DGIM algorithm

Datar-Gionis-Indynk-Motwani Algorithm
Counting 1’s in a stream

Amazon example:

- For every product **X** we keep 0/1 stream of whether that product was sold in the **n**-th transaction
- We want answer queries, how many times have we

Sliding Window: 1 Stream

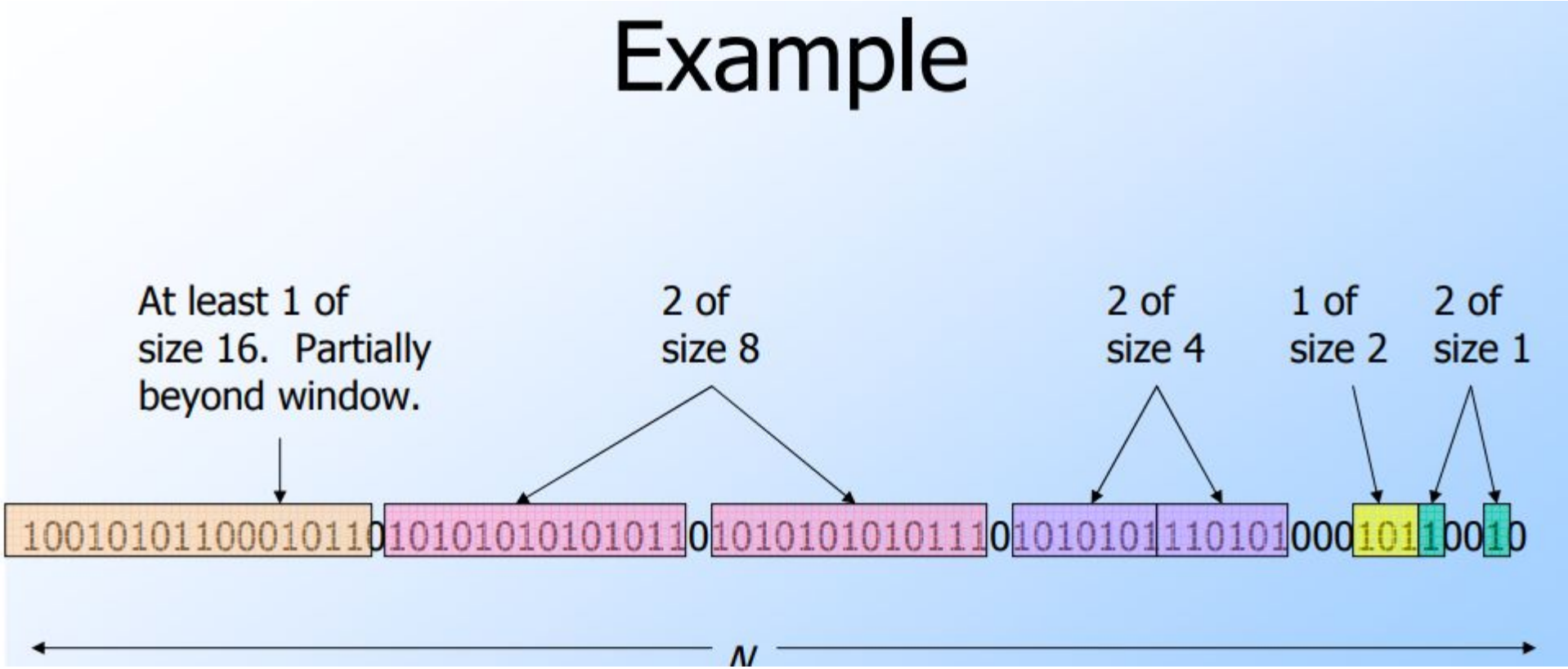
- **Sliding window on a single stream:** **N = 6**

DGIM Algorithm

Representing a Stream by Buckets

- Either one or two buckets with the same power-of-2 number of 1's.
- Buckets do not overlap in timestamps.
- Buckets are sorted by *size* (# of 1's).
  - Earlier buckets are not smaller than later buckets.
- Buckets disappear when their end-time is > N time units in the past.

There can be 2 buckets of size 2 or 1 buckets of size 2, as in this case.



Example 2

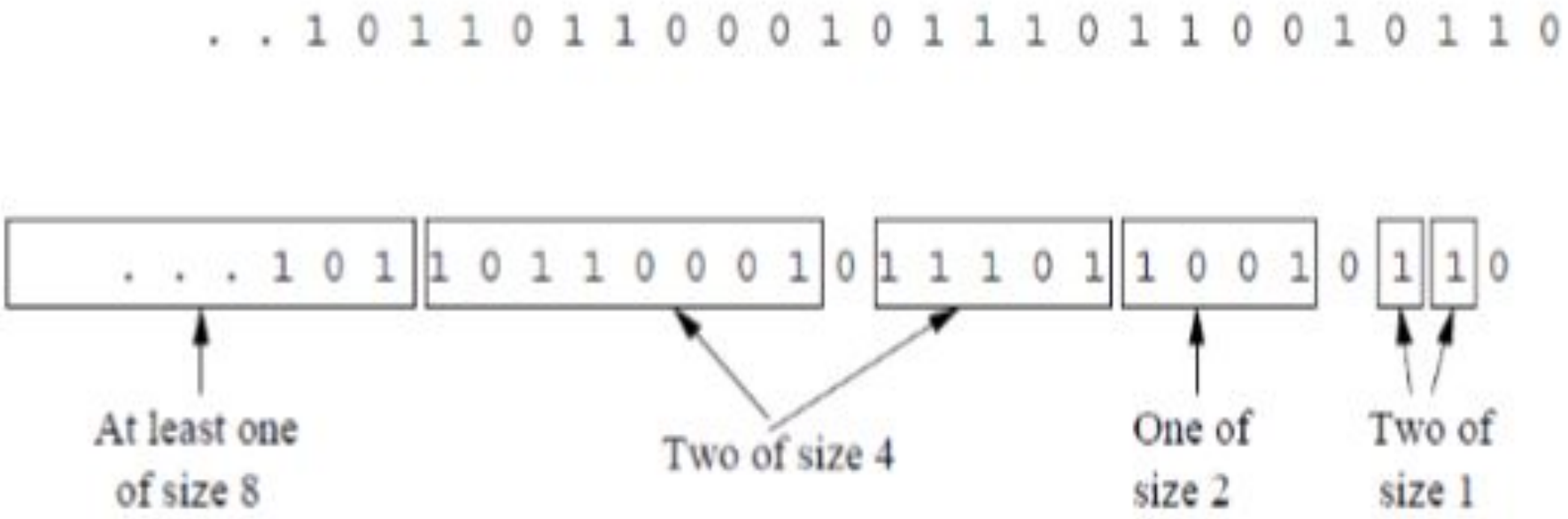
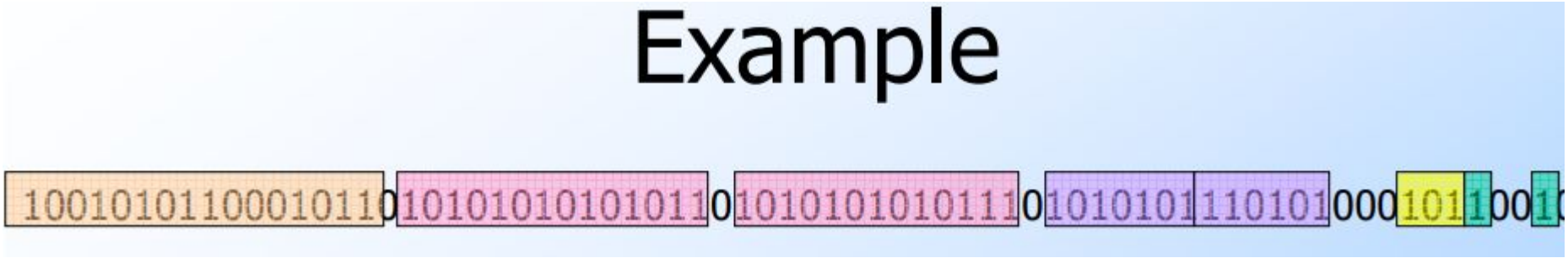


Figure: A bit-stream divided into buckets following the DGIM rules

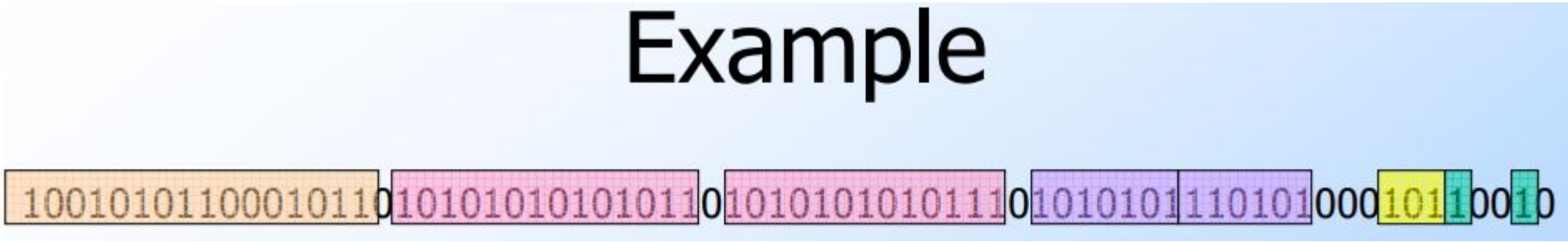
Updating Buckets --- (1)

- When a new bit comes in, drop the last (oldest) bucket if its end-time is prior to N time units before the current time.
- If the current bit is 0, no other changes are needed.

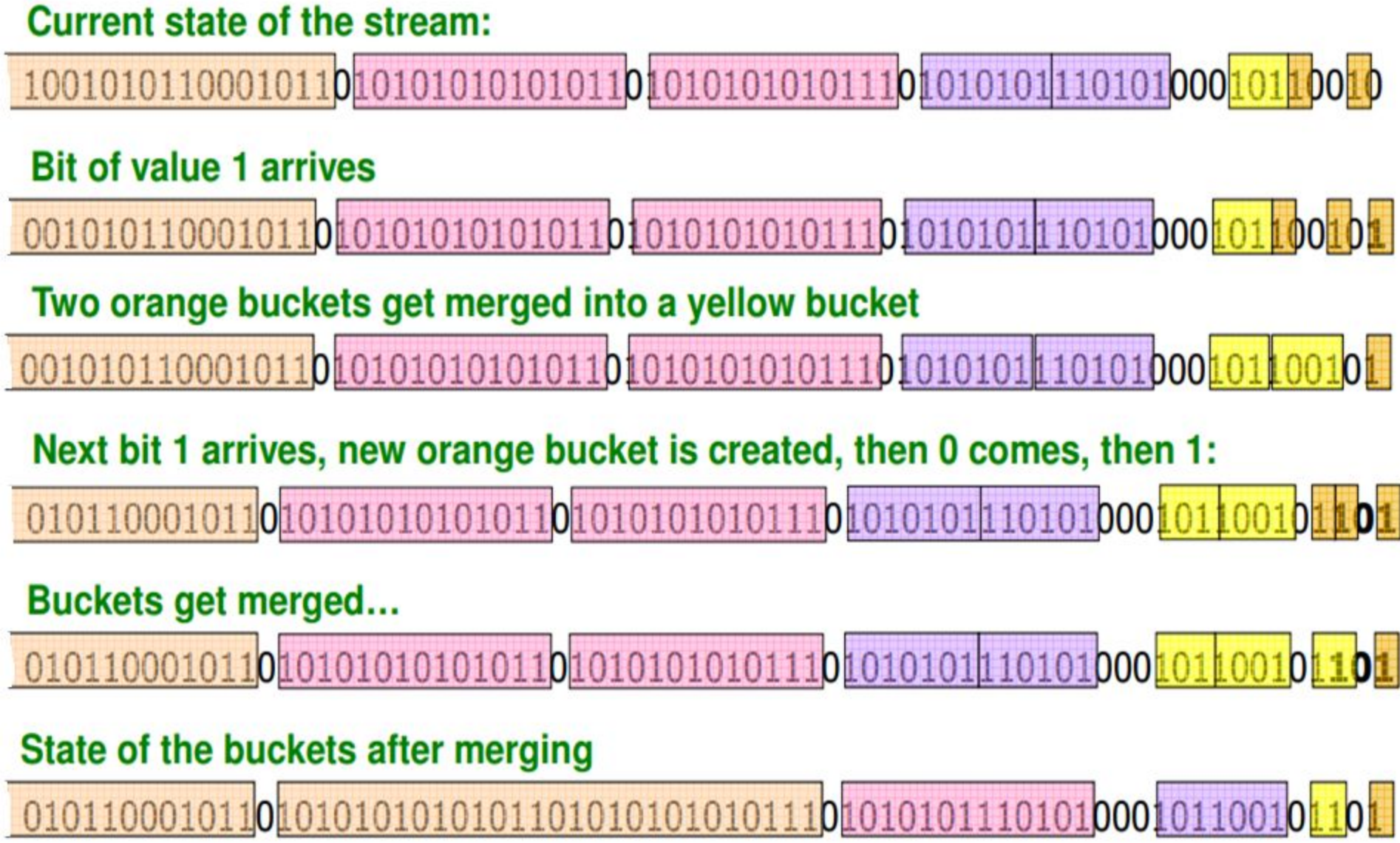
Updating Buckets when 0 comes in



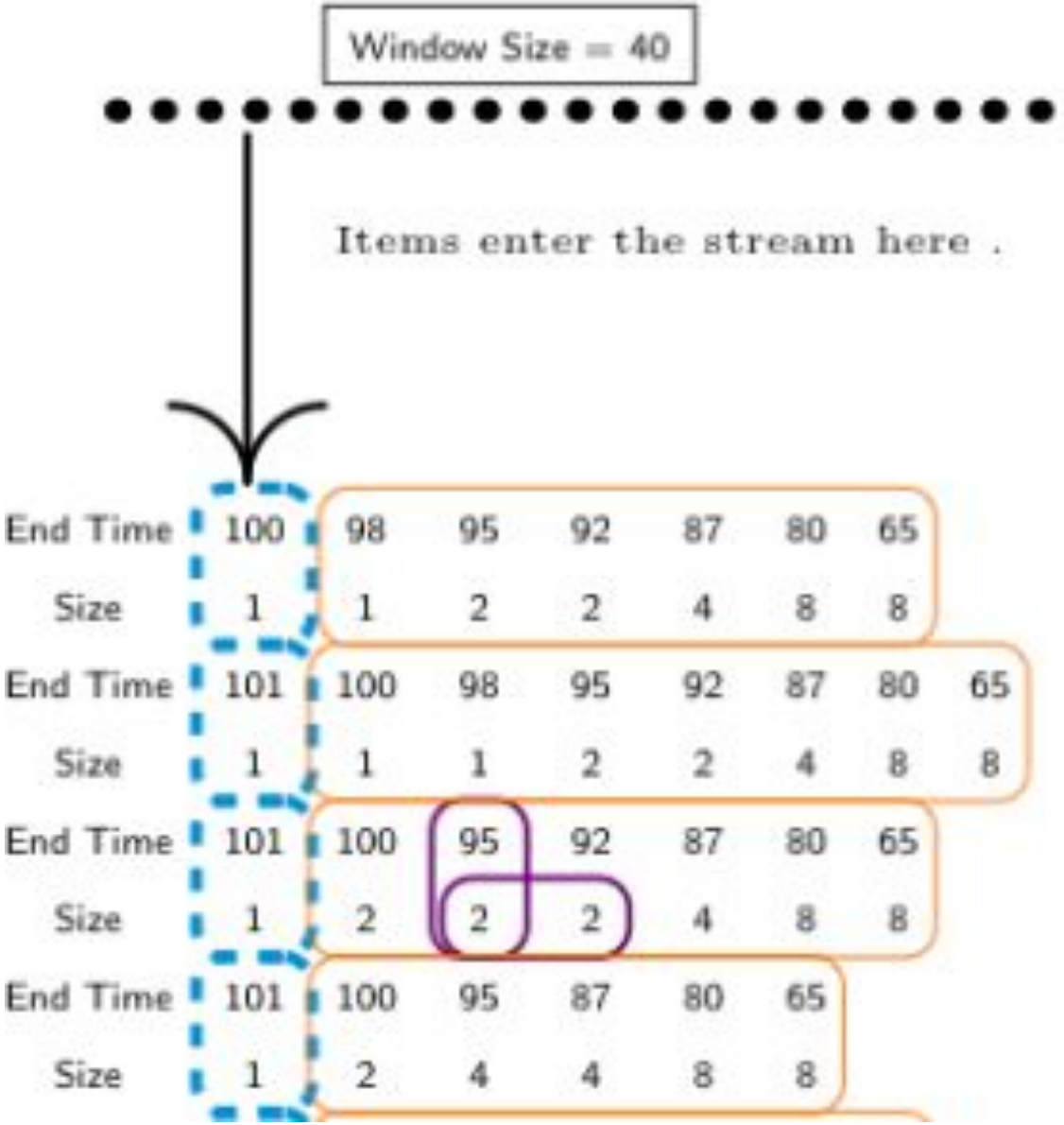
Updating Buckets when 0 comes in

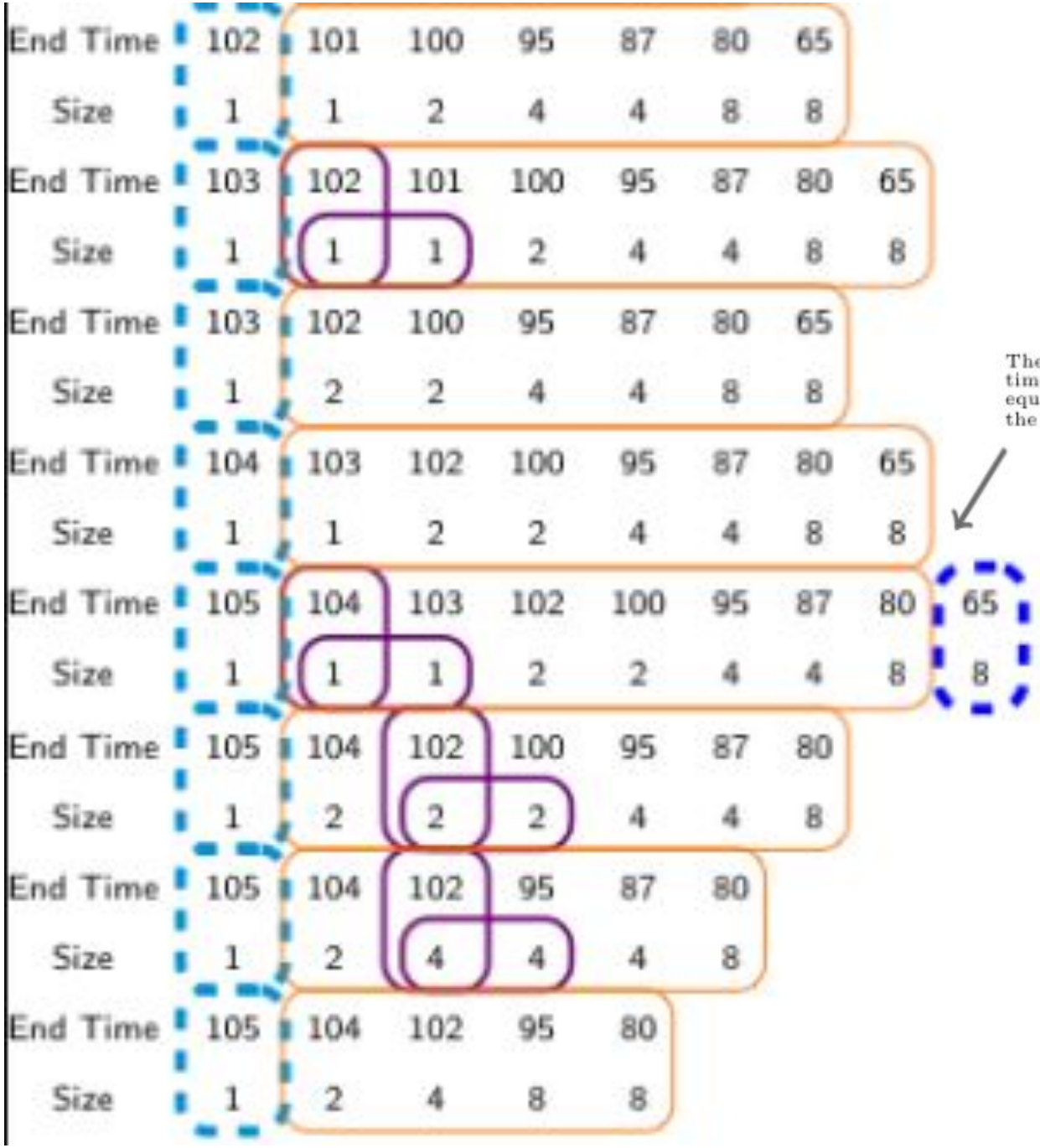


Updating Buckets when 1 comes in



Sliding window of length 40. The current timestamp is 100. Suppose that at times 101 through 105, 1's appear in the stream. Compute the set of buckets that would exist in the system at time 105.




End Time 102 101 100 95 87 80 65
Size 1 1 2 4 4 8 8
End Time 103 102 101 100 95 87 80 65
Size 1 1 1 2 4 4 8 8
End Time 103 102 100 95 87 80 65
Size 1 2 2 4 4 8 8
End Time 104 103 102 100 95 87 80 65
Size 1 1 2 2 4 4 8 8
End Time 105 104 103 102 100 95 87 80 65
Size 1 1 1 2 2 4 4 8 8
End Time 105 104 102 100 95 87 80
Size 1 2 2 2 4 4 8
End Time 105 104 102 95 87 80
Size 1 2 4 4 4 8
End Time 105 104 102 95 80
Size 1 2 4 8 8
The difference between the latest timestamp(105) and the oldest(65) equals the windows size(40). So the oldest bucket is dropped .