

Conception Avancée de Bases de Données



Traduction en cours

Opérateurs
Relationnels

Et Arbres de requêtes

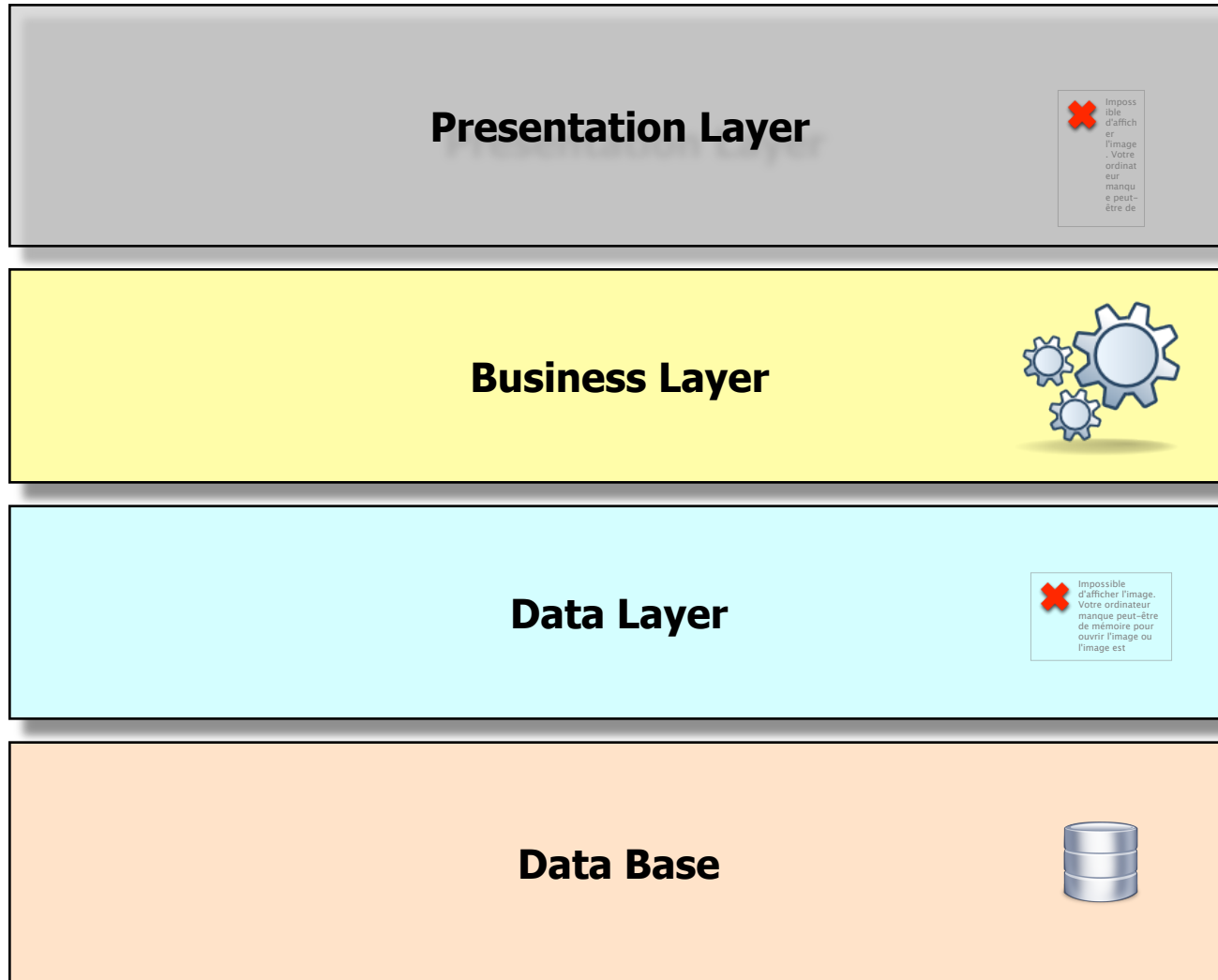


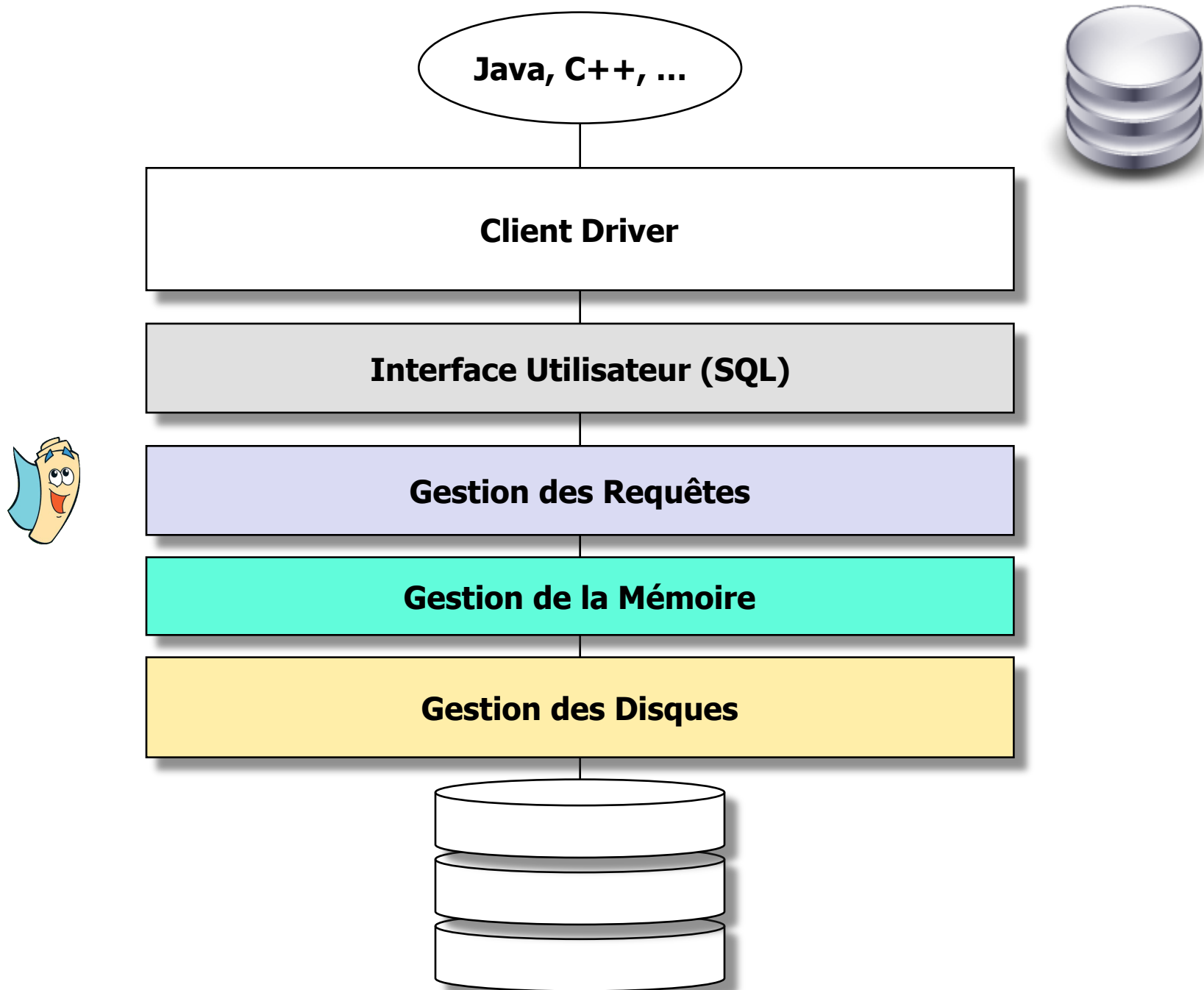
Π

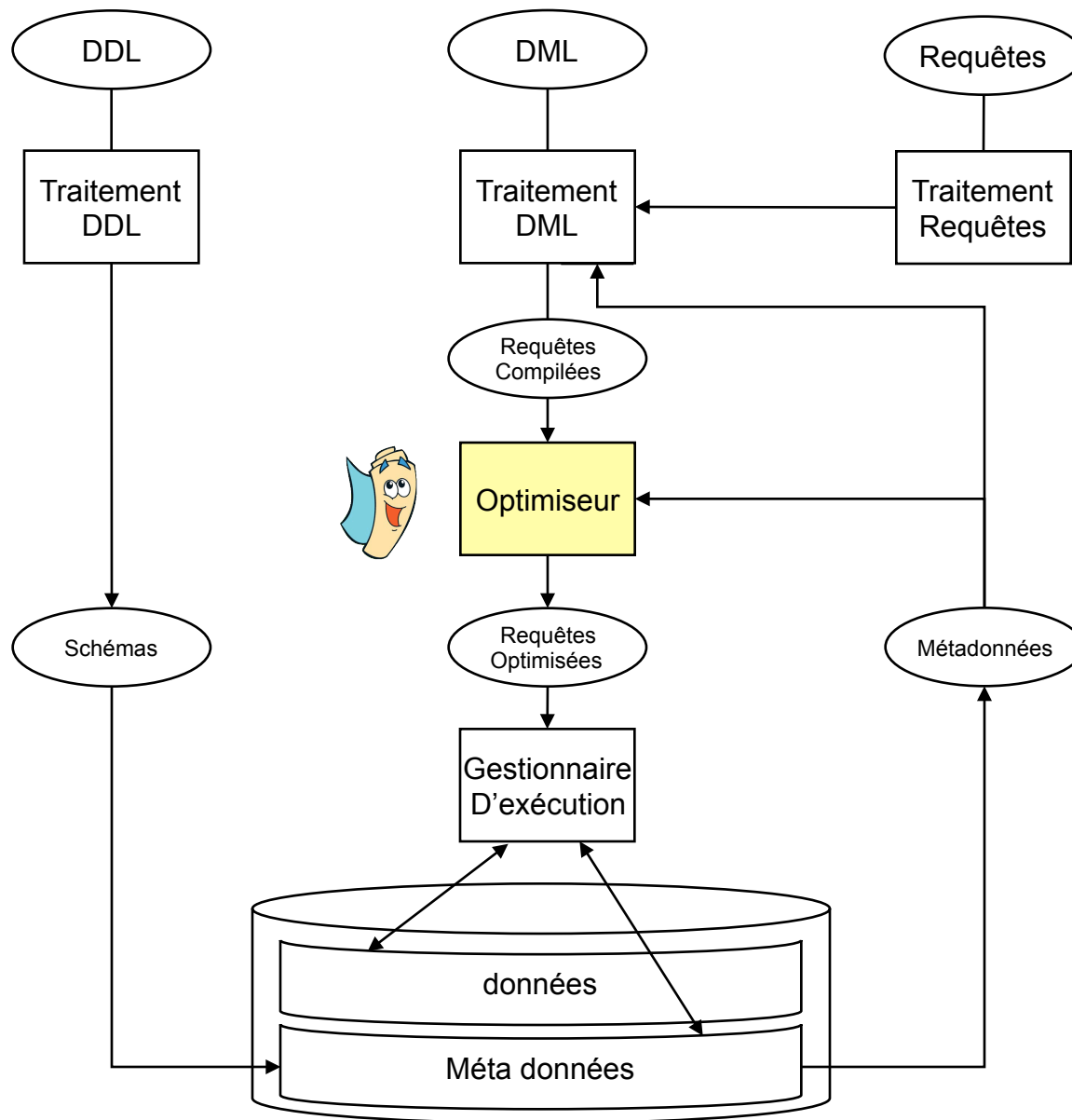
σ

Sigma minuscule

Layered Architecture



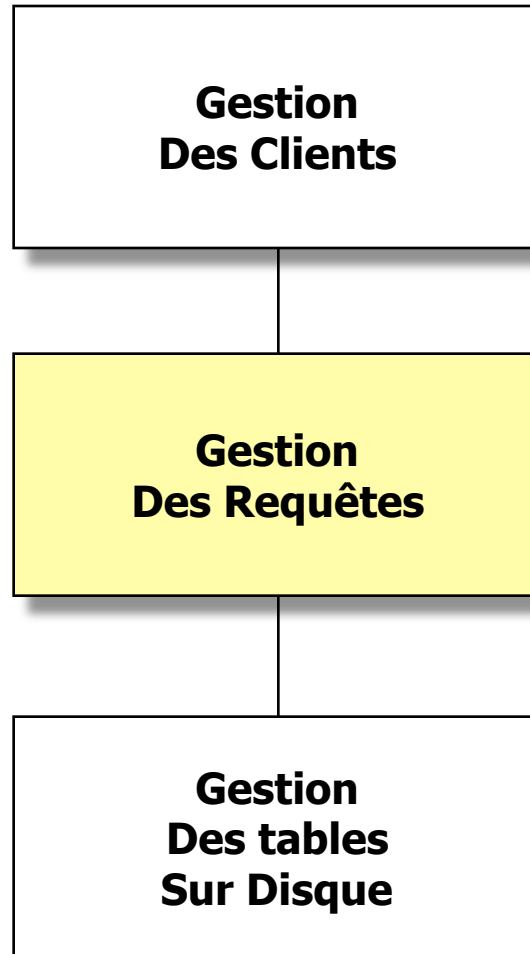




D'après C.J DATE

DDL : langage de définition des données; DML : langage de manipulation des données

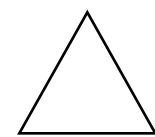
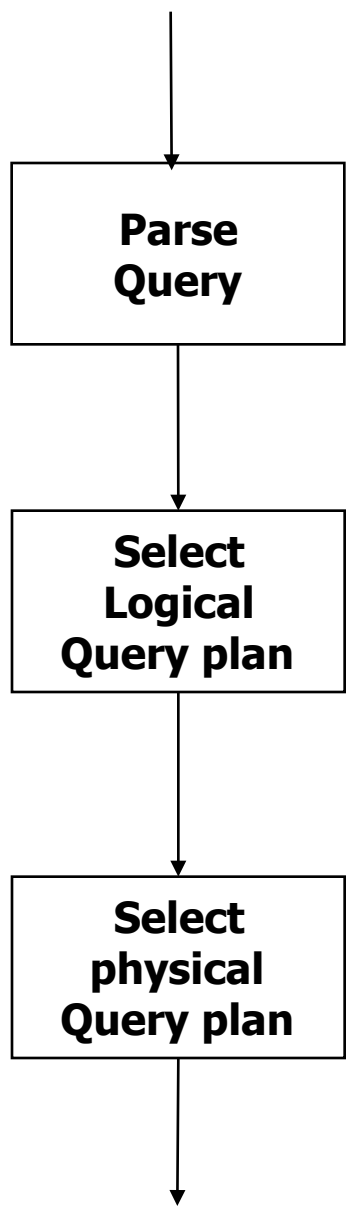
Big Picture



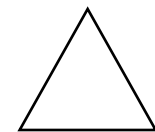
From Ullman



**Query
Optimization**



**Query expression
tree**

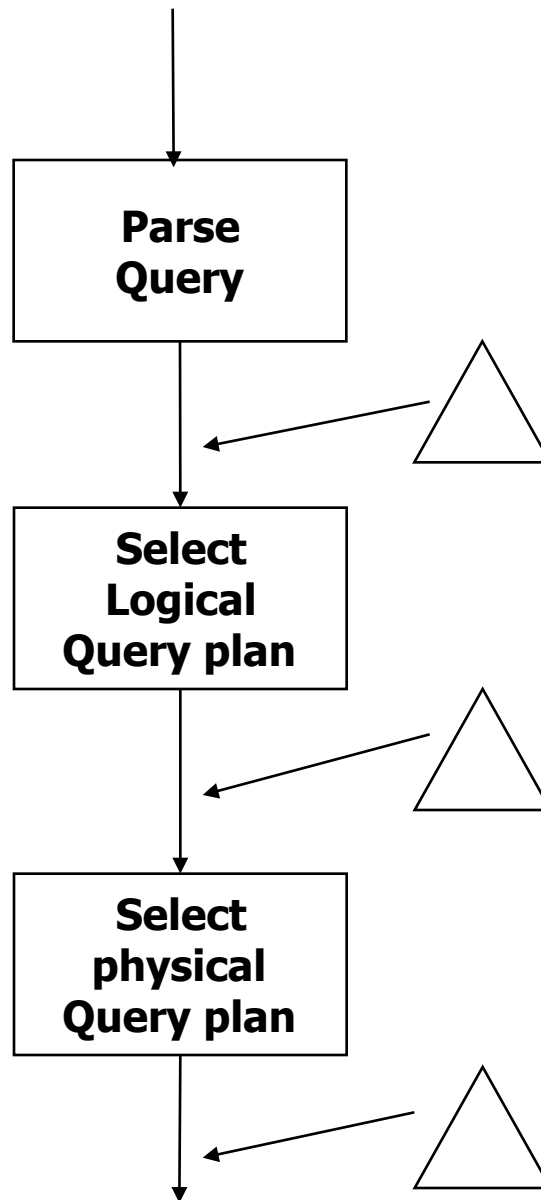
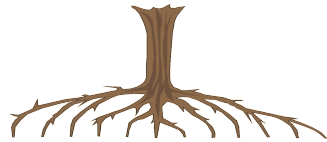
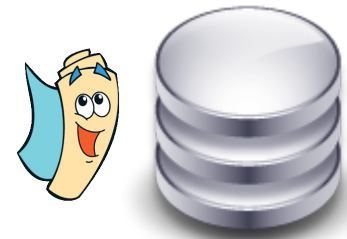


**Logical Query
Plan tree**



**Physical Query
Plan tree**

From Ullman



**Query expression
tree**

**Logical Query
Plan tree**

**Physical Query
Plan tree**

Arbre de requêtes



Cats

name	owner
Fluffy	Harold
Claws	Gwen

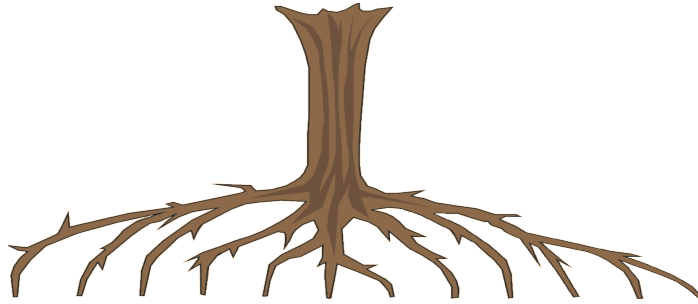
Dogs

name	owner
Buffy	Harold
Fang	Benny
Bowser	Diane

Quels sont les chats et les chiens qui appartiennent à Harold ?



**Arbre
Logique**



**Arbre
Physique**

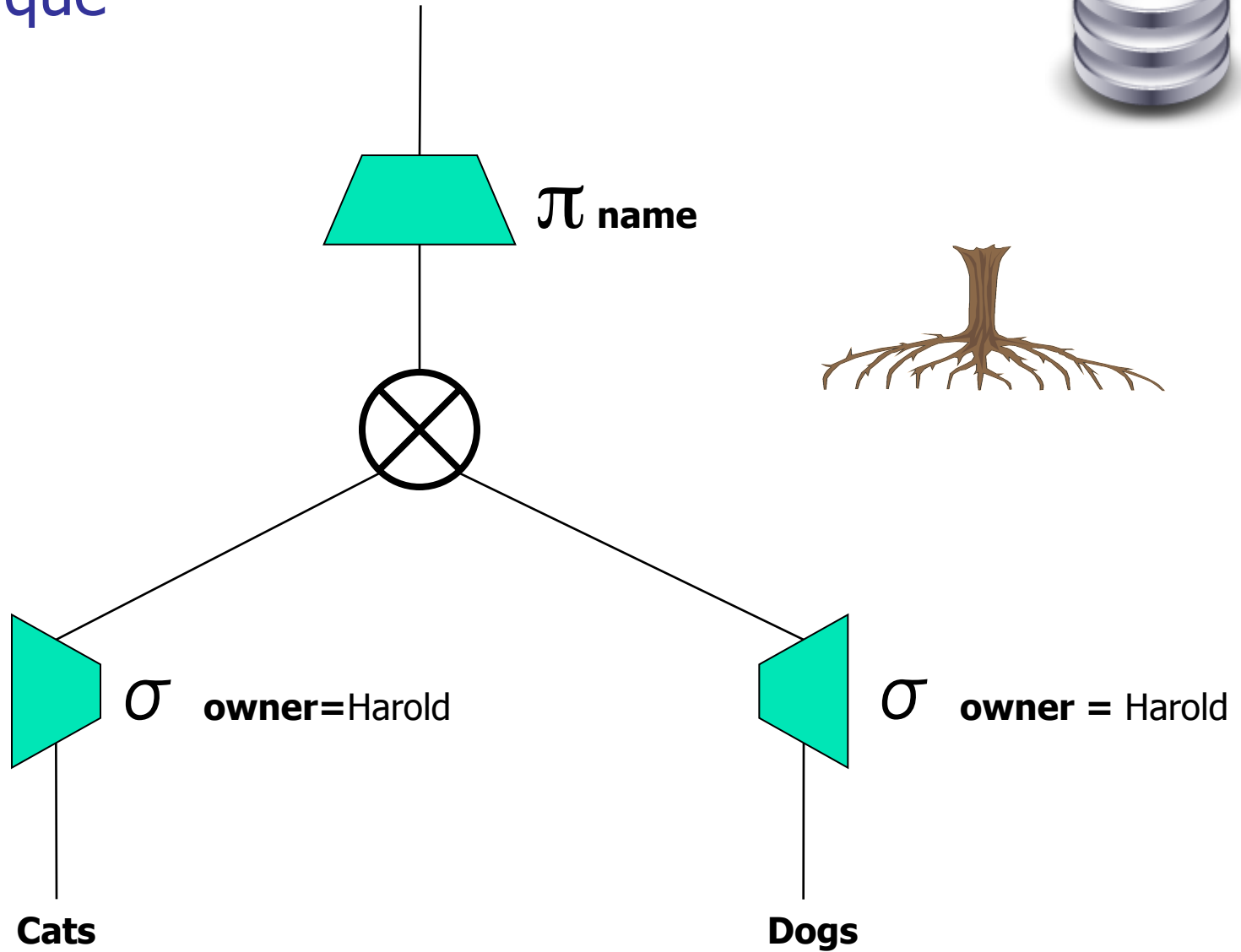


SQL

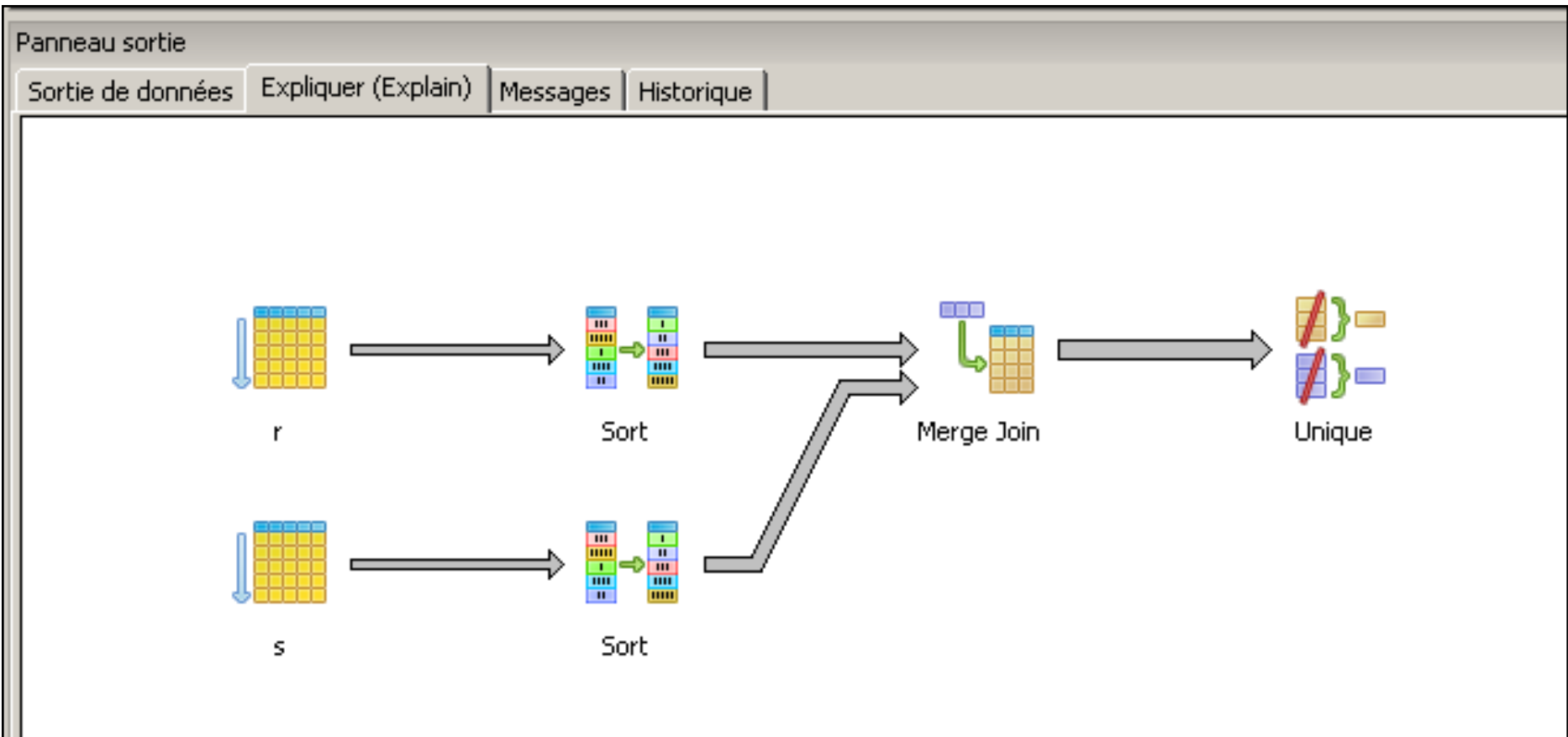
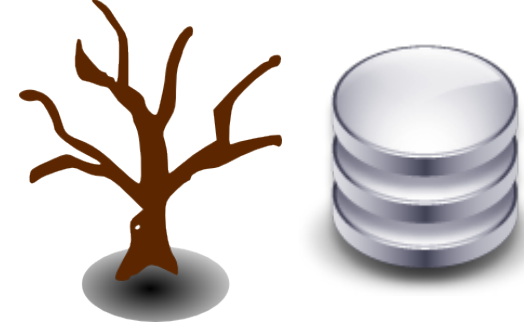


```
SELECT cats.name  
FROM cats, dogs  
WHERE cats.owner = 'Harold' and dogs.owner = 'Harold';
```

Arbre Lpgique



Explain plan : Arbre Physique



Niveaux d'abstraction



Modèle

...
...
...
...
...
...
...



Algèbre

$$\sigma_{\text{owner1}=\text{owner2}} (\text{Cats} \otimes \text{Dogs}) = \text{Cat} \bowtie \text{Dogs}$$

Logiciel



Java, C++, ..

Opérateurs

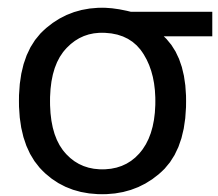
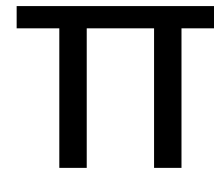
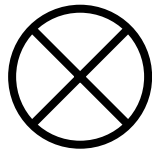


- ① SELECT $\rightarrow \sigma$ (sigma)
- ② PROJECT $\rightarrow \pi$ (pi)
- ③ PRODUCT $\rightarrow \times$ (times)
- ④ JOIN $\rightarrow (|\times|) \bowtie$ (bow-tie)
- ⑤ UNION $\rightarrow \cup$ (cup)
- ⑥ INTERSECTION $\rightarrow \cap$ (cap)
- ⑦ DIFFERENCE $\rightarrow -$ (minus)
- ⑧ RENAME $\rightarrow \rho$ (rho)

Opérateurs pour la jointure



- Produit Cartésien
- Sélection
- Projection



Sigma minuscule

Produit Cartésien



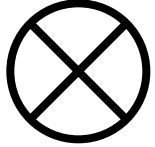
Rappel :

Si $E = \{a,b,c\}$ et $F = \{1,2\}$

$E \times F = \{(a,1),(a,2),(b,1),(b,2),(c,1),(c,2)\}$.

$E \times F$	a	b	c
1	(a,1)	(b,1)	(c,1)
2	(a,2)	(b,2)	(c,2)

Produit Cartésien



R

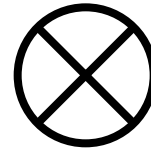
A	B	C
9	3	9
5	6	1
2	8	1

S

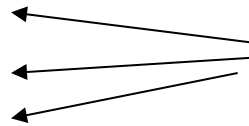
D	E	F
1	2	9
5	7	3
9	1	2

R  **S**

Produit Cartésien

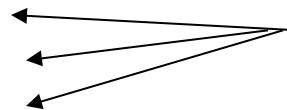


A	B	C
9	3	9
5	6	1
2	8	1



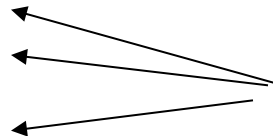
1	2	9
---	---	---

A	B	C
9	3	9
5	6	1
2	8	1



5	7	3
---	---	---

A	B	C
9	3	9
5	6	1
2	8	1



9	1	2
---	---	---

R

S

Produit Cartésien



A	B	C	D	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9

A	B	C	D	E	F
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3

R  S

A	B	C	D	E	F
9	3	9	9	1	2
5	6	1	9	1	2
2	8	1	9	1	2

Produit Cartésien



R

S

A	B	C
9	3	9
5	6	1
2	8	1

D	E	F
1	2	9
5	7	3
9	1	2



A	B	C	D	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9

R  **S**

Produit Cartésien

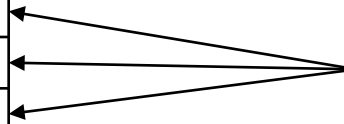


R

S

A	B	C
9	3	9
5	6	1
2	8	1

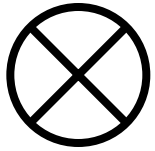
D	E	F
1	2	9
5	7	3
9	1	2



R  **S**

A	B	C	D	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3

Produit Cartésien

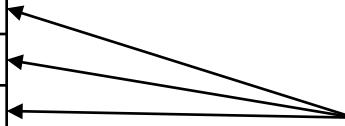


R

S

A	B	C
9	3	9
5	6	1
2	8	1

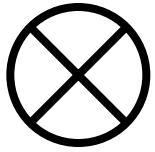
D	E	F
1	2	9
5	7	3
9	1	2



R  **S**

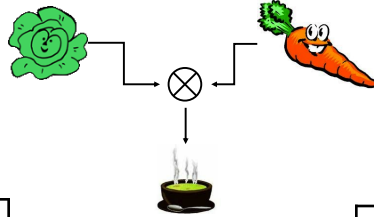
A	B	C	D	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3
9	3	9	9	1	2
5	6	1	9	1	2
2	8	1	9	1	2

Produit Cartésien



R

A	B	C
9	3	9
5	6	1
2	8	1



S

D	E	F
1	2	9
5	7	3
9	1	2

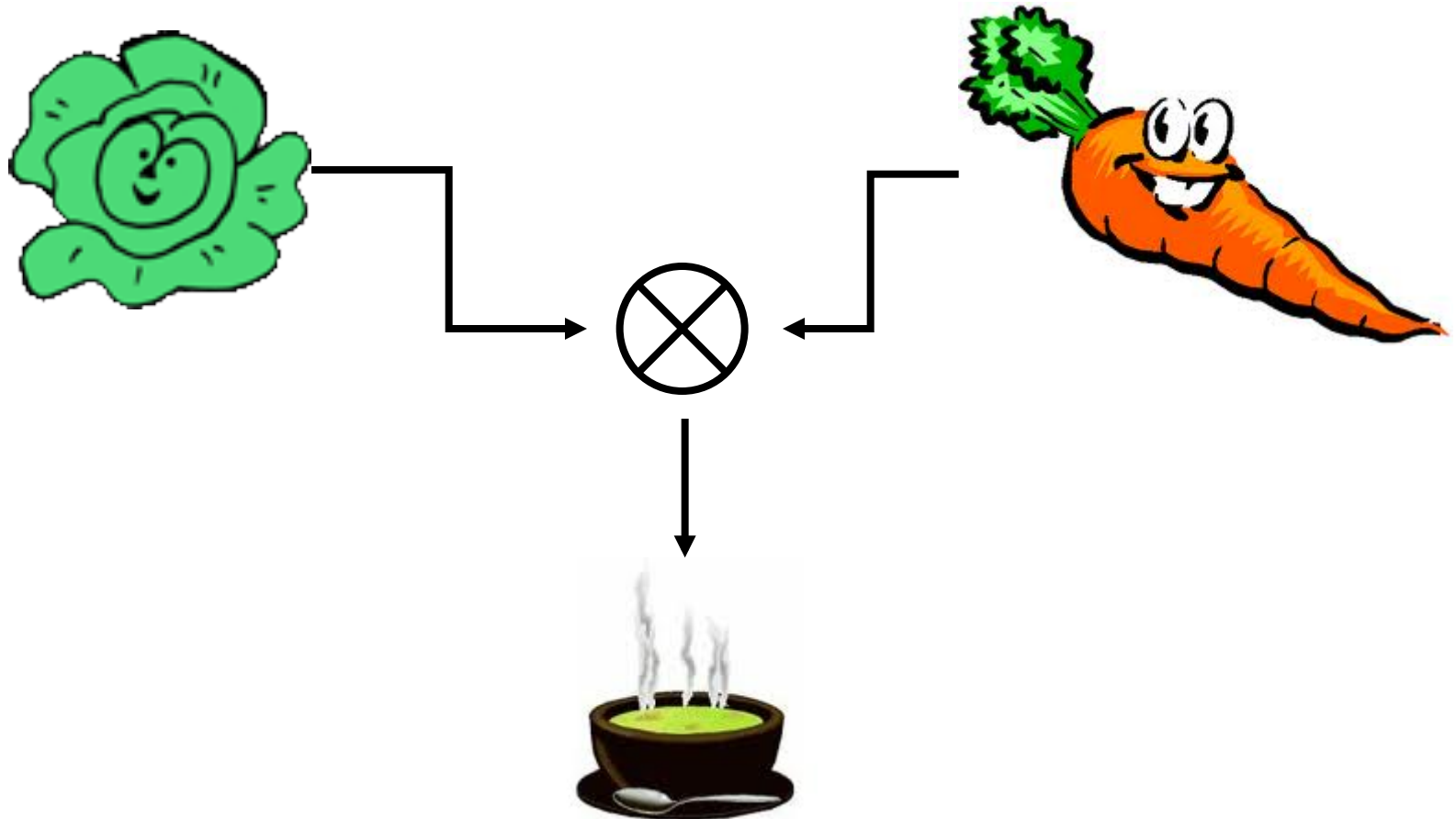
R  **S**

A	B	C	D	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3
9	3	9	9	1	2
5	6	1	9	1	2
2	8	1	9	1	2

Pas de sémantique



- On mélange les choux et les carottes



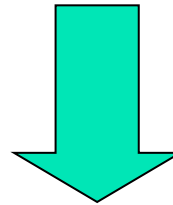
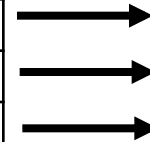
Sélection : On enlève des lignes



σ

Sigma

A	B	C	D	E
2	8	9	1	2
2	8	9	3	9
2	9	3	9	2
9	2	8	9	2
2	8	9	3	9
2	9	3	9	2



A	B	C	D	E
2	8	9	1	2
2	8	9	3	9
2	9	3	9	2

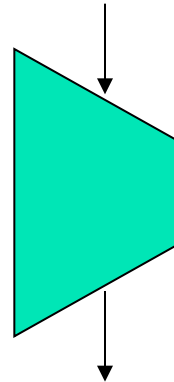
Symbole : On enlève des lignes



σ

Sigma

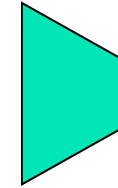
A	B	C	D	E
2	8	9	1	2
2	8	9	3	9
2	9	3	9	2
9	2	8	9	2
2	8	9	3	9
2	9	3	9	2



A	B	C	D	E
2	8	9	1	2
2	8	9	3	9
2	9	3	9	2

Pets

name	owner	species	sex	age
Fluffy	Harold	cat	f	9,00
Claws	Gwen	cat	m	12,00
Buffy	Harold	dog	f	2,00
Fang	Benny	dog	m	3,00
Bowser	Diane	dog	m	17,00
Chirpy	Gwen	bird	f	3,00
Whistler	Gwen	bird	m	9,00
Slim	Benny	snake	m	2,00



Sélection sur une constante

$\sigma_{\text{sex} = \text{f}}(\text{Pets})$

name	owner	species	sex	age
Fluffy	Harold	cat	f	9,00
Buffy	Harold	dog	f	2,00
Chirpy	Gwen	bird	f	3,00

notation



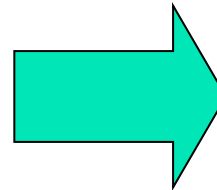
σ <predicate> (<relation>)

Projection : On enlève des colonnes



Π

A	B	C	D	E
2	8	9	1	2
2	8	9	3	9
2	9	3	9	2
9	2	8	9	2
2	8	9	3	9
2	9	3	9	2



A	C	E
2	9	2
2	9	9
2	3	2
9	8	2
2	9	9
2	3	2



Symbole : On enlève des colonnes



A	B	C	D	E
2	8	9	1	2
2	8	9	3	9
2	9	3	9	2
9	2	8	9	2
2	8	9	3	9
2	9	3	9	2

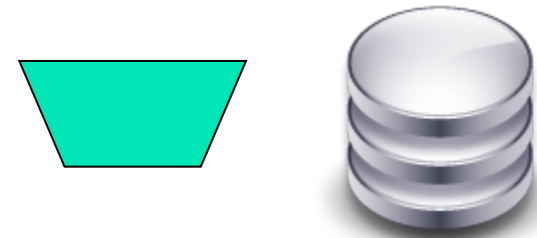


A	C	E
2	9	2
2	9	9
2	3	2
9	8	2
2	9	9
2	3	2

π

Pets

name	owner	species	sex	age
Fluffy	Harold	cat	f	9,00
Claws	Gwen	cat	m	12,00
Buffy	Harold	dog	f	2,00
Fang	Benny	dog	m	3,00
Bowser	Diane	dog	m	17,00
Chirpy	Gwen	bird	f	3,00
Whistler	Gwen	bird	m	9,00
Slim	Benny	snake	m	2,00



π name,owner (Pets)

Liste des animaux et du nom de leur propriétaire

name	owner
Buffy	Harold
Chirpy	Gwen
Fluffy	Harold
Slim	Benny
Fang	Benny
Whistler	Gwen
Claws	Gwen
Bowser	Diane

notation



π

$\pi \langle \text{attribute1}, \text{attribute2}, \text{attribute } n \rangle (\langle \text{relation} \rangle)$

Décomposition

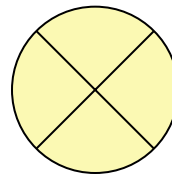


■ Jointure =

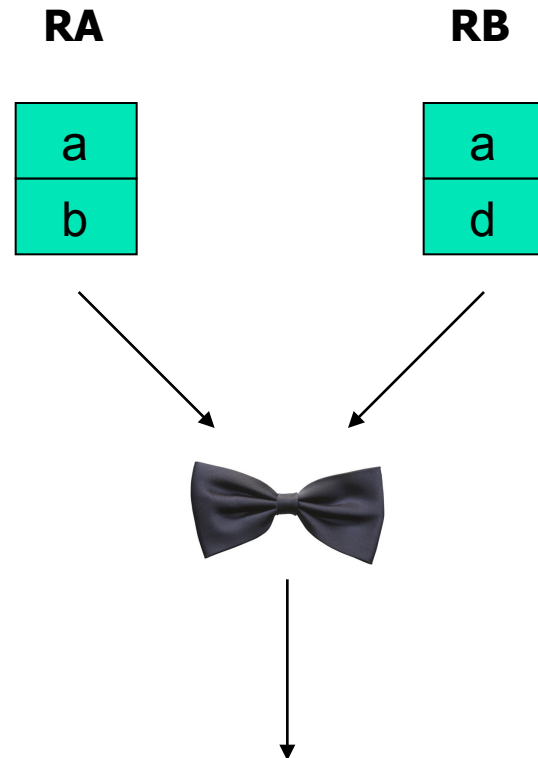
■ produit cartésien puis
selection



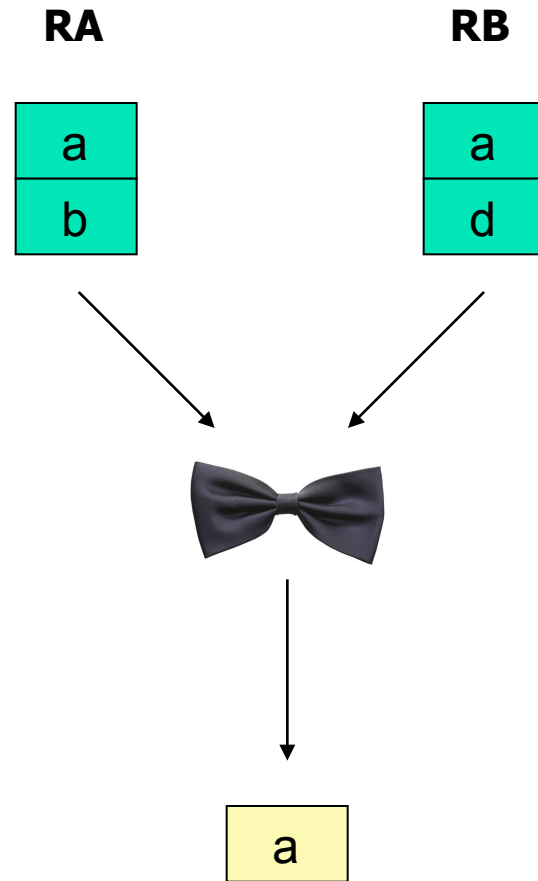
Sigma



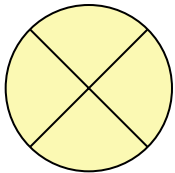
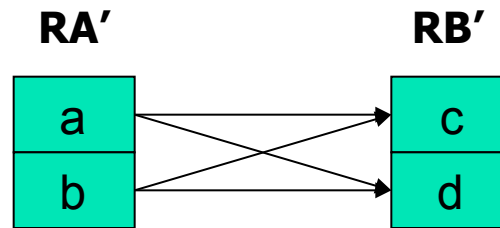
Jointure



Jointure

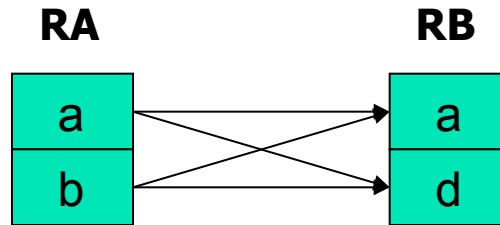


Produit Cartésien



ra	rb
a	c
a	d
b	c
b	d

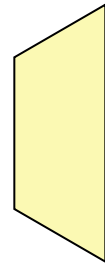
Sélection



ra	rb
a	a
a	d
b	a
b	d

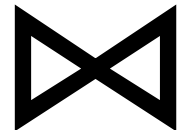
σ

Sigma



ra = rb

a	a
---	---



Autre cas



2 relations

RA

A	B	C
9	3	9
5	6	1
2	8	1

RB

C	D	E
1	2	9
5	7	3
9	1	2

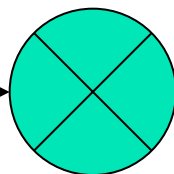


RA

A	B	C
9	3	9
5	6	1
2	8	1

RB

C	D	E
1	2	9
5	7	3
9	1	2



Produit Cartésien

A	B	C	C	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3
9	3	9	9	1	2
5	6	1	9	1	2
2	8	1	9	1	2

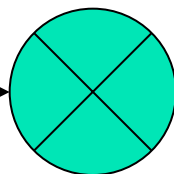


RA

A	B	C
9	3	9
5	6	1
2	8	1

RB

C	D	E
1	2	9
5	7	3
9	1	2



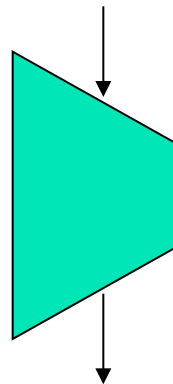
Produit Cartésien

A	B	C	C	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3
9	3	9	9	1	2
5	6	1	9	1	2
2	8	1	9	1	2

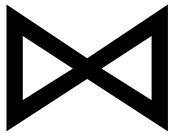
Sélection



A	B	C	C	E	F
9	3	9	1	2	9
5	6	1	1	2	9
2	8	1	1	2	9
9	3	9	5	7	3
5	6	1	5	7	3
2	8	1	5	7	3
9	3	9	9	1	2
5	6	1	9	1	2
2	8	1	9	1	2



σ Sigma



A	B	C	E	F
5	6	1	2	9
2	8	1	2	9
9	3	9	1	2



