

Output Model

A picture is worth a thousand words

Coordinate Systems

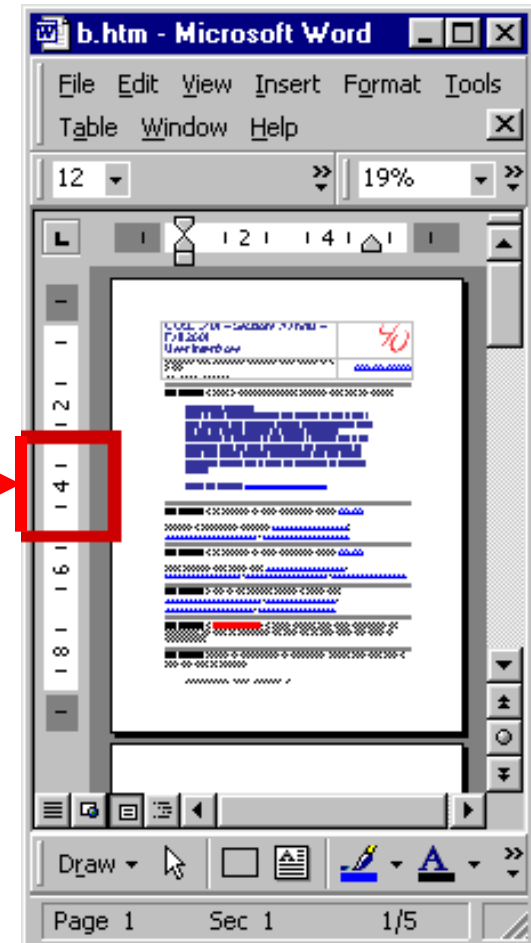
- Device coordinates
- Physical coordinates

Device Coordinates

- Most natural units for the output device
- Typically dots or pixels
- Origin possibilities
 - Centre
 - Bottom left
 - Upper left

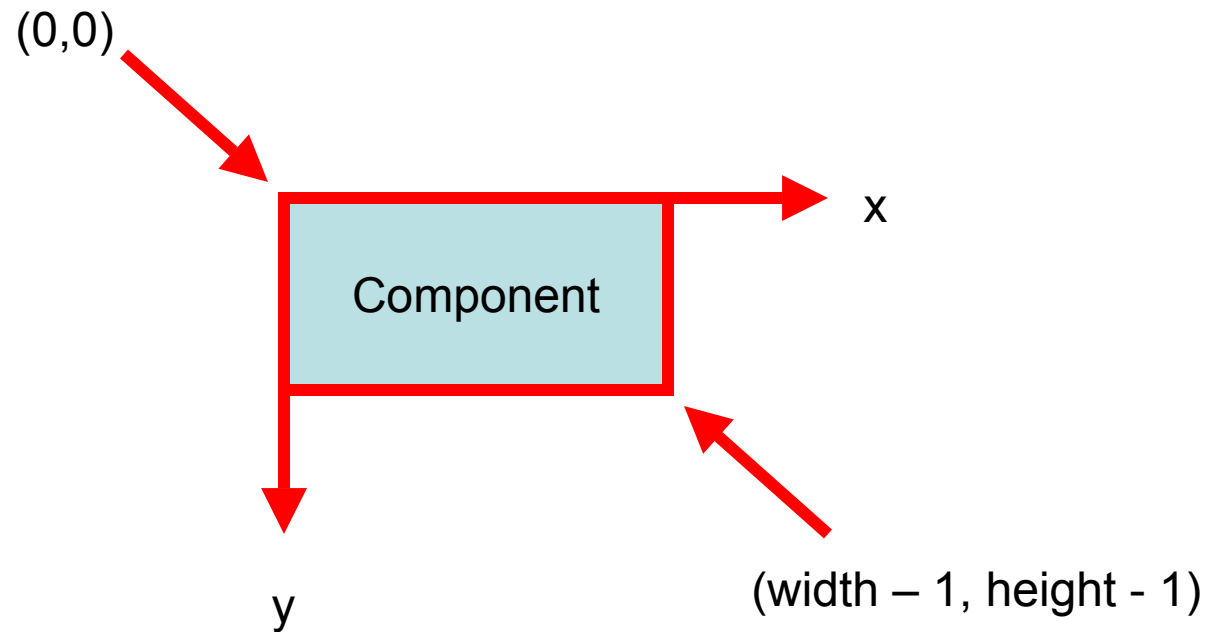
Physical Coordinates

- Printed page → inches, cm



- Architectural drawings → feet, meters

Java's Coordinate System

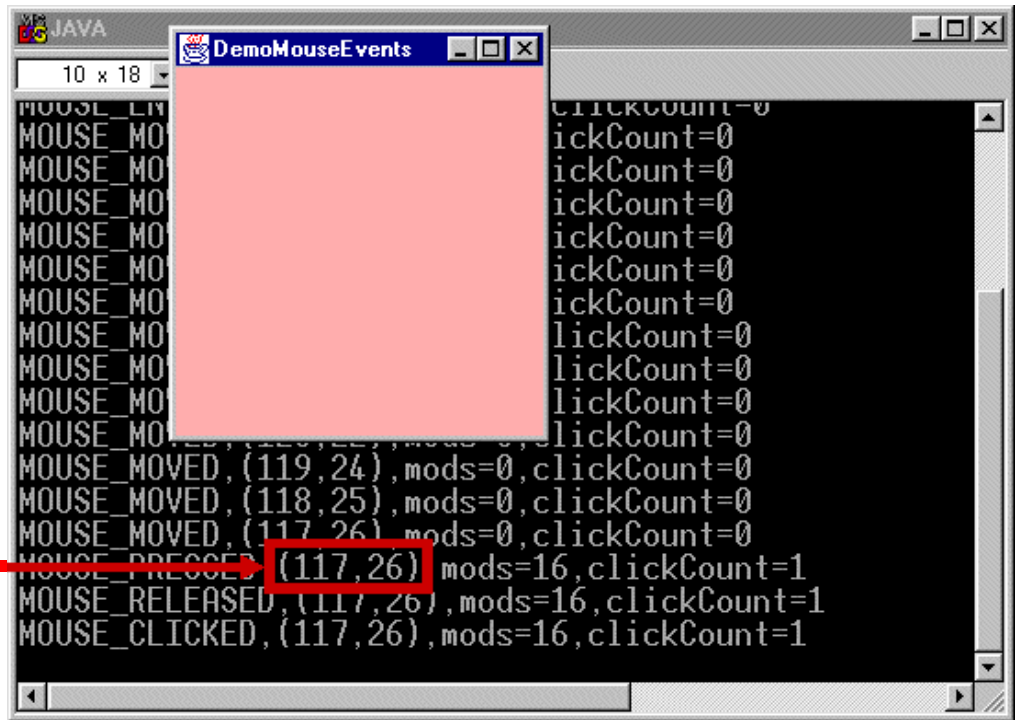


Example Program

DemoMouseEvents.java

Shown earlier

(x, y)
coordinate
of pointer in
component

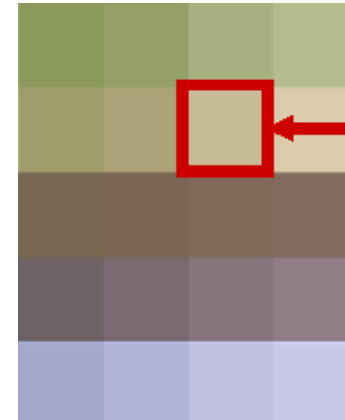
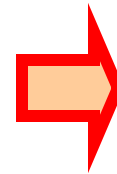
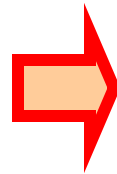
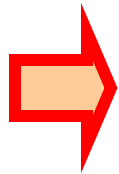
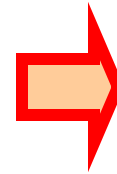
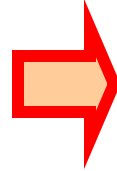


```
MOUSE_CLICKED, (117, 26), mods=16, clickCount=1
```

Pixels

- A Pixel is a “picture element”
 - a single point in a graphic image
 - A graphics display is divided into thousands (or millions) of pixels arranged in rows and columns
 - The pixels are so close together they appear connected
 - The number of bits used to represent each pixel determines how many colours or shades of grey can be represented
 - For a B&W (black and white) display, each pixel is represented by 1 bit
 - With 8 bits per pixel, a monitor can display 256 shades of grey or 256 colours (Note: $2^8 = 256$)

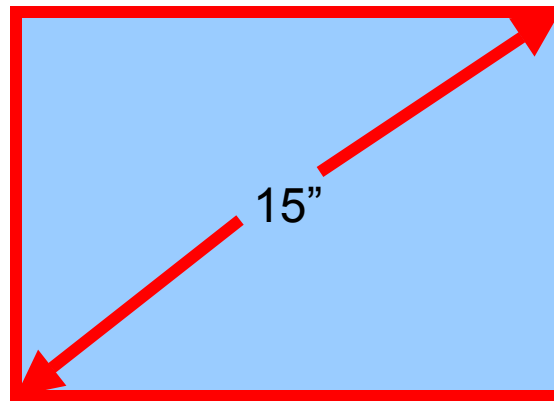
An image presented on a display is composed of pixels



pixel

Display Size

- Usually specified in “inches”
- Value cited is the diagonal dimension of the raster -- the viewable area of the display
- E.g., a 15” monitor



Resolution


- Resolution is the number of pixels on a display
- Usually cited as n by m
 - n is the number of pixels across the display
 - m is the number of pixels down the display
- Typical resolutions range from...
 - 640 by 480 (low end), to
 - 1,600 by 1,200 (high end)

Video RAM Requirements

- Total number of pixels is $n \times m$
- Examples
 - $640 \times 480 = 307,200$ pixels
 - $1,600 \times 1,200 = 1,920,000$ pixels
- Video RAM required equals total number of pixels times the number of bits/pixel
- Examples
 - $640 \times 480 \times 8 = 2,457,600$ bits = 307,200 bytes = 300 KB
 - $1,600 \times 1,200 \times 24 = 46,080,000$ bits = 5,760,000 bytes = 5,625 KB = 5.49 MB
 - Note: 1 KB = $2^{10} = 1024$ bytes, 1 MB = $2^{20} = 1,048,576$ bytes

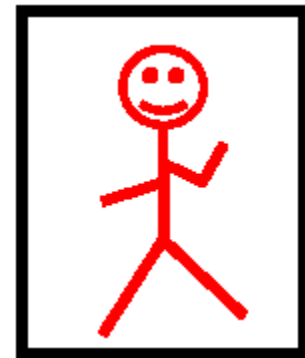
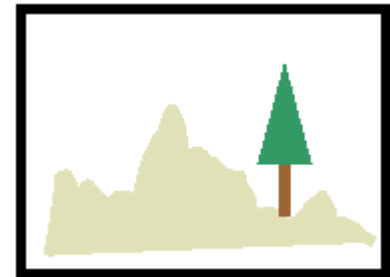
Video RAM (KB) By Resolution

Resolution	Bits per pixel		
	8 bit	16 bit	24 bit
640 x 480	300	600	900
800 x 600	468.75	937.5	1406.25
1024 x 768	768	1536	2304
1152 x 1024	1152	2304	3456
1280 x 1024	1280	2560	3840
1600 x 1200	1875	3750	5625

 See previous slide for calculations

Aspect Ratio

- Aspect ratio is the ratio of the width to height of a display screen
- For a 640 by 480 display, the aspect ratio is 640:480, or 4:3
- Related terms
 - Landscape
 - The width is greater than the height
 - Portrait
 - The height is greater than the width



Dot Pitch

- Dot pitch is a measure of the diagonal distance between phosphor dots (pixels) on a display screen
- One of the principal characteristics that determines the quality of a display
- The lower the number, the crisper the image
- Cited in mm (millimeters)
- Typical values range from 0.15 mm to 0.30 mm
- Note
 - Dot pitch, as specified, is the capability of the display
 - For a particular image, dot pitch can be calculated as...

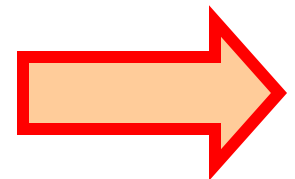
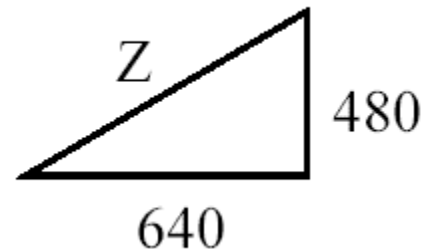
Dot Pitch Image Example

- Question:
 - What is the dot pitch of an image displayed on a 15" monitor with a resolution of 640 by 480?
- Answer:

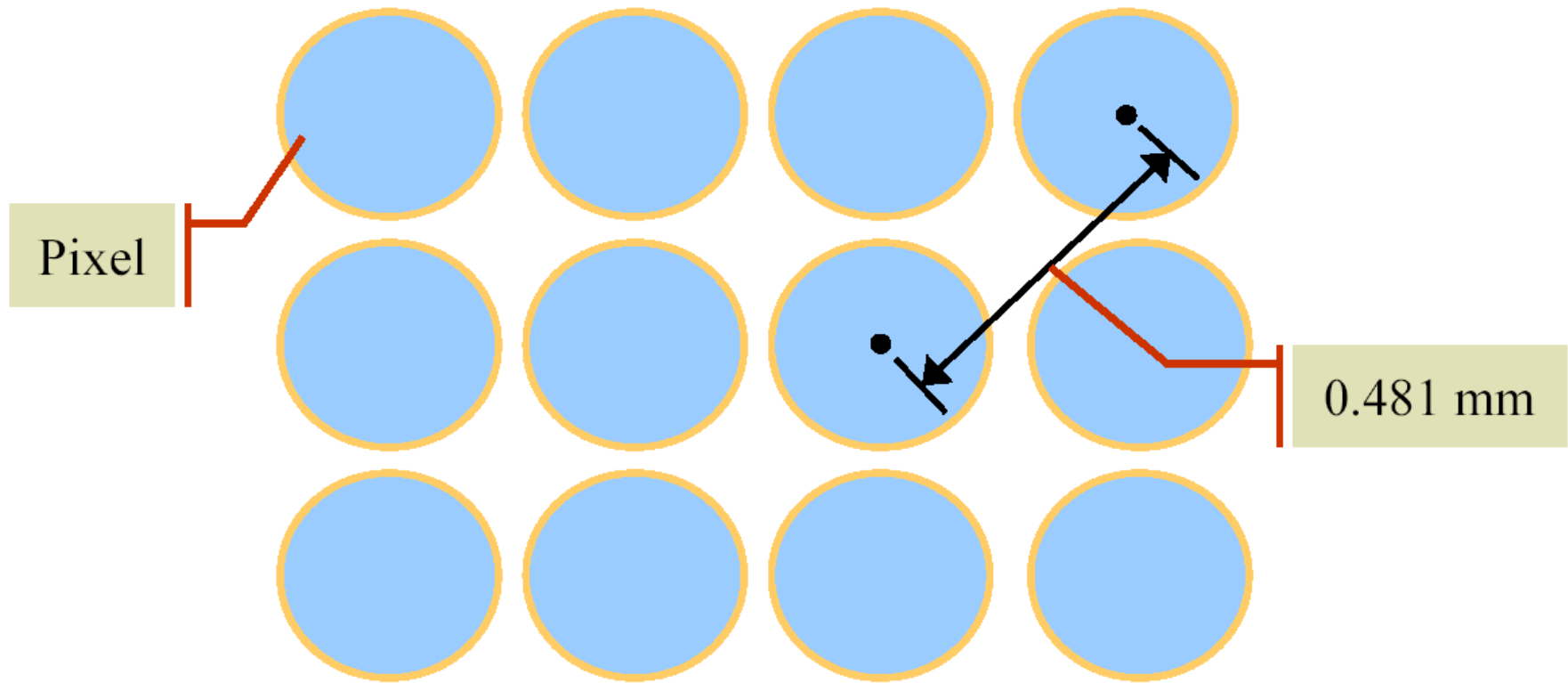
$$\begin{aligned}\text{Dot pitch} &= 15 / 800 \text{ inches} \\ &= 0.01875 \text{ inches} \\ &= 0.01875 / 0.039 \text{ mm} \\ &= 0.481 \text{ mm}\end{aligned}$$

Notes:

1. $Z = (640^2 + 480^2)^{1/2} = 800$
2. 1 mm = 0.039 inch



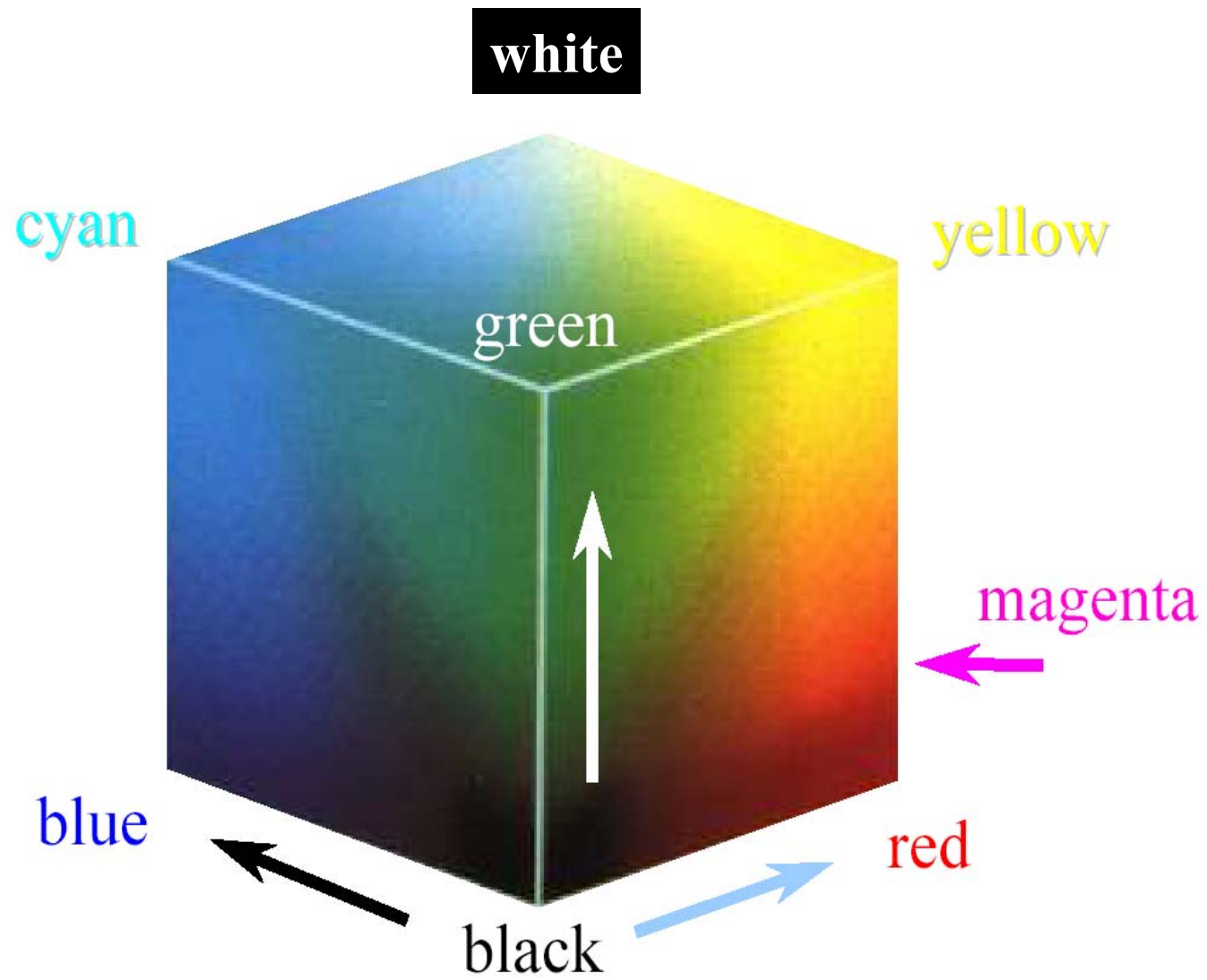
Dot Pitch Illustrated











Colour

- Two models for colour
 - RGB
 - Individual specifications for **RED**, **GREEN**, and **BLUE**
 - HSB
 - Individual specifications for hue, saturation, and brightness
 - Together, hue and saturation are called chrominance; they represent the colour
 - Hue is the distinction between colours (e.g., red, orange, yellow, green, etc.)
 - Saturation is the purity of a colour, or the amount of grey in proportion to the hue
 - High saturation very intense
 - Low saturation washed out
 - Zero saturation white
 - brightness is also called luminance or intensity

RGB model

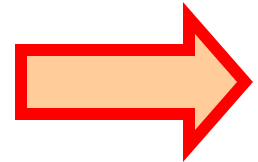


RGB Model (2)

	Color	Red	Green	Blue
	Red	255	0	0
	Green	0	255	0
	Blue	0	0	255
	Yellow	255	255	0
	Cyan	0	255	255
	Magenta	255	0	255
	White	255	255	255
	Black	0	0	0

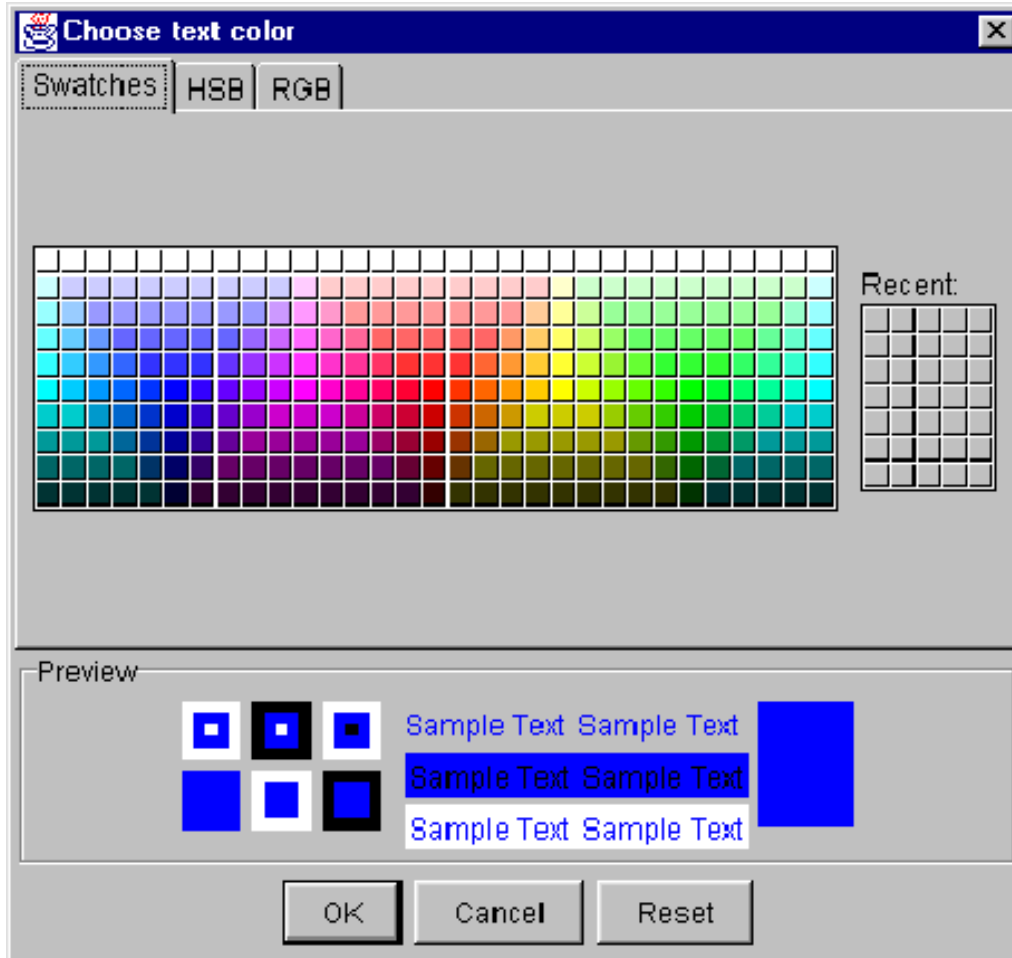
Colour Choosers

- Control for colour usually employs a colour chooser (aka colour picker)
- Colour selected three ways:
 - A pre-defined palette
 - HSB values
 - RGB values



Java's JColorChooser (1)

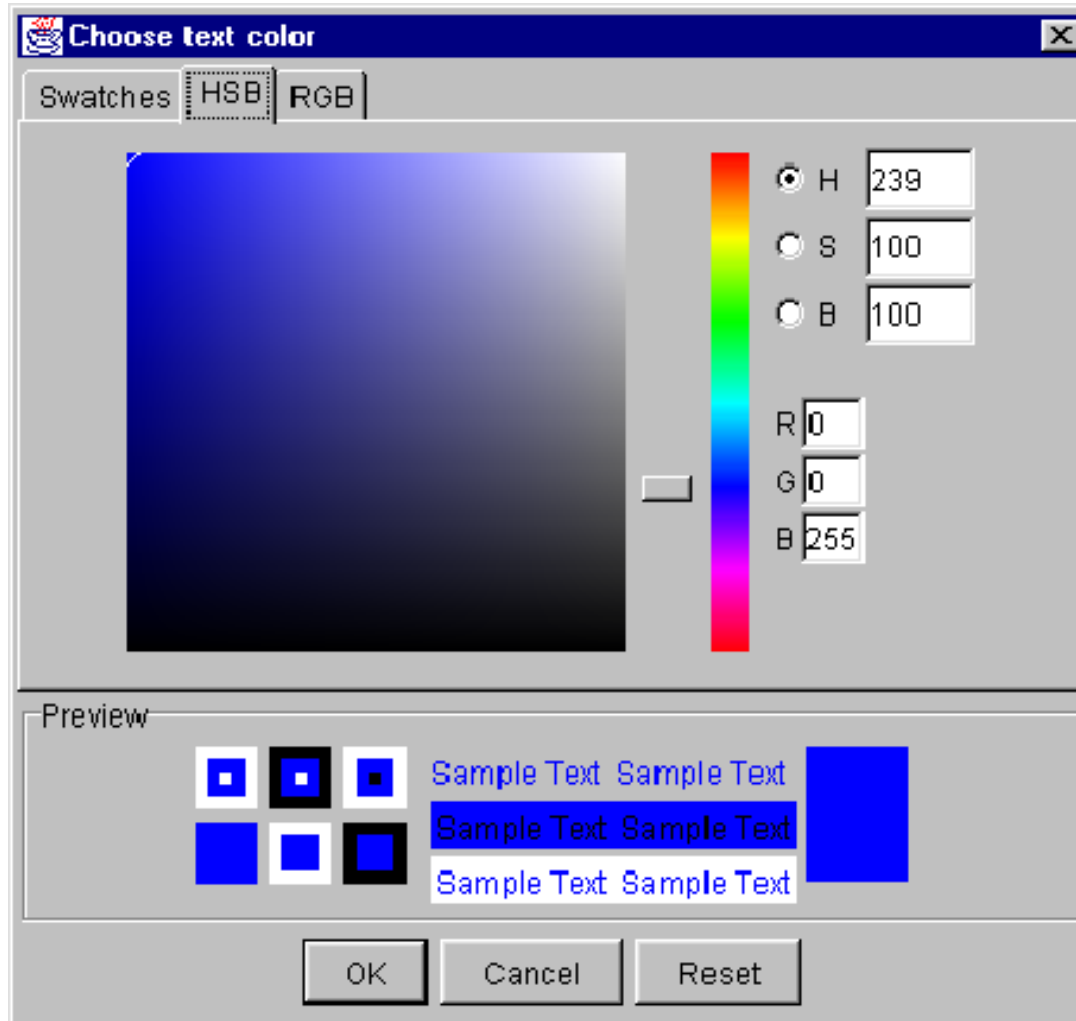
Pre-defined
palette



For a demo, see
DemoMenu2.java

Java's JColorChooser (2)

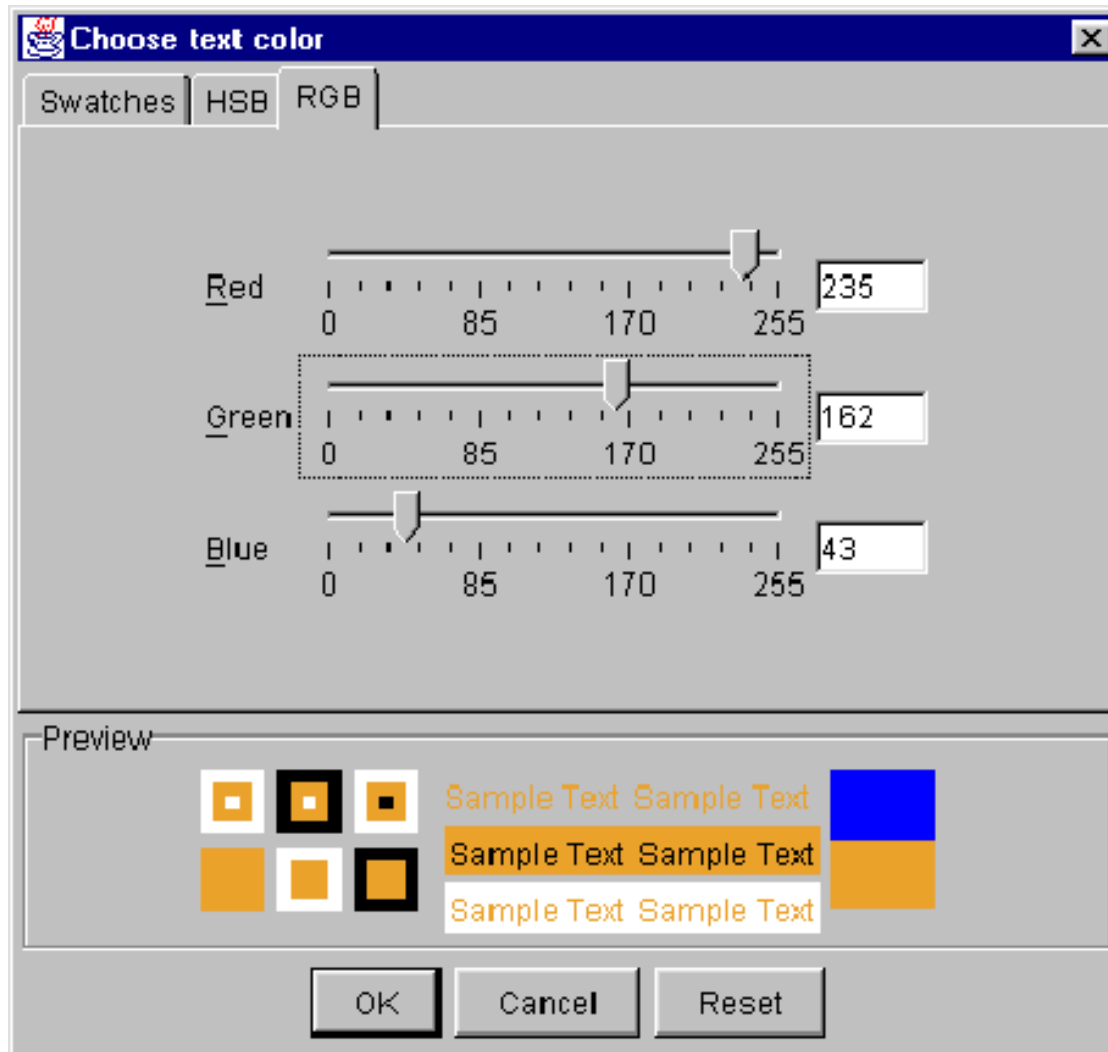
HSB



For a demo, see
DemoMenu2.java

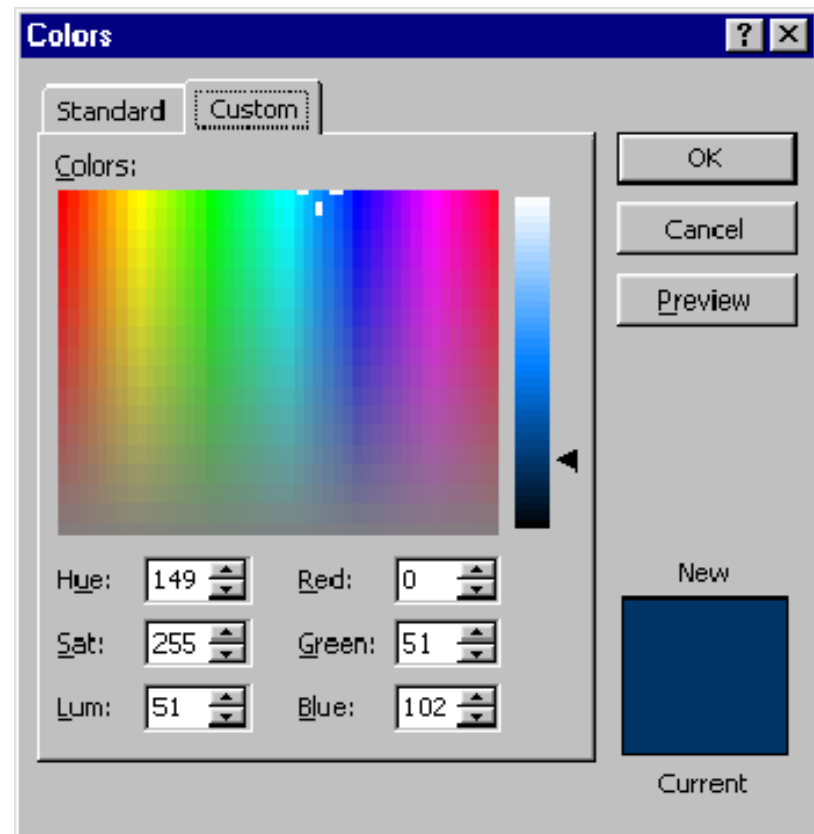
Java's JColorChooser (3)

RGB

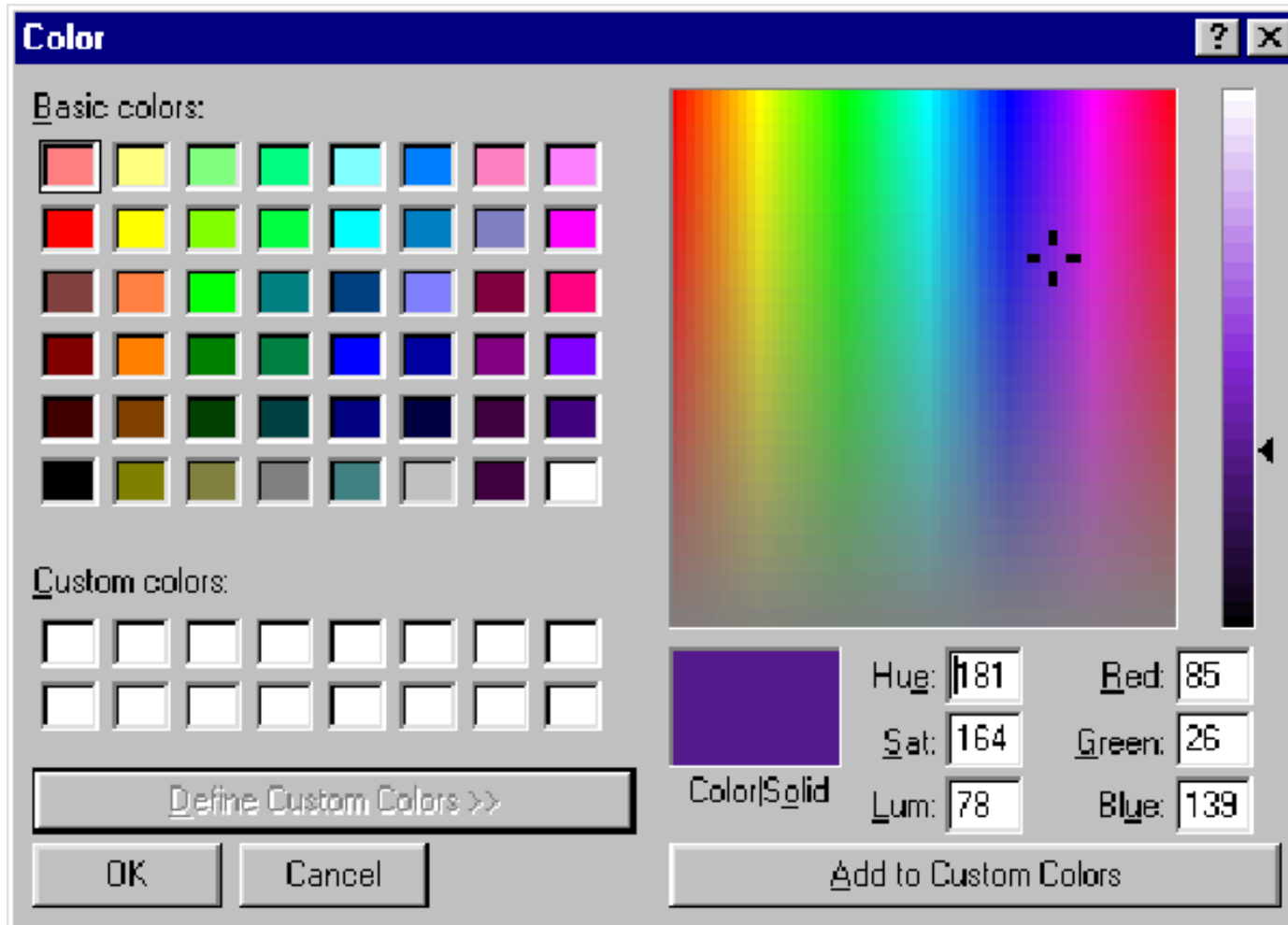


For a demo, see
DemoMenu2.java

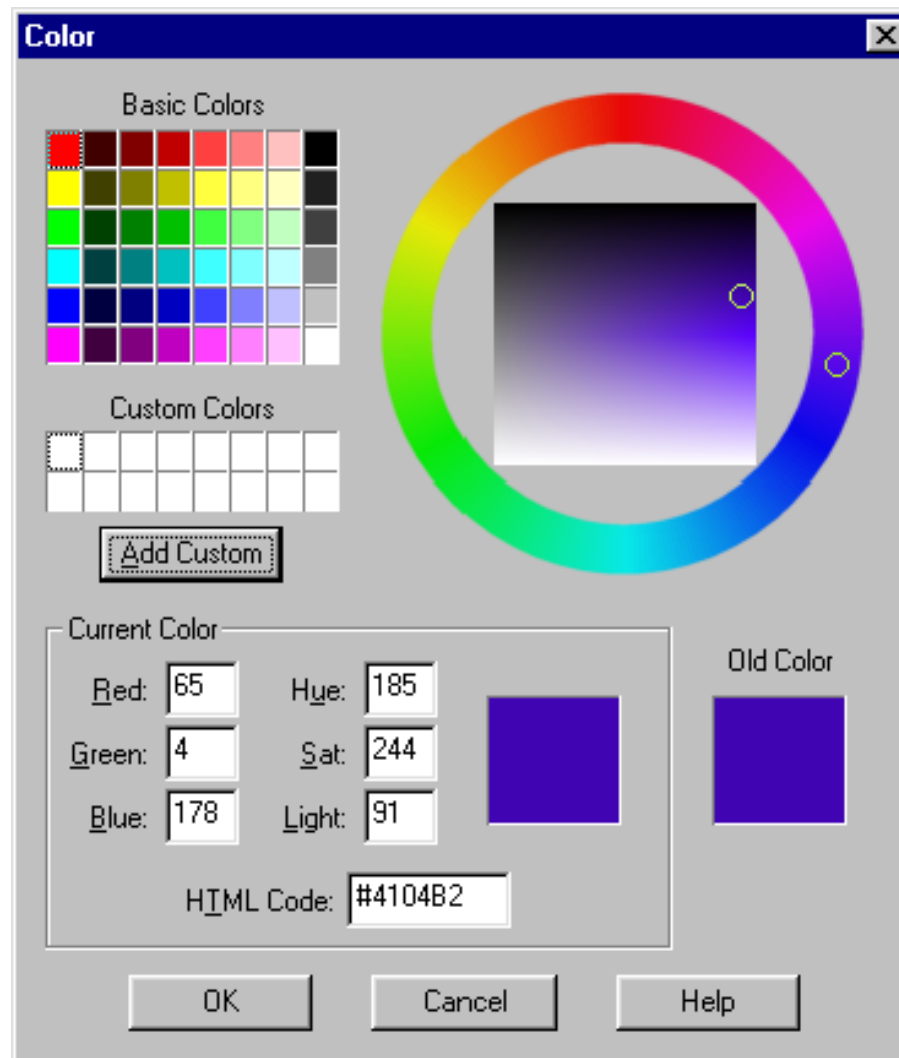
Microsoft Office



Netscape Navigator and Microsoft IE



Paint Shop Pro

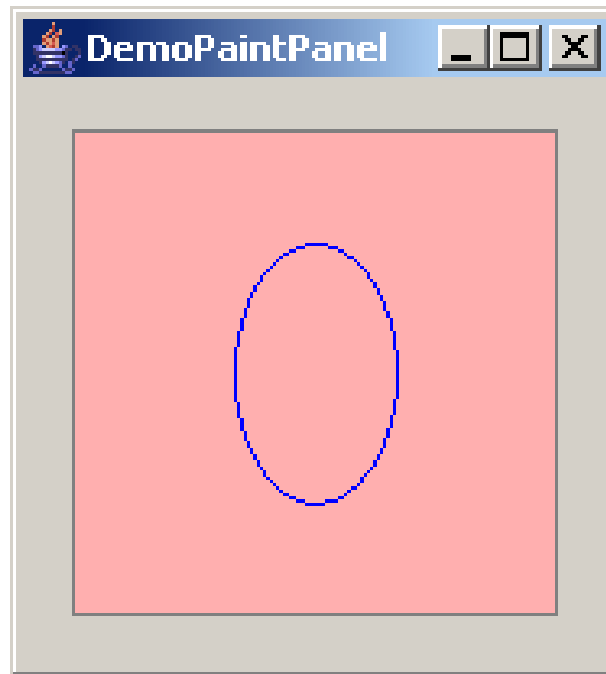


Drawing

- Java's "J" components are the building blocks
- of graphical user interfaces
- At a lower level, Java provides a set of drawing primitives for
 - Shapes
 - Lines
 - Curves
 - Images
 - Text

Example Program

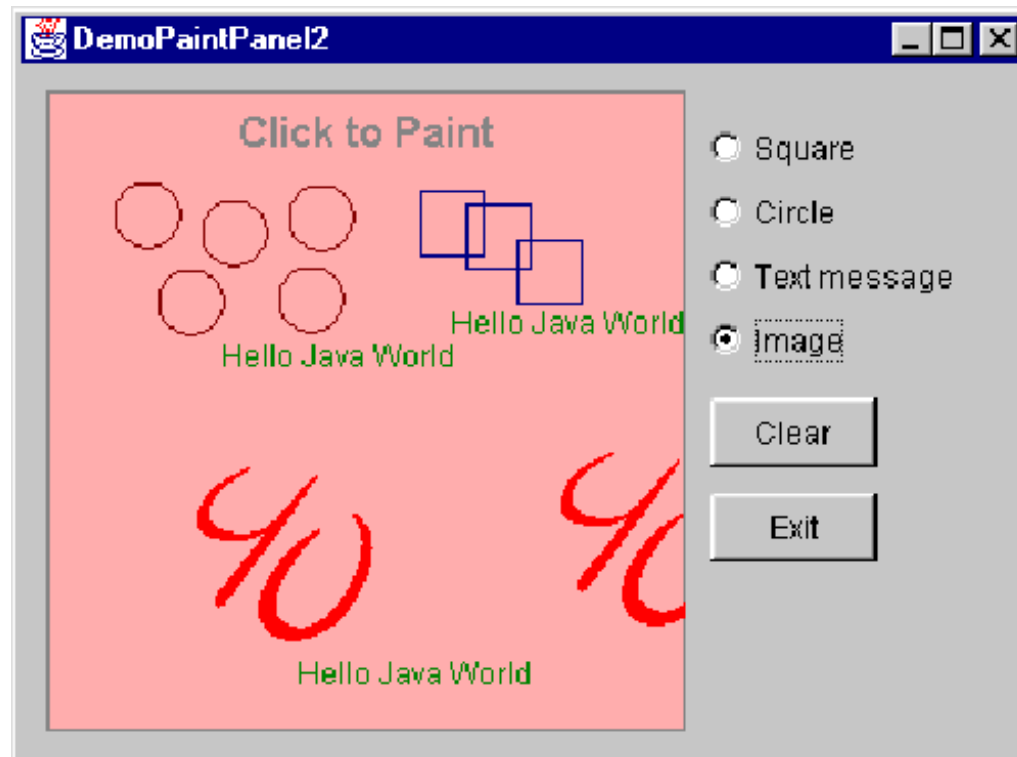
DemoPaintPanel.java



Example Program

DemoPaintPanel2.java

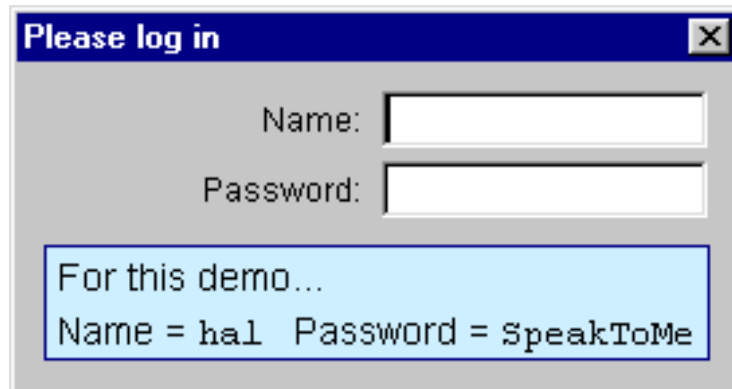
DemoPaintPanel3.java



Example Program

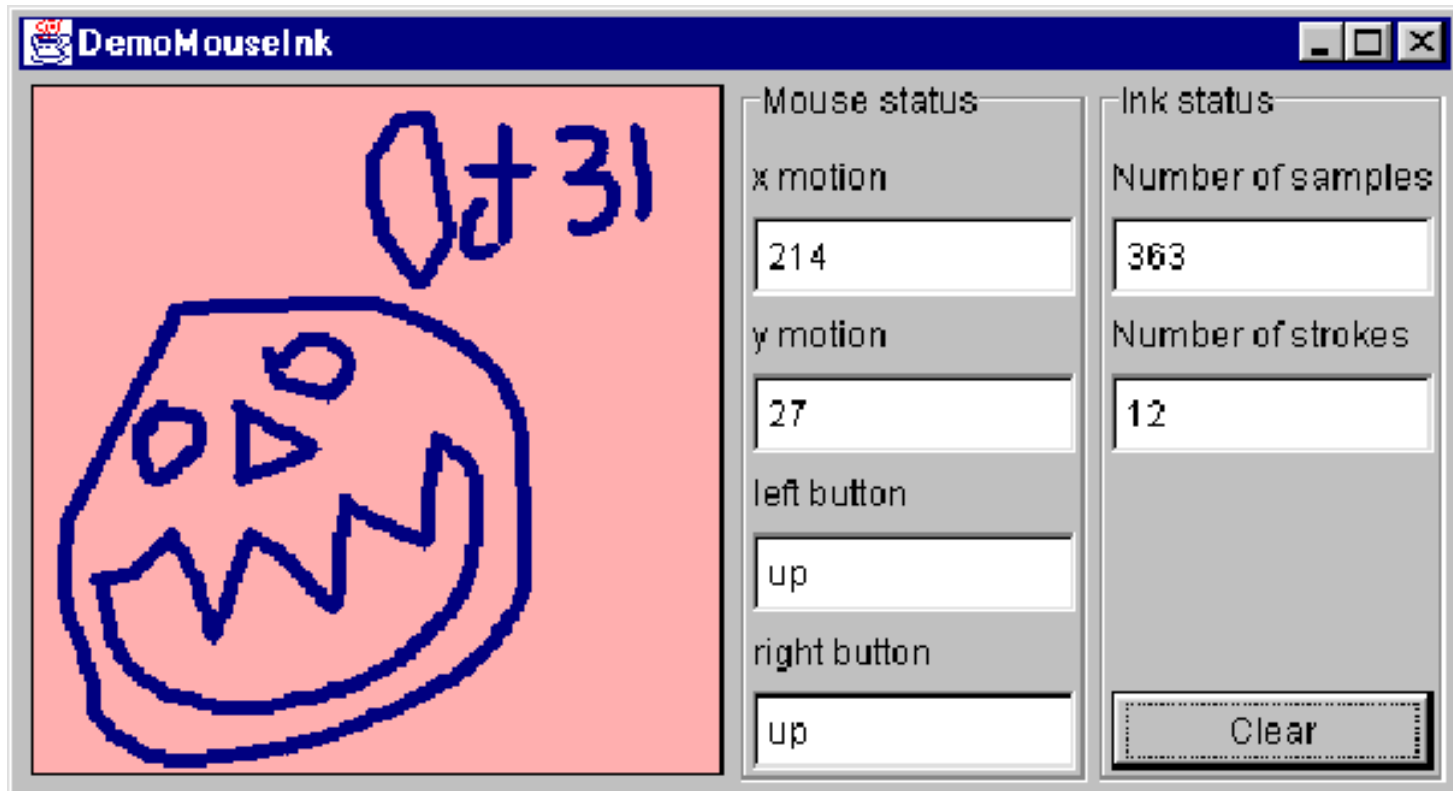
DemoPassword.java

(Shown earlier)



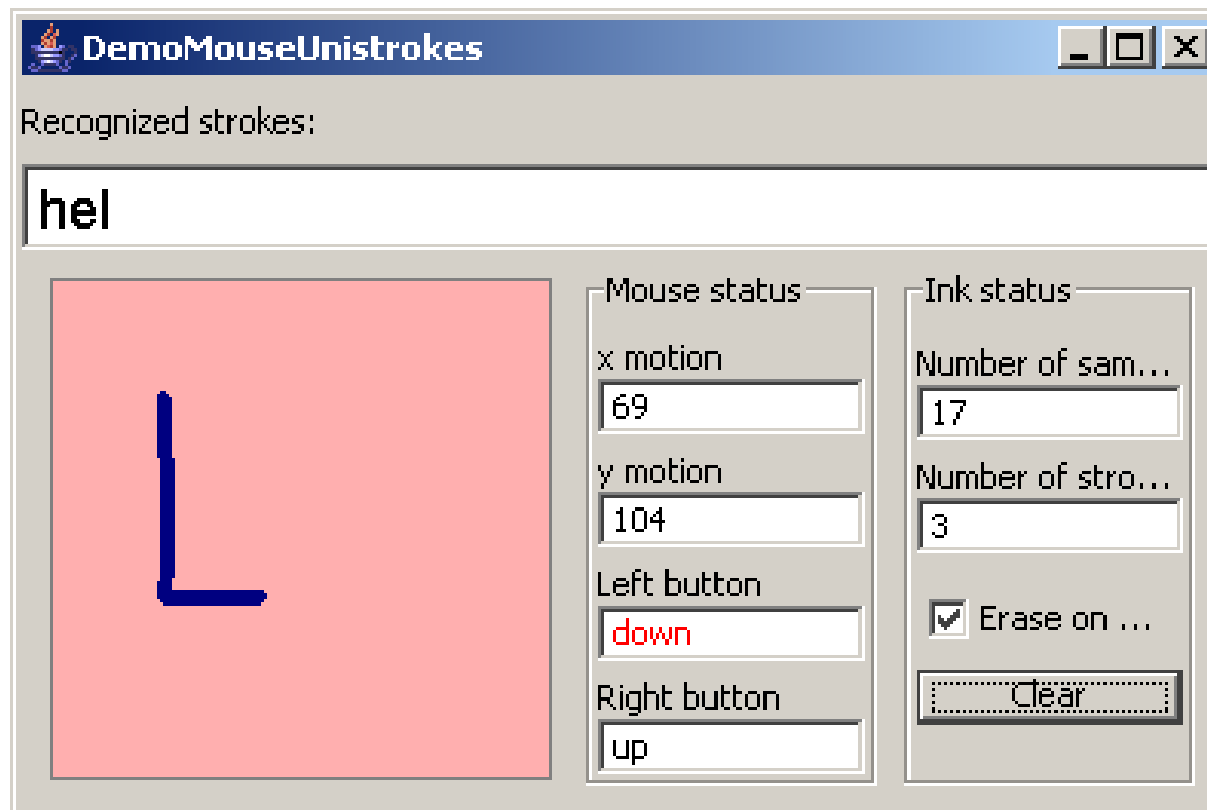
Example Program

DemoMouseInk.java



Example Program

DemoMouseUnistrokes.java



Images

DemoImage.java

DemoImage2.java



Example Program

DemoImageSizePosition.java



Text

- Characterized by
 - Font family
 - Style
 - Size and Spacing

Font Families

- Three types
 - Serif
 - A serif is a short line extending from and at an angle to the upper and lower strokes of a letter
 - Serif fonts facilitate human perception in distinguishing among letters
 - Sans serif
 - Without serifs
 - Monospaced or fixed-pitch
 - Each character occupies the same amount of horizontal space (cf. variable pitch)

Serifs Illustrated

Times roman

A B a b



Bookman oldstyle

A B a b



 serifs

Sans Serifs Illustrated

Arial

CD cd

Lucida sans

CD cd

Monospaced Illustrated

Courier new

IM im

OCR A Extended

IM im

Font Style

- Plain Hello Java World 
- Italic *Hello Java World* 
- Bold **Hello Java World** 
- Italic + bold ***Hello Java World*** 

Font Size

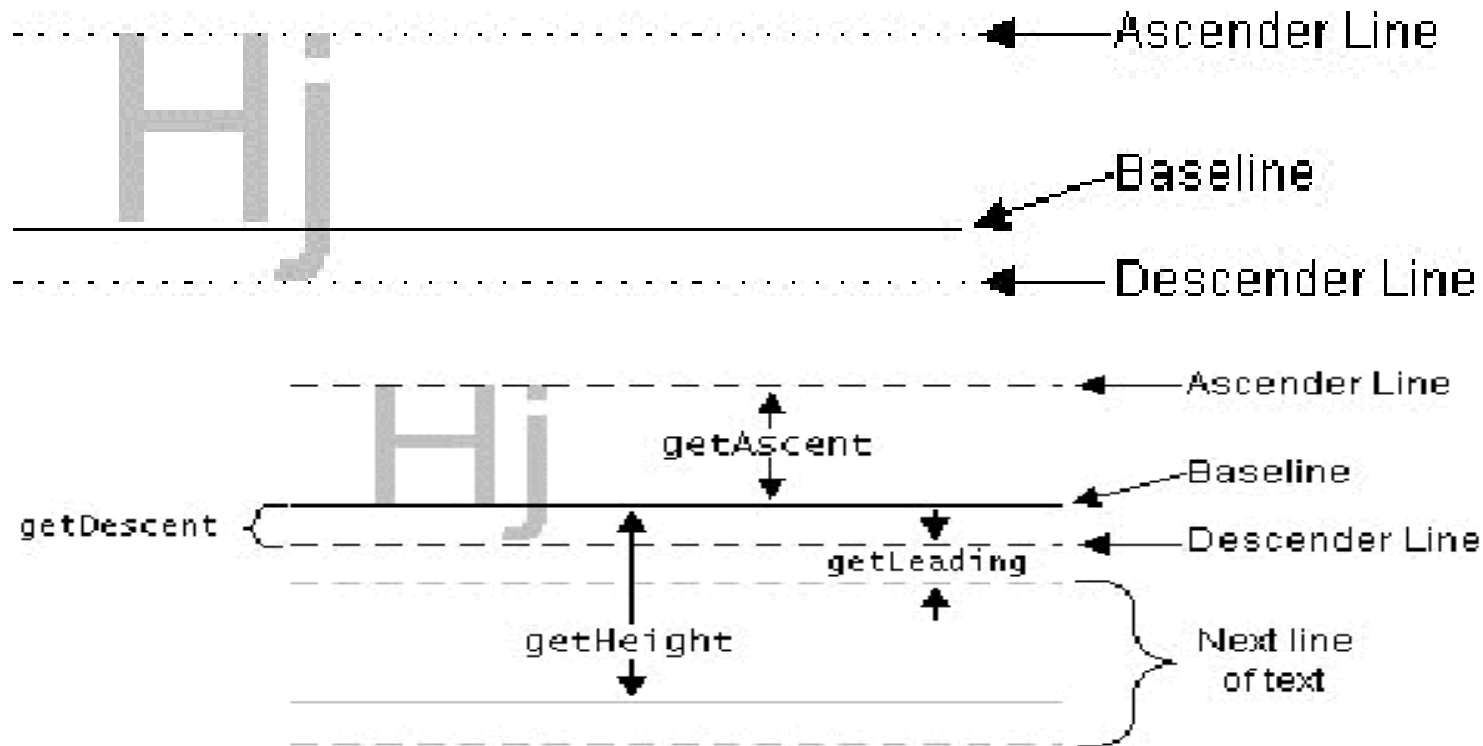
- Font size is measured in points
- A point is the smallest typographical unit of measurement
- 1 point = 1 / 72 inch (i.e., 72 points per inch)

Hello Java World



48 point font size

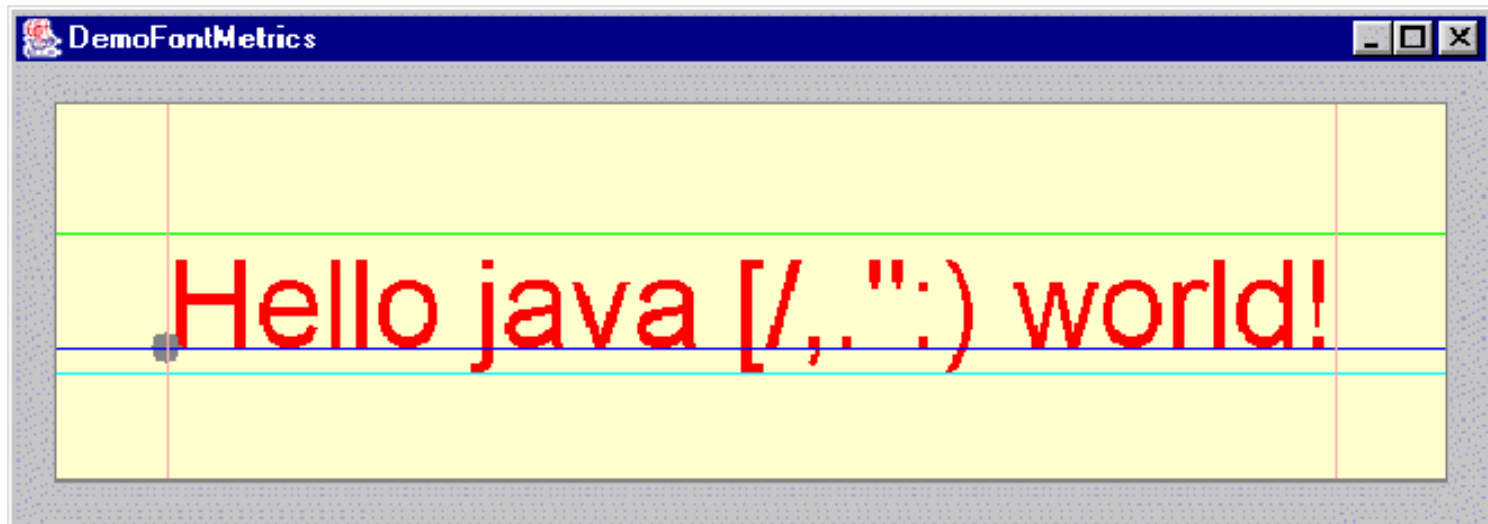
Font Spacing



See `FontMetrics` API

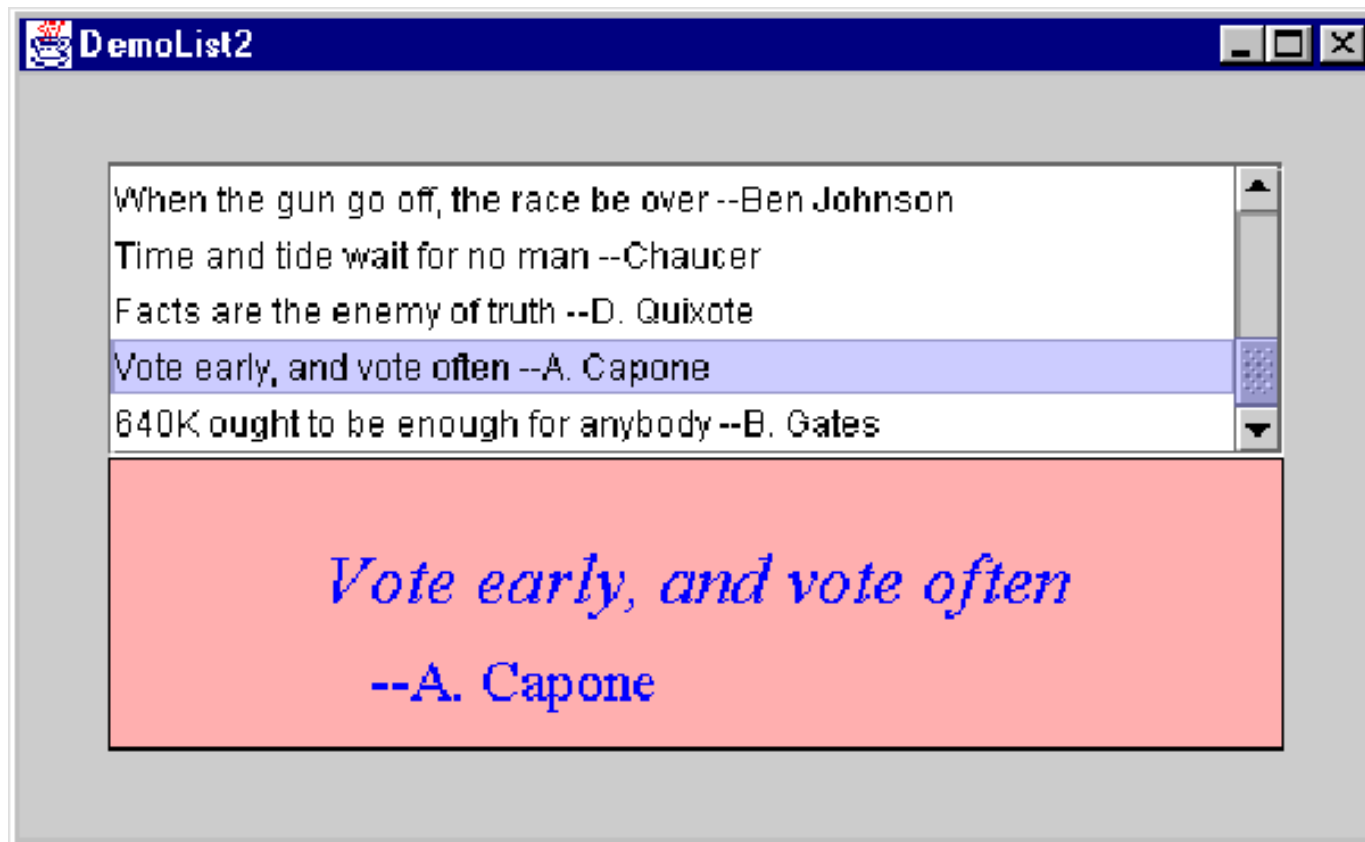
Example Program

DemoFontMetrics.java



Example Program

DemoList3.java



Readability of Text

- Guidelines:

- Uppercase vs lowercase

- WORDS WRITTEN IN BLOCK CAPITALS take longer to read than those written in lowercase
 - However, an important word written in CAPITALS is quickly perceived provided it is surrounded by words in lowercase

- Serif vs sans serif

- For printed text, serif fonts are easier to run one's eyes along and take in the written content
 - For on-screen text, serif fonts generally produce less well than sans serif fonts due to poorer resolution of the display

Example Program

DemoComboBox2.java

Shown
earlier



Image File Formats

- There are many, many file formats for storing images
- These include...
 - gif, jpg, tiff, bmp

gif

- gif = graphics interchange format
- Pronounced *giff* (with a hard 'g')
- Introduced in 1987 by CompuServe Inc.
- Very popular format for web pages
- Features
 - Limited to 256 colors (8-bit)
 - Lossless data compression^a
 - Compresses best for images with lots of repetition; e.g., flat colors)
 - Support for transparency
 - one colour in the image's palette (usually the 'background') is treated as transparent
 - Support for animation

^a decompressed data exactly the same as original data

jpg

- jpg = jpeg = joint photographic experts group
- Pronounced *jay-peg*
- Features
 - Always uses 24-bit color
 - Lossy data compression (up to 95% reduction, but with loss of image quality proportional to amount of compression)

tiff

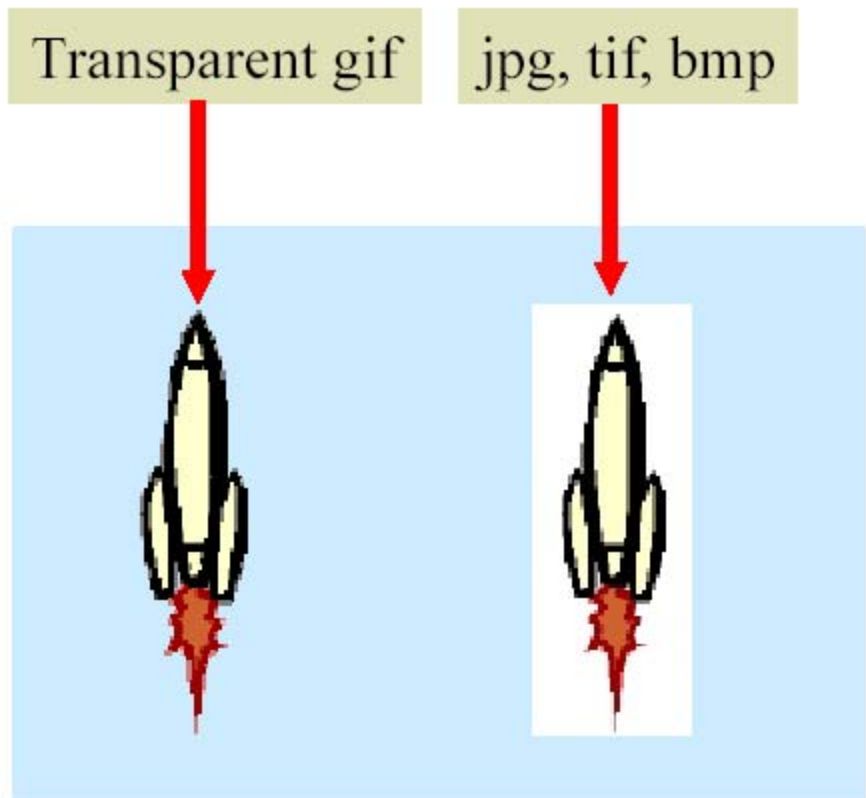
- tif = tiff = tagged image file format
- Features
 - Supports different compression schemes (lossy and lossless)
 - Supports any resolution
 - Black and white, color, or grey shades

bmp

- bmp = bit-map
- Standard for *Windows* environment
- Uses a pixel map to hold line-by-line raster information
- Features
 - No compression
 - Files are large

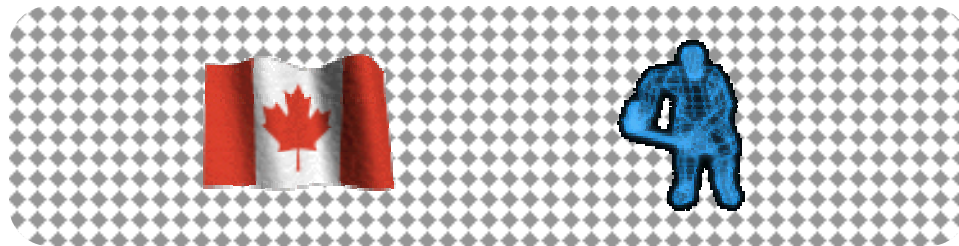
Example (1)

Format	File Size
gif	1639
jpg	5522
tif	3328
bmp	7942



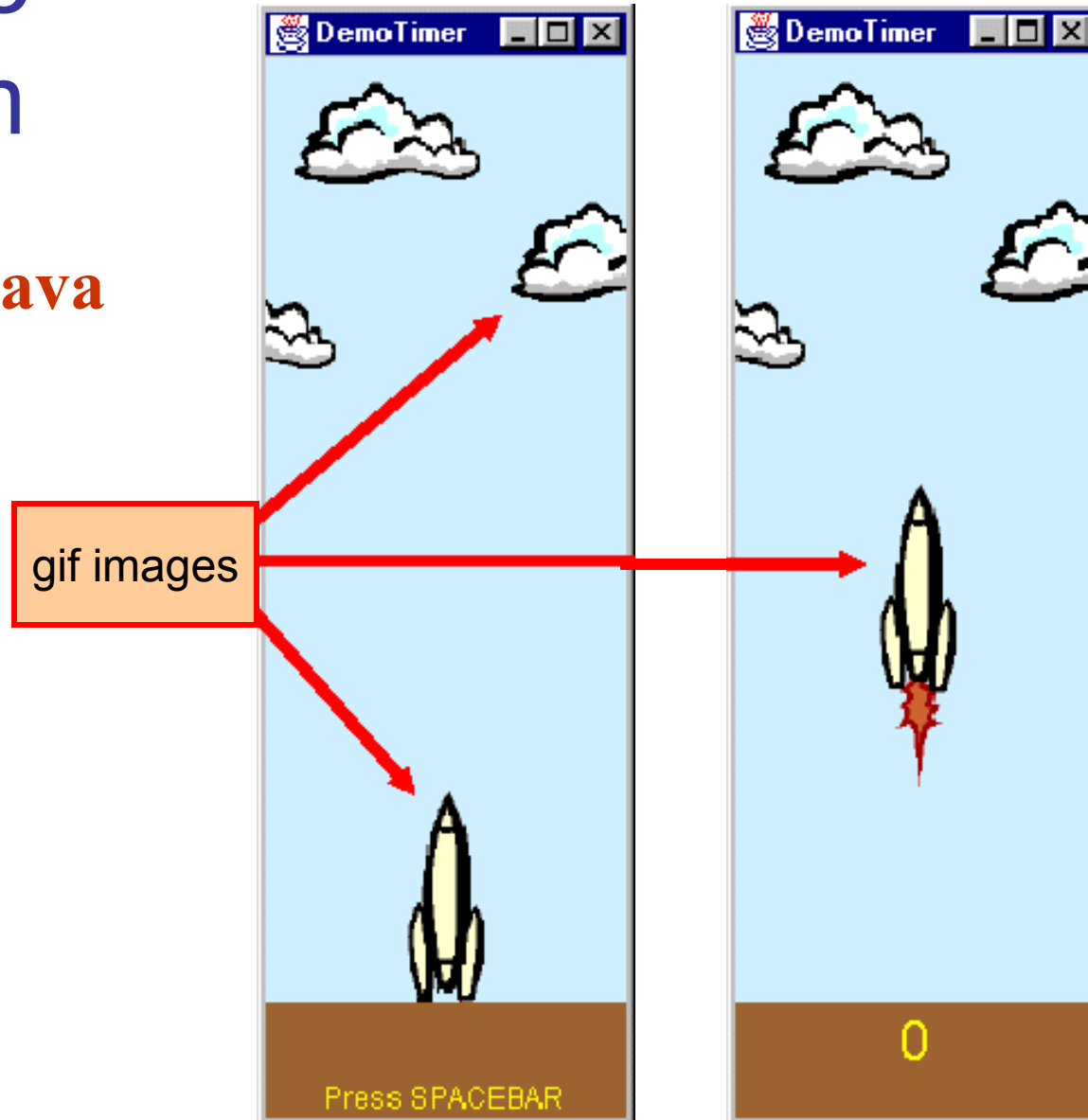
Example (2)

Animated gif
with transparent
background



Example Program

DemoTimer.java



Next Topic...