

JP Implementation
CS 443-01
Hayeong Chung
01 May 2021

Team One : Leonie Nutz
Jordan Biffle
Keyara Coleman
Nicholas Zwolinski
Tyler Goodwyn

Project Description

For the JPEG Implementation project, our team had to implement the lossy compression formula mentioned in the JPEG algorithm. The JPEG algorithm was applied to two images (alu.tif and tulips.png) to demonstrate compression and decompression process. The outputs were then saved to a PNG format and the error computation was calculated and recorded.

Team One Contributions

Each member of Team One's roles and contributions are listed below. Team One consisted of each team member as follows:

Keyara Coleman: Technical Writer

Leonie Nutz: Team Lead

Nicholas Zwolinski: Test Lead

Tyler Goodwyn: Tools Lead

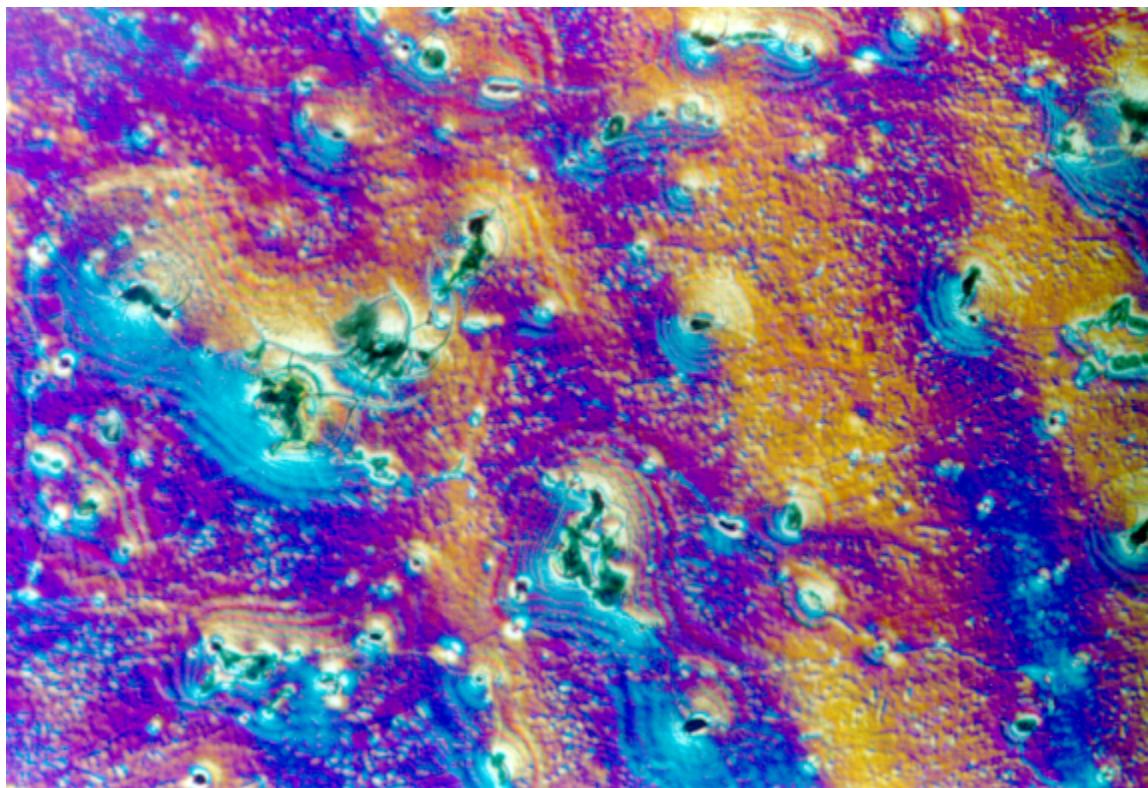
Jordan Biffle: Technical Writer

Table of Contents

Project Description	1
Team One contributions	1
Output values and images / ALU step 1	3
Output values and images / ALU step 2	8
Output values and images / Tulip step 1	11
Output values and images / Tulip step 2	16
8x8 block images	19
Discussions / Picture Life	20
Result Comparisons	22
Error Values / ALU	24
Error Values / Tulip	25
Error Discussions	25

Output Values**ALU****Step 1****Stage 0***Matrix of first 8x8 values:*

148	145	157	182	211	194	161	174
167	145	144	152	172	175	162	161
178	167	159	150	156	162	155	150
163	166	170	162	156	158	155	149
115	123	153	166	165	161	157	168
125	126	152	169	175	175	174	173
192	174	172	181	188	204	200	180
182	171	176	180	181	194	194	176

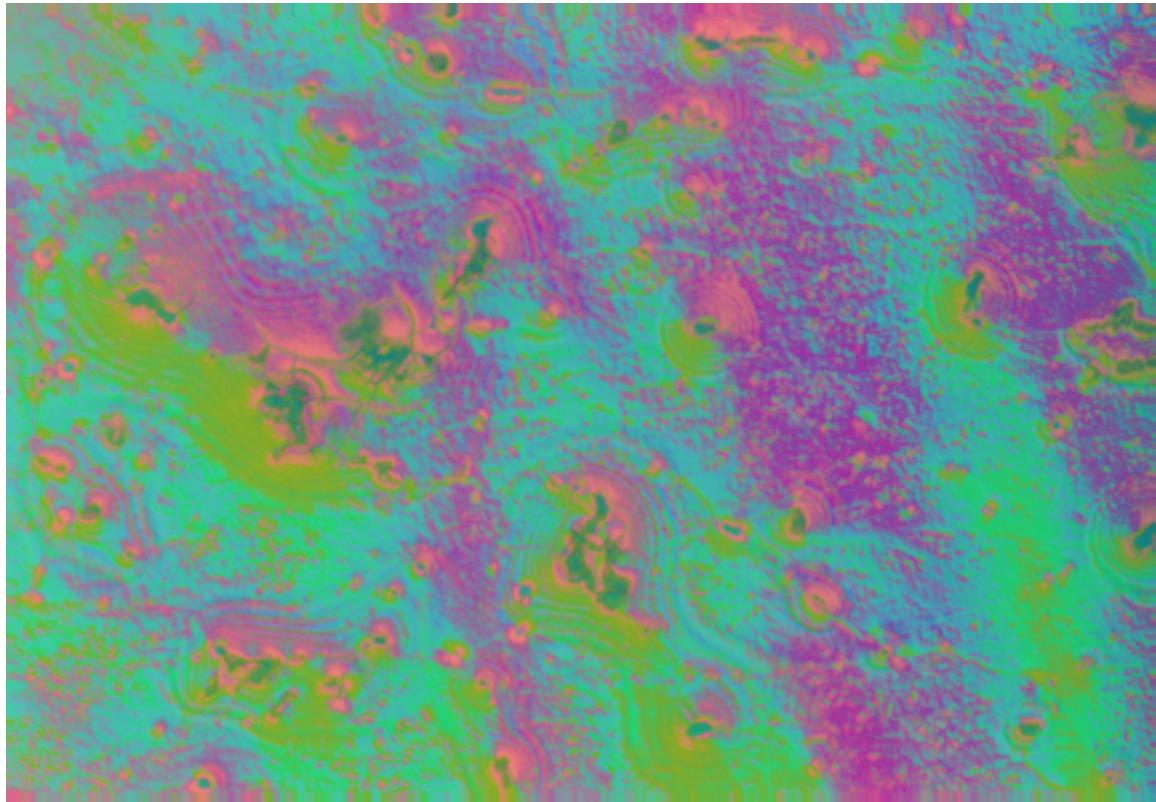
Image at this stage:

Stage 1

Matrix of first 8x8 values:

133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
137	137	137	120	116	129	140	133
142	142	142	126	124	113	122	122
149	149	149	137	127	123	110	111

Image at this stage:

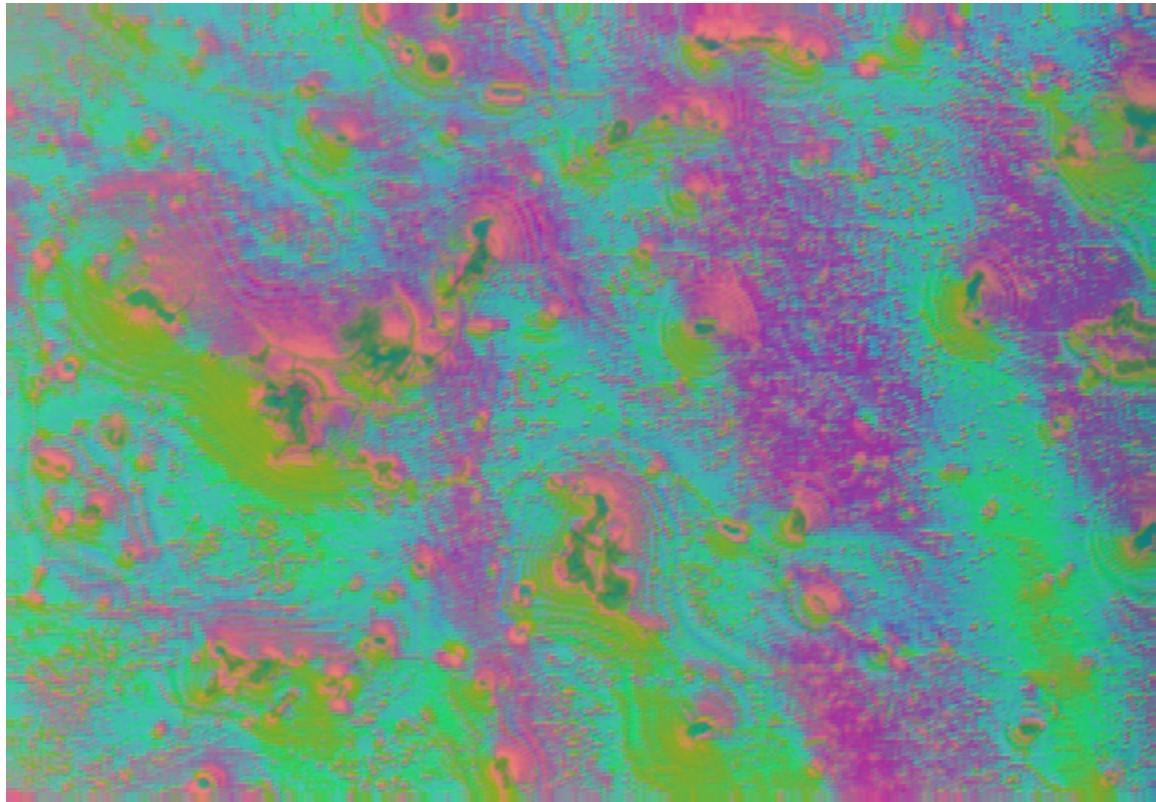


Stage 2

Matrix of first 8x8 values:

133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
133	133	133	127	131	155	163	149
137	137	137	120	116	129	140	133
142	142	142	126	124	113	122	122
149	149	149	137	127	123	110	111

Image at this stage:



Stage 3

Matrix of first 8x8 values:

54.92523 03108907	-54.86390 61280135	65.33500 04831486	-11.05932 7124587	-19.280806 6796476	6.4402626 8392132	5.1135765 1005429	3.1792489 9979514
-3.058542 20636868	-41.22832 10110174	7.253062 6444003	0.4960581 25605752	1.7730745 4058937	-0.374487 29862643 7	0.8252883 86498088	-5.755105 80696568
6.039653 40968824	40.30637 19519528	-13.44496 56416953	2.4776018 9196796	0.0772430 491217964	-0.164721 27910247 3	-0.248584 22526498	4.7130594 805481
-9.333032 48000599	-21.81156 80222188	15.03679 60883647	-5.615811 40905606	-1.5505917 9379328	0.4986192 54449208	-1.321715 2390318	-1.106190 85064832
16.93751 97850434	-3.861828 59490454	-1.436469 78178151	4.6238737 0890979	-2.1511777 6019929	0.8124210 00173267	3.7290895 6256515	-1.669053 92072321
-5.637068 72755006	-3.481020 2253056	3.971997 5141669	-3.676632 92441457	2.5547895 6457751	-0.857643 44522433 7	-3.645693 48204457	2.1874151 0365523
2.655957 52423052	4.402969 2843702	2.219905 48312815	0.7029729 06840855	-4.4051071 5428868	1.3968520 2295325	3.0689893 2081146	-1.145368 77723765
3.711935 1791556	-8.280813 08325275	3.546582 00891411	-0.637417 13640615 7	0.7219015 35782004	-0.185765 19730523 9	-0.750281 54508242 9	0.3036996 35490223

Image at this stage:

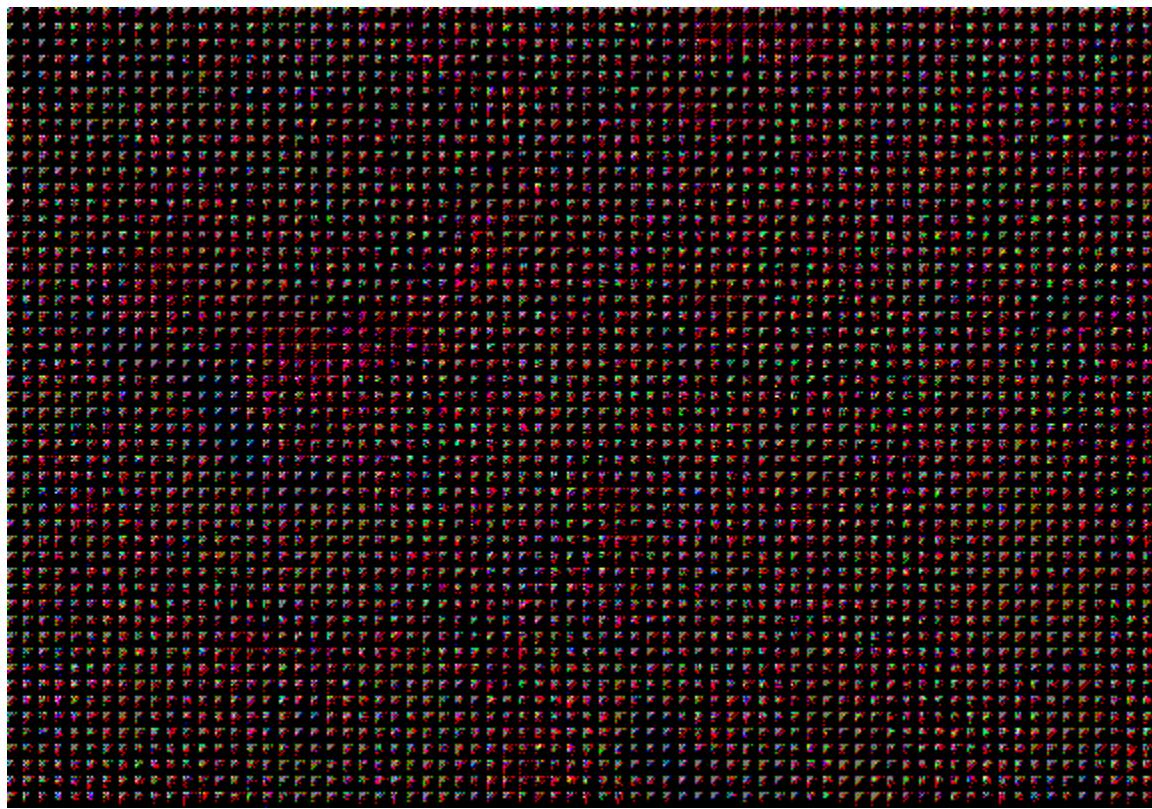


Stage 4

Matrix of first 8x8 values:

3	-5	7	-1	-1	0	0	0
-0	-3	1	0	0	-0	0	-0
0	3	-1	0	0	-0	-0	0
-1	-1	1	-0	-0	0	-0	-0
1	-0	-0	0	-0	0	0	-0
-0	-0	0	-0	0	-0	-0	0
0	0	0	0	-0	0	0	-0
0	-0	0	-0	0	-0	-0	0

Image at this stage:



Step 2**Stage 1**

Matrix of first 8x8 values:

48	-55	70	-16	-24	0	0	0
-0	-36	14	0	0	-0	0	-0
0	39	-16	0	0	-0	-0	0
-14	-17	22	-0	-0	0	-0	-0
18	-0	-0	0	-0	0	0	-0
-0	-0	0	-0	0	-0	-0	0
0	0	0	0	-0	0	0	-0
0	-0	0	-0	0	-0	-0	0

Image at this stage:

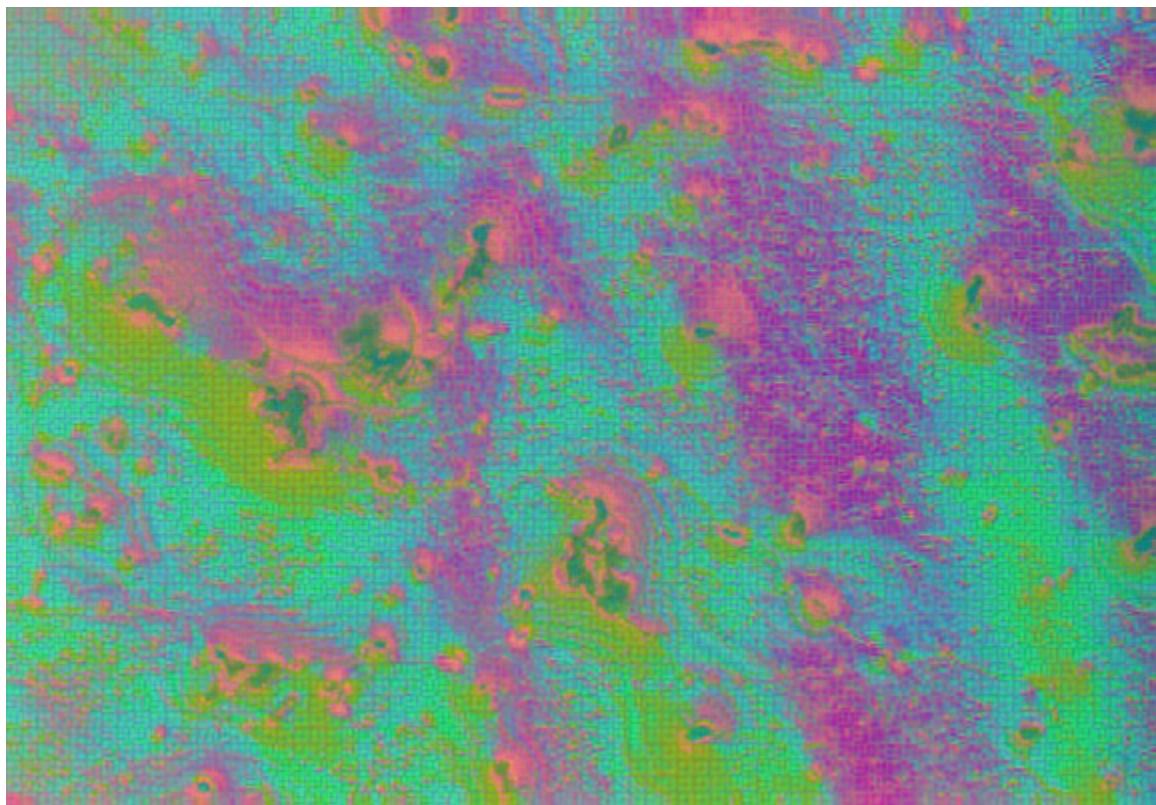


Stage 2

Matrix of first 8x8 values:

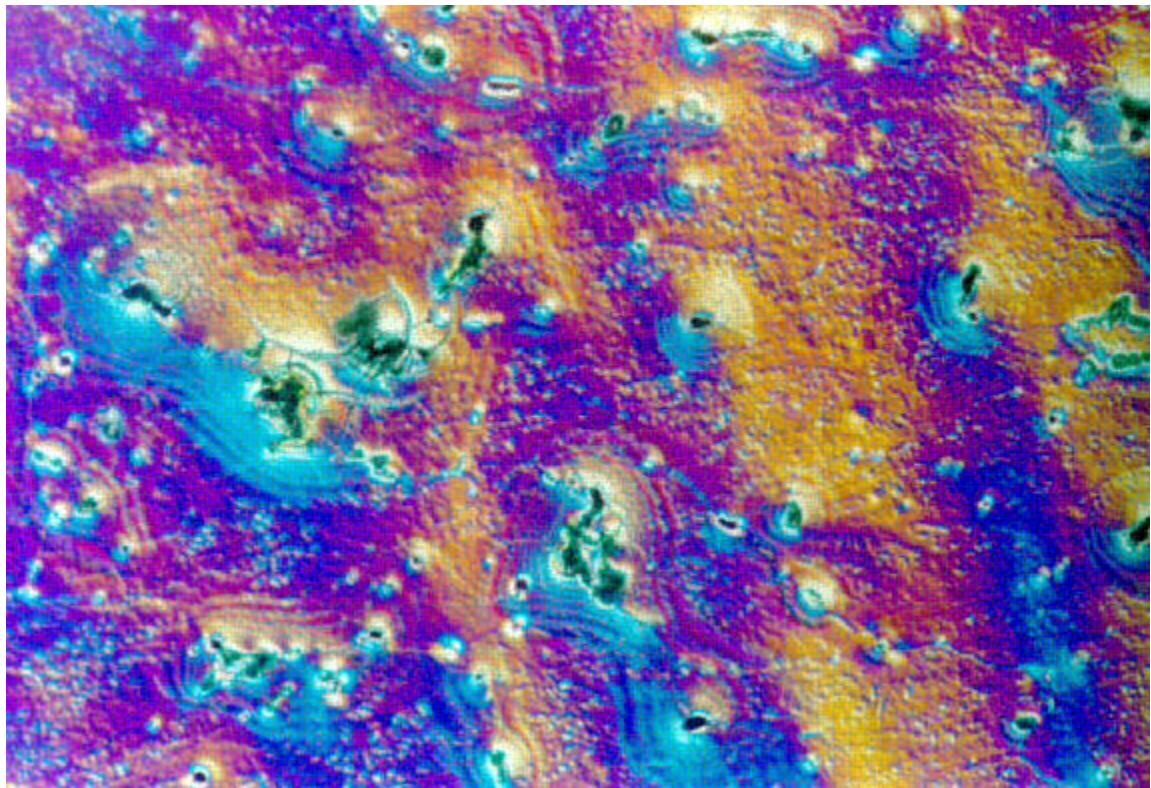
132	136	132	122	127	149	160	148
130	135	133	120	126	155	168	153
127	133	134	125	130	154	163	149
131	137	137	128	134	157	166	151
132	135	132	121	127	151	162	150
131	133	129	118	117	131	140	136
136	142	142	131	120	117	116	119
139	146	148	141	129	118	112	115

Image at this stage:



Stage 3*Matrix of first 8x8 values:*

132	136	132	122	127	149	160	148
130	135	133	120	126	155	168	153
127	133	134	125	130	154	163	149
131	137	137	128	134	157	166	151
132	135	132	121	127	151	162	150
131	133	129	118	117	131	140	136
136	142	142	131	120	117	116	119
139	146	148	141	129	118	112	115

Image at this stage:

Tulip

Step 1

Stage 0

Matrix of first 8x8 values:

54	49	46	46	50	50	52	53
45	47	49	49	51	53	53	58
49	51	51	51	53	54	55	57
48	54	54	56	57	59	62	62
54	56	57	59	60	62	64	72
66	67	68	72	82	96	112	131
69	80	99	129	158	175	185	195
103	139	175	195	203	207	202	200

Image at this stage:

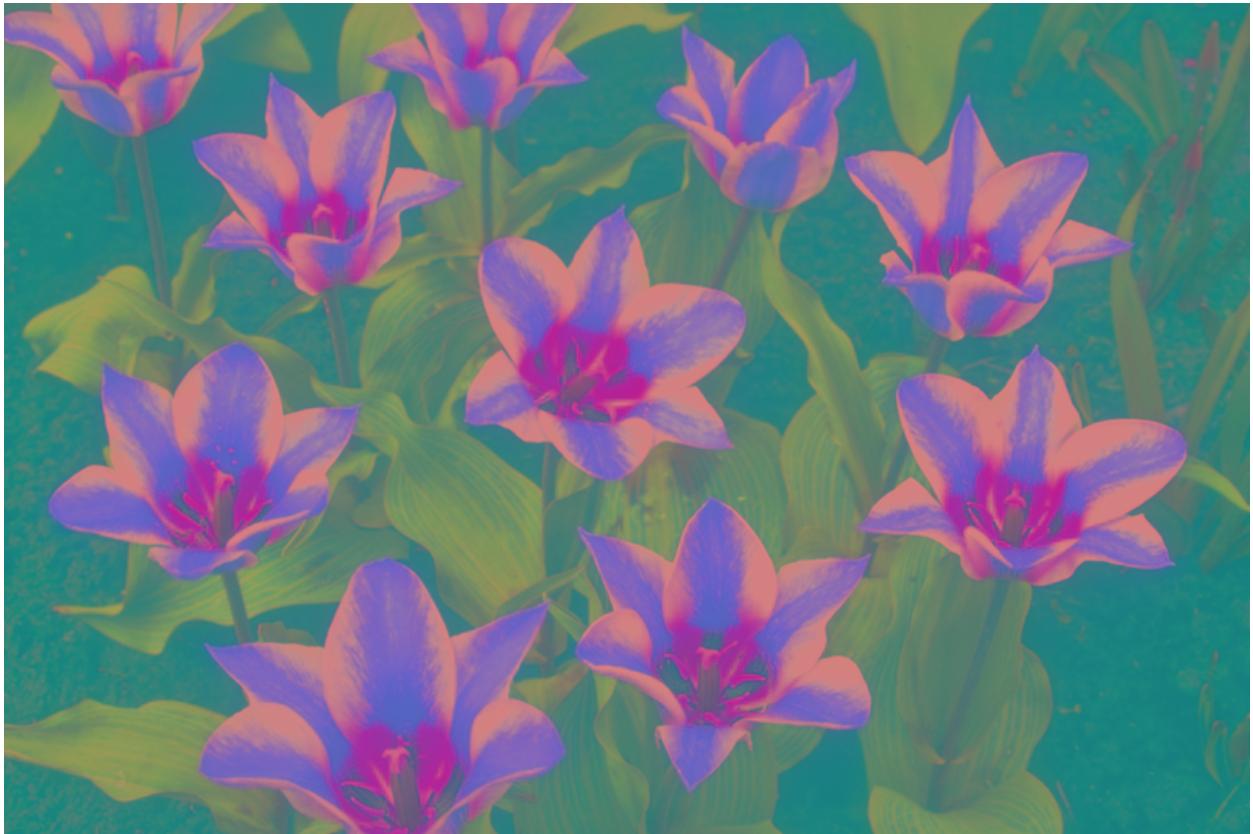


Stage 1

Matrix of first 8x8 values:

89	82	76	75	79	79	80	81
78	78	78	76	78	80	80	84
78	78	78	78	80	81	82	82
76	80	80	80	81	81	82	80
80	80	81	81	80	79	79	83
83	81	80	82	89	99	112	125
82	86	98	121	145	159	168	174
98	124	153	170	178	183	180	176

Image at this stage:

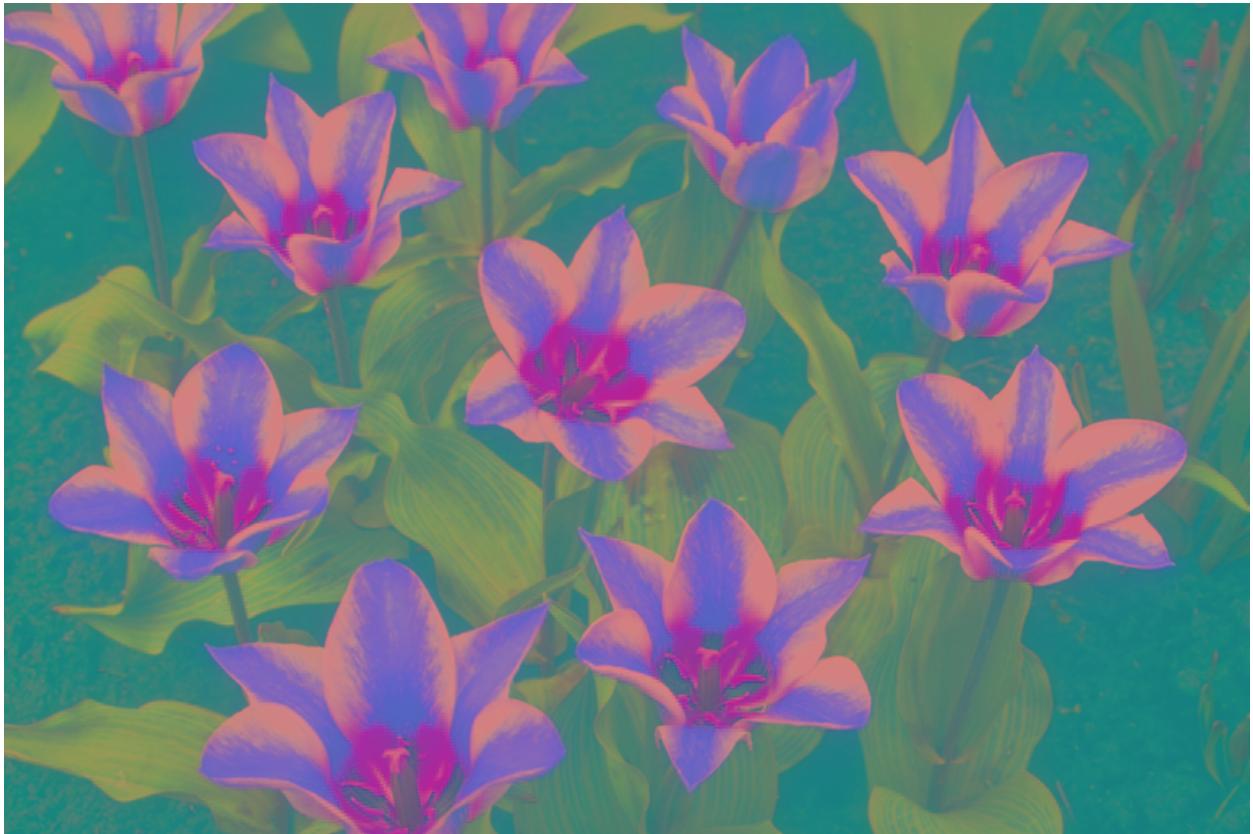


Stage 2

Matrix of first 8x8 values:

89	82	76	75	79	79	80	81
78	78	78	76	78	80	80	84
78	78	78	78	80	81	82	82
76	80	80	80	81	81	82	80
80	80	81	81	80	79	79	83
83	81	80	82	89	99	112	125
82	86	98	121	145	159	168	174
98	124	153	170	178	183	180	176

Image at this stage:

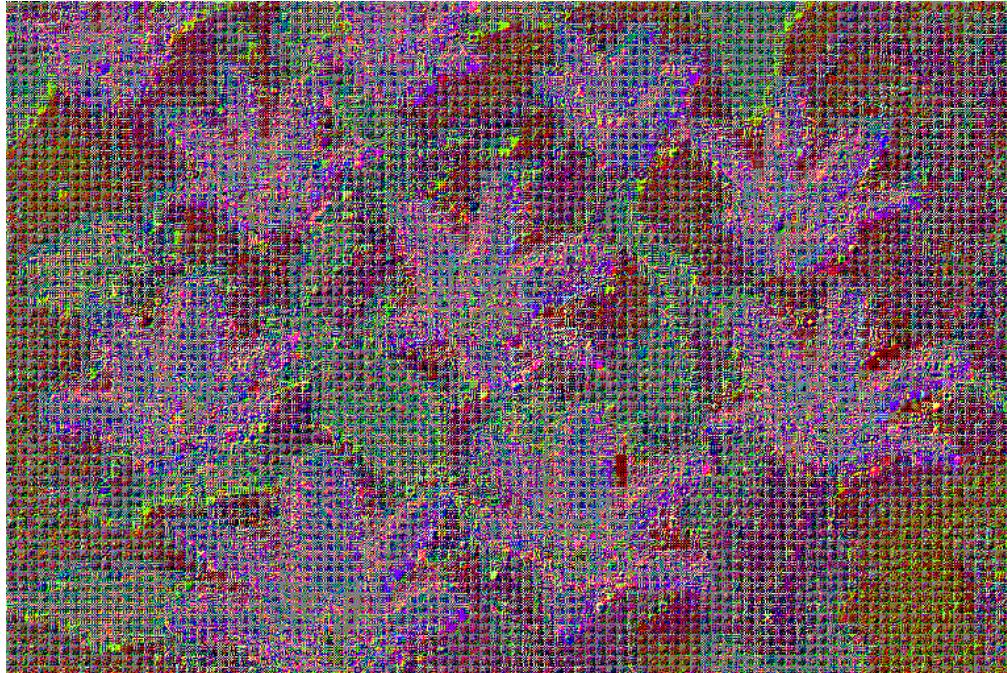


Stage 3

Matrix of first 8x8 values:

-294.8089 22871911	41.717741 0021305	-47.99961 97152756	12.11861 56121492	-28.40450 71809535	-4.304531 5029133	-19.10057 89559507	-10.572143 3356409
-20.99322 42435007	87.935817 7823712	-17.71169 52709546	25.30001 12816852	-8.490773 72921347	12.242615 2619107	-0.572534 4	5.8725038 4776977
54.20925 55531922	-92.23690 91307027	20.28523 17645295	-20.28726 98205893	10.472170 508959	-11.26790 14667147	3.2089189 1811043	-3.2760038 0670462
-77.33151 55586495	67.972058 0960145	2.309953 46985519	15.47007 72105586	0.1568316 70667479	6.4288365 2571868	0.5615964 29488707	3.4132931 2966555
28.11021 4971528	-9.485364 53241824	-18.23168 04620656	-2.257811 93488118	-6.267153 43529482	-0.681713 72160009	-2.165205 1	-1.5560785 9146951
-30.21834 17104282	-0.997539 45142113	9.499662 87970539	7.580418 59495601	3.8541885 2694245	1.5636041 0030727	-1.286142 20073339	0.8124739 86584709
-4.409985 30260018	11.081627 7656043	-1.295988 74854244	-1.577326 59416767	-2.859800 04433653	0.6970149 45366233	-1.145782 98862628	0.0117029 514511717
-14.06773 14185305	4.0103984 3056997	-2.842768 20602266	6.095402 18997159	0.9343011 04725111	2.1633299 3376828	-0.352451 22526972	0.9671284 7

Image at this stage:

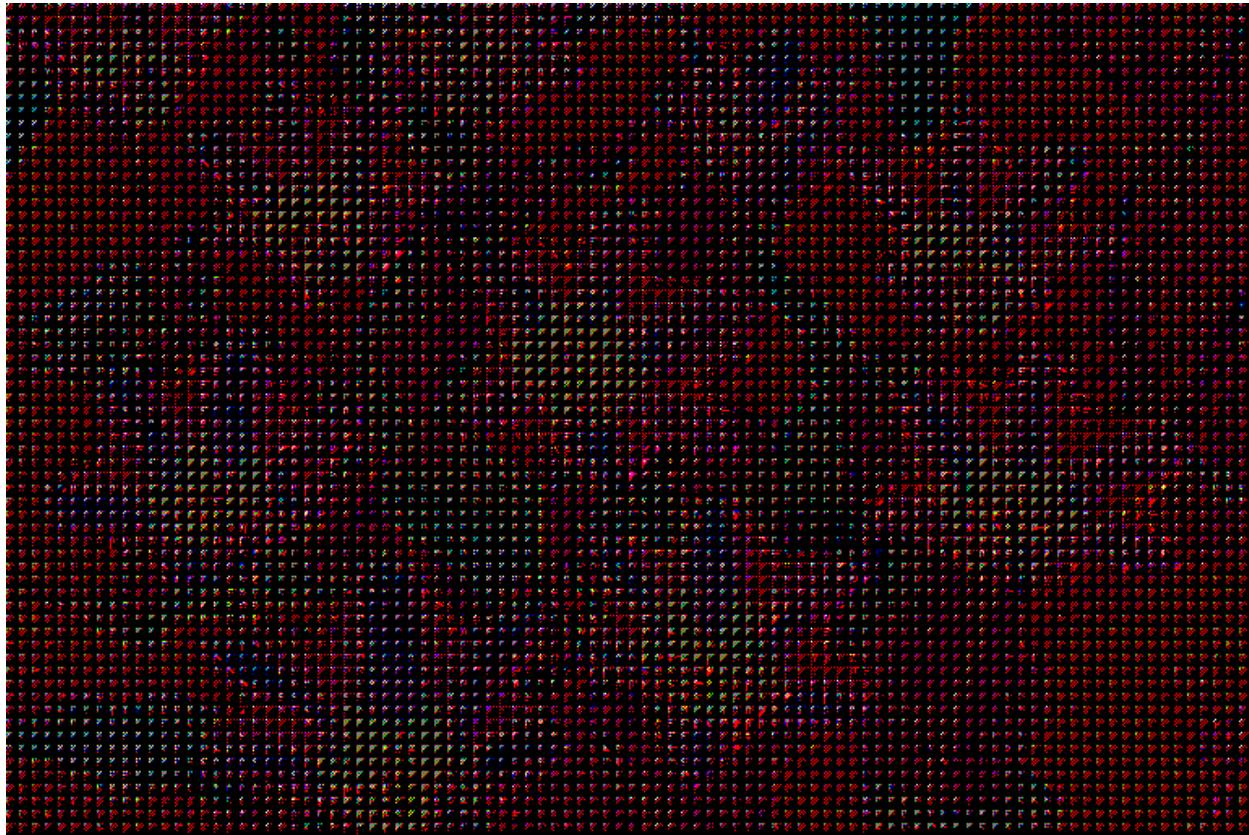


Stage 4

Matrix of first 8x8 values:

-18	4	-5	1	-1	-0	-0	-0
-2	7	-1	1	-0	0	-0	0
4	-7	1	-1	0	-0	0	-0
-6	4	0	1	0	0	0	0
2	-0	-0	-0	-0	-0	-0	-0
-1	-0	0	0	0	0	-0	0
-0	0	-0	-0	-0	0	-0	0
-0	0	-0	0	0	0	-0	0

Image at this stage:



Step 2**Stage 1**

Matrix of first 8x8 values:

-288	44	-50	16	-24	-0	-0	-0
-24	84	-14	19	-0	0	-0	0
56	-91	16	-24	0	-0	0	-0
-84	68	0	29	0	0	0	0
36	-0	-0	-0	-0	-0	-0	-0
-24	-0	0	0	0	0	-0	0
-0	0	-0	-0	-0	0	-0	0
-0	0	-0	0	0	0	-0	0

Image at this stage:

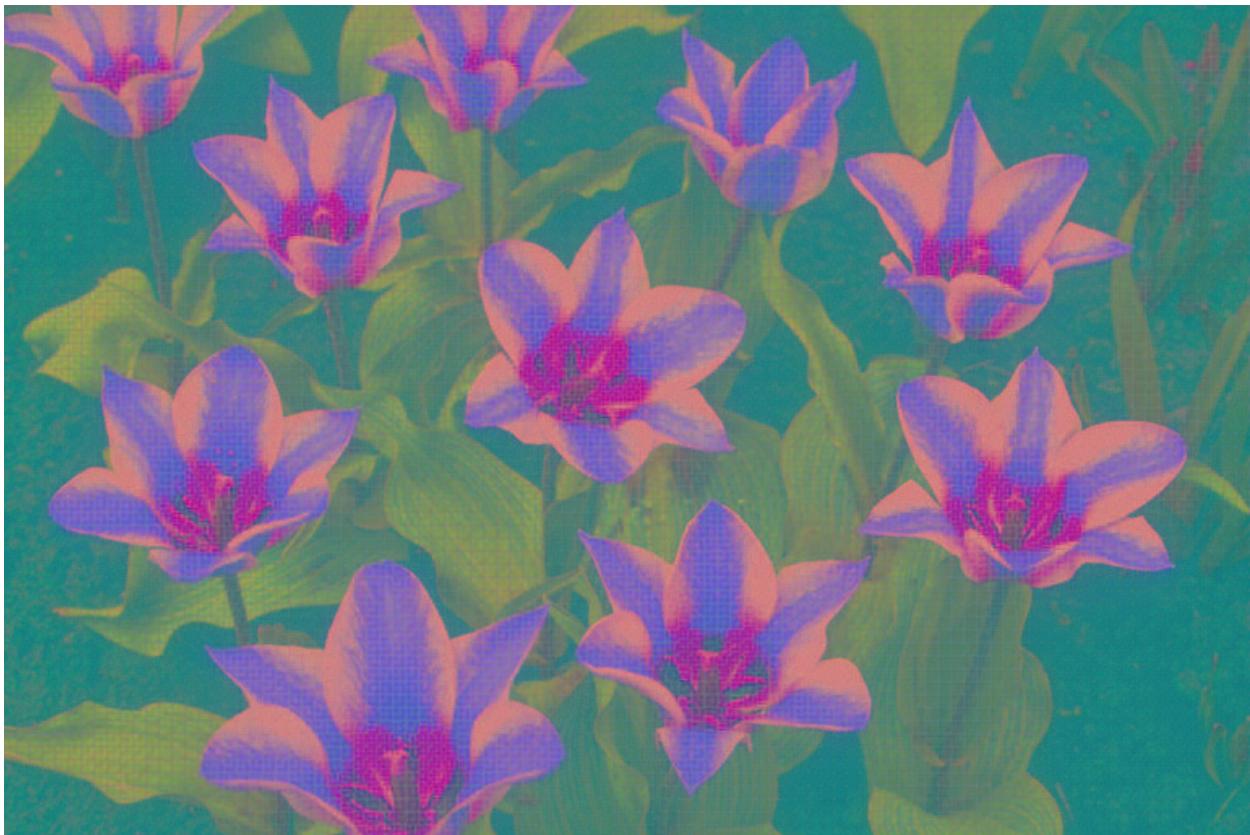


Stage 2

Matrix of first 8x8 values:

96	84	82	78	82	85	80	88
83	70	75	72	74	78	72	81
80	71	86	86	84	86	83	91
87	77	84	81	81	81	76	86
97	83	79	75	80	83	75	84
83	70	77	83	94	106	109	112
83	82	114	131	140	157	171	160
112	124	156	171	172	182	192	175

Image at this stage:



Stage 3*Matrix of first 8x8 values:*

96	84	82	78	82	85	80	88
83	70	75	72	74	78	72	81
80	71	86	86	84	86	83	91
87	77	84	81	81	81	76	86
97	83	79	75	80	83	75	84
83	70	77	83	94	106	109	112
83	82	114	131	140	157	171	160
112	124	156	171	172	182	192	175

Image at this stage:

8x8 block images**ALU**

Stage	8x8 img
0	■
1	■
2	■
3	■■
4	■■
1	■■
2	■
3	■

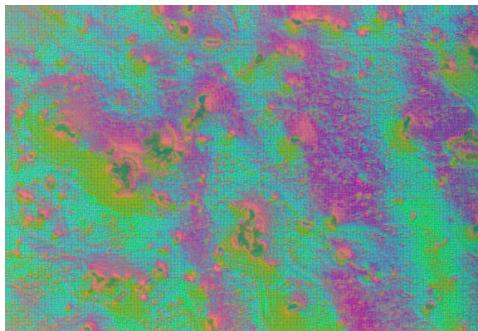
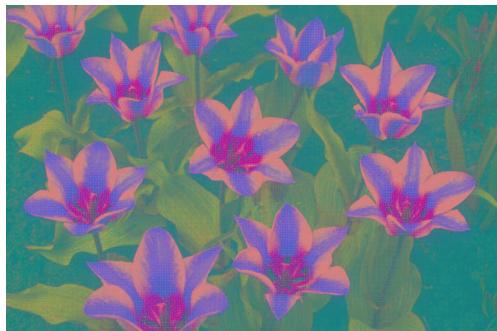
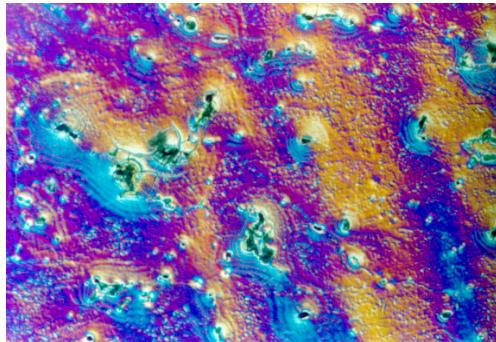
Tulip

Stage	8x8 img
0	■
1	■
2	■
3	■■
4	■■
1	■■
2	■
3	■

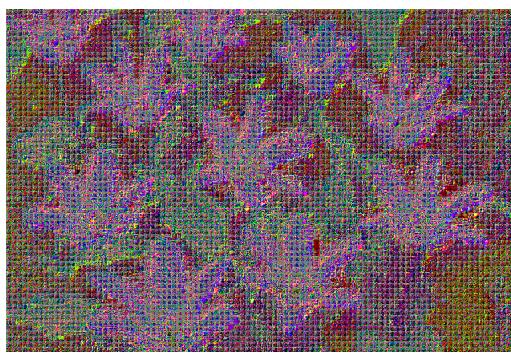
Discussions/Picture Life

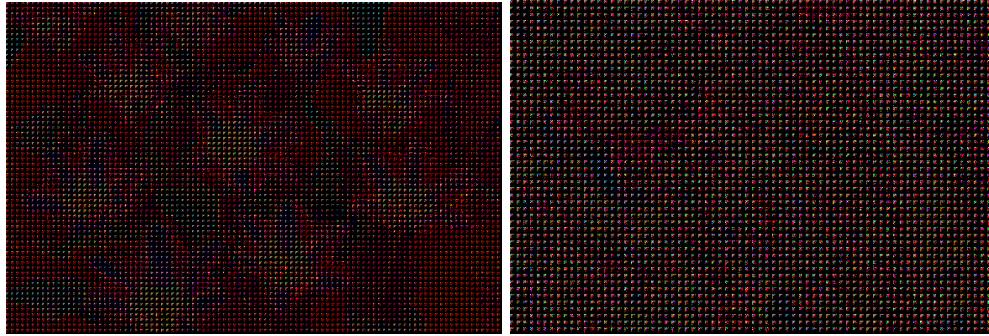
At each stage of step 1 the image's colors get transferred visually the same for both image 1 and 2.

Each original image starts out extremely vibrant and colorful. After stage 1 the images lose their vibrance and the colors appear to be washed out.

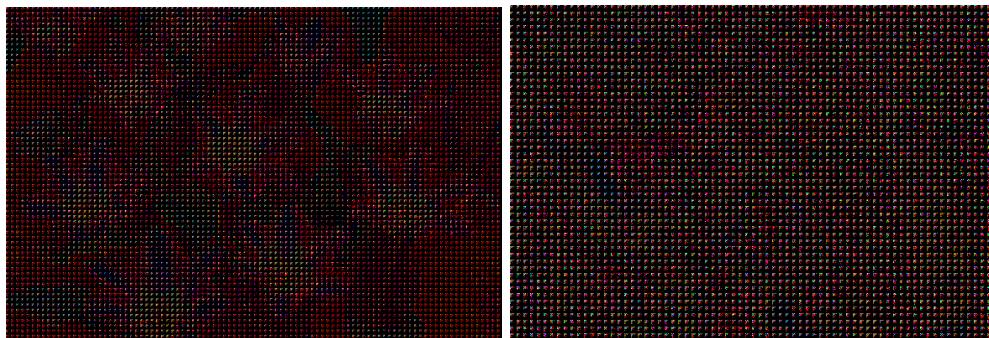


At the beginning of stage 3 the images look like they are being warped by static and by stage 4 it is impossible to make out the image without looking very closely.

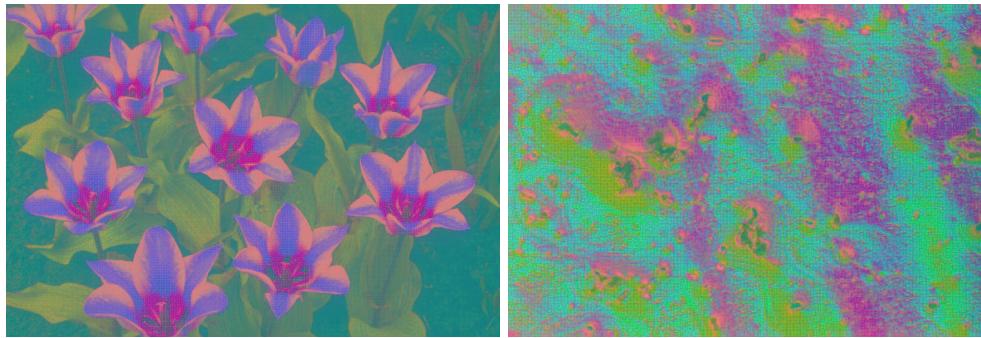




At the beginning of step 2 we begin to see the image we left off with in stage 4 of step 1.



At stage 2 of step 2 we return to see the washed out color images



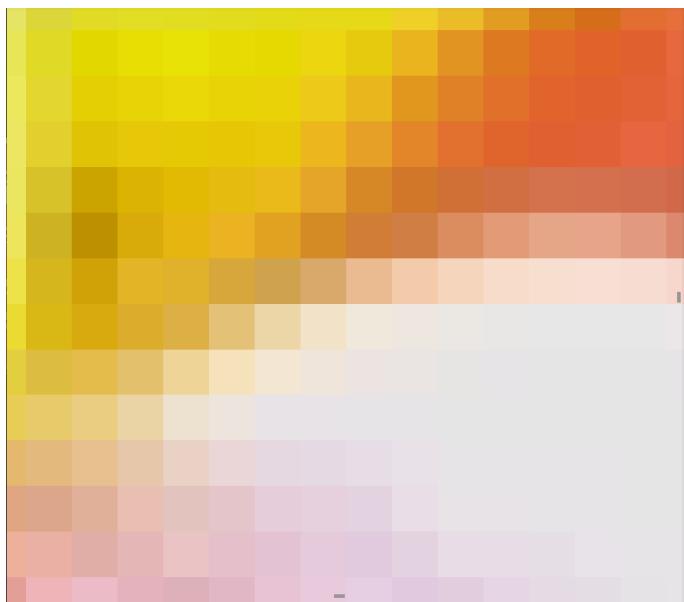
Finally at stage 3 we return to see an image that is like our original image



Result comparisons

As you can see, the input and output images are very close. They look like the same image at first glance, but if we zoom in a bit we can see some obvious differences.

Input:



Output:

In the input images the colors of the pixels are all the same and consistent for the same color, however, in the output images the colors are all different per pixel in places where the image should be the same color.

Error Values**Table:**

	MSE	PSNR
Alu.tif	61.7889	30.230
Tulip.png	50.8236	31.069

ALU:

MSE = 61.7889

PSNR = 30.230

Image displaying pixel wise difference (the whiter, the bigger the difference)

Tulip:

MSE = 50.8236

PSNR = 31.069

Image displaying pixel wise difference (the whiter, the bigger the difference)

**Error Discussions**

The results of the error values mirror the images very well outlining different color contrasts within each image. If you look closely, it is possible to make out some of the details in the original images from the white differences. This shows us that the noise ratio is at its highest when and where colors change in an image. Overall, the tulip image is compressed better (with

less error) than the alu one, as is indicated by the considerably lower MSE value and slightly higher PSNR.