## Question 1

1. Sub-sampling the image changes the image resolution, since for each sub-sampling ratio, we skip pixels in the x and y direction based on the ratio. Figures 1 to 4 show the results obtained for each sub-sampling ratio.



Figure 1: Sub-sampling 2:1



Figure 2: Sub-sampling 4:1



Figure 3: Sub-sampling 8:1



Figure 4: Sub-sampling 16:1

1. Figures 5 to 8 show the results obtained via quantization. As can be seen, 1 and 2 bit quantization gives false contours.



Figure 5: 1 bit quantization



Figure 6: 2 bit quantization



Figure 7: 4 bit quantization



Figure 8: 6 bit quantization

1. It was observed that the perceived image quality differed greatly when having SNR as -30, -10, 0, 10 and 30 dB. The resulting image in these three cases are shown in figures 9, 10, 11, 12 and 13 respectively.



Figure 9: Gaussian noise with SNR = -30dB



Figure 10: Gaussian noise with SNR = -10dB



Figure 11: Gaussian noise with SNR = 0dB



Figure 12: Gaussian noise with SNR = 10dB



Figure 13: Gaussian noise with SNR = 30dB

1. The resulting image obtained by corrupting the pixels with i.i.d noise for impulse probability 0.1, 1, 5 and 10 percent is shown from figures 14 to 18 respectively. To calculate the SNR, the Pnoise was calculated by squaring each entry in the noise matrix and summing the result. Pimage was calculated in a similar manner, and the two powers divided by each other to arrive at the SNR. Log10 of this result was taken and then multiplied by 10 to arrive at SNR in dB. For 0.1 probability, the SNR = 30.81 dB. For 1 probability, SNR = 21.07 dB. For 5 probability, SNR = 14.17 dB. For 10 probability, SNR = 11.16 dB.



Figure 14: probability iid = 0.1%



Figure 15: probability iid = 1%



Figure 16: probability iid = 5%



Figure 17: probability iid = 10%

1. The Gaussian noise seems to add black pixels as noise in the image, whereas the iid one seems to add white pixels.

## Question 2