

Greyscale Images



187	199	213	223
187	199	213	223
187	199	213	223
186	209	220	228
186	209	220	228
186	209	220	228
167	186	195	211
167	186	195	211
167	186	195	211
88	107	119	153
86	107	119	153
86	107	119	153
35	43	48	77
35	43	48	77
35	43	48	77
33	34	25	31
33	34	25	31
33	34	25	31
29	32	35	33
29	32	35	33
29	32	35	33

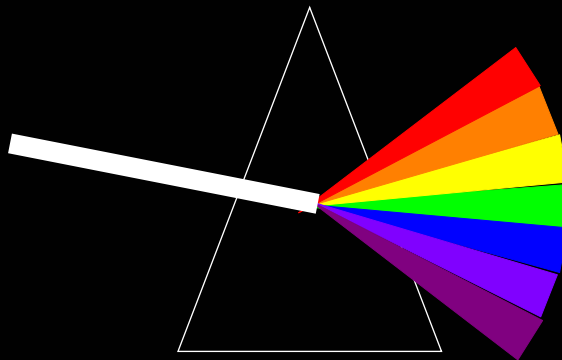
Each *pixel* is represented by a number from 0 to 255 (8 bits = 1 byte). This number tells how bright the pixel is

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Color Mixing

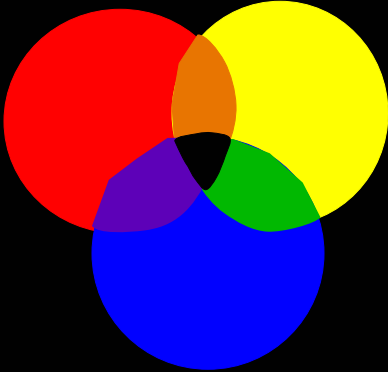
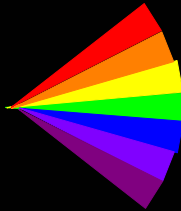


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Primary Colors



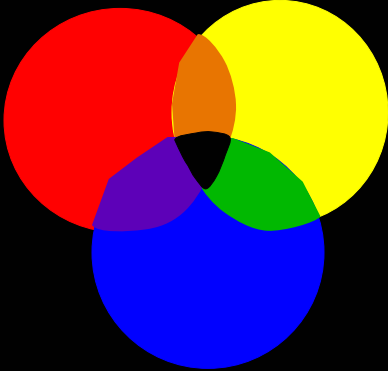
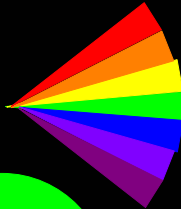
Paint mixing primaries
(Subtractive)

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3

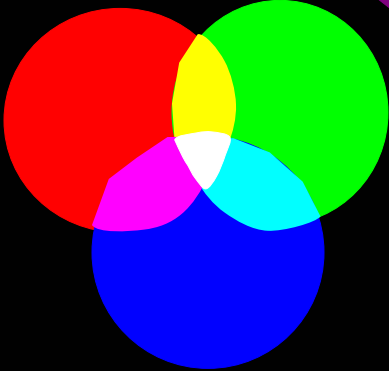
Primary Colors



Paint mixing primaries
(Subtractive)

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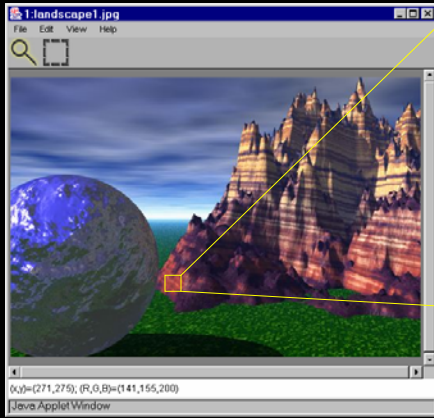


Lighting primaries
(Additive)

RGB

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Color Images



172	164	153	151	149	149	162	167
78	65	57	61	68	67	67	65
98	83	71	71	75	71	65	61
180	168	147	137	134	142	155	168
81	65	50	51	61	67	63	66
101	84	67	64	70	72	64	64
175	166	148	138	132	136	152	170
76	65	54	54	61	63	61	70
96	83	70	69	75	74	68	72
160	156	150	144	133	129	148	172
69	62	62	63	62	57	58	73
88	78	78	80	80	71	68	78
136	139	149	151	144	139	149	173
54	55	66	74	72	84	58	73
66	70	62	62	62	84	73	81
146	137	148	153	157	160	175	175
43	47	60	73	79	79	69	76

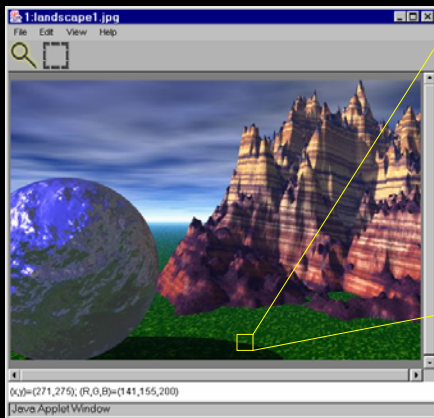
Each pixel is represented by 3 numbers, the red, blue and green intensities.

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Color Images



30	20	26	10	23	47	54	68
81	76	83	68	85	107	114	120
15	3	7	0	11	35	44	51
98	96	98	99	99	78	74	88
102	96	111	105	114	133	130	109
40	29	40	37	46	66	65	44
44	43	47	51	51	62	46	13
83	86	95	99	101	112	100	64
93	70	35	39	42	53	43	7
6	0	0	11	16	30	28	2
39	36	36	50	55	72	70	46
1	0	0	1	5	24	22	0
3	2	0	0	0	0	0	3
30	29	28	25	24	27	32	37
1	0	0	0	0	0	0	0
2	0	0	1	3	2	2	1
24	21	22	23	26	26	26	27

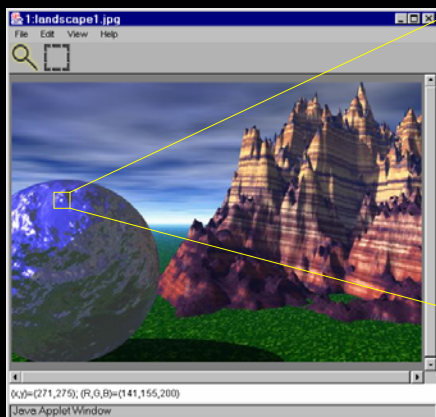
The mix of color intensities provides a wide range of colors

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Color Images



130	109	96	85	85	137	230	241
128	104	92	81	82	136	232	245
255	251	239	228	221	255	255	255
124	108	100	93	102	159	234	220
111	103	96	89	86	158	235	223
255	251	245	238	242	255	255	255
114	107	93	81	85	121	170	160
112	105	90	78	83	119	171	163
255	255	243	231	229	255	255	255
99	101	86	79	78	89	111	114
87	88	82	71	72	87	111	118
243	251	237	226	223	230	243	239
92	90	84	81	81	92	85	81
85	85	82	77	77	80	84	81
238	241	237	234	232	226	224	223
99	80	77	78	78	71	74	83
85	75	73	72	71	70	72	82

When all the color values are high, the pixel is close to white.

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Compression

- Most image formats *compress* the pixel information
- One simple method is *Run Length Encoding*
- 5, 3, 8, 8, 8, 8, 8, 8, 8, 1, 1, 9, 9, 9, 9, 2
is shortened to
5, 3, *, 5, 8, 1, 1, *, 4, 9, 2
(The * means "the next 2 numbers are a run, the first number is the length, the second is the value.")

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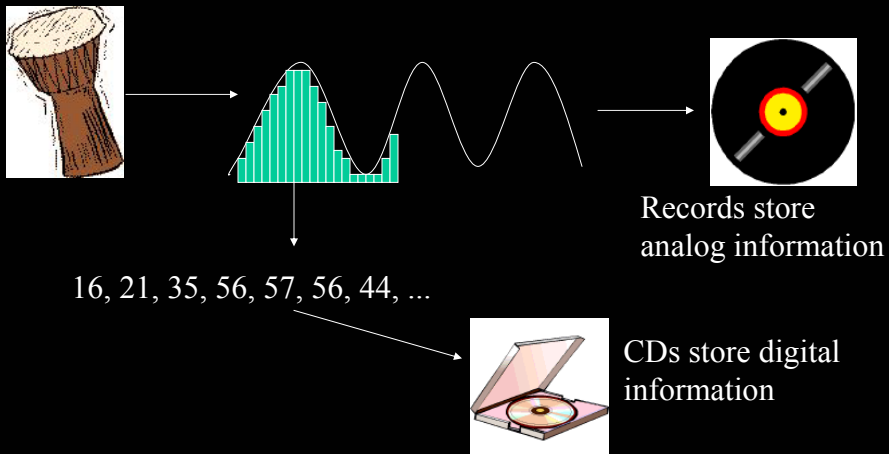
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More Bytes = More Colors

- 8 bits = 256 colors
- 24 bits = “Millions of colors”
 - 3 color *channels* (red, blue, green)
 - 1 byte per channel

What is a Digital Representation



Analog Representation

- Examples: Vinyl record/watch dial
- Continuous
 - An infinite number of possible values
- Accuracy
 - Can (potentially) represent with infinite accuracy
 - Error prone (in real life)

Digital Representation

- Examples: CD/Digital watch
- Discrete
 - Only a few possible values
- Accuracy
 - Can only represent an approximation
 - (e.g. audio sampling)

Advantages of Digital Reps.

- Easy to manipulate
 - Discrete symbols limit complexity
- General
 - For example: the compression algorithm described earlier applies to any data represented digitally
- Accurate copying
 - Examples: DNA, Napster