

# 1. Image elements for the web

## 1.1. Formats and uses of the different types of image

To use an image on a web page, it must be in a web-compatible format, that is, defined by standards and supported by browsers. The HTML element that allows you to insert an image into the content is `img`.

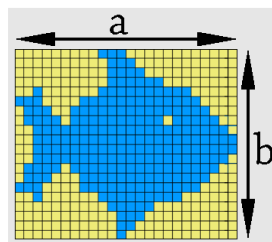
Broadly speaking, images for the web are of two types: bitmap and vector.

**Bitmaps** are images made up of a grid of colored pixels and are usually saved in formats such as PNG, JPEG or GIF. Recently, new formats have emerged, more optimized for the web, such as WebP and AVIF.

**Vector images** are XML documents with tags that describe the image geometrically. They have the advantage of not losing quality when enlarged, they are scaled without loss of resolution. They are usually used for icons, logos and the like. They use the SVG format (Scalable Vector Graphics).

### 1.1.1. Bitmaps

Bitmaps are images made up of a grid of colored pixels. Thus, they contain information about the size of the grid, determined by its width and height, and the color of each of the pixels that make it up. Color information depends on the color depth of the image, which is determined by the number of bits used to encode the possible color of each pixel.



It is a monochromatic image, where pixels can only have two values, which are usually black and white.

The color depth, or bits per pixel, is the amount of colors an image can display.

If we use a single bit to represent each color pixel, we have 2 values per pixel, on and off, that is, white and black.

A bitmap file can be quite large, which increases the larger the grid and the more color depth it has, as it requires more space for color encoding. For example, if we have a 100×100 pixel image and use a 16-bit color depth, we have a 100×100 matrix that holds the information of 10,000 pixels, and each of these pixels will have a value between 0 and 65,535 to encode its color.

16 bits per pixel:  $2^{16} = 65535$  color

That is why there are different formats that use compression techniques to optimize the space occupied by images encoded in this way.

### **JPEG format**

One of the most widespread formats on the web is JPEG (Joint Photographic Experts Group, which is the name of the group that defined this standard). This format is most recommended if the image to be optimized is a photograph or contains smooth color transitions. The JPEG compression algorithm is very effective with gradients and color blends, but doesn't work very well with flat colors or solid edges.

The JPEG compression scheme is lossy, and this means that part of the information in the original image is lost in the compression process.

Fortunately, this loss is not noticeable for most images, even images with high compression levels.



### **PNG format**

Another widely used image format in web design is PNG (Portable Network Graphics). This format was designed to replace the GIF format for online transmission needs and the TIFF format as an image storage and printing system. This format allows images to be saved in several formats: 8-bit indexed color (256-color palette), 24- and 48-bit RGB color, and 16-bit grayscale. For web page production environments, 8-bit (PNG-8) and 24-bit (PNG-24) are usually used.

Although it took some time to be adopted by most browsers, the PNG format has become the most common choice used by web designers, as this format provides:

- Lossless compression
- Multi-level transparency (Alpha) or binary (On / Off)
- Progressive display
- Information on adjusting image brightness (Gamma)
- Possibility of text (this allows adding metadata that gives additional information about the image).

The PNG-8 format is suitable for very flat color images, such as logos, icons and symbols.

With PNG-8 images (and GIFs) you can also set transparent areas to let the background color behind the image show through.

The PNG-24 format is good for images such as photographs with a very wide color range that do not lose information from the original image.

### **GIF format**

The GIF format (Graphic Interchange Format) was the first image format supported by browsers and for a long time the only format capable of being viewed by a browser. Its versatility, file size optimization, and cross-platform compatibility made it ideal for the web.

Its main use is to display graphics and logos. It also supports basic animation, which is why they are common in memes and social media comments. For static images it is no longer used as much, as the PNG format does the same, usually with better quality and efficiency.

Its main characteristics are:

- 8-bit indexed color mode.
- Lossless compression. Because it uses compression techniques based on finding repeating patterns in the information, it is particularly effective with flat color images, which have many pixels with the same color information.
- Binary transparency, where pixels are either fully opaque or fully transparent.
- Ability to display simple animations. This makes it ideal for eye-catching visual effects commonly used in banner ads and social media.

### **WebP format**

You can find a lot of information about the WebP format and tools...

WebP defined by Google as "the Swiss army knife of image formats". It provides all the functionality of JPEG, PNG and GIF formats with 25-35% smaller files.

Its main functionalities are:

- Possibility to use compression with or without loss (lossy or lossless).
- Alpha transparency. The WebP format incorporates an alpha channel for multiple levels of transparency
- Animations, as with GIFs, with higher compression levels.
- Ability to add embedded metadata, such as PNG format.

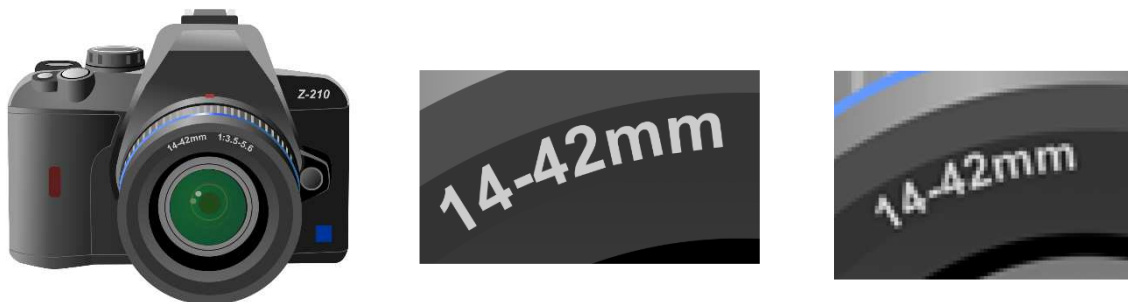
- Incorporation of Color Profile Information (ICC)

### 1.1.2. Vector images

Unlike bitmaps, where the image information is stored in a grid of pixels, vector images contain information in XML format about the geometry of the image, that is, the geometric elements that make it up with all the properties that define them (type of shape, position, color). The most widespread vector image format is SVG.

The main feature of these images is that they can be scaled without losing quality. Pixelation of the image does not occur due to insufficient pixel density, but the geometric shapes that make up the image are drawn each time at the resolution of the corresponding device.

When an area of the SVG image is enlarged, it does not lose detail, because the image was drawn using the device's maximum resolution. In contrast, the bitmap image has a resolution fixed by its pixel density. When enlarged, this density is lower than that of the screen and a pixelation effect occurs, a loss of display quality.



Vector images are ideal for icons, logos and statistical charts of all kinds (bars, pie, etc.). Because they are made up of figures and strokes, the file size is also usually smaller than the equivalent image in bitmap format.

A special case of vector graphics are fonts. Originally, fonts were made up of bitmaps, but from 1980 Adobe introduced a type of vector fonts, which solved the problem of sharpness when scaling fonts and improved their quality.

Example of icon embedding with Font Awesome.

SVG files are human-readable text files. In fact, SVG images can be created with a simple text editor like Notepad. Although for complex images, the usual way is to use vector drawing tools, such as Inkscape (free license) or Adobe Illustrator (paid license).

SVG images can be embedded into a web page in a number of ways:

- SVG code embedded inline within the HTML flow of the document supported by the HTML standard.

```
<!DOCTYPE html>
<html>
<body>

<h1>La meva imatge SVG</h1>

<svg width="100" height="100">
  <circle cx="50" cy="50" r="40" stroke="green" stroke-width="4" fill="yellow"
/>
</svg>

</body>
</html>
```

- `<img>` tag. This method is the simplest and has an equivalent syntax to that used for images in JPEG, PNG or GIF format.

```

```

- Embedded object, using an `<object>` tag. This is the best option if interactivity is required, since through the object element you can access from Javascript each of the elements of the SVG image, available in the DOM model.

```
<object type="image/svg+xml" data="imatge.svg"></object>
```

### 1.1.3. Color modes.

Regardless of the final file format, all image editing tasks should be done in RGB color mode (or grayscale mode for black and white images). To check which mode the image is in with Photoshop or GIMP, go to Image / Mode and check that the RGB Color option is checked. With JPEG, PNG-24 and WebP formats there is direct color compression. To export to PNG-8 or GIF format, the image must first be converted to indexed color mode.

**Color indexed.** To modify an image that is already in GIF or PNG-8 format, the first thing to do is to convert it to RGB color mode. This allows the full RGB color spectrum to be used with the editing tools. If, for example, the original image is resized in indexed color mode, there will be losses during the process, as the resulting image is limited to the existing color table.

**CMYK.** Graphic designers for print media tend to work in the CMYK color mode, which is not appropriate for web images. When working with an image generated with this color mode for a web page, it is necessary to convert it to RGB color mode before starting the editing process.

### Example of exporting to different formats from Photoshop and GIMP

The export of two images with very different characteristics (a photograph and a logo with flat colors) is different. The export will be done in different formats with Photoshop and GIMP and the results obtained will be compared.

Image 1



Image 2



The first export is from the photograph (image 1):

1. The photo is opened and exported in JPEG format with different compression rates: 100%, 60% and 10%.
2. It is exported in PNG-24 format. GIMP automatically renders it in this format if the color mode is not changed. In Photoshop, you must leave the Smaller File (8-bit) option unchecked.
3. With GIMP, export to WebP format with image qualities and alpha of 60%.
4. The image is converted to indexed color mode and a palette of 256 colors is selected. The image is exported to PNG-8, and GIMP automatically saves color-indexed images as PNG-8. In Photoshop, check the Smaller File (8-bit) option. Still with the original image in indexed color mode, it is exported again, now in GIF format.
5. When comparing the resulting file sizes exported to the various formats with the two programs, there are slight size differences due to the different compression algorithms.



Programa	JPEG 100%	JPEG 60%	JPEG 10%	PNG-24	WebP	PNG-8	GIF
Photoshop	1.015KB	<b>285KB</b>	77KB	2.153KB	-	732KB	849KB
GIMP	1.373KB	<b>173KB</b>	53KB	2.028KB	<b>127KB</b>	597KB	680KB

The conclusion is clear: when working with photographs with a lot of color depth, the ideal format that achieves a better ratio between quality and size is WebP, followed by JPEG, with a quality of 60%. PNG-8 and GIF formats are triple the size and lower quality

The second export is from the logo (image 2):

By converting the logo to indexed mode, you can try reducing the color palette down to 32 colors. Since the original image has a limited number of colors, this allows the resulting file size to be further reduced without affecting the quality of the final image.

Programa	JPEG 100%	JPEG 60%	JPEG 10%	PNG-24	WebP	PNG-8 (32 colors)	GIF
Photoshop	195KB	83,6KB	32,5KB	58KB	-	<b>23,1KB</b>	30,6KB
GIMP	231,2KB	61,9KB	27,7KB	69KB	<b>28,2KB</b>	<b>29,3KB</b>	23,8KB

PNG-8 and GIF formats with a reduced palette of colors get the best quality-to-size ratio. The JPEG file with 10% quality is even smaller in size with GIMP, but the quality is not comparable, as you can see in next image. The JPEG format does not work very well with flat colors, as it gives a pixelated effect. The WebP format also achieves reduced size, with a quality higher than JPEG but with some distortion, lower than JPEG, but the quality of PNG- and GIF-formats with reduced palettes is higher.

Logo comparison JPEG 10% versus GIF with 32 colors



Comparison of WebP logo versus GIF with 32 colors.

