Question 2)

a) For rgb denoising, the image is transformed into YCbCr and the gradient descent is performed on the luminance channel(Y). The advantage of YCbCr color space is that it can separate luminance from chrominance more effectively compare to RGB color space. Luminance in image is actually a light intensity or the amount of light ranges from black to white. Luminance is very similar to the grayscale version of the original image.

b) $Y = (77/256)R + (150/256)G + (29/256)B$
$Cb = -(44/256)R - (87/256)G + (131/256)B + 128$
$Cr = (131/256)R - (110/256)G - (21/256)B + 128$
The above calculation is used for converting rgb space to YCbCr space.

c) RMSE for optimum values:- Refer part d.

d) For quadratic function:-

a = 0.6

RRMSE(a) = 0.0426
RRMSE(1.2a) = 0.0443
RRMSE (0.8a) = 0.0442

(Note: a = α)

For huber function:-

a = 0.975 b = 0.0025

RRMSE(a, b) = 0.0430
RRMSE(1.2a, b) = 0.0673
RRMSE (0.8a, b) = 0.1029
RRMSE(a, 1.2b) = 0.0962
RRMSE (a, 0.8b) = 0.0951

(Note: a = α and b = ɣ)

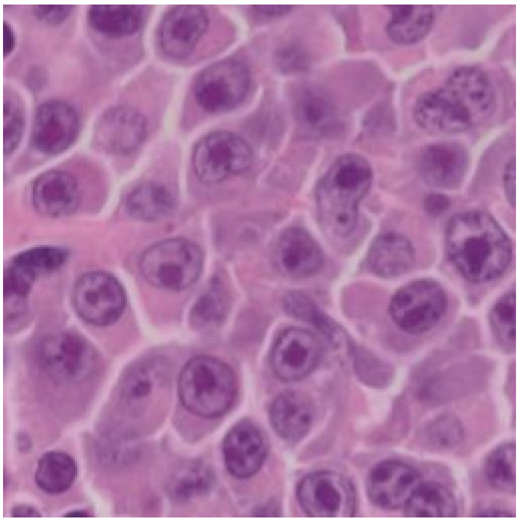
For Discontinuity-adaptive function:-

a = 0.9981 b = 0.000225

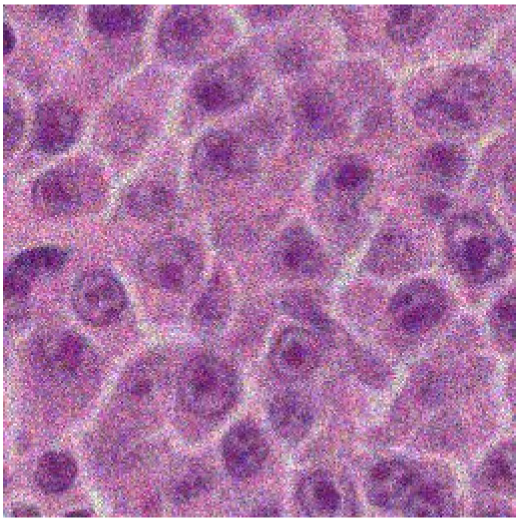
RRMSE(a, b) = 0.0425
RRMSE(1.2a, b) = 0.0981
RRMSE (0.8a, b) = 0.1185
RRMSE(a, 1.2b) = 0.1394
RRMSE (a, 0.8b) = 0.1421

(Note: a = α and b = ɣ)

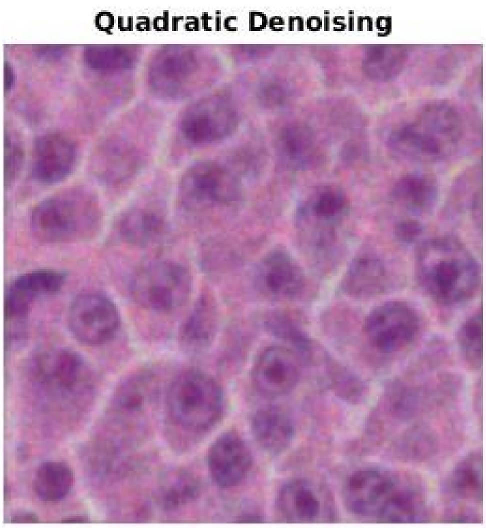
e) 1) Noiseless:-



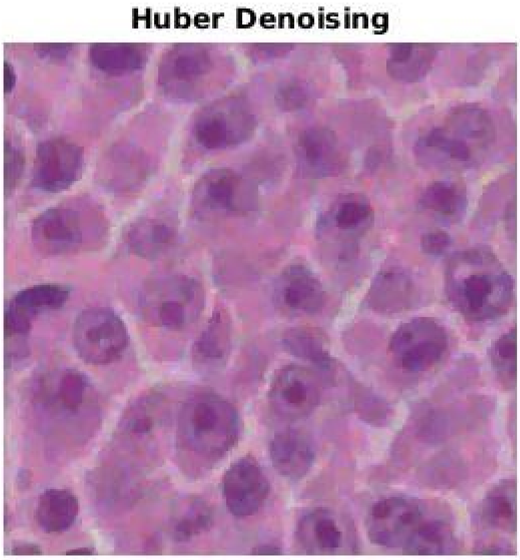
2) Noisy



3) Image denoised using quadratic prior

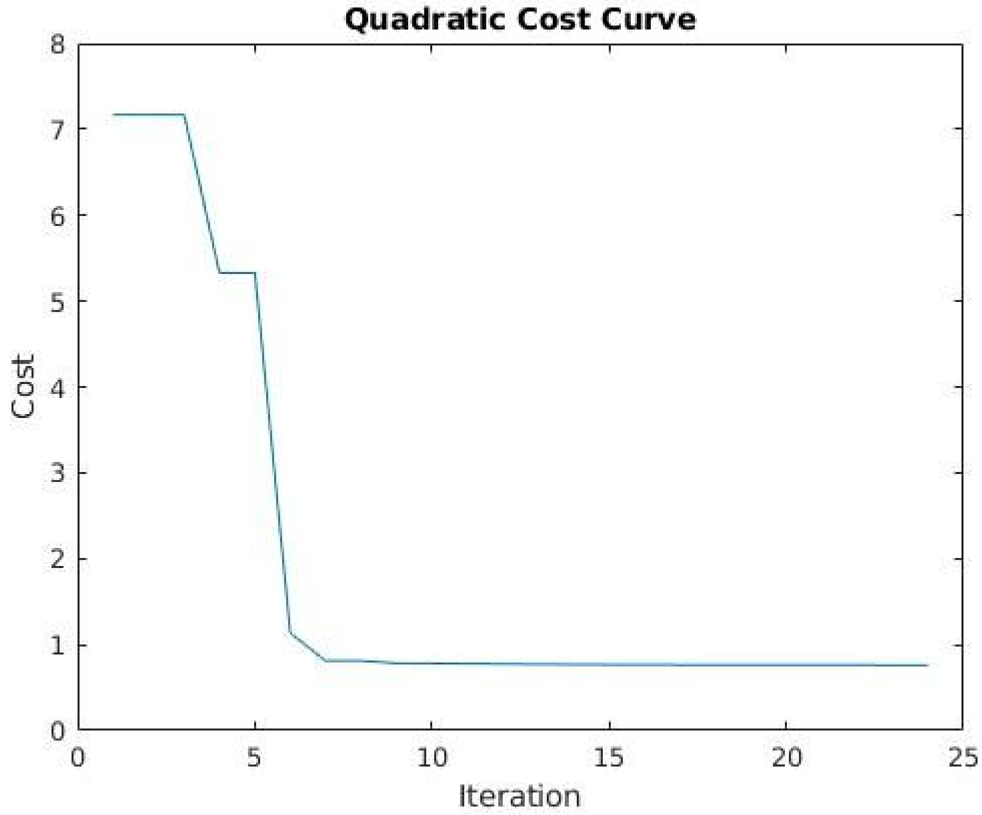


4) Image denoised using Huber prior

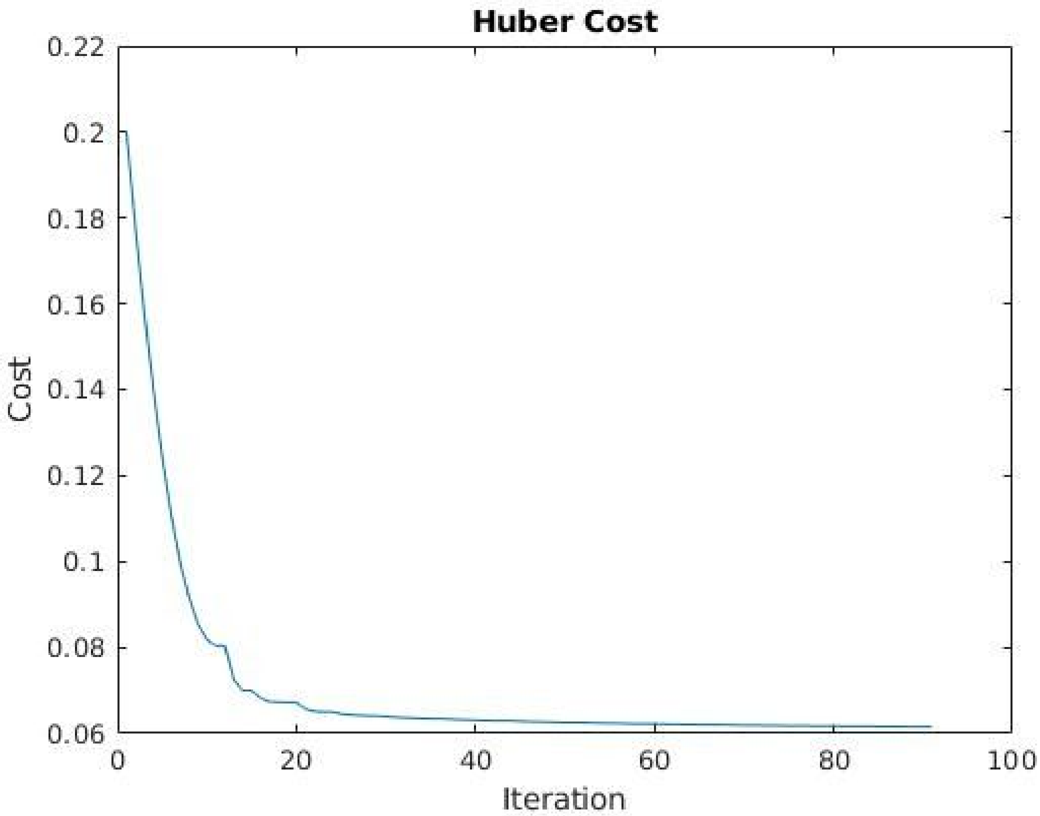


5) Image denoised using discontinuity-adaptive prior

f) 1) Objective function using quadratic prior



2) Objective function using huber prior



3) Objective function using discontinuity-adaptive prior