

Instruction: You must show all your work clearly for credit. Partial credit will only be given to meaningful answers.

1. Given a set S of 15 records with priorities $\{5, 12, 15, 8, 9, 4, 1, 18, 6, 16, 11, 2, 16, 7, 8\}$. Perform the following operations. You must show your tree clearly after each insert/delete operations.
 - (a) (10) Build a min 3-heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMin once followed by deleteMax once.
 - (b) (10) Build a max 3-heap for S by using the $O(n)$ bottom-up buildheap operation. When done, perform deleteMin once followed by deleteMax once.
 - (c) (10) Build a minMax heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMin once followed by deleteMax once.
 - (d) (10) Build a maxMin heap for S by using the $O(n)$ bottom-up buildheap operation. When done, perform deleteMin once followed by deleteMax once.
 - (e) (10) Build a min leftist heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMin once. Illustrate the data structure of the final heap.
 - (f) (10) Build a max leftist heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMax once. Illustrate the data structure of the final heap.
 - (g) (10) Build a min skew heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMin once. Illustrate the data structure of the final heap.
 - (h) (10) Build a max skew heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMax once. Illustrate the data structure of the final heap.
 - (i) (10) Build a min pairing heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMin once and use the two-pass method for merging. Show the data structure of the final heap.
 - (j) (10) Build a max pairing heap for S by inserting the records, in the order given, into an initially empty heap. When done, perform deleteMax once and use the multi-ass method for merging. Show the data structure of the final heap.

Remark: To resolve ambiguity, you must operate from left (preferred) to right.

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