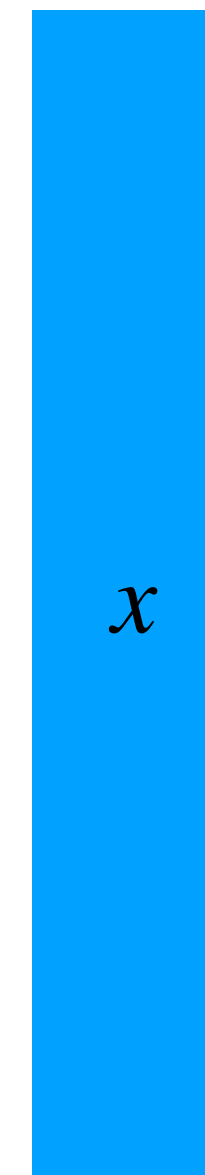


# Fast and Space Optimal Streaming Algorithms

with Mikkel Thorup, Rasmus Pagh and David Woodruff [FOCS '23]

# Turnstile Streaming

- Initialize  $x \leftarrow 0 \in \mathbb{R}^n$
- On update  $(i, \Delta)$  :
  - Set  $x_i \leftarrow x_i + \Delta$
- Answer queries about  $x$  using **small space**
  - $\max_i |x_i|$
  - $\sum_i |x_i|^p$  ( $F_p$  moments)



Updates:  $(i_1, \Delta_1) (i_2, \Delta_2) \dots (i_m, \Delta_m)$