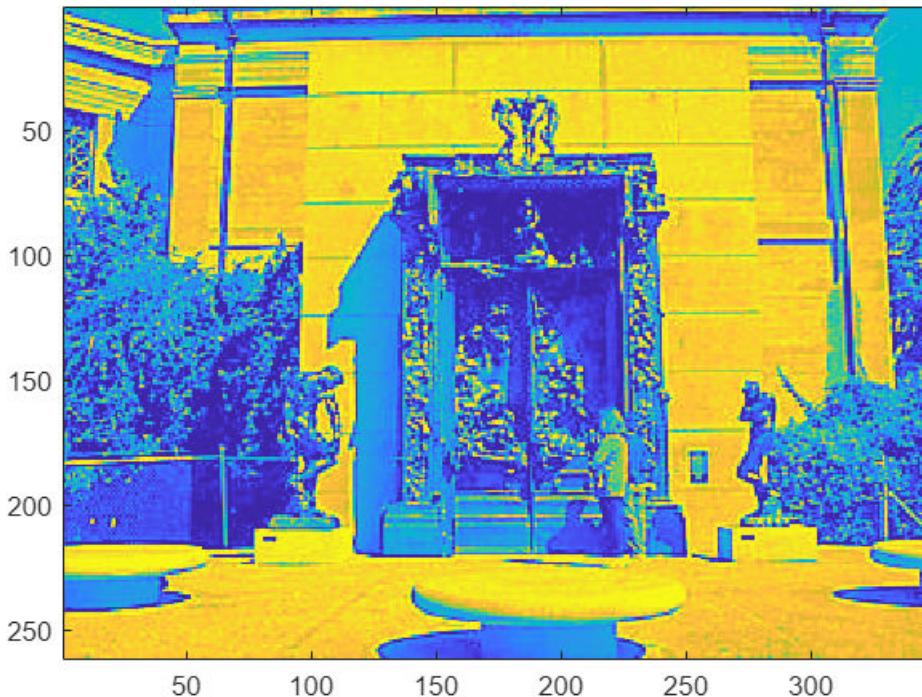


Lab 4 report

12210309 Lizhiying

Problem 1 - Image scaling

```
% (1)
f = fopen('rodin.raw');
image = fread(f,[348 inf] , "uint8");
image = image';
figure;
imagesc(image);
axis('equal'); axis('image');
```

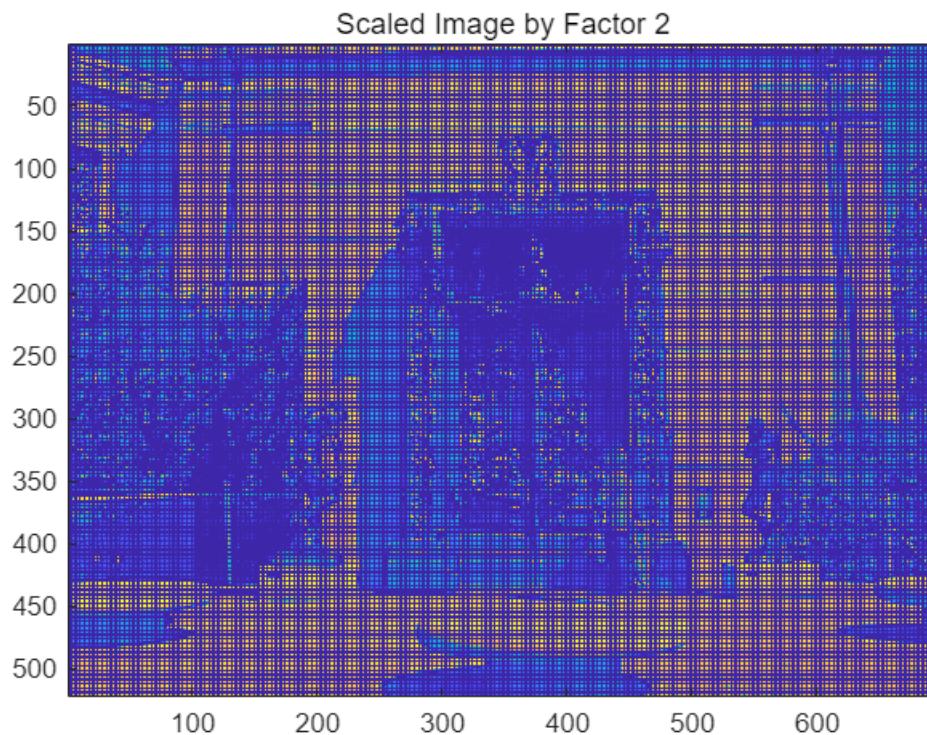


```
disp(['Image size: ', num2str(size(image))]);
```

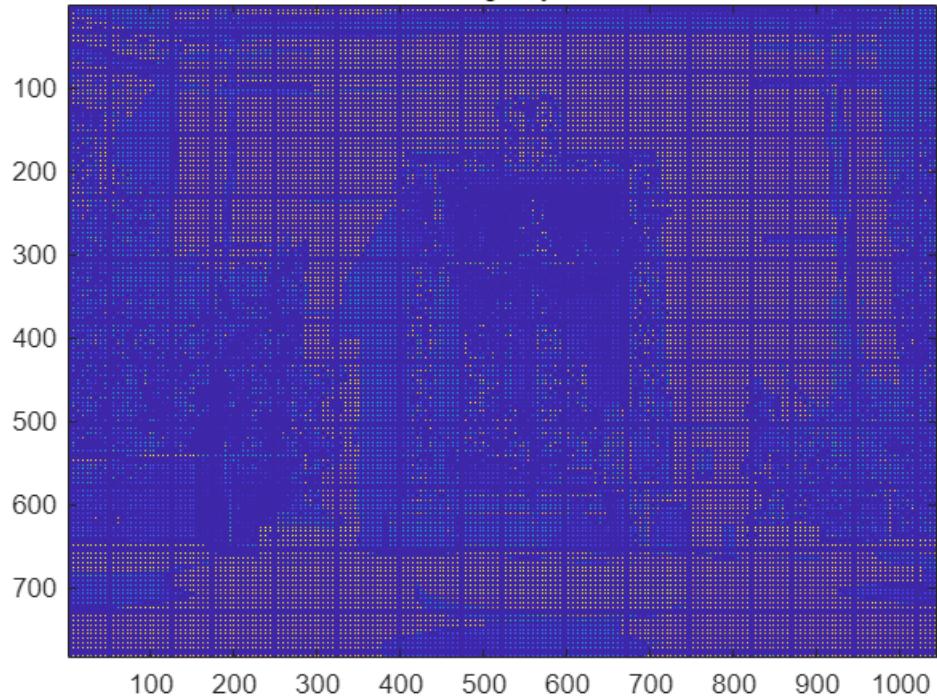
Image size: 261 348

```
% (2)
scaleFactors = [2, 3, 4];
for scaleFactor = scaleFactors
    scaledImage = zeros(scaleFactor * size(image));
    scaledImage(1:scaleFactor:end, 1:scaleFactor:end) = image;
    figure;
```

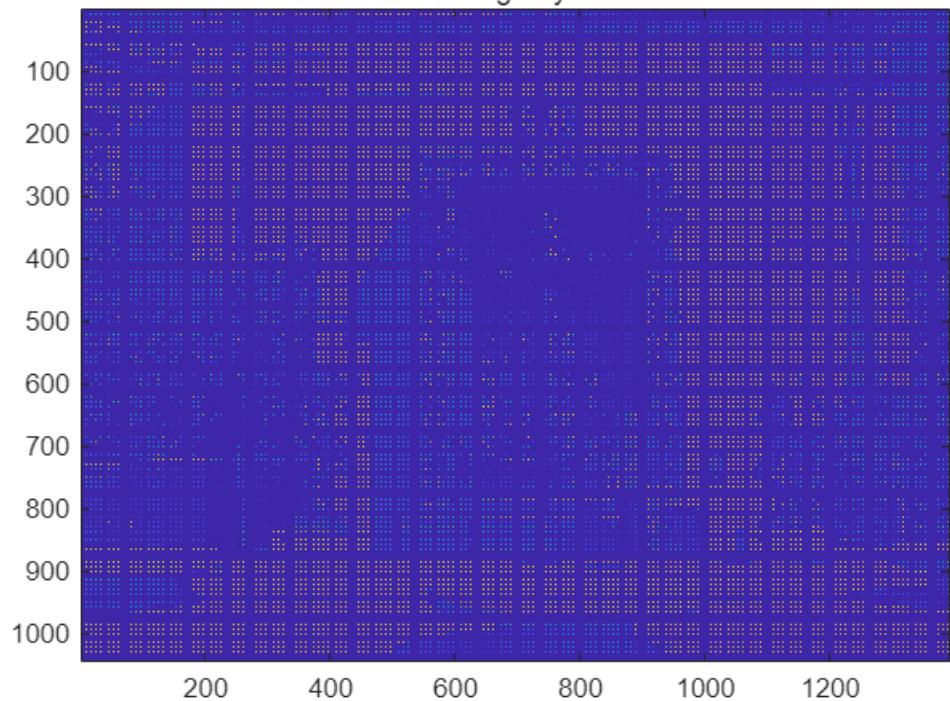
```
imagesc(scaledImage);
axis('equal'); axis('image');
title(['Scaled Image by Factor ', num2str(scaleFactor)]);
end
```



Scaled Image by Factor 3



Scaled Image by Factor 4



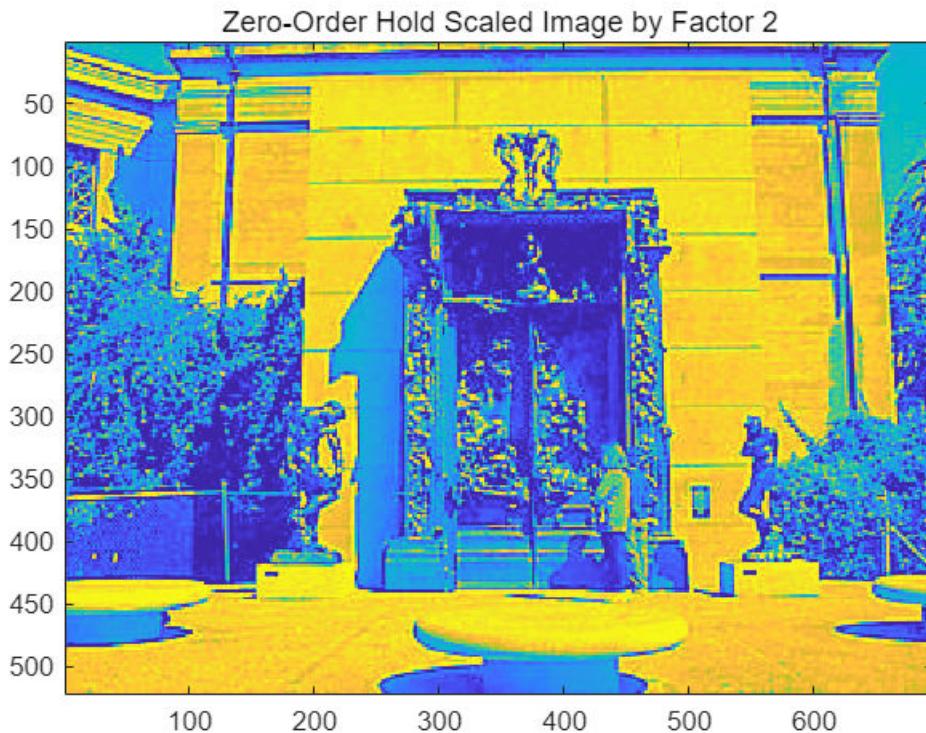
Comment: 当我们通过散布零行和零列来放大图像时，生成的图像会出现像素化并显示间隙（黑色行和列）。这些间隙是我们在已知数据点之间添加的零。随着缩放倍数增大，零行零列越来越多且越来越明显。

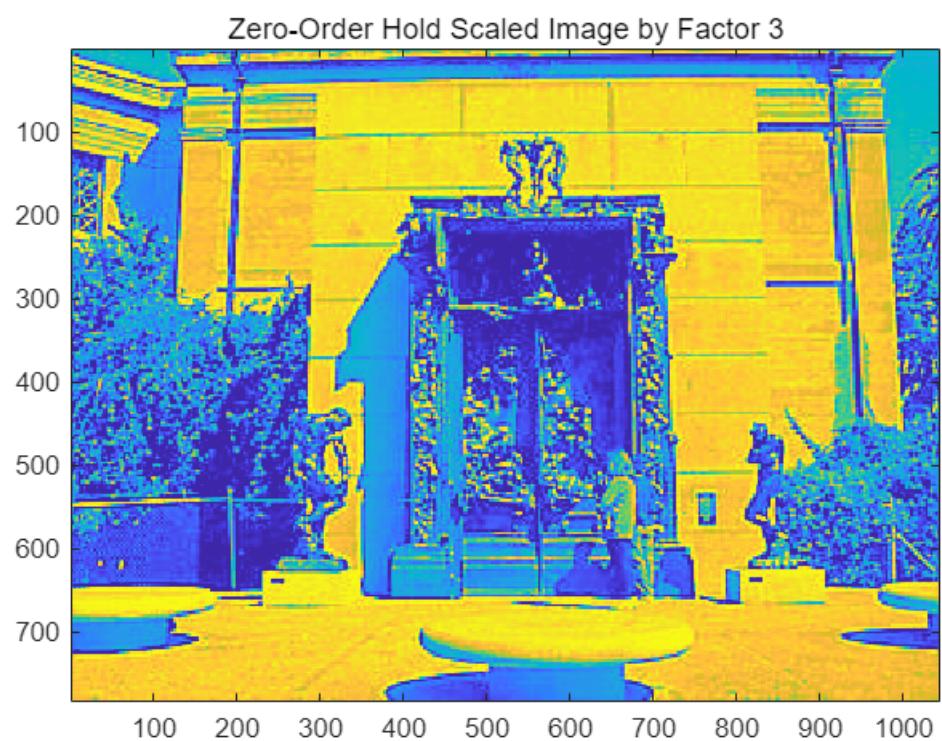
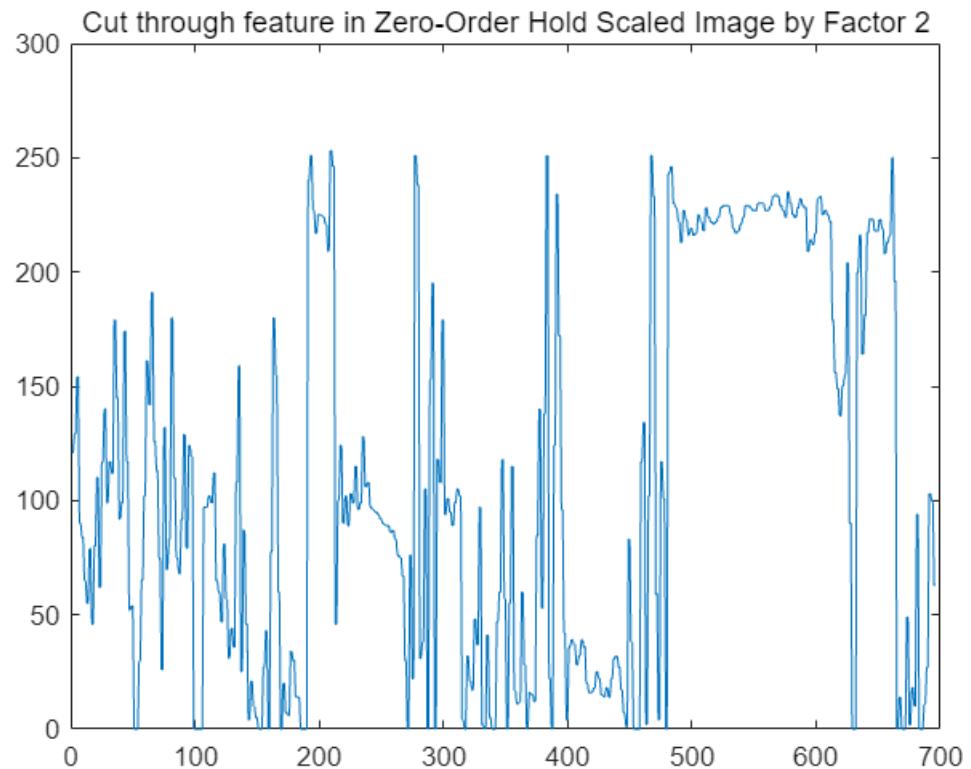
```
% (3)
for scaleFactor = scaleFactors

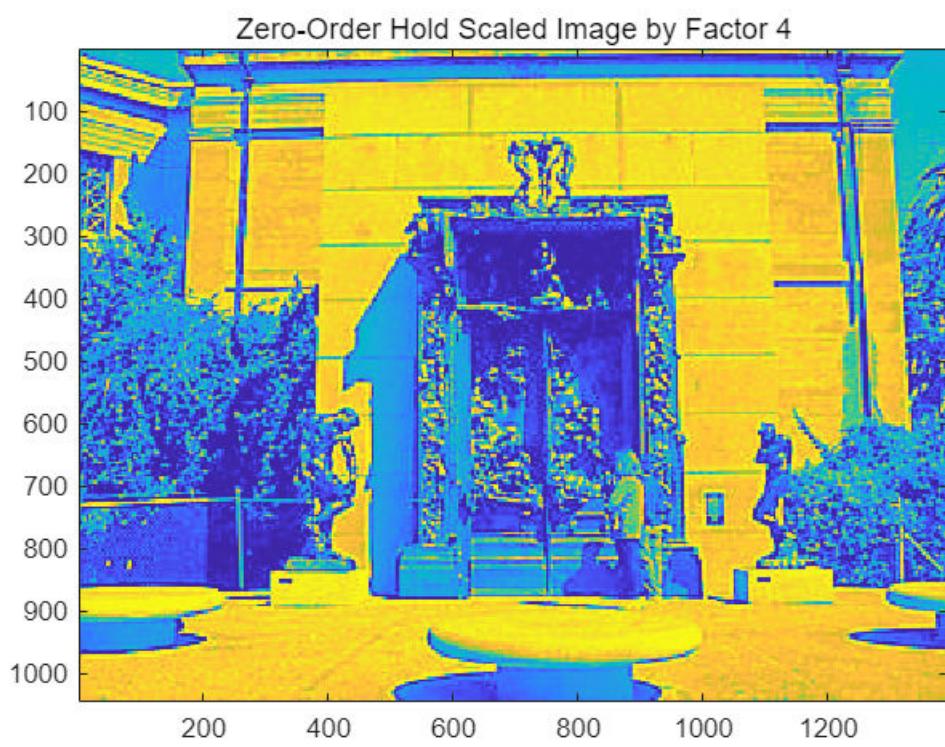
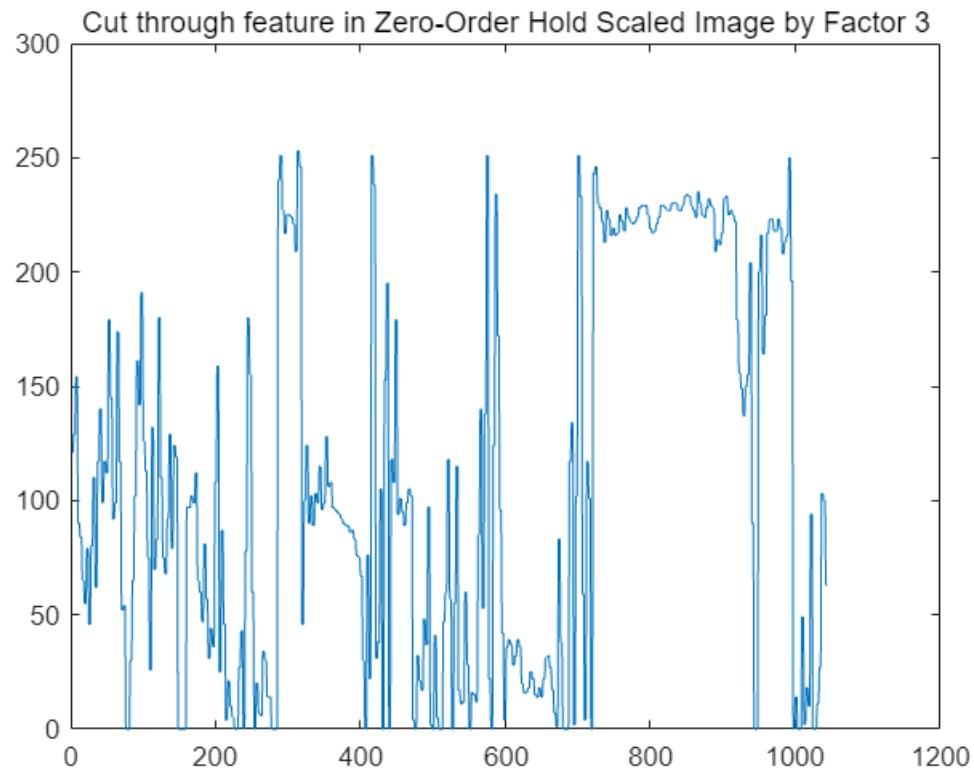
    scaledImage = imresize(image, scaleFactor, 'nearest');

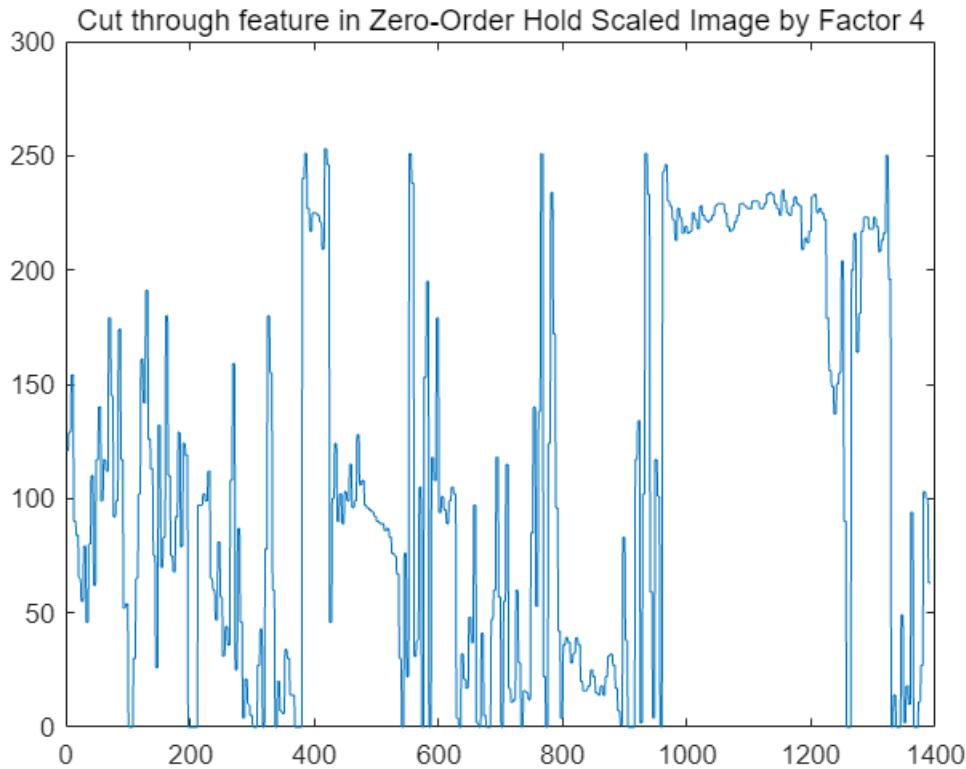
    figure;
    imagesc(scaledImage);
    axis('equal'); axis('image');
    title(['Zero-Order Hold Scaled Image by Factor ', num2str(scaleFactor)]);

    cutLine = round(size(scaledImage, 1) / 2);
    figure;
    plot(scaledImage(cutLine, :));
    title(['Cut through feature in Zero-Order Hold Scaled Image by Factor ', num2str(scaleFactor)]);
end
```









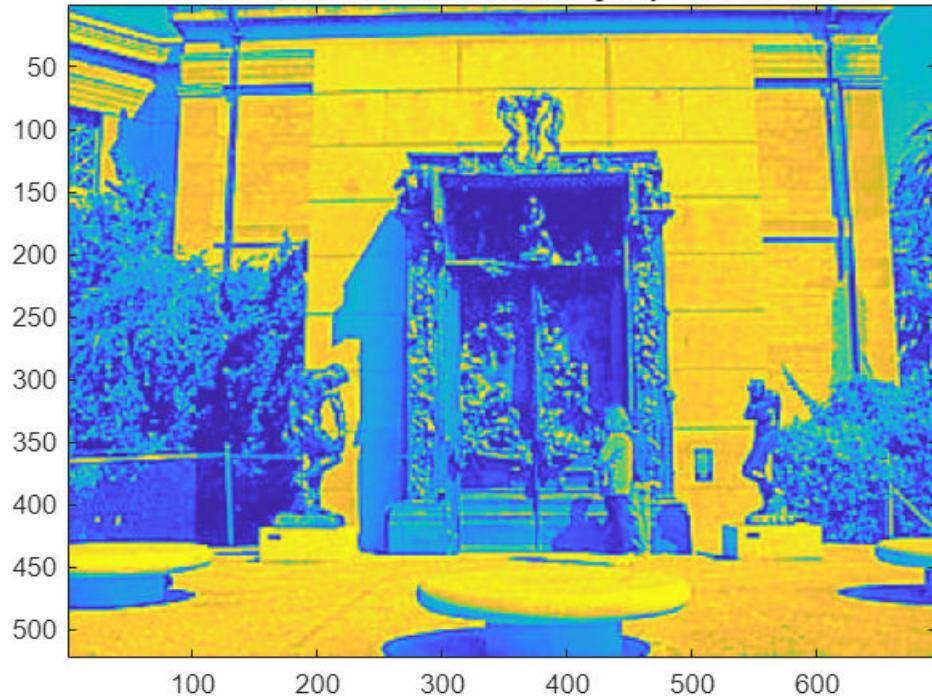
Comment : 特征曲线的形状呈现块状，类似阶梯。

```
% (4)
for scaleFactor = scaleFactors
    scaledImage = imresize(image, scaleFactor, 'bilinear');

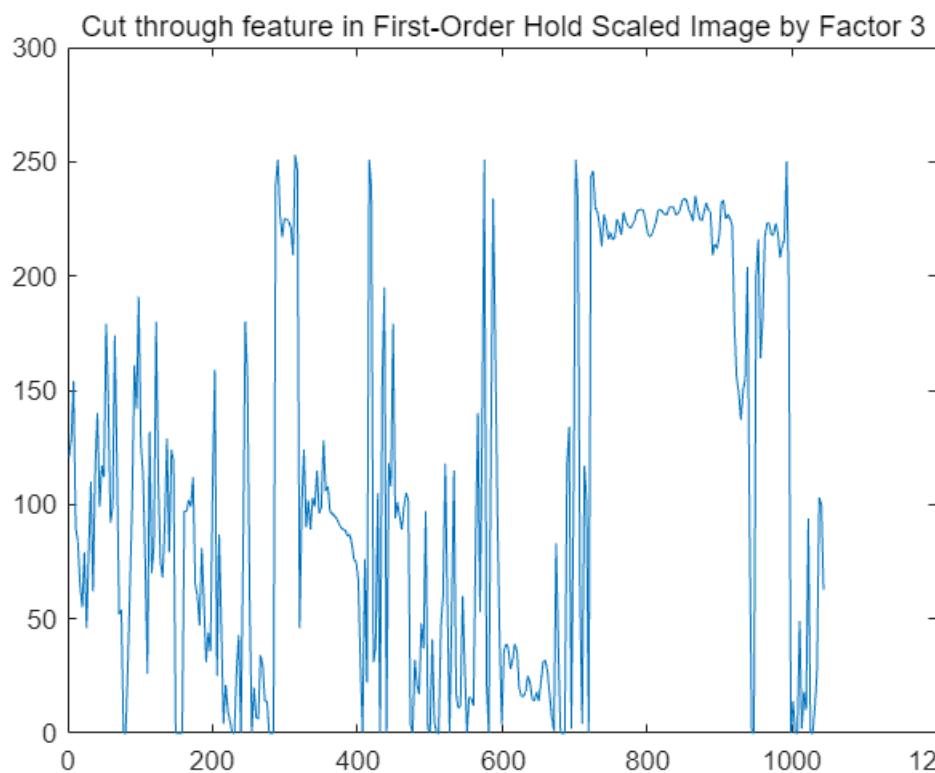
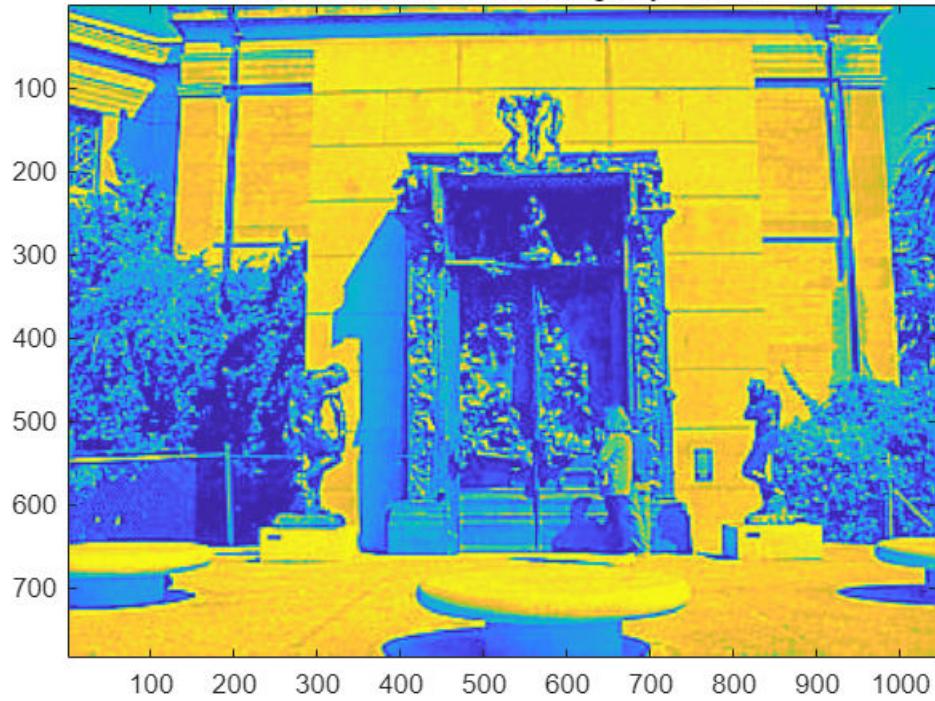
    figure;
    imagesc(scaledImage);
    axis('equal'); axis('image');
    title(['First-Order Hold Scaled Image by Factor ', num2str(scaleFactor)]);

    cutLine = round(size(scaledImage, 1) / 2);
    figure;
    plot(scaledImage(cutLine, :));
    title(['Cut through feature in First-Order Hold Scaled Image by Factor ', num2str(scaleFactor)]);
end
```

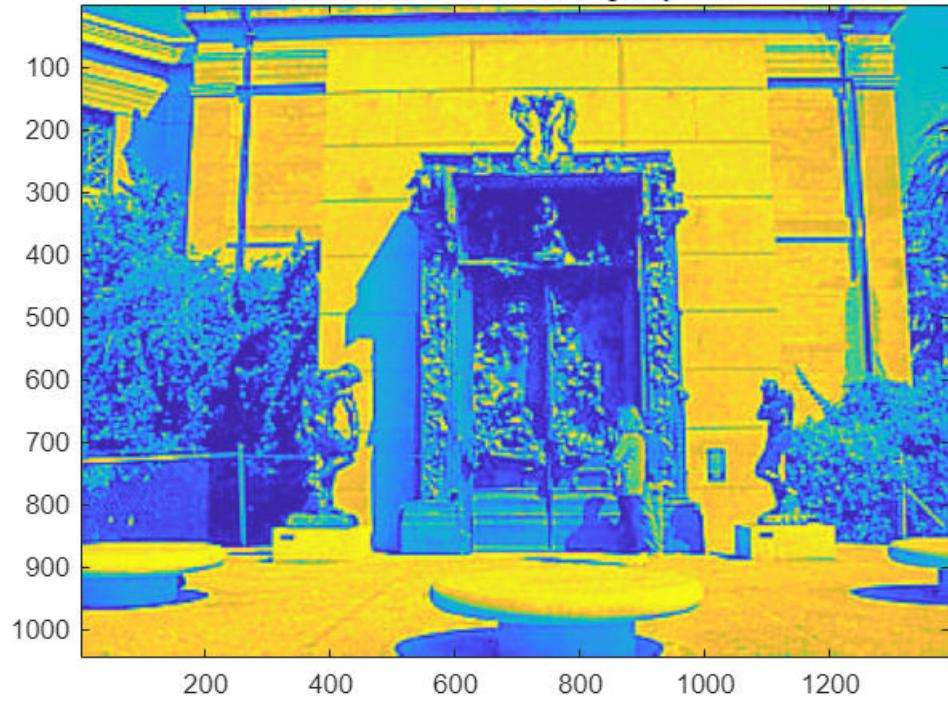
First-Order Hold Scaled Image by Factor 2



First-Order Hold Scaled Image by Factor 3



First-Order Hold Scaled Image by Factor 4

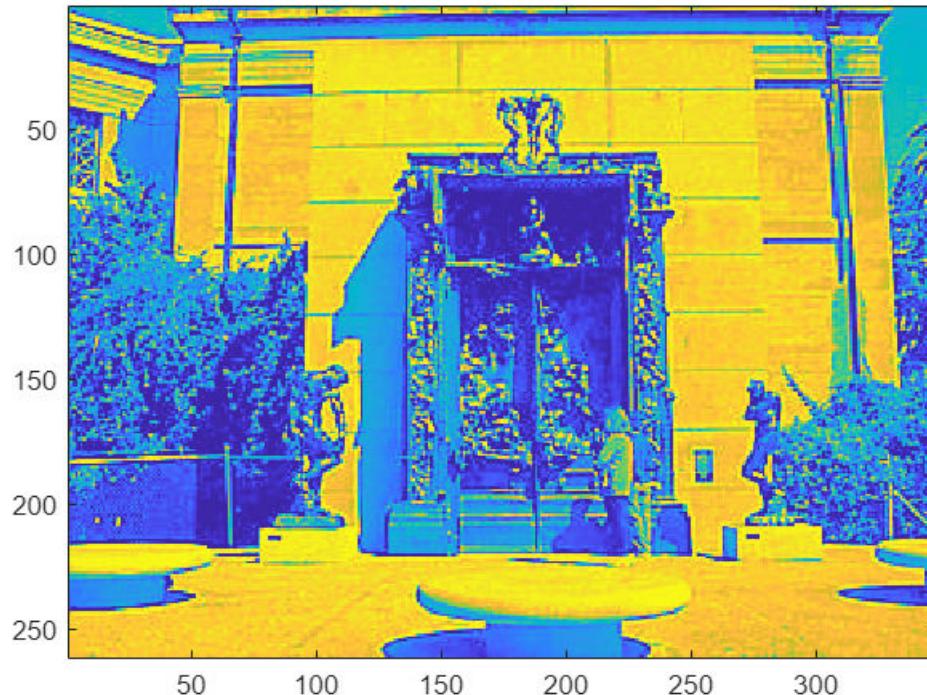


Comment: 与零阶保持相比，一阶保持的特征曲线显得更加平滑。

```
clc;close all;clear;
```

Problem 2 - Rotations

```
% (1)  
f = fopen('rodin.raw');  
image = fread(f,[348 inf] , "uint8");  
image = image';  
figure;  
imagesc(image);  
axis('equal'); axis('image');
```



```
% (2)  
angles = [45, 100, 670];  
for angle = angles  
  
    theta = deg2rad(angle);  
  
    [rows, cols] = size(image);  
  
    centerX = ceil((cols + 1) / 2);  
    centerY = ceil((rows + 1) / 2);  
  
    rotatedImage = zeros(rows, cols, 'uint8');
```

```

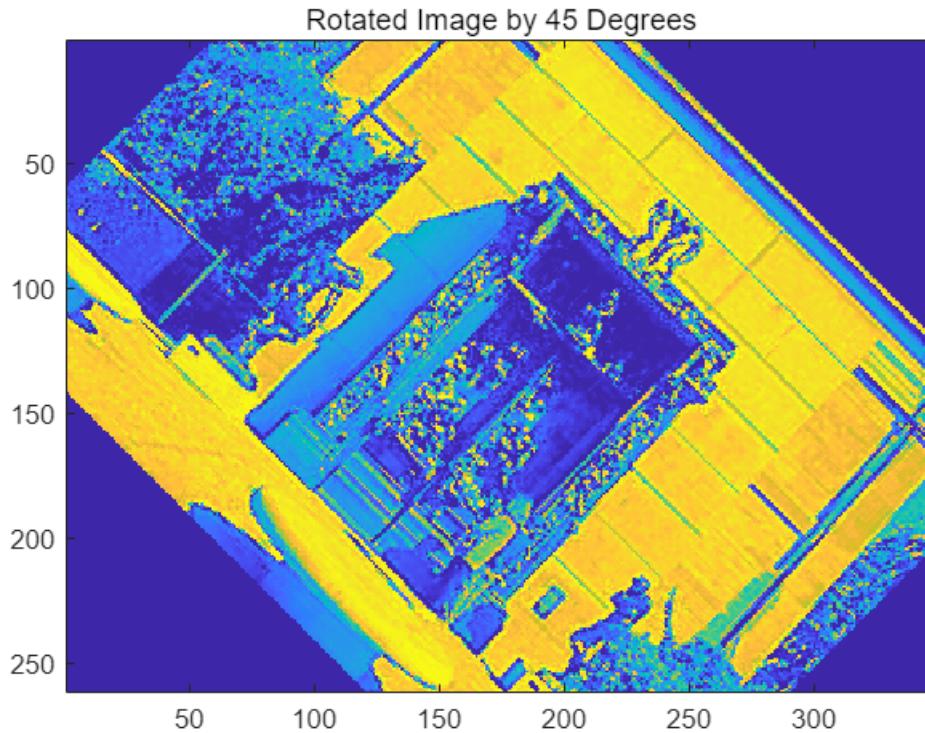
for x = 1:cols
    for y = 1:rows
        xShifted = x - centerX;
        yShifted = y - centerY;

        xOriginal = round(cos(theta) * xShifted + sin(theta) * yShifted) +
centerX;
        yOriginal = round(-sin(theta) * xShifted + cos(theta) * yShifted) +
centerY;

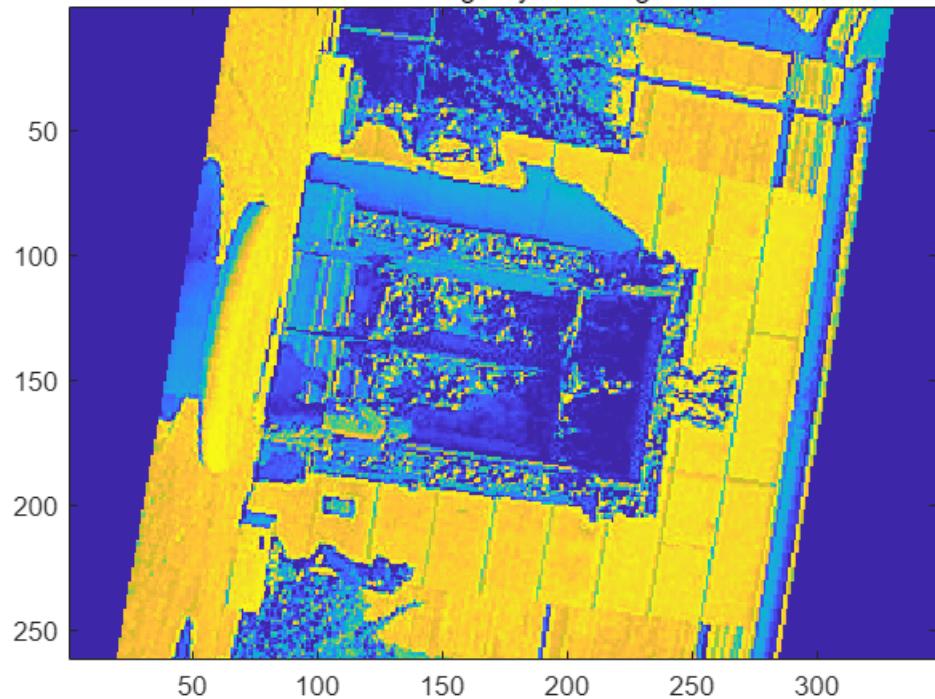
        if xOriginal >= 1 && xOriginal <= cols && yOriginal >= 1 && yOriginal
<= rows
            rotatedImage(y, x) = image(yOriginal, xOriginal);
        end
    end
end

figure;
imagesc(rotatedImage);
axis('equal'); axis('image');
title(['Rotated Image by ', num2str(angle), ' Degrees']);
end

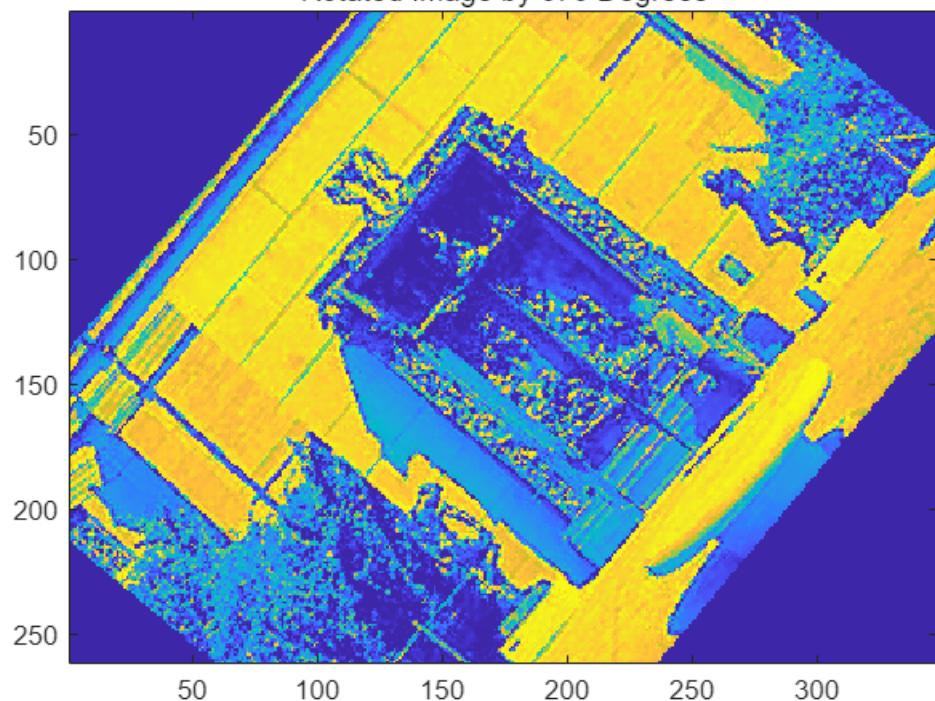
```



Rotated Image by 100 Degrees



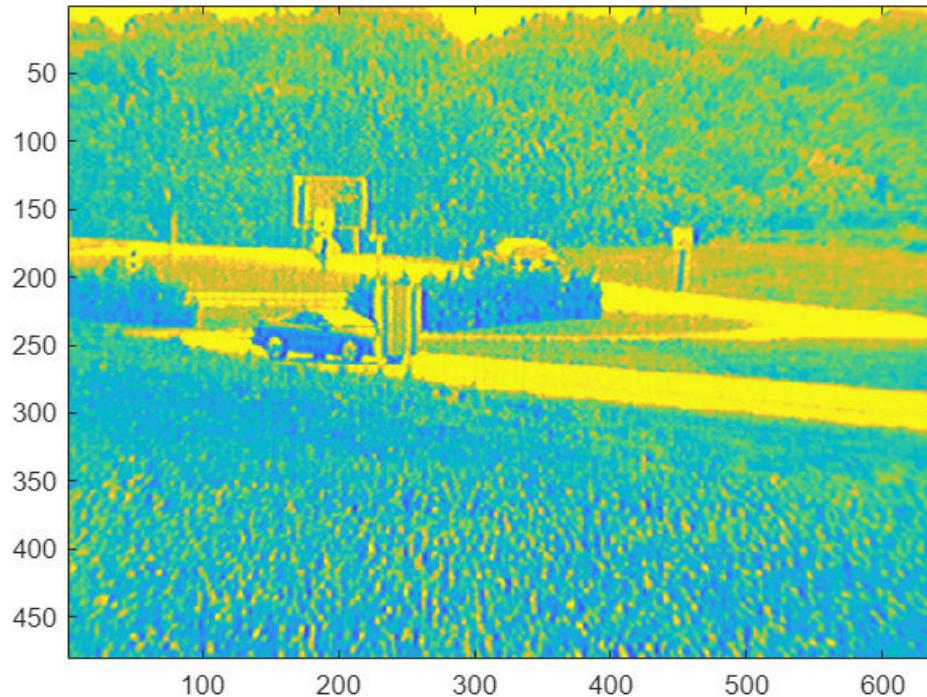
Rotated Image by 670 Degrees



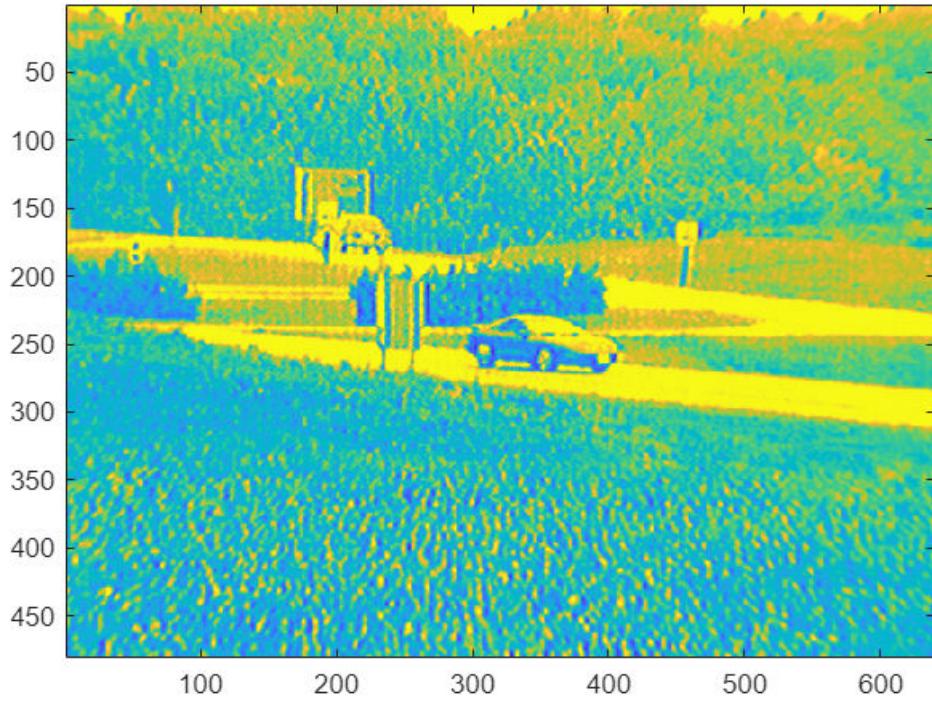
```
clc;clear;close all;
```

Problem 3 - Problem 3 - Subtracting to get image change.

```
% (1)
f1 = fopen('lab4prob3data1');
image1 = fread(f1,[640 inf] , "uint8");
image1 = image1';
figure;
imagesc(image1);
axis('equal'); axis('image');
```



```
f2 = fopen('lab4prob3data2');
image2 = fread(f2,[640 inf] , "uint8");
image2 = image2';
figure;
imagesc(image2);
axis('equal'); axis('image');
```



```
% (2)
```

Comment : 从两张图我们可以很明显的看出，这张图代表的时间不同，分别是两个时间两辆小车驶过同一条道路。

```
% (3)
imageDiff = image1 - image2;
figure;
imagesc(imageDiff);
colormap gray;
axis image;
axis off;
title('Difference Image');
```

Difference Image

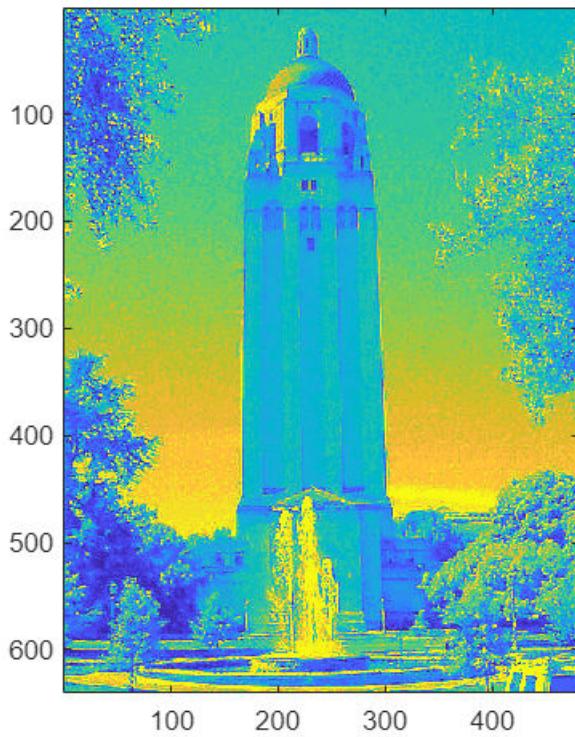


Comment: 在这张图中两辆车的位置被 highlight 了，因为这两张图是两辆车在同一道路不同时间的前后照片，所以他们的差值是前后位置。

```
clc;clear;close all;
```

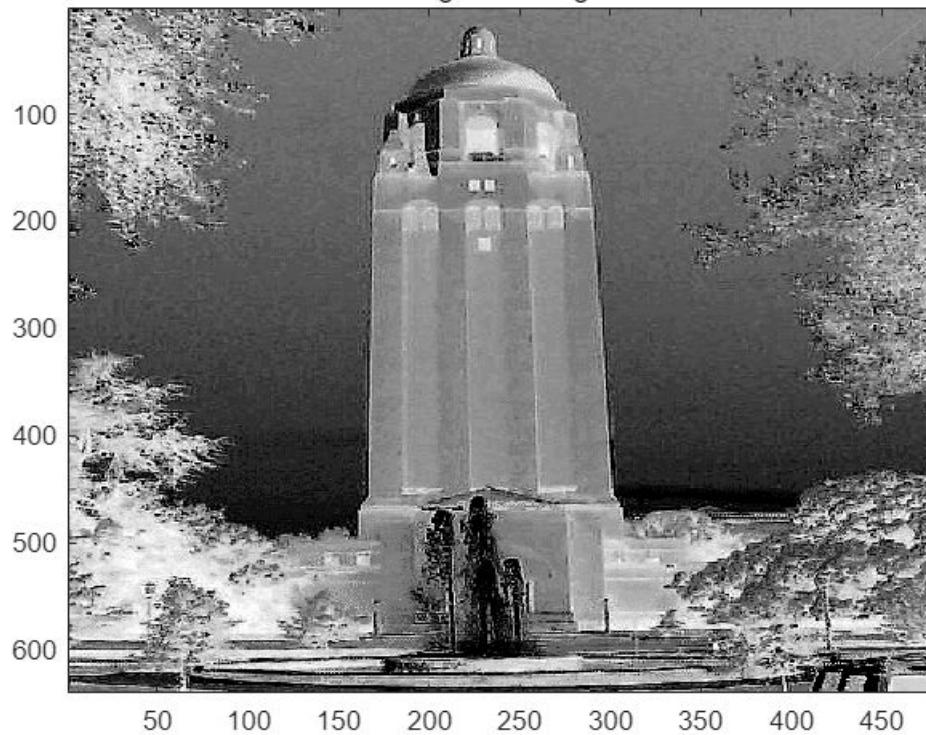
Problem 4 - Image inversion.

```
f = fopen('lab4prob4data');
image = fread(f,[480 inf] , "uint8");
image = image';
figure;
imagesc(image);
axis('equal'); axis('image');
```



```
% (2)  
imageNegative = - image;  
figure;  
imagesc(imageNegative);  
colormap('gray');  
title('Negative Image');
```

Negative Image



Comment: 负片图像的亮暗部分相反，原来亮的部分变暗，原来暗的部分变亮。

Application: 负片可以用于增强对比度，以便更好地观察细节，例如在医学影像中。

```
clc;clear;close all;
```

Problem 5

```
% (1)
imageGroup = imread('pictures.jpg');
imageGroupGray = rgb2gray(imageGroup);
figure;
imagesc(imageGroupGray);
colormap gray;
axis image;
axis off;
title('Original Group Image');

% (2)
rect = round(getrect);
```



```
x1 = round(rect(1));
y1 = round(rect(2));
x2 = round(rect(1) + rect(3) - 1);
y2 = round(rect(2) + rect(4) - 1);
subsetImage = imageGroupGray(y1:y2, x1:x2);

figure;
imagesc(subsetImage);
colormap gray;
axis image;
axis off;
title('Subset Image (Face)');
```

Subset Image (Face)



```
% (4)
figure;
imagesc(imageGroupGray);
colormap gray;
axis image;
axis off;
title('Click to Select Coordinates for Image Placement');

coordinatesList = zeros(3, 2);
for i = 1:3
    [x, y] = ginput(1);
    coordinatesList(i, :) = round([x, y]);
end
```



```
outputImage = imageGroupGray;
for i = 1:size(coordinatesList, 1)
    outputImage = placeImage(outputImage, subsetImage, coordinatesList(i, :));
end
```

```
figure;
imagesc(outputImage);
colormap gray;
axis image;
axis off;
title('Image with Inserted Faces at Different Locations');
```

Image with Inserted Faces at Different Locations



```
% (5)
figure;
imagesc(imageGroupGray);
colormap gray;
axis image;
axis off;
title('Click to Select Coordinates for Image Placement');

coordinatesList = zeros(3, 2);
for i = 1:3
    [x, y] = ginput(1);
    coordinatesList(i, :) = round([x, y]);
end
```



```
outputImage = imageGroupGray;
for i = 1:size(coordinatesList, 1)
    outputImage = blendImage(outputImage, subsetImage, coordinatesList(i, :));
end

figure;
imagesc(outputImage);
colormap gray;
axis image;
axis off;
title('Image with Inserted Faces at Different Locations');
```

Image with Inserted Faces at Different Locations



```
clc; clear; close all;
```

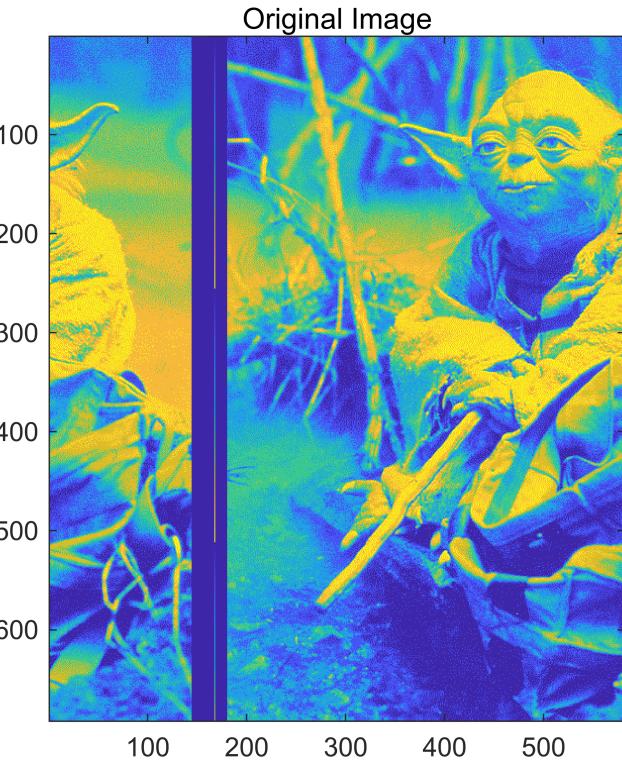
Problem 6 - An unknown format.

```
f = fopen('lab4prob6data');

f = 4

fileData = fread(f, [582, inf], 'uint8');

fileData= fileData';
figure;
imagesc(fileData);
axis('equal'); axis('image');
title('Original Image');
```



```

num_columns = size(fileData, 2);
first_zero_col = -1;
last_zero_col = -1;

subset_data = fileData(2:end, :);
for col = 1:num_columns
    if all(subset_data(:, col) == 0)
        first_zero_col = col;
        break;
    end
end

for col = num_columns:-1:1
    if all(subset_data(:, col) == 0)
        last_zero_col = col;
        break;
    end
end

if first_zero_col ~= -1
    fprintf('第一列全为 0 的列索引是: %d\n', first_zero_col);
else
    fprintf('没有找到全为 0 的列\n');
end

```

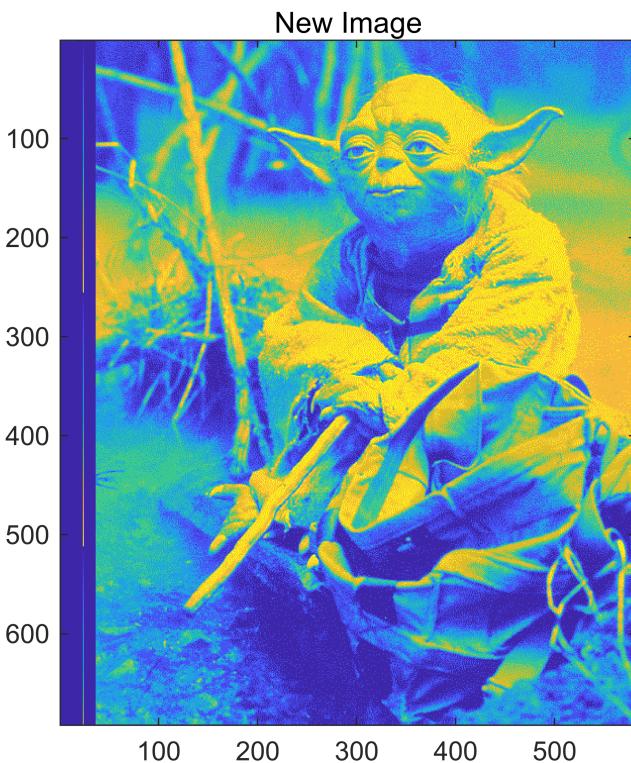
```
第一列全为 0 的列索引是: 145
```

```
if last_zero_col ~= -1
    fprintf('最后一列全为 0 的列索引是: %d\n', last_zero_col);
else
    fprintf('没有找到全为 0 的列\n');
end
```

```
最后一列全为 0 的列索引是: 180
```

```
fileData_new = fileData;
fileData_new(:, 1:582-145+1) = fileData(:, 145:582);
fileData_new(:, 582-145+1+1:582) = fileData(:, 1:144);

figure;
imagesc(fileData_new);
axis('equal'); axis('image');
title('New Image')
```



```
function outputImage = placeImage(baseImage, insertImage, coordinates)
[rows, cols] = size(insertImage);
x = coordinates(1);
```

```
y = coordinates(2);

outputImage = baseImage;
outputImage(y:y+rows-1, x:x+cols-1) = insertImage;
end

function outputImage = blendImage(baseImage, insertImage, coordinates)

[rows, cols] = size(insertImage);

x = coordinates(1);
y = coordinates(2);

outputImage = baseImage;
outputImage(y:y+rows-1, x:x+cols-1) = (baseImage(y:y+rows-1, x:x+cols-1) +
insertImage) / 2;
end
```