CS 576 Spring 2023– Assignment 1

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Part 1 –Spatial Resampling and Aliasing

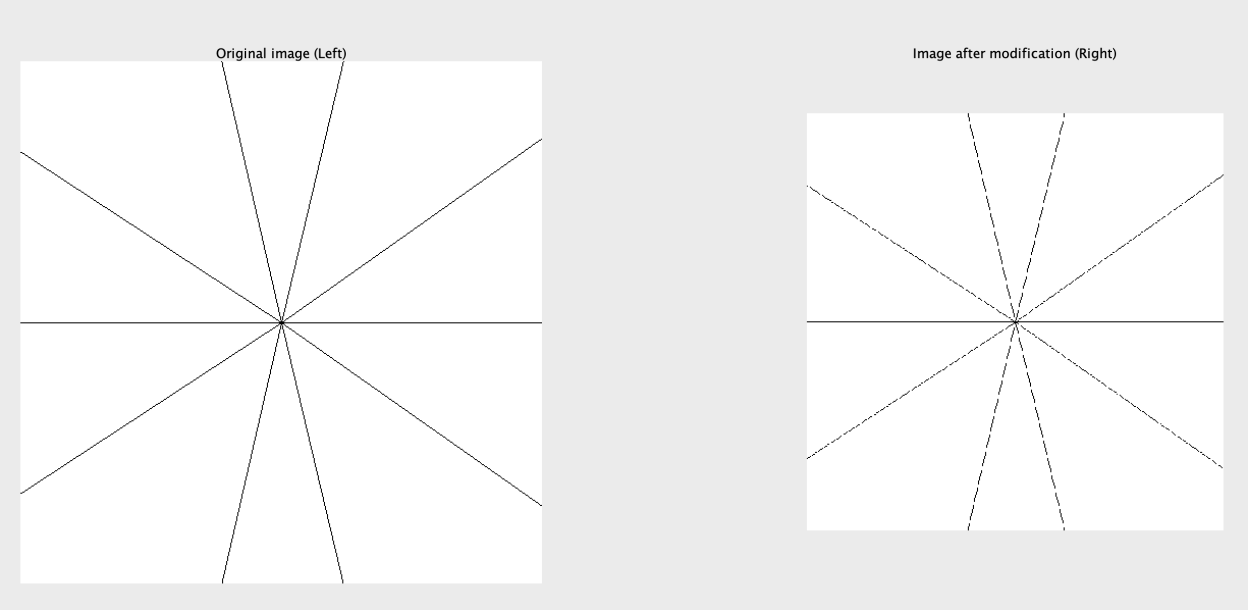
Analysis Questions for part 1

1. Let's try an experiment where s (scale factor) remains constant and n (number of lines) is allowed to vary. Comment on your results by using various constant values of s for changing n. You may attach results, plot charts etc. to qualify your results.

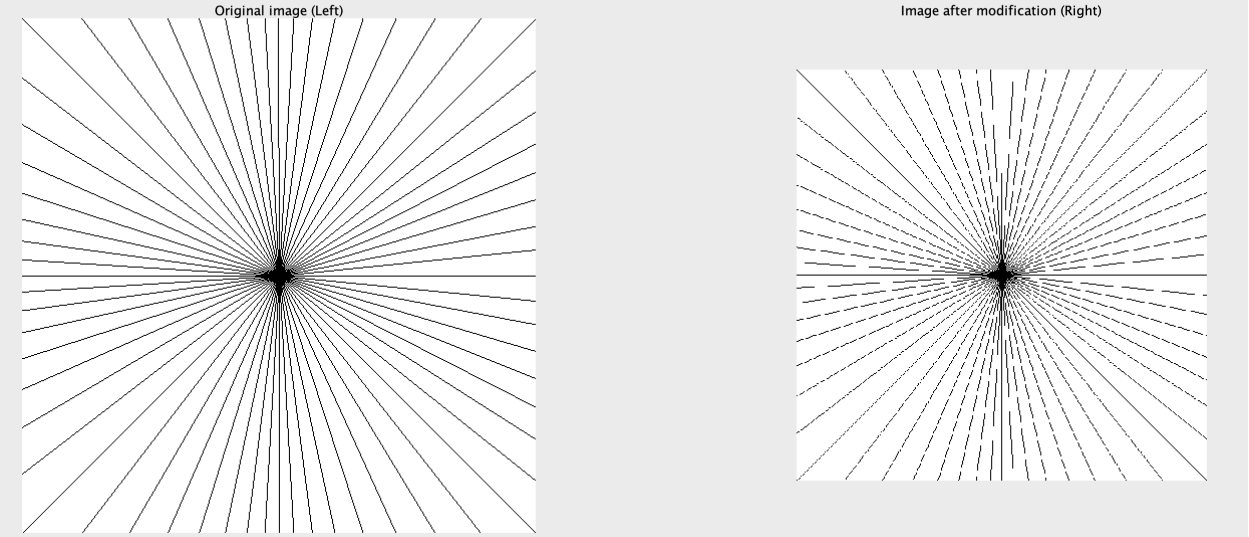
Answer) When the scale factor is constant and the number of lines n is updated, we are simply changing the frequency. As the number of lines, n, increases, the aliasing increases. With greater n, the quality of the scaled-down image decreases; thus antialiasing is needed. When aliasing occurs in this case, the lines seem to be broken since some of the pixels are missing, this is because of the smaller resolution of the scaled-down image. The lines become more broken in case of greater n (since there are more lines in the original image, ie, more data; more data is lost). Upon performing antialiasing, the lines tend to complete.

No antialiasing performed

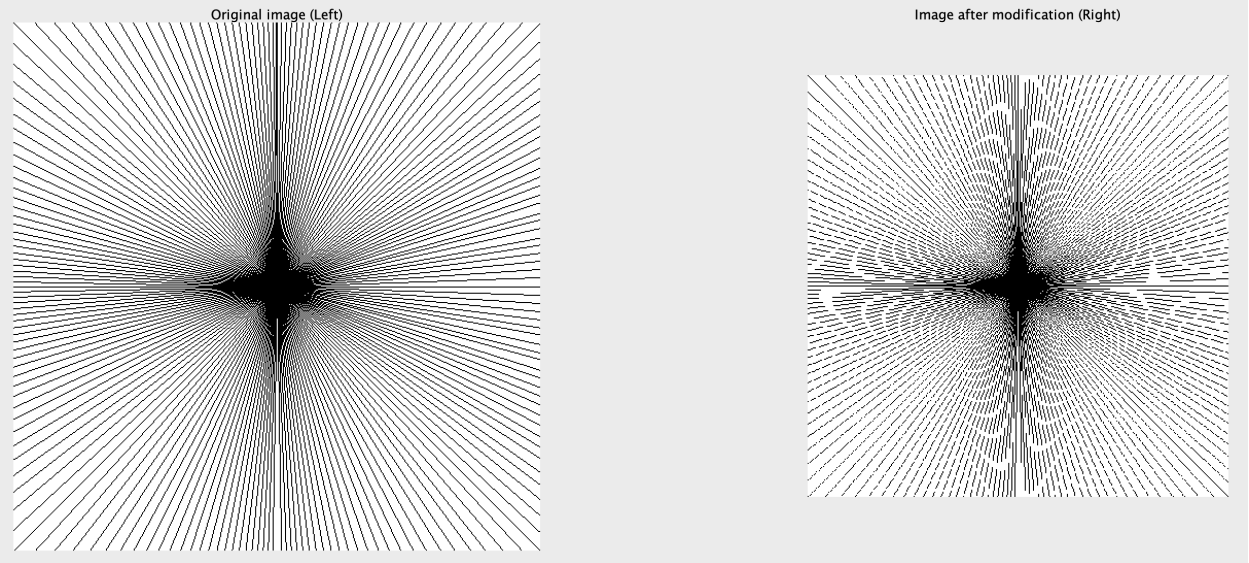
```
java ImageDisplay.java 10 0.2 0
```



```
java ImageDisplay.java 64 0.2 0
```

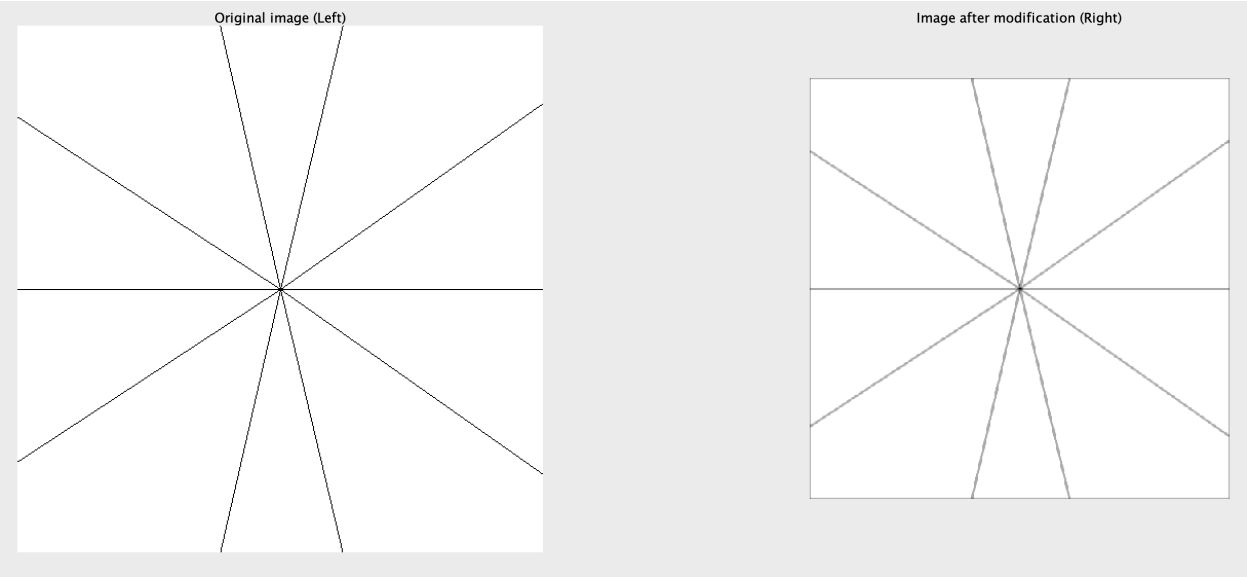



```
java ImageDisplay.java 200 0.2 0
```

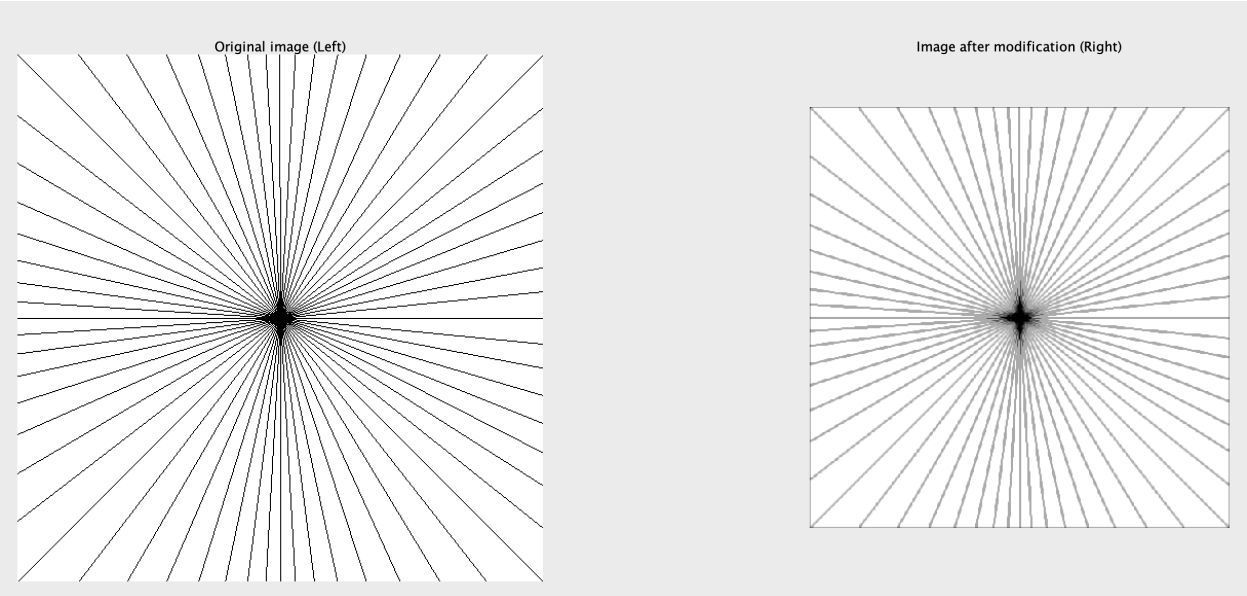


Antialiasing performed

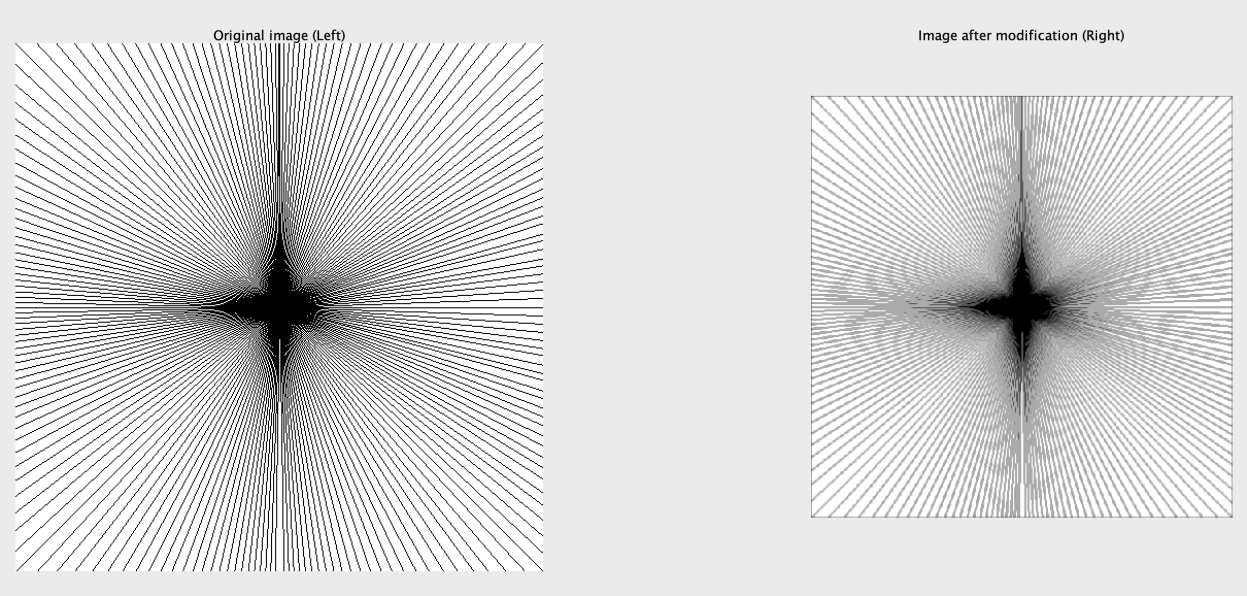
```
java ImageDisplay.java 10 0.2 1
```




```
java ImageDisplay.java 64 0.2 1
```



```
java ImageDisplay.java 200 0.2 1
```



2. Let's try another experiment, this time keep n (number of lines) constant and varying s (scale factor). Comment on your results by using various constant values of n for changing s. You may attach results, plot charts etc. to qualify your results

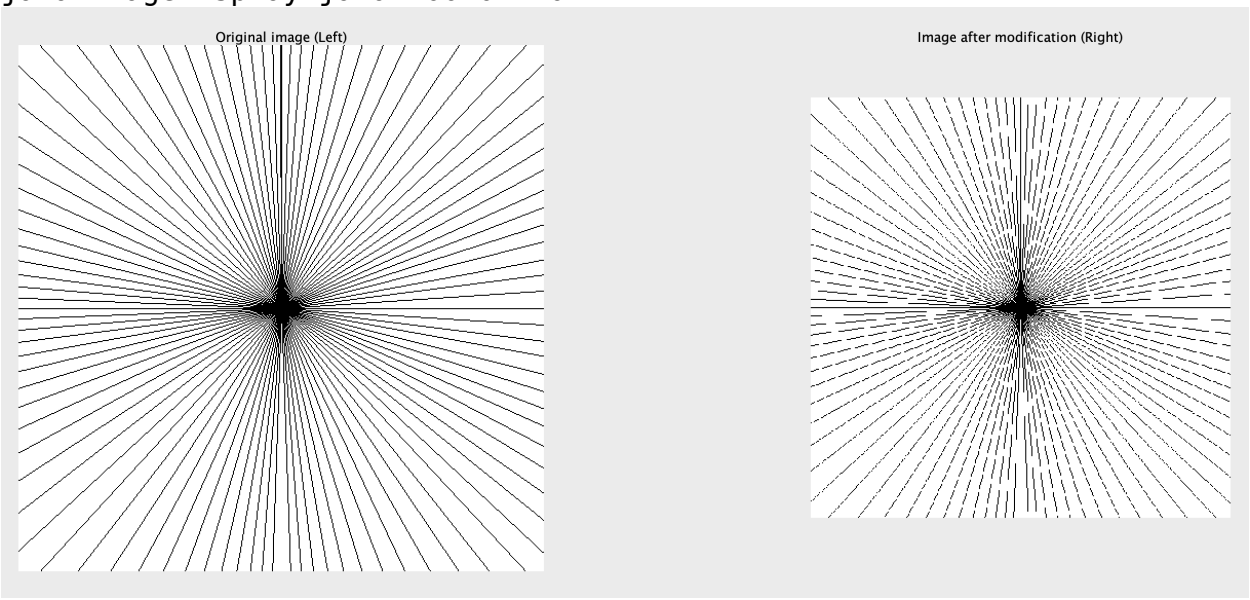
Answer)

Note: The problem description specifies that: "The second parameter s will be scaling value that scales the input image by a factor." I have interpreted this in the following way; If s is 0.8, it scales the image by a factor of s, ie 80% reduction of the image. This implies the image will be 20% of the original image since 80% of the pixels are removed.

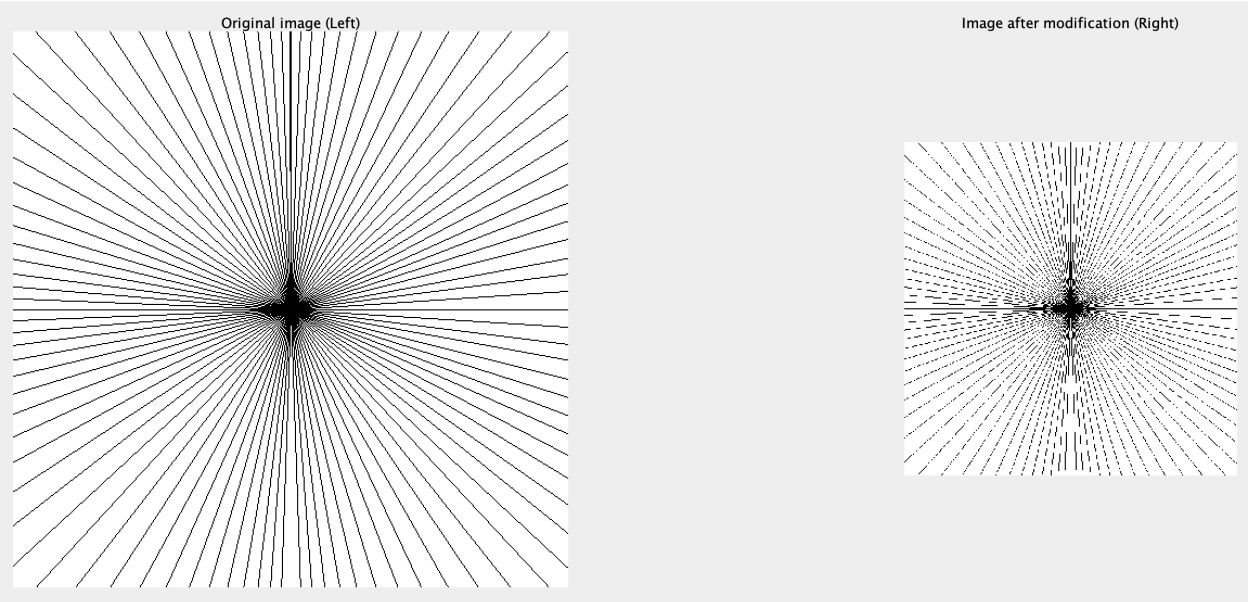
Since n is constant the frequency of lines remains same, here we are varying the scale factor which affects the number of pixels used to represent the image. As s increases, the image is reduced to a smaller size, which means that now we have lesser pixels to represent the same image, this decreases the quality of the image. As s increases the lines become more broken as the aliasing increases.
Thus, we need to perform antialiasing to observe the original image in a scaled-down version with no broken lines.

No antialiasing performed

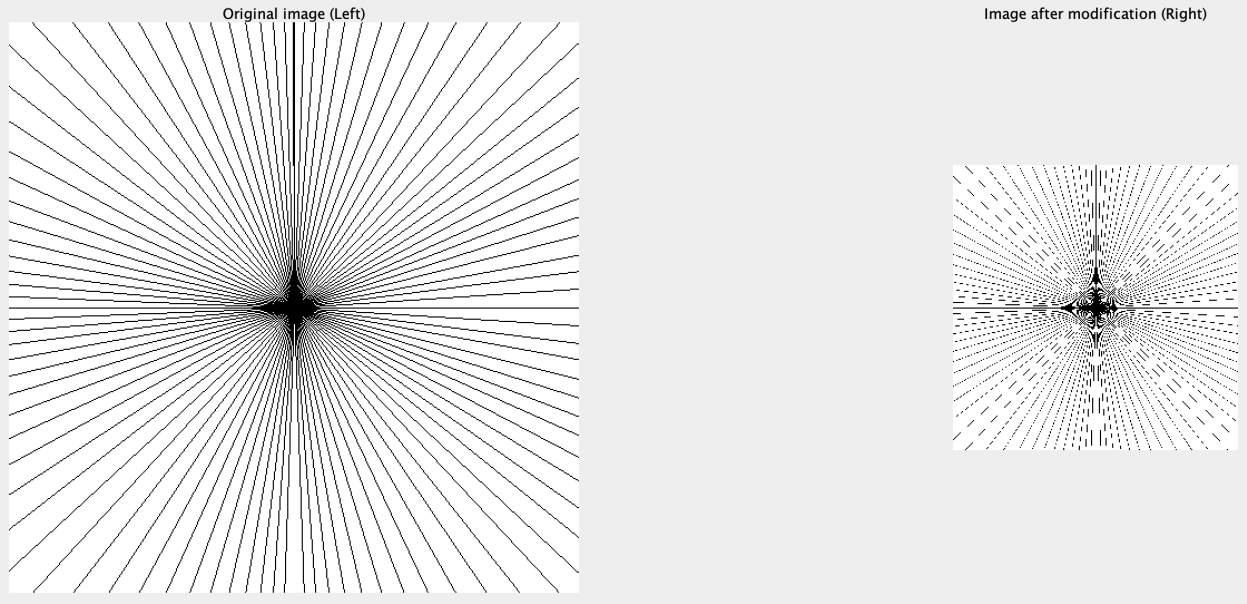
```
java ImageDisplay.java 100 0.2 0
```




```
java ImageDisplay.java 100 0.4 0
```

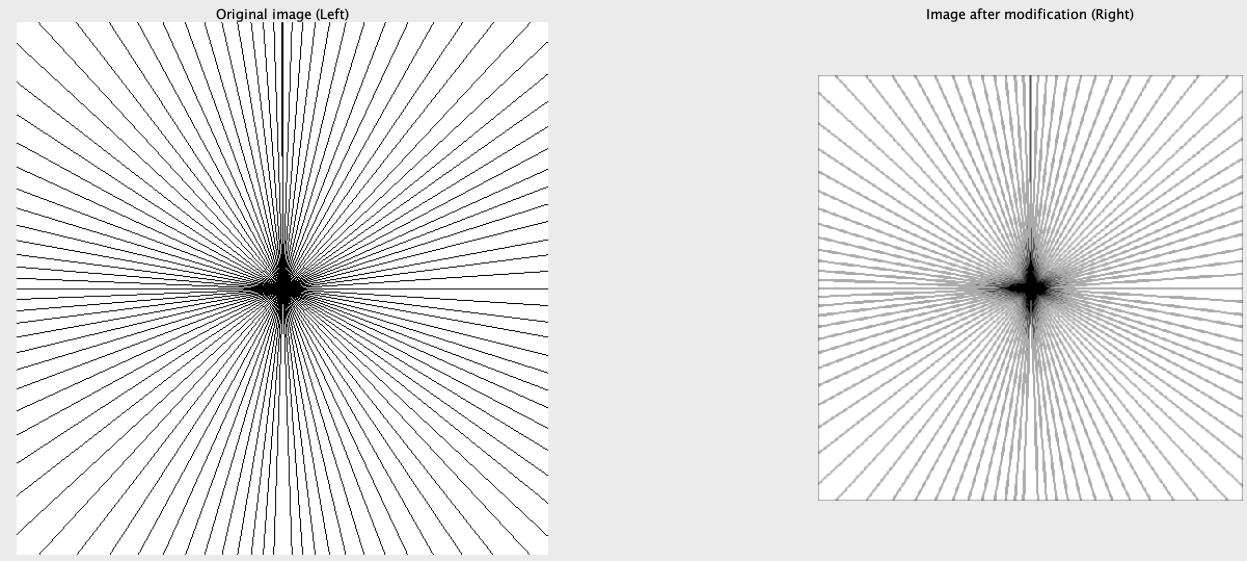


```
java ImageDisplay.java 100 0.5 0
```

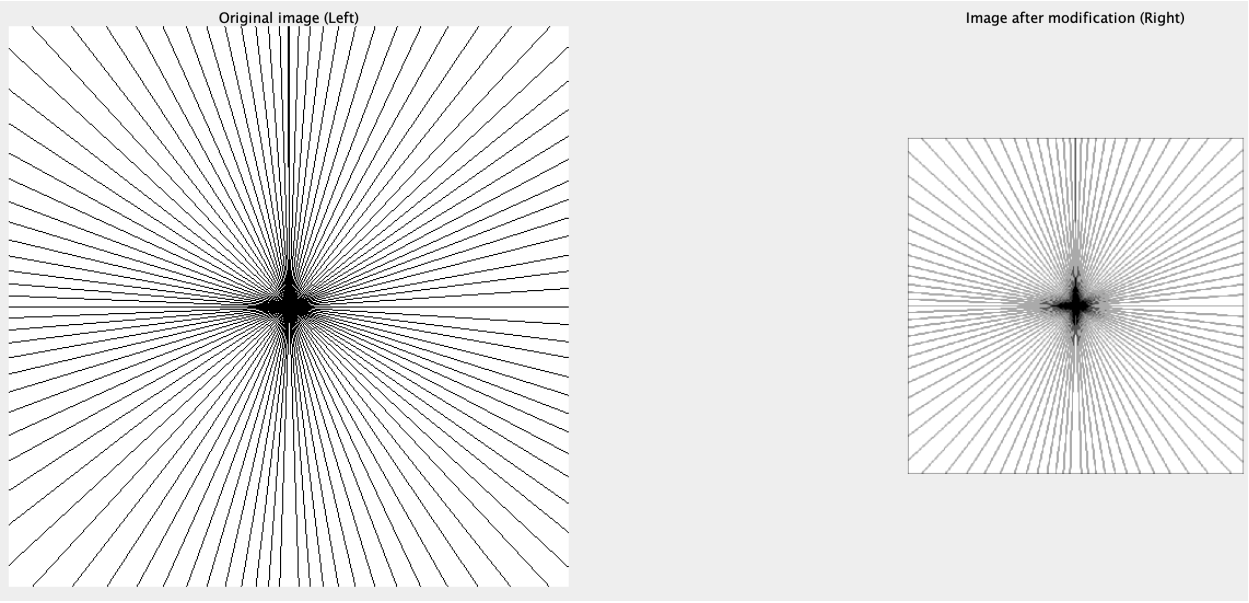


Antialiasing performed

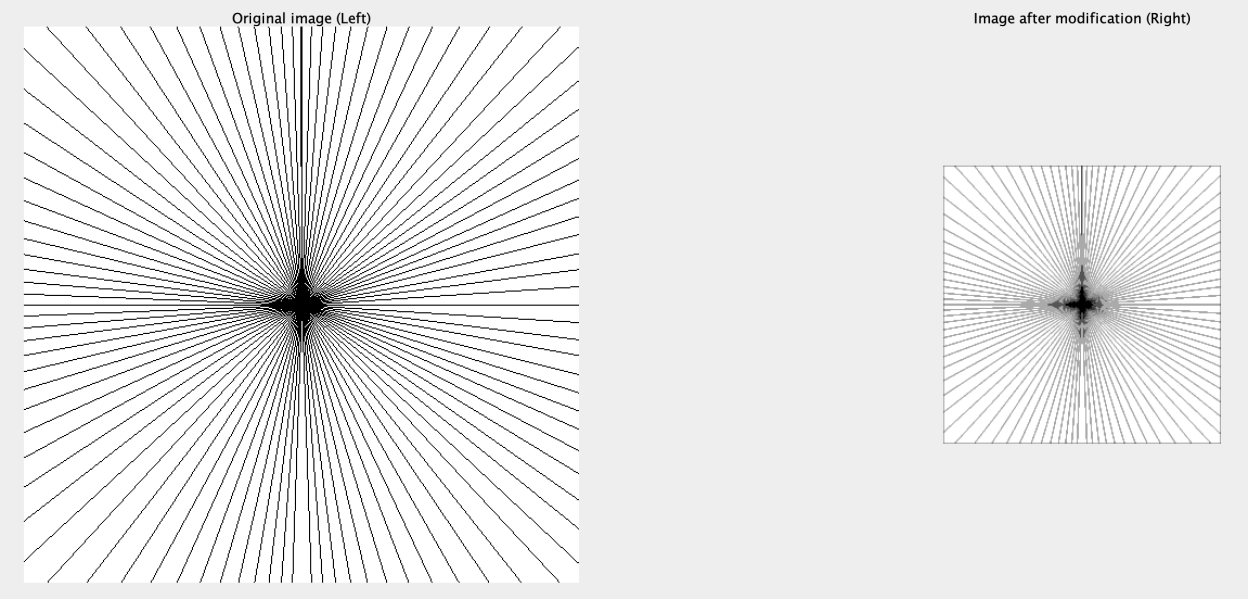
```
java ImageDisplay.java 100 0.2 1
```



```
java ImageDisplay.java 100 0.4 1
```




```
java ImageDisplay.java 100 0.5 1
```



Part 2 –Temporal Aliasing

Analysis Questions for part 2

Let's try an experiment where s (speed of rotation) remains constant and fps (number of lines) is allowed to vary. Study the value of the os (observed speed of rotation) , especially when there is temporal aliasing.
1. Can you design a formula relating s, fps and os.
Evaluate if your formula works for certain values of s and fps. If s = 10 rotations per second,
2. What is the observed speed os for an fps of 25?
3. What is the observed speed os for an fps of 16?
4. What is the observed speed os for an fps of 10?
5. What is the observed speed os for an fps of 8?

Answer) The observed speed of the wheel is independent of the number of lines in the wheel. The observed speed depends on the fps and speed of rotation. The observed speed is the same as the speed of the wheel when there is no aliasing. When the fps falls below twice the revolutions per second of the wheel, aliasing occurs and the observed and the original speed of the wheel are not the same.

1. Observed speed depends on both s and fps. When fps is greater than twice s then the observed speed and original speed are same. In other cases aliasing occurs as a result of which the observed speed can be greater than s, less than s, 0 or the wheel can rotate in the opposite direction.
   Observed speed = ((((s*360)/fps)-360)fps)/360

2. Here s=10, fps = 25. Os = (((10*360)/25)-360)*25)/360 = -15 rot/sec
   Here the fps is 25, which is greater than twice the value of s, this means that aliasing doesn't occur in this case.

3. Here s=10, fps = 16. Os = (((10*360)/16)-360)*16)/360 = -6 rot/sec

4. Here s=10, fps = 10. Os = (((10*360)/10)-360)10)/360 = 0 rot/sec

5. Here s=10, fps = 8. Os = (((10*360)/8)-360)*8)360 = 2 rot/sec