Warm up Question:

- **Question**: 8-bit indexed colour uses 256 colours.
  - True
  - False
- **Question**: Vector images look good even if you resize them to make them bigger.
  - True
  - False
- **Question**: How many different colours will 6 bits allow for (a 6 bit colour depth)?

Computer Science 1033 – Week 5

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

Overview of Today's Topics

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

Reading for this week from our online textbook:

- Graphics → Image Formats and Compression Techniques

Announcements

- Poster Assignment
  - Due THIS Friday!!! Get it handed in by Thursday, make your life less stressful ☺
  - Remember that the t.a.s have till Feb 18th to mark the assignments, don't email me till then if yours is not marked.
  - TA have consulting this week in MC16a, schedule is in OWL.
  - You will lose 15% if you did not submit correctly in OWL. MAKE SURE YOU SAVE THE EMAIL TO PROVE YOU SUBMITTED, we will NOT give you this mark back without the email even if your assignment was up on Panther BEFORE the due date.

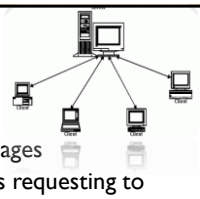
Announcements

- Handing in Assignment is 2-part:
  - Part 1: Uploading to panther.uwo.ca via WinSCP
  - Part 2: Submitting the links and references via Owl
- Video of how to hand it in:
  - http://www.csd.uwo.ca/~lreid/cs1033/howtohandinassignment1/SubmissionVideos.html

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!

Servers vs. Clients



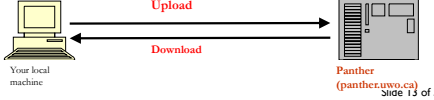
- **Web Server** → a computer that delivers (serves up) web pages
- **Client** → the computer that is requesting to see/visit the web page.
- Many clients will visit one web server, for example 20,000 students might visit Western's web server to see the page: http://www.uwo.ca
- We will put/post our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

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

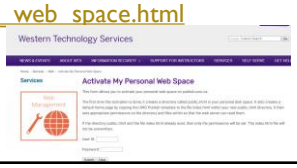
Web Server at Western

- We will use 2 different Western Web Servers
  - *panther.uwo.ca (poster assignment)*
  - *cs1033.gaul.csd.uwo.ca (web & major assign)*
- Panther will be hosting (holding) our jpg image and our .afphoto file.
- We will create/edit/work with the web pages on our local machine and then upload them to panther to see them on the internet



Creating an area for our web pages

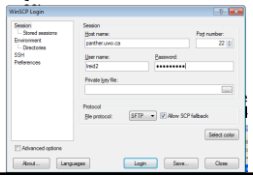
- Each student needs to initiate a folder called *public_html* to hold his/her web pages and images. This folder is created automatically at Western by visiting the site: (YOU ALL SHOULD HAVE DONE THIS IN LAB 1) https://wts.uwo.ca/services/web/activate_my_personal_web_space.html



Slide 14 of 54

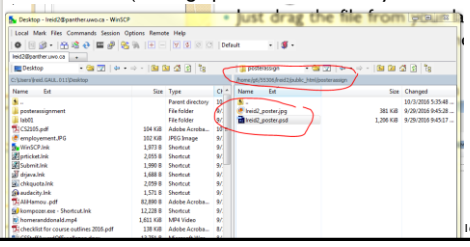
Uploading our Web Pages to Panther

- Upload by using a File Transfer Protocol program such as:
  - WinSCP
  - FileZilla
  - WS-FTP
  - Fugu (for Mac)
- Log on to the Web Server, Panther, by select Secure File Transfer Client, click on the Quick Connect button and entering the following
  - panther.uwo.ca
  - Your userid
  - Your password
  - Port 22 (should be default)



Using WinSCP

- Create a folder inside the folder *public_html* called *posterassign*
- Then drag the files from your laptop/lab machine to your *posterassign* folder inside of *public_html* folder on the machine: *panther.uwo.ca*
- Then you might have to set the permissions on your files and folders (although permissions will likely be set already)



16 of 54

Double check that it worked:

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

Slide 17 of 54

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: FTP to panther.uwo.ca
- Step 4: create a folder called *posterassign*
- Step 5: move the .psd and .jpg files into *posterassign* folder
- Step 6: using IE (Chrome, Safari or Firefox) double check that you can see your jpg

Slide 18 of 54

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 Owl and go to Poster Assignment
- Step 10: Copy the information in the .txt file into the *Assignment Text* box in Owl for Poster Assignment
- Step 11: Press the Submit button
- Step 12: SAVE the email that Owl sends you to prove you handed in the assignment.

YOU'RE DONE!

NEED A REMINDER, GO TO → http://www.csd.uwo.ca/~lreid/cs1033/howtohandinassignment1/SubmissionVideos.html

Slide 19 of 54

Announcements

- Hints for Assignment 1 (Poster Assignment)
  - Hints for marking:
    - Have all required items
    - Have something clever/eye catching
    - Don't touch the edge of the posters/shape with text
    - Have white space (don't be too verbose)
    - Make sure text is easy to read
    - Make sure images aren't skewed and make sense
    - Pick good colours and have it looking "professional" (remember CRAP!)
    - Make sure you have that EMAIL from OWL!!!!

Hints on the marking of assignment

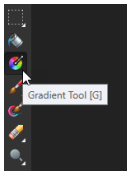
- Follow the instructions carefully, for example:
  - you get 2 marks if you named your files as stated in the instructions!
  - If you get a mark for every requirement we ask for.
- DON'T Collapse your layers
- Name your layers with good names
- Check for spelling
- Text:
  - Contrast
  - Edges
- Images
  - Crisp
  - Appropriate
- Colours
- Professional looking – remember CRAP

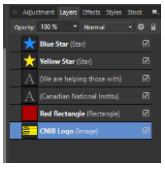
Poster Assignment Tips

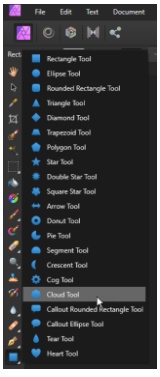
- Follow the instructions carefully. Just by following the instructions, you can get a good mark for this assignment!
- Check that you have all the required criteria such as a shape from the shape tool.
- Check that you named all your files EXACTLY as we indicated.
- Make sure you picked good layer names
- Remember to follow the CRAP rules!
- Other tips
- Colour Choices → https://kuler.adobe.com/ and http://design-seeds.com/

Hints on Assignment

- Use the shape tool to create:
  - A shape, you can use the custom shape tool
  - Give the shape a good name, don't collapse the layers





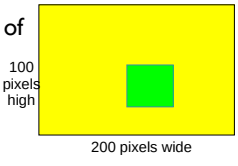


How Does Compression Work?

- 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?**

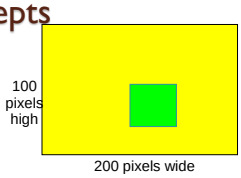
Compression for images with large blocks of the same colour

- 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



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

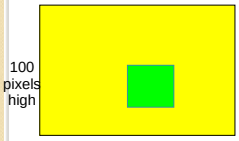



```
#FFFF00
#FFFF00
#FFFF00
#FFFF00
#FFFF00
…
#FFFF00
#00CC99
#00CC99
…
#FFFF00
```

YellowWithGreen.raw

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



Compression Concepts

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

Other Compression Ideas

- Looks for patterns, for example: 123451234512345
- If "1" represents pattern 12345, compresses it to "111"
- Build a decoding hash table
  - 0 13245
  - 1 12345
  - 2 23423
  - 3 11223

Pattern:
`132452342312345112232342 3`
Based on table will map to
`02132`

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

- **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?**

- ASCII code
- Huffman code
- see
- zoo

Slide 32 of 54

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

Slide 33 of 54

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=Jcgg7jq1W3o&list=PLQMVnqe4XbictUtFZK1-gBYvyUzTWJnOk

Slide 34 of 54

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?

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

Slide 36 of 54

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

Slide 37 of 54

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!

Slide 38 of 54

GIF

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

Slide 39 of 54

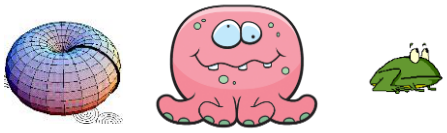
One Colour Transparency

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

GIF → Transparency

GIF → Animation

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



Slide 41 of 54

GIF → Dithering

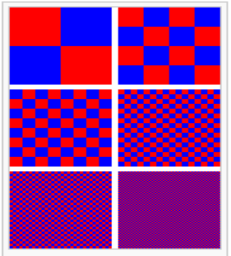
- Allows for ***dithering***:
- **Question**: What do you think a program, that converts images into gifs does, if the image has more than 256 colors?
  - **Solution 1**: Substitute one of the colors you have for one of the colors you are missing
  - **Solution 2:** Any guesses?
    - **HINT:** What 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

Slide 42 of 54

GIF → Dithering

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

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.

Slide 44 of 54

GIF → Dithering

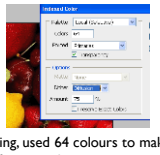
- You can reduce the number of colors in a GIF and choose options to control the way colors dither in the application or in a browser.

Different ways to dither produce different results

Slide 45 of 54

GIF → Dithering

← Original Image

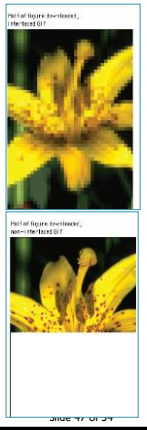


Dithering, used 64 colours to make the differences show up more to the naked eye!

Slide 46 of 54

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)

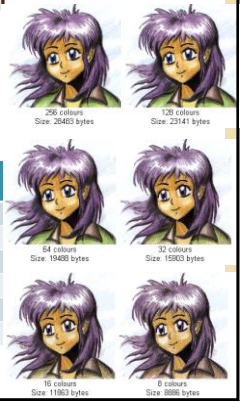


Slide 47 of 54

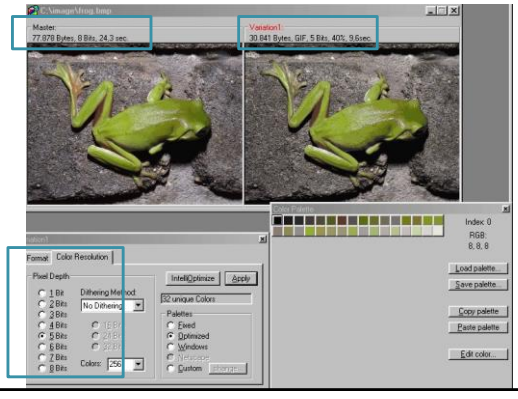
GIF → Compression

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

Colour Resolution	Size (KB)	% Decreased
256	28483	
128	23141	19
64	19488	32
32	15903	44
16	11863	58
8	8886	69



GIF



Break

- A cute commercial from a Superbowl (A Canadian one!)
  - https://www.youtube.com/watch?v=yXFKPcEfigk
- A freaky painting → http://www.youtube.com/watch?v=d6egUsZvWu4
- Do your review sheet!

Review Sheet

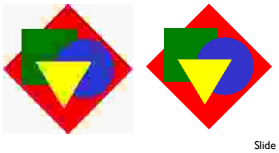
- http://www.csd.uwo.ca/~lreid/cs1033

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!**

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:



JPG

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

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

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.

Slide 56 of 54

JPG

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

Slide 57 of 54

JPG

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

Slide 58 of 54

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

Slide 59 of 54

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)

Slide 60 of 54

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

Slide 61 of 54

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		

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	

Slide 63 of 54

Things to think about when working with images:

Nice Review

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

Slide 65 of 54

Review

- **Question**: How big will an image be in terms of bytes if it is uncompressed, true colour and 200 by 400 pixels?
- **Question:** What type of compression doesn't lose any of the original information about the image?
- **Question**: Which type(s) of file formats perform a lossless compression?
- **Question** JPGs will produce a smaller file size than PNG 24 for a photograph: TRUE OR FALSE

Slide 66 of 54