Homework3:

#Problem1:

a.

n=5								
Initial Values	d	0	0.8	1.6	2.4	3.2	4	
iteration1	r	0.4375	1.1610	1.995	2.6629	3.7025		
	d	0	0.7993	1.5780	2.3289	3.1827	4	
iteration2	r	0.4375	1.161	1.9386	2.6629	3.7025		
	d	0	0.7993	1.5498	2.3007	3.1827	4	
iteration3	r	0.4375	1.161	1.9386	2.6629	3.7025		
	d	0	0.7993	1.5498	2.3007	3.1827	4	

n=6								
Initial Values	d	0.0000	0.6667	1.3333	2.0000	2.6667	3.3333	4.0000
iteration1	r	0.3567	1.0088	1.6638	2.4333	2.8400	3.7025	
	d	0.0000	0.6827	1.3363	2.0485	2.6367	3.2713	4.0000
iteration2	r	0.4375	1.0557	1.6638	2.4333	2.8400	3.7025	
	d	0.0000	0.7466	1.3597	2.0485	2.6367	3.2713	4.0000
iteration3	r	0.4375	1.0925	1.7086	2.4333	2.8400	3.7025	
	d	0.0000	0.7650	1.4005	2.0710	2.6367	3.2713	4.0000
iteration4	r	0.4375	1.1267	1.7600	2.4333	2.8400	3.7025	
	d	0.0000	0.7821	1.4433	2.0967	2.6367	3.2713	4.0000
iteration5	r	0.4375	1.1267	1.7600	2.4333	2.8400	3.7025	
	d	0.0000	0.7821	1.4433	2.0967	2.6367	3.2713	4.0000

n=8										
Initial Values	d	0.0000	0.5000	1.0000	1.5000	2.0000	2.5000	3.0000	3.5000	4.0000
iteration1	r	0.2500	0.7617	1.2557	1.8180	2.3525	2.6775	3.3900	3.8067	
	d	0.0000	0.5058	1.0087	1.5369	2.0853	2.5150	3.0338	3.5983	4.0000
iteration2	r	0.2529	0.7617	1.2557	1.8180	2.3525	2.7420	3.4800	3.9250	
	d	0.0000	0.5073	1.0087	1.5369	2.0853	2.5473	3.1110	3.7025	4.0000
iteration3	r	0.2536	0.7617	1.2557	1.8180	2.3525	2.7420	3.4800	3.9250	
	d	0.0000	0.5077	1.0087	1.5369	2.0853	2.5473	3.1110	3.7025	4.0000
iteration4	r	0.2538	0.7617	1.2557	1.8180	2.3525	2.7420	3.4800	3.9250	
	d	0.0000	0.5077	1.0087	1.5369	2.0853	2.5473	3.1110	3.7025	4.0000
iteration5	r	0.2539	0.7617	1.2557	1.8180	2.3525	2.7420	3.4800	3.9250	
	d	0.0000	0.5078	1.0087	1.5369	2.0853	2.5473	3.1110	3.7025	4.0000
iteration6	r	0.2539	0.7617	1.2557	1.8180	2.3525	2.7420	3.4800	3.9250	
	d	0.0000	0.5078	1.0087	1.5369	2.0853	2.5473	3.1110	3.7025	4.0000

b.

n=5

X	Q(X)	D(X)
0.0000	1	0.4375
0.5200	1	0.4375
0.5500	1	0.4375
0.6800	1	0.4375
0.9100	2	1.1610
0.9400	2	1.1610
0.9700	2	1.1610
1.0300	2	1.1610
1.0400	2	1.1610
1.2000	2	1.1610
1.3000	2	1.1610
1.3500	2	1.1610
1.4000	2	1.1610
1.4700	2	1.1610
1.6000	3	1.9386
1.7000	3	1.9386
1.8500	3	1.9386
1.9500	3	1.9386
1.9900	3	1.9386
2.2000	3	1.9386
2.2800	3	1.9386
2.4500	4	2.6629
2.4800	4	2.6629
2.5600	4	2.6629
2.6300	4	2.6629
2.6700	4	2.6629
2.8500	4	2.6629
3.0000	4	2.6629
3.3900	5	3.7025
3.5700	5	3.7025
3.8600	5	3.7025
3.9900	5	3.7025

MSE5 = 0.0465

n=6

X	Q(X)	D(X)
0.0000	1	0.4375
0.5200	1	0.4375
0.5500	1	0.4375
0.6800	1	0.4375
0.9100	2	1.1267
0.9400	2	1.1267
0.9700	2	1.1267
1.0300	2	1.1267
1.0400	2	1.1267
1.2000	2	1.1267
1.3000	2	1.1267
1.3500	2	1.1267
1.4000	2	1.1267
1.4700	3	1.7600
1.6000	3	1.7600
1.7000	3	1.7600
1.8500	3	1.7600
1.9500	3	1.7600
1.9900	3	1.7600
2.2000	4	2.4333
2.2800	4	2.4333
2.4500	4	2.4333
2.4800	4	2.4333
2.5600	4	2.4333
2.6300	4	2.4333
2.6700	5	2.8400
2.8500	5	2.8400
3.0000	5	2.8400
3.3900	6	3.7025
3.5700	6	3.7025
3.8600	6	3.7025
3.9900	6	3.7025

MSE6 = 0.0367

n=8

X	Q(X)	D(X)
0.0000	1	0.2539
0.5200	2	0.7617
0.5500	2	0.7617
0.6800	2	0.7617
0.9100	2	0.7617
0.9400	2	0.7617
0.9700	2	0.7617
1.0300	3	1.2557
1.0400	3	1.2557
1.2000	3	1.2557
1.3000	3	1.2557
1.3500	3	1.2557
1.4000	3	1.2557
1.4700	3	1.2557
1.6000	4	1.8180
1.7000	4	1.8180
1.8500	4	1.8180
1.9500	4	1.8180
1.9900	4	1.8180
2.2000	5	2.3525
2.2800	5	2.3525
2.4500	5	2.3525
2.4800	5	2.3525
2.5600	6	2.7420
2.6300	6	2.7420
2.6700	6	2.7420
2.8500	6	2.7420
3.0000	6	2.7420
3.3900	7	3.4800
3.5700	7	3.4800
3.8600	8	3.9250
3.9900	8	3.9250

MSE8 = 0.0240

c.

n=5

X	Q(X)	D(X)
0.0000	1	0.4000
0.5200	1	0.4000
0.5500	1	0.4000
0.6800	1	0.4000
0.9100	2	1.2000
0.9400	2	1.2000
0.9700	2	1.2000
1.0300	2	1.2000
1.0400	2	1.2000
1.2000	2	1.2000
1.3000	2	1.2000
1.3500	2	1.2000
1.4000	2	1.2000
1.4700	2	1.2000
1.6000	3	2.0000
1.7000	3	2.0000
1.8500	3	2.0000
1.9500	3	2.0000
1.9900	3	2.0000
2.2000	3	2.0000
2.2800	3	2.0000
2.4500	4	2.8000
2.4800	4	2.8000
2.5600	4	2.8000
2.6300	4	2.8000
2.6700	4	2.8000
2.8500	4	2.8000
3.0000	4	2.8000
3.3900	5	3.6000
3.5700	5	3.6000
3.8600	5	3.6000
3.9900	5	3.6000

MSE5=0.0543

n=6

X	Q(X)	D(X)
0.0000	1	0.3333
0.5200	1	0.3333
0.5500	1	0.3333
0.6800	2	1.0000
0.9100	2	1.0000
0.9400	2	1.0000
0.9700	2	1.0000
1.0300	2	1.0000
1.0400	2	1.0000
1.2000	2	1.0000
1.3000	2	1.0000
1.3500	3	1.6667
1.4000	3	1.6667
1.4700	3	1.6667
1.6000	3	1.6667
1.7000	3	1.6667
1.8500	3	1.6667
1.9500	3	1.6667
1.9900	3	1.6667
2.2000	4	2.3333
2.2800	4	2.3333
2.4500	4	2.3333
2.4800	4	2.3333
2.5600	4	2.3333
2.6300	4	2.3333
2.6700	5	3.0000
2.8500	5	3.0000
3.0000	5	3.0000
3.3900	6	3.6667
3.5700	6	3.6667
3.8600	6	3.6667
3.9900	6	3.6667

MSE6=0.044

n=8

X	Q(X)	D(X)
0.0000	1	0.2500
0.5200	2	0.7500
0.5500	2	0.7500
0.6800	2	0.7500
0.9100	2	0.7500
0.9400	2	0.7500
0.9700	2	0.7500
1.0300	3	1.2500
1.0400	3	1.2500
1.2000	3	1.2500
1.3000	3	1.2500
1.3500	3	1.2500
1.4000	3	1.2500
1.4700	3	1.2500
1.6000	4	1.7500
1.7000	4	1.7500
1.8500	4	1.7500
1.9500	4	1.7500
1.9900	4	1.7500
2.2000	5	2.2500
2.2800	5	2.2500
2.4500	5	2.2500
2.4800	5	2.2500
2.5600	6	2.7500
2.6300	6	2.7500
2.6700	6	2.7500
2.8500	6	2.7500
3.0000	7	3.2500
3.3900	7	3.2500
3.5700	8	3.7500
3.8600	8	3.7500
3.9900	8	3.7500

MSE8=0.0290

d.

n=5

X	Q(X)	D(X)
0.0000	1	0.4375
0.5200	1	0.4375
0.5500	1	0.4375
0.6800	1	0.4375
0.9100	2	1.1610
0.9400	2	1.1610
0.9700	2	1.1610
1.0300	2	1.1610
1.0400	2	1.1610
1.2000	2	1.1610
1.3000	2	1.1610
1.3500	2	1.1610
1.4000	2	1.1610
1.4700	2	1.1610
1.6000	3	1.9950
1.7000	3	1.9950
1.8500	3	1.9950
1.9500	3	1.9950
1.9900	3	1.9950
2.2000	3	1.9950
2.2800	3	1.9950
2.4500	4	2.6629
2.4800	4	2.6629
2.5600	4	2.6629
2.6300	4	2.6629
2.6700	4	2.6629
2.8500	4	2.6629
3.0000	4	2.6629
3.3900	5	3.7025
3.5700	5	3.7025
3.8600	5	3.7025
3.9900	5	3.7025

MSE5=0.0472

n=6

X	Q(X)	D(X)
0.0000	1	0.3567
0.5200	1	0.3567
0.5500	1	0.3567
0.6800	2	1.0088
0.9100	2	1.0088
0.9400	2	1.0088
0.9700	2	1.0088
1.0300	2	1.0088
1.0400	2	1.0088
1.2000	2	1.0088
1.3000	2	1.0088
1.3500	3	1.6638
1.4000	3	1.6638
1.4700	3	1.6638
1.6000	3	1.6638
1.7000	3	1.6638
1.8500	3	1.6638
1.9500	3	1.6638
1.9900	3	1.6638
2.2000	4	2.4333
2.2800	4	2.4333
2.4500	4	2.4333
2.4800	4	2.4333
2.5600	4	2.4333
2.6300	4	2.4333
2.6700	5	2.8400
2.8500	5	2.8400
3.0000	5	2.8400
3.3900	6	3.7025
3.5700	6	3.7025
3.8600	6	3.7025
3.9900	6	3.7025

MSE6=0.0401

n=8

X	Q(X)	D(X)
0.0000	1	0.2500
0.5200	2	0.7617
0.5500	2	0.7617
0.6800	2	0.7617
0.9100	2	0.7617
0.9400	2	0.7617
0.9700	2	0.7617
1.0300	3	1.2557
1.0400	3	1.2557
1.2000	3	1.2557
1.3000	3	1.2557
1.3500	3	1.2557
1.4000	3	1.2557
1.4700	3	1.2557
1.6000	4	1.8180
1.7000	4	1.8180
1.8500	4	1.8180
1.9500	4	1.8180
1.9900	4	1.8180
2.2000	5	2.3525
2.2800	5	2.3525
2.4500	5	2.3525
2.4800	5	2.3525
2.5600	6	2.6775
2.6300	6	2.6775
2.6700	6	2.6775
2.8500	6	2.6775
3.0000	7	3.3900
3.3900	7	3.3900
3.5700	8	3.8067
3.8600	8	3.8067
3.9900	8	3.8067

MSE8=0.0282

E.

	ML_n	UQ_n	SUQ_n
N=5	0.0465	0.0543	0.0472
N=6	0.0367	0.0447	0.0401
N=8	0.0240	0.0290	0.0282

#Problem2

a.

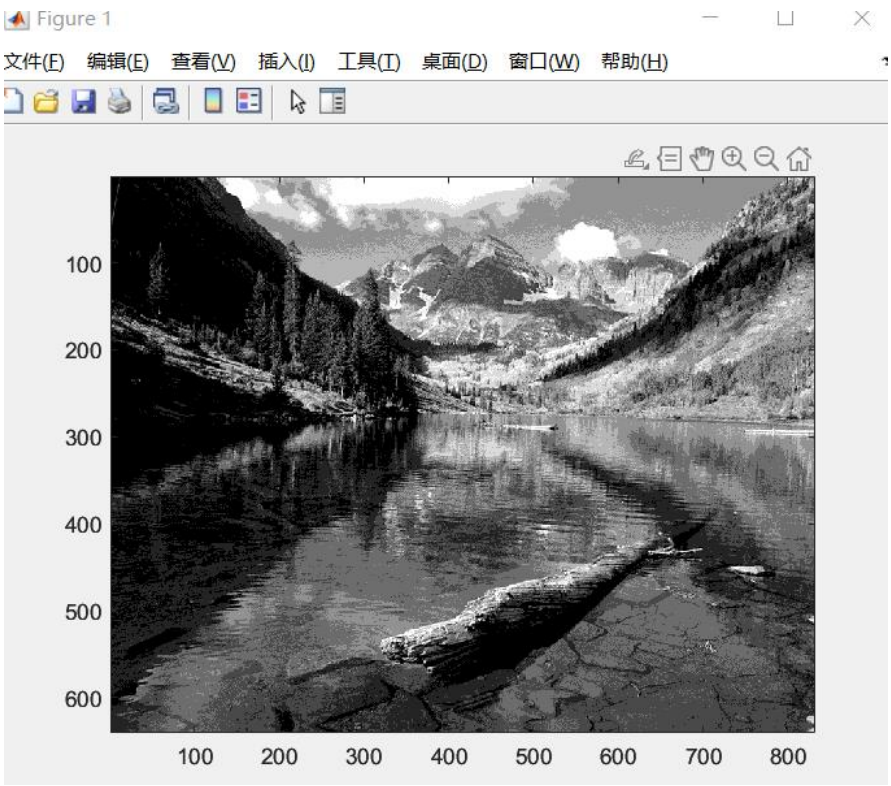
```
[I,map]=imread('river.gif');
G=ind2gray(I,map);
H = entropy(G);
```

The entropy is 6.5977.

b.

	0	1	2	3	4	5	6	7	8
d	7.0000	36.5001	66.0003	95.5004	125.0005	154.5006	184.0008	213.5009	243.0010
r		21.7501	51.2502	80.7503	110.2504	139.7506	169.2507	198.7508	228.2509

The entropy of $G_u^{'} = 2.7870$

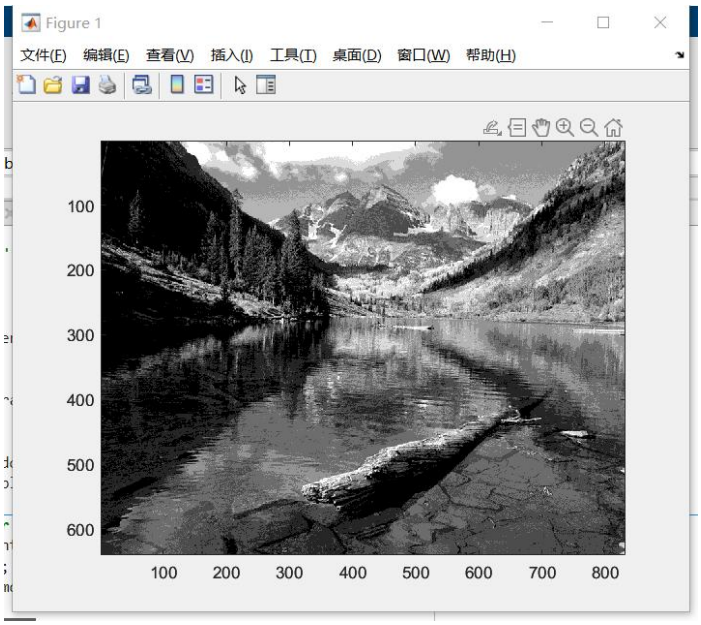


$SNR(G,\hat{G}) = 21.6257$

C.

	0	1	2	3	4	5	6	7	8
d	7.0000	36.5001	66.0003	95.5004	125.0005	154.5006	184.0008	213.5009	243.0010
r		19.4255	50.5406	81.4728	108.1254	139.8669	166.5409	196.9545	226.8551

The entropy of $G_u^{'} = 2.7870$

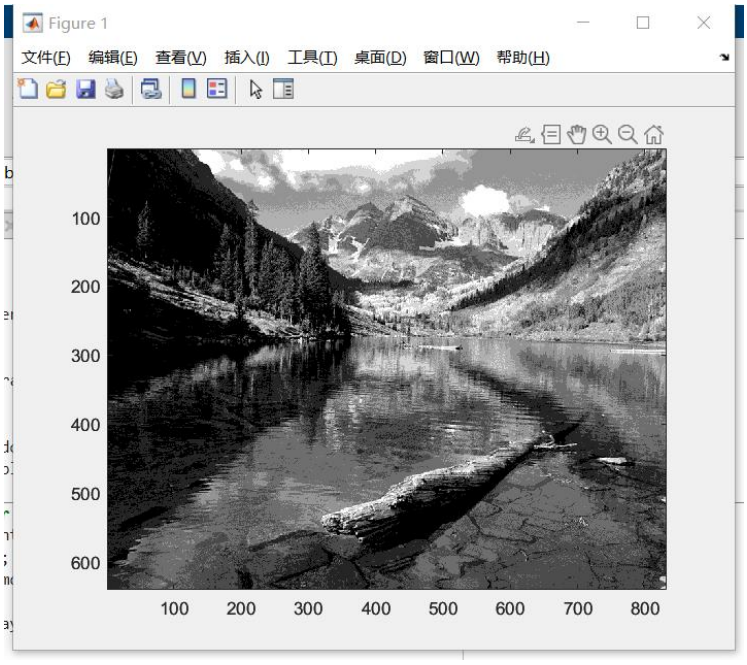


$SNR(G,\hat{G}) = 21.7776$

D.

	0	1	2	3	4	5	6	7	8
d	7.0000	33.9234	65.0721	94.5351	123.3596	150.3083	177.2087	209.1865	243.0010
r		18.6473	49.1994	80.9449	108.1254	138.5939	162.0226	192.3948	225.9781

The entropy of $G_u^{'} = 2.8097$



$SNR(G,\hat{G}) = 21.9496$

#Problem3

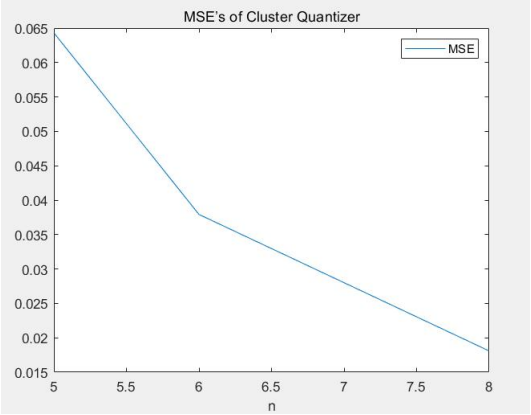
a.

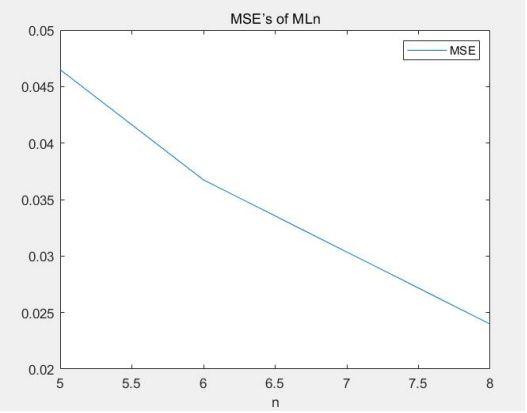
X	D(X)~n=5	D(X)~n=6	D(X)~n=8
0.0000	0.0000	0.0000	0.0000
0.5200	0.8300	0.8300	0.5833
0.5500	0.8300	0.8300	0.5833
0.6800	0.8300	0.8300	0.5833
0.9100	0.8300	0.8300	1.0150
0.9400	0.8300	0.8300	1.0150
0.9700	0.8300	0.8300	1.0150
1.0300	0.8300	0.8300	1.0150
1.0400	0.8300	0.8300	1.0150
1.2000	1.4838	1.3440	1.0150
1.3000	1.4838	1.3440	1.4240
1.3500	1.4838	1.3440	1.4240
1.4000	1.4838	1.3440	1.4240
1.4700	1.4838	1.3440	1.4240
1.6000	1.4838	1.8180	1.4240
1.7000	1.4838	1.8180	1.8725
1.8500	1.4838	1.8180	1.8725
1.9500	2.4060	1.8180	1.8725
1.9900	2.4060	1.8180	1.8725
2.2000	2.4060	2.5689	2.3525
2.2800	2.4060	2.5689	2.3525
2.4500	2.4060	2.5689	2.3525
2.4800	2.4060	2.5689	2.3525
2.5600	2.4060	2.5689	2.7420
2.6300	2.4060	2.5689	2.7420
2.6700	2.4060	2.5689	2.7420
2.8500	2.4060	2.5689	2.7420
3.0000	3.5620	2.5689	2.7420
3.3900	3.5620	3.7025	3.7025
3.5700	3.5620	3.7025	3.7025
3.8600	3.5620	3.7025	3.7025
3.9900	3.5620	3.7025	3.7025

B.

MSE5	0.0643
MSE6	0.0379
MSE8	0.0181

C.



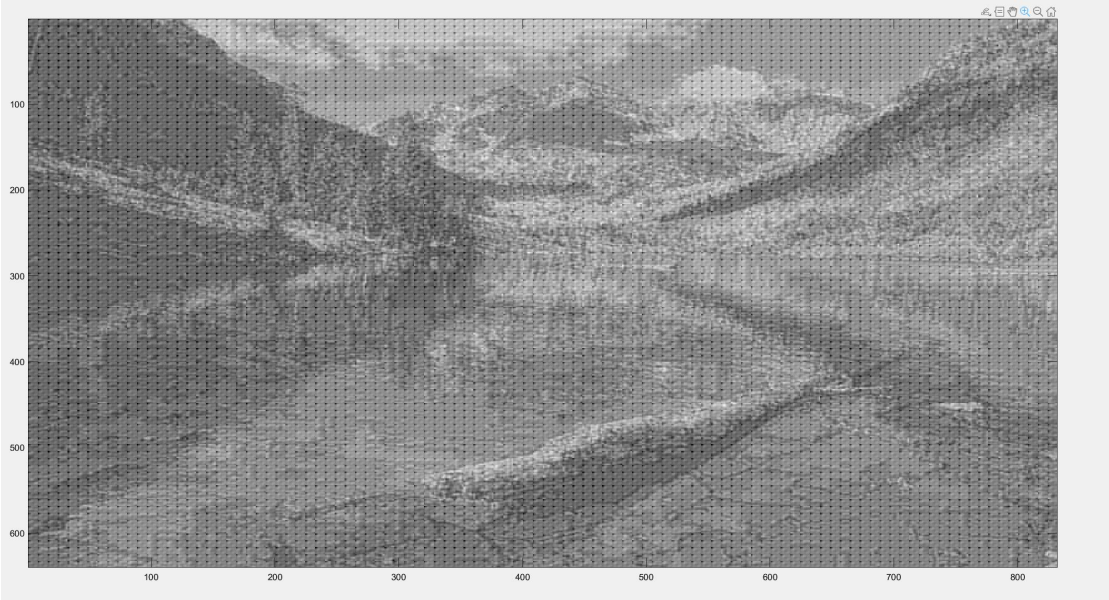


#Problem4

a.

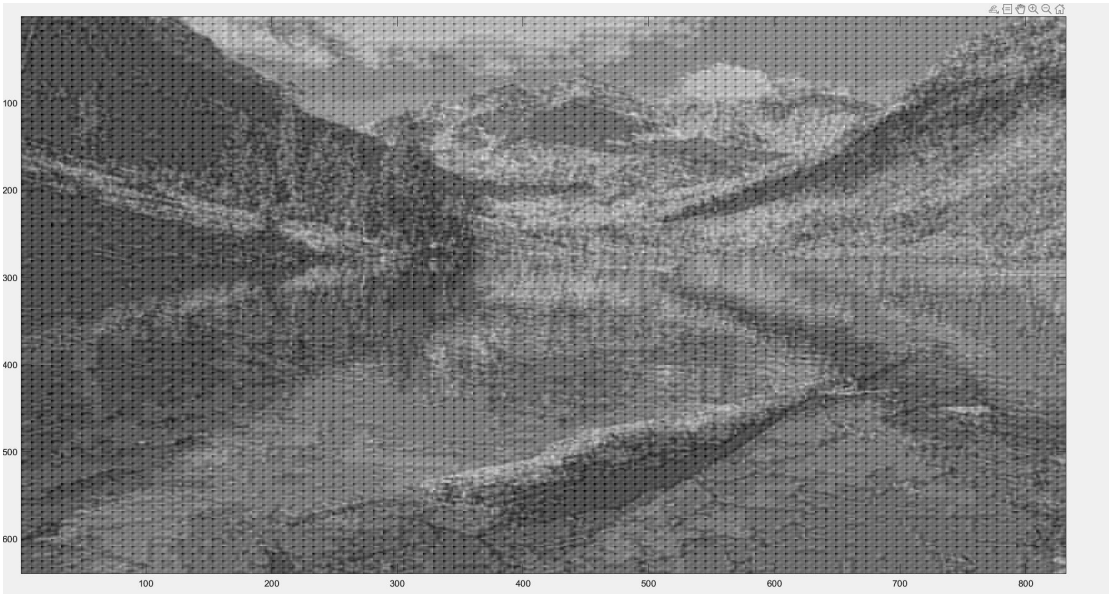
$$\textbf{BR}=\frac{3*1+2*14}{8*8*8}=\frac{31}{512}\text{ , }\quad \textbf{CR}=\frac{512}{31}$$

b.



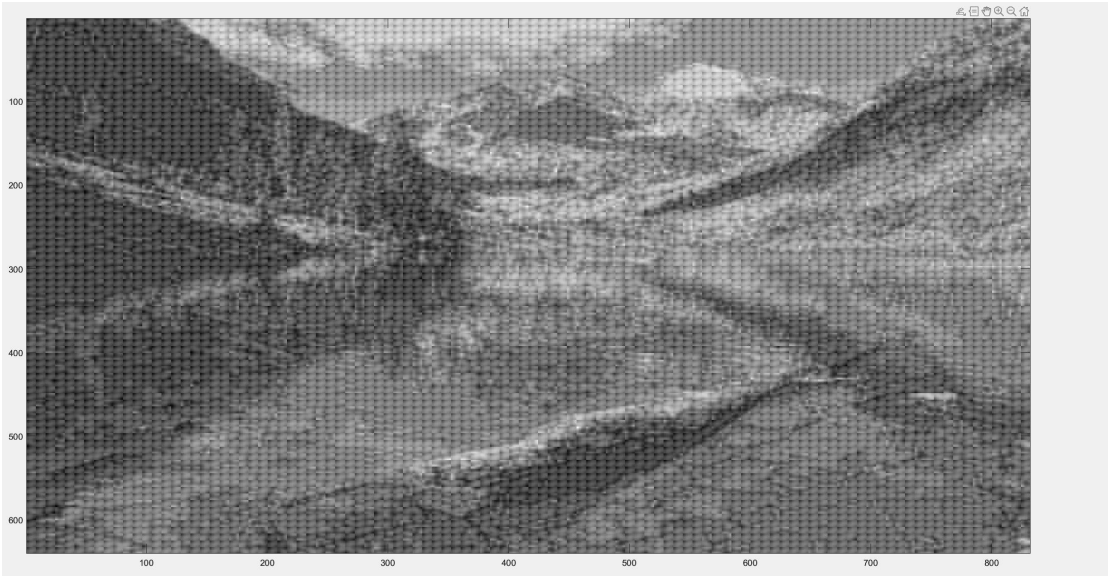
$SNR = 7.6859$

C.



$SNR = 9.4027$ $\quad \textbf{BR}=\frac{3*1+2*9}{8*8*8}=\frac{21}{512}\text{ , }\quad \textbf{CR}=\frac{512}{21}$

d.



$SNR = 11.3568$ **BR=**$\frac{3*1+2*5}{8*8*8} = \frac{13}{512}$**,** **CR=**$\frac{512}{13}$

E.

$SNR = 14.3281$ **BR=**$\frac{3*1}{8*8*8} = \frac{3}{512}$**,** **CR=**$\frac{512}{3}$

F.

	Ghat15	Ghat10	Ghat6	Ghat1
BR	**31/512**	**21/512**	**13/512**	**3/512**
SNR	**7.6859**	**9.4027**	**11.3568**	**14.3281**
Image