Implementation of DBMS
Exercise Sheet 11, Solutions
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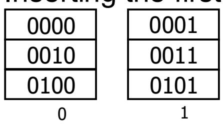
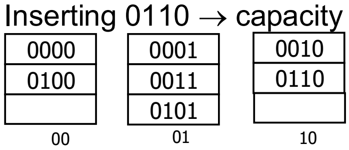
1) Suppose that keys are hashed to four-bit sequences and that blocks can hold three records. If we start with a hash table with two empty blocks (corresponding to 0 and 1), show how the hash table evolves if we insert records with the following hash values:
0000, 0001, ..., 1111, and the method of hashing is linear hashing with a capacity threshold of 100%.
Solution:
We add buckets as follows:

number of buckets	100% capacity	add bucket when the number of records becomes
2	6	7
3	9	10
4	12	13
5	15	16

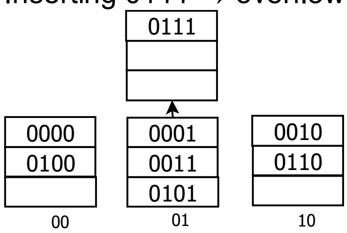
Inserting the first 6 records:



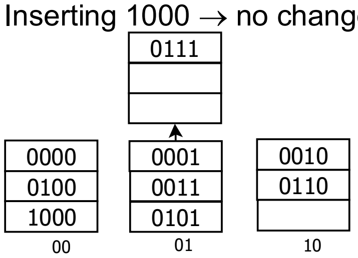
Inserting 0110 → capacity exceeded, new bucket created:



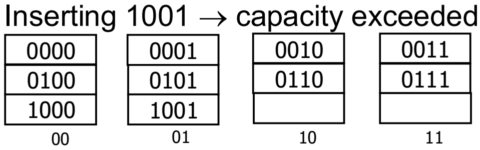
Inserting 0111 → overflow block created:



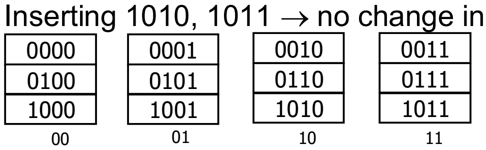
Inserting 1000 → no change in the structure of the table



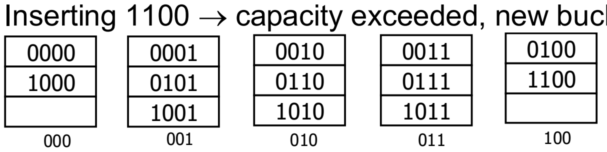
Inserting 1001 → capacity exceeded, new bucket created:



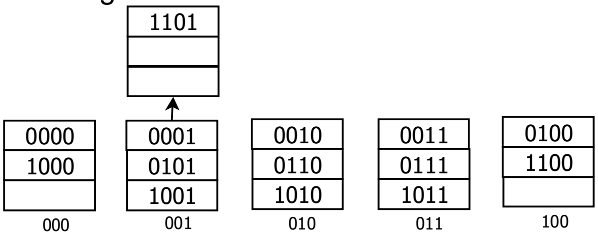
Inserting 1010, 1011 → no change in the structure of the table



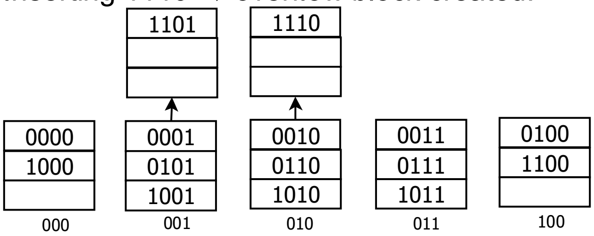
Inserting 1100 → capacity exceeded, new bucket created:



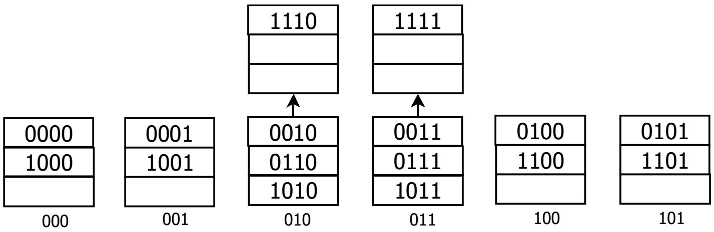
Inserting 1101 → overflow block created:



Inserting 1110 → overflow block created:



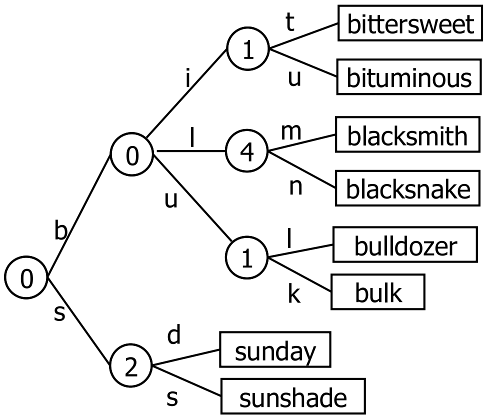
Inserting 1111 → capacity exceeded, new bucket created, one overflow block disappears, another one is created:



2) Consider the following set of strings: {bittersweet, bituminous, blacksmith, blacksnake, bulldozer, bulk, sunday, sunshade} and construct for these strings

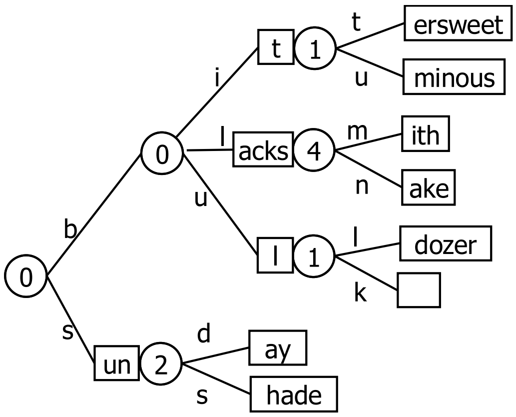
a) a patricia tree

Solution:



b) a prefix tree

Solution:



3) We assume in this task that a projection (like in SQL) does not remove duplicates. Give an example to show that projection cannot be pushed below set (no duplicates!) union. E.g., give relations R and S such that $\pi_A(R \cup S) \neq \pi_A(R) \cup \pi_A(S)$

Solution:

We can use the different handling of duplicates by the two operators to create an example in which the two expressions produce different result relations. Consider:

R:

A	**B**
1	2

S:

A	**B**
1	3

Then we have

$R \cup S$:

A	**B**
1	2
1	3

$\pi_A(R \cup S)$:

A
1
1

On the other hand we get:

$\pi_A(R) \cup \pi_A(S)$:

A
1