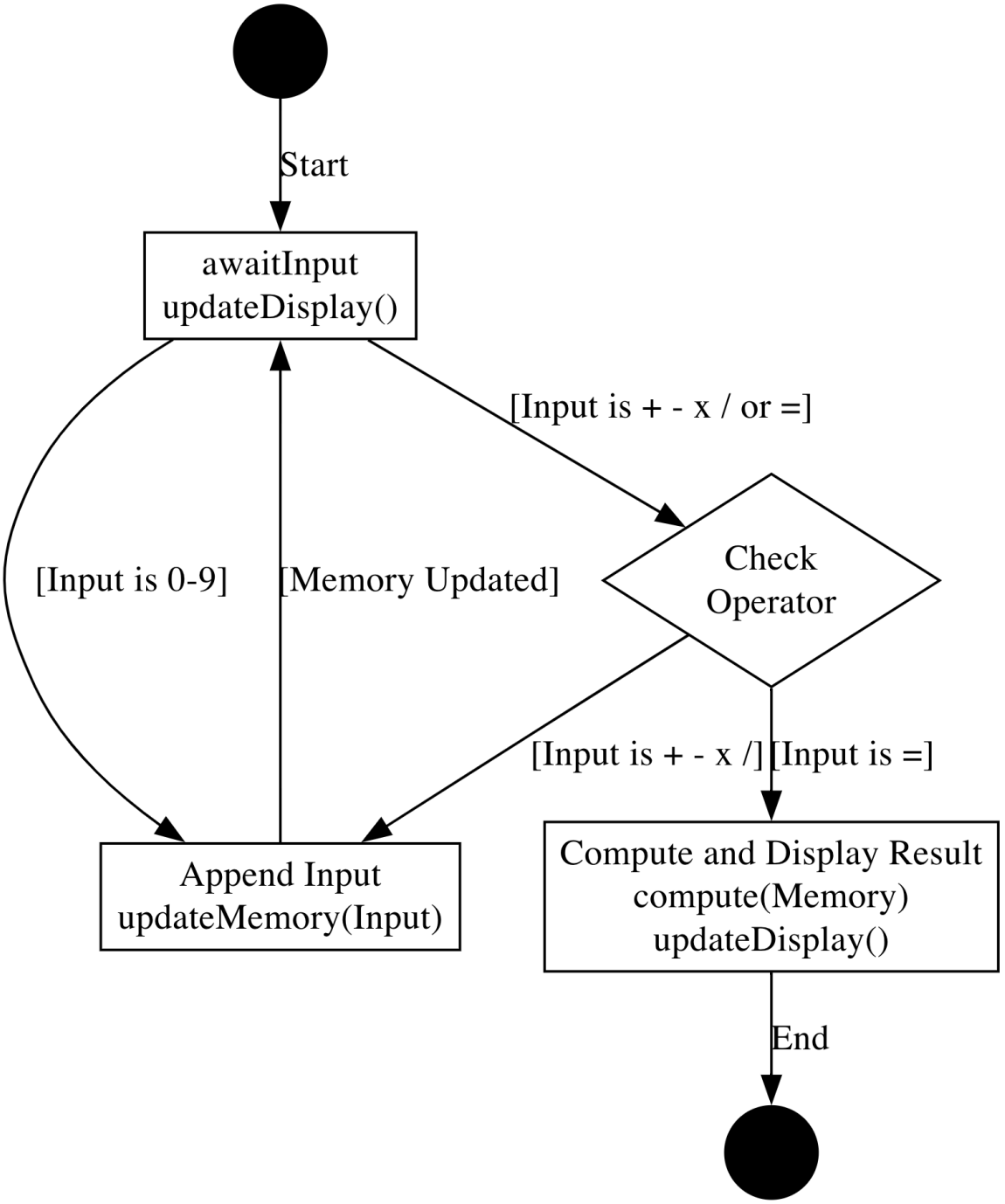
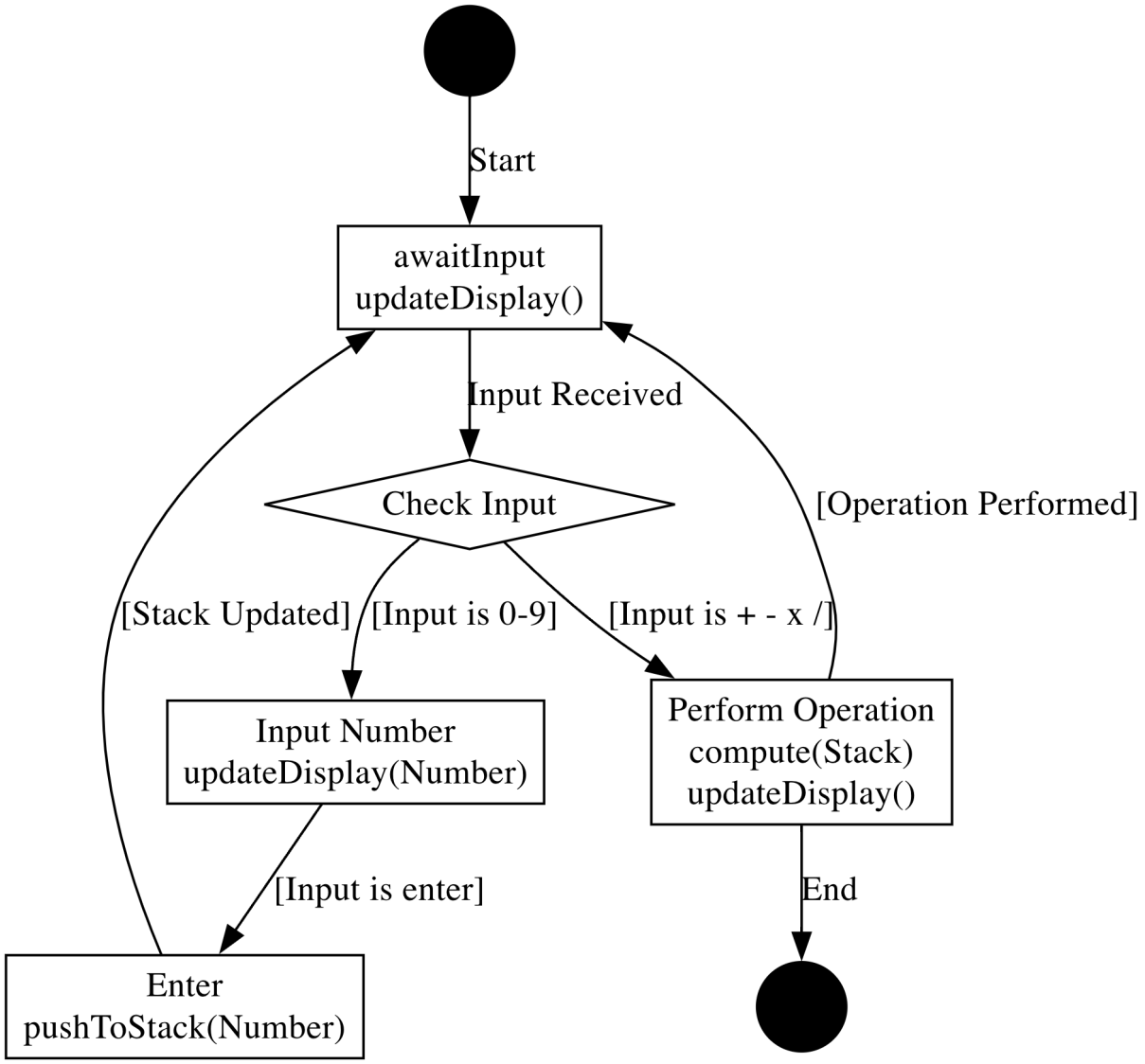
User Interface Design and Usability Evaluation

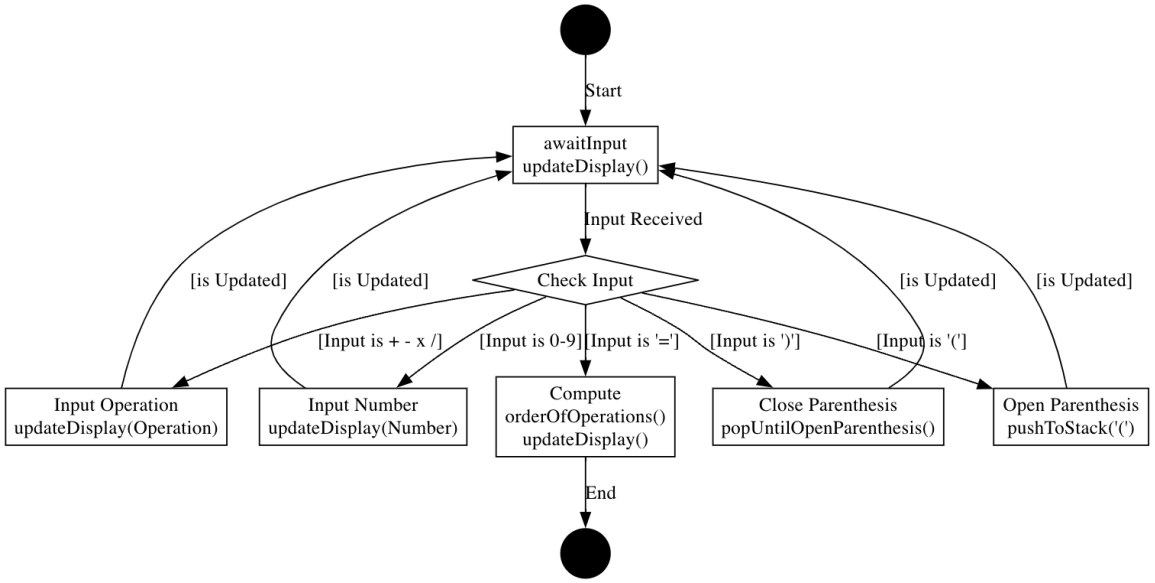
Part 1: 4-function “INFIX” calculator STATE DIAGRAM



Part 2: 4-function “RPN” calculator STATE DIAGRAM



Part 3: 4-function calculator order of operations precedence calculator STATE DIAGRAM



TEST CASES

For each of the three calculator modes (1) (2) and (3), investigate the Utility and Usability of these three interfaces as tools to assist with the following calculations. From these word-based problems, which of the first three calculator interface interaction models are most usable ?

(a) What is the difference between the following two numbers: 57 times 13 -- and 161 divided by 7.

- **Infix without precedence:** Requires input as it reads but will not correctly handle the operations without manual sequencing by the user.
- **RPN:** Users must input operands first, which is straightforward but requires understanding RPN logic.
- **Infix with precedence:** Allows for direct input of the problem as stated, with correct computation order.

(b) Double the number that results from the difference between 1023 and 127

- Similar analysis to (a), but simpler since only one operation type is involved. Infix with precedence is most direct and least prone to error.

(c) What is the area of a rectangle that has one side 789cm and the other side is 148cm longer than that amount ?

- All modes can handle this simple multiplication, but infix modes are likely more intuitive for direct entry.

(d) If the tax on gasoline is 9 cents per litre, and last week you consumed 135 litres of gasoline, but this week, you only consumed 117 litres of gasoline, then what is the total amount of tax that you saved?

- Infix with precedence allows for the most straightforward calculation, especially if calculated as (135 - 117) x 9. RPN is also efficient but less intuitive.

(e) If two numbers differ by 154, but the ratio of these two numbers is 15, then what is the smaller of the two numbers?

- This involves setting up equations, which are most straightforwardly solved in infix mode with precedence. The problem might require additional steps not directly related to simple calculator input but rather algebraic manipulation.

Conclusion:

- For direct and straightforward calculations ((a), (b), and (c)), **Infix mode with operator precedence (3)** is the most usable as it allows for natural input of mathematical expressions and handles operator precedence automatically, making it less prone to user error.
- **RPN mode (2)** is efficient for users familiar with it, especially in scenarios involving sequential operations without the need for parentheses, but it has a learning curve and is less intuitive for those unfamiliar with RPN logic.
- **Infix mode without operator precedence (1)** is the least practical for calculations requiring multiple types of operations due to its lack of automated precedence handling, necessitating manual sequencing by the user.

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