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**15.082 and 6.855J**  
**February 25, 2003**

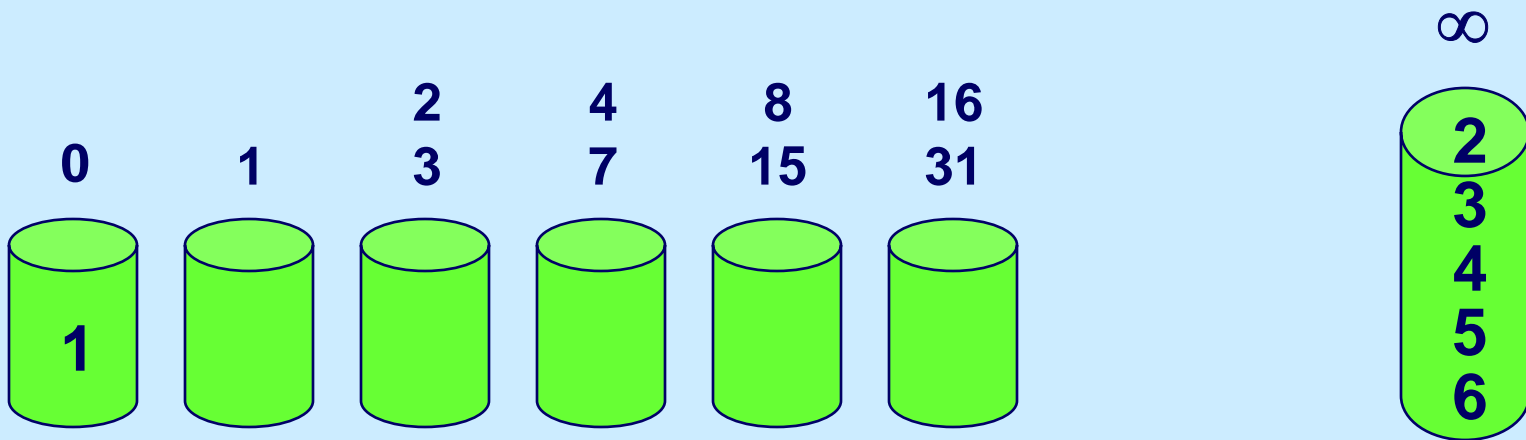
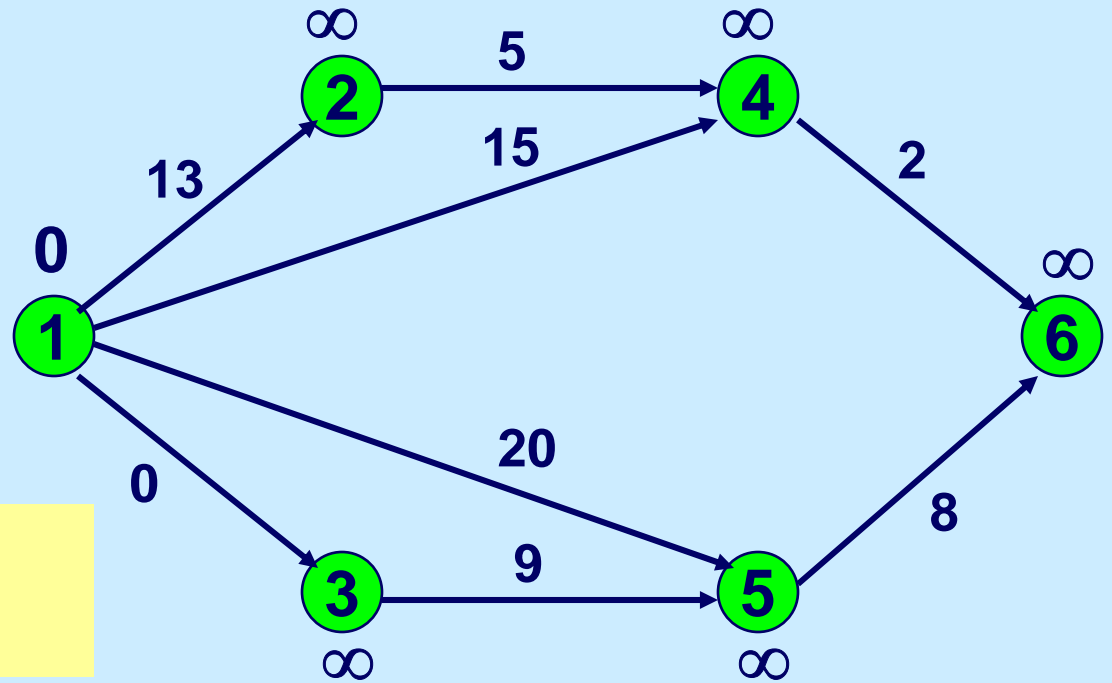
**Radix Heap Animation**

# An Example from AMO (with a small change)

Initialize distance labels

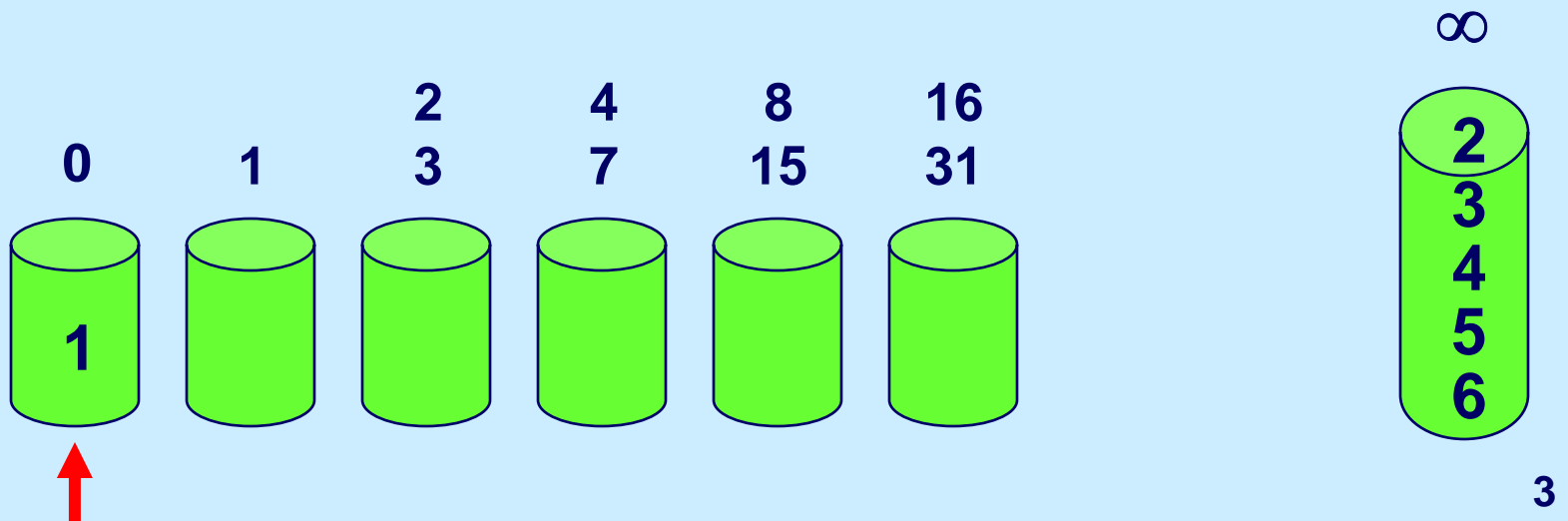
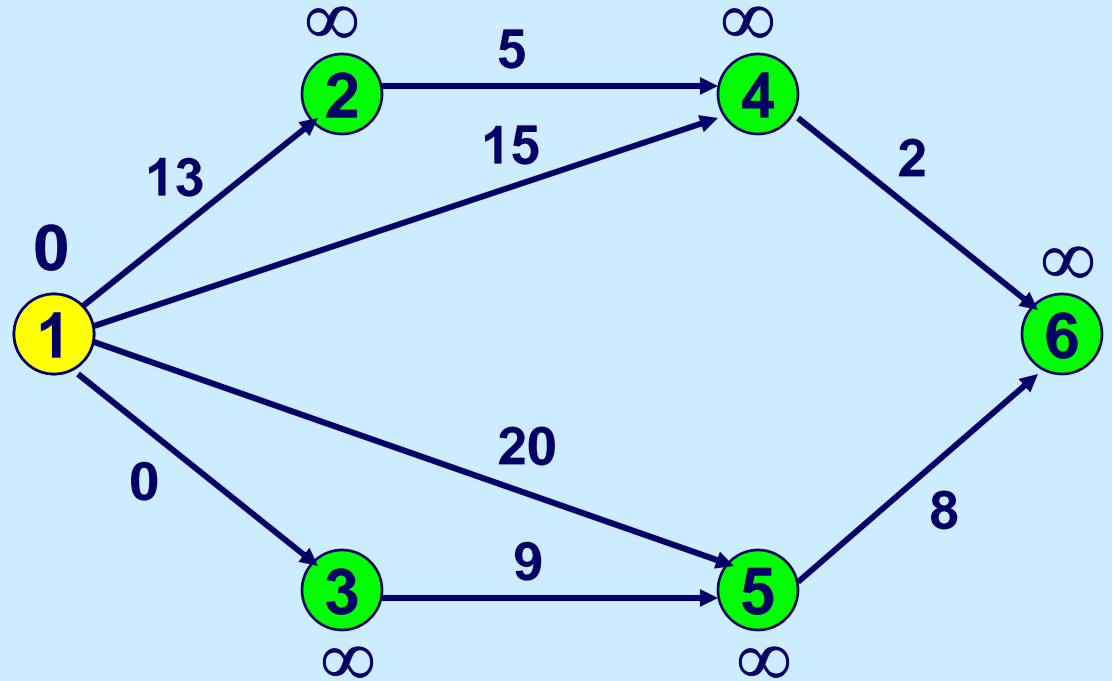
Initialize buckets and their ranges.

Insert nodes into buckets.



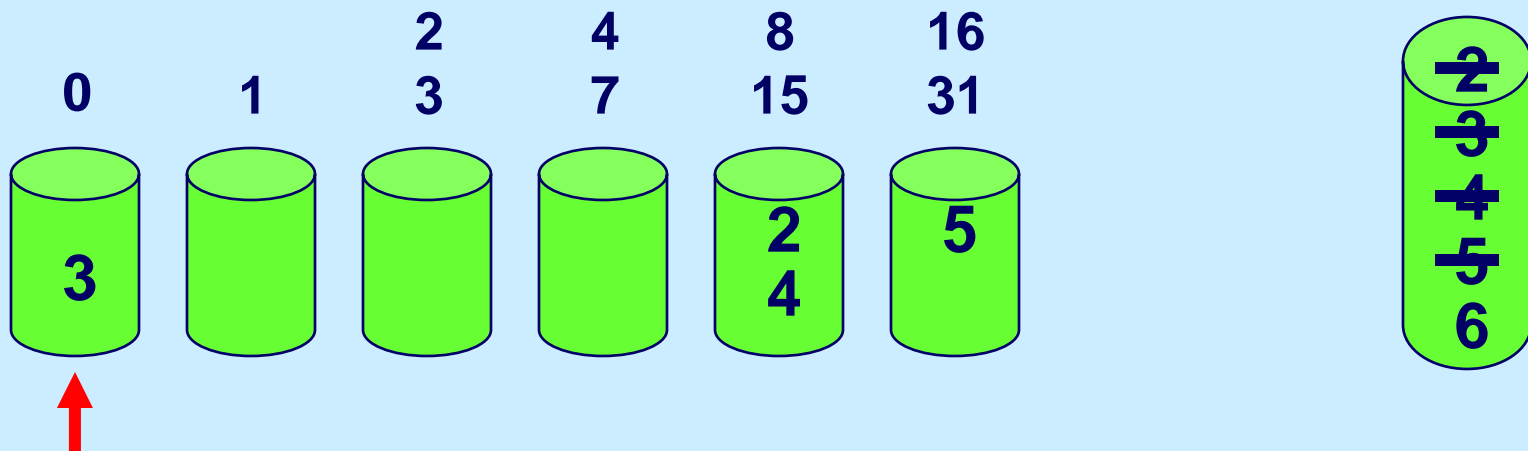
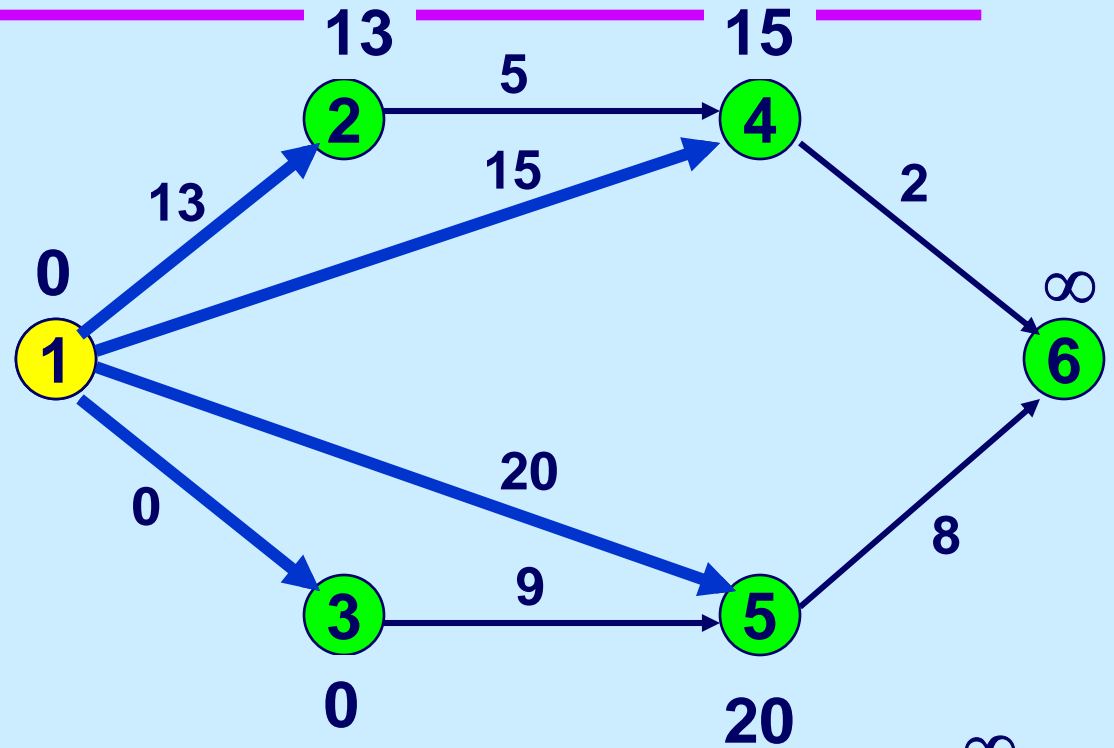
# Select

Select the node with minimum distance label



# Update

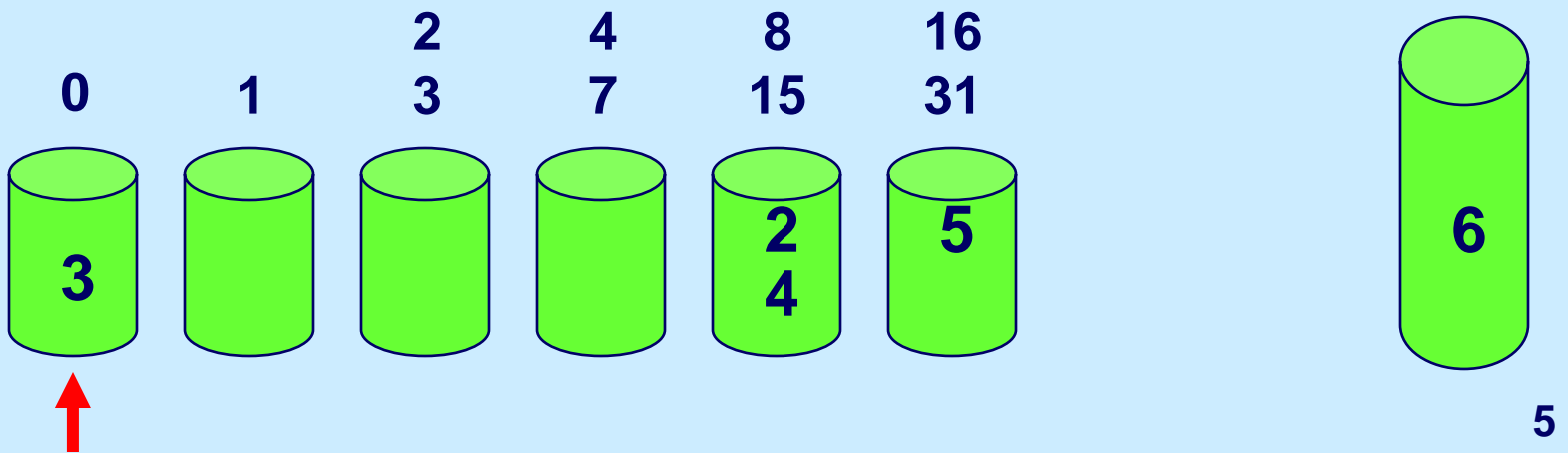
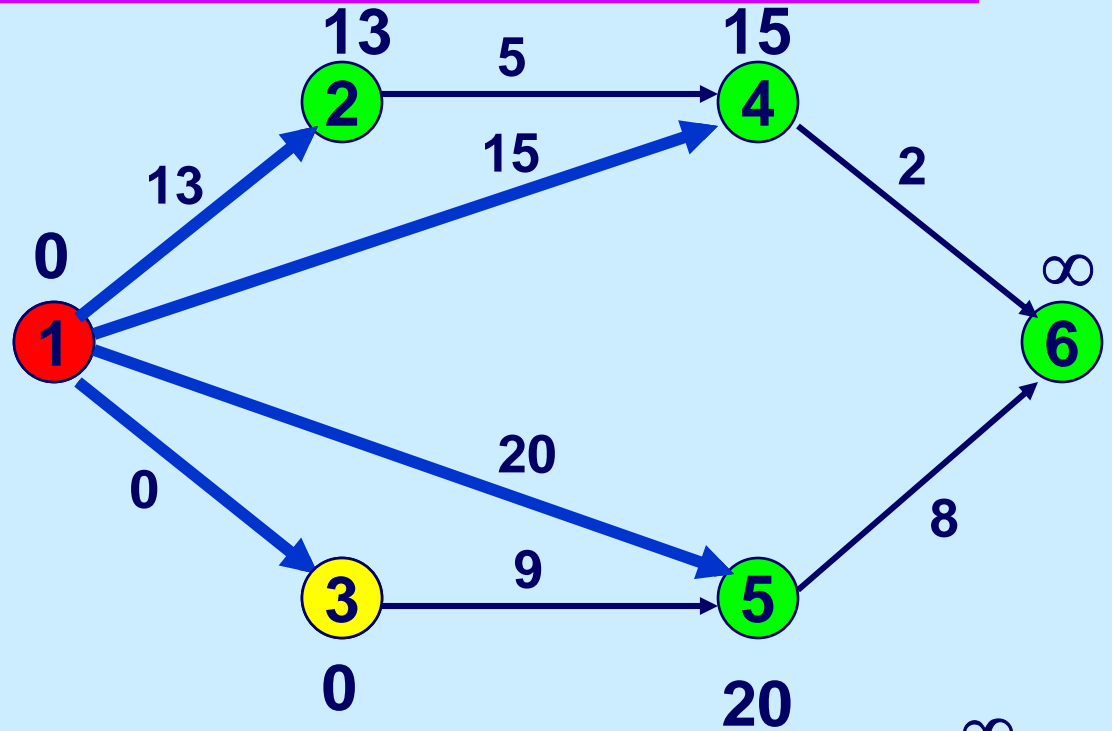
Scan arcs out of node 1 and update distance labels.



# Select

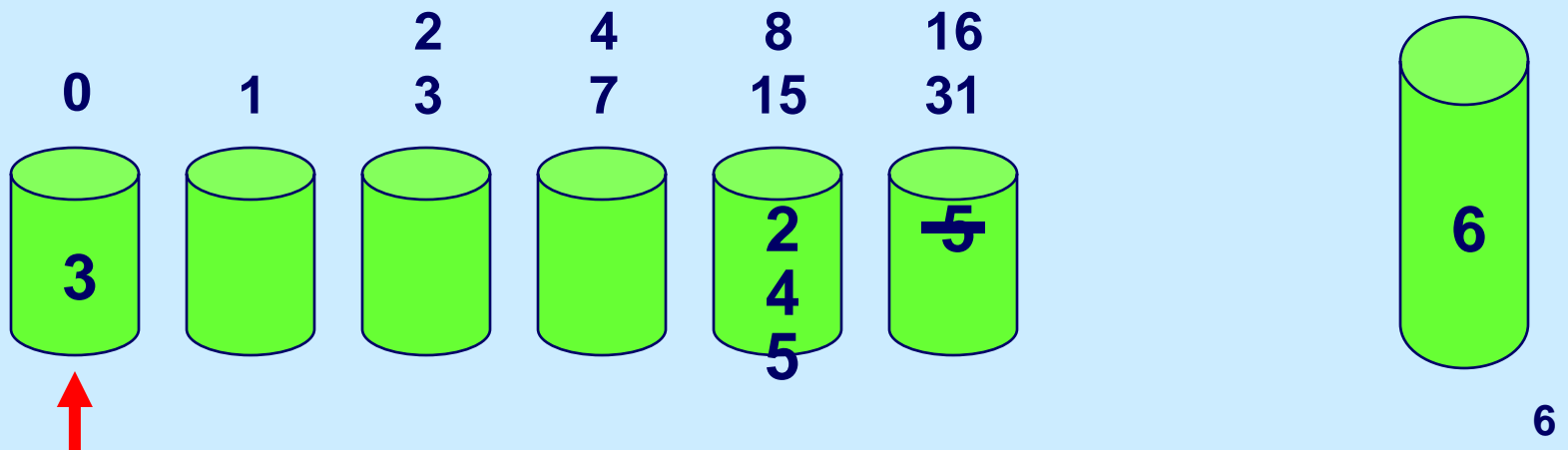
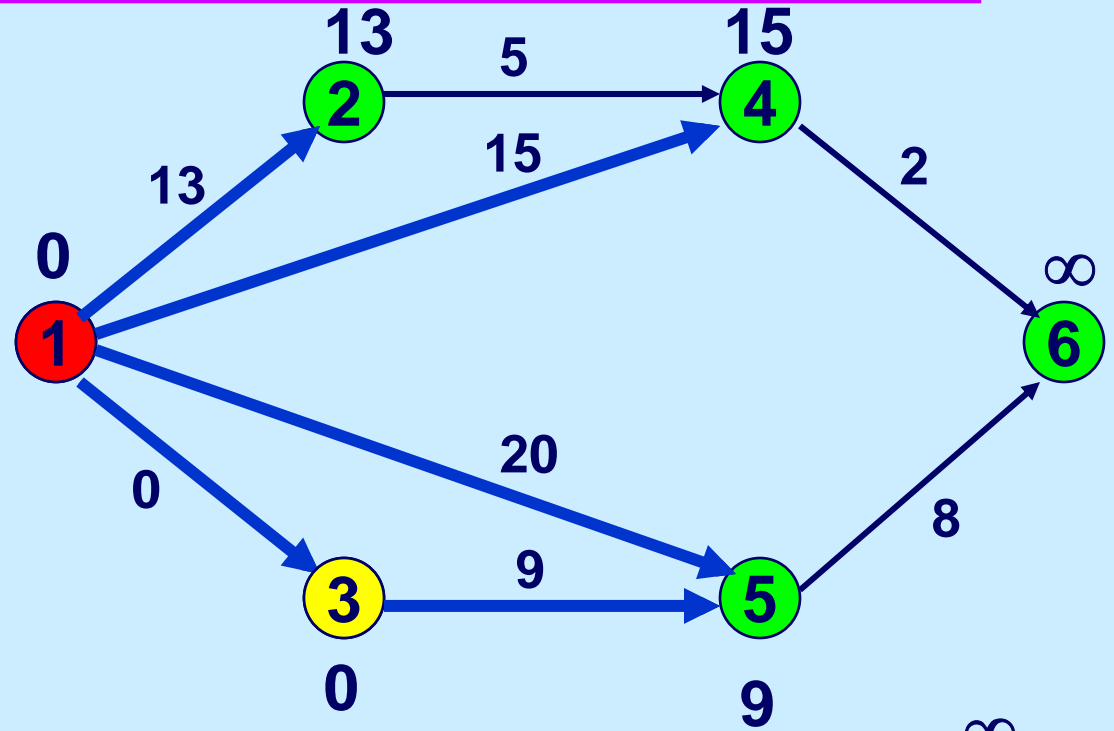
Select the node with minimum distance label

Node 3 has label 0, which is minimum.



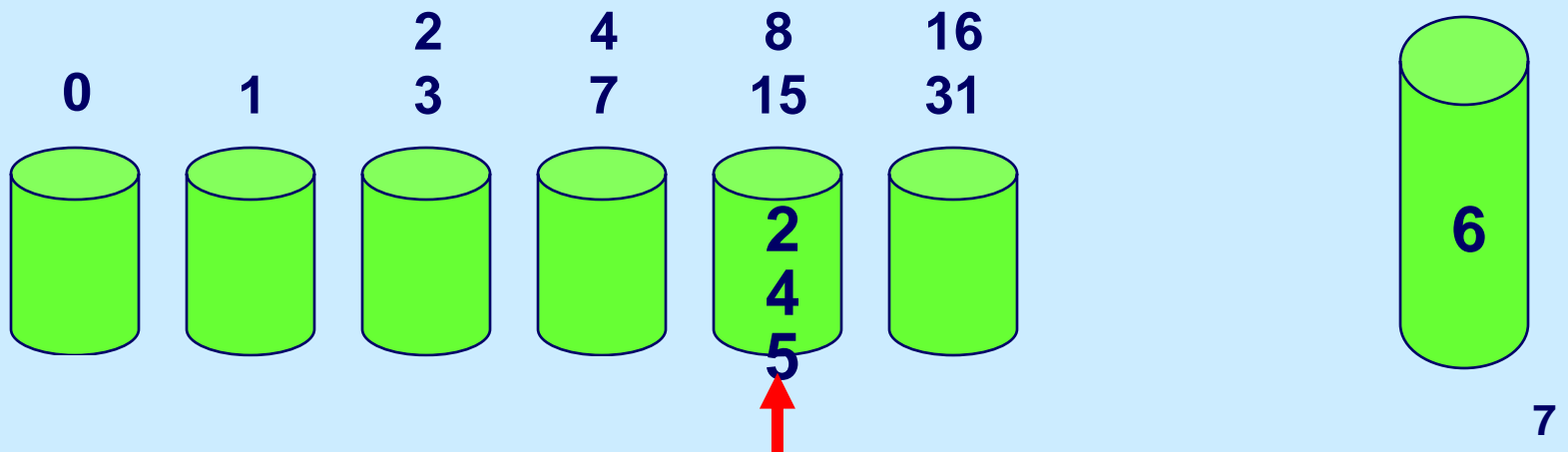
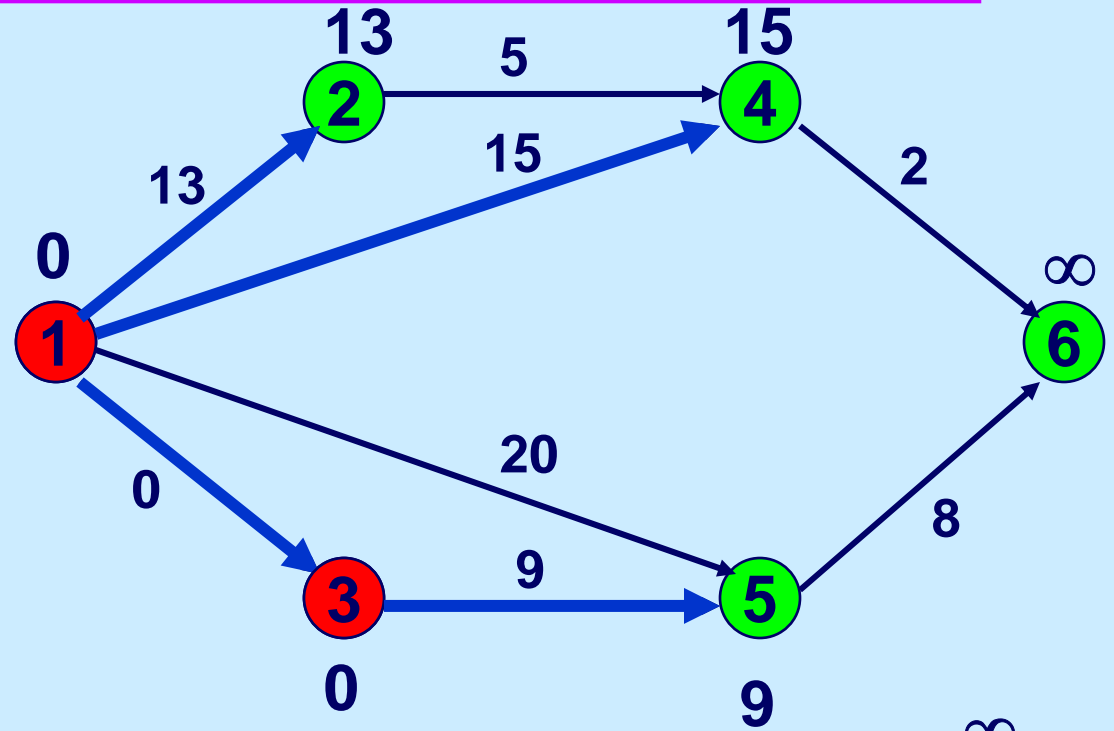
# Update

Scan arcs out of node 3 and update distance labels.



# Select: part 1

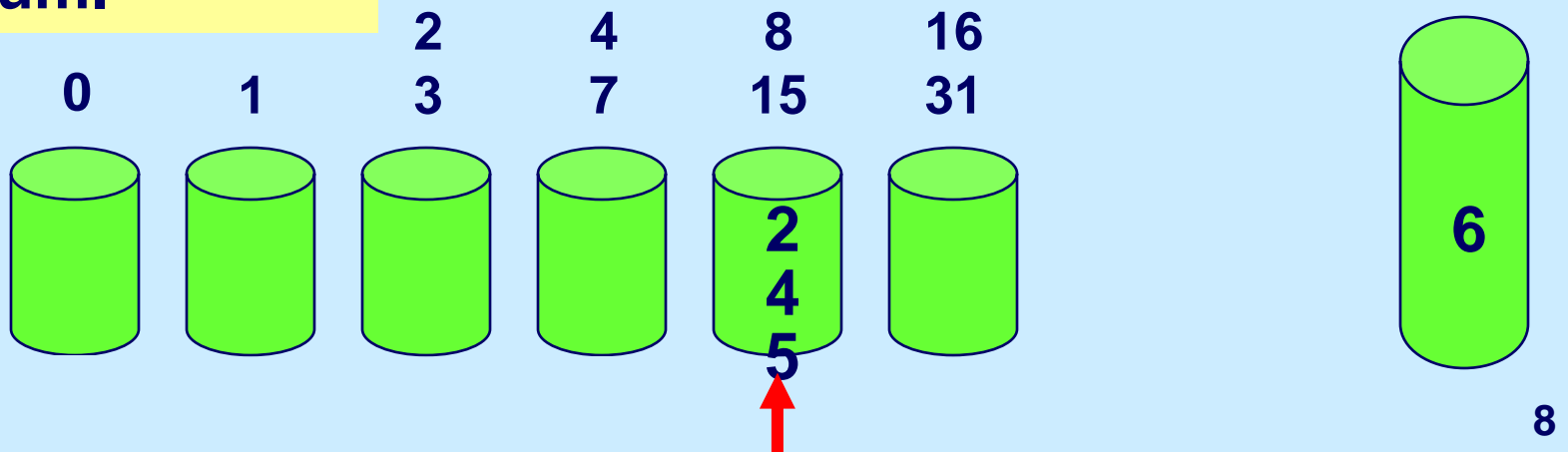
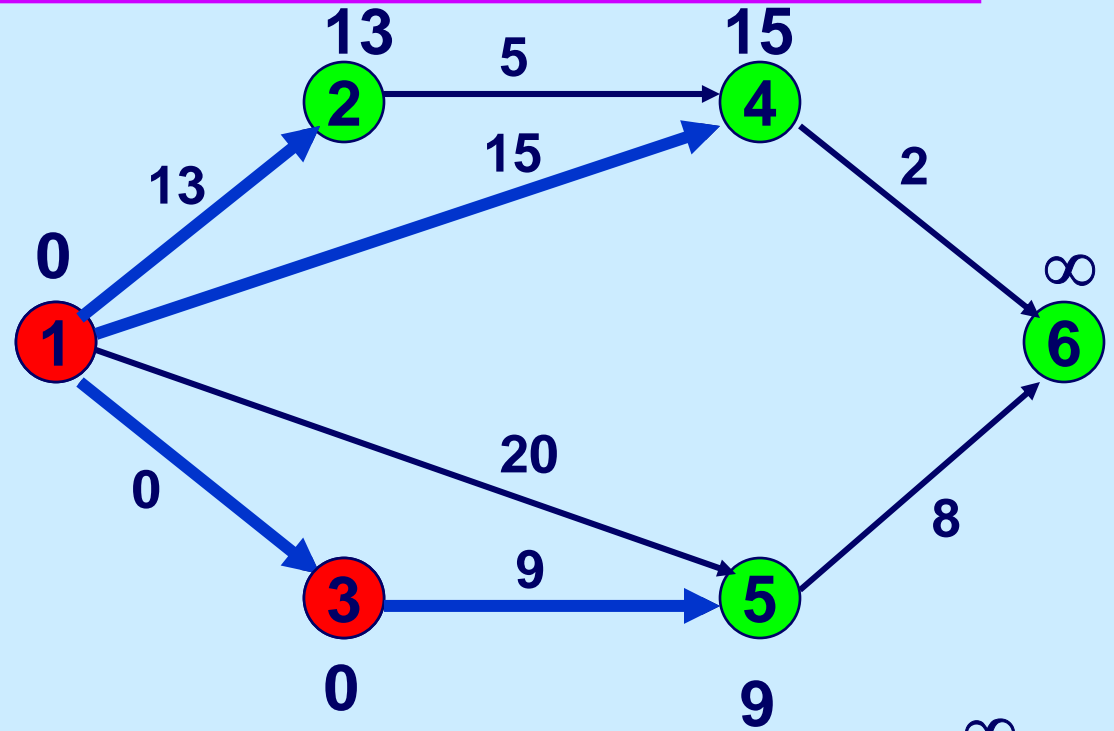
Find the first non-empty bucket, by scanning buckets from left to right.



# Select: part 2

Determine the minimum distance value in the bucket, by scanning all nodes in the bucket.

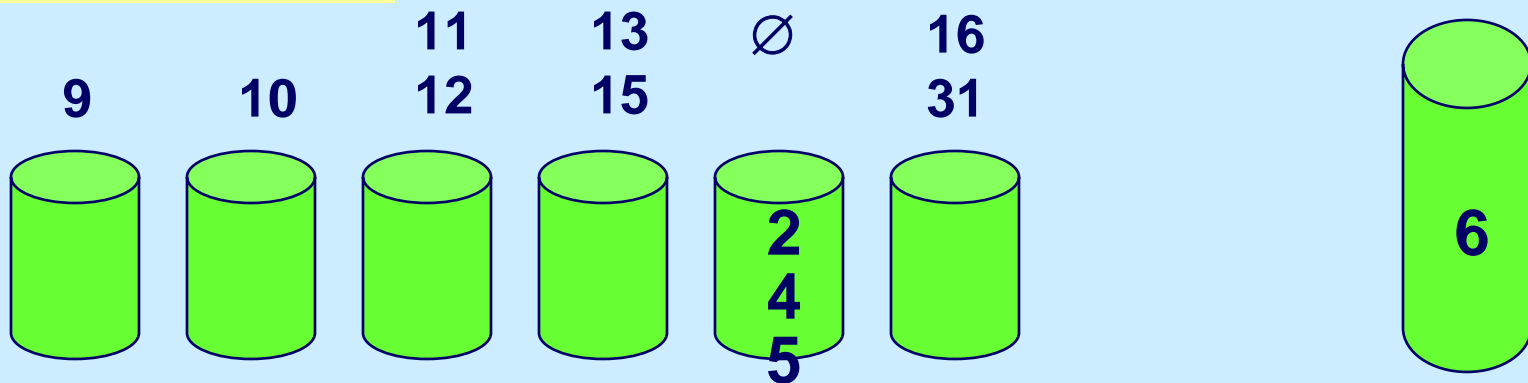
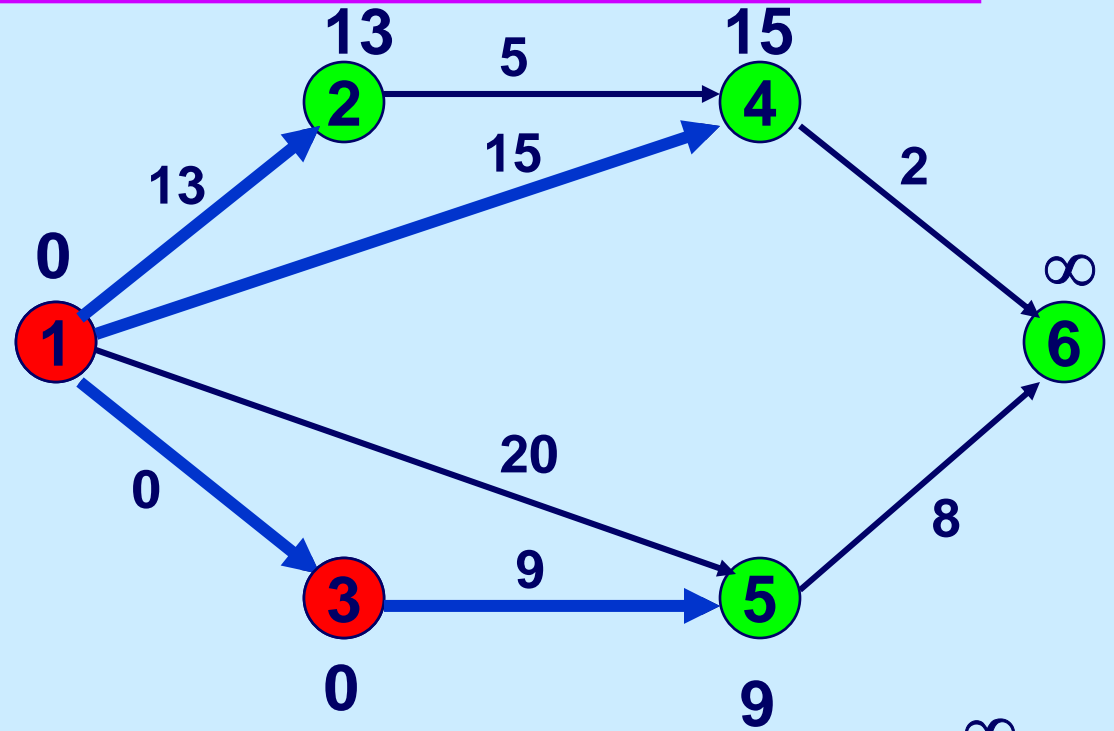
$d(5) = 9$ , which is minimum.



# Select: part 3

**Redistribute** the range of bucket 5 into the first 4 buckets, starting with value 9.

Bucket widths stay the same, except that some may be smaller.

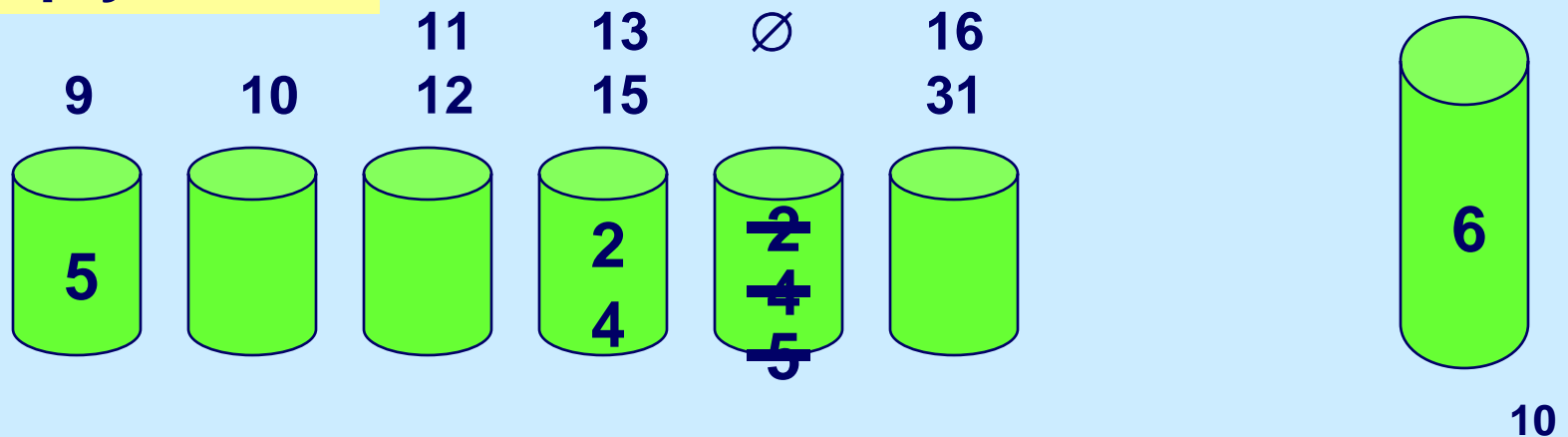
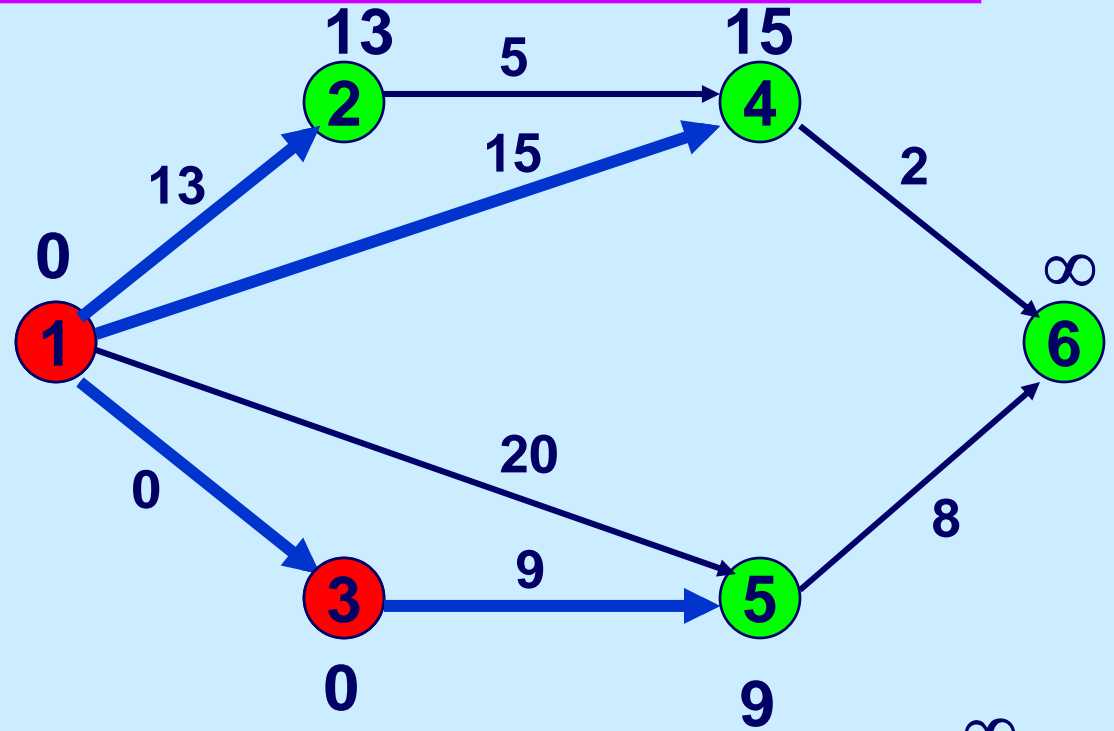


# Select: part 4

**Reinsert** nodes in the correct bucket.

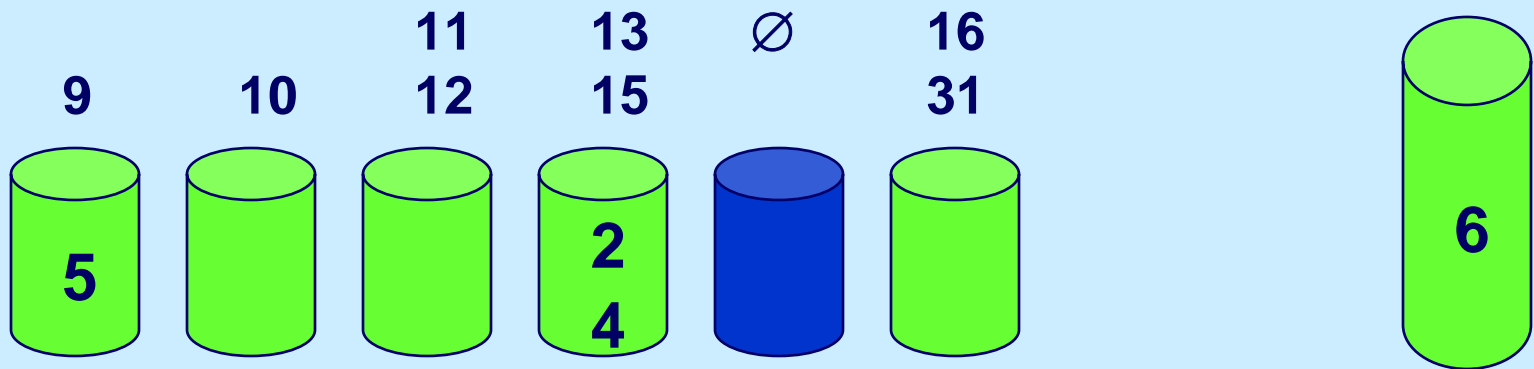
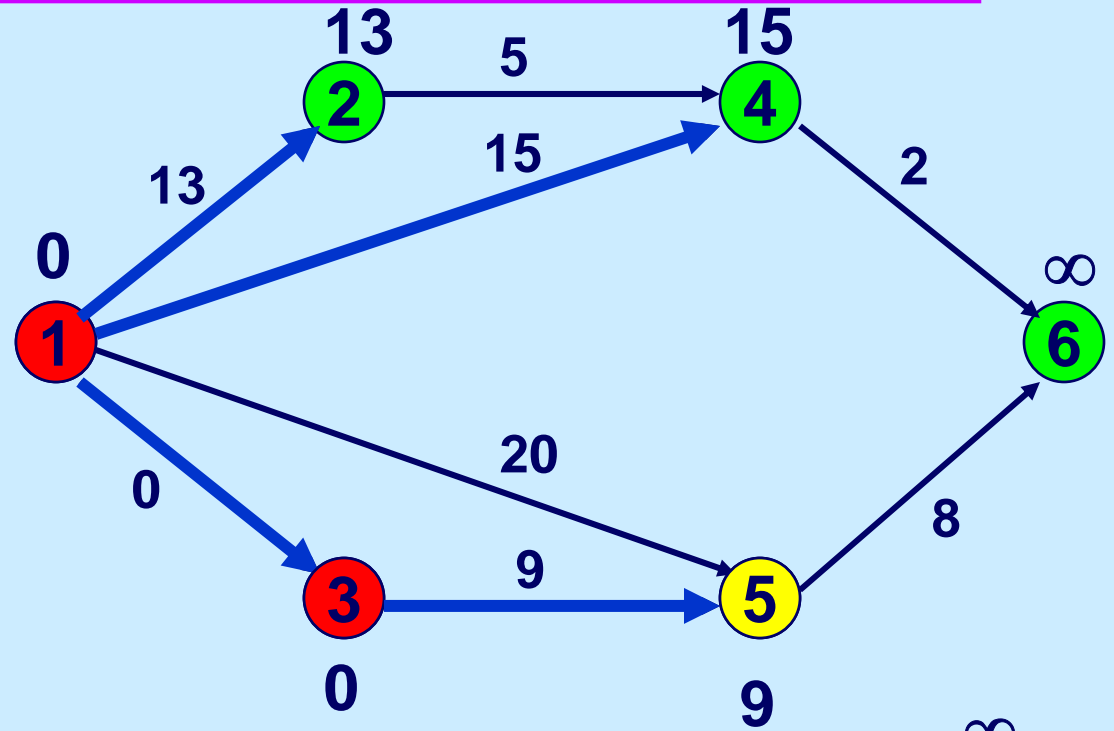
Determine the bucket by scanning left.

At this point the leftmost bucket is non-empty



# Select: part 5

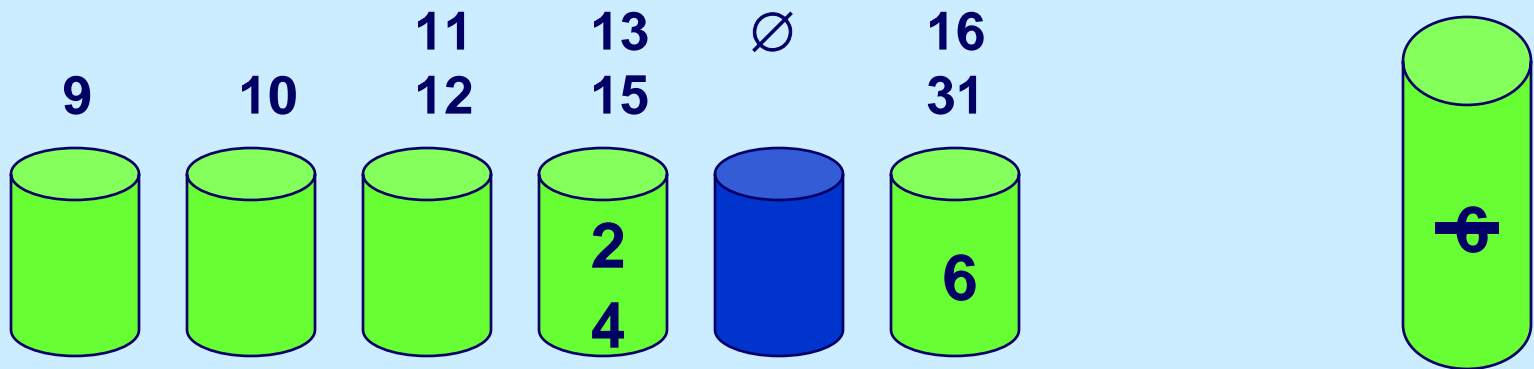
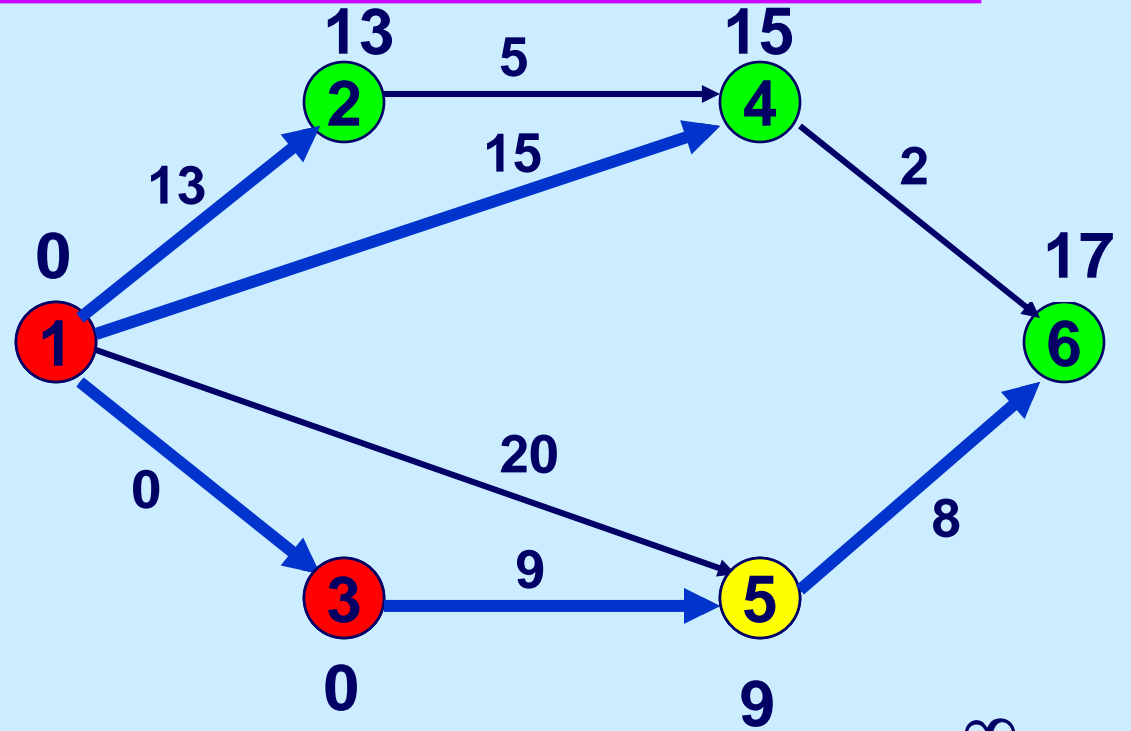
Select a node in the leftmost bucket.



# Update

Scan arcs out of node 5 and update distance labels.

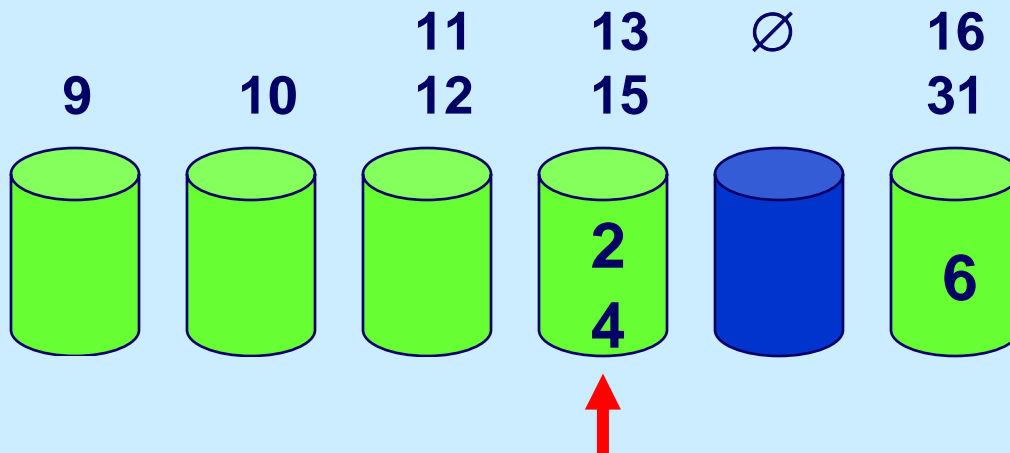
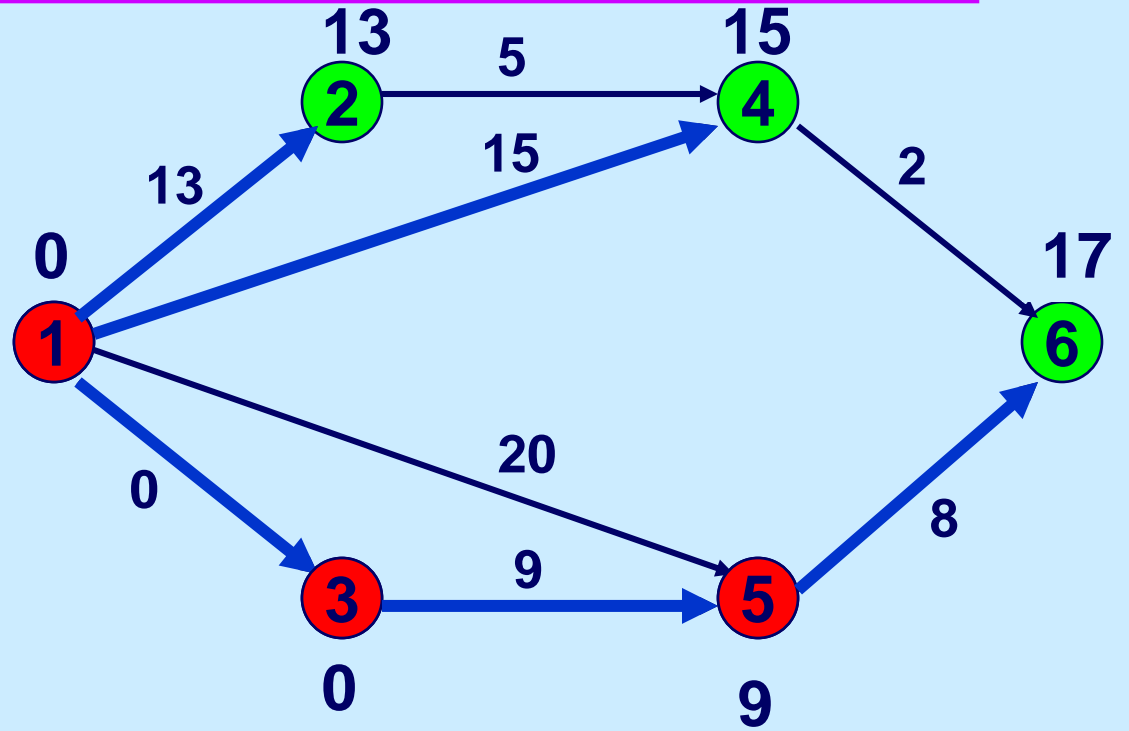
Reinsert nodes in correct buckets by scanning left.



# Select: parts 1 and 2

Find the minimum non-empty bucket.

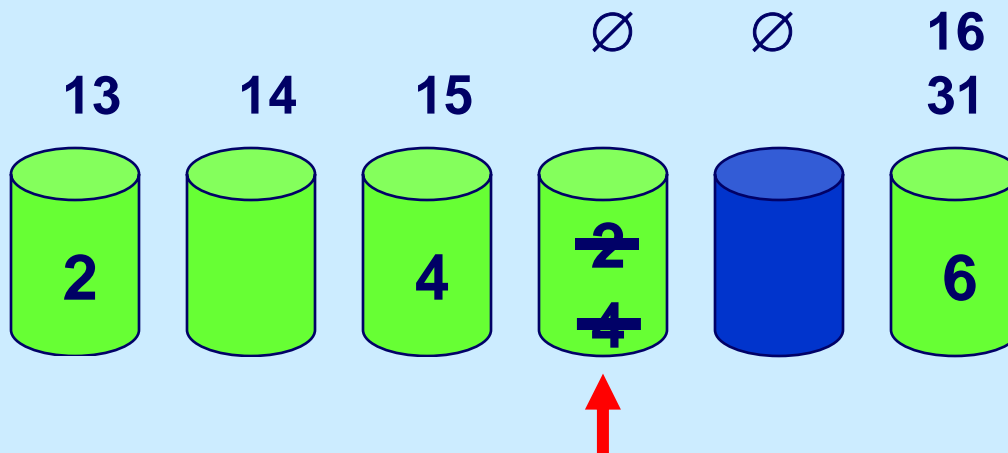
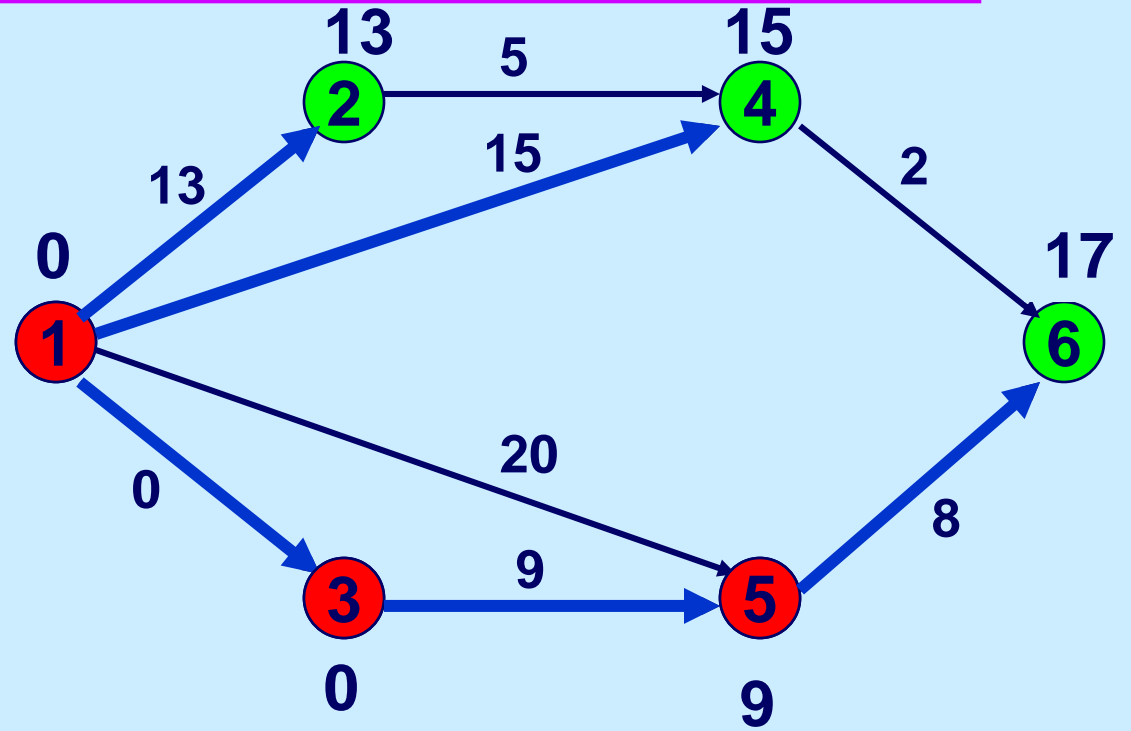
Find the minimum distance label in the bucket



# Select: parts 3 and 4

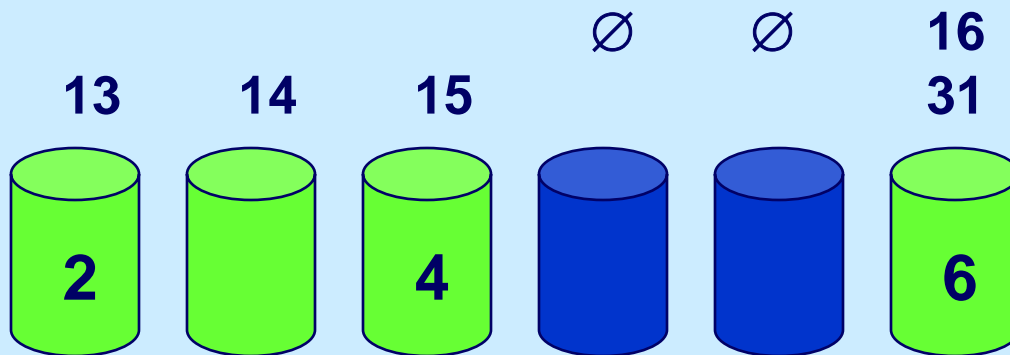
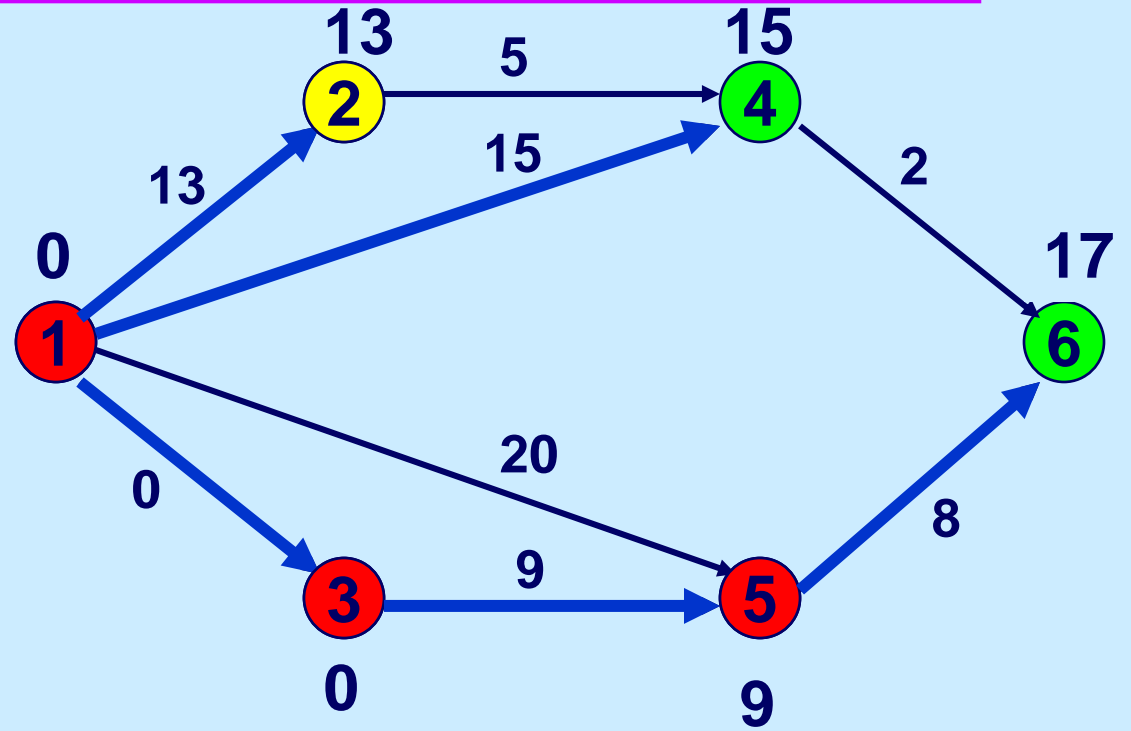
Redistribute bucket ranges in the minimum bucket

Reinsert nodes in correct buckets.



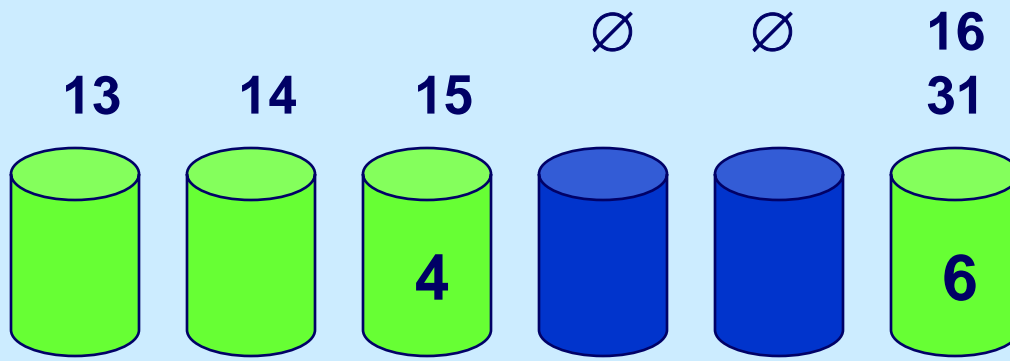
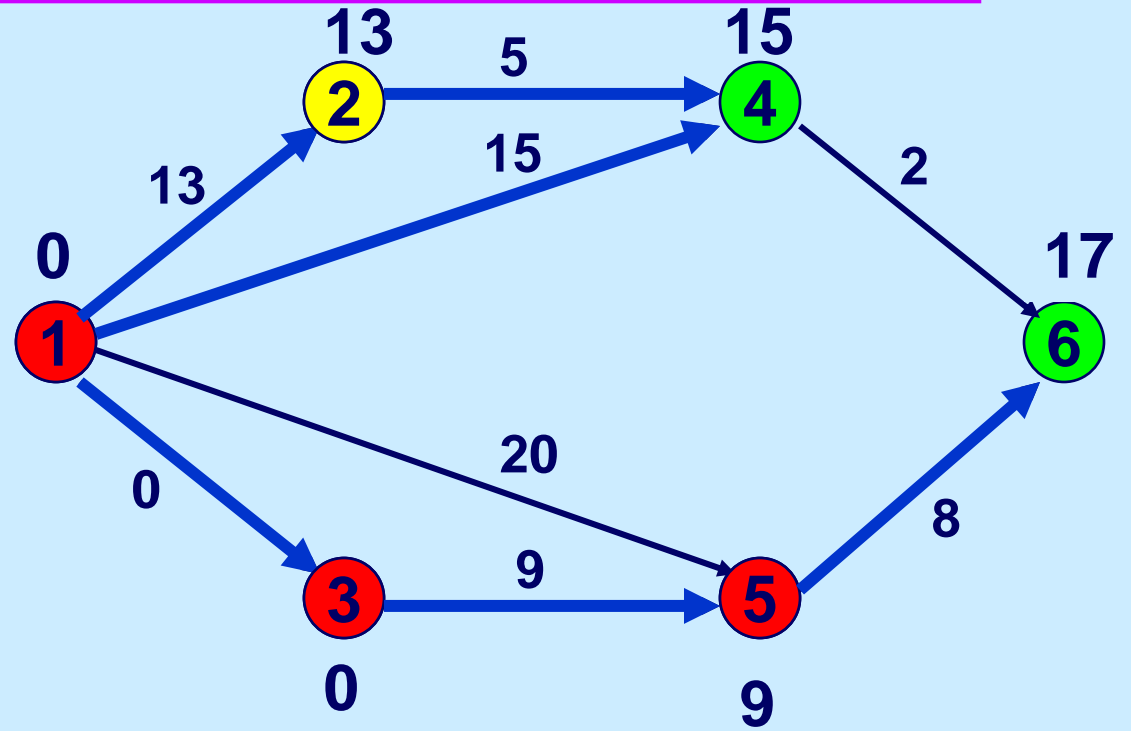
# Select: part 5

Select a node from the leftmost bucket.



# Update

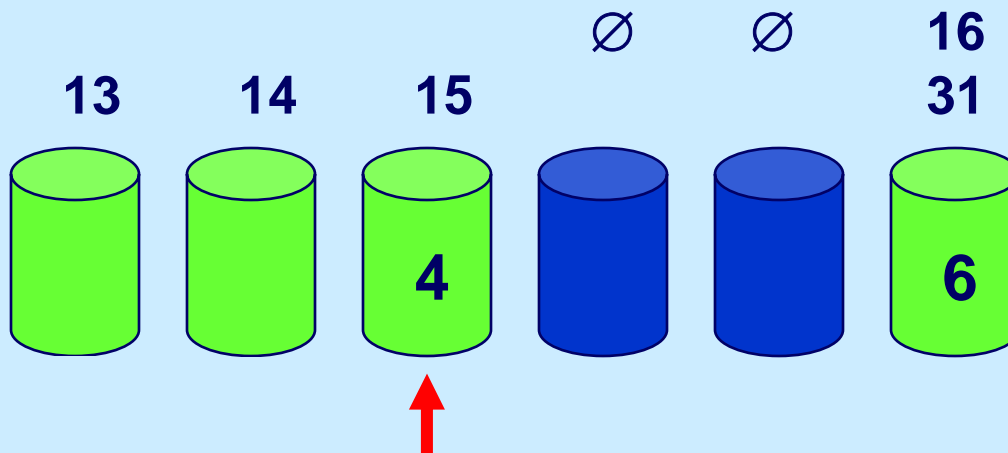
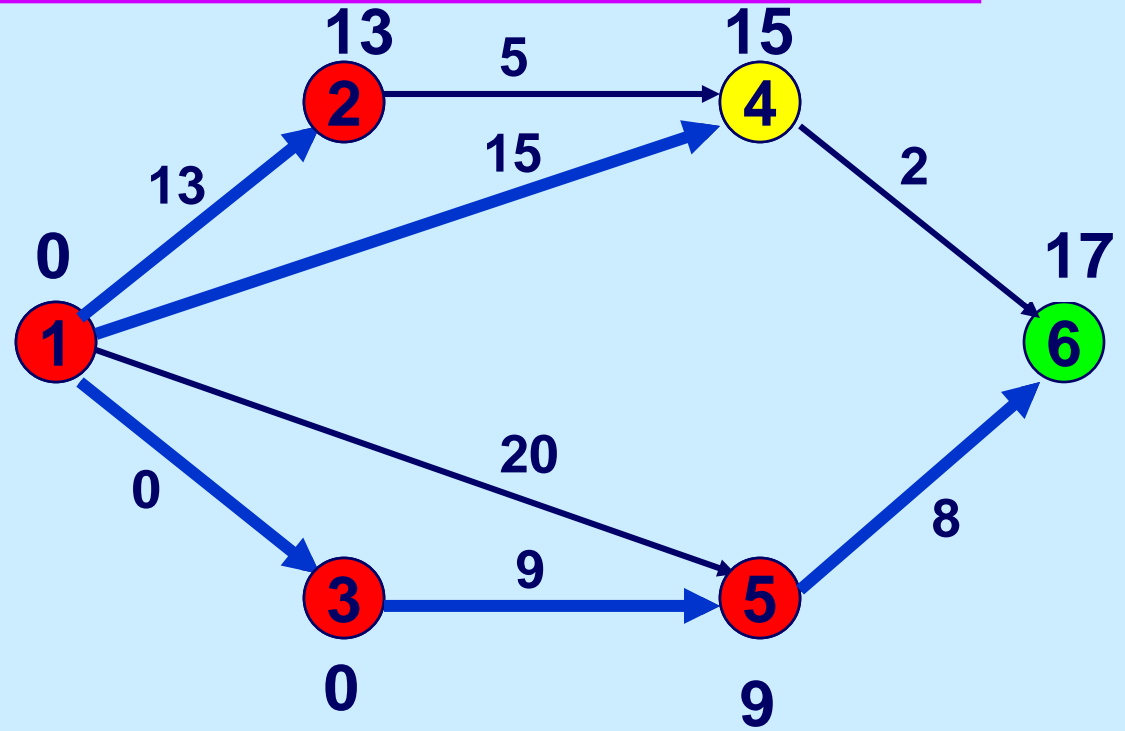
Scan the arc out of node 2.



# Select, Modified rule 1

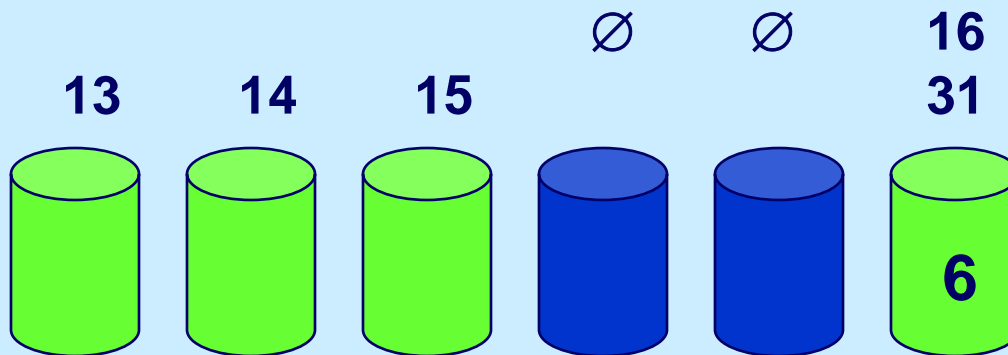
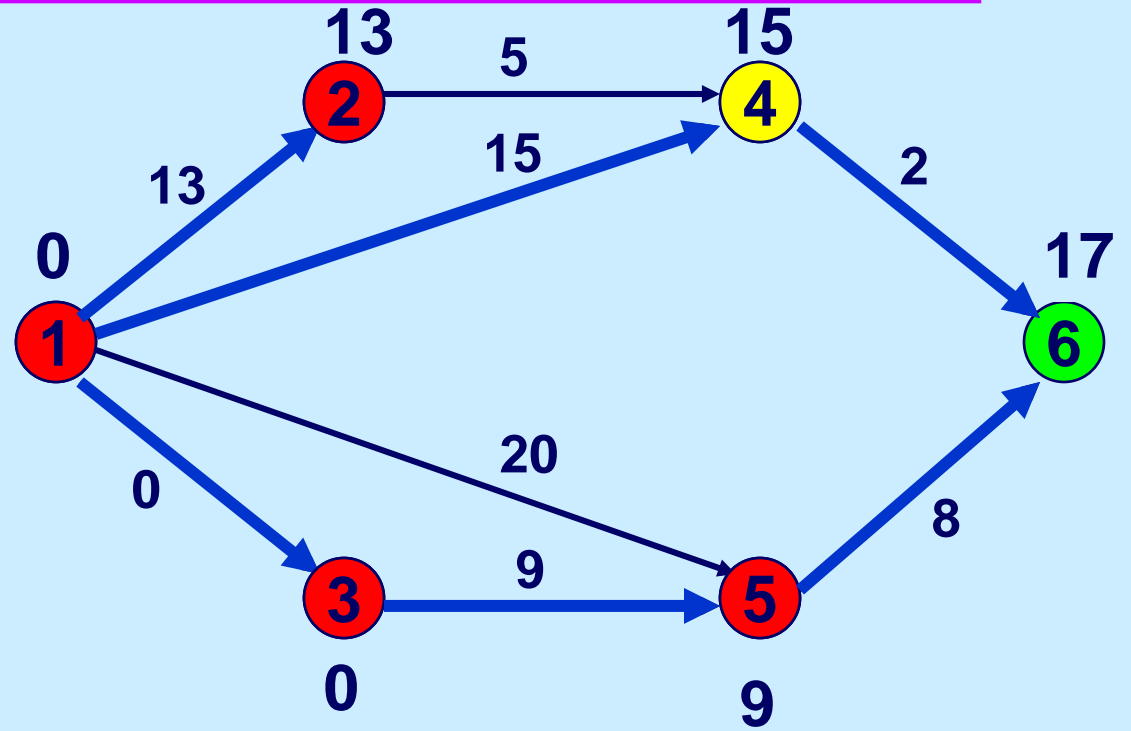
Find the minimum non-empty bucket

If the bucket has a width of 1, select any node in the bucket.



# Update

Scan the arc out of node 4

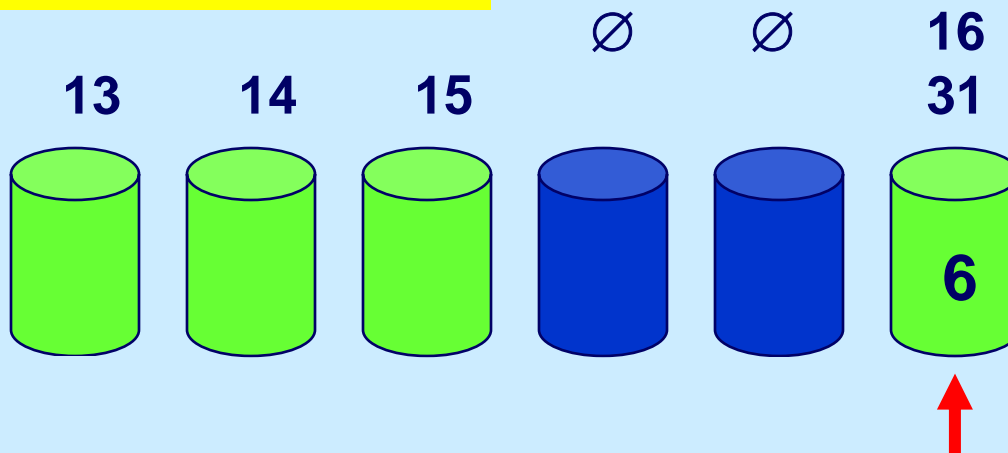
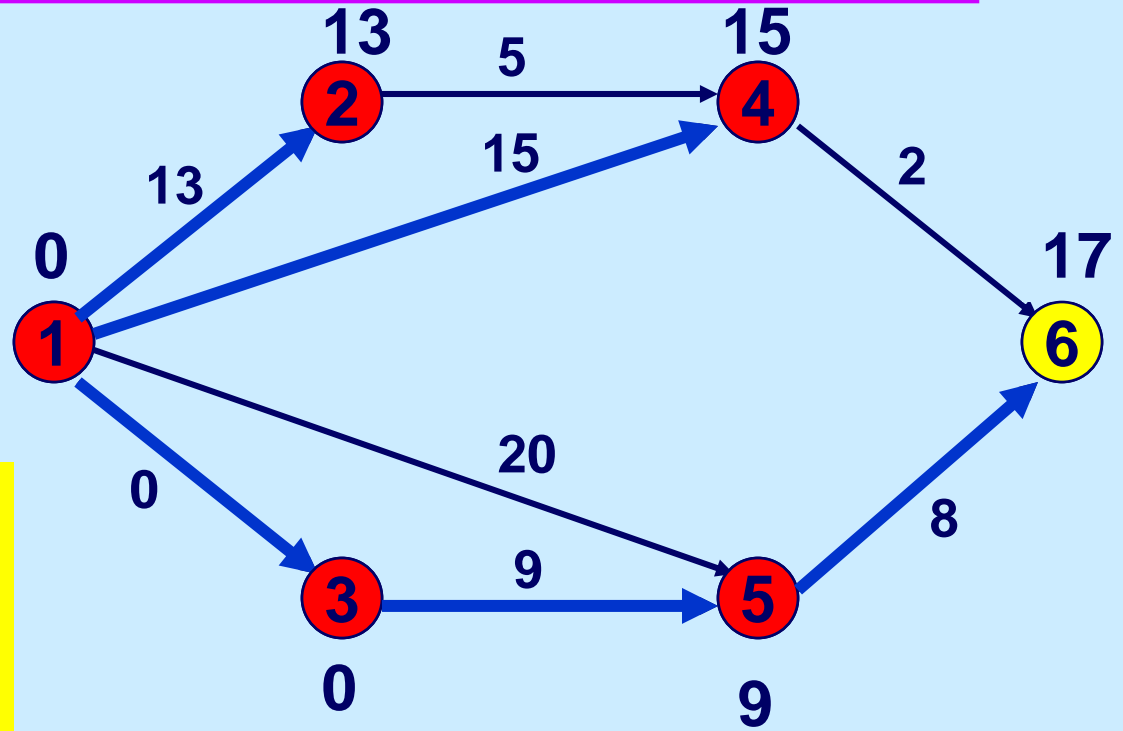


# Select: modified rule 2

Find the minimum non-empty bucket

If the bucket has a single node, then select the node.

Modified rules and heuristics often help in practice, but must be used carefully.



# The algorithm ends

There are no arcs to update.

There are no nodes that need to be permanently labeled.

