1-d and 2

Question 1-d

k with dialation 2 =

$$K' = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 5 & -2 & 2 \\ -2 & 4 & 4 & -1 \\ 1 & -2 & 6 & 3 \\ 3 & -3 & 6 & 1 \end{bmatrix}$$

Output W = floor((4 - 3 + 0)/1 + 1) = 2
Output H = floor((4 - 3 + 0)/1 + 1) = 2

$$\begin{bmatrix} 1 & 5 & -2 \\ -2 & 4 & 4 \\ 1 & -2 & 6 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix} = -5$$

$$\begin{bmatrix} 5 & -2 & 2 \\ 4 & 4 & -1 \\ -2 & 6 & 3 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix} = 2$$

$$\begin{bmatrix} -2 & 4 & 4 \\ 1 & -2 & 6 \\ 3 & -3 & 6 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix} - 8$$

$$\begin{bmatrix} 4 & 4 & -1 \\ -2 & 6 & 3 \\ -3 & 6 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix} = 3$$

$$A * K' = \begin{bmatrix} -5 & 2 \\ -8 & 3 \end{bmatrix}$$

Question 2

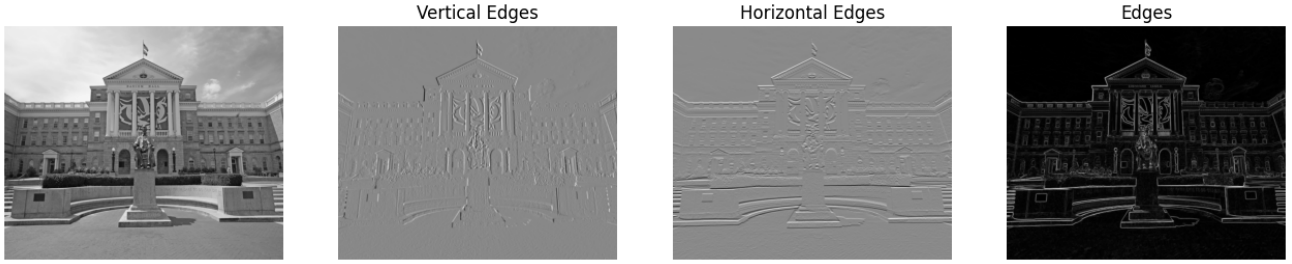
In [1]:
```
import torch
import torch.nn as nn

import requests
from io import BytesIO
from PIL import Image, ImageOps
```

```
import numpy as np
```

In [5]:
```
# Define the image
url = "https://www.jsonline.com/gcdn/presto/2020/08/13/PMJS/086e6c1e-a091-49
def get_image_from_url(url):
    response = requests.get(url,headers={'User-Agent': 'Mozilla/5.0'})
    img = Image.open(BytesIO(response.content))
    img = img.resize((600, 500))
    img = ImageOps.grayscale(img)
    return img

img = get_image_from_url(url)
img = torch.from_numpy(np.array(img)).float() / 255.

# Define Sobel kernels
sobel_x = torch.tensor([[-1, 0, 1],
                        [-2, 0, 2],
                        [-1, 0, 1]]).float()

sobel_y = torch.tensor([[1, 2, 1],
                        [0, 0, 0],
                        [-1, -2, -1]]).float()
```

In [7]:
```
# Convolution operation using PyTorch's F.conv2d function
import torch.nn.functional as F
response_x = F.conv2d(img.unsqueeze(0).unsqueeze(0), sobel_x.unsqueeze(0).ur
response_y = F.conv2d(img.unsqueeze(0).unsqueeze(0), sobel_y.unsqueeze(0).ur
grad_magnitude = torch.sqrt(response_x**2 + response_y**2)
```

In [8]:
```
from matplotlib import pyplot as plt
f, ax = plt.subplots(1, 4, figsize=(16, 4))
ax[0].imshow(img, "gray")
ax[0].axis(False)
ax[1].imshow(response_x[0, 0], "gray")
ax[1].axis(False)
ax[1].set_title("Vertical Edges")
ax[2].imshow(response_y[0, 0], "gray")
ax[2].axis(False)
ax[2].set_title("Horizontal Edges")
ax[3].imshow(grad_magnitude[0, 0], "gray")
ax[3].axis(False)
ax[3].set_title("Edges");
```



In [ ]: