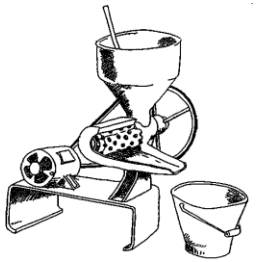
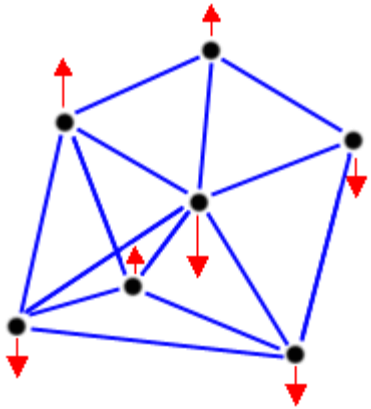
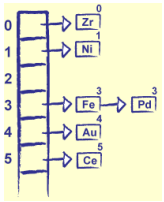


Conception Avancée de Bases de Données



Hash Join



Traduction en cours

Table R and S

$$RS = R \bowtie S$$

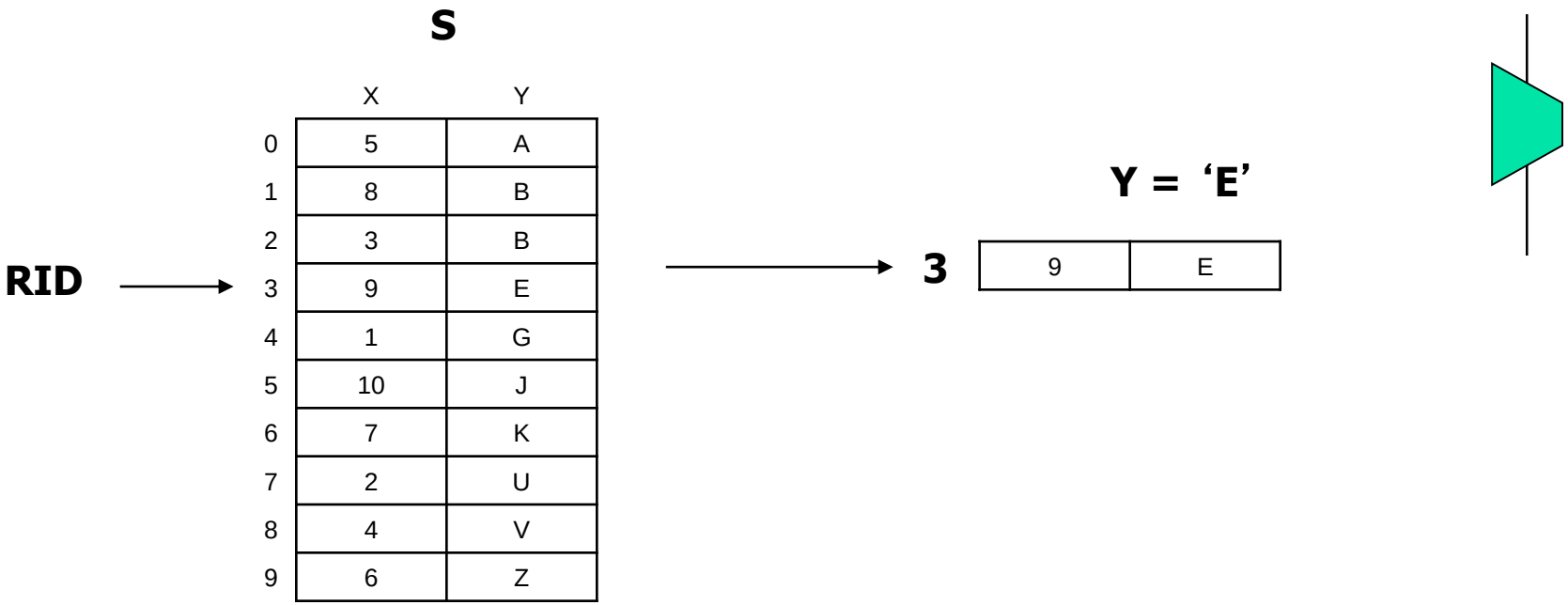
R

Y	Z
Z	20
B	22
E	28
K	24
M	25
N	30
U	27
L	23
V	21
X	26

S

X	Y
5	A
8	B
3	B
9	E
1	G
10	J
7	K
2	U
4	V
6	Z

Raw Identifier (RID)



Sequential Scan select : Y = 'E'

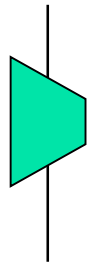
- Seek for Y attribute value "E"

S

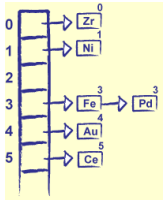
X	Y
5	A
8	B
3	B
9	E
1	G
10	J
7	K
2	U
4	V
6	Z

Y = 'E'

9	E



Seq Scan select : Y = ’E’



Seq Scan :

While i in index range

if Y = ‘E’ then OutPut = S(i)

End while

S

RID →

loop

RID →

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

1

RID

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

Z ?= A

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

RID

RID

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

RID

1

Z ?= B

RID

RID

RID

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

1

RID

RID

RID

RID

Z ?= B

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

RID

1

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

RID

Z ?= E

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

RID

1

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

Z ?= G

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

RID

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

RID

1

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

RID

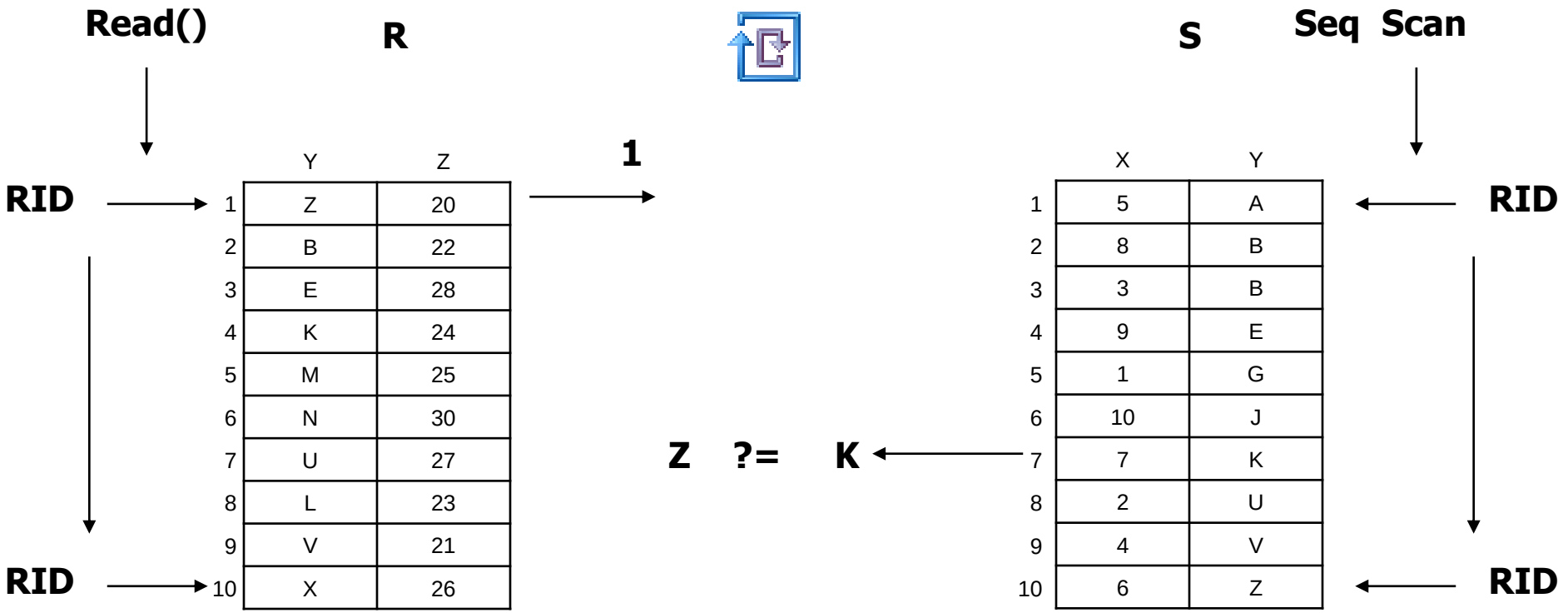
Z ?= J

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

Nested Loop with Seq Scan



Nested Loop with Seq Scan

Read()

R

S

Seq Scan

RID

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

1

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

RID

RID

Z ?= U

Nested Loop with Seq Scan

Read()

R

S

Seq Scan

RID

RID

RID

RID

1

Z ?= V

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

Nested Loop with Seq Scan

Read(i)

R

S

Seq Scan

1

RID

RID

RID

RID

Z ?= Z

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

Nested Loop with Seq Scan

Read(i)

R

S

Seq Scan

RID

1

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

RID

RID

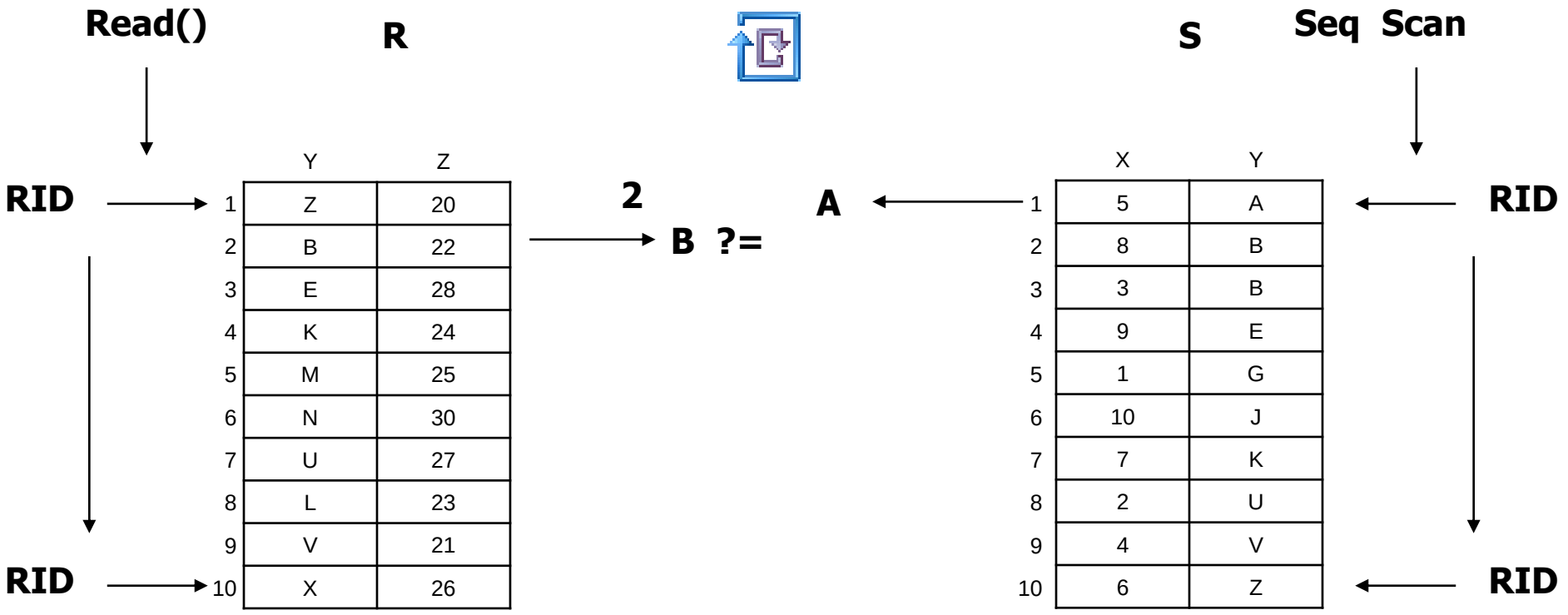
	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

10

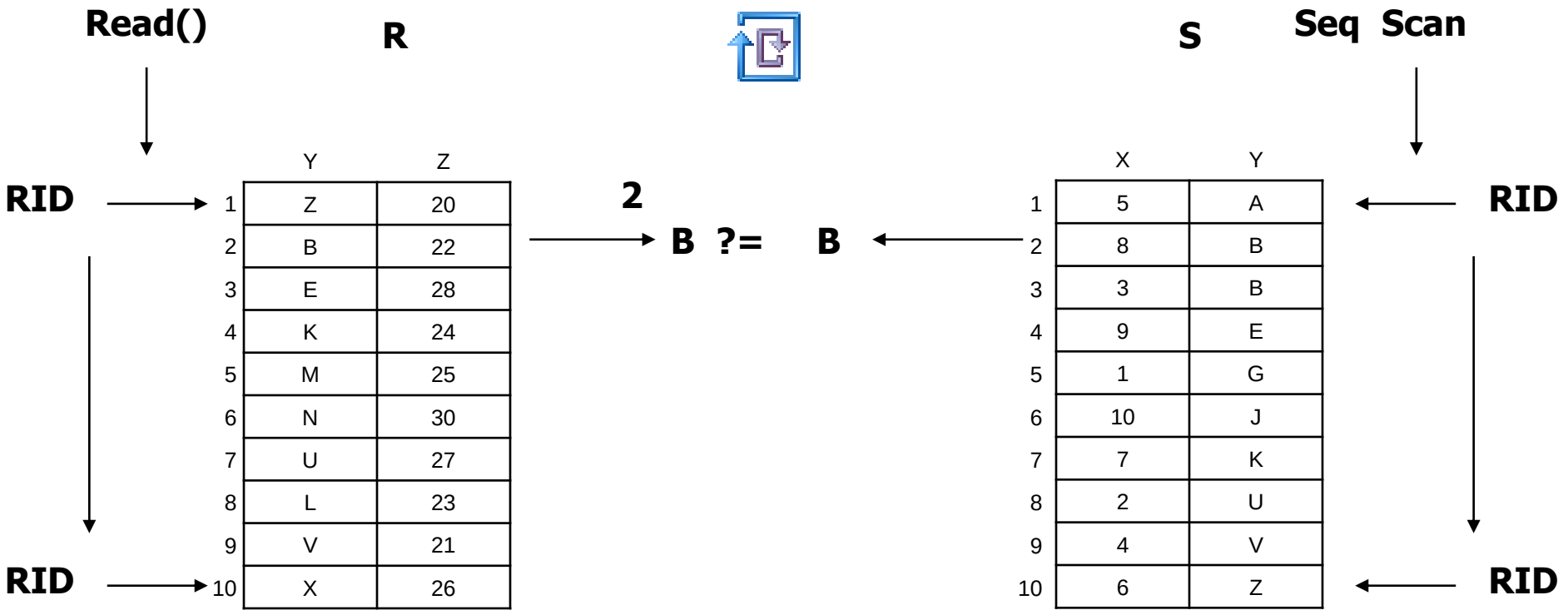
RID

OutPut (S.Read(10) + S.Read(10))

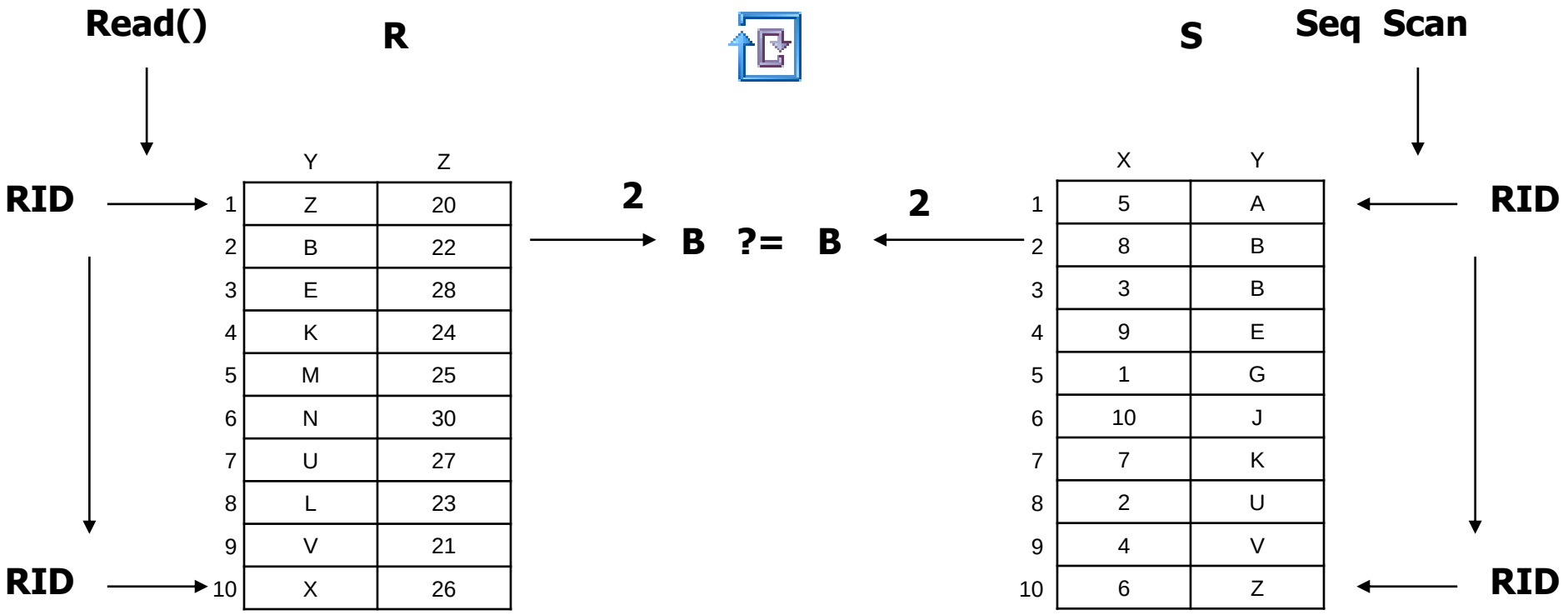
Nested Loop with Seq Scan



Nested Loop with Seq Scan



Nested Loop with Seq Scan



OutPut (S.Read(2) + S.Read(2))

Tuple physical access : RID

Raw Identifier (RID)

R

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

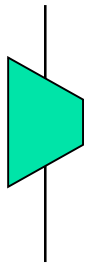
RID →

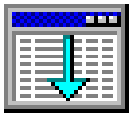
→ **3**

Y = ‘E’

9	E

R (3)





Hash table access

Hash

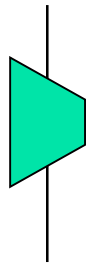
R

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Y = ‘E’

3

9	E



Hash(E)

Hash Join Principle : Hash Key, Hash Value

Relation R

hash keys = Attribut Y

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

hash values = RID

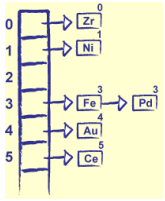
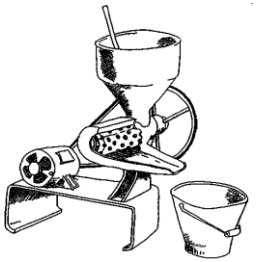
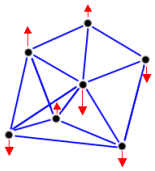


Tableau associatif





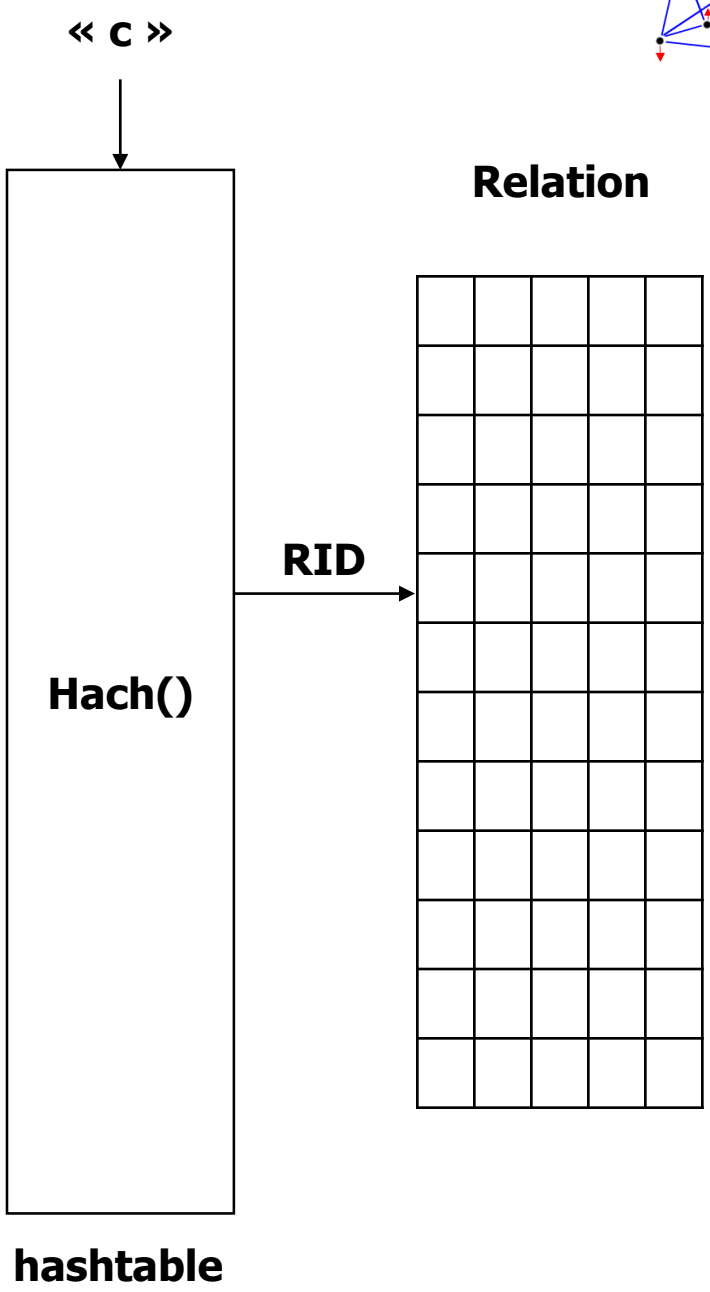


Tableau associatif

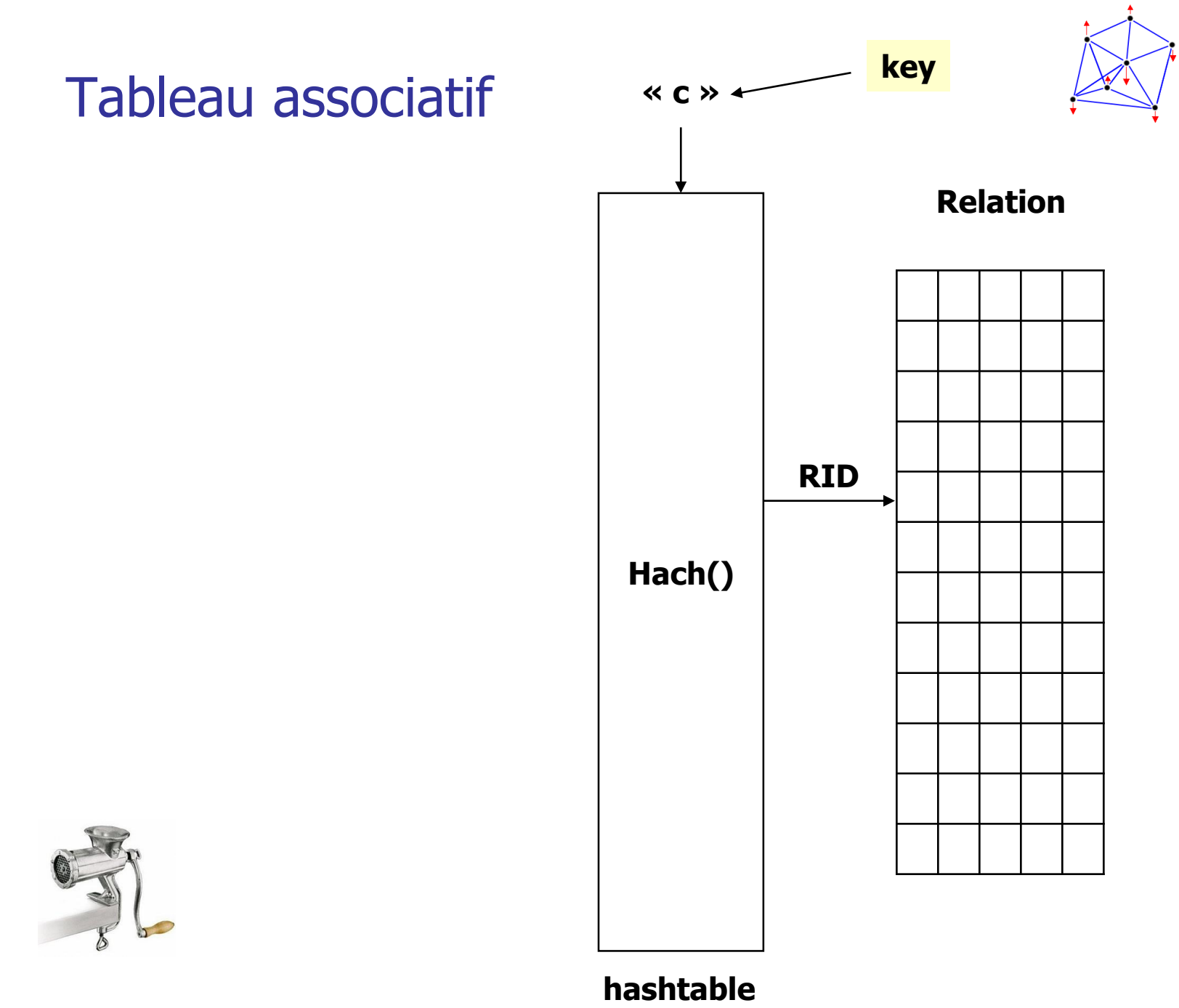


Tableau associatif

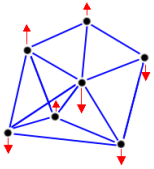
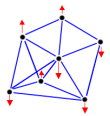


Tableau associatif



« E »

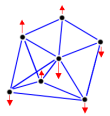
Hach()

3

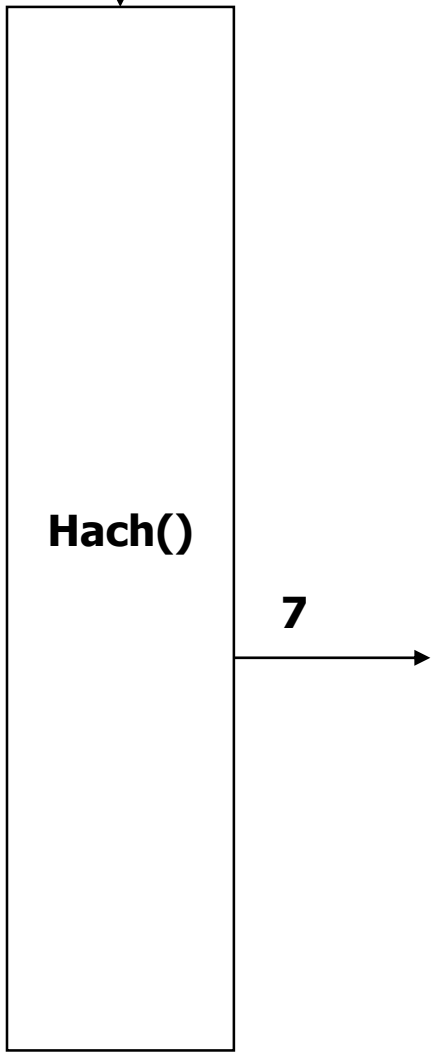
hashtable

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Tableau associatif



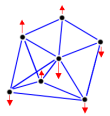
« U »



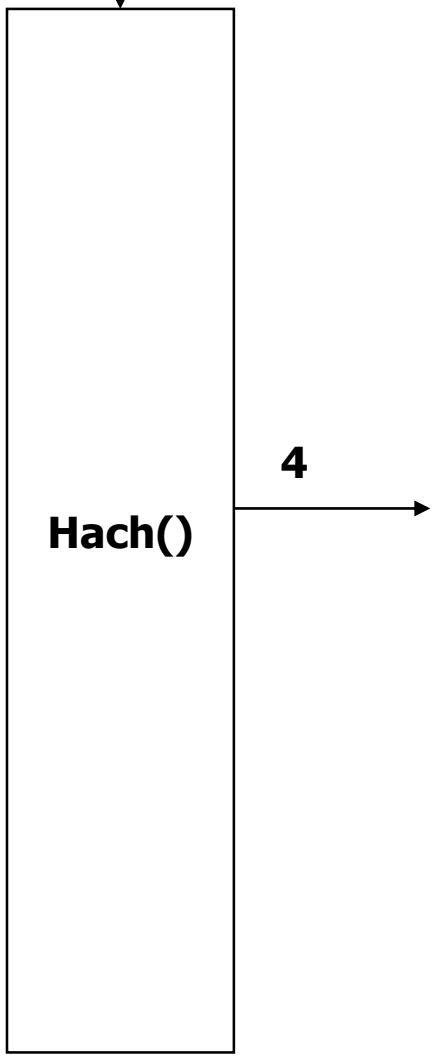
hashtable

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Tableau associatif

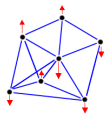


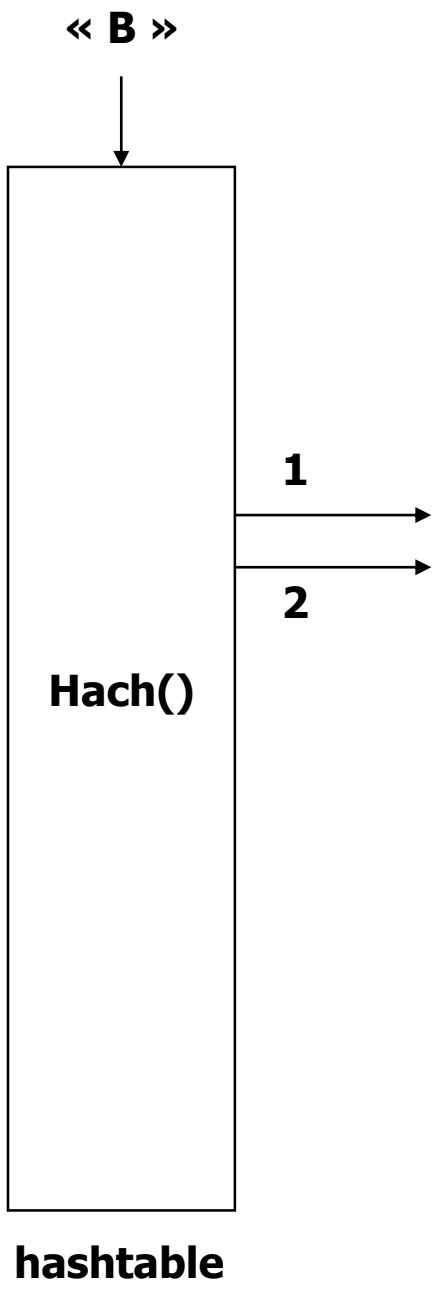
« G »



	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Tableau associatif





	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Reminder : Seq Scan

Raw Identifier (RID)

Seq Scan

R

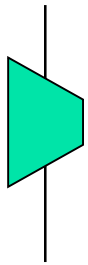
RID		X	Y
	0	5	A
	1	8	B
	2	3	B
	3	9	E
	4	1	G
	5	10	J
	6	7	K
	7	2	U
	8	4	V
RID	9	6	Z

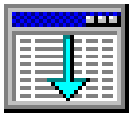
Y = 'E'

3

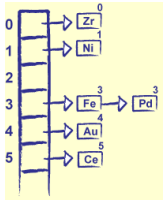
9	E

S (3)





Reminder : Seq Scan select Y = ’ E’



Seq Scan :

While i in index range

if Y = ‘E’ then OutPut = S(i)

End while

S

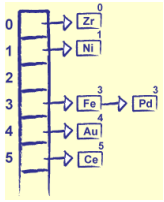
RID →

loop

RID →

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Equivallent Hash select : Y = ’E’



OutPut = R (Hash(‘E’)° ;

« E »

Hach()

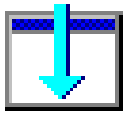
3

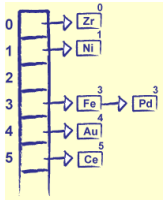
Hash Table

R

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Seq scan VS Hash scan





Seq Scan :

While i in index range

if Y = 'E' then OutPut = S(i)

End while

OutPut = R(Hash('E');

S

RID →

RID →

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

loop

« E »

Hach()

3

Hash Table

R

	X	Y
0	5	A
1	8	B
2	3	B
3	9	E
4	1	G
5	10	J
6	7	K
7	2	U
8	4	V
9	6	Z

Hash Join

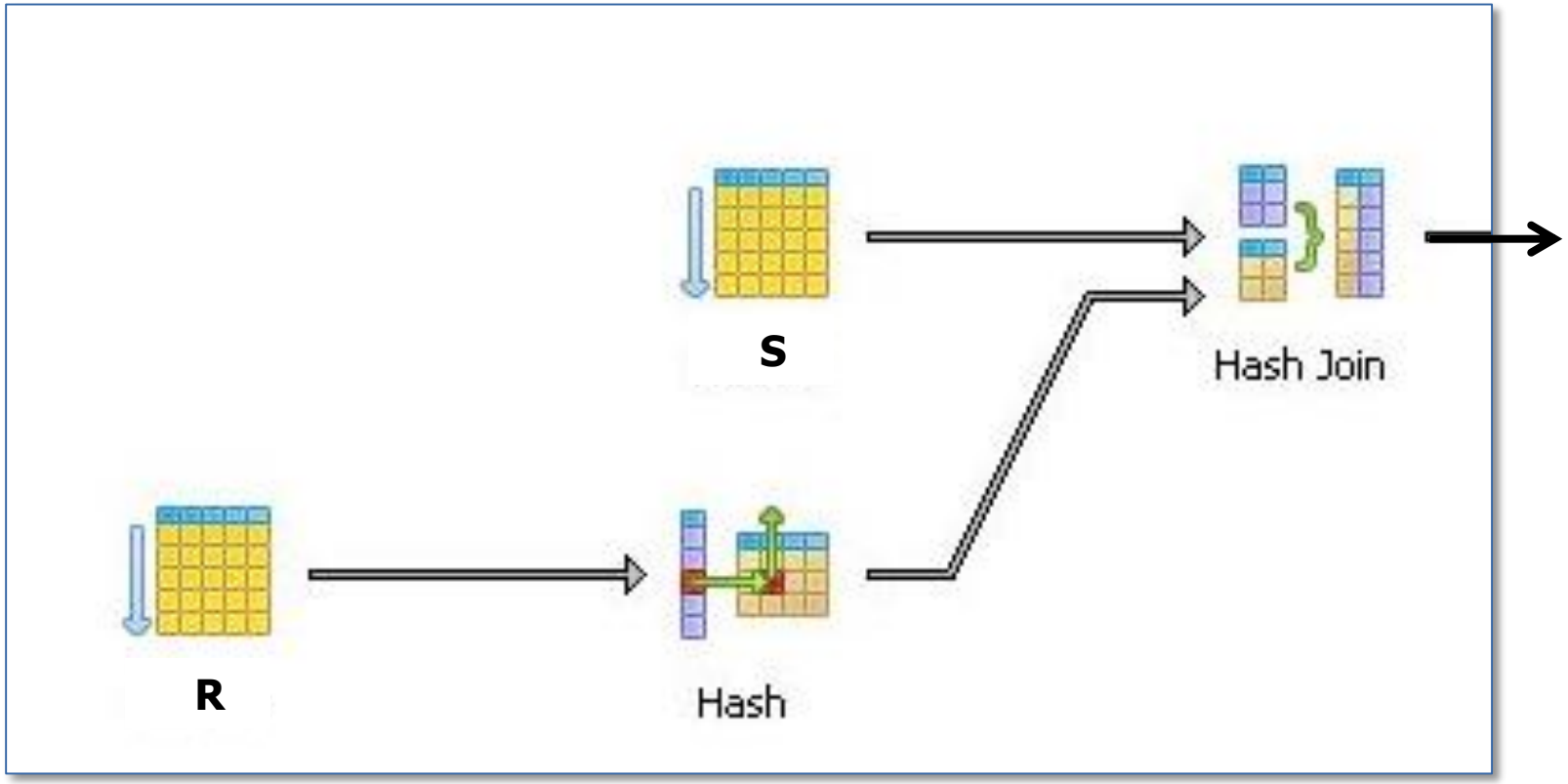
R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

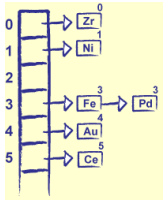
S

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

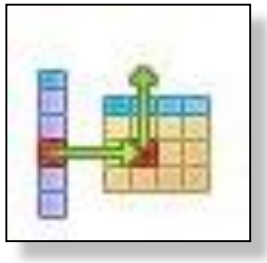
Hash Join



R hash table Build phase



Hash(i, Ry(i))



R

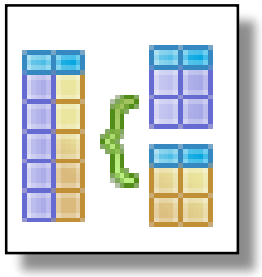
	Y	Z
0	Z	20
1	B	22
2	E	28
3	K	24
4	M	25
5	N	30
6	U	27
7	L	23
8	V	21
9	X	26

Y

Hach()

Hash Table

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« A »

Hach()

Hash Table

S

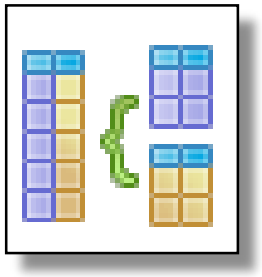
Read S(i)

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« B »

2

Hach()

Hash Table

S

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

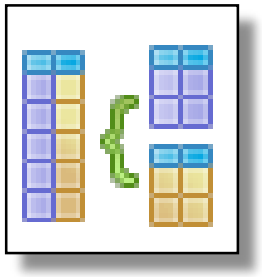
Read S(i)

RID

RID

OutPut (S.Read(2) + S.Read(2))

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« B »

2

Hach()

Hash Table

S

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

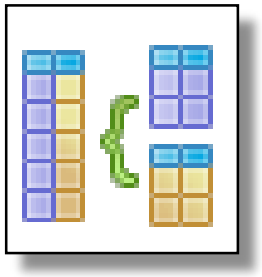
Read S(i)

RID

RID

OutPut (S.Read(2) + S.Read(3))

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« E »

3

Hach()

Hash Table

S

Read S(i)

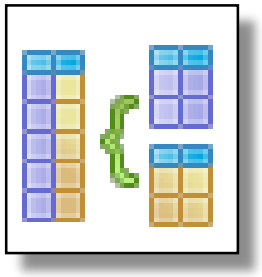
	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

OutPut (S.Read(3) + S.Read(3))

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« G »

Hach()

Hash Table

S

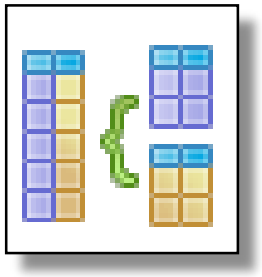
Read S(i)

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« J »

Hach()

Hash Table

S

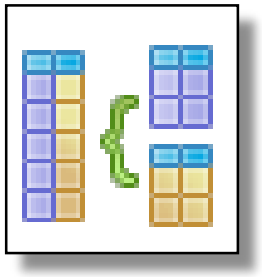
Read S(i)

	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« K »

4

Hach()

Hash Table

S

Read S(i)

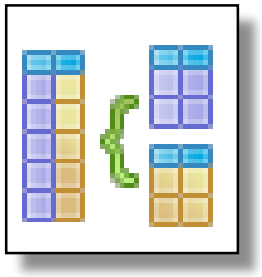
	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

RID

OutPut (S.Read(4) + S.Read(7))

Hash Join



R

	Y	Z
1	Z	20
2	B	22
3	E	28
4	K	24
5	M	25
6	N	30
7	U	27
8	L	23
9	V	21
10	X	26

« U »

Hach()

7

Hash Table

S

Read S(i)

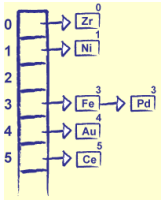
	X	Y
1	5	A
2	8	B
3	3	B
4	9	E
5	1	G
6	10	J
7	7	K
8	2	U
9	4	V
10	6	Z

RID

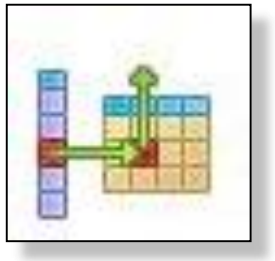
RID

OutPut (S.Read(7) + S.Read(8))

Hash join R S



- R is stored in the R hash table :
  - Join Attribute is the Hash Key,
    - Y= Key,
  - The RID is the value
    - RID = Value



- Seq scan on S to probe R hash table
  - For each record of S we use the Join Attribute as the probe key in R hash table
    - If S Join Attribute probe is postive then the value is used as index to get R Join Attribute value.