Strassen's Matrix Multiplication

Formula if -

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

Formula :-

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

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

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

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

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

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

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

T ⊕ →

⊖ S ↑ $\begin{bmatrix} 11 & 12 \\ 21 & 22 \end{bmatrix}$ ↓ ⊖ R

← Q ⊕

B A A B

B_{11} A_{11} A_{22} B_{22}

P Q R S T U V

R A T

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

$c_{12} = R + T$

$c_{21} = Q + S$

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

Q: $A = \begin{bmatrix} 5 & 6 \\ -4 & 3 \end{bmatrix}$; $B = \begin{bmatrix} -7 & 6 \\ 5 & 9 \end{bmatrix}$

$P = (A_{11} + A_{22})(B_{11} + B_{22}) = (5+3)(-7+9) = 16$

$Q = B_{11}(A_{21} + B_{22}) = -7(-4+3) = 7$

$R = A_{11}(B_{12} - B_{22}) = 5(6-9) = -15$

$S = A_{22}(B_{21} - B_{11}) = 3(5+7) = 36$

$T = B_{22}(A_{11} + A_{12}) = 9(5+6) = 99$

$U = (A_{21} - A_{11})(B_{11} + B_{12}) = (-4-5)(-7+6) = 9$

$V = (B_{21} + B_{22})(A_{12} - A_{22}) = (5+9)(6-3) = 42$

$c_{11} = P + S - T + V = 16 + 36 - 99 + 42 = -5$

$c_{12} = R + T = -15 + 99 = 84$

$c_{21} = Q + S = 7 + 36 = 43$

$c_{22} = P + R - Q + U = 16 - 15 - 7 + 9 = 3$

$= \begin{bmatrix} -5 & 84 \\ 43 & 3 \end{bmatrix}$