# Supplemental Document for Project IV:

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**Date:** 4/29/2022
**Professor:** Dr. Palacios

## Data Structures, Algorithms, and Design Section:

### DSA in Account.cpp and Account.h:

There were pretty much no data structures used in this class as well as in the associated .h file. Likewise, there aren't many algorithms. The only algorithm was in the calcInt method in the Account.cpp file where interest is calculated by multiplying the balance by the monthly interest rate.

### DSA in Checking.cpp and Checking.h:

Like the Account class, there weren't any data structures created in the Checking.cpp file or the Checking.h file. Most of the methods access and modify variables of a given object. In regards to algorithms, when a double amt of money is withdrawn from the account, a check is done to make sure that the user's account has enough of a balance to pay amt dollars. Finally, the last algorithm implemented in the Checking.cpp file is the calculation for the monthly service charge which is calculated by adding a flat fee of 5 and 0.1 multiplied by this month's withdrawals to the current service charges amount.

### Data Structures and Algorithms in Savings.cpp and Savings.h:

There were no data structures implemented in the Savings.cpp file and the Savings.h file. Much like the Checking account, there were some algorithms implemented in the cpp file for Savings. For instance, monthly procedures were calculated - this time slightly differently than in the Checking account. The existing service charge was summed with the current withdrawals for this month if the number of withdrawals was greater than 4. Likewise, if the balance fell below 25 the account status would be changed to inactive.

### DSA in Longhorn.cpp:

In Longhorn.cpp on line 30 we used a result 1D string array to store data on the deposits and withdrawals the user performed on their account. Then on line 93, an Account was declared and would be later dynamically allocated based on a user's preference.  Then in the main method an account object was created on line 288. This stores the user's account. On line 295, the result of the populated string array from line 30 will get stored as the transaction log string  pointer. There weren't any algorithms in our Longhorn.cpp file since most of the heavy lifting was done by the Checking and Saving class method implementations.

### Design Decisions Explained:

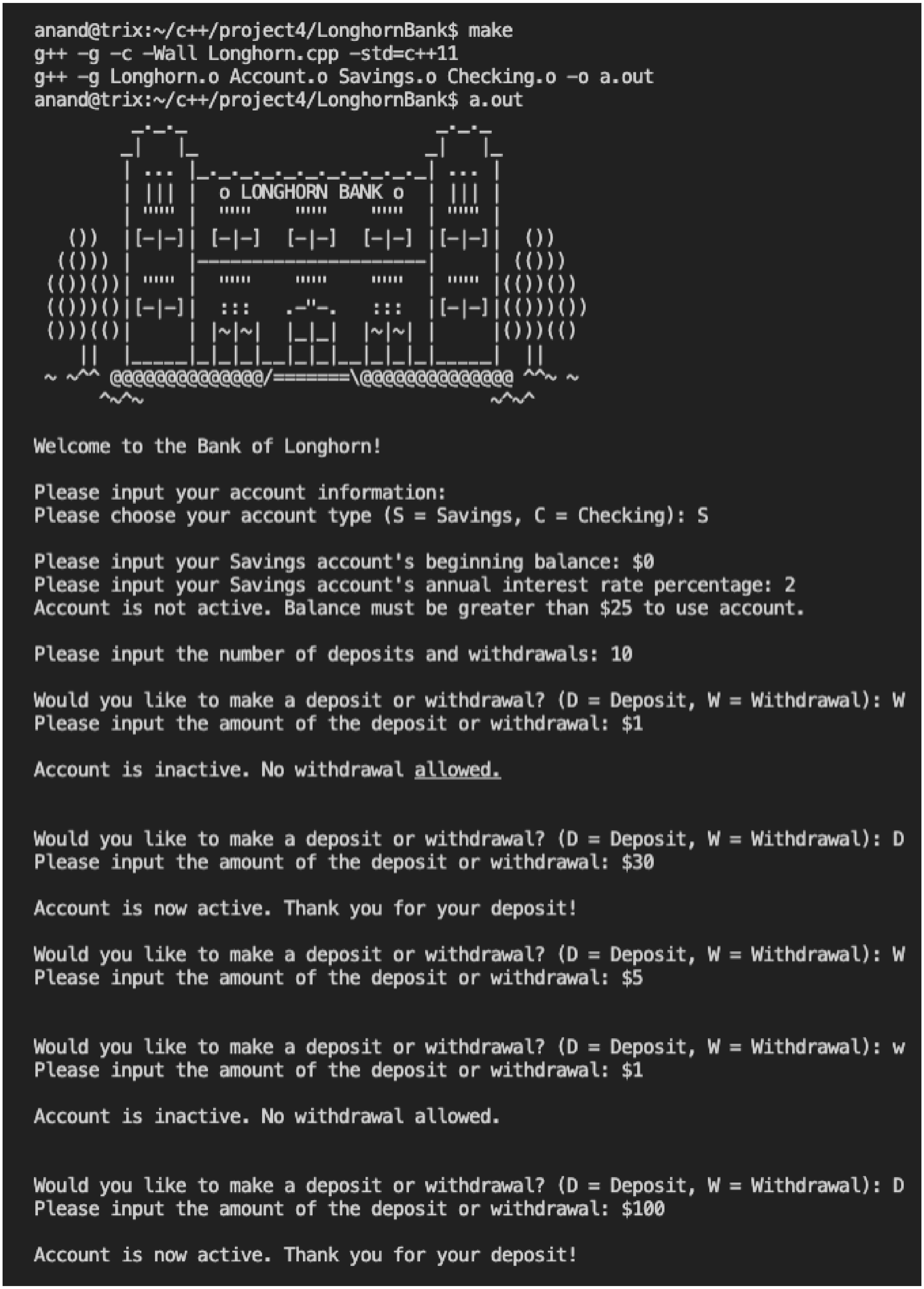
One overarching design decision we made was to make the program such that it would work with any user input and output. An advantage of this decision is that the program is more functional and has more value to the end user. A disadvantage this design has is that overall it is more cumbersome to test many different test cases to ensure the programming is functioning as intended. Another small design decision we made was to continually inform the user of the status of their account for their edification. Another design decision that makes the program more functional is asking the user for a percentage for the annual interest rate as opposed to a decimal. A pro of this desigo n decision is that it requires the user to calculate less things, thus making the program more usable. A con to this design decision is that we have to do more calculation on our end.

**Steps to Run Program:**

1. Ensure you are in the project directory on a linux machine
2. Type and enter ‘make’ to compile the program
3. Type and enter ‘a.out’ to run the program

**Test Cases:**

1.



```
anand@trix:~/c++/project4/LonghornBank$ make
g++ -g -c -Wall Longhorn.cpp -std=c++11
g++ -g Longhorn.o Account.o Savings.o Checking.o -o a.out
anand@trix:~/c++/project4/LonghornBank$ a.out
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Welcome to the Bank of Longhorn!

Please input your account information:
Please choose your account type (S = Savings, C = Checking): S

Please input your Savings account's beginning balance: $0
Please input your Savings account's annual interest rate percentage: 2
Account is not active. Balance must be greater than $25 to use account.

Please input the number of deposits and withdrawals: 10

Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): W
Please input the amount of the deposit or withdrawal: $1

Account is inactive. No withdrawal allowed.


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): D
Please input the amount of the deposit or withdrawal: $30

Account is now active. Thank you for your deposit!

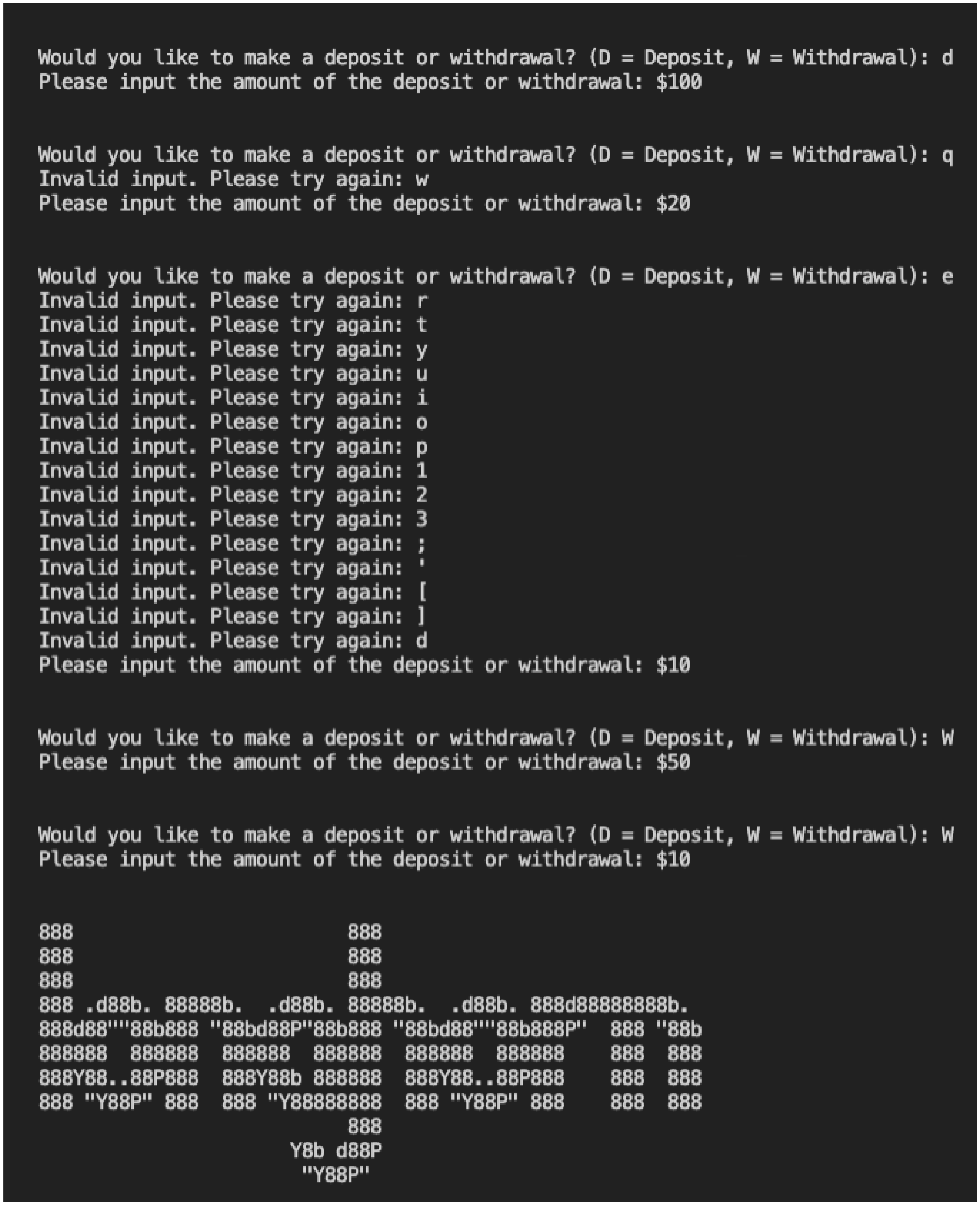
Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): W
Please input the amount of the deposit or withdrawal: $5


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $1

Account is inactive. No withdrawal allowed.


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): D
Please input the amount of the deposit or withdrawal: $100

Account is now active. Thank you for your deposit!
```



```
Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): d
Please input the amount of the deposit or withdrawal: $100


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): q
Invalid input. Please try again: w
Please input the amount of the deposit or withdrawal: $20


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): e
Invalid input. Please try again: r
Invalid input. Please try again: t
Invalid input. Please try again: y
Invalid input. Please try again: u
Invalid input. Please try again: i
Invalid input. Please try again: o
Invalid input. Please try again: p
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Invalid input. Please try again: 2
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Invalid input. Please try again: ;
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Invalid input. Please try again: [
Invalid input. Please try again: ]
Invalid input. Please try again: d
Please input the amount of the deposit or withdrawal: $10


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): W
Please input the amount of the deposit or withdrawal: $50


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): W
Please input the amount of the deposit or withdrawal: $10


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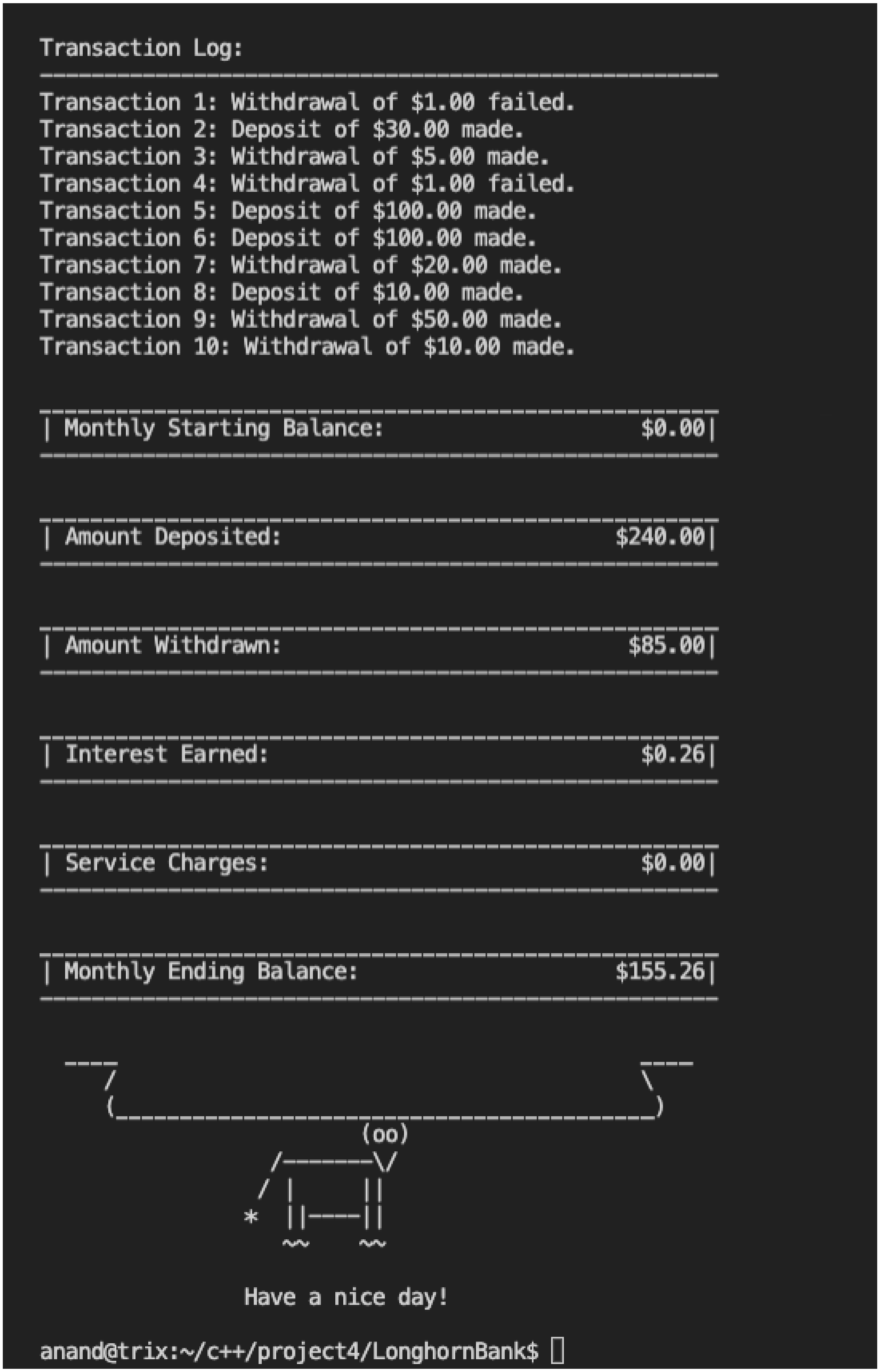

```
Transaction Log:
-----------------------------------------------------
Transaction 1: Withdrawal of $1.00 failed.
Transaction 2: Deposit of $30.00 made.
Transaction 3: Withdrawal of $5.00 made.
Transaction 4: Withdrawal of $1.00 failed.
Transaction 5: Deposit of $100.00 made.
Transaction 6: Deposit of $100.00 made.
Transaction 7: Withdrawal of $20.00 made.
Transaction 8: Deposit of $10.00 made.
Transaction 9: Withdrawal of $50.00 made.
Transaction 10: Withdrawal of $10.00 made.

_____________________________________________________
| Monthly Starting Balance:                    $0.00|
-----------------------------------------------------

_____________________________________________________
| Amount Deposited:                          $240.00|
-----------------------------------------------------

_____________________________________________________
| Amount Withdrawn:                           $85.00|
-----------------------------------------------------

_____________________________________________________
| Interest Earned:                             $0.26|
-----------------------------------------------------

_____________________________________________________
| Service Charges:                             $0.00|
-----------------------------------------------------

_____________________________________________________
| Monthly Ending Balance:                    $155.26|
-----------------------------------------------------

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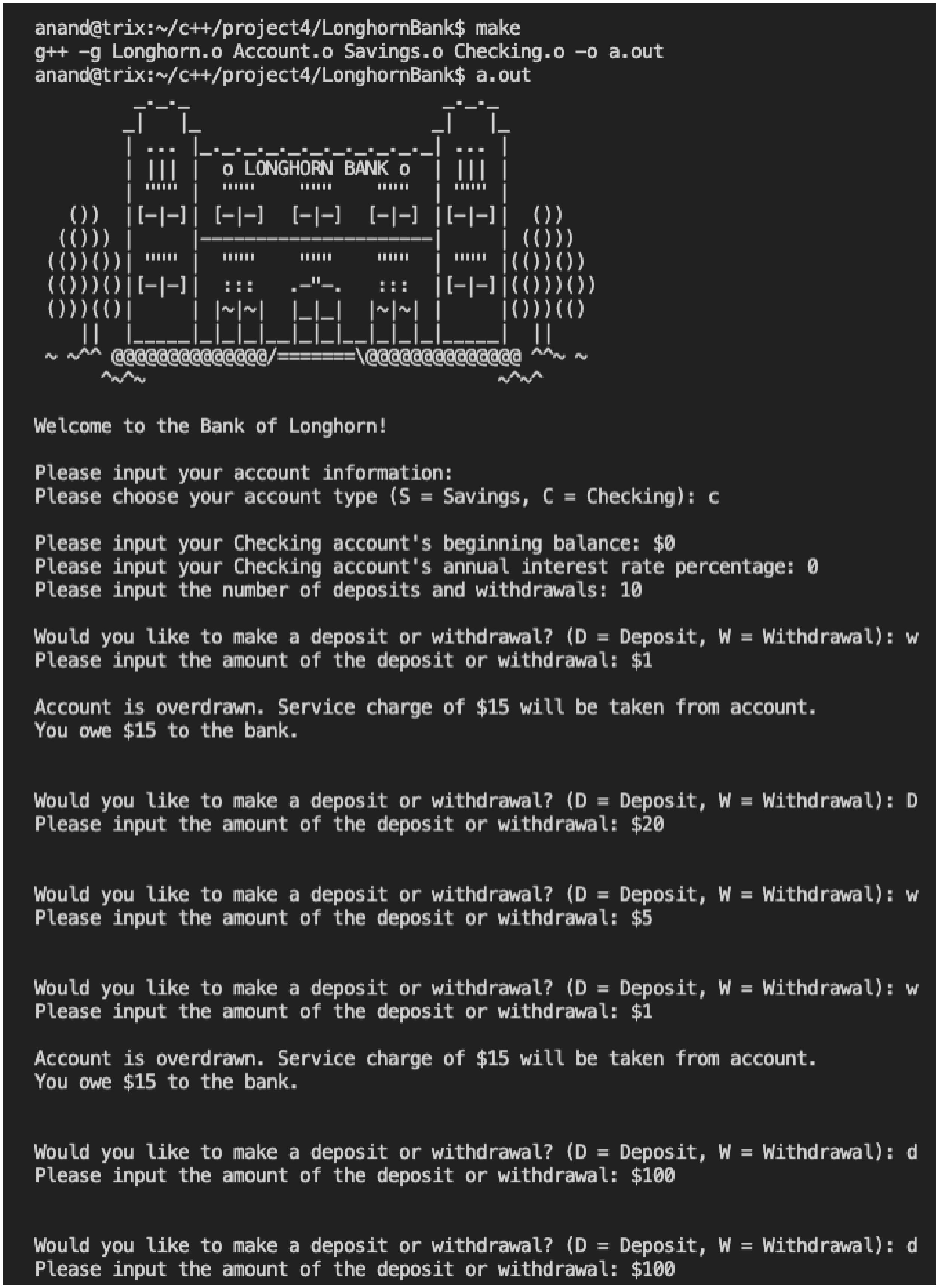
                Have a nice day!

anand@trix:~/c++/project4/LonghornBank$ ▯
```

2.



```
anand@trix:~/c++/project4/LonghornBank$ make
g++ -g Longhorn.o Account.o Savings.o Checking.o -o a.out
anand@trix:~/c++/project4/LonghornBank$ a.out
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Welcome to the Bank of Longhorn!

Please input your account information:
Please choose your account type (S = Savings, C = Checking): c

Please input your Checking account's beginning balance: $0
Please input your Checking account's annual interest rate percentage: 0
Please input the number of deposits and withdrawals: 10

Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $1

Account is overdrawn. Service charge of $15 will be taken from account.
You owe $15 to the bank.


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): D
Please input the amount of the deposit or withdrawal: $20

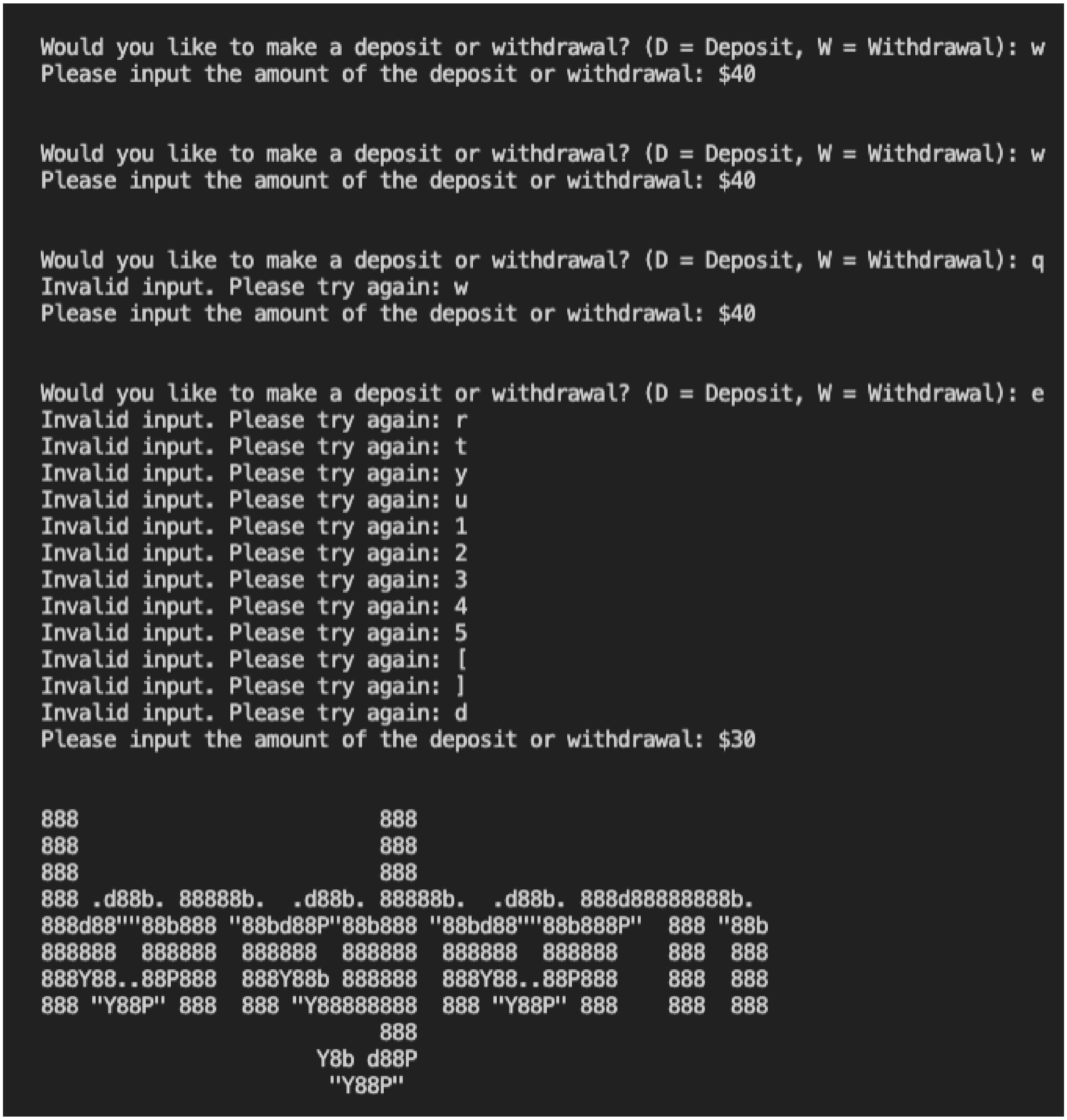

Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $5


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $1

Account is overdrawn. Service charge of $15 will be taken from account.
You owe $15 to the bank.


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): d
Please input the amount of the deposit or withdrawal: $100


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): d
Please input the amount of the deposit or withdrawal: $100
```



```
Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $40


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $40


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): q
Invalid input. Please try again: w
Please input the amount of the deposit or withdrawal: $40


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): e
Invalid input. Please try again: r
Invalid input. Please try again: t
Invalid input. Please try again: y
Invalid input. Please try again: u
Invalid input. Please try again: 1
Invalid input. Please try again: 2
Invalid input. Please try again: 3
Invalid input. Please try again: 4
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Invalid input. Please try again: ]
Invalid input. Please try again: d
Please input the amount of the deposit or withdrawal: $30


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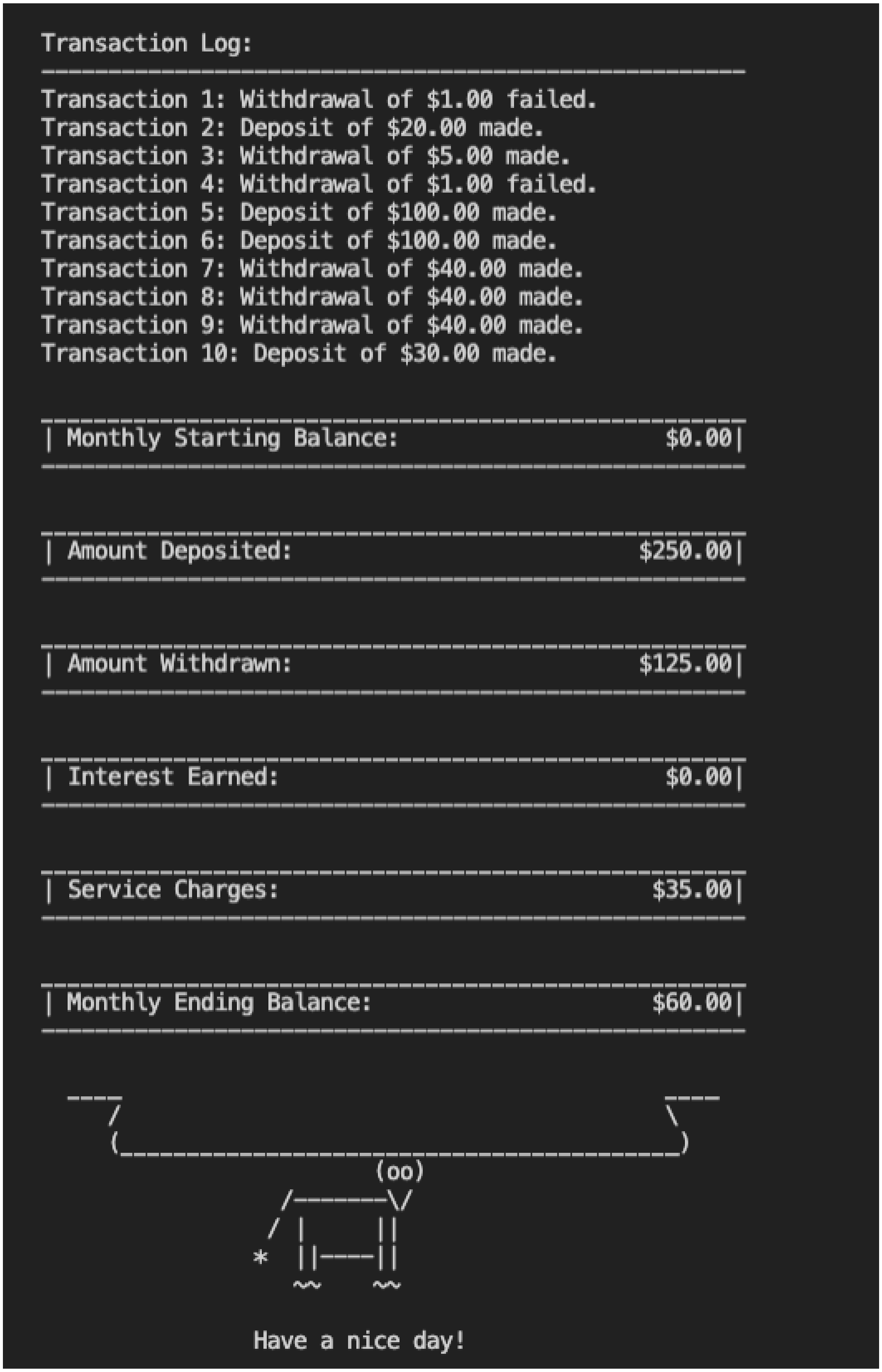

```
Transaction Log:
-----------------------------------------------------
Transaction 1: Withdrawal of $1.00 failed.
Transaction 2: Deposit of $20.00 made.
Transaction 3: Withdrawal of $5.00 made.
Transaction 4: Withdrawal of $1.00 failed.
Transaction 5: Deposit of $100.00 made.
Transaction 6: Deposit of $100.00 made.
Transaction 7: Withdrawal of $40.00 made.
Transaction 8: Withdrawal of $40.00 made.
Transaction 9: Withdrawal of $40.00 made.
Transaction 10: Deposit of $30.00 made.

_____________________________________________________
| Monthly Starting Balance:                    $0.00|
-----------------------------------------------------


_____________________________________________________
| Amount Deposited:                          $250.00|
-----------------------------------------------------


_____________________________________________________
| Amount Withdrawn:                          $125.00|
-----------------------------------------------------


_____________________________________________________
| Interest Earned:                             $0.00|
-----------------------------------------------------


_____________________________________________________
| Service Charges:                            $35.00|
-----------------------------------------------------


_____________________________________________________
| Monthly Ending Balance:                     $60.00|
-----------------------------------------------------


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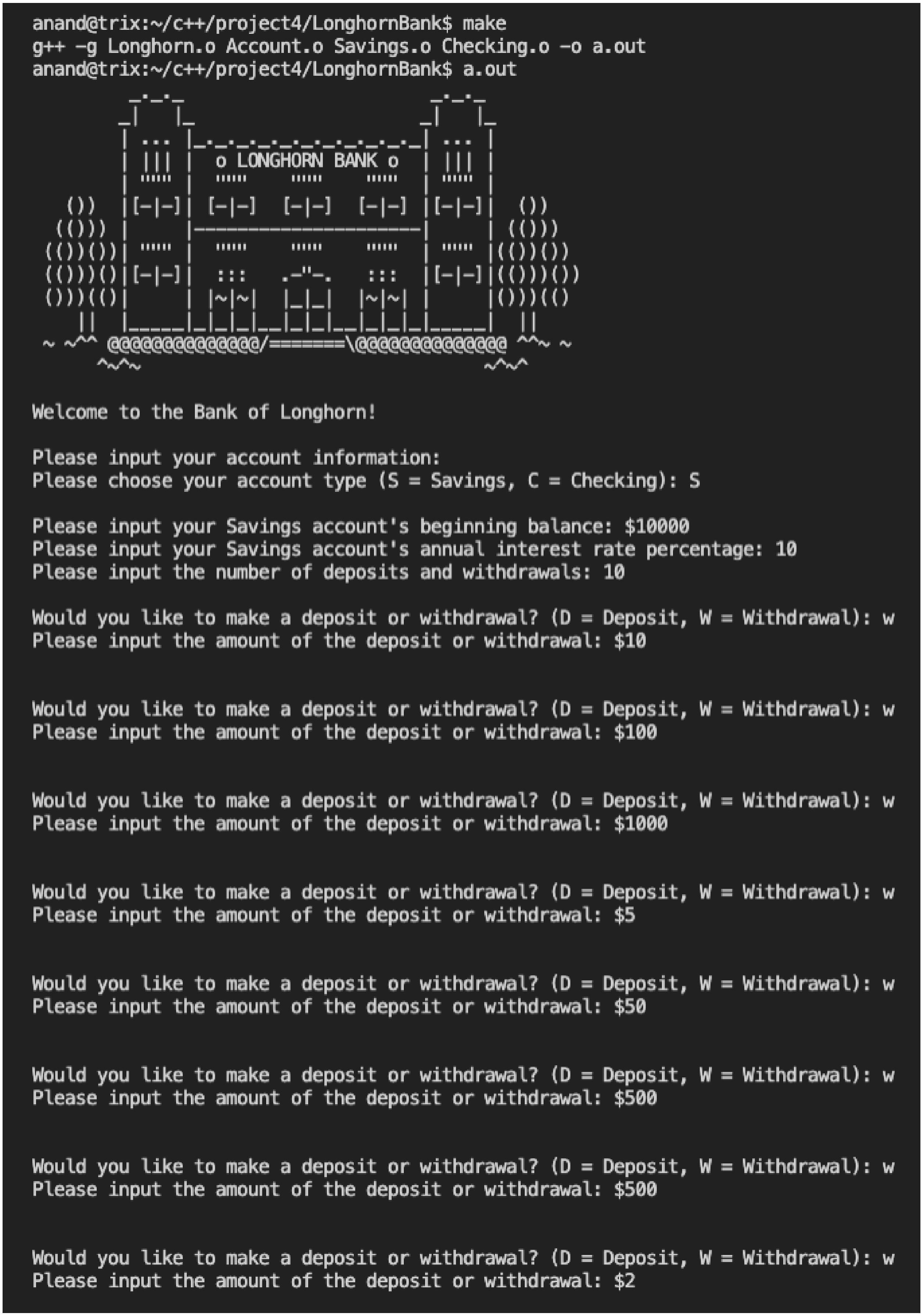
3.



```
anand@trix:~/c++/project4/LonghornBank$ make
g++ -g Longhorn.o Account.o Savings.o Checking.o -o a.out
anand@trix:~/c++/project4/LonghornBank$ a.out
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Welcome to the Bank of Longhorn!

Please input your account information:
Please choose your account type (S = Savings, C = Checking): S

Please input your Savings account's beginning balance: $10000
Please input your Savings account's annual interest rate percentage: 10
Please input the number of deposits and withdrawals: 10

Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $10


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $100


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $1000

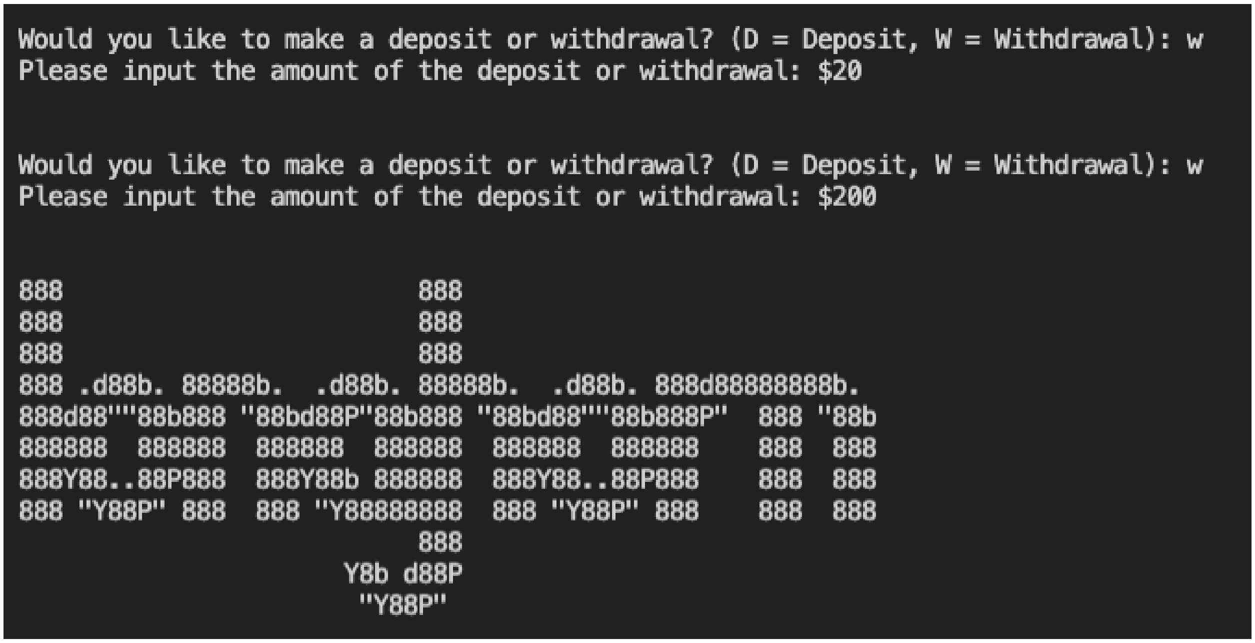

Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $5


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $50


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $500


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $500


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $2
```



```
Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $20


Would you like to make a deposit or withdrawal? (D = Deposit, W = Withdrawal): w
Please input the amount of the deposit or withdrawal: $200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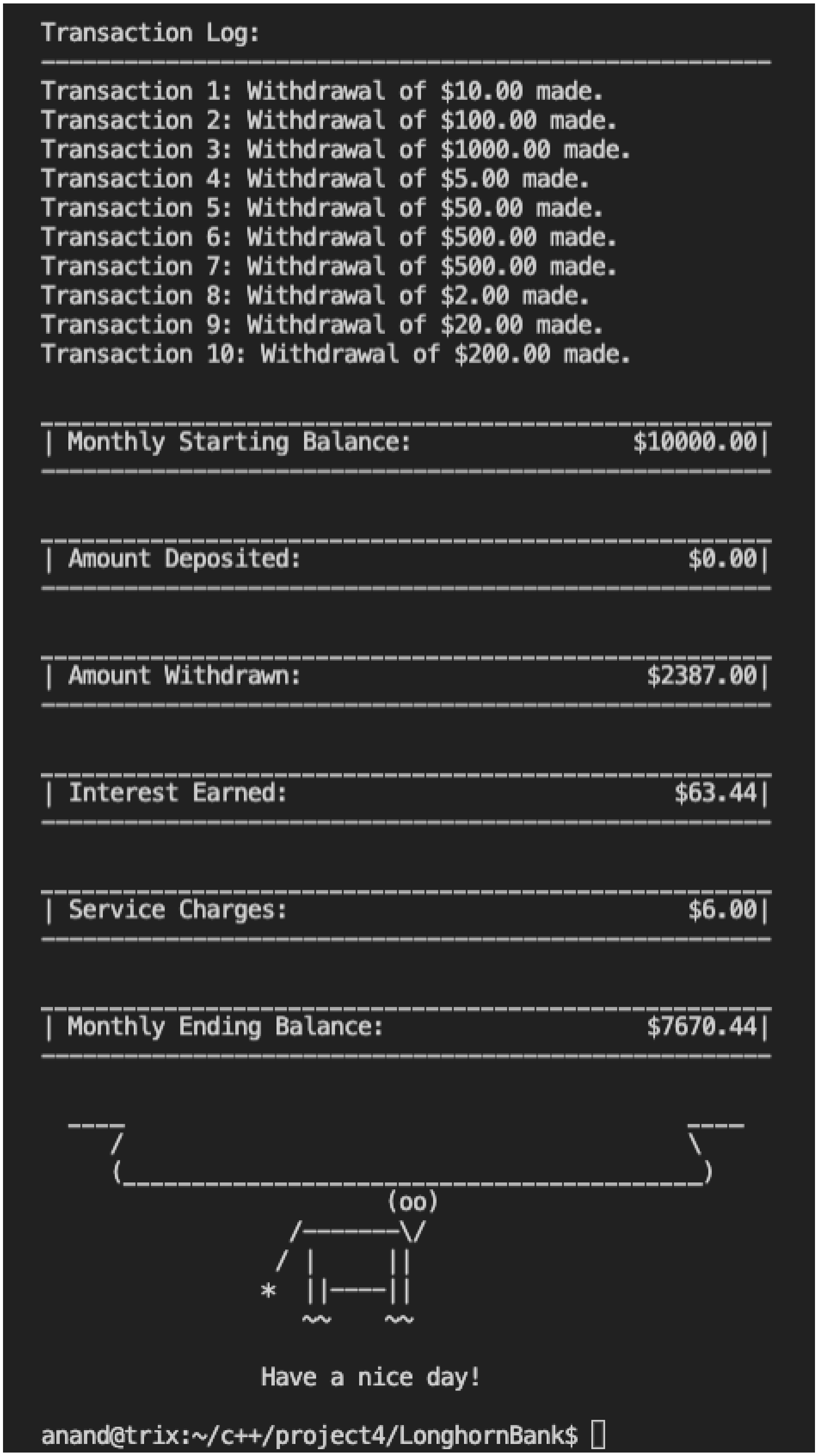

```
Transaction Log:
-----------------------------------------------------
Transaction 1: Withdrawal of $10.00 made.
Transaction 2: Withdrawal of $100.00 made.
Transaction 3: Withdrawal of $1000.00 made.
Transaction 4: Withdrawal of $5.00 made.
Transaction 5: Withdrawal of $50.00 made.
Transaction 6: Withdrawal of $500.00 made.
Transaction 7: Withdrawal of $500.00 made.
Transaction 8: Withdrawal of $2.00 made.
Transaction 9: Withdrawal of $20.00 made.
Transaction 10: Withdrawal of $200.00 made.

_____________________________________________________
| Monthly Starting Balance:                $10000.00|
-----------------------------------------------------


_____________________________________________________
| Amount Deposited:                            $0.00|
-----------------------------------------------------


_____________________________________________________
| Amount Withdrawn:                         $2387.00|
-----------------------------------------------------


_____________________________________________________
| Interest Earned:                            $63.44|
-----------------------------------------------------


_____________________________________________________
| Service Charges:                             $6.00|
-----------------------------------------------------


_____________________________________________________
| Monthly Ending Balance:                   $7670.44|
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                Have a nice day!

anand@trix:~/c++/project4/LonghornBank$ 
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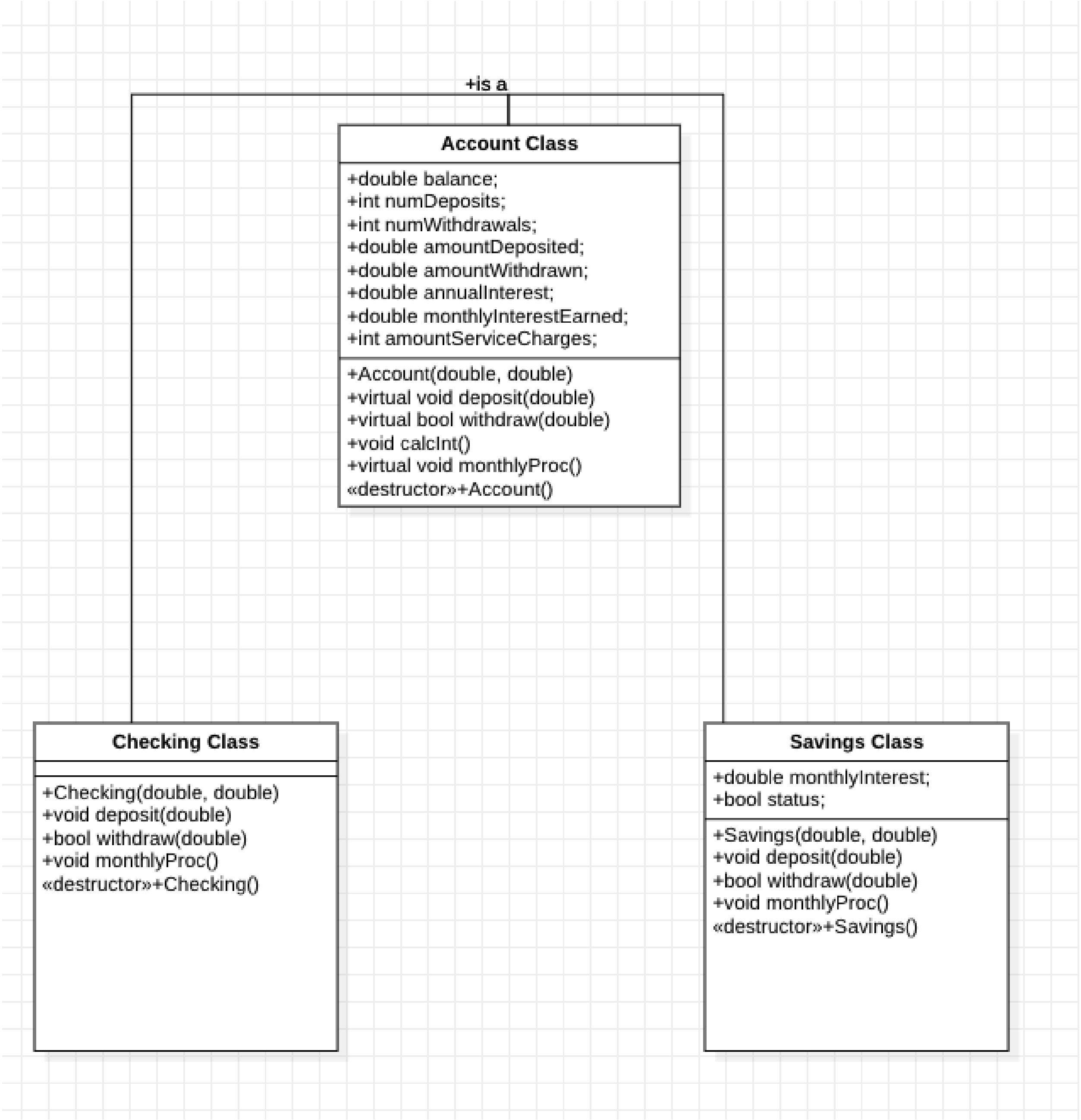
**UML Class Design:**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Account Class
+double balance;
+int numDeposits;
+int numWithdrawals;
+double amountDeposited;
+double amountWithdrawn;
+double annualInterest;
+double monthlyInterestEarned;
+int amountServiceCharges;
+Account(double, double)
+virtual void deposit(double)
+virtual bool withdraw(double)
+void calcInt()
+virtual void monthlyProc()
«destructor»+Account()
Checking Class
+Checking(double, double)
+void deposit(double)
+bool withdraw(double)
+void monthlyProc()
«destructor»+Checking()
Savings Class
+double monthlyInterest;
+bool status;
+Savings(double, double)
+void deposit(double)
+bool withdraw(double)
+void monthlyProc()
«destructor»+Savings()