

Digital Images

Raster & Vector

Raster/Bitmap

Vector

Pixel

Voxel

Tessellation

Rendering

What is a Digital Image?

A digital image consists of discrete (discontinuous) units rather than continually varying shades.

In their simplest form, digital images are **raster** (bitmap) rather than **vector** graphics.

Raster Graphics consist of a
grid of values.

From Latin: rake, scrape:
systematic sampling on a
grid.



1	1	1	1
0	0	0	0
1	1	1	1
0	0	0	0

RASTER
(bitmap)

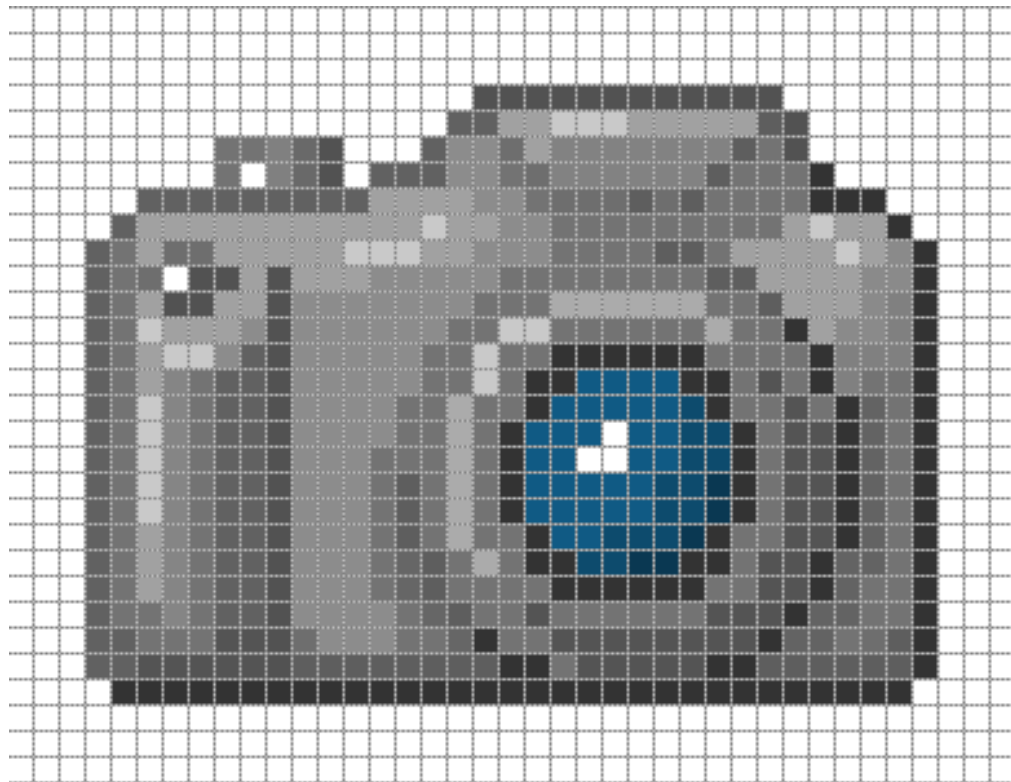
That is, a raster image is a matrix of numbers.

Each number corresponds to a color or intensity.

White=1

1	1	1	1
0	0	0	0
1	1	1	1
0	0	0	0

Black=0



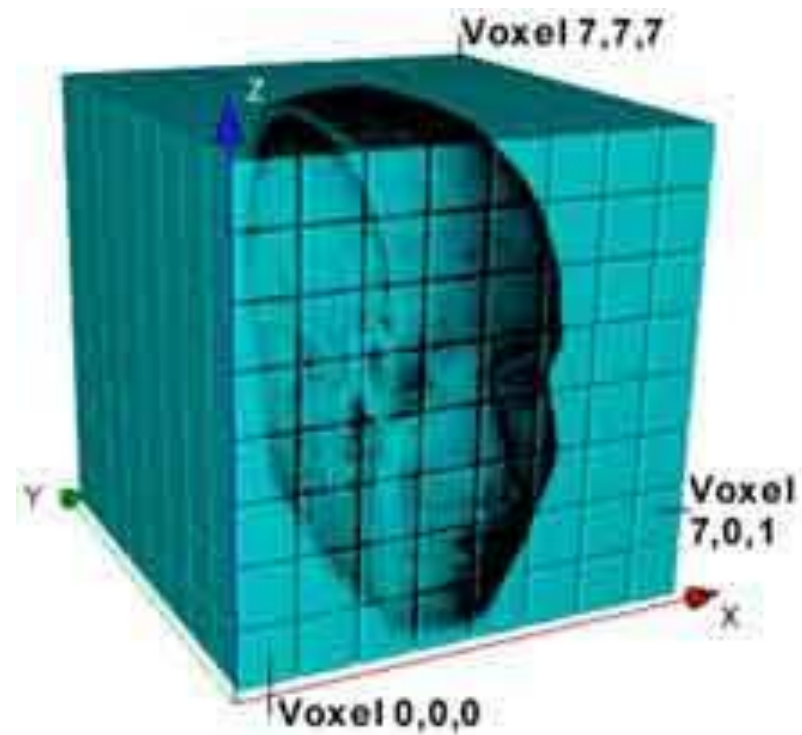
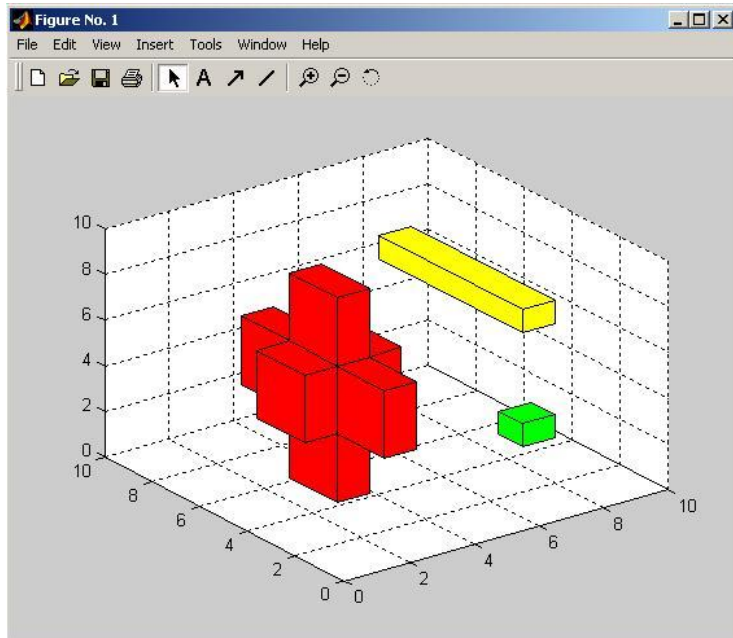
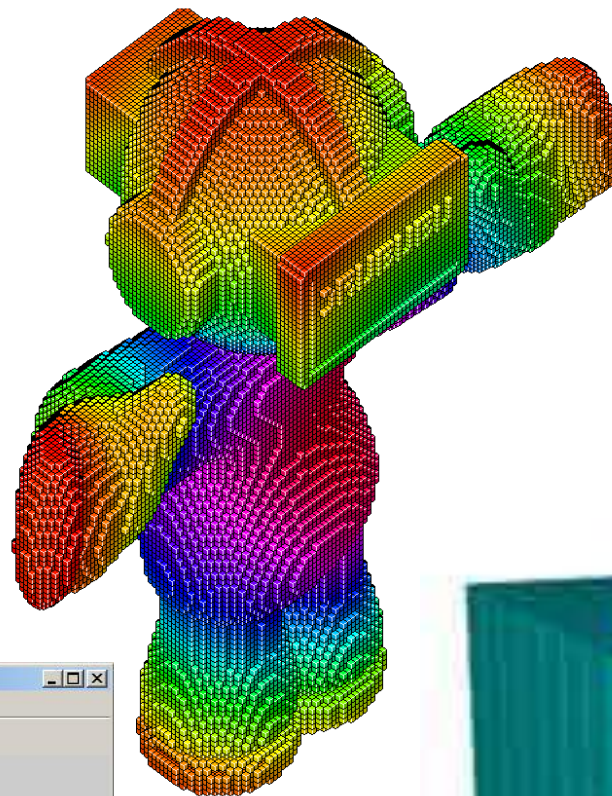
And each value in the
matrix is one
picture element
(**pixel**).



Medical images from the scanner are all raster images.

Because medical images are 3D, they consist of **voxels** (volume elements) rather than pixels.

Other than being 3D, voxels are like pixels.



Summary

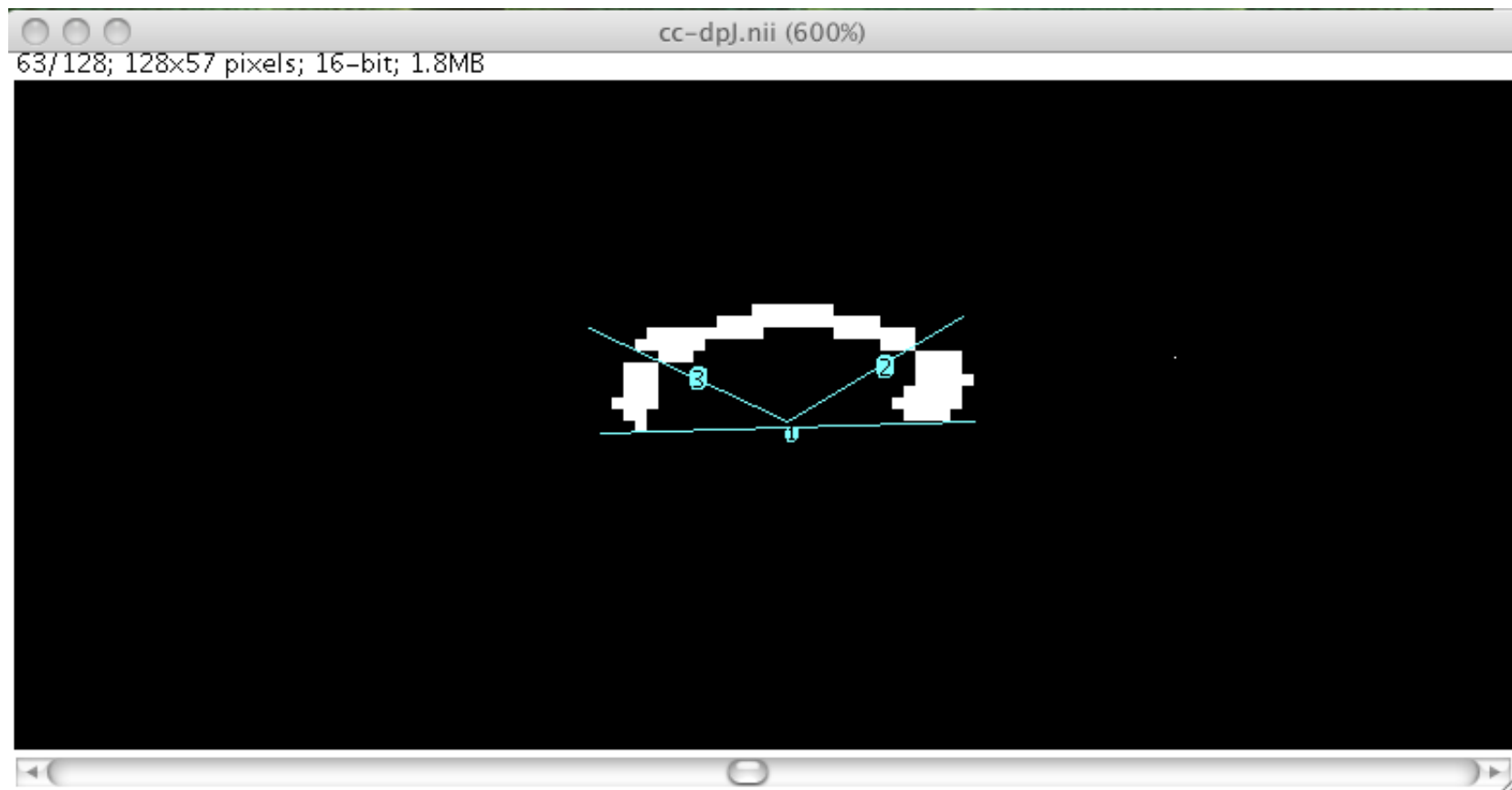
Raster graphics are the simplest form of image. They are based on a grid and used in medical imaging.

In 2D, the basic unit of a raster graphic is called a pixel.

In 3D, the basic unit is called a voxel.

However,

if we want to draw straight lines, perfect circles, and measure angles... then we need vector graphics.



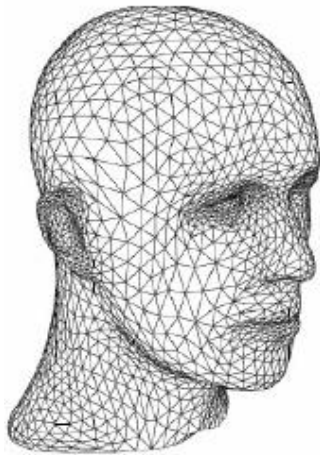
If we want a 3D model,
we can build a wireframe or
mesh surface out of tiles
(**tessellation**).

Then we produce a rendered
model with lighting and
shadows, this is called
rendering.

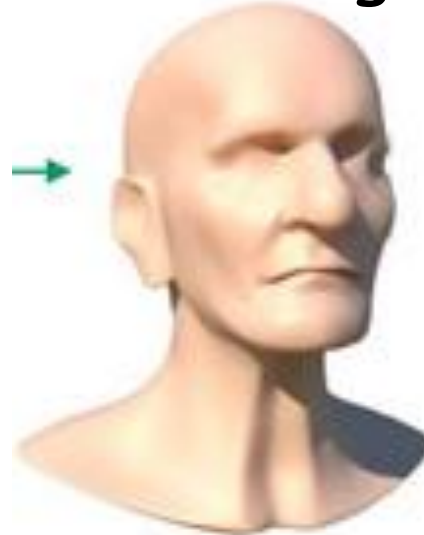
Build a 3D volume from a stack of 2D slices



Tessellation



Rendering



Vector Graphics consist of geometrical primitives like lines, points and curves.

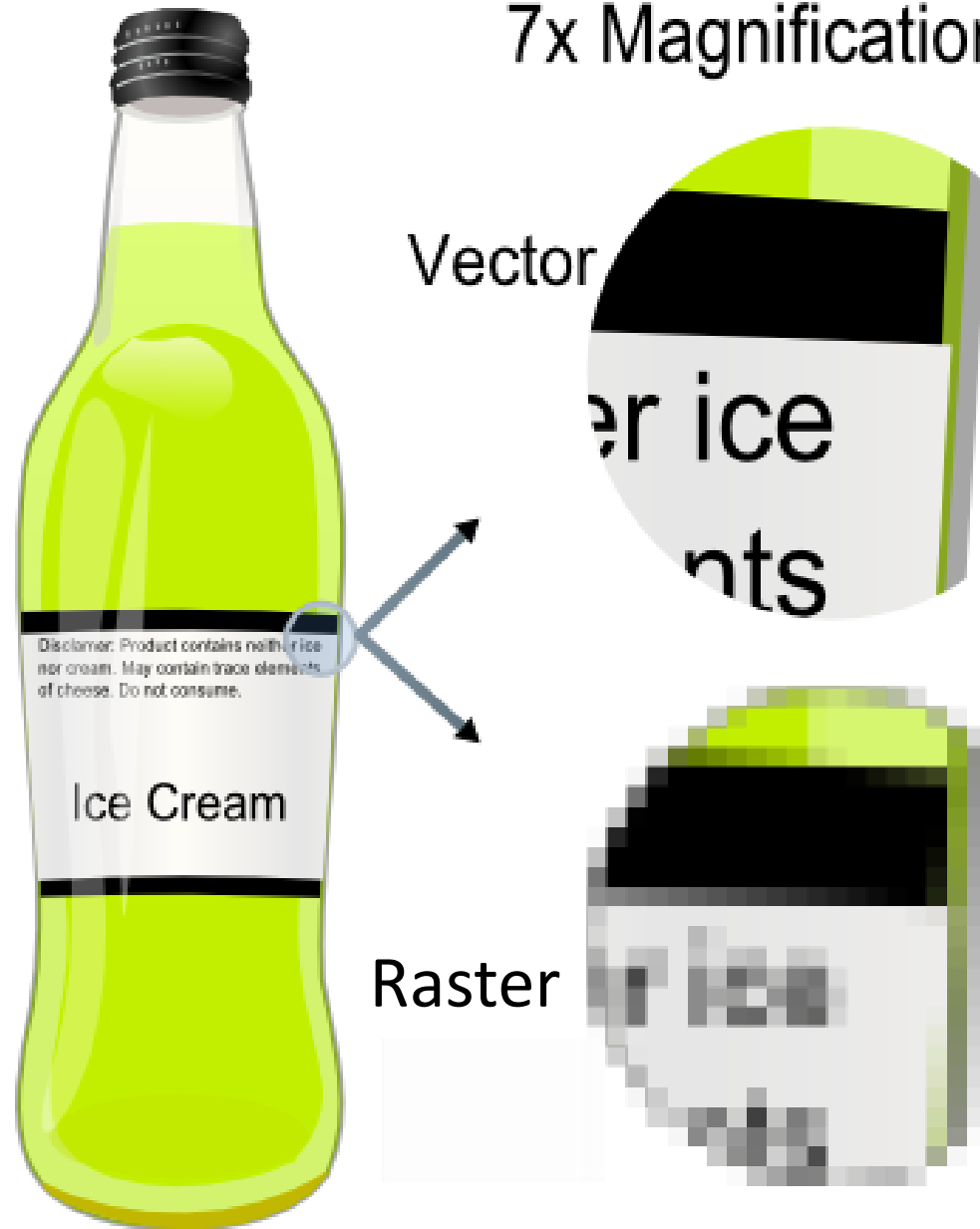
Vector graphics have some advantages:

A vector graphic is better at scaling:

It has clean lines regardless of size

It never requires more storage space in the computer just because its dimensions increase

7x Magnification



But, vector graphics have
some disadvantages:

But, vector graphics have some disadvantages:

A Vector Graphic is worse:

For continuous color variation,

For support by different applications.

Examples

- Common Raster / Bitmap Images
 - e.g., GIF, JPG, TIFF
- Medical Image Bitmaps
 - e.g., img/hdr, BRIK/HEAD, nifti
- Common Vector Graphics
 - CGM (Computer Graphics Metafile)
 - SVG (Scalable Vector Graphics)
- Medical/Scientific Vector Graphics
 - VTK (Visualization Toolkit)

Summary

Medical images are raster graphics.

- They are based on a grid

2D raster graphics consist of pixels.

3D raster graphics consist of voxels.

The vector graphic

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graph TD; A[The vector graphic] --> B[It consists of lines, points and curves]; A --> C[It is more efficient for scaling (resizing).]; A --> D[It doesn't handle continuous color variation as well.]
```

It consists of lines, points and curves

It is more efficient for scaling (resizing).

It doesn't handle continuous color variation as well.

Raster/Bitmap

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