REQUIREMENTS INCOMPLETENESS AND INCONSISTENCY

PROBLEMS

A. Find at least one incompleteness in the following set of top-level requirements (Use checklist-based approach):

1. The system shall consider a transaction to be any movement of money between any accounts.
2. The system shall consider a transfer of money to be a transaction in which money leaves the account.
3. When scheduling a transfer, the system shall require the user to specify the account to which the money will be transferred, the amount of money to be transferred, and the date the transfer will occur.
4. The system shall allow a user to schedule a transfer of money to a different account held by the same user.
5. The system shall allow a user to schedule a transfer of money to an account held by a different user.

B. Find at least one inconsistency in the following set of top-level requirements (Use ad-hoc approach):

1. The system shall require approval for transfers of money in excess of a thousand dollars.
2. The system shall not require approval for transfers of money less than or equal to a thousand dollars.
3. The system shall never require approval for transfers of money between accounts held by the same user.

C. Find at least one incompleteness or inconsistency in the following requirements (Use antagonistic scenario-based approach):

1. The system shall not require approval for transfers of money to a different account held by the same user.
2. The system shall require approval for transfers of money in excess of a thousand dollars to the account of a different user.
3. The system shall not require approval for transfers of money less than or equal to a thousand dollars.
4. The system shall not require approval for transactions in which money enters the account.
5. When a transfer originates from a nation that is not the account holder's nation, then the system shall flag the transfer.
    a. The system shall set the flagged property to true.
        i. The system shall contain a boolean flagged property for transfers.
    b. The system shall display a flag icon to the left of the transfer.
        i. When the transfer of money is less than or equal to a thousand dollars, then the system shall display a yellow flag.
        ii. When the transfer of money is in excess of a thousand dollars, then the system shall display a red flag.
6. When a transfer is flagged, then the system shall require approval for the transfer.
7. The system shall allow designated controllers to approve transfers.

D. Find at least one incompleteness or inconsistency in the following requirements (Use prioritized approach):

1. The system shall track a user's time of inactivity.
   a. The system shall consider time without activity to be time in which no elements of the system are interacted with by the user.
      i. The system shall be able to track time in minutes.
      ii. The system shall reset the tracked time when the user interacts with an element of the system.
   b. The system shall consider a user's interaction with the warning prompt to be time with activity.
2. The system shall log the user out following five minutes of inactivity.
3. The system shall generate two warnings for the user before automatically logging the user out.
   a. The system shall generate a warning following two minutes of inactivity.
   b. The system shall generate a warning following four minutes of inactivity.
   c. The system shall display a warning as a prompt in a new window.

E. Find all incompleteness and inconsistencies in the following requirements (Use coverage-driven scenario-based approach):

BANKING SYSTEM

Login Screen –> Accounts Screen –> Transactions Screen (for each account)

LOGIN SCREEN

1. The system shall prompt the user to enter a username and a password.
2. The system shall allow the user to log in when the user enters a valid username and the correct password for the specified username.
3. In a failed attempt, the system shall indicate that the credentials entered were incorrect.
4. In a failed attempt, the system shall not indicate which of the credentials, the username or the password, was incorrect.
5. The system shall allow accounts to be locked.
    a. The system shall set the boolean property isLocked to true.
    b. When an account is locked, the system shall not allow the user to log in with the username of the locked account.
6. The system shall allow IP addresses to be locked.
    a. The system shall set the boolean property isLocked to true.
    b. When an IP address is locked, the system shall not allow the user to log in from the locked IP address.
7. The system shall allow a system administrator to lock and unlock accounts and IP addresses.
8. The system shall allow a locked account to be unlocked by a system administrator at a user's request.
    a. The system shall set the boolean property isLocked to false.
    b. The system shall allow the user to log in with the username of the account.
9. The system shall allow a locked IP address to be unlocked by a system administrator at a user's request.
    a. The system shall set the boolean property isLocked to false.
    b. The system shall allow the user to log in with from the IP address.
10. The system shall only allow five invalid login attempts per username per day.
    a. The system shall record the username(s) of the invalid login attempts.
    b. The system shall lock the account of a username with five invalid login attempts.
11. The system shall only allow invalid five login attempts per IP address per day.

      a. The system shall record the IP address(es) of the invalid login attempts.

      b. The system shall lock the IP address of a computer with five invalid login attempts.

12. On a successful login, the Login Screen shall redirect to the Accounts Screen.
13. The system shall provide the option to save the login credentials.
14. The system shall provide the option to save the username.
15. The system shall never provide the option to save password.

ACCOUNTS SCREEN

1. The system shall show the user's bank accounts.
2. The system shall show each account name, account number, account balance, and interest rate, if applicable, for each account.
   a. The system shall show only the last four digits of the account numbers upon logging in.
   b. The system shall allow the user to view the full account numbers.
   c. The system shall show negative account balances in parentheses.
3. When an account is selected, the system shall redirect to the Transaction Screen for that account.
   a. The system shall allow users to select a bank account.

TRANSACTIONS SCREEN

1. The system shall show the recent transactions of the selected account.
   a. The system shall allow the user to view all transactions from the last day, the last week, the last month, and the last year.
   b. By default, the system shall show all transactions from the last week.
2. The system shall indicate the status of the transactions shown.
   a. The system shall show "Successful" status for completed transactions.
   b. The system shall show "Pending" status for processing transactions.
   c. The system shall show "Unsuccessful" status for denied transactions.
3. The system shall consider a transaction to be complete when the impacted accounts are updated at the close of the business day.
4. The system shall consider a transaction to be processing when the transaction has been approved or does not require approval but has not been completed at the close of the business day.
5. The system shall consider a transaction to be awaiting approval when the transaction requires approval and has not been approved or denied.
6. The system shall consider a transaction to be denied when the transaction requires approval and has been denied.

7. The system shall consider a transfer of money to be a transaction in which money leaves the account.
8. When scheduling a transfer, the system shall require the user to specify the account to which the money will be transferred, the amount of money to be transferred, and the date the transfer will occur.
9. The system shall allow a user to schedule a transfer of money to a different account held by the same user.
10. The system shall allow a user to schedule a transfer of money to an account held by a different user.
11. The system shall not allow a user to schedule a transfer of money in excess of the amount of money currently scheduled to be transferred subtracted from the amount of money currently in the account.
12. The system shall not require approval for transfers of money to a different account held by the same user.
13. The system shall require approval for transfers of money in excess of a thousand dollars to the account of a different user.
14. The system shall not require approval for transfers of money less than or equal to a thousand dollars unless the transfer has been flagged.
15. The system shall not require approval for transactions in which money enters the account.
16. When a transfer is denied, then the system shall send a notice of the denial to the owners of the accounts impacted and record the denial in the transactions lists of the accounts impacted.
    a. The system shall track denied transfers.
    b. The system shall consider the impacted accounts to be the account transferring the money and the account receiving the money.
    c. The system shall record the transaction as "Denied" in the transactions lists for the impacted accounts.
17. When a transfer is approved, then the system shall indicate that the transfer is processing.
18. When a transfer is approved, the transfer shall be completed at the close of the business day.
19. When a transfer originates from a nation that is not the account holder's nation, then the system shall flag the transfer.
    a. The system shall set the flagged property to true.
        i. The system shall contain a boolean flagged property for transfers.
    b. The system shall display a flag icon to the left of the transfer.
        i. When the transfer of money is less than or equal to a thousand dollars, then the system shall display a yellow flag.

      ii. When the transfer of money is in excess of a thousand dollars, then the system shall display a red flag.

20. When a transfer is flagged, then the system shall require approval for the transfer.
21. The system shall allow designated controllers to approve transfers.

COMPUTATIONS

1. The system shall compound interest according to the terms of the account.
   a. The system shall post interest compounded monthly or annually as a completed transaction at the close of the business day.
   b. The system shall only allow interest to be compounded according to daily, monthly, or annual terms.
2. When money is deposited, the system shall compute the new account balance when the transaction is complete.
3. When money is withdrawn, the system shall compute the new account balance when the transaction is complete.

SECURITY

1. The system shall track a user's time of inactivity.
   a. The system shall consider time without activity to be time in which no elements of the system are interacted with by the user.
      i. The system shall be able to track time in minutes.
      ii. The system shall reset the tracked time when the user interacts with an element of the system.
   b. The system shall not consider a user's interaction with the warning prompt to be time with activity.
      i. The system shall not reset the tracked time when the user interacts with the warning prompt.
2. The system shall log the user out following five minutes of inactivity.
3. The system shall generate two warnings for the user before automatically logging the user out.
   a. The system shall generate a warning following two minutes of inactivity.
   b. The system shall generate a warning following four minutes of inactivity.
   c. The system shall display a warning as a prompt in a new window.
4. The system shall allow the user to log out manually at any time.

SOLUTIONS

NOTE: Italicized red text is an insertion, red text with a strikethrough is a deletion, and plain red text indicates a requirement of interest or a comment.

A. Find at least one incompleteness in the following set of top-level requirements (Use checklist-based approach):

1. The system shall consider a transaction to be any movement of money between any accounts.
2. The system shall consider a transfer of money to be a transaction in which money leaves the account.
3. When scheduling a transfer, the system shall require the user to specify the account to which the money will be transferred, the amount of money to be transferred, and the date the transfer will occur.
4. The system shall allow a user to schedule a transfer of money to a different account held by the same user.
5. The system shall allow a user to schedule a transfer of money to an account held by a different user.
6. *The system shall not allow a user to schedule a transfer of money in excess of the amount of money currently scheduled to be transferred subtracted from the amount of money currently in the account.*

INCOMPLETENESS: Without this requirement, a user could schedule transfers that would overdraw the account

B. Find at least one inconsistency in the following set of top-level requirements (Use ad-hoc approach):

1. The system shall require approval for transfers of money in excess of a thousand dollars.
2. The system shall not require approval for transfers of money less than or equal to a thousand dollars.
3. The system shall not require approval for transfers of money between accounts held by the same user.

INCONSISTENCY: Requirement (1.) and requirement (3.) are in conflict. Requirement (1.) expects transfers in excess of a thousand dollars to require approval, regardless of which accounts are involved. Meanwhile, requirement (3.) expects transfers between accounts held by the same user to not require approval, even in excess of a thousand dollars.

C. Find at least one incompleteness or inconsistency in the following requirements (Use antagonistic scenario-based approach):

1. The system shall not require approval for transfers of money to a different account held by the same user.
2. The system shall require approval for transfers of money in excess of a thousand dollars to the account of a different user.
3. The system shall not require approval for transfers of money less than or equal to a thousand dollars.
4. The system shall not require approval for transactions in which money enters the account.
5. When a transfer originates from a nation that is not the account holder's nation, then the system shall flag the transfer.
   a. The system shall set the flagged property to true.
      i. The system shall contain a boolean flagged property for transfers.
   b. The system shall display a flag icon to the left of the transfer.
      i. When the transfer of money is less than or equal to a thousand dollars, then the system shall display a yellow flag.
      ii. When the transfer of money is in excess of a thousand dollars, then the system shall display a red flag.
6. When a transfer is flagged, then the system shall require approval for the transfer.
7. The system shall allow designated controllers to approve transfers.

INCONSISTENCY: Requirement (3.) and requirement (6.) are in conflict. Requirement (3.) states that transfers of money less than or equal to a thousand dollars do not require approval. Meanwhile, requirement (6.) states that flagged transfers, including flagged transfers of money less than or equal to a thousand dollars, require approval.

D. Find at least one incompleteness or inconsistency in the following requirements (Use prioritized approach):

1. The system shall track a user's time of inactivity.
    a. The system shall consider time without activity to be time in which no elements of the system are interacted with by the user.
        i.   The system shall be able to track time in minutes.
        ii. The system shall reset the tracked time when the user interacts with an element of the system.
    b. The system shall consider a user's interaction with the warning prompt to be time with activity.
2. The system shall log the user out following five minutes of inactivity.
3. The system shall generate two warnings for the user before automatically logging the user out.
    a. The system shall generate a warning following two minutes of inactivity.
    b. The system shall generate a warning following four minutes of inactivity.
    c. The system shall display a warning as a prompt in a new window.
4. *The system shall allow the user to log out manually at any time.*

INCOMPLETENESS: Without this requirement, the user would have to wait for the system to time out in order to log out.

E. Find all incompleteness and inconsistencies in the following requirements (Use coverage-driven scenario-based approach):

BANKING SYSTEM

Login Screen –> Accounts Screen –> Transactions Screen (for each account)

LOGIN SCREEN

1. The system shall prompt the user to enter a username and a password.
2. The system shall allow the user to log in when the user enters a valid username and the correct password for the specified username.
3. In a failed attempt, the system shall indicate that the credentials entered were incorrect.
4. In a failed attempt, the system shall not indicate which of the credentials, the username or the password, was incorrect.
5. The system shall allow accounts to be locked.
    a. The system shall set the boolean property isLocked to true.
    b. When an account is locked, the system shall not allow the user to log in with the username of the locked account.
6. The system shall allow IP addresses to be locked.
    a. The system shall set the boolean property isLocked to true.
    b. When an IP address is locked, the system shall not allow the user to log in from the locked IP address.
7. The system shall allow a system administrator to lock and unlock accounts and IP addresses.
8. The system shall allow a locked account to be unlocked by a system administrator at a user's request.
    a. The system shall set the boolean property isLocked to false.
    b. The system shall allow the user to log in with the username of the account.
9. The system shall allow a locked IP address to be unlocked by a system administrator at a user's request.
    a. The system shall set the boolean property isLocked to false.
    b. The system shall allow the user to log in with from the IP address.
10. The system shall only allow five invalid login attempts per username per day.
    a. The system shall record the username(s) of the invalid login attempts.
    b. The system shall lock the account of a username with five invalid login attempts.
11. The system shall only allow invalid five login attempts per IP address per day.

      a. The system shall record the IP address(es) of the invalid login attempts.

      b. The system shall lock the IP address of a computer with five invalid login attempts.

12. On a successful login, the Login Screen shall redirect to the Accounts Screen.

13. ~~The system shall provide the option to save the login credentials.~~

14. The system shall provide the option to save the username.

15. The system shall never provide the option to save password.

INCONSISTENCY: Requirement (13.) and requirement (15.) are in conflict. Requirement (13.) provides the option to save the login credentials, while requirement (15.) does not allow the password, which is one of the login credentials, to be saved.

ACCOUNTS SCREEN

1. The system shall show the user's bank accounts.

2. The system shall show each account name, account number, account balance, and interest rate, if applicable, for each account.

      a. The system shall show only the last four digits of the account numbers upon logging in.

      b. The system shall allow the user to view the full account numbers.

      c. The system shall show negative account balances in parentheses.

3. When an account is selected, the system shall redirect to the Transaction Screen for that account.

      a. The system shall allow users to select a bank account.

TRANSACTIONS SCREEN

1. The system shall show the recent transactions of the selected account.

      a. The system shall allow the user to view all transactions from the last day, the last week, the last month, and the last year.

      b. By default, the system shall show all transactions from the last week.

2. The system shall indicate the status of the transactions shown.

      a. The system shall show "Successful" status for completed transactions.

      b. The system shall show "Pending" status for processing transactions *and for transactions awaiting approval.*

      c. The system shall show ~~"Unsuccessful"~~ *"Denied"* status for denied transactions.

3. The system shall consider a transaction to be complete when the impacted accounts are updated at the close of the business day.

4. The system shall consider a transaction to be processing when the transaction has been approved or does not require approval but has not been completed at the close of the business day.
5. The system shall consider a transaction to be awaiting approval when the transaction requires approval and has not been approved or denied.
6. The system shall consider a transaction to be denied when the transaction requires approval and has been denied.
7. The system shall consider a transfer of money to be a transaction in which money leaves the account.
8. When scheduling a transfer, the system shall require the user to specify the account to which the money will be transferred, the amount of money to be transferred, and the date the transfer will occur.
9. The system shall allow a user to schedule a transfer of money to a different account held by the same user.
10. The system shall allow a user to schedule a transfer of money to an account held by a different user.
11. The system shall not allow a user to schedule a transfer of money in excess of the amount of money currently scheduled to be transferred subtracted from the amount of money currently in the account.
12. The system shall not require approval for transfers of money to a different account held by the same user.
13. The system shall require approval for transfers of money in excess of a thousand dollars to the account of a different user.
14. The system shall not require approval for transfers of money less than or equal to a thousand dollars unless the transfer has been flagged.
15. The system shall not require approval for transactions in which money enters the account.
16. When a transfer is denied, then the system shall send a notice of the denial to the owners of the accounts impacted and record the denial in the transactions lists of the accounts impacted.
    a. The system shall track denied transfers.
    b. The system shall consider the impacted accounts to be the account transferring the money and the account receiving the money.
    c. The system shall record the transaction as "Denied" in the transactions lists for the impacted accounts.
17. When a transfer is approved, then the system shall indicate that the transfer is processing.
18. When a transfer is approved, the transfer shall be completed at the close of the business day.
19. When a transfer originates from a nation that is not the account holder's nation, then the system shall flag the transfer.

      a. The system shall set the flagged property to true.

         i. The system shall contain a boolean flagged property for transfers.

      b. The system shall display a flag icon to the left of the transfer.

         i. When the transfer of money is less than or equal to a thousand dollars, then the system shall display a yellow flag.

         ii. When the transfer of money is in excess of a thousand dollars, then the system shall display a red flag.

20. When a transfer is flagged, then the system shall require approval for the transfer.

21. The system shall allow designated controllers to approve transfers.

INCOMPLETENESS: Requirement (2.) contains an incompleteness: It describes what the system will show for completed, processing, or denied transactions, but not what it will show for a transaction awaiting approval. The addition to requirement (2.b.) fixes the incompleteness.

INCONSISTENCY: Requirement (2.c.) is in conflict with requirement (16.c.). Requirement (2.c.) says that denied transactions should have "Unsuccessful" status, while requirement (16.c.) says that denied transactions should have "Denied" status. Replacing "Unsuccessful" with "Denied" in requirement (2.c.) fixes this inconsistency.

COMPUTATIONS

1. The system shall compound interest according to the terms of the account.

      a. The system shall post interest compounded *daily,* monthly, or annually as a completed transaction at the close of the business day.

      b. The system shall only allow interest to be compounded according to daily, monthly, or annual terms.

2. When money is deposited, the system shall compute the new account balance when the transaction is complete.

3. When money is withdrawn, the system shall compute the new account balance when the transaction is complete.

INCOMPLETENESS: Requirement (1.) contains an incompleteness because requirement (1.b.) allows interest to be compounded daily, but the case of interest compounded daily is not handled in the requirements. The addition to requirement (1.a.) fixes this incompleteness.

SECURITY

1. The system shall track a user's time of inactivity.

      a. The system shall consider time without activity to be time in which no elements of the system are interacted with by the user.

           i. The system shall be able to track time in minutes.

          ii. The system shall reset the tracked time when the user interacts with an element of the system.

      b. The system shall ~~not~~ consider a user's interaction with the warning prompt to be time with activity.

           i. ~~The system shall not reset the tracked time when the user interacts with the warning prompt.~~

2. The system shall log the user out following five minutes of inactivity.
3. The system shall generate two warnings for the user before automatically logging the user out.

      a. The system shall generate a warning following two minutes of inactivity.

      b. The system shall generate a warning following four minutes of inactivity.

      c. The system shall display a warning as a prompt in a new window.

4. The system shall allow the user to log out manually at any time.

INCONSISTENCY: Requirement (1.a.) conflicts with requirement (1.b.) because the warning prompt is an element of the system. As such, by requirement (1.a.), it should be considered time with activity and should reset the tracked time. However, requirement (1.b.) says the system should not consider the interaction with the warning prompt to be time with activity and should not reset the tracked time. The deletion in requirement (1.b.) fixes this inconsistency.