Speeding up static van Emde Boas. In this problem we will develop a static data structure matching the $O\left(\lg \frac{w - \lg n}{a}\right)$ predecessor time bound mentioned in class.

1. Develop and analyze a data structure that supports successor and predecessor queries in the word-RAM model in $O\left(\lg(w - \lg n)\right)$ worst-case time using $O(n)$ space.

2. Develop and analyze a data structure that supports successor and predecessor queries in the word-RAM model in $O\left(\lg \frac{w}{\lg \lg n}\right)$ worst-case time using $O(n \log n)$ space.

Neither of your data structures needs to support insertions or deletions.