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Theory Homework Assignment 2

Q1. Order from light smoothness to heavy smoothness

M4<M3<M1<M2

M4 has least smoothness as it has all values as 0 except for center pixel.
M3 has more smoothing at center but less smoothing at edges.
M1 has uniform smoothing as all values are 1. So, it is a bit more smooth as compared to M3.
M2 is a gaussian mask and it has highest level of smoothness.

Q2.
- First-order derivatives generally produce thicker edges in an image.
- Second-order derivatives have a stronger response to fine detail, such as thin lines and isolated points.
- First order derivatives generally have a stronger response to a gray-level step.
- Second-order derivatives produce a double response at step changes in gray level.

- Therefore, second derivative is better suited than the first derivative for image enhancement because of the ability to enhance fine detail.

Q4. We should blur the image first as it helps in smoothening out image and reduce extra noise that may be incorrectly identified as an edge.
Blurring the image first will ensure that edge enhancement correctly detects the edges.

Q5. a) M1 with 3x3 median filter:

```
4    4    4    4    4    4    4    4
4    4    4    4    4    4    4    4
4    4   48   64   64    4    4    4
4    4   64   64   64   64    4    4
4    4   64   64   64   64    4    4
4    4   56   64   64   23    4    4
4    4    4    4    4    4    4    4
4    4    4    4    4    4    4    4
```

b) M2 with 5x5 median filter:

```
4   4   4   4   4   4   4   4
4   4   4   4   4   4   4   4
4   4  64  64  64  64   4   4
4   4  64  64  64  64   4   4
4   4  64  64  64  64   4   4
4   4  64  64  64  64   4   4
4   4   4   4   4   4   4   4
4   4   4   4   4   4   4   4
```

c) M2:5x5 is a better filter as it has more consistent pixel values than M1 which will have less noise.