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Estrutura de Dados Bidimensional Homogênea Indexada (Matrizes)

1. Matrizes

- Muitas vezes pode ser útil ter “vetores de vetores”:

NOTAS1	10	5	8	4	2	9	3	1
--------	----	---	---	---	---	---	---	---

NOTAS2	1	7	8	9	3	6	3	6
--------	---	---	---	---	---	---	---	---

NOTAS3	5	6	4	7	9	4	7	8
--------	---	---	---	---	---	---	---	---

1. Matrizes

- Muitas vezes pode ser útil ter “vetores de vetores”:

NOTAS

10	5	8	4	2	9	3	1
1	7	8	9	3	6	3	6
5	6	4	7	9	4	7	8

1. Matrizes

- Muitas vezes pode ser útil ter “vetores de vetores”:

NOTAS	0	1	2	3	4	5	6	7	
	10	5	8	4	2	9	3	1	0
	1	7	8	9	3	6	3	6	1
	5	6	4	7	9	4	7	8	2

1. Matrizes

- Declaração de matrizes:

➤ Em Portugal:

var
<nome> : **matriz**[<linhas>, <colunas>] **de** <tipo>

1. Matrizes

- Declaração de matrizes:

➤ Exemplo:

Algoritmo "notas"

var

NOTAS: matriz[3,8] de real

inicio

<comandos>

fimalgoritmo

1. Matrizes

- Declaração de matrizes:

➤ Em C:

```
<tipo> <nome> [<linhas>] [<colunas>];
```


1. Matrizes

- Declaração de matrizes:

➤ Exemplo:

```
#include <stdio.h>
#include <stdlib.h>
```

```
int main()
{
    float NOTAS[3][8];

    system("PAUSE");
    return 0;
}
```

1. Matrizes

- Preenchimento de matrizes:

```
#include <stdio.h>
#include <stdlib.h>
```

```
int main()
{
    float notas[3][8];
    int i, j;

    for(i=0; i<=2; i++) {
        for(j=0; j<=7; j++) {
            printf("Digite nota [%d][%d]:", i, j);
            scanf("%f", &notas[i][j]);
        }
    }

    system("PAUSE");
    return 0;
}
```

1. Matrizes

- Acessando elementos de uma matriz:

```
#include <stdio.h>
#include <stdlib.h>
#define MAXL 3
#define MAXC 3

int main()
{
    float matriz[MAXL][MAXC];
    int i, j;

    for(i=0; i<=MAXL-1; i++) {
        for(j=0; j<=MAXC-1; j++) {
            printf("Digite matriz[%d][%d]:", i, j);
            scanf("%f", &matriz[i][j]);
        }
    }
}
```

1. Matrizes

- Acessando elementos de uma matriz:

```
for (i=0; i<=MAXL-1; i++) {  
    for (j=0; j<=MAXC-1; j++) {  
        printf ("%f\t", matriz[i][j]);  
    }  
    printf ("\n");  
}  
  
system ("PAUSE");  
return 0;  
}
```

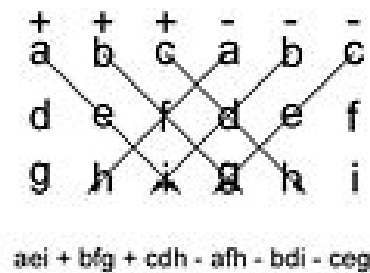
4. Exemplos

Exercício 1: Escreva um programa que leia uma matriz $A_{3 \times 3}$ e calcule seu determinante, mostrando o resultado na tela.

+	+	+	-	-	-
a	b	c	a	b	c
d	e	f	d	e	f
g	h	i	g	h	i

$$aei + bfg + cdh - afh - bdi - ceg$$

4. Exemplos



$$a = B[0] [0]$$

$$e = B[1] [1]$$

$$i = B[2] [2]$$

$$b = B[0] [1]$$

$$f = B[1] [2]$$

$$g = B[2] [3]$$

$$c = B[0] [2]$$

$$d = B[1] [3]$$

$$h = B[2] [4]$$

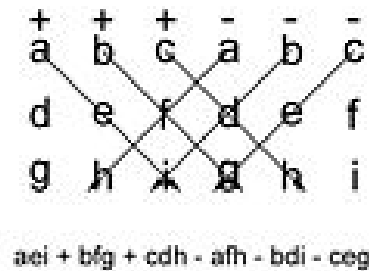
4. Exemplos

$i = 0..2$

i

$a = B[0] [0]$
 $e = B[1] [1]$
 $i = B[2] [2]$

$i = 0..2$



i

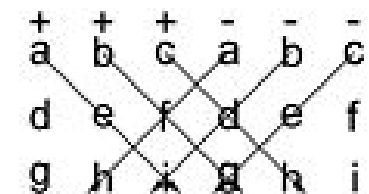
$b = B[0] [1]$
 $f = B[1] [2]$
 $g = B[2] [3]$

$i = 0..2$

i

$c = B[0] [2]$
 $d = B[1] [3]$
 $h = B[2] [4]$

4. Exemplos



$$aei + bfg + cdh - afh - bdi - ceg$$

$$\begin{aligned} a &= B[i][0] \\ e &= B[i][1] \\ i &= B[i][2] \end{aligned} \quad \begin{matrix} i \\ [0] \\ [1] \\ [2] \end{matrix} \quad i+0$$

$$i = 0..2$$

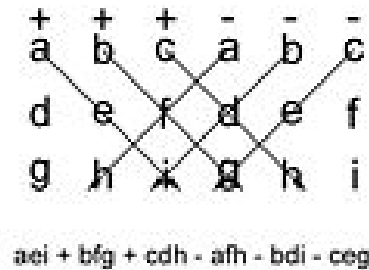
$$\begin{aligned} b &= B[i][1] \\ f &= B[i][2] \\ g &= B[i][3] \end{aligned} \quad \begin{matrix} i \\ [1] \\ [2] \\ [3] \end{matrix} \quad i+1$$

$$i = 0..2$$

$$\begin{aligned} c &= B[i][2] \\ d &= B[i][3] \\ h &= B[i][4] \end{aligned} \quad \begin{matrix} i \\ [2] \\ [3] \\ [4] \end{matrix} \quad i+2$$

$$i = 0..2$$

4. Exemplos



$$\begin{array}{l} a = B[i][0] \\ e = B[i][1] \\ i = B[i][2] \end{array} \quad \begin{array}{c} i \\ [0] \\ [1] \\ [2] \end{array} \quad i+0$$

$$i = 0..2$$

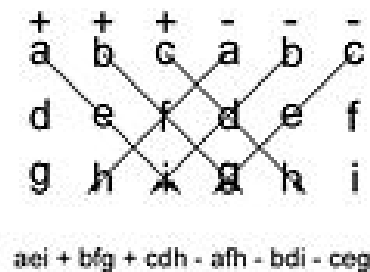
$$\begin{array}{l} b = B[i][1] \\ f = B[i][2] \\ g = B[i][3] \end{array} \quad \begin{array}{c} i \\ [1] \\ [2] \\ [3] \end{array} \quad i+1$$

$$i = 0..2$$

$$\begin{array}{l} c = B[i][2] \\ d = B[i][3] \\ h = B[i][4] \end{array} \quad \begin{array}{c} i \\ [2] \\ [3] \\ [4] \end{array} \quad i+2$$

$$i = 0..2$$

4. Exemplos



i
 $a = B[0]$ [0]
 $e = B[1]$ [1]
 $i = B[2]$ [2]

i
 $b = B[0]$ [1]
 $f = B[1]$ [2]
 $g = B[2]$ [3]

i
 $c = B[0]$ [2]
 $d = B[1]$ [3]
 $h = B[2]$ [4]

$i+0$

$i+1$

$i+2$

$i = 0..2$

$i = 0..2$

$i = 0..2$

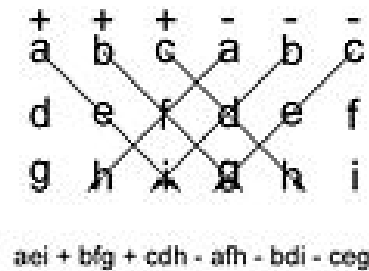
$j = 0..2$

4. Exemplos

$$j = 0, i = 0..2$$

i $i+j$
 $a = B[0] [0]$
 $e = B[1] [1]$
 $i = B[2] [2]$

$$i = 0..2$$

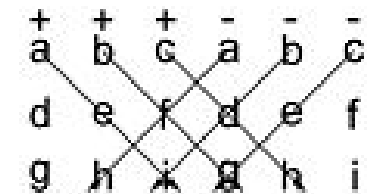


i $i+j$
 $b = B[0] [1]$
 $f = B[1] [2]$
 $g = B[2] [3]$

$$i = 0..2$$

i $i+j$
 $c = B[0] [2]$
 $d = B[1] [3]$
 $h = B[2] [4]$

4. Exemplos



$$aei + bfg + cdh - afh - bdi - ceg$$

$i \quad i+j$
 $a = B[0] \quad [0]$
 $e = B[1] \quad [1]$
 $i = B[2] \quad [2]$

$i \quad i+j$
 $b = B[0] \quad [1]$
 $f = B[1] \quad [2]$
 $g = B[2] \quad [3]$

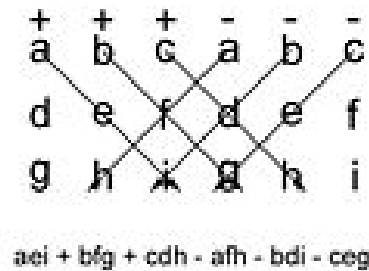
$i \quad i+j$
 $c = B[0] \quad [2]$
 $d = B[1] \quad [3]$
 $h = B[2] \quad [4]$

$j = 0, i = 0..2$

$j = 1, i = 0..2$

$i = 0..2$

4. Exemplos



i $i+j$
 $a = B[0] \quad [0]$
 $e = B[1] \quad [1]$
 $i = B[2] \quad [2]$

$j = 0, i = 0..2$

i $i+j$
 $b = B[0] \quad [1]$
 $f = B[1] \quad [2]$
 $g = B[2] \quad [3]$

$j = 1, i = 0..2$

i $i+j$
 $c = B[0] \quad [2]$
 $d = B[1] \quad [3]$
 $h = B[2] \quad [4]$

$j = 2, i = 0..2$

4. Exemplos

$$j = 0, i = 0..2$$

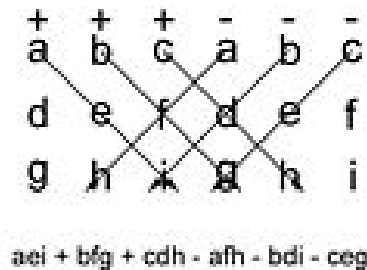
$i \quad i+j$
 $a = B[0] \quad [0]$
 $e = B[1] \quad [1] \rightarrow \text{termoP} = a * e * i$
 $i = B[2] \quad [2]$

$$j = 1, i = 0..2$$

$i \quad i+j$
 $b = B[0] \quad [1]$
 $f = B[1] \quad [2] \rightarrow \text{termoP} = b * f * g$
 $g = B[2] \quad [3]$

$$j = 2, i = 0..2$$

$i \quad i+j$
 $c = B[0] \quad [2]$
 $d = B[1] \quad [3] \rightarrow \text{termoP} = c * d * h$
 $h = B[2] \quad [4]$



4. Exemplos

```
#include <stdio.h>
#include <stdlib.h>

int main()
{

    float A[3][3] = { {1,2,3}, {4,5,6}, {7,8,9} };
    float B[3][6], termoP, Soma;
    int i,j;

    for (i=0; i<3; i++){
        for (j=0; j<3; j++){
            B[i][j] = A[i][j];
            B[i][j+3] = A[i][j];
            printf("%f \n", B[i][j]);
        }
    }
}
```

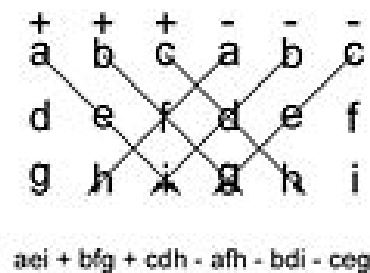
4. Exemplos

```
Soma = 0;
for (j=0; j<3; j++) {
    termoP = 1;
    for (i=0; i<3; i++) {
        termoP = termoP*B[i][i+j];
    }
    Soma = Soma + termoP;
}

printf("Determinante: %f\n", Soma);

system("PAUSE");
return 0;
}
```


4. Exemplos



$$a = B[0] [3]$$

$$f = B[1] [2]$$

$$h = B[2] [1]$$

$$b = B[0] [4]$$

$$d = B[1] [3]$$

$$i = B[2] [2]$$

$$c = B[0] [5]$$

$$e = B[1] [4]$$

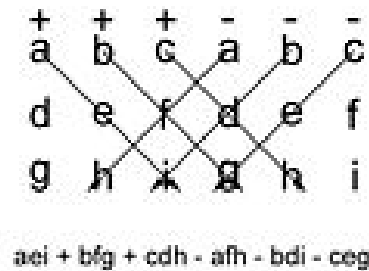
$$g = B[2] [3]$$

4. Exemplos

$i = 0..2$

i
 $a = B[0] \quad [3]$
 $f = B[1] \quad [2]$
 $h = B[2] \quad [1]$

$i = 0..2$

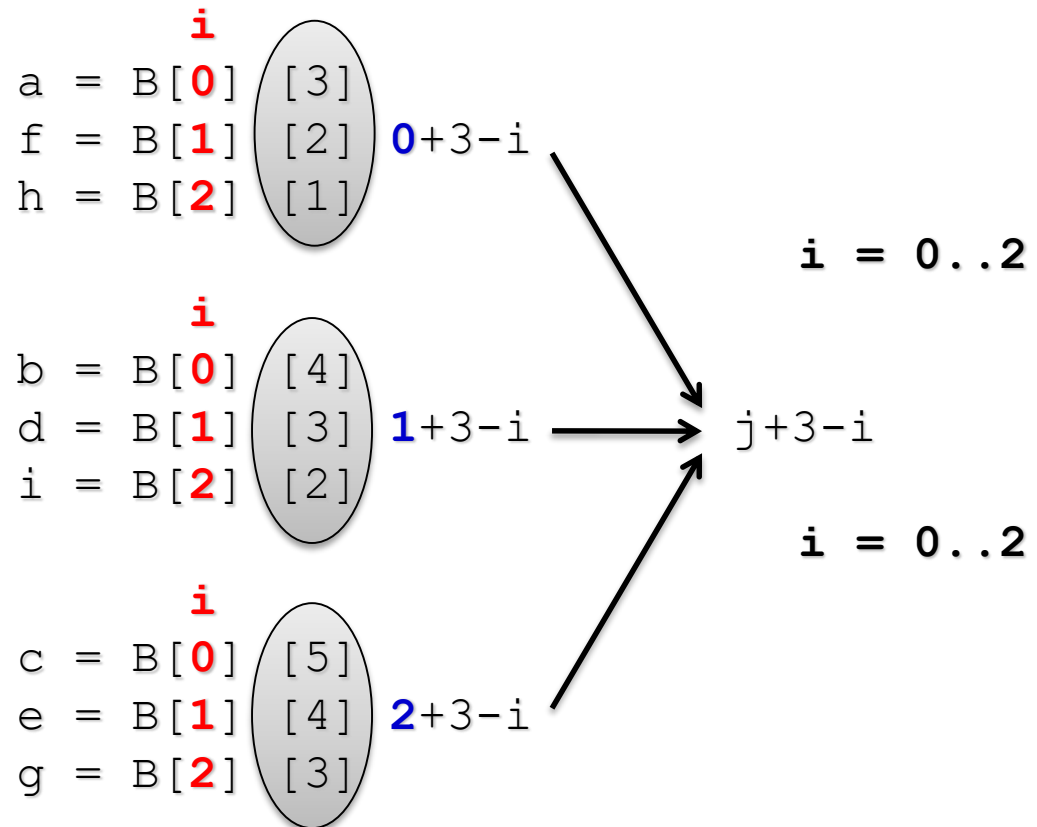
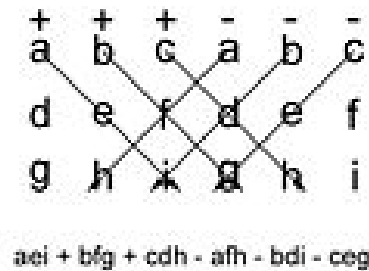


i
 $b = B[0] \quad [4]$
 $d = B[1] \quad [3]$
 $i = B[2] \quad [2]$

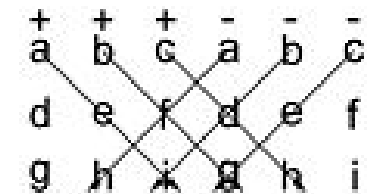
$i = 0..2$

i
 $c = B[0] \quad [5]$
 $e = B[1] \quad [4]$
 $g = B[2] \quad [3]$

4. Exemplos



4. Exemplos



$$aei + bfg + cdh - afh - bdi - ceg$$

$$i \quad j+3-i$$

$$a = B[0] \quad [3]$$

$$f = B[1] \quad [2]$$

$$h = B[2] \quad [1]$$

$$j = 0, i = 0..2$$

$$i \quad j+3-i$$

$$b = B[0] \quad [4]$$

$$d = B[1] \quad [3]$$

$$i = B[2] \quad [2]$$

$$j = 1, i = 0..2$$

$$i \quad j+3-i$$

$$c = B[0] \quad [5]$$

$$e = B[1] \quad [4]$$

$$g = B[2] \quad [3]$$

$$j = 2, i = 0..2$$

4. Exemplos

$$j = 0, i = 0..2$$

$$i \quad j+3-i$$

$$a = B[0] [3]$$

$$f = B[1] [2] \rightarrow \text{termoN} = a*f*h$$

$$h = B[2] [1]$$

$$j = 1, i = 0..2$$

$$i \quad j+3-i$$

$$b = B[0] [4]$$

$$d = B[1] [3] \rightarrow \text{termoN} = b*d*i$$

$$i = B[2] [2]$$

$$j = 2, i = 0..2$$

$$i \quad j+3-i$$

$$c = B[0] [5]$$

$$e = B[1] [4] \rightarrow \text{termoN} = c*e*g$$

$$g = B[2] [3]$$

$$\begin{array}{cccccc} + & + & + & - & - & - \\ a & b & c & a & b & c \\ d & e & f & d & e & f \\ g & h & i & g & h & i \end{array}$$

$$aei + bfg + cdh - afh - bdi - ceg$$

4. Exemplos

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int main()
{

    float A[3][3] ={{ {1,2,3}, {4,5,6}, {7,8,9} }};
    float B[3][6], termoP, termoN, Soma;
    int i,j;

    for (i=0; i<3; i++){
        for (j=0; j<3; j++){
            B[i][j] = A[i][j];
            B[i][j+3] = A[i][j];
            printf("%f \n", B[i][j]);
        }
    }
}
```

4. Exemplos

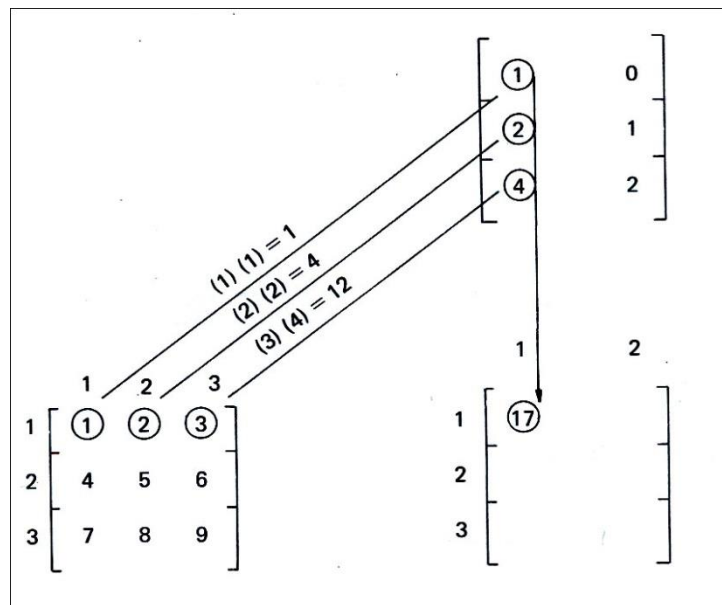
```
Soma = 0;
for (j=0;j<3;j++){
    termoP = 1;
    termoN = 1;
    for (i=0;i<3;i++){
        termoP = termoP*B[i][i+j];
        termoN = termoN*B[i][j+3-i];
    }
    Soma = Soma + termoP - termoN;
}

printf("Determinante: %f\n", Soma);

system("PAUSE");
return 0;
}
```

4. Exemplos

Exercício 2: Escreva um programa que leia duas matrizes $A_{3 \times 3}$ e $B_{3 \times 2}$, e realiza o produto matricial entre elas, guardando o resultado em uma terceira matriz $C_{3 \times 2}$, que é mostrada na tela do computador.



4. Exemplos

$$j = 0$$

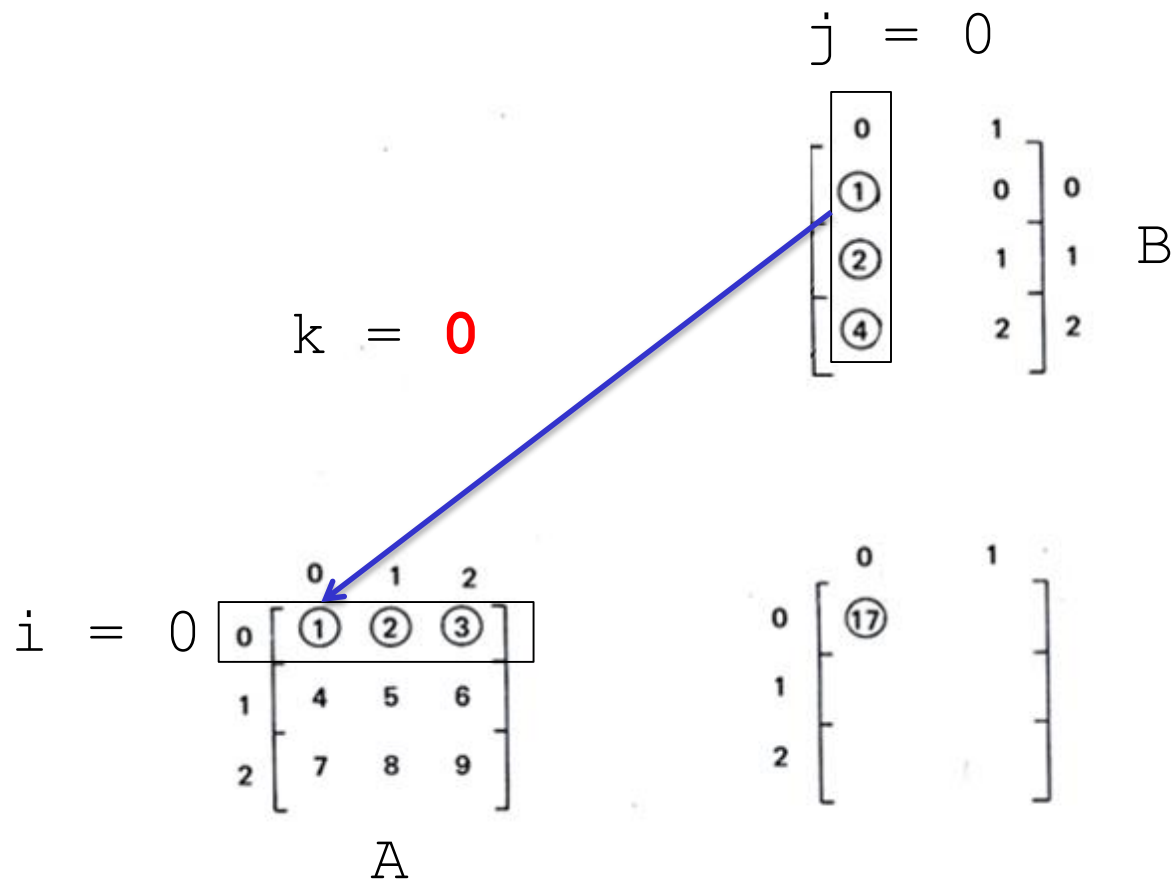
$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{matrix} 1 \\ 0 \\ 1 \\ 2 \end{matrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

$$i = 0 \quad \begin{matrix} & 0 & 1 & 2 \end{matrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \begin{bmatrix} \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

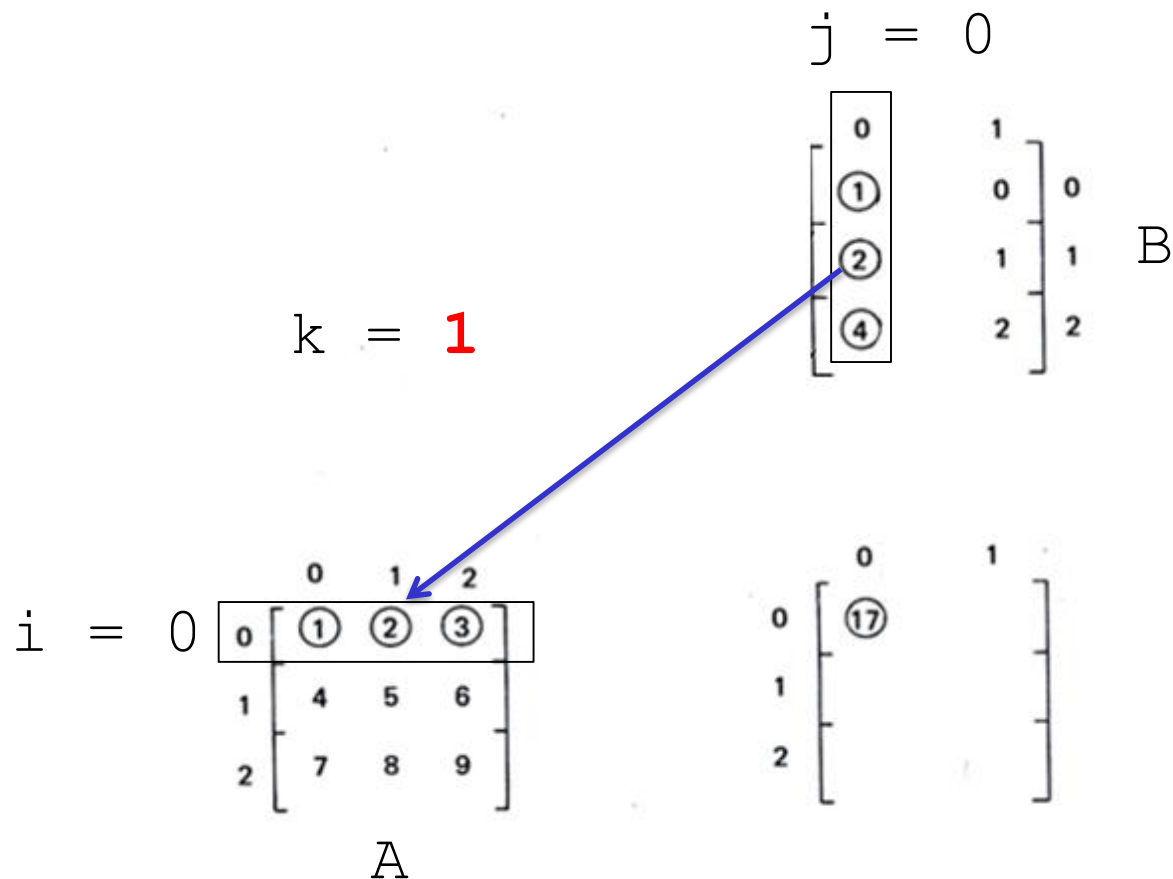
A

$$\begin{matrix} & 0 & 1 \end{matrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \begin{bmatrix} \textcircled{17} \\ \\ \end{bmatrix}$$

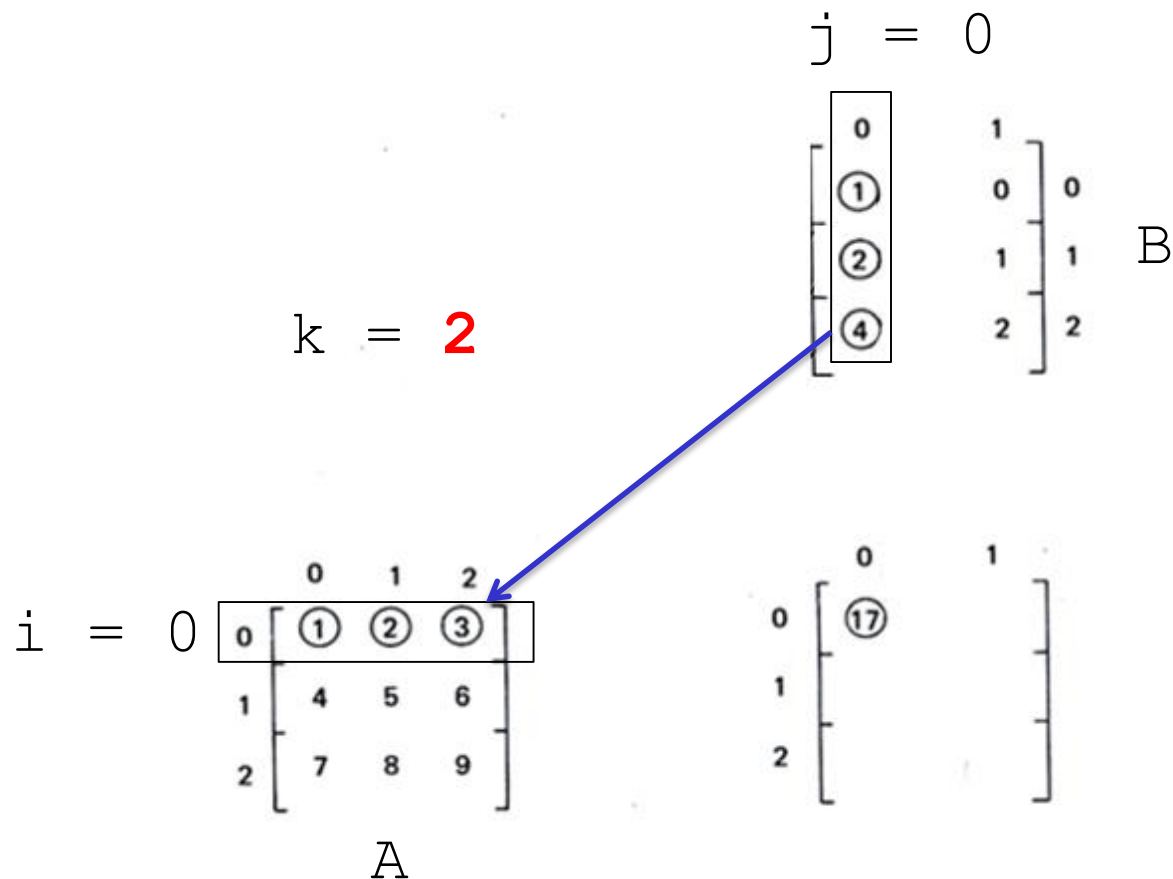
4. Exemplos



4. Exemplos



4. Exemplos



4. Exemplos

$$j = 1$$

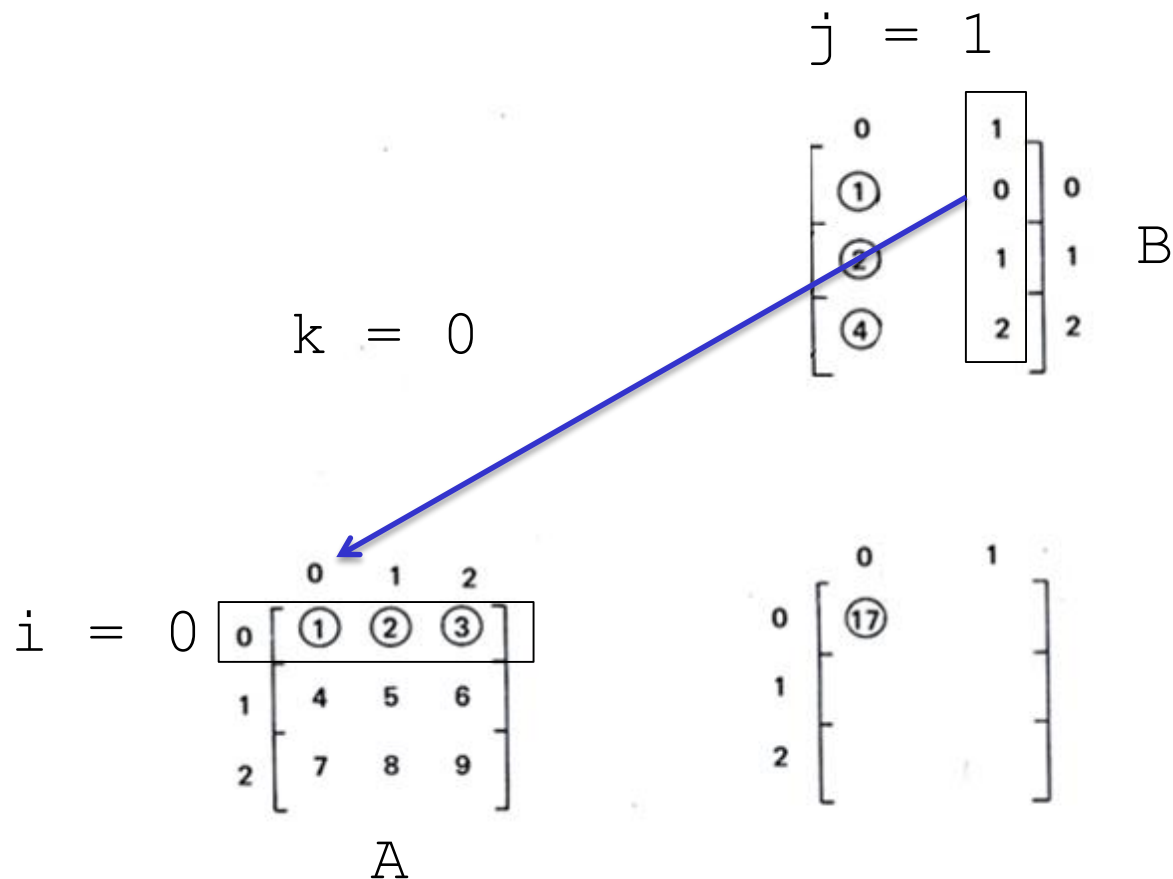
$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 2 \end{bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

$$i = 0 \quad \begin{matrix} & 0 & 1 & 2 \\ 0 & \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 1 & 4 & 5 & 6 \\ 2 & 7 & 8 & 9 \end{matrix}$$

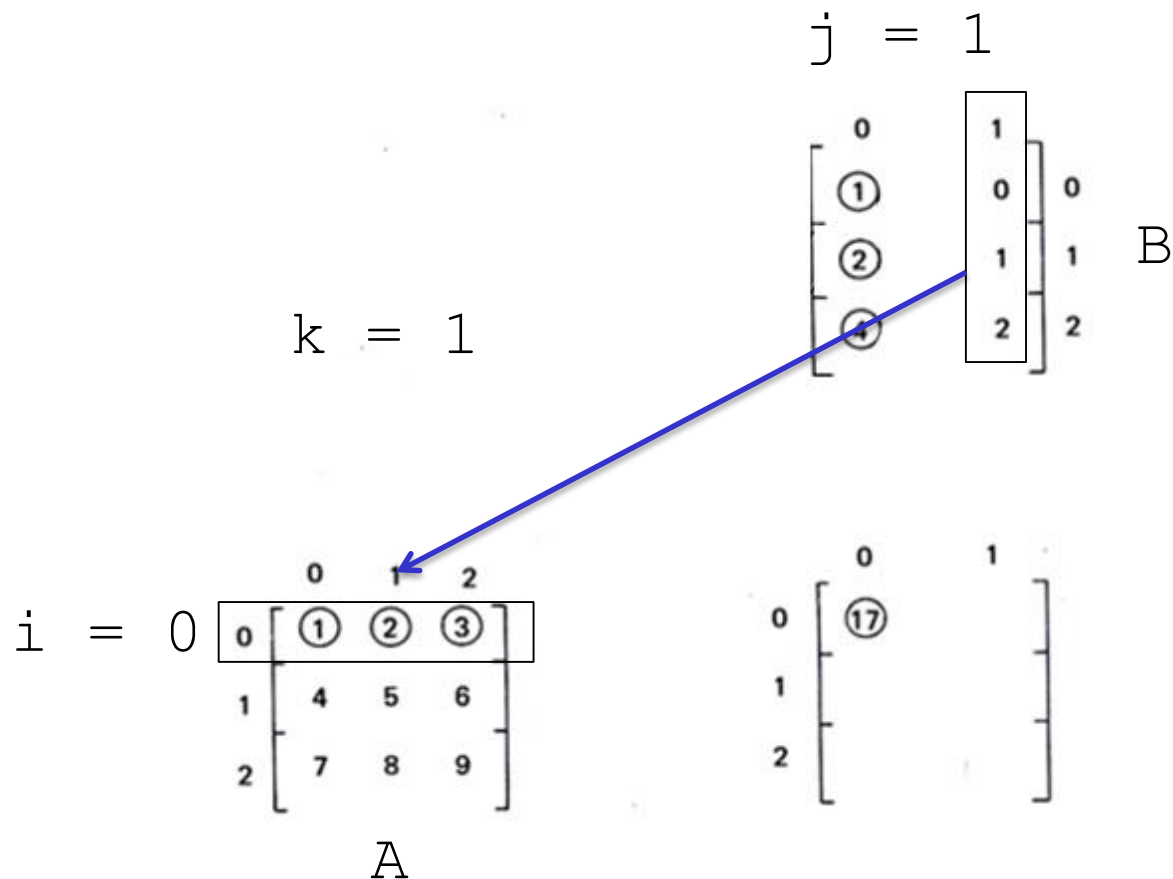
A

$$\begin{matrix} & 0 & 1 \\ 0 & \textcircled{17} & \\ 1 & & \\ 2 & & \end{matrix}$$

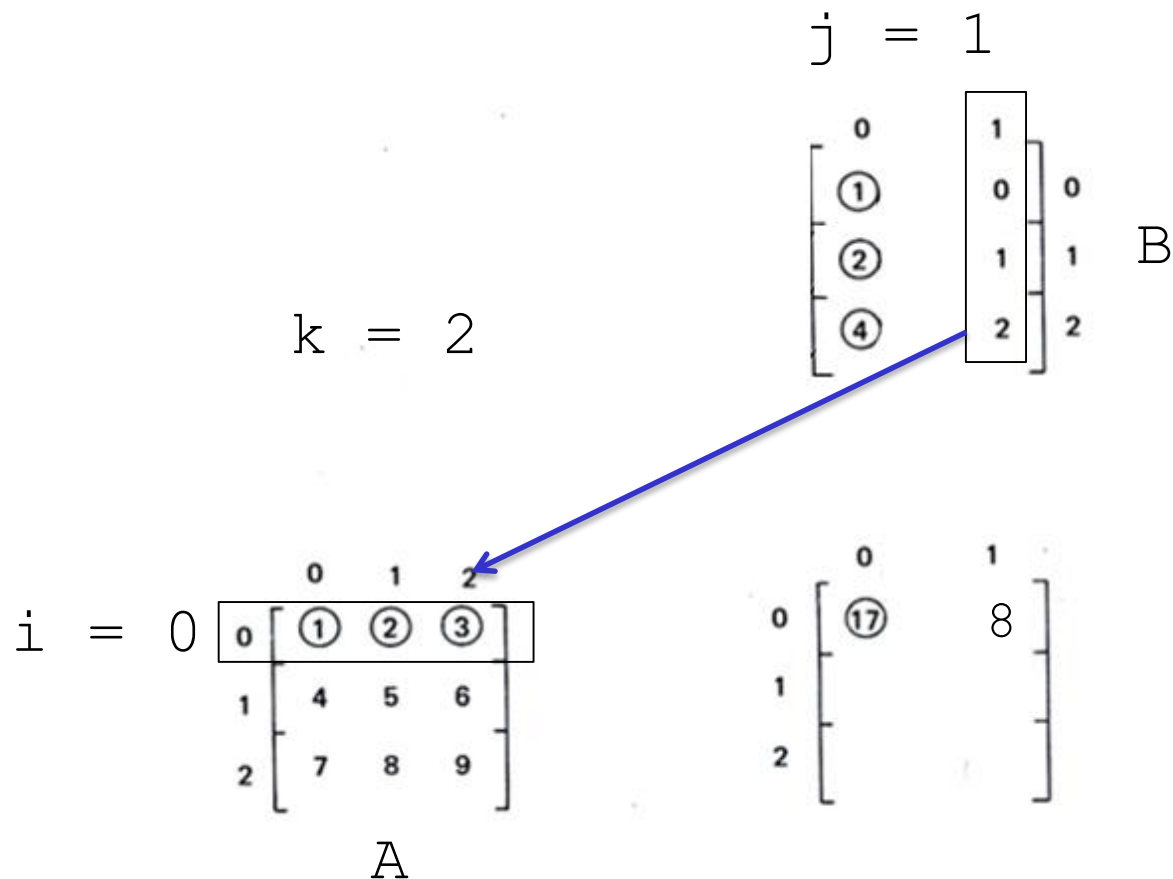
4. Exemplos



4. Exemplos



4. Exemplos



4. Exemplos

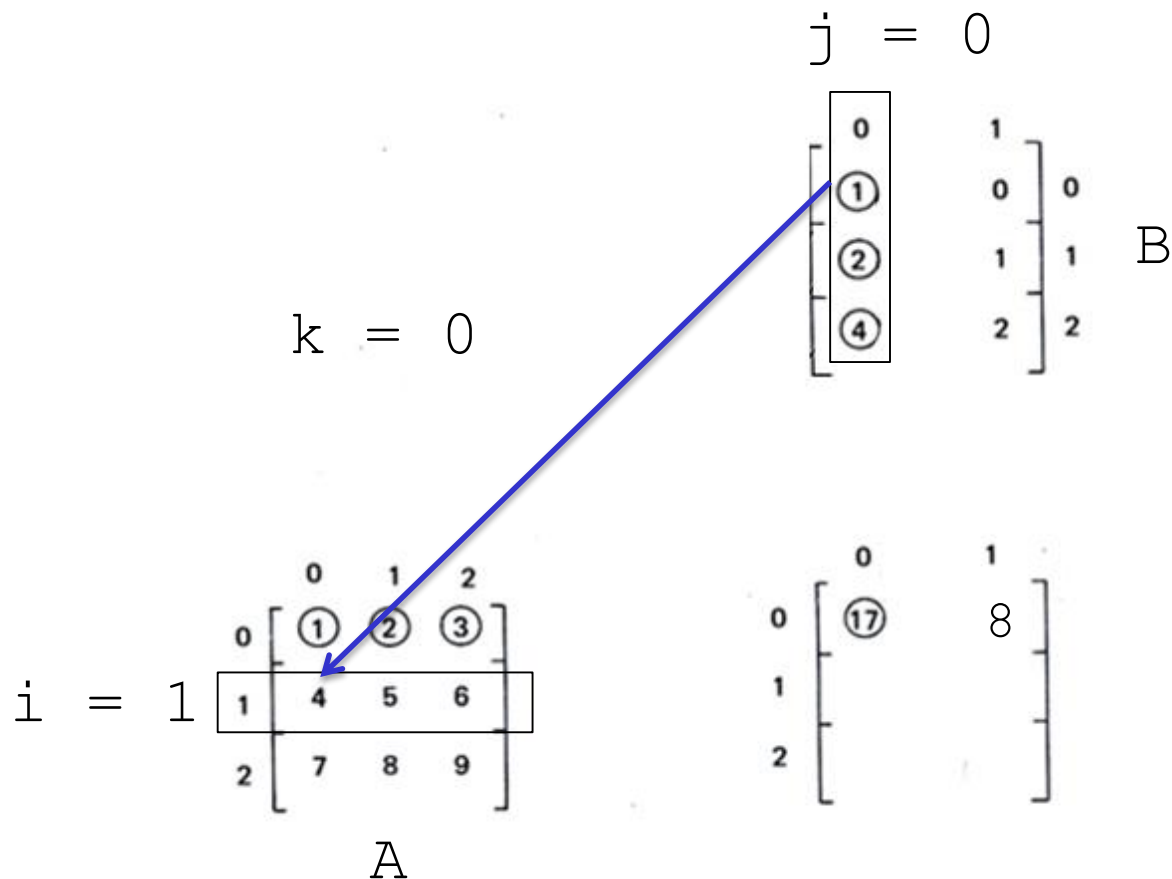
$$j = 0$$

$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 2 \end{bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

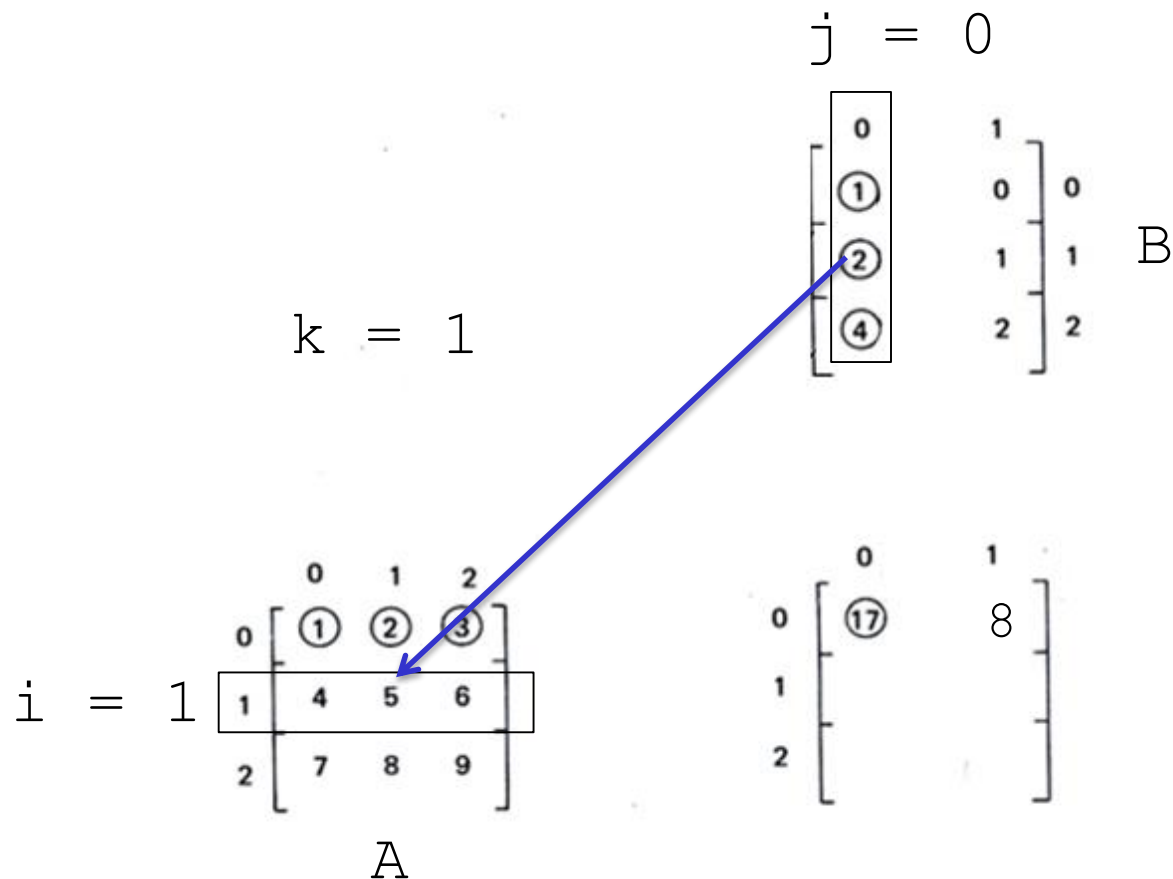
$$i = 1 \quad \begin{matrix} & 0 & 1 & 2 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 1 & 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \end{matrix} \quad A$$

$$\begin{matrix} & 0 & 1 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{17} \\ 8 \end{bmatrix} \end{matrix}$$

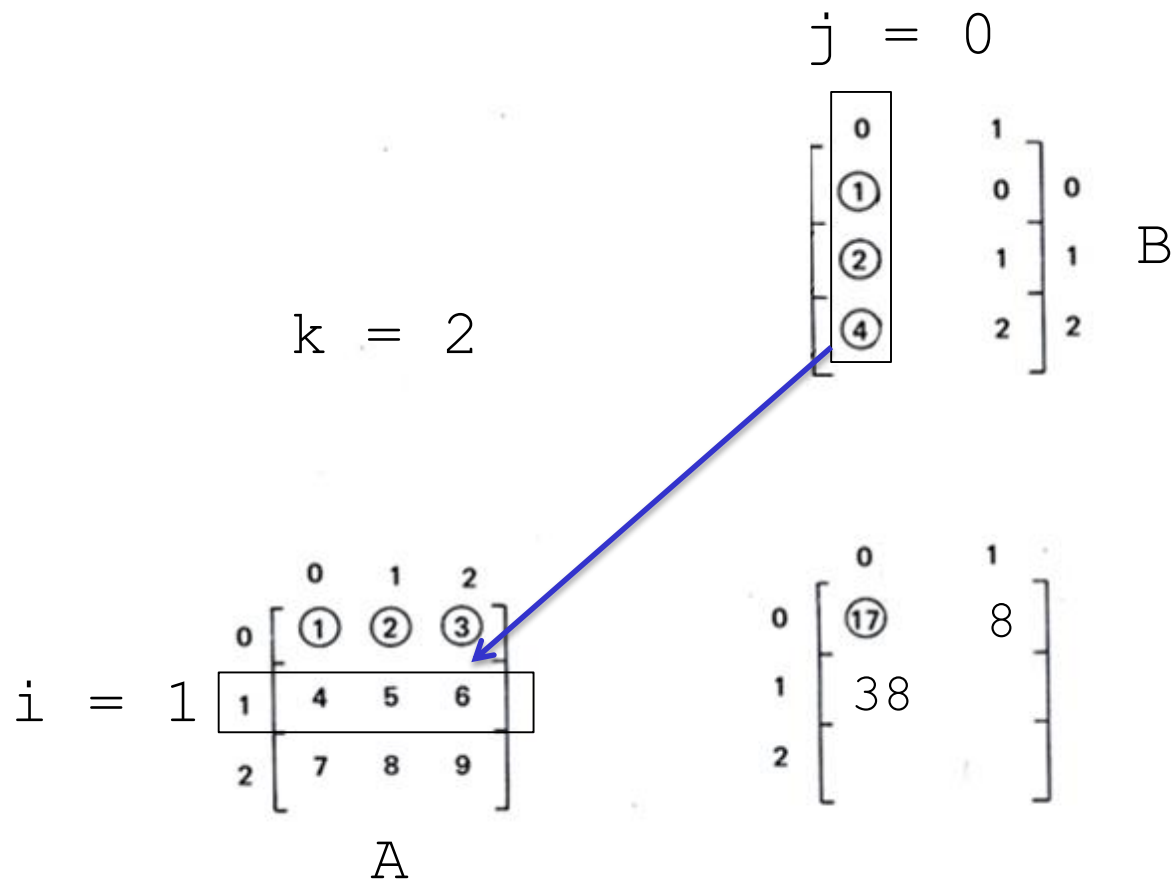
4. Exemplos



4. Exemplos



4. Exemplos



4. Exemplos

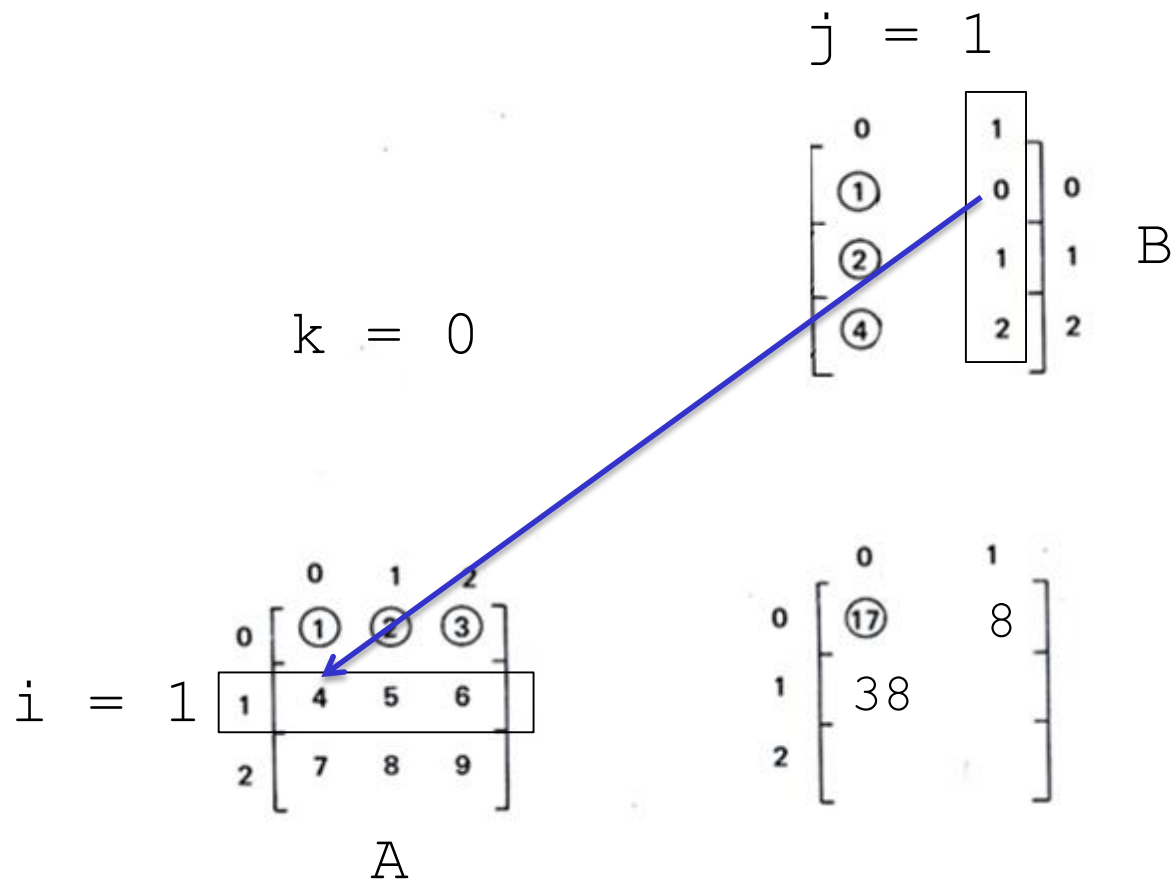
$$j = 0$$

$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 2 \end{bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

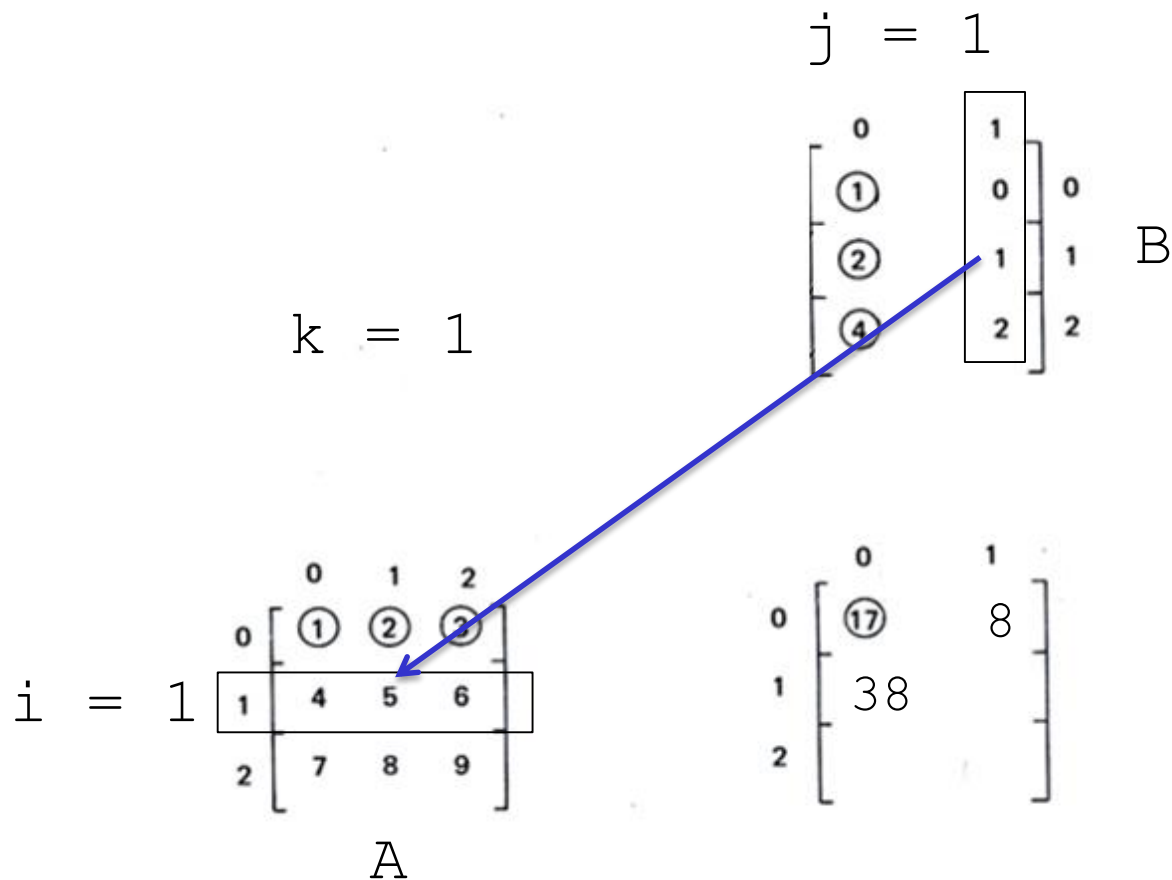
$$i = 1 \quad \begin{matrix} & 0 & 1 & 2 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 1 & 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \end{matrix} \quad A$$

$$\begin{matrix} & 0 & 1 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{17} & 8 \\ 38 \end{bmatrix} \end{matrix}$$

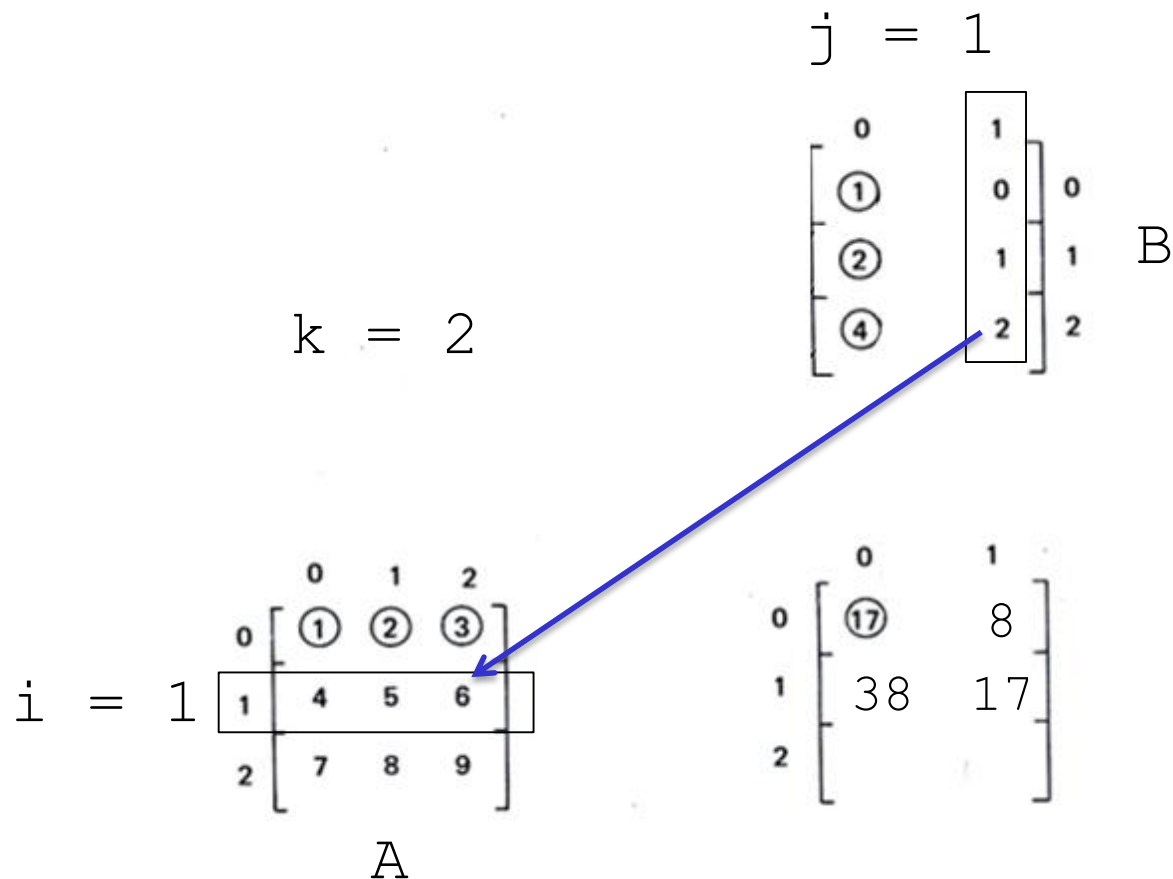
4. Exemplos



4. Exemplos



4. Exemplos



4. Exemplos

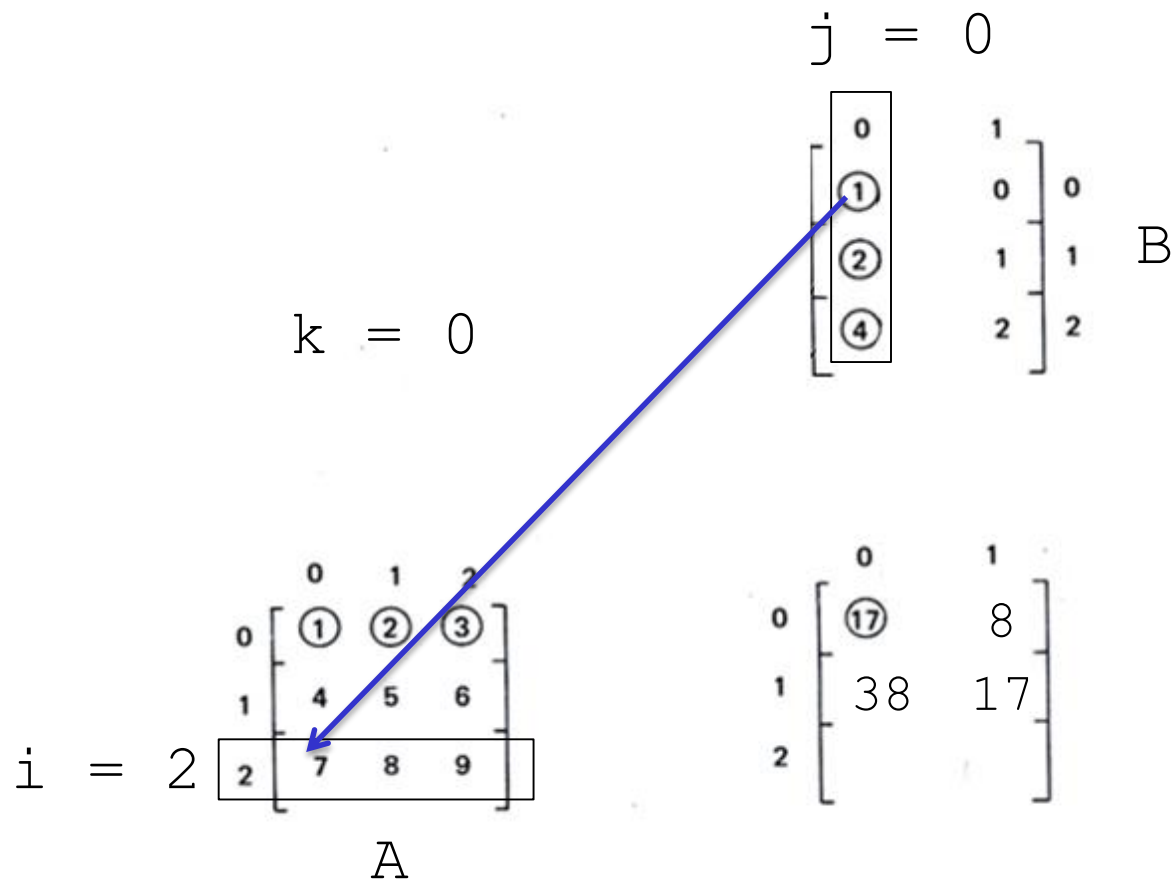
$$j = 1$$

$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 2 \end{bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

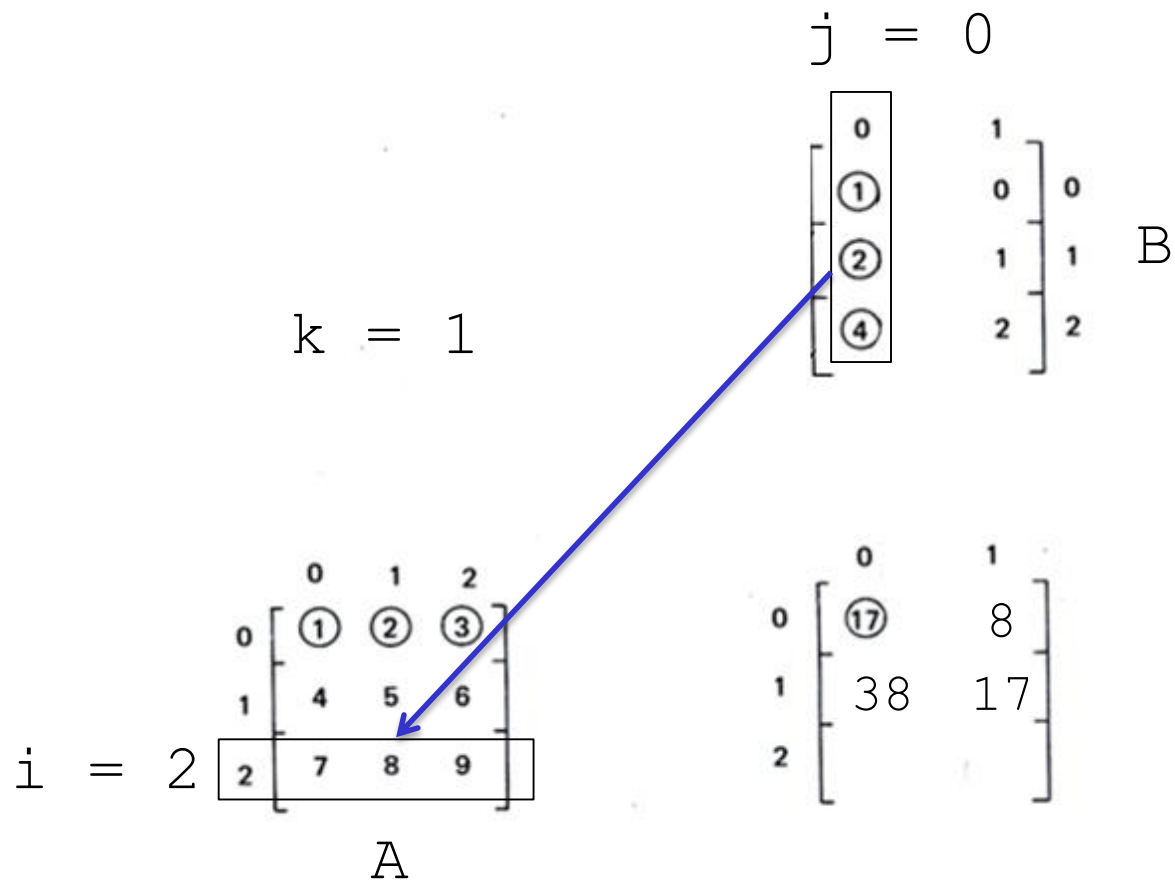
$$i = 1 \quad \begin{matrix} & \begin{matrix} 0 & 1 & 2 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 1 & 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \end{matrix} \quad A$$

$$\begin{matrix} & \begin{matrix} 0 & 1 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{17} & 8 \\ 38 & 17 \end{bmatrix} \end{matrix}$$

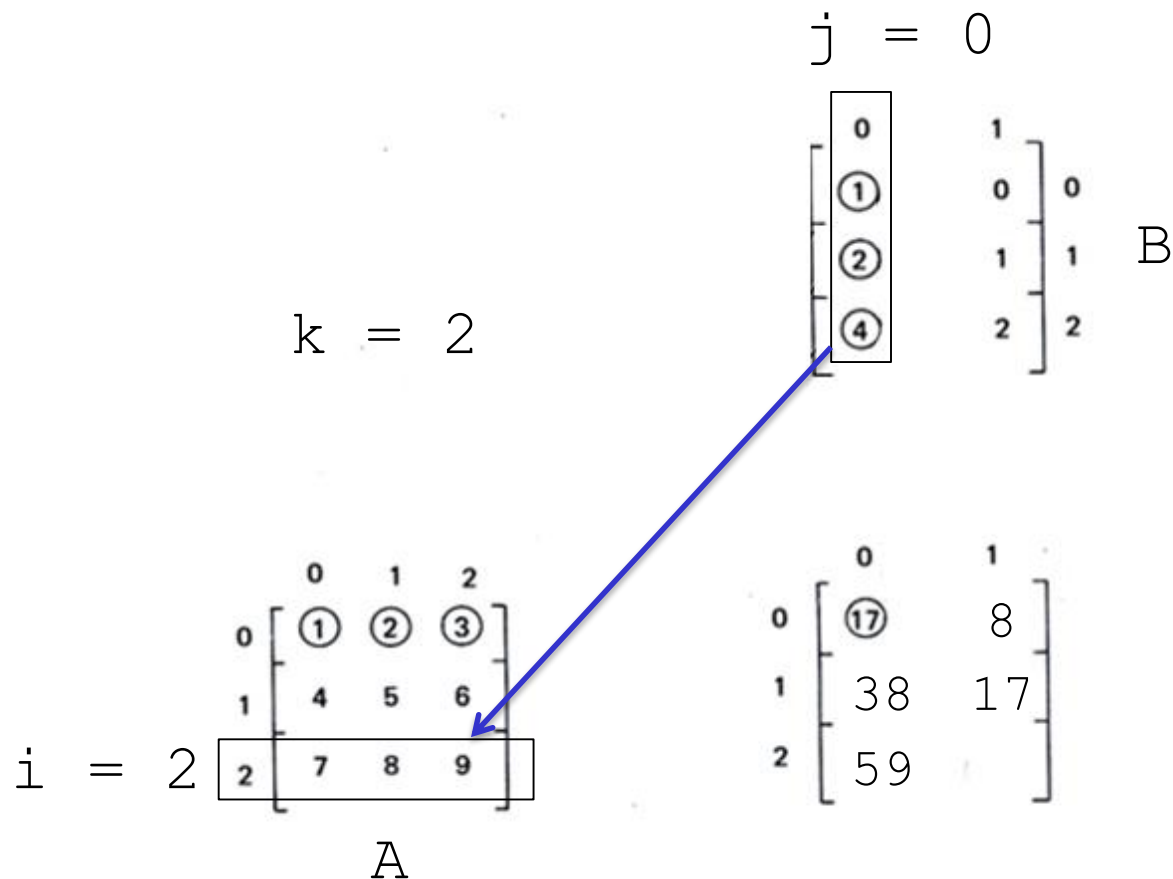
4. Exemplos



4. Exemplos



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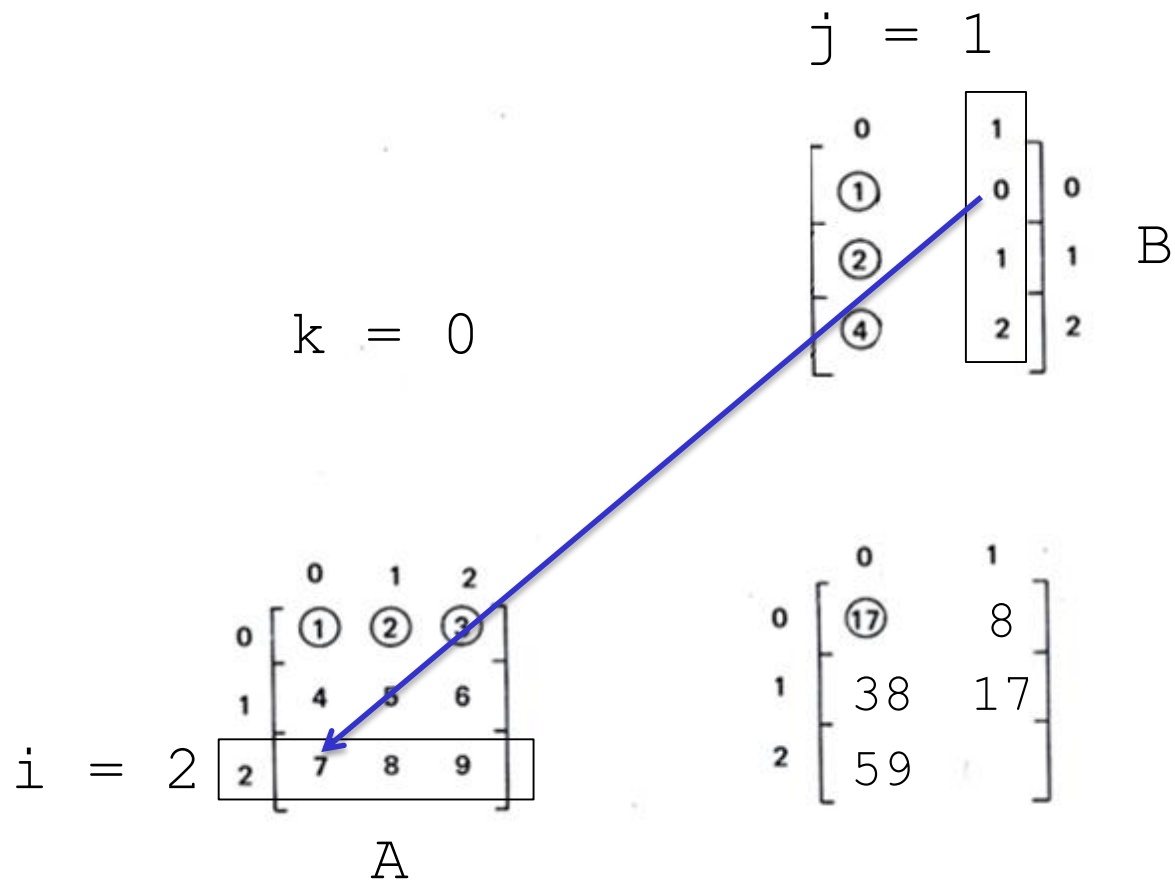
$$j = 0$$

$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 2 \end{bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

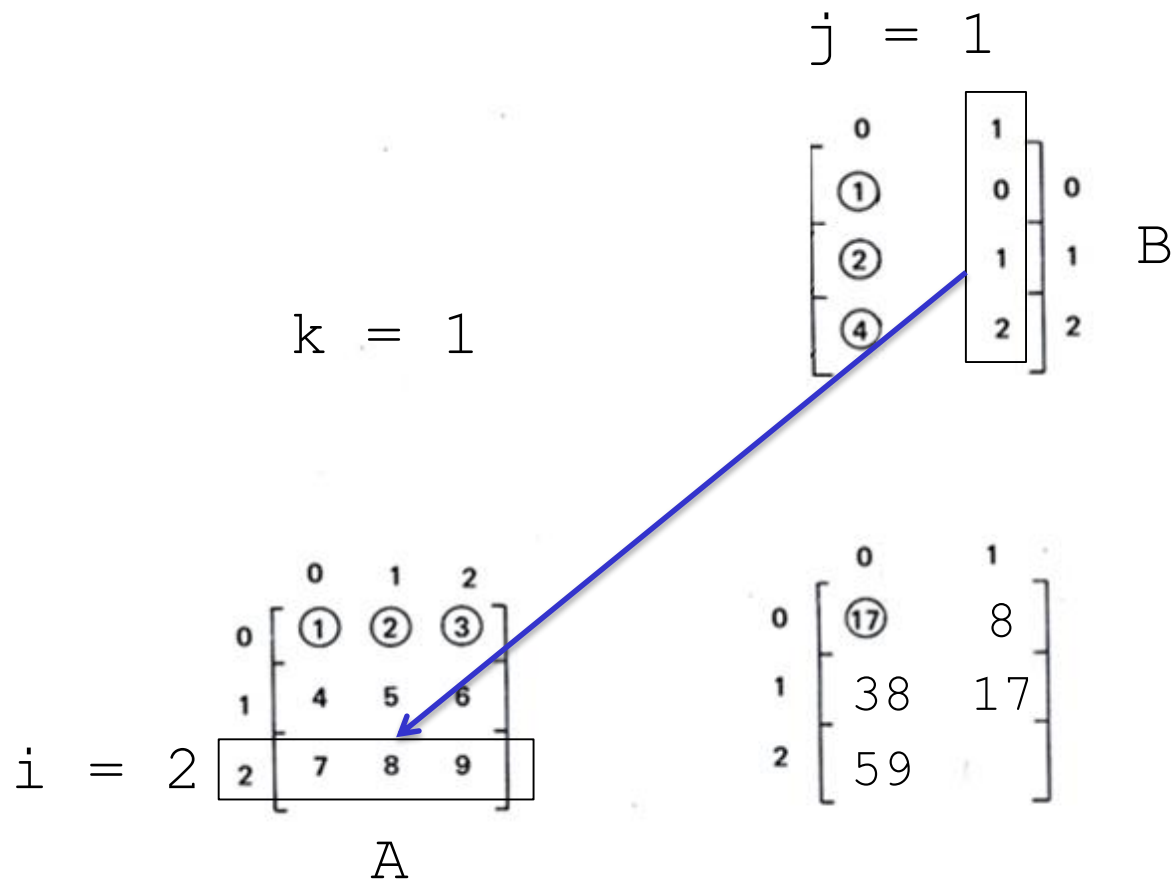
$$i = 2 \quad \begin{matrix} & 0 & 1 & 2 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 4 & 5 & 6 \\ 2 & 7 & 8 & 9 \end{bmatrix} \end{matrix} \quad A$$

$$\begin{matrix} & 0 & 1 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{bmatrix} \textcircled{17} & 8 \\ 38 & 17 \\ 59 & \end{bmatrix} \end{matrix}$$

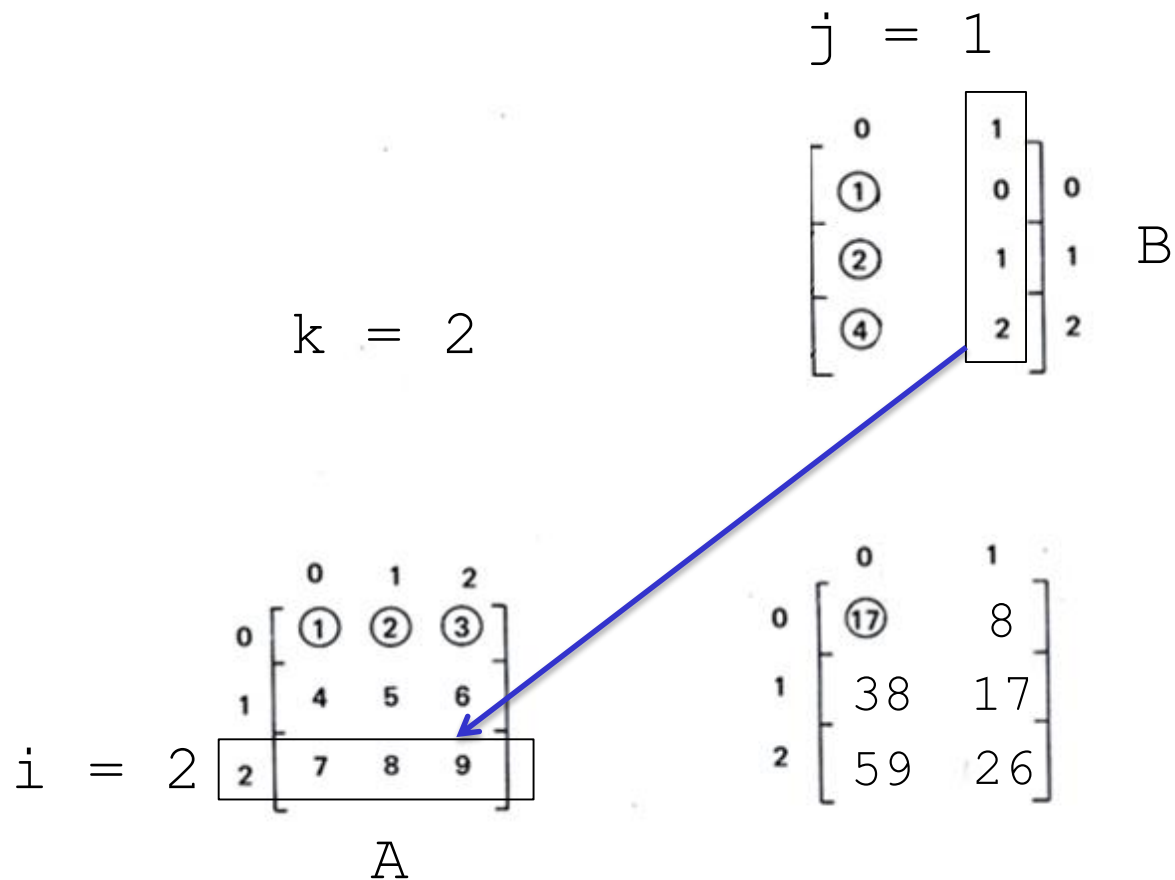
4. Exemplos



4. Exemplos



4. Exemplos



4. Exemplos

$$j = 1$$

$$\begin{bmatrix} 0 \\ \textcircled{1} \\ \textcircled{2} \\ \textcircled{4} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ 1 \\ 2 \end{bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} \quad B$$

$$i = 2 \quad \begin{matrix} & 0 & 1 & 2 \\ 0 & \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 1 & 4 & 5 & 6 \\ 2 & 7 & 8 & 9 \end{matrix} \quad A$$

$$\begin{matrix} & 0 & 1 \\ 0 & \textcircled{17} & 8 \\ 1 & 38 & 17 \\ 2 & 59 & 26 \end{matrix}$$

4. Exemplos

Para i de 0 ate 2 passo 1

Para j de 0 ate 1 passo 1

elemento = 0;

Para k de 0 ate 2

elemento = elemento +
 $A[i][k] * B[k][j];$

fimpara

fimpara

fimpara

$$i = 2 \quad \begin{array}{c|ccc} & 0 & 1 & 2 \\ \hline 0 & \textcircled{1} & \textcircled{2} & \textcircled{3} \\ 1 & 4 & 5 & 6 \\ 2 & 7 & 8 & 9 \end{array}$$

A

$j = 1$

$$\begin{array}{c|ccc} & 0 & 1 & 2 \\ \hline \textcircled{1} & 1 & 0 & 0 \\ \textcircled{2} & 1 & 1 & 1 \\ \textcircled{4} & 2 & 2 & 2 \end{array} \quad B$$

$$\begin{array}{c|cc} & 0 & 1 \\ \hline 0 & \textcircled{17} & 8 \\ 1 & 38 & 17 \\ 2 & 59 & 26 \end{array}$$

4. Exemplos

```
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
```

```
int main ()
{
```

```
    float A[3][3] = {{1,2,3}, {4,5,6}, {7,8,9}};
```

```
    float B[3][2] = {{1,2}, {4,5}, {7,8}};
```

```
    float C[3][2], elemento;
```

```
    int i, j, k;
```

4. Exemplos

```
for (i=0; i<3; i++){  
    for (j=0; j<2;j++)    {  
        elemento = 0;  
        for (k=0;k<3;k++)  
            elemento = elemento + A[i][k]*B[k][j];  
  
        C[i][j] = elemento;  
    }  
}
```

```
for (i=0; i<3; i++){  
    for (j=0; j<3;j++)    {  
        printf("%f ", A[i][j]);  
    }  
    printf("\n");  
}  
  
printf("\n\n");
```

4. Exemplos

```
for (i=0; i<3; i++){  
    for (j=0; j<2;j++)    {  
        printf("%f ", B[i][j]);  
    }  
    printf("\n");  
}  
  
printf("\n\n");  
  
for (i=0; i<3; i++){  
    for (j=0; j<2;j++)    {  
        printf("%f \t", C[i][j]);  
    }  
    printf("\n");  
}  
  
system("PAUSE");  
return 0;  
}
```