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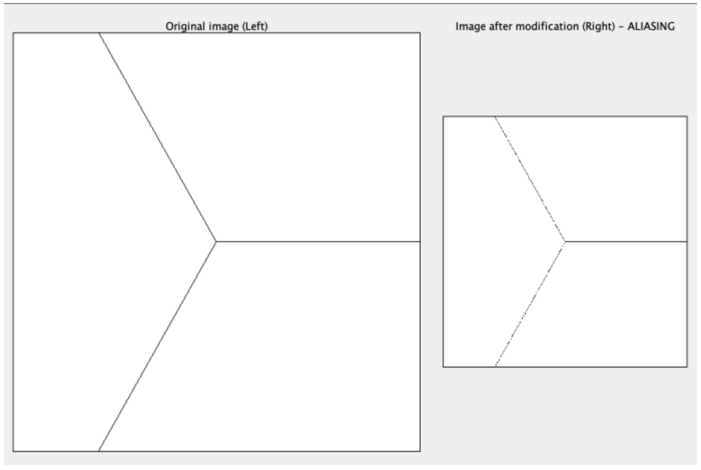
CSCI 576 – Homework 1 Analysis Questions

<u>PART 1 Analysis Questions</u>:

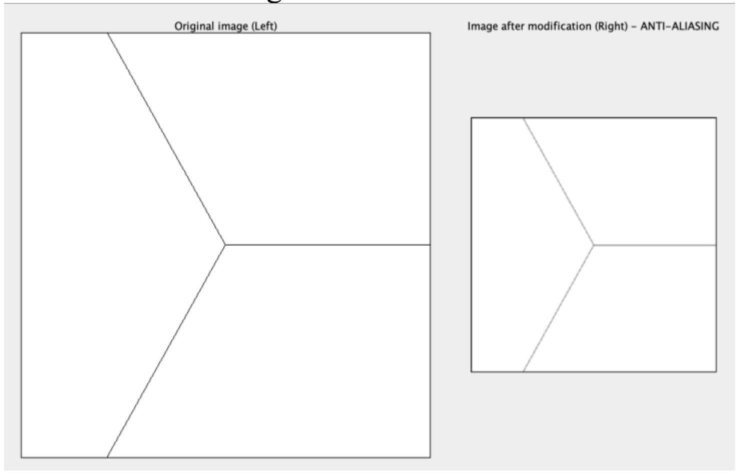
1. Suppose **s=0.6** and suppose **n=3, 5, 8, 10, 16, 20, and 25**. (Analysis comments reside at the end of pictures)

<u>s=0.6 & n=3</u>

WITH Aliasing

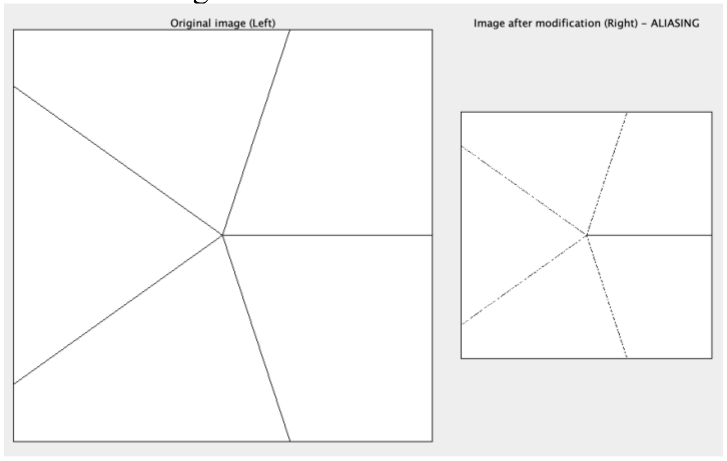


WITHOUT Aliasing

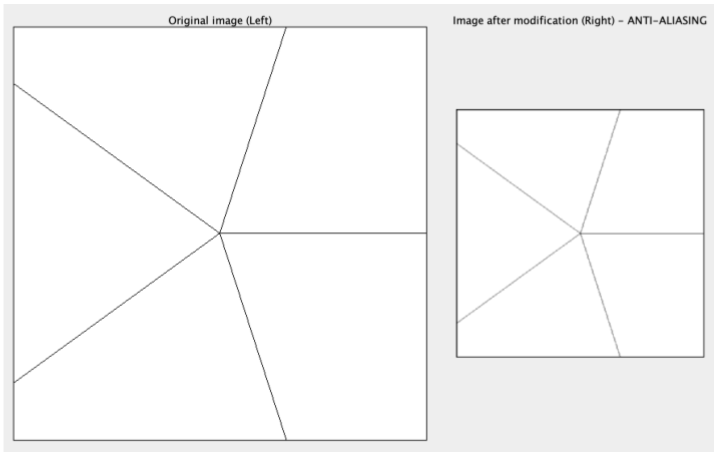


<u>s=0.6 & n=5</u>

WITH Aliasing



WITHOUT Aliasing



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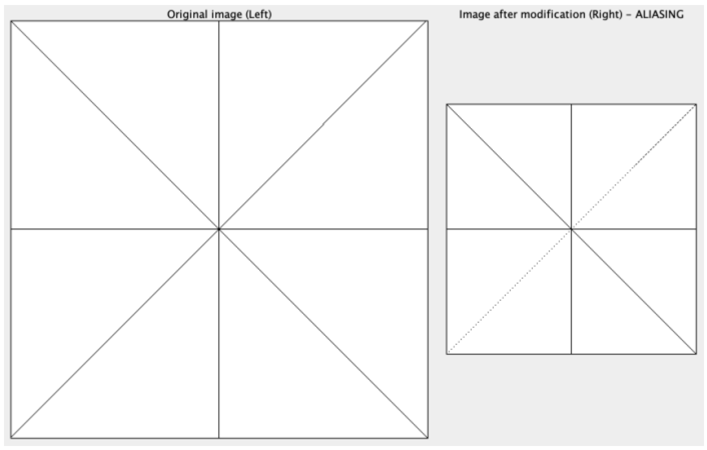
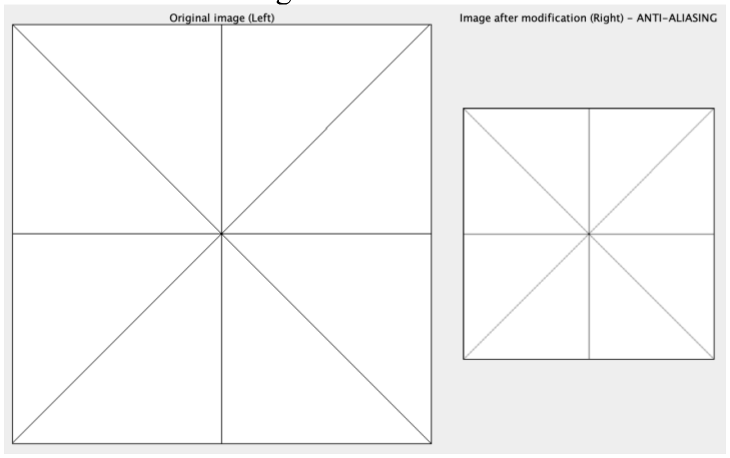
s=0.6 & n=8

WITH Aliasing



WITHOUT Aliasing



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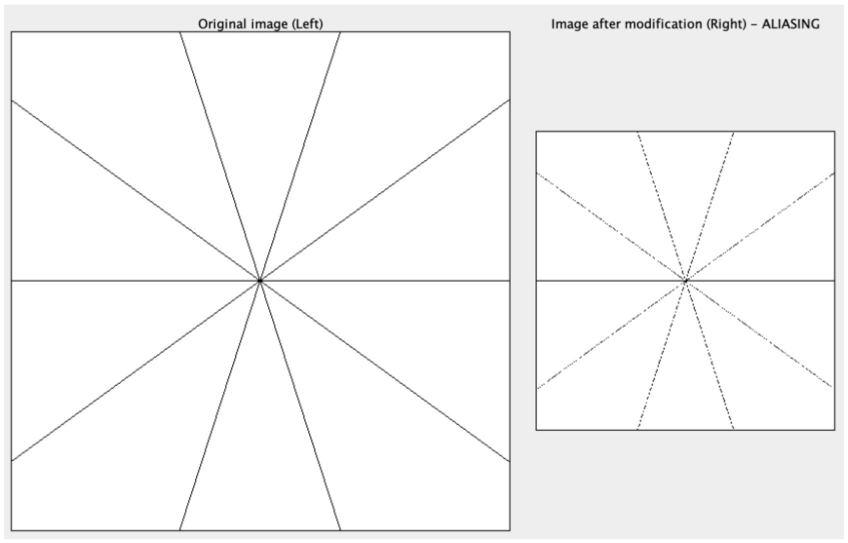
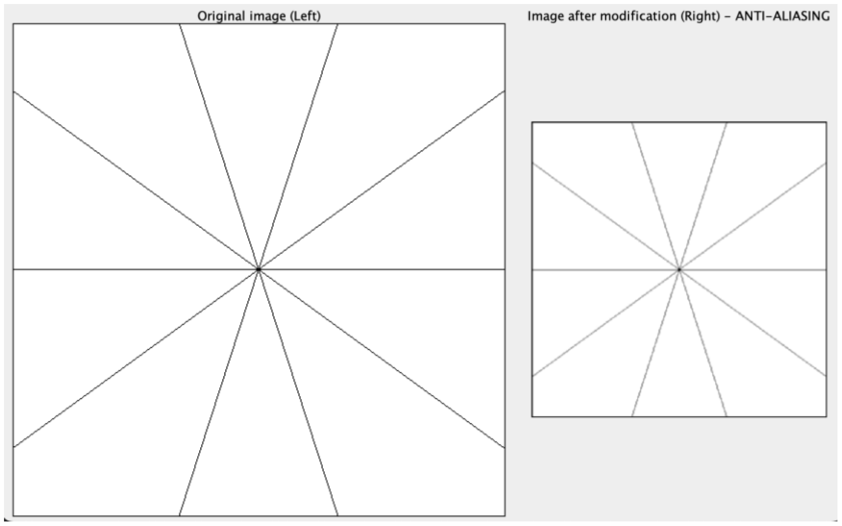
s=0.6 & n=10



WITH Aliasing



WITHOUT Aliasing

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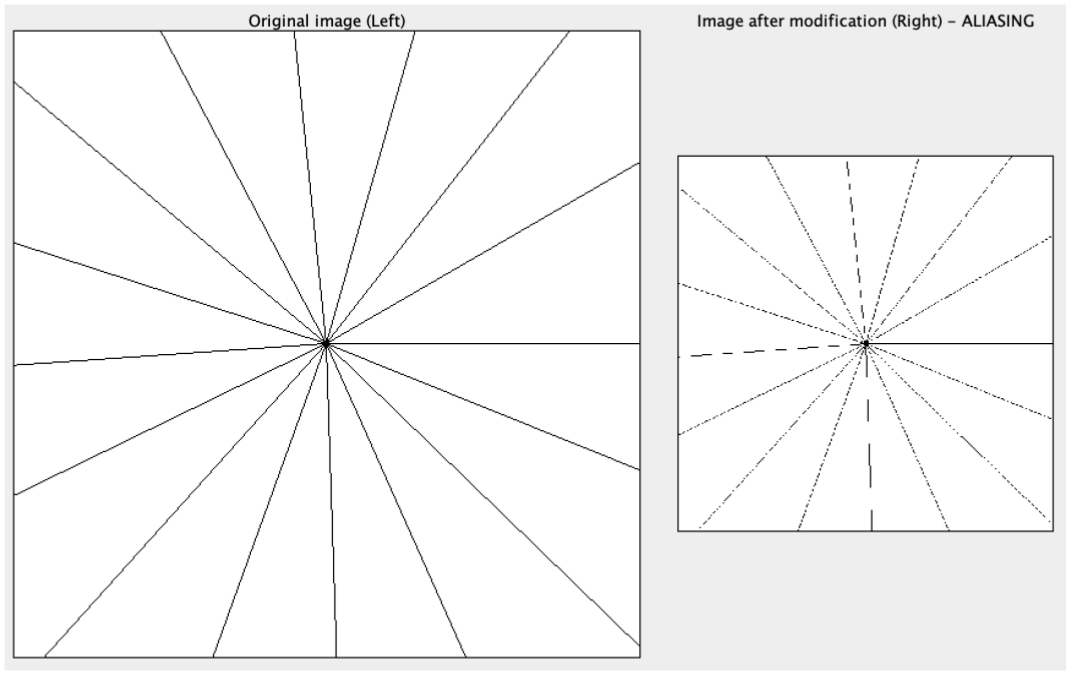
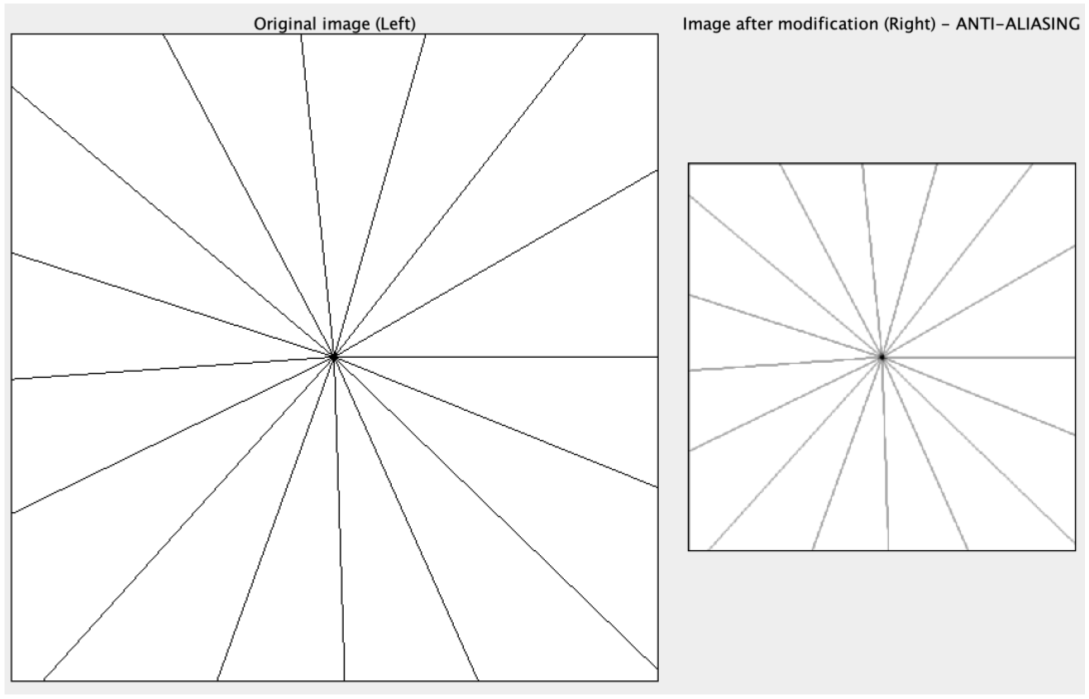
s=0.6 & n=16



WITH Aliasing



WITHOUT Aliasing

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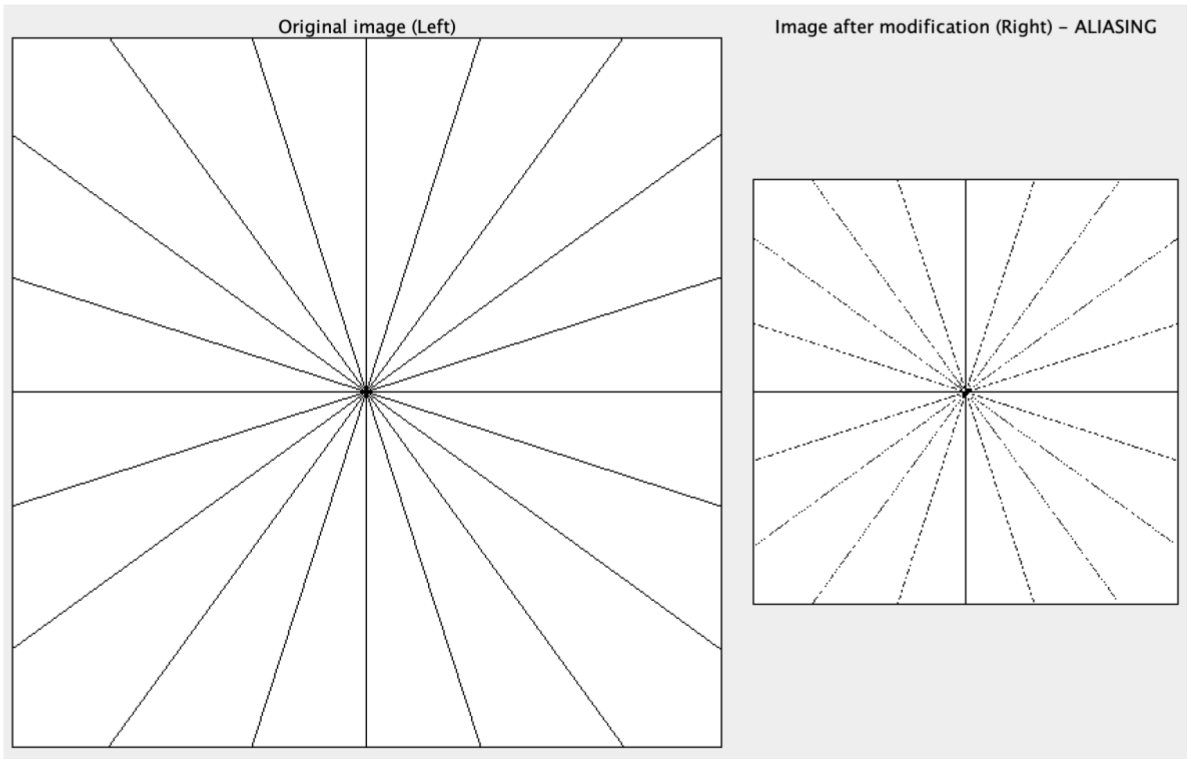
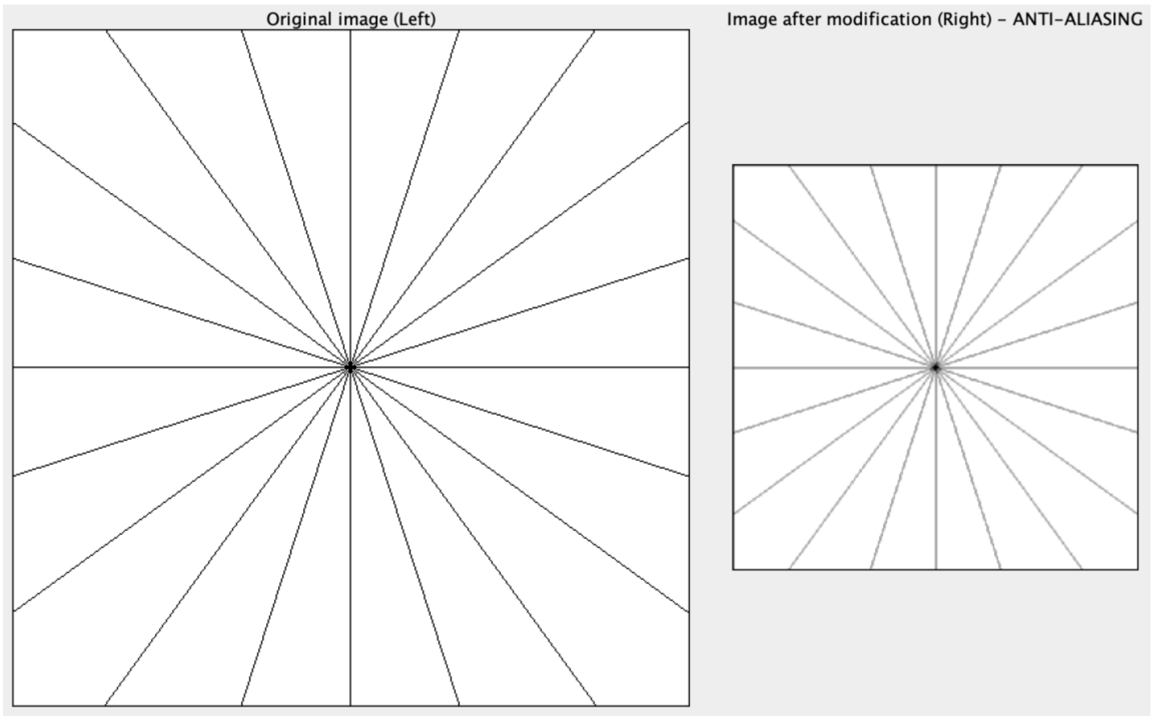
s=0.6 & n=20



WITH Aliasing



WITHOUT Aliasing

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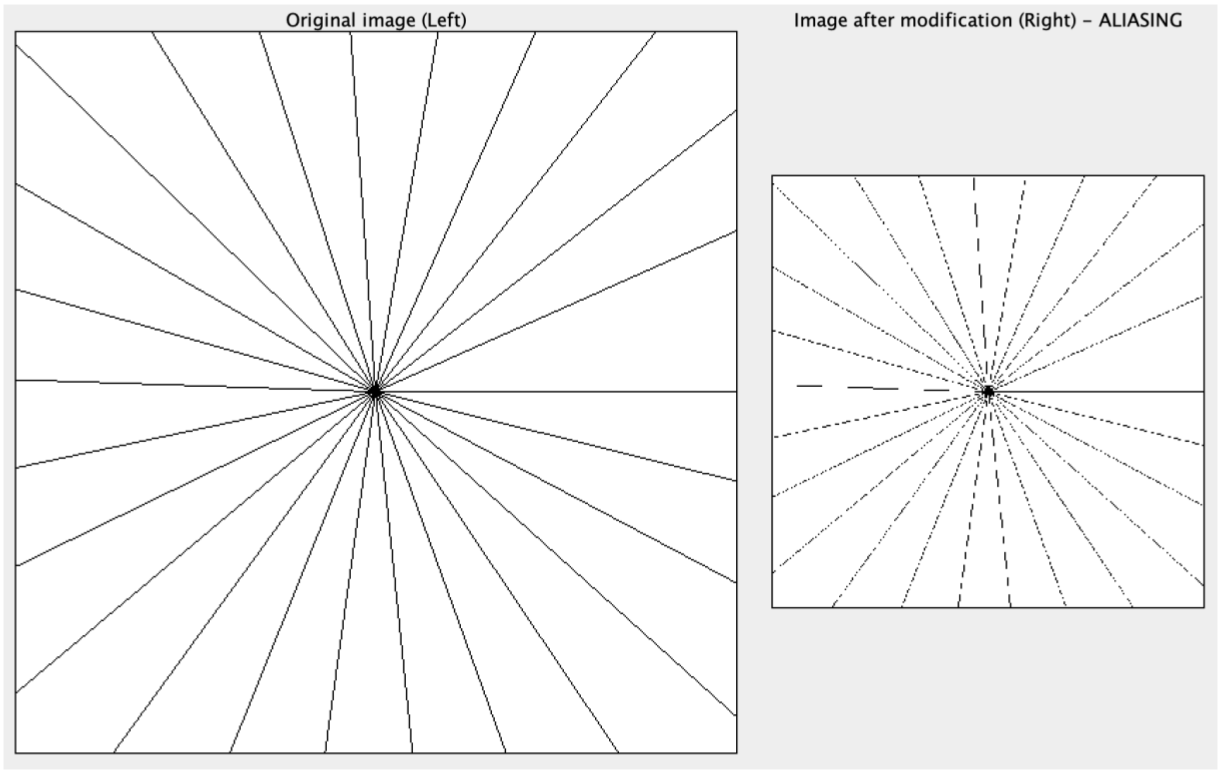
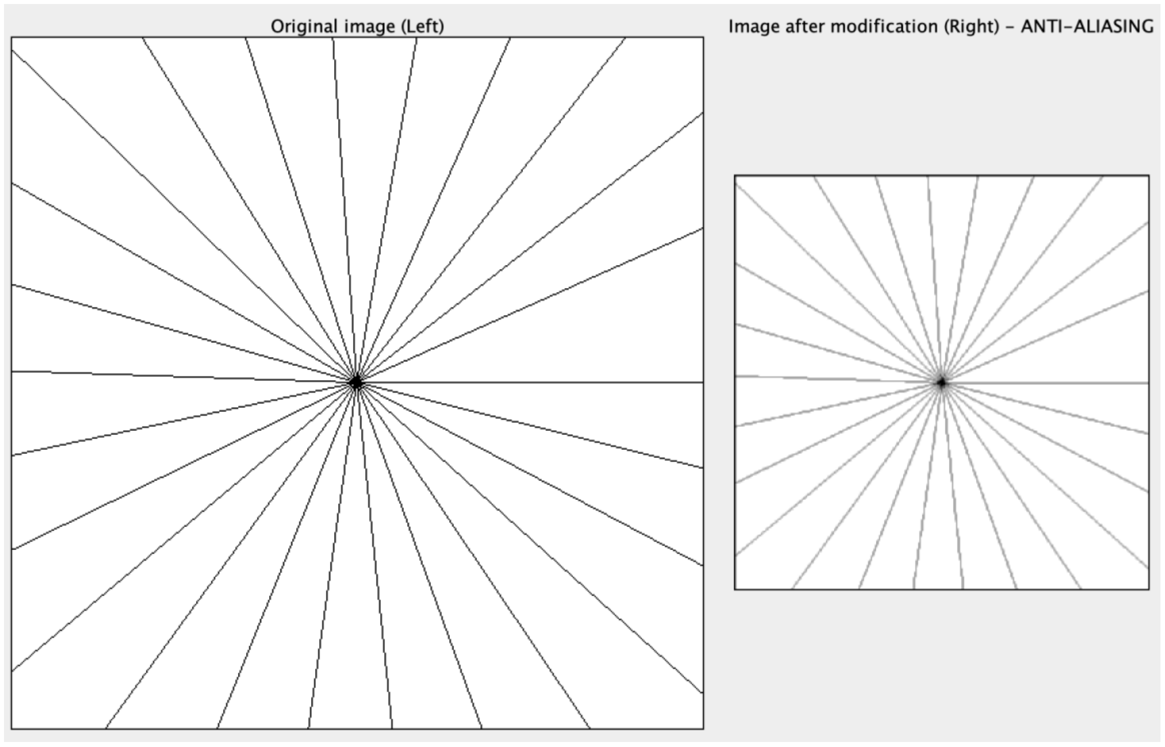
s=0.6 & n=25



WITH Aliasing



WITHOUT Aliasing

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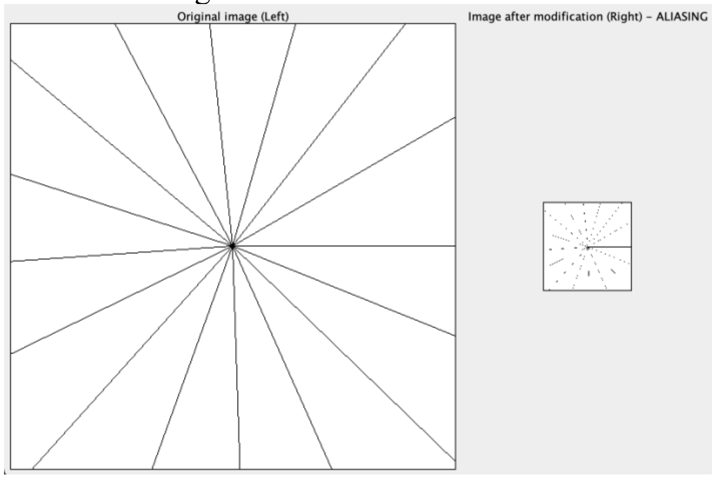
Comments:

The results shown above exhibit the use of the scale factor s = 0.6, and number of lines n=3, 5, 8, 10, 16, 20, and 25, respectively. In all the outcomes above, aliasing caused some data to be lost which in turn made the image look "choppy" or distorted. Contingent upon the scale factor, when the image is reduced (i.e., height and width of image decrease at some rate), the number of pixels vertically and horizontally is going to reduce; the Nyquist criteria then becomes violated. Aliasing occurs because the resolution is not high enough to capture the frequency variation. Based on the examples above, we can see that with a constant scale factor (s) and increasing number of lines (n), the aliasing effect tends to increase when resampling the rendered image. As N increases with constant scale factor, the output quality decreases (right image). Looking at the examples for when n=8 versus n=20, we can see that aliasing was not as prevalent in n=8 as it was when n=20; more lines in n=20 exhibited aliasing since more of the lines appeared choppier and more incomplete, whereas in n=8, there was only 1 line that appeared incomplete. To efficiently minimize aliasing, we use apply a low pass filter that takes the average of a 3x3 neighborhood. This technique reduces the frequency content variation of the pixels in the image before copying into the output. In the pictures above, the effects of applying a filter is shown and we could see that the scaled-down images seem to be more complete than the ones that lacked the filter.

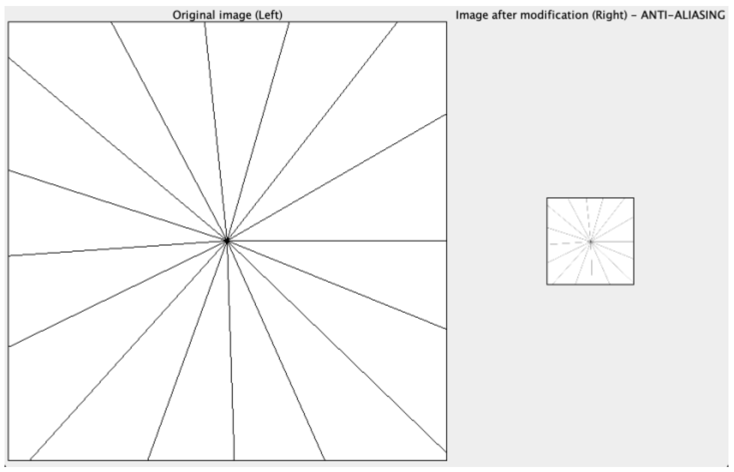
2. Now, suppose **n=16** and suppose **s=0.2, 0.4, 0.5, and 0.8**. (Analysis comments reside at the end of pictures)

n=16 & s=0.2

WITH Aliasing



WITHOUT Aliasing



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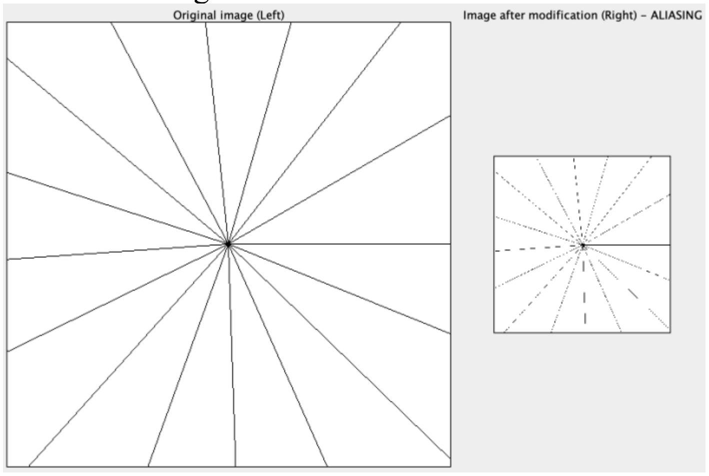
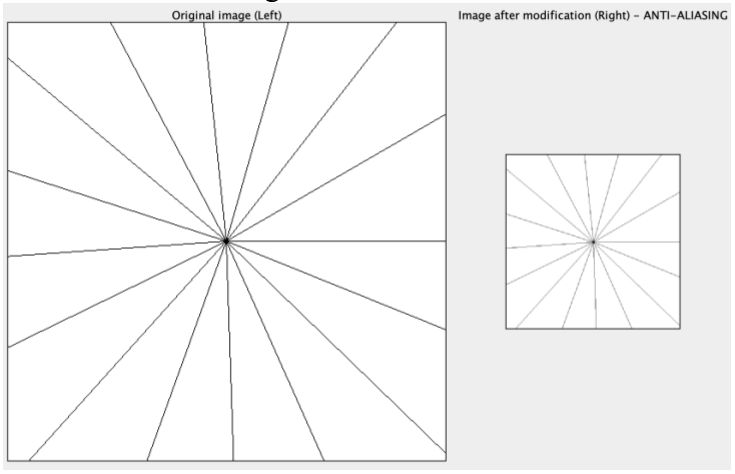
n=16 & s=0.4

WITH Aliasing



WITHOUT Aliasing



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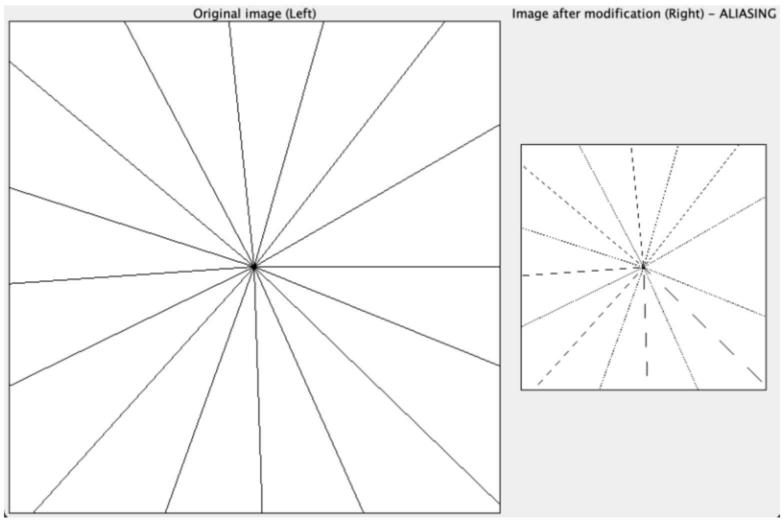
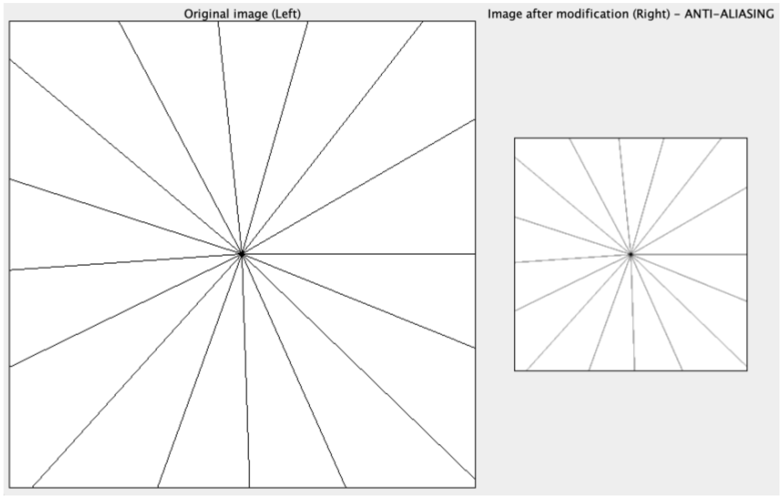
n=16 & s=0.5



WITH Aliasing



WITHOUT Aliasing

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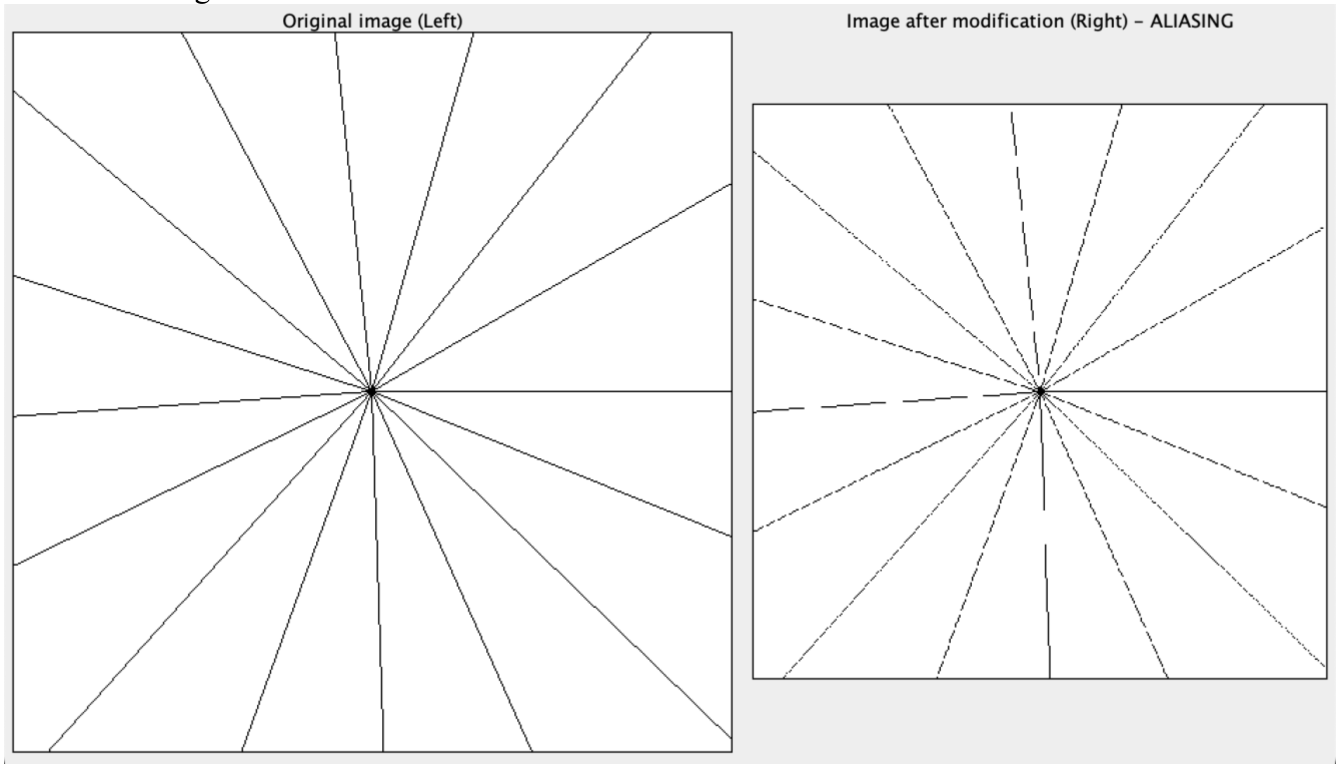
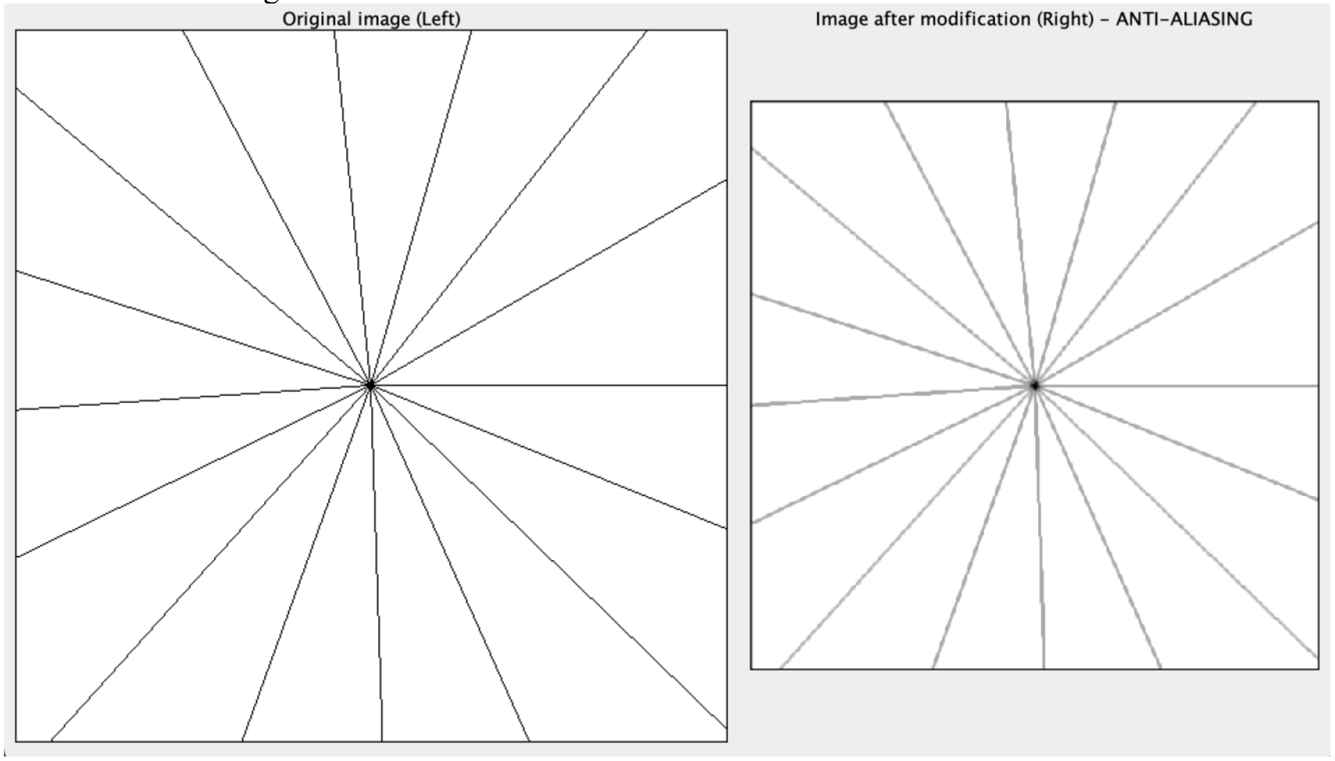
n=16 & s=0.8

WITH Aliasing



WITHOUT Aliasing



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Comments:

The results shown above exhibit the use of the number of lines n=16, and the scale factor s=0.2, 0.4, 0.5, and 0.8, respectively. In all the outcomes above, aliasing caused some data to be lost which in turn made the image look “choppy” or distorted. Based on the examples above, we can see that with a constant number of lines (n) and an increasing scale factor (s), the aliasing effect tends to decrease when resampling the rendered image. As s decreases with a constant n, the quality of output decreases (right image). Looking at examples for when s=0.4 versus s=0.8, we can see that aliasing was not as prevalent in s=0.8 as it was when s=0.4. In other words, given a constant number of lines with a decreasing scale factor, one will tend to see increased aliasing when resampling the image. Like question 1, we apply the low pass filter of 3x3 neighborhood average to efficiently minimize aliasing. The filter seemed to work better in images with a higher scale factor.

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PART 2 Analysis Questions:

Given that *s* (speed of rotation) remains constant and *fps* (frames per second) can vary, we will observe the *os* (observed speed of rotation) when there is temporal aliasing.

1. os = s/(1/fps)/360 = s*fps/360; given s=10, we have the following for the respective fps:
2. fps = 25, os = 0.6944
3. fps = 16, os = 0.4444
4. fps = 10, os = 0.2778
5. fps = 8, os = 0.2222

Given s is a constant, the observed speed is rotations per second (s) divided by the time between each frame (1/fps). This is with the assumption that temporal aliasing occurs when the rotational speed is faster than what the frame rate can capture, hence violating the Nyquist criteria. Therefore, the observed speed will seem to appear lower than the actual given speed.