

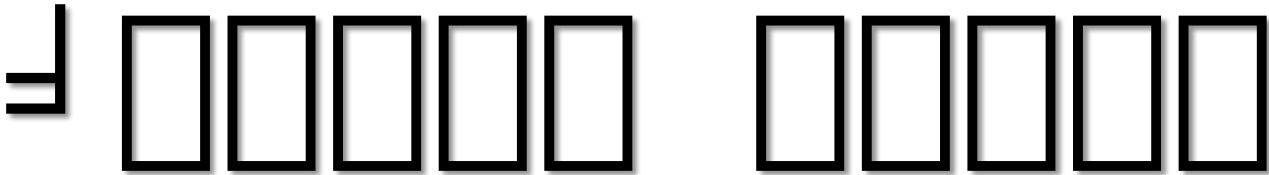
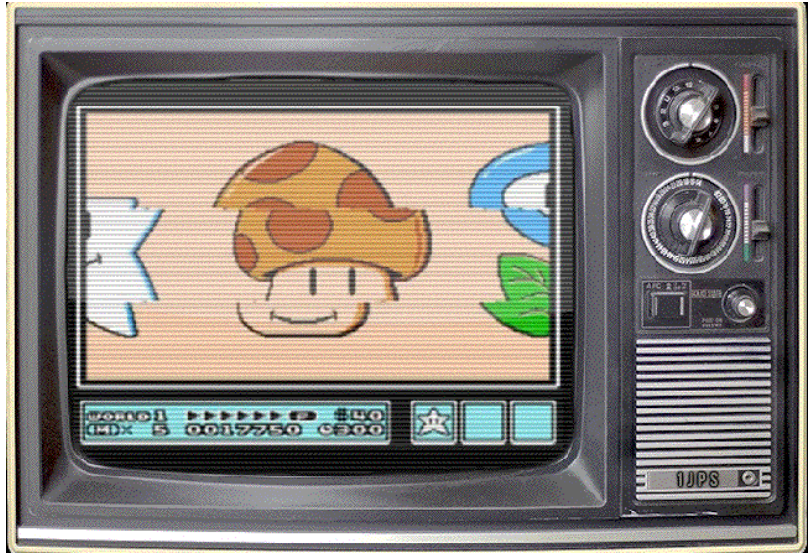
Sistem Multimedia

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Analog Video

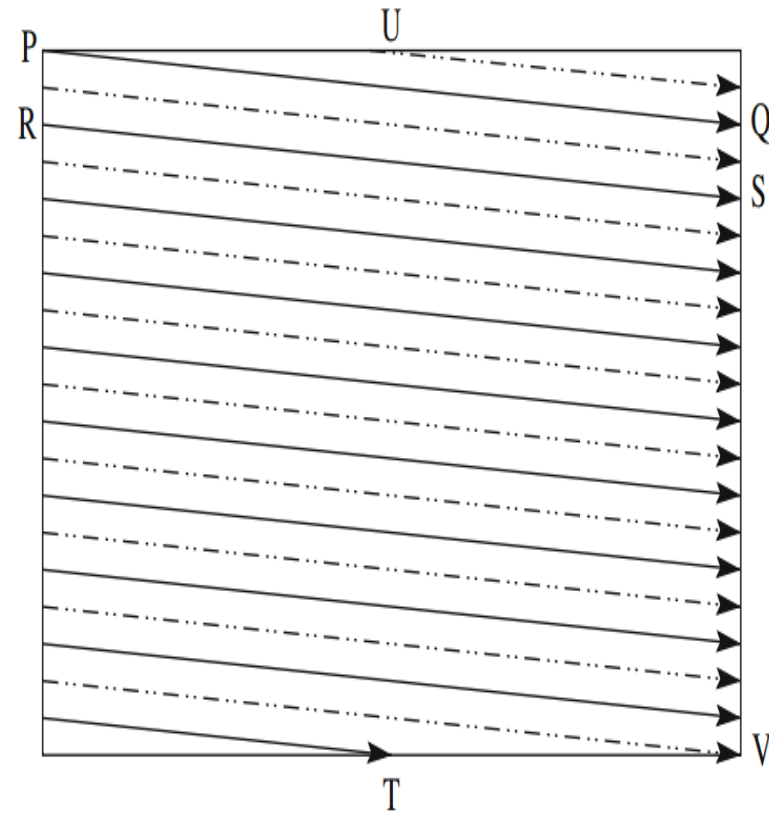
- Up until last decade, most TV programs were sent and received as an **analog signal**
- **Progressive scanning** traces through a complete picture (a frame) row-wise for each time interval
- In some monitors and multimedia standards, **interlaced scanning** is used

How Television Works?



Interlaced Scanning

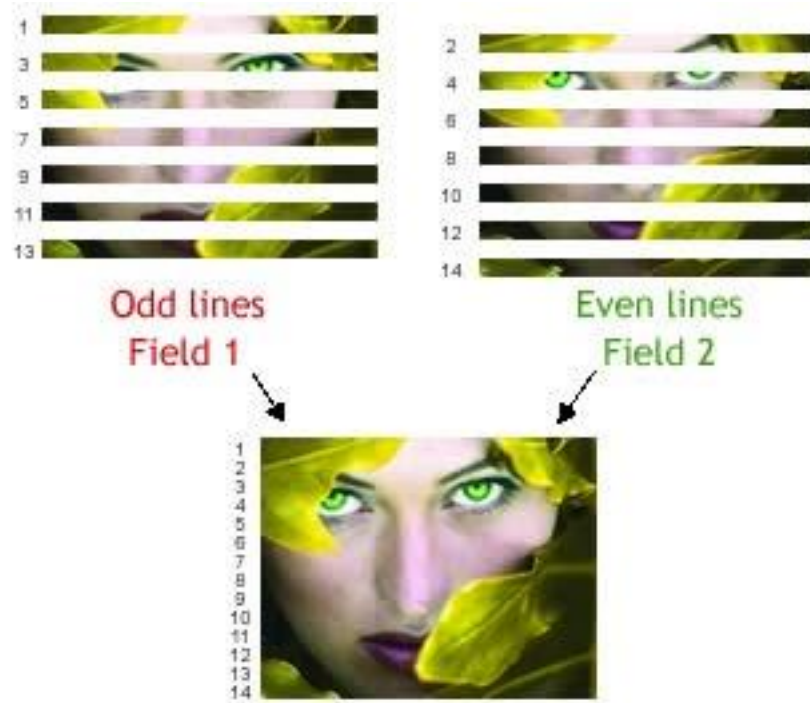
- The **odd-numbered lines** are traced first, then the **even-numbered lines**
- These two fields make up one frame
- First the solid (odd) lines are traced—**P** to **Q**, then **R** to **S**, and so on, ending at **T**
- Then the even field starts at **U** and ends at **V**



Interlaced Scanning

- The jump from Q to R and so on is called the **horizontal retrace**
- The jump from T to U or V to P is called the **vertical retrace**

Interlaced Scanning



Field 1 + Field 2 = Frame (complete image)
Display Rate: 60 fields per second (North America)

Interlaced Scanning

- Interlacing was invented because it was **difficult** to transmit the amount of information in a full frame quickly enough
- This is generally not noticeable **except** when fast action is taking place onscreen



- **Pros :**
 - Reduce Bandwidth
 - Lower Prices
- **Cons :**
 - Image Artefact





Interlaced scan image



progressive scan image

Interlaced vs Progressive

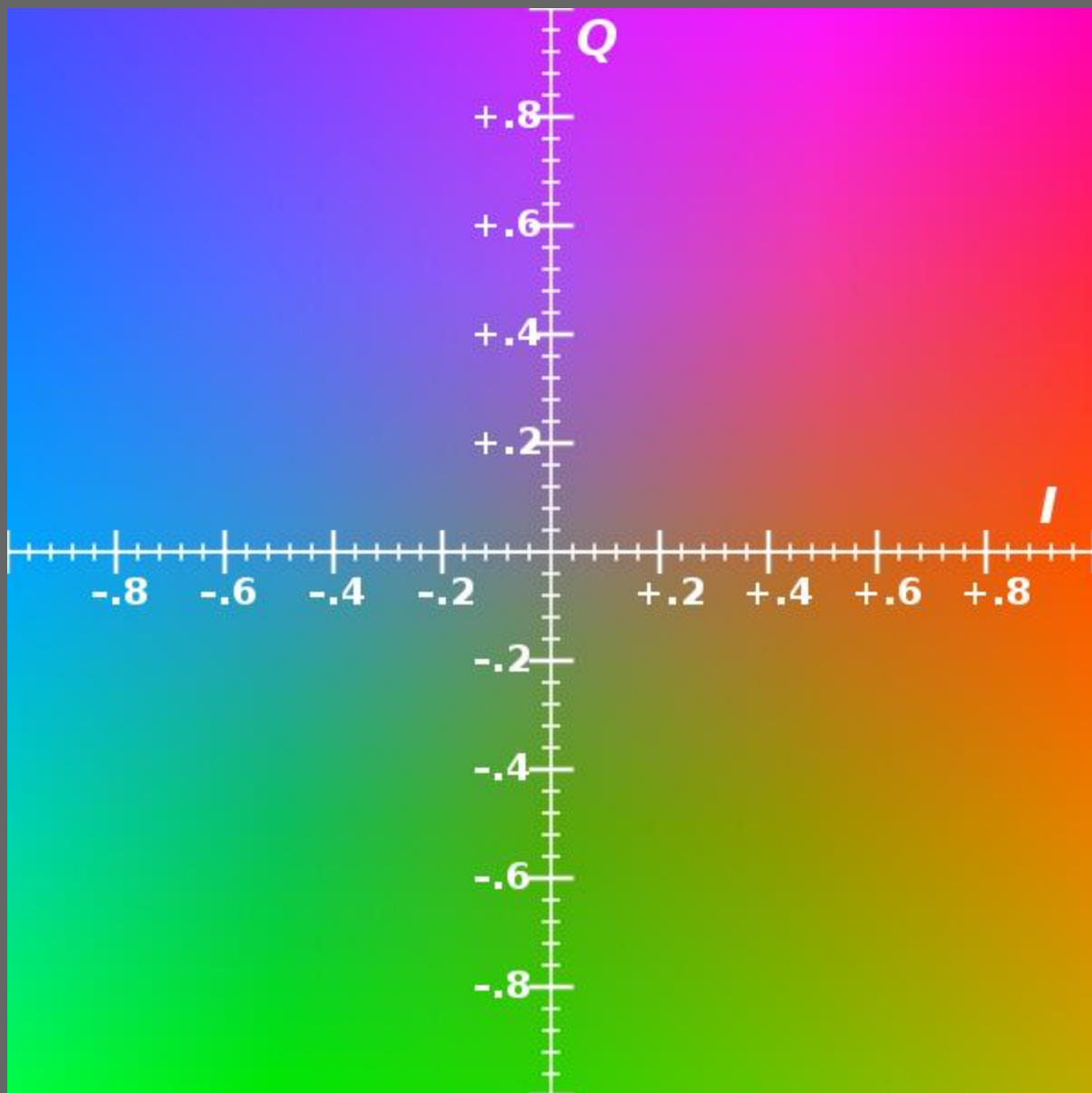
NTSC Video

- The **NTSC TV standard** is mostly used in North America and Japan (National Television System Committee)
- It uses a **4:3** aspect ratio and **525** scan lines per frame at **30** fps (60Hz:60half frame / second)
- NTSC follows the **interlaced** scanning system
- Each frame is divided into two fields, with **262.5** lines/field

NTSC Video

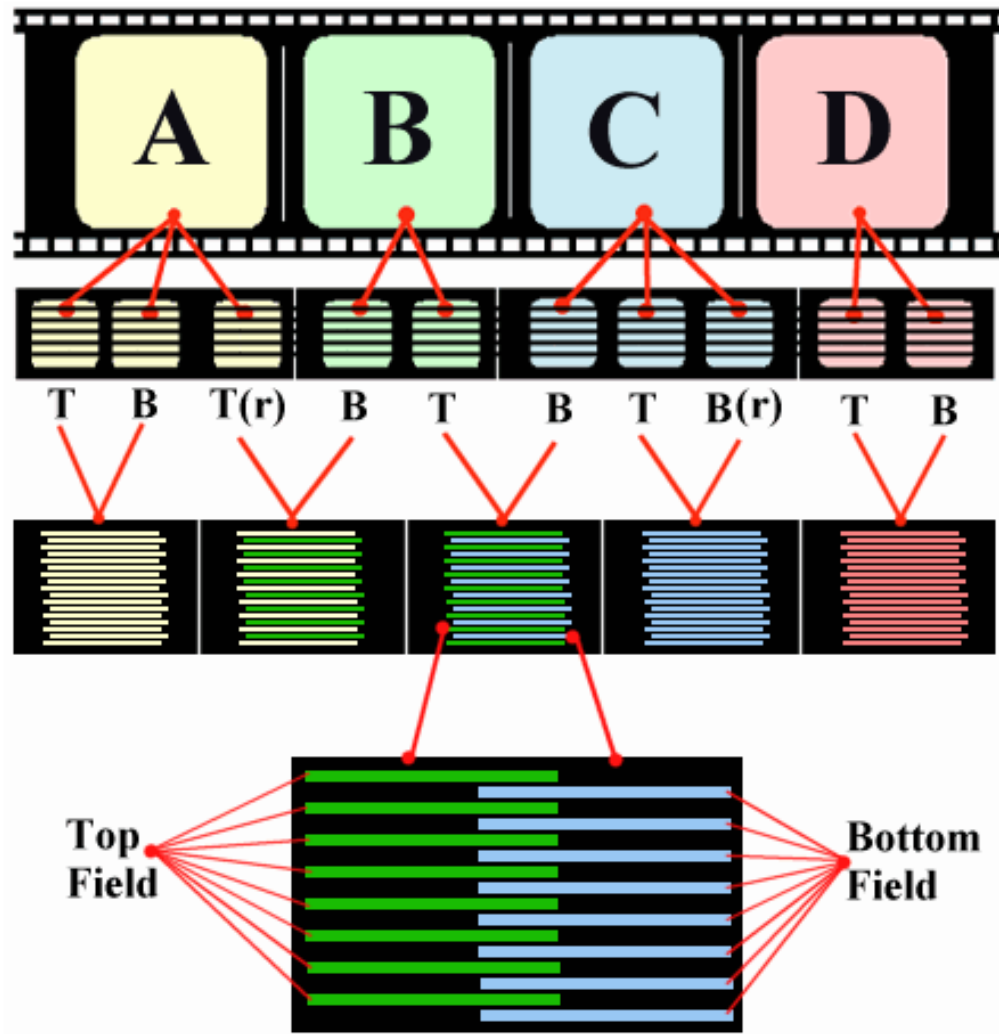
- NTSC uses the **YIQ** color model
- Each line is represented by a number of samples. A sample equals to one pixel

Format	Samples per lines
VHS	240
S-VHS	400-425
Beta-SP	500
Standar 8 mm	300
Hi-8 mm	425



3:2 Pulldown NTSC

- a motion picture camera captures its images at **24 frames every second**
- **NTSC** It uses frame at **30 fps** (60Hz:60half frame / second)
- The only way we are going to be able to play a 24 fps motion picture on NTSC television is to **change** it from **24 fps to 30 fps (PullDown)**



- 3, 2, 3, 2 and so on
- It can be said to "pull down" a whole frame and split it into three fields and two fields.

PAL Video

- Phase Alternating Line
- Uses 625 scan lines per frame, at 25 fps, with a 4:3 aspect ratio and interlaced fields
- Widely used in Western Europe, China, India, and many other parts of the world
- Visual quality of its pictures is generally better than that of NTSC

PAL Video

- Uses the **YUV** color model with an **8 MHz channel**, allocating a **bandwidth** of **5.5 MHz** to **Y** and **1.8 MHz** each to **U** and **V**



SECAM Video

- Systeme Electronique Couleur Avec Mémoire
- Invented by the French
- 625 scan lines per frame, at 25 fps, with a 4:3 aspect ratio and interlaced fields
- Uses the YUV color model

- PAL and SECAM television systems run at 25 frames per second. They are close enough to the film frame rate that **3:2 pulldown isn't required**. (using 2:2)

Table 5.2 Comparison of analog broadcast TV systems

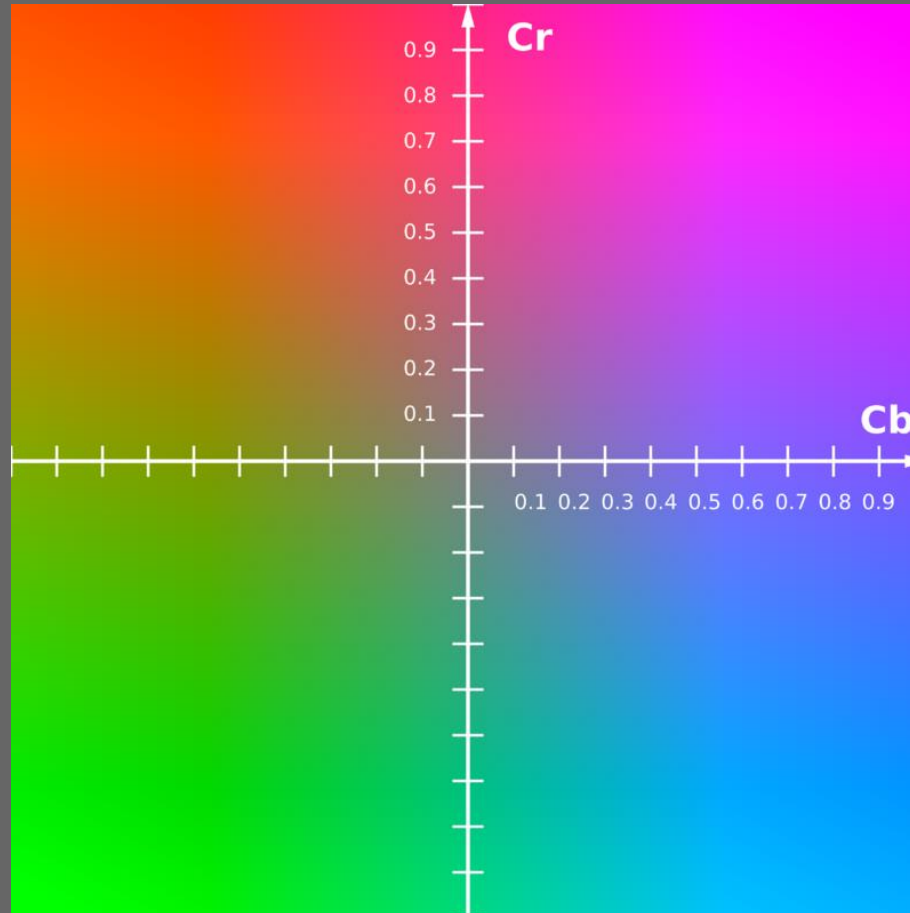
TV system	Frame rate (fps)	Number of scan lines	Total channel width (MHz)	Bandwidth allocation (MHz)		
				<i>Y</i>	<i>I</i> or <i>U</i>	<i>Q</i> or <i>V</i>
NTSC	29.97	525	6.0	4.2	1.6	0.6
PAL	25	625	8.0	5.5	1.8	1.8
SECAM	25	625	8.0	6.0	2.0	2.0

Digital Video

The **advantages** of digital representation for video are many:

- Storing video on digital devices or in memory, **ready to be processed**
- Direct access, which makes **video editing simple**
- **Repeated recording** without degradation of image quality
- Ease of **encryption** and better tolerance to channel **noise**
- The usual color space is **YCbCr**

YCbCr



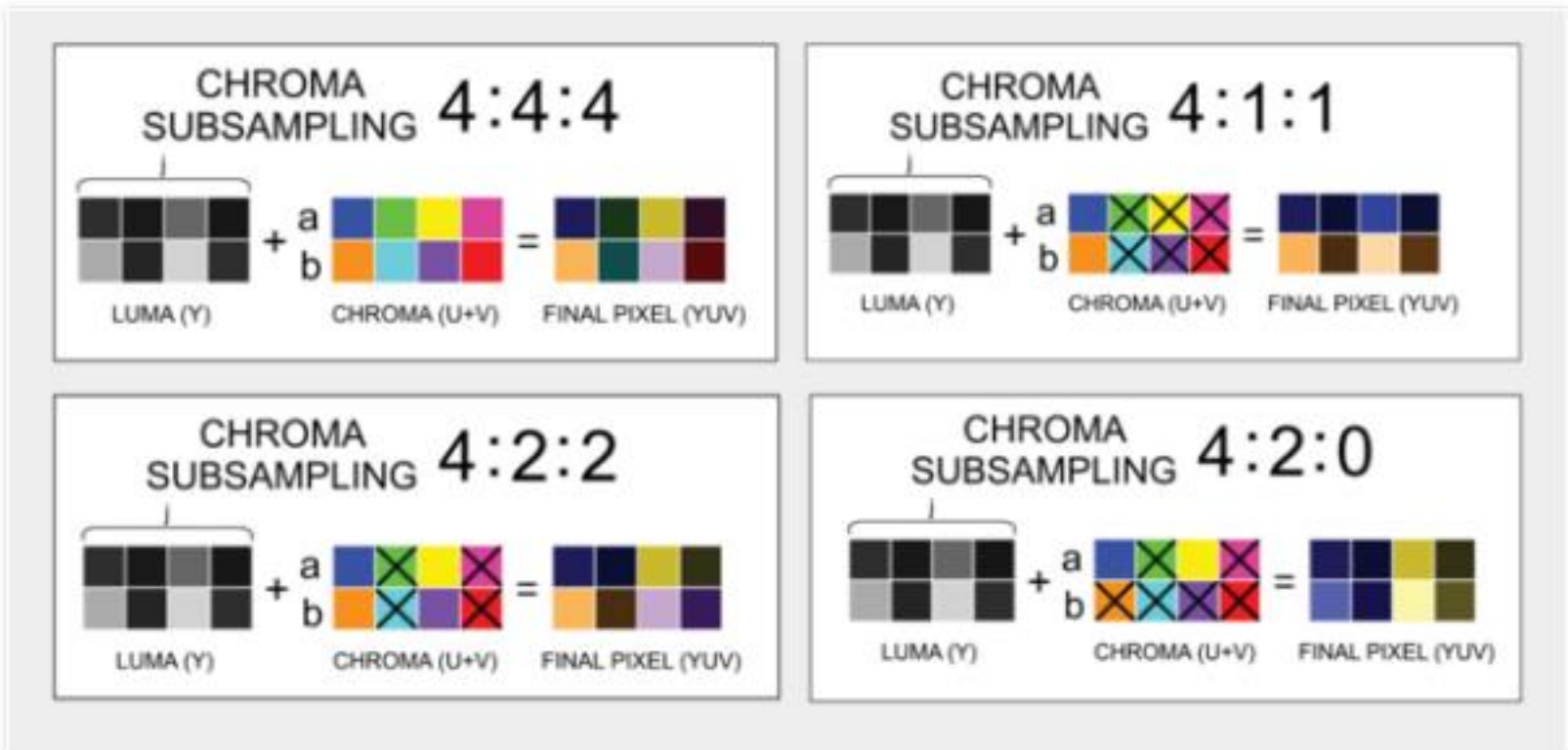
Chroma Subsampling

- The human eye is **more sensitive to the luminance, the brightness and contrast** portion of an image and **less sensitive to the chroma, color information** of an image.
- **Chroma subsampling** is **a reduction of color information**. It's achieved through the **sharing of data for one pixel across a sampling of several pixels**, fewer than those that compose the entire image.

- Chroma subsampling is expressed as a **numerical formula** that represents the **ratio of pixels** used in the subsampling of that clip.
- Written out it appears as **J:a:b**
- "**J**" : total **number of pixels in the horizontal sampling region**. In most cases "J" will equal four
- "**a**" position, is the number of pixels sampled amongst the **first row** of **pixels as defined by "J"**.
- "**b**" position of the ratio is the number of pixels sampled amongst **the second row of pixels in the "J" region**

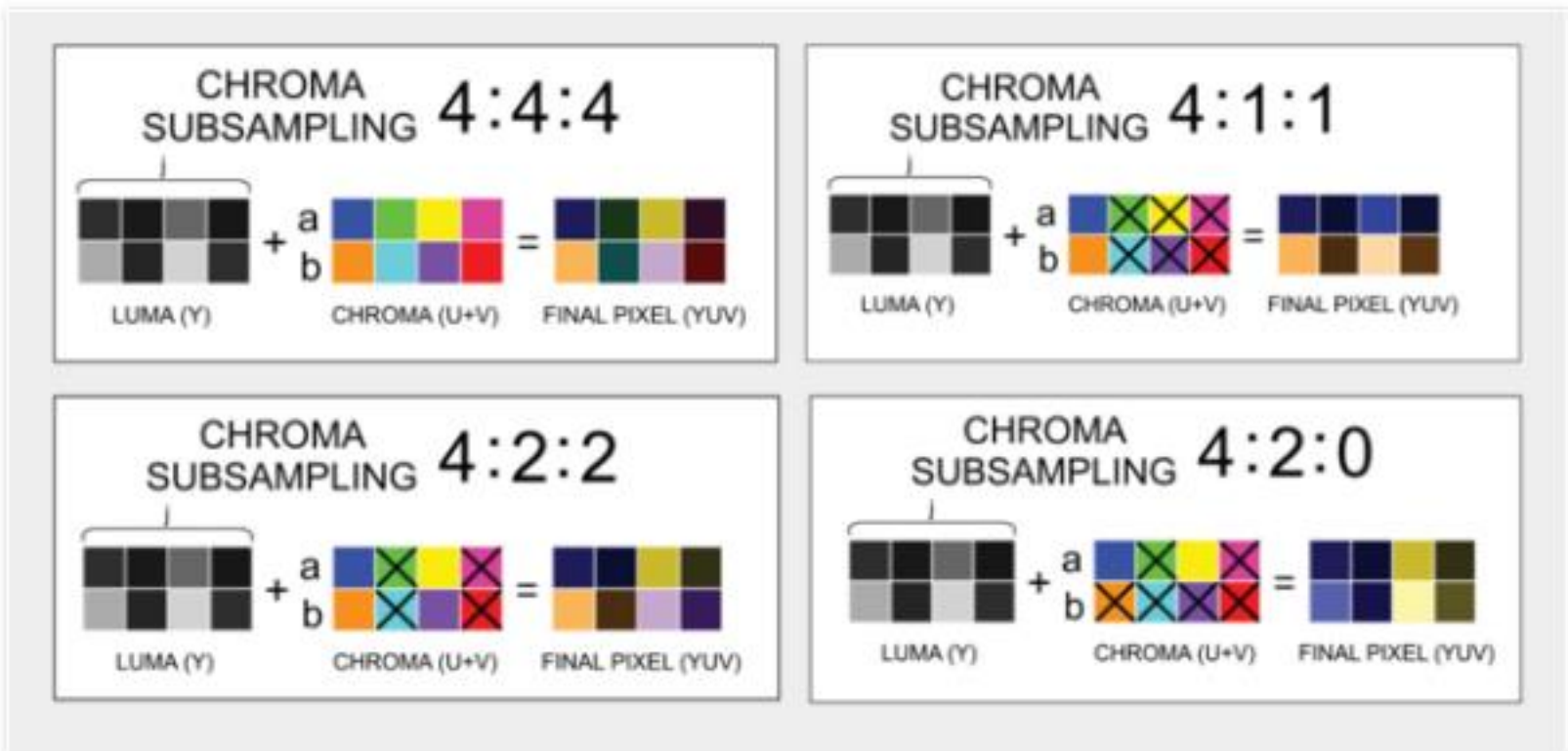
Chroma Subsampling

- “4:4:4” indicates that **no chroma subsampling** is used
- “4:2:2”, samples **two pixels from both the top and bottom rows**. This is one of the more popular samplings and is found in codecs such as AVC-Intra 100, Digital Betacam, Panasonic DVCPRO HD



Chroma Subsampling

- **4:2:0** sampling takes two chroma samples from the top “a” row of pixels and none from the bottom “b” row. Instead, the bottom row shares chroma information from the top row sampling
- **4:1:1** It takes one sample from the top “a” row of pixels and one sample from the lower “b” row of pixels.



Chroma Subsampling

- The **NTSC** version uses **4:2:2**
- Each pixel can be represented with **two bytes (16 bits)**-(8 bits for Y and 8 bits alternating between Cb and Cr)

Table 5.3 ITU-R digital video specifications

	Rec. 601 525/60 NTSC	Rec. 601 625/50 PAL/SECAM
Luminance resolution	720 × 480	720 × 576
Chrominance resolution	360 × 480	360 × 576
Color subsampling	4:2:2	4:2:2
Aspect ratio	4:3	4:3
Fields/sec	60	50
Interlaced	Yes	Yes

High-Definition TV

- ▶ The main purpose of HDTV is **not to increase the “definition”** in each unit area, but rather to **increase the visual field**, especially its **width**
- ▶ HDTV has a wider aspect ratio of **16:9** instead of 4:3 (conventional TV) and use **progressive** (noninterlaced) scan
- ▶ Initially uses MPEG-2 as compression standard. In 2008 H.264 compression is adopted.



PICTURE
QUALITY



480i



ANALOG



480i~480p



SDTV
STANDARD DEFINITION TELEVISION



720p~1080i



HDTV
HIGH-DEFINITION TELEVISION



1080p



Full HD
1920x1080

Ultra High Definition TV

- ▶ UHDTV is a new development
- ▶ The standards announced in 2012 support **4K**: 2160P (3,840x2,160) and **8K**: 4320P (7,680x4,320)
- ▶ The aspect ratio is **16:9**
- ▶ The bit-depth can be up to **12 bits**



Ultra High Definition TV

- The **chroma subsampling** can be **4:2:0** or **4:2:2**
- The supported **frame rate** has been gradually increased to **120 fps**
- The UHDTV will provide superior picture quality, comparable to IMAX movies, but it will require a much higher bandwidth and/or bitrate

720P, 720i, 1080P, 1080i ?

- **720P** : 1280x720 Progressive
- **720i** : 1280x720 Interlace
- **1080P** : 1920x1080 Progressive
- **1080i** : 1920x1080 Interlace

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Component Video

- Higher end video systems, such as for studios, make use of three separate video signals for the red, green, and blue image
- This kind of system has three wires (and connectors) connecting the camera or other devices to a TV or monitor
- Color signals are not restricted to RGB, We can form three signals via a luminance–chrominance transformation of the RGB signals—for example, YIQ or YUV



Component Video

- Component video gives the **best color reproduction**, since there is no “crosstalk” between the three different channels
- Component video, however, **requires more bandwidth** and good synchronization of the three components

CROSSTALK



Composite Video

- Color (“chrominance”) and intensity (“luminance”) signals are **mixed** into a **single carrier** wave
- The **audio signal** is another **addition** to this one signal
- Some **interference** between the luminance and chrominance signals is inevitable



S-Video

- S-video uses **two wires**: one for luminance and another for a composite chrominance signal
- There is **less crosstalk** between **the color information** and **the grayscale information**
- The reason is **that black-and white information** is **most important** for visual perception



Video Graphics Array

- A video display interface that was first introduced by IBM in 1987, along with its PS/2 personal computers
- The initial VGA resolution was 640×480 using the 15-pin D-subminiature VGA connector



Video Graphics Array

- Later extensions can carry **resolutions** ranging from 640x400 pixels at 70 Hz to 1,280x1,024 pixels (SXGA) at 85 Hz and up to 2,048x1,536 (QXGA) at 85 Hz
- Since the video signals are **analog**, it will suffer from **interferences**, particularly when the cable is long

3D Video

- The main advantage of the 3D video is that it enables the experience of immersion—be there, and really Be there!
- Depth perception is achieved through **multiple cues**
- **Monocular cues** provides depth perception when viewing with one eye.
- **Binocular cues** provides depth perception when viewing with two eyes
- Most 3D videos and TVs are based on stereopsis, which is a type of binocular cues

Monocular Cue

linear perspective

Involving parallel lines

Linear perspective is a depth cue that utilizes the fact that lines converge in the distance. That is, **parallel lines** will get "closer together" or **narrower** as they appear **farther** from the viewer. A common illustration of this cue is that of a road or path.



texture gradients

Involving coarse and fine textures

Details are too small to see when they are far away. This idea is known as **texture gradient**. Therefore, areas closer to the viewer will look **coarser**, and areas farther away will have a **finer** texture.



interposition

Involving overlapping objects

Interposition involves objects that appear to be coming **inbetween** the viewer and another object. If an object is interfering with, or **overlapping** the sight of the second object, it is perceived as **closer** than the second to the viewer.



relative size

Involving separate objects expected to be the same size

Closer objects appear **larger** than objects further away. Therefore, if two objects are expected to be the same size, then the larger object will appear closer. This is called **relative size**.



height in plane

Involving separate high and low in the visual field

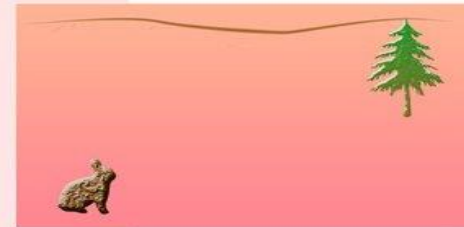
In a picture, objects that are **further** from the viewer appear **higher** in the visual field. Likewise, **lower** objects suggest that they are **closer** to the viewer. This concept is called **height in plane**.



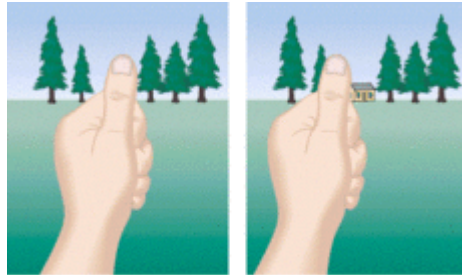
light and shadow

Involving patterns of light and dark

Patterns of **light** and **dark** can create the illusion of a **three dimensional** figure. This concept can be useful in judging distance.



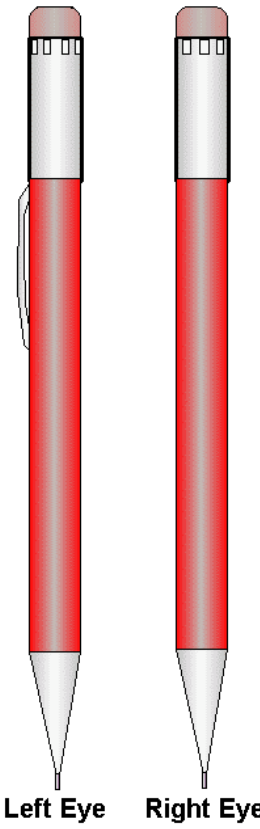
Binocular View



Seen by left eye

Seen by right eye

©Brooks/Cole Publishing Company/ITP



Simple 3D Camera Models

- A simple 3D camera can be built using two identical camera placed side-by-side
- This model exploits disparity parallax to perceive depth



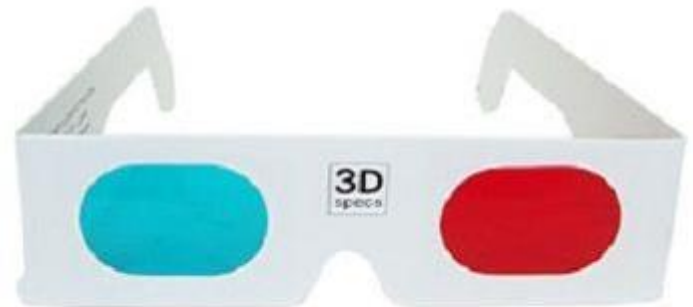
3D Movie and TV

- 3D movie is shown in a screen using various methods :
 - 3D movie using colored glasses
 - 3D Movies Using Circularly Polarized Glasses
 - 3D TV with Shutter Glasses
 - Autostereoscopic display



3D Movie with Colored Glasses

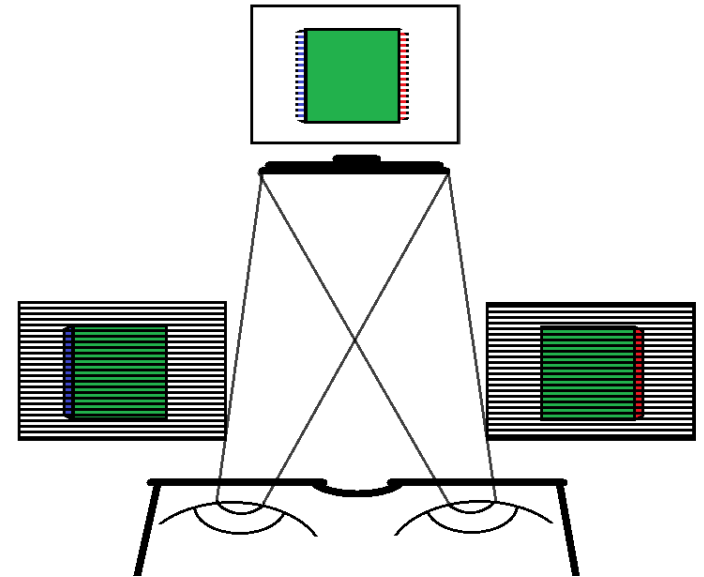
- Old style 3D movies required colored glasses, **red** on the left and **cyan** on the right
- To prepare stereo pictures, **blue and green are filtered out from left image, right image is filtered to remove Red**
- Both images are projected onto the same screen with proper disparities
- After the stereo pictures pass through the glasses, they are fused in the brain
- This is called Anaglyph 3D





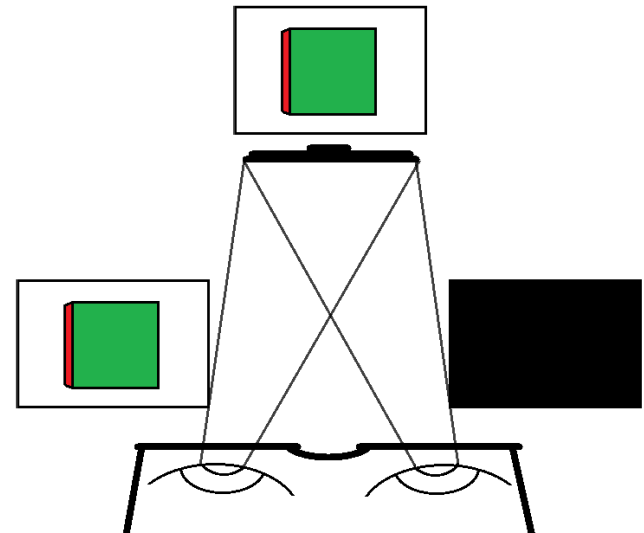
3D Movies Using Circularly Polarized Glasses

- Recent 3D theaters uses this technology
- Polarized glasses are required
- Lights from the left and right pictures are polarized in different directions
- They are projected and superimposed on the same screen
- Left and right polarized glasses that the audience wear are polarized accordingly
- Exp : LG 3d TV



3D TV with Shutter Glass

- Most TVs use shutter glasses to show 3D images.
- Liquid crystal layer on the glasses becomes opaque when voltage is applied
- The glasses are synchronized with the TV (via infrared)
- The TV alternately shows left and right images
- Exp : Samsung 3D TV

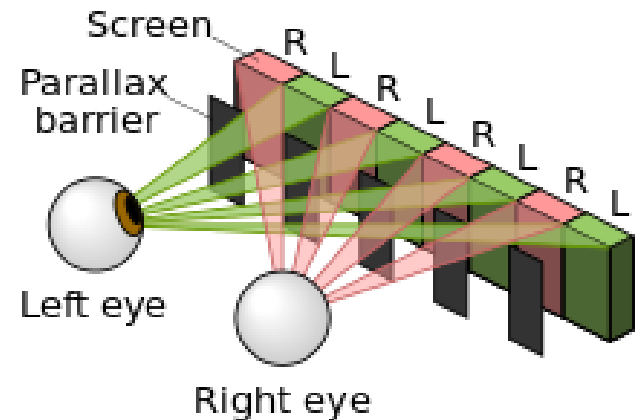


Autostereoscopic display

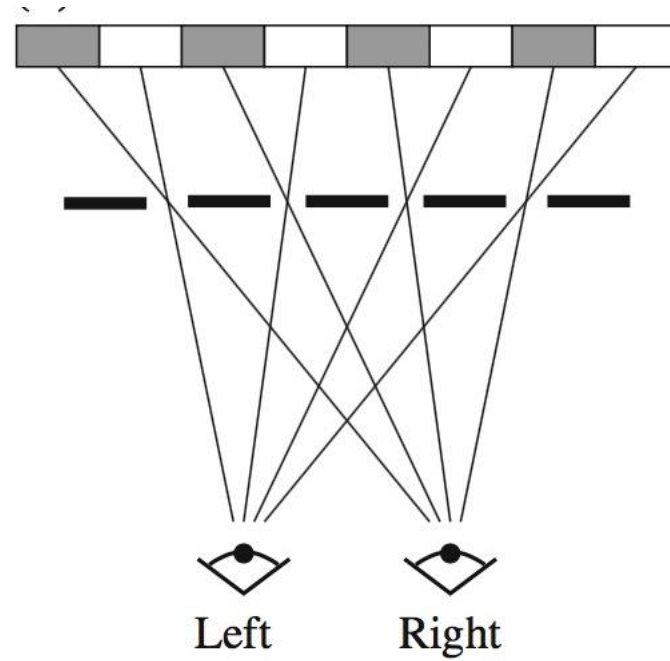
- Wearing glasses to watch 3D movie is uncomfortable
- Autostereoscopic Display Devices require no additional glasses
- Two common methods : Parallax Barrier and Lenticular Lens

Autostereoscopic display

- **Parallax barrier** makes use of a layer of opaque material with small gaps placed in front of a normal screen (e.g. LCD)
- Each eye only sees half of columns on the display
- Stereo left-right images need to be aligned to separate left and right eyes viewing



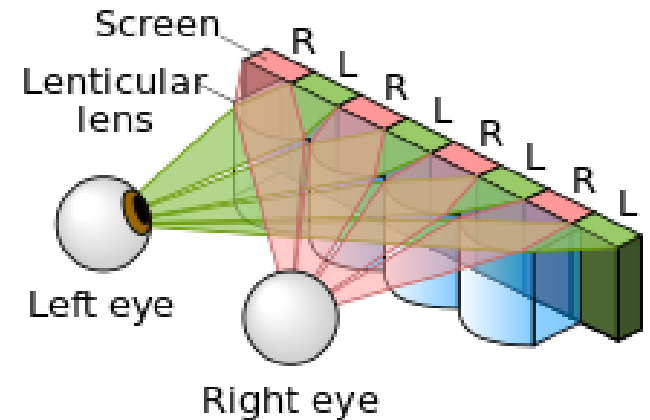
Autostereoscopic display



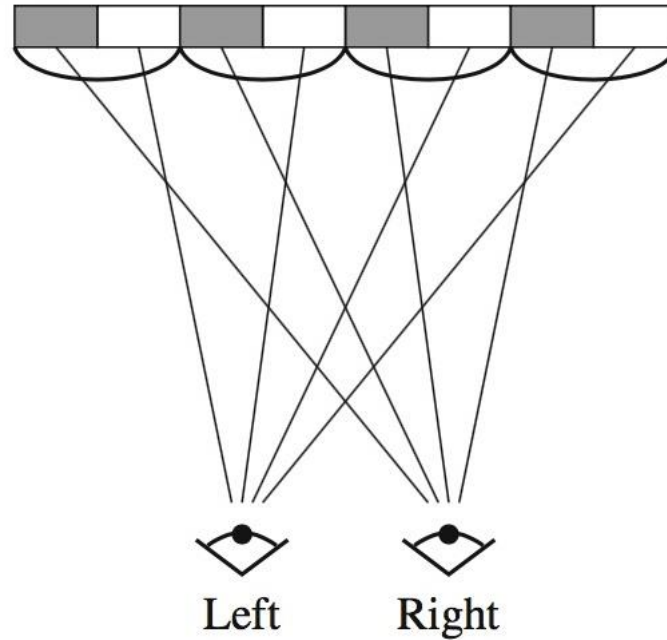
An illustration of parallax barrier system

Autostereoscopic display

- **Lenticular lens** uses columns of magnifying lenses in front of a display to direct lights to the left and right eyes.
- The same technology is also applied to lenticular printing to generate 3D pictures or animations



Autostereoscopic display



An illustration of lenticular lenses system

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