

## 6.851 ADVANCED DATA STRUCTURES (SPRING'12)

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**Problem 6**

*Due: Thursday, Apr. 5*

Be sure to read the instructions on the assignments section of the class web page. Remember to keep your solutions to one page!

**Concise van Emde Boas.** Develop and analyze a data structure that supports insert, delete, successor and predecessor in the word-RAM model in  $O(\lg \lg u)$  worst-case time. Your data structure should use  $O(u)$  bits of space. Note that the van Emde Boas data structure from lecture used  $\Theta(u)$  words of space, and thus  $\Theta(u \lg u)$  bits of space.

**Union-Split-Find.** Develop and analyze a word-RAM data structure to maintain a set of disjoint intervals of the form  $[a, b)$  such that  $a, b \in \mathcal{U}$ . Your data structure should support the following operations in  $O(\lg \lg u)$  time:

- **make** $(a, b)$  : Create the interval  $[a, b)$  (must not overlap existing intervals).
- **union** $(a, b, c)$  : Merge the adjacent intervals  $[a, b)$  and  $[b, c)$  into  $[a, c)$ .
- **split** $(a, b, k)$  : For  $k \in [a, b)$ , split the interval  $[a, b)$  into  $[a, k)$  and  $[k, b)$ .
- **find** $(k)$  : Return the interval  $[a, b)$  that contains  $k$ , or report that no interval contains  $k$ .

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