5.3.3 Matrix-matrix multiplication by rows

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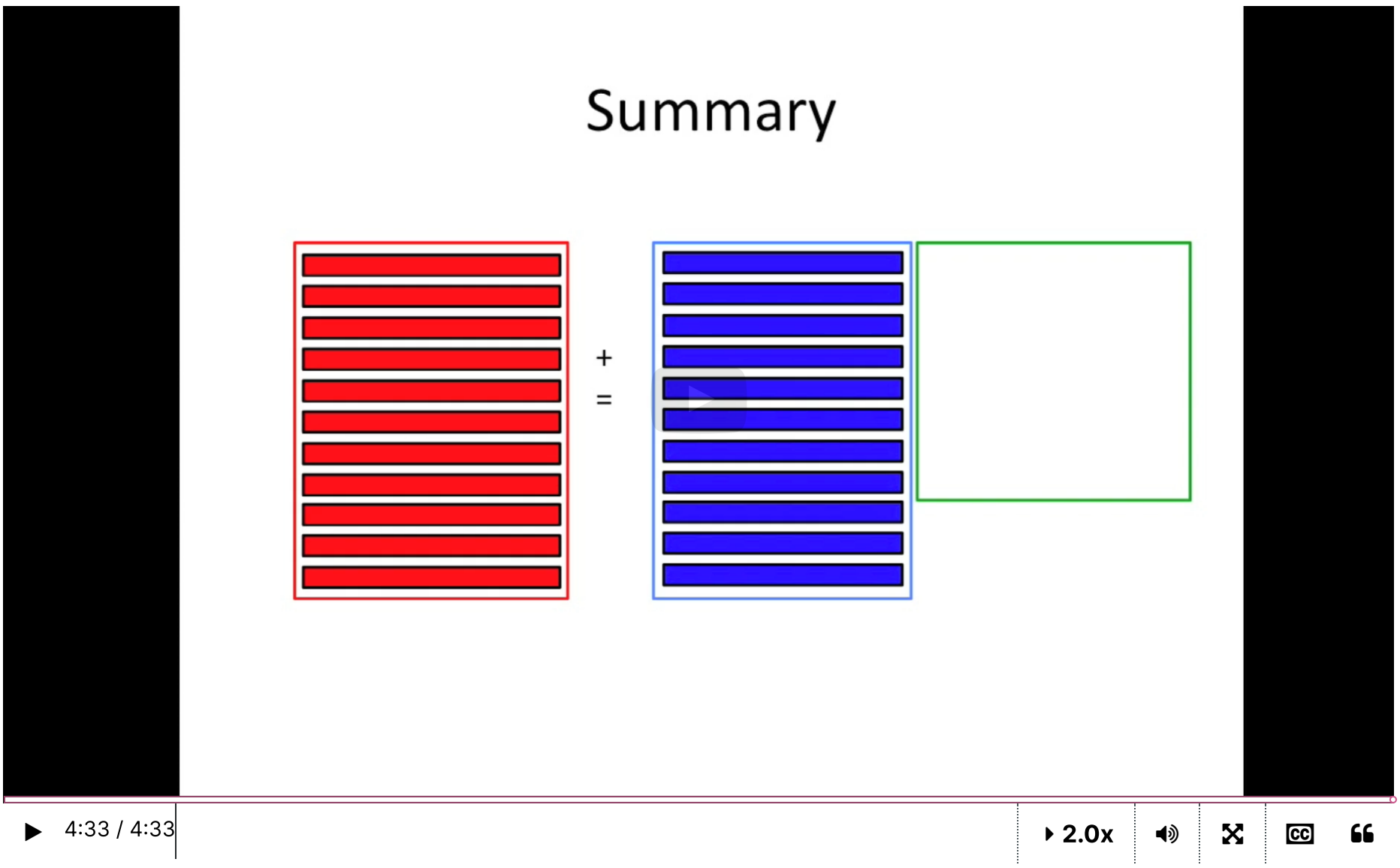
5.3.3 Matrix-matrix multiplication by rows



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Reading Assignment

0 points possible (ungraded)

Read Unit 5.3.3 of the notes. [LINK]

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Calculator

Minor mistake in video 5.3.3

At 1:36 in the video for 5.3.3 Matrix-matrix multiplication by rows, the loop for j should have been: - **for j = 0, ..., n-1** rather than ..... "m-1".

4

Homework 5.3.3.1

1/1 point (graded)

Let A and B be matrices and AB be well-defined and let A have at least four rows. If the first and fourth rows of A are the same, then the first and fourth rows of AB are the same.

Always ✔ Answer: Always

Explanation

Answer: Always

Partition

$$A = \begin{pmatrix} \widetilde{a}_0^T \\ \widetilde{a}_1^T \\ \widetilde{a}_2^T \\ \widetilde{a}_3^T \\ A_4 \end{pmatrix}$$

where A_4 represents the part of the matrix below the first four rows. Then

$$AB = \begin{pmatrix} \widetilde{a}_0^T \\ \widetilde{a}_1^T \\ \widetilde{a}_2^T \\ \widetilde{a}_3^T \\ A_4 \end{pmatrix} B = \begin{pmatrix} \widetilde{a}_0^T B \\ \widetilde{a}_1^T B \\ \widetilde{a}_2^T B \\ \widetilde{a}_3^T B \\ A_4 B \end{pmatrix}.$$

Now, if $\widetilde{a}_0^T = \widetilde{a}_3^T$ then $\widetilde{a}_0^T B = \widetilde{a}_3^T B$ and hence the first and fourth rows of AB are equal.

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Answers are displayed within the problem

Homework 5.3.3.2

18/18 points (graded)

Compute each of the following matrix-matrix multiplications:

$$\left(\begin{array}{ccc} 1 & -2 & 2 \end{array}\right) \begin{pmatrix} -1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{pmatrix} =$$

-3 ✔ -4 ✔ 7 ✔

Answer: -3 Answer: -4 Answer: 7

$$\left(\begin{array}{ccc} 1 & -2 & 2 \\ \hline -1 & 2 & 1 \end{array}\right) \begin{pmatrix} -1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{pmatrix} =$$

Calculator

-3 -4 7

Answer: -3 Answer: -4 Answer: 7

6 1 -1

Answer: 6 Answer: 1 Answer: -1

$$\left(\begin{array}{ccc} 1 & -2 & 2 \\ \hline -1 & 2 & 1 \\ \hline 0 & 1 & 2 \end{array}\right) \left(\begin{array}{ccc} -1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{array}\right) =$$

-3 -4 7

Answer: -3 Answer: -4 Answer: 7

6 1 -1

Answer: 6 Answer: 1 Answer: -1

4 -1 3

Answer: 4 Answer: -1 Answer: 3

$$\left(\begin{array}{ccc} \hline 1 & -2 & 2 \\ \hline \end{array}\right) \left(\begin{array}{ccc} -1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{array}\right) = \left(\begin{array}{ccc} \hline -3 & -4 & 7 \\ \hline \end{array}\right)$$

$$\left(\begin{array}{ccc} 1 & -2 & 2 \\ \hline -1 & 2 & 1 \\ \hline \end{array}\right) \left(\begin{array}{ccc} -1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{array}\right) = \left(\begin{array}{ccc} -3 & -4 & 7 \\ \hline 6 & 1 & -1 \\ \hline \end{array}\right)$$

$$\left(\begin{array}{ccc} 1 & -2 & 2 \\ \hline -1 & 2 & 1 \\ \hline 0 & 1 & 2 \end{array}\right) \left(\begin{array}{ccc} -1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{array}\right) = \left(\begin{array}{ccc} -3 & -4 & 7 \\ \hline 6 & 1 & -1 \\ \hline 4 & -1 & 3 \end{array}\right)$$

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Calculator

Homework 5.3.3.3

1/1 point (graded)

Algorithm: $C := \text{GEMM\_UNB\_VAR2}(A, B, C)$

Partition $A \rightarrow \left(\frac{A_T}{A_B}\right)$, $C \rightarrow \left(\frac{C_T}{C_B}\right)$

where A_T has 0 rows, C_T has 0 rows

while $m(A_T) < m(A)$ **do**

Repartition

$$\left(\frac{A_T}{A_B}\right) \rightarrow \left(\frac{A_0}{\frac{a_1^T}{A_2}}\right), \left(\frac{C_T}{C_B}\right) \rightarrow \left(\frac{C_0}{\frac{c_1^T}{C_2}}\right)$$

where a_1 has 1 row, c_1 has 1 row

$$c_1^T := a_1^T B + c_1^T$$

Continue with

$$\left(\frac{A_T}{A_B}\right) \leftarrow \left(\frac{A_0}{\frac{a_1^T}{A_2}}\right), \left(\frac{C_T}{C_B}\right) \leftarrow \left(\frac{C_0}{\frac{c_1^T}{C_2}}\right)$$

endwhile

Write the routine

- `[ C_out ] = Gemm_unb_var2( A, B, C )`

that computes $C := AB + C$ using the above algorithm.

Some links that will come in handy:

- Spark (alternatively, open the file `LAFF-2.0xM -> Spark -> index.html`)
- PictureFLAME (alternatively, open the file `LAFF-2.0xM -> PictureFLAME -> PictureFLAME.html`)

The update $c_1^T := a_1^T B + c_1^T$ can be accomplished by the call to

```
laff_gemv( ..., 1, ..., ...., 1, .... )
```

(click on the "laff routines" tab at the top of the page for more info). Hint: Revisit Homework 4.6.1.2

You may want to use the following script to test your implementation:

- test_Gemm_unb_var2.m

Done/Skip

Gemm_unb_var2.m

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