

Programming and Data Structures
Programming Project 1: Exception Handling, File IO, Abstract Classes, and Interfaces

Objectives of the project

Students should demonstrate the following abilities:

1. Create an exception class that extend one of the Java exception classes
2. Create an abstract class to model common behavior between related classes
3. Extend an abstract class to create concrete classes
4. Use interfaces to model common behavior between unrelated classes
5. Use polymorphism to manipulate subtype instances using the supertype
6. Read data from and write data to text files
7. Handles runtime exceptions using exception handling mechanisms

Project

You are provided with a typical behavior of a bank manager program and the input file used by the program to read/write the information about the bank accounts. Your task is to write the bank manager program with the following requirements:

1. You must use an abstract class to model the common behavior between all bank accounts.
2. You must create concrete classes that extend the abstract class and represent the three types of bank accounts. It is up to you to determine the needed data members and methods.
3. You must use the interface **Comparable** to define how bank accounts are ordered (use the balance). You must create and use an interface **Closable** with only one abstract method **isClosable()** that returns **true** if the object is closable, **false** otherwise.
4. You must read the bank account information from the provided file `accounts.txt` and update the file at the end of the program to keep track of any changes made to the list of bank accounts.
5. You must create an exception class that extends the class **Exception** for invalid bank account numbers. You must also validate the bank account number entered by the user,

throw an exception if the number is invalid, and handle the thrown exception. The bank account numbers read from the file are always valid and should not be checked.

Test your program for the different operations of the bank manager program as illustrated in the sample runs given below.

Draw a UML diagram of the class hierarchy you created and submit it on **Github** as a pdf file. Document your code using Javadoc comments and submit your Java files for the classes and the interface on **Github**.

Important notes:

-
1. The bank account numbers should be created automatically (random number of 6 digits) when the account is created for the first time (add account operation). When the bank account information is read from the file, create a bank account object with the account number read from the file. Do not generate a new account number.
 2. The apply investment risk operation on investment accounts generates a random number between 0 and 1 to simulate the probability for profit or loss (≥ 0.5 means profit and < 0.5 means loss) and generates another random amount (less than 5% of the balance) to deposit to (profit) or withdraw from (loss) the investment bank account.
 3. A bank account is considered closable if its balance falls below \$200.
 4. It is recommended to discuss the design of the class hierarchy needed for this program with your classmates, graders, or the instructor before starting coding.

Sample RUN 1

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylors	5.96	Shares
Savings	232136	Jina, Briddick	18170.25	11.40
Checking	447166	Kanisha, Waycott	146.50	
Investment	137421	Emerson, Bowley	87684.78	Growth
Checking	141964	David, Lin	101.75	

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

1

Enter Account Number (6 digits):

44716

Invalid Account Number.

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

1

Enter Account Number (6 digits):

447766

Account not found.

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

1

Enter Account Number (6 digits):

447166

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

1

Balance: \$146.50

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

2

Enter the amount you want to withdraw:

200

Withdrawal failed. You do not have enough money.

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

2

Enter the amount you want to withdraw:

50

Withdrawal completed. New balance: \$96.50

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

3

Enter the amount you want to deposit:

100

Deposit completed. New balance: \$196.50

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

4

Invalid operation. Not a savings account.

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

5

Invalid operation. Not an investment account.

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

6

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts

6: Sort Account

7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18170.25	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	87684.78	Growth
Checking	141964	David, Lin	101.75	

Select an operation:

1: Find Account

2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

6: Sort Account

7: Exit

1

Enter Account Number (6 digits):

137421

Select an operation:

1: Check Balance

2: Withdraw

3: Deposit

4: Apply Monthly Interest

5: Apply Investment Risk

6: Go Back to the Main Menu

1

Balance: \$87684.78

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

4

Invalid operation. Not a savings account.

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

5

Loss – New balance: \$86940.85

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

6

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts

6: Sort Account

7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18170.25	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	141964	David, Lin	101.75	

Select an operation:

1: Find Account

2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

6: Sort Account

7: Exit

1

Enter Account Number (6 digits):

232136

Select an operation:

1: Check Balance

2: Withdraw

3: Deposit

4: Apply Monthly Interest

5: Apply Investment Risk

6: Go Back to the Main Menu

4

New balance: \$18342.87

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

5

Invalid operation. Not an investment account.

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

6

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

2

Enter the account type (checking/savings/investment):

checking

Enter the owner name (first and last name):

Houria,Oudghiri

Enter the initial balance:

2000

Account successfully added.

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
.
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18342.87	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	141964	David, Lin	101.75	
Checking	479832	Houria, Oudghiri	2000.00	

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

1

Enter Account Number (6 digits):

479832

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

1

Balance: \$2000.00

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

2

Enter the amount you want to withdraw:

500

Withdrawal completed. New balance: \$1500.00

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

3

Enter the amount you want to deposit:

1000

Deposit completed. New balance: \$2500.00

Select an operation:

- 1: Check Balance
- 2: Withdraw

3: Deposit
 4: Apply Monthly Interest
 5: Apply Investment Risk
 6: Go Back to the Main Menu
 6

Select an operation:

1: Find Account
 2: Add Account
 3: Remove Account
 4: View Accounts
 5: View Closable Accounts
 6: Sort Account
 7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18342.87	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	141964	David, Lin	101.75	
Checking	479832	Houria, Oudghiri	2500.00	

Select an operation:

1: Find Account
 2: Add Account
 3: Remove Account
 4: View Accounts
 5: View Closable Accounts
 6: Sort Account

7: Exit

3

Enter Account Number (6 digits):

141964

Account removed successfully.

Select an operation:

1: Find Account

2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

6: Sort Account

7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18342.87	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	479832	Houria, Oudghiri	2500.00	

Select an operation:

1: Find Account

2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

6: Sort Account

7: Exit

2

Enter the account type (checking/savings/investment):

savings

Enter the owner name (first and last name):

Alice,Bloomberg

Enter the initial balance:

1000

Enter the yearly interest:

9.5

Account successfully added.

Select an operation:

1: Find Account

2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

6: Sort Account

7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylors	5.96	Shares
Savings	232136	Jina, Briddick	18342.87	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	479832	Houria, Oudghiri	2500.00	
Savings	346897	Alice, Bloomberg	1000.00	9.50

Select an operation:

1: Find Account

- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

1

Enter Account Number (6 digits):

346897

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

4

New balance: \$1007.92

Select an operation:

- 1: Check Balance
- 2: Withdraw
- 3: Deposit
- 4: Apply Monthly Interest
- 5: Apply Investment Risk
- 6: Go Back to the Main Menu

6

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account

7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
. . .				
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18342.87	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	479832	Houria, Oudghiri	2500.00	
Savings	346897	Alice, Bloomberg	1007.92	9.50

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

3

Enter Account Number (6 digits):

222222

Account not found.

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account

7: Exit

5

List of accounts with balance less than \$200:

Checking	734347	Simona,Morasca	93.43	
Investment	126883	Mattie,Poquette	120.70	Property
Investment	845166	Gladys,Rim	96.60	Shares
Investment	683865	Veronika,Inouye	117.81	Growth
Investment	985279	Albina,Glick	141.63	Growth
Checking	652922	Rozella,Ostrosky	139.13	
Savings	276417	Kati,Rulapaugh	3.61	11.93
Investment	824284	Dyan,Oldroyd	187.96	Shares
Savings	428341	Lavera,Perin	162.29	5.95
Investment	174691	Fatima,Saylors	5.96	Shares
Checking	447166	Kanisha,Waycott	196.50	

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

7

Sample RUN 2 (Note how the changes made in RUN 1 were saved in the file `accounts.txt` and read in RUN 2)

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

4

CSE17

Lehigh University

Fall 2021

Type	Account no.	Owner	Balance	Interest/Investment type
Investment	981313	James, Butt	81649.45	Property
Investment	746833	Josephine, Darakjy	4040.81	Property
Savings	248392	Art, Venere	45654.87	10.55
Checking	626268	Lenna, Paprocki	869.74	
Investment	224493	Donette, Foller	21218.54	Growth
Investment	174691	Fatima, Saylor	5.96	Shares
Savings	232136	Jina, Briddick	18342.87	11.40
Checking	447166	Kanisha, Waycott	196.50	
Investment	137421	Emerson, Bowley	86940.85	Growth
Checking	479832	Houria, Oudghiri	2500.00	
Savings	346897	Alice, Bloomberg	1007.92	9.50

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

6

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Savings	276417	Kati, Rulapaugh	3.61	11.93

CSE17

Lehigh University

Fall 2021

Investment	174691	Fatima,Saylors	5.96	Shares
Checking	734347	Simona,Morasca	93.43	
Investment	845166	Gladys,Rim	96.60	Shares
Investment	683865	Veronika,Inouye	117.81	Growth
Investment	126883	Mattie,Poquette	120.70	Property
Checking	652922	Rozella,Ostrosky	139.13	
Investment	985279	Albina,Glick	141.63	Growth
. . .				
Checking	496495	Jose,Stockham	62920.68	
Investment	324658	Erick,Ferencz	67611.95	Property
Investment	361674	Roxane,Campain	76812.06	Property
Investment	981313	James,Butt	81649.45	Property
Investment	137421	Emerson,Bowley	86940.85	Growth
Savings	752857	Kiley,Caldarera	89232.67	1.33
Savings	347338	Alisha,Slusarski	91541.37	6.43
Checking	984868	Valentine,Gillian	93501.44	

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account
- 7: Exit

7

Sample RUN 3 (Note how the sorted bank accounts (by balance) were saved to accounts.txt in RUN 2 and read in RUN 3)

Select an operation:

- 1: Find Account
- 2: Add Account
- 3: Remove Account
- 4: View Accounts
- 5: View Closable Accounts
- 6: Sort Account

7: Exit

4

Type	Account no.	Owner	Balance	Interest/Investment type
Savings	276417	Kati,Rulapaugh	3.61	11.93
Investment	174691	Fatima,Saylors	5.96	Shares
Checking	734347	Simona,Morasca	93.43	
Investment	845166	Gladys,Rim	96.60	Shares
Investment	683865	Veronika,Inouye	117.81	Growth
Investment	126883	Mattie,Poquette	120.70	Property
Checking	652922	Rozella,Ostrosky	139.13	
Investment	985279	Albina,Glick	141.63	Growth
Checking	496495	Jose,Stockham	62920.68	
Investment	324658	Erick,Ferencz	67611.95	Property
Investment	361674	Roxane,Campaign	76812.06	Property
Investment	981313	James,Butt	81649.45	Property
Investment	137421	Emerson,Bowley	86940.85	Growth
Savings	752857	Kiley,Caldarera	89232.67	1.33
Savings	347338	Alisha,Slusarski	91541.37	6.43
Checking	984868	Valentine,Gillian	93501.44	

Select an operation:

1: Find Account

2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

6: Sort Account

7: Exit

7