
Certified LabVIEW Developer Examination

Examinee: _____ Date: _____

Administrator: _____ Date: _____

Instructions:

If you did not receive this exam in a sealed envelope stamped “NI Certification,” **DO NOT ACCEPT** this exam. Return it to the proctor immediately. You will be provided with a replacement exam.

- **Do not detach the binding staple of any section. If any part of the exam paper is missing or detached when returned to National Instruments, you will be deemed to have failed the exam.**
- This examination may not be taken from the examination area or reproduced in any way. You may not keep any portion of this exam after you have completed it.
- Do not ask the proctor for help. If any part of the exam is not clear, you may make appropriate assumptions and document them either on the exam paper or on the LabVIEW block diagram.
- A computer with a standard installation of LabVIEW is the only reference allowed for the examination. Externally developed code or third party tools are not allowed in the exam.
- The application must be specifically developed for the exam submission.
- The front panel and associated controls for the application are provided to you in a folder hierarchy on the USB memory stick. You **must** maintain the folder hierarchy and use these components to develop your application. Solutions that do not use the hierarchy or the given components are not graded.
- Do **not** rename the main VI or any of the provided controls. Solutions with renamed main VI or controls are not graded. You may use LabVIEW design patterns, templates, and examples available in the development environment as a guide/resource for the application development.
- **Submit your completed application on the provided USB memory stick.** Failure to provide the solution on the memory stick results in automatic failure.
- Total time allocated for the exam: 4 hours
- Exam passing grade: 70%

Grading:

The application development exam consists of a total of 40 points which are allocated as follows:

- Programming style (**15 points**)
- Functionality (**15 points**)
- Documentation (**10 points**)

IMPORTANT:

- **When you complete the exam, place the exam document and the USB memory stick containing the saved application, along with any deliverables, in the envelope provided.**
- **Please SEAL and give the sealed envelope to your proctor.**

Section I: General Requirements

The Certified LabVIEW Developer exam tests your ability to develop a LabVIEW application.

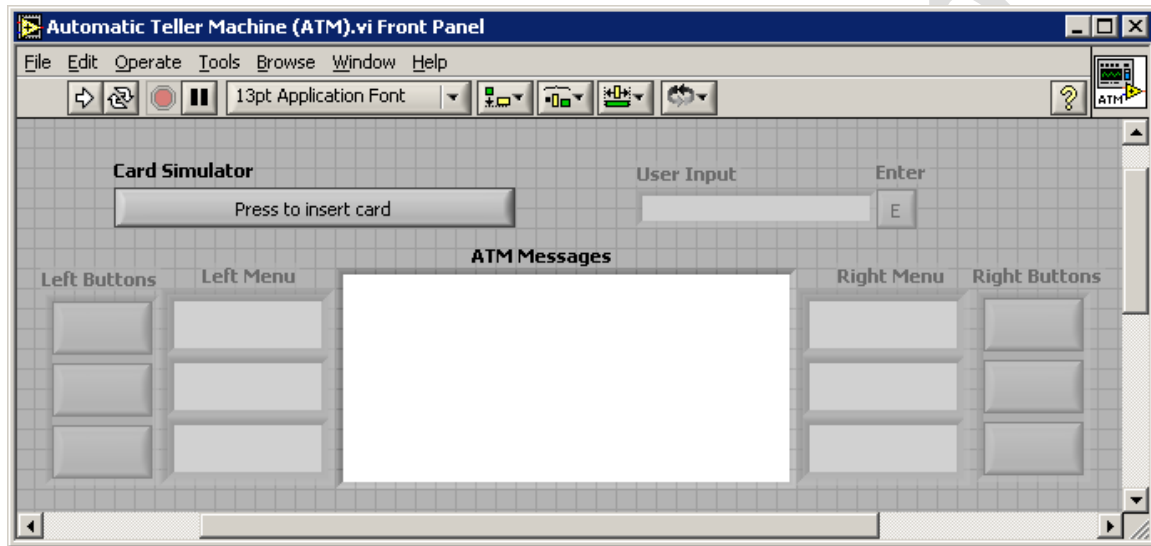
The application should do the following:

- Function as specified in Section II of this document
- Conform to LabVIEW coding style and documentation standards (found in LabVIEW documentation – *LabVIEW Development Guidelines*)
- Be created expressly for this exam using VIs and functions available in LabVIEW. Templates, examples, or code developed outside the bounds of this exam are not acceptable for use in the application
- Be hierarchical in nature. All major functions should be performed in subVIs
- Use a state machine that either uses a type-defined enumerated control, queue, or Event structure for state management
- Be easily scalable to add more states/features without manually updating the hierarchy
- Minimize the use of excessive structures, variables (locals/globals) and property nodes
- Respond to front panel controls (within 100 ms) without utilizing 100 % of CPU time
- Close all opened references and handles where used
- Be well-documented, and include the following:
 - Labels on appropriate wires within the main VI and subVIs
 - Descriptions for each algorithm
 - Documentation in **VI Properties»Documentation** for both main VI and subVIs
 - Tip strips and descriptions for front panel controls and indicators
 - Labels for constants

Application Development
Section II: Application Requirements
Automated Teller Machine (ATM)

Objective

Design an Automated Teller Machine (ATM) controller using LabVIEW. The front panel of the simulator resembling the following front panel is provided to you as a VI on the USB memory stick. You **must** use the provided VI and controls to develop your application.



General Operation

The ATM controller simulates the control system of an Automated Teller Machine. The user interacts with controls and indicators on the front panel to perform common ATM functions such as deposit funds, withdraw funds, and inquire about the balance of funds from the user account.

The ATM controller has access to user account information stored in the `Accounts.txt` file. You, the developer, are responsible for creating the `Accounts.txt` file, which the ATM controller reads from or writes to, depending on user-initiated transactions. Refer to the *ATM Accounts File specification* section for more information about the initial content and data format of the `Accounts.txt` file.

The controller should perform the following general operations:

- Obtain user input through the **User Input**, **Left Buttons**, and **Right Buttons**.
- Manage the **Left Menu** and **Right Menu** strings and take appropriate action by responding to the corresponding **Left Buttons** and **Right Buttons**.

- Prompt user actions and confirm transactions by displaying appropriate messages in the **ATM Messages** indicator.
- Monitor user inactivity and terminate the user session after the specified time expires.

Sequence of Operation

Start (Application Run): When the application starts, the **User Input**, **Enter (E)**, **Left Menu**, **Right Menu**, **Left Buttons**, and **Right Buttons** should be disabled.

The **Card Simulator** button should be enabled and the **ATM Messages** indicator should display the *Welcome Message*.

Refer to the *ATM Message Types* section of the specification for message types and font specifications for the messages.

Insert ATM card: Click the **Card Simulator** button. The button should remain pressed and the Boolean text should display **Card Inserted**. This action enables the **Enter (E)** button and the **User Input** string control, focuses the cursor to the **User Input** control and waits for the user to enter the account number in the control. The **Card Simulator** button should remain pressed until the user completes the session or a timeout (10 seconds) occurs.

After the user completes keying in the account number and presses the **Enter (E)** button, the ATM controller should access the ATM Accounts file and verify that the account exists.

If the account does not exist, the **ATM Messages** indicator should display the *Account Verification Failed Message* and prompt the user to re-enter the account number. If the account exists, the ATM controller should enable the **Left Menu**, **Right Menu**, **Left Buttons** and **Right Buttons**, and display the *Main Menu Message* on the **ATM Messages** indicator. The ATM controller should also populate the **Left Menu** and **Right Menu** with the Main Menu and wait for user action.

Refer to the *ATM Menus* section of the specification for more information about the strings that appear in the menus.

Note: If, at anytime after the insertion of the ATM card, the ATM controller does not detect use of front panel controls for 10 seconds, the **Card Simulator** button should be released and the user session should be terminated by stopping the application. The **ATM Messages** indicator should display the *Session Terminate Message*.

Deposit: Click the button next to the corresponding **Right Menu** item. This action should display the *Deposit Message*, focus the cursor to the **User Input**, and allow the user to enter the amount to be deposited. After the user enters an amount in the **User Input** and presses the **Enter (E)** button, the *Deposit Complete Message* should display on the **ATM Messages** indicator and the ATM Accounts file should update with the new balance.

Withdraw: Click the button next to the corresponding **Right Menu** item. This action should display the *Withdrawal Message*, focus the cursor to the **User Input** control, and allow the user to enter the amount to withdraw from the account. After the user

enters an amount in the **User Input** control and presses the **Enter** (E) button, the ATM controller should check if the account has sufficient funds to complete the transaction. If the account has sufficient funds, the controller should deduct the keyed in amount from the current balance, update the ATM Accounts file with the new balance, and display the Withdrawal Complete Message on the **ATM Messages** indicator.

If the account has insufficient funds, the Withdrawal Failed Message should display on the **ATM Messages** indicator.

Fast Cash \$50: Click the button next to the corresponding **Right Menu** item. The ATM controller should check if the account has sufficient funds to complete the transaction. If the account has at least \$50, the ATM controller should deduct \$50 from the current balance, update the ATM Accounts file with the new balance, and display the Withdrawal Complete Message on the **ATM Messages** indicator. If the account has insufficient funds, the Withdrawal Failed Message should display on the **ATM Messages** indicator.

None: This button is reserved for future use. Clicking the button next to the corresponding **Left Menu** item should not produce any results. The **ATM Messages** indicator should continue to display the current message.

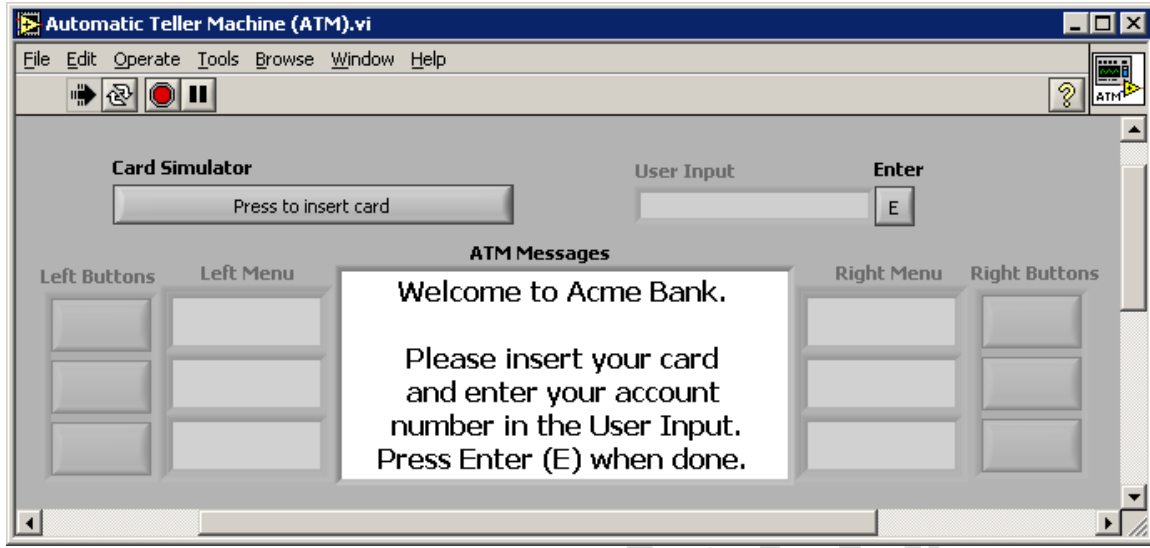
Balance Inquiry: Click the button next to the corresponding **Left Menu** item to get the current balance from the ATM Accounts file. The **ATM Messages** indicator should display the Balance Inquiry Message.

Return Card and Terminate: Click the button next to the corresponding **Left Menu** item to terminate the user session. The **ATM Messages** indicator should display the Session Terminate Message. The ATM controller should release the **Card Simulator** button to indicate the return of the ATM card, disable the **User Input** control, and terminate the application.

ATM Message Types

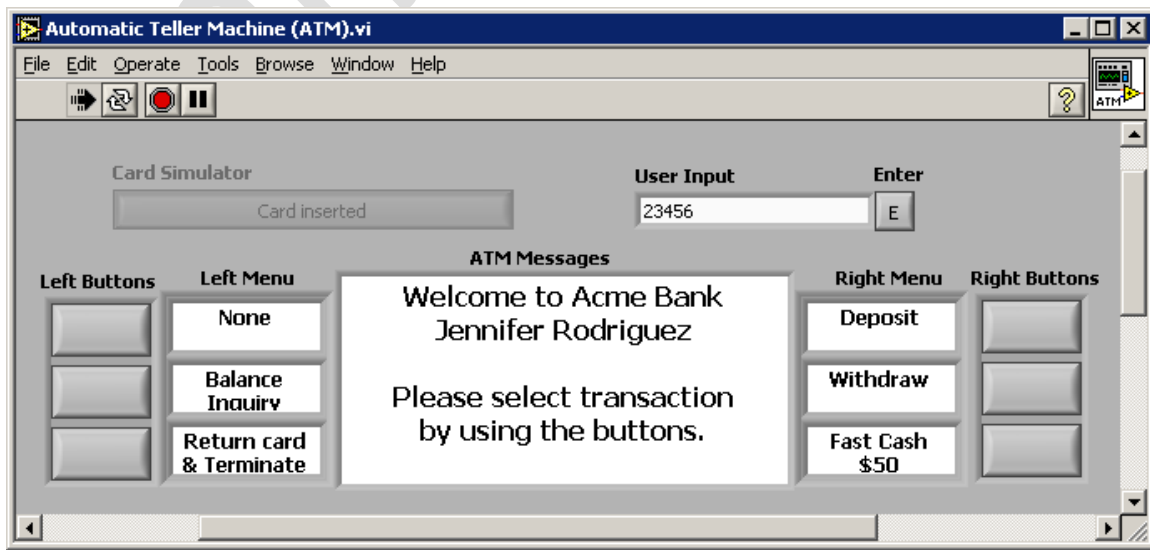
| Message Type | Message |
|-------------------------------------|---|
| Welcome Message | Welcome to Acme Bank. Please insert your card and enter your account number in the User Input. Press Enter (E) when done. |
| Main Menu Message | Welcome to Acme Bank First Name, Last Name (from file) Please select transaction by using the buttons. |
| Account Verification Failed Message | Account Information Incorrect Please Re-Enter Account Number. Press Enter (E) when done |
| Session Terminate Message | Your session has been terminated due to inactivity or menu selection. Please take your card Goodbye! |
| Deposit Message | Please enter amount to deposit and press Enter (E) when done |
| Deposit Complete Message | \$ (Amount) Deposited |
| Withdrawal Message | Please enter amount to withdraw and press Enter (E) when done |
| Withdrawal Complete Message | \$ (Amount) Withdrawn |
| Withdrawal Failed Message | Insufficient funds in account Please check your balance and try again |
| Balance Inquiry Message | Your Balance Is: \$ (Balance Amount from file) |

The font for the **ATM Message** indicator should be 14 point and bold. The message should be centered in the display, as shown in the following figure.

Sample screen shot for ATM messages**ATM Menus:****Main Menu:**

| Left Menu (Strings) | Right Menu (Strings) |
|---------------------------|----------------------|
| None | Deposit |
| Balance Inquiry | Withdraw |
| Return Card and Terminate | Fast Cash \$50 |

Note: The application should be scalable to add other menus without major modifications to the application.

Sample screen shot with Main Menu displayed:

ATM Accounts File specification:

The file should be a text file containing ATM account information in a Comma Separated Value (CSV) format. The file should be located in the same folder as the main VI. The ATM controller should not prompt the user for a filename or prompt the user to update the file.

The account information should be in the following format:
Account Number (5 digits), First Name, Last Name, Balance

Each account should be identified by a unique account number only.

The following four records should exist to test the operation of the ATM:

12345,John,Doe,550

23456,Jennifer,Rodriguez,1000

34567,Bryan,Smith,750

45678,Julie,Ramirez,900