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Computer Science 1033 – Week 4

GRAPHICS CONTINUED

"Give a person a fish and you feed them for a day; teach that person to use the Internet and they won't bother you for weeks".→ Anonymous

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Slide 2

Overview of This Week's Topics

- How to hand in Assignment 1
- Compression
- File types: GIF, JPG and PNG

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Reading for this week from our online textbook:

- Graphics → Image Formats and Compression Techniques

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Slide 4

Handing in the Poster Assignment

- Handing in Assignment is 2-part:
  - Part 1: Uploading to cs1033.gaul.csd.uwo.ca via WinSCP
  - Part 2: Submitting the links and references via kritik.io
- Video of how to hand it in: go to Poster Assignment and there is a video that explains how to hand everything in.
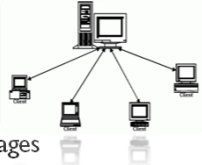
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Transferring Files to the World Wide Web

- This info is a refresher of Lab 1 and help on what you will need to do for all 3 assignments and for all your labs!

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Servers vs. Clients

- **Web Server** → a computer that delivers (serves up) web pages
- **Client** → the computer that is requesting to see/visit the web page.
- Many clients will visit one web server, for example 20,000 students might visit Western's web server to see the page: http://publish.uwo.ca
- We will put/post our web pages on the Western web server so clients can see our pages.

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Advantages of a Web Server

- **Connected**: Computer is on all the time and connected to the Internet
- **Always Available:** Since it never gets turned off, your website will always be available
- **Well Maintained:** The people running the servers will take care of security and computer maintenance issues

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## Uploading our Web Pages to a Web Server

- Upload by using a File Transfer Protocol program such as:
  - WinSCP
  - FileZilla
  - Cyberduck – THIS IS A GREAT ONE FOR MAC USERS!
  - WS-FTP
  - Fugu (for Mac)
- Log on to the Web Server by select Secure File Transfer Client, click on the Quick Connect button and entering the following
  - cs1033.gaul.csd.uwo.ca
  - Your userid
  - Your password
  - Port 1033
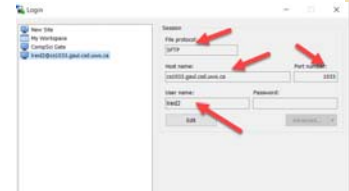
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Using WinSCP

- Create a folder inside your area called *posterassign*
- Then drag the files from your laptop/lab machine to your *posterassign* folder to your area on the machine: *cs1033.gaul.csd.uwo.ca*
- Then you might have to set the permissions on your files and folders (although permissions will likely be set already)
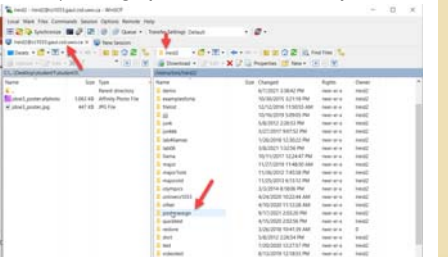
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Double check that it worked:

- Open a browser like Chrome
- Type in the web address: *http://cs1033.gaul.csd.uwo.ca/~youruserid/folder name*
- For example:
  - http://cs1033.gaul.csd.uwo.ca/~lreid2/posterassign
  - usually when things don't work it is because your permissions are wrong or you didn't use all lowercase!

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Handing in Poster Assignment

- Step 1: Create your assignment in Affinity Photo
- Step 2: Save your file as a afphoto and jpg with the correct file name
- Step 3: SFTP to cs1033.gaul.csd.uwo.ca
- Step 4: create a folder called *posterassign*
- Step 5: move the .afphoto and .jpg files into *posterassign* folder
- Step 6: using IE (Chrome, Safari or Firefox) double check that you can see your jpg

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Handing in Poster Assignment

- Step 7: Create a file in a simple text editor such as Notepad (.txt)
- Step 8: Put the necessary info in the .txt file
- Step 9: Log onto kritik.io and go to Poster Assignment
- Step 10: (CREATE STAGE) Copy the information in the .txt file into the *Assignment Text* box in kritik.io for Poster Assignment
- Step 11: Press the Submit button
- Step 12: (EVALUATION STAGE – 2 to 3 days) Then you will be notified of the 5 other assignments you have to mark via kritik.io
- Step 13: (FEEDBACK STAGE – 1 day only!) Once you have marked the 5 students assigned to you, you will need to review the comment each of the students who marked you gave and submit your review.

YOU'RE DONE!

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Big Ideas For This Week

- Big Idea 1: **Size Matters** → Squishing is important in computer science!
- Big Idea 2: **Gif vs Jpg vs Png** → Make the right choice!

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How Does Compression Work?

- Several different ways to do compression depend on the type of image
- Are you willing to do a lossy compression and lose some of the original information?
- For example: When packing a suitcase, what are you two options for filling the suitcase?
  - A. Folding carefully and sitting on the case!
  - B. Leaving some unimportant stuff at home and using a smaller case!
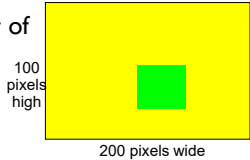 - ○ **QUESTION: Which is lossy and which is lossless?**

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Compression for images with large blocks of the same colour

- Assume this is an image (boring though it may be!) we want to compress.
- Say the image is 100 pixels high and 200 pixels wide, so we would have to store info about 20,000 pixels.
- We need to store the color of every pixel
- NOTE:
  - ○ the yellow is: #FFFF00
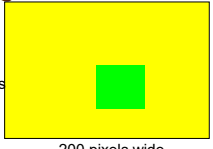 - ○ the green is: #00CC99

100 pixels high

200 pixels wide

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Compression Concepts

- RAW has no compression – large file
- A RAW stores the information about each pixel, one at a time, so the RAW file would look something like this: (Starting at the top, left corner, going left to right, ending at the bottom right)
- Each color is 3 byte, so that is 60,000 bytes of information we are storing

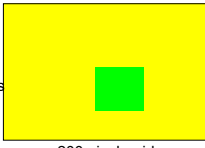100 pixels high

200 pixels wide

#FFFF00
#FFFF00
#FFFF00
#FFFF00
#FFFF00
…
#FFFF00
#00CC99
#00CC99
…
#FFFF00

YellowWithGreen.raw

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Compression Concepts

- Can anyone think of a way to store the data about the color of each pixel, without losing any information (lossless compression) and do it in less than 60,000 bytes

100 pixels high

200 pixels wide

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Compression Concepts

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AMAZING:

- 35 bytes vs 60,000 bytes!
- NOTE:
  - This idea works great with rectangular shapes but gets a lot more complicated when curves are involved!
  - GIF compressions are, in reality, a bit, a lot more complicated
- Thus compression aids with making smaller file size…downloads faster images

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Other Compression Ideas

- Looks for patterns, for example: 143451434514345
- If "1" represents pattern 14345, compresses it to "111"
- Build a decoding hash table
  - 0   13245
  - 1   14345
  - 2   23423
  - 3   11223

Pattern:
13245234231434511223323423
Based on table will map to
02132

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Compression Tricks – Compressing Words (for example text in a dictionary)

- **ASCII Code – each letter is represented by 8 bits (1 byte)**
- **Question:** Which letter is the most common in the English language?
  - **Huffman Coding** - rather than ASCII (each letter is 8bits or 1 byte) use the least number of bits for common letters and more bits for less common letters → Sample Huffman code
- **QUESTIONS**
  - **How many bytes will the word "see" be in ASCII? in Huffman?**
  - **How many bytes will the word "zoo" be in ASCII, in Huffman?**

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- ASCII code
- Huffman code
- see
- zoo

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Other Compression Ideas

- How do our eyes see images?
- **QUESTION: which one looks more different from the original image?**

Original Image

A. Brightness Adjusted Slightly

B. Colour Adjusted Slightly

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Brightness vs. Colour

- The designers of the JPEG compression algorithm realized that the human eye is more sensitive to brightness details than to fine color details. *(This is an example of how Biology and Computer Science and Physics overlap ☺!)*
- If it finds two adjacent pixels with very similar colors, it will store both those pixels with the same color and discard the other color.

https://www.youtube.com/watch?v=Jcgq7jq1W3o&list=PLQMVnge4XbictUtFZK1-gBYvyUzTWJnOk

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How do we pick the most appropriate file format?

- Depends on what type of image we are representing
- QUESTIONS:
  - How many colours are needed for the first image?
  - How many for the second image?

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Depends on type of image!

- The type of image we are trying to compress will determine the best file format to choose!
- 3 file formats we will look at:
  - GIF
  - JPG
  - PNG

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GIF (Graphic Interchange Format)

- Widely used on the World Wide Web
- Cross Platform (works on Macs, Windows)
- ONLY supports 8 bit colour!
  - **QUESTION**: How many colours can you have in a GIF file if it allows for 8 bit colour?
  - Not great for photographs but good for clipart, logos, animation
- Looks for large blocks of area that all have the same colour
- Saving an image with 24 bit colour as a gif will lower the quality the first time you convert it to a gif

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GIF

- Produces smaller file sizes than jpgs
- Does a *lossless* compression:
  - Assume we have an image that is
    - 200 by 200 pixels
    - If the original image had 256 colours or less
  - With no compression the file size would be 200*200*3/1024 = **117 KB**
  - Same image, save as a gif:
    - With 256 Colours → **8.4 KB**
    - With 16 Colours → **5 KB**
- NOTICE: NO CHANGE IN QUALITY, LOSSLESS COMPRESSION!

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GIF

- Not great for photography because can only store 256 colours.
- **QUESTION: Can you tell which image has fewer colours?**

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One Colour Transparency

- Allows for transparency of ONE colour
- Background will show through:
- **Question:** Can you see the problem with this type of transparency?

GIF → Transparency

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GIF → Animation

- Allows for animation
- Don't need a plug in for gif animation!
- Works in all browsers, universal format!

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GIF → Dithering

- Allows for *dithering*:
- **Question:** What do you think a program, that converts images into gifs does, if the image has more than 256 colors?
  ◦ **Solution 1**: Substitute one of the colors you have for one of the colors you are missing
  ◦ **Solution 2:** Any guesses?
    • **HINT:** What did you do when you were a kid and your parent gave you **red** and **blue** and **yellow** and **black** play-doh?
    • you didn't realize it but you were using a 2-bit color depth play-doh palette $= 2^2 = 4$ colors
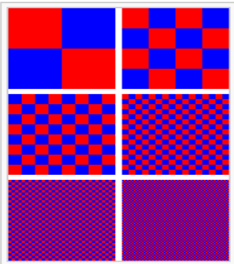
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GIF → Dithering

- Juxtaposing (place side by side) pixels of two colors to create the illusion that a third color is present (grainy look)
- **Example:**

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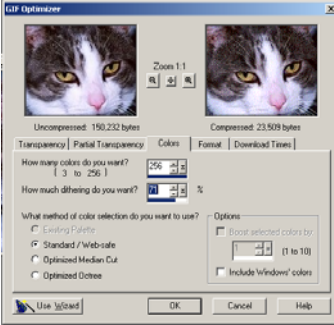## Another Example of Dithering

An illustration of dithering. Red and blue are the only colors used, but as the pixels become smaller, the patch appears violet.

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GIF → Dithering

- You can reduce the number of colors in a GIF and choose options to control the way colors dither in the application or in a browser.

Different ways to dither produce different results

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GIF → Dithering

← Original Image

Dithering, used 64 colours to make the differences show up more to the naked eye!

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GIF → Interlacing

- How images are downloaded to your screen
- Interlacing lets you have a feel for the whole picture, you don't have to wait around to see it download (good for dial up connections)
- a process by which the image is drawn in a series of passes rather than all at the same time (file size bigger)
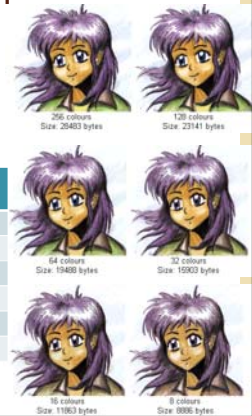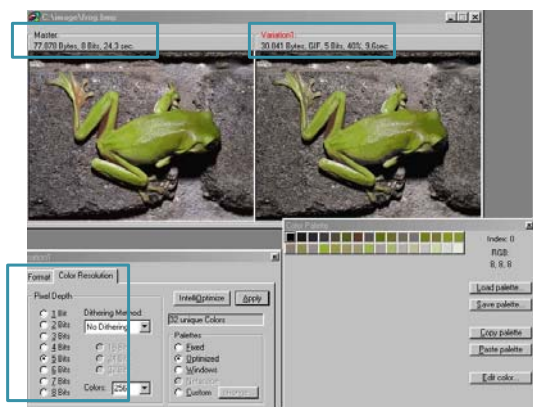

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GIF → Compression

- Can compress more by reducing the number of colours in the image:

Colour Resolution	Size (KB)	% Decreased
256	28,483	
128	23,141	19
64	19,488	32
32	15,903	44
16	11,863	58
8	8,886	69

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GIF

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## JPG (JPEG) – Joint Photographic Experts Group

- Widely used on the World Wide Web
- Cross Platform (works on Macs, Windows)
- Supports 24 bit colour
  - **Question**: How many colours can you have in a JPG file if it allows for 24 bit colour?
- Great for photographs
- Larger file sizes than GIFs BUT allows for a **full colour scheme!**

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JPG

- Good for photographs, computer games, screenshots, stills from a movie, etc
- Best for blends of color, softer shadow effects, subtle changes in color
- **Not** good for well-defined lines or sharp contrasts between colours
- **Question**: Guess which one is the GIF and which one is the JPG:
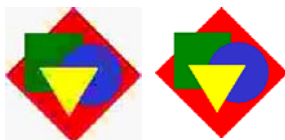
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JPG

- Notice what happened to Homer when his original GIF was resaved as a JPG:


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JPG

- JPG does a **lossy** compression
  - Discards more data about colours than about brightness
- Not all of the information in the original image is preserved – not the same as the original
- Degrades the image quality
- Compression is achieved by 'forgetting' certain details about the image, which the JPG will then try to fill in later when it is being displayed
- Degree of amount of information LOST (lossyness) can be varied by adjusting compression parameters. (controlled by you)
- Because image data is lost with each compression, work with the image in native format, and when ready with final product, save it as a .jpg file

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JPG

Original → 0% Compression = 100% Quality
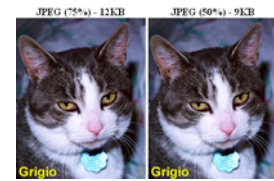
- Quality of image is inversely proportional to amount of compression
- A higher image quality setting (has a lower compression value) results in less data being discarded.
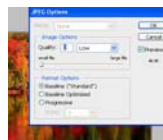
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JPG

Can you tell which image was saved with low quality, high compression in Photoshop?

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JPG

- No Transparency
- No Animation
- No Interlacing
- No dithering (**Question**: why no dithering?)

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PNG

- Pronounced PING
- Created specifically because of licensing issues with GIFs in the 90s
- Does LOSSLESS compression
- Three versions of PNG
  - PNG-8
  - PNG-24
  - PNG-32

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PNG-8

- Similar to GIF
- Only allows for 256 colours
- Allows for 1 transparent colour
- Storing of colours is more efficient in PNG files than GIFS thus PNG-8 files might be SMALLER than their GIF counterparts (this is software dependent)

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PNG-24 (and PNG 32)

- Allows for 24 bit colour
- It is LOSSLESS
  - **QUESTION: If I take the same image and save it (same quality level) as JPG file, then as a PNG 24 file, which file size will be smaller? (keep in mind that jpgs are lossy and pngs are lossless).**
- Allows for transparency on each pixel, with different levels of opacity:
- PNG 32 allows for a full palette with full transparency but with PNG 24 if you want varying levels transparency, you will lose some colours

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Comparison of GIF, JPG, PNG

	GIF	JPG	PNG-8	PNG-24/PNG-32
Best For	Logos, Cartoons, Drawings	Photographs	Logos, Cartoons, Drawings	Photograph Images with a need for transparency
Type of Compression	Lossless	Lossy	Lossless	Lossless
Well Supported in Browsers	All	All	All	Not on IE6
Transparency	One COLOUR only	NO	One COLOUR only	Varying levels of opacity and transparency
Animation	Yes	No	No	No
Dithering	Yes	No	Yes	No
Interlacing	Yes	No	Yes	Yes
Shape of image		Must be rectangular		

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File Size Comparison

Name	Size	Type	Dimensions
polarbearinwater.png	72 KB	PNG Image	200 x 200
polarbearinwater200by200_10Colours.gif	3 KB	GIF Image	200 x 200
polarbearinwater200by200_64Colours.gif	17 KB	GIF Image	200 x 200
polarbearinwater200by200_16Colours.gif	7 KB	GIF Image	200 x 200
polarbearinwater200by200_256Colours.gif	29 KB	GIF Image	200 x 200
polarbearinwater200by200LowestQuality.jpg	25 KB	JPEG Image	200 x 200
polarbearinwater200by200HighestQuality.jpg	58 KB	JPEG Image	200 x 200
polarbearinwater.raw	118 KB	RAW File	

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Things to think about when working with images:

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Nice Review

- https://www.youtube.com/watch?v=15aqFQQVBWU

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