https://genuinenotes.com

Computer Graphics

Unit 2

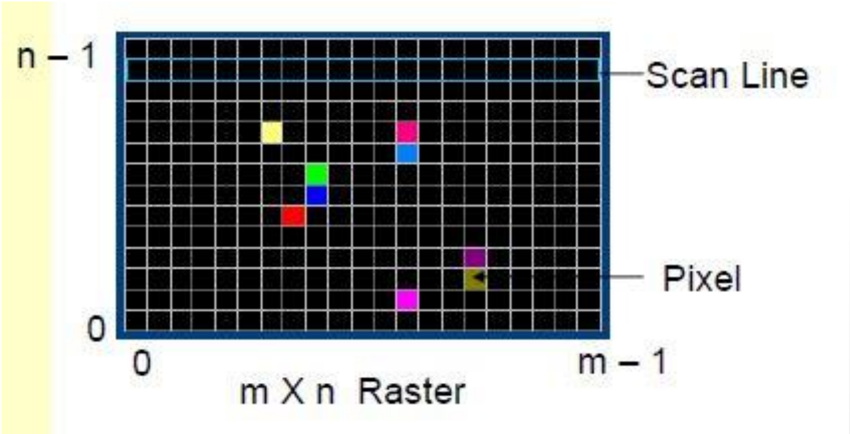
(Hardware and Software Concept)

Nipun Thapa (Computer Graphics)

https://genuinenotes.com

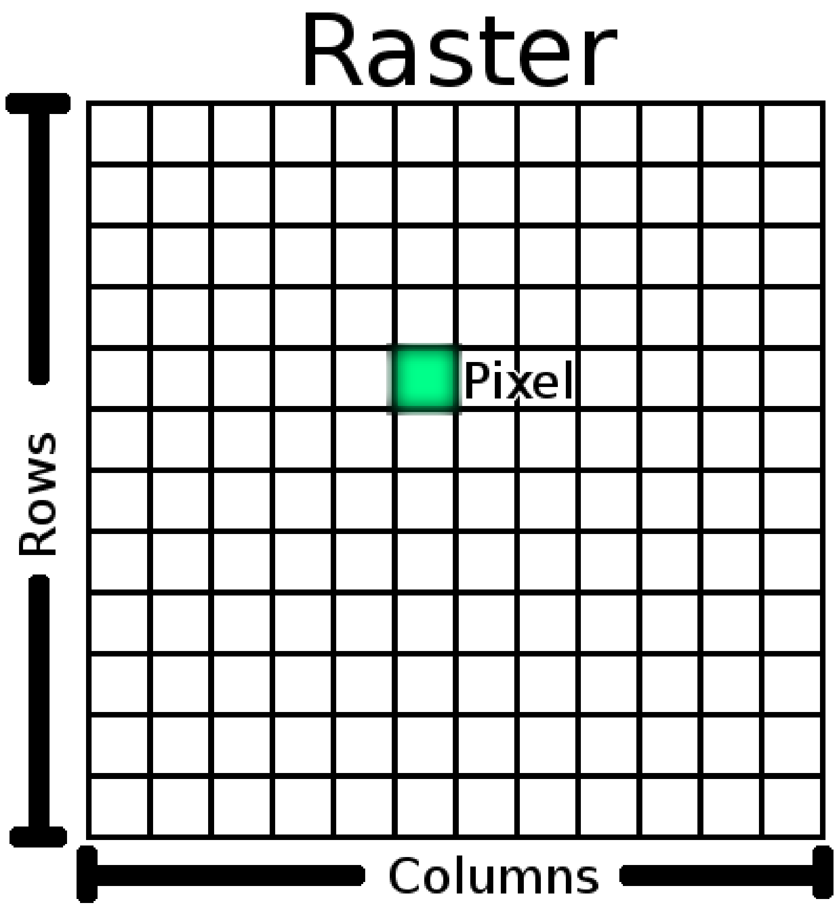
Basic Concept

- **RASTER :** A rectangular array of points or dots.
- **PIXEL** (picture element) **:**One dot or picture element of the raster
- **SCAN LINE :** A row of pixels
- **BITMAP :**ones and zeros representation of the rectangular array points on screen
  - Black and white :- bitmap
  - Pixmap :- color (colored raster image)



Raster

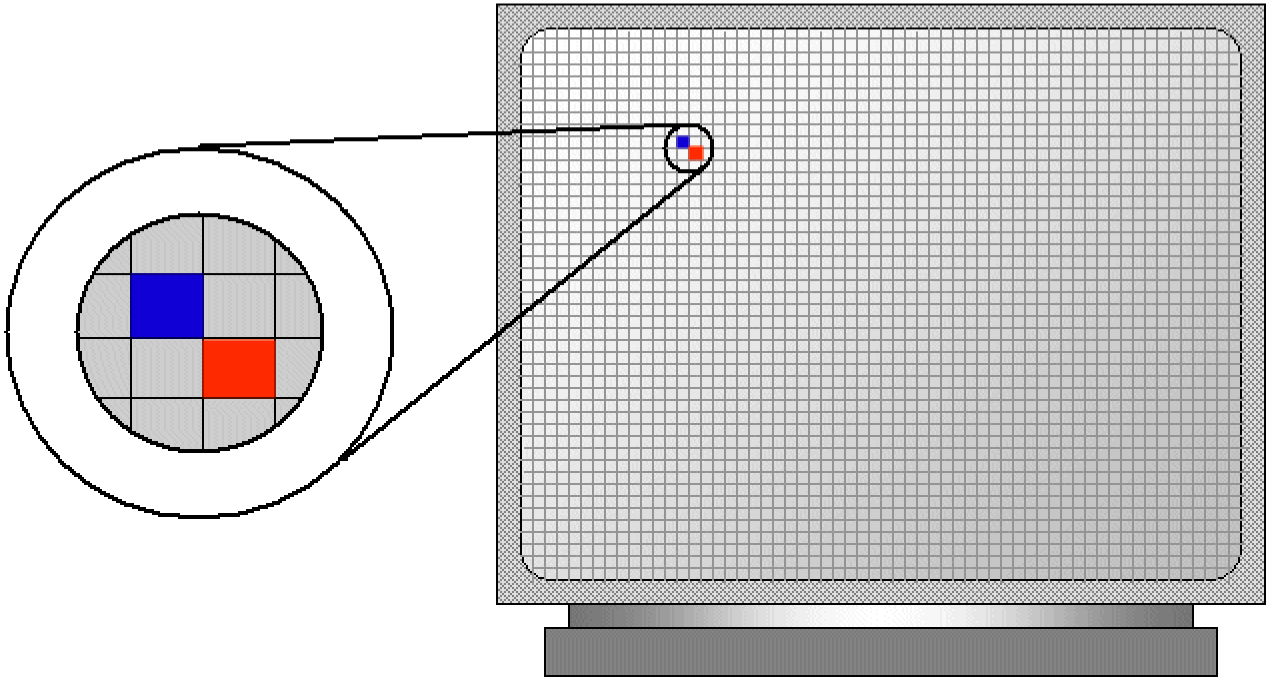
- A rectangular array of points or dots.



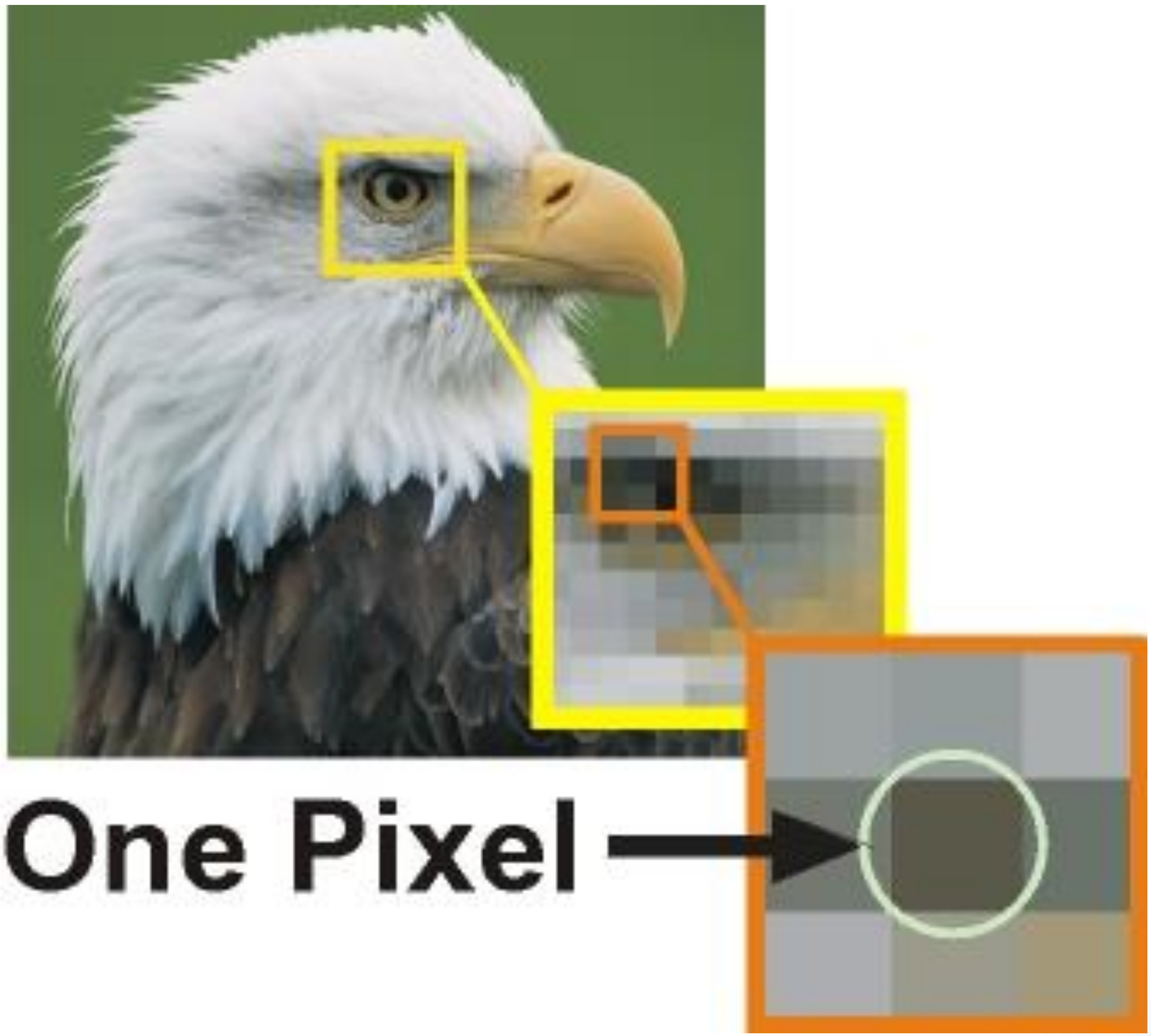
https://genuinenotes.com

Pixel

- One dot or picture element of the raster
- The pixel (a word invented from "picture element") is the basic unit of programmable color on a computer display or in a computer image

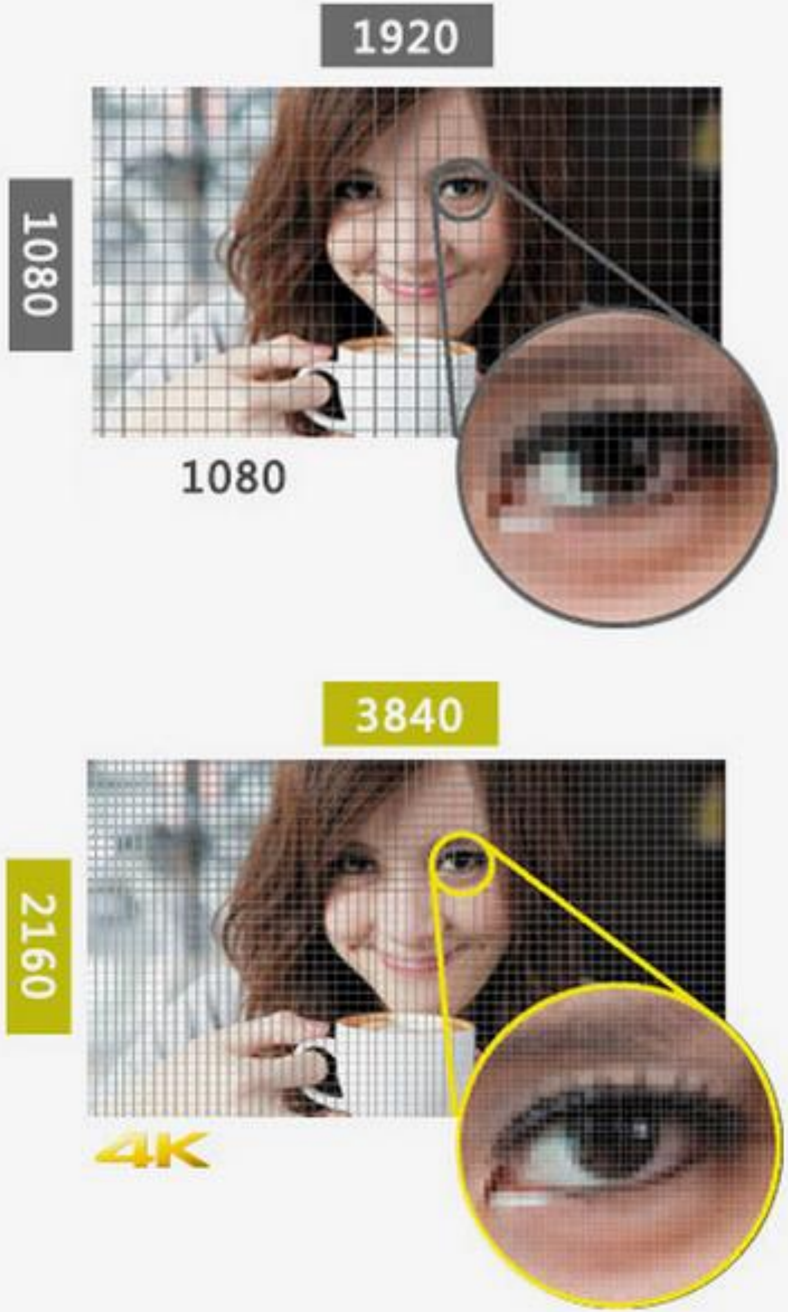


Pixel



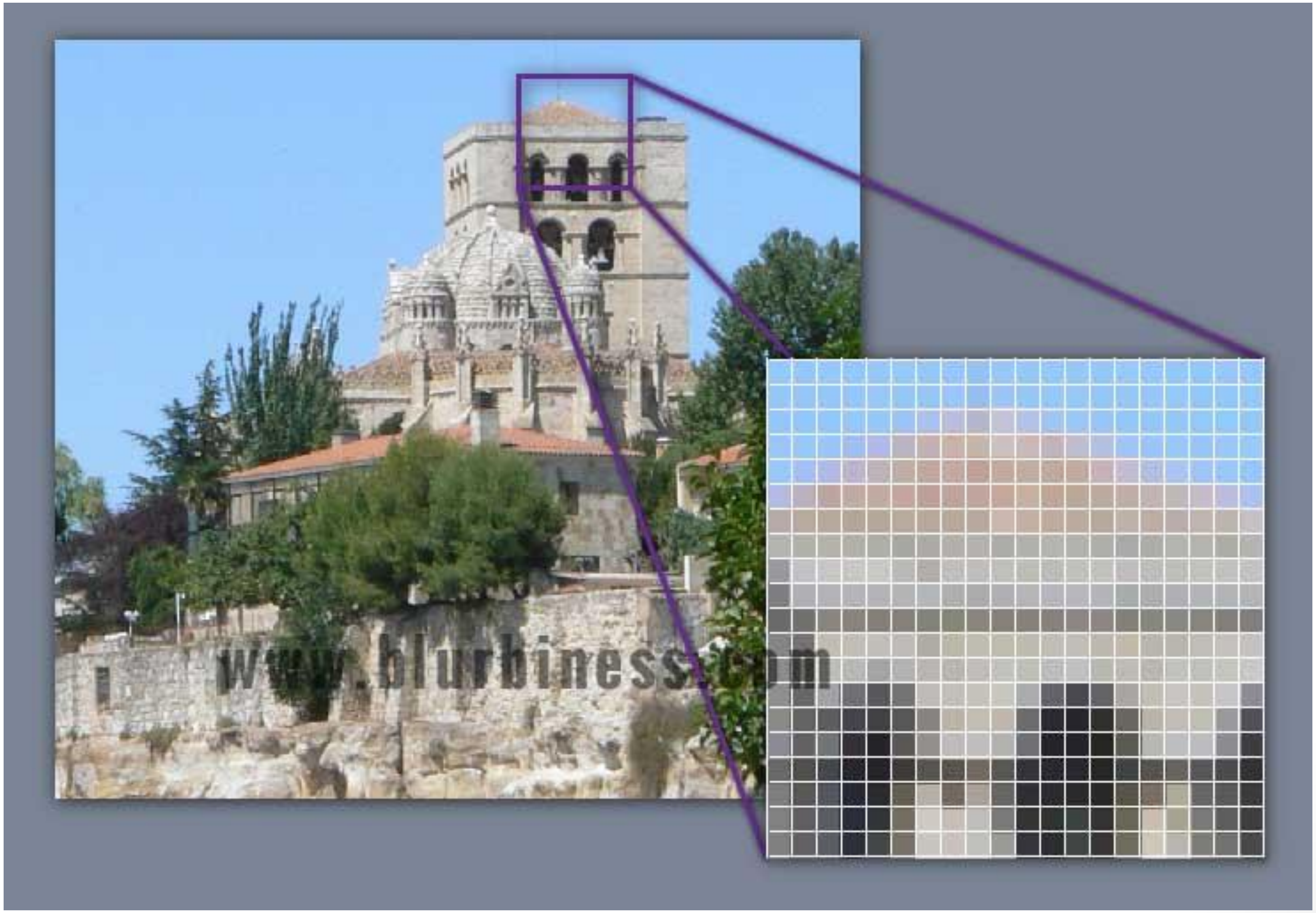
https://genuinenotes.com

Pixel



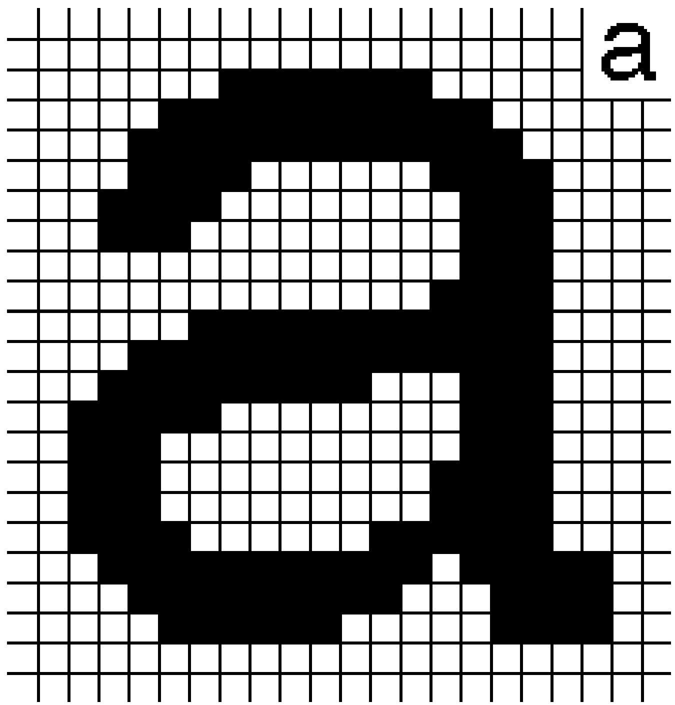
https://genuinenotes.com

Pixel



Bitmap

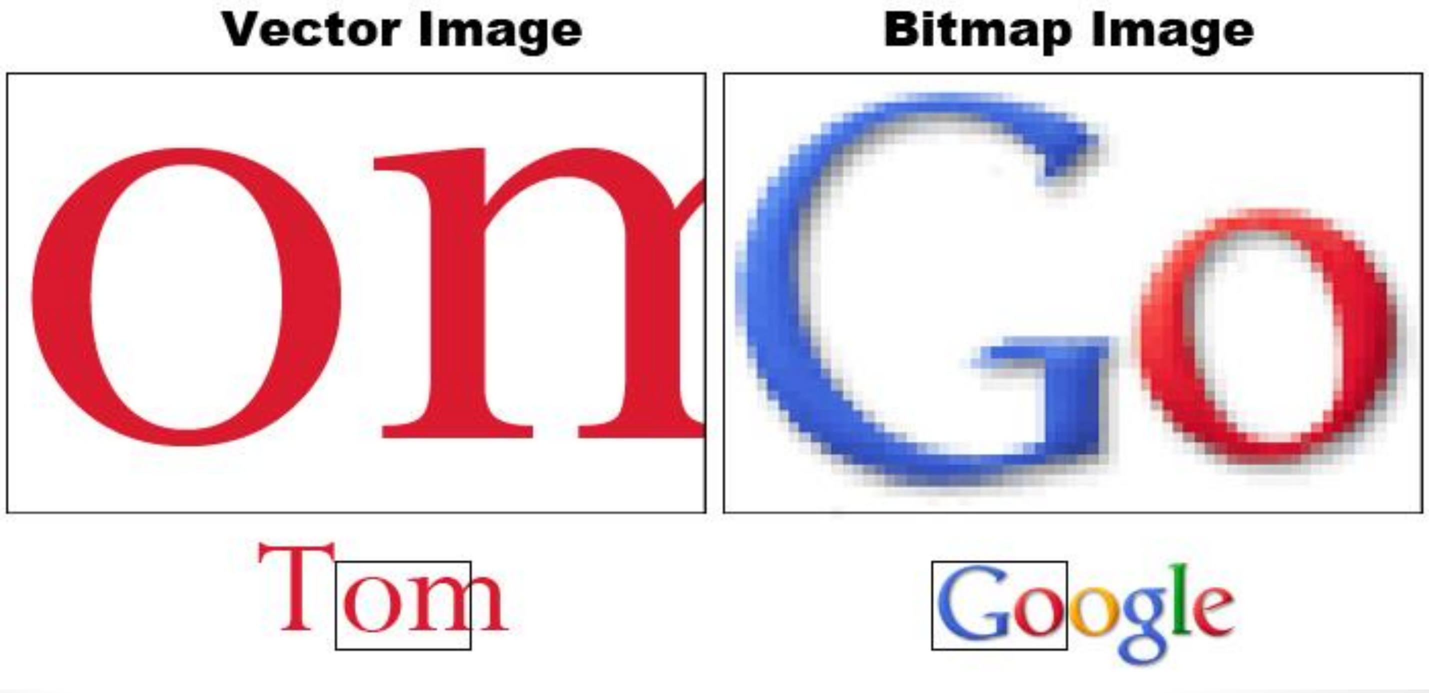
- ones and zeros representation of the rectangular array points on screen
  - Black and white :- bitmap
  - Pixmap :- color (colored raster image)



https://genuinenotes.com

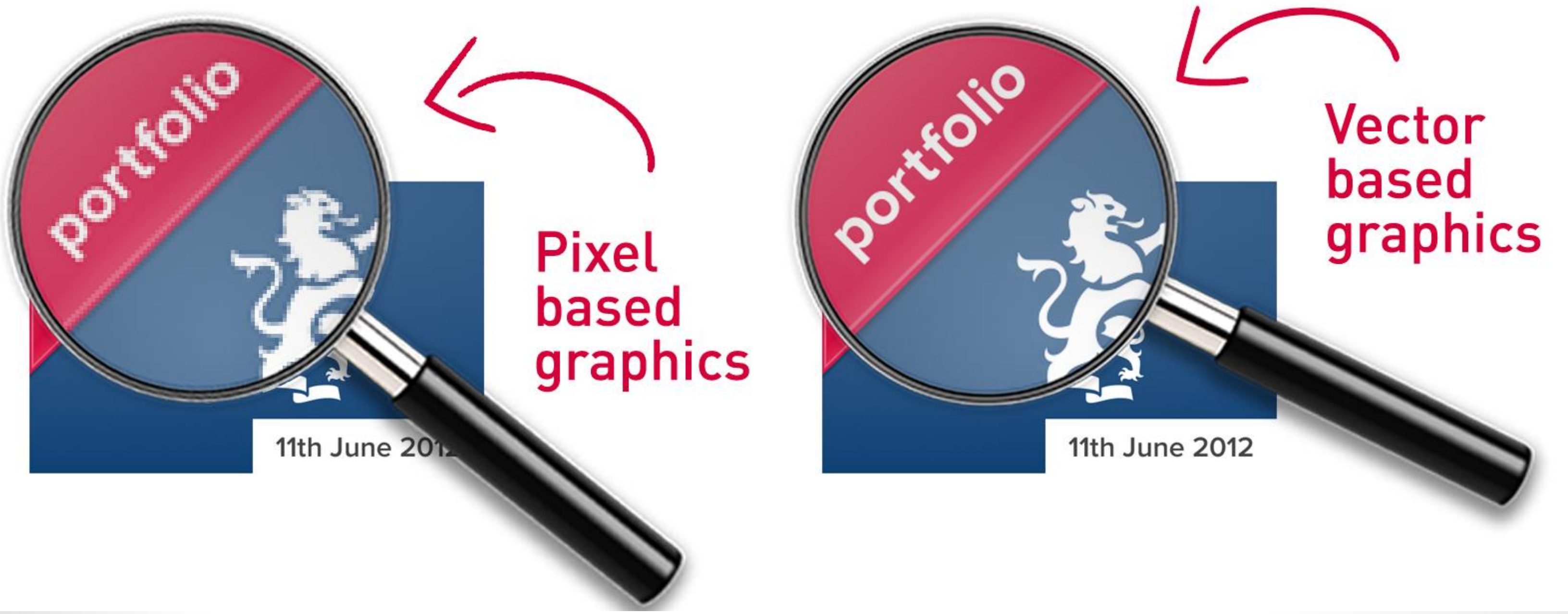
Vector

- **Vector graphics** is the creation of digital **images** through a sequence of commands or mathematical statements that place lines and shapes in a given two-dimensional or three-dimensional space. In physics, a **vector** is a representation of both a quantity and a direction at the same time.



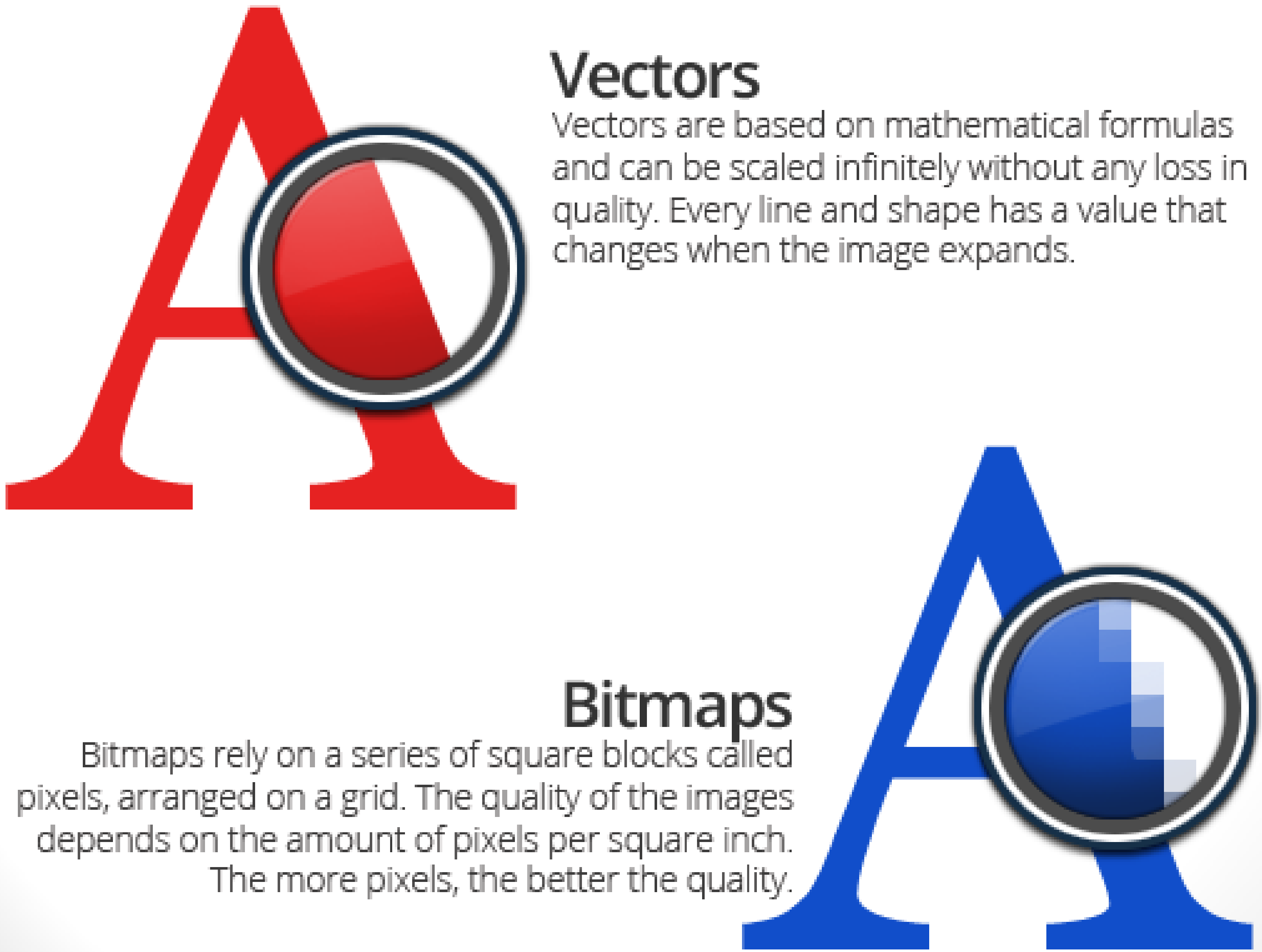
Vector

- Vector graphics are based on vectors, which lead through locations called control points or nodes. Each of these points has a definite position on the ***x*- and *y*-axes** of the work plane and determines the direction of the path; further, each path may be assigned various attributes, including such values as stroke color, shape, curve, thickness, and fill



https://genuinenotes.com

Vector



https://genuinenotes.com

Resolution

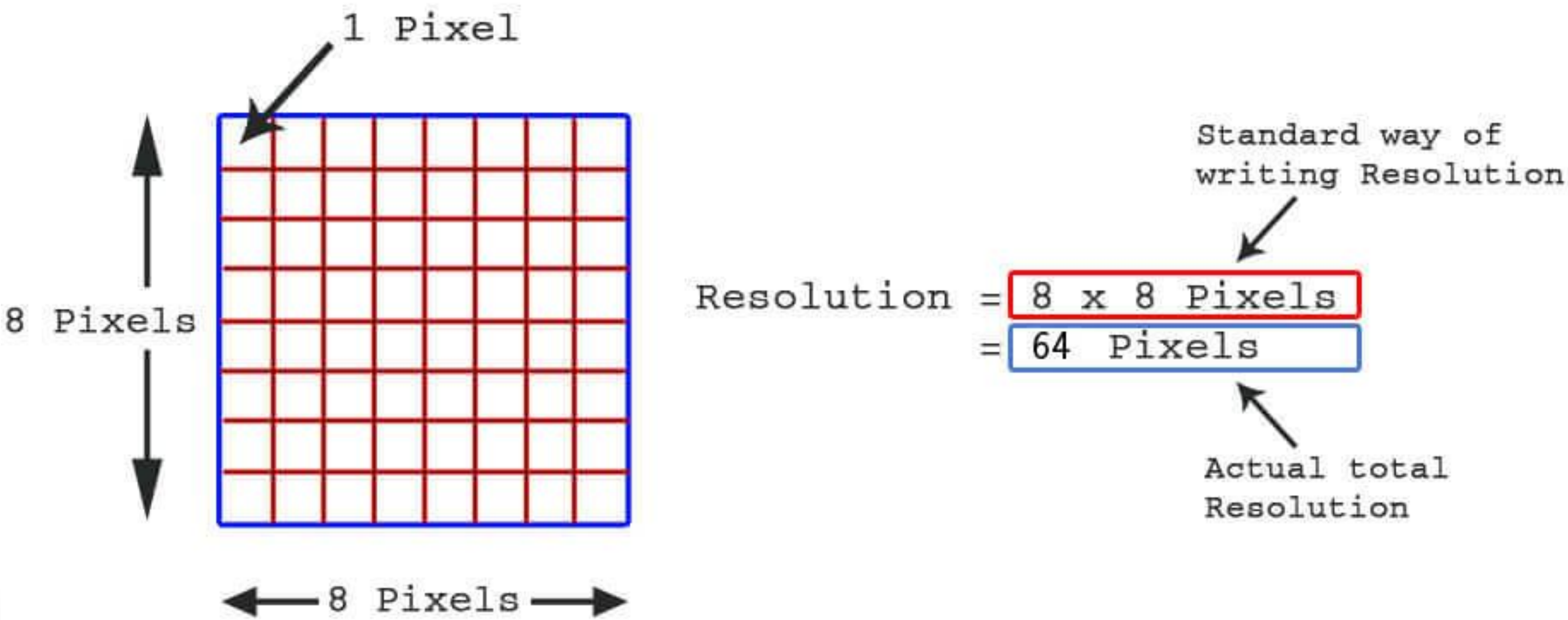
- The maximum number of points (pixel) that can be displayed without overlap on a CRT is referred to as the resolution.
- It is also defined as the number of points per unit of measure (per centimeter or per inch) that can be plotted horizontally and vertically.
- Resolution is defined as the maximum member of points that can be displayed horizontally and vertically without overlap on a display device.

https://genuinenotes.com

Resolution

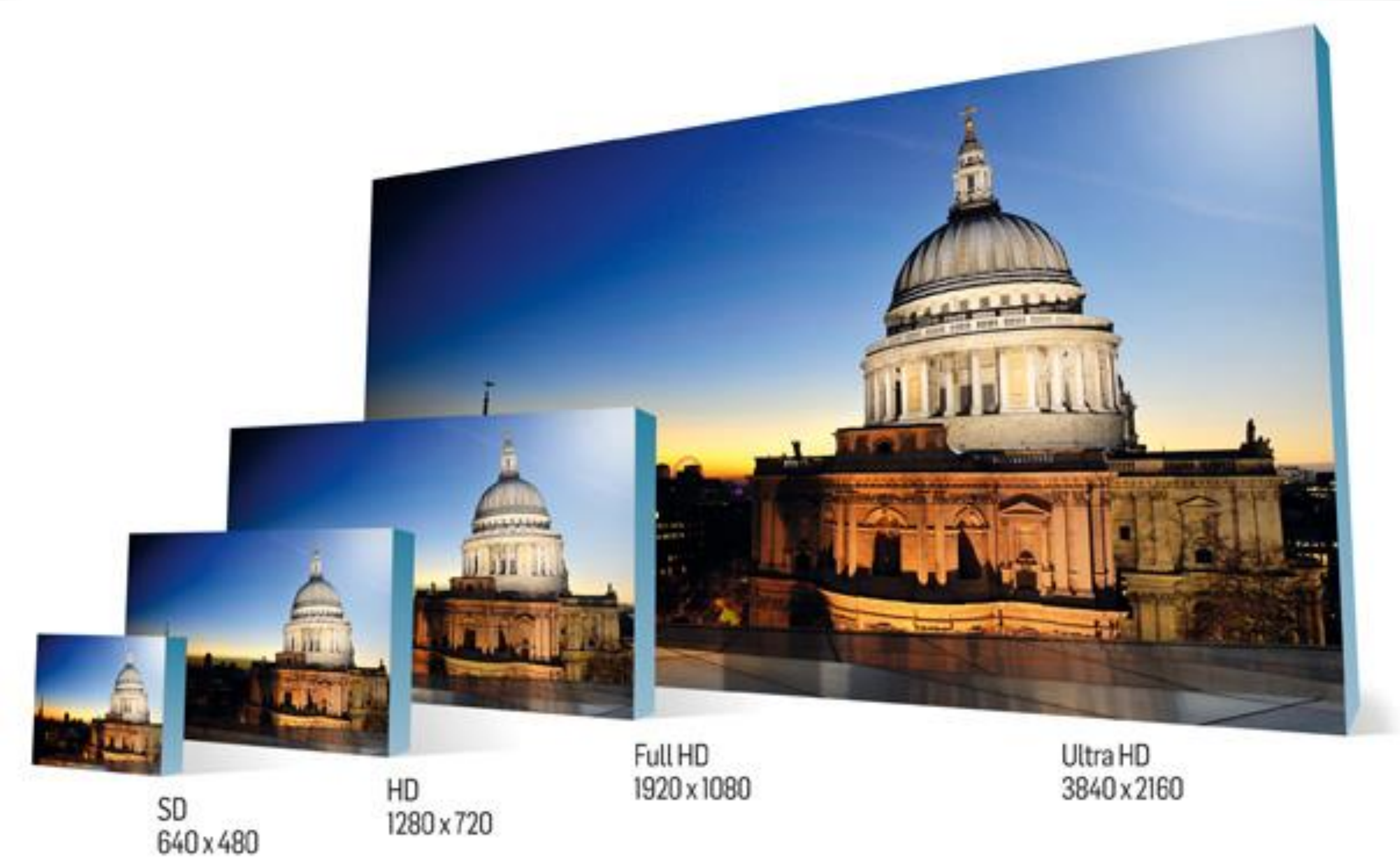
https://genuinenotes.com

Resolution



https://genuinenotes.com

Resolution



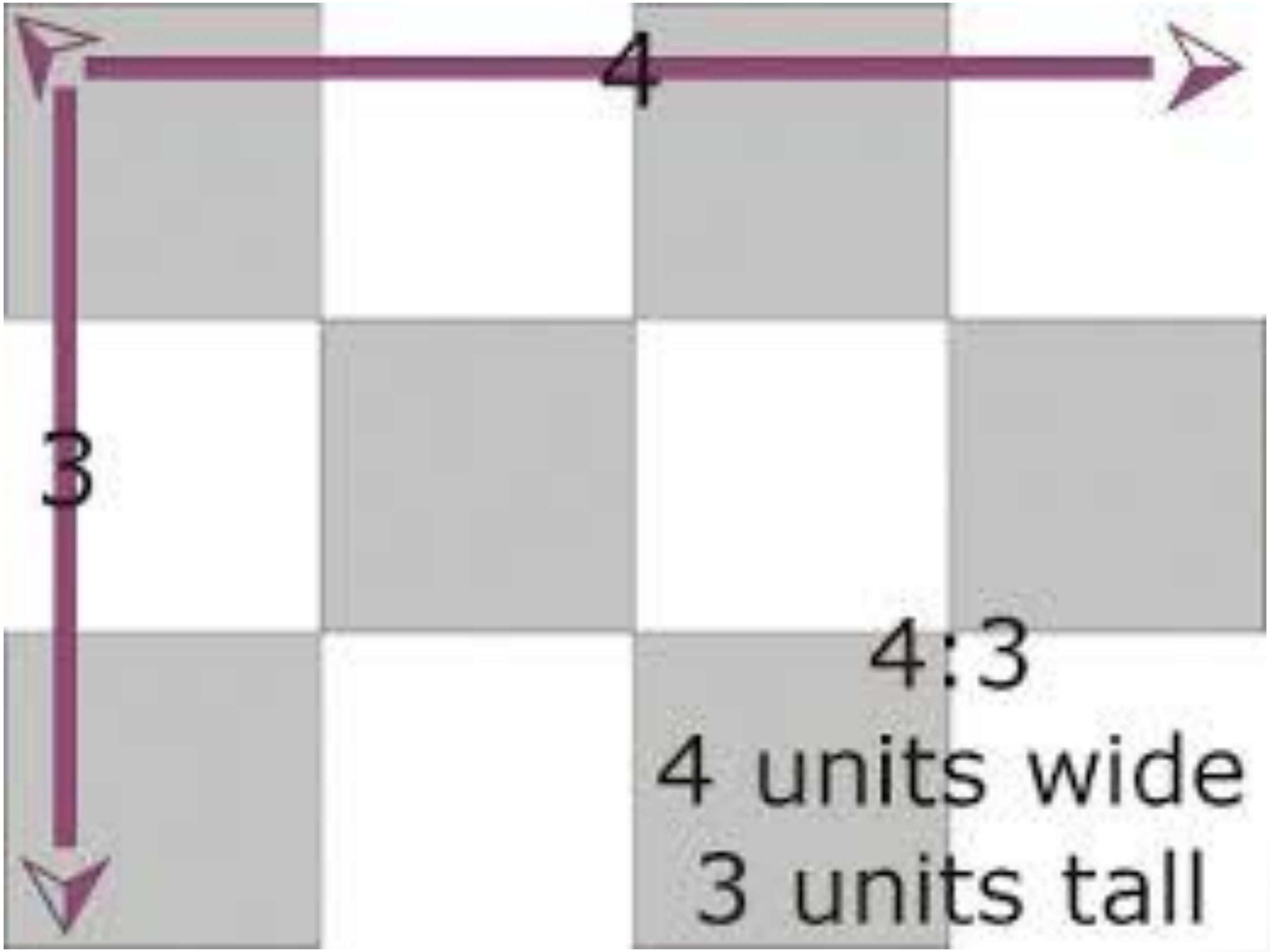
https://genuinenotes.com

Aspect Ratio

- The **aspect ratio** of an image describes the proportional relationship between its width and its height.
- It is commonly expressed as two numbers separated by a colon, as in *16:9*. For an *x*:*y* aspect ratio, no matter how big or small the image is, if the width is divided into *x* units of equal length and the height is measured using this same length unit, the height will be measured to be *y* units.
- In, for example, a group of images that all have an aspect ratio of 16:9, one image might be 16 inches wide and 9 inches high, another 16 centimeters wide and 9 centimeters high, and a third might be 8 yards wide and 4.5 yards high.

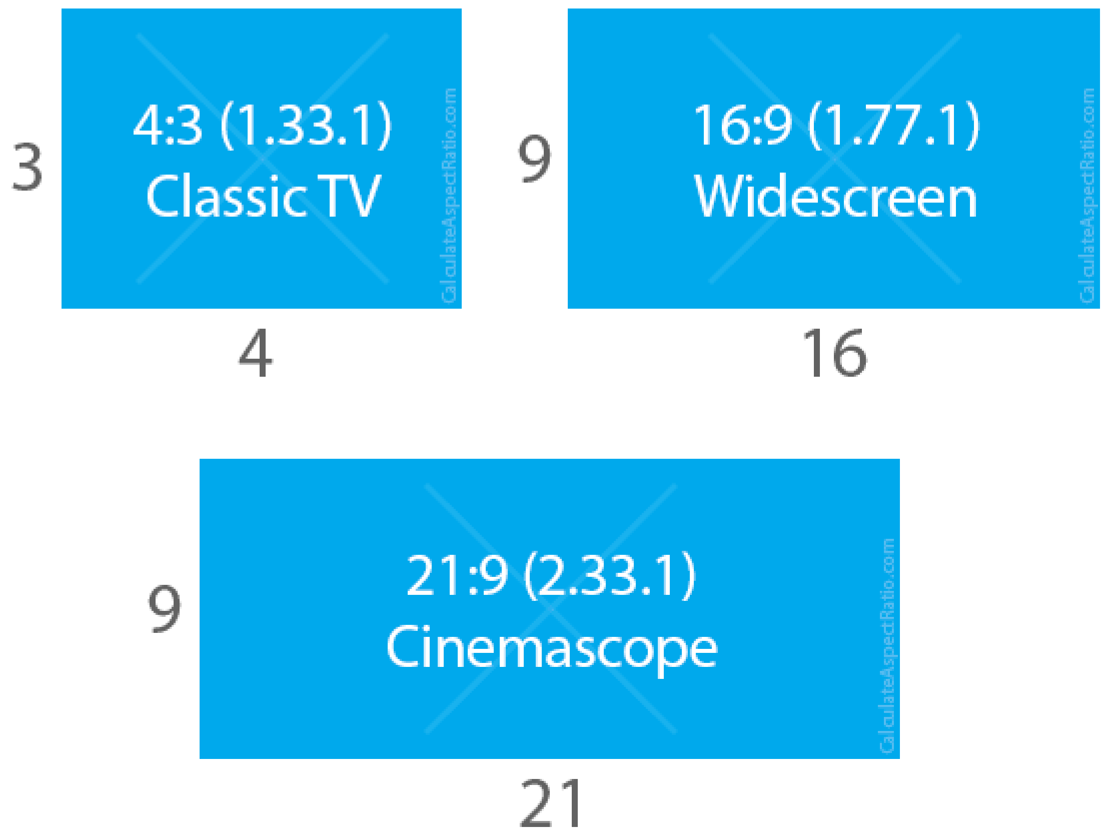
https://genuinenotes.com

Aspect Ratio



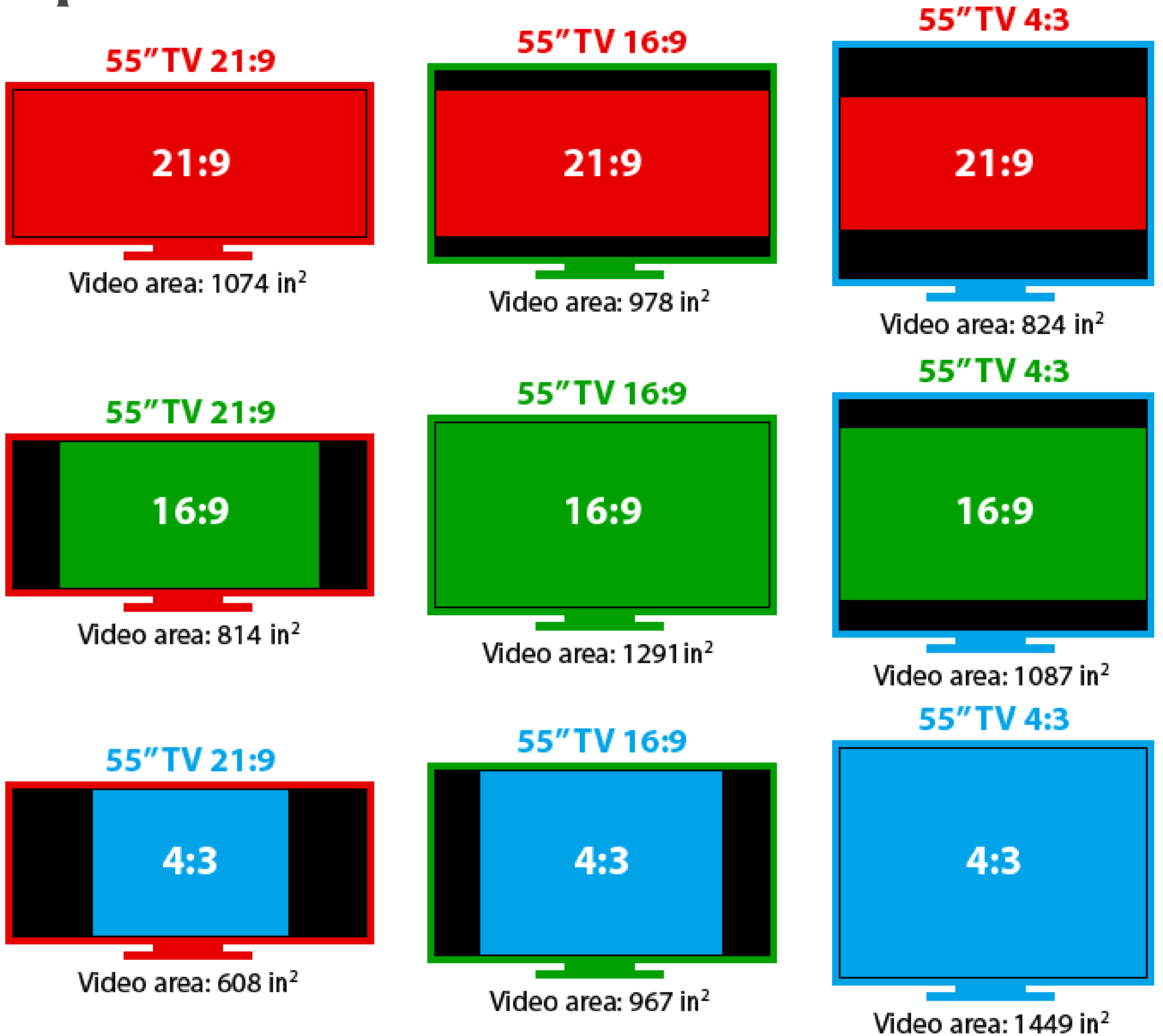
https://genuinenotes.com

Aspect Ratio



https://genuinenotes.com

Aspect Ratio



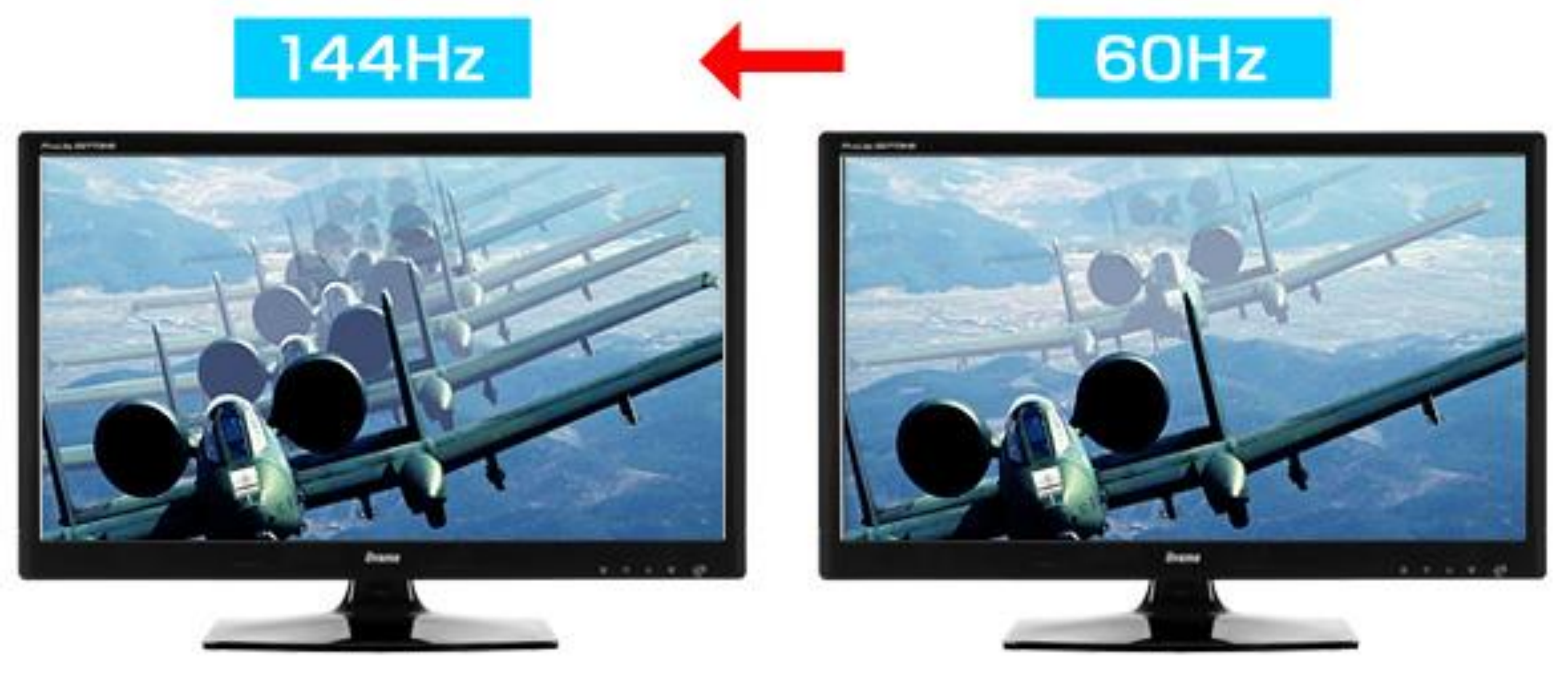
Persistence

- It means how long they continue to emit light after the electron beam is removed.
- Persistence is defined as the time it takes the emitted light from the screen to decay to one-tenth of its original intensity.
- Lower persistence phosphors require higher refresh rates to maintain a picture on the screen.
- A phosphor with lower persistence is useful for animation and a higher–persistence phosphor is useful for displaying highly complex static picture.
- Graphics monitor are usually constructed with the persistence 10 to 60 microseconds.

https://genuinenotes.com

Refresh Rate

- The number of times the screen is redrawn each second.
- Higher refresh rates mean less flicker on the screen, which translates into less eyestrain.



https://genuinenotes.com

Refresh Rate

Refresh Rate

60hz at 60fps/60fps+

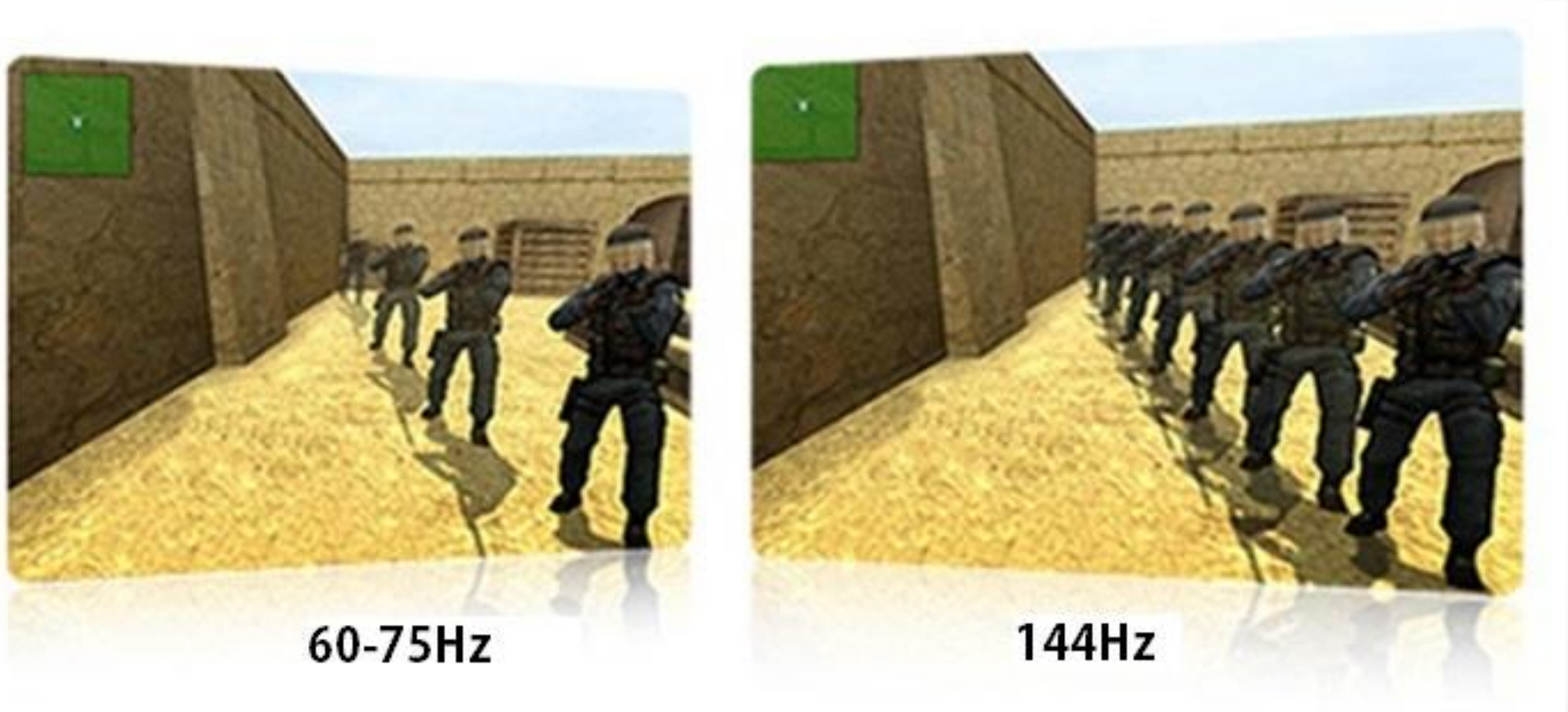
100Hz/100Hz+ at 100fps

https://genuinenotes.com

Refresh Rate

https://genuinenotes.com

Refresh Rate



https://genuinenotes.com

1. Input Devices

- Mouse, Touch Screen, Light Pen, Data Glove, Tablet (Digitizer), Bar Code Reader

https://genuinenotes.com

1.1. Mouse

- A mouse is a small hand-held device used to position the cursor on the screen.
- Mouse are relative devices, that is, they can be picked up, moved in space, and then put down gain without any change in the reported position.
  - Types
    - Mechanical mouse
    - Optical mouse

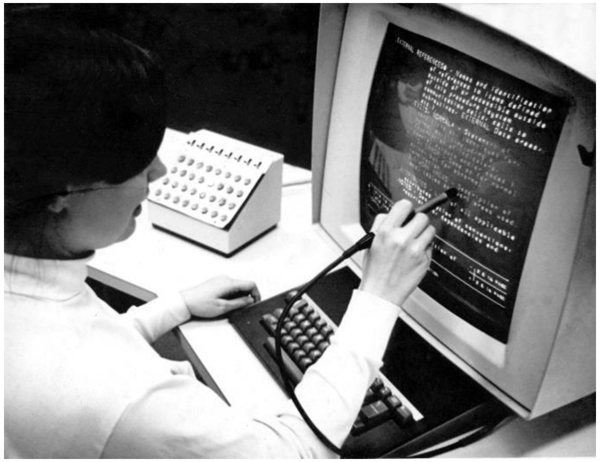
1.2. Touch Screen

- Touch panels are a sensitive surface that is used to point directly. The panel can be touched by finger or any other object like stylus. Transparent touch panels are integrated with computer monitor for the manipulation of information display. A basic touch panel senses voltage drop when a user touches the panel. It knows where the voltage has dropped and accordingly calculates the touch position.

https://genuinenotes.com

1.3. Light Pen

- a computer input device in the form of a light sensitive wand used in conjunction with a computer's CRT TV set or monitor
- works by sensing the sudden small change in brightness of a point on the screen when the electron gun refreshes that spot
- Light pens have the advantage of 'drawing' directly onto the screen, but this can become uncomfortable, and they are not as accurate as digitizing tablets

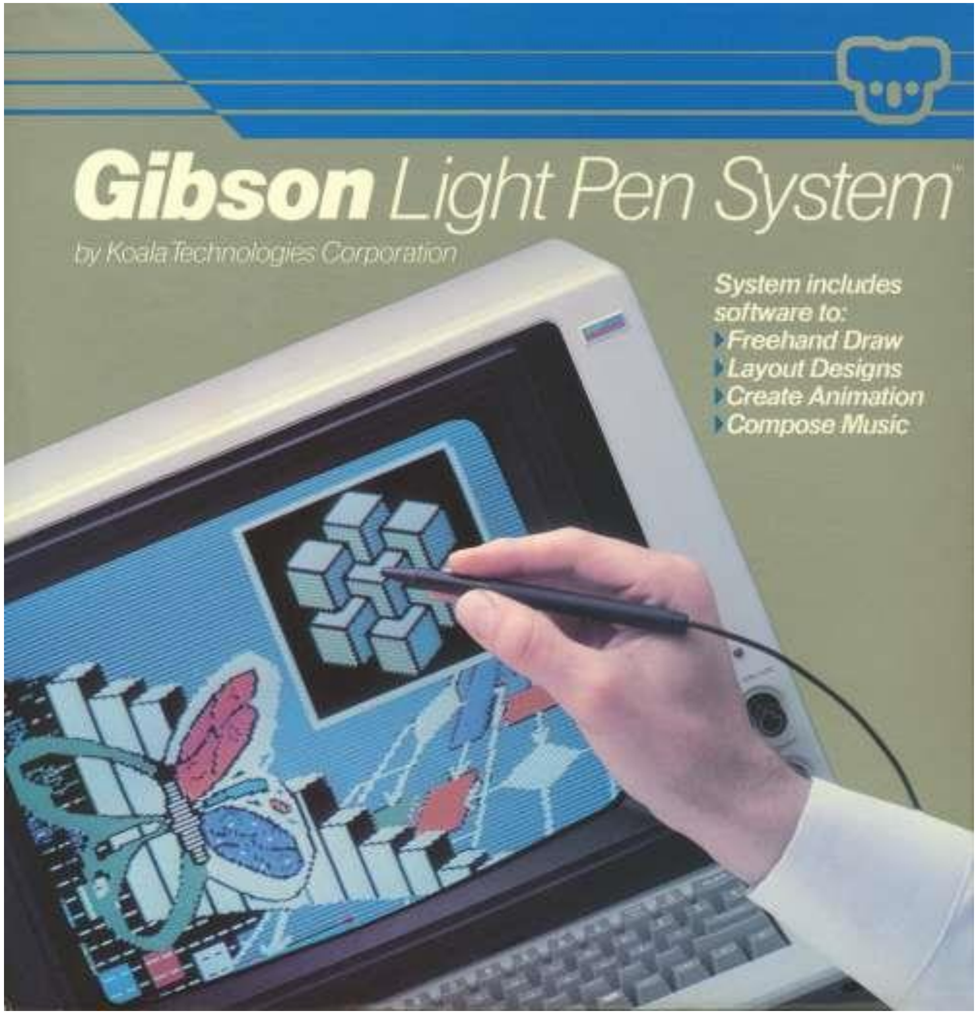


https://genuinenotes.com

1.3. Light Pen

https://genuinenotes.com

1.3. Light Pen



https://genuinenotes.com

1.4. Data Glove

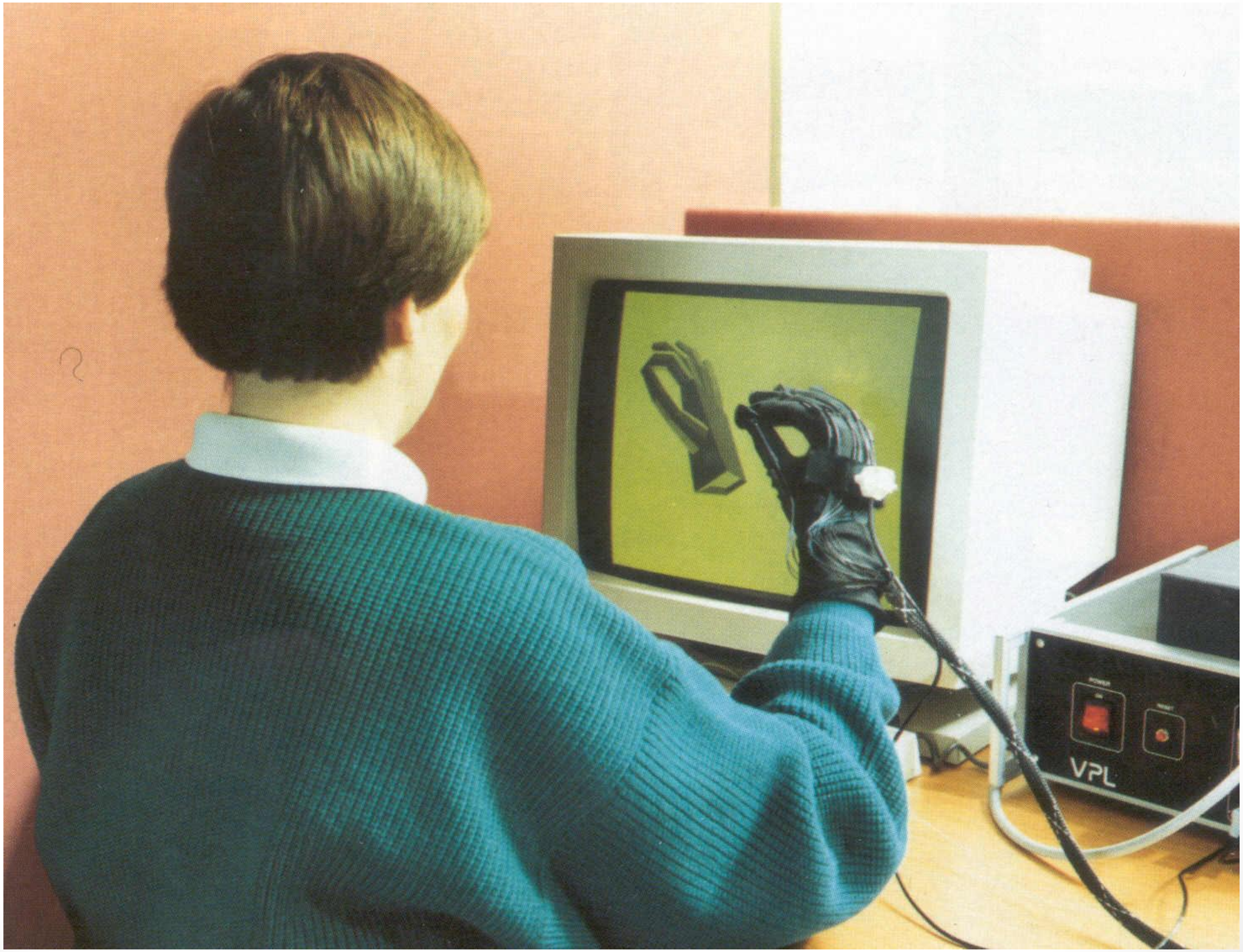
- Constructed with a series of sensors that can detect hand and finger motions.
- The transmitting and receiving antennas can be structured as a set of three mutually perpendicular cols, forming a three dimensional Cartesian coordinates system.
- Electromagnetic coupling between the three pairs of coil is used to provide information about the position and orientation of hand.

https://genuinenotes.com

1.4. Data Glove

https://genuinenotes.com

1.4. Data Glove



https://genuinenotes.com

1.4. Data Glove

https://genuinenotes.com

1.5. Tablet (Digitizer)

- A tablet is digitizer.
- In general a digitizer is a device which is used to scan over an object, and to input a set of discrete coordinate positions.
- No keyboard, no mouse. Instead, you have an LCD screen and a stylus
- You don't need to convert handwriting to text
- Tablets are gaining popularity as a replacement for the computer mouse as a pointing device

https://genuinenotes.com

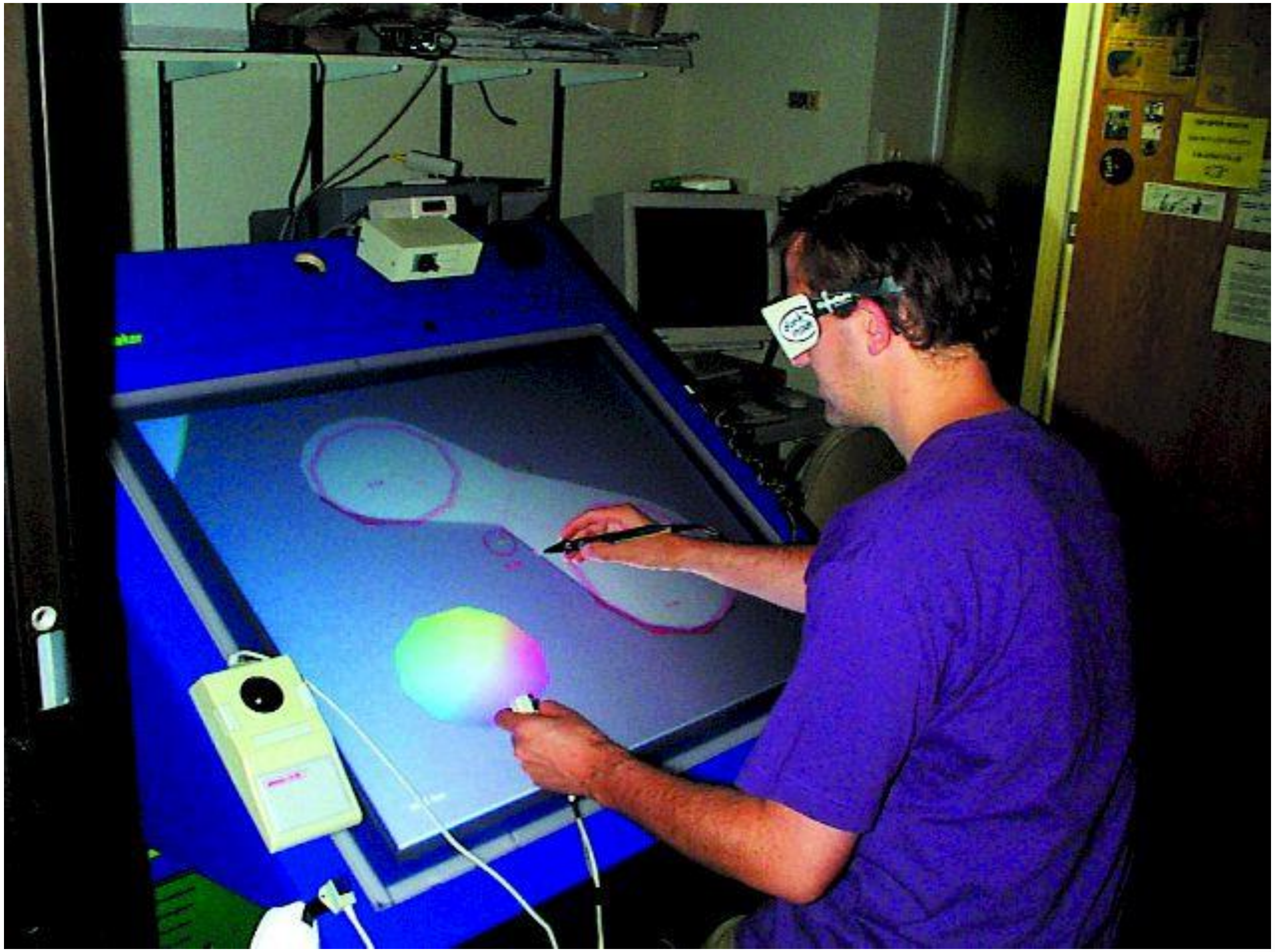
1.5. Tablet (Digitizer)

https://genuinenotes.com

1.5. Tablet (Digitizer)

https://genuinenotes.com

1.5. Tablet (Digitizer)



https://genuinenotes.com

1.6. Bar Code Reader

- A bar code is a machine-readable code in the form of a pattern of parallel vertical lines.
- They are commonly used for labeling gods that are available in supermarkets, numbering books in libraries etc.
- These codes are sensed and read by a **photoelectric device** called bar *code reader* that reads the code by means of reflected light.
- The information recorded in a bar code reader is fed into the computer, which recognizes the information from the thickness and spacing of bars.

https://genuinenotes.com

2.Output Devices

- The most common graphics output device is the video monitor which is based on the standard cathode ray tube (CRT) design, but several other technologies exist such as LCDs, LEDs, the direct view storage tube(DVST) etc.

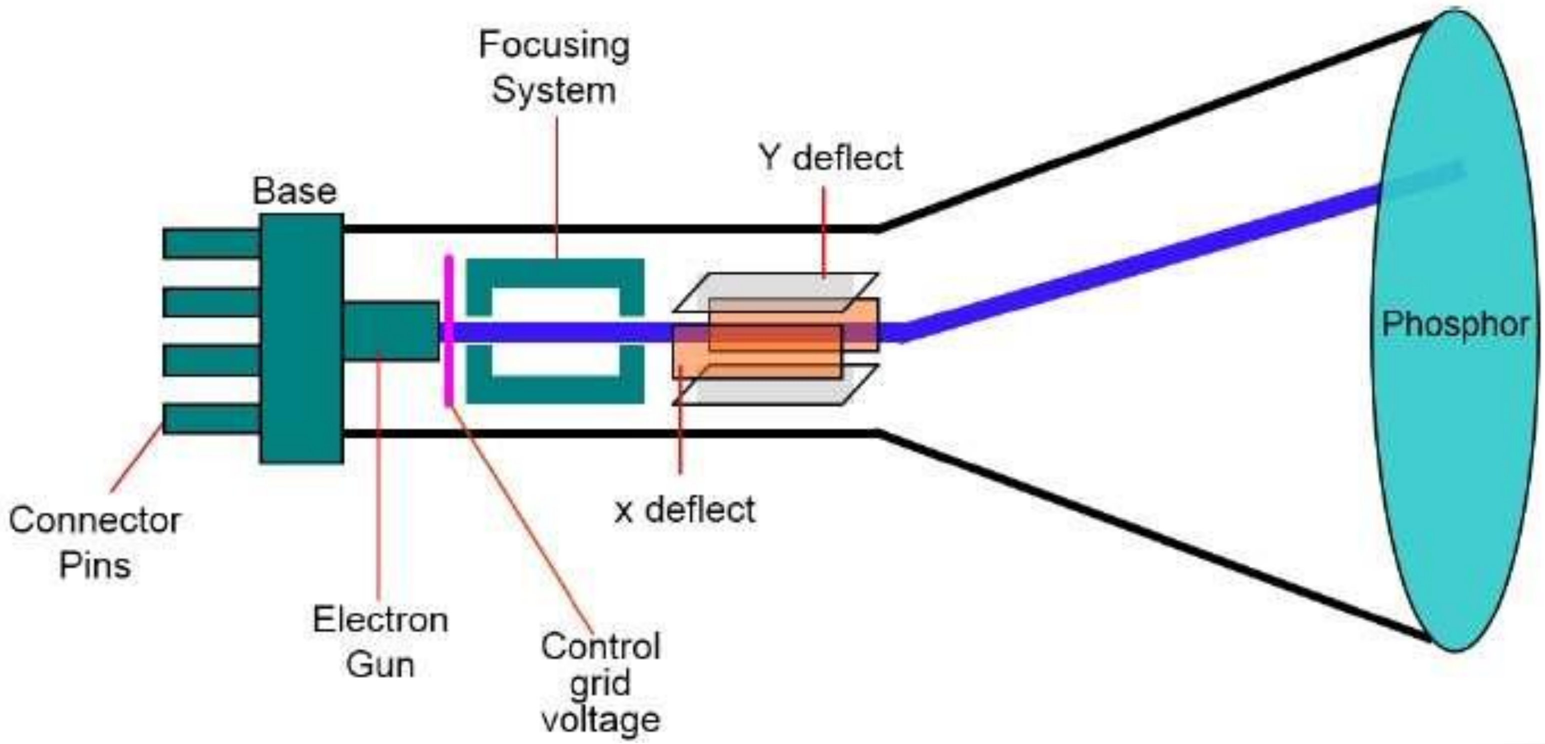
https://genuinenotes.com

2.1. CRT

- CRT are the most common display devices on computer *today*.
- A CRT is an **evacuated glass tube**, with a heating element on one end and a **phosphor-coated** screen on the other end.
- When a current flows through this heating element (filament) the conductivity of metal is reduced due to high temperature. These cause electrons to pile up on the filament.
- These electrons are attracted to a strong positive charge from the outer surface of the focusing anode cylinder.
- The forwarding fast electron beam is called **Cathode Ray**. A cathode ray tube is shown in figure below.

https://genuinenotes.com

2.1. CRT



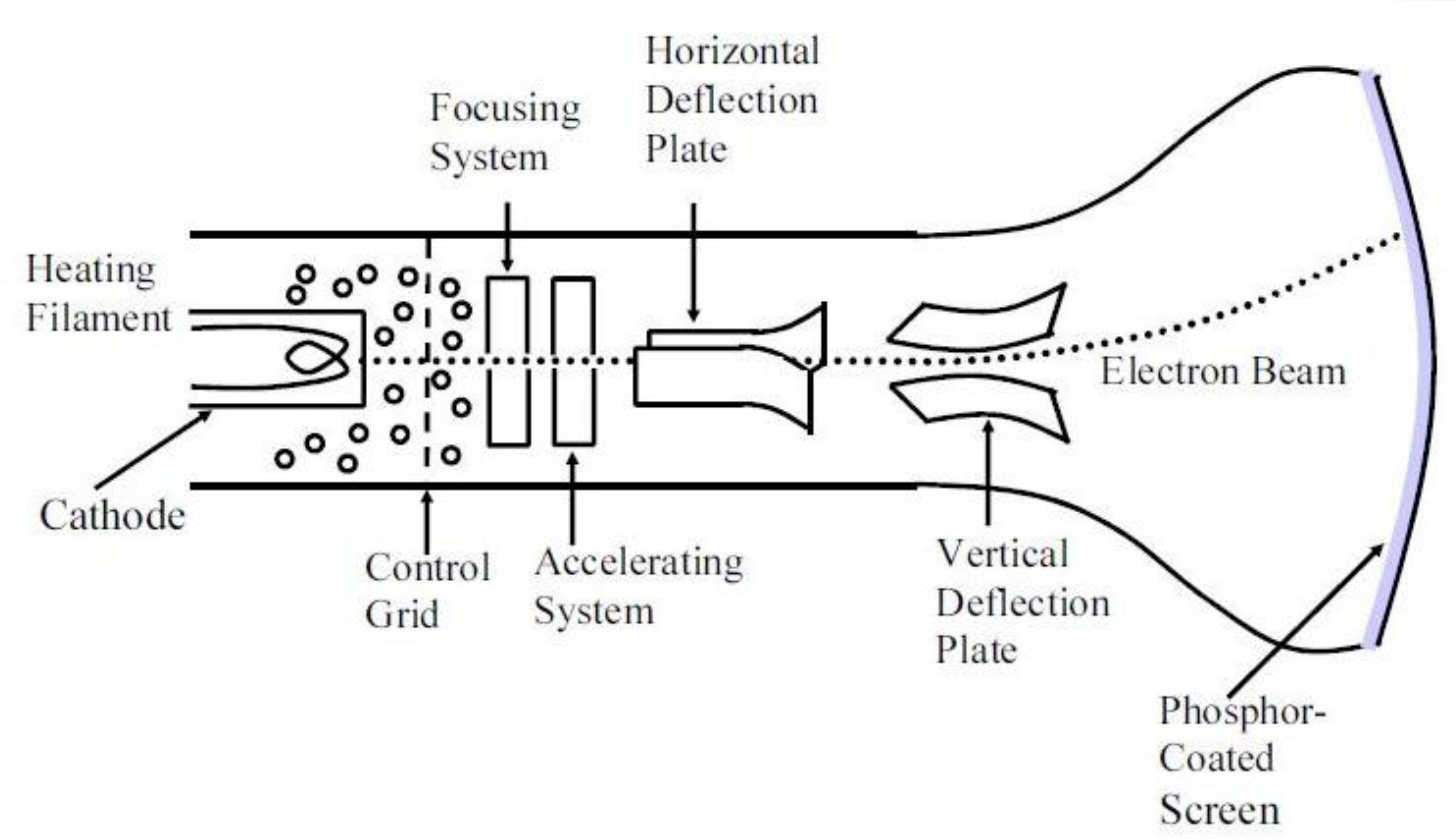
https://genuinenotes.com

2.1. CRT

- The cathode ray tube (CRT) is a tube containing one or more electron guns (a source of electron) and a fluorescent screen used to view images.
- A beam of electrons (cathode rays) emitted by an electron gun, passes through focusing and deflection systems that direct the beam toward specified positions on the phosphor-coated screen.
- When the electrons hit the screen, the phosphor emits visible light.
- Because the light emitted by the phosphor decays very rapidly with time, so the entire picture must be **refreshed** (**redrawn**) many times per second by quickly directing the electron beam back over the same points.
- Therefore, also called a ***refresh CRT***.

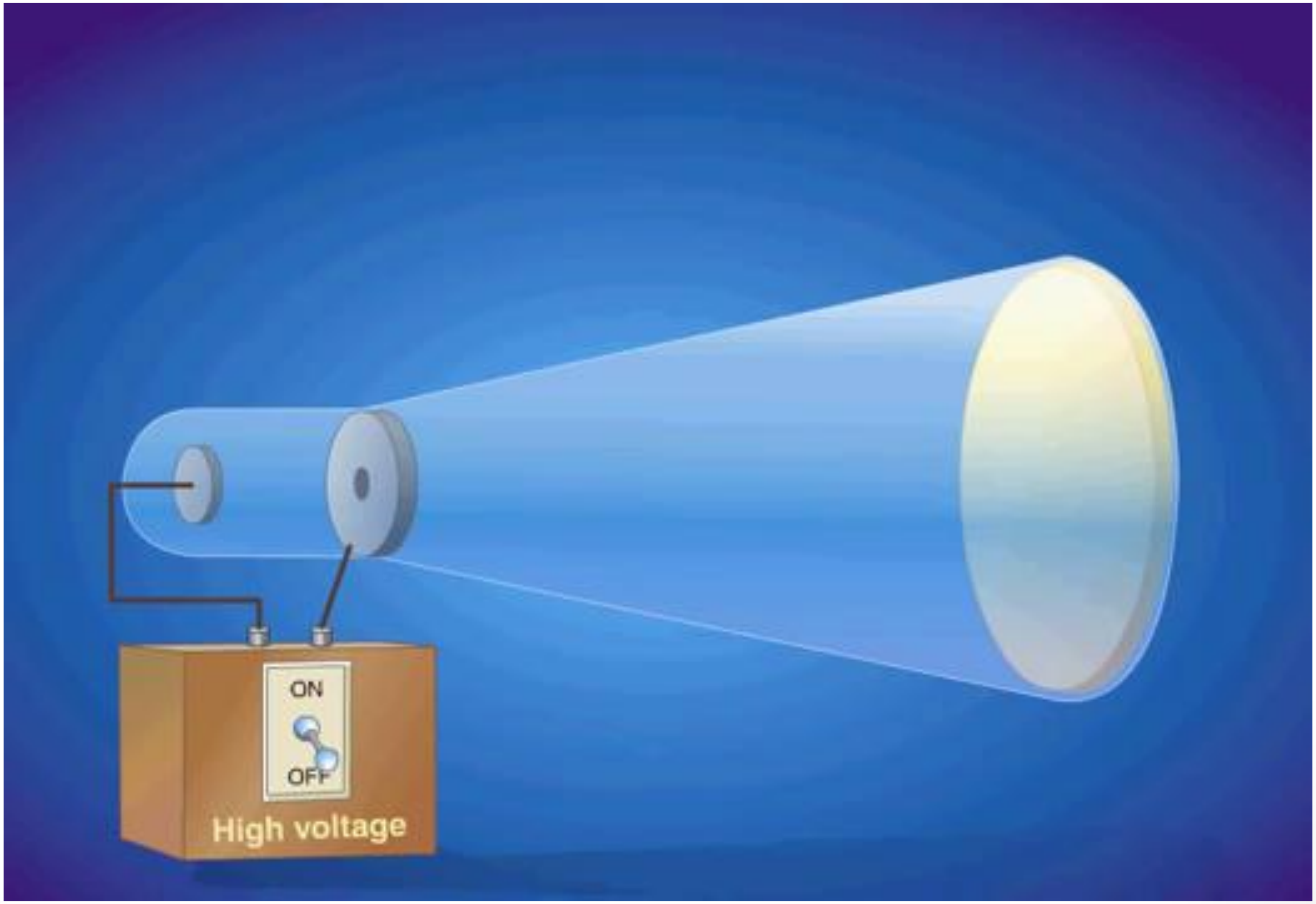
https://genuinenotes.com

2.1. CRT



https://genuinenotes.com

2.1 CRT



https://genuinenotes.com

2.1.CRT

- There are two sets of weakly charged deflection plates with oppositely charged, one positive and another negative. The first set displaces the beam up and down and the second displaces the beam left and right.
- The electrons are sent flying out of the neck of bottle (tube) until the smash into the phosphor coating on the other end.
- When electrons strike on phosphor coating, the phosphor then emits a small spot of light at each position contacted by electron beam. The glowing positions are used to represent the picture in the screen.
- The amount of light emitted by the phosphor coating depends on the no of electrons striking the screen. The brightness of the display is controlled by varying the voltage on the control grid.

https://genuinenotes.com

2.1.1Main Components of CRT

- **An electron gun**
  - The primary components of an electron gun in a CRT are the heated metal cathode and a control grid.
    - **Heated metal cathode:** Heat is supplied to the cathode by directing the beam through a coil of wire called the filament inside the cylindrical cathode structure.
    - **Control grid:** Intensity of the electron beam is controlled by setting the voltage levels on the control grid, which is a metal cylinder that fits to the cathode.
- **Focusing System & Accelerating Anode**
  - The focusing system in a CRT is needed to force the electron beam to converge into a small spot as it strikes the phosphor.
  - And the accelerating anode is used to accelerate electron beam towards the phosphor coated screen. Otherwise, the electron beam would not reach to the screen.
- **Deflection System**
  - It is used to control the vertical and horizontal scanning of the electron beam.

https://genuinenotes.com

2.1.1 Properties of CRT

- ***Persistence***
- ***Resolution***
- ***Aspect Ratio***

https://genuinenotes.com

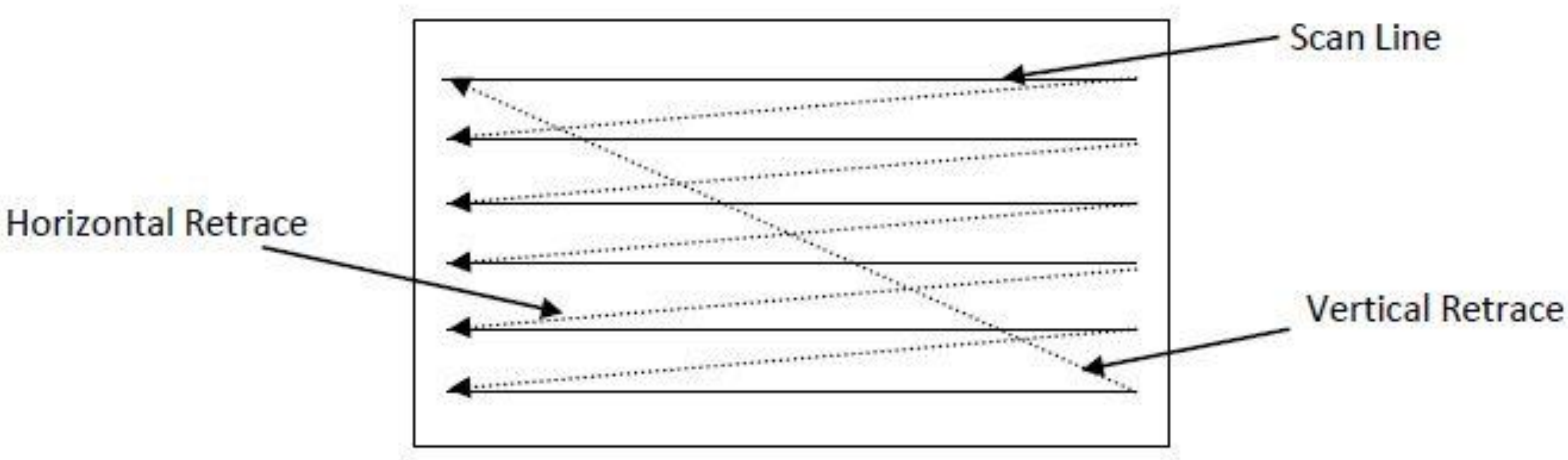
2.1.1. Types of Refresh CRT's

1. *Raster-Scan Displays*
2. *Random-Scan Displays*

https://genuinenotes.com

2.1.1.1. Raster-Scan Displays

- The most common type of graphics monitor employing a CRT is the raster-scan display. In raster scan approach, the viewing screen is divided into a large number of discrete phosphor picture elements, called pixels. Row of pixels is called the scan line. The matrix of pixels or collection of scan lines constitutes the raster (shown in figure below).



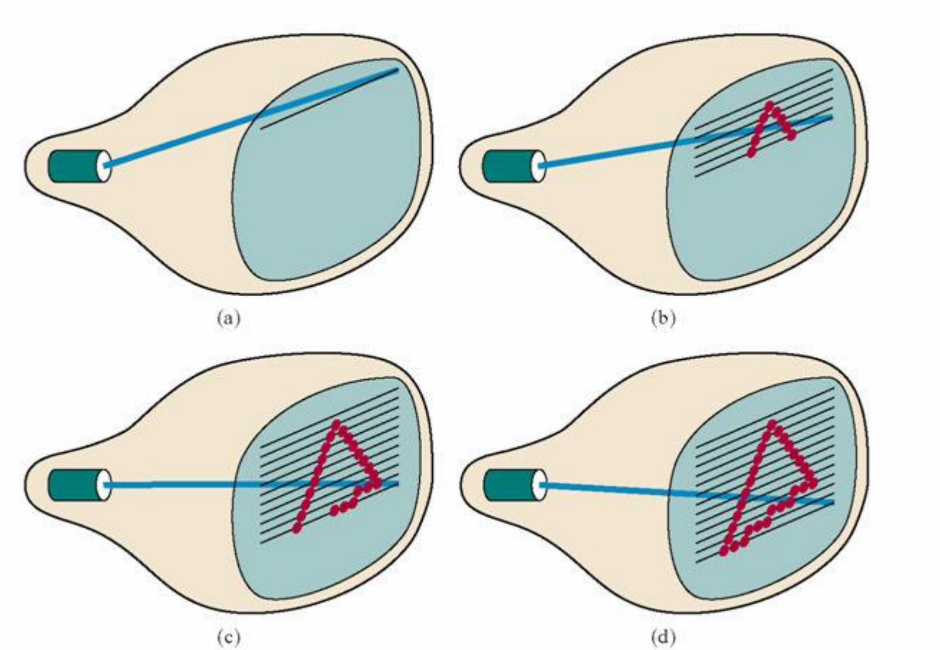
https://genuinenotes.com

2.1.1.1. Raster-Scan Displays

- *Two types of Raster-scan systems:*
    i. Non-interlaced Raster-Scan System
    ii. Interlaced Raster-Scan System

i. Non-Interlaced Raster-Scan Displays

- *In a non-interlaced raster-scan system, the electron beam is swaps across the screen, one row at a time from top to bottom. As the electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots.*



raster scan system

https://genuinenotes.com

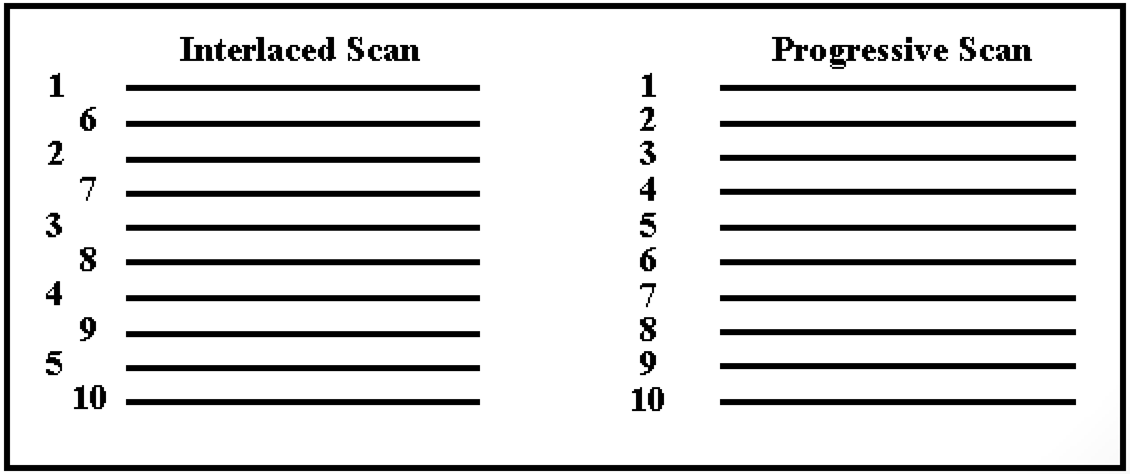
i. Non-Interlaced Raster-Scan Displays

- Picture definition is stored in a memory area, called the **refresh buffer** or **frame buffer**. This memory area holds the set of intensity values for all the screen points. Stored intensity values are then retrieved from the refresh buffer and "painted" on the screen one row (scan line) at a time
- In monochromatic CRT‟s (i.e., *black-and-white system*) with one bit per pixel, the frame buffer is commonly called a ***bitmap***. For systems with multiple bits per pixel, the frame buffer is often referred to as a ***pixmap***

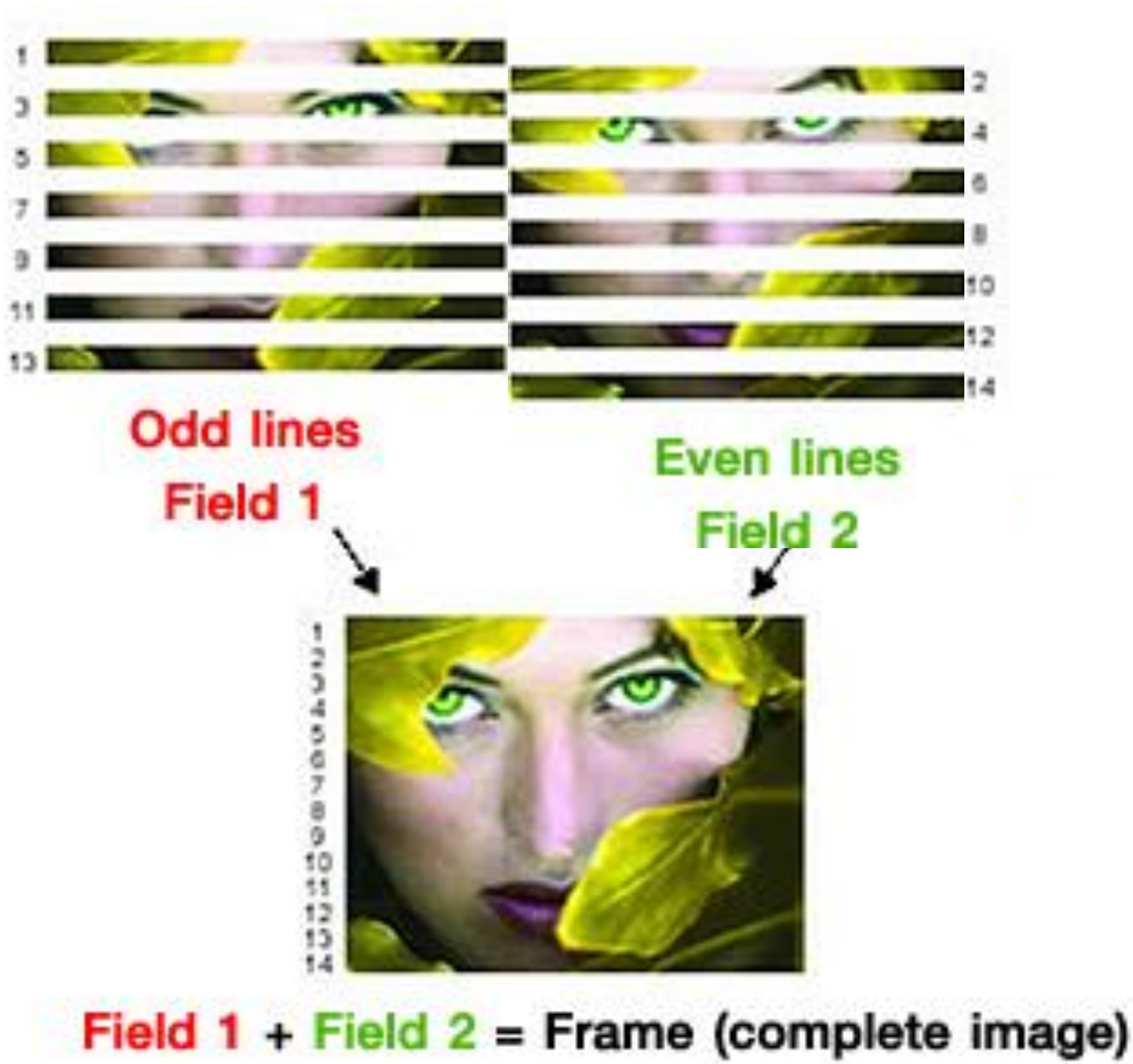
https://genuinenotes.com

ii. Interlaced Raster-Scan Displays

- On some raster-scan systems (and in TV sets), each frame is displayed in two passes using an interlaced refresh procedure. In the first pass, the beam sweeps across every other scan line from top to bottom.
- Then after the vertical re-trace, the beam sweeps out the remaining scan lines
- Interlacing is primarily used with slower refreshing rates. This is an effective technique for avoiding screen flickering.

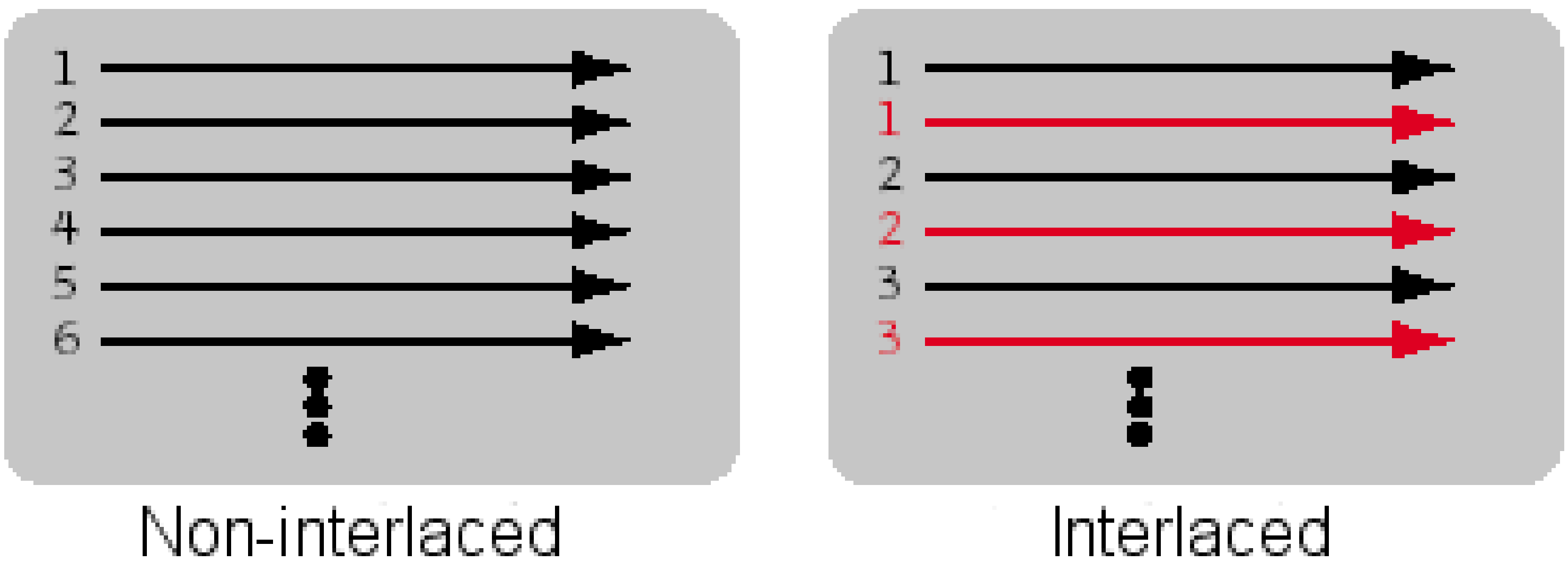


ii. *Interlaced Raster-Scan Displays*



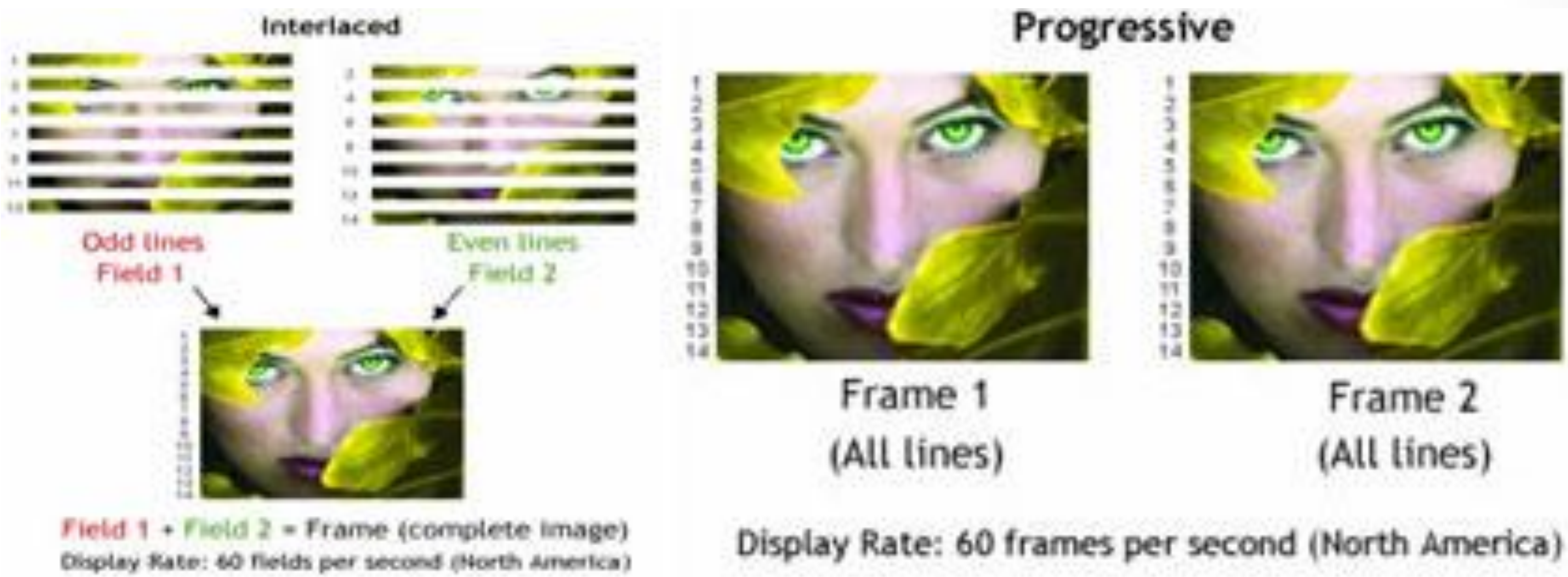
https://genuinenotes.com

Interlaced Raster-Scan System
VS
Non-interlaced Raster-Scan System



https://genuinenotes.com

Interlaced Raster-Scan System
VS
Non-interlaced Raster-Scan System



https://genuinenotes.com

Architecture of Raster Scan System

- The raster graphics systems typically consists of several processing units. CPU is the main processing unit of computer systems. Besides CPU, graphics system consists of a special purpose processor called video controller or display processor. The display processor controls the operation of the display device.
- A fixed area of system memory is reserved for the frame buffer. The video controller has the direct access to the frame buffer for refreshing the screen.

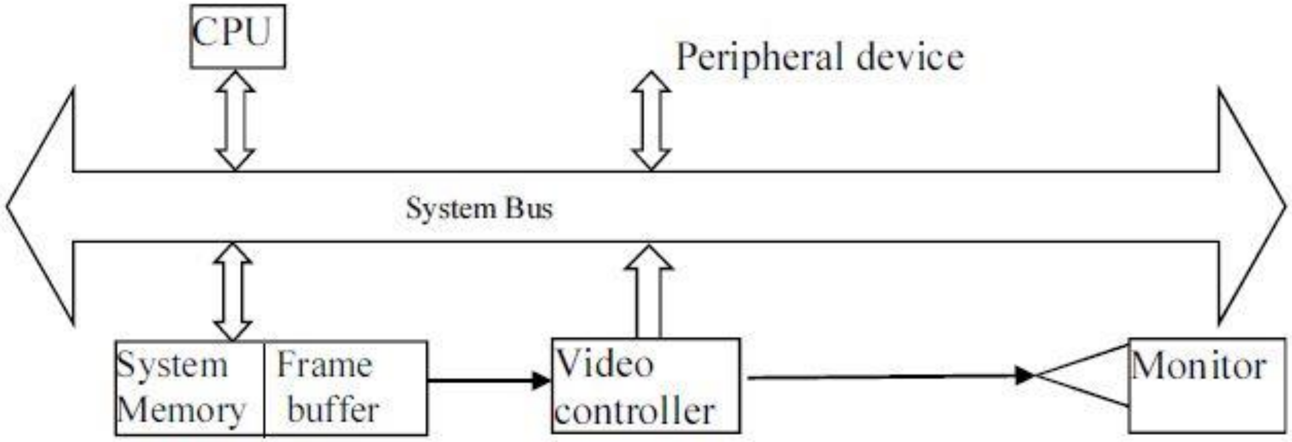
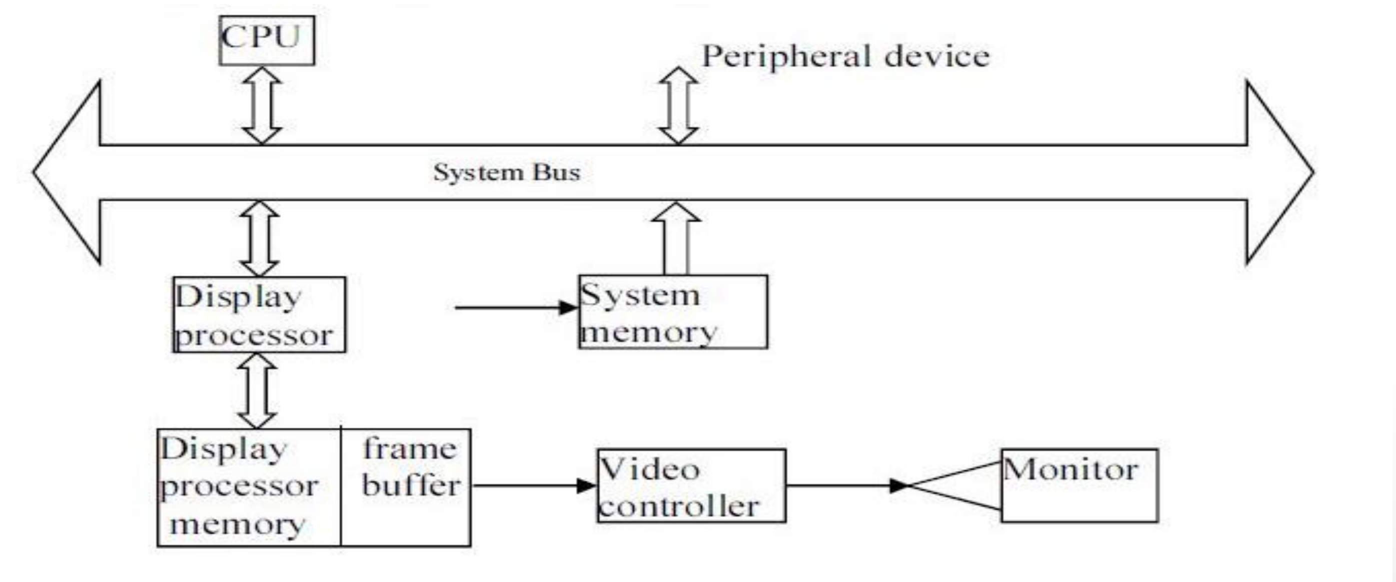


Figure: A simple Raster System.

https://genuinenotes.com

Architecture of Raster-Scan Display Processor

- The display processor has its own separate memory called display processor memory.
  - System memory holds data and those programs that execute on the CPU, and the application program, graphics packages and OS.
  - The display processor memory holds data plus the program that perform scan conversion and raster operations.
  - The frame buffer stores displayable image created by scan conversion and raster operations.



https://genuinenotes.com

2.1.1.1. Random-Scan Displays

- In a random scan display unit, electron beam directed towards only to the parts of the screen where a picture is to be drawn.
- Random-scan monitors draw a picture one line at a time and for this reason are also referred to as vector displays (or stroke-writing or calligraphic displays). Random scan system uses an electron beam which operates like a pencil to create a line image on the CRT. The component line can be drawn or refreshed by a random scan display system in any specified order

https://genuinenotes.com

2.1.1.1. Random-Scan Displays

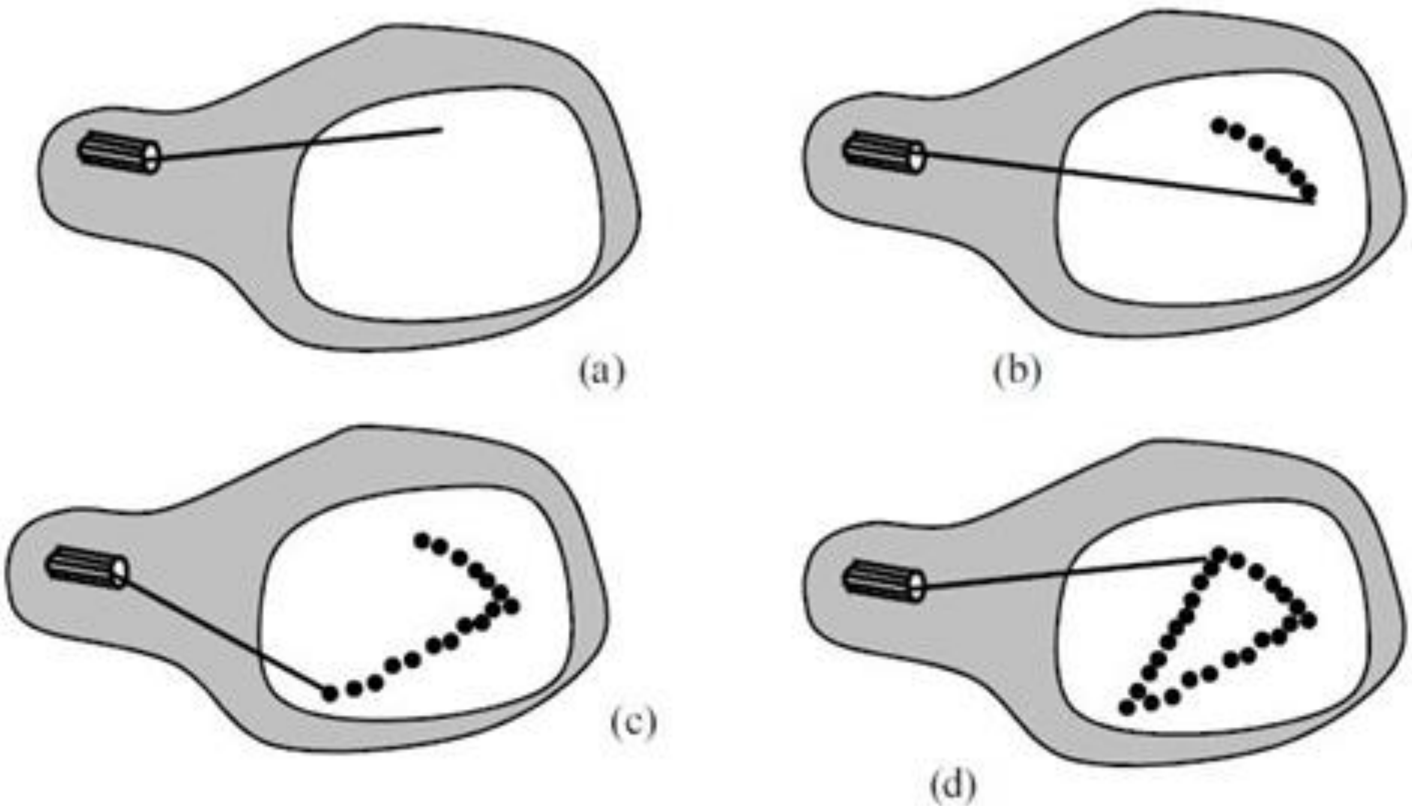


Figure: Random Scan Display

Example: *A pen plotter operates in a similar way and is an example of a random-scan, hard-copy device*

https://genuinenotes.com

Architecture of Random Scan Display

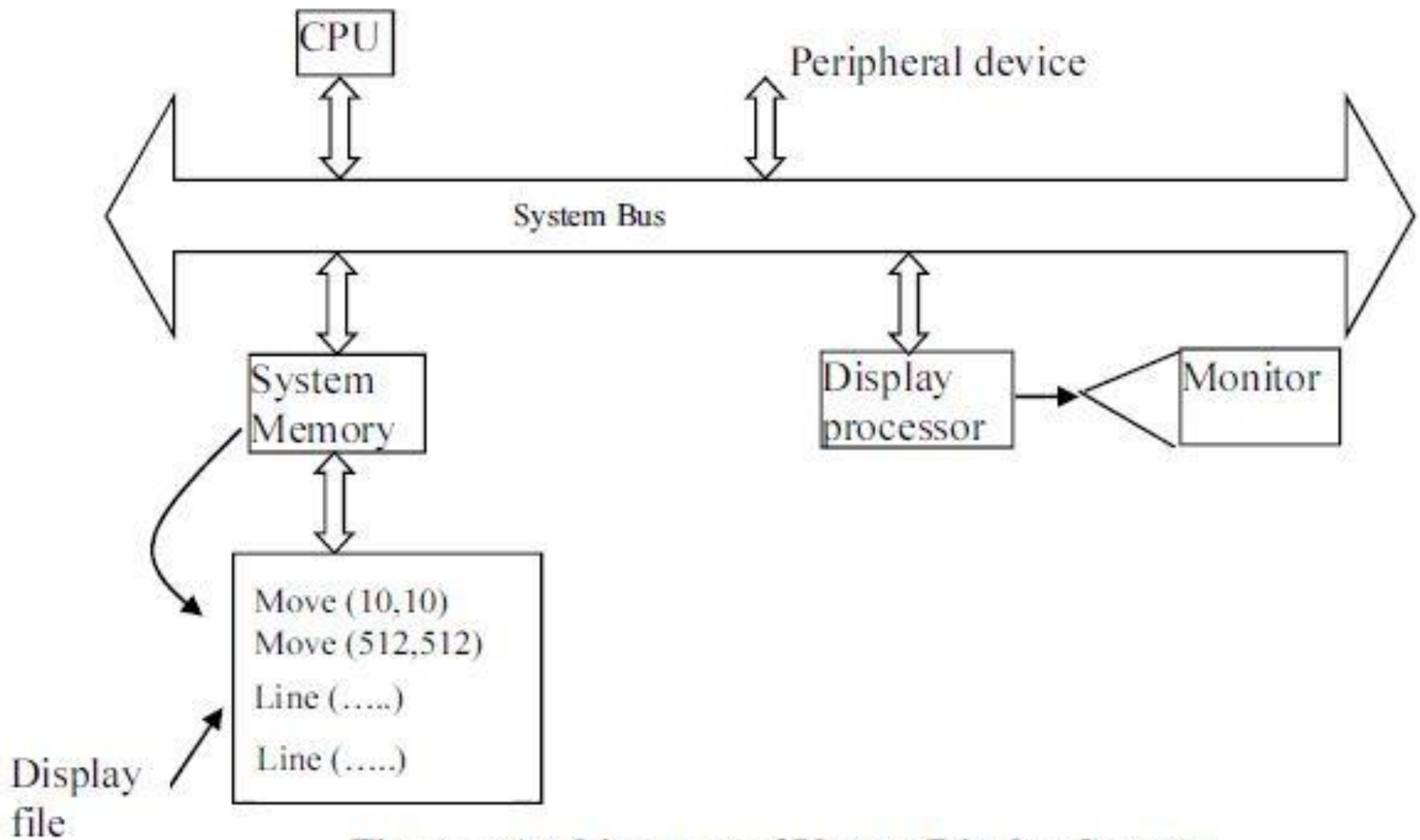


Figure : Architecture of Vector Display System

https://genuinenotes.com

Architecture of Random Scan Display…..

- Vector display system consists of several units along with peripheral devices. The display processor is also called as graphics controller.
- Graphics package creates a display list and stores in systems memory (consists of points and line drawing commands) called display list or display file.
- Refresh time around so cycle per second.
- Vector display technology is used in monochromatic or beam penetration color CRT.
- Graphics are drawn on a vector display system by directing the electron beam along component line.

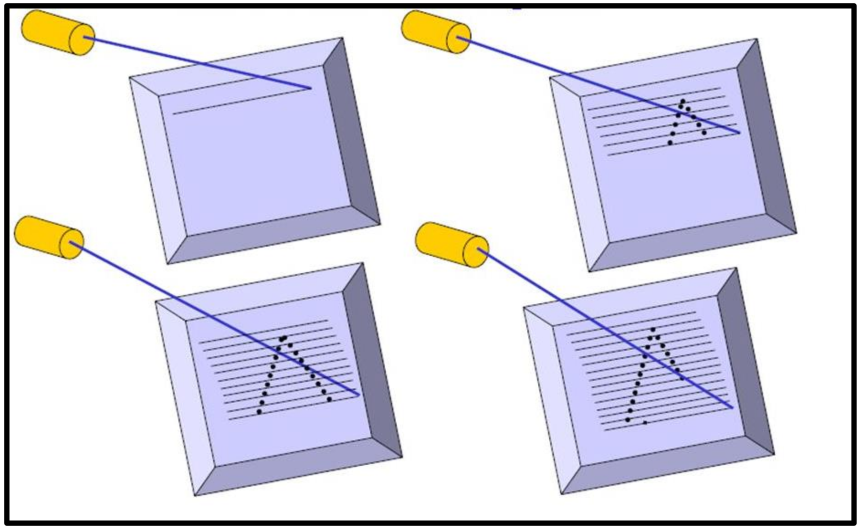
Raster VS Random

Raster	Random
1.Refresh Rates : Refreshing on raster scan display is carried out at the rate of 60 to 80 frames per second. Sometimes, refresh rates are described in units of cycles per second, or ***Hertz (Hz)***, where a cycle corresponds to one frame.	***1.Refresh Rates :*** Generally, refreshing on random-scan display is carried out at the rate of 60 frames per second. Refresh rate on a random-scan system depends on the number of lines to be displayed. Picture definition is now stored as a set of line-drawing commands in an area of memory, referred to as the *refresh display file*.
2.Applications: i. For the realistic display of scenes containing subtle shading and color patterns. ii. Home television sets and printers are examples of raster-scan systems.	***2.Applications:*** i. Random-scan systems are used in *line-drawing applications*. ii. Vector displays generally used to produce graphics with higher resolution.

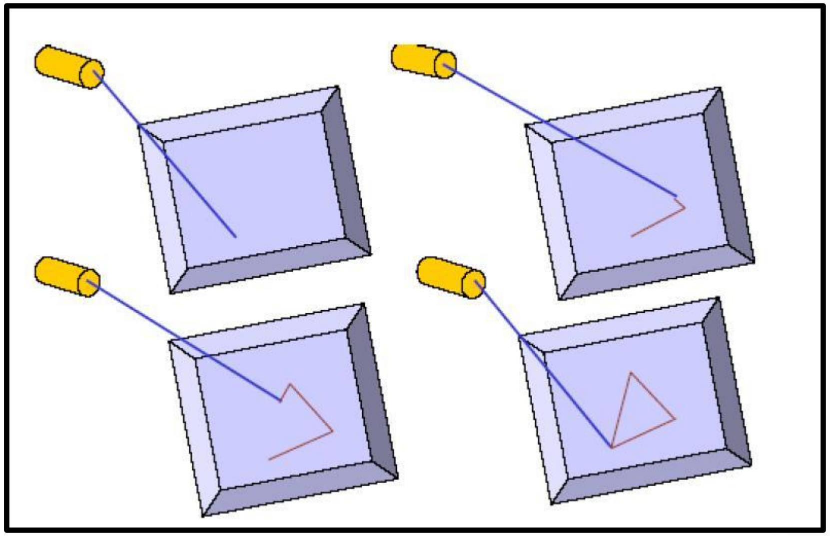
https://genuinenotes.com

Raster VS Random

Raster

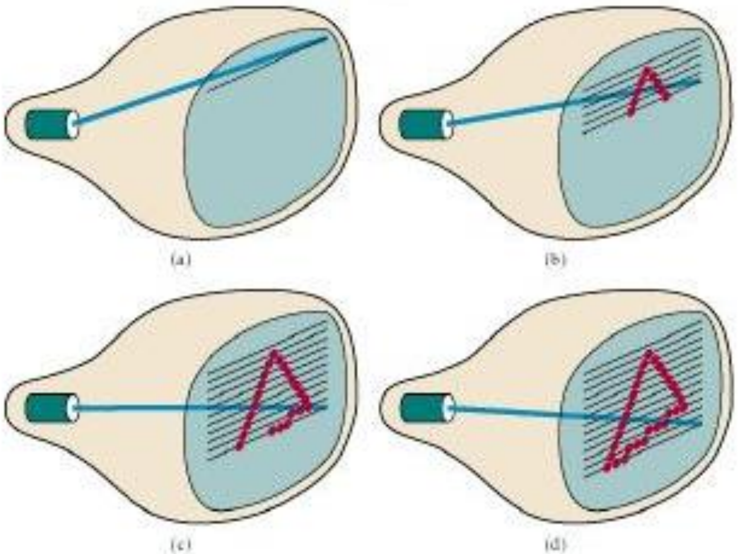


Random

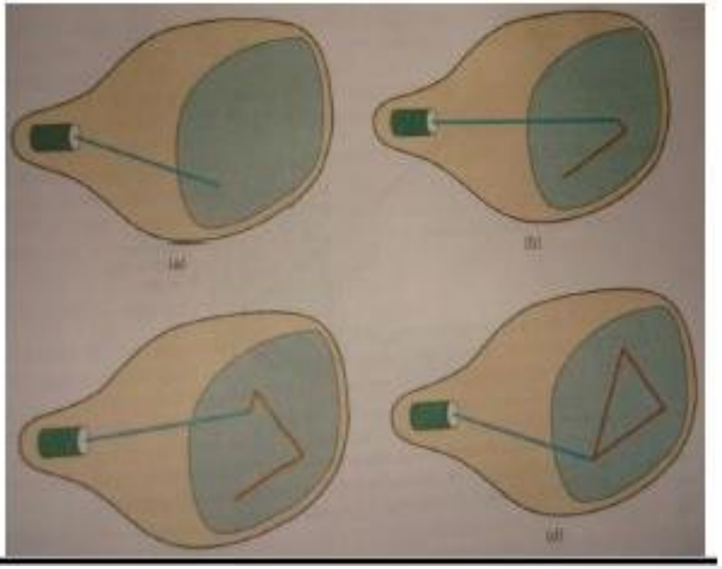


Raster VS Random

- Raster Scan
  - Electron beam swept across the screen ,one row at a time from top to bottom. e.g. television



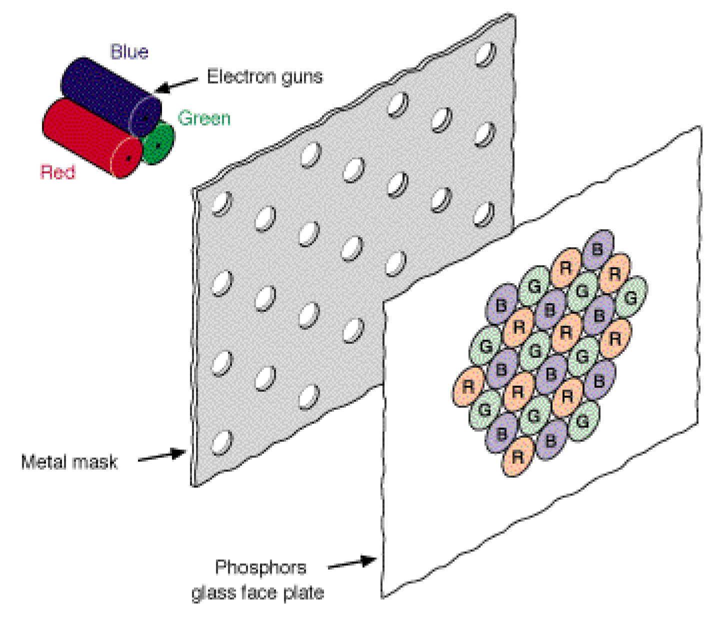
- Random or vector Scan
  - Electron beam directed only to parts of the screen where a picture is drawn. e.g. pen plotter



https://genuinenotes.com

2.2. Color CRT

- A color CRT monitor displays color pictures by using a combination of phosphors that emit different-colored light. By combining the emitted light from the different phosphors, a range of colors can be generated. The two basic techniques for producing color displays with a CRT are;
    1. *Beam Penetration Method*
    2. *Shadow Mask Method*

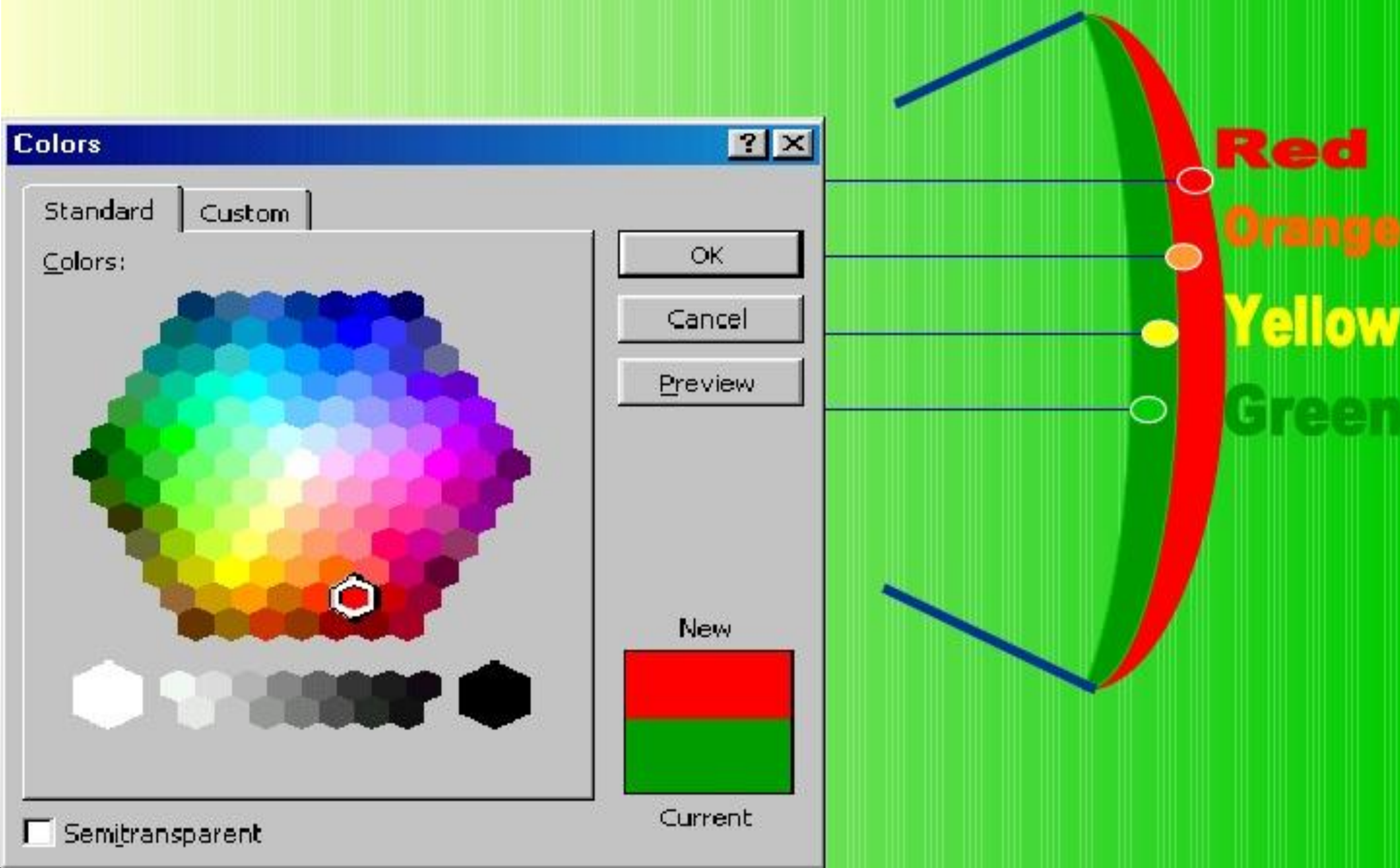


2.2.1. Beam Penetration Method

- It is a cheaper method and is used in Vector scan displays.
- In this method the inside section of CRT is coated with **red** (outer layer) and **green** (inner layer) phosphors.
- If the electrons are **slow** they penetrate only the outer layer thus emitting red light, and if the electrons are moving fast they penetrate the outer layer and the inner layer. The electrons speed is also adjusted in such a way that by combination of **red** and **green**, **orange** and **yellow** color are also produced. The limitation of this method is that only four colors can be displayed in the screen. Since we have only four colors the quality of image is diminished.

https://genuinenotes.com

Beam penetration method



https://genuinenotes.com

2.2.1. Beam Penetration Method……..

- Used with random-scan monitors
- Two layers of phosphor: **red** and **green**
- The displayed color depends on how far the electron beam penetrates into the phosphor layers.
- Only four colors are possible: **red**, **green**, **orange**, and **yellow**.

ADVANTAGE:

- Economical way to produce colors

LIMITATIONS:

- Generation of only four colors is possible
- Poor picture quality

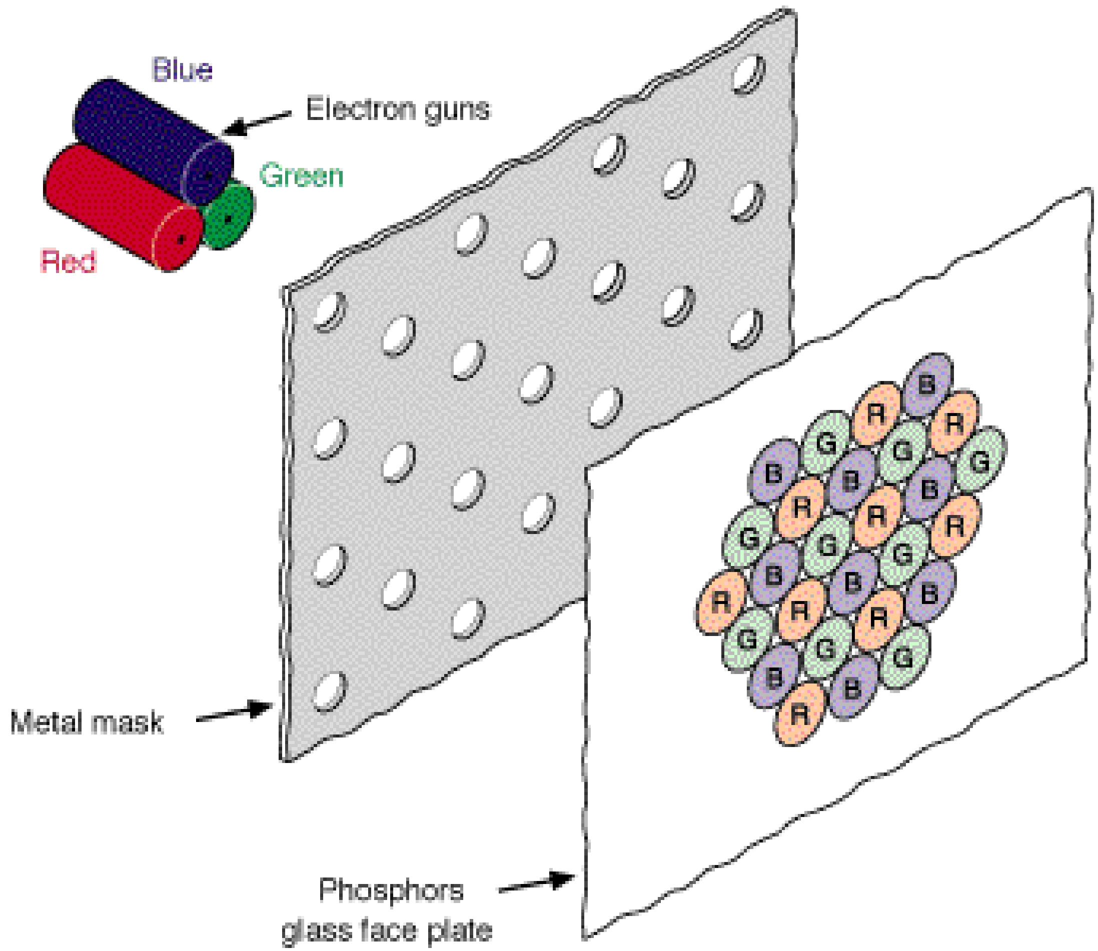
https://genuinenotes.com

2.2.2. Shadow Mask Method

- **Shadow-mask** methods are commonly used in **raster-scan systems** (including color TV) because they produce a much wider range of colors than the *beam-penetration* method.
- It gives much wider range of colors than a beam penetration method.
- A shadow Mask CRT has three phosphor color dots at each pixel location. One phosphor dot emits a red light, another emits green light and the last one emits a blue light.
- This type of CRT also has three electron guns one for each color dot. A shadow mask grid is installed just behind the phosphor coated screen.
- The three electron beams are deflected and focused as a group onto the shadow mask, which contains a series of very fine holes aligned with the phosphor dot patterns.
- When the three beams pass through a hole in the shadow mask, they activate a dot triangle, which appears as a small color spot on the screen. The color of pixel is controlled by light of intensity. Different colors can be obtained by varying the intensity levels.

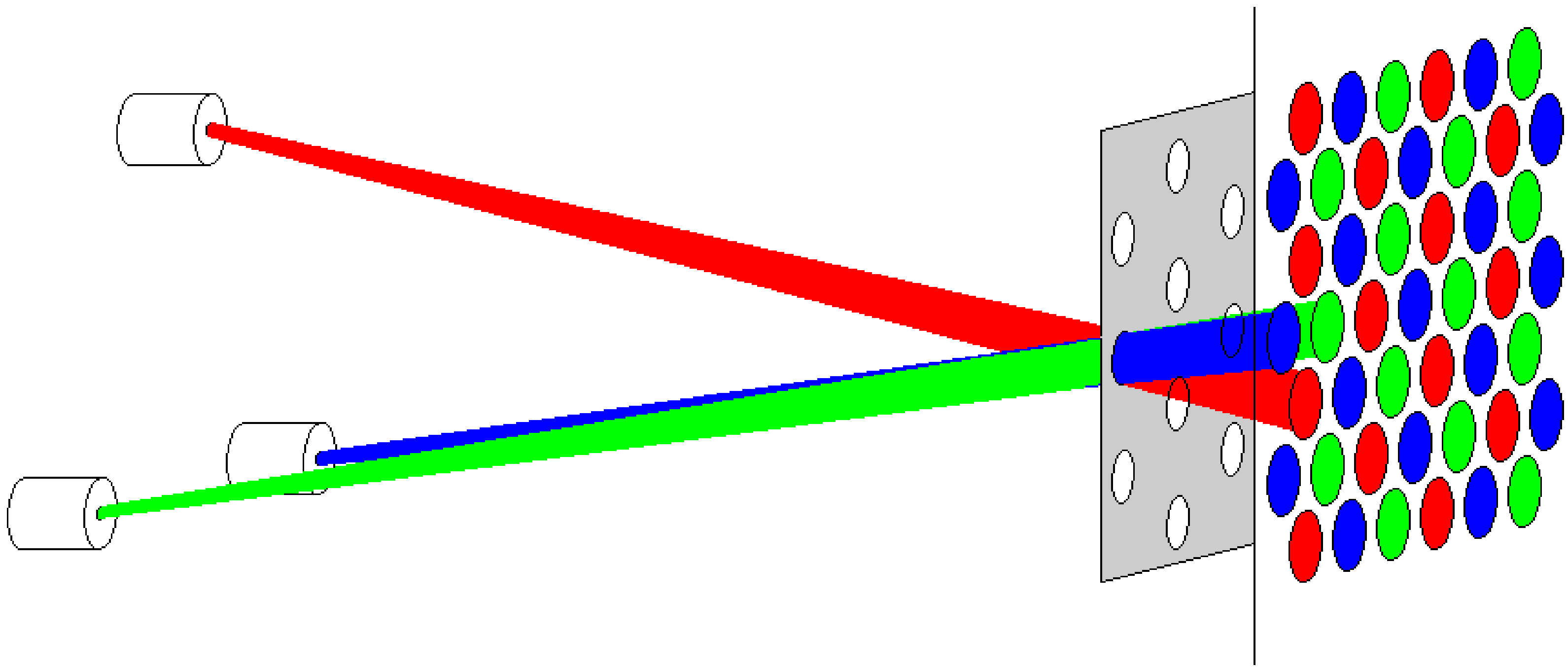
https://genuinenotes.com

2.2.2. Shadow Mask Method …..



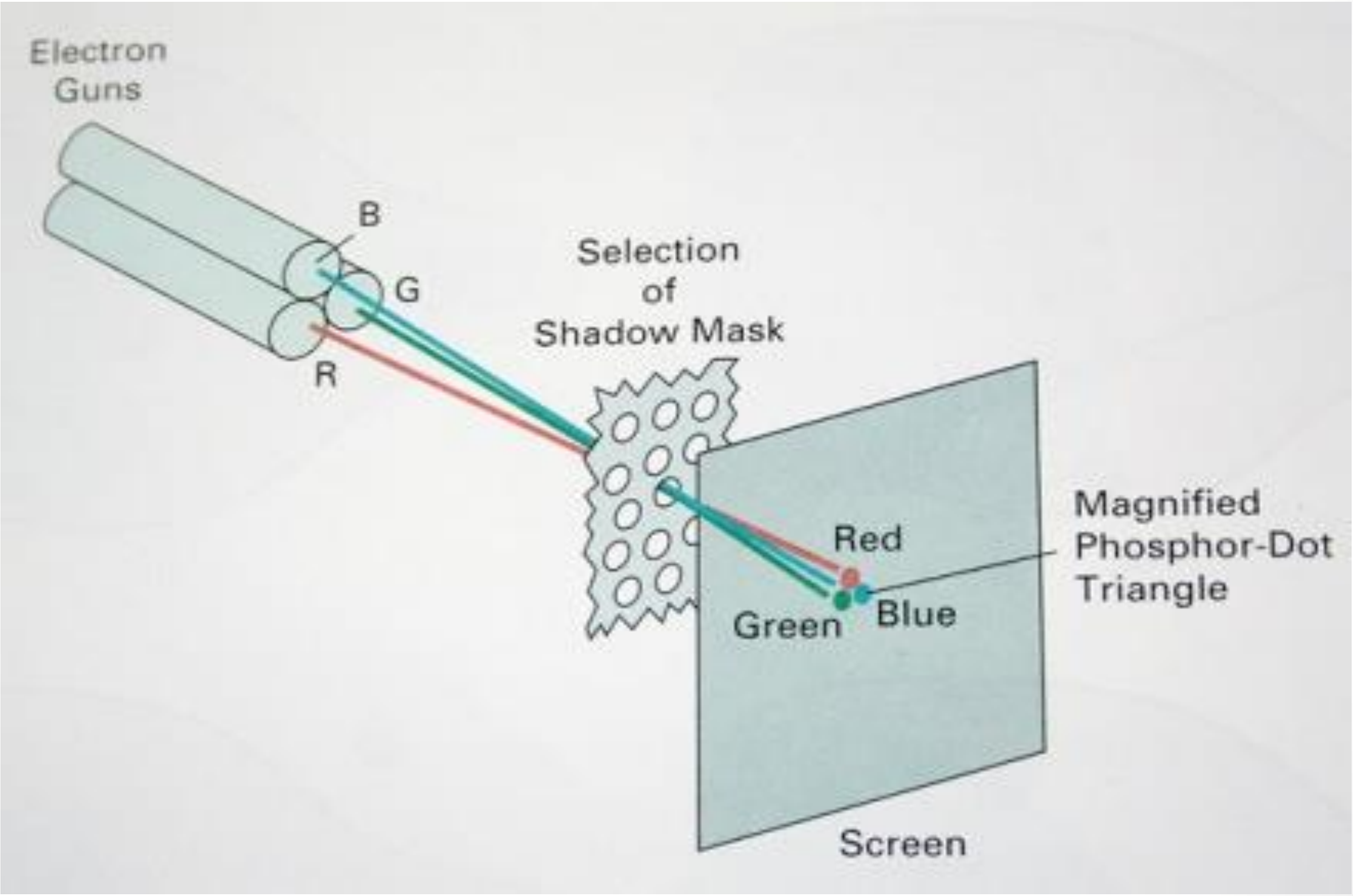
https://genuinenotes.com

2.2.2. Shadow Mask Method …..



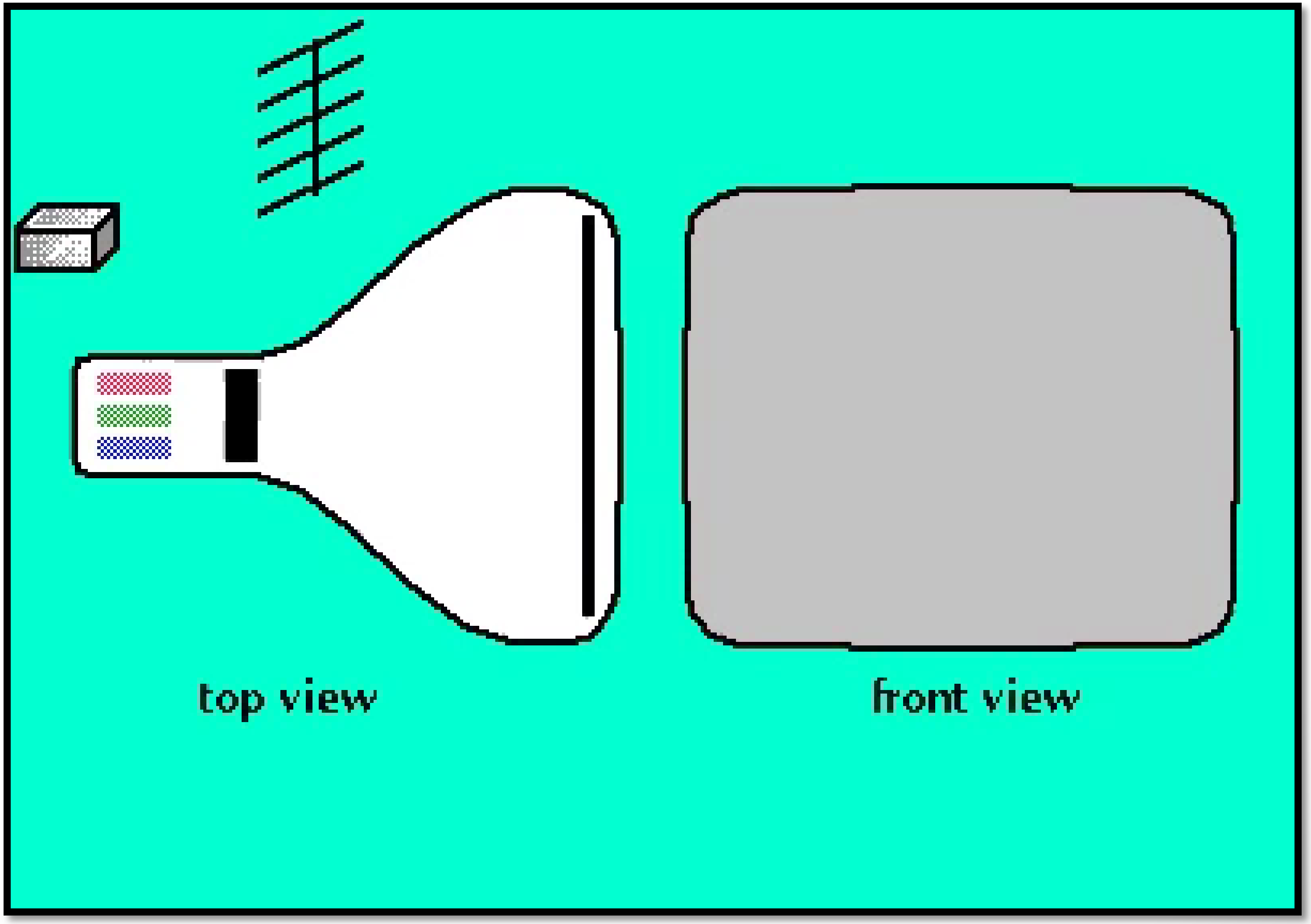
https://genuinenotes.com

2.2.2. Shadow Mask Method …..



https://genuinenotes.com

2.2.2. Shadow Mask Method …..



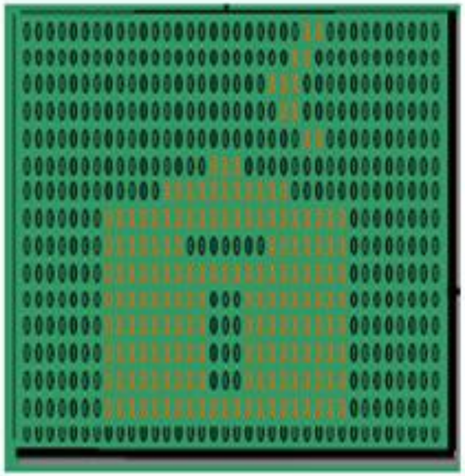
https://genuinenotes.com

2.2.2. Shadow Mask Method …..

https://genuinenotes.com

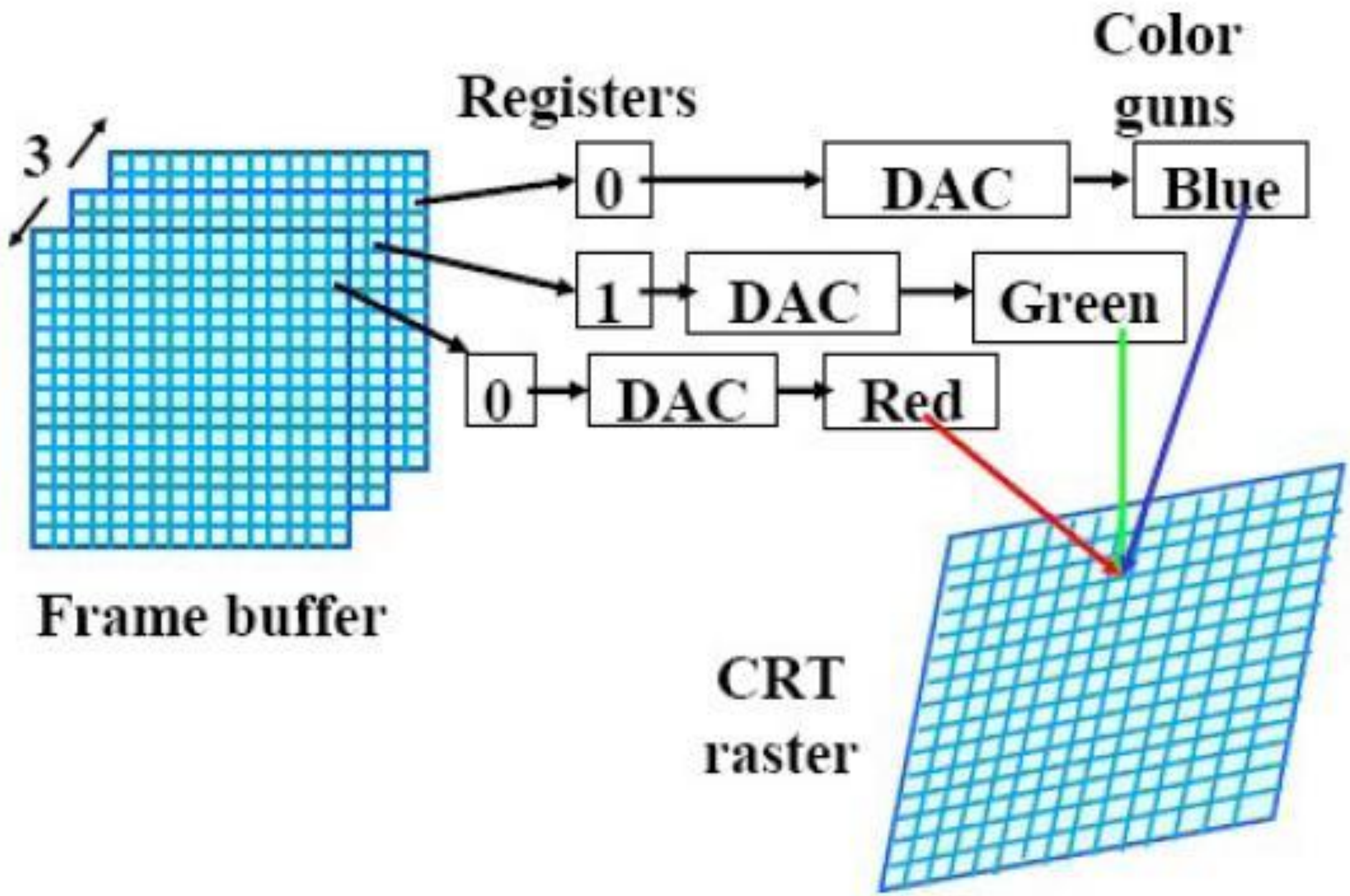
Frame Buffer

- The information in the buffer typically consists of color values for every pixel .
- A frame buffer may be thought of as computer memory organized as a two dimensional array . with each (x , y) addressable location corresponding to one pixel.
- Bit planes or bit depth is the number of bit corresponding to each pixel.



https://genuinenotes.com

Frame Buffer…..



Simple Color buffer

https://genuinenotes.com

2.3. Flat Panel Display(FPD)

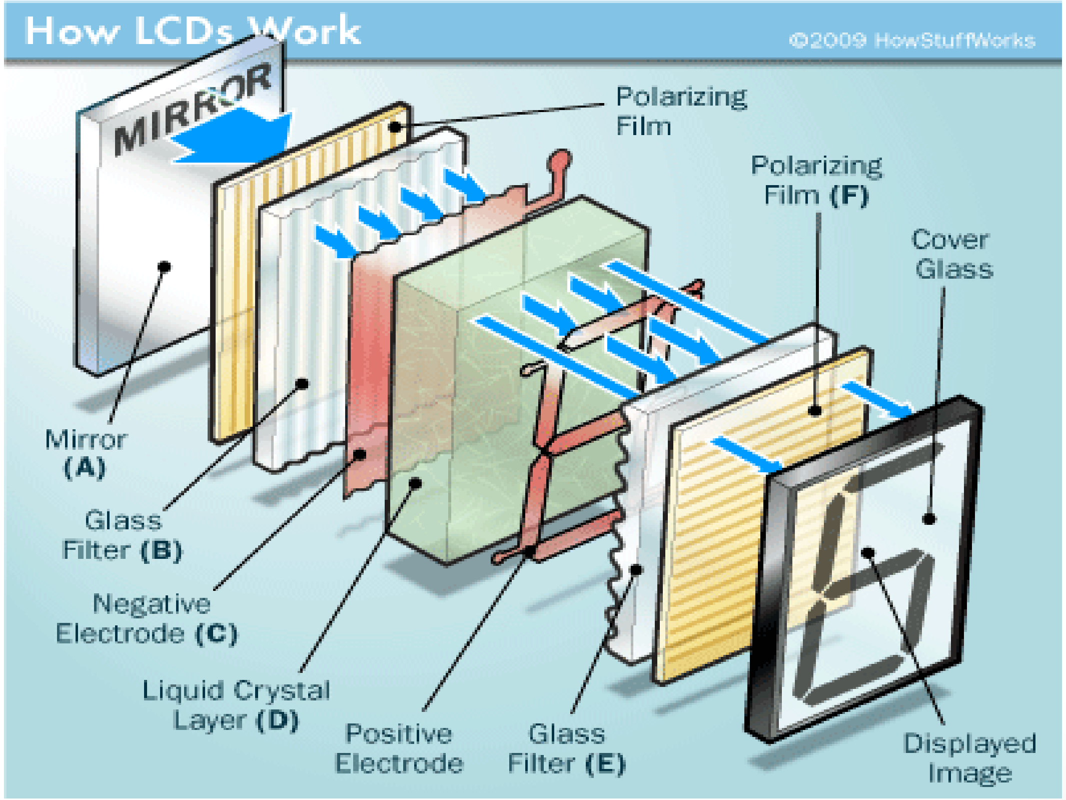
- They are far lighter and thinner than traditional cathode ray tube (CRT) television sets and video displays and are usually less than 10 centimeters (3.9 in) thick.
- Sometimes abbreviated as **FPD**, a **flat-panel display** is a thin screen display found on all portable computers and is the new standard for desktop computers. Unlike (CRT) monitors, flat-panel displays use liquid-crystal display (LCD) or light-emitting diode (LED) technology to make them much lighter and thinner compared to a traditional monitor.
- Types
  1. LCD (liquid-crystal display)
  2. LED (light-emitting diode)

2.3.1. LCD(Liquid-crystal display)

- A **liquid-crystal display** (**LCD**) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals .
- Liquid crystals do not emit light directly.
- LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and indoor and outdoor signage.
- Small LCD screens are common in portable consumer devices such as digital cameras, watches , calculators ,and mobile telephones , including smartphones.

How LCD work

- The pixels are controlled in completely different ways in plasma and **LCD** screens. In a plasma screen, each pixel is a tiny fluorescent lamp switched on or off electronically. In an **LCD** television, the pixels are switched on or off electronically using liquid crystals to rotate polarized light



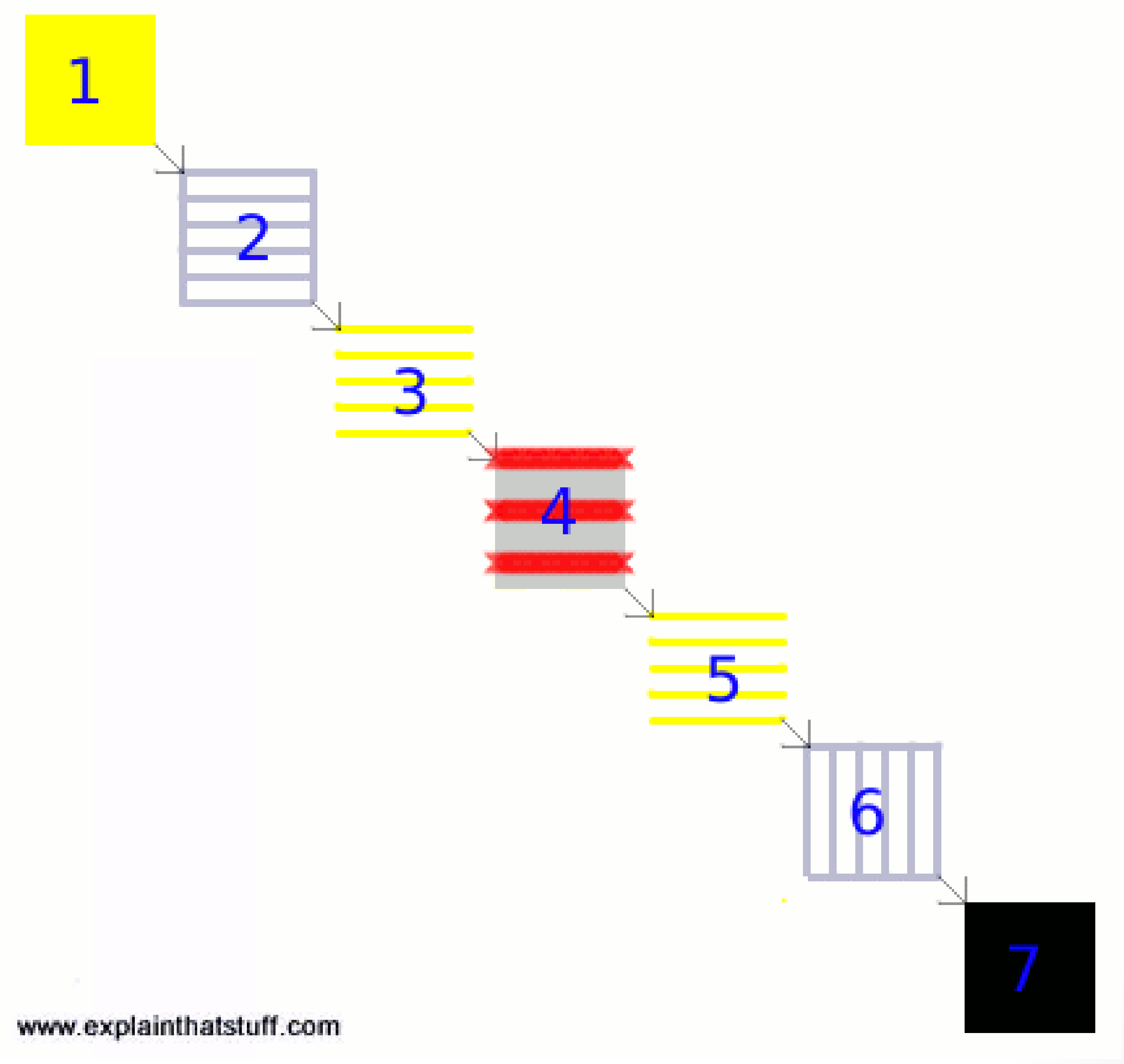
https://genuinenotes.com

How pixels are switched off

1. Light travels from the back of the TV toward the front from a large bright light.
2. A horizontal polarizing filter in front of the light blocks out all light waves except those vibrating horizontally.
3. Only light waves vibrating horizontally can get through.
4. A transistor switches off this pixel by switching *on* the electricity flowing through its liquid crystal. That makes the crystal straighten out (so it's completely untwisted), and the light travels straight through it unchanged.
5. Light waves emerge from the liquid crystal still vibrating horizontally.
6. A vertical polarizing filter in front of the liquid crystal blocks out all light waves except those vibrating vertically. The horizontally vibrating light that travelled through the liquid crystal cannot get through the vertical filter.
7. No light reaches the screen at this point. In other words, this pixel is dark.

https://genuinenotes.com

How pixels are switched off

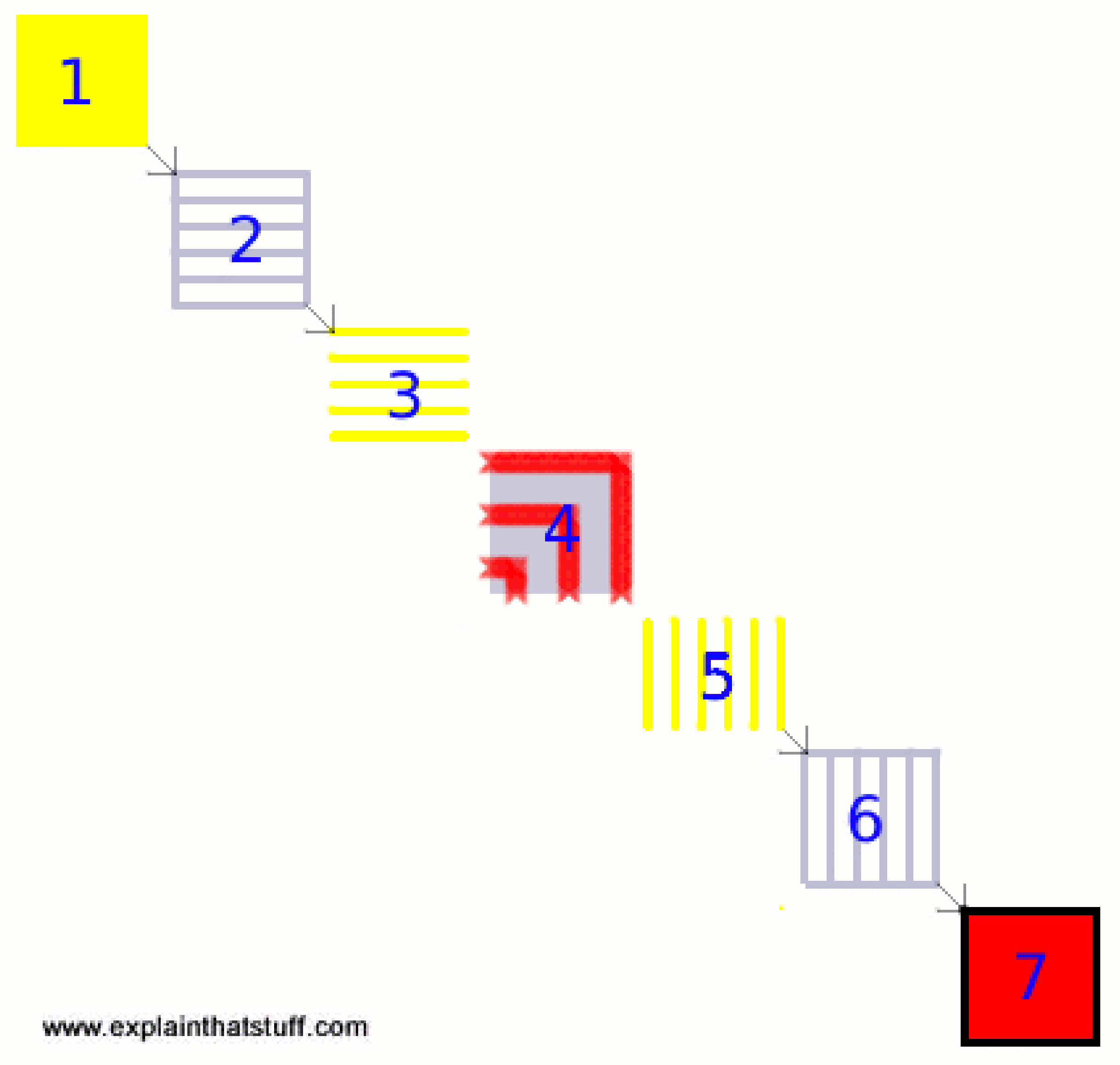


How pixels are switched on

1. The bright light at the back of the screen shines as before.
2. The horizontal polarizing filter in front of the light blocks out all light waves except those vibrating horizontally.
3. Only light waves vibrating horizontally can get through.
4. A transistor switches on this pixel by switching *off* the electricity flowing through its liquid crystal. That makes the crystal twist. The twisted crystal rotates light waves by 90° as they travel through it.
5. Light waves that entered the liquid crystal vibrating horizontally emerge from it vibrating vertically.
6. The vertical polarizing filter in front of the liquid crystal blocks out all light waves except those vibrating vertically. The vertically vibrating light that emerged from the liquid crystal can now get through the vertical filter.
7. The pixel is lit up. A red, blue, or green filter gives the pixel its color.

https://genuinenotes.com

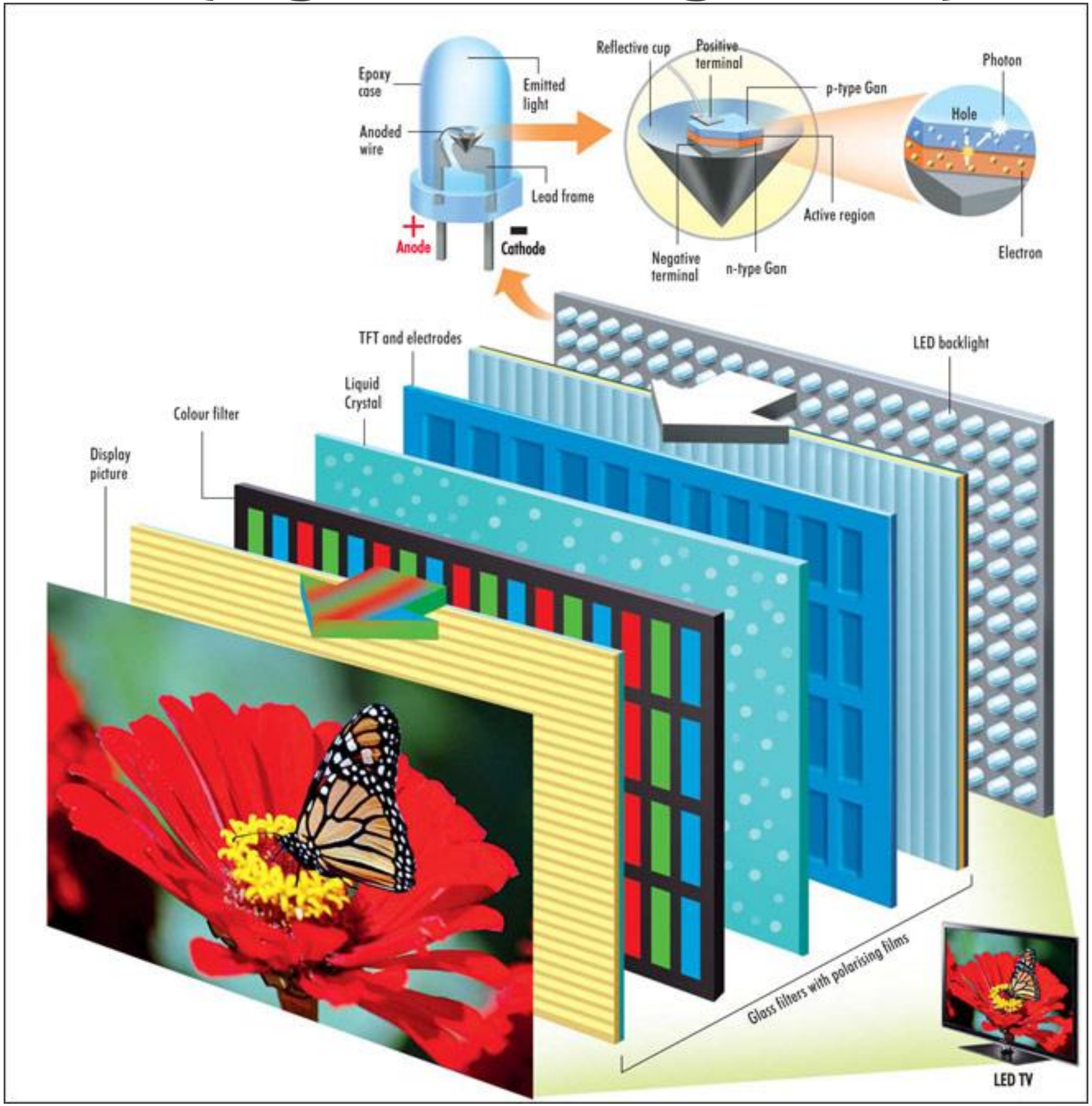
How pixels are switched on



LCD

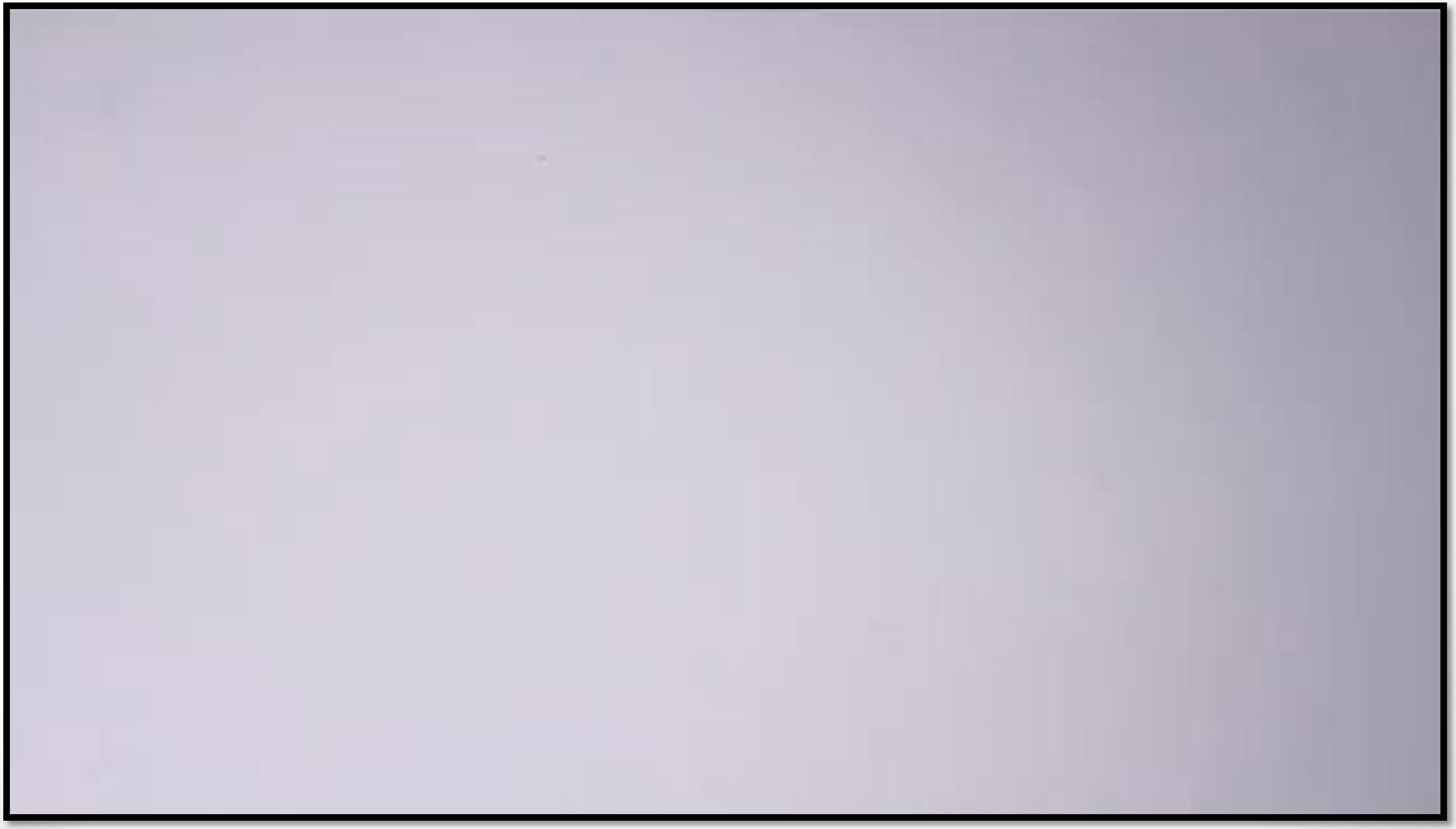
https://genuinenotes.com

2.3.1. LED(Light Emitting Diode)



https://genuinenotes.com

2.3.1. LED(Light Emitting Diode)



https://genuinenotes.com

Difference between LCD & LED

Numerical

https://genuinenotes.com

<u>Q.N.1.:</u> **If the pixel values are accessed from the frame buffer with an average access time (for one single pixel) of 20 ns and the total resolution of the screen is 1024 X 800 , will there be a flickering effect seen on the screen ?**

- To glow one single pixel takes = 20 ns

To glow all pixel on screen it takes = 1024 X 800 X 20ns
= 16,384,000ns
= 0.01638 second

Now

frequency(F) = 1/T
= 1/0.01638
= 61.05 HZ

since it is above 50times/sec there will be no flickering effect seen on screen

Numerical

***Q.N.2:*.** **In case of raster system with resolution 1024 X 1280, how many pixel could be accessed per second in the system by a display controller at a rate of 60 frames per second?**

what is accessed time per pixel in this system ?

Ans :

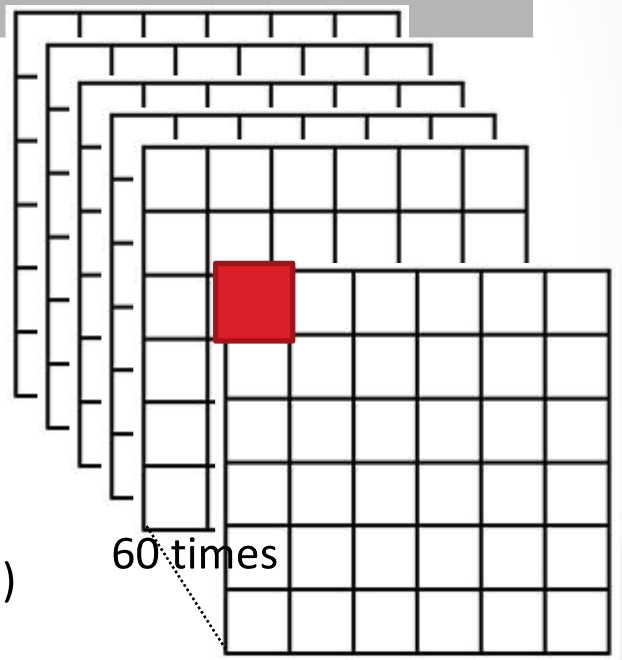
1. Pixel accessed :

= 1024 X 1280 X 60 pixel can be accessed in this system

2. Access time per pixel:

= 1/(1024 X 1280 X 60)

= 12.71ns



https://genuinenotes.com

Numerical

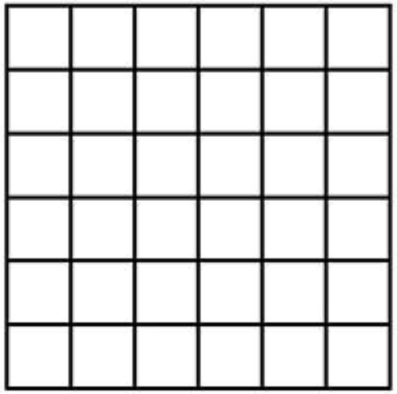
<u>*Q.N.3.:*</u> How long would it takes to load a 640 X 480 frame buffer with 12 bit per pixels if 10^5 bits can be transferred per second.

Ans :

total size of frame buffer :

= 640 X 480 X 12

it takes = (640 X 480 X 12)/10^5



**Formula:*

Required size of frame= Resolution or total no. of pixel ***X*** *no. of bit per pixel on screen*

https://genuinenotes.com

Numerical

Q.N.4.: **if the total number of intensities achievable out of a single pixel on the screen is 1024 and the total resolution of the screen is 1024 X 800 , what will be the required size of frame buffer in this case for the display purpose ?**

Ans :

(Note : 2^n = pixel on the screen) where n= no. of bit on screen

So, $2^n = 1024$

$n = 10$ bit

Required size of frame buffer = 10 X 1024 X 800

= 8,192,000 bit

**Formula:*

Required size of frame= Resolution or total no. of pixel ***X*** *no. of bit per pixel on screen*

where , single pixel on screen = 2^n and n= total no. of intensities out of a single pixel

https://genuinenotes.com

Numerical

Q.N.5.: **Consider three different raster system with resolution 640 by 400, 1280 by 1024 and 2560 by 2048. what size frame buffer (in byte) is needed for each of the system to store 12 bits per pixel ? How much storage is required for each system if 24 bit per pixel are to be stored.**

Ans :

1) for 12 bit per pixel system

the frame buffer(in byte) size needed

a. for 640 by 400 resolution = $\frac{(640 \text{ X } 400 \text{ X } 12)}{8}$

=384000 byte

b. for 1280 by 1024 resolution = $\frac{(1280 \text{ X } 1024 \text{ X } 12)}{8}$

=1966080 byte

c. for 2560 by 2048 resolution = $\frac{(2560 \text{ X } 2048 \text{ X } 12)}{8}$

=7864320 byte

2) for 24 bit per pixel system

the frame buffer(in byte) size needed

a. for 640 by 400 resolution = $\frac{(640 \text{ X } 400 \text{ X } 24)}{8}$

=768000 byte

b. for 1280 by 1024 resolution = $\frac{(1280 \text{ X } 1024 \text{ X } 24)}{8}$

=3932160 byte

c. for 2560 by 2048 resolution = $\frac{(2560 \text{ X } 2048 \text{ X } 24)}{8}$

=15728600byte

https://genuinenotes.com

Numerical

Q.N.6.: **Suppose an RGB raster system is to be designed using 8-inch by 10-inch screen with a resolution of 100 pixels per inch in each direction . If we wont to store 9 bit per pixel in the frame buffer . How much storage (in byte) do we need for the frame buffer ?**

Ans :

Size of screen = 8 inch × 10 inch.
Pixel per inch(Resolution) = 100.

Then, Total no of pixels = 8 x100 by 10x100 pixels
= (8*100 X 10*100) pixels
= 8,00,000

Bit per pixel storage = 9

Therefor , total storage required in frame buffer $= \frac{8,00,000 \times 9}{8}$ bytes
= 9,00,000 bytes

Numerical

https://genuinenotes.com

Q.N.7.: **How long would it take to load a 640 by 480 frame buffer with 12 bits per pixel , if 10^5 bit can be transferred per second? How long would it take to lead a 24-bit per pixel frame buffer with a resolution of 1280 by 1024 using this same transfer rate?**

Ans :

- for 640 X 480 frame buffer with 12 bits for pixels

  total pixel = 640 X 480 X12

  time required $= \frac{(640 \times 480 \times 12)}{10^5}$

  = 36.864 second

- for 1280 X 1024 frame buffer with 24 bits for pixels

  total pixel = 1280 X 1024 X 24

  time required $= \frac{(1280 \times 1024 \times 24)}{10^5}$

  = 314.57 second

https://genuinenotes.com

Numerical

Q.N.8.: **Consider two raster system with resolution of 640 by 480 and 1280 by 1024. how many pixel could be accessed per second in each of these system by a display controller that refreshes the screen at the rate of 60 frames per second ? What is the access time per pixel in each system ?**

Ans :

for a raster system with resolution of 640 by 480,

i) No.of pixel accessed per second = 640 X 480 X 60

ii) Total access time = 1/60 = 0.0167

access time per pixel = (0.0167)/(640 X 480)

= 54.36 ns

for a raster system with resolution of 1280 by 1024,

i) No.of pixel accessed per second = 1280 X 1024 X 60

ii) Total access time = 1/60 = 0.0167

access time per pixel = (0.0167)/(1280 X 1024)

= 12.7 ns

Numerical

https://genuinenotes.com

Q.N.9.: A raster system can produce a total number of 1024 different level of intensities from a single pixel composed of red, green and blue phosphor dots. If the resolution of the screen is 1280 X 1024, what will be the required size of frame buffer for the display purpose?

Ans :

(Note : 2^n = pixel on the screen) where n= no. of pixel

So, $2^n = 1024$

$n = 10$ bit

Required size of frame buffer = 10 X 1280 X 1024

= 13107200 bit

= 1638400 byte

Numerical

https://genuinenotes.com

Q.N.10. : A system with 24 bits per pixel and resolution of 1024 by 1024. Calculate the size of frame buffer (in Megabytes).

Ans :

Frame size in bits= 24*1024*1024 bits

Frame size in bytes= 24*1024*1024 / 8 bytes

(since, 8 Bits = 1 Byte)

Frame size in kilobytes= 24*1024*1024 / (8 * 1024 kb)

(since, 1024 Bytes = 1 KB)

So, Frame size in megabytes= 24*1024*1024 **/ (**8*1024*1024) MB

(since, 1024 KB = 1 MB)

= 3 MB.

Numerical

https://genuinenotes.com

<u>*Q.N.11.* : </u>How Many k bytes does a frame buffer needs in a 600 x 400 pixel ?

Ans :

Resolution is 600 x 400.
Suppose 1 pixel can store n bits
Then, the size of frame buffer = Resolution * bits per pixel

$= (600 * 400) * n$ bits

$= 240000\, n$ bits

$= \frac{240000\, n}{1024 * 8}$ kb (as 1kb = 1024 bites)

$= 29.30\, n$ k bytes.

https://genuinenotes.com

Numerical

Q.N.12. : Find out the aspect ratio of the raster system using 8 x 10 inches screen and 100 pixel/inch.

Ans :

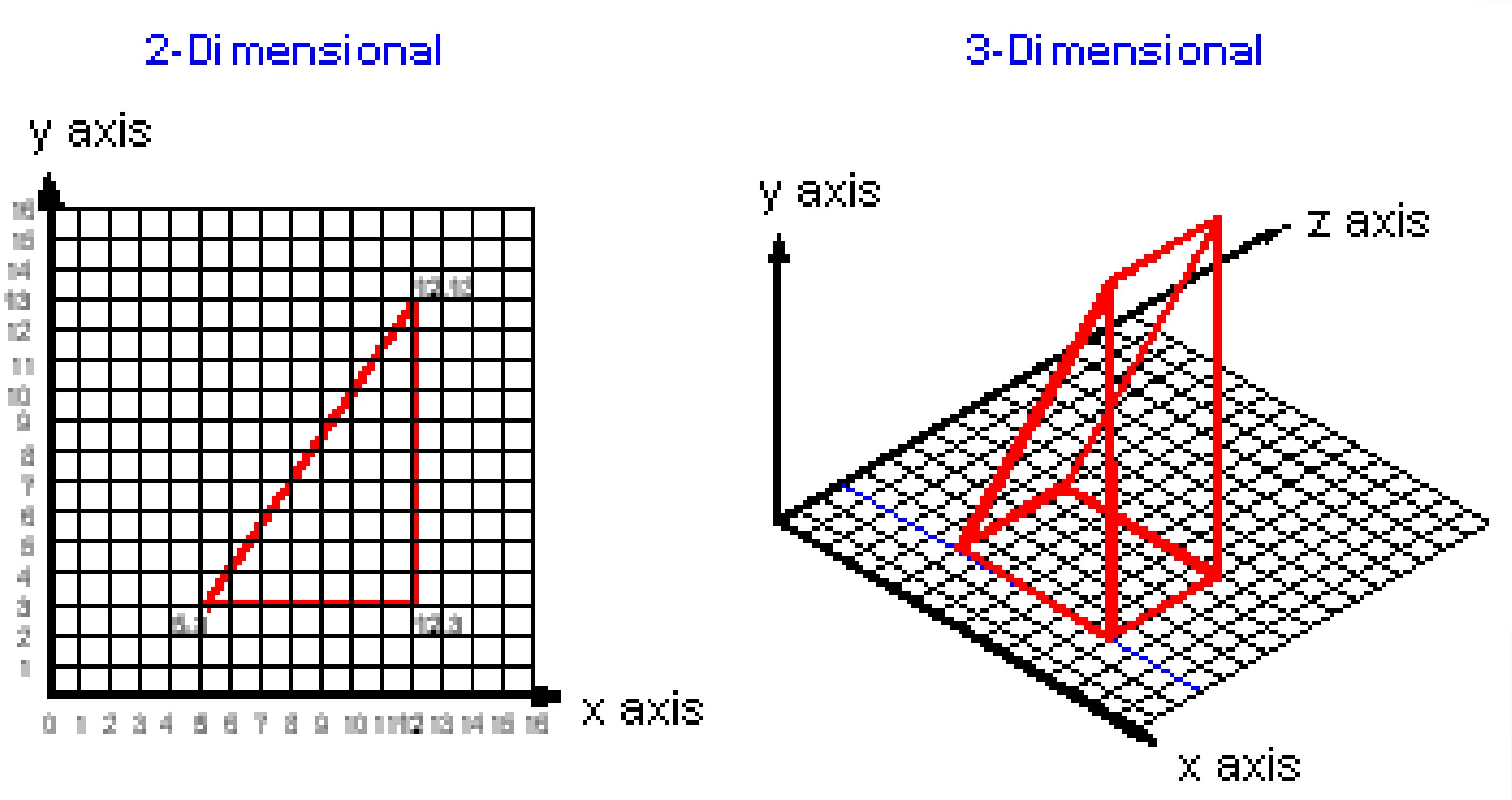
We know that, Aspect ratio $= \text{Width} \,/\, \text{Height}$

$$= \frac{8 \times 100}{10 \times 100} = 4 / 5$$

So, aspect ratio = 4 : 5.

https://genuinenotes.com

2.4. Concept of Three Dimension viewing devices



https://genuinenotes.com

2.5. Graphics Software

- In computer **graphics**, **graphics software** refers to a **program** or collection of **programs** that enable a person to manipulate images or models visually on a computer. Computer **graphics** can be classified into distinct categories: raster **graphics** and vector **graphics**, with further 2D and 3d variants.
- Many graphics programs focus exclusively on either vector or raster graphics, but there are a few that combine them in interesting ways. It is simple to convert from vector graphics to raster graphics, but going the other way is harder. Some software attempts to do this.

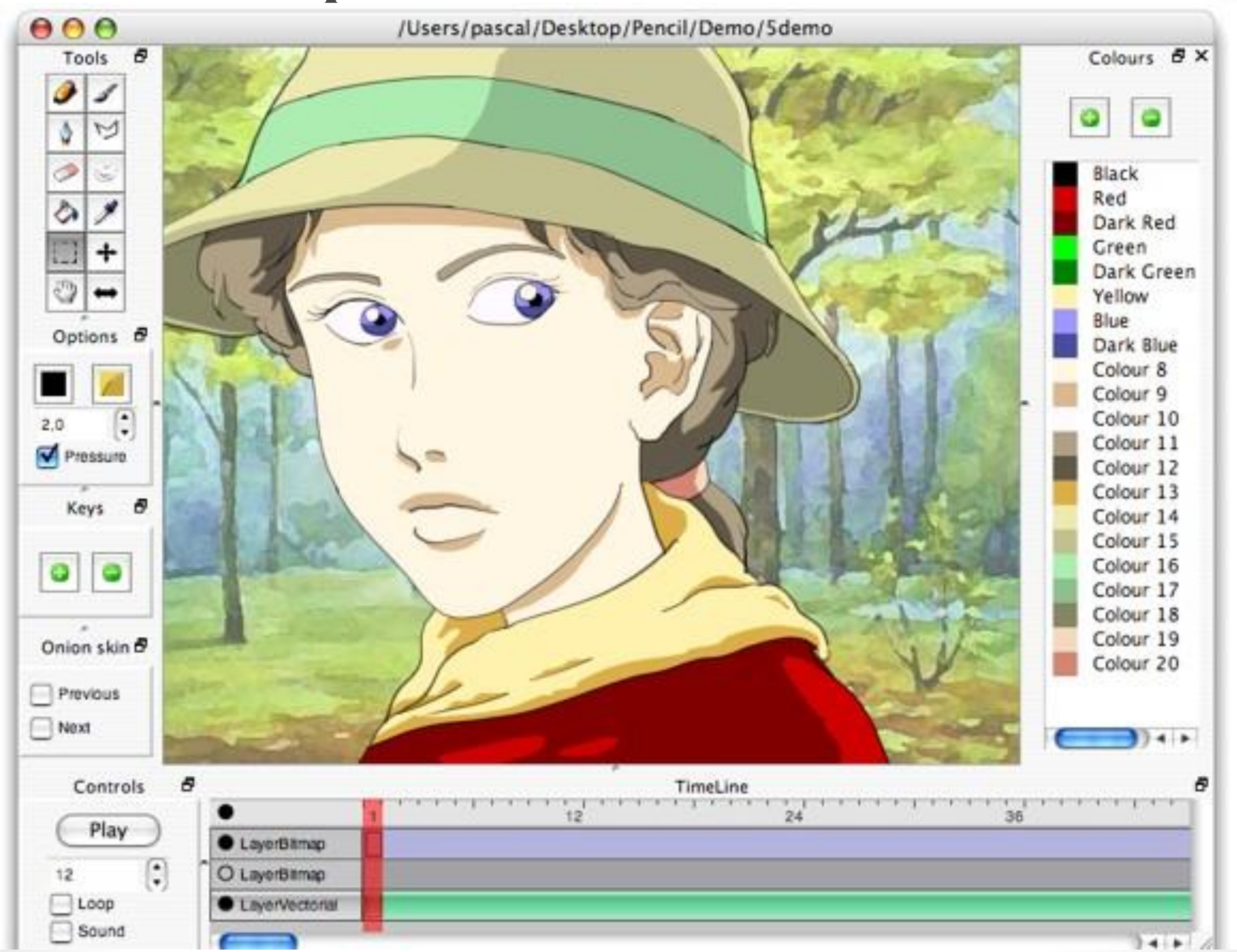
https://genuinenotes.com

2.5. Graphics Software

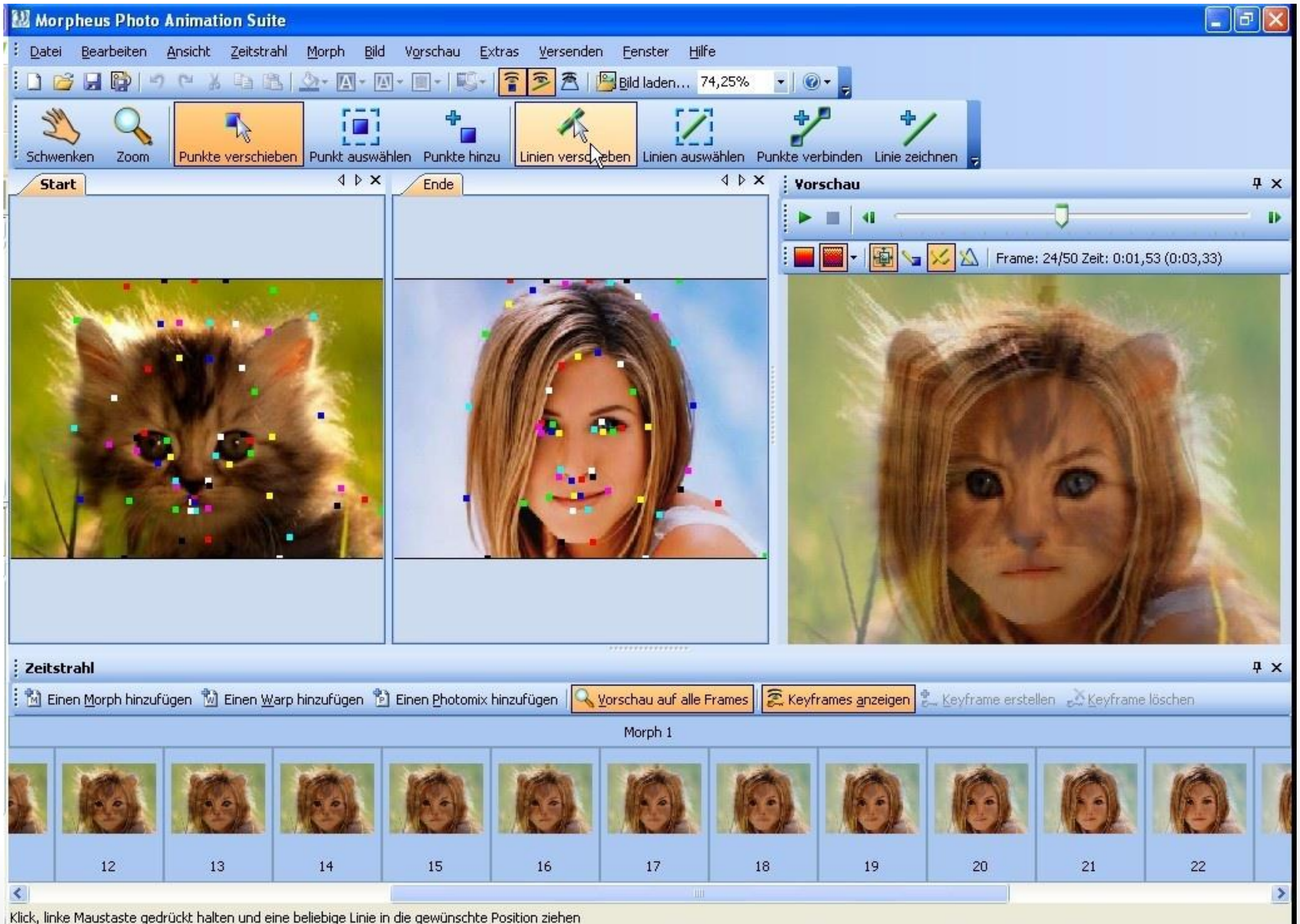
- In addition to static graphics, there are animation and video editing software. Different types of software are often designed to edit different types of graphics such as video, photos, and drawings. The exact sources of graphics may vary for different tasks, but most can read and write files.
- Most graphics programs have the ability to import and export one or more graphics file formats, including those formats written for a particular computer graphics program. Examples of such programs include Vectr, GIMP, Adobe Photoshop, Pizap, Microsoft Publisher, Picasa, etc.

https://genuinenotes.com

2.5. Graphics Software

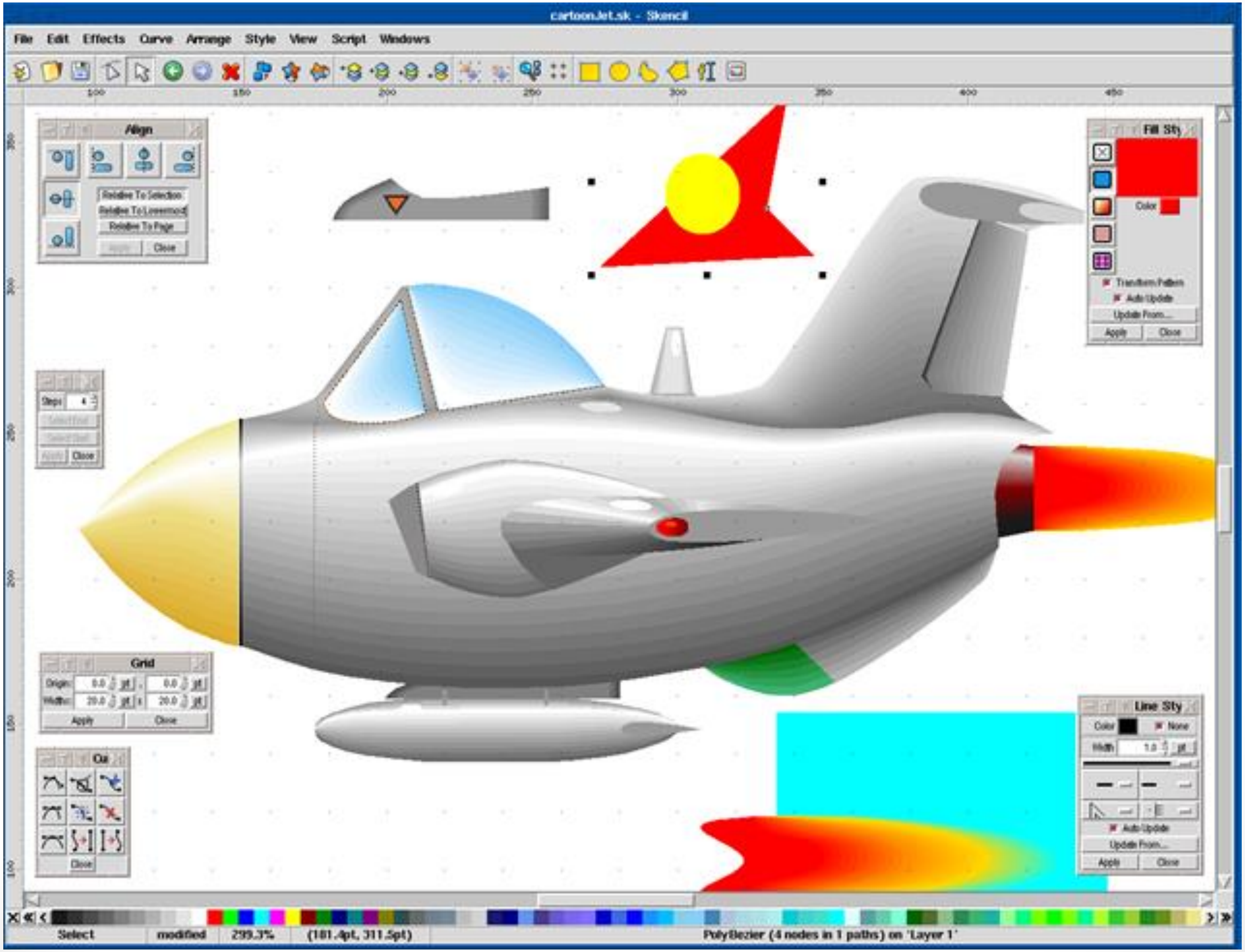


2.5. Graphics Software



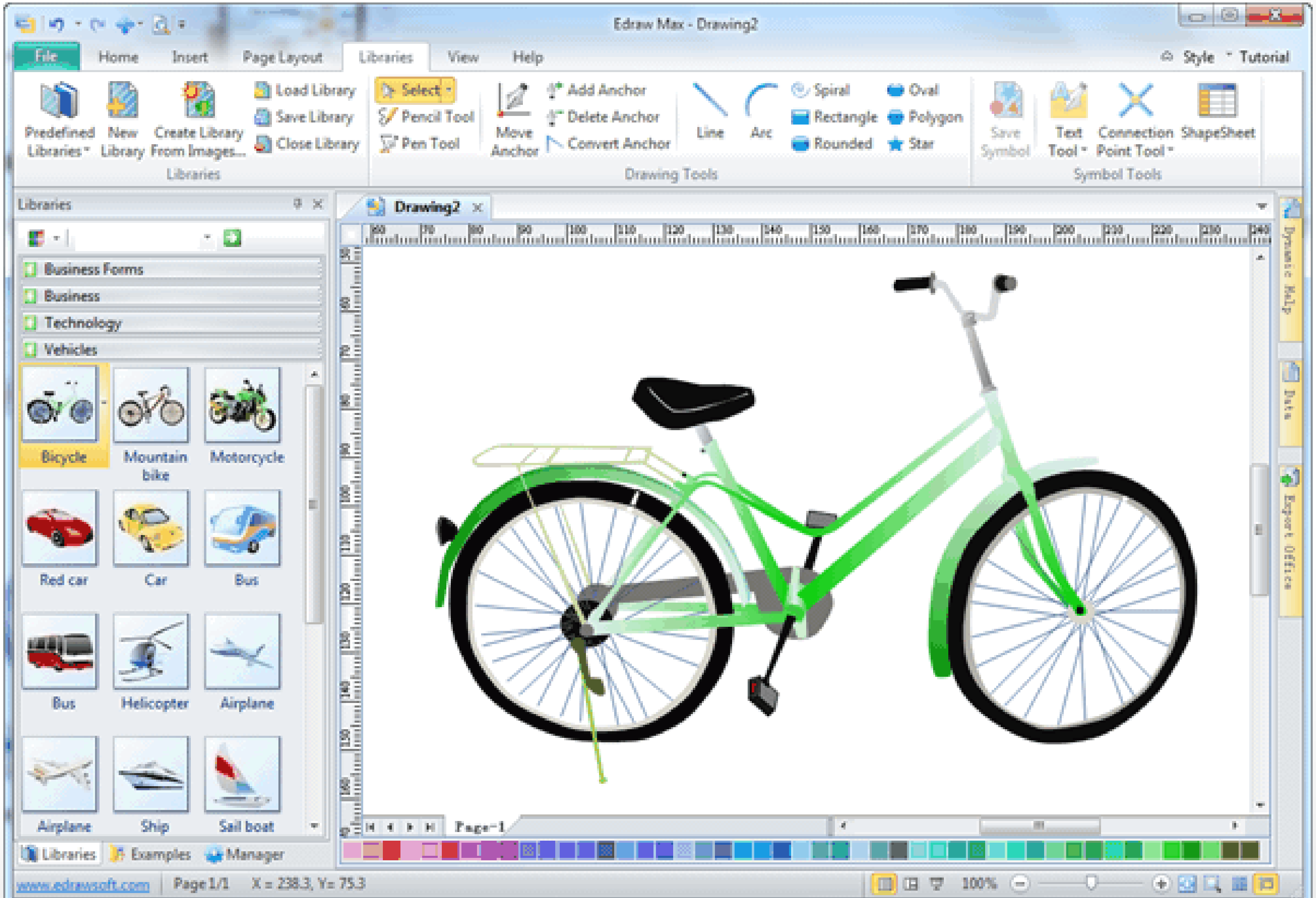
https://genuinenotes.com

2.5. Graphics Software



https://genuinenotes.com

2.5. Graphics Software



https://genuinenotes.com

2.5. Graphics Software

- Interactive graphics allow users to make change over the displayed objects. Several graphics software packages are now available. There are two general classifications for graphics software:

    I. ***General programming packages***

    II. ***Special-purpose application packages***

2.5.1. General programming packages

- *contain graphics functions that can be used with high level programming languages such as C, FORTRAN, Java etc.* **Example,** Open GL (Graphics library). A general-purpose graphics package provides users with a variety of functions for creating and manipulating pictures. These graphic functions include tools for generating picture components, setting color, selecting views, and applying transformations.

https://genuinenotes.com

2.5.2. Special-purpose application packages

- *Specifically designed for particular applications. Maya, CINEMA 4D are particularly used for animations, different types of CAD applications are designed for medical and business purposes. These are primarily oriented to non-programmers.*

https://genuinenotes.com

Software standards

- Many problems have been encountered due to the plate-form dependency of the graphic software's. So primary goal of standardized graphics software is portability. When graphics packages are designed with *standard graphics functions* (set of specifications that is independent of any programming languages), software can be easily moved from one H/W system to another. And it can be used in different implementations and applications.
- I. ***Graphical Kernel System (GKS):*** GKS was the first graphics software standard adopted by the international standards organization (ISO). It was originally designed as a 2-dimensional graphics package. GKS supports the grouping of logically related primitives such as; lines, polygons, character strings.
- II. ***Programmer's Hierarchical Interactive Graphics System (PHIGS):*** It is an extension of GKS. Increased capabilities in object modeling, color specifications, surface rendering, and picture manipulations are provided in PHIGS. PHIGS include all primitives supported by GKS, in addition it also includes geometric transformations (***Scaling, Translation, and Rotation***).
- III. ***PHIGS+:*** Extension of earlier PHIGS. 3-d surface shading capabilities are added to the PHIGS.

https://genuinenotes.com

Need of machine independent graphics language?

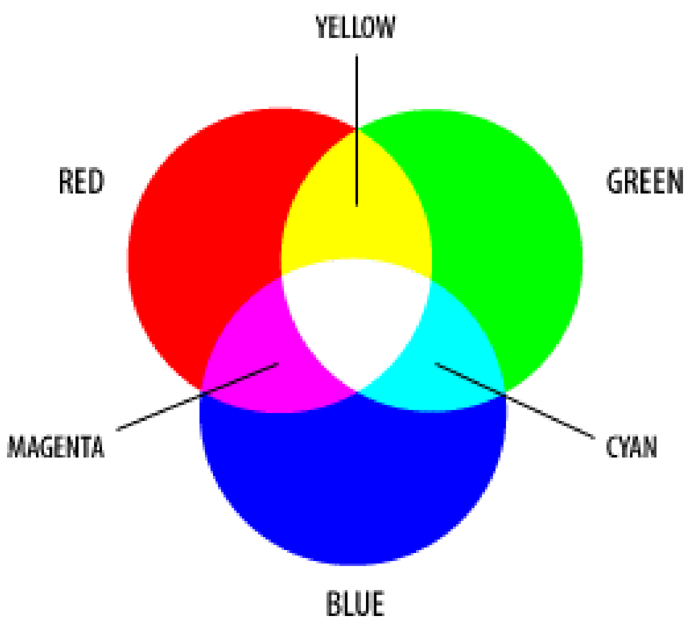
https://genuinenotes.com

2.6. Color Models

- A **color model** is an abstract mathematical model describing the way colors can be represented as tuples of numbers, typically as three or four values or color components.
  - RGB
  - HSV

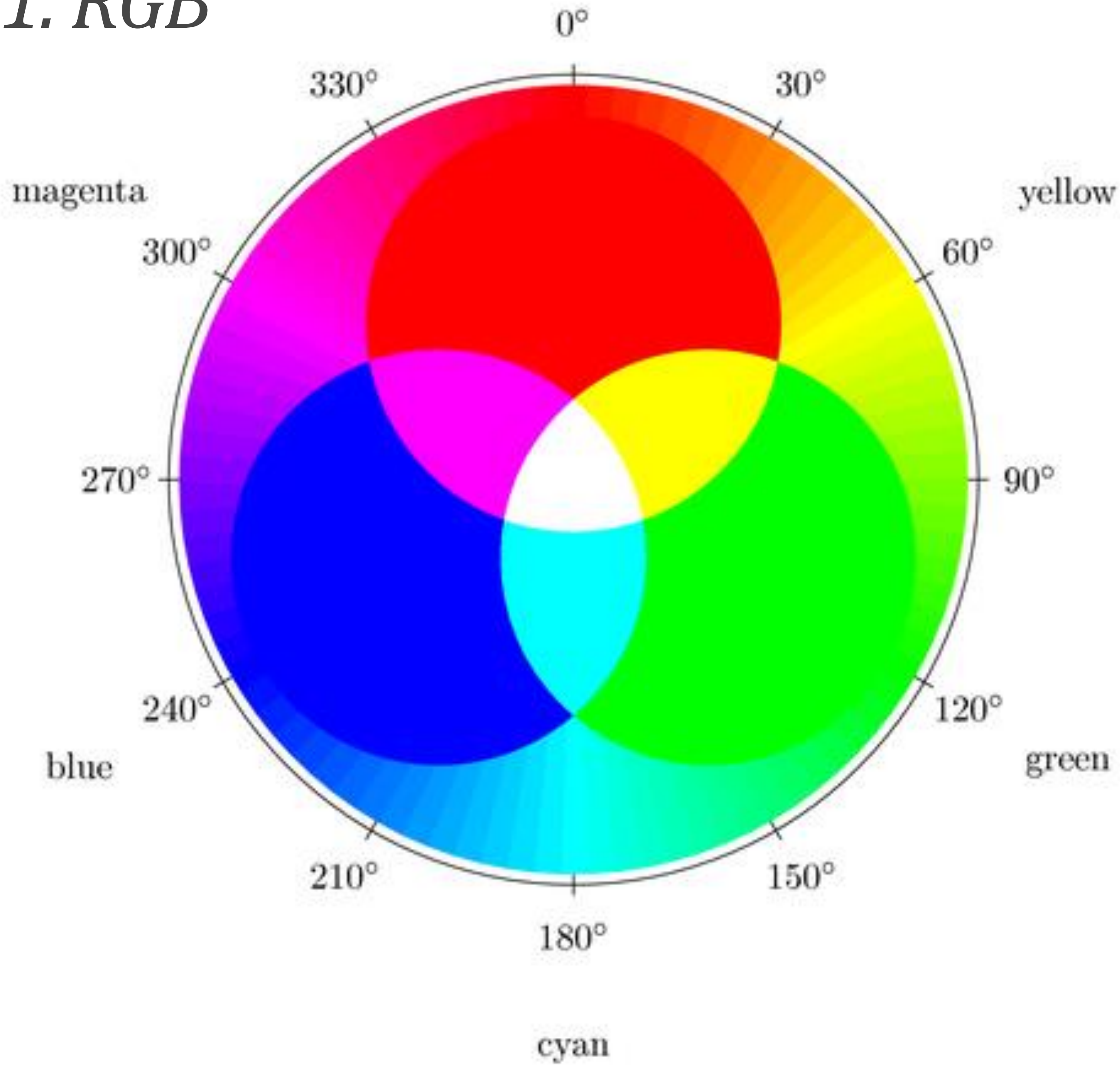
2.6.1. RGB

- The **RGB color** model is an additive **color** model in which red, green and blue light are added together in various ways to reproduce a broad array of **colors**.
- The name of the model comes from the initials of the three additive primary colors, red, green and blue.

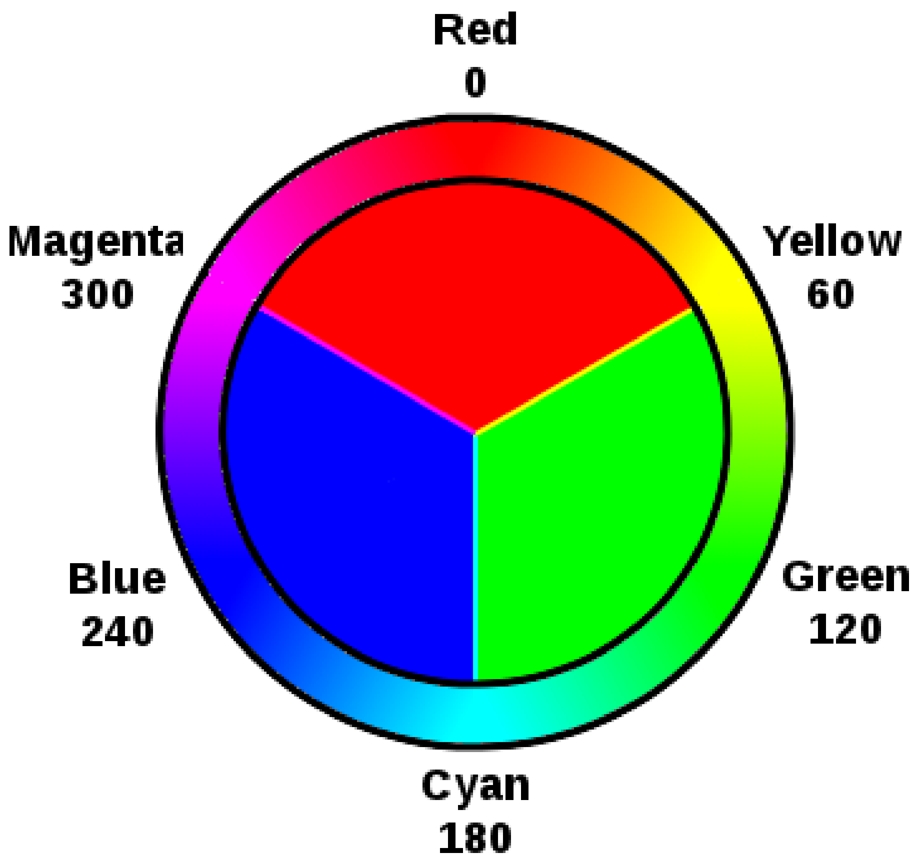


https://genuinenotes.com

2.6.1. RGB



2.6.1. RGB



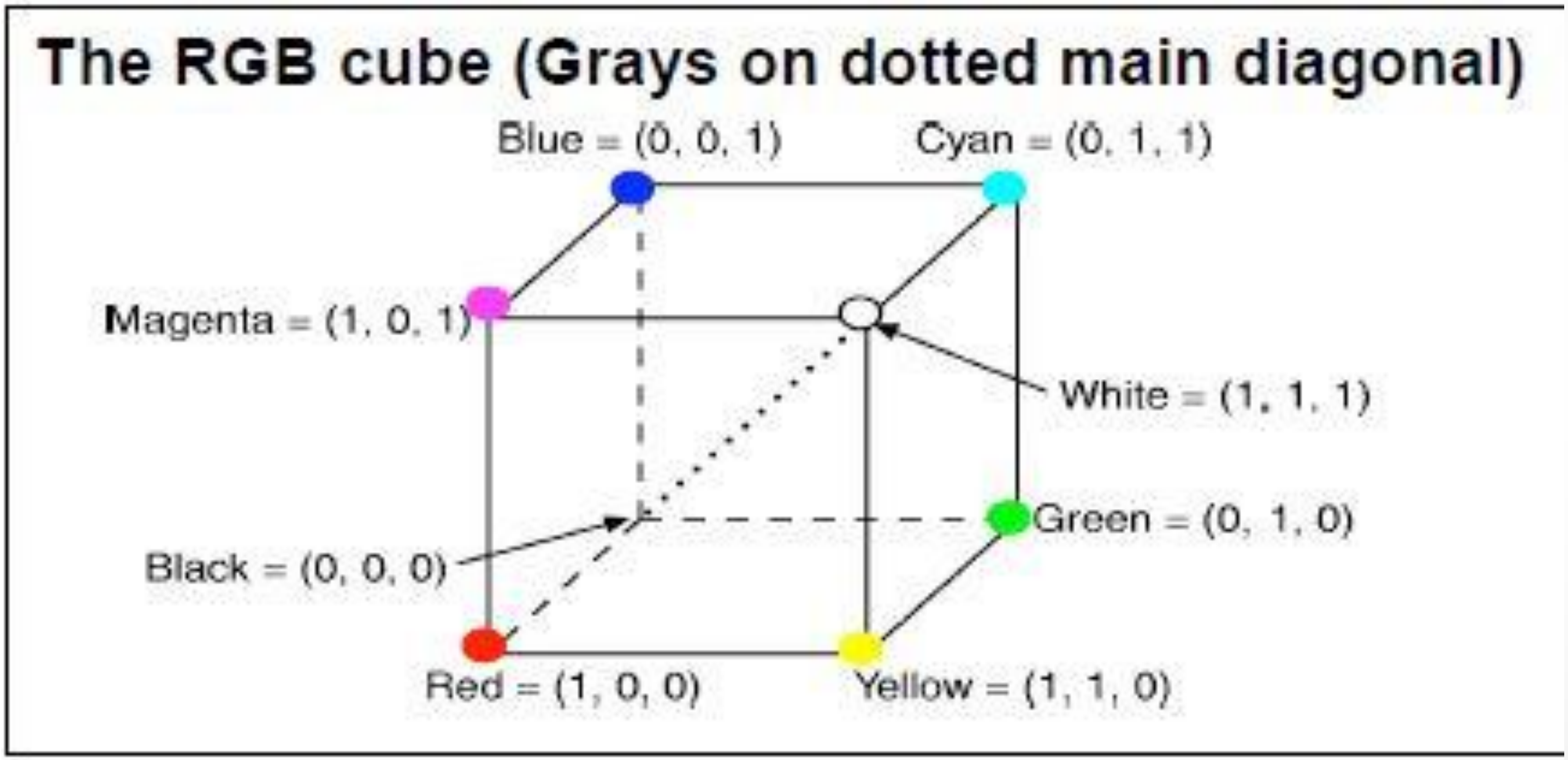
https://genuinenotes.com

2.6.1. RGB

- Main diagonal => gray levels
  - black is (0, 0, 0)
  - white is (1, 1, 1)
- Hue is defined by the one or two largest parameters
- Saturation can be controlled by varying the collective minimum value of R, G and B
- Luminance can be controlled by varying magnitudes while keeping ratios constant

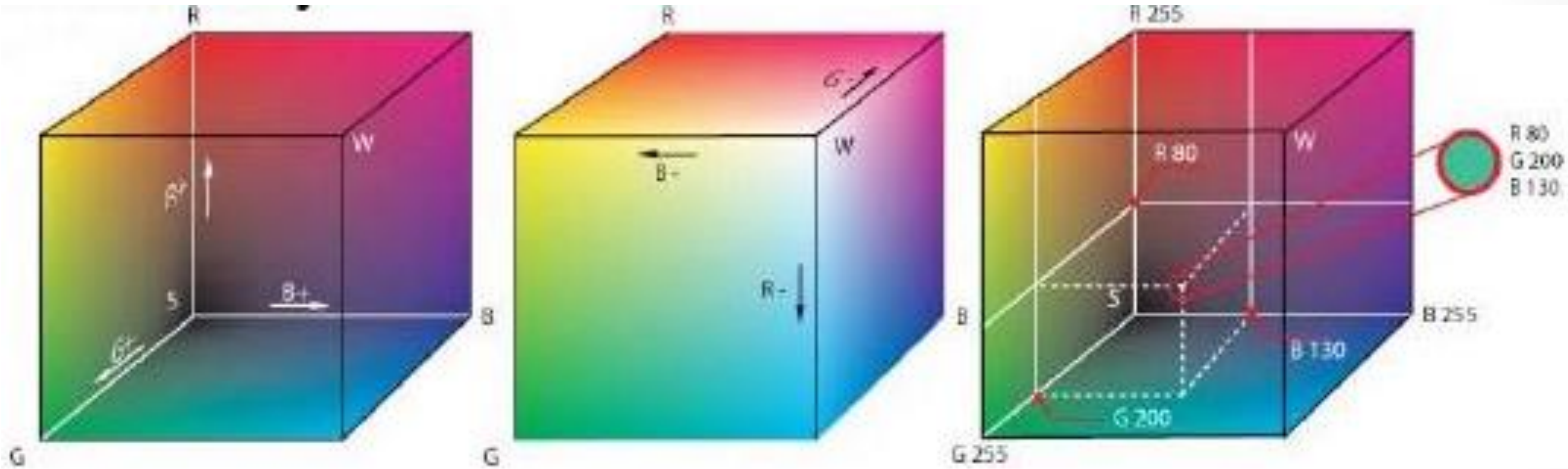
https://genuinenotes.com

2.6.1. RGB



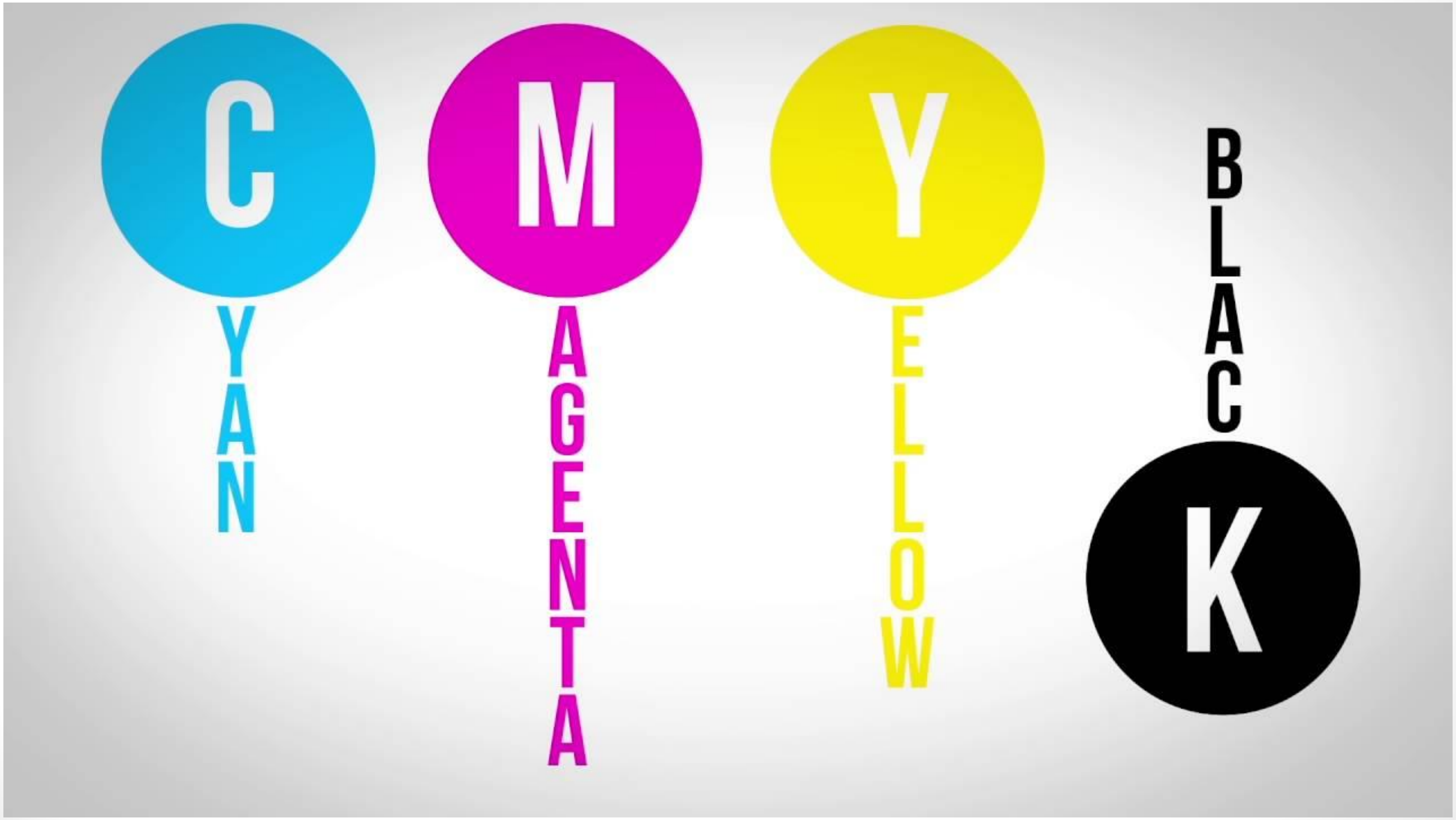
https://genuinenotes.com

2.6.1. RGB



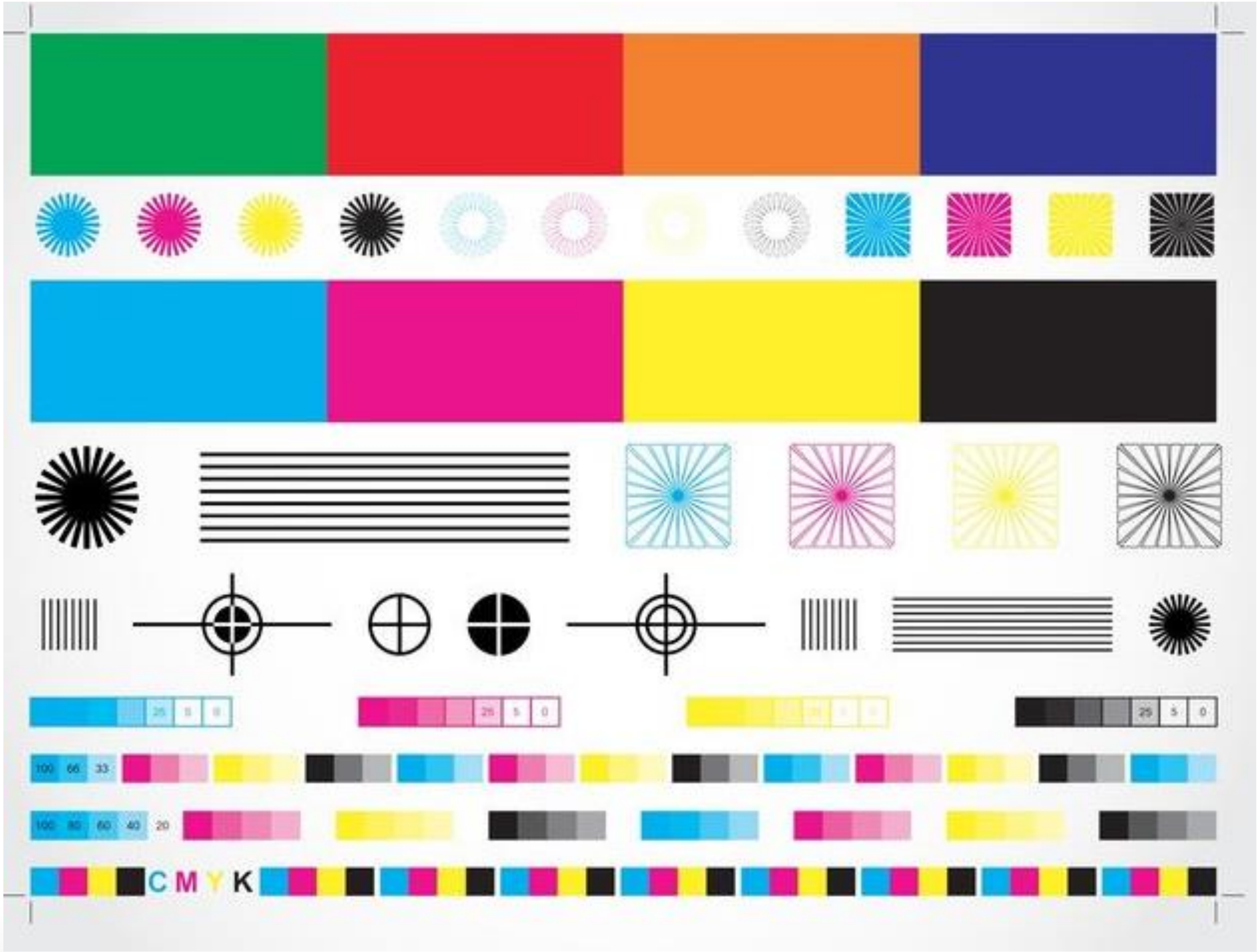
https://genuinenotes.com

CMYK



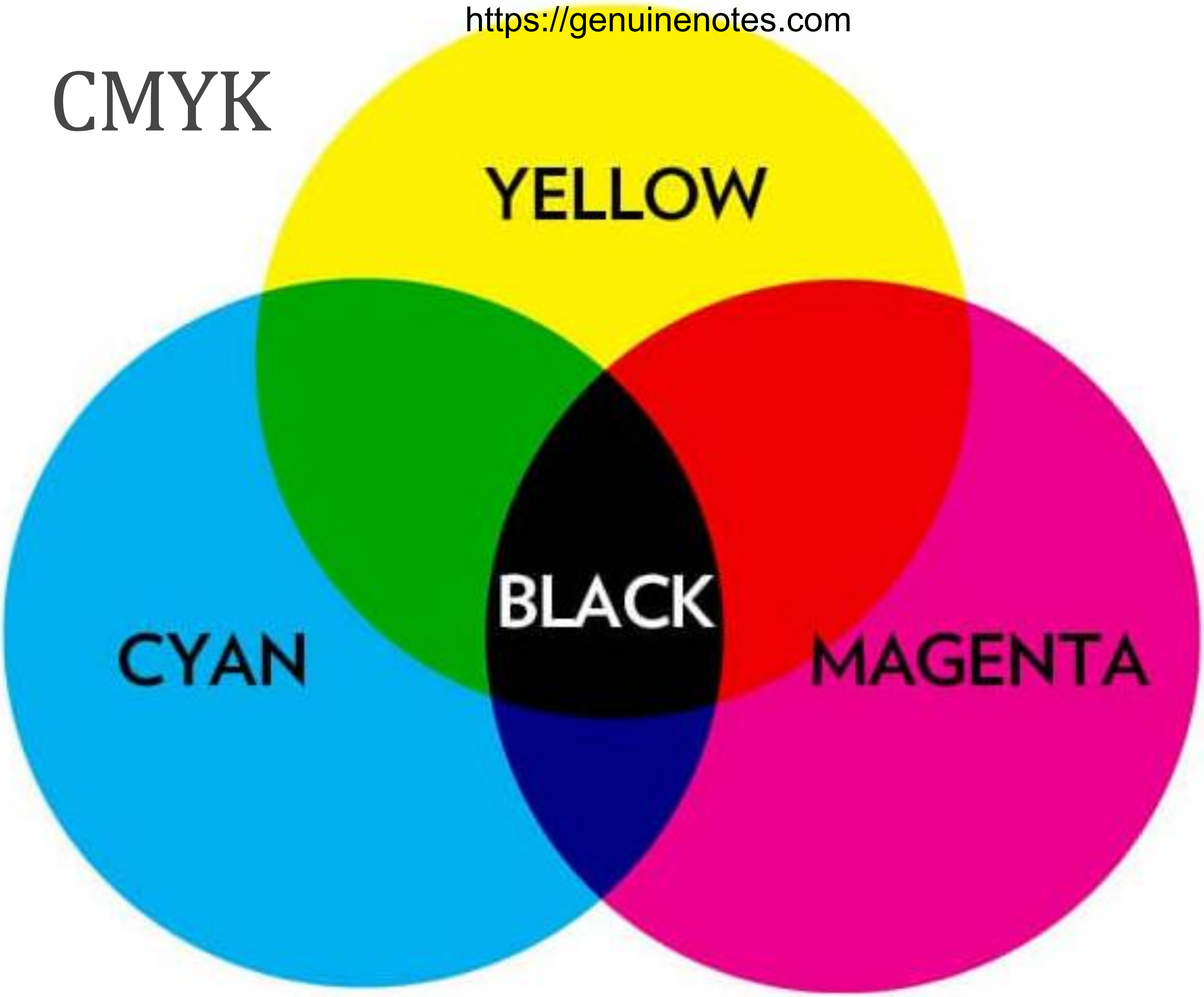
https://genuinenotes.com

CMYK Chart



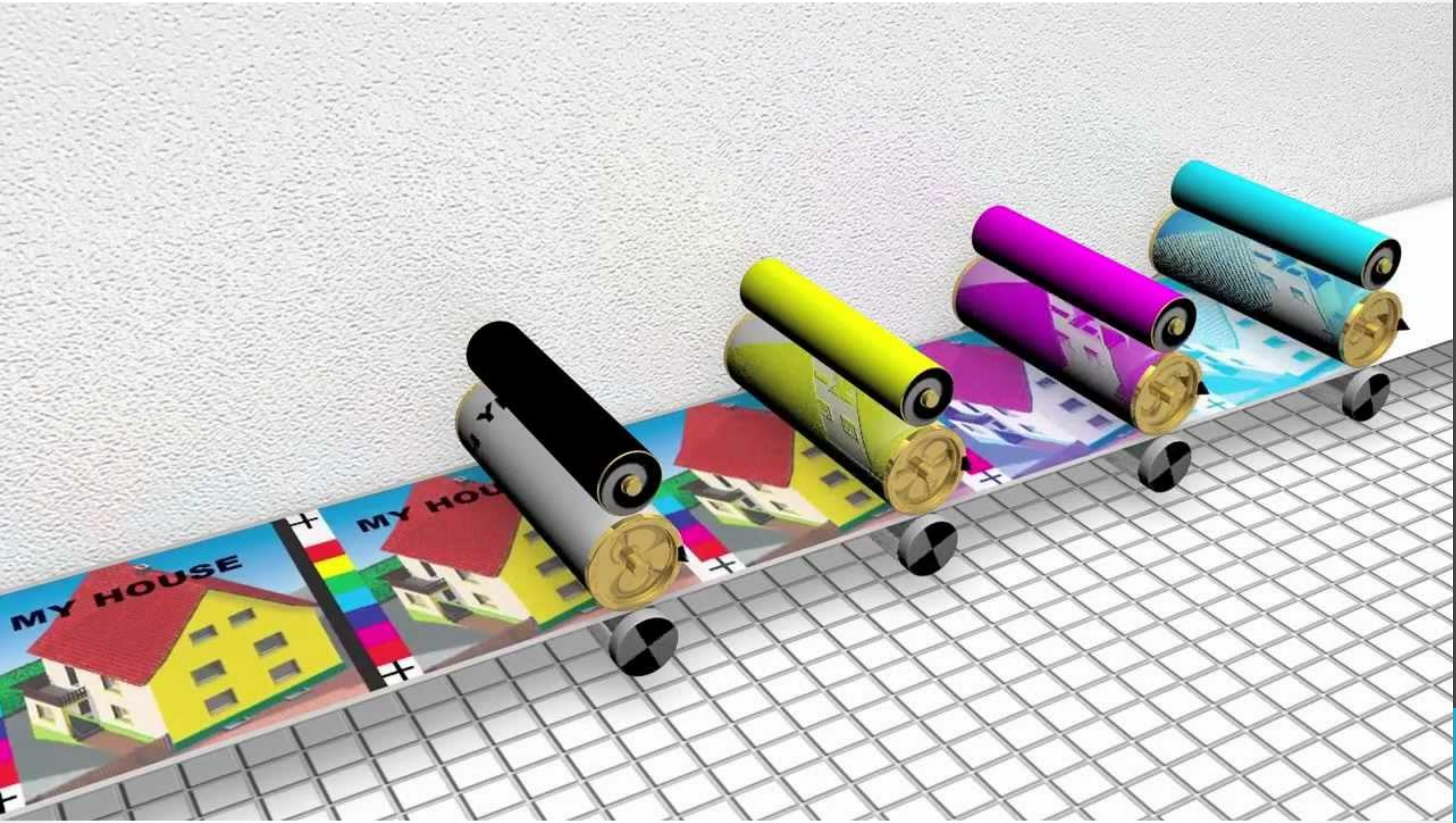
https://genuinenotes.com

CMYK



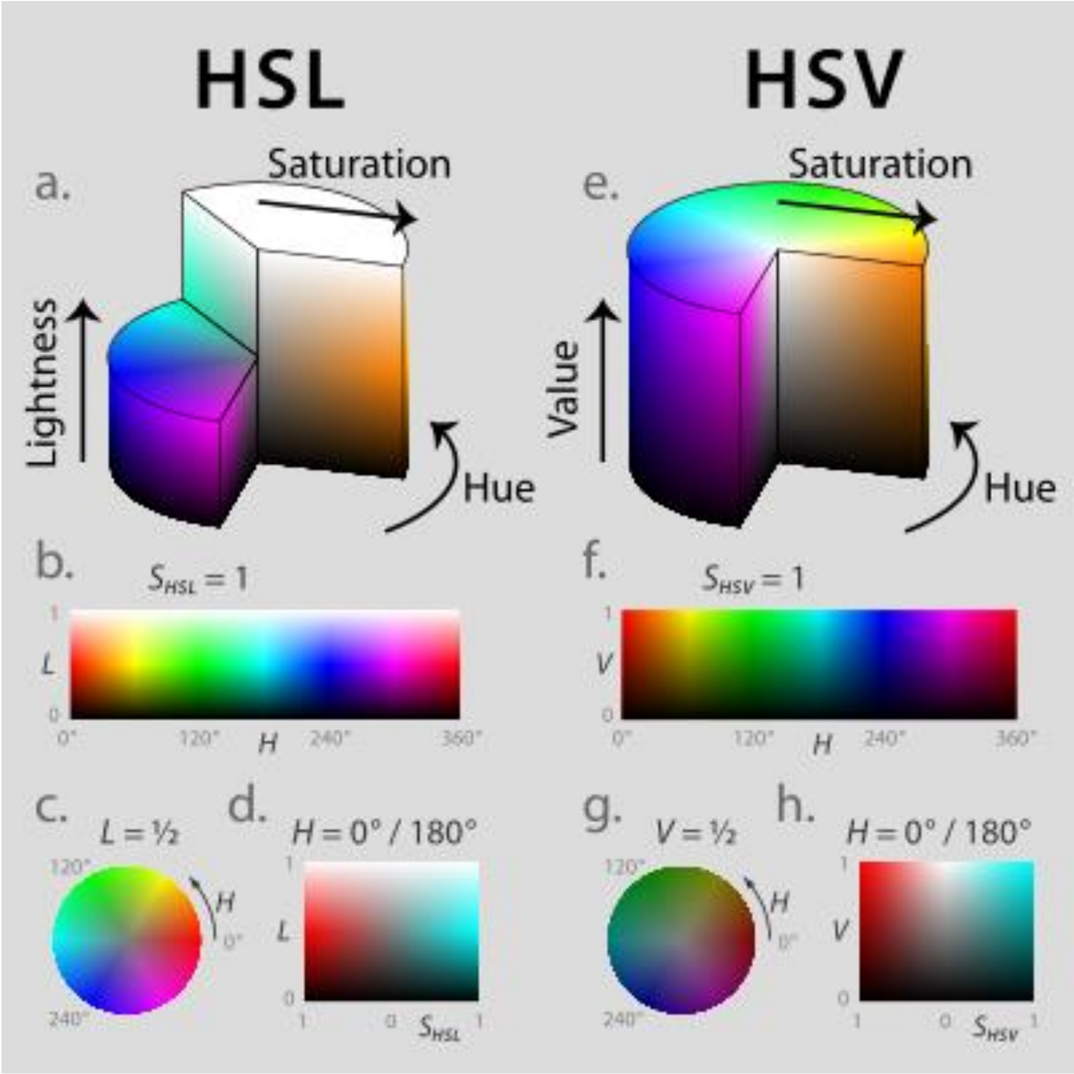
https://genuinenotes.com

CMYK Print



https://genuinenotes.com

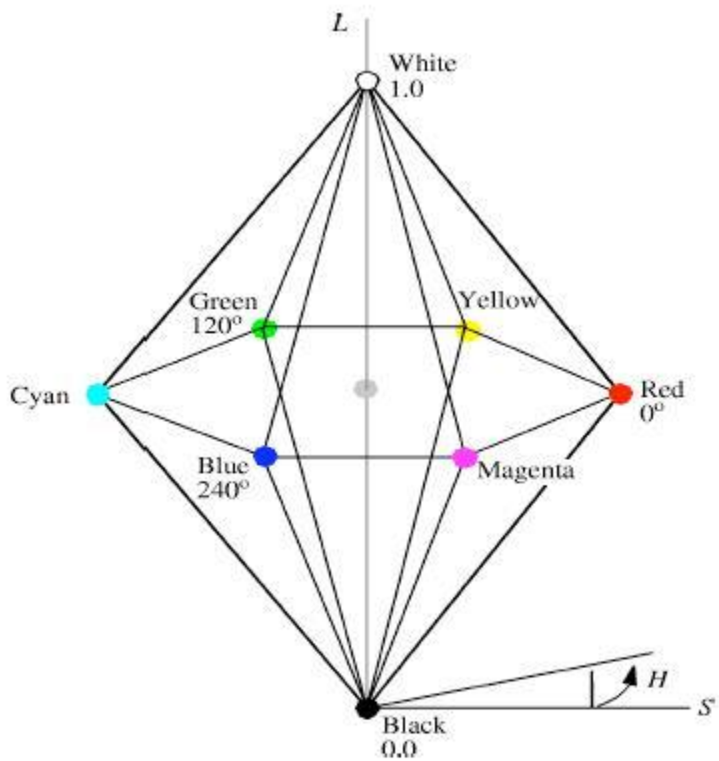
2.6.1. HSV



https://genuinenotes.com

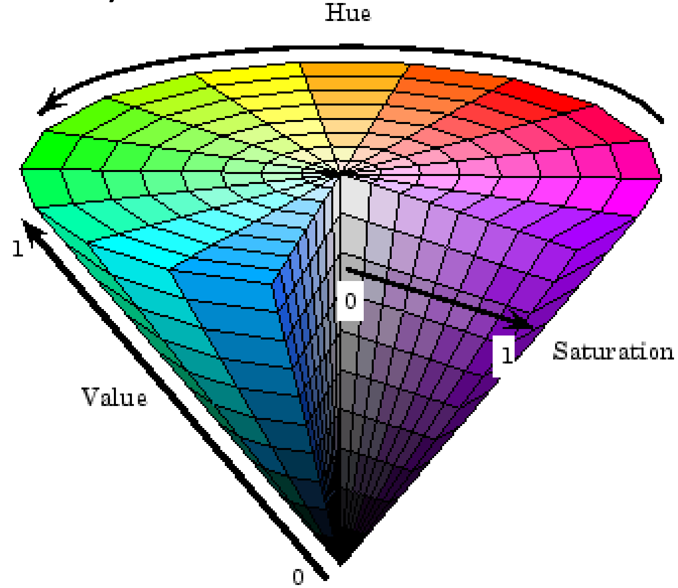
2.6.1. HSV

- This color model is based on polar coordinates, not Cartesian coordinates.
- Hue, saturation, value (brightness)

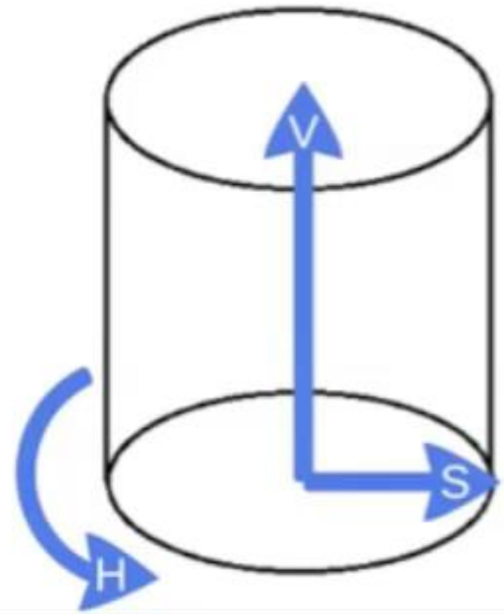


https://genuinenotes.com

- HSV is a non-linearly transformed (skewed) version of RGB cube
  - Hue: quantity that distinguishes color family, say red from yellow, green from blue (**what color**?)
  - Saturation (Chroma): color intensity (**strong to weak**). Intensity of distinctive hue, or degree of color sensation from that of white or grey (**what purity**?)
  - Value (luminance): light color or dark color (**what strength**?)

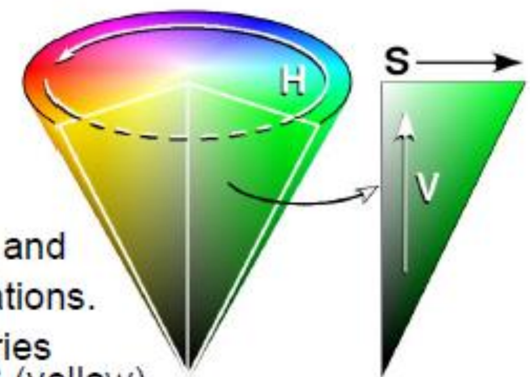


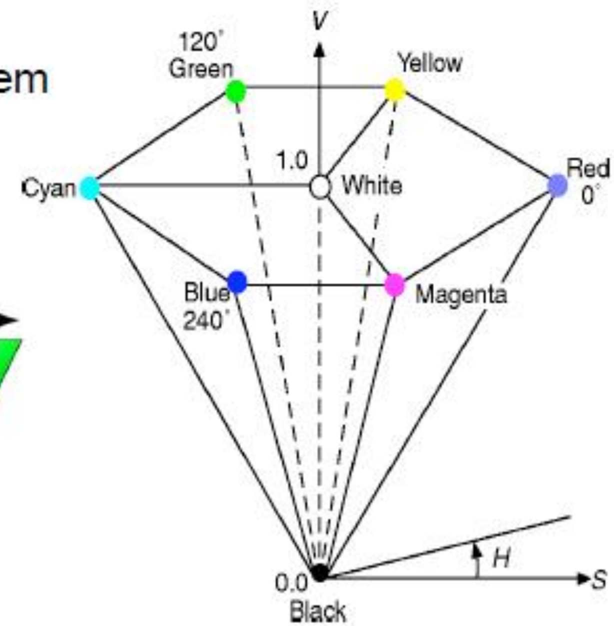
HSV is a cylindrical coordinate representation of points in an RGB color model



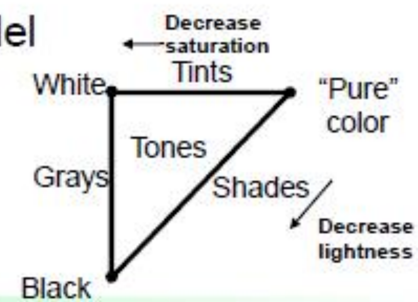
The HSV Color Model

- Hue, saturation, value (brightness)
- Hexcone subset of cylindrical (polar) coordinate system
- Single hexcone HSV color model.
  (The V = 1 plane contains the RGB model's
  R = 1, G = 1, B = 1, in the regions shown):





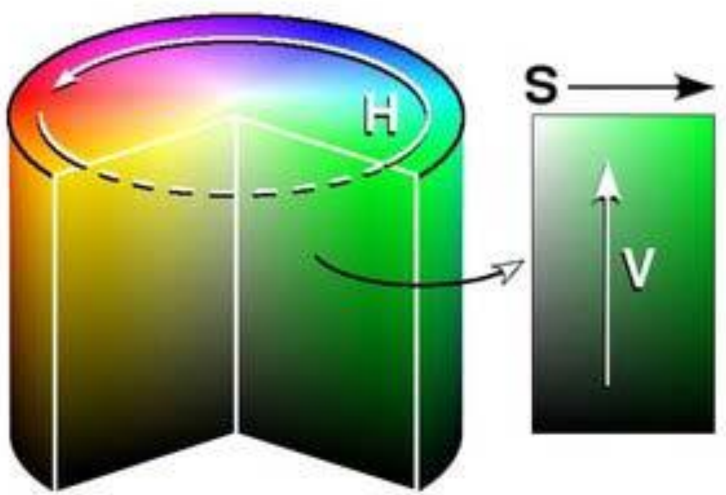
- The eye can see
  - about 128 different hues, and
  - about 130 different saturations.
  - The number of values varies between 16 (blue) and 23 (yellow)
- Has intuitive appeal of the artist's tint, shade, and tone model
  - pure red = **H** = 0, **S** = 1, **V** = 1; pure pigments are (I, 1, 1)
  - tints: adding white pigment ⇔ decreasing **S** at constant **V**
  - shades: adding black pigment ⇔ decreasing **V** at constant **S**
  - tones: decreasing **S** and **V**



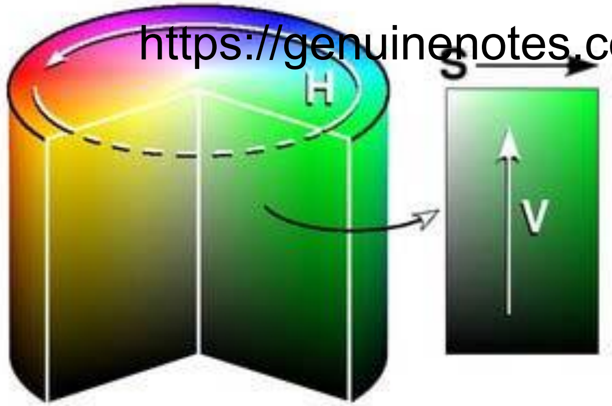
https://genuinenotes.com

Converting from RGB to HSV

- HSV color space describes colors in terms of the **H**ue, **S**aturation, and **V**alue
- The HSV model describes colors similarly to how the human eye tends to perceive color
- RGB defines color in terms of a combination of primary colors, where as, HSV describes color using more familiar comparisons such as color, vibrancy and brightness.

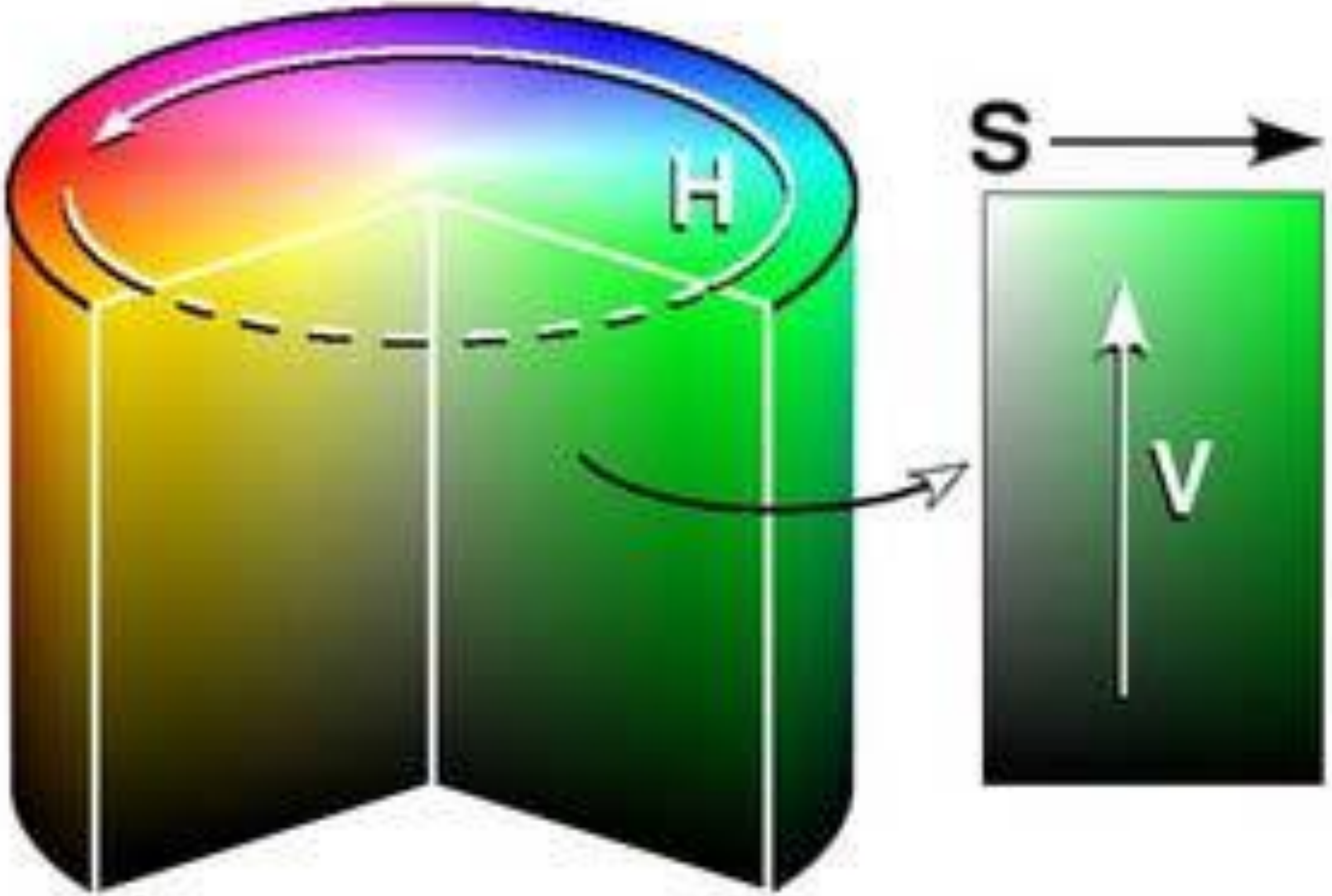


https://genuinenotes.com



- Hue represents the color type. It can be described in terms of an angle on the above circle. Although a circle contains 360 degrees of rotation, the hue value is normalized to a range from 0 to 255, with 0 being red.
- Saturation represents the vibrancy of the color. Its value ranges from 0 to 255. The lower the saturation value, the more gray is present in the color, causing it to appear faded.
- Value represents the brightness of the color. It ranges from 0 to 255, with 0 being completely dark and 255 being fully bright.
- White has an HSV value of 0-255, 0-255, 255. Black has an HSV value of 0-255, 0-255, 0. The dominant description for black and white is the term, value. The hue and saturation level do not make a difference when value is at max or min intensity level.

https://genuinenotes.com



https://genuinenotes.com

Unit 2 Finished

Thank You