Digital Images: A Technical Introduction

- Images comprise a significant portion of a multimedia application
- This is an introduction to what is under the technical hood that drives digital images — particularly issues that may affect multimedia authoring

Two Kinds of “Images”

- **Raster:** Two-dimensional grid of colors (“picture element” = “pixel”)
- **Vector:** List of shapes defined in terms of their properties
- Typically easier to go from vector to raster, not vice versa
Digital displays are virtually all raster-oriented, so in the end, all images end up being “rasterized”

Resolution refers to the number of rows and columns in a raster image — e.g., 1024x768 pixels

Because vector graphics can be resized to any resolution, they are said to be resolution-independent
**Raster Image “Life Cycle”**

creation, acquisition, revision/repurposing

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**Vector Image “Life Cycle”**

creation, revision, rasterization — moves to the raster image life cycle
Colors

• Ultimately, all images are represented internally as sequences of numbers

• In particular, pixels, which are essentially units of color, have a numeric interpretation

• The “numerical conversion” of colors can be traced to a color model

Regardless of the color model, every pixel is ultimately interpreted as some sequence (“tuple”) of component values. This is the essence of a digital image.
From Pixels to Colors

- Two primary ways for determining a pixel's color
- Direct (a.k.a. RGB) — the pixel's number is the color
- Indirect (a.k.a. indexed) — the pixel's number corresponds to a color from a palette — a lot like “paint by numbers”

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indexed</th>
</tr>
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<tbody>
<tr>
<td>204 102 255</td>
<td>167</td>
</tr>
<tr>
<td>pixel</td>
<td>palette</td>
</tr>
<tr>
<td>color</td>
<td>color</td>
</tr>
</tbody>
</table>

Table showing Direct and Indexed methods for pixel and color representation.
Image Formats

• In the end, all images become two-dimensional grids of pixels; however, there are many ways to represent these grids

• One big consideration: file size — large images require large amounts of memory

• Thus, many image formats are distinguished by how they compress an image’s data

Image Format Terms

• Compression algorithm: Process used to decrease the amount of data space occupied by an image

• Header: Block of information about the image, separate from the image’s pixels (e.g. its width, height, number of colors)

• Lossy vs. lossless: Whether or not a format completely restores the original image
<table>
<thead>
<tr>
<th>Image Format</th>
<th>Depth</th>
<th>Compression</th>
<th>Typical Use</th>
<th>Vector?</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPEG</td>
<td>16 million</td>
<td>lossy</td>
<td>photo, photorealistic</td>
<td>no</td>
</tr>
<tr>
<td>GIF</td>
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<td>LZW (lossless)</td>
<td>icons, view elements</td>
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<td>RLE (lossless)</td>
<td>Windows default</td>
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<tr>
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<tr>
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<td>printing, publishing</td>
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<tr>
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<td>no</td>
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<tr>
<td>SVG</td>
<td>16 million</td>
<td>n/a: primarily vector</td>
<td>Internet</td>
<td>yes</td>
</tr>
</tbody>
</table>

Image Formats and You

- Generally, unless there is a specific feature from a format that interests you, you should be “format-agile”
- A versatile image format converter (or an image editor that can read/write many formats) is a useful part of your arsenal
Proprietary or Commercial Formats

- Aforementioned formats are those that are generally considered “open” — programs that read/write these formats are not rooted in any single company

- On the other hand, there are formats such as Photoshop, Illustrator, among others: these formats adhere closely to an application’s feature set (e.g. layers)

- For maximum flexibility, images are typically acquired in an open or standard format since devices need broad coverage

- Images are then integrated into proprietary formats such as Photoshop to maximize an image editor’s features

- For deployment, images are re-encoded to something more standard, again for broad coverage