ASSIGNMENT 4
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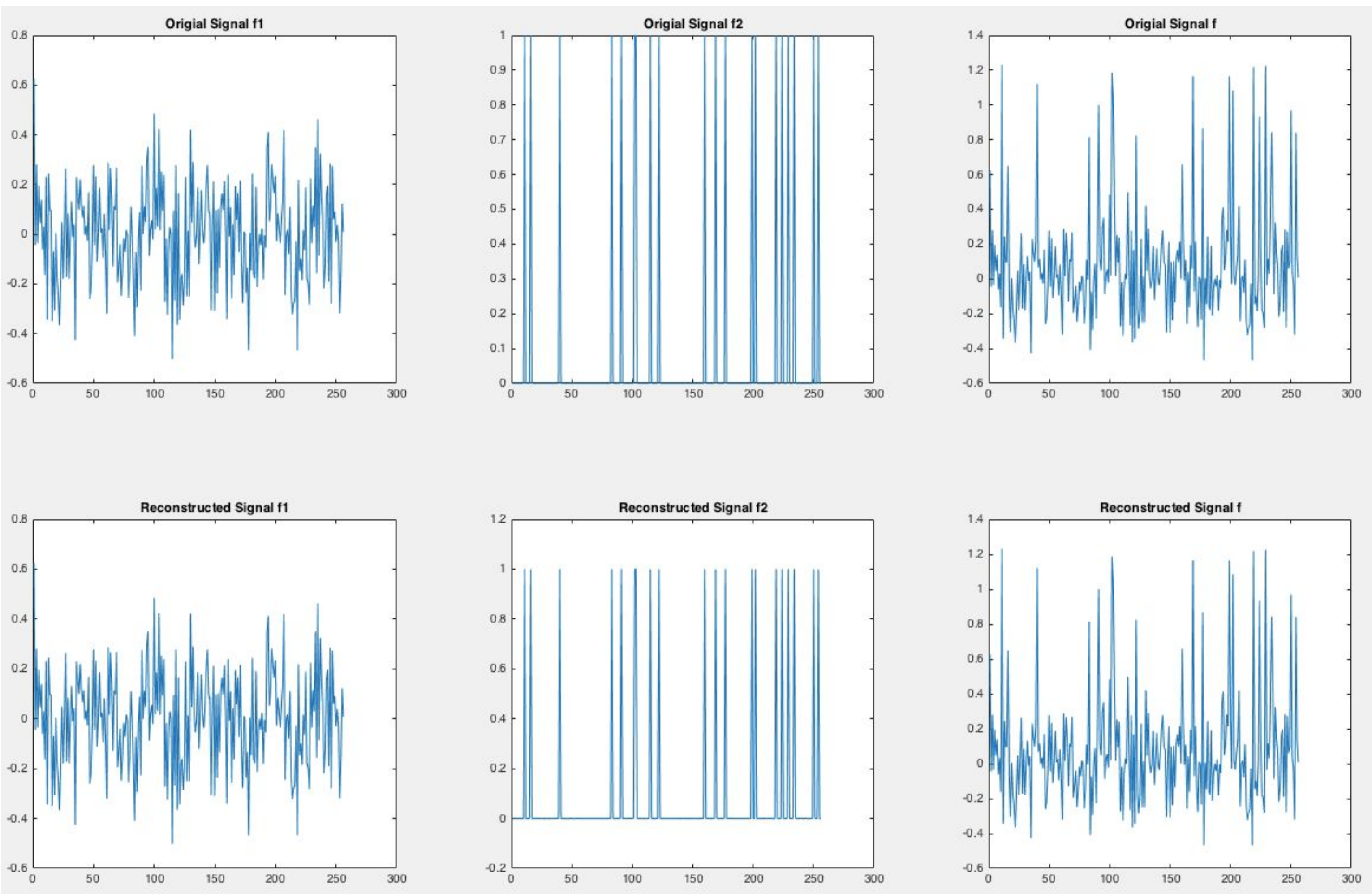
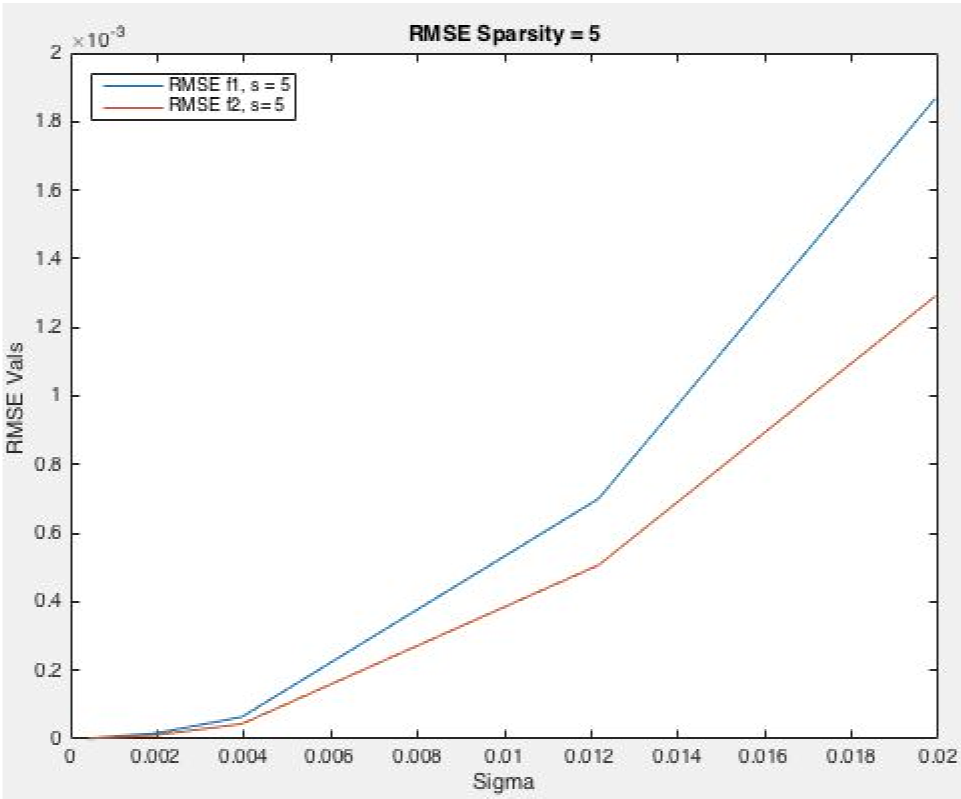
Question 2)
Sample Reconstruction Images

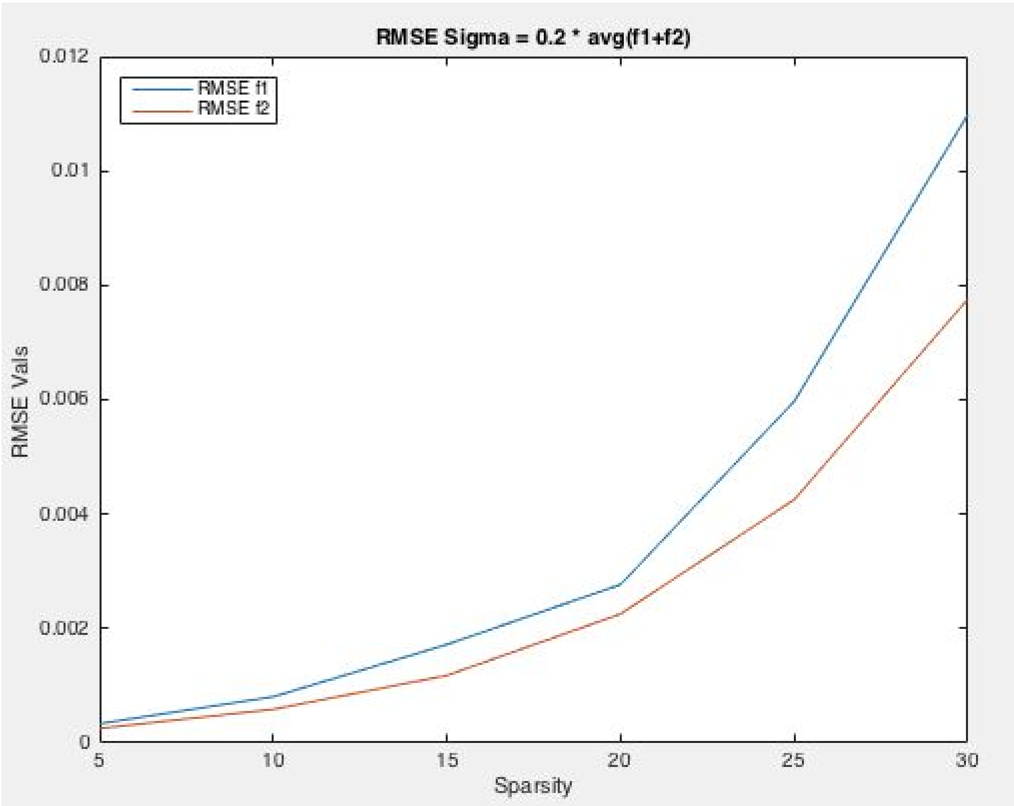


Q2) Plot of Varying Sigma and Fixed Sparsity



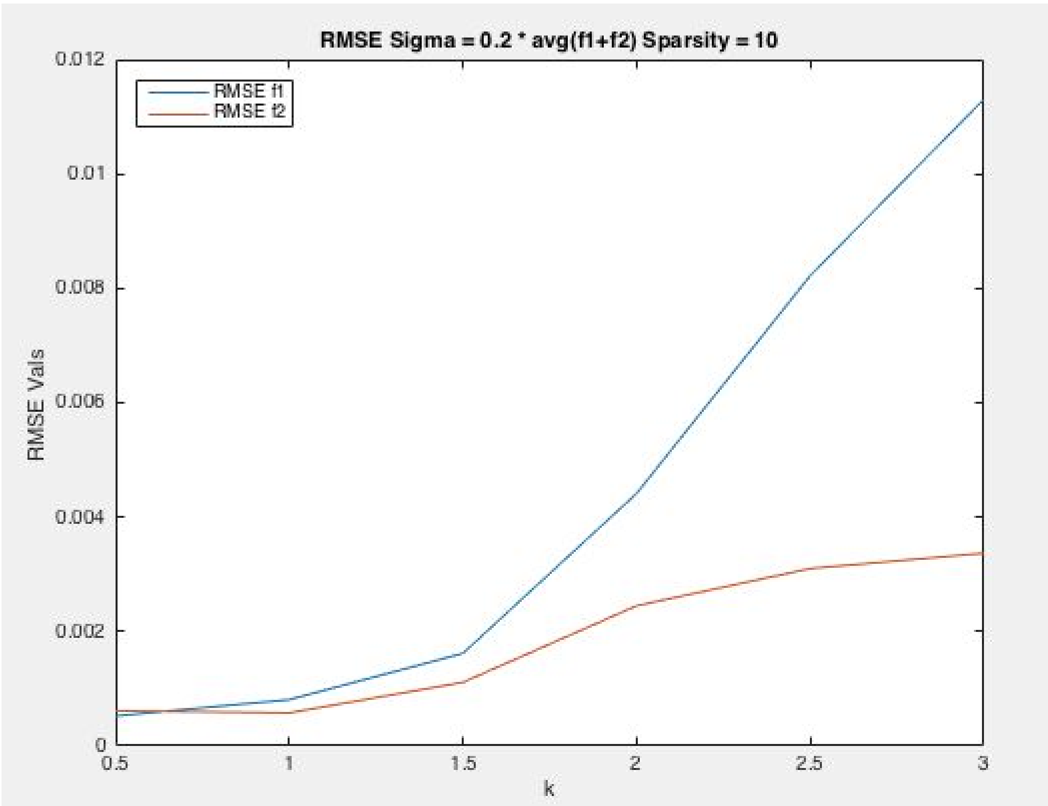
Clearly we can see that RMSE error increases as the magnitude of noise increases for both f1 and f2. Hence the graph is as expected.

Q2) Plot of Varying Sparsity and Fixed Sigma



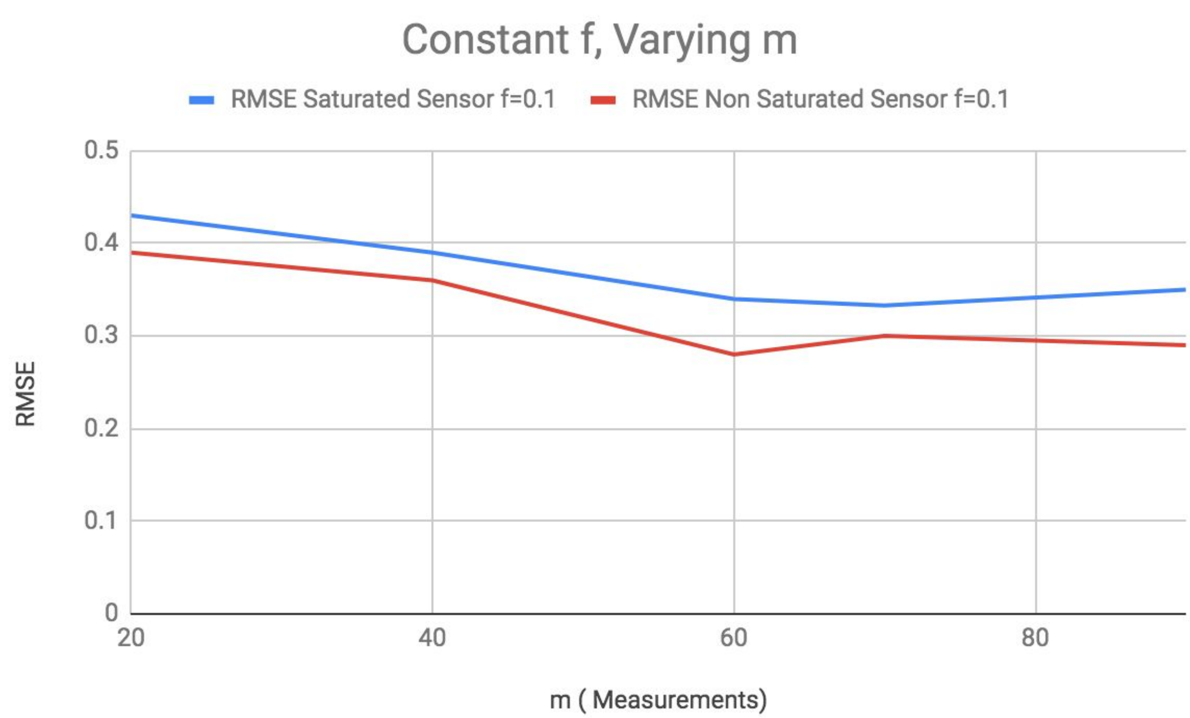
As we increase the sparsity of the original signals f1 and f2 in there basis, the CS theory is less strictly followed and our assumptions and theorems and bounds for compressed sensing recovery get loose. The increasing RMSE error in the graph with increasing sparsity just confirms our arguments.

Q2) Effect of k on RMSE

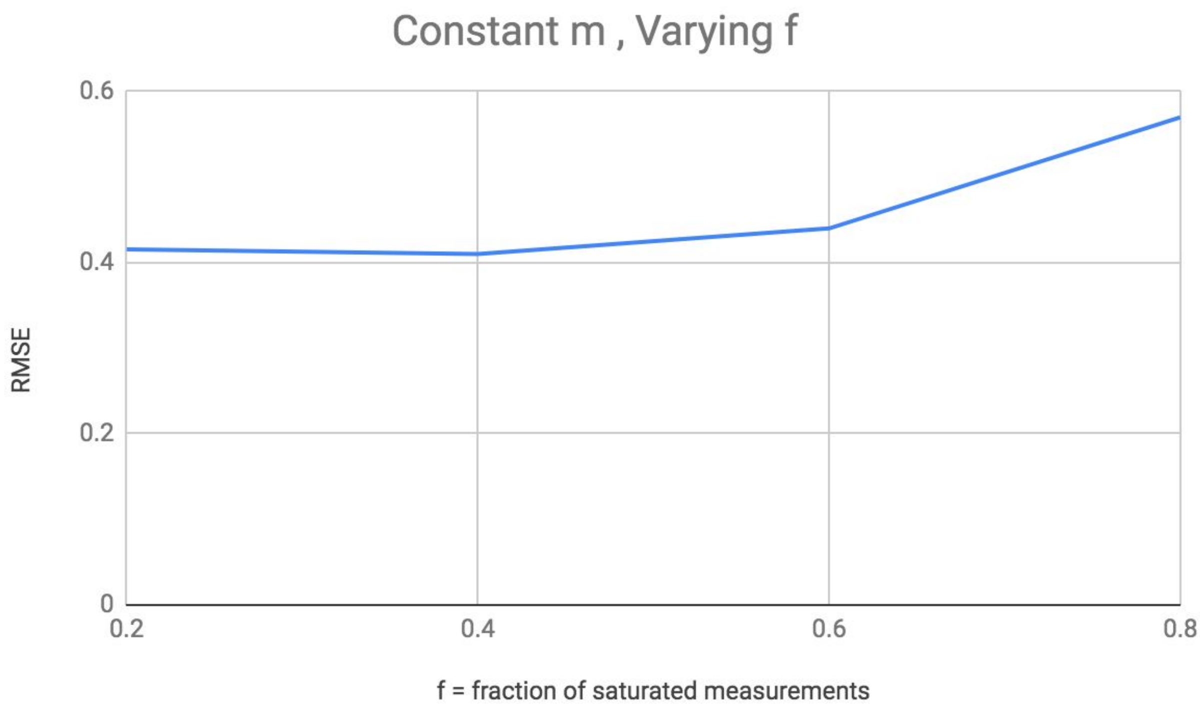


As we increase k, the RMSE increases, probably because the increase in k, causes f2 to act more like noise and cause more disturbance to the actual values of f1. The effect of increasing k should not be much on f2 because f2 is itself k, and this can be seen in the graph as well.

QUESTION 4
OUR SOLUTION
We are **just neglecting the saturated values from the measurements, i.e. we remove all the measurements whose values are greater than or equal to L (The saturation value) . The corresponding rows in the phi matrix are also removed and only the remaining measurement values (the non saturated ones) are used for reconstruction.**
Initially we also tried reconstruction using the saturated measurement as it is, but found the above strategy to be more useful.

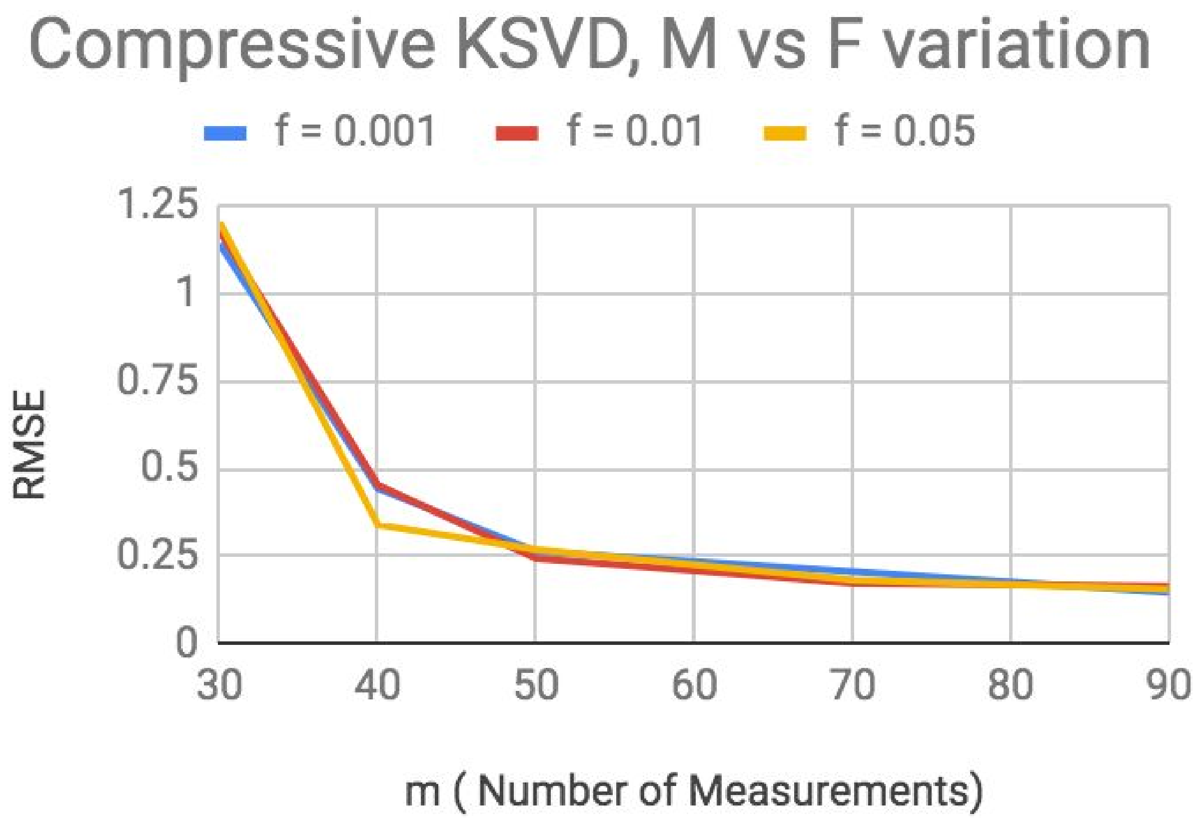


As expected, RMSE decreases with increase in the measurements. We can say that our strategy works good, since the difference in RMSE error with non saturated sensors is very less (~0.05)



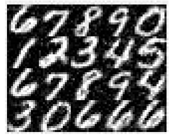
As expected, RMSE error increases with increases in the percentage of saturated values in the sensor.

QUESTION 1.a)

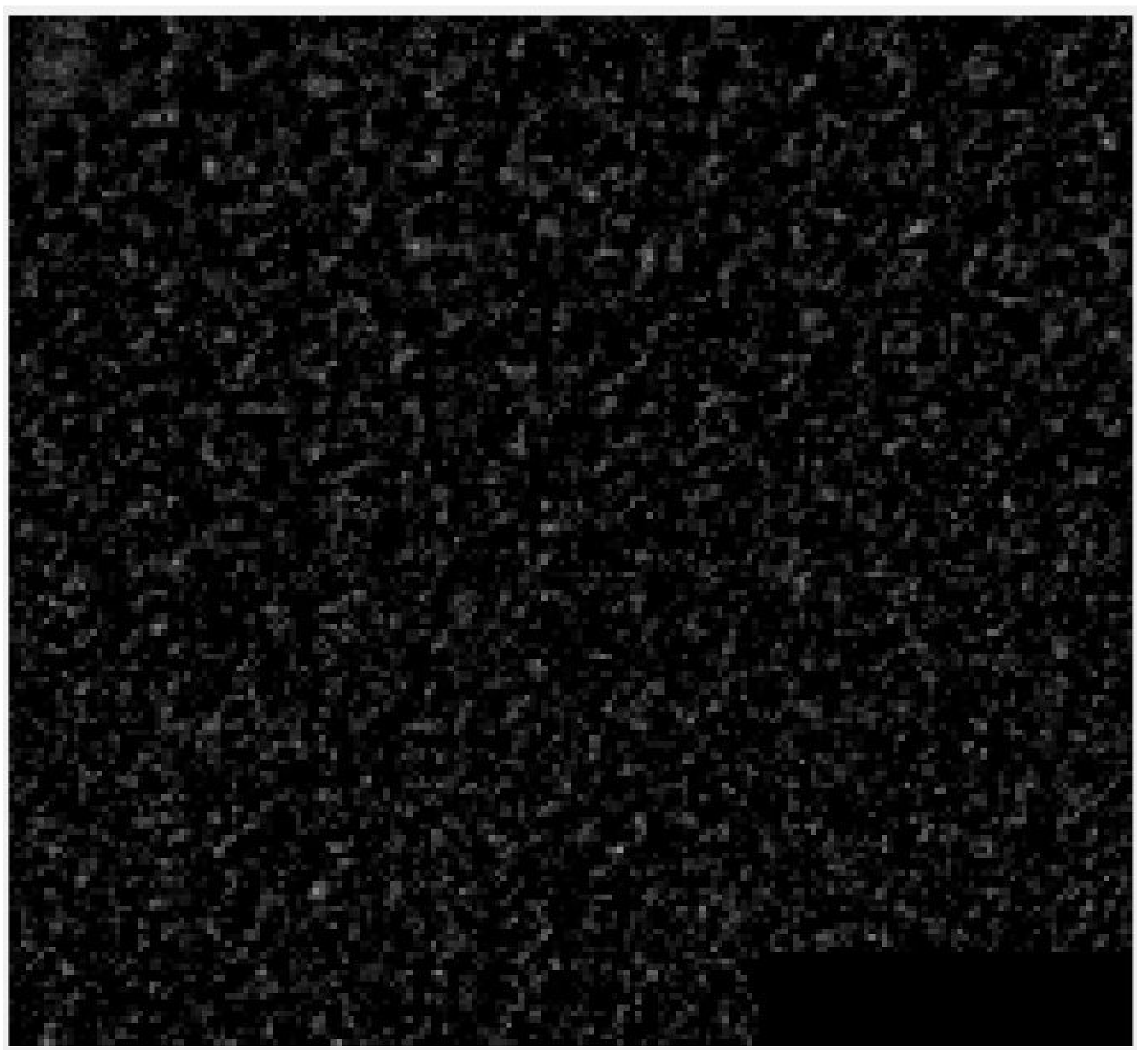


As expected RMSE decreases as we increase the measurements. With increase in value of f, RMSE should increase ideally. But the same can't be observed in our graph. The reason for this maybe that the given variation in values of f may not be sufficient enough or maybe OMP is robust enough to such range of values of f (<0.1).

Question 1.b)
For m = 200 measurements, some sample reconstruction images

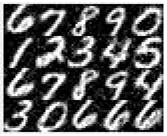


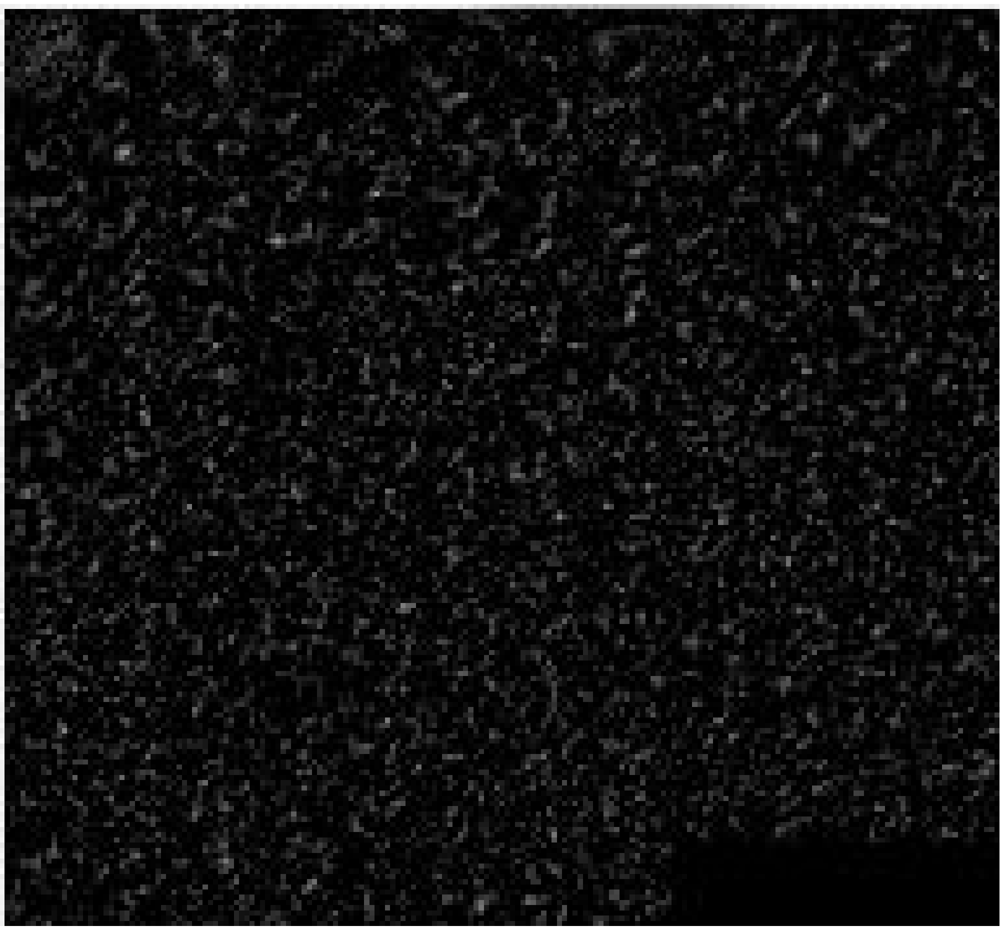
DICTIONARY ->

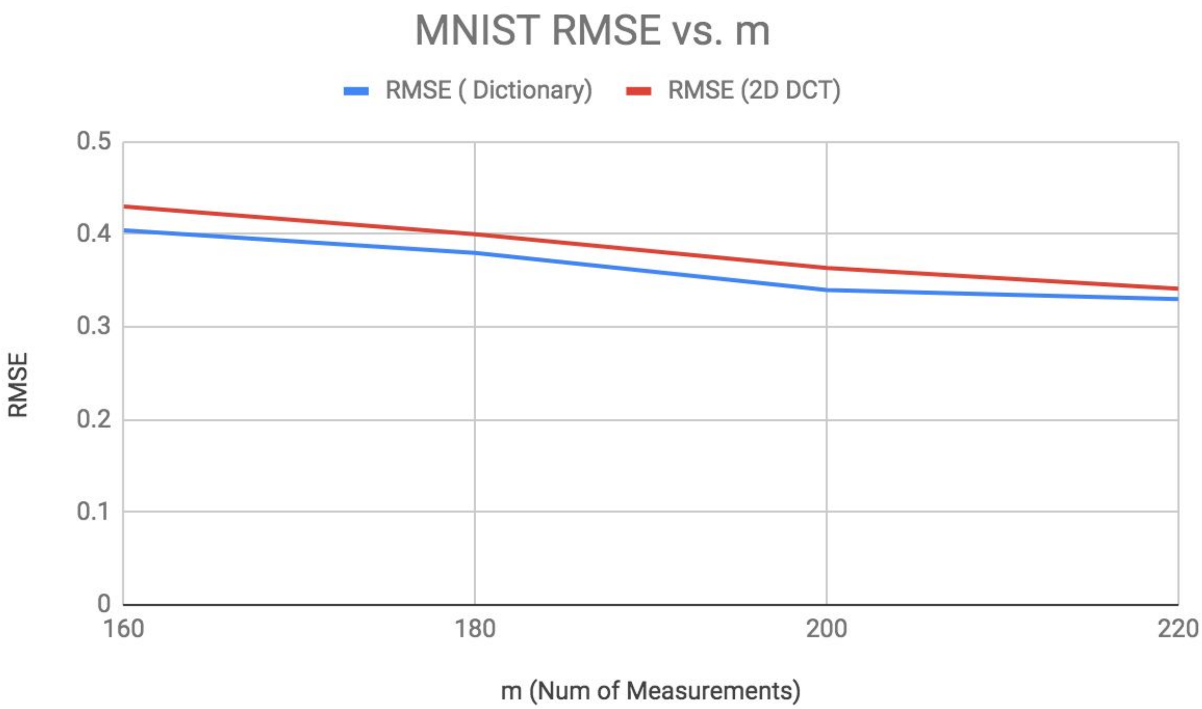


On a close inspection, we can see each dictionary column contains some very distorted version of numbers. Some 6 and 9 are prominently visible in the image.

M =220







As expected, the RMSE Error decreases with increase in m. Also the RMSE for dictionary learning method is a bit less (~0.03) then the RMSE using 2D DCT + OMP based reconstruction

NOTE :
The OMP function has been used from internet and is not the one I coded in previous assignments.
Link :
https://in.mathworks.com/matlabcentral/fileexchange/32402-cosamp-and-omp-for-sparse-recovery