CS754 Assignment-1

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Declaration: The work submitted is our own, and we have adhered to the principles of academic honesty while completing and submitting this work. We have not referred to any unauthorized sources, and we have not used generative AI tools for the work submitted here.

Question 5

OMP

The code is present in the file `assignment1/5/code/omp.m`. On opening matlab in that folder, the code can be run by executing the command `omp`.

Firstly, we need to plot RMSE vs m (number of measurements), for various values of sparsity k.

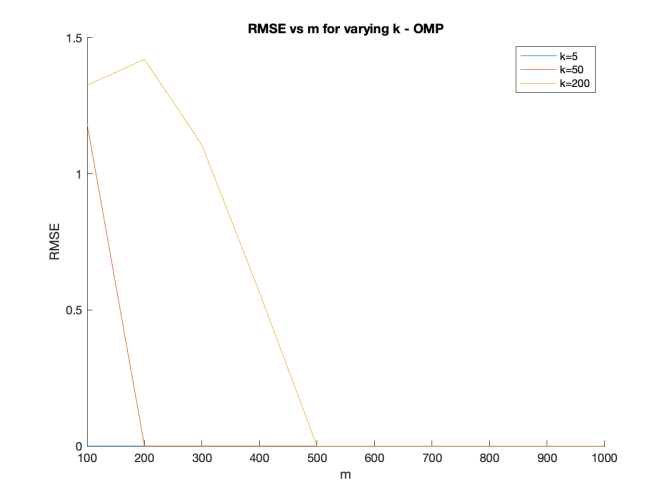


Figure 1: Comparison of RMSE vs m for different values of k for OMP

From the above plot, we can see that OMP performs really well, because RMSE is very low for almost all values of m. It decreases as m increases, which is expected as more measurements should lead to better reconstruction. The RMSE is lower for higher various values of k (sparsity level), which is again as expected as higher sparsity level should make reconstruction easier.

Next, we plot RMSE vs k for various values of m.

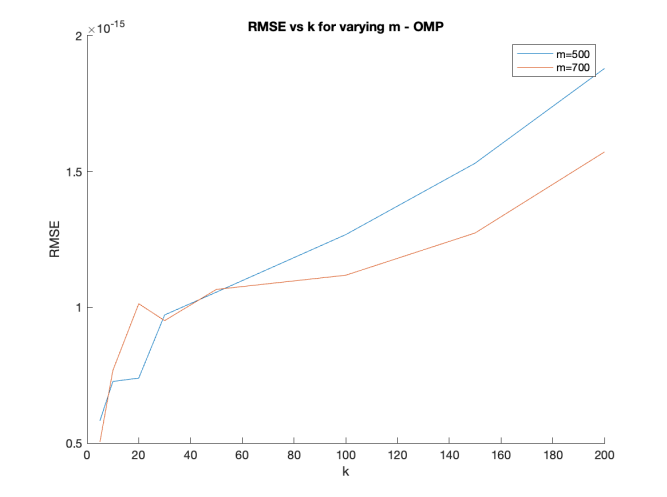
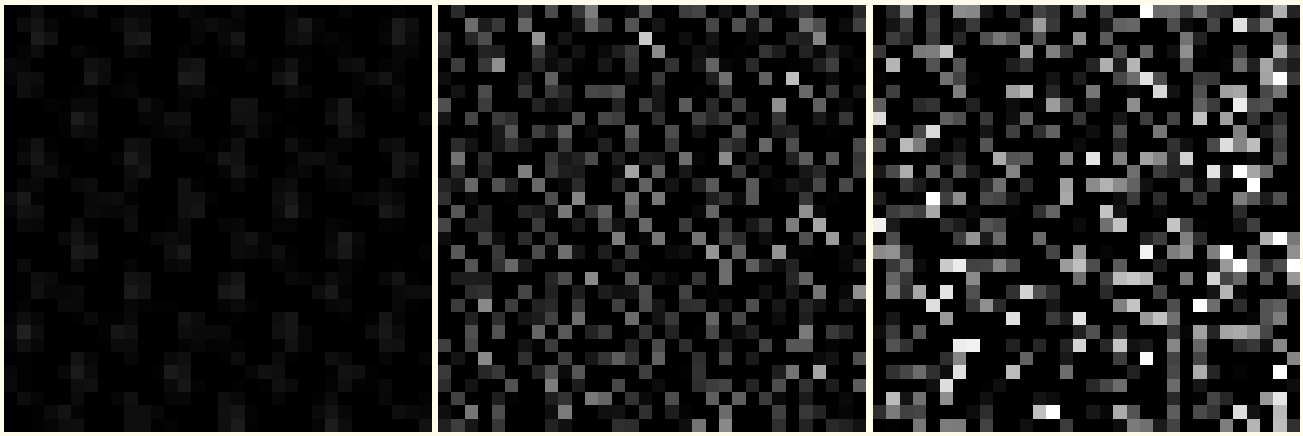


Figure 2: Comparison of RMSE vs k for different values of m for OMP

In general, as k increases (increase in the number of non-zero indices), the RMSE increases. This is expected, as a higher sparsity level makes reconstruction harder. Some fluctuations in the RMSE for intermediate values of k could be due to the randomness in the measurement matrix or noise in the reconstruction.

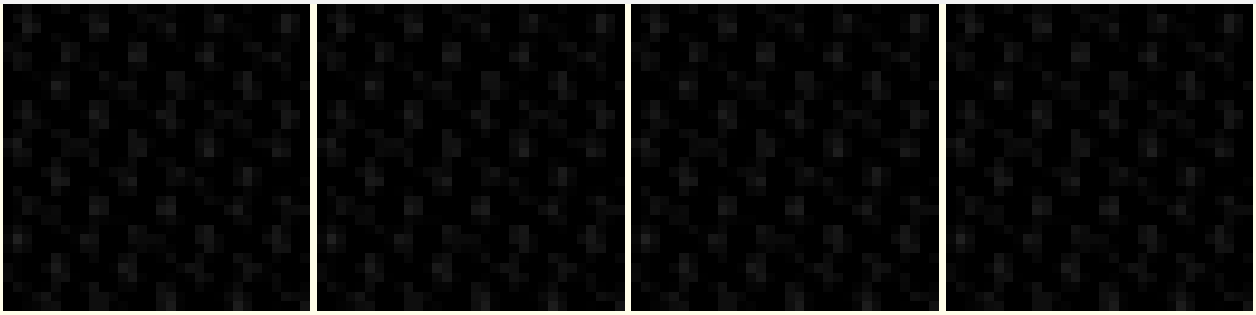
Here is the ground truth images for various values of k:



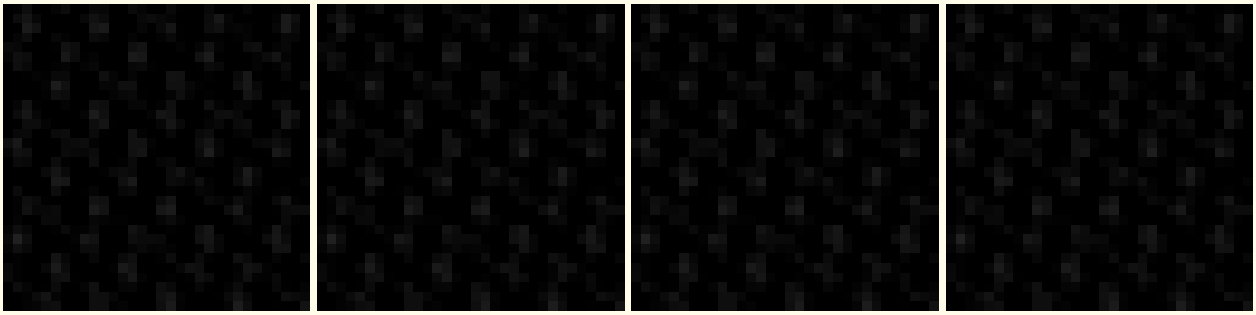
(a) Ground truth for $k = 5$ (b) Ground truth for $k = 50$ (c) Ground truth for $k = 200$

Figure 3: Ground truth images for different values of k

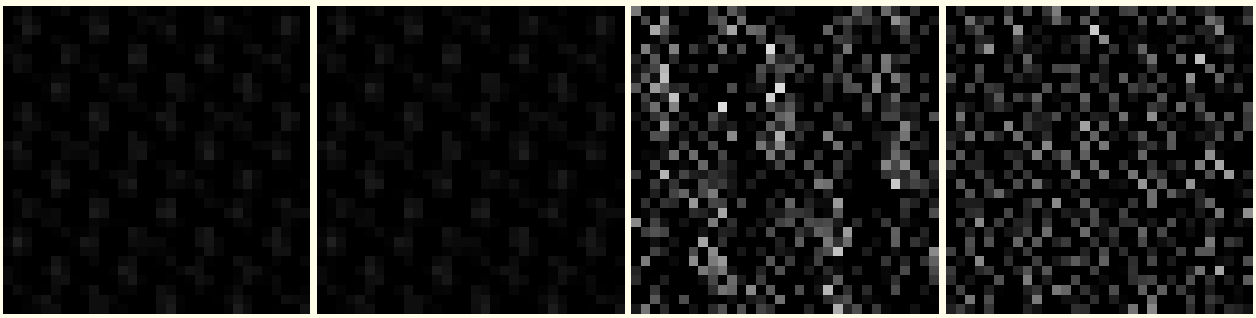
Here are the corresponding reconstructed images for various m values `images/omp` folder:



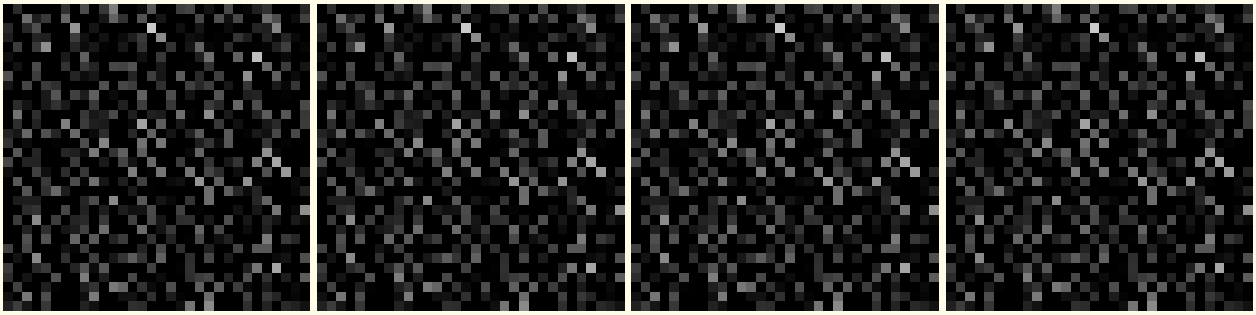
(a) Reconstructed for $k = 5, m = 100$ (b) Reconstructed for $k = 5, m = 200$ (c) Reconstructed for $k = 5, m = 300$ (d) Reconstructed for $k = 5, m = 400$



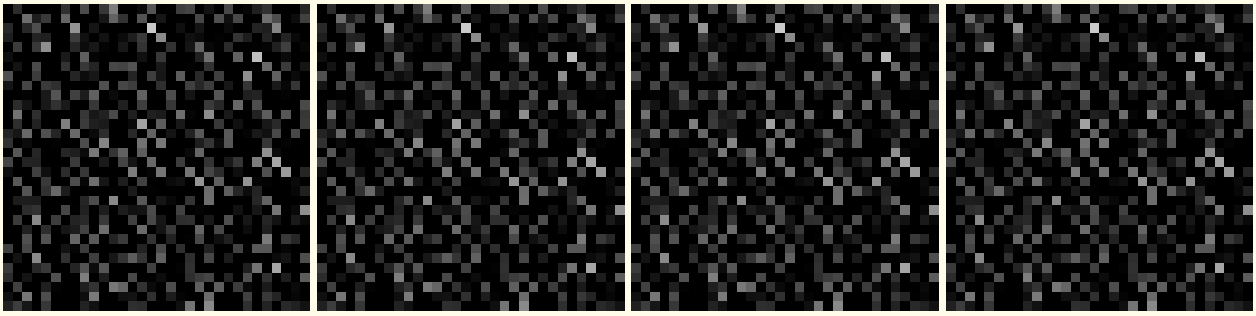
(e) Reconstructed for $k = 5, m = 500$ (f) Reconstructed for $k = 5, m = 600$ (g) Reconstructed for $k = 5, m = 700$ (h) Reconstructed for $k = 5, m = 800$



(i) Reconstructed for $k = 5, m = 900$ (j) Reconstructed for $k = 5, m = 1000$ (k) Reconstructed for $k = 50, m = 100$ (l) Reconstructed for $k = 50, m = 200$

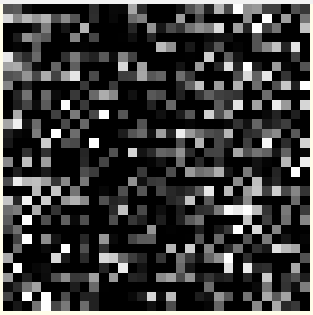


(m) Reconstructed for $k = 50, m = 300$ (n) Reconstructed for $k = 50, m = 400$ (o) Reconstructed for $k = 50, m = 500$ (p) Reconstructed for $k = 50, m = 600$

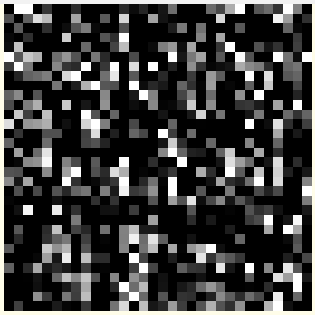


(q) Reconstructed for $k = 50, m = 700$ (r) Reconstructed for $k = 50, m = 800$ (s) Reconstructed for $k = 50, m = 900$ (t) Reconstructed for $k = 50, m = 1000$

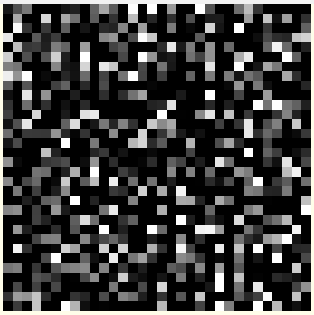
Figure 4: Reconstructed images for different values of k and m



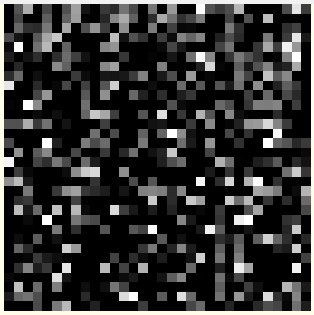
(a) Reconstructed for $k = 200, m = 100$



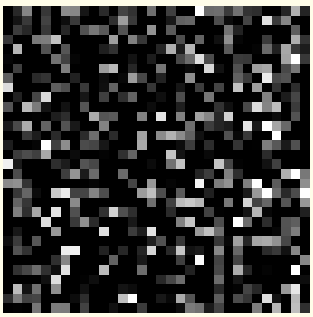
(b) Reconstructed for $k = 200, m = 200$



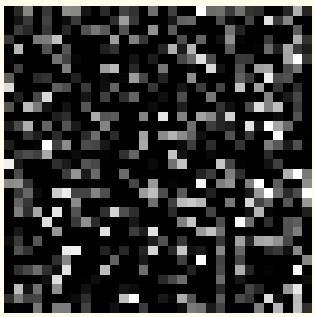
(c) Reconstructed for $k = 200, m = 300$



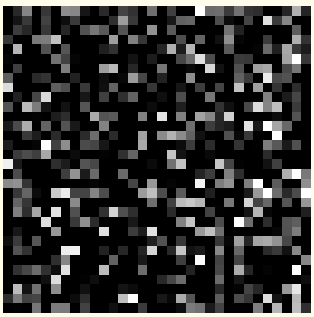
(d) Reconstructed for $k = 200, m = 400$



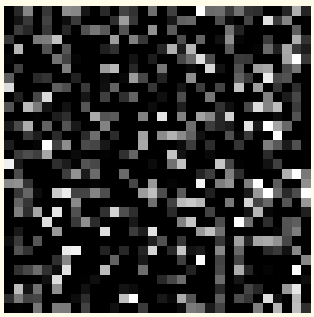
(e) Reconstructed for $k = 200, m = 500$



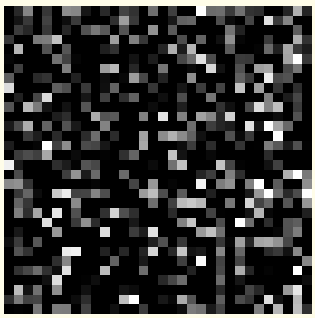
(f) Reconstructed for $k = 200, m = 600$



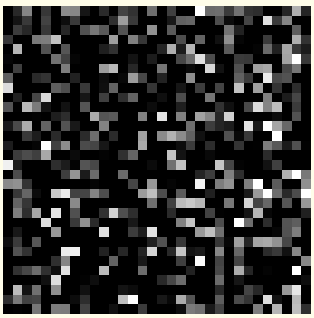
(g) Reconstructed for $k = 200, m = 700$



(h) Reconstructed for $k = 200, m = 800$



(i) Reconstructed for $k = 200, m = 900$



(j) Reconstructed for $k = 200, m = 1000$

Figure 5: Reconstructed images for different values of k and m

COSAMP

The code is present in the file `assignment1/5/code/cosamp.m`. On opening matlab in that folder, the code can be run by executing the command `cosamp`.

Firstly, we need to plot RMSE vs m (number of measurements), for various values of sparsity k.

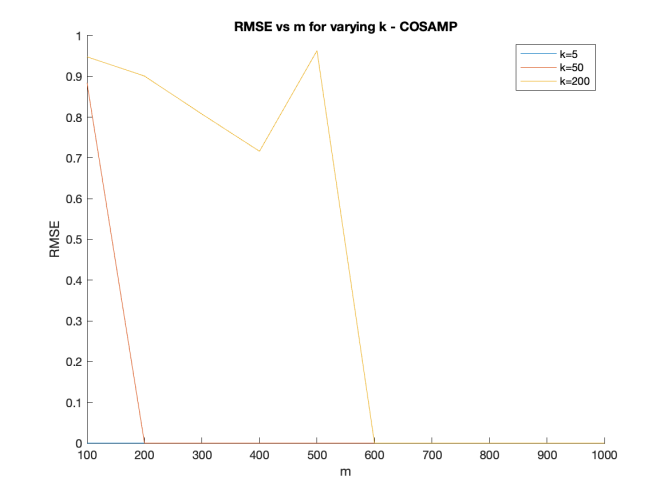


Figure 6: Comparison of RMSE vs m for different values of k for COSAMP

From the above plot, we can see that COSAMP performs really well (although not as good as OMP for some values of m). It decreases as m increases, which is expected as more measurements should lead to better reconstruction. The RMSE is lower for higher various values of k (sparsity level), which is again as expected as higher sparsity level should make reconstruction easier.

Next, we plot RMSE vs k for various values of m.

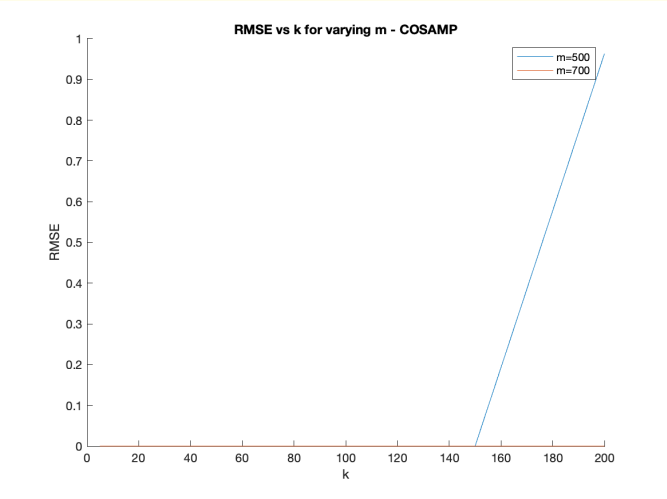
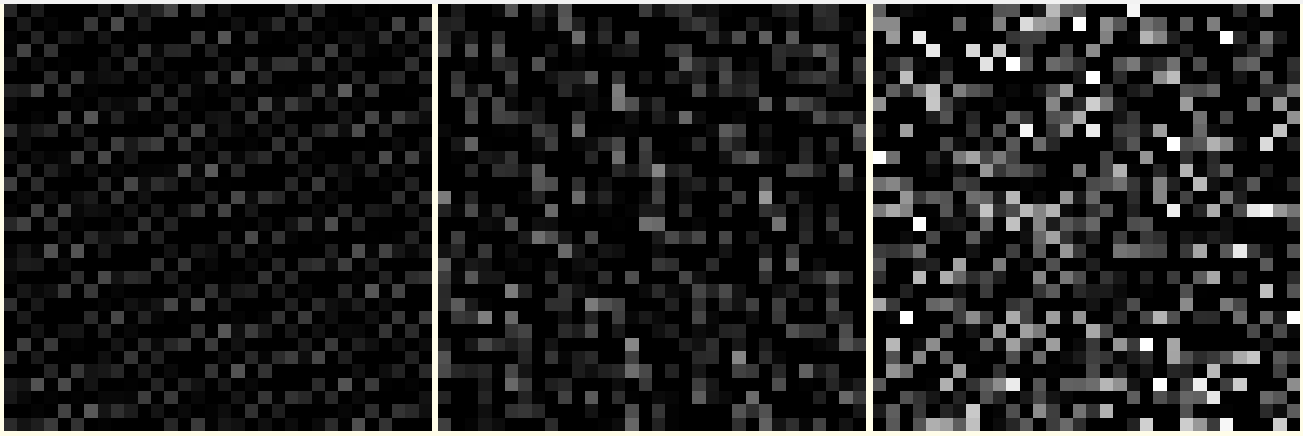


Figure 7: Comparison of RMSE vs k for different values of m for cosamp

In general, as k increases (increase in the number of non-zero indices), the RMSE increases. This is expected, as a higher sparsity level makes reconstruction harder.

If we compare OMP and COSAMP, we can see that OMP performs better than COSAMP for most values of m and k. Moreover, OMP is quite fast as compared to COSAMP.

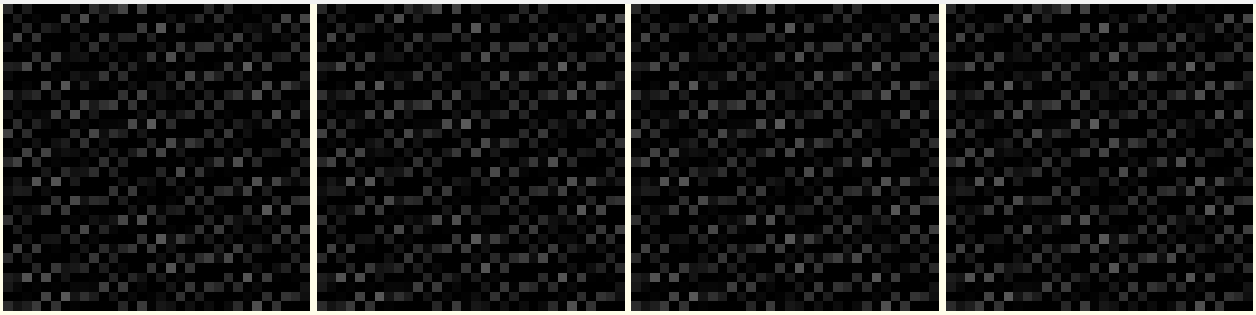
Here is the ground truth images for various values of k:



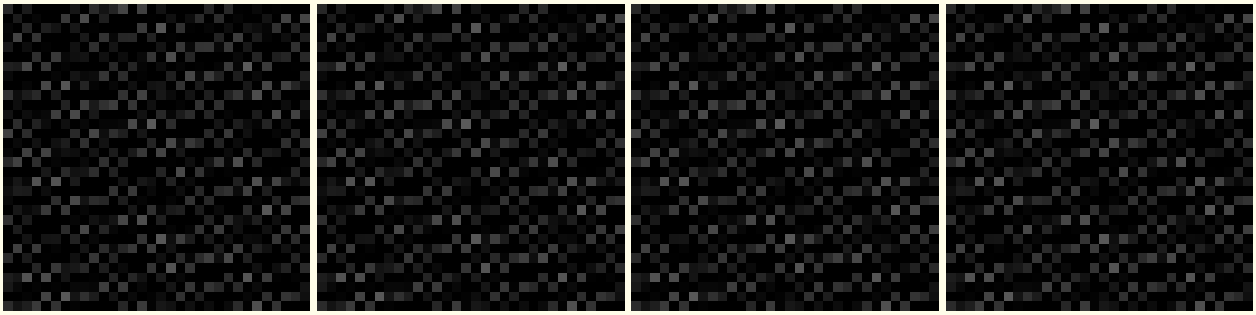
(a) Ground truth for $k = 5$ (b) Ground truth for $k = 50$ (c) Ground truth for $k = 200$

Figure 8: Ground truth images for different values of k

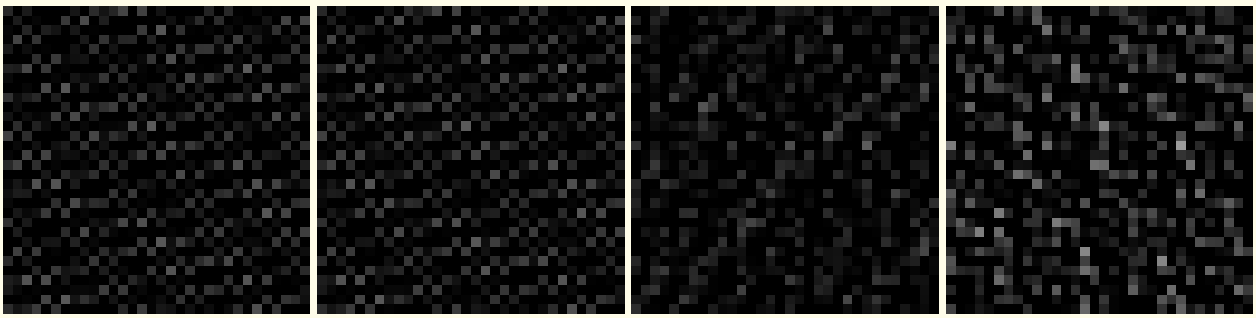
Here are the corresponding reconstructed images for various m values `images/cosamp` folder:



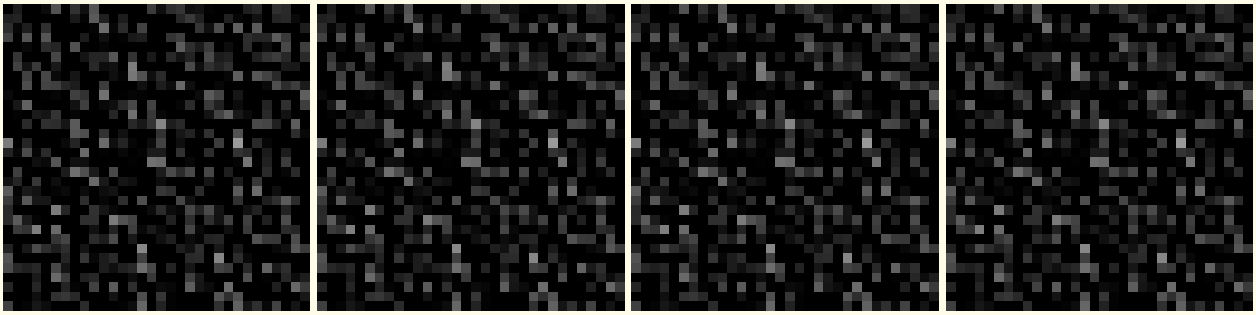
(a) Reconstructed for $k = 5, m = 100$ (b) Reconstructed for $k = 5, m = 200$ (c) Reconstructed for $k = 5, m = 300$ (d) Reconstructed for $k = 5, m = 400$



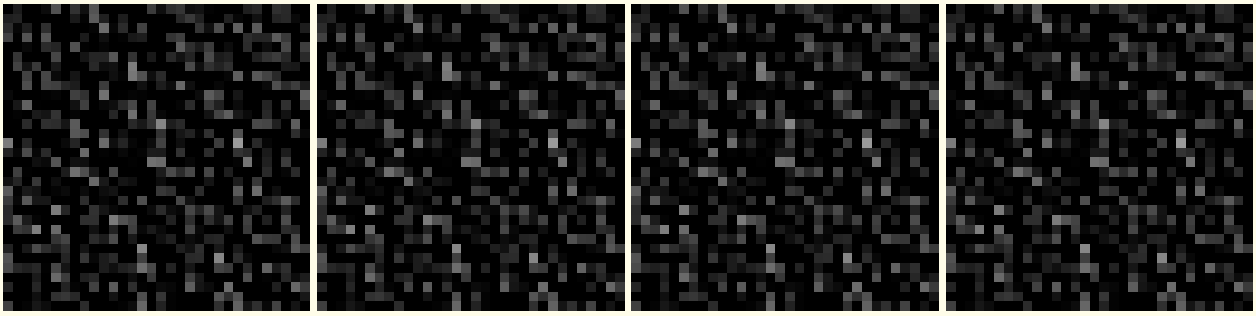
(e) Reconstructed for $k = 5, m = 500$ (f) Reconstructed for $k = 5, m = 600$ (g) Reconstructed for $k = 5, m = 700$ (h) Reconstructed for $k = 5, m = 800$



(i) Reconstructed for $k = 5, m = 900$ (j) Reconstructed for $k = 5, m = 1000$ (k) Reconstructed for $k = 50, m = 100$ (l) Reconstructed for $k = 50, m = 200$

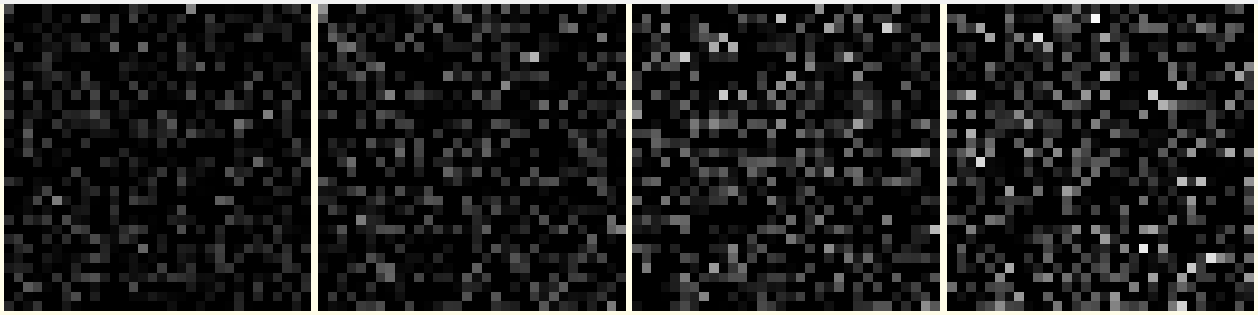


(m) Reconstructed for $k = 50, m = 300$ (n) Reconstructed for $k = 50, m = 400$ (o) Reconstructed for $k = 50, m = 500$ (p) Reconstructed for $k = 50, m = 600$



(q) Reconstructed for $k = 50, m = 700$ (r) Reconstructed for $k = 50, m = 800$ (s) Reconstructed for $k = 50, m = 900$ (t) Reconstructed for $k = 50, m = 1000$

Figure 9: Reconstructed images for different values of k and m

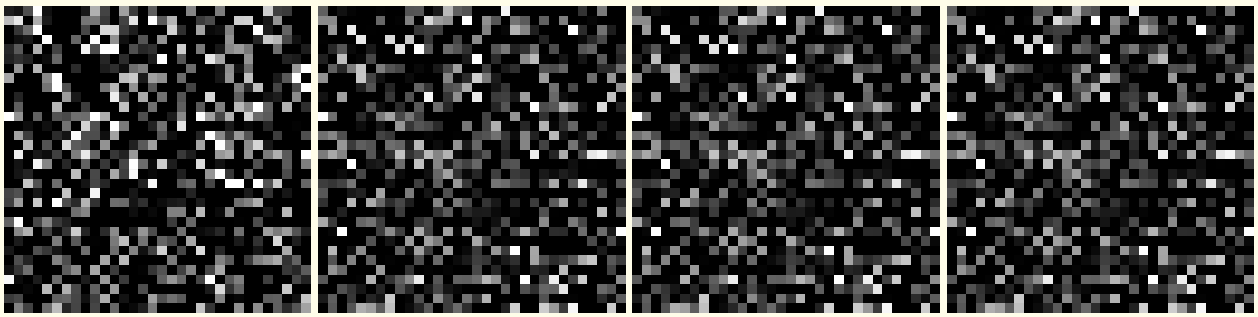


(a) Reconstructed for $k = 200$, $m = 100$

(b) Reconstructed for $k = 200$, $m = 200$

(c) Reconstructed for $k = 200$, $m = 300$

(d) Reconstructed for $k = 200$, $m = 400$

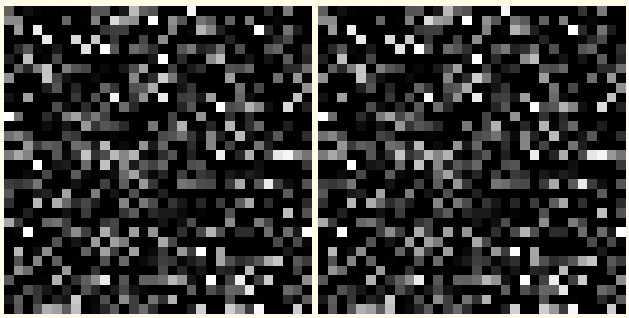


(e) Reconstructed for $k = 200$, $m = 500$

(f) Reconstructed for $k = 200$, $m = 600$

(g) Reconstructed for $k = 200$, $m = 700$

(h) Reconstructed for $k = 200$, $m = 800$



(i) Reconstructed for $k = 200$, $m = 900$

(j) Reconstructed for $k = 200$, $m = 1000$

Figure 10: Reconstructed images for different values of k and m