Lecture 02

- ✓ Concept of images
- ✓ Colour
- ✓ Colour images

Concept of images

Concept of images

We will consider how electronic pictures (monochrome) are made up.

Consider some important characteristics of electronic images.

See how image are represented in a computer.

Appreciate compromises and limitations.

Finally you will be able to edit individual picture elements and change the brightness, contrast and of an image.

Picture presentation by a (old CRT) television set

Consider monochrome first.

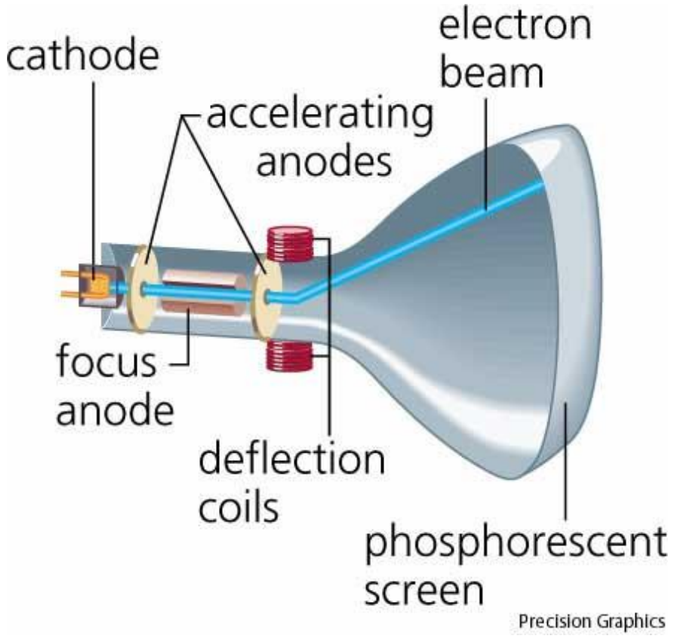
The image that we see on our monitors is composed of a series of horizontal lines.

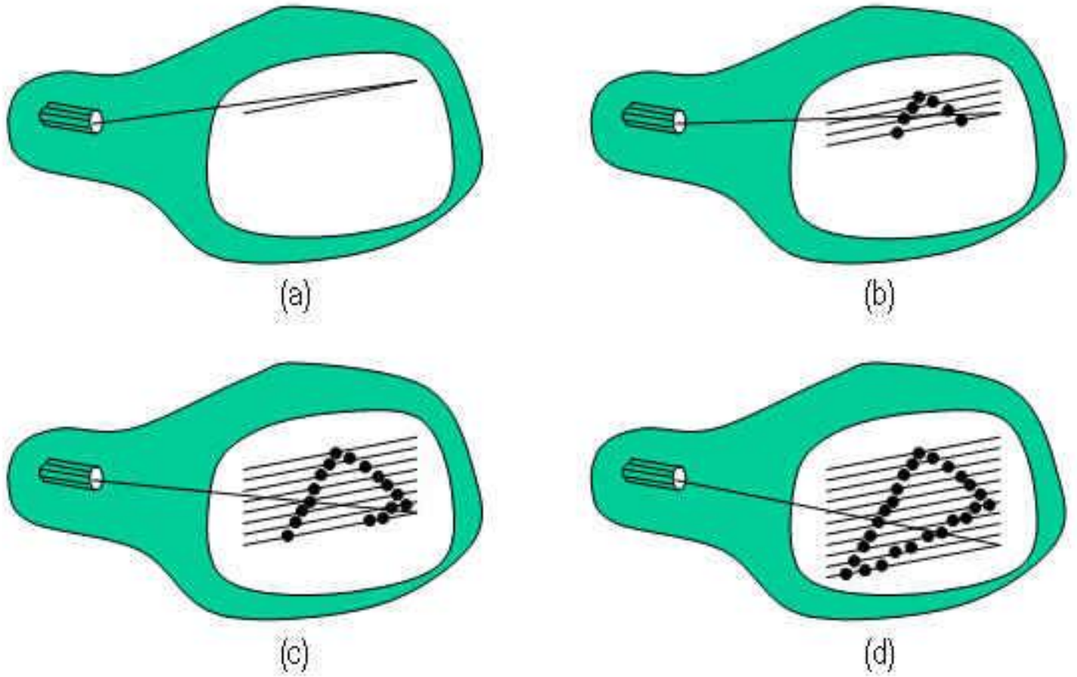
So it is sampled in the vertical direction.

The television picture (Cathode ray tube)

Raster Scan System

the electron beam is swept across the screen, one row at a time from top to bottom. When electron beam moves across each row the beam intensity is turned ON and OFF to create a pattern of illuminated spots.

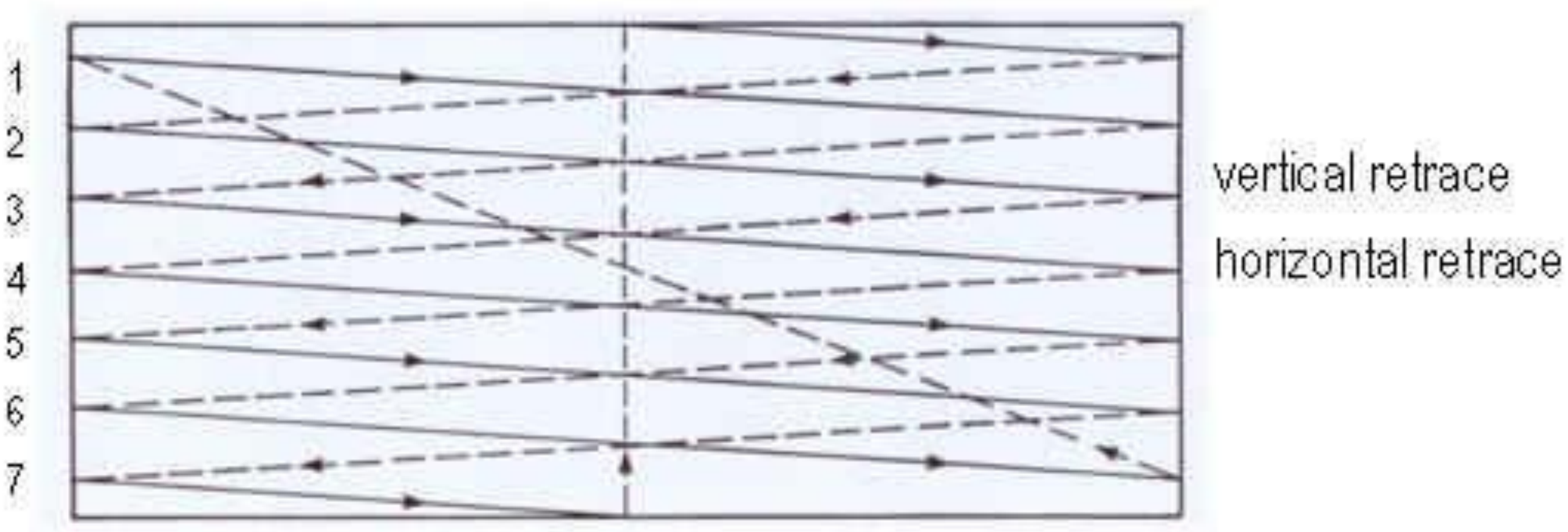




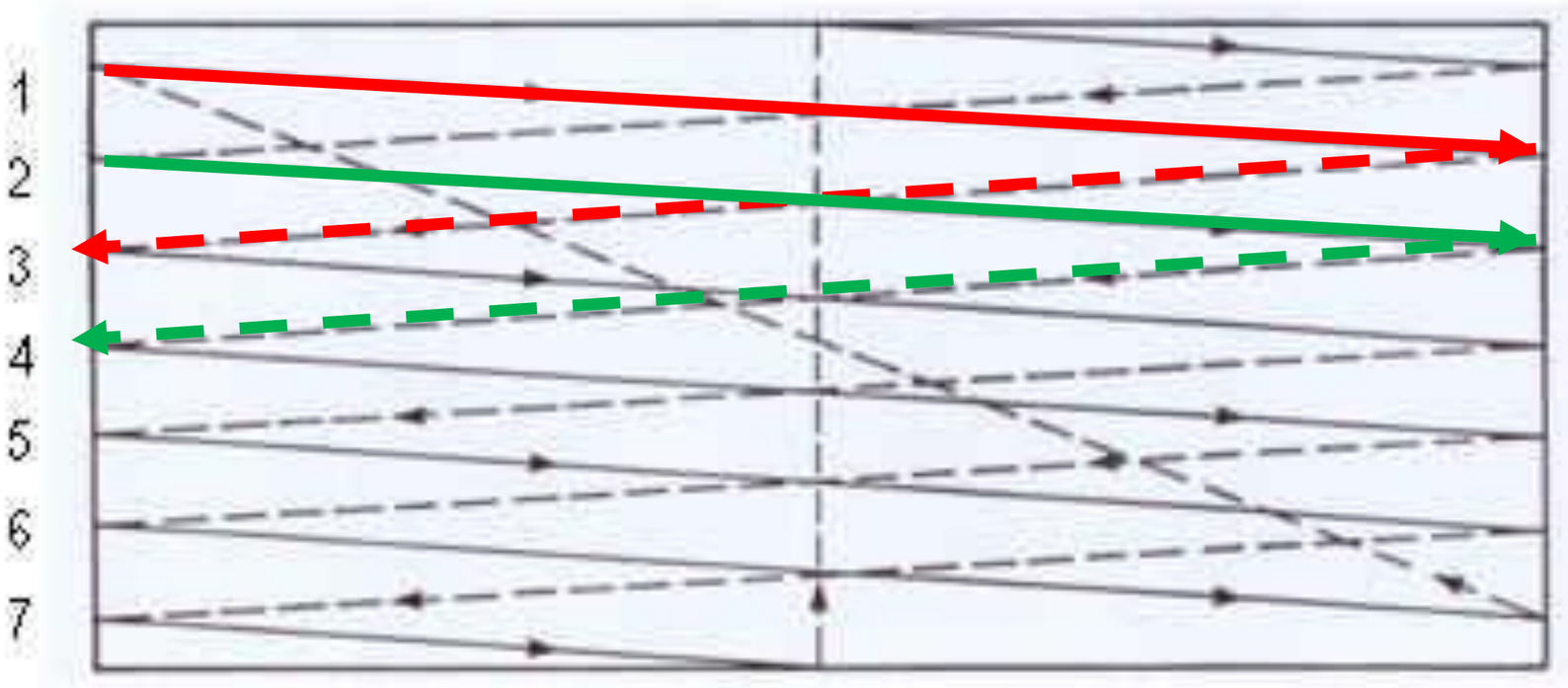
Picture definition is stored in a memory called frame buffer which holds the set of intensity values.

The television picture

At the end of each line the beam must be turned off and redirect to the left hand side of the CRT, this is called Horizontal Retrace. At the end of each frame (field), the electron beam return to top of the screen to begin the next frame (field) called Vertical Retrace as shown in figure below:



Inkjet printers create their images basically by raster scanning.



A frame is a complete image captured during a known time interval, and a field is the set of odd-numbered or even-numbered scanning lines composing a partial image.

When video is sent in interlaced-scan format, each frame is sent as the field of odd-numbered lines followed by the field of even-numbered lines.

Interlaced video

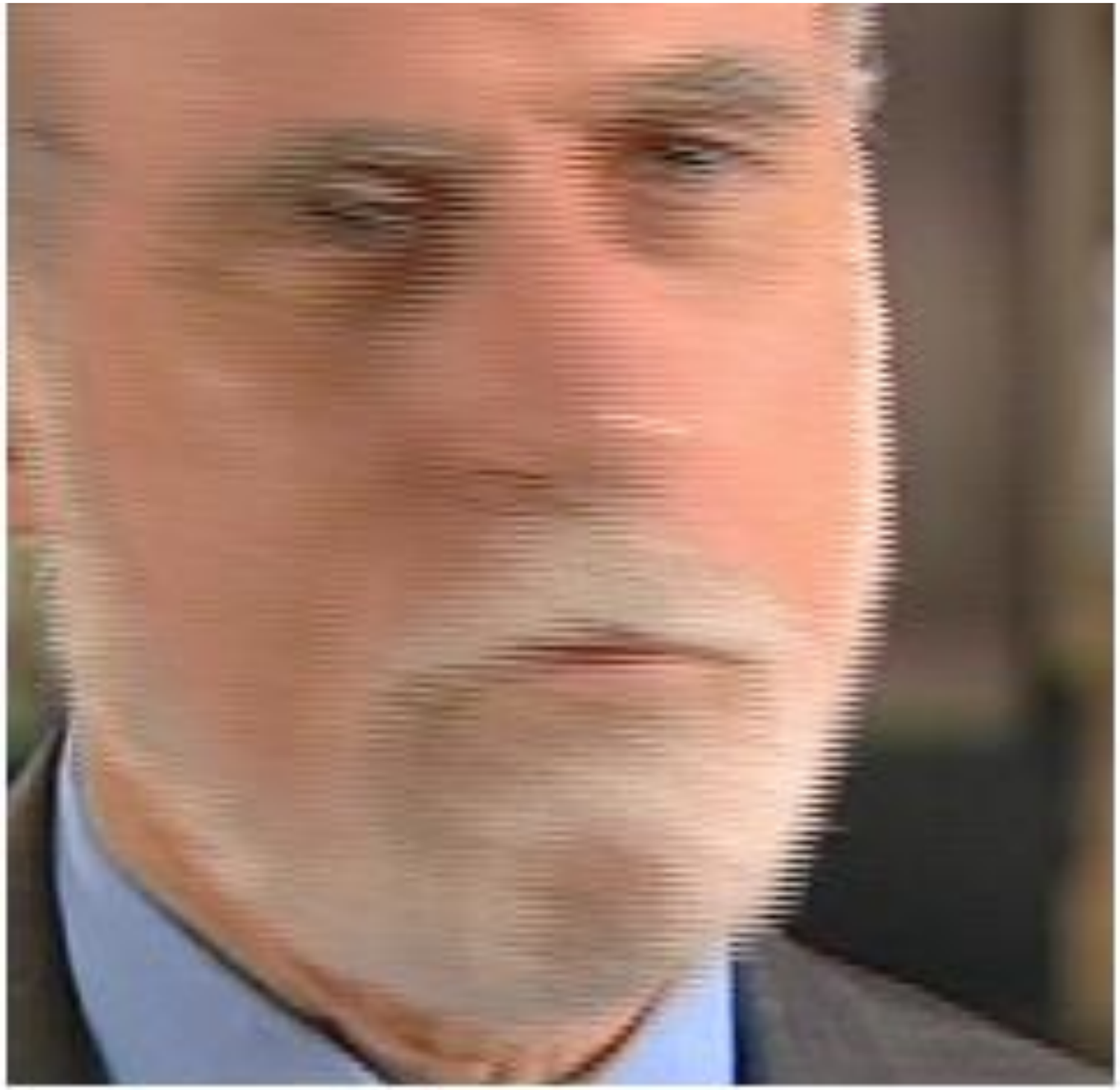
Some HD TV channels are broadcasted today using interlaced video format to reduce the data rate.

The following slide gives an example of the de-interlaced TV content from one of the UK TV broadcasters.

sky SPORTS 1
LIVE
AON

even lines
odd lines

De-interlace



Source

Best

How many lines (samples) / Spatial resolution.

Spatial resolution is finest detail in the vertical and horizontal direction we can resolve (see).

If the television picture is to have good spatial resolution we must have a minimum number of lines (vertical samples).

For (CRT) television there are 625 lines in the European television picture. In the American NTSC standard there are nominally 525 lines per frame..

Aspect ratios

The maximum angle that our eyes can see (without moving them) is greater in the horizontal direction (than in the vertical direction).

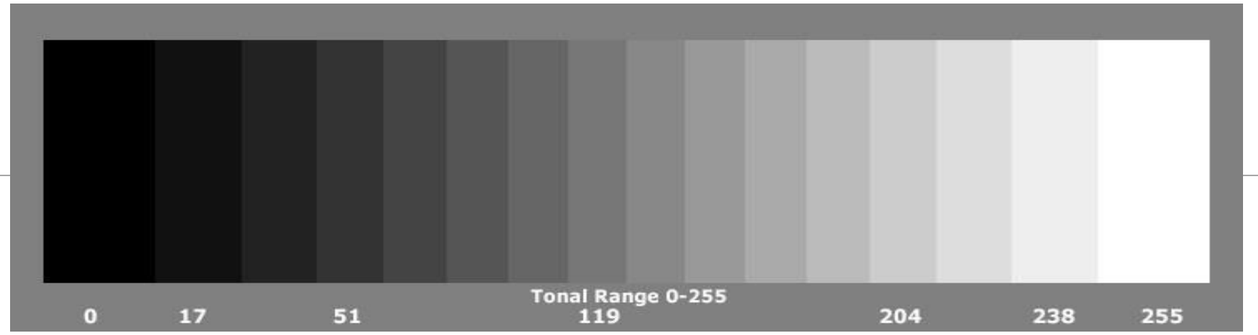
TV screens are larger horizontally than vertically.

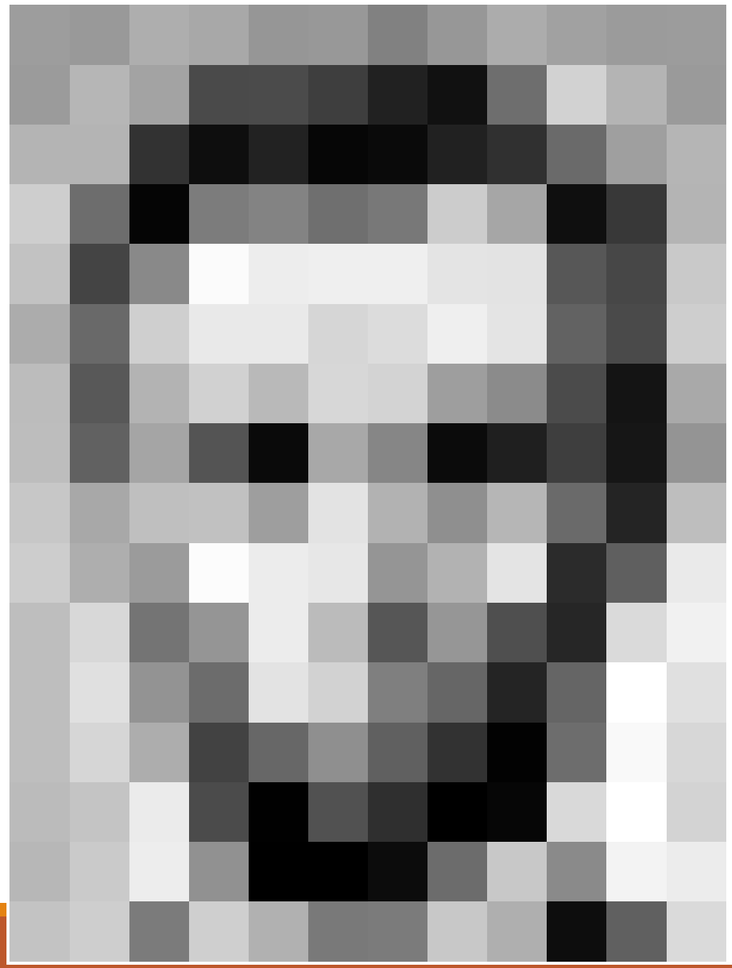
The ratio of the width to the height is called the aspect ratio.

Two common television aspect ratios are:

- 4:3
- 16:9

Greyscale img





157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

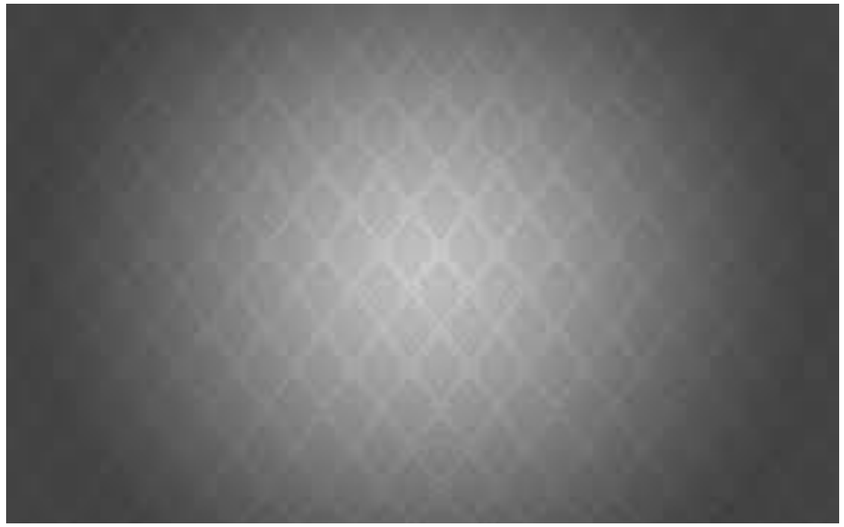
157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	33	17	110	210	180	154
180	180	50	14	34	6	10	33	48	106	159	181
206	109	5	124	131	111	120	204	166	15	56	180
194	68	137	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	84	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	106	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	86	150	79	38	218	241
190	224	147	108	227	210	127	102	36	101	255	224
190	214	173	66	103	143	96	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

The digital picture - Monochrome

We allow 256 values (typically) for each pixel value (8 bit).

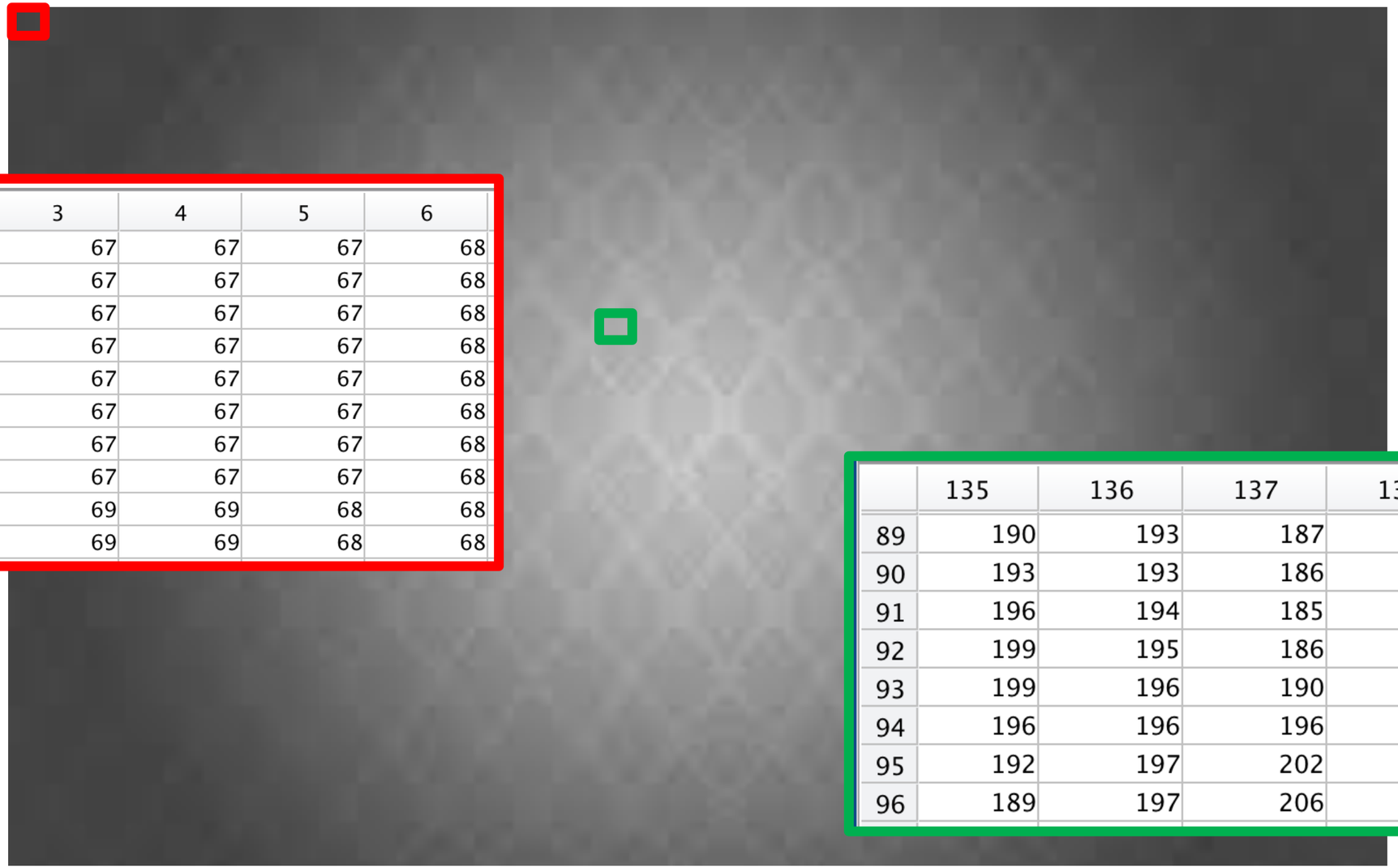
Each sample from our television line must be quantised.

That is we must find the nearest value in the range 0-255 to represent it.



```
im = plt.imread(r'img.jpg')
plt.imshow(im,cmap='gray')
```

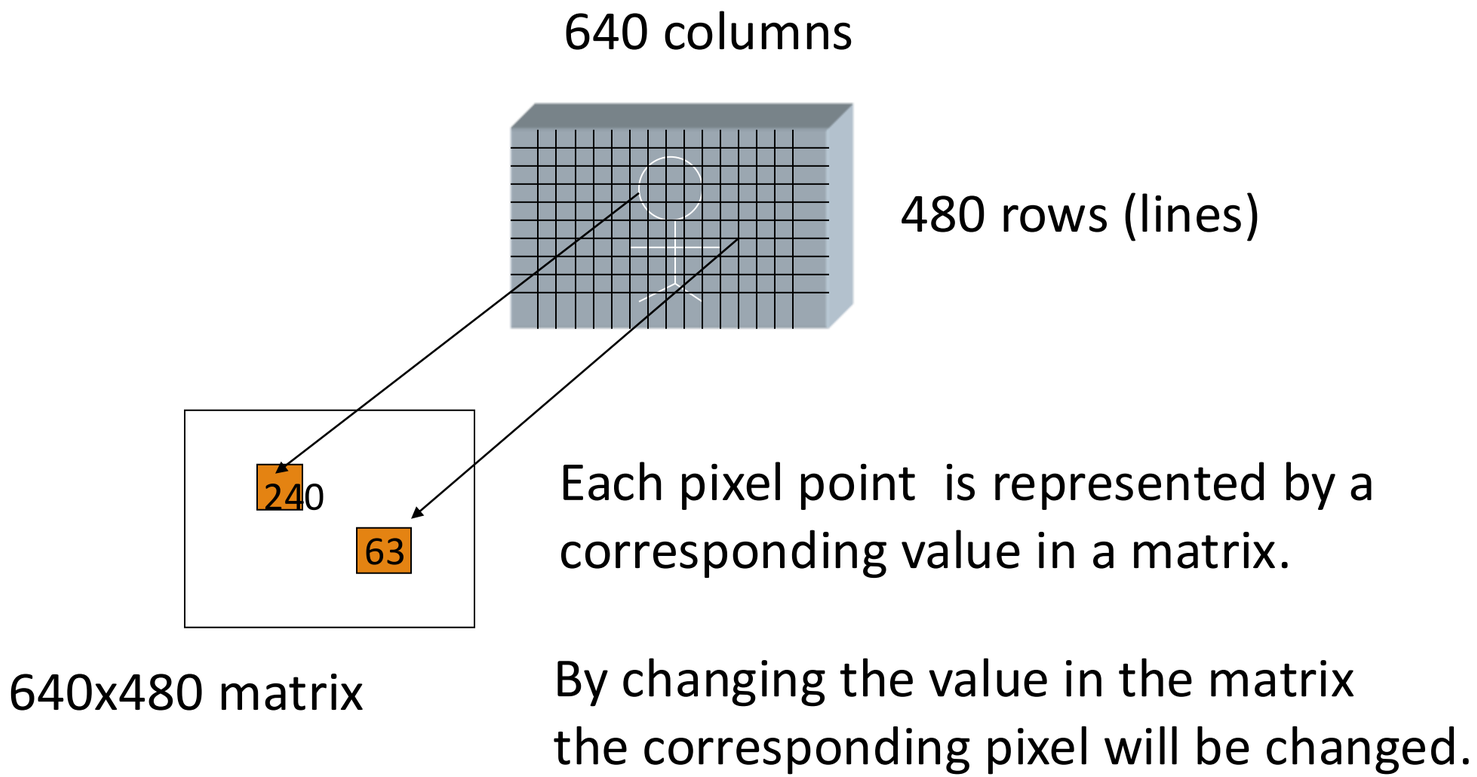
The digital picture - Monochrome



	1	2	3	4	5	6
1	66	66	67	67	67	68
2	66	66	67	67	67	68
3	66	66	67	67	67	68
4	66	66	67	67	67	68
5	66	66	67	67	67	68
6	66	66	67	67	67	68
7	66	66	67	67	67	68
8	66	66	67	67	67	68
9	69	69	69	69	68	68
10	69	69	69	69	68	68

	135	136	137	138	139
89	190	193	187	193	191
90	193	193	186	191	191
91	196	194	185	189	190
92	199	195	186	188	190
93	199	196	190	190	192
94	196	196	196	193	195
95	192	197	202	197	198
96	189	197	206	199	200

Total number of samples, physical significance



Matrices and pictures

But the matrix doesn’t have to be so large.

We can make up an image by putting values into a 3 x 3 matrix.

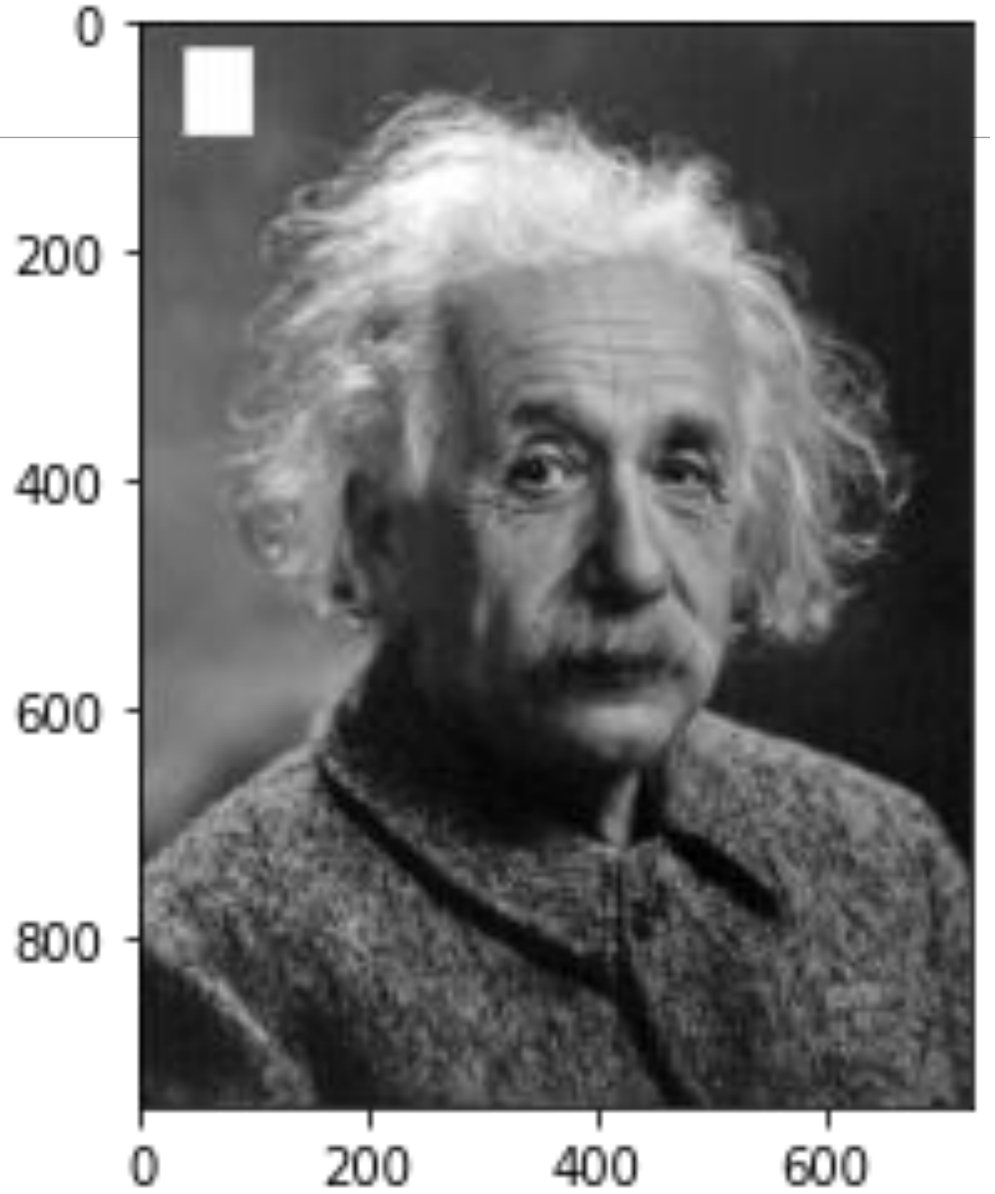
The values at each point in the matrix represent the brightness of a pixel.

The position (in terms of rows and columns) in the matrix will correspond directly to the position on the screen.

Indexing

```
img[400,350] = 255

img[23:100,40:100] = 255
```



Brightness and contrast

The value of each point in this two dimensional matrix represents the brightness of a pixel.

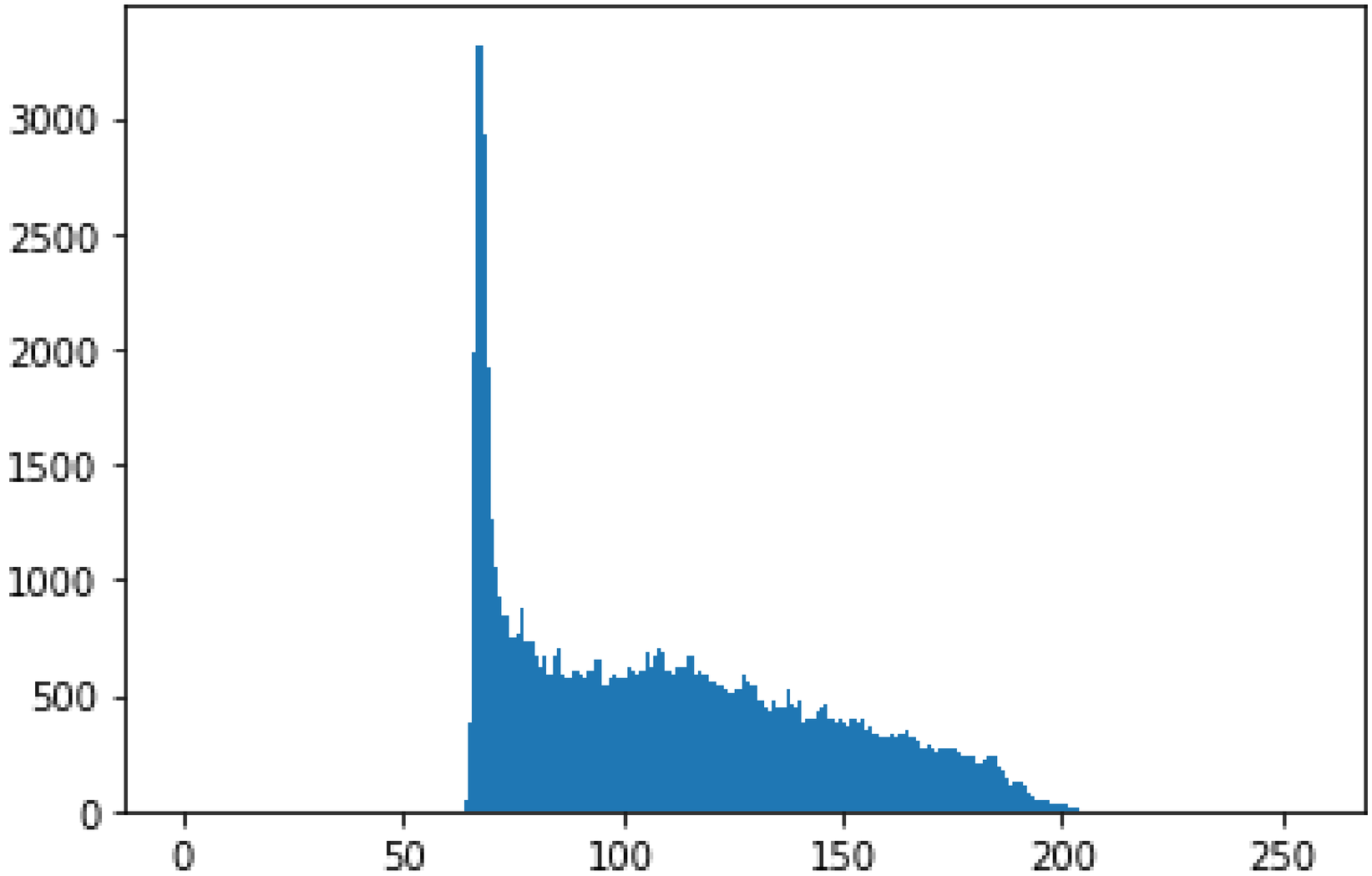
brightness is the absolute value of a pixel.

Contrast is the difference between the brightest pixel and the darkest pixel in an image.

Changing Brightness and contrast

The above implies that we must add or subtract to change the brightness of a pixel, and multiply or divide the change the contrast of an image.

Reading histogram



Changing Brightness

Our image is full brightness in most parts so lets decrease the brightness and view it.

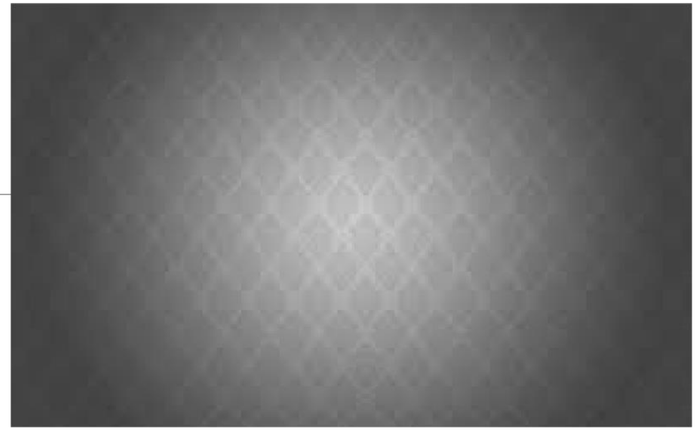
subtract 127

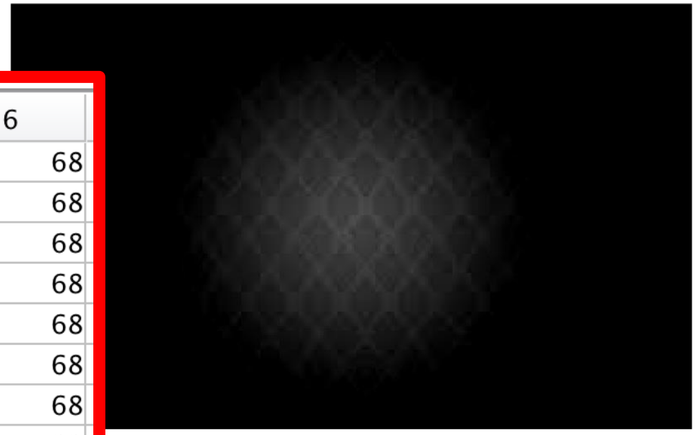
We can increase it again

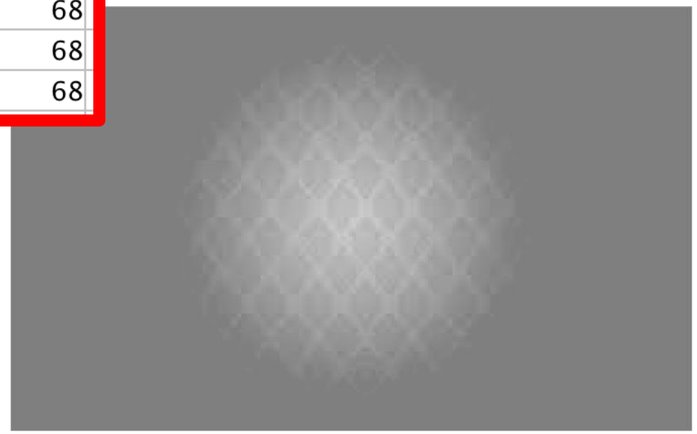
Add 127

If we increase/decrease val
we lose information in the i

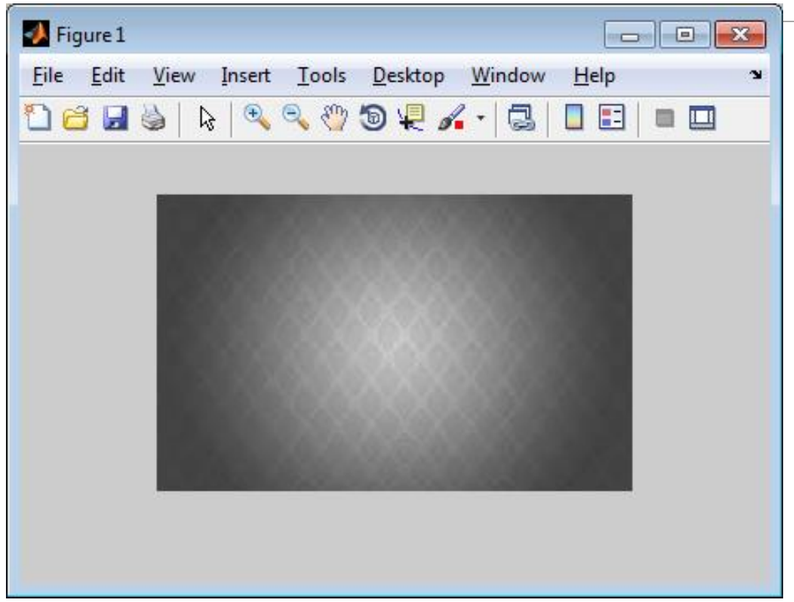
	1	2	3	4	5	6
1	66	66	67	67	67	68
2	66	66	67	67	67	68
3	66	66	67	67	67	68
4	66	66	67	67	67	68
5	66	66	67	67	67	68
6	66	66	67	67	67	68
7	66	66	67	67	67	68
8	66	66	67	67	67	68
9	69	69	69	69	68	68
10	69	69	69	69	68	68

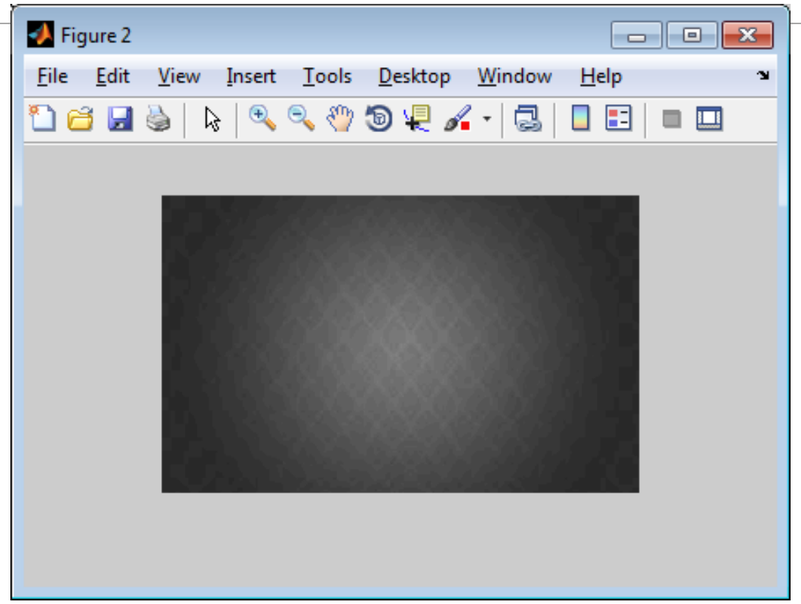




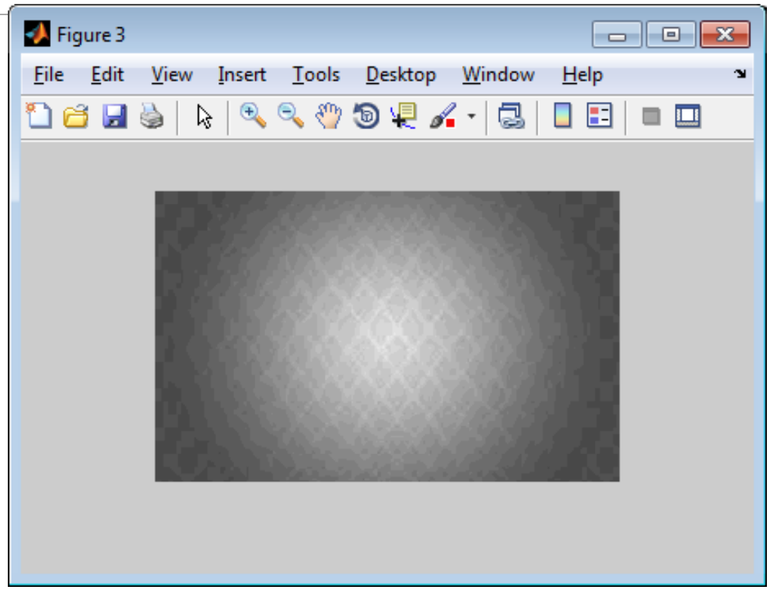


Changing Contrast





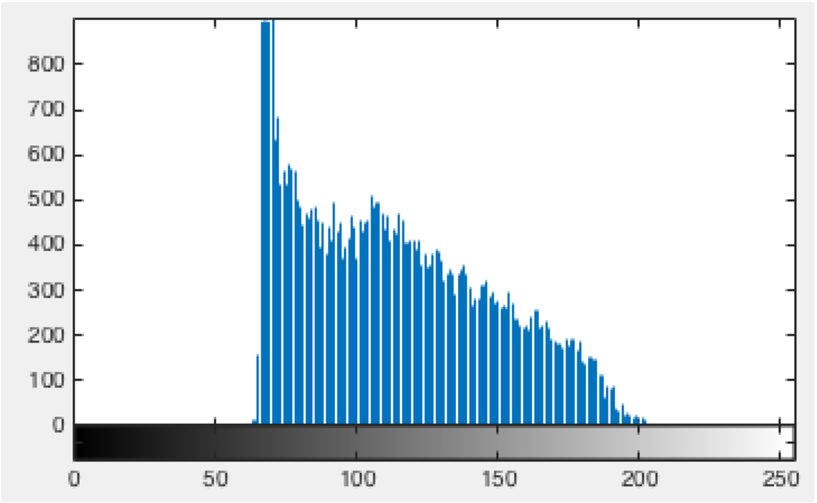
Multiply with 0.6

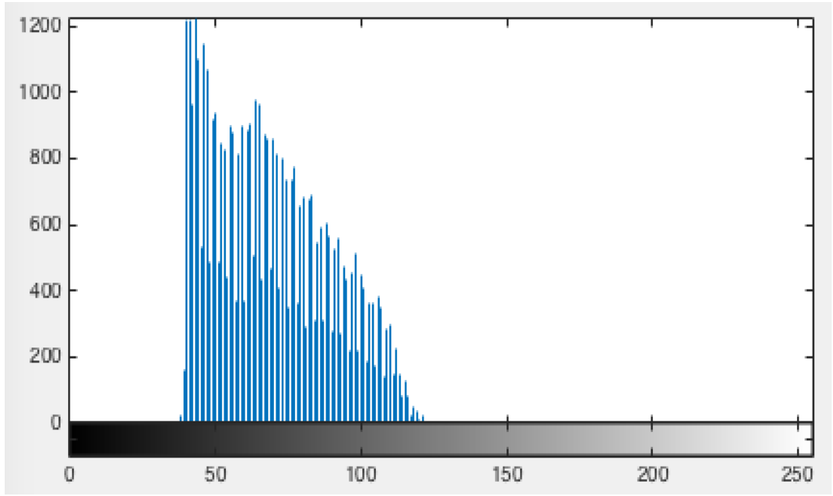


Multiply with 1.2

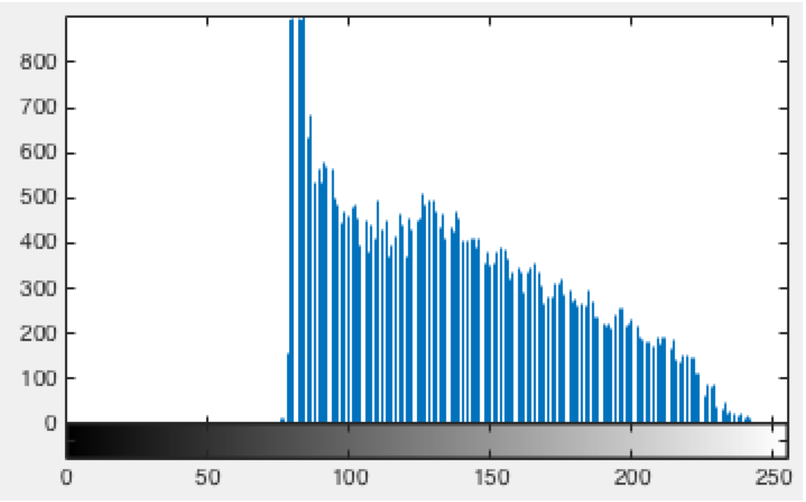
x	1	3	5	5-1=4
x*0.6	0.6	1.8	3	3-0.6=2.4
x*1.2	1.2	3.6	6	6-1.2=4.8

Changing Contrast





Multiply with 0.6



Multiply with 1.2

How a TV Works in Slow Motion - The Slow Mo Guys

https://www.youtube.com/watch?v=3BJU2drrtCM

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