

TECNOLÓGICO DE MONTERREY

FUNDAMENTOS DE COMPUTACIÓN

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## Homework 7

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# 1 Problems

Solve the following problems:

1. Generate two 4 X 4 matrices and manually apply the Strassen's method to multiply them. Verify that the result is correct by comparing with the one provided by the traditional method. Show the steps.

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

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

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

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

$$A_1 = \begin{bmatrix} 1 & 2 \\ 5 & 6 \end{bmatrix}$$

$$A_2 = \begin{bmatrix} 3 & 4 \\ 7 & 8 \end{bmatrix}$$

$$B_1 = \begin{bmatrix} 16 & 15 \\ 12 & 11 \end{bmatrix}$$

$$B_2 = \begin{bmatrix} 14 & 13 \\ 10 & 9 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} 9 & 10 \\ 13 & 14 \end{bmatrix}$$

$$A_4 = \begin{bmatrix} 11 & 12 \\ 15 & 16 \end{bmatrix}$$

$$B_3 = \begin{bmatrix} 8 & 7 \\ 4 & 3 \end{bmatrix}$$

$$B_4 = \begin{bmatrix} 6 & 5 \\ 2 & 1 \end{bmatrix}$$

$$C_1 = A_1 B_1$$

$$C_2 = A_2 B_2$$

$$C_3 = A_3 B_3$$

$$C_4 = A_4 B_4$$

$$A_1 B_1$$

$$A_2 B_2$$

$$X_1 = (1 + 6) * (16 + 11) = 189$$

$$X_2 = 16 * (5 + 6) = 176$$

$$X_3 = 1 * (15 - 11) = 4$$

$$X_4 = 6 * (12 - 16) = -24$$

$$X_5 = 11 * (1 + 2) = 33$$

$$X_6 = (5 - 1) * (16 + 15) = 124$$

$$X_7 = (2 - 6) * (12 + 11) = -92$$

$$X_1 = (3 + 8) * (14 + 9) = 253$$

$$X_2 = 14 * (7 + 8) = 210$$

$$X_3 = 3 * (13 - 9) = 12$$

$$X_4 = 8 * (10 - 14) = -32$$

$$X_5 = 9 * (3 + 4) = 63$$

$$X_6 = (7 - 3) * (14 + 13) = 108$$

$$X_7 = (4 - 8) * (10 + 9) = -76$$

$$C_1 = \begin{bmatrix} 189 + -24 - 33 + -92 & 4 + 33 \\ 176 + -24 & 189 + 4 - 176 + 124 \end{bmatrix} = \begin{bmatrix} 40 & 37 \\ 152 & 141 \end{bmatrix}$$

$$C_2 = \begin{bmatrix} 253 + -32 - 63 + -76 & 12 + 63 \\ 210 + -32 & 253 + 12 - 210 + 108 \end{bmatrix} = \begin{bmatrix} 82 & 75 \\ 178 & 163 \end{bmatrix}$$

$$A_3B_3$$

$$\begin{aligned} X_1 &= (3 + 8) * (14 + 9) = 253 \\ X_2 &= 8 * (13 + 14) = 216 \\ X_3 &= 9 * (7 - 3) = 36 \\ X_4 &= 14 * (4 - 8) = -56 \\ X_5 &= 3 * (9 + 10) = 57 \\ X_6 &= (13 - 9) * (8 + 7) = 60 \\ X_7 &= (10 - 14) * (4 + 3) = -28 \end{aligned}$$

$$C_3 = \begin{array}{cc} \boxed{\begin{array}{cc} 253 + -56 - 57 + -28 & 36 + 57 \\ 216 + -56 & 253 + 36 - 216 + 60 \end{array}} \\ = \boxed{\begin{array}{cc} 112 & 93 \\ 160 & 133 \end{array}} \end{array}$$

$$A_4B_4$$

$$\begin{aligned} X_1 &= (1 + 6) * (16 + 11) = 189 \\ X_2 &= 6 * (15 + 16) = 186 \\ X_3 &= 11 * (5 - 1) = 44 \\ X_4 &= 16 * (2 - 6) = -64 \\ X_5 &= 1 * (11 + 12) = 23 \\ X_6 &= (15 - 11) * (6 + 5) = 44 \\ X_7 &= (12 - 16) * (2 + 1) = -12 \end{aligned}$$

$$C_4 = \begin{array}{cc} \boxed{\begin{array}{cc} 189 + -64 - 23 + -12 & 44 + 23 \\ 186 + -64 & 189 + 44 - 186 + 44 \end{array}} \\ = \boxed{\begin{array}{cc} 90 & 67 \\ 122 & 91 \end{array}} \end{array}$$

2. Generate a monic polynomial with  $k = 4$  (that is  $n = 15$ ) and solve it using the recursive algorithm presented in class. show the steps.