

```

1 // fo1/9/bank/Bank.java
2 //
3 //
4 // Copyright 2003 Bill Campbell and Ethan Bolker
5
6 import java.util.*;
7 import java.io.*;
8
9 /**
10  * A Bank object simulates the behavior of a simple bank/ATM.
11  * It contains a Terminal object and a collection of
12  * BankAccount objects.
13
14  * The visit method opens this Bank for business,
15  * prompting the customer for input.
16
17  * It is persistent: it can save its state to a file and read it
18  * back at a later time.
19
20  * To create a Bank and open it for business issue the command
21  * <code>java Bank</code> with appropriate arguments.
22
23  * @see BankAccount
24  * @version 9
25  */
26
27 public class Bank
28     implements Serializable
29 {
30     private String bankName; // the name of this Bank
31     private transient Terminal atm; // for communication with world
32     private int balance = 0; // total cash on hand
33     private int transactionCount = 0; // number of Bank transactions
34     private Month month; // the current month.
35     private Map accountList; // mapping names to accounts.
36
37     private int checkFee = 2; // cost for each check
38     private int transactionFee = 1; // fee for each transaction
39     private int monthlyCharge = 5; // monthly charge
40     private double interestRate = 0.05; // annual rate paid on savings
41     private int maxFreeTransactions = 3; // for savings accounts
42
43     // what the banker can ask of the bank
44
45     private static final String BANKER_COMMANDS =
46         "Banker commands: " +
47         "exit, open, customer, nextmonth, report, help.";
48
49     // what the customer can ask of the bank
50
51     private static final String CUSTOMER_TRANSACTIONS =
52         " Customer transactions: deposit, withdraw, transfer,\n" +
53         " balance, cash check, quit, help.";
54
55     /**
56      * Construct a Bank with the given name.

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57
58     * @param bankName the name for this Bank.
59     */
60
61     public Bank( String bankName )
62     {
63         this.atm = atm;
64         this.bankName = bankName;
65         accountList = new TreeMap();
66         month = new Month();
67     }
68
69     /**
70      * Simulates interaction with a Bank.
71      * Presents the user with an interactive loop, prompting for
72      * banker transactions and in the case of the banker
73      * transaction "customer", an account id and further
74      * customer transactions.
75      */
76
77     public void visit()
78     {
79         instructUser();
80
81         String command;
82         while ( ! (command =
83             atm.readWord("banker command: ").equals("exit")) ) {
84
85             if (command.startsWith("h")) {
86                 help( BANKER_COMMANDS );
87             }
88             else if (command.startsWith("o")) {
89                 openNewAccount();
90             }
91             else if (command.startsWith("n")) {
92                 newMonth();
93             }
94             else if (command.startsWith("r")) {
95                 report();
96             }
97             else if (command.startsWith("c") ) {
98                 BankAccount acct = whichAccount();
99                 if ( acct != null ) {
100                     processTransactionsForAccount( acct );
101                 }
102             }
103             else {
104                 // Unrecognized Request
105                 atm.println( "unknown command: " + command );
106             }
107         }
108         report();
109         atm.println( "Goodbye from " + bankName );
110     }
111 }
112

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113 // Open a new bank account,
114 // prompting the user for information.
115
116 private void openNewAccount()
117 {
118     String accountName = atm.readWord( "Account name: " );
119     char accountType =
120     atm.readChar( "Type of account (r/c/f/s): " );
121     try {
122         int startup = readPosAmt( "Initial deposit: " );
123         BankAccount newAccount;
124         switch( accountType ) {
125             case 'c':
126                 newAccount = new CheckingAccount( startup, this );
127                 break;
128             case 'f':
129                 newAccount = new FeeAccount( startup, this );
130                 break;
131             case 's':
132                 newAccount = new SavingsAccount( startup, this );
133                 break;
134             case 'r':
135                 newAccount = new RegularAccount( startup, this );
136                 break;
137             default:
138                 atm.println( "invalid account type: " + accountType );
139                 return;
140         }
141         accountList.put( accountName, newAccount );
142         atm.println( "opened new account " + accountName
143                 + " with $" + startup );
144     }
145     catch (NegativeAmountException e) {
146         atm.errPrintln(
147             "You cannot open an account with a negative balance");
148     }
149     catch (InsufficientFundsException e) {
150         atm.errPrintln( "Initial deposit doesn't cover fee" );
151     }
152 }
153
154 // Prompt the customer for transaction to process.
155 // Then send an appropriate message to the account.
156
157 private void processTransactionsForAccount( BankAccount acct )
158 {
159     help( CUSTOMER_TRANSACTIONS );
160
161     String transaction;
162     while ( !(transaction =
163         atm.readWord( " transaction: ")).equals("quit")) {
164
165         try {
166             if ( transaction.startsWith( "h" ) ) {
167                 help( CUSTOMER_TRANSACTIONS );
168             }

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169         else if ( transaction.startsWith( "d" ) ) {
170             int amount = readPosAmt( " amount:" );
171             atm.println( " deposited "
172                 + acct.deposit( amount ) );
173         }
174         else if ( transaction.startsWith( "w" ) ) {
175             int amount = readPosAmt( " amount:" );
176             atm.println( " withdrew "
177                 + acct.withdraw( amount ) );
178         }
179         else if ( transaction.startsWith( "c" ) ) {
180             int amount = readPosAmt( " amount of check: " );
181             try { // to cast acct to CheckingAccount ...
182                 atm.println( " cashed check for " +
183                     ((CheckingAccount) acct).honorCheck( amount ) )
184             }
185             catch (ClassCastException e) {
186                 // if not a checking account, report error
187                 atm.errPrintln(
188                     " Sorry, not a checking account. " );
189             }
190         }
191         else if ( transaction.startsWith( "t" ) ) {
192             atm.print( " to " );
193             BankAccount toacct = whichAccount();
194             if ( toacct != null ) {
195                 int amount = readPosAmt( " amount to transfer: " );
196                 atm.println( " transferred "
197                     + toacct.deposit( acct.withdraw( amount ) ) );
198             }
199         }
200         else if ( transaction.startsWith( "b" ) ) {
201             atm.println( " current balance "
202                 + acct.requestBalance() );
203         }
204         else {
205             atm.println( " sorry, unknown transaction " );
206         }
207     }
208     catch (InsufficientFundsException e) {
209         atm.errPrintln( " Insufficient funds " +
210             e.getMessage() );
211     }
212     catch (NegativeAmountException e) {
213         atm.errPrintln( " Sorry, negative amounts disallowed. " );
214     }
215     atm.println();
216 }
217
218 // Prompt for an account name (or number), look it up
219 // in the account list. If it's there, return it;
220 // otherwise report an error and return null.
221
222 private BankAccount whichAccount()
223 {
224

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225 String accountName = atm.readWord( "account name: " );
226 BankAccount account = (BankAccount) accountList.get(accountName);
227 if (account == null) {
228     atm.println( "not a valid account" );
229 }
230 return account;
231 }
232
233 // Action to take when a new month starts.
234 // Update the month field by sending a next message.
235 // Loop on all accounts, sending each a newMonth message.
236
237 private void newMonth()
238 {
239     month.next();
240     Iterator i = accountList.keySet().iterator();
241     while ( i.hasNext() ) {
242         String name = (String) i.next();
243         BankAccount acct = (BankAccount) accountList.get( name );
244         try {
245             acct.newMonth();
246         }
247         catch ( InsufficientFundsException ) {
248             atm.errPrintln( "Insufficient funds in account \"\" +
249                 name + "\" for monthly fee" );
250         }
251     }
252 }
253
254 // Report bank activity.
255 // For each BankAccount, print the customer id (name or number),
256 // account balance and the number of transactions.
257 // Then print Bank totals.
258
259 private void report()
260 {
261     atm.println( bankName + " report for " + month );
262     atm.println( "\nSummaries of individual accounts:" );
263     atm.println( "account balance transaction count" );
264     for ( Iterator i = accountList.keySet().iterator();
265         i.hasNext(); ) {
266         String accountName = (String) i.next();
267         BankAccount acct = (BankAccount) accountList.get(accountName)
268             atm.println(accountName + "\t$" + acct.getBalance() + "\t\t"
269                 + acct.getTransactionCount());
270     }
271     atm.println( "\nBank totals" );
272     atm.println( "open accounts: " + getNumberOfAccounts() );
273     atm.println( "cash on hand: $" + getBalance() );
274     atm.println( "transactions: " + getTransactionCount() );
275     atm.println();
276 }
277
278 // Welcome the user to the bank and instruct her on
279 // her options.
280

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281
282 private void instructUser()
283 {
284     atm.println( "Welcome to " + bankName );
285     atm.println( month.toString() );
286     atm.println( "Open some accounts and work with them." );
287     help( BANKER_COMMANDS );
288 }
289
290 // Display a help string.
291
292 private void help( String helpString )
293 {
294     atm.println( helpString );
295     atm.println();
296 }
297
298 // Read amount prompted for from the atm.
299 // Throw a NegativeAmountException if amount < 0
300
301 private int readPosAmt( String prompt )
302     throws NegativeAmountException
303 {
304     int amount = atm.readInt( prompt );
305     if (amount < 0) {
306         throw new NegativeAmountException();
307     }
308     return amount;
309 }
310
311 /**
312  * Increment bank balance by given amount.
313  */
314 *@param amount the amount increment.
315 */
316
317 public void incrementBalance(int amount)
318 {
319     balance += amount;
320 }
321
322 /**
323  * Increment by one the count of transactions,
324  * for this bank.
325  */
326
327 public void countTransaction()
328 {
329     transactionCount++;
330 }
331
332 /**
333  * Get the number of transactions performed by this bank.
334  */
335 *@return number of transactions performed.
336 */

```

```

337 public int getTransactionCount( )
338 {
339     return transactionCount ;
340 }
341
342 /**
343  * The charge this bank levies for cashing a check.
344  */
345 * @return check fee
346 */
347
348 public int getCheckFee( )
349 {
350     return checkFee ;
351 }
352
353 /**
354  * The charge this bank levies for a transaction.
355  */
356 * @return the transaction fee
357 */
358
359 public int getTransactionFee( )
360 {
361     return transactionFee ;
362 }
363
364 /**
365  * The charge this bank levies each month.
366  */
367 * @return the monthly charge
368 */
369
370 public int getMonthlyCharge( )
371 {
372     return monthlyCharge ;
373 }
374
375 /**
376  * The current interest rate on savings.
377  */
378 * @return the interest rate
379 */
380
381 public double getInterestRate( )
382 {
383     return interestRate ;
384 }
385
386 /**
387  * The number of free transactions per month.
388  */
389 * @return the number of transactions
390 */
391
392

```

```

393 public int getMaxFreeTransactions( )
394 {
395     return maxFreeTransactions ;
396 }
397
398 /**
399  * Get the current bank balance.
400  */
401 * @return current bank balance.
402 */
403
404 public int getBalance( )
405 {
406     return balance ;
407 }
408
409 /**
410  * Get the current number of open accounts.
411  */
412 * @return number of open accounts.
413 */
414
415 public int getNumberOfAccounts( )
416 {
417     return accountList.size( ) ;
418 }
419
420 /**
421  * Set the atm for this Bank.
422  */
423 * @param atm the Bank's atm.
424 */
425
426 public void setAtm( Terminal atm ) {
427     this.atm = atm ;
428 }
429
430 /**
431  * Run the simulation by creating and then visiting a new Bank.
432  */
433 * <p>
434  * A -e argument causes the input to be echoed.
435  * This can be useful for executing the program against
436  * a test script, e.g.,
437  * <pre>
438  * java Bank -e < Bank.in
439  * </pre>
440  *
441  * The -f argument reads the bank's state from the specified
442  * file, and writes it to that file when the program exits.
443  *
444  * @param args the command line arguments:
445  *     <pre>
446  *     -e echo input.
447  *     -f filename
448  *     bankName any other command line argument.

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```

449  *      </pre>
450  */
451
452  public static void main( String[] args )
453  {
454      boolean echo      = false;
455      String bankName   = null;
456      String bankName   = "Persistent Bank";
457      Bank theBank      = null;
458
459      // parse the command line arguments
460      for (int i = 0; i < args.length; i++ ) {
461          if (args[i].equals("-e")) { // echo input to output
462              echo = true;
463              continue;
464          }
465          if (args[i].equals("-f")) { // read/write Bank from/to file
466              bankName = args[i+1];
467              continue;
468          }
469      }
470
471      // create a new Bank or read one from a file
472      if (bankName == null) {
473          theBank = new Bank( bankName );
474      }
475      else {
476          theBank = readBank( bankName, bankName );
477      }
478
479      // give the Bank a Terminal, then visit
480      theBank.setAtm(new Terminal(echo));
481      theBank.visit();
482
483      // write theBank's state to a file if required
484      if (bankName != null) {
485          writeBank(theBank, bankName);
486      }
487
488      // Read a Bank from a file (create it if file doesn't exist).
489
490      //
491      // @param bankName   the name of the Bank
492      // @param bankName the name of the file containing the Bank
493      //
494      // @return the Bank
495
496      private static Bank readBank(String bankName, String bankName)
497      {
498          File file = new File( bankName );
499          if (!file.exists()) {
500              return new Bank( bankName );
501          }
502          ObjectInputStream inputStream = null;
503          try {
504              inputStream = new ObjectInputStream(

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```

505          new FileInputStream( file ) );
506          Bank bank = (Bank) inputStream.readObject();
507          System.out.println(
508              "Bank state read from file " + bankName);
509          return bank;
510      }
511      catch (Exception e ) {
512          System.err.println(
513              "Problem reading " + bankName );
514          System.err.println(e);
515          System.exit(1);
516      }
517      finally {
518          try {
519              inputStream.close();
520          }
521          catch (Exception e) {
522              }
523          }
524          return null; // you can never get here
525      }
526
527      // Write a Bank to a file.
528
529      //
530      // @param bank       the Bank
531      // @param fileName the name of the file to write the Bank to
532
533      private static void writeBank( Bank bank, String fileName)
534      {
535          ObjectOutputStream outputStream = null;
536          try {
537              outputStream = new ObjectOutputStream(
538                  new FileOutputStream( fileName ) );
539              outputStream.writeObject( bank );
540              System.out.println(
541                  "Bank state written to file " + fileName);
542          }
543          catch (Exception e ) {
544              System.err.println(
545                  "Problem writing " + fileName );
546          }
547          finally {
548              try {
549                  outputStream.close();
550              }
551              catch (Exception e ) {
552              }
553          }
554      }
555  }

```

```

1 // fo1/9/bank/BankAccount.java
2 //
3 //
4 // Copyright 2003 Bill Campbell and Ethan Bolker
5
6 import java.io.Serializable;
7
8 /**
9  * A BankAccount object has private fields to keep track
10 * of its current balance, the number of transactions
11 * performed and the Bank in which it is an account, and
12 * and public methods to access those fields appropriately.
13  *
14  * @see Bank
15  * @version 9
16  */
17
18 public abstract class BankAccount
19 implements Serializable
20 {
21     private int balance = 0; // Account balance (whole dollars)
22     private int transactionCount = 0; // Number of transactions performed
23     private Bank issuingBank; // Bank issuing this account
24
25     /**
26      * Construct a BankAccount with the given initial balance and
27      * issuing Bank. Construction counts as this BankAccount's
28      * first transaction.
29      *
30      * @param initialBalance the opening balance.
31      * @param issuingBank the bank that issued this account.
32      *
33      * @exception InsufficientFundsException when appropriate.
34      */
35     protected BankAccount( int initialBalance, Bank issuingBank )
36     throws InsufficientFundsException
37     {
38         this.issuingBank = issuingBank;
39         deposit( initialBalance );
40     }
41
42     /**
43      * Get transaction fee. By default, 0.
44      *
45      * Override this for accounts having transaction fees.
46      *
47      * @return the fee.
48      */
49     protected int getTransactionFee()
50     {
51         return 0;
52     }
53 }
54
55 /**
56  * The bank that issued this account.

```

```

57  *
58  * @return the Bank.
59  */
60
61     protected Bank getIssuingBank()
62     {
63         return issuingBank;
64     }
65
66     /**
67      * Withdraw the given amount, decreasing this BankAccount's
68      * balance and the issuing Bank's balance.
69      *
70      * Counts as a transaction.
71      *
72      * @param amount the amount to be withdrawn
73      * @return amount withdrawn
74      *
75      * @exception InsufficientFundsException when appropriate.
76      */
77     public int withdraw( int amount )
78     throws InsufficientFundsException
79     {
80         incrementBalance( -amount - getTransactionFee() );
81         countTransaction();
82         return amount ;
83     }
84
85     /**
86      * Deposit the given amount, increasing this BankAccount's
87      * balance and the issuing Bank's balance.
88      *
89      * Counts as a transaction.
90      *
91      * @param amount the amount to be deposited
92      * @return amount deposited
93      *
94      * @exception InsufficientFundsException when appropriate.
95      */
96     public int deposit( int amount )
97     throws InsufficientFundsException
98     {
99         incrementBalance( amount - getTransactionFee() );
100         countTransaction();
101         return amount ;
102     }
103
104     /**
105      * Request for balance. Counts as a transaction.
106      *
107      * @return current account balance.
108      *
109      * @exception InsufficientFundsException when appropriate.
110      */
111     public int requestBalance()
112

```

```

113     throws InsufficientFundsException
114     {
115         incrementBalance( - getTransactionFee() );
116         countTransaction();
117         return getBalance() ;
118     }
119 }
120
121 /**
122  * Get the current balance.
123  * Does NOT count as a transaction.
124  */
125 * @return current account balance
126 */
127
128 public int getBalance()
129 {
130     return balance;
131 }
132
133 /**
134  * Increment account balance by given amount.
135  * Also increment issuing Bank's balance.
136  * Does NOT count as a transaction.
137  */
138 * @param amount the amount of the increment.
139 * @exception InsufficientFundsException when appropriate.
140 */
141
142 public final void incrementBalance( int amount )
143     throws InsufficientFundsException
144     {
145         int newBalance = balance + amount;
146         if (newBalance < 0) {
147             throw new InsufficientFundsException(
148                 "For this transaction" );
149         }
150         balance = newBalance;
151         getIssuingBank().incrementBalance( amount );
152     }
153 }
154
155 /**
156  * Get the number of transactions performed by this
157  * account. Does NOT count as a transaction.
158  */
159 * @return number of transactions performed.
160 */
161
162 public int getTransactionCount()
163 {
164     return transactionCount;
165 }
166
167 /**
168  * Increment by 1 the count of transactions, for this account
169  * and for the issuing Bank.

```

```

169     * Does NOT count as a transaction.
170     *
171     * @exception InsufficientFundsException when appropriate.
172     */
173 }
174
175 public void countTransaction()
176     throws InsufficientFundsException
177     {
178         transactionCount++;
179         this.getIssuingBank().countTransaction();
180     }
181 }
182
183 /**
184  * Action to take when a new month starts.
185  *
186  * @exception InsufficientFundsException thrown when funds
187  * on hand are not enough to cover the fees.
188  */
189
190 public abstract void newMonth()
191     throws InsufficientFundsException;

```

```

1 // foj/9/bank/class Month
2 //
3 //
4 // Copyright 2003 Bill Campbell and Ethan Bolker
5
6 import java.io.*;
7 import java.util.Calendar;
8
9 /**
10  * The Month class implements an object that keeps
11  * track of the month of the year.
12  *
13  * @version 9
14  */
15
16 public class Month
17     implements Serializable
18 {
19     private static final String[] monthName =
20         { "Jan", "Feb", "Mar", "Apr", "May", "Jun",
21           "Jul", "Aug", "Sep", "Oct", "Nov", "Dec" };
22
23     private int month;
24     private int year;
25
26     /**
27      * Month constructor constructs a Month object
28      * initialized to the current month and year.
29      */
30
31     public Month()
32     {
33         Calendar rightNow = Calendar.getInstance();
34         month = rightNow.get( Calendar.MONTH );
35         year = rightNow.get( Calendar.YEAR );
36     }
37
38     /**
39      * Advance to next month.
40      */
41
42     public void next()
43     {
44         month = (month + 1) % 12;
45         if (month == 0) {
46             year++;
47         }
48     }
49
50     /**
51      * How a Month is displayed as a String -
52      * for example, "Jan, 2003".
53      *
54      * @return String representation of the month.
55      */
56

```

```

57     public String toString()
58     {
59         return monthName[month] + ", " + year;
60     }
61
62     /**
63      * For unit testing.
64      */
65
66     public static void main( String[] args )
67     {
68         Month m = new Month();
69         for (int i=0; i < 14; i++, m.next()) {
70             System.out.println(m);
71         }
72         for (int i=0; i < 35; i++, m.next()); // no loop body
73         System.out.println( "three years later: " + m );
74         for (int i=0; i < 120; i++, m.next()); // no loop body
75         System.out.println( "ten years later: " + m );
76     }
77 }

```