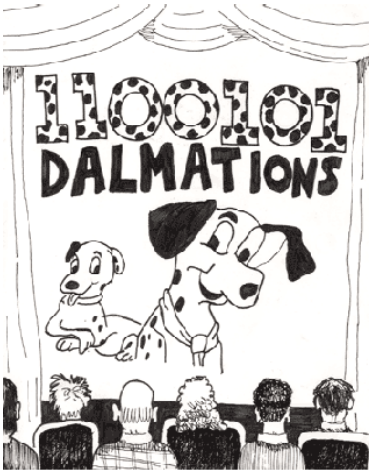
Digital Data and Binary Numbers



Film Night at the Binary Society

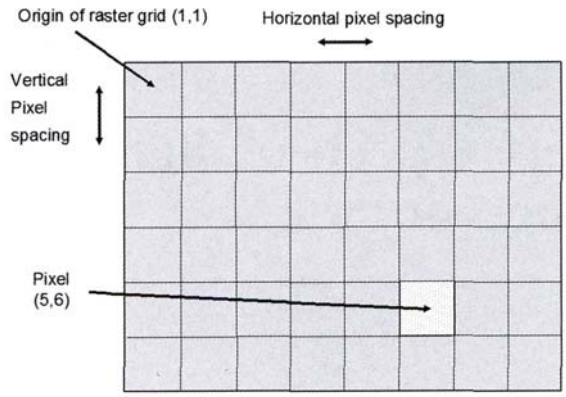
1. Digital Data
2. Binary numbers
3. How digital data is displayed on the monitor
4. Color
5. Data formats

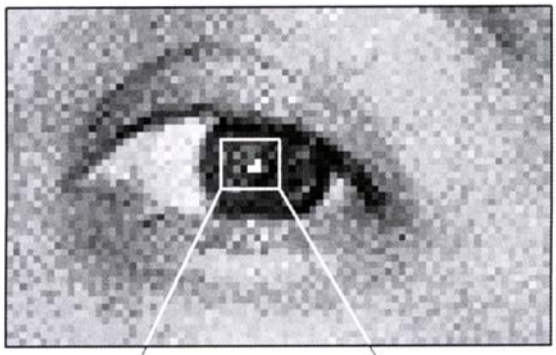
Digital Remote Sensing Data

-Matrix of rows and columns

-Each pixel has a value

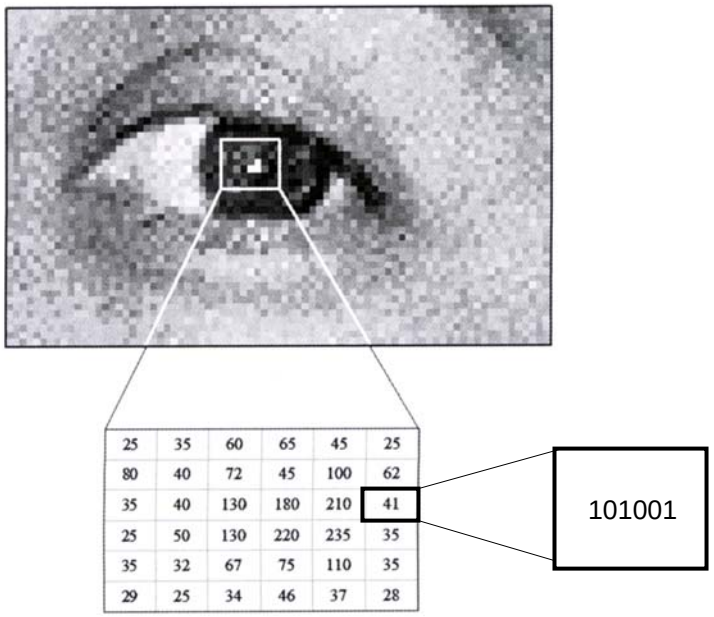
-corresponds to brightness range of the color in each array





25	35	60	65	45	25
80	40	72	45	100	62
35	40	130	180	210	41
25	50	130	220	235	35
35	32	67	75	110	35
29	25	34	46	37	28

Binary Numbers



Binary numbers are ‘base two digits’

193= 100+90+3

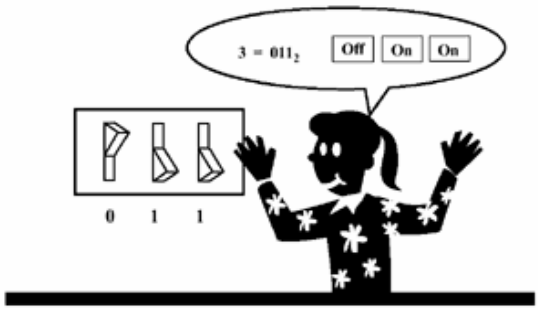
Hundreds	Tens	Ones
1	9	3

10^2	10^1	10^0
1	9	3

193 is really {(1*10*10)+(9*10)+(3*1)} =100+90+3

Binary numbers are ‘base two digits’

2^2	2^1	2^0



Binary numbers are ‘base two digits’

7= 4+2+1

2^2	2^1	2^0
1	1	1

Binary number= 111

3 = 0 + 1 + 1

2^2	2^1	2^0
0	1	1

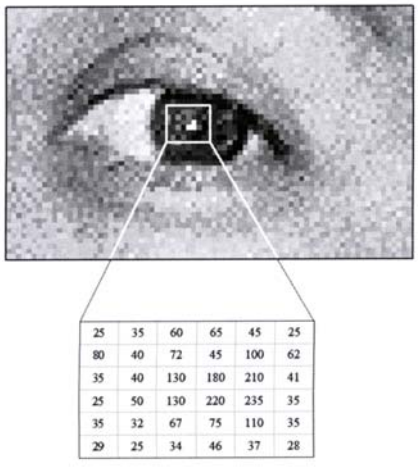
Binary number= 11

- Each column represents one “bit”

2^2	2^1	2^0
1	1	1

- “8-bit image” stores 8 bits for each pixel (from 00000000-11111111)

2^8 = 256 (grayscale)



25	35	60	65	45	25
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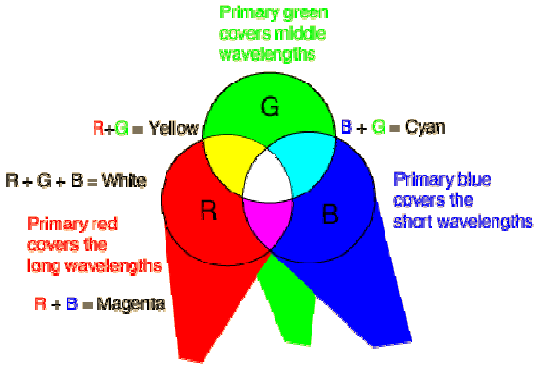
25	50	130	220	235	35
35	32	67	75	110	35
29	25	34	46	37	28

“Additive color”

-Red, Green, and Blue are primary colors, all others can be made from them

-yellow is not yellow, it is a combination of red and green

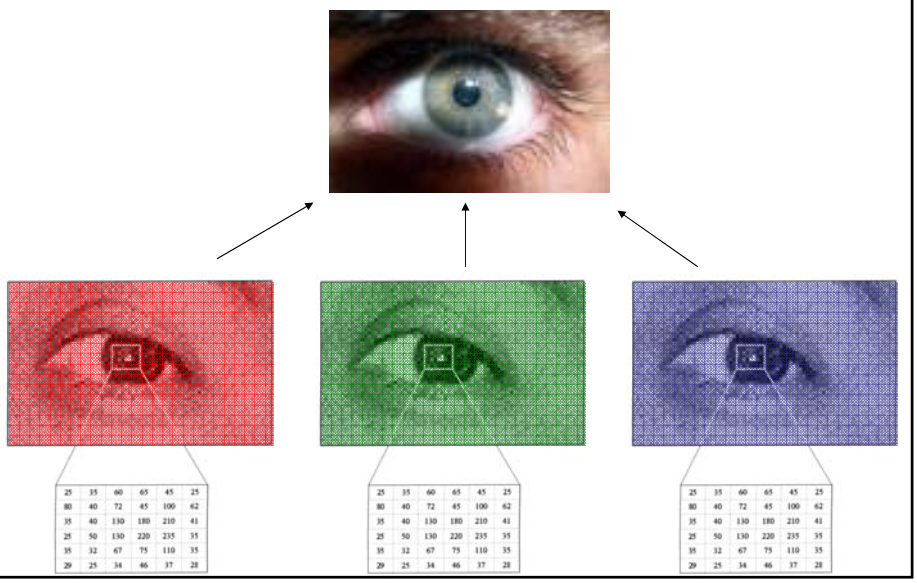


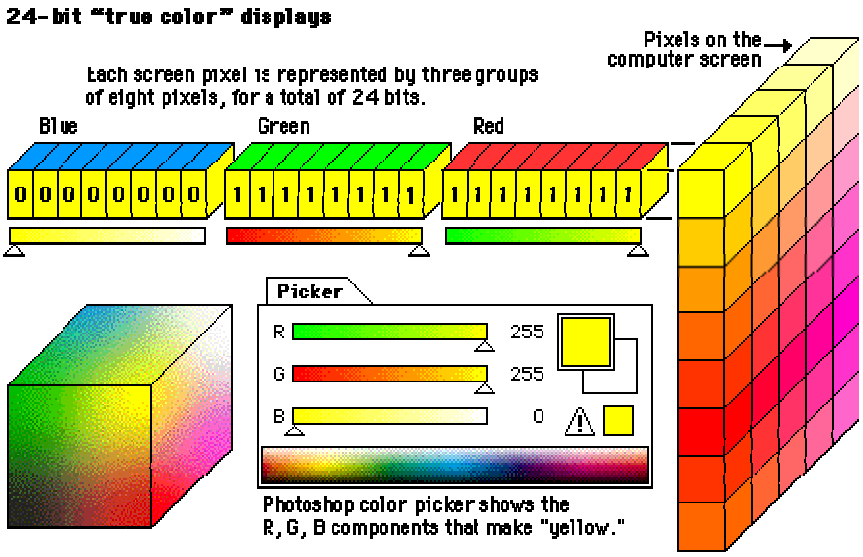
Additive color mixing with red, green and blue additive primary colors.

True Color

-Adds Red, Green, Blue arrays (each are 8 bits) together

- “24-bit image”





But data collected from sensors not in 0-255 values, so must be converted.

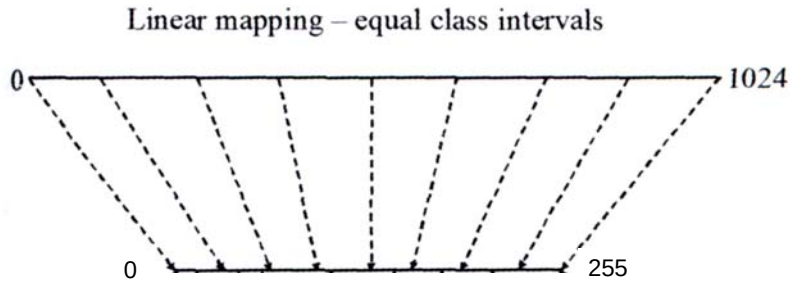
Signed vs. Unsigned

Number Type Name	No. of Bits	Minimum Possible Value	Maximum Possible Value	Other Names, Abbreviations & Symbols in Use
Unsigned Byte	8	0	255	Byte
Signed Short Integer	16	-32,768	32,767	Short, I2, Integer*2
Signed Long Integer	32	-2,147,483,648	2,147,483,647	Long, I4, Integer*4
Single Precision Floating Point (SAR image)	32	$-3.403*10^{38}$	$3.403*10^{38}$	Single, R4, Real*4

2 ways to convert:

1. Linear Mapping

Take numerical range of data for each of the three colors and create a linear map (equal class intervals)

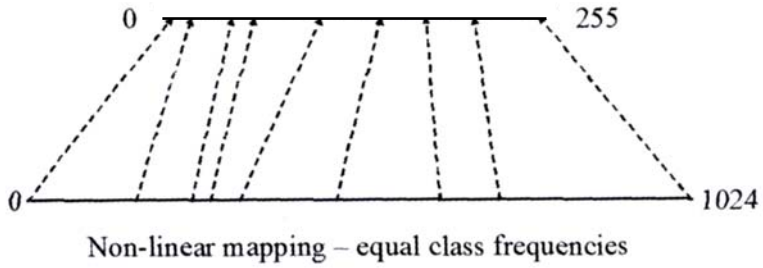


Problem: if you have outliers, image will be really dark or really light.

2 ways to convert:

2. **Equalization** (equal class frequencies)

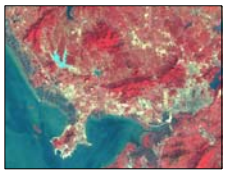
Produces image with more contrast



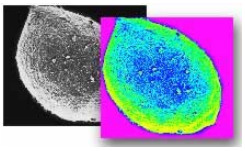
3 types of images can be stored and seen on the computer:

1. Color images

a) Natural color images:
Red, green, blue bands represent these actual colors as we see them



b) False color images:
assign three bands that do not represent actual green blue and red

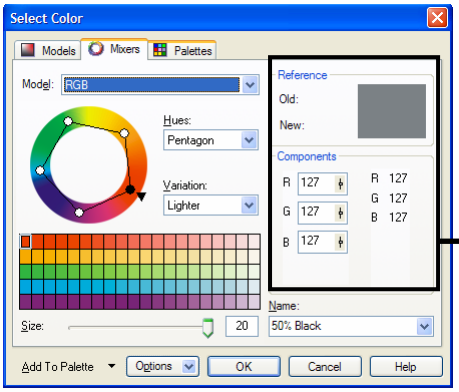


c) Pseudocolor image:
one band, values range from 0-265 and levels of values are assigned a color on a look up table.

3 types of images can be stored and seen on the computer:

2. Grayscale images

-One single band
-has all colors, but colors have same values (127, 127, 127)

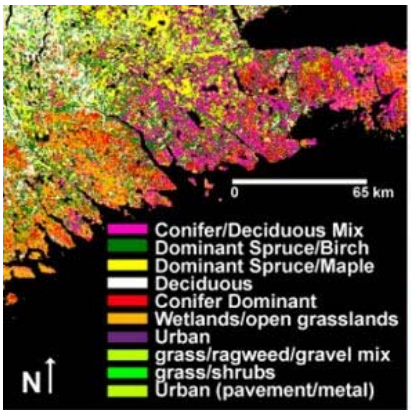


3 types of images can be stored and seen on the computer:

3. Labeled/classified images

-pixels' value represents a tag that indicates a property

-used for landcover, e.g.: 1=ag., 2=water, etc.



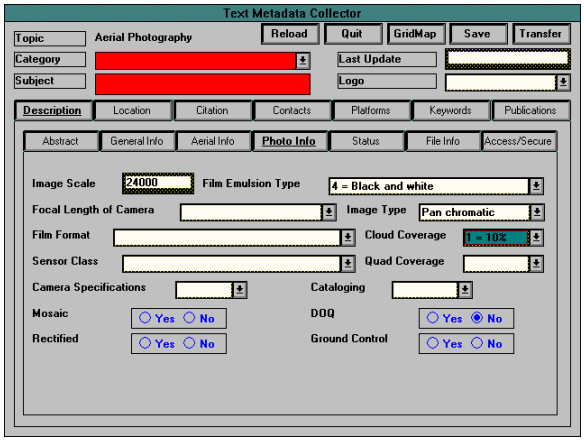
Data Formats

Data format

Describes the way that data is written to storage

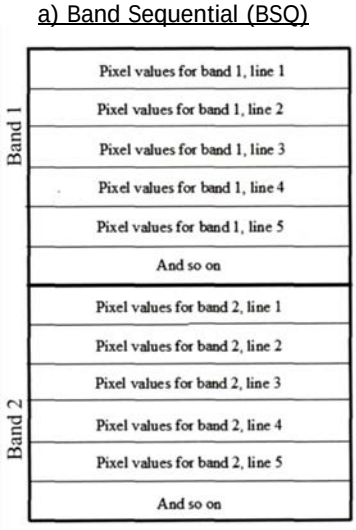
Usually contain:

1. Metadata (description about the data: projection, scan lines, pixels per line)

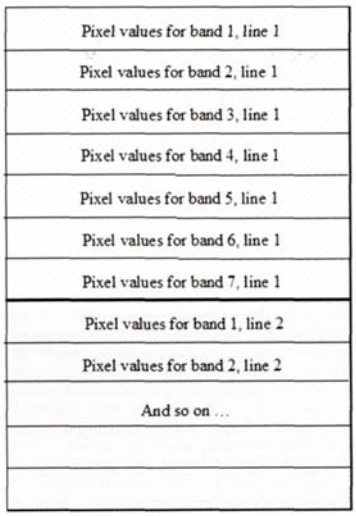


2. Image Data
   -pixel values of each band, arranged band by band

a) Band Sequential (BSQ)



b) Band Interleaved by Line (BIL)



File compression

Lossy vs. Lossless

Lossless: preserve all data
-can always obtain original data
- file size may not be compressed that much

Lossy: loses some information in compression (JPEG)
-smaller file sizes, easy sharing
-cannot obtain original data

8888883333

Lossless: 8[6]3[4]

Lossy: 83

File compression

quadtree: as a 2-D compression scheme

-image must be square and length must be a power of 2.

If many homogeneous areas, file will be compressed
If many non-homogeneous areas are there, file may be much larger

System Processing

***System Processing:**
need to take info collected from sensors and turn into usable format

-remove noise

-correct for pixel misalignments from sensors
(called geometric correction in Ch.4)

-pixels relocated (projected) (Chapter 4)

-image geometry corrected
determined by orbital height,
direction of motion