MATRIX MULT.

$[3\times3] \times [3\times2]$

$$\begin{bmatrix} a_{00} & a_{01} & a_{02} \\ a_{10} & a_{11} & a_{12} \\ a_{20} & a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} b_{00} & b_{01} \\ b_{10} & b_{11} \\ b_{20} & b_{21} \end{bmatrix} = \begin{bmatrix} c_{00} & c_{01} \\ c_{10} & c_{11} \\ c_{20} & c_{21} \end{bmatrix}$$

STEP 1: $\begin{bmatrix} a_{00} & a_{01} & a_{02} \end{bmatrix} \begin{bmatrix} b_{00} \\ b_{10} \\ b_{20} \end{bmatrix} = a_{00}b_{00} + a_{01}b_{10} + a_{02}b_{20}$

$= \sum_{i=0}^{2} a_{0i}\, b_{i0}$

0 row for a

0 col for b

Position: 0, 0

STEP 2: $\begin{bmatrix} a_{00} & a_{01} & a_{02} \end{bmatrix} \begin{bmatrix} b_{01} \\ b_{11} \\ b_{21} \end{bmatrix} = a_{00}b_{01} + a_{01}b_{11} + a_{02}b_{21}$

$= \sum_{i=0}^{2} a_{0i}\, b_{i1}$

0 row for a

1 col for b

Position: 0, 1

STEP 3: $\begin{bmatrix} a_{10} & a_{11} & a_{12} \end{bmatrix} \begin{bmatrix} b_{00} \\ b_{10} \\ b_{20} \end{bmatrix} = a_{10}b_{00} + a_{11}b_{10} + a_{12}b_{20}$

$= \sum_{i=0}^{2} a_{1i}\, b_{i0}$

1 row for a

0 col for b

Position: 1, 0

STEP 4: $\begin{bmatrix} a_{10} & a_{11} & a_{12} \end{bmatrix} \begin{bmatrix} b_{01} \\ b_{11} \\ b_{21} \end{bmatrix} = a_{10}b_{01} + a_{11}b_{11} + a_{12}b_{21}$

$= \sum_{i=0}^{2} a_{1i}\, b_{i1}$

1 row for a

1 col for b

Position: 1, 1

STEP 5: $\begin{bmatrix} a_{20} & a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} b_{00} \\ b_{10} \\ b_{20} \end{bmatrix} =$

$a_{20}b_{00} + a_{21}b_{10} + a_{22}b_{20}$

$= \sum_{i=0}^{2} a_{2i} b_{i0}$

2 row for a

1 col for b

Position: $2, 0$

STEP 6: $\begin{bmatrix} a_{20} & a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} b_{01} \\ b_{11} \\ b_{21} \end{bmatrix} =$

$a_{20}b_{01} + a_{21}b_{11} + a_{22}b_{21}$

$= \sum a_{2i} b_{i1}$

2 row for a

1 col. for b

Position: $2, 1$

Generalize:

$$[n \times m][m \times l] \rightarrow [n \times l]$$

STEP 1: $\begin{bmatrix} a_{00} & a_{01} & \cdots & a_{0,m-1} \end{bmatrix} \begin{bmatrix} b_{00} \\ b_{10} \\ \vdots \\ b_{m-1,0} \end{bmatrix}$