

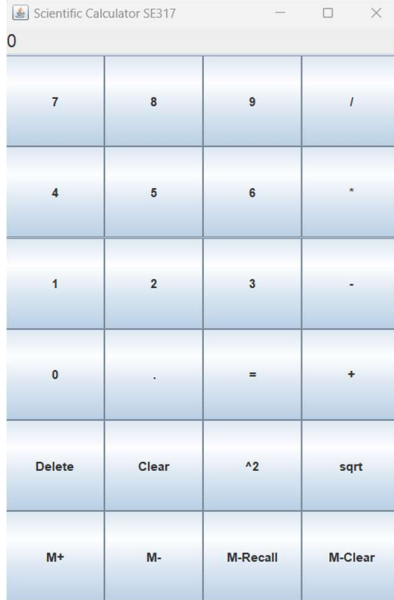
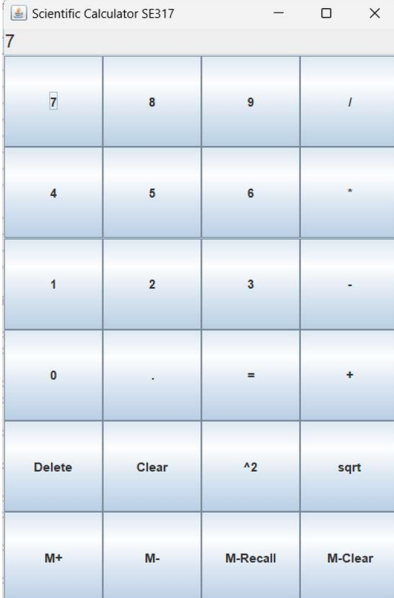
SE 317, Lab 7

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CalculatorApp Program

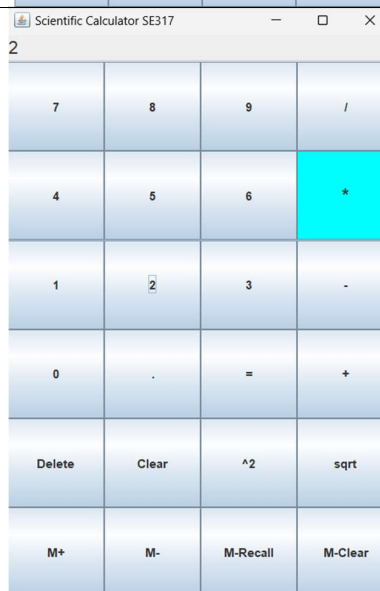
Screenshots of a Simple Mutiplication Program Execution:

Phase/Action	Screenshot
Initial View	 A screenshot of a software application titled "Scientific Calculator SE317". The window has standard Windows controls (minimize, maximize, close). The display shows the number "0". Below the display is a grid of buttons. The first row contains buttons for "7", "8", "9", and "/". The second row contains "4", "5", "6", and "*". The third row contains "1", "2", "3", and "-". The fourth row contains "0", ".", "=", and "+". The fifth row contains "Delete", "Clear", "^2", and "sqrt". The sixth row contains "M+", "M-", "M-Recall", and "M-Clear".
Clicking on the first operand (7)	 A screenshot of the same "Scientific Calculator SE317" application. The display now shows the number "7". The button layout is identical to the previous screenshot. The "7" button in the first row is highlighted, indicating it was just clicked.

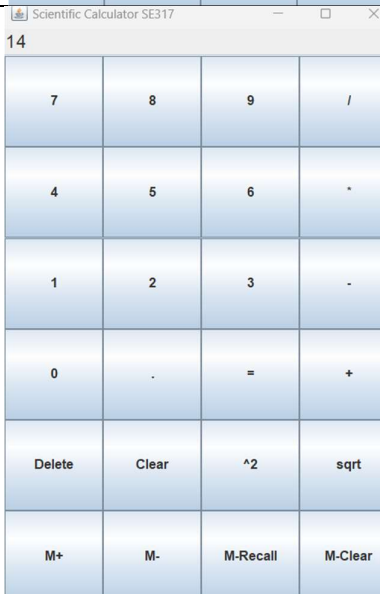
Clicking on the operation chosen (*)



Clicking on the second operand (2)

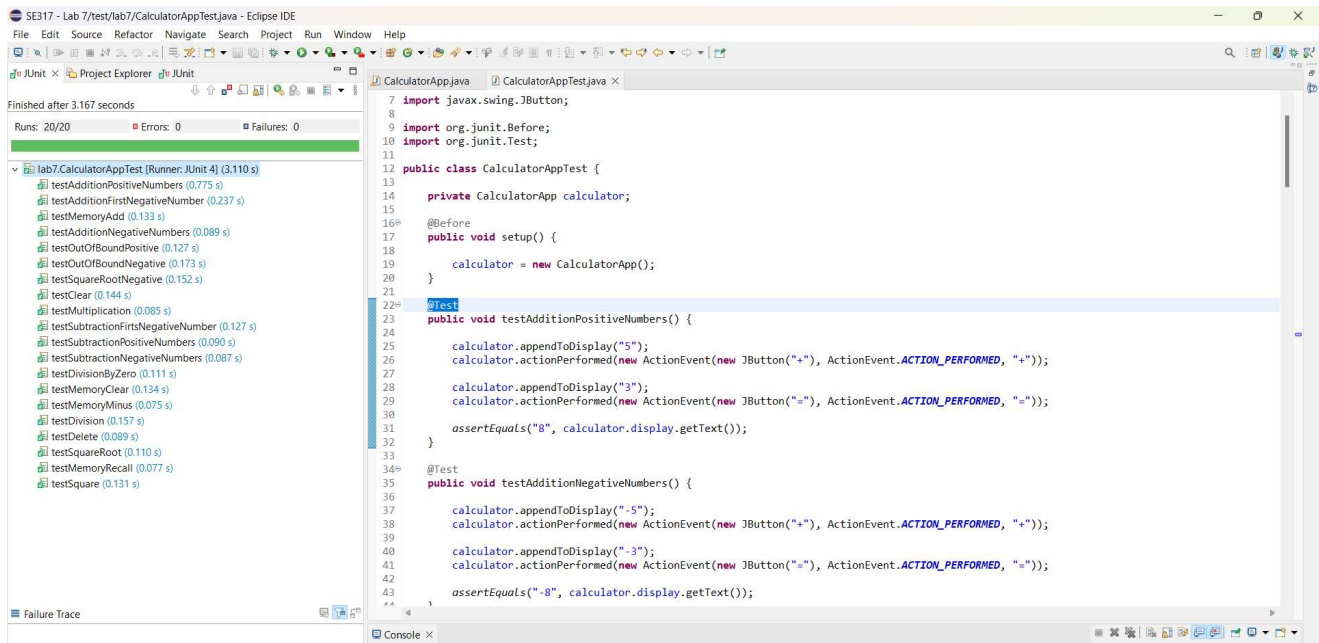


Clicking on calculate result (=) and obtain the result



Unit Testing

- a. The Model will be tested at the code level by simulated function calls using java test code, with screenshots of the output (like all previous assignments)



Unit Testing – Data Analysis & Interpretation

Test Criterion	Test Requirement Set	Test Set
Addition	Ensure that the values are added mathematically correct.	<ul style="list-style-type: none">testAdditionPositiveNumbers()testAdditionFirstNegativeNumber()testAdditionNegativeNumbers()
Subtraction	Ensures that the values are subtracted mathematically correct.	<ul style="list-style-type: none">testSubtractionPositiveNumbers()testSubtractionNegativeNumbers()testSubtractionFirtsNegativeNumber()
Multiplication	Ensures that the values are multiplied mathematically correct.	<ul style="list-style-type: none">testMultiplicationPositiveDecimal()testMultiplicationTwoNegativeNumbers()
Division	Ensures that the values are divided mathematically correct.	<ul style="list-style-type: none">testDivision()testDivisionByZero()
Square	Ensures that the values are squared mathematically correct.	<ul style="list-style-type: none">testSquarePositiveNumber()testSquareNegativeNumber()
Square Root	Ensures that the values are being square root mathematically correct.	<ul style="list-style-type: none">testSquareRoot()testSquareRootNegative()
Memory	Ensure that the memory functions are working as per requirements.	<ul style="list-style-type: none">testMemoryAdd()testMemoryAddFail()testMemoryMinus()testMemoryRecall()testMemoryClear()

Delete & Clear	Ensure that the Delete and Clear Function are functioning as intended.	<ul style="list-style-type: none"> • testDelete() • testClear()
Out-of-Range	Ensure that the calculator application receives value in allowed range (-100000000 to 100000000)	<ul style="list-style-type: none"> • testOutOfBoundsPositive() • testOutOfBoundsNegative()

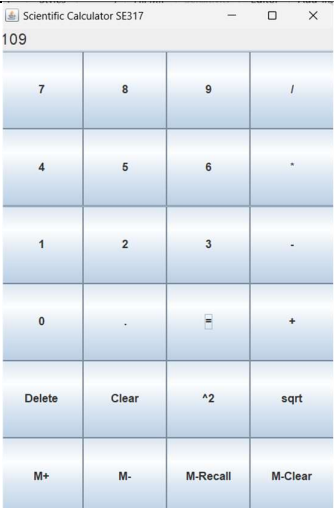
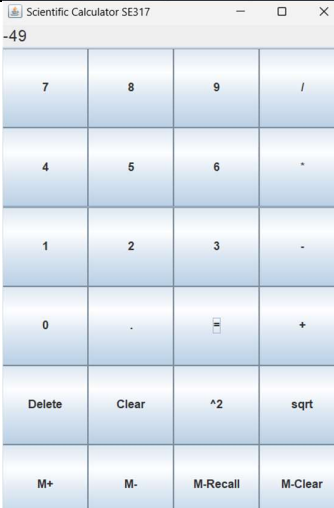
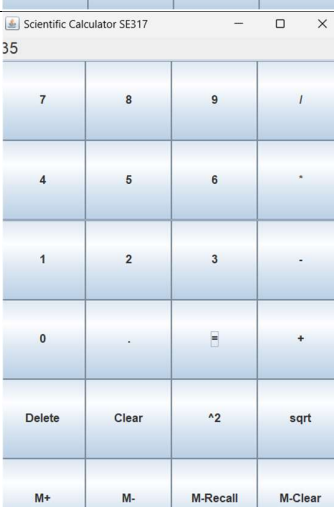
Unit Testing – Summary

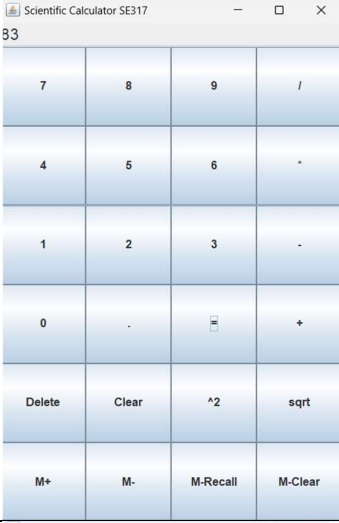
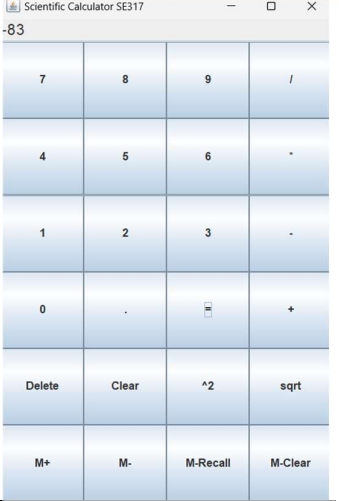
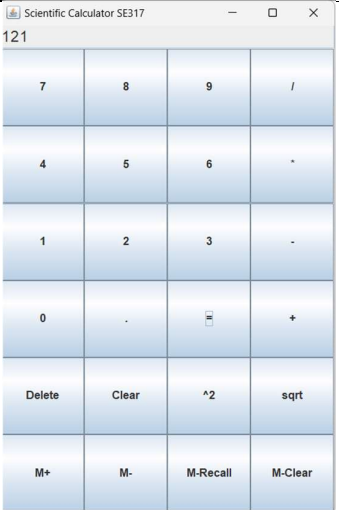
- Total Number of Test Criteria: 9
- Total Number of Test Cases: 23
- Test Set Size: 23
- All Pass

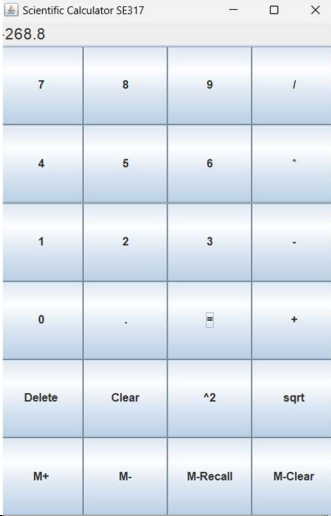

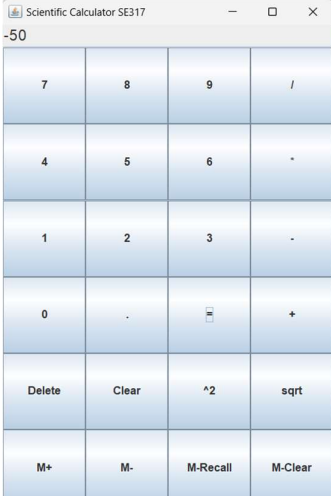
UI Testing

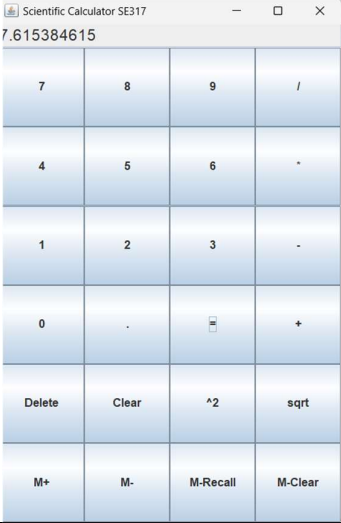
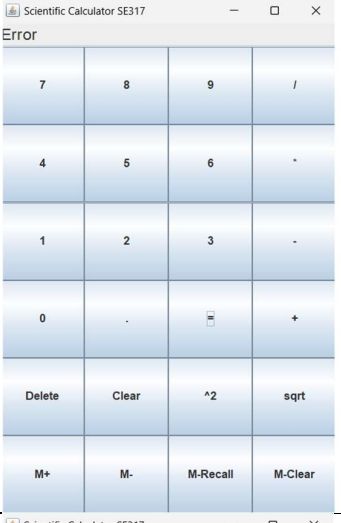
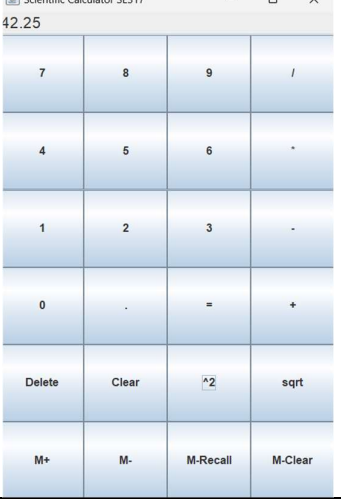
- b. The GUI will be tested MANUALLY by just providing the test cases of given features to be run on the interactive GUI with the expected results. You will need to run each UI test as a sequence of GUI inputs (manually) and record the final output of each test as pass or fail, next to the expected one.

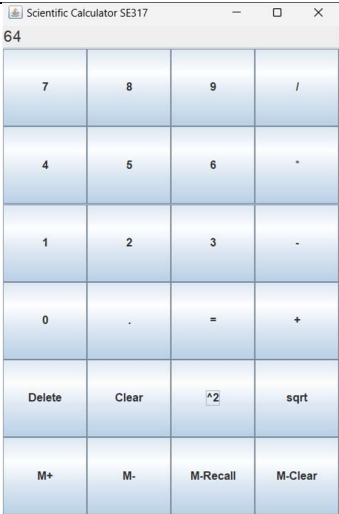
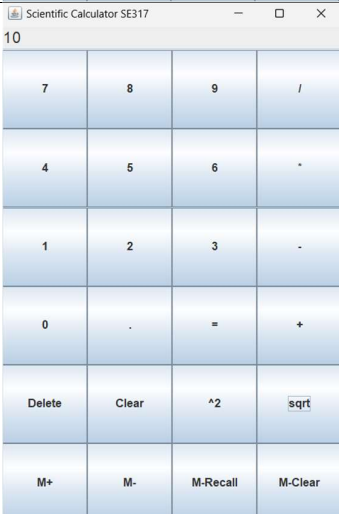
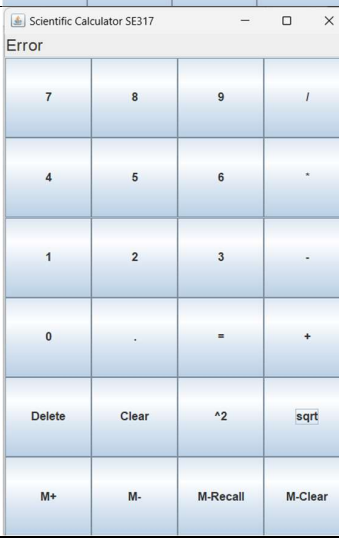
UI Testing – Data Analysis & Interpretation

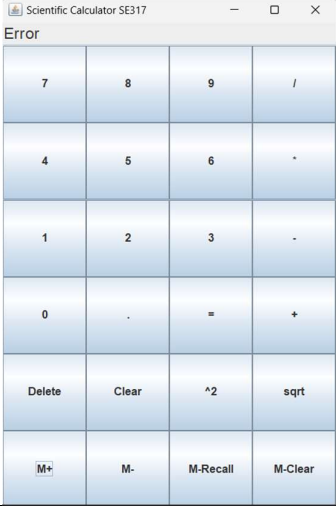
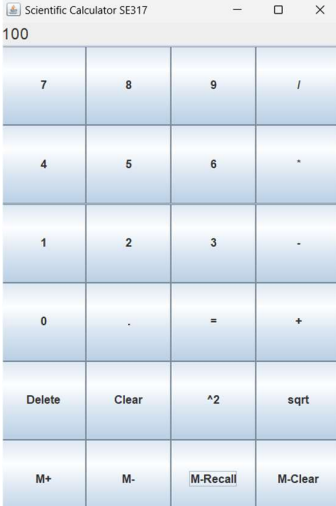
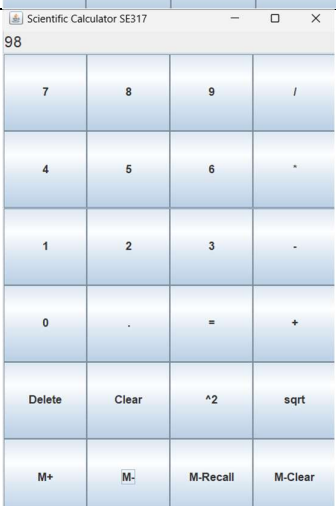
Test Case	Input Sequence	Expected Result	Actual Result	Pass/Fail
Addition of Two Positive Numbers	$67 + 42 =$	109		Pass
Addition of Two Negative Numbers	$-7 + -42 =$	-49		Pass
Addition of a Negative & Positive Number	$-7 + 42 =$	35		Pass

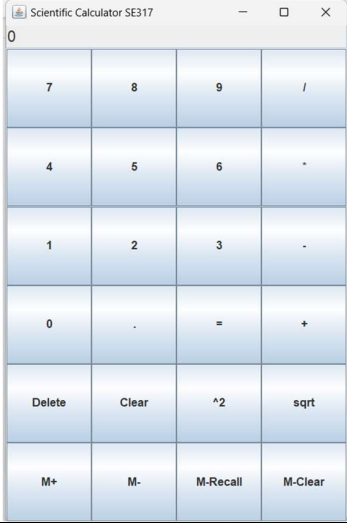
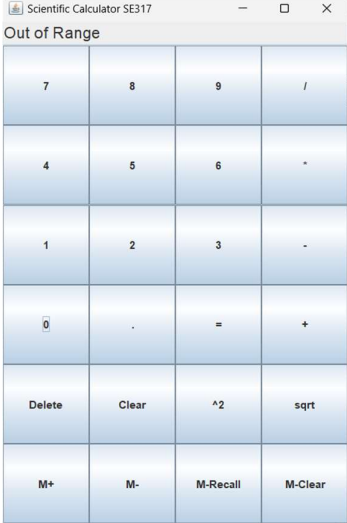
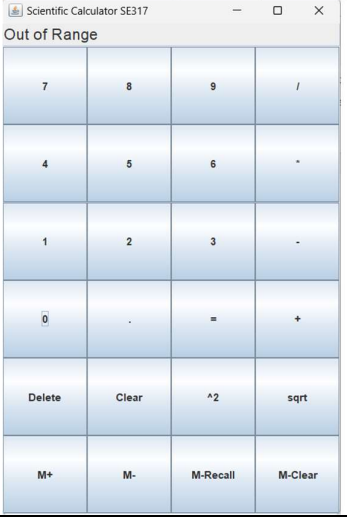
Subtraction of Two Negative Numbers	$-7 - -90 =$	83	 A screenshot of a scientific calculator window titled 'Scientific Calculator SE317'. The display shows the number 83. The calculator has a grid of buttons: a top row with 7, 8, 9, and a division button (/); a second row with 4, 5, 6, and a multiplication button (*); a third row with 1, 2, 3, and a subtraction button (-); a fourth row with 0, a decimal point button (.), a square root button (sqrt), and an addition button (+); a fifth row with a Delete button, a Clear button, an exponentiation button (^2), and a square root button (sqrt); and a bottom row with memory buttons: M+, M-, M-Recall, and M-Clear.	Pass
Subtraction of Two Positive Numbers	$7 - 90 =$	-83	 A screenshot of a scientific calculator window titled 'Scientific Calculator SE317'. The display shows the number -83. The calculator has a grid of buttons: a top row with 7, 8, 9, and a division button (/); a second row with 4, 5, 6, and a multiplication button (*); a third row with 1, 2, 3, and a subtraction button (-); a fourth row with 0, a decimal point button (.), a square root button (sqrt), and an addition button (+); a fifth row with a Delete button, a Clear button, an exponentiation button (^2), and a square root button (sqrt); and a bottom row with memory buttons: M+, M-, M-Recall, and M-Clear.	Pass
Subtraction of a Positive & Negative Number	$67 - -54 =$	121	 A screenshot of a scientific calculator window titled 'Scientific Calculator SE317'. The display shows the number 121. The calculator has a grid of buttons: a top row with 7, 8, 9, and a division button (/); a second row with 4, 5, 6, and a multiplication button (*); a third row with 1, 2, 3, and a subtraction button (-); a fourth row with 0, a decimal point button (.), a square root button (sqrt), and an addition button (+); a fifth row with a Delete button, a Clear button, an exponentiation button (^2), and a square root button (sqrt); and a bottom row with memory buttons: M+, M-, M-Recall, and M-Clear.	Pass

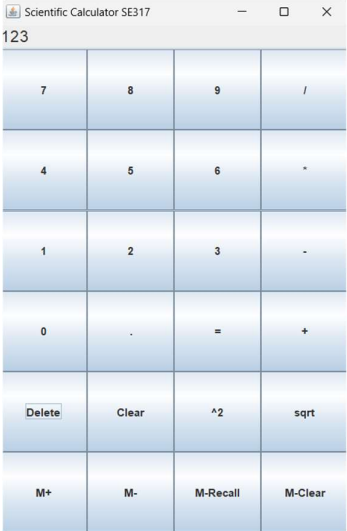
Multiplication of a Positive Decimal with a Negative Number	$67.2 \times -4 =$	-268.8	 A screenshot of a scientific calculator window titled 'Scientific Calculator SE317'. The display shows the number 268.8. The calculator has a grid of buttons: a top row with 7, 8, 9, and a division button; a second row with 4, 5, 6, and a multiplication button; a third row with 1, 2, 3, and a subtraction button; a fourth row with 0, a decimal point, a fraction template button, and an addition button; a fifth row with a 'Delete' button, a 'Clear' button, a power button (^2), and a square root button (sqrt); and a bottom row with memory buttons: M+, M-, M-Recall, and M-Clear.	Pass
Multiplication of Two Negative Numbers	$-98 \times -3 =$	294	 A screenshot of a scientific calculator window titled 'Scientific Calculator SE317'. The display shows the number 294. The calculator has a grid of buttons: a top row with 7, 8, 9, and a division button; a second row with 4, 5, 6, and a multiplication button; a third row with 1, 2, 3, and a subtraction button; a fourth row with 0, a decimal point, a fraction template button, and an addition button; a fifth row with a 'Delete' button, a 'Clear' button, a power button (^2), and a square root button (sqrt); and a bottom row with memory buttons: M+, M-, M-Recall, and M-Clear.	Pass
Division of a Positive Number with a Negative Number	$100 \div -2 =$	-50	 A screenshot of a scientific calculator window titled 'Scientific Calculator SE317'. The display shows the number -50. The calculator has a grid of buttons: a top row with 7, 8, 9, and a division button; a second row with 4, 5, 6, and a multiplication button; a third row with 1, 2, 3, and a subtraction button; a fourth row with 0, a decimal point, a fraction template button, and an addition button; a fifth row with a 'Delete' button, a 'Clear' button, a power button (^2), and a square root button (sqrt); and a bottom row with memory buttons: M+, M-, M-Recall, and M-Clear.	Pass

Division of Two Negative Numbers	$-99 / -13 =$	7.615384615		Pass
Division by Zero	$99 / 0 =$	Error		Pass
Square of a Positive Decimal Number	$6.5 ^2$	42.25		Pass

Square of a Negative Number	-8^2	64	 <p>The calculator interface shows the number 64 at the top. The keypad includes buttons for digits 0-9, a decimal point, an equals sign, a plus sign, a minus sign, a multiply sign, a divide sign, a square button (x^2), a square root button (sqrt), a delete button, a clear button, a memory plus button (M+), a memory minus button (M-), a memory recall button (M-Recall), and a memory clear button (M-Clear).</p>	Pass
Square Root of a Positive Number	100 sqrt	10	 <p>The calculator interface shows the number 10 at the top. The keypad layout is identical to the first row, showing the result of the square root operation.</p>	Pass
Square Root of a Negative Number	-100 sqrt	Error	 <p>The calculator interface shows the word "Error" at the top, indicating that the operation is invalid because the square root of a negative number is not a real number.</p>	Pass

M+ without a Successful Execution	100 M+	Error		Pass
M+ & M-Recall After a Successful Execution	$10^2 M + 2 + 5 = \text{M-Recall}$	Memory should be 100		Pass
M- After a Successful M+ & M-Recall	$10^2 M + 2 + 5 = \text{M-Recall}$ M-	Memory should be 98 after called 2 and M-consecutively.		Pass

M-Clear	$10^2 \text{ M} + 2 + 5$ = M-Recall M- Clear M-Recall	Memory should reset to 0		Pass
Out of Range Positive	10000000000	Out of Range		Pass
Out of Range Negative	-89546987	Out of Range		Pass

Delete	123.456 Delete Delete Delete Delete	123		Pass
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UI Testing – Summary

- Total Number of Test Criteria: 9
- Total Number of Test Cases: 23
- Test Set Size: 23
- All Pass

Integration Testing

- Since the UI and model functions are interconnected, the UI tests implicitly cover integration testing.

Conclusion

The testing plan for the calculator application included comprehensive unit tests and manual UI tests. Both tests were executed successfully, with all actual results matching the expected results. This indicates that the calculator application performs as expected, both at the code level and through the user interface. The use of existing exceptions for error handling ensures sturdy performance in edge cases such as division by zero and out-of-bounds value.