7

Interaction Modeling

7.1 Here are answers for a physical bookstore.

a. Some actors are:

- **Customer**. A person who initiates the purchase of an item.
- **Cashier**. An employee who is authorized to check out purchases at a cash register.
- **Payment verifier**. The remote system that approves use of a credit or debit card.

b. Some use cases are:

- **Purchase items**. A customer brings one or more items to the checkout register and pays for the items.
- **Return items**. The customer brings back items that were previously purchased and gets a refund.

c. Figure A7.1 shows a use case diagram.

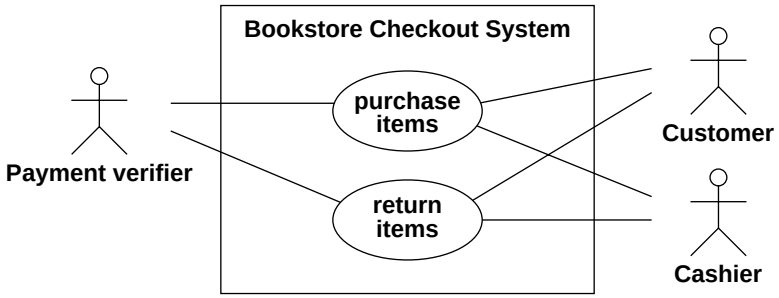

Figure A7.1 Use case diagram for a physical bookstore checkout system

d. Here is a normal scenario for each use case. There are many possible answers. [Instructor's note: You may wish to give the students the answers to Exercise 7.1 parts a-c.]

- **Purchase items**.
  Customer brings items to the counter.
  Cashier scans each customer item.
  Cashier totals order, including tax.
  Cashier requests form of payment.
  Customer gives a credit card.
  Cashier scans card.
  Checkout system communicates scan data to verifier.
  Verifier reports that credit card payment is acceptable.
  Customer signs credit card slip.
- **Return items**.
  Customer brings purchased item to the counter.
  Customer has receipt from earlier purchase.
  Cashier notes that payment was in cash.
  Cashier accepts items and gives customer a cash refund.

e. Here is an exception scenario for each use case. There are many possible answers. [Instructor's note: You may wish to give the students the answers to Exercise 7.1 parts a-c.]

- **Purchase items**.
  Customer brings items to the counter.
  Cashier scans each customer item.
  An item misscans and cashier goes to item display to get the item price.
- **Return items**.
  Customer brings purchased item to the counter.
  Customer has no receipt from earlier purchase.
  Customer is given a credit slip, but no refund.

f. Figure A7.2 shows a sequence diagram for the first scenario in (d). Figure A7.3 shows a sequence diagram for the second scenario in (d). [Instructor's note: You may wish to give the students the answers to Exercise 7.1 parts a-e.]

7.2 Here are answers for a computer email system.

a. Some actors are:

- **User**. A person who is the focus of services.
- **Server**. A computer that communicates with the email system and is the intermediate source and destination of email messages.
- **Virus checker**. Software that protects against damage by a malicious user.

b. Some use cases are:

- **Get email**. Retrieve email from the server and display it for the user.

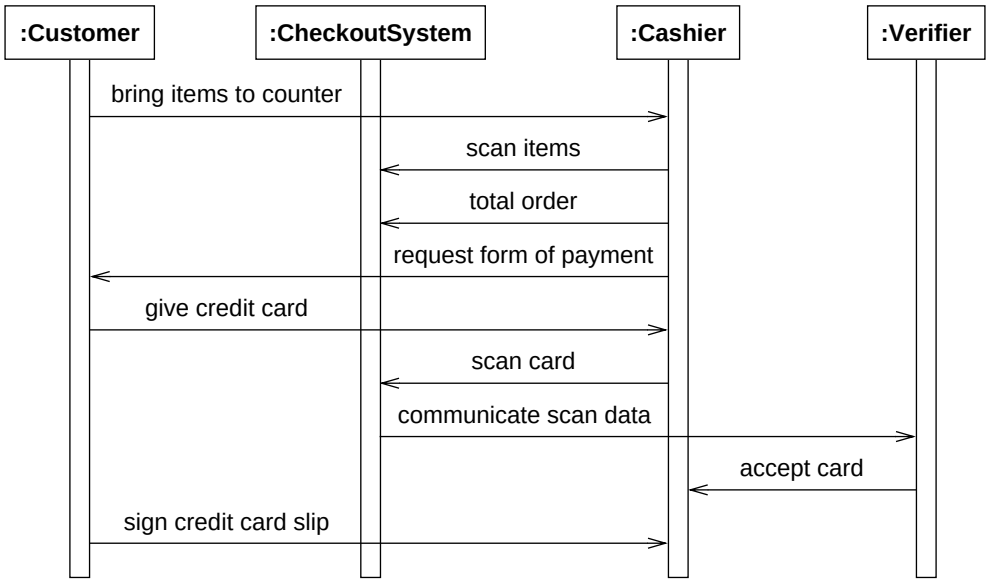

Figure A7.2 Sequence diagram for a purchase of items

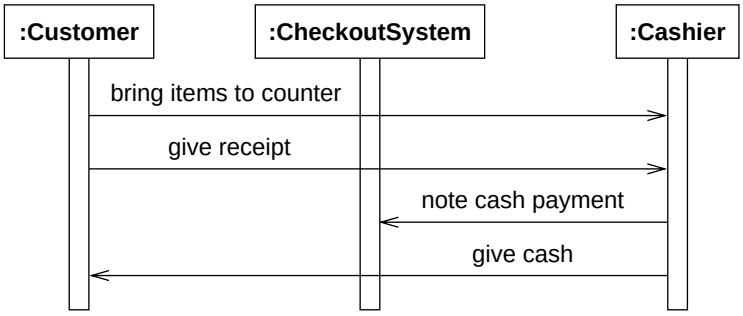

Figure A7.3 Sequence diagram for a return of items

- **Send email**. Take a message that was composed by the user and send it to the server.
- **Manage email**. Perform tasks such as deleting email, managing folders, and moving email between folders.
- **Set options**. Do miscellaneous things to tailor preferences to the user's liking.
- **Maintain address list**. Keep a list of email addresses that are important to the user.

c. Figure A7.4 shows a use case diagram. The diagram assumes that mail is moved from the server to the email system as the user reads it. If mail is kept on the server, then the server would also be involved in the *manage email* and *maintain address list* use cases.

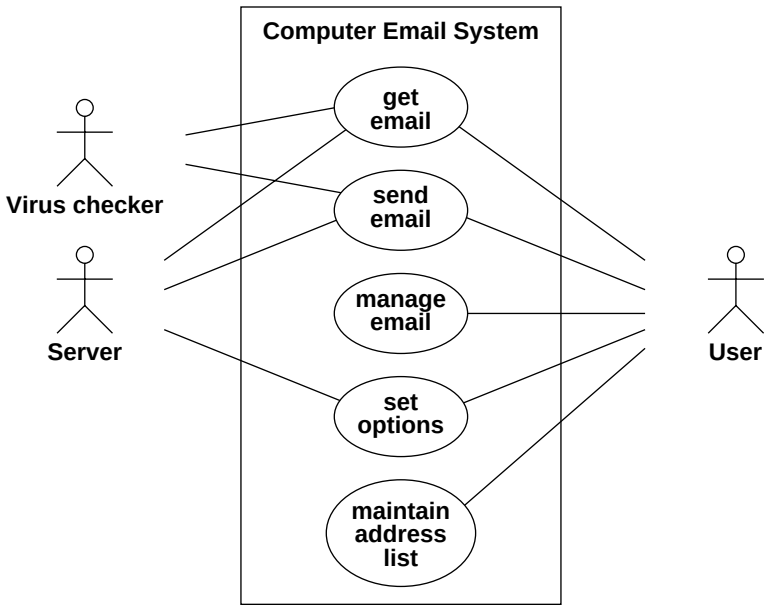

Figure A7.4 Use case diagram for a computer email system

d. Here is a normal scenario for each use case. There are many possible answers. [Instructor's note: You may wish to give the students the answers to Exercise 7.2 parts a-c.]

- **Get email**.
  User logs in to email system.
  System displays the mail in the *Inbox* folder.
  User requests that system get new email.
  System requests new email from server.
  Server returns new email to system.
  System displays the mail in the *Inbox* folder and highlights unread messages.
- **Send email**.
  User composes an email message and requests that system sends it.
  Local computer sends email to server.
  Server acknowledges receipt of email to send.
- **Manage email**.
  User logs in to email system.
  User clicks on *Sent* folder.
  User deletes all email in *Sent* folder.

- **Set options**.
  User logs in to email system.
  User requests change of password.
  Local computer displays password change form.
  User enters new password.
  User reenters new password.
  Local computer sends new password to server.
  Server accepts new password.
- **Maintain address list**.
  User clicks on *Inbox* folder.
  User selects a message.
  User adds sender to address list.

e. Here is an exception scenario for each use case. There are many possible answers. [Instructor's note: You may wish to give the students the answers to Exercise 7.2 parts a-c.]

- **Get email**.
  User logs in to email system.
  Local computer sends password to server.
  Server rejects password as incorrect.
- **Send email**.
  User composes an email message.
  User requests that system sends email.
  System detects loss of Internet connection.
- **Manage email**.
  User logs in to email system.
  User clicks on *Sent* folder.
  System reports that data in folder is corrupted.
- **Set options**.
  User logs in to email system.
  User requests change of password.
  Local computer displays password change form.
  User enters new password.
  Password length is illegal and password is not accepted.
- **Maintain address list**.
  User clicks on *Inbox* folder.
  User selects a message.
  User tries to add sender to address list.
  System reports that sender is already in address list.

f. Figure A7.5 through Figure A7.9 show the sequence diagrams for the scenarios in (d). [Instructor's note: You may wish to give the students the answers to Exercise 7.2 parts a-e.]

7.3 Here are answers for an online airline reservation system.

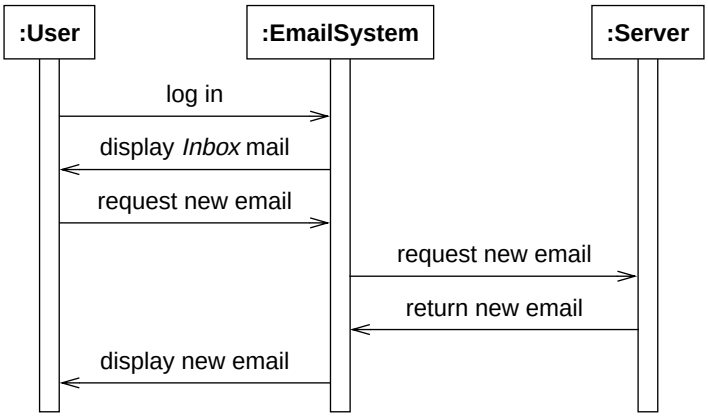

Figure A7.5 Sequence diagram for getting email

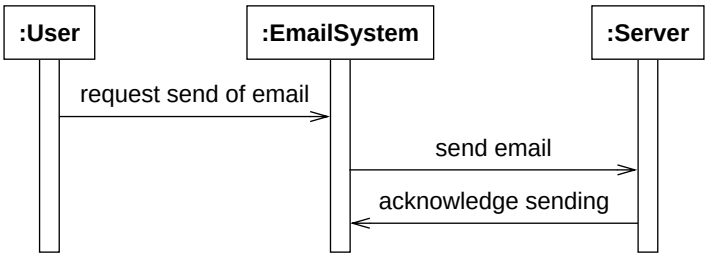

Figure A7.6 Sequence diagram for sending email

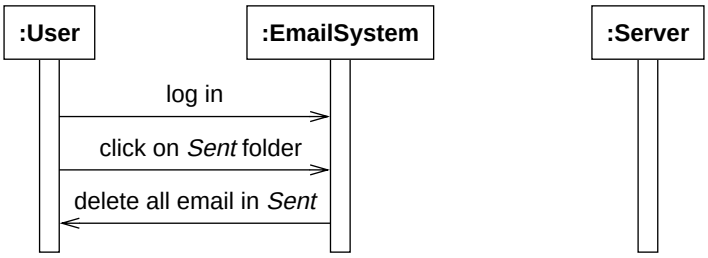

Figure A7.7 Sequence diagram for managing email

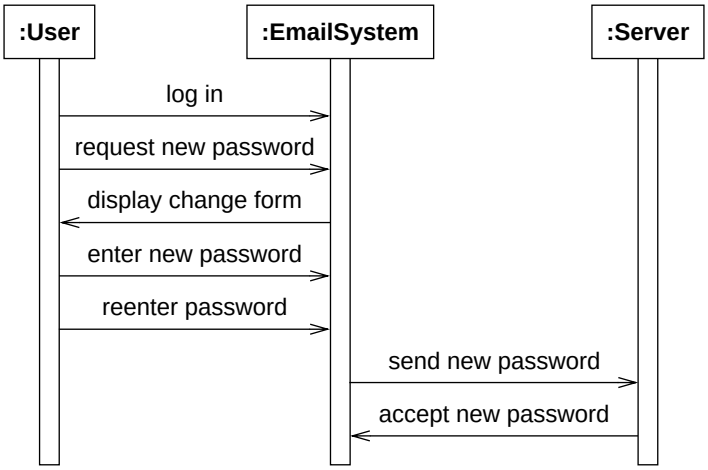

Figure A7.8 Sequence diagram for setting options

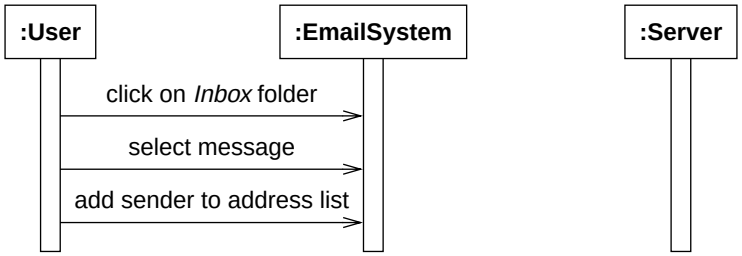

Figure A7.9 Sequence diagram for maintaining address list

a. Some actors are:

- **User**. The person who is seeking service from the airline.
- **Airline**. A company that offers scheduled flights available for purchase.

b. Some use cases are:

- **Make reservation**. Book and pay for an airline flight and possibly choose a seat.
- **Check availability**. Given data (such as origin, destination, date, airline preference), find the available flights and prices.
- **Check flight status**. Report the status of a flight that is underway (on-time, delayed, missing information, ...).
- **Handle benefits**. Display the current frequent traveler status for a person, register a new frequent traveler, book frequent traveler flights, show available flights, ...

- **Send an inquiry**. Let a user submit email to report flight dissatisfaction, frequent traveler benefit problem, or communicate some miscellaneous message to an airline.

c. Figure A7.10 shows a use case diagram.

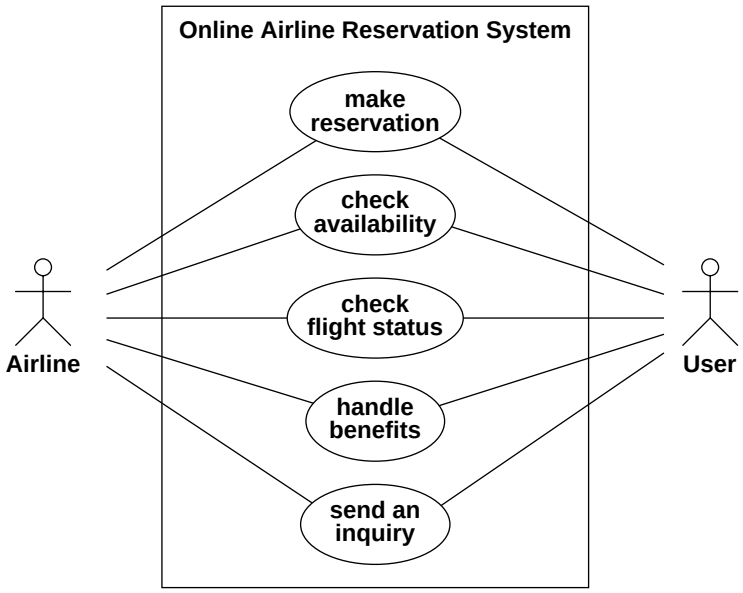

Figure A7.10 Use case diagram for an online airline reservation system

7.4 Here are answers for a library checkout system.

a. Some actors are:

- **Patron**. Someone who is the beneficiary of library services.
- **Librarian**. A library employee who handles most interaction with patrons.
- **Library**. A facility that mediates the borrowing of copies of library items. We assume that the library checkout system spans multiple libraries and that items can be exchanged between libraries.
- **Library item**. A book, magazine, movie, compact disc, or audio tape that a library offers for borrowing.

b. Some use cases are:

- **Borrow library item**. Remove an item from the library premises and promise to return it within the specified time.
- **Return library item**. Bring an item back to the library after borrowing it, and possibly pay a fine if it is late.

- **Inquire about library item**. Get data about library items that are of interest.
- **Reserve library item**. Secure placement on a waiting list for a library item that is currently checked out by another user.

c. Figure A7.11 shows a use case diagram. We assume inquiries and reservations can be handled without the intervention of a librarian.

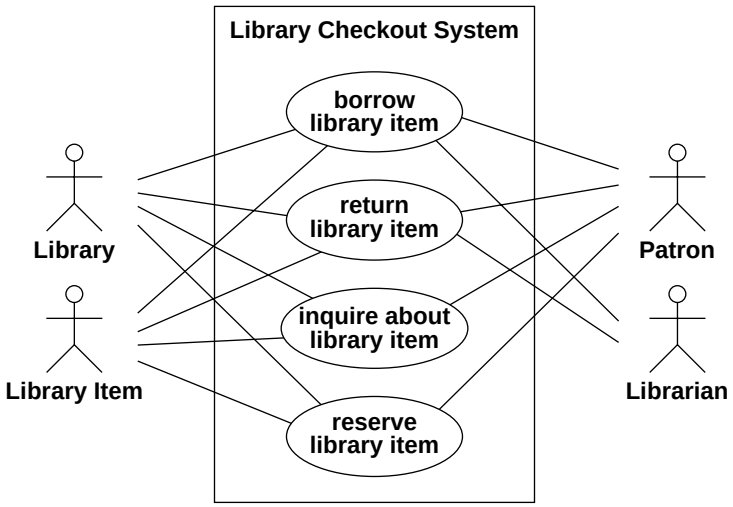

Figure A7.11 Use case diagram for a library checkout system

7.5 Here are some use cases for the Windows Explorer.

- **Create new folder**. Create a new folder as a child of the current folder.
- **Create new shortcut**. Create a new shortcut and place it in the current folder.
- **Select file**. Choose a file for subsequent activity and highlight the file icon.
- **Deselect file**. Deactivate a file for subsequent activity and unhighlight the file icon.
- **Copy file**. Copy the file to the file buffer.
- **Cut file**. Move the file to the file buffer. Shade the file icon to indicate cutting.
- **Paste file**. Move the file from the file buffer to the new folder. If the file was being cut, remove the file icon from the original folder.
- **Delete file**. Remove the file from file storage.
- **Open file**. Launch the application associated with the file.
- **View file properties**. Show the file name, creator, last update, and other incidental data.

- **Expand folder**. Show the files in the folder and make the folder the focus of subsequent actions.
- **Go up to parent folder**. Show the files in the parent folder and make the parent folder the focus of subsequent actions.

7.6 Here are the scenarios.

a. Assume that everything starts out on the east side and is to be moved to the west side. A scenario in which nothing gets eaten:

(Farmer, fox, goose, corn all on W.)
Farmer takes goose to E.
Farmer returns alone to W.
Farmer takes fox to E.
Farmer takes goose to W.
Farmer takes corn to E.
Farmer returns alone to W.
Farmer takes goose to E.
(Farmer, fox, goose, corn all on E.)

A scenario in which something gets eaten:

(Farmer, fox, goose, corn all on W.)
Farmer takes goose to E.
Farmer returns alone to W.
Farmer takes corn to E.
Farmer returns alone to W.
Goose eats corn.
Farmer takes fox to E.
(Farmer, fox, goose on E. Corn is gone.)

b. There is ambiguity about what to include and how much detail to show. This is common for specifications. One possible scenario:

Open door.
Get in car and sit down.
Close door.
Put key in ignition.
Put on seat belt.
Check that transmission is in park.
Depress and release accelerator pedal.
Turn key.
Engine starts.
Release key.
Depress brake pedal.
Release emergency brake.
Move transmission lever to drive.
Check for traffic in rear view mirror.

Turn on left directional light.
Move foot to accelerator pedal.
Depress pedal slowly and begin to drive.

c. Again there is considerable ambiguity about what to include.

Press “up” button.
Button lights up.
Bell sounds and “up” indicator lights.
Elevator door opens.
Get in elevator.
Press button for floor 6.
Button lights up.
Elevator door closes.
Elevator moves up.
Elevator stops at floor 3.
Elevator door opens.
Two passengers get on.
Elevator door closes.
Elevator moves up.
Elevator stops at floor 6.
Elevator door opens.
You and the other two passengers get out.
Note that specific incidents are properly part of a scenario.

d. This is similar to the previous part. Conditions are shown in parentheses:

(Traveling on the highway in drive.)
Accelerate to 90 km/hr.
Press “set” button on cruise control.
Cruise control engages control of accelerator.
Take foot off the accelerator pedal.
(Car operates accelerator under cruise control.)
Encounter slow moving car that you want to pass.
Depress accelerator and pass car.
Remove foot from accelerator.
(Cruise control continues to maintain speed.)
Encounter slow moving traffic that you cannot pass.
Depress brake pedal.
Cruise control disengages control of accelerator.
Maneuver past slow moving traffic.
Press “resume” button on cruise control.
Cruise control re-engages control of accelerator.
Take foot off accelerator.
Cruise control accelerates to preset speed.
(Car is operating under cruise control)

7.7 One of many possible scenarios:

Get into tub.
Turn on cold and hot water.
Water flows from faucet.
Adjust temperature.
Pull shower diverter.
Warm water flows from shower head.
Phone rings.
Turn off hot and cold water.
Water stops flowing.
Get out of tub.
Answer phone.
Talk.
Hang up phone.
Get into tub.
Turn on cold and hot water.
Push shower diverter.
Water flows from faucet.
Adjust temperature.
Pull shower diverter.
Warm water flows from shower head.
Wash yourself.
Turn off hot and cold water.
Water stops flowing.
Get out of tub.

7.8 Figure A7.12 shows an activity diagram for computing a restaurant bill.

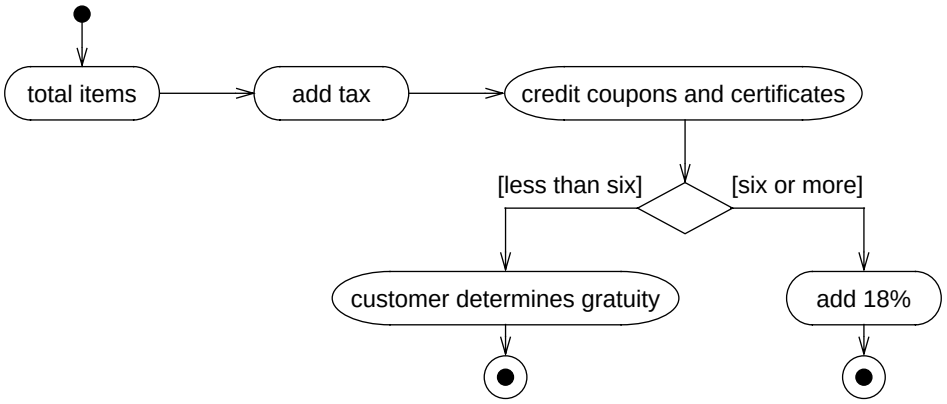

Figure A7.12 Activity diagram for computing a restaurant bill

7.9 Figure A7.13 shows an activity diagram for awarding frequent flyer credits.

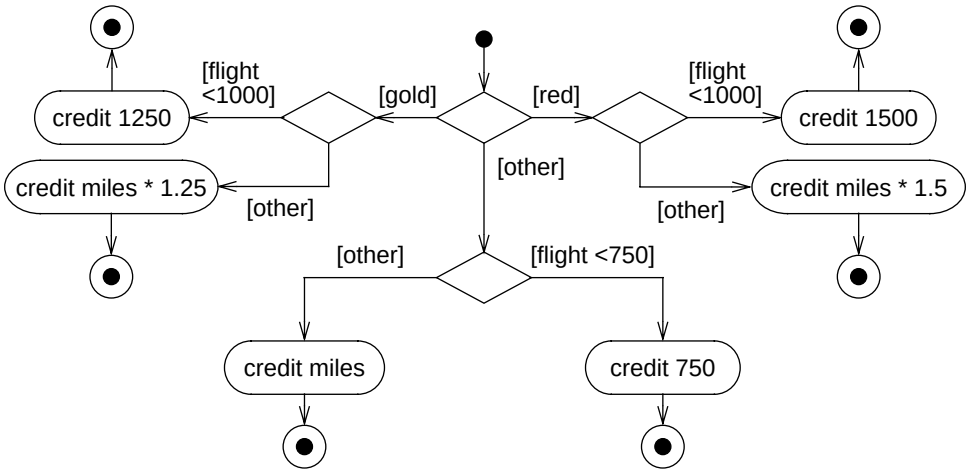

Figure A7.13 Activity diagram for awarding frequent flyer credits

7.10 Figure A7.14 shows an activity diagram that elaborates the details of logging into an email system.

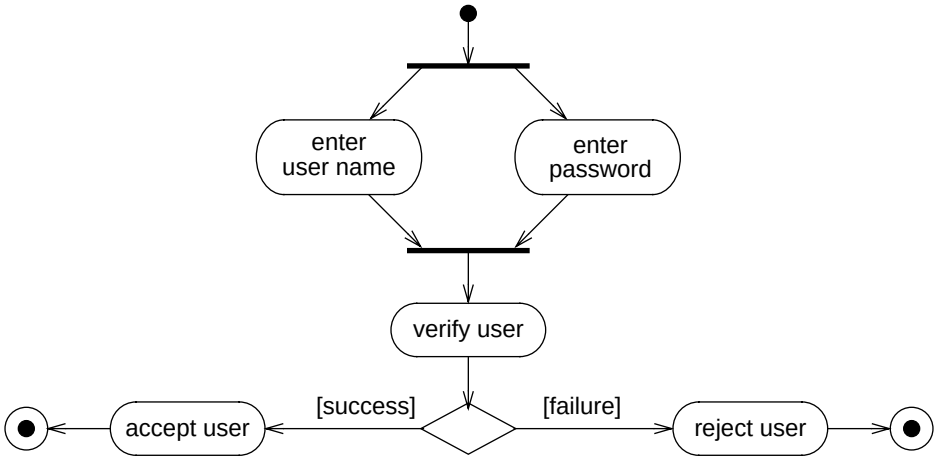

Figure A7.14 Activity diagram for logging into an email system