Advanced Data Structures (COP 5536 /NTU AD 711R)
Exam 1 (Oct. 1, 1999)
CLOSED BOOK
60 Minutes

NOTE All answers will be graded on correctness, efficiency, clarity, elegance and other normal criteria that determine quality. The points assigned to each question are provided in parentheses.

1. (8) We can use either a winner or loser tree for external sort.
   Which will run faster in practice? Why?

2. (10) Suppose we have an internal memory of m records (all records are equal length). Determine the range of buffer size b in terms of m so that the run length of loser tree scheme is bigger than that of simple scheme.

   - *simple scheme* : Divide memory into 3 parts of equal size. Two parts are used for I/O and one for internal sorting.
   - *loser tree scheme* : Allocate two input buffers and two output buffers, each of size b records. The rest of memory is used for a loser tree for k records. Assume that the length of a run from this scheme is always $2k$.

3. You are given 6 runs that have 500, 800, 1000, 1000, 1200, 1500 equal-length records. It takes 1 second to read or write one block from/to disk and it also takes 1 second of CPU time to merge one block of records.

   Assume that all input, output, and CPU processing is sequential and there is no waiting time. The block size is 100 records.

   (a) (7) Give an optimal 4-way merging scheme to merge the 6 runs into 1.

   (b) (5) What is the total time taken by the optimal scheme?

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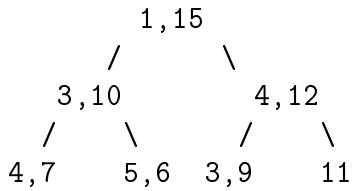
4. Consider the following interval heap.



   (a) (5) *Insert 20*, showing each step.

   (b) (7) Perform *Delete_min* from the resulting interval heap of (a). Show each step.

5. (8) *Meld* the following min height-biased leftist trees using the algorithm in the text. Describe each step.