Image Formats and Optimization

Survey Final Presentation

Group 2

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Santiago Juste Valverde, Jaime Martinez de Miguel, Michaela Meindl

Agenda

1. Introduction
2. Image Formats
3. Concept Demonstrations via Web Pages
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    2. Image Delivery
4. Tools
    1. ImageMagick
    2. squoosh.app
    3. Responsive Breakpoints

Introduction

- Different formats for different purposes
- Evolution of image formats: Current and “futuristic” formats
  - Presented formats: GIF, JPEG, PNG, WebP, AVIF, JPEG XL
- Delivery in Web Browsers
  - Usages of browser’s native features
  - Static vs. responsive delivery
- Tooling as support for optimization

Image Formats

GIF

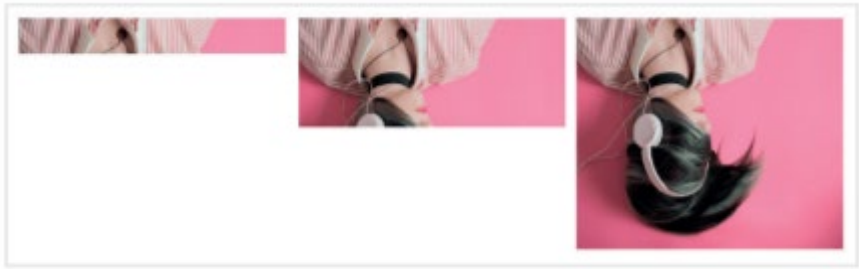
- The predecessor to PNG
- Most known for animations
- Lossless.
- Limitation of 256 colors → visual loss from conversion
- Very large files for animations.

JPEG

- Lossy compression → Discard info to save space
- Best for images with continuously varying colors (few hard edges)
- Two compression modes Baseline and Progessive
- Chroma subsampling availability

Baseline and Progressive JPEGs

- Baseline:
  - One row at a time:
    Top to the bottom
  - Same quality



- Progressive:
  - Full picture from start
  - Increasing quality by progressively loading higher frequent data into it

PNG

- Lossless compression
- Supports alpha transparency
- Ideal for images with regions of the exact same color
- Popular for:
  - sharp contrasts
  - opacity and transparency
  - multiple edits
- 3 Color palette modes:
  - PNG8
  - PNG 24
  - PNG 32 (not very used)

WebP

- lossless and lossy compression
- lower file size with acceptable image quality
- supports alpha transparency
- supports animation
- compression more CPU intensive (static > dynamic)

Downsides

- lacks gamut and chroma
- no progressive decoding

https://developers.google.com/speed/webp/
Addy Osmani (2021): Image Optimization

AVIF

- Better compression than other formats:
  - 50% more effective compression than JPEG.
- High-quality images
- Supports transparency, lossy or lossless compression, HDR color, etc
- Support in browsers with Chrome 85+ and Firefox 77+
- For animations, live photos, and image sequences
- For monochrome images and multichannel images.

JPEG XL

- Work in progress
- 60% more compression efficiency than JPEG.
- Lossless transform from JPEG XL to JPEG with file size reduction, in both directions.
- Browser support can be activated under a flag in Firefox and Chrome

Comparing Formats (1/2)

3 dimensions for choosing the optimal image format:

- Functionality
- Support
- Use-case:
  - Colors
  - Photo vs. Illustration
  - Animation

Comparing Formats (2/2)

	Decoding Speed	Delivery	Browser Support	Compression
GIF	slow	progressive decoding	all	lossless
JPEG	very fast	progressive decoding, preview	all	lossy
PNG	ok	poor progressive decoding but with alpha, preview, low format overhead	all	lossless
WebP	rather slow	low format overhead but no progressive decoding, no LQIP, no preview	all except Safari (just partial support)	lossless and lossy
AVIF	pretty fast	no progressive decoding, no LQIP, no preview, no low format overhead	Chrome, Firefox, Android	lossless and lossy
JPEG XL	slower	very good delivery! (in all compared aspects)	under a flag Firefox, Chrome	lossless and lossy

Addy Osmani (2021): Image Optimization
https://caniuse.com/
https://commandlinefanatic.com/cgi-bin/showarticle.cgi?article=art011

Compression vs. Quality

Kodak Images

r0k.us/graphics/kodak/

- Links to lossless, true color (24 bits per pixel, aka "full color") images
- Used as a standard test suite for compression testing

Responsive Delivery

```
<h2>AVIF</h2>
   <div class="row">
       <div class="column">
           <picture>
               <img
               sizes="(max-width: 2100px) 100vw, 2100px"
               srcset="
               img/hood_avif/hood_plh9uu_c_scale,w_190.avif 190w,
               img/hood_avif/hood_plh9uu_c_scale,w_399.avif 399w,
               img/hood_avif/hood_plh9uu_c_scale,w_541.avif 541w,
               img/hood_avif/hood_plh9uu_c_scale,w_683.avif 683w,
               img/hood_avif/hood_plh9uu_c_scale,w_804.avif 804w,
               img/hood_avif/hood_plh9uu_c_scale,w_961.avif 961w,
               img/hood_avif/hood_plh9uu_c_scale,w_1087.avif 1087w,
               img/hood_avif/hood_plh9uu_c_scale,w_1227.avif 1227w,
               img/hood_avif/hood_plh9uu_c_scale,w_1362.avif 1362w,
               img/hood_avif/hood_plh9uu_c_scale,w_1501.avif 1501w,
               img/hood_avif/hood_plh9uu_c_scale,w_2029.avif 2029w,
               img/hood_avif/hood_plh9uu_c_scale,w_2094.avif 2094w,
               img/hood_avif/hood_plh9uu_c_scale,w_2100.avif 2100w"
               src="hood_plh9uu_c_scale,w_2100.avif"
               alt="hood in Ljubljana">
               </picture>
       </div>
   </div>
```

Tools

ImageMagick Description

- free software to create, edit, compose or convert digital images
- open source
- consists of a number of command-line utilities
- Examples of features:
  - format conversion
  - transform (resize, rotate, crop, flip…)
  - transparency, animation
  - color management
  - image identification (format, attributes)
  - noise and color reduction
  - large image support
  - ...

https://imagemagick.org/index.php

ImageMagick Conversion, Resizing and Cropping code

Conversion

magick image.jpg image.png

magick *.jpg images.png

Resizing and Cropping

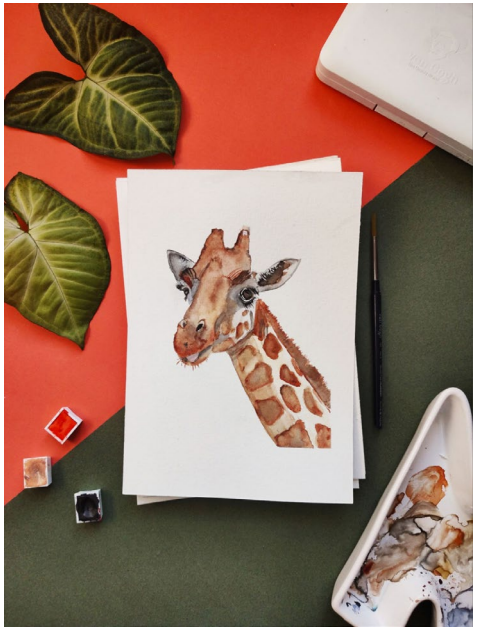
magick image.jpg[120x120] thumbnailGiraffe1.png

magick image.jpg[120x120+1000+1300] thumbnailGiraffe5.png

magick image.jpg[240x240] thumbnailGiraffeBig.png

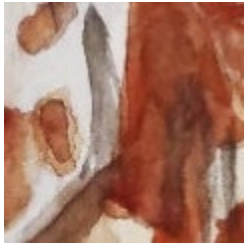
magick thumbnailGiraffeBig.png[120x120+30+60] thumbnailGiraffeBigCrop2.png

ImageMagick Resizing and Cropping

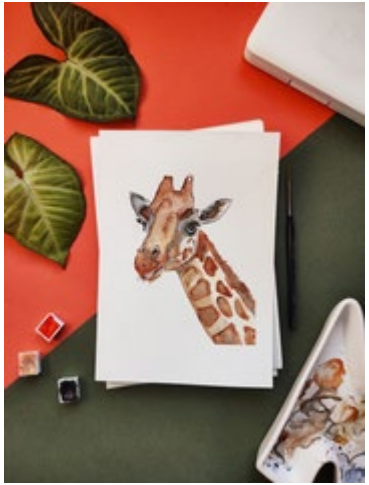


JPEG 1983x2643

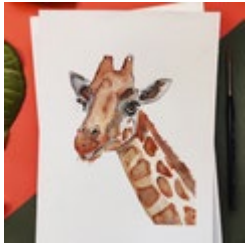
resized to 120x120 png



crop the middle part of Original jpg and resize it to 120x120



resized to 240x240 png



crop the middle of resized png and resize to 120x120

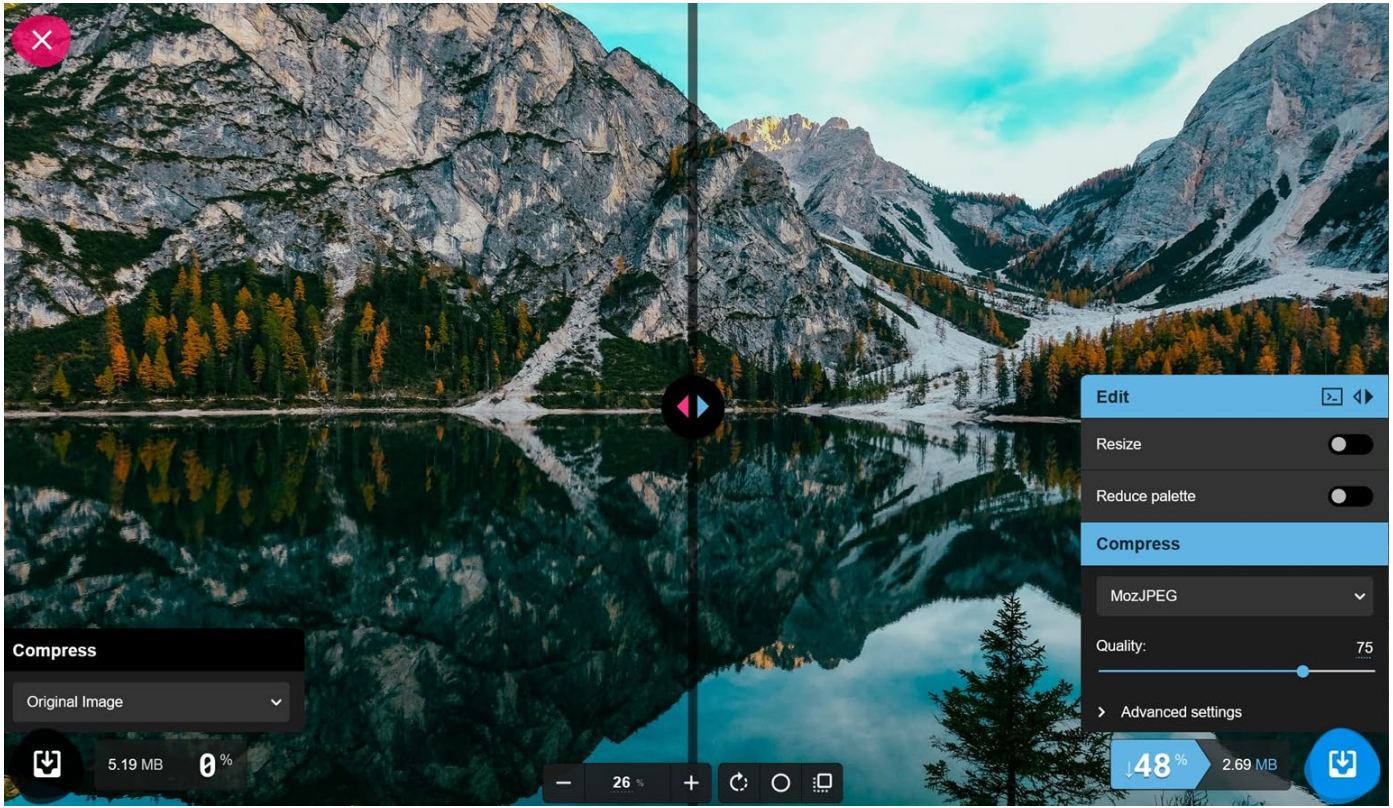
ImageMagick Compression

Choices are: None, BZip, Fax, Group4, JPEG, JPEG2000, Lossless, LZW, RLE or Zip.

- Compress by reducing quality (and stripping any comment or EXIF metadata):
  - magick Fotoshooting.jpg -strip -quality 85% resultFotoshooting.jpg
  - original 2030KB → result 1878 KB
- Compress by reducing sampling factor (chroma downsampling)
  - magick Fotoshooting.jpg -sampling-factor 4:2:2 resultFotoshootingSampling.jpg
  - original 2030 KB → result 1524 KB (no recognizable difference)

https://imagemagick.org/script/command-line-options.php#compress

Squoosh.app squoosh.app/editor



squoosh.app Pros and Cons

+ no prior knowledge required
+ good-looking user interface
+ few functions
+ user optimized
+ no installation necessary
+ progressive Webapp

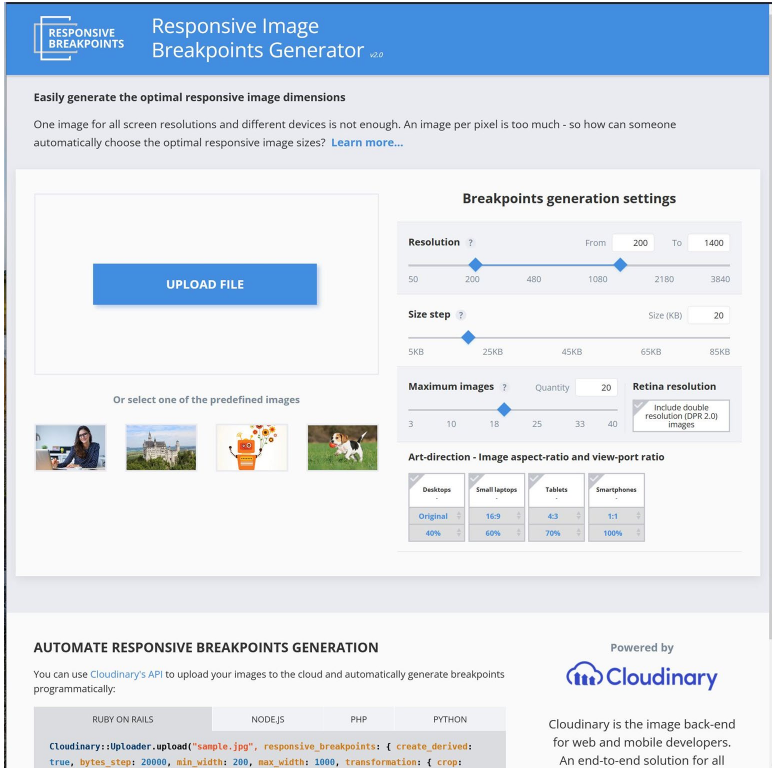
- very memory intensive

Squoosh Showcase

https://youtu.be/G_COBsX8WYA

Responsive Breakpoints

responsivebreakpoints.com



Responsive Breakpoints

- Generate resized images to make it responsive.
- Ability to set a maximum of images.
- Width range selection.
- HTML code and image folder generated.

Responsive Breakpoints Showcase

https://youtu.be/umKTnDAAVa4

Recommendations

Which format would we choose in which case?

Use Case	**Recommended Format**
Very small images (thumbnails)	AVIF
Larger images	JPEG XL
Cartoons or similar	PNG or WebP
Animations	WebP