NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

SC0006 - Software Engineering
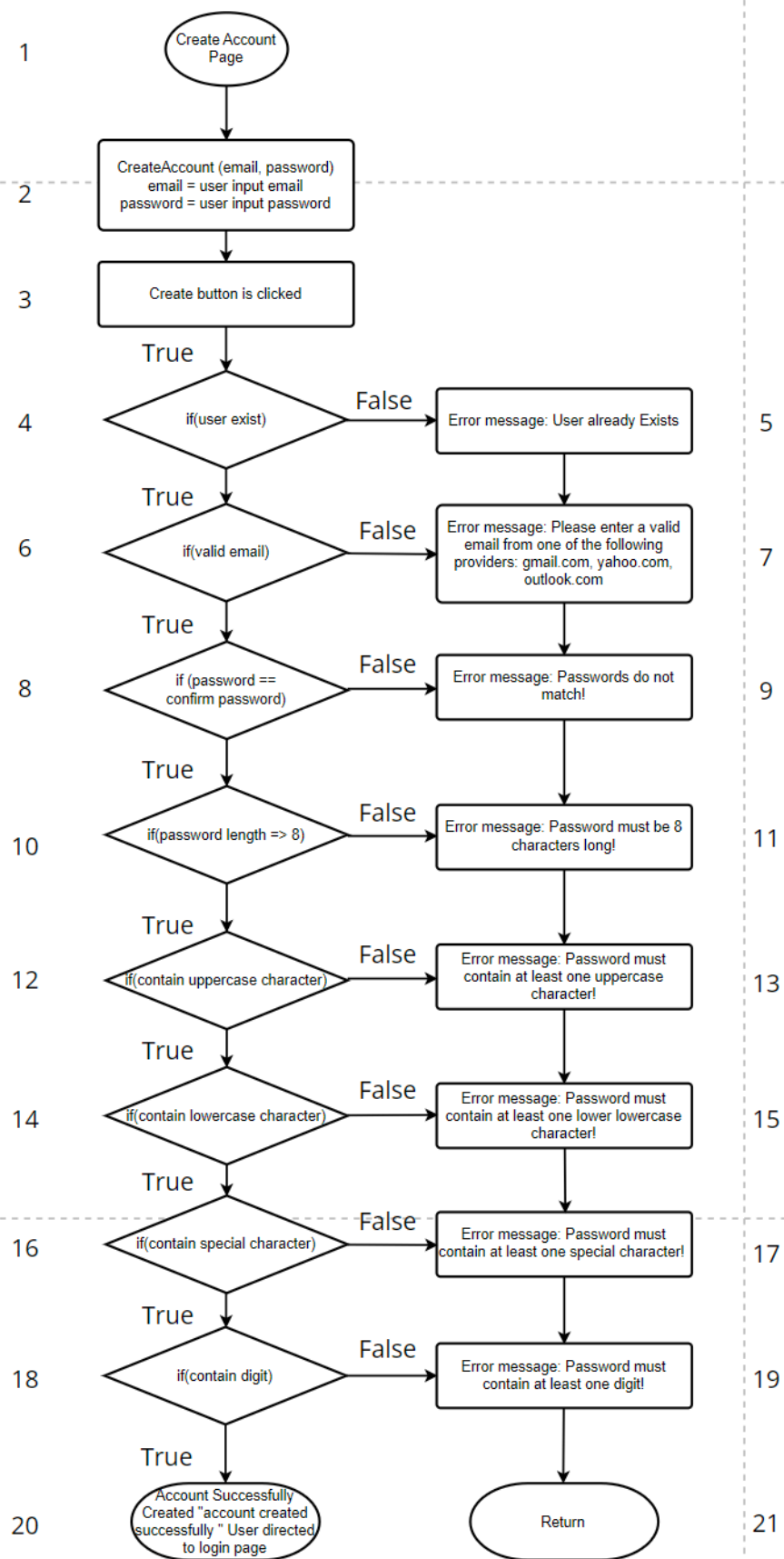
Group Project Report (Software Testing)

Table No.: C14

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Test Case 1 White box (Account Creation Process)

```
1        ( Create Account Page )

2        CreateAccount (email, password)
         email = user input email
         password = user input password

3        Create button is clicked

         True

4        if(user exist)  --False-->  5  Error message: User already Exists

         True

6        if(valid email)  --False-->  7  Error message: Please enter a valid
                                         email from one of the following
                                         providers: gmail.com, yahoo.com,
                                         outlook.com

         True

8        if (password == confirm password)  --False-->  9  Error message: Passwords do not match!

         True

10       if(password length => 8)  --False-->  11  Error message: Password must be 8 characters long!

         True

12       if(contain uppercase character)  --False-->  13  Error message: Password must contain at least one uppercase character!

         True

14       if(contain lowercase character)  --False-->  15  Error message: Password must contain at least one lower lowercase character!

         True

16       if(contain special character)  --False-->  17  Error message: Password must contain at least one special character!

         True

18       if(contain digit)  --False-->  19  Error message: Password must contain at least one digit!

         True

20       ( Account Successfully Created "account created successfully " User directed to login page )

21       ( Return )
```

Cyclomatic Complexity: 9 (8 Decision Points + 1)

Baseline path: 1,2,3,4,6,8,10,12,14,16,18,20

Basis Path 1: 1,2,3,**4**,5,21

Basis Path 2: 1,2,3,4,**6**,7,21

Basis Path 3: 1,2,3,4,6,**8**,9,21

Basis Path 4: 1,2,3,4,6,8,**10**,11,21
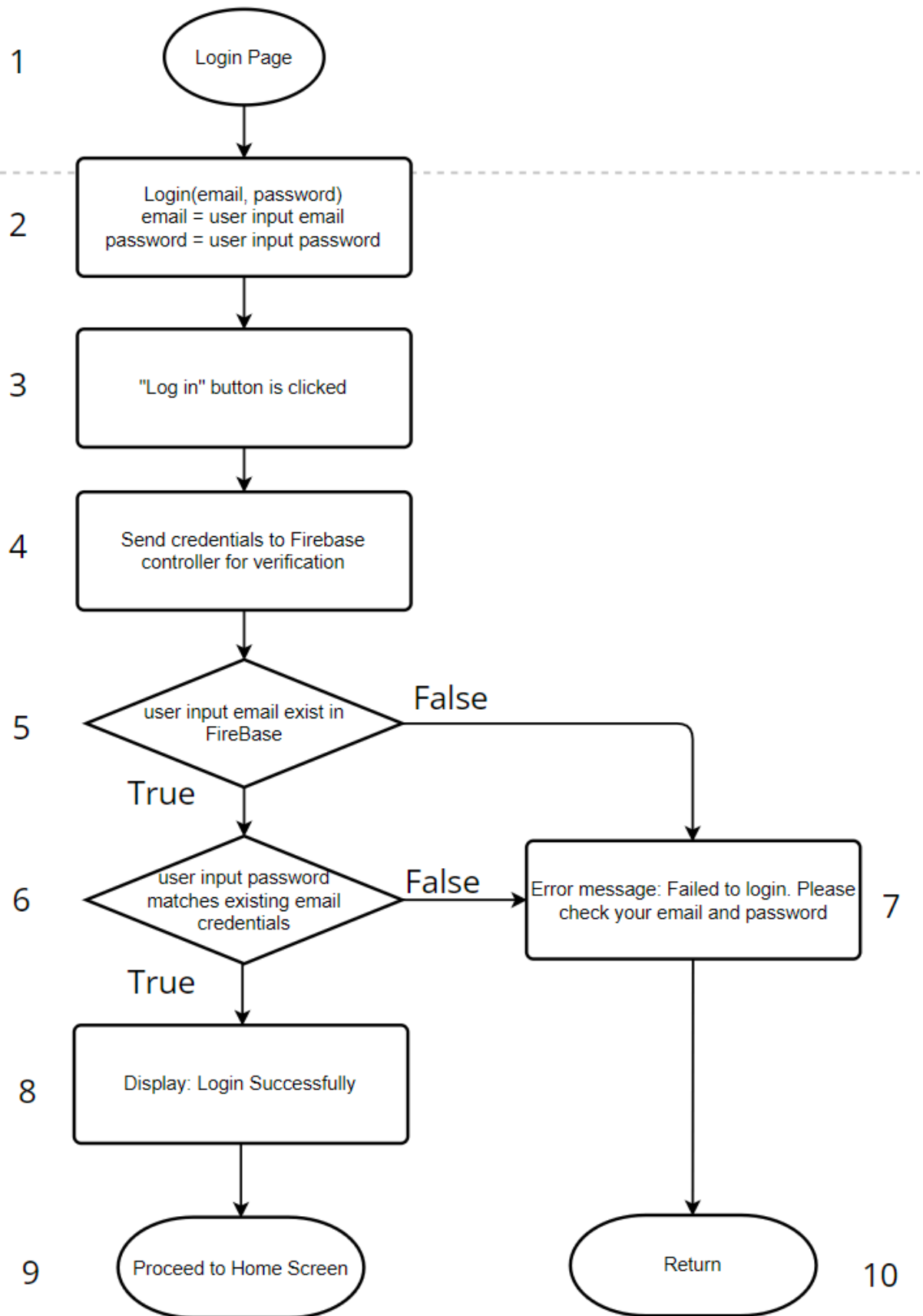
Basis Path 5: 1,2,3,4,6,8,10,**12**,13,21

Basis Path 6: 1,2,3,4,6,8,10,12,**14**,15,21

Basis Path 7: 1,2,3,4,6,8,10,12,14,**16**,17,21

Basis Path 8: 1,2,3,4,6,8,10,12,14,16,**18**,19,21

Email	Password	Confirm Password	Expected Result	Actual Result
newvaliduser@gmail.com	1234Abc@	1234Abc@	Account created successfully	Account created successfully
newvaliduser@gmail.com	1234Abc@	1234Abc@	User already Exists	User already Exists
invaliduser@vmail.com	1234Abc@	1234Abc@	Please enter a valid email from one of the following providers: gmail.com, yahoo.com, outlook.com	Please enter a valid email from one of the following providers: gmail.com, yahoo.com, outlook.com
validuser@gmail.com	1234Abc@	1234Abc!	Passwords do not match!	Passwords do not match!
validuser@gmail.com	1234Ab!	1234Ab!	Password must be 8 characters long!	Password must be 8 characters long!
validuser@gmail.com	1234abc@	1234abc@	Password must contain at least one uppercase character!	Password must contain at least one uppercase character!
validuser@gmail.com	1234ABC@	1234ABC@	Password must contain at least one lower lowercase character!	Password must contain at least one lower lowercase character!
validuser@gmail.com	1234Abcd	1234Abcd	Password must contain at least one special character!	Password must contain at least one special character!
validuser@gmail.com	abcdAbc@	abcdAbc@	Password must contain at least one digit!	Password must contain at least one digit!

Test Case 2 White box (User Login Process)

1 — Login Page

2 — Login(email, password)
email = user input email
password = user input password

3 — "Log in" button is clicked

4 — Send credentials to Firebase controller for verification

5 — user input email exist in FireBase
False
True

6 — user input password matches existing email credentials
False
True

7 — Error message: Failed to login. Please check your email and password

8 — Display: Login Successfully

9 — Proceed to Home Screen

10 — Return

Cyclomatic Complexity: 4 (3 Decision Points + 1)

Baseline path: 1,2,3,4,5,6,8,9

Basis Path 1: 1,2,3,4,**5**,7,10

Basis Path 2: 1,2,3,4,5,**6**,7,10

Valid email: validuser@gmail.com

Valid password: 1234Abc@

Email	Password	Expected Result	Actual Result
validuser@gmail.com	1234Abc@	Login successfully	Login successfully
invaliduser@vmail.com	1234Abc@	Failed to login. Please check your email and password	Failed to login. Please check your email and password
validuser@gmail.com	2468Abc@	Failed to login. Please check your email and password	Failed to login. Please check your email and password

Test Case 3 White box (User Logout Process)

Cyclomatic Complexity: 2 (1 Decision Point +1)

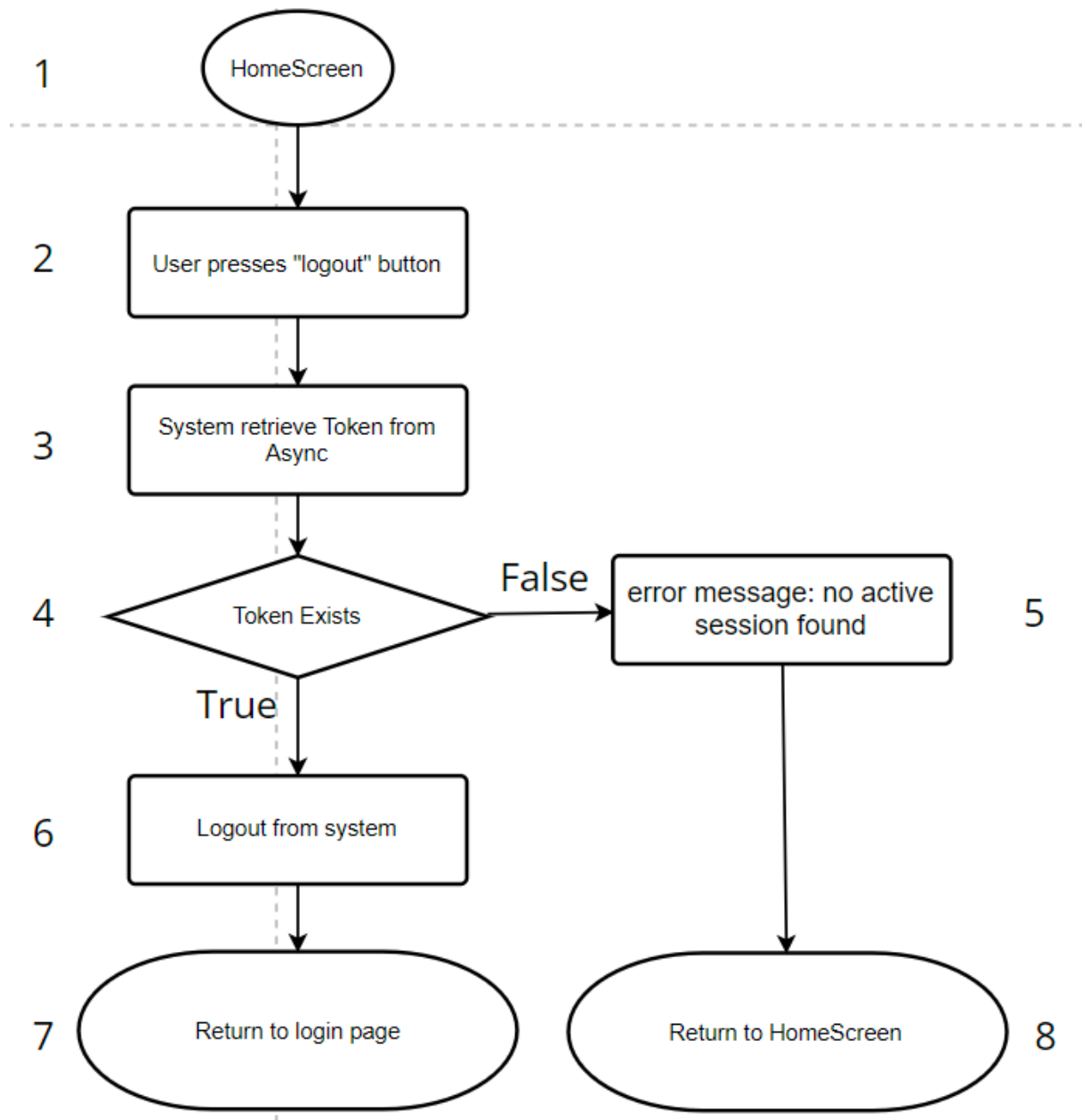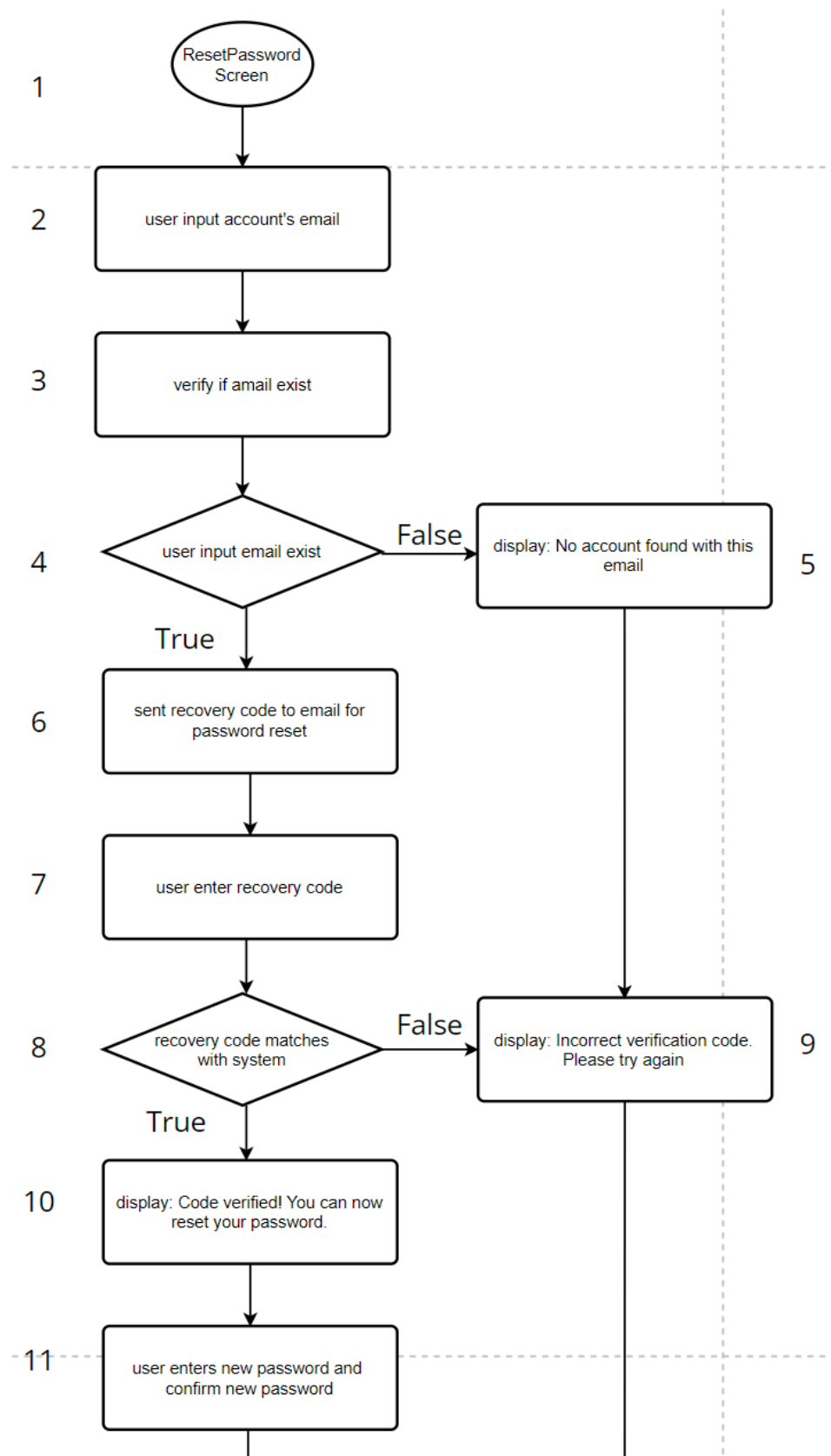**Baseline Path**: 1,2,3,4,6,7

Basis Path 1: 1,2,3,**4**,5,8
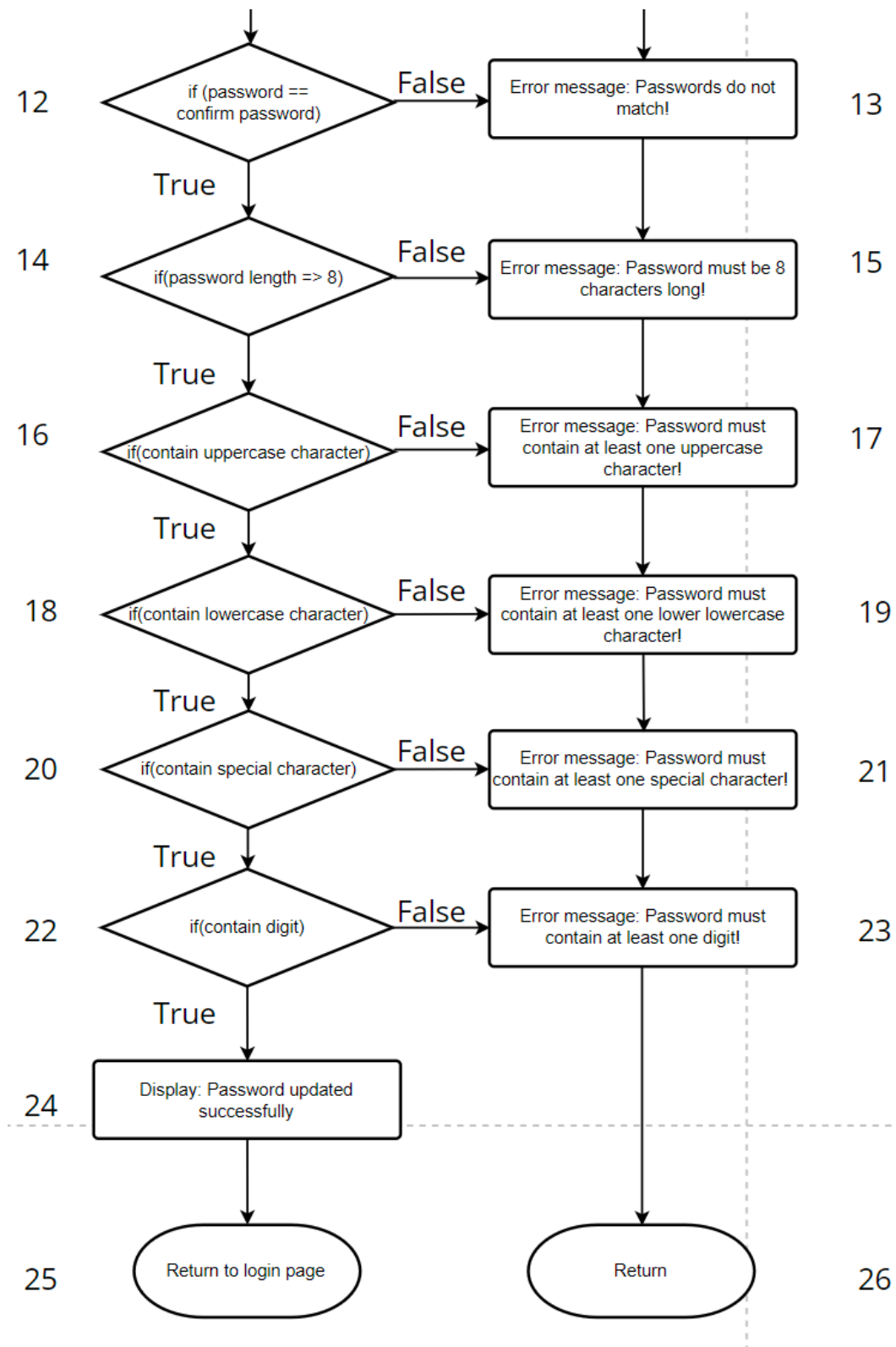
Token Exist?	Expected Result	Actual Result
Yes	Logged out successfully	Logged out successfully
No	No active session found	No active session found

Test Case 4 White box (Reset Password Process)

```
                    ↓                                    ↓
        ┌───────────────────────┐    False   ┌─────────────────────────┐
  12    │  if (password ==       │──────────→│ Error message: Passwords │   13
        │  confirm password)     │           │ do not match!            │
        └───────────────────────┘           └─────────────────────────┘
                    │ True                              │
                    ↓                                    ↓
        ┌───────────────────────┐    False   ┌─────────────────────────┐
  14    │  if(password length    │──────────→│ Error message: Password  │   15
        │  => 8)                 │           │ must be 8 characters long!│
        └───────────────────────┘           └─────────────────────────┘
                    │ True                              │
                    ↓                                    ↓
        ┌───────────────────────┐    False   ┌─────────────────────────┐
  16    │ if(contain uppercase   │──────────→│ Error message: Password  │   17
        │ character)             │           │ must contain at least one│
        └───────────────────────┘           │ uppercase character!     │
                    │ True                   └─────────────────────────┘
                    ↓                                    ↓
        ┌───────────────────────┐    False   ┌─────────────────────────┐
  18    │ if(contain lowercase   │──────────→│ Error message: Password  │   19
        │ character)             │           │ must contain at least one│
        └───────────────────────┘           │ lower lowercase character!│
                    │ True                   └─────────────────────────┘
                    ↓                                    ↓
        ┌───────────────────────┐    False   ┌─────────────────────────┐
  20    │ if(contain special     │──────────→│ Error message: Password  │   21
        │ character)             │           │ must contain at least one│
        └───────────────────────┘           │ special character!       │
                    │ True                   └─────────────────────────┘
                    ↓                                    ↓
        ┌───────────────────────┐    False   ┌─────────────────────────┐
  22    │ if(contain digit)      │──────────→│ Error message: Password  │   23
        └───────────────────────┘           │ must contain at least one│
                    │ True                   │ digit!                   │
                    ↓                        └─────────────────────────┘
        ┌───────────────────────┐                       │
  24    │ Display: Password      │                       │
        │ updated successfully   │                       │
        └───────────────────────┘                       │
                    │                                    │
                    ↓                                    ↓
        ╭───────────────────────╮           ╭─────────────────────────╮
  25    │  Return to login page │           │         Return          │   26
        ╰───────────────────────╯           ╰─────────────────────────╯
```

8

Cyclomatic Complexity: 9 (8 Decision point + 1)

Baseline Path: 1,2,3,4,6,7,8,10,11,12,14,16,18,20,22,24,25

Basis Path 1: 1,2,3,**4**,5,26

Basis Path 2: 1,2,3,4,6,7,**8**,9,26

Basis Path 3: 1,2,3,4,6,7,8,10,11,**12**,13,26

Basis Path 4: 1,2,3,4,6,7,8,10,11,12,**14**,15,26
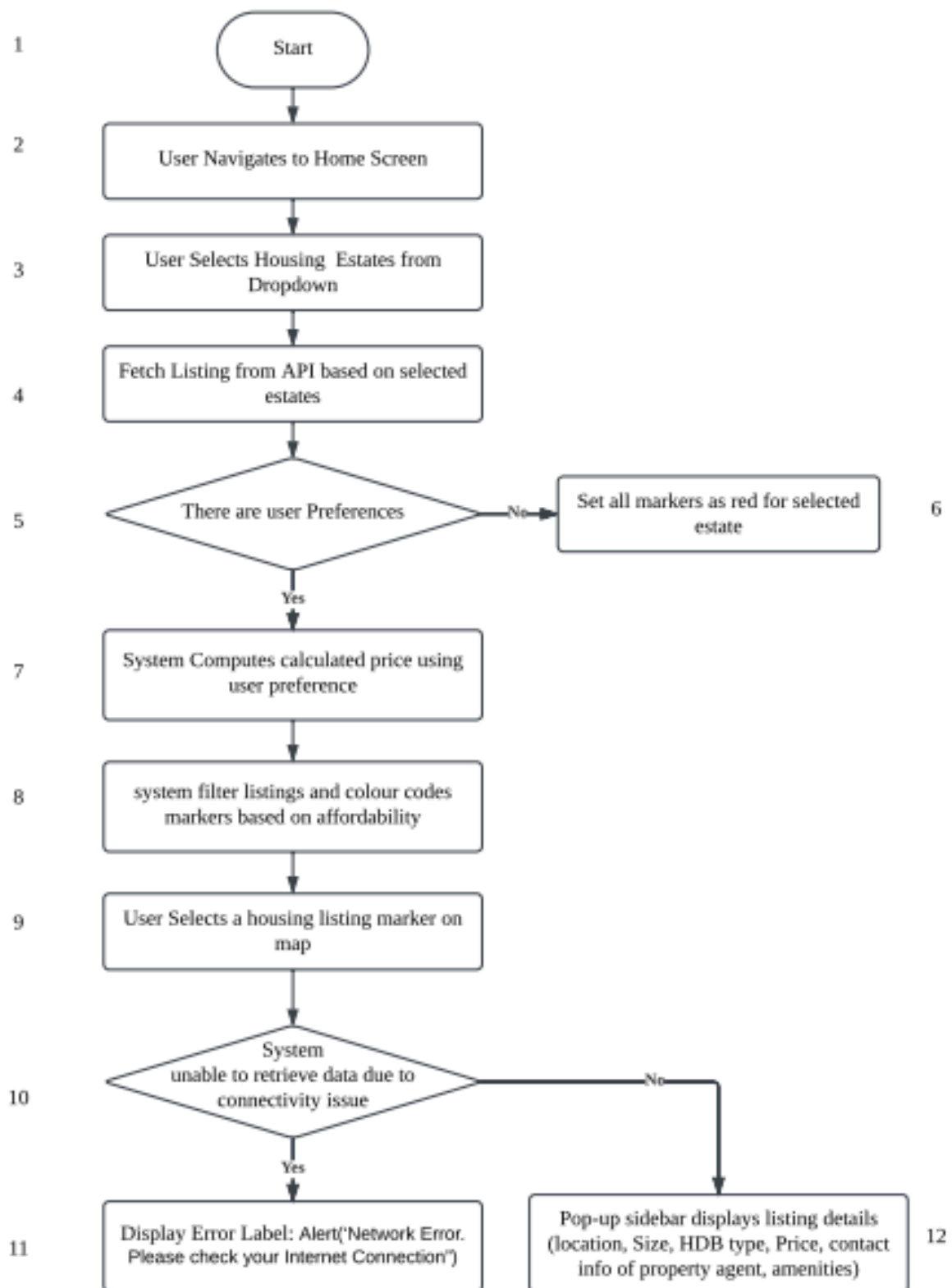
Basis Path 5: 1,2,3,4,6,7,8,10,11,12,14,**16**,17,26

Basis Path 6: 1,2,3,4,6,7,8,10,11,12,14,16,**18**,19,26

Basis Path 7: 1,2,3,4,6,7,8,10,11,12,14,16,18,**20**,21,26

Basis Path 8: 1,2,3,4,6,7,8,10,11,12,14,16,18,20,**22**,23,26

Email	Recovery code	Input recovery code	Password	Confirm Password	Expected Result	Actual Result
validuser@gmail.com	272138	272138	1234Abc@	1234Abc@	Password updated successfully!	Password updated successfully!
invaliduser@vmail.com	-	-	-	-	No account found with this email	No account found with this email
validuser@gmail.com	456130	458130	-	-	Incorrect verification code. Please try again.	Incorrect verification code. Please try again.
validuser@gmail.com	658009	658009	1234Abc@	1234Abc!	Passwords do not match!	Passwords do not match!
validuser@gmail.com	658009	658009	1234Ab!	1234Ab!	Password must be 8 characters long!	Password must be 8 characters long!
validuser@gmail.com	658009	658009	1234abc@	1234abc@	Password must contain at least one uppercase character!	Password must contain at least one uppercase character!
validuser@gmail.com	658009	658009	1234ABC@	1234ABC@	Password must contain at least one lower lowercase character!	Password must contain at least one lower lowercase character!
validuser@gmail.com	658009	658009	1234Abcd	1234Abcd	Password must contain at least one special character!	Password must contain at least one special character!
validuser@gmail.com	658009	658009	abcdAbc@	abcdAbc@	Password must contain at least one digit!	Password must contain at least one digit!

Test Case 5 White box (Display Listings Process)

1 — **Start**

2 — User Navigates to Home Screen

3 — User Selects Housing Estates from Dropdown

4 — Fetch Listing from API based on selected estates

5 — There are user Preferences

6 — **No** → Set all markers as red for selected estate

Yes

7 — System Computes calculated price using user preference

8 — system filter listings and colour codes markers based on affordability

9 — User Selects a housing listing marker on map

10 — System unable to retrieve data due to connectivity issue — **No**

Yes

11 — Display Error Label: Alert('Network Error. Please check your Internet Connection')

12 — Pop-up sidebar displays listing details (location, Size, HDB type, Price, contact info of property agent, amenities)

Cyclomatic Complexity: 3 (2 Decision Point + 1)

Baseline Path: 1,2,3,4,5,7,8,9,10,12

Basis Path 1: 1,2,3,4,**5**,6

Basis Path 2: 1,2,3,4,5,7,8,9,**10**,11

User Preference	System unable to retrieve data due to Connectivity Issue	Expected Result	Actual Result
Yes	No	Pop-up Sidebar Displays listing Details	Pop-up Sidebar Displays listing Details
No	-	Markers Set red for selected Estate	Markers Set red for selected Estate
yes	yes	Alert('Network Error. Please check your Internet Connection")	Alert('Network Error. Please check your Internet Connection")

Test Case 5.1 (White Box) (Display Street View Process)
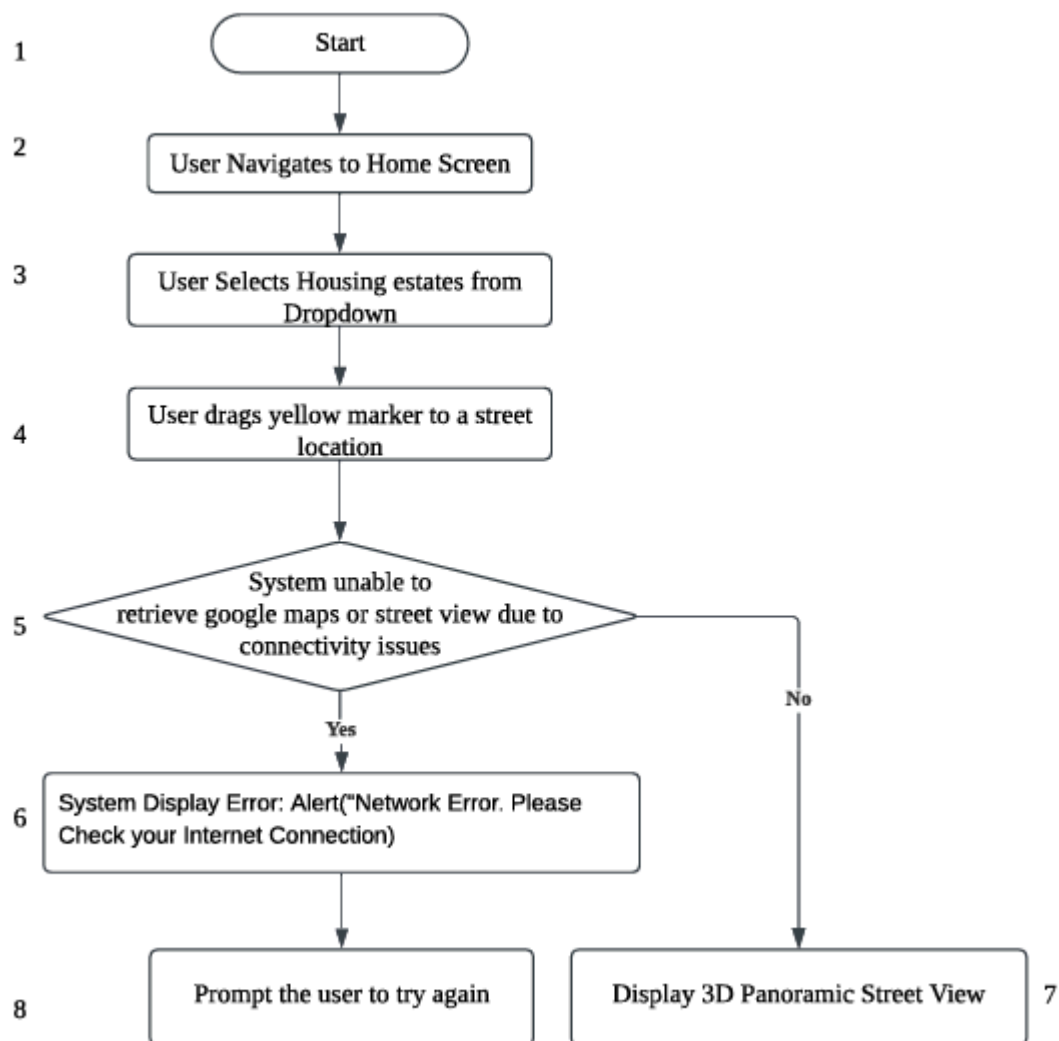
Cyclomatic Complexity: 2 (1 Decision Point +1)

Baseline Path: 1,2,3,4,5,**7**

Basis Path 1: 1,2,3,4,5,**6**,8

Connectivity Issue	Expected Result	Actual Result
No	3D Panoramic Street View	3D Panoramic Street View
Yes	Alert('Network Error. Please check your Internet Connection")	Alert('Network Error. Please check your Internet Connection")

Test Case 5.2 White Box (Compare Listing Process)
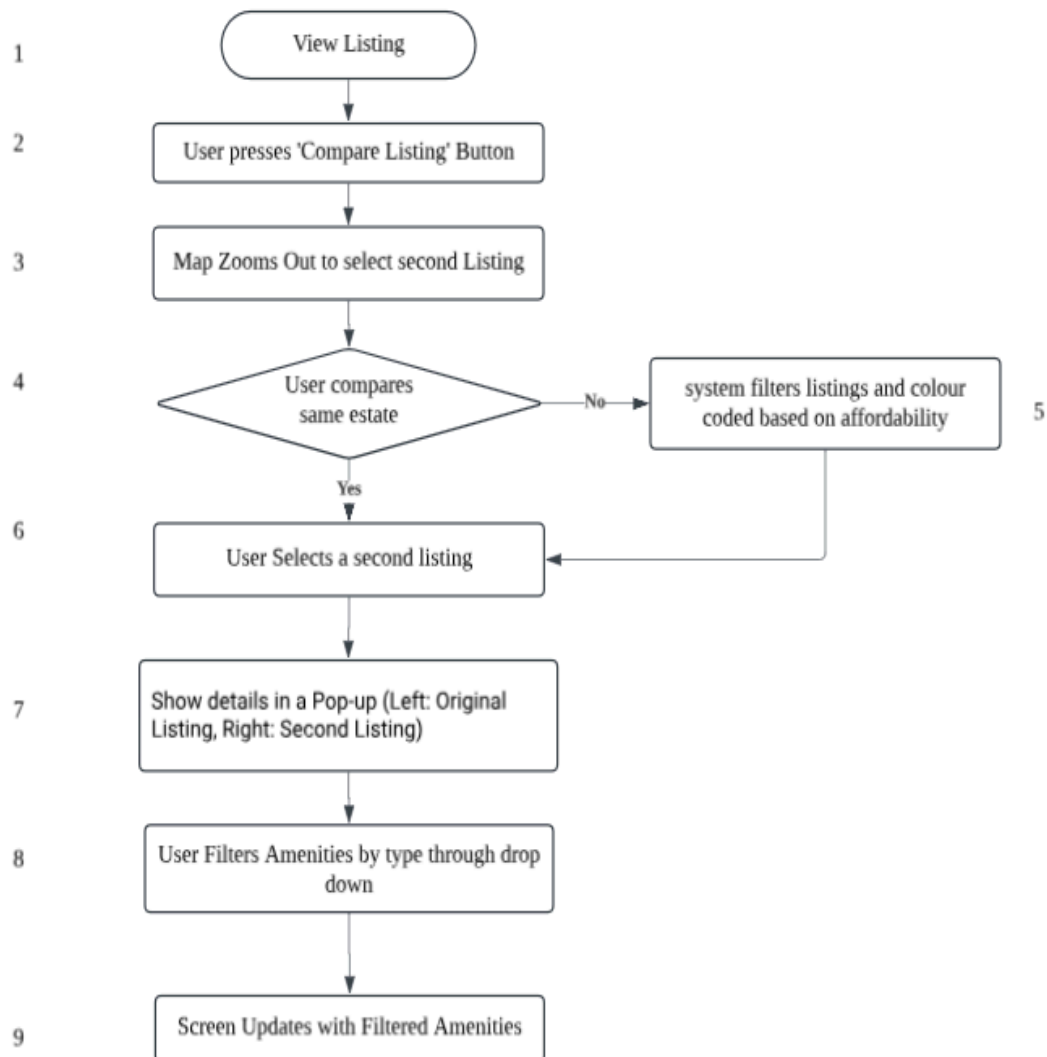
Cyclomatic Complexity: 2 (1 Decision Points + 1)

Baseline Path:1,2,3,4,6,7,8,9

Basis Path 1: 1,2,3,4,**5**,6,7,8,9

User Compares same Estate	Expected output	Actual Output
Yes	Updated screen with Filtered Amenities	Updated screen with Filtered Amenities
No	Updated screen with Filtered Amenities	Updated screen with Filtered Amenities

Test Case 5.3 White Box (Bookmark Listing from Pop-up)

1 — Start

2 — User Clicks Heart Icon (not filled)

3 — Network connected

5 — Display: Alert("Please Check your Internet Connection")

Yes

4 — System saves listing to user's database

7 — Display Success Message

8 — Heart Icon turns Full Red (Listing Saved)

6 — Heart Icon remains Unfilled

9 — User Clicks Heart Icon (Filled)

10 — Network Connected

No

12 — Display: Alert("Please Check your Internet Connection")

Yes

11 — System removes Listing from User Database

14 — Display Removal Success Message

15 — Heart Icon turns Unfilled (Listing not Saved)

13 — Heart Icon Remains Filled

Cyclomatic Complexity: 3 (2 Decision Points + 1)

Baseline Path: 1,2,3,4,7,8,9,10,11,14,15

Basis Path 1: 1,2,**3**,5,6

Basis Path 2: 1,2,3,4,7,8,9,**10**,12,13

Input	Connectivity Issue	Expected Result	Actual Result
User Clicks unfilled Heart Icon	No	Heart Icon Filled	Heart Icon Filled
User Clicks Unfilled Heart Icon	Yes	Alert('Network Error. Please check your Internet Connection") Heart Icon Remains Unfilled	Alert('Network Error. Please check your Internet Connection") Heart Icon Remains Unfilled
User Clicks Filled Heart Icon	No	Heart Icon Unfilled	Heart Icon Unfilled

Test Case 6 White Box (Delete Listing from Bookmark Page)
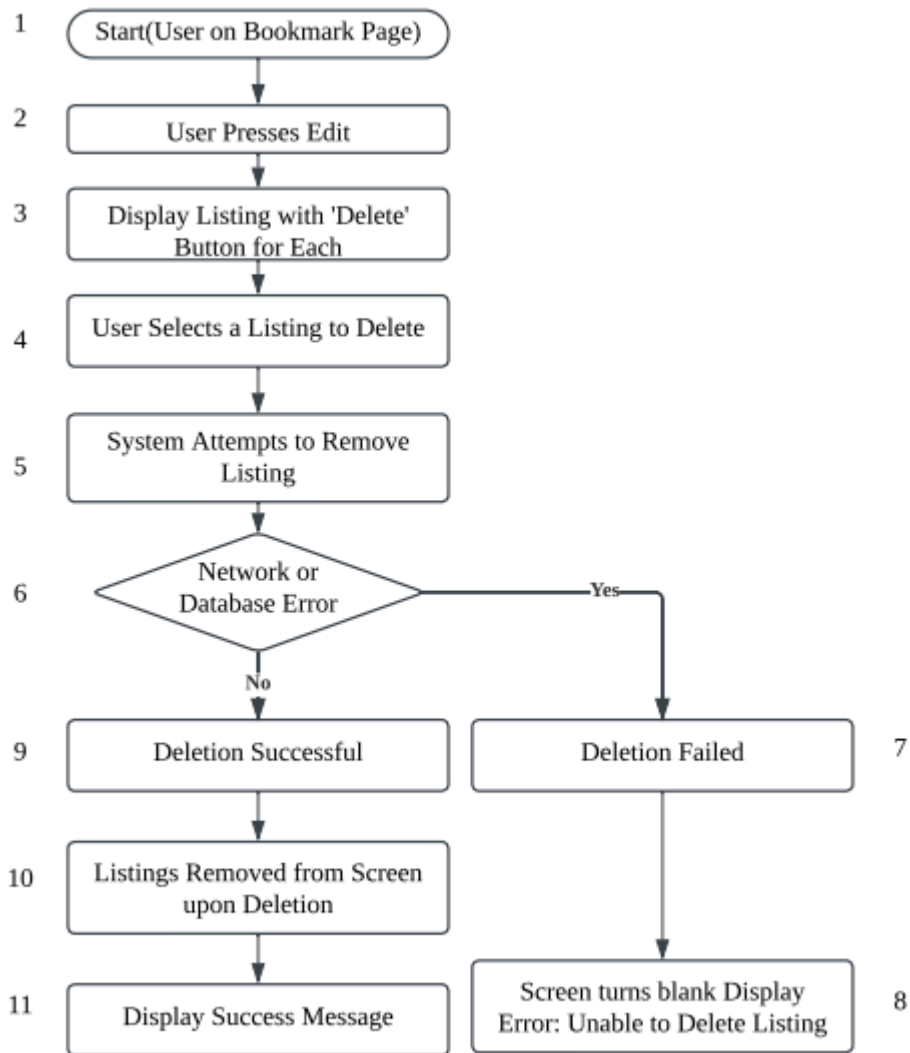
Cyclomatic Complexity: 2 (1 Decision Point + 1)

Baseline Path: 1,2,3,4,5,6,9,10,11

Basis Path 1: 1,2,3,4,5,6,**7**,8

Database Error	Expected Result	Actual Result
No	Success Message	Success Message
Yes	"Unable to Delete Listing"	"Unable to Delete Listing"

Test Case 7 Black Box (User Preference Field Testing)

7.1 BB Equivalent Class Test for empty fields

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$5,000	$750,000	$100,000	4-Room	HDB Housing Loan	Approve (Preferences saved successfully.)	Approve (Preferences saved successfully.)
$5,000	$750,000	$100,000	4-Room	(Empty)	Reject (Please fill out all fields.)	Reject (Please fill out all fields.)

Reason for choosing ECT: This test focuses on whether fields are filled or left empty, which are distinct classes of input (filled vs. empty). Since we are testing whether the system correctly handles these different classes, Equivalence Class Testing is appropriate.

Requirements: The system requires all fields to be filled for preferences to be saved successfully.

Valid Class: All Fields Filled. The inputs belong to the class where all required fields have values. The system should accept and process these inputs successfully.

Invalid Class: At Least One Field Empty. The inputs belong to the class where one or more required fields are empty. The system should reject these inputs and prompt the user to fill out all fields.

7.2 BB Boundary Value Test for invalid Salary

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$0(Invalid)	$750,000	$100,000	4-Room	HDB Housing Loan	Reject (Salary must be a positive number with up to 2 decimal places)	Reject (Salary must be a positive number with up to 2 decimal places)
-$1000 (Out of boundary)	$750,000	$100,000	4-Room	HDB Housing Loan	Reject (Salary must be a positive number with up to 2 decimal places)	Reject (Salary must be a positive number with up to 2 decimal places)

Reason for choosing BVT: These test cases focus on the boundary values of the Monthly Salary input, specifically the lower limit where the salary transitions from invalid to valid. By testing at the boundary ($0) and just beyond it (negative values), Boundary Value Testing is the appropriate technique.

Requirements: The system requires Monthly Salary to be a positive number with up to 2 decimal places.

Valid Boundary: Any positive number greater than $0 (e.g., $0.01).

Invalid Boundaries:

- Salary at Zero ($0): At the boundary where the salary transitions from positive to non-positive.

- Negative Salary (-$1,000): Below the minimum boundary of acceptable salary values.

7.3 BB Boundary Value Test for invalid preferred price

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$5,000	0 (Invalid)	$100,000	4-Room	HDB Housing Loan	Reject (Preferred Price must be a positive number with up to 2 decimal places)	Reject (Preferred Price must be a positive number with up to 2 decimal places)
$5,000	$199999 (Out of Boundary)	$100,000	4-Room	HDB Housing Loan	Reject (Preferred price must be $200,000 or more)	Reject (Preferred price must be $200,000 or more)

Reason for choosing BVT: These values focus on boundary points related to the Preferred Price input. The boundaries are specifically defined as below minimum (0) and just below the acceptable minimum ($200,000), making it suitable for Boundary Value Testing.

Requirements: The system requires the Preferred Price to be at least $200,000 and a positive value.

Valid Boundary: Preferred Price is $200,000 or higher with up to two decimal places.

Invalid Boundary: Preferred Price below $200,000, zero, negative values, or non-numeric entries.

7.4 BB Boundary Value Test for invalid CPF Balance

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$5,000	$750,000	0 (Invalid)	4-Room	HDB Housing Loan	Reject (CPF Balance must be a positive number with up to 2 decimal places.)	Reject (CPF Balance must be a positive number with up to 2 decimal places.)

Reason for choosing BVT: The test case here focuses on the boundary condition for CPF OA Balance where the minimum allowable positive boundary is not met (0 instead of a positive amount). Since this is the lower boundary of valid input, it is ideal for Boundary Value Testing.

Requirements: The system requires the CPF OA Balance to be a positive number.

Valid Boundary: CPF OA Balance is a positive number, above $0 with up to two decimal places.

Invalid Boundary: CPF OA Balance is zero, negative, or non-numeric.

7.5 BB Equivalent Class Test for invalid fields

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$5,000	$750,000	$100,000	4-Room	HDB Housing Loan	Approve (Preferences saved successfully.)	Approve (Preferences saved successfully.)
abc (Not a number)	$750,000	$100,000	4-Room	HDB Housing Loan	Reject (Salary must be a positive number with up to 2 decimal places.)	Reject (Salary must be a positive number with up to 2 decimal places.)
$5,000	$$$ (Not a number)	$100,000	4-Room	HDB Housing Loan	Reject (Preferred Price must be a positive number with up to 2 decimal places.)	Reject (Preferred Price must be a positive number with up to 2 decimal places.)
$5,000	$750,000	123a (Not a number)	4-Room	HDB Housing Loan	Reject (CPF Balance must be a positive number with up to 2 decimal places.)	Reject (CPF Balance must be a positive number with up to 2 decimal places.)

Reason for choosing ECT: These cases involve inputs that fall into classes of invalid data types or non-numeric values (e.g., "abc", "$$$", "123a"). Since we are testing types (numeric vs. non-numeric) rather than values near a boundary, these cases are ideal for Equivalence Class Testing.

Requirements: The system requires Monthly Salary, Preferred Price, and CPF OA Balance to be numeric values with up to two decimal places.

Valid Class: Monthly Salary, Preferred Price, and CPF OA Balance are non-zero, positive numbers with up to two decimal places.

Invalid Class: Inputs contain non-numeric characters, symbols, or mixed alphanumeric characters.

7.6 BB Boundary Value Test for invalid loans

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$7,001	$750,000	$100,000	4-Room	HDB Housing Loan	Reject (HDB Loan is only allowed if salary is less than or equal to 7000.)	Reject (HDB Loan is only allowed if salary is less than or equal to 7000.)
$7,001	$750,000	$100,000	4-Room	DBS 5 Year Fixed Package	Approve (Preferences saved successfully.)	Approve (Preferences saved successfully.)

Reason for choosing BVT: These cases test the boundary condition for choosing an HDB Housing Loan based on Monthly Salary. The boundary value is $7,000, above which HDB Housing Loan is disallowed. Testing just above this threshold (e.g., $7,001) makes it suitable for Boundary Value Testing.

Requirements: The system allows an HDB Housing Loan only if Monthly Salary is $7,000 or less.

Valid Boundary: Monthly Salary is $7,000, non-zero, non-negative, allowing for the HDB Housing Loan.

Invalid Boundary: Monthly Salary exceeds $7,000 with an HDB Housing Loan selected.

7.7 BB Equivalent Class Test for Grants

Monthly Salary	Preferred Price	CPF OA Balance	HDB Type	Loan Type	Expected Results	Test Result
$7,001	$750,000	$100,000	4-Room	HDB Housing Loan	Not eligible for any grants.	Not eligible for any grants.
$7,000	$750,000	$100,000	5-Room	HDB Housing Loan	Eligible for: HDB Singles Grant. Amount: $25000	Eligible for: HDB Singles Grant. Amount: $25000
$4,001	$750,000	$100,000	5-Room	HDB Housing Loan	Eligible for: HDB Singles Grant. Amount: $25000	Eligible for: HDB Singles Grant. Amount: $25000
$7,000	$750,000	$100,000	4-Room	HDB Housing Loan	Eligible for: HDB Singles Grant. Amount: $40000	Eligible for: HDB Singles Grant. Amount: $40000
$4,001	$750,000	$100,000	4-Room	HDB Housing Loan	Eligible for: HDB Singles Grant. Amount: $40000	Eligible for: HDB Singles Grant. Amount: $40000
$4,000	$750,000	$100,000	5-Room	HDB Housing Loan	Eligible for: HDB Singles Grant and Enhanced CPF Housing Grant. Amount: $85000	Eligible for: HDB Singles Grant and Enhanced CPF Housing Grant. Amount: $85000
$4000	$750,000	$100,000	4-Room	HDB Housing Loan	Eligible for: HDB Singles Grant and Enhanced CPF Housing Grant. Amount: $100000	Eligible for: HDB Singles Grant and Enhanced CPF Housing Grant. Amount: $100000

Reason for choosing ECT: These cases fall under distinct categories of grant eligibility based on income, housing type, and grant policies. The test values are selected to cover different eligibility classes, making Equivalence Class Testing suitable for these cases.

Requirements: The system determines eligibility for grants based on the monthly salary and the type of HDB unit.

Valid Class: Specific monthly salaries and housing types meet criteria for certain grants.

Invalid Class: Salaries exceeding grant eligibility thresholds, or ineligible housing types, receive no grants.

Grants:

More than $7000: no grants

Less than or equals to $7000 but more than $4000 but 5R or Ex: SG $25000

Less than or equals to $7000 but more than $4000: SG $40000

Less than or equals $4000 but 5R or Ex: SG $25000 + EHG $60000

Less than or equals to $4000: EHG $60000 + SG $40000

It can be noted that BVT can also be used to test for this test case. Given that for each class, there are boundary values in which the class falls under. Anything above or below the threshold belongs to another class.

No grants:
- Lower boundary ($7001)

HDB Singles Grant ($25,000) for 5 Rooms or EC:
- Lower boundary ($4001)
- Upper boundary ($7000)

HDB Singles Grant ($40,000) for 4 Rooms or smaller:
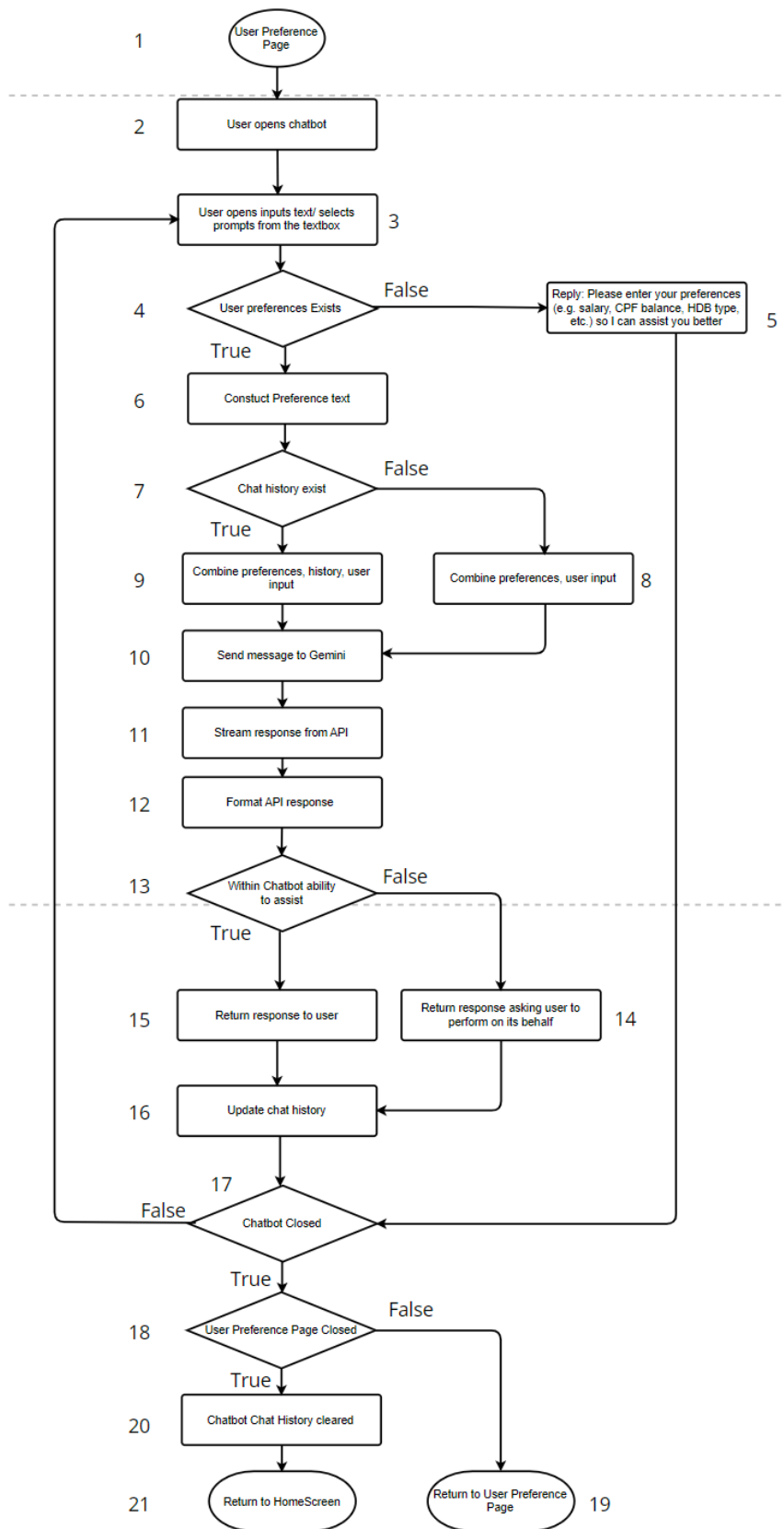- Lower boundary ($4001)
- Upper boundary ($7000)

HDB Singles Grant ($25,000) & Enhanced Housing Grant ($60,000) for 5 Rooms or EC:
- Upper boundary ($4000)

HDB Singles Grant ($40,000) & Enhanced Housing Grant ($60,000) for 4 Rooms or smaller:
- Upper boundary ($4000)

Test Case 8 White box (Interactive Chatbot Testing)

Cyclomatic Complexity: 6 (5 Decision Point + 1)

Baseline Path: 1,2,3,4,6,7,9,10,11,12,13,15,16,17,18,20,215

Basis Path 1: 1,2,3,4,5,17,18,20,21

Basis Path 2: 1,2,3,4,6,7,8,10,11,12,13,15,16,17,18,20,21

Basis Path 3: 1,2,3,4,6,7,9,10,11,12,13,14,16,17,18,20,21

Basis Path 4: 1,2,3,4,6,7,9,10,11,12,13,15,16,17,3,4,6,7,9,10,11,12,13,15,16,17,18,20,21

Basis Path 5: 1,2,3,4,6,7,9,10,11,12,13,15,16,17,18,19

User Preferences Exist	Chat History Exist	Within ability to assist	Chatbot Closed	User Preference Page Closed	Expected Result	Actual Result
Yes	Yes	Yes	No	No	Customised response which considers user's current and previous enquiries, and their financial and housing preferences	Customised response which considers user's current and previous enquiries, and their financial and housing preferences
No	-	-	No	No	Reply: Please enter your preferences (e.g. salary, CPF balance, HDB type, etc.) so I can assist you better	Reply: Please enter your preferences (e.g. salary, CPF balance, HDB type, etc.) so I can assist you better
Yes	No	Yes	No	No	Customised response which considers user's current enquiry, and their financial and housing preferences	Customised response which considers user's current enquiry, and their financial and housing preferences
Yes	Yes	No	No	No	Response indicating that it is unable to assist, and to contact flatfinder@gmail.com for further enquiries	Response indicating that it is unable to assist, and to contact flatfinder@gmail.com for further enquiries
Yes	Yes	-	Yes	No	User able to reopen chatbot with chat history retained	User able to reopen chatbot with chat history retained
Yes	Yes	-	-	Yes	Chat history cleared when user opens up the chatbot upon returning to user preference page	Chat history cleared when user opens up the chatbot upon returning to user preference page