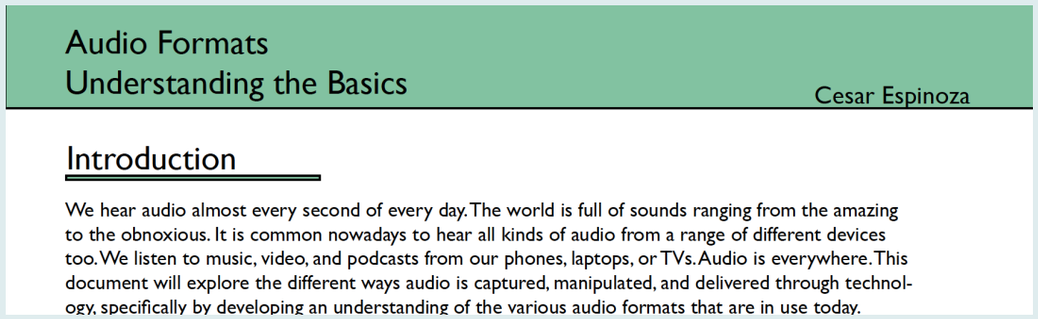
Designing Media Output Technical Documents



Audio Formats
Understanding the Basics

Cesar Espinoza

Introduction

We hear audio almost every second of every day. The world is full of sounds ranging from the amazing to the obnoxious. It is common nowadays to hear all kinds of audio from a range of different devices too. We listen to music, video, and podcasts from our phones, laptops, or TVs. Audio is everywhere. This document will explore the different ways audio is captured, manipulated, and delivered through technology, specifically by developing an understanding of the various audio formats that are in use today.

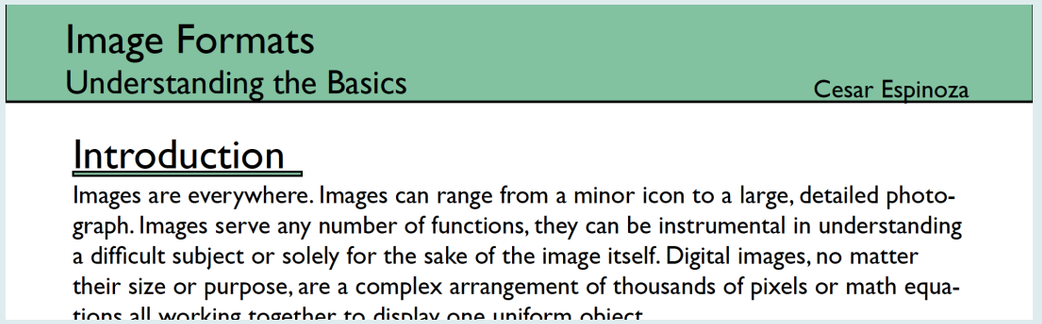


Image Formats
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In my Media Formats and Outputs class, I was introduced to a technical document. A document that is designed to educate people on a technical subject.

I was assigned to create multiple technical documents going over media formats such as audio, images, and video. My goal was to design a layout for information in a manner that anyone could easily understand. The information was dense and technical so it was crucial that I included images and graphics that would make the information easier to digest.

Getting Started

In order to educate someone else, I had to research media formats and outputs to make sure I was using accurate information in my documents. I then wrote out the text content of the document, simplifying the information as much as possible.

Research the computer-based technology systems we use to design and develop media-rich experiences.

Create a chart, a diagram, or an illustration (with accompanying explanation) that shows a solid understanding of these robust systems.

Your documentation should include items critical to electronic systems:

- Screen Resolution Pixel Diagram(s)
  - TV screens
  - Smart phones
  - Tablets
  - Computers
  - Browsers
- Bit Depth Chart (2-bits to 128-bit) and correlation with color, video and audio
- Storage Chart (Hard-drives and amounts by designation starting at KB, MB....to YB)
- Alias vs Anti-alias Diagram
- Lossy vs Lossless Example
- Raster vs Vector Example
- Others as needed

Display resolution" refers to the number of pixels your monitor uses to create an image
https://www.cnet.com/tech/home-entertainment/from-4k-to-uhd-to-1080p-what-you-should-know-about-tv-resolutions/
From 4K to UHD to 1080p: What you should know about TV resolutions

https://developer.mozilla.org/en-US/docs/Web/Media/Formats/Audio_concepts
Digital audio concepts

https://www.pcmag.com/encyclopedia/term/screen-resolution
screen resolution

The number of horizontal and vertical pixels on a display screen. The more pixels, the more information is visible without scrolling. Screen resolutions have a pixel count such as 1600x1200, which means 1,600 horizontal pixels and 1,200 vertical pixels (see high-definition resolutions).

https://www.creativebloq.com/news/the-ultimate-guide-to-screen-resolution

https://www.videosolo.com/tutorials/screen-resolution-comparison.html
GRAPHIC: tv-screen.png

Research for media output hardware

MP4 (MPEG-4 Part 14) is the most common type of video file format. Apple's preferred format, MP4 can play on most other devices as well. It uses the MPEG-4 encoding algorithm to store video and audio files and text, but it offers lower definition than some others. MP4 works well for videos posted on YouTube, Facebook, Twitter, and Instagram.

MOV (QuickTime Movie) stores high-quality video, audio, and effects, but these files tend to be quite large. Developed for QuickTime Player by Apple, **MOV files use MPEG-4 encoding** to play in QuickTime for Windows. MOV is supported by Facebook and YouTube, and it works well for TV viewing.

WMV (Windows Media Viewer) files offer good video quality and large file size like MOV. Microsoft developed WMV for Windows Media Player. YouTube supports WMV, and Apple users can view these videos, but they must download Windows Media Player for Apple. Keep in mind you can't select your own aspect ratio in WMV.

AVI (Audio Video Interleave) works with nearly every web browser on Windows, Mac, and Linux machines. Developed by Microsoft, AVI offers the highest quality but also large file sizes. It is supported by YouTube and works well for TV viewing.

AVCHD: Advanced Video Coding High Definition is specifically for high-definition video. Built for Panasonic and Sony digital camcorders, these files compress for easy storage without losing definition.

Flash video formats **FLV, F4V, and SWF** (Shockwave Flash) are **designed for Flash Player**, but they're commonly used to stream video on YouTube. Flash is not supported by iOS devices.

MKV: Developed in Russia, **Matroska Multimedia Container** format is free and open source. It **supports nearly every codec, but it is not itself supported by many programs**. MKV is a smart choice if you expect your video to be viewed on a TV or computer using an open-source media player like VLC or Miro.

WEBM or HTML5: These formats are best for videos embedded on your personal or business website. They are small files, so they load quickly and stream easily.

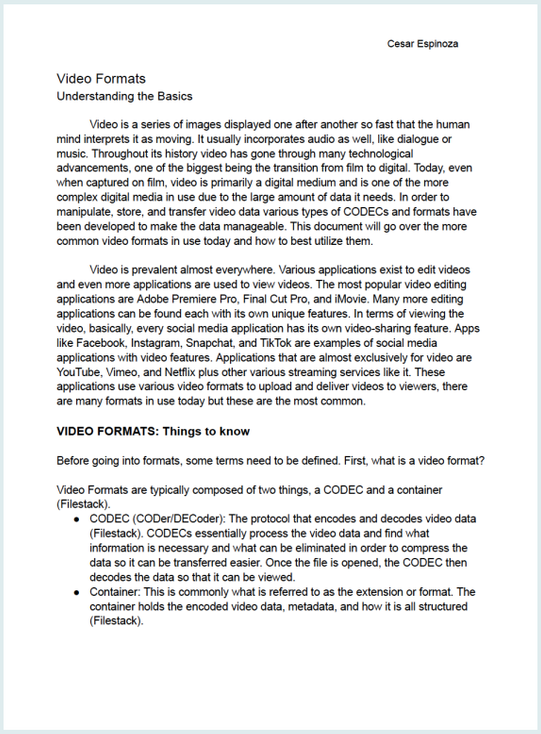
MPEG-2: If you want to burn your video to a DVD, MPEG-2 with an H.262 codec is the way to go.

https://developer.mozilla.org/en-US/docs/Web/Media/Formats/Containers
Media container formats (file types)

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6316136
Overview of the High Efficiency Video Coding (HEVC) Standard

Research for video formats

I had very few restrictions when it came to the content and layout of the documents. One guideline I did have was making a compelling narrative through use of text, images, and graphics. Alongside that, my content had to be easy to understand for any reader. These guidelines were at first frustrating since I had almost unlimited possibilities.



Cesar Espinoza

Video Formats
Understanding the Basics

Video is a series of images displayed one after another so fast that the human mind interprets it as moving. It usually incorporates audio as well, like dialogue or music. Throughout its history video has gone through many technological advancements, one of the biggest being the transition from film to digital. Today, even when captured on film, video is primarily a digital medium and is one of the more complex digital media in use due to the large amount of data it needs. In order to manipulate, store, and transfer video data various types of CODECs and formats have been developed to make the data manageable. This document will go over the more common video formats in use today and how to best utilize them.

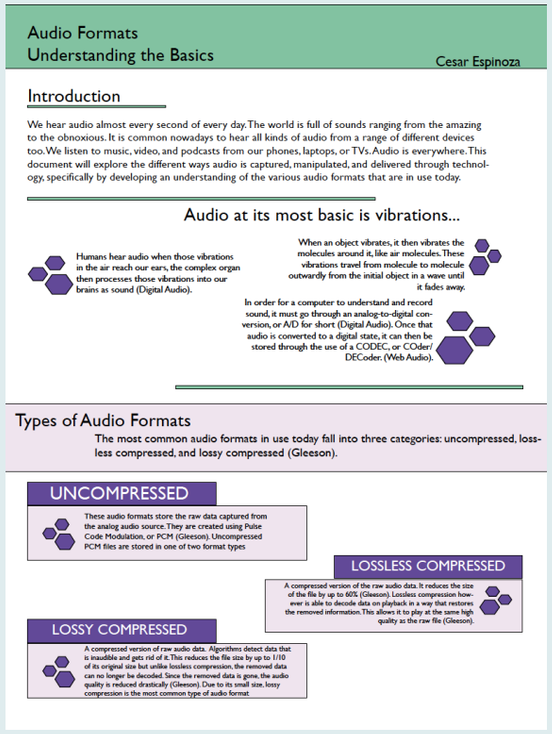
Video is prevalent almost everywhere. Various applications exist to edit videos and even more applications are used to view videos. The most popular video editing applications are Adobe Premiere Pro, Final Cut Pro, and iMovie. Many more editing applications can be found each with its own unique features. In terms of viewing the video, basically, every social media application has its own video-sharing feature. Apps like Facebook, Instagram, Snapchat, and TikTok are examples of social media applications with video features. Applications that are almost exclusively for video are YouTube, Vimeo, and Netflix plus other various streaming services like it. These applications use various video formats to upload and deliver videos to viewers, there are many formats in use today but these are the most common.

VIDEO FORMATS: Things to know

Before going into formats, some terms need to be defined. First, what is a video format?

Video Formats are typically composed of two things, a CODEC and a container (Filestack).

- CODEC (CODer/DECoder): The protocol that encodes and decodes video data (Filestack). CODECs essentially process the video data and find what information is necessary and what can be eliminated in order to compress the data so it can be transferred easier. Once the file is opened, the CODEC then decodes the data so that it can be viewed.
- Container: This is commonly what is referred to as the extension or format. The container holds the encoded video data, metadata, and how it is all structured (Filestack).



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Audio at its most basic is vibrations...

Humans hear audio when those vibrations in the air reach our ears, the complex organ then processes those vibrations into our brains as sound (Digital Audio).

When an object vibrates, it then vibrates the molecules around it, like air molecules. These vibrations travel from molecule to molecule outwardly from the initial object in a wave until it fades away.

In order for a computer to understand and record sound, it must go through an analog-to-digital conversion, or A/D for short (Digital Audio). Once that audio is converted to a digital state, it can then be stored through the use of a CODEC, or COder/DECoder. (Web Audio).

Types of Audio Formats

The most common audio formats in use today fall into three categories: uncompressed, lossless compressed, and lossy compressed (Gleeson).

UNCOMPRESSED

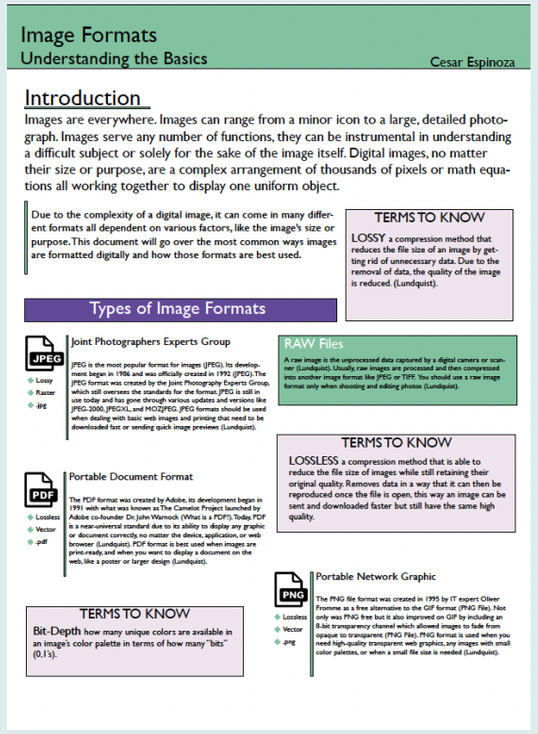
These audio formats store the raw data captured from the analog audio source. They are created using Pulse Code Modulation, or PCM (Gleeson). Uncompressed PCM files are stored in one of two format types

LOSSLESS COMPRESSED

A compressed version of the raw audio data. It reduces the size of the file by up to 60% (Gleeson). Lossless compression however is able to decode data on playback in a way that restores the removed information. This allows it to play at the same high quality as the raw file (Gleeson).

LOSSY COMPRESSED

A compressed version of raw audio data. Algorithms detect data that is inaudible and gets rid of it. This reduces the file size by up to 1/10 of its original size but unlike lossless compression, the removed data can no longer be decoded. Since the removed data is gone, the audio quality is reduced drastically (Gleeson). Due to its small size, lossy compression is the most common type of audio format



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Due to the complexity of a digital image, it can come in many different formats all dependent on various factors, like the image's size or purpose. This document will go over the most common ways images are formatted digitally and how those formats are best used.

TERMS TO KNOW

LOSSY a compression method that reduces the file size of an image by getting rid of unnecessary data. Due to the removal of data, the quality of the image is reduced. (Lundquist).

Types of Image Formats

JPEG
Joint Photographers Experts Group
Lossy
Raster
.jpg

JPEG is the most popular format for images (JPEG). Its development began in 1986 and was officially created in 1992 (JPEG). The JPEG format was created by the Joint Photography Experts Group, which still oversees the standards for the format. JPEG is still in use today and has gone through various updates and versions like JPEG-2000, JPEGXL, and MOZJPEG. JPEG formats should be used when dealing with basic web images and printing that need to be downloaded fast or sending quick image previews (Lundquist).

RAW Files

A raw image is the unprocessed data captured by a digital camera or scanner (Lundquist). Usually, raw images are processed and then compressed into another image format like JPEG or TIFF. You should use a raw image format only when shooting and editing photos (Lundquist).

PDF
Portable Document Format
Lossless
Vector
.pdf

The PDF format was created by Adobe, its development began in 1991 with what was known as The Camelot Project launched by Adobe co-founder Dr. John Warnock (What is a PDF?). Today, PDF is a near-universal standard due to its ability to display any graphic or document correctly, no matter the device, application, or web browser (Lundquist). PDF format is best used when images are print-ready, and when you want to display a document on the web, like a poster or larger design (Lundquist).

TERMS TO KNOW

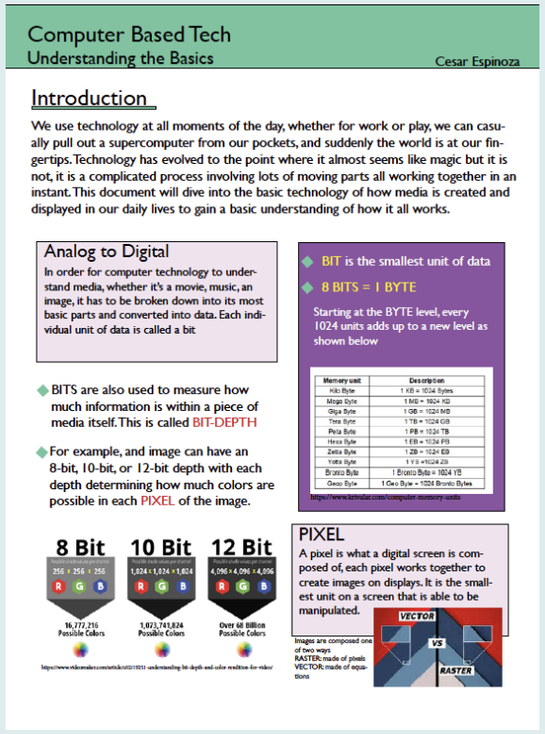
LOSSLESS a compression method that is able to reduce the file size of images while still retaining their original quality. Removes data in a way that it can then be reproduced once the file is open, this way an image can be sent and downloaded faster but still have the same high quality.

TERMS TO KNOW

Bit-Depth how many unique colors are available in an image's color palette in terms of how many "bits" (0,1's).

PNG
Portable Network Graphic
Lossless
Vector
.png

The PNG file format was created in 1995 by IT expert Oliver Fromme as a free alternative to the GIF format (PNG File). Not only was PNG free but it also improved on GIF by including an 8-bit transparency channel which allowed images to fade from opaque to transparent (PNG File). PNG format is used when you need high-quality transparent web graphics, any images with small color palettes, or when a small file size is needed (Lundquist).



Computer Based Tech
Understanding the Basics
Cesar Espinoza

Introduction

We use technology at all moments of the day, whether for work or play, we can casually pull out a supercomputer from our pockets, and suddenly the world is at our fingertips. Technology has evolved to the point where it almost seems like magic but it is not, it is a complicated process involving lots of moving parts all working together in an instant. This document will dive into the basic technology of how media is created and displayed in our daily lives to gain a basic understanding of how it all works.

Analog to Digital

In order for computer technology to understand media, whether it's a movie, music, an image, it has to be broken down into its most basic parts and converted into data. Each individual unit of data is called a bit

BIT is the smallest unit of data
8 BITS = 1 BYTE

Starting at the BYTE level, every 1024 units adds up to a new level as shown below

Memory unit	Description
Kilo Byte	1 KB = 1024 Bytes
Mega Byte	1 MB = 1024 KB
Giga Byte	1 GB = 1024 MB
Tera Byte	1 TB = 1024 GB
Peta Byte	1 PB = 1024 TB
Hexa Byte	1 EB = 1024 PB
Zetta Byte	1 ZB = 1024 EB
Yotta Byte	1 YB =1024 ZB
Bronto Byte	1 Bronto Byte = 1024 YB
Geop Byte	1 Geo Byte = 1024 Bronto Bytes

https://www.kmvalar.com/computer-memory-units

BITS are also used to measure how much information is within a piece of media itself. This is called BIT-DEPTH

For example, and image can have an 8-bit, 10-bit, or 12-bit depth with each depth determining how much colors are possible in each PIXEL of the image.

8 Bit
256 × 256 × 256
R G B
16,777,216 Possible Colors

10 Bit
1,024 × 1,024 × 1,024
R G B
1,073,741,824 Possible Colors

12 Bit
4,096 × 4,096 × 4,096
R G B
Over 68 Billion Possible Colors

https://www.videomaker.com/article/c10/19251-understanding-bit-depth-and-color-rendition-for-video/

PIXEL

A pixel is what a digital screen is composed of, each pixel works together to create images on displays. It is the smallest unit on a screen that is able to be manipulated.

VECTOR
VS
RASTER

Images are composed one of two ways
RASTER: made of pixels
VECTOR: made of equations

I produced one pure text document that primarily relied on alignment, paragraphs and bullet points to organize information. I then explored the use of lines and shapes along with color in following documents. As I became more confident I then utilized icons and graphics to help support my written text more.

Experimentation

As I continued to create these documents I gained a sense of appreciation for the small amount of restrictions we had. I enjoyed being able to do something completely different for every document and experiment to see what worked and what I liked.

Another way I was able to experiment was with design software. I got a lot of experience using Adobe InDesign before switching over to Figma. Both software were interesting to use but ultimately I preferred FIgma. I felt it was easier to use and navigate compared to InDesign.

As the technical documents started to focus more on processes and experiments using media outputs, the content changed too. To go along with that I began to use less shapes and boxes and relied more on negative space, alignment, and hierarchy. I also focused my use of color to be more consistent throughout the document.

The biggest change that I made was the orientation of my pages. When I started I constrained myself to using portrait orientation without even realizing. Speaking with my professor to get feedback and ideas allowed me to break out of my comfort zone and explore landscape orientation. It was an interesting change that let me try different things with my layouts.

JPEG Compression
Using Photoshop

Cesar Espinoza

What is JPEG?

JPEG is one of the most common image formats used since its release in 1992. It was released and has been mantained by the Joint Photographic Experts Group, which is where the acronym comes from. JPEG compresses images so that its data size is reduced, making it easier to store and transfer. JPEG compression however affects the image quality so knowing the various ways JPEG compresses images is vital to using it effectively.

Test Scenario

There are many scenarios why someone would need to compress a JPEG image. For this document, we will be testing JPEG compression methods using Adobe Photoshop in order to find the right balance of quality and size to upload an image for use on a website.

- We'll be taking a raw image file and compressing it to JPEG format using three methods: **SAVE AS**, **EXPORT AS**, and **SAVE FOR WEB**
- For each of the three methods, we will compress at three different levels of quality: **MAXIMUM**, **MEDIUM**, and **LOW**
- To manage the amount of files created, we will be using a **File Naming Convention**

Adobe Photoshop

As one of the most popular photo editing software, we will be using Photoshop to compress a raw image using JPEG. Note that many other photo softwares exist that can perform JPEG compression.

File Naming Convention

A file naming convention is a system for naming files in a descriptive manner that allows you to know exactly what it contains and how it relates to other files. It is best practice to establish a naming convention before beginning a project.

Practices and naming conventions to consider:

- Files should be named consistently
- File names should be short but descriptive
- Avoid special characters, use underscores and capitalization
- Consider these elements in a file name:
  - Date of creation
  - Short Description
  - Work
  - Location
  - Project name or number
  - Sample
  - Analysis
  - Version number

Test Image

The image below is a compressed version of the raw image we will be using in our tests. The raw image file size is 72.1MB, it is saved as a TIFF file.

Export Evaluation

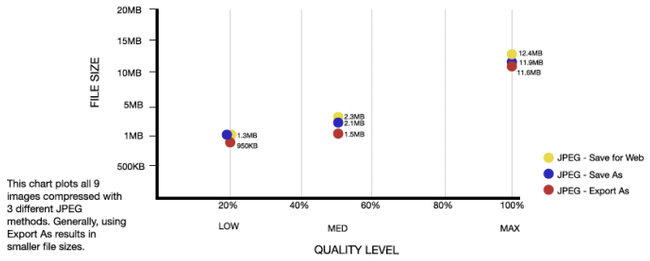
Cesar Espinoza

Evaluating JPEG

As one of the more common formats, Photoshop offered three different ways to compress using JPEG, each method offering quality control settings. As a result, we exported out a total of 9 images. For this evaluation we will compare the image quality of 3 images and compare the file size for all 9.

Image Quality Evaluation

	100%	300%	500%	
Max Quality (12) File Size: 11.9MB				Using Save As to compress as JPEG allowed a max quality setting up to "12". We compressed 3 images at three different levels. JPEG compression has consistently been updated to allow for higher quality compression. This results in massive drops in file size while maintaining a relatively high quality image.
Med Quality (7) File Size: 2.1MB				The sample image at 100% zoom is almost identical at all three quality levels. At 300% zoom it is still difficult to tell a difference between Max and Med quality but slight artifacting is noticeable at the low quality compression
Low Quality (4) File Size: 1.3MB				500% zoom is where you can see the most differences. Pixels become more prominent as the quality lowers. The shine seen in the texture is also lost and blurred. The beads that make up the eagle are also less prominent and blend with each other.



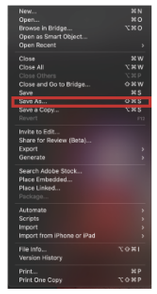
This chart plots all 9 images compressed with 3 different JPEG methods. Generally, using Export As results in smaller file sizes.

JPEG Compression
Using Photoshop

Cesar Espinoza

Compression using Save As

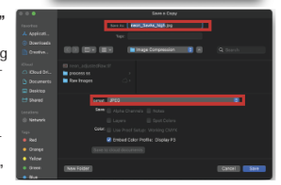
With the raw image open in PS, clicking on the "File" menu along the top you'll see various options. Select "Save As"



Clicking **"Save As"** will open this settings box. In order to save it in the JPEG format, you will need to select **"Save a Copy..."**

In the **"Save a Copy"** menu you can now rename your file using your naming convention a the top.

Where it says **"Format"** using the drop-down menu select "JPEG". Click "Save"



You'll be presented with JPEG options at this point. Focus on quality or size. **The higher the quality, the higher the file size will be** and vice versa.

For this test, compress images at the MAX quality (**12**), at MEDIUM quality (**7**), and LOW quality (**4**).

File Size Results

Compressing at the three levels of quality will result in the following file sizes:

- MAX (12): **9.6MB**
- MEDIUM (7): **1.4MB**
- LOW (4): **829KB**

Documents focusing on image compression experiments using less boxes, less color variation, more use of text alignment and hierarchy.

Audio Listening Experience

Out of the many types of media we interact with every day, music is considered to be the most common type in use. Usually, we listen to music as conveniently as possible as we go about our daily tasks. But do we *really* listen to music? In this document I'll layout my experiences listening to the most common audio formats in use and attempt to discern how each format affects the quality of sound. In addition, I'll test out two different headphones to hear what changes, if any, occur to the sound quality.

Audio Formats

The type of audio format a song is in determines a lot about its sound quality. There are many formats in use so for this experiment we'll focus on four of the most common.

AIFF: Audio Interchange File Format
Compression: None (Raw)
Extension: .aif

FLAC: Free Lossless Audio Codec
Compression: Lossless
Extension: .flac

AAC: Advanced Audio Coding
Compression: Lossy
Extension: .aac, .m4a, various others

MP3: MPEG-1 Audio Layer 3
Compression: Lossy
Extension: .mp3

The Music

For this experiment I'll listen to five songs. These songs offer a range of various sounds and instruments that are perfect for deep listening. Each song will be in the four different formats listed to the left, I'll select specific time stamps from each song to really listen in to the sounds and compare each format.


Don Henley: The End of The Innocence


Pink Floyd: On The Turning Away


Coldplay: Clocks


Tears for Fears: The Seeds of Love


Tears for Fears: Everybody Wants to Rule the World

Listening Equipment

I will be listening to all the music on a MacBook Air using two different pairs of headphones: The Apple AirPods 2nd Generation and the Grado Labs SR325x. I chose this listening gear to compare my everyday use pair with a higher end, high quality pair. I'll start with the Grado Labs pair before using my Airpods.

Grado Labs SR325x

Apple AirPods 2nd Gen

Listening to Don Henley's The End of The Innocence

Listening on: MacBook Air
Listening in: Classroom
Volume Level: Half
Focusing on: (1) 1:30-1:45 (2) 3:07-3:31 (3) 4:30-4:50

AIFF
File size: 56.1MB

At the same volume level compared to the Airpods, the SR325x sounded so much louder. The sound was almost more spacious than what I am used to, like each instrument and unique sound had room to shine while still playing as part of a whole.

On AirPods there is a very obvious drop in quality compared to the SR325x pair. The volume is much quieter which makes it harder to hear the subtler background elements that I could easily listen to while on the Grados. I can still hear those elements but they don't have the same impact.

FLAC
File size: 56.3MB

Sounded very similar to the AIFF file, I did notice that the vocals weren't as pronounced in terms of volume, specifically on section 3. At the same volume setting, the vocals on FLAC sounded quieter than AIFF.

FLAC sounded slightly louder than AIFF, almost like it was playing closer to my ear while AIFF was a bit further. I did not notice any difference in the lyrics this time. The AirPods don't have the same sense of space that the Grados had so it is harder to hear the more subtle elements that helped me differentiate the formats. Generally FLAC sounds similar to AIFF.

AAC
File Size: 10.5MB

It is a bit difficult to tell any major differences, especially comparing AAC with FLAC but I do get the sense that on AAC, each of the unique sounds/instruments blend together more and fade to the background to focus on one aspect. Like in section two, the saxophones take up more space so its harder to focus on the other instrumentals

AAC and FLAC were more different. I could more easily understand the lyrics on FLAC. Comparing the two headphones, the Grados are much better than the AirPods. The instruments don't sound as clear and crisp on the AirPods, the blending I noticed with AAC was more obvious too.

MP3
File Size: 7.6MB

I am still having a hard time hearing differences, even comparing MP3 with FLAC. Again I think that the differences that do stand out is how much space each sound has. Focusing on section 2 again, on MP3 the saxophone solo was almost overwhelmed by the piano portion, it wasn't as balanced like FLAC or even AAC was.

When I listened to MP3 I couldn't tell a difference compared to AAC. I listened to section two to compare MP3 with FLAC while focusing on the saxophone. Comparing those two I could hear a more clear, piercing sound with FLAC but only after listening a few times.

Streaming Video Experience

Introduction
For the last few years, viewers looking to watch movies and TV shows have had an overwhelming amount of options at their fingertips. What started as a DVD-by-mail rental service company, Netflix launched a revolution by bringing streaming entertainment to the mainstream. Since its explosion in popularity, other companies have raced to catch-up by creating their own streaming services, each with unique viewing options. Never has it been so easy yet so difficult to watch TV.

What is video streaming?
Streaming at its most basic is a progressive download. A progressive download allows a viewer to watch a video as soon as enough data is downloaded to a device. This method of download allows almost instantaneous viewing and saves a viewer from having to store a massive video file on their device. With their success in the DVD rental business, Netflix was able to bring video streaming offering popular movies and TV shows to their existing subscribers, providing an even faster more convenient method of viewing than ever before.

Streaming Wars
Netflix's massive success and disruption of the entertainment industry spurred major media companies to launch competing streaming services. At this point, it seems like there are too many streaming platforms to chose from, so in this document we will explore three popular services to see what they each offer and how they compare. We'll focus on the quality of the video streaming and how to get the most of a monthly subscription.

Channel Surfing

I researched three streaming services and explored their apps to experience what they had to offer. These services are Netflix, HBOMax, and Hulu.

Viewing Equipment

All three apps offer HD streaming. Select offerings are available in even higher resolutions. In order to get the most out of the services I'll be using a 4K UHD capable TV. I'll be streaming from a Sony Playstation 5 using high-speed internet.

LG 4K UHD HDR LED TV

Streaming at
Download: 467.4mbps
Upload: 18.6mbps

Netflix
Subscriber Count: 230.8 million*
Max Resolution: 4K UHD
Price: $7-$20

Introduction
The original and biggest streaming service, Netflix boasts around 230 million subscribers as of the end of 2022*. Netflix had a massive head start compared to the other two services so it has basically set the standard for what a streaming app is and what it offers.

Breakdown
Netflix offers four plans. The cheapest come in at $7 and offers HD viewing with ads. To get the highest quality resolution you'll have get Netflix's premium plan for $20. I couldn't find a specific number but I found at least 200+ titles streaming in 4K. In terms of technical specifications, Netflix uses H.264 for their baseline CODEC. For HD quality they use VP9, for HDR they use HVEC. As of Nov 2021 they started to roll out AV1 CODEC to devices that support it. You can stream Netflix on almost any device capable of connecting to the internet.

Experience
I watched Okja in 4K UHD. It looked really good. The movie itself was very colorful and brightly lit for the most part. I think the 4K really enhanced the colors of the film and made it more captivating. I watched around 20 minutes of it and there was no drop in quality that I noticed.

Landscape oriented documents showcasing audio and video experiences.

While this project started off a bit frustrating for me due to the lack of specific guidelines and requirements, ultimately the freedom to experiment became something I appreciated. I was able to learn what I liked and what worked from my experiences. It pushed me to use my creativity by allowing me solve the issues I faced on my own.

Beyond the experimentation, I also learned how to conduct thorough research and how to condense that research to target a specific audience. In this case our goal to simplify my research also taught me the value of images and graphics in supporting my written content. Overall, this project pushed me outside my comfort zone and allowed me to be self-motivated in problem solving. I received an A for the documents I've had graded so far.