CSCI 445

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(Strassen Matrix Multiplication Algorithm)

Description

The assignment was to implement a recursive function that computes the product of two matrices A and B using Strassen's Matrix Multiplication algorithm.

Input:

2 matrices (2^n x 2^n)

Below are pairs of matrices I used to test the code:

1. 2x2 matrices

$$\begin{bmatrix} 2 & 4 \\ 6 & 8 \end{bmatrix} \tag{1}$$

$$\begin{bmatrix} 3 & 5 \\ 7 & 9 \end{bmatrix} \tag{2}$$

When running MATLAB code, please use following command:

StrassenMatrixMult([2 4; 6 8], [3 5; 7 9])

2. Random 4x4 matrices

$$\begin{bmatrix} 21 & 96 & 75 & 74 \\ 44 & 58 & 1 & 30 \\ 32 & 87 & 40 & 85 \\ 100 & 7 & 7 & 21 \end{bmatrix} \tag{3}$$

$$\begin{bmatrix} 22 & 29 & 97 & 12 \\ 21 & 92 & 54 & 13 \\ 86 & 25 & 82 & 12 \\ 38 & 47 & 26 & 77 \end{bmatrix} \tag{4}$$

When running MATLAB code, please use following command:

StrassenMatrixMult([21 96 75 74; 44 58 1 30; 32 87 40 85; 100 7 7 21], [22 29 97 12; 21 92 54 13; 86 25 82 12; 38 47 26 77])

Output:

(2^n x 2^n) matrices

1.
$$\begin{bmatrix} 34 & 46 \\ 74 & 102 \end{bmatrix} \tag{5}$$

2.
$$\begin{bmatrix} 11740 & 14794 & 15295 & 8098 \\ 3412 & 8047 & 8262 & 3604 \\ 9201 & 13927 & 13292 & 8540 \\ 3747 & 4706 & 11198 & 2992 \end{bmatrix} \tag{6}$$

The Strassen Algorithm used is:

SQUARE-MATRIX-MULTIPLY-RECURSIVE (A, B)
1 $n = A.rows$
2 let C be a new n x n matrix
3 **if** $n == 1$
4 $\quad c_{11} = a_{11} * b_{11}$
5 **else** partition *A, B, and C* as in equations (4, 9)
6 $\quad C_{11} = SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{11}, B_{11}) +$
$\qquad SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{12}, B_{21})$
7 $\quad C_{12} = SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{11}, B_{12}) +$
$\qquad SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{12}, B_{22})$
8 $\quad C_{21} = SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{21}, B_{11}) +$
$\qquad SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{22}, B_{21})$
9 $\quad C_{22} = SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{21}, B_{12}) +$
$\qquad SQUARE{-}MATRIX{-}MULTIPLY{-}RECURSIVE(A_{22}, B_{22})$
10 **return** C

The equations used in the code for computing the 7 products and for adding and subtracting the submatrices back together were closely followed with the book, on pages 80-81 (Chapter 4), and article posted in the Discussion Board.