Correctness Proof Exercises

For each problem, derive an appropriate precondition while generating the proof. For functional proofs, first write the function, then prove the program meets it.

Problem 1:

\[
i = 0; \\
\text{while } (i < A.\text{length()} \text{ and } A[i] \neq \text{val}) \{ \\
\quad i = i + 1; \\
\}\]

// (i = A.\text{length()} or A[i] = \text{val}) and for all j in [0,i), A[j] \neq \text{val})

Problem 2: The dot in the postcondition is a dot-product.

\[
p = 0; \\
i = 0; \\
\text{while } (i < A.\text{length()}) \{ \\
\quad p = p + A[i] \times B[i]; \\
\quad i = i + 1; \\
\}\]

// p = A \cdot B

Problem 3: Hint: the precondition should include that A is sorted. Note that this program has a small bug… Try to prove, find bug, correct, and prove corrected program.

\[
i = 0; \\
j = A.\text{length()} - 1; \\
\text{while } (i \neq j) \{ \\
\quad k = (i + j) / 2; \\
\quad \text{if } (A[k] == \text{val}) \{ \\
\quad \quad i = k; \\
\quad \quad j = k; \\
\quad \} \text{ else } \{ \\
\quad \quad \text{if } (A[k] < \text{val}) \{ \\
\quad \quad \quad i = k; \\
\quad \quad \} \text{ else } \{ \\
\quad \quad \quad j = k; \\
\quad \quad \} \\
\quad \} \\
\}\]

// A[i] = val