Mandatory Exercise: Predecessors

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1   The Colored Predecessor Problem   Let $S = \{0, \ldots, n-1\}$ be a set of integers and associate each integer with a *color* from a set of colors $C = \{0, \ldots, c-1\}$

- color-predecessor(x, c): return the largest element with color c that is smaller than x.

Solve the following exercises.

1.1 Give a data structure that answers queries in $O(1)$ time and uses little space. *Hint:* a good solution depends on both on the number of colors and n.

1.2 Give a data structure that uses $O(n)$ space and supports fast queries.

In each of the exercises only consider space and query time. Ignore preprocessing time.