Assignments are due on the due date before class and have to include this cover page. Plagiarism in assignment answers will not be tolerated. By submitting their answers to this assignment, the authors named above declare that its content is their original work and that they did not use any sources for its preparation other than the class notes, the textbook, and ones explicitly acknowledged in the answers. Any suspected act of plagiarism will be reported to the Faculty’s Academic Integrity Officer and possibly to the Senate Discipline Committee. The penalty for academic dishonesty may range from failing the course to expulsion from the university, in accordance with Dalhousie University’s regulations regarding academic integrity.
Question 1 (20 marks) Construct a data structure that stores a set $S$ of numbers, supports insertions into and deletions from $S$, and supports MinPair queries. Given the current set of elements $S$, a MinPair query reports a pair of elements $x, y \in S$ such that $|x - y|$ is minimized. Your data structure should use linear space, support insertions and deletions in $O(\lg n)$ time, and support MinPair queries in $O(1)$ time. Argue briefly that it does indeed achieve these update and query times and that the data structure is correct.