(player2)==21){       //player2 has 21, wins
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Player2==============="<<endl;
    printVector(player2);
    cout<<" --> "<<scoreHand(player2)<<endl;
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Player2 Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    player2won++;
    runnum++;
    player.clear();
    dealer.clear();
    player2.clear();
    dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
continue;
}
```

```
    if(scoreHand(player)>21 && scoreHand(dealer)<21 && scoreHand(player2)<21 && scoreHand(dealer)>scoreHand(player2)){
//player1 has 21, wins
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(player2)>21 && scoreHand(dealer)<21 && scoreHand(player)<21 && scoreHand(dealer)>scoreHand(player)){
//player1 has 21, wins
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
```

```
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)>21 && scoreHand(player)>21 && scoreHand(player2)>21 && scoreHand(dealer)>scoreHand(player2) &&
scoreHand(player)<scoreHand(dealer)){       //player1 has 21, wins
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player==============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2==============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer==============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Players Win!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        playerwon++;
        player2won++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
```

```
continue;
}

if(scoreHand(player)>21 && scoreHand(player2)>21){       //player over 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player=============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Player2=============="<<endl;
    printVector(player2);
    cout<<" --> "<<scoreHand(player2)<<endl;
    cout<<"=Dealer=============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Players Bust, Dealer Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    dealerwon ++;
    runnum++;
    player.clear();
    dealer.clear();
    player2.clear();
    dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
continue;
}

if(scoreHand(player)>=18){};        //player between 18 and 21

if(scoreHand(player2)>=18){};       //player2 between 18 and 21

if(scoreHand(player)<=12){
    while(scoreHand(player)<=17 ){
        if(deck.size()==0) break;
        player.push_back(deck.top());
        deck.pop();
    }
}
```

```
if(scoreHand(player2)<=12){
    while(scoreHand(player2)<=17 ){
        if(deck.size()==0) break;
        player2.push_back(deck.top());
        deck.pop();
    }
}

 if(scoreHand(player)>=13 && scoreHand(player)<=17){        //player between 13 and 17
    int hitstand = randomInRange(0,1);
    if(hitstand){
        if(deck.size()==0) break;
        player.push_back(deck.top());
        deck.pop();
    }
}

if(scoreHand(player2)>=13 && scoreHand(player2)<=17){       //player2 between 13 and 17
    int hitstand = randomInRange(0,1);
    if(hitstand){
        if(deck.size()==0) break;
        player2.push_back(deck.top());
        deck.pop();
    }
}

if(scoreHand(dealer)==21){      //dealer has 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player=============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Player2=============="<<endl;
    printVector(player2);
    cout<<" --> "<<scoreHand(player2)<<endl;
    cout<<"=Dealer=============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Dealer Wins!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    dealerwon++;
```

```
    runnum++;
    player.clear();
    dealer.clear();
    player2.clear();
    dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
continue;
}

if(scoreHand(dealer)>21 && scoreHand(player)<=21 && scoreHand(player2)<=21){       //dealer over 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player==============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Player2==============="<<endl;
    printVector(player2);
    cout<<" --> "<<scoreHand(player2)<<endl;
    cout<<"=Dealer==============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Dealer Bust, Players Win!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    playerwon ++;
    player2won++;
    runnum++;
    player.clear();
    dealer.clear();
    player2.clear();
    dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
continue;
}
```

```
if(scoreHand(dealer)>21 && scoreHand(player)>21 && scoreHand(player2)<=21){      //dealer over 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player=============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Player2=============="<<endl;
    printVector(player2);
    cout<<" --> "<<scoreHand(player2)<<endl;
    cout<<"=Dealer=============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Player2 Win!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    player2won++;
    runnum++;
    player.clear();
    dealer.clear();
    player2.clear();
    dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
dealplayer(deck, player, dealer);
dealplayer2(deck, player2, dealer);
dealdealer(deck, player, dealer);
continue;
}

if(scoreHand(dealer)>21 && scoreHand(player)<=21 && scoreHand(player2)>21){      //dealer over 21
    cout<<"=Start Hand "<<runnum<<"======================"<<endl;
    cout<<"=Player=============="<<endl;
    printVector(player);
    cout<<" --> "<<scoreHand(player)<<endl;
    cout<<"=Player2=============="<<endl;
    printVector(player2);
    cout<<" --> "<<scoreHand(player2)<<endl;
    cout<<"=Dealer=============="<<endl;
    printVector(dealer);
    cout<<" --> "<<scoreHand(dealer)<<endl;
    cout<<"Players Win!!"<<endl;
    cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
    playerwon ++;
```

```
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)>21 && scoreHand(player)<=21 && scoreHand(player2)>21 && scoreHand(player)<scoreHand(dealer)){
//dealer over 21
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player==============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2==============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer==============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon ++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }
```

```
    if(scoreHand(dealer)>21 && scoreHand(player)<=21 && scoreHand(player2)>21 && scoreHand(player)>scoreHand(dealer)){
//dealer over 21
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        playerwon ++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)>21 && scoreHand(player2)<=21 && scoreHand(player)>21 && scoreHand(player2)<scoreHand(dealer)){
//dealer over 21
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
```

```
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon ++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)>21 && scoreHand(player2)<=21 && scoreHand(player)>21 && scoreHand(player2)>scoreHand(dealer)){
//dealer over 21
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player==============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2==============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer==============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player2 Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon ++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
```

```
    }

    if(scoreHand(dealer)>=17 && scoreHand(dealer)<=21){};       //dealer is betwen 17 and 21

    if(scoreHand(dealer)<17){       //dealer below 17       //FIX THIS STATEMENT
        while(scoreHand(dealer)<17){
        if(deck.size()==0) break;
        dealer.push_back(deck.top());
        deck.pop();
        if(scoreHand(dealer)>=21) break;
        }
    }

    if(scoreHand(player)==scoreHand(dealer)==scoreHand(player2) && scoreHand(player)!=21 &&scoreHand(player)<21){
//scores are equal but not 21
         cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player==============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2==============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer==============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Players Win!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        playerwon++;
        player2won++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }
```

```
    if(scoreHand(dealer)<scoreHand(player)<scoreHand(player2) && scoreHand(dealer)<21&&
scoreHand(player)<21&&scoreHand(player2)<21){     //player has higher score than dealer
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player2 Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        player2won++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)<scoreHand(player2)<scoreHand(player) && scoreHand(dealer)<21&&
scoreHand(player)<21&&scoreHand(player2)<21){     //player has higher score than dealer
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player Wins!!"<<endl;
```

```
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        playerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)<scoreHand(player2)<scoreHand(player) && scoreHand(dealer)<21&&
scoreHand(player)<21&&scoreHand(player2)>21){     //player has higher score than dealer
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player==============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2==============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer==============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Player Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        playerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
```

```
    }

    if(scoreHand(dealer)>scoreHand(player2)>=scoreHand(player) && scoreHand(dealer)<21&&
scoreHand(player)<21&&scoreHand(player2)<21){     //player has higher score than dealer
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

    if(scoreHand(dealer)>scoreHand(player)>=scoreHand(player2) && scoreHand(dealer)<21&&
scoreHand(player)<21&&scoreHand(player2)<21){     //player has higher score than dealer
        cout<<"=Start Hand "<<runnum<<"======================"<<endl;
        cout<<"=Player=============="<<endl;
        printVector(player);
        cout<<" --> "<<scoreHand(player)<<endl;
        cout<<"=Player2=============="<<endl;
        printVector(player2);
        cout<<" --> "<<scoreHand(player2)<<endl;
        cout<<"=Dealer=============="<<endl;
        printVector(dealer);
```

```
        cout<<" --> "<<scoreHand(dealer)<<endl;
        cout<<"Dealer Wins!!"<<endl;
        cout<<"=End Hand "<<runnum<<"======================"<<endl<<endl;
        dealerwon++;
        runnum++;
        player.clear();
        dealer.clear();
        player2.clear();
        dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    dealplayer(deck, player, dealer);
    dealplayer2(deck, player2, dealer);
    dealdealer(deck, player, dealer);
    continue;
    }

}
    cout<<"====Deck Empty===Game Over===="<<endl;
    cout<<endl<<endl<<"Player 1 won "<<playerwon<<" hands"<<endl<<"Player 2 won "<<player2won<<" hands"<<endl<<"Dealer
won "<<dealerwon<<" hands"<<endl;
}

int main(){
    srandomdev();
    mapinput();     //function to input all the values in a deck into the map
    stack<card> deck;       //stack of cards
    vector<card> player;        //player vector
    vector<card> player2;       //player2 vector
    vector<card> dealer;        //dealer vector
    vector<card> cardsvec;      //cards vector
    //==========SIZE OF ARRAY==========
    int size =52;

    //==========SIZE OF ARRAY FOR PLAY2==========
    //int size =52*5;

    //==========ARRAY==========
    card cardsarr[52];

    //==========ARRAY FOR PLAY2==========
```

```
//card cardsarr[52*5];

//==========READ DATA==========
readData("cards.txt", cardsarr, 52);

//==========READ FILE FOR PLAY2==========
//readData2("cards2.txt", cardsarr, 52*5);

//==========SHUFFLE==========
shuffle(cardsarr, 52);        //fisher yates algorithm

//==========SHUFFLE2==========
//shuffle(cardsarr, 52*5);        //fisher yates algorithm

//==========FILL DECK FROM ARRAY==========
for(int i=0; i<size; i++) deck.push(cardsarr[i]);

//==========PRINT ARRAY==========
//printArray(cardsarr, 52);

//==========PRINT ARRAY FOR PLAY2==========
//printArray(cardsarr, 52*5);

//==========PRINT VECTOR==========
//for (size_t i = 0; i < 52; ++i)     //fill vector from array
//cardsvec.push_back(cardsarr[i]);
//printVector(cardsvec);        //print the vector

//==========PRINT VECTOR FOR PLAY 2==========
//for (size_t i = 0; i < 52*5; ++i)     //fill vector from array
//cardsvec.push_back(cardsarr[i]);
//printVector(cardsvec);        //print the vector

//==========SCORE HAND==========
//scoreHand(cardsvec);          //calculates the score of a hand

//==========PLAY FUNCTION==========
play(deck, player, dealer);

//==========PLAY2 FUNCTION==========
//play2(deck, player, player2, dealer);
```

```
    return 0;
}
```