# 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.
- 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.
- 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.</p>
- **3.** A bank account is considered closable is 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
                                                             Balance
                                                                        Interest/Investment type
Type
           Account no.
                            0wner
Investment 981313
                            James, Butt
                                                             81649.45
                                                                        Property
Investment 746833
                            Josephine, Darakiy
                                                             4040.81
                                                                        Property
                                                             45654.87
                                                                        10.55
Savings
          248392
                           Art, Venere
                           Lenna, Paprocki
                                                             869.74
Checking 626268
Investment 224493
                            Donette, Foller
                                                             21218.54
                                                                        Growth
Investment 174691
                                                             5.96
                            Fatima, Saylors
                                                                        Shares
                            Jina, Briddick
Savings
           232136
                                                             18170.25
                                                                        11.40
Checking
                            Kanisha, Waycott
                                                             146.50
           447166
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
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
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
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
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
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
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
Enter the amount you want to deposit:
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
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
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
Select an operation:
1: Find Account
2: Add Account
3: Remove Account
4: View Accounts
```

5: View Closable Accounts

Balance

4040.81

869.74

5.96

81649.45

45654.87

21218.54

18170.25

87684.78

196.50

101.75

Interest/Investment type

Property

Property

10.55

Growth

Shares

11.40

Growth

```
6: Sort Account
7: Exit
4
Type
           Account no.
                            0wner
Investment 981313
                            James, Butt
                            Josephine, Darakjy
Investment 746833
Savings
          248392
                           Art, Venere
Checking 626268
                           Lenna.Paprocki
Investment 224493
                           Donette, Foller
. . .
Investment 174691
                            Fatima, Saylors
                            Jina, Briddick
Savings
          232136
                           Kanisha, Waycott
Checking 447166
Investment 137421
                            Emerson, Bowley
                            David, Lin
Checking
         141964
Select an operation:
1: Find Account
2: Add Account
3: Remove Account
4: View Accounts
5: View Closable Accounts
6: Sort Account
7: Exit
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 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 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 Select an operation: 1: Find Account 2: Add Account

3: Remove Account

4: View Accounts

5: View Closable Accounts

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Balance

4040.81

869.74

5.96

81649.45

45654.87

21218.54

18170.25

86940.85

196.50

101.75

Interest/Investment type

Property

Property

10.55

Growth

Shares

11.40

Growth

```
6: Sort Account
7: Exit
4
Type
           Account no.
                           0wner
Investment 981313
                           James, Butt
                           Josephine, Darakjy
Investment 746833
Savings
          248392
                           Art, Venere
Checking 626268
                           Lenna.Paprocki
Investment 224493
                           Donette, Foller
. . .
Investment 174691
                           Fatima, Saylors
                           Jina, Briddick
Savings
          232136
                           Kanisha, Waycott
Checking 447166
Investment 137421
                           Emerson, Bowley
                           David, Lin
Checking
         141964
Select an operation:
1: Find Account
2: Add Account
3: Remove Account
4: View Accounts
5: View Closable Accounts
6: Sort Account
7: Exit
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
```

```
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
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
Select an operation:
1: Find Account
2: Add Account
3: Remove Account
4: View Accounts
5: View Closable Accounts
6: Sort Account
7: Exit
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.
                            0wner
                                                             Balance
Investment 981313
                           James, Butt
                                                             81649.45
                           Josephine, Darakjy
                                                             4040.81
Investment 746833
Savings
          248392
                           Art, Venere
                                                             45654.87
Checking 626268
                           Lenna, Paprocki
                                                             869.74
Investment 224493
                           Donette, Foller
                                                             21218.54
. . .
Investment 174691
                                                             5.96
                           Fatima, Saylors
Savings
          232136
                           Jina, Briddick
                                                             18342.87
                           Kanisha, Waycott
                                                             196.50
Checking 447166
Investment 137421
                           Emerson, Bowley
                                                             86940.85
                           David, Lin
                                                             101.75
Checking 141964
                           Houria, Oudghiri
Checking 479832
                                                             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
Enter Account Number (6 digits):
479832
Select an operation:
```

Interest/Investment type

Property

Property

10.55

Growth

Shares

Growth

11.40

```
1: Check Balance
2: Withdraw
3: Deposit
4: Apply Monthly Interest
5: Apply Investment Risk
6: Go Back to the Main Menu
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
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
Enter the amount you want to deposit:
1000
Deposit completed. New balance: $2500.00
Select an operation:
1: Check Balance
2: Withdraw
```

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5: Apply In	onthly Interest nvestment Risk to the Main Menu	J			
Select an of 1: Find Accordance 2: Add Accordance 2: Add Accordance 2: View Accordance 2: View Closs Sort Accordance 2: Exit 4	count ount Account counts osable Accounts				
Туре	Account no.	Owner	Balance	Interest/Investment	type
Investment		James, Butt	81649.45	Property	
Investment		Josephine, Darakjy	4040.81	Property	
Savings	248392	Art, Venere	45654.87	10.55	
	626268	Lenna, Paprocki	869.74		
Investment	224493	Donette,Foller	21218.54	Growth	
Tnyostmont	174601	Fatima Caylons	5.96	Shares	
Investment Savings	232136	Fatima,Saylors Jina,Briddick	18342.87	11.40	
	447166	Kanisha, Waycott	196.50	11.40	
Investment		Emerson, Bowley	86940.85	Growth	
	141964	David, Lin	101.75	OI OWEII	
Checking	479832	Houria, Oudghiri	2500.00		
Select an o	operation:	<u>-</u>			
1: Find Acc	-				

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

#### 7: Exit 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 Type Account no. 0wner Balance Interest/Investment type James, Butt **Property** Investment 981313 81649.45 4040.81 Investment 746833 Josephine, Darakjy **Property** Savings Art, Venere 45654.87 10.55 248392 869.74 Checking 626268 Lenna, Paprocki Investment 224493 Donette, Foller 21218.54 Growth Investment 174691 5.96 Fatima, Saylors Shares Jina, Briddick Savings 232136 18342.87 11.40 Kanisha, Waycott 196.50 Checking 447166 Investment 137421 Emerson, Bowley 86940.85 Growth Checking Houria, Oudghiri 2500.00 479832 Select an operation: 1: Find Account 2: Add Account 3: Remove Account 4: View Accounts 5: View Closable Accounts 6: Sort Account

7: Exit

```
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
Type
                            0wner
                                                             Balance
                                                                        Interest/Investment type
           Account no.
Investment 981313
                           James, Butt
                                                             81649.45
                                                                        Property
                            Josephine, Darakjy
                                                             4040.81
Investment 746833
                                                                        Property
                           Art, Venere
                                                                        10.55
Savings
           248392
                                                             45654.87
                           Lenna, Paprocki
                                                             869.74
Checking
           626268
Investment 224493
                            Donette, Foller
                                                             21218.54
                                                                        Growth
. . .
Investment 174691
                           Fatima, Saylors
                                                             5.96
                                                                        Shares
Savings
                            Jina, Briddick
                                                             18342.87
                                                                        11.40
           232136
                                                             196.50
Checking 447166
                            Kanisha, Waycott
Investment 137421
                            Emerson, Bowley
                                                             86940.85
                                                                        Growth
Checking
           479832
                           Houria, Oudghiri
                                                             2500.00
                           Alice, Bloomberg
Savings
           346897
                                                             1000.00
                                                                        9.50
```

Select an operation:

1: Find Account

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

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Balance

81649.45

4040.81

18342.87

196.50 86940.85

2500.00 1007.92

869.74 21218.54

5.96

45654.87

Interest/Investment type

Property

Property

10.55

Growth

Shares

Growth

9.50

11.40

7: Exit		
Type Investment Investment Savings Checking Investment	746833 248392 626268	Owner James,Butt Josephine,Darakjy Art,Venere Lenna,Paprocki Donette,Foller
Investment Savings Checking Investment Checking Savings	232136 447166 137421 479832	Fatima, Saylors Jina, Briddick Kanisha, Waycott Emerson, Bowley Houria, Oudghiri Alice, Bloomberg
6: Sort Acc 7: Exit 3 Enter Accou	count bunt Account counts bsable Accounts count unt Number (6 di	gits):
Select an o	operation:	
1: Find Acc 2: Add Acco 3: Remove A 4: View Acco 5: View Clo	ount Account	

6: Sort Account

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```
7: Exit
List of accounts with balance less than $200:
Checking
           734347
                            Simona, Morasca
                                                              93.43
Investment 126883
                            Mattie, Poquette
                                                              120.70
                                                                          Property
                            Gladys, Rim
Investment 845166
                                                              96.60
                                                                          Shares
                            Veronika, Inouye
Investment 683865
                                                              117.81
                                                                          Growth
                            Albina, Glick
                                                              141.63
Investment 985279
                                                                          Growth
Checking
           652922
                            Rozella, Ostrosky
                                                              139.13
                            Kati, Rulapaugh
Savings
           276417
                                                              3.61
                                                                          11.93
Investment 824284
                            Dyan, Oldroyd
                                                              187.96
                                                                          Shares
Savings
                            Lavera, Perin
                                                              162.29
                                                                          5.95
           428341
                            Fatima, Saylors
                                                              5.96
Investment 174691
                                                                          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

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Type Investment Investment Savings Checking Investment	746833 248392 626268	Owner James,Butt Josephine,Darakjy Art,Venere Lenna,Paprocki Donette,Foller	Balance 81649.45 4040.81 45654.87 869.74 21218.54	Interest/Investment type Property Property 10.55 Growth
Investment Savings Checking Investment Checking Savings	232136 447166 137421	Fatima, Saylors Jina, Briddick Kanisha, Waycott Emerson, Bowley Houria, Oudghiri Alice, Bloomberg	5.96 18342.87 196.50 86940.85 2500.00 1007.92	Shares 11.40 Growth 9.50
Select an and account of the select account of the sel	count ount Account counts osable Accounts			
Select and 1: Find Accordance 2: Add Accordance 3: Remove Accordance 4: View Accordance 5: View Clo 6: Sort Accordance 7: Exit	count ount Account counts osable Accounts			

Type	Account no.	0wner	Balance	<pre>Interest/Investment type</pre>
Savings	276417	Kati,Rulapaugh	3.61	11.93

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Investment 174691 Checking 734347	Fatima,Saylors Simona,Morasca	5.96 Shares 93.43
Investment 845166	Gladys,Rim	96.60 Shares
Investment 683865	Veronika,Inouye	117 <b>.</b> 81 Growth
Investment 126883	Mattie,Poquette	120.70 Property
Checking 652922	Rozella,Ostrosky	139.13
Investment 985279	Albina,Glick	141 <b>.</b> 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

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7: Exit				
4				
Type	Account no.	0wner	Balance	<pre>Interest/Investment type</pre>
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, 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