



How is Sketching Useful?

**Turnstile Streaming**

- **Implicitly initialize a sketching matrix  $S$**

- Initialize  $sk(x) \leftarrow 0$

- When  $x[i] \leftarrow x[i] + \Delta$ :

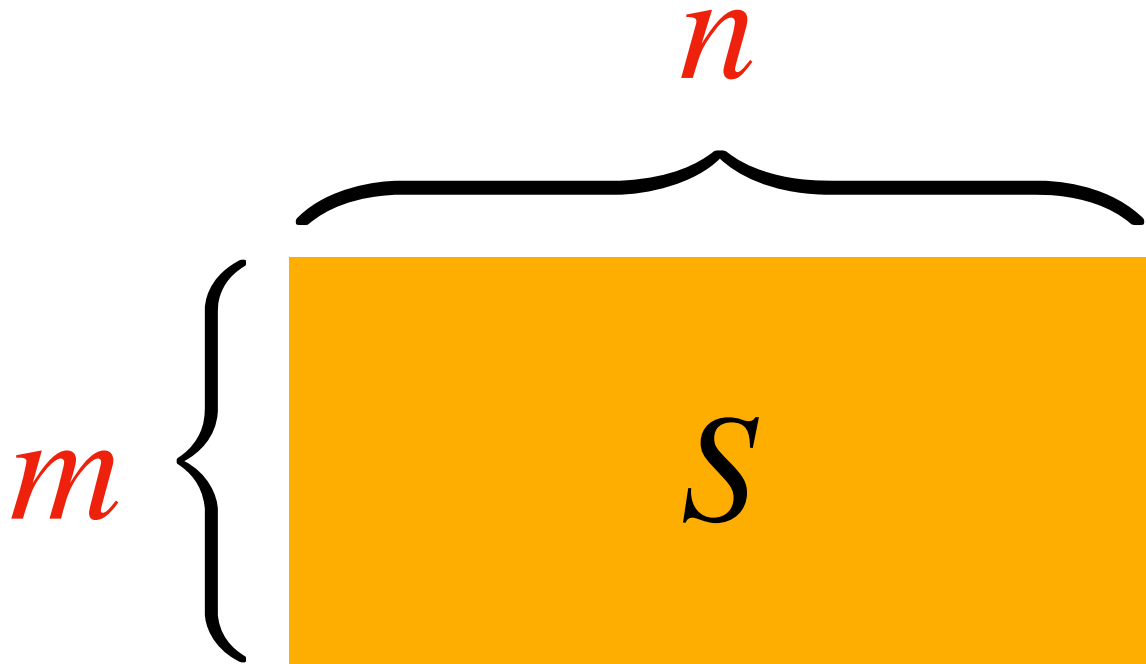
- Retrieve the  $i$ -th column  $S *_i$

- Update  $sk(x) \leftarrow sk(x) + (S_{*i}) \cdot \Delta$

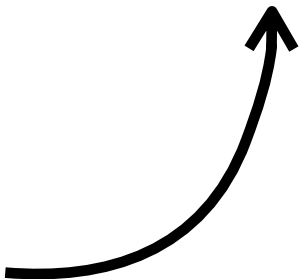


- At all times:  $sk(x) \equiv S \cdot x$

- Extract "information" about  $x$  from  $sk(x)$  at the end



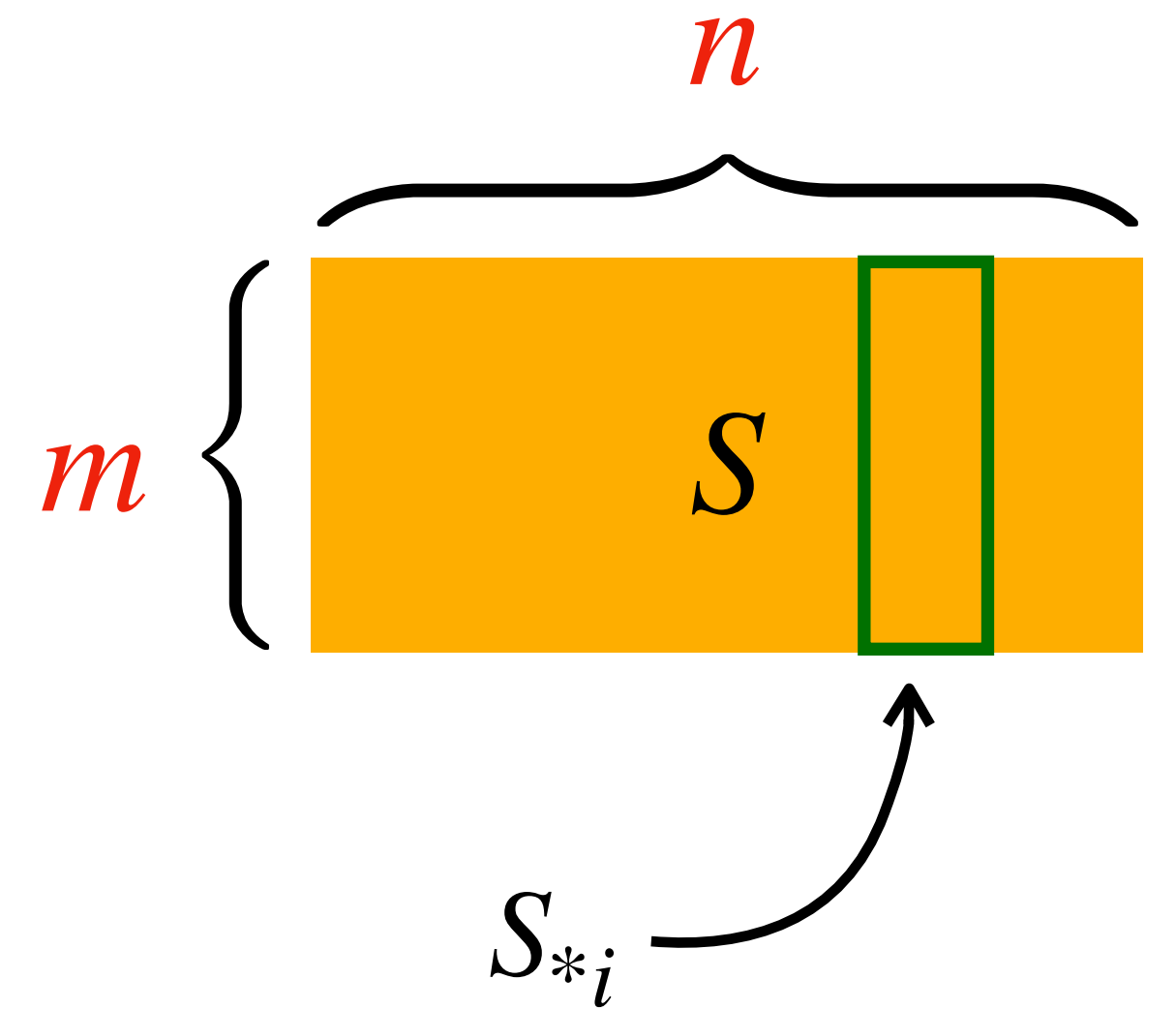
$S_{*i}$



# How is Sketching Useful?

## Turnstile Streaming

- **Implicitly** initialize a sketching matrix  $S$
- Initialize  $\text{sk}(x) \leftarrow 0$
- When  $x[i] \leftarrow x[i] + \Delta$ :
  - Retrieve the  $i$ -th column  $S_{*i}$
  - Update  $\text{sk}(x) \leftarrow \text{sk}(x) + (S_{*i}) \cdot \Delta$
- At all times:  $\text{sk}(x) = S \cdot x$
- Extract "information" about  $x$  from  $\text{sk}(x)$  at the end



# How is Sketching Useful?

## Turnstile Streaming

- $S$  can be stored using small space  $\Rightarrow$  Small space streaming algorithms!
- $S_{*i}$  can be retrieved quickly  $\Rightarrow$  Fast **update** times