Strassen's Matrix Multiplication

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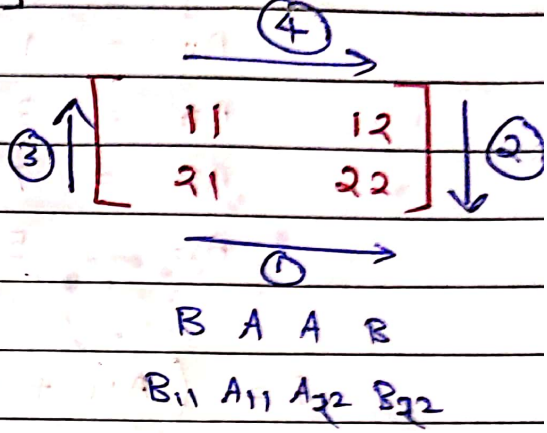
$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \qquad B = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix}$$

$$C = \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix}$$



Formula:

$$P = (A_{11} + A_{22})(B_{11} + B_{22})$$

$$Q = B_{11}(A_{21} + A_{22})$$

$$R = A_{11}(B_{12} - B_{22})$$

$$S = A_{22}(B_{21} - B_{11})$$

$$T = B_{22}(A_{11} + A_{12})$$

$$U = (B_{11} + B_{12})(A_{21} - A_{11})$$

$$V = (B_{21} + B_{22})(A_{12} - A_{22})$$

$$C_{11} = P + S - T + V$$

$$C_{12} = R + T \qquad \text{RAT}$$

$$C_{21} = Q + S$$

$$C_{22} = P + R - Q + V$$

Q. Multiply the matrix using strassen's matrix multiplication

$$A = \begin{bmatrix} 1 & 3 \\ 7 & 5 \end{bmatrix} \qquad B = \begin{bmatrix} 6 & 7 \\ 3 & 8 \end{bmatrix}$$

Sol^n:

$A_{11} = 1$	$B_{11} = 6$
$A_{12} = 3$	$B_{12} = 7$
$A_{21} = 7$	$B_{21} = 3$
$A_{22} = 5$	$B_{22} = 8$

$$P = (A_{11} + A_{22})(B_{11} + B_{22})$$
$$= (1 + 5)(6 + 8)$$
$$= 6 * 14$$
$$= \underline{84}$$

$$Q = B_{11}(A_{21} + A_{22})$$
$$= 6(7 + 5)$$
$$= 6(12)$$
$$= \underline{72}$$

$$R = A_{11}(B_{12} - B_{22})$$
$$= 1(7 - 8)$$
$$= 1(-1)$$
$$= \underline{-1}$$

$$S = A_{22}(B_{21} - B_{11})$$
$$= 5(3 - 6)$$
$$= 5(-3)$$
$$= \underline{-15}$$

$T = B_{22} (A_{11} + A_{12})$

$= 8 (1 + 3)$

$= 8 (4)$

$= 32$

$U = (B_{11} + B_{12}) (A_{21} - A_{11})$

$= (6 + 7) (7 - 1)$

$= 13 * 6$

$= 78$

$V = (B_{21} + B_{22}) (A_{12} - A_{22})$

$= (3 + 8) (3 - 5)$

$= 11 * -2$

$= -22$

$C_{11} = P + S - T + V$

$= 84 + (-15) - 32 + (-22)$

$= 15$

$C_{12} = R + T$

$= -1 + 32$

$= 31$

$C_{21} = Q + S$

$= 72 + (-15)$

$= 57$

$C_{22} = P + R - Q + U$

$= 84 + (-1) - 72 + 78$

$= 89$

$$C = \begin{bmatrix} 15 & 31 \\ 57 & 89 \end{bmatrix}$$

Q. Multiply the matrix using Strasson's matrix multiplication

$$A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & 4 \\ 2 & 1 \end{bmatrix}$$

Soln:

$A_{11} = 2$	$B_{11} = 3$
$A_{12} = 3$	$B_{12} = 4$
$A_{21} = 4$	$B_{21} = 2$
$A_{22} = 5$	$B_{22} = 1$

$$P = (A_{11} + A_{22})(B_{11} + B_{22})$$
$$= (2 + 5)(3 + 1)$$
$$= 7 * 4$$
$$= 28$$

$$Q = B_{11}(A_{21} + A_{22})$$
$$= 3(4 + 5)$$
$$= 3(9)$$
$$= 27$$

$$R = A_{11}(B_{12} - B_{22})$$
$$= 2(4 - 1)$$
$$= 2(3)$$
$$= 6$$

$$S = A_{22}(B_{21} - B_{11})$$
$$= 5(2 - 3)$$
$$= 5(-1)$$
$$= -5$$

$T = B_{22} (A_{11} + A_{12})$

$= 1 (2 + 3)$

$= 1 (5)$

$= 5$

$U = (B_{11} + B_{12}) (A_{21} - A_{11})$

$= (3 + 4) (4 - 2)$

$= 7 * 2$

$= 14$

$V = (B_{21} + B_{22}) (A_{12} - A_{22})$

$= (2 + 1) (3 - 5)$

$= 3 * -2$

$= -6$

$C_{11} = P + S - T + V$

$= 28 + (-5) - 5 + (-6)$

$= 12$

$C_{12} = R + T$

$= 6 + 5$

$= 11$

$C_{21} = Q + S$

$= 27 + (-5)$

$= 22$

$C_{22} = P + R - Q + V$

$= 28 + 6 - 27 + 14$

$= 21$

$$C = \begin{bmatrix} 12 & 11 \\ 22 & 21 \end{bmatrix}$$