Competitive Programming 2020
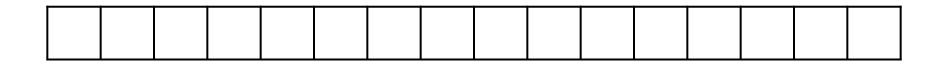
5 Range queries, segment trees

NCPC news

- **NCPC:** on *Saturday, November 7*
- **Warmup:** probably on *Saturday, October 31*
- Team contests
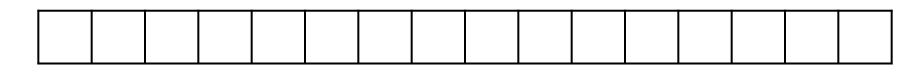- Entirely online
- Both will give participation points

Today's program

- **12:15:** Lecture (Zoom)

- **13:00:** Practice contest (CSES)
  - *team contest again!*
  - enough for participation points if the *team solves 3 problems*

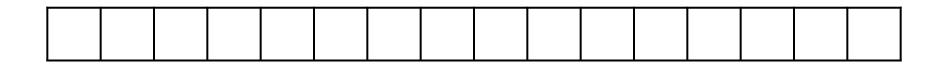- **16:00:** Post-contest wrap-up (Zoom)

Queries and updates

- Arrays handle these fast:
  - **set** the value of element i to c
  - **increment** the value of element i by c
  - query the current **value** of element i
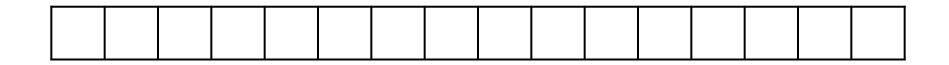
Queries and updates

- Arrays handle these fast:
  - *set* the value of element i to c
  - *increment* the value of element i by c
  - query the current *value* of element i

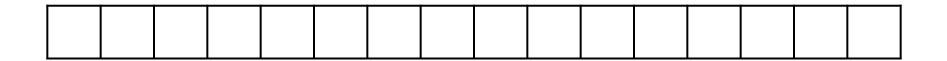- What about more complicated updates?

- What about more complicated queries?

Queries and updates

- *Set* all elements $i, ..., j$ to c

- *Increment* all elements $i, ..., j$ by c

- Query the *sum* of elements $i, ..., j$
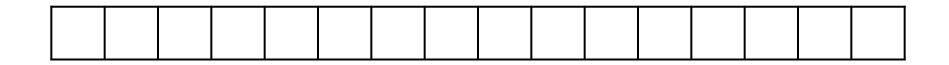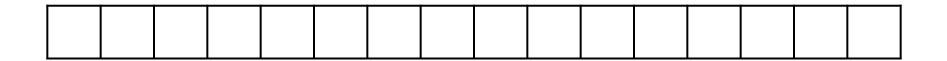
- Query the *minimum* of elements $i, ..., j$

  ...

Queries only

- Given a static array *x*
- Query the **sum** of elements *i, ..., j*

Queries only

Queries only

- Given a static array x

- Query the **xor** of elements $i, ..., j$

Queries only

Queries only

- Given a static array x

- Query the **minimum** of elements $i, ..., j$

Queries only

Queries and updates

- **Set** the value of element i to c
- Query the *minimum* of elements $i, ..., j$

Queries and updates

Queries and updates

- *Set* the value of element i to c
- Query the *sum* of elements $i, ..., j$

Queries and updates

Queries and updates

- *Increment* all elements $i, ..., j$ by c
- Query the *value* of element i

Queries and updates

Queries and updates

- *Increment* all elements $i, \ldots, j$ by c
- Query the *minimum* of elements $i, \ldots, j$

Queries and updates