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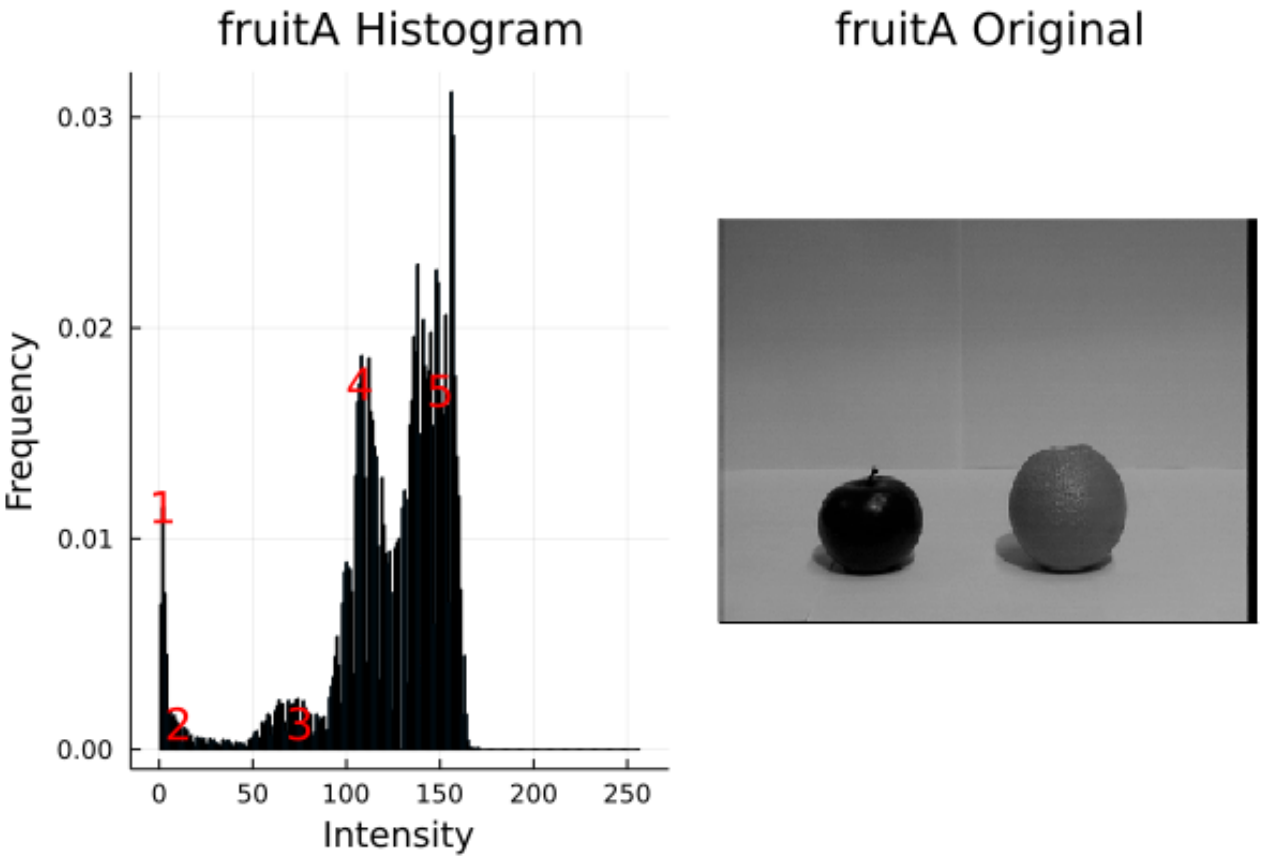
Exercise 1

3. Show the original images and your calculated histogram together in one plot.

Solution. The plot for the picture called "fruitA" is given by the following.



1. Peak 1 is given due to the black border on the right side of the original image.
2. We can see local maxima at 2, which signals a relatively fair amount of all most black pixels. This has to be the left side apple.
3. We got another peak at 3. Which peaks slightly higher than peak 2. If we account the sizes of the apple, one can see that 3 musst result from the right side apple.
4. Peak 4 results from the upper background. We can see a weaker inscreasing growing peek than 5. This results from the fact, that the upper background is not really uniformly colored. There are some darker and brighter regions.
5. Peak 5 has to be the lower background. We see high Frequency to Intensity ratio due to the fact that the lower background is uniformly colored. There is almost no variation in more brighter and darker pixels

The plot for the Picutre called "fruitB" is given by the following.

1. As before we got a peak in 1 due to the black boarder on the right side. We have again almost black frequencies due to the apple stalk and pixels beneath the apple.

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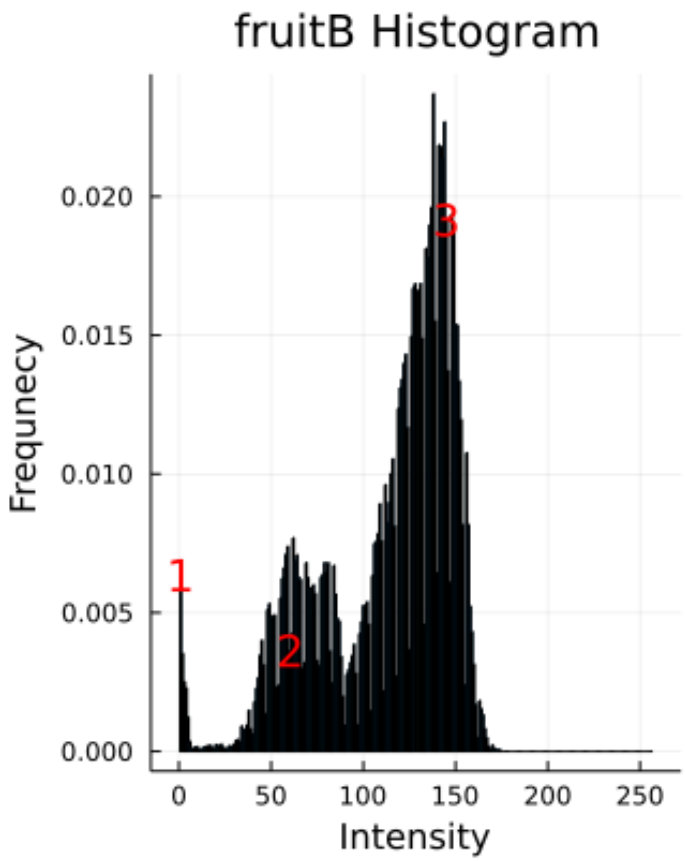

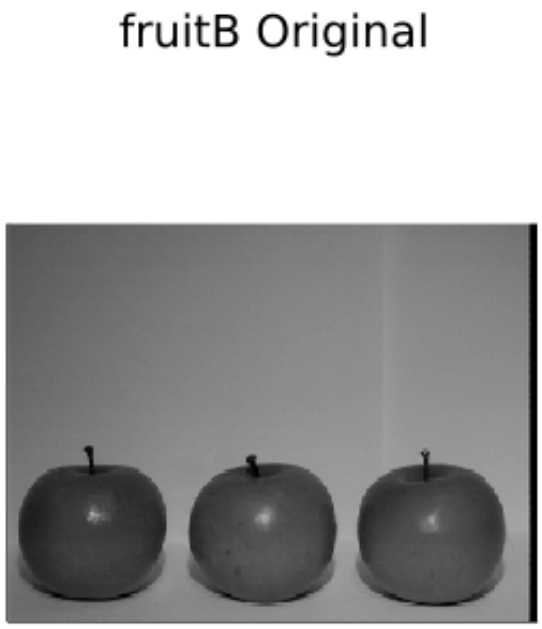

2. Peak 2 has to be the 3 apples. The brightness of the apples are almost idendical with execption being the left one. The left apple is slightly darker then the two on the right. We can see this fact in the sudden fall of the peak 2 on the right side near intensity 100. In contrast the Peak starts growing slowly on the left side at around 50 intensity.
3. Peak 3 is the background. The background is brighter then the apples, therefore the intensity must be higher.

Exercise 2

1. Consider the following image I and mask F:

$$I = \begin{pmatrix} 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \end{pmatrix} \text{ and } F = \begin{pmatrix} -1 & -1 & 0 \\ -1 & 0 & 1 \\ 0 & 1 & 1 \end{pmatrix}.$$

Calculate the response of the mask for the positions marked in red with the reference position of the mask in the center.

Solution. We get

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$$F = \begin{pmatrix} -1 & -1 & 0 \\ -1 & 0 & 1 \\ 0 & 1 & 1 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \end{pmatrix} \rightarrow \begin{pmatrix} & & & \\ 1 & -1 & -3 & \\ 1 & 1 & 0 & \\ & & & \end{pmatrix}$$

from the calculations

1. $a_{22} = (-1) \cdot 0 + (-1) \cdot 0 + 0 \cdot 1 + (-1) \cdot 0 + 0 \cdot 0 + 1 \cdot 1 + 0 \cdot 0 + 1 \cdot 0 + 1 \cdot 0 = 1$
2. $a_{23} = (-1) \cdot 0 + (-1) \cdot -1 + 0 \cdot 1 + (-1) \cdot 0 + 0 \cdot 1 + 1 \cdot 0 + 0 \cdot 0 + 1 \cdot 0 + 1 \cdot 0 = -1$
3. $a_{24} = (-1) \cdot -1 + (-1) \cdot -1 + 0 \cdot 1 + (-1) \cdot 1 + 0 \cdot 0 + 1 \cdot 0 + 0 \cdot 0 + 1 \cdot 0 + 1 \cdot 0 = -3$
4. $a_{32} = (-1) \cdot 0 + (-1) \cdot 0 + 0 \cdot 1 + (-1) \cdot 0 + 0 \cdot 0 + 1 \cdot 0 + 0 \cdot 0 + 1 \cdot 0 + 1 \cdot 1 = 1$
5. $a_{33} = (-1) \cdot 0 + (-1) \cdot 1 + 0 \cdot 1 + (-1) \cdot 0 + 0 \cdot 0 + 1 \cdot 0 + 0 \cdot 0 + 1 \cdot 1 + 1 \cdot 1 = 1$
6. $a_{34} = (-1) \cdot 1 + (-1) \cdot 0 + 0 \cdot 1 + (-1) \cdot 0 + 0 \cdot 0 + 1 \cdot 0 + 0 \cdot 0 + 1 \cdot 1 + 1 \cdot 0 = 0$