Q)

→

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix}$$

(A_{11}, A_{12}, A_{21}, A_{22})

$$B = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

(B_{11}, B_{12}, B_{21}, B_{22})

Normal multiplication

$$\Rightarrow A \times B = \begin{bmatrix} (1+2+3+4) & (1+2+3+4) & (1+2+3+4) & (1+2+3+4) \\ (5+6+7+8) & (5+6+7+8) & (5+6+7+8) & (5+6+7+8) \\ (9+10+11+12) & (9+10+11+12) & (9+10+11+12) & (9+10+11+12) \\ (13+14+15+16) & (13+14+15+16) & (13+14+15+16) & (13+14+15+16) \end{bmatrix}$$

$$= \begin{bmatrix} 10 & 10 & 10 & 10 \\ 26 & 26 & 26 & 26 \\ 42 & 42 & 42 & 42 \\ 58 & 58 & 58 & 58 \end{bmatrix}$$

Strassen's Matrix

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

$Q = (A_{21} + A_{22})B_{11}$ $\quad U = (A_{21} - A_{11})(B_{11} + B_{12})$

$R = A_{11}(B_{12} - B_{22})$ $\quad V = (A_{12} - A_{22})(B_{21} + B_{22})$

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

Calculation

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

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

$$C_{12} = R + T$$

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

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

$$P = \begin{bmatrix} 12 & 14 \\ 20 & 22 \end{bmatrix}\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} = \begin{bmatrix} 52 & 52 \\ 84 & 84 \end{bmatrix}$$

$$Q = \begin{bmatrix} 20 & 22 \\ 28 & 30 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 42 & 42 \\ 58 & 58 \end{bmatrix}$$

$$R = \begin{bmatrix} 1 & 2 \\ 5 & 6 \end{bmatrix}\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$S = \begin{bmatrix} 11 & 12 \\ 15 & 16 \end{bmatrix}\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$T = \begin{bmatrix} 4 & 6 \\ 12 & 14 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 10 & 10 \\ 26 & 26 \end{bmatrix}$$

$$U = \begin{bmatrix} 8 & 8 \\ 8 & 8 \end{bmatrix}\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} = \begin{bmatrix} 32 & 32 \\ 32 & 32 \end{bmatrix}$$

$$V = \begin{bmatrix} -8 & -8 \\ -8 & -8 \end{bmatrix}\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} = \begin{bmatrix} -32 & -32 \\ -32 & -32 \end{bmatrix}$$

$$c_{11} = \begin{bmatrix} 10 & 10 \\ 26 & 26 \end{bmatrix}$$

$$c_{12} = \begin{bmatrix} 10 & 10 \\ 26 & 26 \end{bmatrix}$$

$$c_{21} = \begin{bmatrix} 42 & 42 \\ 58 & 58 \end{bmatrix}$$

$$c_{22} = \begin{bmatrix} 42 & 42 \\ 58 & 58 \end{bmatrix}$$

$$c = \begin{bmatrix} 10 & 10 & 10 & 10 \\ 26 & 26 & 26 & 26 \\ 42 & 42 & 42 & 42 \\ 58 & 58 & 58 & 58 \end{bmatrix}$$