

Calcolo scientifico

Prodotto Matrice per Matrice

Qual è l'algoritmo ?

```
for  $i=0, n-1$  do
```

```
  for  $j=0, n-1$  do
```

```
     $c_{ij} = 0$ 
```

```
    for  $k=0, n-1$  do
```

```
       $c_{ij} = c_{ij} + a_{ik} b_{kj}$ 
```

```
    endfor
```

```
  endfor
```

```
endfor
```

la matrice C
viene "generalmente" calcolata
componente per componente
secondo un ordine prestabilito

*Il generico elemento di C
è il prodotto scalare della
 i -esima riga di A per la
 j -esima colonna di B*

Qual è
l'algoritmo a blocchi

?

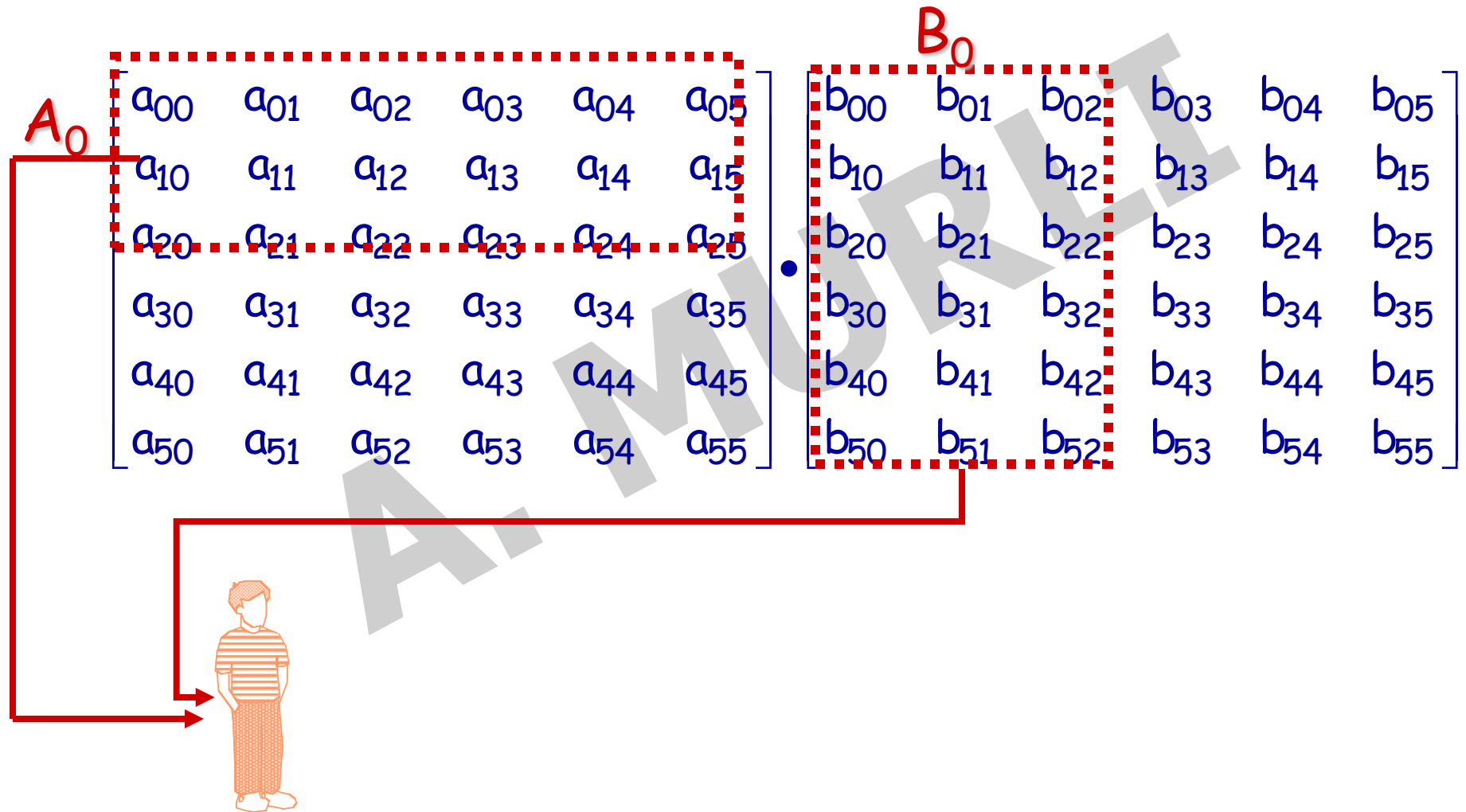
ovvero

Come decomporre
il problema

I STRATEGIA

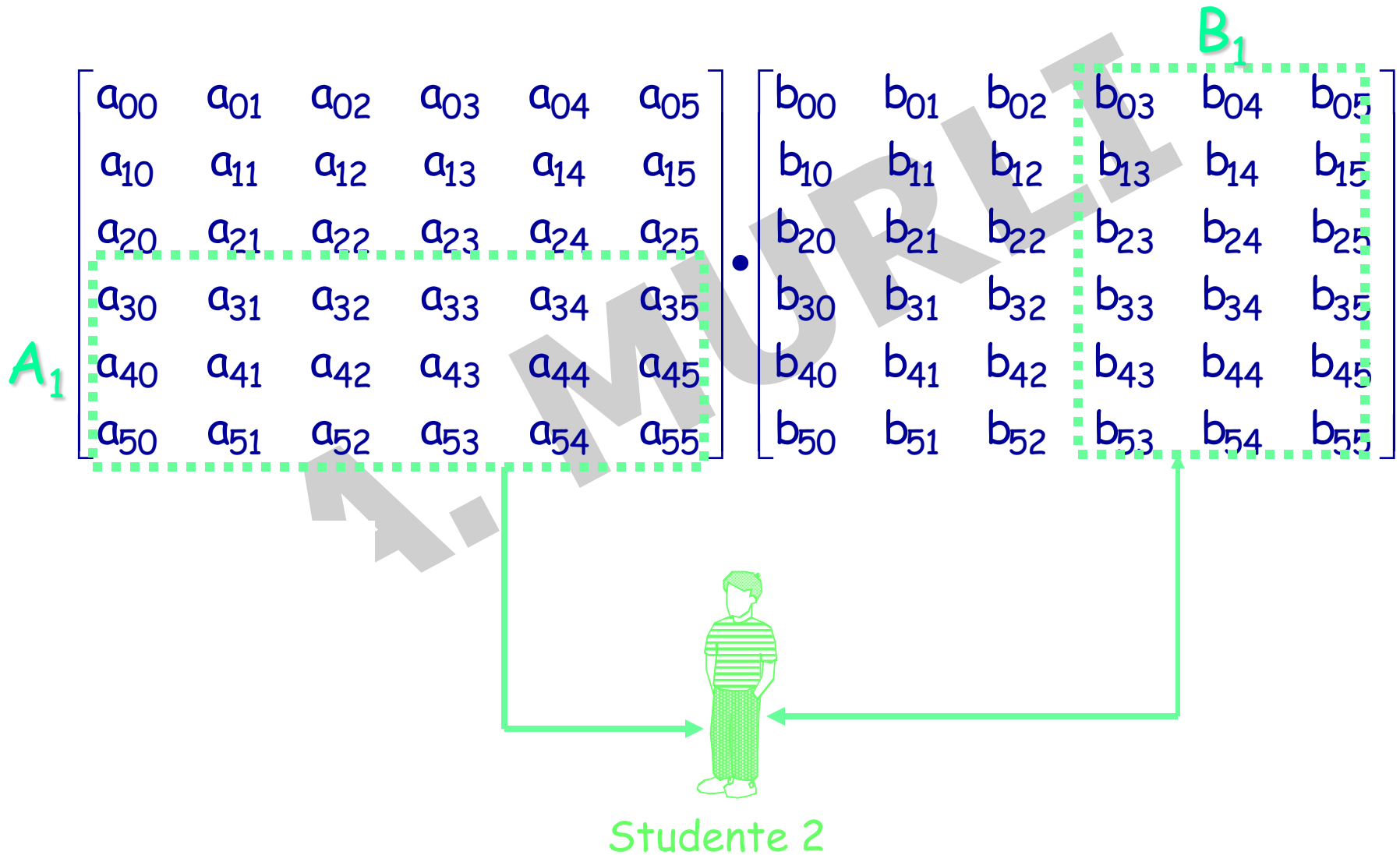
suddividiamo
la matrice A in
blocchi di **RIGHE**
e la matrice B in
blocchi di **COLONNE**

Distribuzione dei dati: Esempio $n=6, p=2$



Studente 1

Distribuzione dei dati: Esempio $n=6, p=2$



I Strategia:

$$\begin{matrix} & & \mathbf{A}_0 & & & \\ & & & & & \\ \begin{bmatrix} a_{00} & a_{01} & a_{02} & a_{03} & a_{04} & a_{05} \\ a_{10} & a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{20} & a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \end{bmatrix} & \cdot & \begin{bmatrix} b_{00} & b_{01} & b_{02} \\ b_{10} & b_{11} & b_{12} \\ b_{20} & b_{21} & b_{22} \\ b_{30} & b_{31} & b_{32} \\ b_{40} & b_{41} & b_{42} \\ b_{50} & b_{51} & b_{50} \end{bmatrix} & = & \begin{matrix} & & \mathbf{C}_{00} & & & \\ & & & & & \\ \begin{bmatrix} c_{00} & c_{01} & c_{02} & c_{03} & c_{04} & c_{05} \\ c_{10} & c_{11} & c_{12} & c_{13} & c_{14} & c_{15} \\ c_{20} & c_{21} & c_{22} & c_{23} & c_{24} & c_{25} \\ c_{30} & c_{31} & c_{32} & c_{33} & c_{34} & c_{35} \\ c_{40} & c_{41} & c_{42} & c_{43} & c_{44} & c_{45} \\ c_{50} & c_{51} & c_{52} & c_{53} & c_{54} & c_{55} \end{bmatrix} & & & & & \end{matrix}
 \end{matrix}$$



Studente 1

Matrice - Matrice

*Lo studente 1
calcola
alcune componenti
della matrice C!*

I Strategia:

$$\begin{bmatrix} a_{00} & a_{01} & a_{02} & a_{03} & a_{04} & a_{05} \\ a_{10} & a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{20} & a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \end{bmatrix} \cdot \begin{bmatrix} b_{00} & b_{01} & b_{02} & b_{03} & b_{04} & b_{05} \\ b_{10} & b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{20} & b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ b_{30} & b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{40} & b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \\ b_{50} & b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \end{bmatrix} = \begin{bmatrix} c_{00} & c_{01} & c_{02} & c_{03} & c_{04} & c_{05} \\ c_{10} & c_{11} & c_{12} & c_{13} & c_{14} & c_{15} \\ c_{20} & c_{21} & c_{22} & c_{23} & c_{24} & c_{25} \\ c_{30} & c_{31} & c_{32} & c_{33} & c_{34} & c_{35} \\ c_{40} & c_{41} & c_{42} & c_{43} & c_{44} & c_{45} \\ c_{50} & c_{51} & c_{52} & c_{53} & c_{54} & c_{55} \end{bmatrix}$$

The matrix B is partitioned into two blocks: B_0 (rows 0-2, columns 0-2) and B_1 (rows 0-2, columns 3-5). The resulting matrix C is partitioned into two blocks: C_{00} (rows 0-2, columns 0-2) and C_{01} (rows 0-2, columns 3-5).



Studente 1

I Strategia:

$$\begin{bmatrix} a_{30} & a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{40} & a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{50} & a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \cdot \begin{bmatrix} b_{03} & b_{04} & b_{05} \\ b_{13} & b_{14} & b_{15} \\ b_{23} & b_{24} & b_{25} \\ b_{33} & b_{34} & b_{35} \\ b_{43} & b_{44} & b_{45} \\ b_{53} & b_{54} & b_{55} \end{bmatrix} = \begin{bmatrix} c_{00} & c_{01} & c_{02} & c_{03} & c_{04} & c_{05} \\ c_{10} & c_{11} & c_{12} & c_{13} & c_{14} & c_{15} \\ c_{20} & c_{21} & c_{22} & c_{23} & c_{24} & c_{25} \\ c_{30} & c_{31} & c_{32} & c_{33} & c_{34} & c_{35} \\ c_{40} & c_{41} & c_{42} & c_{43} & c_{44} & c_{45} \\ c_{50} & c_{51} & c_{52} & c_{53} & c_{54} & c_{55} \end{bmatrix}$$



Studente 2

Lo studente 2 ^{c_{11}}
calcola
alcune componenti
della matrice C!

I Strategia:

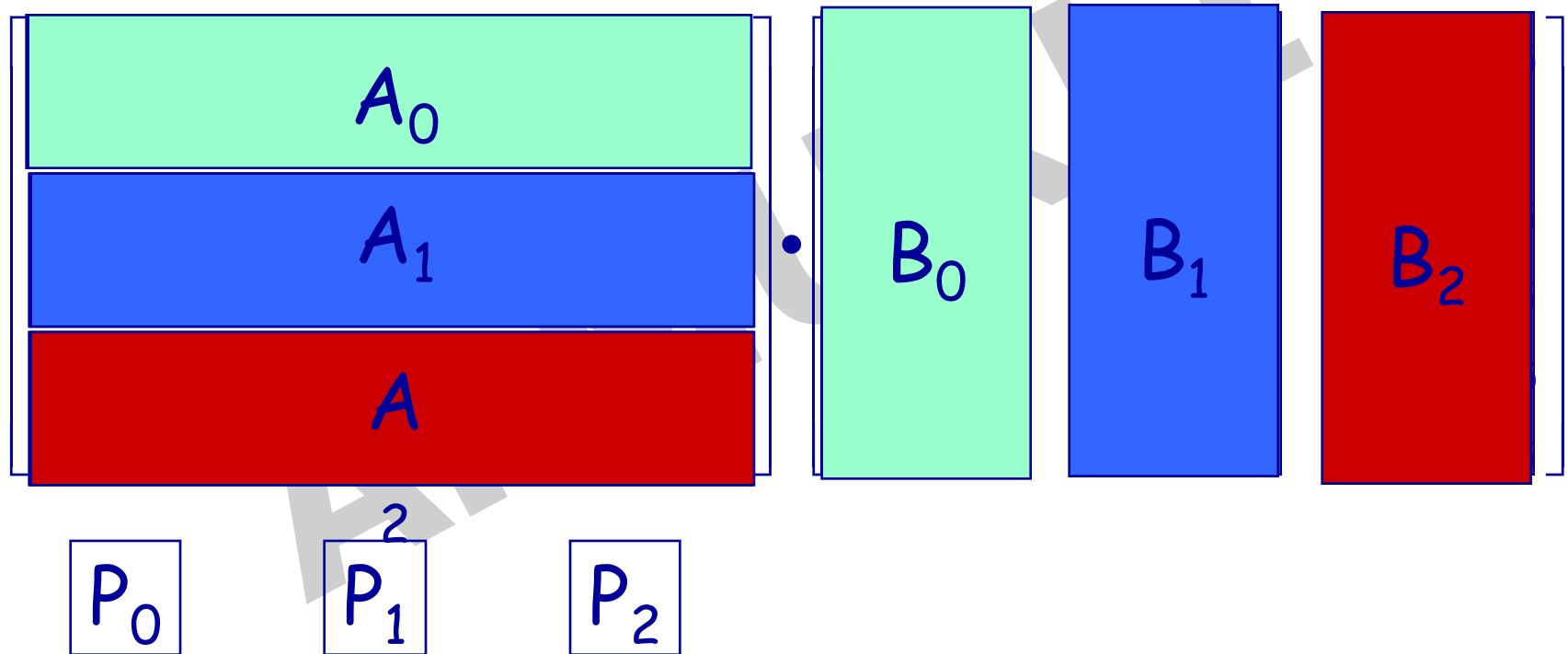
$$\begin{bmatrix} a_{30} & a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{40} & a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{50} & a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \cdot \begin{bmatrix} b_{00} & b_{01} & b_{02} & b_{03} & b_{04} & b_{05} \\ b_{10} & b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{20} & b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ b_{30} & b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{40} & b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \\ b_{50} & b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \end{bmatrix} = \begin{bmatrix} c_{00} & c_{01} & c_{02} & c_{03} & c_{04} & c_{05} \\ c_{10} & c_{11} & c_{12} & c_{13} & c_{14} & c_{15} \\ c_{20} & c_{21} & c_{22} & c_{23} & c_{24} & c_{25} \\ c_{30} & c_{31} & c_{32} & c_{33} & c_{34} & c_{35} \\ c_{40} & c_{41} & c_{42} & c_{43} & c_{44} & c_{45} \\ c_{50} & c_{51} & c_{52} & c_{53} & c_{54} & c_{55} \end{bmatrix}$$

A_1 (green), B_0 (red), B_1 (green), C_{10} (green), C_{11} (green)



Studente 2

I STRATEGIA: distribuzione $n=6$ $p=3$



I STRATEGIA: calcolo

The diagram illustrates the multiplication of a 3x2 matrix A by a 3x1 vector of matrices $[B_0, B_1, B_2]$ to produce a 3x1 vector of matrices $[C_{00}, C_{11}, C_{22}]$. The matrix A is composed of three rows: A_0 (green), A_1 (blue), and A (red). The matrices B_0 , B_1 , and B_2 are also colored green, blue, and red respectively. The resulting matrices C_{00} , C_{11} , and C_{22} are colored green, blue, and red respectively. The matrix C_{00} is a 3x2 matrix with elements $c_{00}, c_{02}, c_{03}, c_{04}, c_{05}$ in the first row; $c_{12}, c_{13}, c_{14}, c_{15}$ in the second row; and $c_{20}, c_{21}, c_{24}, c_{25}$ in the third row. The matrix C_{11} is a 3x2 matrix with elements $c_{30}, c_{31}, c_{34}, c_{35}$ in the first row; $c_{40}, c_{41}, c_{42}, c_{43}$ in the second row; and $c_{50}, c_{51}, c_{52}, c_{53}$ in the third row. The matrix C_{22} is a 3x2 matrix with elements c_{34}, c_{35} in the first row; c_{42}, c_{43} in the second row; and c_{52}, c_{53} in the third row.

$$\begin{bmatrix} A_0 \\ A_1 \\ A \end{bmatrix} \times \begin{bmatrix} B_0 \\ B_1 \\ B_2 \end{bmatrix} = \begin{bmatrix} C_{00} \\ C_{11} \\ C_{22} \end{bmatrix}$$

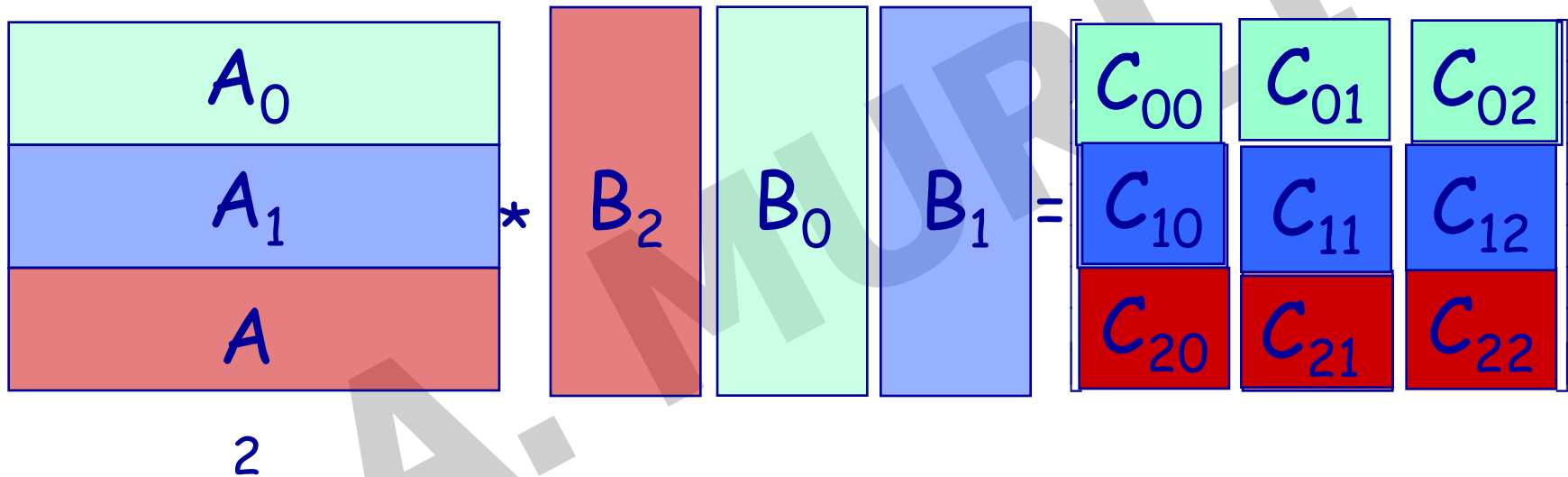
2

I STRATEGIA: calcolo

$$\begin{array}{|c|} \hline A_0 \\ \hline A_1 \\ \hline A \\ \hline \end{array} * \begin{array}{|c|} \hline B_1 \\ \hline B_2 \\ \hline B_0 \\ \hline \end{array} = \begin{array}{|c|} \hline C_{00} \\ \hline C_{11} \\ \hline C_{20} \\ \hline \end{array} \begin{array}{|c|} \hline C_{01} \\ \hline C_{12} \\ \hline C_{22} \\ \hline \end{array} \begin{array}{|c|} \hline c_{04} \quad c_{05} \\ c_{14} \quad c_{15} \\ \hline \end{array}$$

2

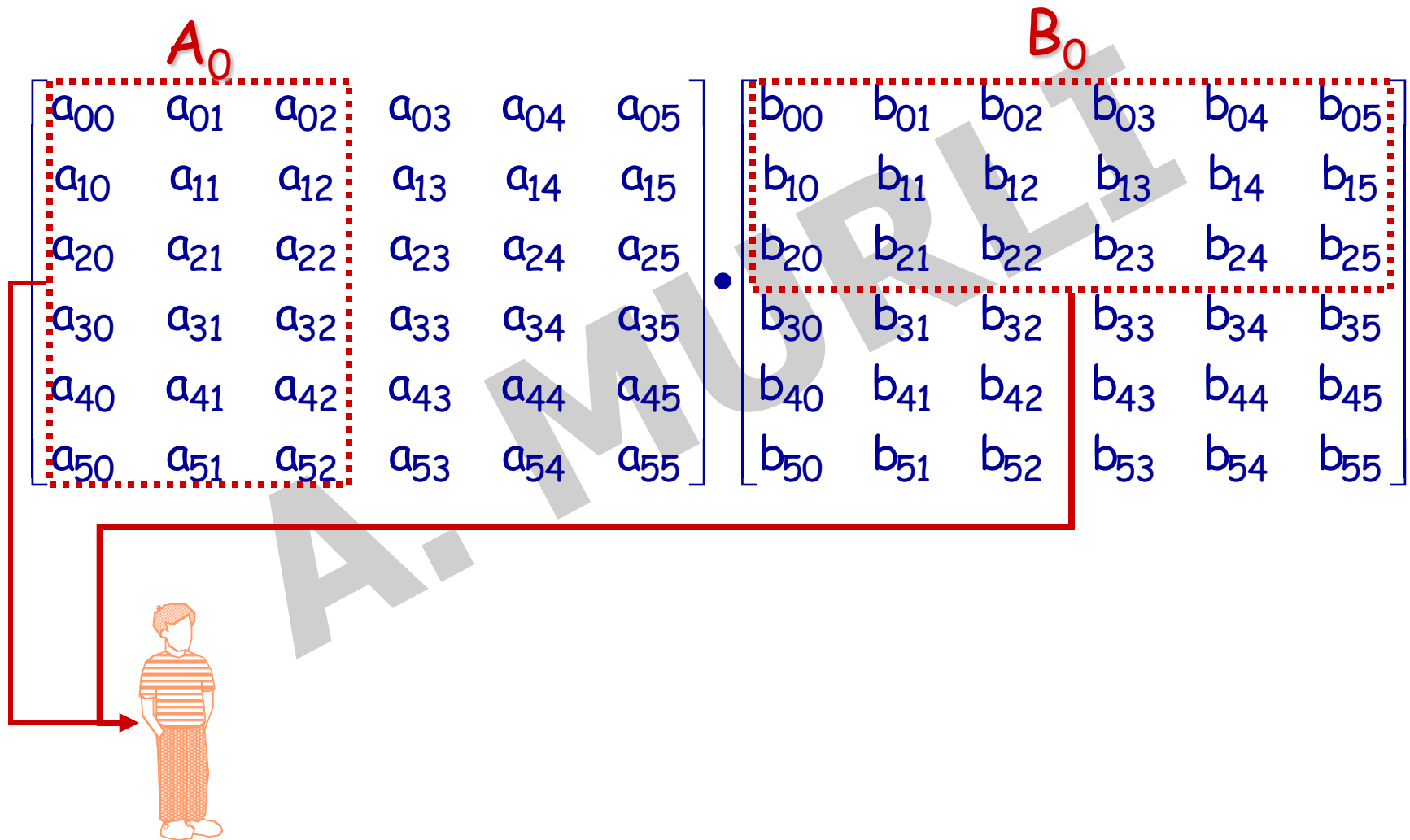
I STRATEGIA: calcolo



II strategia

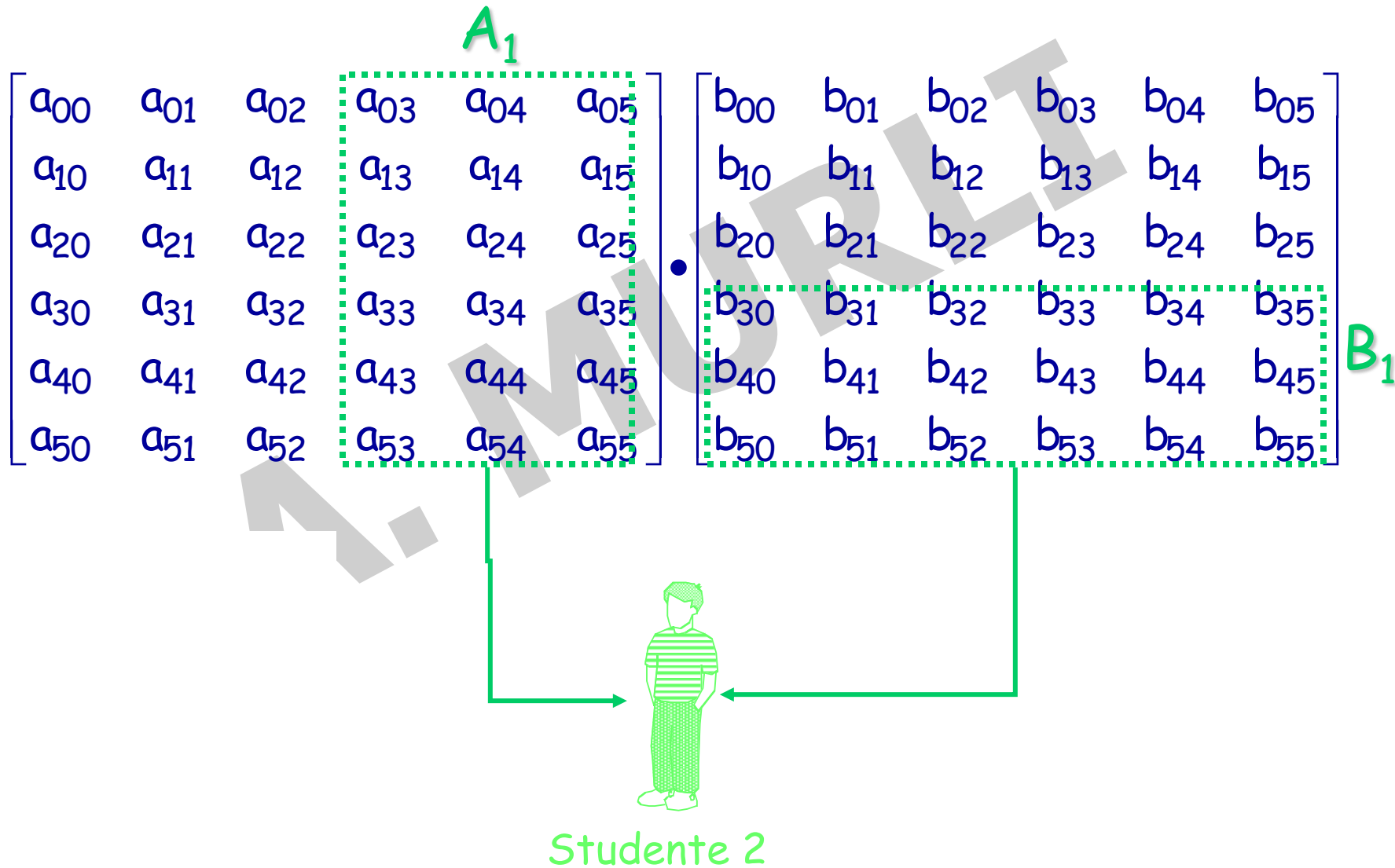
suddividiamo
la matrice A in
blocchi di COLONNE
e la matrice B in
blocchi di RIGHE

II strategia: Distribuzione dei dati



Studente 1

Distribuzione dei dati: Esempio $n=6, p=2$



II Strategia: Esempio $n=6, p=2$

$$\begin{matrix} & \mathbf{A_0} \\ \begin{bmatrix} a_{00} & a_{01} & a_{02} \\ a_{10} & a_{11} & a_{12} \\ a_{20} & a_{21} & a_{22} \\ a_{30} & a_{31} & a_{32} \\ a_{40} & a_{41} & a_{42} \\ a_{50} & a_{51} & a_{50} \end{bmatrix} & \cdot & \begin{bmatrix} b_{00} & b_{01} & b_{02} & b_{03} & b_{04} & b_{05} \\ b_{10} & b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{20} & b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \end{bmatrix} & = & \begin{bmatrix} ? \\ ? \\ ? \\ ? \\ ? \\ ? \end{bmatrix} \end{matrix}$$



Studente 1

Matrice - Matrice

*quali componenti
della matrice C
calcola lo studente 1*

?

II Strategia: Esempio $n=6, p=2$

$$A_1 \cdot B_1 = [?]$$

The image shows the multiplication of two matrices, A_1 and B_1 , resulting in a matrix with a question mark. Matrix A_1 is a 6×3 matrix with elements a_{ij} where i is the row index (0 to 5) and j is the column index (3 to 5). Matrix B_1 is a 3×6 matrix with elements b_{ij} where i is the row index (3 to 5) and j is the column index (0 to 5). The result is a 6×6 matrix, indicated by a large question mark in brackets.



Studente 2

*quali componenti
della matrice C
calcola lo studente 2*

?

Osservazione: esempio $n = 6, p = 2$

Il generico elemento della matrice C è uguale a:

$$c_{ij} = \sum_{k=0}^5 a_{ik} b_{kj} \quad i, j = 0, 5$$

k = Indice delle colonne di A
e Indice di riga di B

Pertanto...

$$c_{ij} = \sum_{k=0}^5 a_{ik} b_{kj} = \sum_{k=0}^2 a_{ik} b_{kj} + \sum_{k=3}^5 a_{ik} b_{kj}$$

$i, j = 0, 5$

*Ciascun studente calcola
"un contributo"
di tutti gli elementi
della matrice C!*



Studente 1



Studente 2

Ovvero, in forma matriciale

$$\begin{bmatrix} C_{00} & C_{01} & C_{02} & C_{03} & C_{04} & C_{05} \\ C_{10} & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} \\ C_{20} & C_{21} & C_{22} & C_{23} & C_{24} & C_{25} \\ C_{30} & C_{31} & C_{32} & C_{33} & C_{34} & C_{35} \\ C_{40} & C_{41} & C_{42} & C_{43} & C_{44} & C_{45} \\ C_{50} & C_{51} & C_{52} & C_{53} & C_{54} & C_{55} \end{bmatrix} = \begin{bmatrix} C_{00}^1 & C_{01}^1 & C_{02}^1 & C_{03}^1 & C_{04}^1 & C_{05}^1 \\ C_{10}^1 & C_{11}^1 & C_{12}^1 & C_{13}^1 & C_{14}^1 & C_{15}^1 \\ C_{20}^1 & C_{21}^1 & C_{22}^1 & C_{23}^1 & C_{24}^1 & C_{25}^1 \\ C_{30}^1 & C_{31}^1 & C_{32}^1 & C_{33}^1 & C_{34}^1 & C_{35}^1 \\ C_{40}^1 & C_{41}^1 & C_{42}^1 & C_{43}^1 & C_{44}^1 & C_{45}^1 \\ C_{50}^1 & C_{51}^1 & C_{52}^1 & C_{53}^1 & C_{54}^1 & C_{55}^1 \end{bmatrix} + \begin{bmatrix} C_{00}^2 & C_{01}^2 & C_{02}^2 & C_{03}^2 & C_{04}^2 & C_{05}^2 \\ C_{10}^2 & C_{11}^2 & C_{12}^2 & C_{13}^2 & C_{14}^2 & C_{15}^2 \\ C_{20}^2 & C_{21}^2 & C_{22}^2 & C_{23}^2 & C_{24}^2 & C_{25}^2 \\ C_{30}^2 & C_{31}^2 & C_{32}^2 & C_{33}^2 & C_{34}^2 & C_{35}^2 \\ C_{40}^2 & C_{41}^2 & C_{42}^2 & C_{43}^2 & C_{44}^2 & C_{45}^2 \\ C_{50}^2 & C_{51}^2 & C_{52}^2 & C_{53}^2 & C_{54}^2 & C_{55}^2 \end{bmatrix}$$

*Ciascun studente calcola
"un contributo"
dell'intera matrice C!*



Studente 1



Studente 2

Ovvero, in forma matriciale

$$\begin{bmatrix} C_{00} & C_{01} & C_{02} & C_{03} & C_{04} & C_{05} \\ C_{10} & C_{11} & C_{12} & C_{13} & C_{14} & C_{15} \\ C_{20} & C_{21} & C_{22} & C_{23} & C_{24} & C_{25} \\ C_{30} & C_{31} & C_{32} & C_{33} & C_{34} & C_{35} \\ C_{40} & C_{41} & C_{42} & C_{43} & C_{44} & C_{45} \\ C_{50} & C_{51} & C_{52} & C_{53} & C_{54} & C_{55} \end{bmatrix} = \begin{array}{c} \text{C1} \\ \text{C2} \end{array}$$

*Ciascun studente calcola
"un contributo"
dell'intera matrice C!*



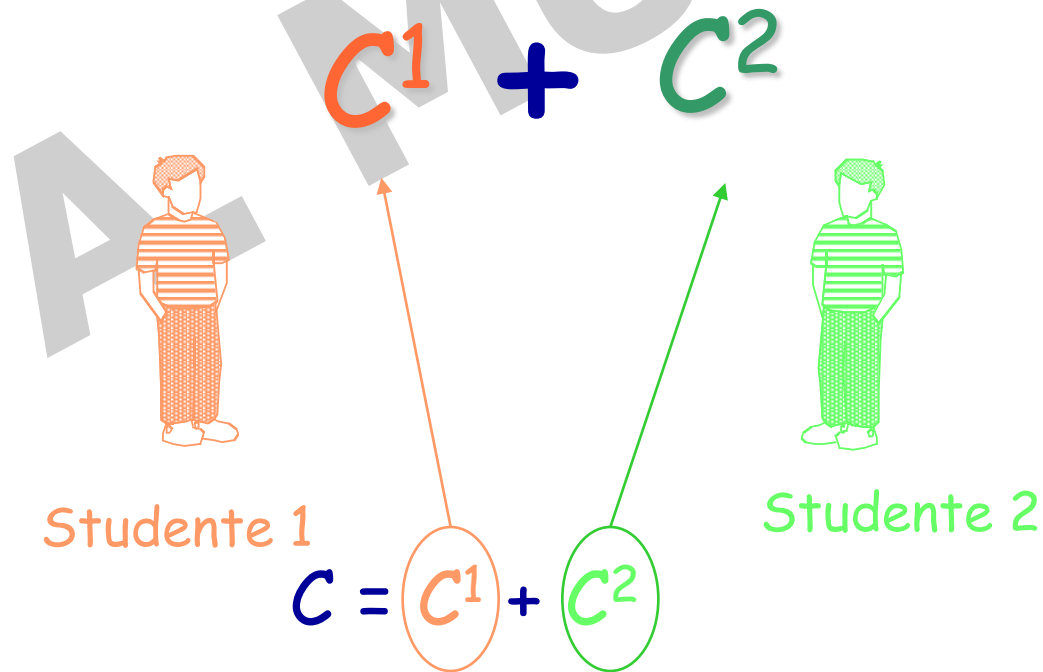
Studente 1



Studente 2

II STRATEGIA: Esempio $n=6, p=2$

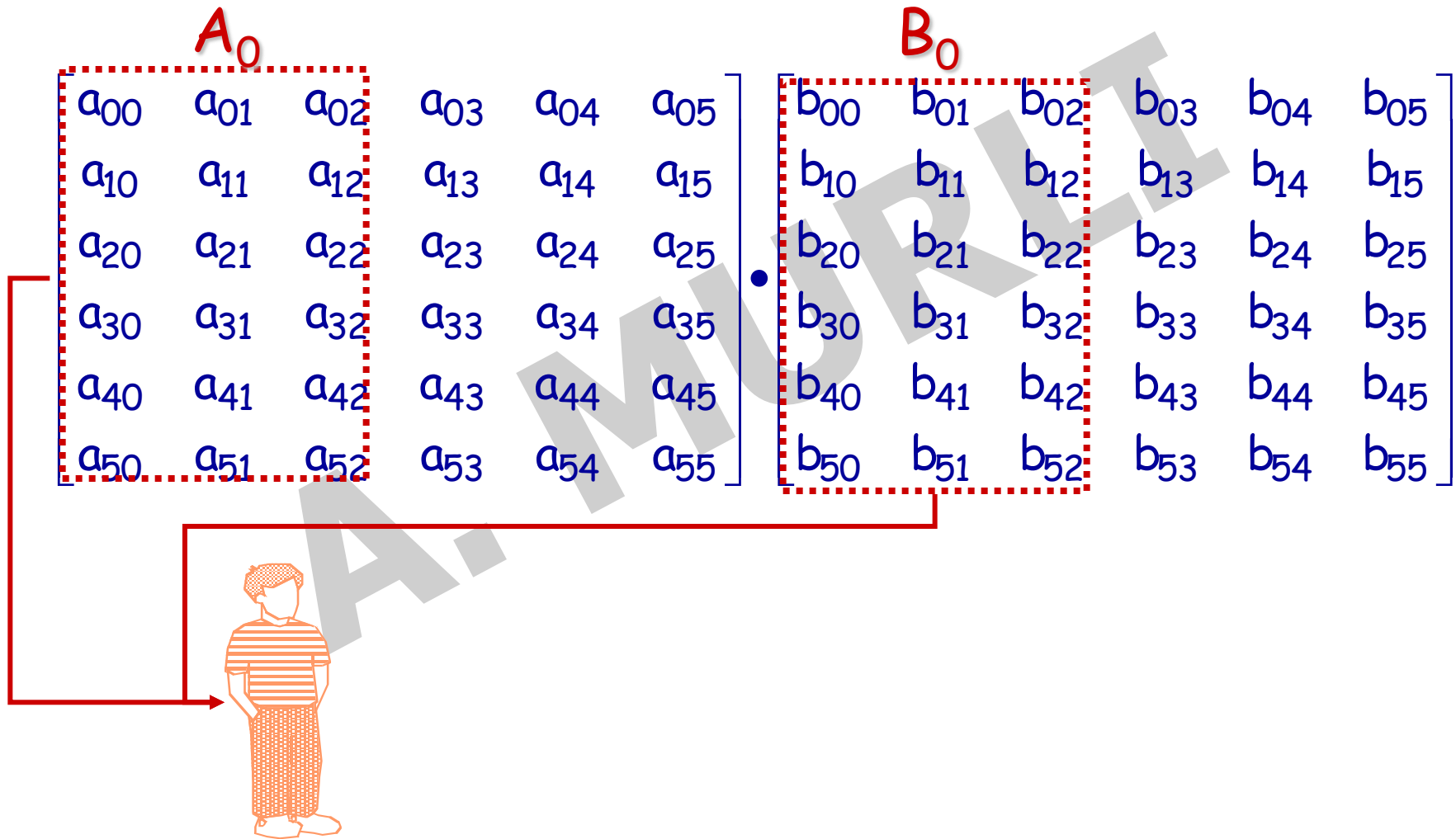
Per ottenere la matrice C
Si devono **sommare** i risultati parziali



III strategia

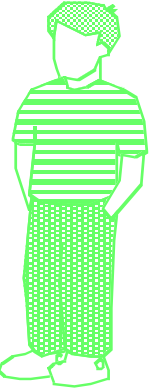
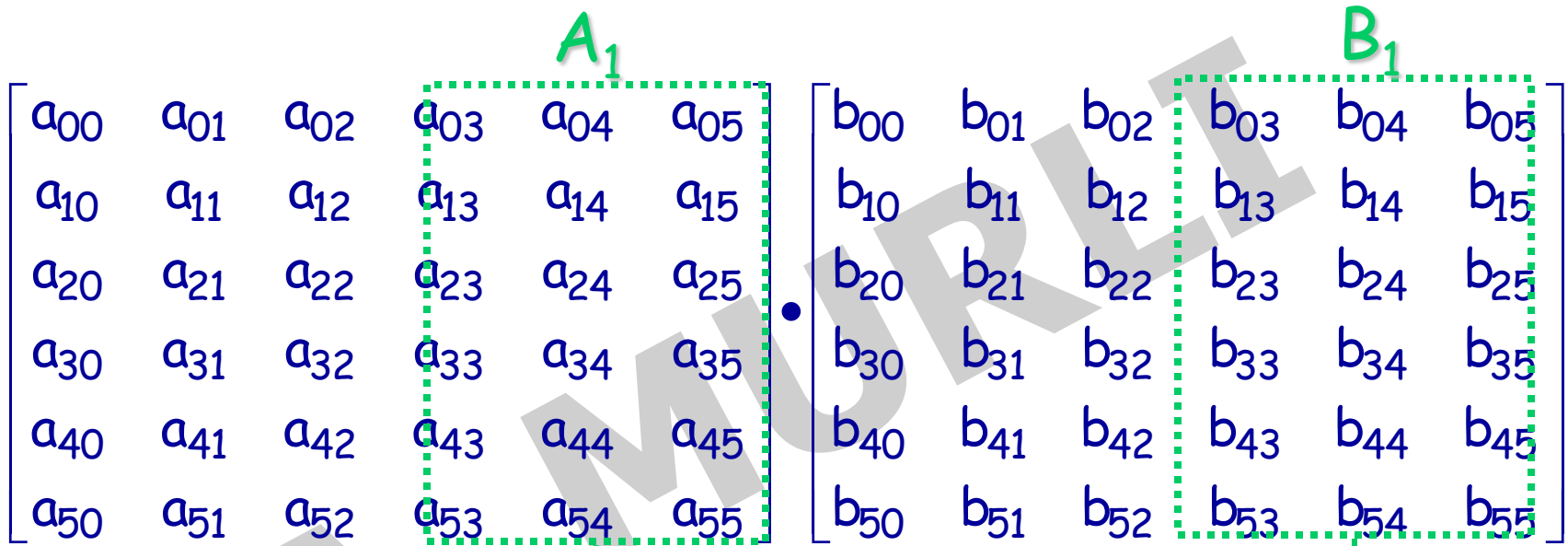
Suddividiamo
ENTRAMBE
le matrici A e B in
blocchi di COLONNE

Distribuzione dei dati: Esempio n=6



studente1

Distribuzione dei dati: Esempio n=6



studente2

III Strategia: Esempio n=6

$$\begin{matrix} & A_0 & & B_0 & & \\ \begin{bmatrix} a_{00} & a_{01} & a_{02} \\ a_{10} & a_{11} & a_{12} \\ a_{20} & a_{21} & a_{22} \\ a_{30} & a_{31} & a_{32} \\ a_{40} & a_{41} & a_{42} \\ a_{50} & a_{51} & a_{52} \end{bmatrix} & \cdot & \begin{bmatrix} b_{00} & b_{01} & b_{02} \\ b_{10} & b_{11} & b_{12} \\ b_{20} & b_{21} & b_{22} \\ b_{30} & b_{31} & b_{32} \\ b_{40} & b_{41} & b_{42} \\ b_{50} & b_{51} & b_{52} \end{bmatrix} & = & \begin{bmatrix} ? \\ ? \\ ? \\ ? \\ ? \\ ? \end{bmatrix} \end{matrix}$$



Studente 1

Matrice - Matrice

*quali componenti
della matrice C
calcola lo studente 1*

?

III Strategia: Esempio n=6

$$\begin{matrix} A_1 \\ \left[\begin{array}{ccc} a_{03} & a_{04} & a_{05} \\ a_{13} & a_{14} & a_{15} \\ a_{23} & a_{24} & a_{25} \\ a_{33} & a_{34} & a_{35} \\ a_{43} & a_{44} & a_{45} \\ a_{53} & a_{54} & a_{55} \end{array} \right] \cdot \left[\begin{array}{ccc} b_{03} & b_{04} & b_{05} \\ b_{13} & b_{14} & b_{15} \\ b_{23} & b_{24} & b_{25} \\ b_{33} & b_{34} & b_{35} \\ b_{43} & b_{44} & b_{45} \\ b_{53} & b_{54} & b_{55} \end{array} \right] = \left[? \right] \end{matrix}$$



Studente 2

*quali componenti
della matrice C
calcola lo studente 2*

?

Premessa...

C

A

B

$$\begin{bmatrix} c_{00} & c_{01} & c_{02} & c_{03} & c_{04} & c_{05} \\ c_{10} & c_{11} & c_{12} & c_{13} & c_{14} & c_{15} \\ c_{20} & c_{21} & c_{22} & c_{23} & c_{24} & c_{25} \\ c_{30} & c_{31} & c_{32} & c_{33} & c_{34} & c_{35} \\ c_{40} & c_{41} & c_{42} & c_{43} & c_{44} & c_{45} \\ c_{50} & c_{51} & c_{52} & c_{53} & c_{54} & c_{55} \end{bmatrix} = \begin{bmatrix} a_{00} & a_{01} & a_{02} & a_{03} & a_{04} & a_{05} \\ a_{10} & a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{20} & a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{30} & a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{40} & a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{50} & a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \cdot \begin{bmatrix} b_{00} & b_{01} & b_{02} & b_{03} & b_{04} & b_{05} \\ b_{10} & b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{20} & b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ b_{30} & b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{40} & b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \\ b_{50} & b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \end{bmatrix}$$

A_0
 A_1
 B_0
 B_1

Riorganizziamo la matrice **C** in blocchi quadrati

Premessa...

$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} a_{00} & a_{01} & a_{02} & a_{03} & a_{04} & a_{05} \\ a_{10} & a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ a_{20} & a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ a_{30} & a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ a_{40} & a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \\ a_{50} & a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \cdot \begin{bmatrix} b_{00} & b_{01} & b_{02} & b_{03} & b_{04} & b_{05} \\ b_{10} & b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{20} & b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ b_{30} & b_{31} & b_{32} & b_{33} & b_{34} & b_{35} \\ b_{40} & b_{41} & b_{42} & b_{43} & b_{44} & b_{45} \\ b_{50} & b_{51} & b_{52} & b_{53} & b_{54} & b_{55} \end{bmatrix}$$

A_0 A_1 B_0 B_1

Riorganizziamo la matrice C in blocchi quadrati

Allo stesso modo riorganizziamo

i blocchi di colonne di A e B !

Osservazione...

$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} A_{00} & A_{01} \\ A_{10} & A_{11} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} \\ B_{10} & B_{11} \end{bmatrix}$$

The diagram illustrates the block matrix multiplication of $C = A \cdot B$. The matrix C is partitioned into four blocks: C_{00} , C_{01} , C_{10} , and C_{11} . The matrix A is partitioned into two columns of blocks: A_0 (containing A_{00} and A_{10}) and A_1 (containing A_{01} and A_{11}). The matrix B is partitioned into two rows of blocks: B_0 (containing B_{00} and B_{10}) and B_1 (containing B_{01} and B_{11}). A dot indicates the multiplication of the A and B matrices. The labels A_0 , A_1 , B_0 , and B_1 are shown below their respective block matrices.

Riorganizziamo la matrice C in **blocchi quadrati**

Allo stesso modo riorganizziamo

i blocchi di colonne di A e B !

Osservazione...

$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} A_{00} & A_{01} \\ A_{10} & A_{11} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} \\ B_{10} & B_{11} \end{bmatrix}$$

A_0 A_1 B_0 B_1

Pertanto...

$$C_{00} = A_{00} B_{00} + A_{01} B_{10}$$

$$C_{10} = A_{10} B_{00} + A_{11} B_{10}$$

$$C_{01} = A_{00} B_{01} + A_{01} B_{11}$$

$$C_{11} = A_{10} B_{01} + A_{11} B_{11}$$

Fase di calcolo

$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} A_{00} & A_{01} \\ A_{10} & A_{11} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} \\ B_{10} & B_{11} \end{bmatrix}$$

A_0 B_0

Pertanto...

$$C_{00} = A_{00} B_{00} + A_{01} B_{10}$$

$$C_{10} = A_{10} B_{00} + A_{11} B_{10}$$

$$C_{01} = A_{00} B_{01} + A_{01} B_{11}$$

$$C_{11} = A_{10} B_{01} + A_{11} B_{11}$$



Studente 1

Lo studente 1
calcola "un contributo"
di "una parte" della
matrice C!

Fase di calcolo

$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} A_{00} & A_{01} \\ A_{10} & A_{11} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} \\ B_{10} & B_{11} \end{bmatrix}$$

A_1 B_1

Pertanto...

$$C_{00} = A_{00} B_{00} + A_{01} B_{10}$$

$$C_{10} = A_{10} B_{00} + A_{11} B_{10}$$

$$C_{01} = A_{00} B_{01} + A_{01} B_{11}$$

$$C_{11} = A_{10} B_{01} + A_{11} B_{11}$$



Studente 2

Lo studente 2
calcola "un contributo"
di "una parte" della
matrice C!

Come "completare"
i contributi calcolati

?

$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} A_{00} & A_{01} \\ A_{10} & A_{11} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} \\ B_{10} & B_{11} \end{bmatrix}$$

A_0

A_1

B_0

Pertanto...

$$C_{00} = A_{00} B_{00} + A_{01} B_{10}$$

$$C_{10} = A_{10} B_{00} + A_{11} B_{10}$$

$$C_{01} = A_{00} B_{01} + A_{01} B_{11}$$

$$C_{11} = A_{10} B_{01} + A_{11} B_{11}$$

Studente 1



$$\begin{bmatrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{bmatrix} = \begin{bmatrix} A_{00} & A_{01} \\ A_{10} & A_{11} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} \\ B_{10} & B_{11} \end{bmatrix}$$

A_0
 A_1
 B_1

Pertanto...

$$C_{00} = A_{00} B_{00} + A_{01} B_{10}$$

$$C_{10} = A_{10} B_{00} + A_{11} B_{10}$$

$$C_{01} = A_{00} B_{01} + A_{01} B_{11}$$

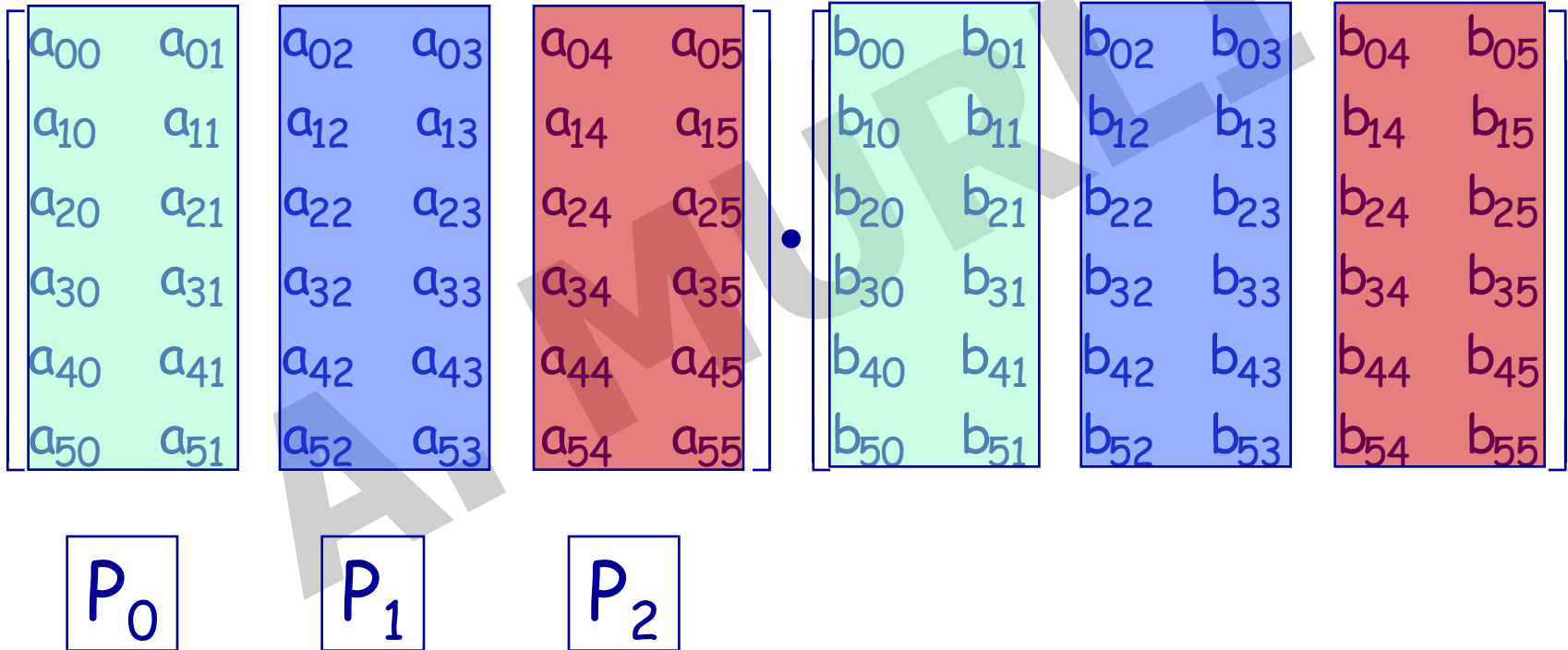
$$C_{11} = A_{10} B_{01} + A_{11} B_{11}$$



Studente 2

III STRATEGIA: $n=6$ $p=3$

Distribuzione dei dati



III STRATEGIA:

 P_0 P_1 P_2

Riguardiamo le matrici a blocchi quadrati

$$\begin{bmatrix} A_{00} & A_{01} & A_{02} \\ A_{10} & A_{11} & A_{12} \\ A_{20} & A_{21} & A_{22} \end{bmatrix} \cdot \begin{bmatrix} B_{00} & B_{01} & B_{02} \\ B_{10} & B_{11} & B_{12} \\ B_{20} & B_{21} & B_{22} \end{bmatrix} = \begin{bmatrix} C_{00} & C_{01} & C_{02} \\ C_{10} & C_{11} & C_{12} \\ C_{20} & C_{21} & C_{22} \end{bmatrix}$$

$$C_{00} = A_{00} * B_{00} + A_{01} * B_{10} + A_{02} * B_{20}$$

$$C_{10} = A_{10} * B_{00} + A_{11} * B_{10} + A_{12} * B_{20}$$

$$C_{20} = A_{20} * B_{00} + A_{21} * B_{10} + A_{22} * B_{20}$$

$$C_{01} = A_{00} * B_{01} + A_{01} * B_{11} + A_{02} * B_{21}$$

$$C_{11} = A_{10} * B_{01} + A_{11} * B_{11} + A_{12} * B_{21}$$

$$C_{21} = A_{20} * B_{01} + A_{21} * B_{11} + A_{22} * B_{21}$$

$$C_{02} = A_{00} * B_{02} + A_{01} * B_{12} + A_{02} * B_{22}$$

$$C_{12} = A_{10} * B_{02} + A_{11} * B_{12} + A_{12} * B_{22}$$

$$C_{22} = A_{20} * B_{02} + A_{21} * B_{12} + A_{22} * B_{22}$$

III STRATEGIA: calcolo

$$C_{00} = A_{00} * B_{00} + A_{01} * B_{10} + A_{02} * B_{20}$$

$$C_{10} = A_{10} * B_{00} + A_{11} * B_{10} + A_{12} * B_{20}$$

$$C_{20} = A_{20} * B_{00} + A_{21} * B_{10} + A_{22} * B_{20}$$

$$C_{01} = A_{00} * B_{01} + A_{01} * B_{11} + A_{02} * B_{21}$$

$$C_{11} = A_{10} * B_{01} + A_{11} * B_{11} + A_{12} * B_{21}$$

$$C_{21} = A_{20} * B_{01} + A_{21} * B_{11} + A_{22} * B_{21}$$

$$C_{02} = A_{00} * B_{02} + A_{01} * B_{12} + A_{02} * B_{22}$$

$$C_{12} = A_{10} * B_{02} + A_{11} * B_{12} + A_{12} * B_{22}$$

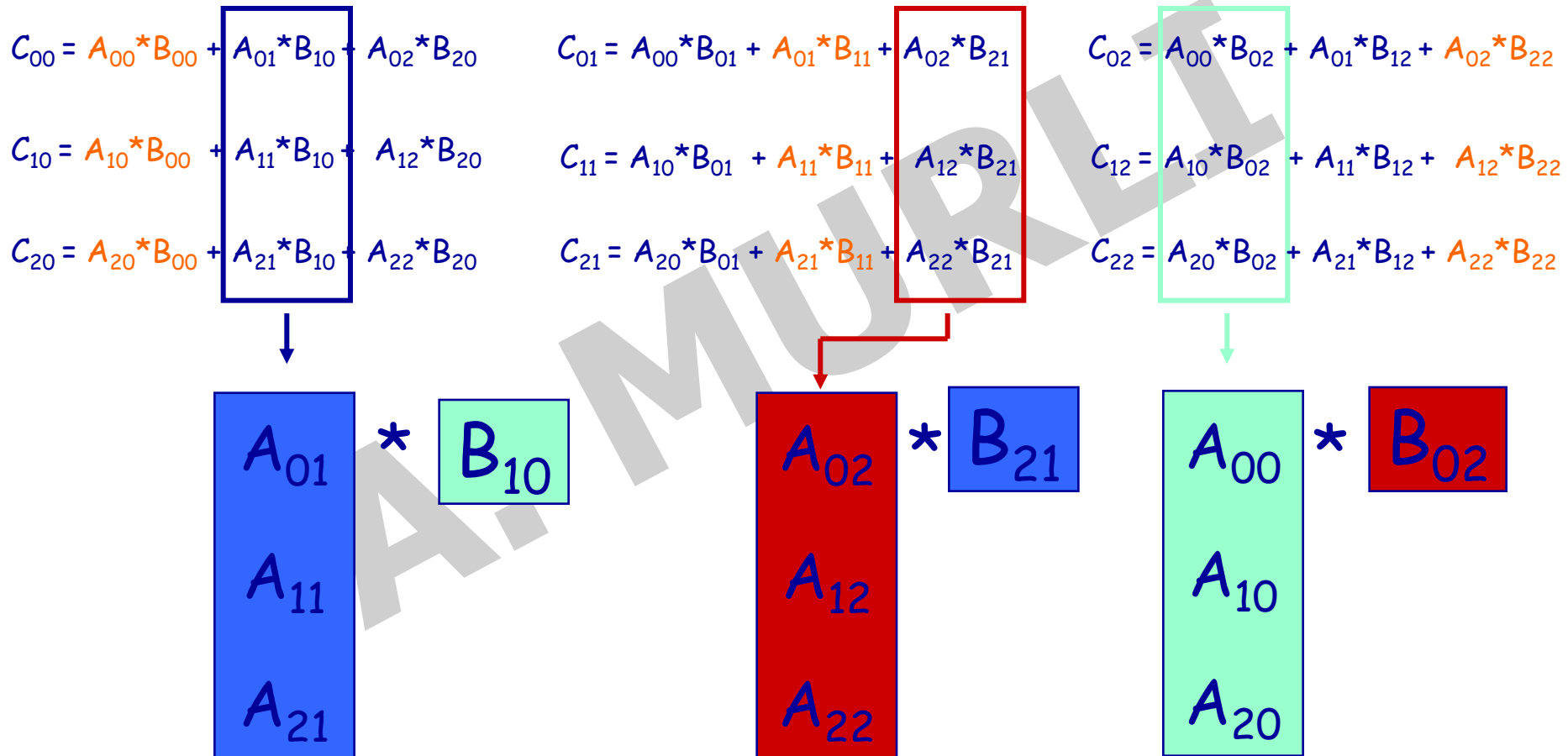
$$C_{22} = A_{20} * B_{02} + A_{21} * B_{12} + A_{22} * B_{22}$$

$$\begin{bmatrix} A_{00} \\ A_{10} \\ A_{20} \end{bmatrix} * B_{00}$$

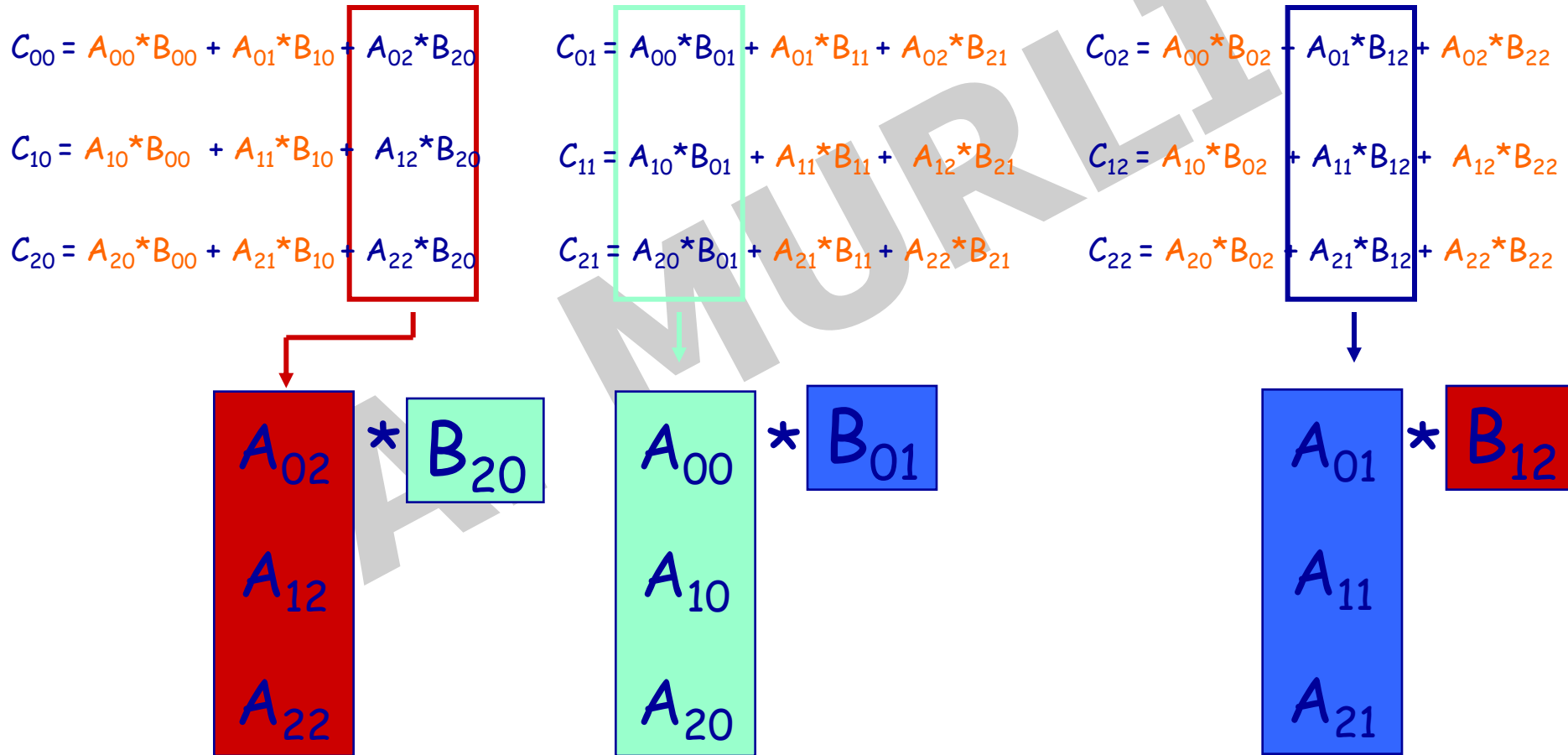
$$\begin{bmatrix} A_{01} \\ A_{11} \\ A_{21} \end{bmatrix} * B_{11}$$

$$\begin{bmatrix} A_{02} \\ A_{12} \\ A_{22} \end{bmatrix} * B_{22}$$

III STRATEGIA: calcolo



III STRATEGIA: calcolo



A. MURLI

FINE LEZIONE