



How is Sketching Useful?

**Turnstile Streaming**

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

- Maintain  $S \cdot x$  in the stream

- Initialize  $sk(x) \leftarrow 0$

• When  $x[i] \leftarrow x[i] + \Delta$

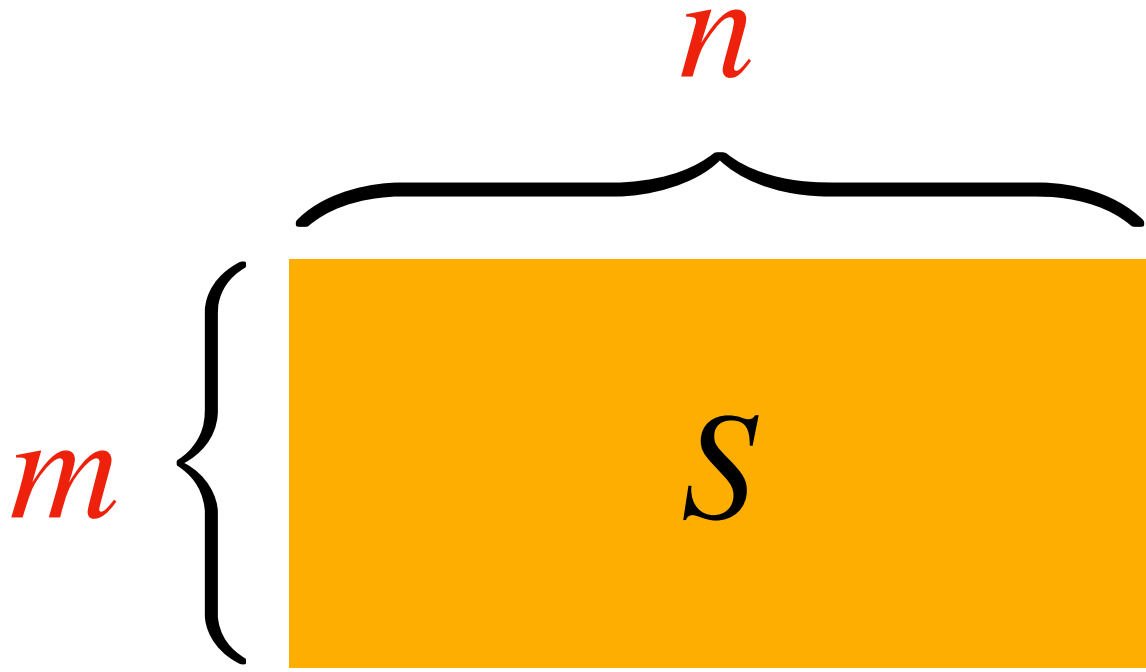
- Retrieve the  $i$ -th column  $S_{*i}$



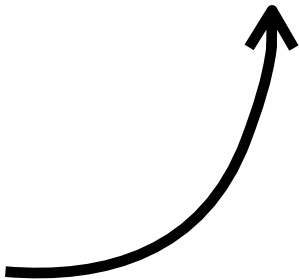
- Update  $sk(x) \leftarrow sk(x) + (S_{*i}) \cdot \Delta$

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

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



$S_{*i}$



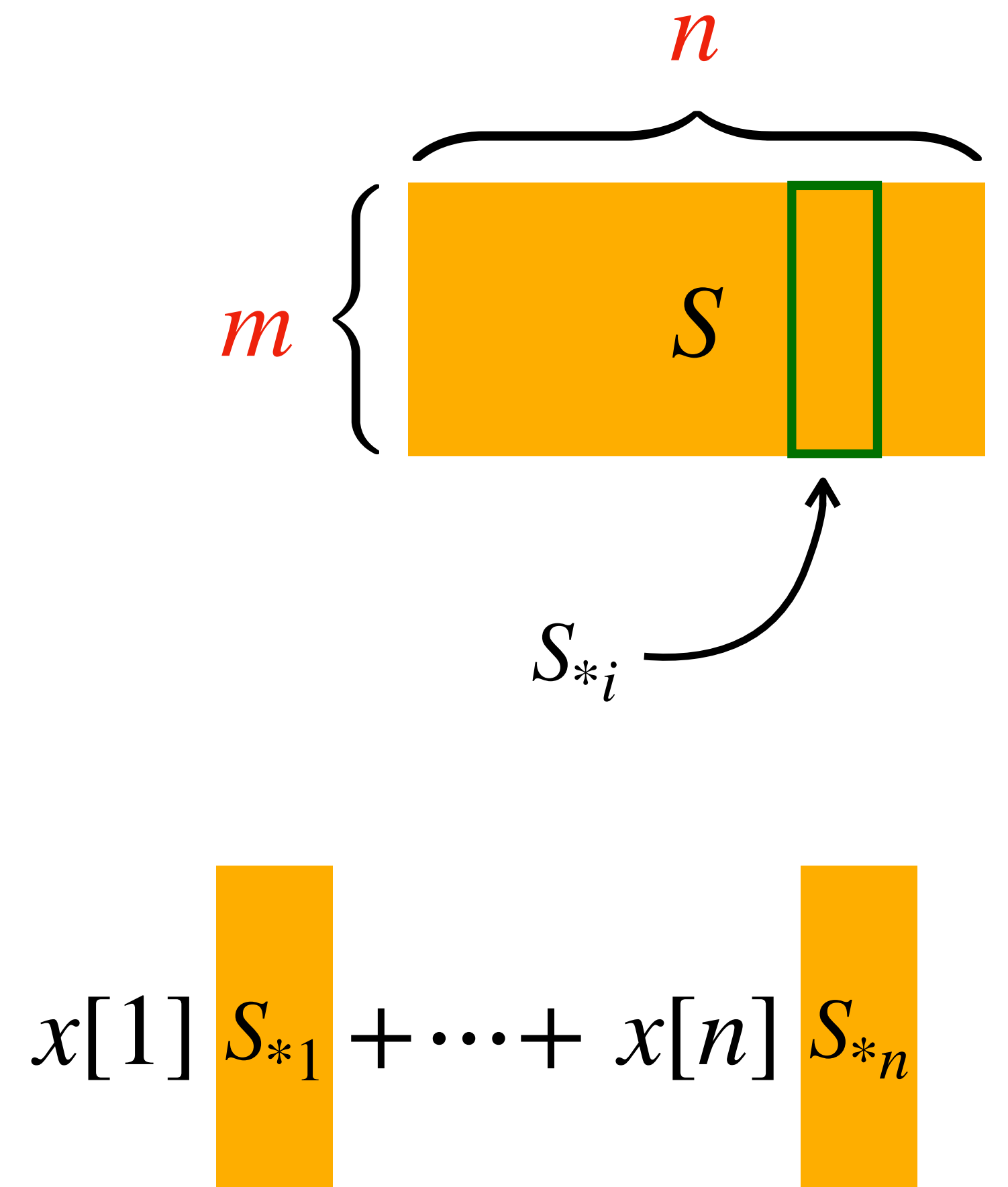
$$x[1] S_{*1} + \cdots + x[n] S_{*n}$$



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- 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





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