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ASSIGNMENT-2.

PROBLEM NO. 1

PROBLEM STATEMENT

We are given the matrices A and B, (15x15) and (15x1) respectively. We have to find the matrix X such that

$$AX = B$$

where x is a matrix of size (15x1).

DESCRIPTION OF METHOD

We will use Gauss Elimination method to solve AX = B.

First we'll convert the matrix A to Row Echelon form in which A is an upper triangular matrix, and will apply the same set of operations on B. After that, we'll use Back substitution to find the matrix X.

Matrix x is our answer and we'll use plot function to plot X.

PSEUDO-CODE

initialize X and operations = 0.
Sort A and B
~~let c be from~~
let c = 1
while c ≤ n # Gauss elimination
    Sort A and B
    let r = m
    while r ≥ c+1
        A(r^th row) = A(r^th row) − (A(r,c) / A(c,c)) A(pivot row)
        B(r) = B(r) − (A(r,c) / A(c,c)) B(c)
        Increase operations to 2n+3
    decrease r by 1
    decrease c by 1
X(n) = B(n)/A(n,n)
let i = m−1
while i ≥ 1 # Back subs.
    sum = 0
    for j in [n : i+1]
        sum += $x_j A_{ij}$
    X(i) = (B(i) − sum)/A(i,i)

```
% Matrix A and B
A = load('A.txt');
B = load('B.txt');

dimensions = size(A); % Dimensions of A
m = dimensions(1); % No. of rows
n = dimensions(2); % No. of columns

X = gauss_elimination(A, B, m, n);
disp('X = ')
disp(X)
plot(X, 'LineWidth', 1.5)
```

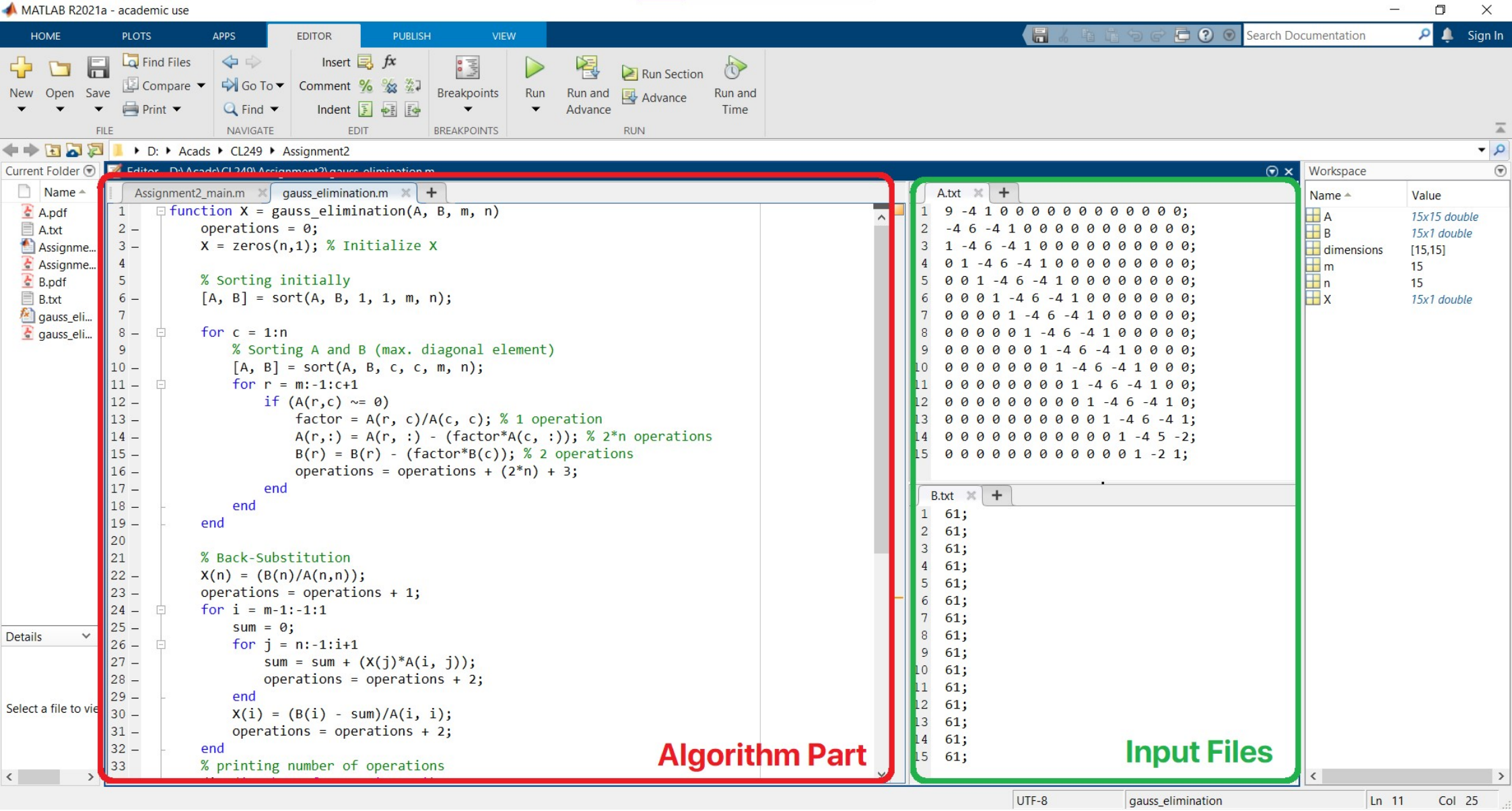
```
function X = gauss_elimination(A, B, m, n)
    operations = 0;
    X = zeros(n,1); % Initialize X

    % Sorting initially
    [A, B] = sort(A, B, 1, 1, m, n);

    for c = 1:n
        % Sorting A and B (max. diagonal element)
        [A, B] = sort(A, B, c, c, m, n);
        for r = m:-1:c+1
            if (A(r,c) ~= 0)
                factor = A(r, c)/A(c, c);  % 1 operation
                A(r,:) = A(r, :) - (factor*A(c, :));  % 2*n operations
                B(r) = B(r) - (factor*B(c));  % 2 operations
                operations = operations + (2*n) + 3;
            end
        end
    end

    % Back-Substitution
    X(n) = (B(n)/A(n,n));
    operations = operations + 1;
    for i = m-1:-1:1
        sum = 0;
        for j = n:-1:i+1
            sum = sum + (X(j)*A(i, j));
            operations = operations + 2;
        end
        X(i) = (B(i) - sum)/A(i, i);
        operations = operations + 2;
    end
    % printing number of operations
    disp('Number of Operations =')
    disp(operations)

end

% Sorting Function
function [mat1, mat2] = sort(A, B, rs, cs, m, n)
    for s = rs:m-1
        for r = rs:m-1
            if abs(A(r, cs)) < abs(A(r+1, cs))
                temp1 = A(r, :);
                A(r, :) = A(r+1, :);
                A(r+1, :) = temp1;
                temp2 = B(r);
                B(r) = B(r+1);
                B(r+1) = temp2;
            end
        end
    end
    mat1 = A;
    mat2 = B;
end
```

A.txt

```
9 -4 1 0 0 0 0 0 0 0 0 0 0 0 0;
-4 6 -4 1 0 0 0 0 0 0 0 0 0 0 0;
1 -4 6 -4 1 0 0 0 0 0 0 0 0 0 0;
0 1 -4 6 -4 1 0 0 0 0 0 0 0 0 0;
0 0 1 -4 6 -4 1 0 0 0 0 0 0 0 0;
0 0 0 1 -4 6 -4 1 0 0 0 0 0 0 0;
0 0 0 0 1 -4 6 -4 1 0 0 0 0 0 0;
0 0 0 0 0 1 -4 6 -4 1 0 0 0 0 0;
0 0 0 0 0 0 1 -4 6 -4 1 0 0 0 0;
0 0 0 0 0 0 0 1 -4 6 -4 1 0 0 0;
0 0 0 0 0 0 0 0 1 -4 6 -4 1 0 0;
0 0 0 0 0 0 0 0 0 1 -4 6 -4 1 0;
0 0 0 0 0 0 0 0 0 0 1 -4 6 -4 1;
0 0 0 0 0 0 0 0 0 0 0 1 -4 5 -2;
0 0 0 0 0 0 0 0 0 0 0 0 1 -2 1;
```

B.txt

```
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
```


MATLAB R2021a - academic use
HOME
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EDIT
Breakpoints
BREAKPOINTS
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Run and Advance
Run Section
Advance
Run and Time
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D: ▸ Acads ▸ CL249 ▸ Assignment2
Current Folder
Name
A.pdf
A.txt
Assignme...
Assignme...
B.pdf
B.txt
gauss_eli...
gauss_eli...
Details
Select a file to vie
Assignment2_main.m
gauss_elimination.m
function X = gauss_elimination(A, B, m, n)
operations = 0;
X = zeros(n,1); % Initialize X
% Sorting initially
[A, B] = sort(A, B, 1, 1, m, n);
for c = 1:n
% Sorting A and B (max. diagonal element)
[A, B] = sort(A, B, c, c, m, n);
for r = m:-1:c+1
if (A(r,c) ~= 0)
factor = A(r, c)/A(c, c); % 1 operation
A(r,:) = A(r, :) - (factor*A(c, :)); % 2*n operations
B(r) = B(r) - (factor*B(c)); % 2 operations
operations = operations + (2*n) + 3;
end
end
end
% Back-Substitution
X(n) = (B(n)/A(n,n));
operations = operations + 1;
for i = m-1:-1:1
sum = 0;
for j = n:-1:i+1
sum = sum + (X(j)*A(i, j));
operations = operations + 2;
end
X(i) = (B(i) - sum)/A(i, i);
operations = operations + 2;
end
% printing number of operations
Algorithm Part
A.txt
9 -4 1 0 0 0 0 0 0 0 0 0 0 0 0;
-4 6 -4 1 0 0 0 0 0 0 0 0 0 0 0;
1 -4 6 -4 1 0 0 0 0 0 0 0 0 0 0;
0 1 -4 6 -4 1 0 0 0 0 0 0 0 0 0;
0 0 1 -4 6 -4 1 0 0 0 0 0 0 0 0;
0 0 0 1 -4 6 -4 1 0 0 0 0 0 0 0;
0 0 0 0 1 -4 6 -4 1 0 0 0 0 0 0;
0 0 0 0 0 1 -4 6 -4 1 0 0 0 0 0;
0 0 0 0 0 0 1 -4 6 -4 1 0 0 0 0;
0 0 0 0 0 0 0 1 -4 6 -4 1 0 0 0;
0 0 0 0 0 0 0 0 1 -4 6 -4 1 0 0;
0 0 0 0 0 0 0 0 0 1 -4 6 -4 1 0;
0 0 0 0 0 0 0 0 0 0 1 -4 6 -4 1;
0 0 0 0 0 0 0 0 0 0 0 1 -4 5 -2;
0 0 0 0 0 0 0 0 0 0 0 0 1 -2 1;
B.txt
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
61;
Input Files
Workspace
Name
Value
A
15x15 double
B
15x1 double
dimensions
[15,15]
m
15
n
15
X
15x1 double
UTF-8
gauss_elimination
Ln 11
Col 25

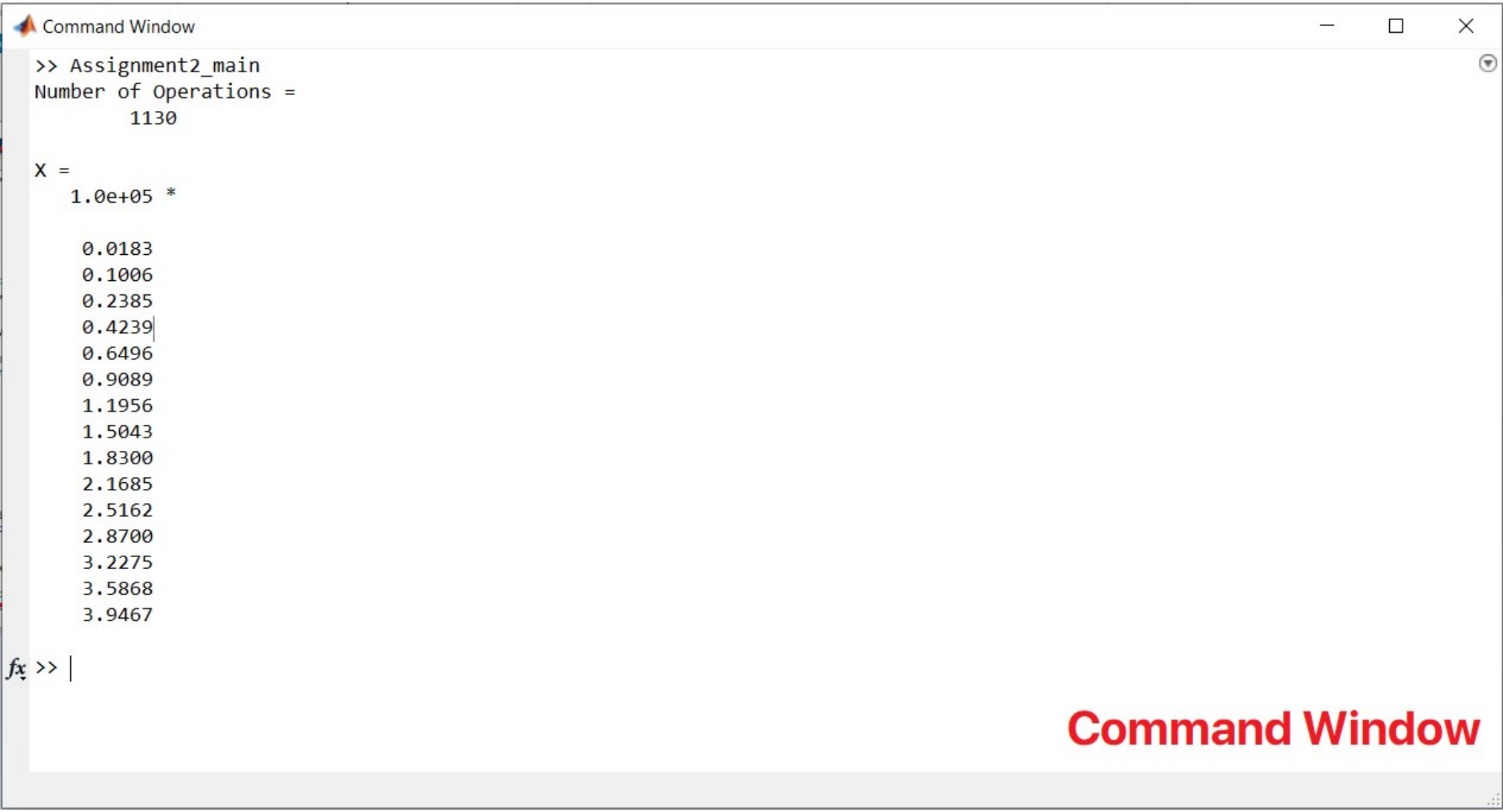
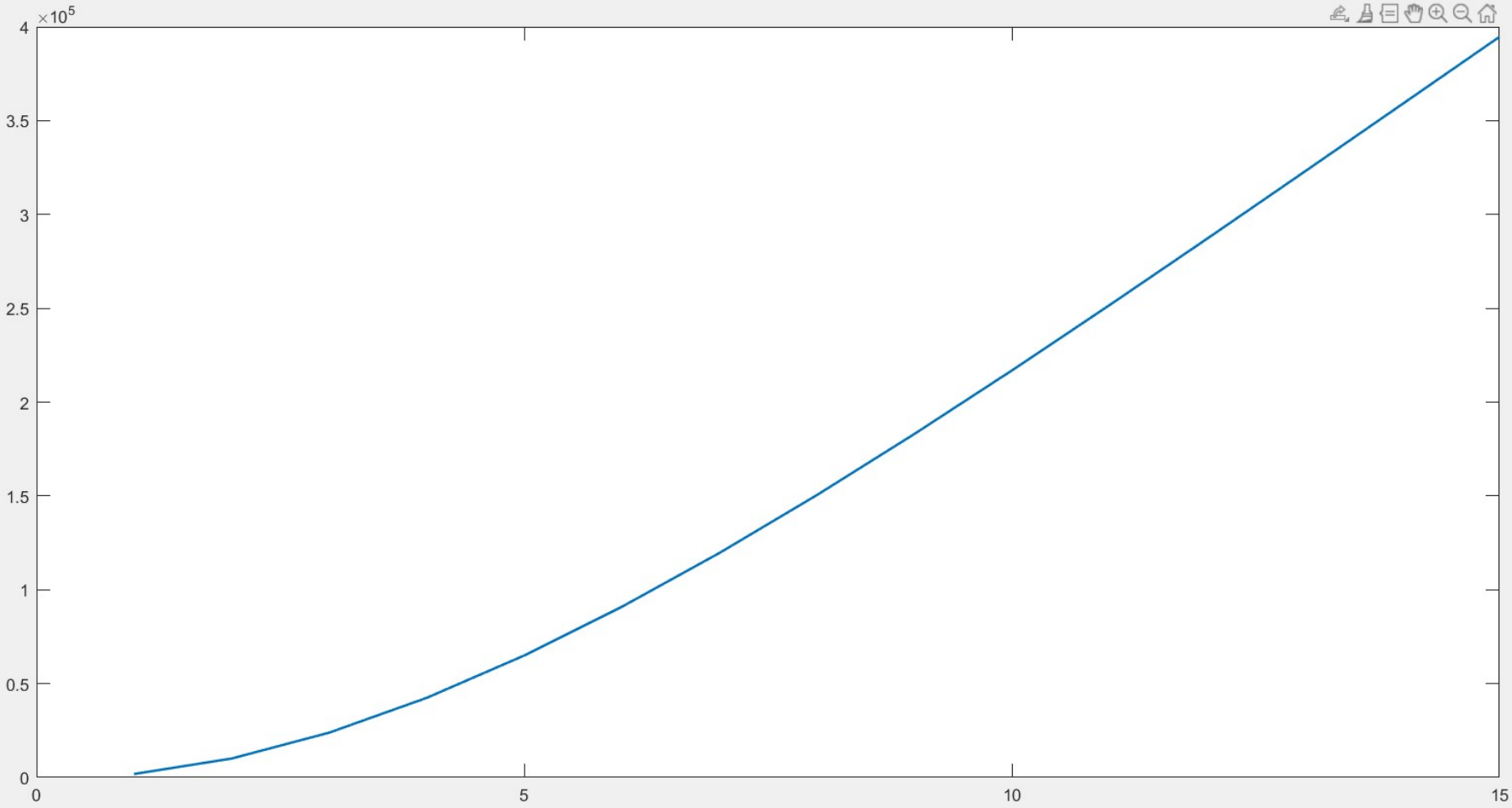

Command Window
>> Assignment2_main
Number of Operations =
1130
X =
1.0e+05 *
0.0183
0.1006
0.2385
0.4239
0.6496
0.9089
1.1956
1.5043
1.8300
2.1685
2.5162
2.8700
3.2275
3.5868
3.9467
>>
Command Window

Figure 1

File Edit View Insert Tools Desktop Window Help



Plot of X