

**Sequence Bloom Trees**

Given the bit vectors (1010), (0010), (0001), and (0101), draw a sequence bloom tree that stores all vectors as leaves. Consider how the arrangement of leaves can affect the usefulness of the tree!

[0]							
[1]							
[2]							

**Count Min Sketch Find**

Given the following hashes and dataset, identify the counts of the following values.

$h_1(k) = k \% 7$      
  $h_2(k) = k + 3(k \% 2) \% 7$      
  $h_3(k) = |k - 4| \% 7$

find(16):

find(1):

find(0):

**Count Min Sketch**

What are the two components of a count min sketch?

- 1.
- 2.

[0]	1	3	5	8	2	0	3
[1]	4	5	8	0	1	4	0
[2]	0	2	4	7	2	2	5

**Count Min Sketch Insertion**

Given the following hashes and dataset, fill in the count min sketch.

$h_1(k) = k \% 7$      
  $h_2(k) = k + 3(k \% 2) \% 7$      
  $h_3(k) = |k - 4| \% 7$

S = {1, 3, 8, 16}

### Count Min Sketch: Deletion

Given the three hash values for the following items, which of them can be safely deleted?

$$H(x) = \{2, 3, 1\}$$

$$H(y) = \{1, 1, 1\}$$

$$H(z) = \{0, 1, 2\}$$

[0]	1	3	5	8	2	0	3
[1]	4	5	8	0	1	4	0
[2]	0	2	4	7	2	2	5

What is the downside to allowing deletion?

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### Minimal Increase

What is minimal increase?

Given the three hash values for the following items, how would the sketch be adjusted?

$$H(x) = \{2, 5, 1\}$$

$$H(y) = \{4, 1, 5\}$$

[0]	1	3	5	8	2	0	3
[1]	4	5	8	0	1	4	0
[2]	0	2	4	7	2	2	5

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### Counting Bloom Filter

Given the following sketch, what is the equivalent counting bloom filter?

[0]	1	3	5	8	2	0	3
[1]	4	5	8	0	1	4	0
[2]	0	2	4	7	2	2	5