Video is a sequence of images

- Recorded/displayed at a certain rate
- Types of video signals
  - component video
    - separate RGB signals; e.g., VGA CRT
  - composite video
    - luminance and chrominance in one signal carrier
  - S-video
    - 1 luminance and 1 composite chrominance signal
Video

• Image
  – picture resolution: e.g., 640x480
  – pixel depth: e.g., 8-bit

• Video
  – frame rate > flicker-free rate
    • movie: 24 frames/second
    • TV: 25 or 30 frames/second
    • VGA CRT: e.g., 50Hz

We see most video on

• Television
  – PAL (Phase Alternating Line)
    • 625 lines interlaced (576 visible)
    • 25 frames/second
    • aspect ratio 4:3
    • YUV
  – NTSC (National TV Standards Committee)
    • 525 lines interlaced (480 visible)
    • 30 frames/second (29.97 to be exact), 4:3, YIQ
Interlaced vs progressive

• Interlaced
  – odd line: P => Q
  – Q => R (H retrace)
  – R => S
  – ...
  – T => U (V retrace)
  – even line: dash-dot

• Progressive

TV broadcasting

• NTSC (6MHz channel)
  – lower band: guard; upper band: audio (FM)
  – Y: 4.2MHz
  – I: 1.6MHz; Q: 0.6MHz
Digital video

Chroma subsampling

- 4:4:4: no subsampling
- 4:2:2, 4:1:1: chroma as 1/2 or 1/4 luma
- 4:2:0: vertical subsampling as well
Chroma subsampling examples

- Common Intermediate Format (CIF)
  - 4:2:0
  - Y: 352 x 288; U and V: 176 x 144
- Quarter CIF (QCIF): 176x144; 4:2:0

HDTV

- High Definition TV: better video/audio

<table>
<thead>
<tr>
<th># of Active Pixels per line</th>
<th># of Active Lines</th>
<th>Aspect Ratio</th>
<th>Picture Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,920</td>
<td>1,080</td>
<td>16:9</td>
<td>60I 30P 24P</td>
</tr>
<tr>
<td>1,280</td>
<td>720</td>
<td>16:9</td>
<td>60P 30P 24P</td>
</tr>
<tr>
<td>704</td>
<td>480</td>
<td>16:9 &amp; 4:3</td>
<td>60I 60P 30P 24P</td>
</tr>
<tr>
<td>640</td>
<td>480</td>
<td>4:3</td>
<td>60I 60P 30P 24P</td>
</tr>
</tbody>
</table>
TV resolution evolution

• LDTV: low definition
  – 240i60, 288i50
• SDTV: standard definition
  – 480i60, 480p30, 576i50, 576p25
• EDTV: enhanced definition
  – 480p60, 576p50, 720i50/60, 720p24/25/30
• HDTV: high definition
  – 720p50/60, 1080p24/25/30, 1080i50, 1080i60

This lecture

• Video representation
  – type of video signals
  – picture resolution and frame rate
  – analog & digital & HD video
  – interlaced vs progressive
  – chroma subsampling
Next lecture

- Multimedia manipulation
  - lossless compression [Ref: Li&Drew Chap 7]
    - compressibility [7.2]
    - Hoffman coding [7.4.2]
    - LZW compression [7.5]