# 236862.1x Project 2
Image Inpainting and Testing Various Pursuit Methods

November 2017

Part A - Data Construction

Discuss advice 2

Zero columns are not a problem because they are not chosen by the algorithms. It's easier to let them in the CA matrix so that we don't need to play with the indices. However to avoid division by zero we simply change the zeros in `atoms_norm` to `eps`.
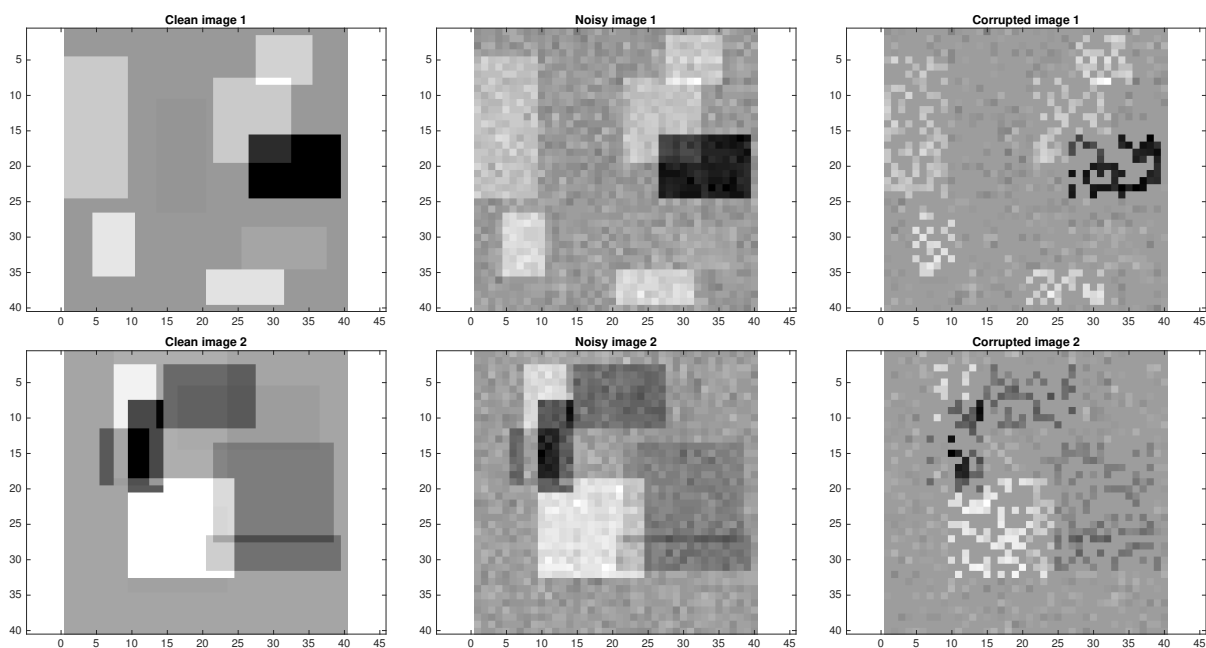
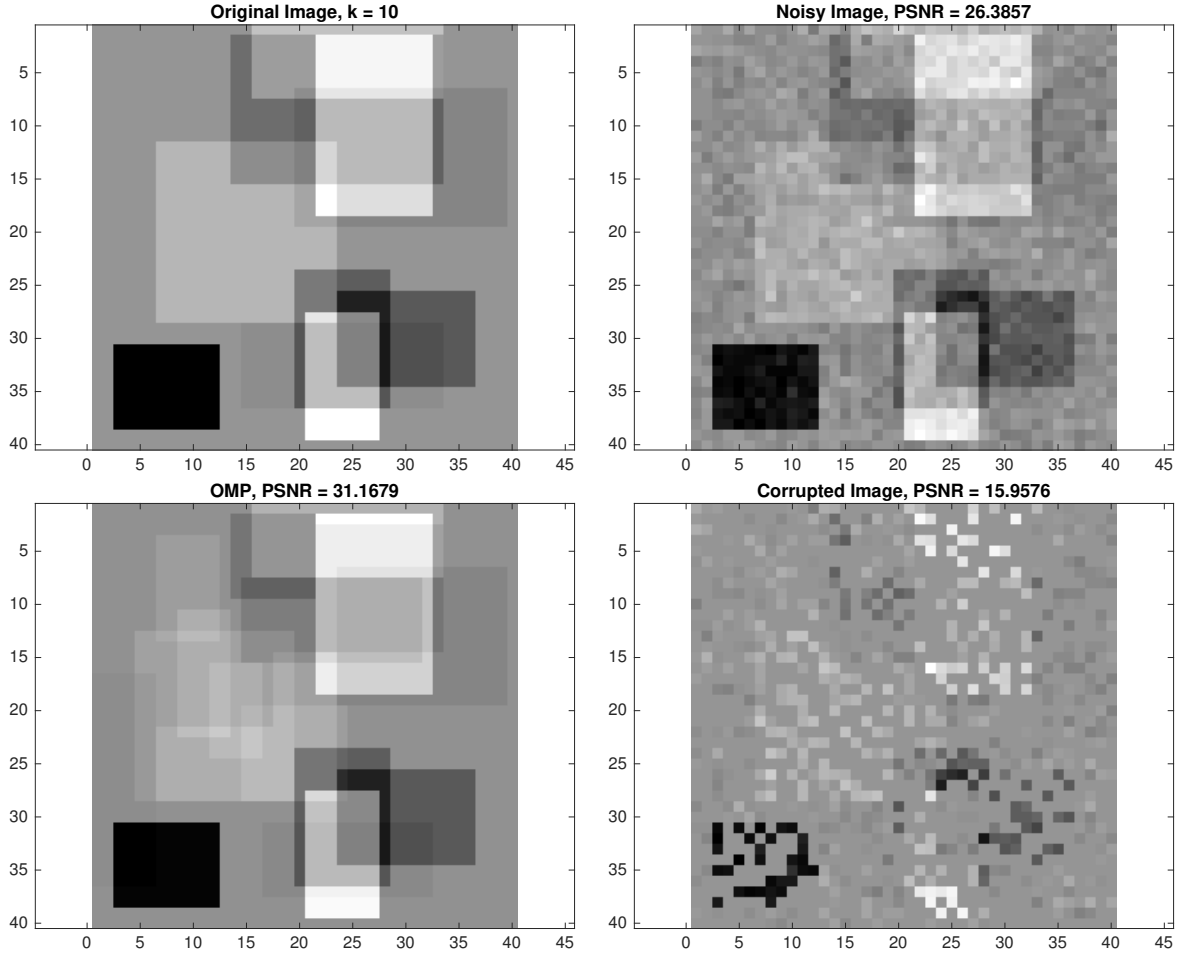# Part B – Inpainting by the Oracle Estimator

Average PSNR result of the Oracle estimator: **44.797**
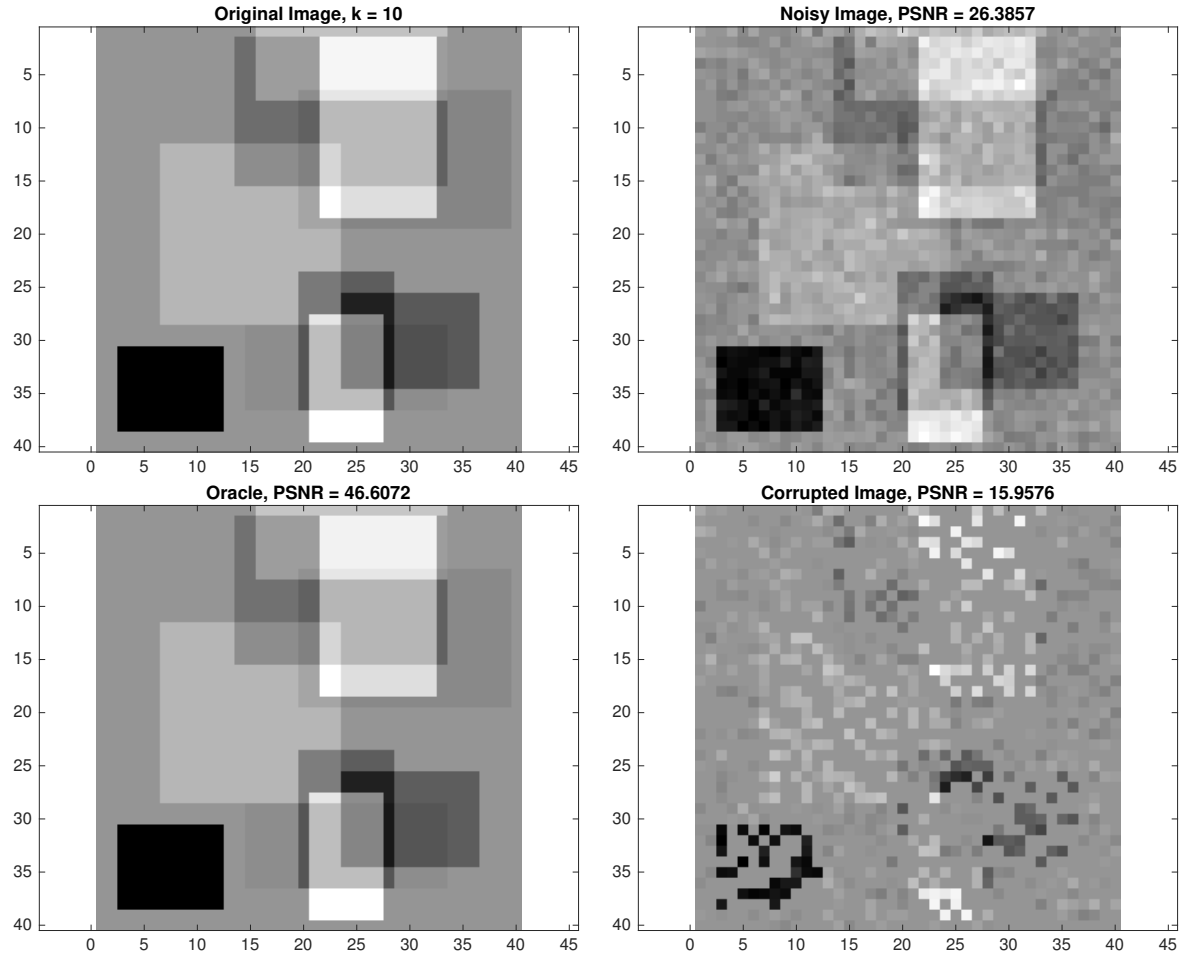
The Oracle reconstruction is almost perfect.

Part C – Inpainting by Greedy Pursuit

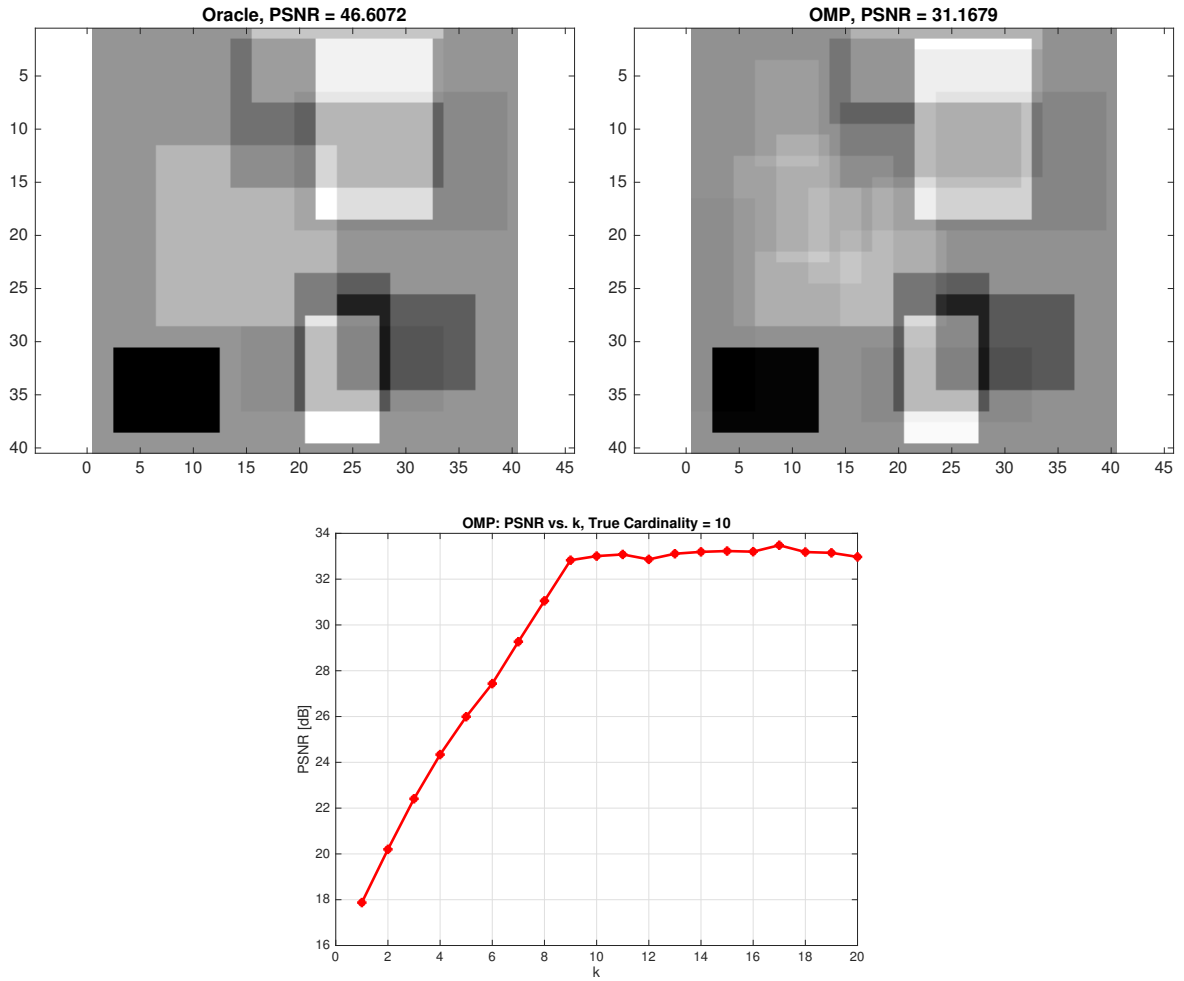Average PSNR result of OMP: **35.352**

Discuss results of OMP and compare to Oracle performance

The OMP reconstruction is pretty good, but not as good as the Oracle one, as expected. There's some mismatch in the choice of the atoms as the true support is not known in advance.

Discuss the average PSNR as a function of k

As long as k is smaller than the true cardinality, each new atom improves quickly the PSNR. After that it barely continues to improve, so the OMP is very efficient. It only needs about the same number of iterations than the true cardinality to achieve a good result.
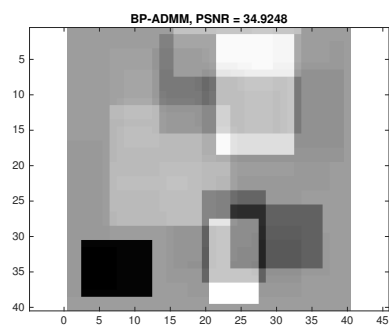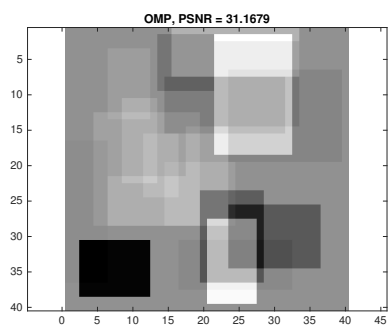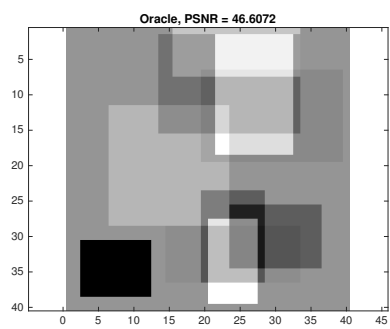
Oracle, PSNR = 46.6072   **OMP, PSNR = 31.1679**
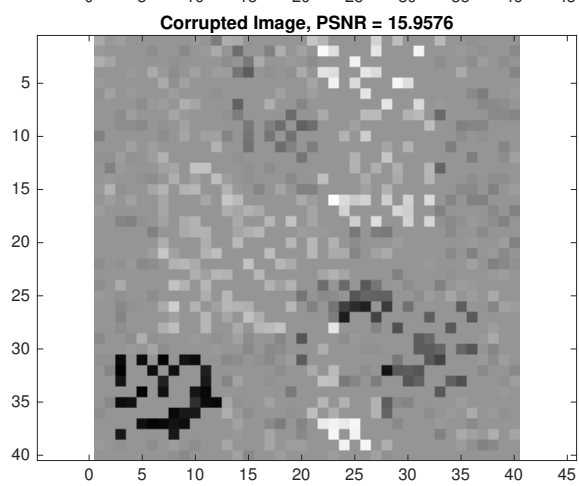

OMP: PSNR vs. k, True Cardinality = 10
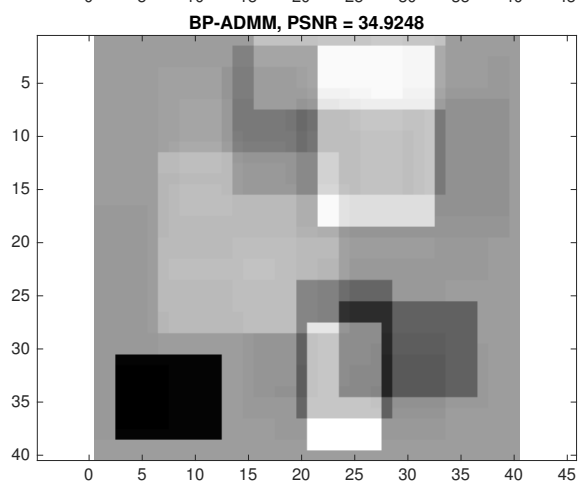
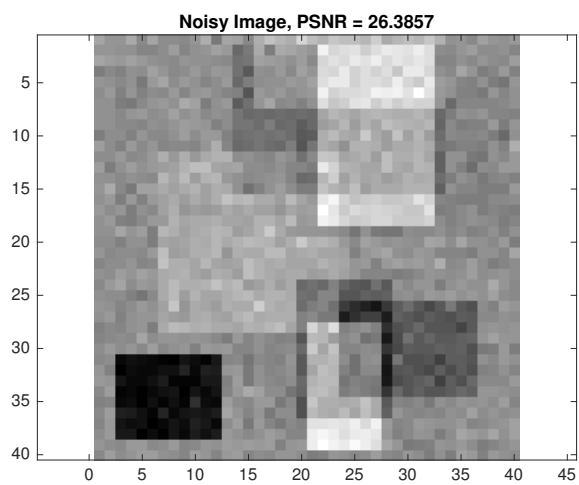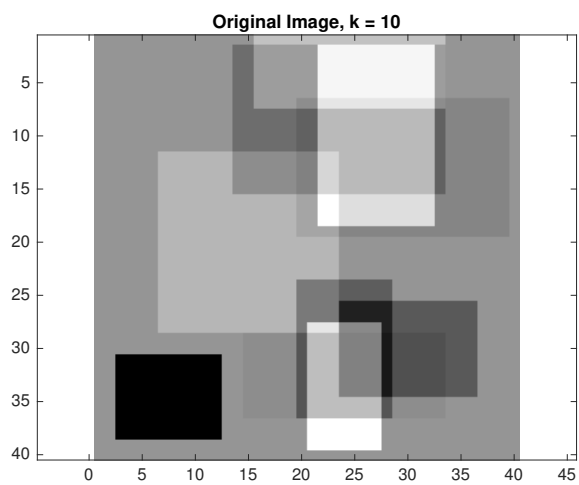# Part D – Inpainting by Basis Pursuit

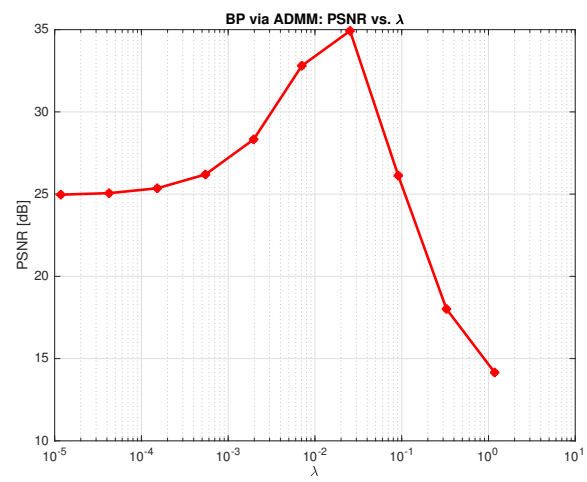Average PSNR result of Basis-Pursuit: **34.832**

Discuss results of BP and compare to OMP and Oracle performance

BP via ADMM achieves a reconstruction result pretty similar to the one of OMP but it takes far more longer to compute. As expected both BP and OMP cannot beat the Oracle.
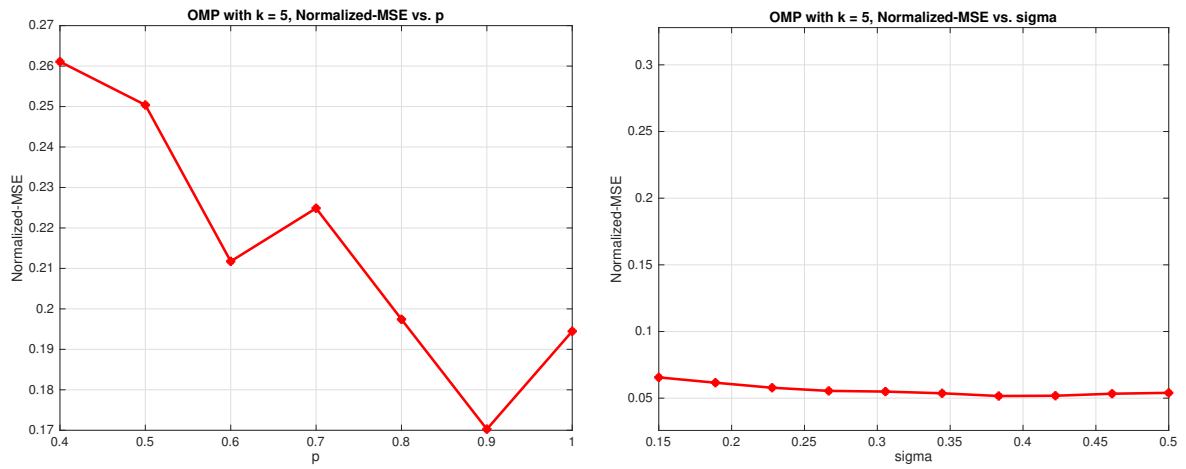
Discuss how λ affects BP reconstruction

λ controls the sparsity of the basis. It tunes how much of the squared error vs. ℓ_1-norm we pay most attention to. Large λ means we care a lot about sparsity, but not about exact matching. For small λ it is the opposite.

Original Image, k = 10

Noisy Image, PSNR = 26.3857

BP-ADMM, PSNR = 34.9248

Corrupted Image, PSNR = 15.9576

Oracle, PSNR = 46.6072

OMP, PSNR = 31.1679

BP-ADMM, PSNR = 34.9248

BP via ADMM: PSNR vs. λ

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Part E – Effect of Parameters

Discuss the effect of p

p influences heavily the reconstruction. This is pretty obvious because the more is known about the original image the better can be the reconstruction and the less is the MSE.

Discuss the effect of σ

σ does not really influence the reconstruction. It shows that the OMP has a strong denoising effect.