lab3_Haar

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```python
In [1]: %matplotlib inline
        import copy
        import numpy as np
        import matplotlib.pyplot as plt
        import matplotlib.image as mpimg
        import pywt

In [2]: image = mpimg.imread('barbara.png')
        plt.figure(figsize = (5, 5))
        plt.imshow(image, cmap = 'gray')
        plt.title('Original image, shape = ({}, {})'.format(image.shape[0], image.shape[1]))
        plt.axis('off')
        plt.show()

        n = 5
        coeffs = pywt.wavedec2(image, 'haar', level = n)
        for i in range(n, 0, -1):
            f, ax = plt.subplots(1, 3, figsize=(20, 20))
            ax[0].imshow(coeffs[i][0], cmap='gray')
            ax[0].axis('off')
            ax[1].imshow(coeffs[i][1], cmap='gray')
            ax[1].axis('off')
            ax[2].imshow(coeffs[i][2], cmap='gray')
            ax[2].axis('off')
            print('Level {}, shape = ({}, {})'.format(n-i+1, coeffs[i][0].shape[0], coeffs[i][0
            plt.show()

        plt.figure(figsize = (5, 5))
        plt.imshow(coeffs[0], cmap = 'gray')
        plt.title('LL for level {}, shape = ({}, {})'.format(n-i+1, coeffs[i][0].shape[0], coe
        plt.axis('off')
        plt.show()
```
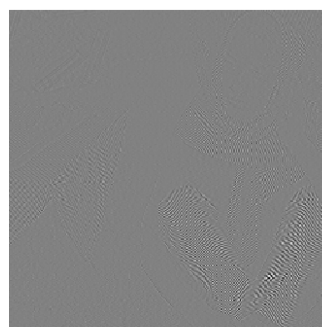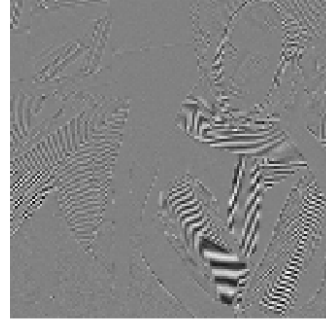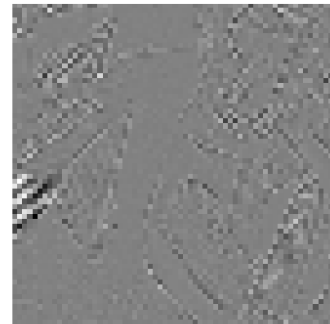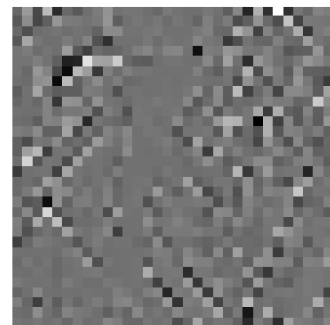
Original image, shape = (512, 512)
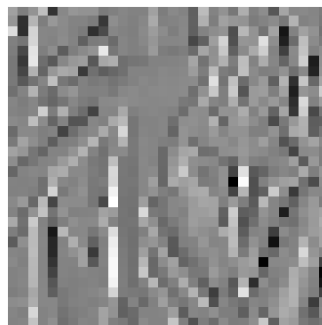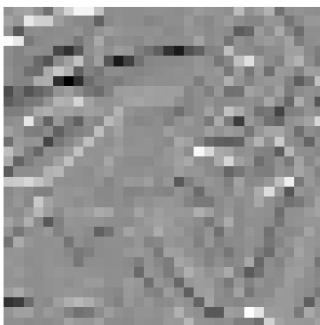

Level 1, shape = (256, 256)
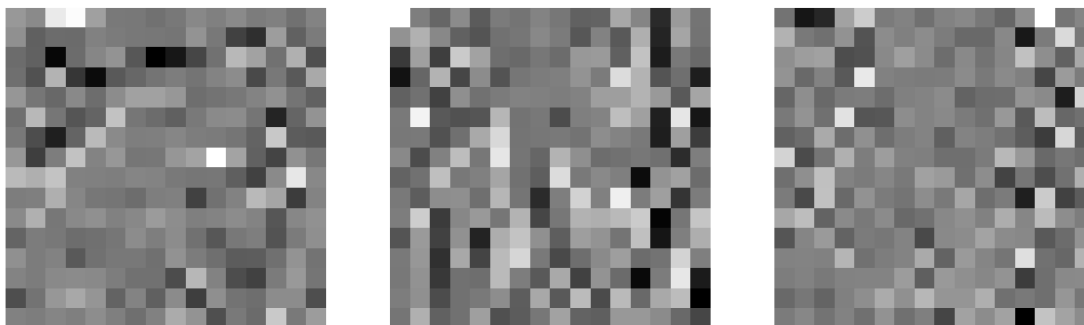

Level 2, shape = (128, 128)

Level 3, shape = (64, 64)
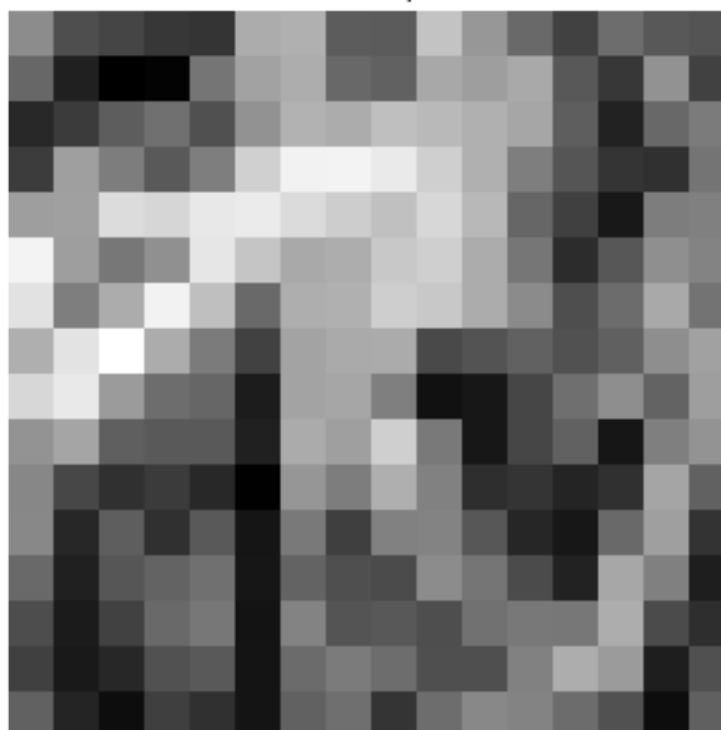

Level 4, shape = (32, 32)

Level 5, shape = (16, 16)

LL for level 5, shape = (16, 16)


```
In [3]: coeffs1 = copy.deepcopy(coeffs)
        tmp = coeffs1[0]
        #print(np.amin(np.abs(tmp)), np.amax(np.abs(tmp)))
        theta = 0.2
        Ix = np.abs(tmp) < theta
        tmp[Ix] = np.zeros(tmp[Ix].shape)
        for i in range(1, n+1):
```

```
        for j in range(3):
            tmp = coeffs1[i][j]
            #print(np.amin(np.abs(tmp)), np.amax(np.abs(tmp)))
            Ix = np.abs(tmp) < theta
            tmp[Ix] = np.zeros(tmp[Ix].shape)
img1 = pywt.waverec2(coeffs1, 'haar')

(f, ax) = plt.subplots(1, 2, figsize=(10,5))
ax[0].imshow(image, cmap = 'gray')
ax[0].set_title('Original image')
ax[0].axis('off')
ax[1].imshow(img1, cmap = 'gray')
ax[1].set_title('Nonlinear Approximation, theta = {}'.format(theta, image.shape[0], ima
ax[1].axis('off')
plt.show()
```


Original image   Nonlinear Approximation, theta = 0.2

```
In [4]: coeffs2 = copy.deepcopy(coeffs)
        for i in range(1, n+1):
            for j in range(3):
                tmp = coeffs2[i][j]
                prev = copy.deepcopy(tmp)
                tmp = np.zeros(tmp.shape)
        img2 = pywt.waverec2(coeffs2, 'haar')

        (f, ax) = plt.subplots(1, 2, figsize=(10,5))
        ax[0].imshow(image, cmap = 'gray')
        ax[0].set_title('Original image')
        ax[0].axis('off')
        ax[1].imshow(img2, cmap = 'gray')
```

```
ax[1].set_title('Linear Approximation')
ax[1].axis('off')
plt.show()
```