

Image and Video Processing Lab

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Experiment 2 2D DFT

Aim: - The objective of this experiment is to evaluate the impact of JPEG compression on image file size and visual quality. The program should prompt the user to input parameters such as the binary or color image.

Software Used: - MATLAB

Code:

```
% IVP Lab - Experiment No: 3 - JPEG Compression
% Yash Rajput - TY EC - 211060042
clc;
try
    % Display menu to select input type
    fprintf('Choose the input type:\n');
    fprintf('1. 4x4 Binary Matrix\n');
    fprintf('2. Image File\n');
    choice = input('Enter your choice (1 or 2): ');

    if choice == 1
        % Option 1: Input a 4x4 binary matrix
        fprintf('Enter a 4x4 binary matrix (0s and 1s):\n');
        binary_matrix = input(''); % Prompt user to input the binary matrix

        % Validate input dimensions
        if ~isequal(size(binary_matrix), [4, 4])
            error('Invalid matrix dimensions. Please provide a 4x4 matrix.');
        end

        % Validate binary values (0s and 1s)
        if ~all(binary_matrix(:) == 0 | binary_matrix(:) == 1)
            error('Invalid matrix values. Please provide a matrix of 0s and 1s.');
        end

        % Convert binary matrix to uint8 image (scale to 0-255 range)
        input_image = uint8(binary_matrix) * 255;

    elseif choice == 2
        % Option 2: Select an image file
        [filename, pathname] = uigetfile({'*.png;*.jpg;*.jpeg', 'Image Files ( *.jpeg)'},
'Select an Image File');

        % Check if the user cancelled the file selection
        if isequal(filename, 0) || isequal(pathname, 0)
            disp('User cancelled the operation.');
            return;
        end
    end
end
```

```

    % Construct the full path to the selected image file
    input_image_path = fullfile(pathname, filename);

    % Open the input image
    input_image = imread(input_image_path);

    % Check if the input image is grayscale (convert to RGB for display)
    if ndims(input_image) == 2 %#ok<ISMAT>
        input_image = cat(3, input_image, input_image, input_image); % Convert to RGB
    end

else
    error('Invalid choice. Please enter 1 or 2.');
```

```
end

% Display the input image
figure('Position', [100, 100, 1000, 400]);

% Display original image with information
subplot(1, 2, 1);
imshow(input_image);
if choice == 1
    title('Input Binary Image');
    original_size = 4 * 4; % Size of 4x4 binary matrix (in elements)
else
    title('Input Image');
    original_info = dir(input_image_path);
    original_size = original_info.bytes; % Size of original image file
end
axis off;

% Resize the image
[height, width, ~] = size(input_image);
new_size = [height/2, width/2];
resized_image = imresize(input_image, new_size);

% Save the resized image
if choice == 1
    output_image_path = 'compressed_binary_image.jpg';
else
    [~, name, ext] = fileparts(input_image_path);
    output_image_path = fullfile(pathname, ['compressed_' name ext]);
end
imwrite(resized_image, output_image_path, 'Quality', 50);

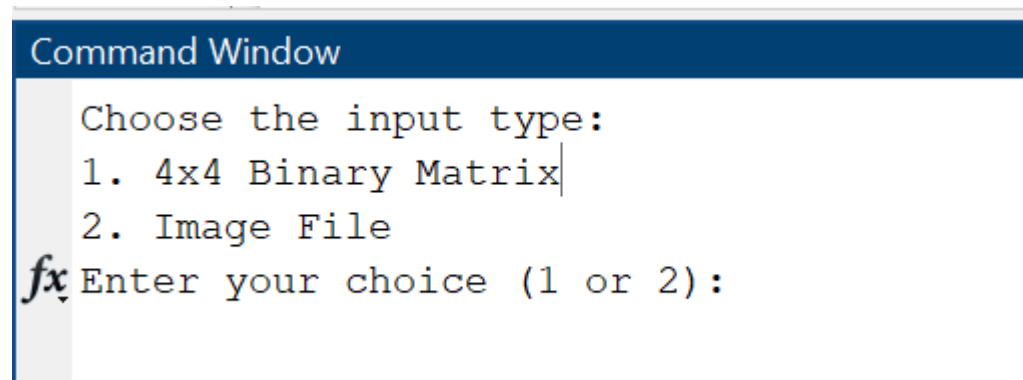
% Display the compressed image
subplot(1, 2, 2);
imshow(resized_image);
title('Compressed Image');
axis off;
% Get compressed image size and calculate compression ratio
compressed_info = dir(output_image_path);
compressed_size = compressed_info.bytes; % Size of compressed image file
compression_ratio = (1 - compressed_size/original_size) * 100 ;

fprintf('Original Size: %d bytes\n', original_size);
fprintf('Compressed Size: %d bytes\n', compressed_size);
fprintf('Compression Ratio: %.2f%%\n', (1 - compressed_size/original_size) * 100);
catch ME
    % Error Handling
    fprintf('Error: %s\n', ME.message);
end

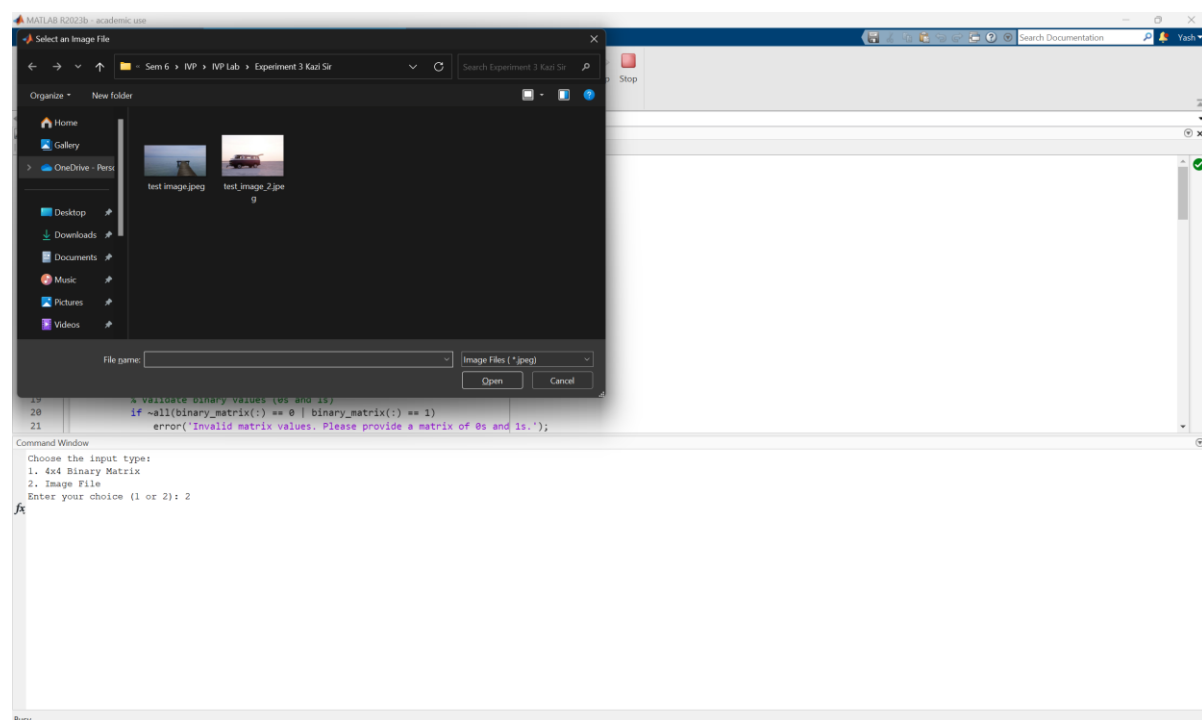
```

User Interface:

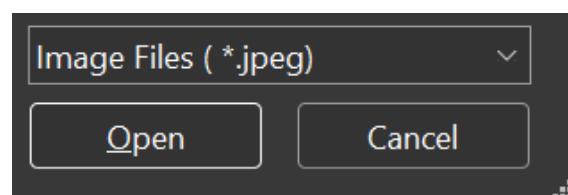
Step 1: The code begins with asking the user for the type of input



Step 2: Assuming that you select 2 where you are going to select image as input, making the code user friendly a file picker opens which can be used to select the image from any folder



NOTE: For better error handling jpeg files can only be selected by regular expression set to jpeg

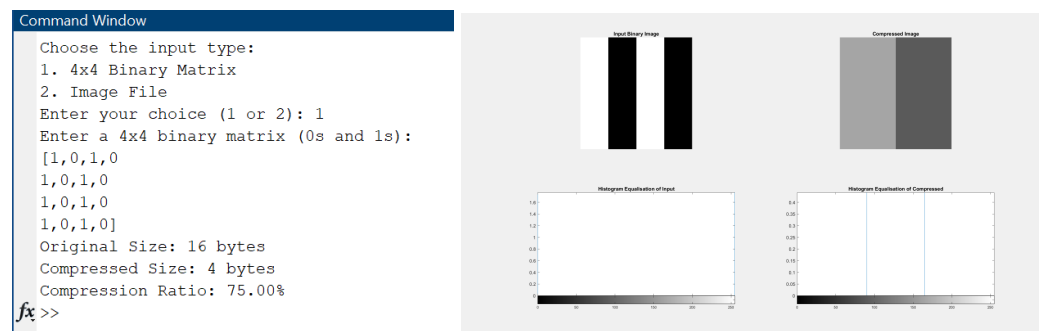


```
'Image Files (*.jpeg)'}},
```

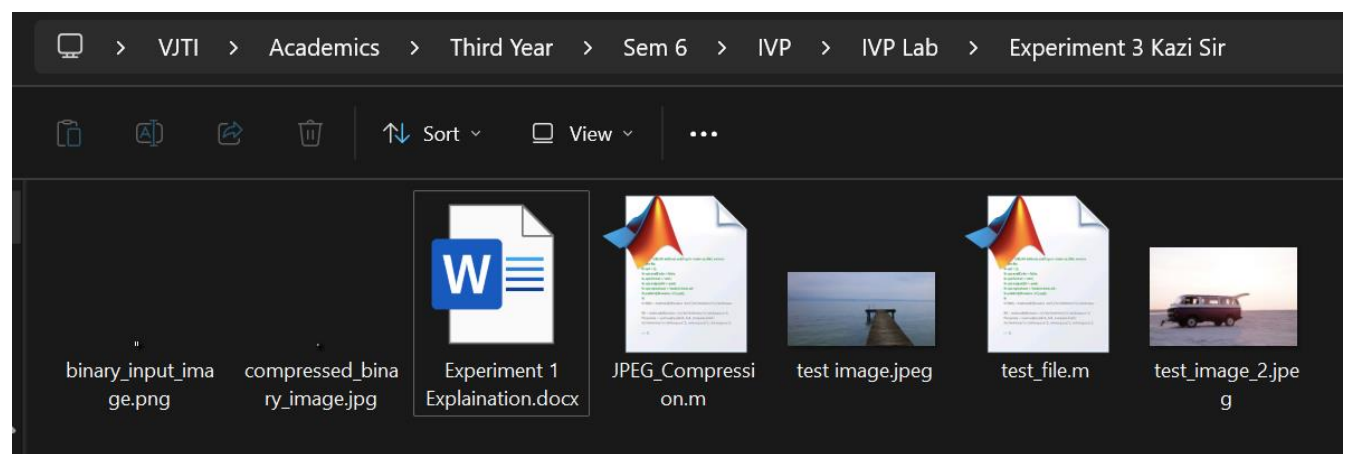
Step 3: If you select the 1st option you will be asked to enter the matrix in binary format

```
Command Window
Choose the input type:
1. 4x4 Binary Matrix
2. Image File
Enter your choice (1 or 2): 1
Enter a 4x4 binary matrix (0s and 1s):
[1,0,1,0
1,0,1,0
1,0,1,0
1,0,1,0]
```

Step 3: After Entering your choice, you can see size of original image and compressed image along with the compression ratio in the command terminal and the Visual representation can be seen in the figure



Step 4: After the compression the if the user has selected binary input the compressed image and binary input image will be saved in your folder and in case of input image your compressed image will be saved in the same directory as your input image



Error Handling:

Case 1: User does not select an image and closes the file picker

Command Window

```
Choose the input type:
1. 4x4 Binary Matrix
2. Image File
Enter your choice (1 or 2): 2
User canceled the operation.
fx >>
```

Case 2: The Entered Matrix is not of 4x4 order

Command Window

```
Choose the input type:
1. 4x4 Binary Matrix
2. Image File
Enter your choice (1 or 2): 1
Enter a 4x4 binary matrix (0s and 1s):
[1,0,1
1,0,1
1,0,1
1,0,1]
Error: Invalid matrix dimensions. Please provide a 4x4 matrix.
```

Case 3: The Entered Matrix contains non numeric number

```
Choose the input type:
1. 4x4 Binary Matrix
2. Image File
Enter your choice (1 or 2): 1
Enter a 4x4 binary matrix (0s and 1s):
[1,0,1,a;
1,0,1,0;
1,0,1,0;
1,0,1,0]
Error: Non Numeric Character
fx >> |
```

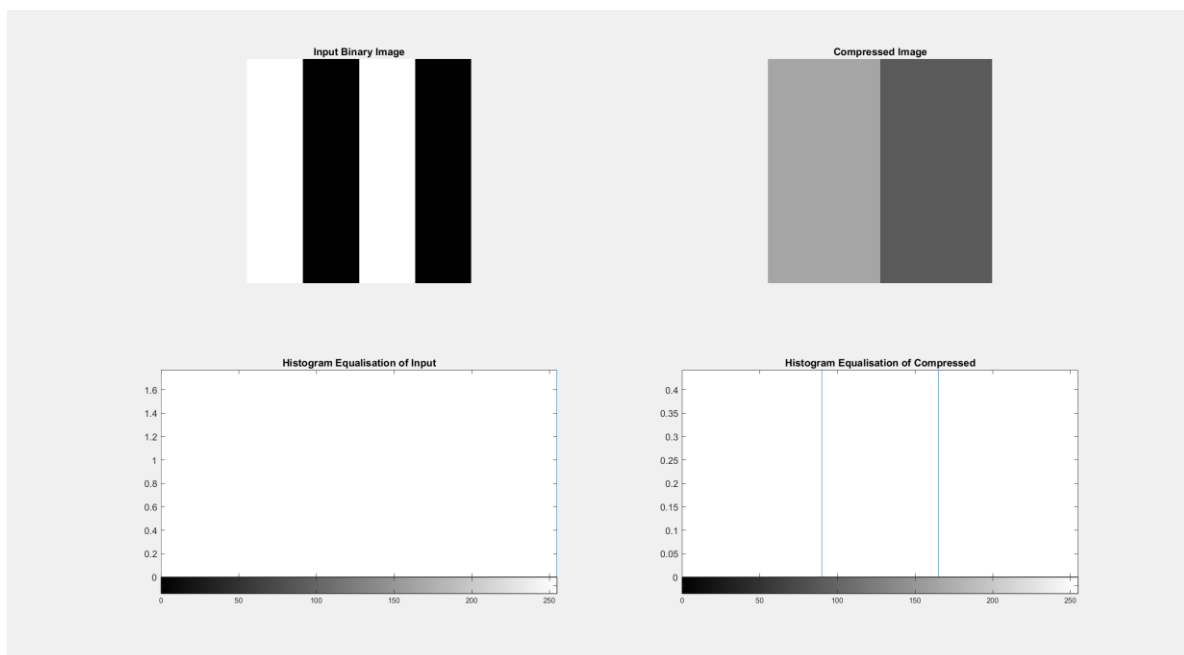
Output Analysis

Binary Test Case 1

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 1  
Enter a 4x4 binary matrix (0s and 1s):  
[1,0,1,0  
1,0,1,0  
1,0,1,0  
1,0,1,0]  
Original Size: 16 bytes  
Compressed Size: 4 bytes  
Compression Ratio: 75.00%  
fx >>
```

Visual Representation:

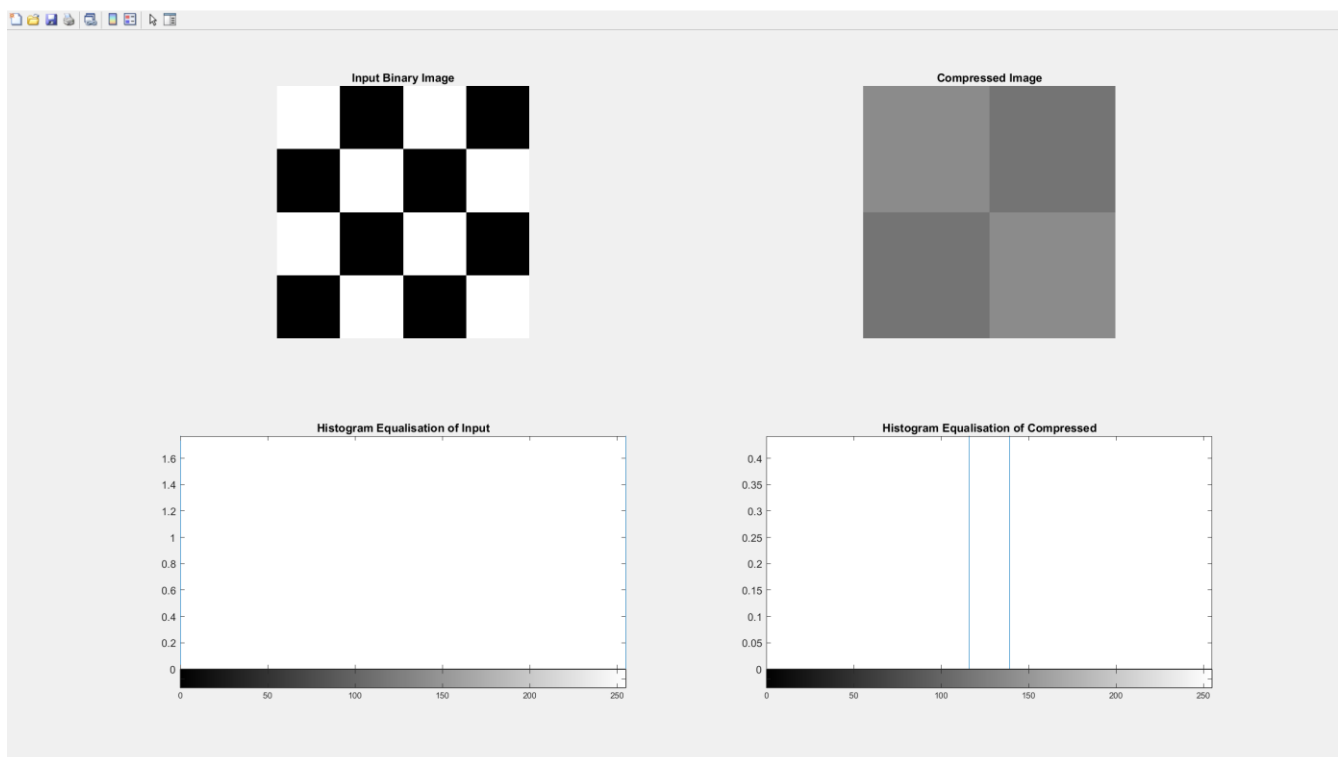


Binary Test Case 2

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 1  
Enter a 4x4 binary matrix (0s and 1s):  
[1,0,1,0,  
0,1,0,1,  
1,0,1,0,  
0,1,0,1]  
Original Size: 16 bytes  
Compressed Size: 4 bytes  
Compression Ratio: 75.00%
```

Visual Representation:



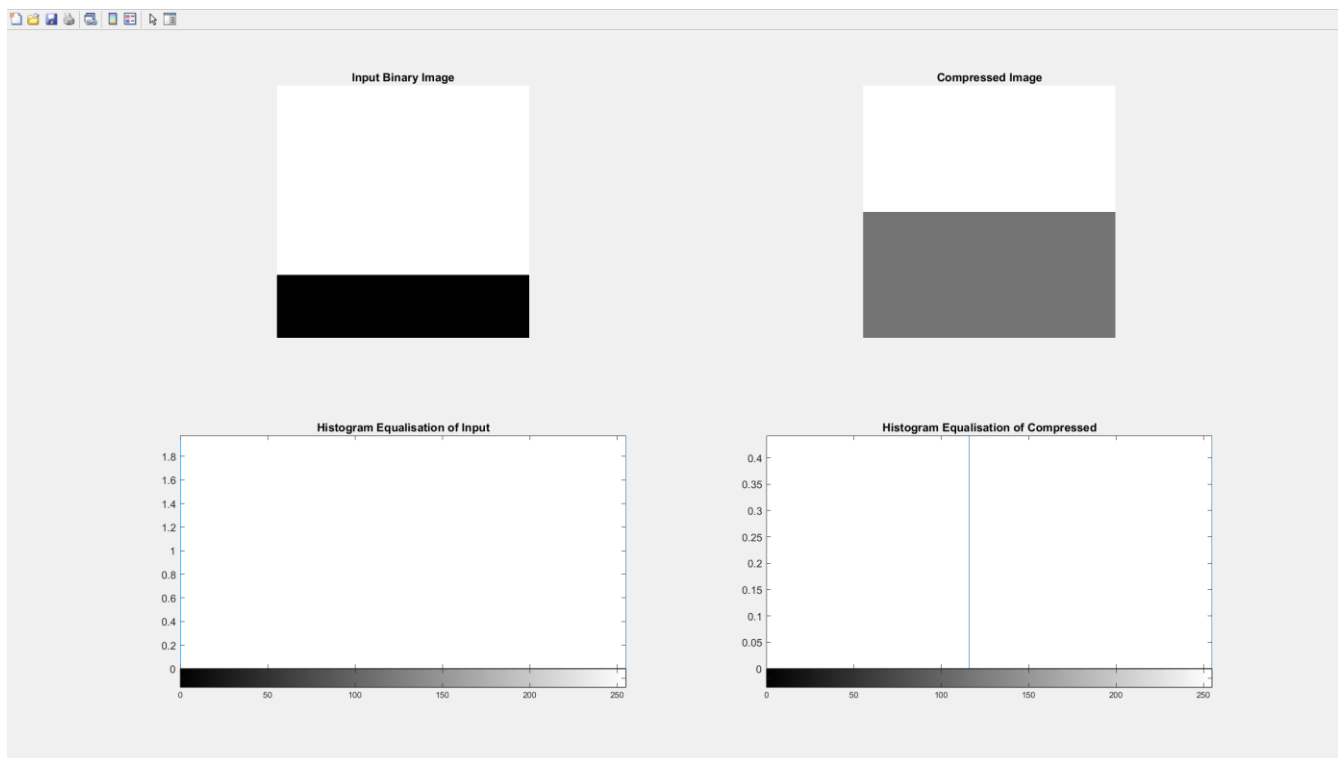
Binary Test Case 3

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 1  
Enter a 4x4 binary matrix (0s and 1s):  
[1,1,1,1  
1,1,1,1,  
1,1,1,1,  
0,0,0,0]  
Original Size: 16 bytes  
Compressed Size: 4 bytes  
Compression Ratio: 75.00%
```

fx >> |

Visual Representation:



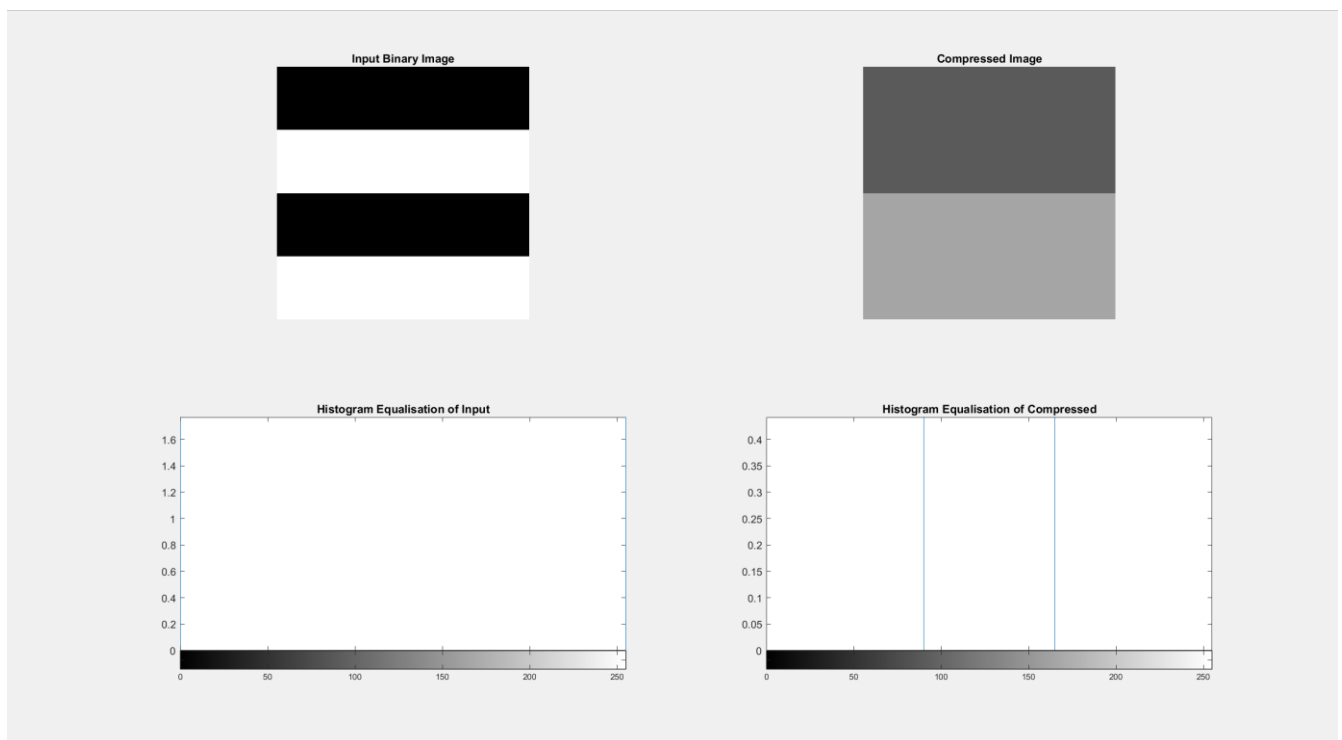
Binary Test Case 4

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 1  
Enter a 4x4 binary matrix (0s and 1s):  
[0,0,0,0,  
1,1,1,1,  
0,0,0,0,  
1,1,1,1]  
Original Size: 16 bytes  
Compressed Size: 4 bytes  
Compression Ratio: 75.00%
```

fx >>

Visual Representation:



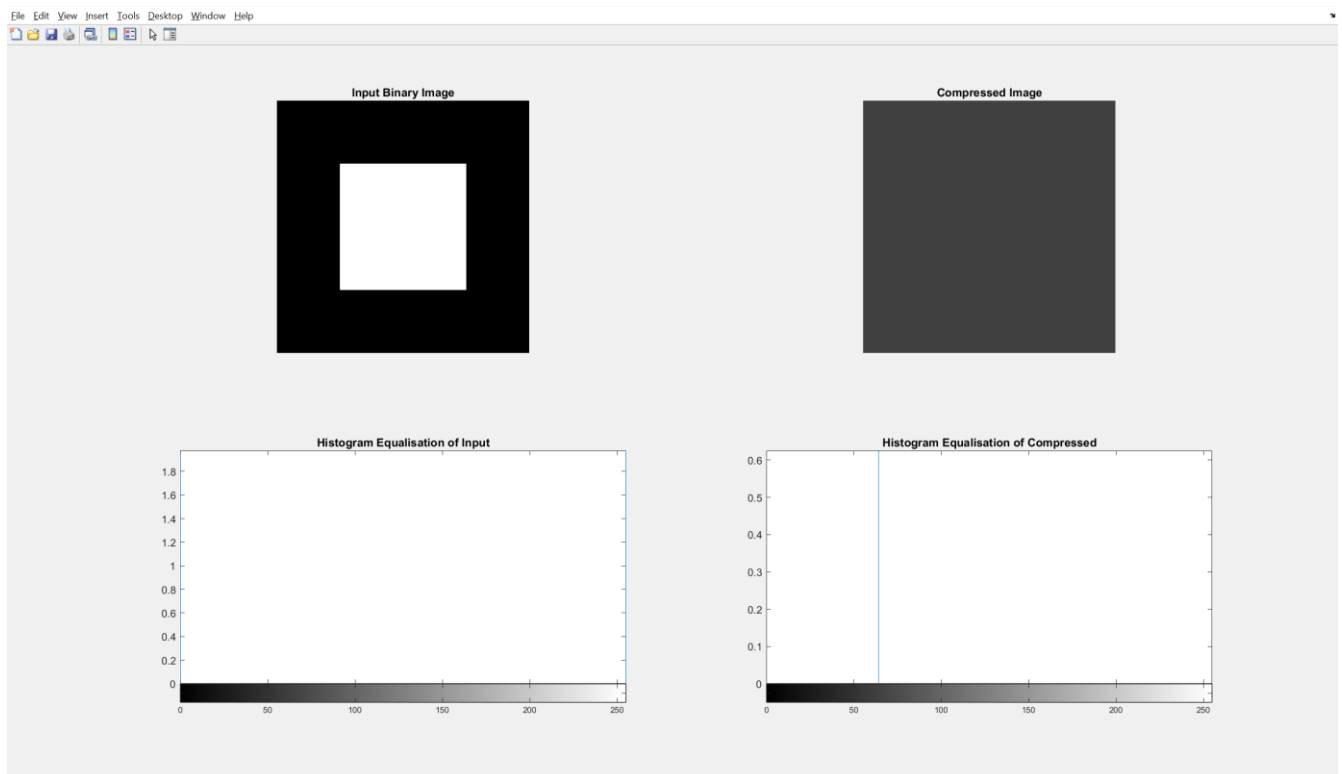
Binary Test Case 5

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 1  
Enter a 4x4 binary matrix (0s and 1s):  
[0,0,0,0,  
0,1,1,0,  
0,1,1,0  
0,0,0,0]  
Original Size: 16 bytes  
Compressed Size: 4 bytes  
Compression Ratio: 75.00%
```

fx >> |

Visual Representation:



NOTE: The compression in the images is not quite visible which is why we can refer to the Size and histogram of the compressed image to see the compression, to see the visible compression zoomed in image of both has been provided

Image Test Case 1

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 2  
Original Size: 1270878 bytes  
Compressed Size: 176457 bytes  
Compression Ratio: 86.12%
```

fx >>

Visual Representation:

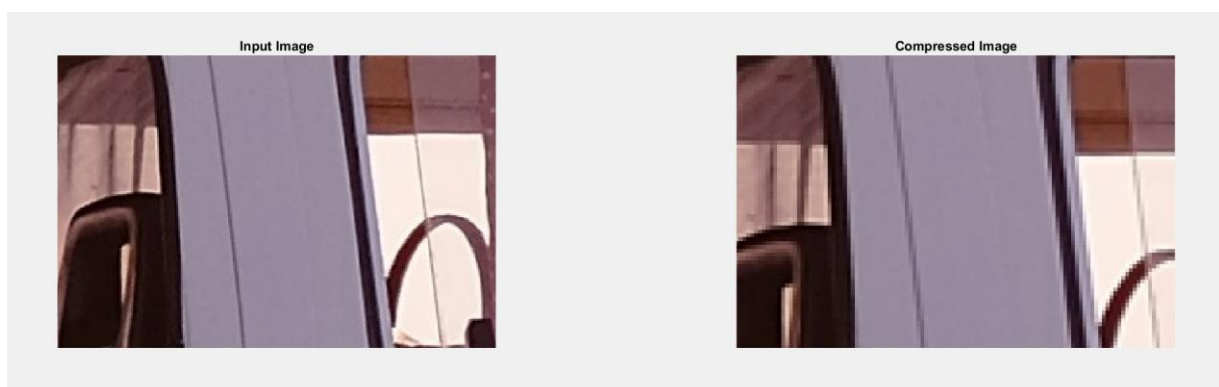
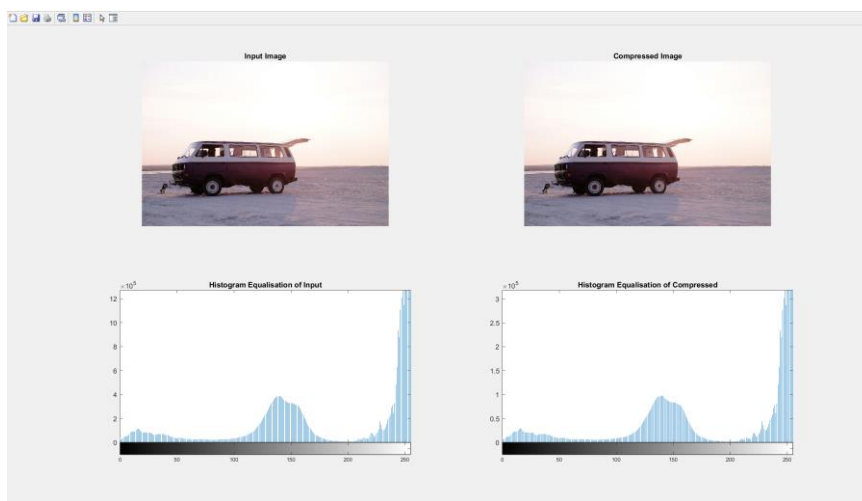


Image Test Case 2

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 2  
Original Size: 3800 bytes  
Compressed Size: 1512 bytes  
Compression Ratio: 60.21%
```

```
fx >>
```

Visual Representation:

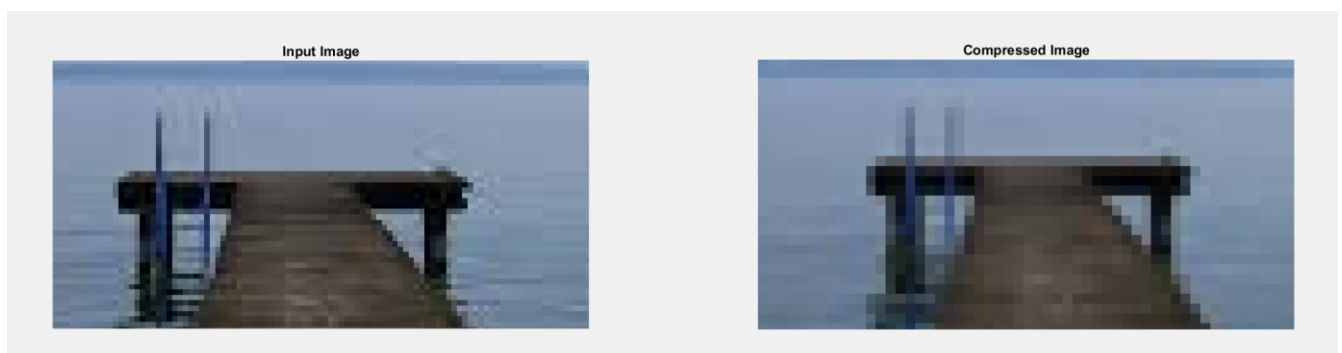
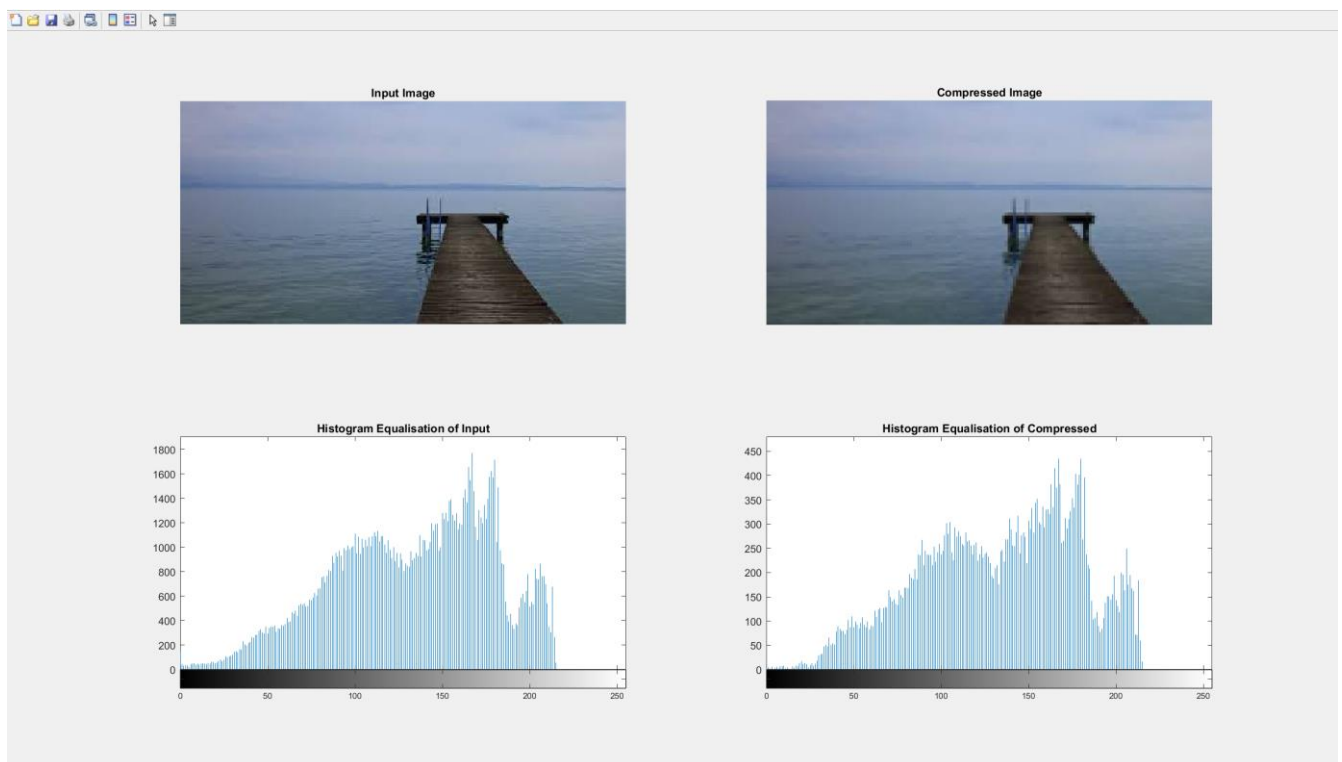


Image Test Case 3

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 2  
Original Size: 2071980 bytes  
Compressed Size: 263782 bytes  
Compression Ratio: 87.27%
```

```
fx>> |
```

Visual Representation:

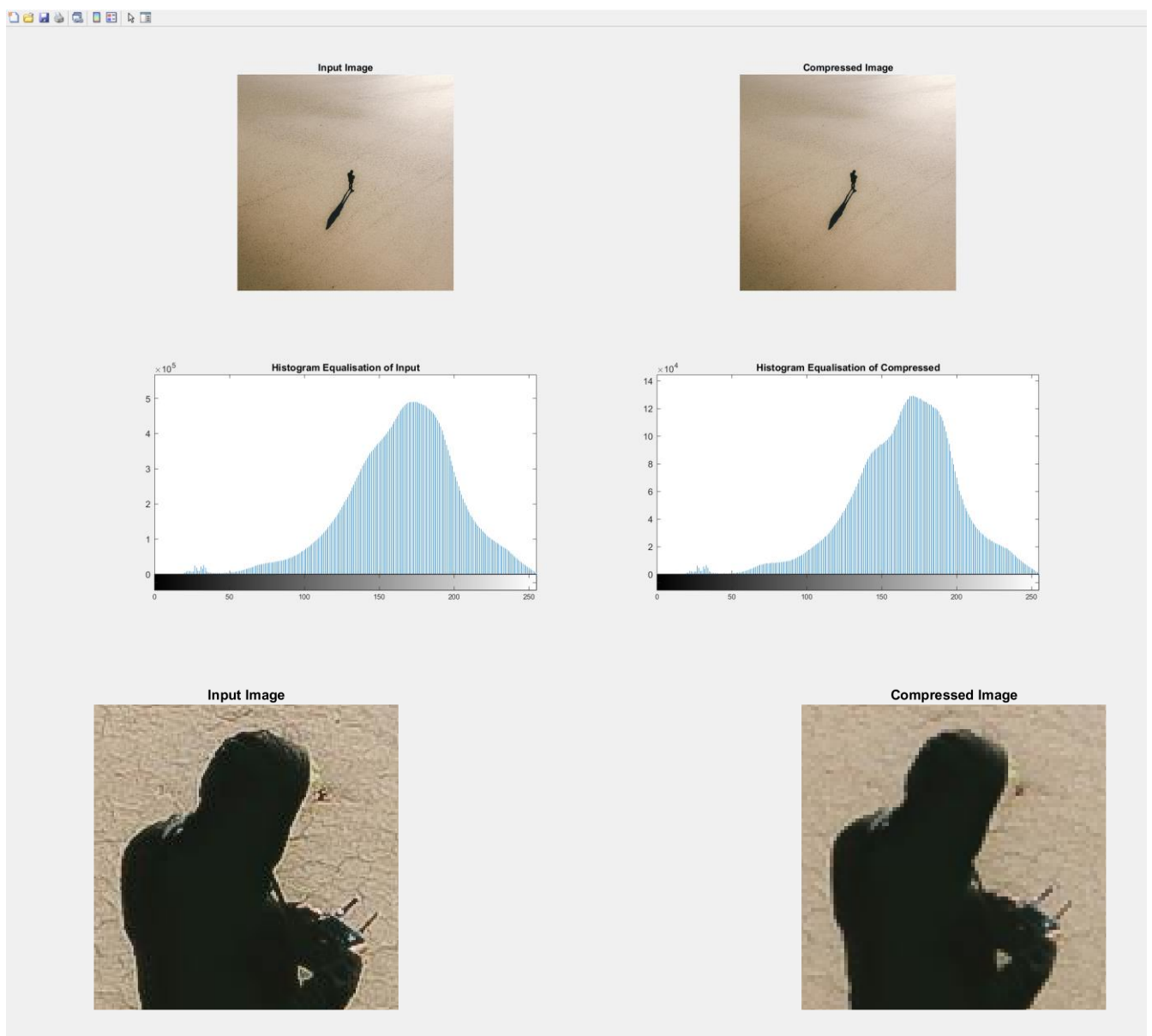


Image Test Case 4

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 2  
Original Size: 429282 bytes  
Compressed Size: 59873 bytes  
Compression Ratio: 86.05%
```

```
fx>> |
```

Visual Representation:

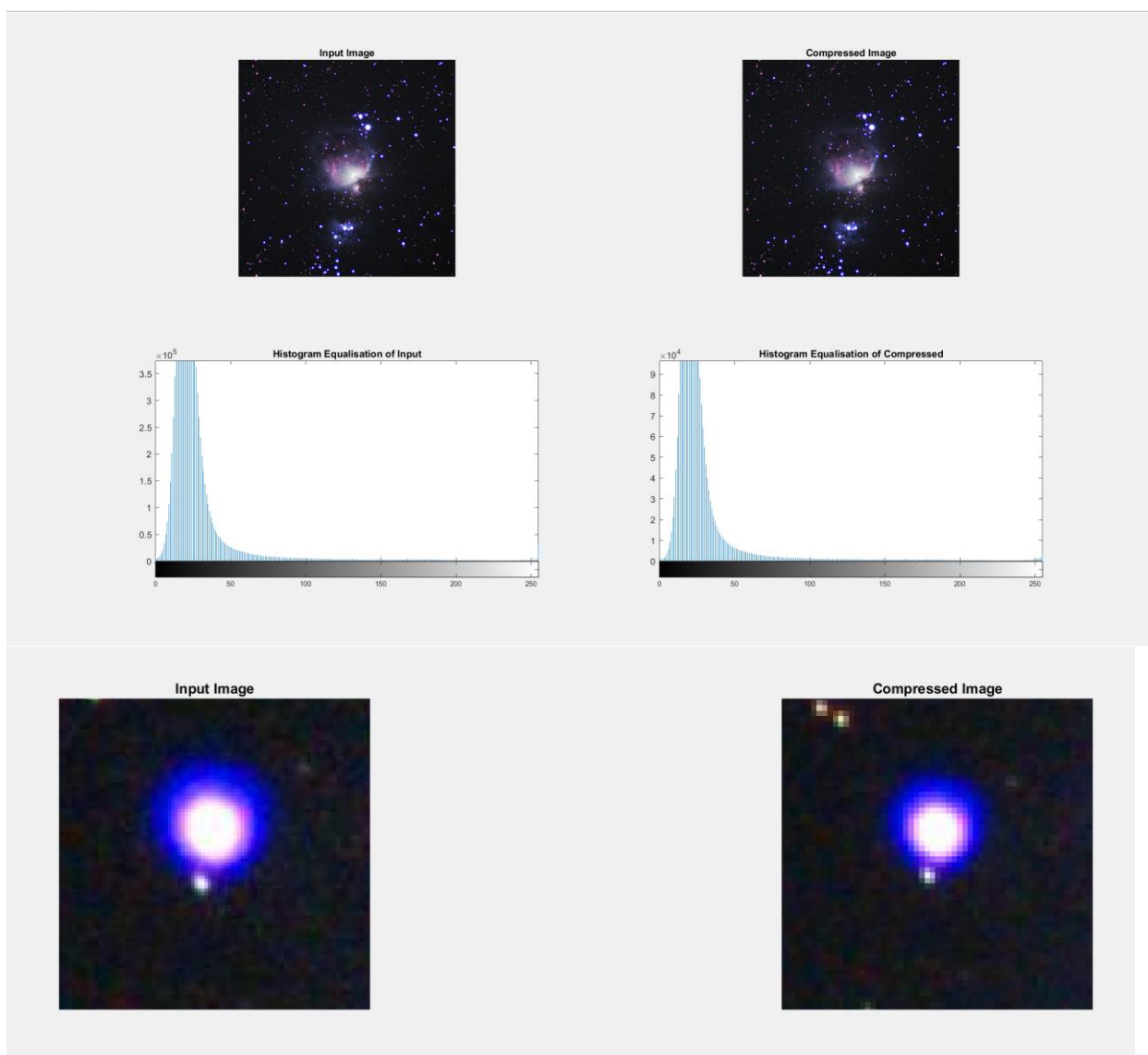


Image Test Case 5

Command Window

```
Choose the input type:  
1. 4x4 Binary Matrix  
2. Image File  
Enter your choice (1 or 2): 2  
Original Size: 501689 bytes  
Compressed Size: 87854 bytes  
Compression Ratio: 82.49%
```

fx >>

Visual Representation:

