X	Y	Z	W
x_1	y_1	z_1	w_1
x_1	y_2	z_1	w_2
x_2	y_2	z_2	w_2
x_2	y_3	z_2	w_3
x_3	y_3	z_2	w_4

Which FDs hold here

- $X \to Z$ ✓
- $X \to Y$ ✗
- $W \to Y$ ✓
- $XY \to Z$ ✓
- $YZ \to X$ ✓

- $X \to Y$
- $X \to W$
- $Y \to X$
- $Y \to Z$ ✗
- $Y \to W$
- $Z \to X$ ✗
- $Z \to Y$
- $Z \to W$
- $W \to X$
- $W \to Z$

✗

book (Acc No, Year, title)

AccNo → Year

A001 → 2010

A001 → 2015

X

one → Many

X

A001 → 2015

A002 → 2015

✓

Many → one ✓

(1) $r(a_1, a_2, a_3)$

Relation r has attributes a1, a2, a3.
a1 is C.K.
how many superkeys are possible?

a_1

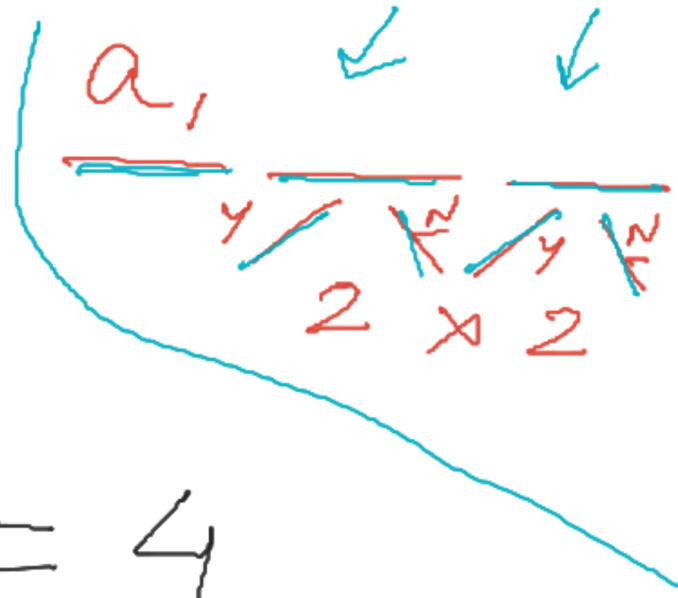
a_1, a_2

a_1, a_3

$a_1, a_2 a_3$

4 S.K.

$\Rightarrow 2^{n-1}$



$\Rightarrow 2^{3-1} = 4$

---

(2) Let $r(a_1, a_2, \ldots, a_n)$, find max^m no. S.K.'s

$\#$ max S.K. $= 2^{n-1}$

C.K. $= \{a_1\}$

(3) $r(a_1, a_2, a_3, a_4, \cdots a_n)$

$C.K. = \{a_1, a_2, a_3\}$

$\#\ \text{map}\ S.K. = 2^{n-3}$

---

(4) $r(a_1, a_2, a_3, \cdots, a_k, a_{k+1}, \cdots a_n)$ $\quad k < n$

$C.K. = \{a_1, a_2, \cdots, a_k\}$

$\#\ \text{map}\ S.K. = 2^{n-k}$

(5) $r(a_1, a_2, a_3, \cdots, a_n)$

C.K. $= \{a_1\}, \{a_2, a_3\}$

S.K. = SK of $\{a_1\}$ + SK for $\{a_2, a_3\}$ — SK of $\{a_1, a_2, a_3\}$

$= 2^{n-1} + 2^{n-2} - 2^{n-3}$

(6) $\gamma \{a_1, a_2, a_3, \cdots, a_n\}$

c.k. → $A_1 = \{ - - - \}$, $A_2 = \{ - - - \}$

$\# S.k. = |A_1 \cup A_2| = |A_1| + |A_2| - |A_1 \cap A_2|$

= Sk with A_1 + Sk with A_2 − Sk with (A_1 and A_2) Common

⑦ $r(a_1, a_2, a_3, \cdots, a_n)$

C.U. $\{a_1, a_2\}$ and $\{a_3, a_4\}$

$$\#\,S.U. = \text{Sufor}\{a_1, a_2\} + \text{Sufor}\{a_3, a_4\} - \text{Su}\{a_1, a_2, a_3, a_4\}$$

$$= 2^{n-2} + 2^{n-2} - 2^{n-4}$$

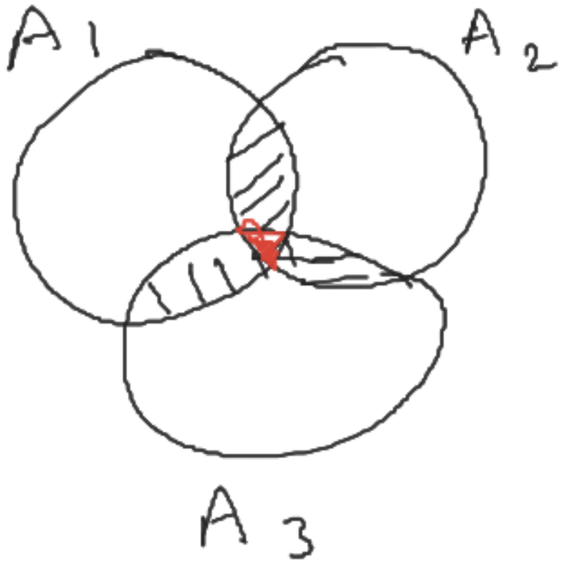
(8) $\gamma(a_1, a_2, \cdots, a_n)$

C.U.: $\underbrace{a_1 a_2}_{A_1}$ and $\underbrace{a_1 a_3}_{A_2}$

$$\# \text{ S.U.} = \text{Su}\{a_1, a_2\} + \text{Su}\{a_1, a_3\} - \text{Su}\{a_1, a_2, a_3\}$$

$$= 2^{n-2} + 2^{n-2} - 2^{n-3}$$

(9)



$$|A_1 \cup A_2 \cup A_3|$$

$$= |A_1| + |A_2| + |A_3|$$

$$- |A_1 \cap A_2| - |A_1 \cap A_3| - |A_2 \cap A_3|$$

$$+ |A_1 \cap A_2 \cap A_3|$$

$$\# \text{ S.L.} = \left(2^{n-1} \times 3\right) - \left(2^{n-2} \times 3\right) + \left(2^{n-3}\right)$$

(10) $r(A, B, C, D, E, F, G, H)$ ⟶ & other Ends

$FDs: \{CH \to G,\ A \to BC,\ B \to CFH,\ E \to A,\ F \to EG\}$

find any S.K.

Sol:

$(AD)^+ = \{A, D, B, C, F, H, G, E\}$

$(ED)^+ = \{E, D, A, B, C, F, G, H\}$

$(BD)^+ = \{B, D, C, F, H, G, E, A\}$

$(FD)^+ = \{F, D, E, G, A, B, C, H\}$

D

⋮

C.K. = { AD, BD, ED, FD }

A_1 A_2 A_3 A_4

8 edges

$$\#\text{S.K.} = |A_1 \cup A_2 \cup A_3 \cup A_4| = (A_1 + A_2 + A_3 + A_4) -$$

$$\rightarrow (A_1 \cap A_2 + A_1 \cap A_3 + A_1 \cap A_4 + A_2 \cap A_3 + A_2 \cap A_4 + A_3 A_4) +$$

$$(A_1 \cap A_2 \cap A_3 + A_1 \cap A_2 \cap A_4 + A_1 \cap A_3 \cap A_4 + A_2 \cap A_3 A_4) -$$

$$(A_1 \cap A_2 \cap A_3 \cap A_4)$$

$$= 4 \times 2^{8-2} - 6 \times 2^{8-3} + 4 \times 2^{8-4} - 2^{8-5} \leftarrow \{A, B, E, F, D\}$$

$$= 120$$

```
select * from customers order by country;
==============================

select city from Customers union select city from Suppliers;
==============================

SELECT count(CustomerID), country FROM Customers
group by country
having count(CustomerID)>3 ;
==============================

SELECT count(CustomerID), country FROM Customers
group by country
having count(CustomerID)>3
order by count(CustomerID) desc ;
```

https://www.w3schools.com/sql/sql_groupby.asp
https://www.w3schools.com/sql/

```
SELECT count(CustomerID), country FROM Customers
group by country
having count(CustomerID)>3 and count(CustomerID)<10;
```

```
SELECT count(CustomerID), country FROM Customers
where country="Brazil" or country="UK"
group by country
having count(CustomerID)>3 and count(CustomerID)<10;
```