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%------------------------------------------------------------
% Date        : 26/01/2026
% Created by  : Abhishek Kumar Jayswal
% Experiment  : Bit Plane Slicing and Bit Plane Removal
% Description :
%   This program performs bit plane slicing on a grayscale
%   image and visualizes individual bit planes (0 to 7).
%   It also demonstrates the effect of removing selected
%   bit planes from the original image.
%------------------------------------------------------------

clc;            % Clear command window
clear all;      % Remove all variables from workspace
close all;      % Close all open figure windows

%------------------ Read and Display Original Image ------------------
I = rgb2gray(imread('C:\Users\Abhishek\Desktop\DIP\Bit_Slicing\Image.jpg'));   % Convert RGB image to grayscale
[m, n] = size(I);                          % Get image dimensions

figure;
imshow(I);
title('Original Grayscale Image');

%------------------ Bit Plane Slicing ------------------
% Each bit plane represents a specific bit (0 to 7) of
% the grayscale image intensity values.

% Pre-allocate matrices for efficiency
Bitp0 = zeros(m,n);
Bitp1 = zeros(m,n);
Bitp2 = zeros(m,n);
Bitp3 = zeros(m,n);
Bitp4 = zeros(m,n);
Bitp5 = zeros(m,n);
Bitp6 = zeros(m,n);
Bitp7 = zeros(m,n);

% Extract individual bit planes using bitwise AND operation
for ii = 1:m
    for jj = 1:n
        Bitp0(ii,jj) = bitand(I(ii,jj), 1);     % 0th bit plane (LSB)
        Bitp1(ii,jj) = bitand(I(ii,jj), 2);     % 1st bit plane
        Bitp2(ii,jj) = bitand(I(ii,jj), 4);     % 2nd bit plane
        Bitp3(ii,jj) = bitand(I(ii,jj), 8);     % 3rd bit plane
        Bitp4(ii,jj) = bitand(I(ii,jj), 16);    % 4th bit plane
        Bitp5(ii,jj) = bitand(I(ii,jj), 32);    % 5th bit plane
        Bitp6(ii,jj) = bitand(I(ii,jj), 64);    % 6th bit plane
        Bitp7(ii,jj) = bitand(I(ii,jj), 128);   % 7th bit plane (MSB)
    end
end

%------------------ Display Bit Planes ------------------
figure; imshow(Bitp0); title('0th Bit Plane Image');
figure; imshow(Bitp1); title('1st Bit Plane Image');
figure; imshow(Bitp2); title('2nd Bit Plane Image');
figure; imshow(Bitp3); title('3rd Bit Plane Image');
figure; imshow(Bitp4); title('4th Bit Plane Image');
figure; imshow(Bitp5); title('5th Bit Plane Image');
figure; imshow(Bitp6); title('6th Bit Plane Image');
figure; imshow(Bitp7); title('7th Bit Plane Image');

%------------------ Bit Plane Removal ------------------
% In this section, selected bit planes are removed from the
% original image to observe their impact on image quality.
% Bit planes removed: 0th, 5th, and 7th

bitpr0 = zeros(m,n);
bitpr5 = zeros(m,n);
bitpr7 = zeros(m,n);

for ii = 1:m
    for jj = 1:n
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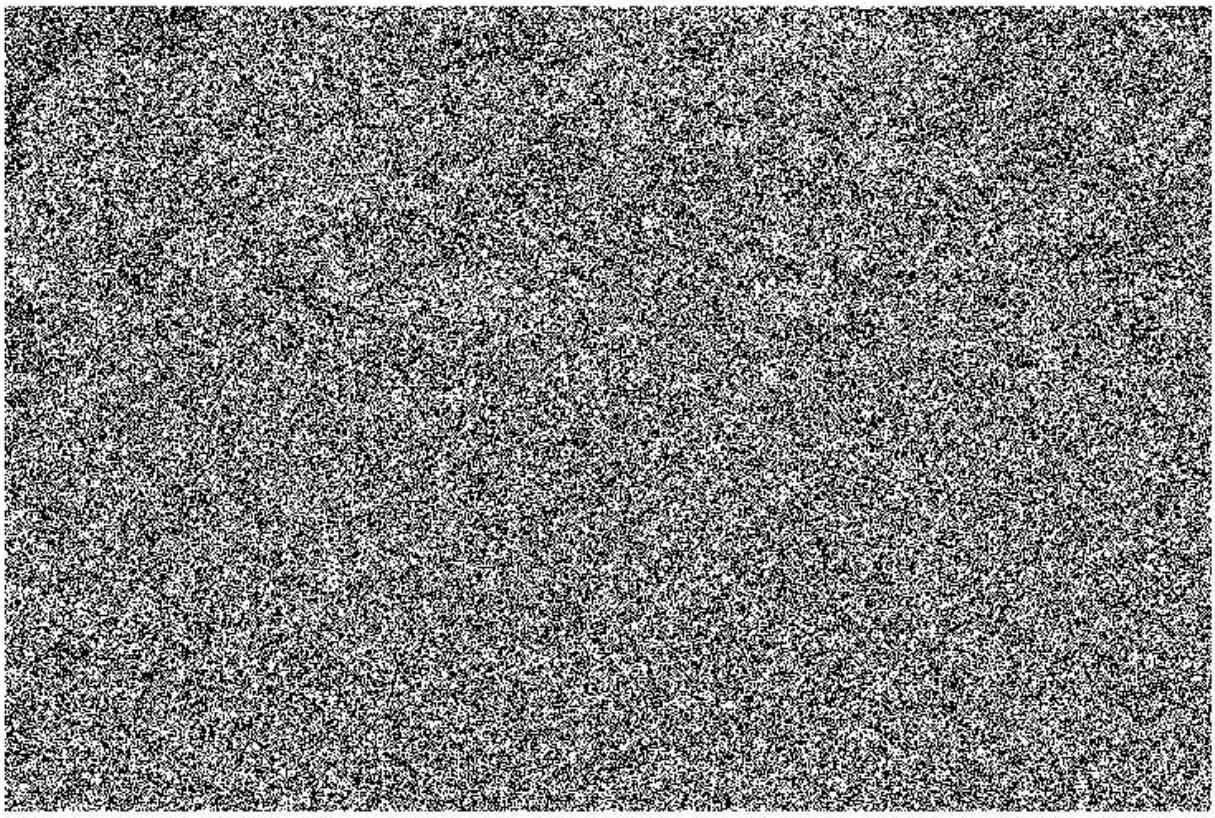
        bitpr0(ii,jj) = bitand(I(ii,jj), 255 - 2^0);   % Remove 0th bit plane
        bitpr5(ii,jj) = bitand(I(ii,jj), 255 - 2^5);   % Remove 5th bit plane
        bitpr7(ii,jj) = bitand(I(ii,jj), 255 - 2^7);   % Remove 7th bit plane
    end
end

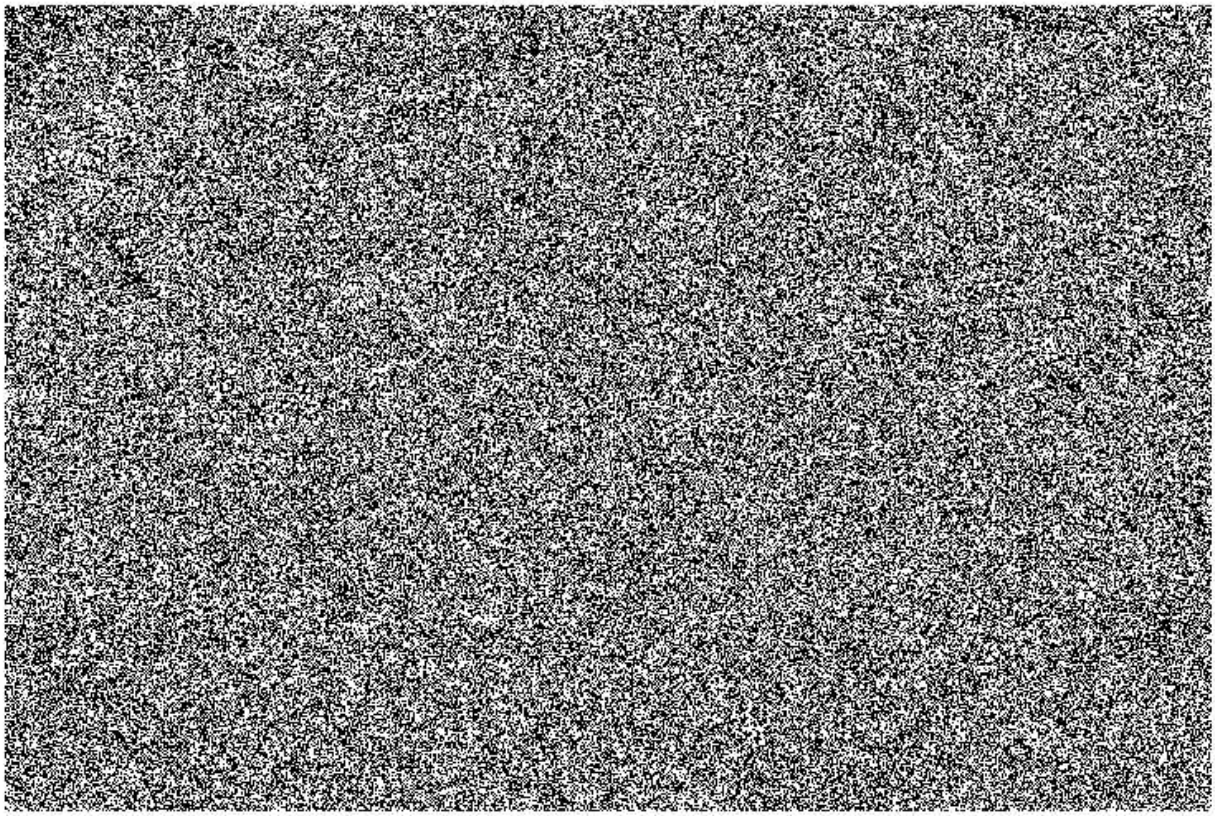
%------------------ Display Images after Bit Plane Removal ------------------
figure; imshow(bitpr0); title('Image with 0th Bit Plane Removed');
figure; imshow(bitpr5); title('Image with 5th Bit Plane Removed');
figure; imshow(bitpr7); title('Image with 7th Bit Plane Removed');
```

Original Grayscale Image

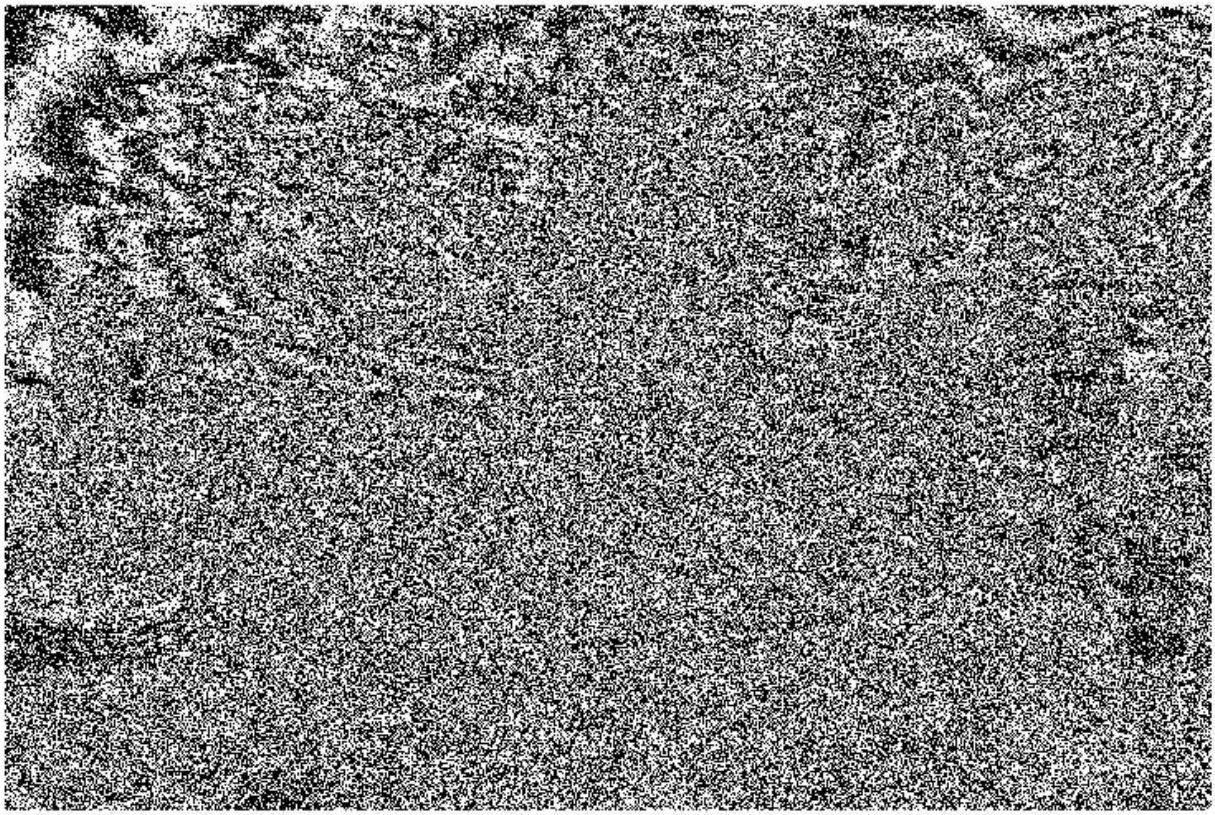
0th Bit Plane Image



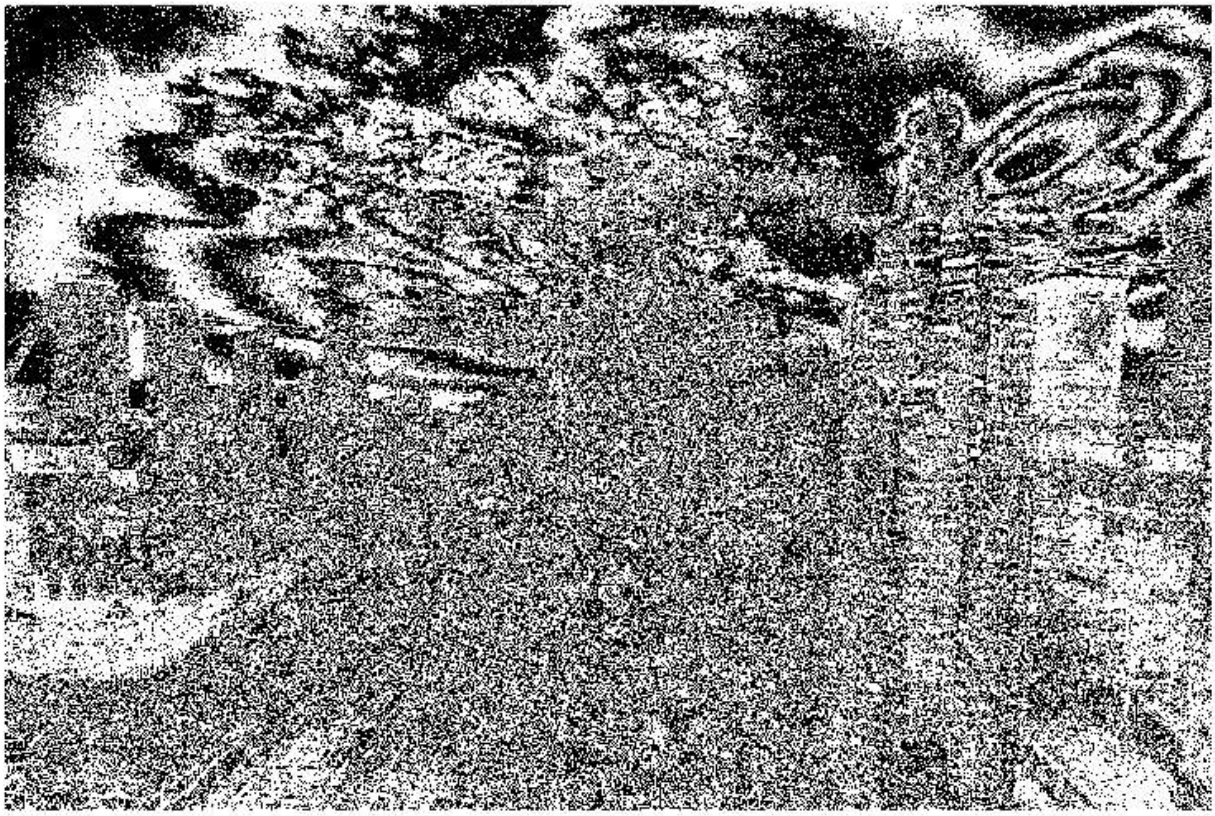
1st Bit Plane Image



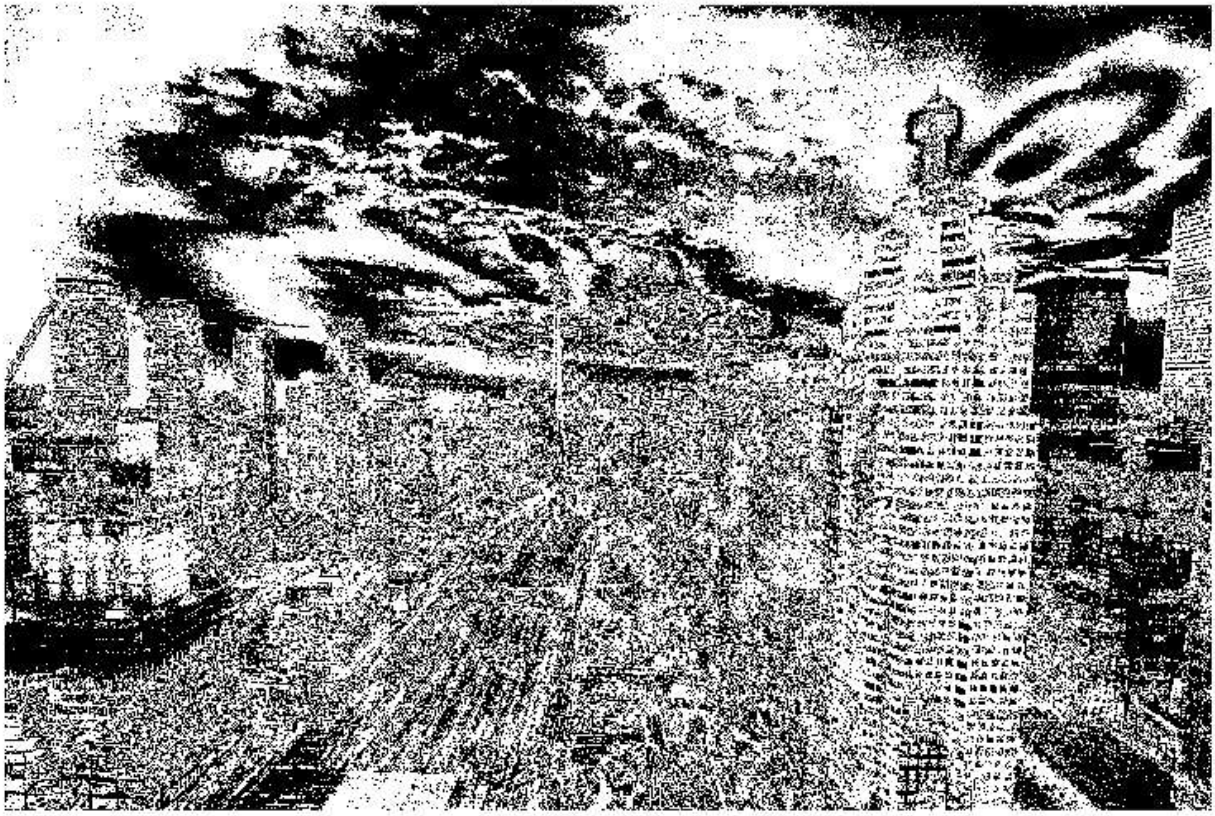
2nd Bit Plane Image



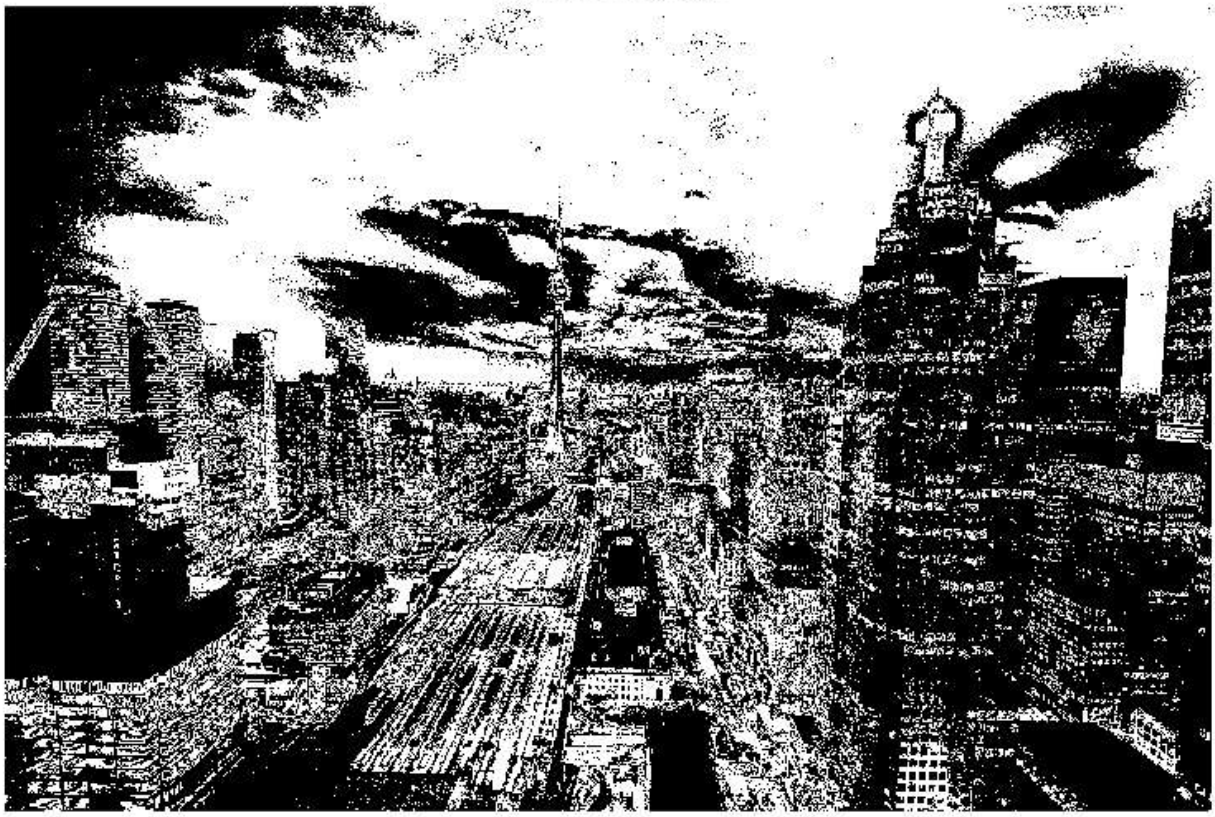
3rd Bit Plane Image



4th Bit Plane Image



5th Bit Plane Image

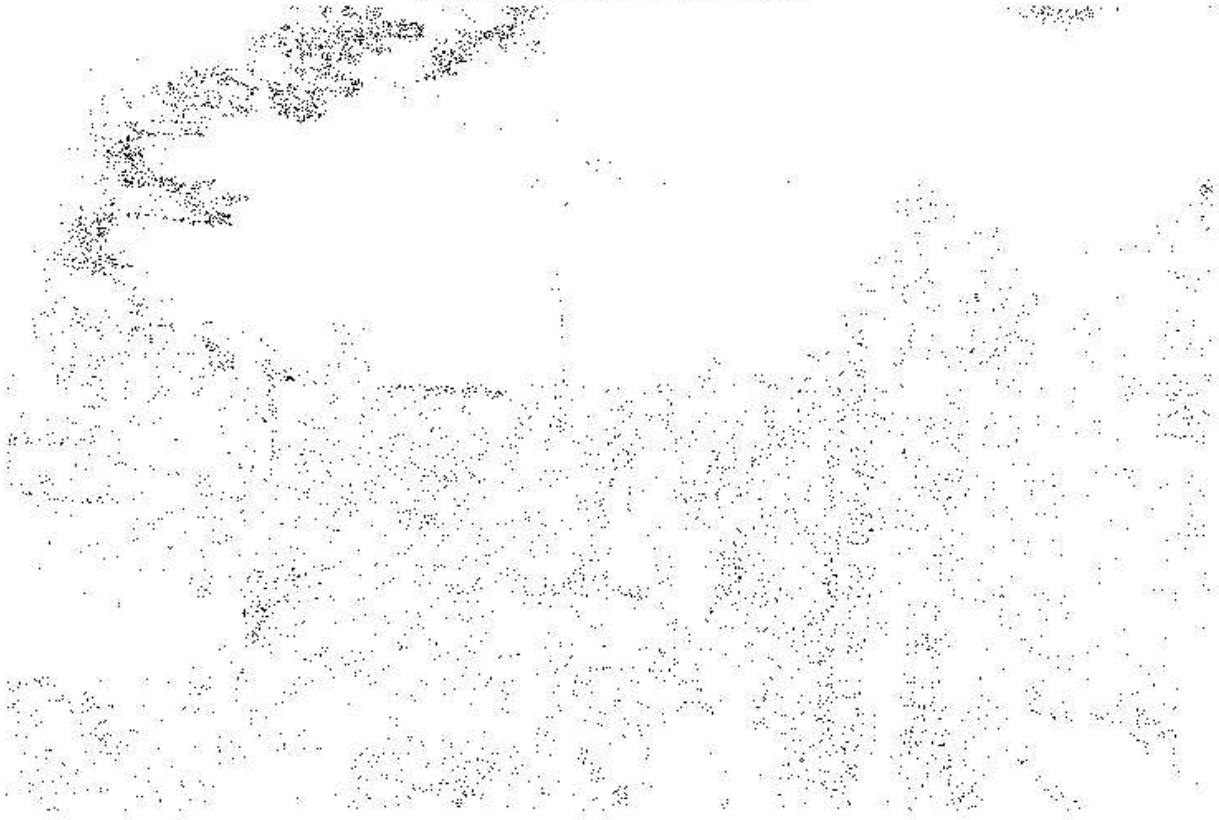


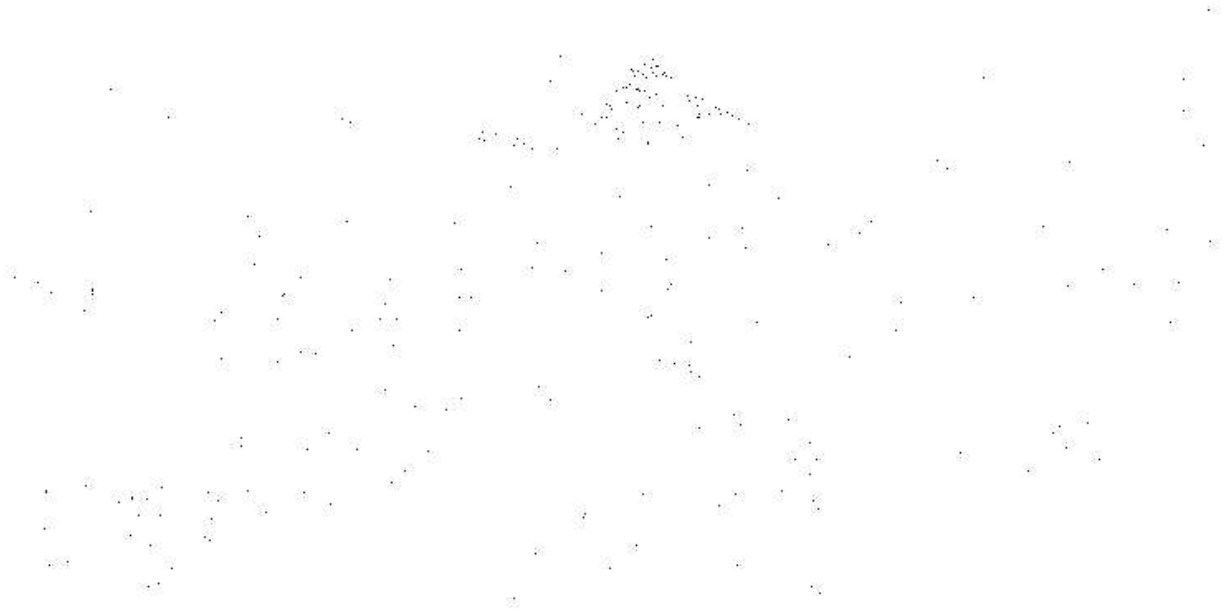
6th Bit Plane Image

7th Bit Plane Image

Image with 0th Bit Plane Removed

Image with 5th Bit Plane Removed





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