Topic support guide

Cambridge International AS & A Level

Cambridge International AS & A Level Information Technology

9626

For examination from 2017

Topic 16 Graphics creation

Cambridge Advanced

CAMBRIDGE International Examinations

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Version 1.1

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Introduction

How to use this guide

The aim of this guide is to facilitate your teaching of Cambridge International AS & A Level Information Technology, syllabus topic 16, Graphics creation. The guidance and activities in this resource are designed to help teachers devise programmes of study for graphics creation that provide teaching time devoted to theory work and opportunities for practical exercises.

Learning objectives

After reading this guide you should be able to teach the following learning objectives:

16.1 Vector images

- create a vector image that meets the requirements of its intended application and audience
  - use layers to overlap items
  - use grouping or merging tools
  - use rotation and place an item
  - use transform tools to resize
  - use selection tools to select parts of an image
  - use crop tools to crop part of an image
  - use fill tools to colour items
  - use colour gradients
  - use node editing
  - fit text to a path
  - save an image in different file formats
  - compress an image to different resolutions using file formats (including: .jpg and .png) to suit different media file size requirements

16.2 Bitmap images

- create a bitmap image that meets the requirements of its intended application and audience
  - use layers to overlap items
  - use rotation and place an item
  - use grouping or merging tools
  - use selection tools to select parts of an image
  - use crop tools to crop part of an image
  - use masking tools
  - use tools to improve parts of an image (including: blend, replicate, retouch)
  - use tools to remove red eye
  - use filters (including: blur, distort, sharpen)
  - convert between colour, duotone and black and white images
  - use colour gradients
  - resize an image
  - resize the canvas
  - change the opacity of all or part of an image
  - use text tools to include text
  - save an image in different file formats
  - compress an image to different resolutions using file formats (including: .bmp, .jpg, .png, gif to suit different media file size requirements)
- describe the difference between a bitmap and a vector graphic
- describe how typical features found in bitmapped and vector graphics software are used in practice
- evaluate their suitability for a given scenario

- evaluate the impact of image editing on society (including: media, advertising, fashion, shopping, politics, entertainment).

Prior knowledge and preparation

Before you begin teaching this topic:

- make sure that you know how to scan photographs or import photographs from a digital camera
- have a basic understanding of graphics software
- make sure that you have access to graphics packages such as Adobe® Illustrator® and Photoshop® or Inkscape™ and GIMP©.

1. Key terms

Word/phrase	Meaning
bitmap graphics	Graphics that are defined by a matrix of pixels, each of which can be a different colour.
compression	The re-encoding of data into a format which uses fewer bits of information than the original. This can speed up loading and transferring the file, and reduce the amount of memory it takes up on your computer.
lossless compression	Compression of a bitmap graphic which removes repeating patterns of data, but allows the original data to be exactly reconstructed from the compressed data.
lossy compression	Compression of a bitmap graphic which uses approximations to remove and discard data within a graphic that is unlikely to be noticed.
meta-graphics	Images containing a combination of bitmap and vector data.
node	An editable point on a line or vector which can be selected, transformed and moved.
pixel	Single unit / picture element of a bitmap graphic – a single coloured dot. Short for 'picture element'.
pixellation	When a bitmap image is enlarged so much that you can start to make out the individual pixels from which it is made. Edges and details lose their sharpness and the whole image can appear blurry or blocky.
rasterisation	Conversion of a vector graphic to a bitmap graphic (at the native resolution of the display device) so that the vector can be viewed on a display.
resolution	The amount of detail in an image, which is dependent on how many pixels it contains. Measured in Megapixels, dpi, ppi, or pixel dimensions.
resolution independent	Graphics which are redrawn, when moved or scaled, at the native resolution of the display or output device (this applies to vector graphics).
run length encoding	A data compression algorithm, that is supported by most bitmap file formats, which reduces the physical size of a file by encoding a run of repeating characters in the file into two bytes. The first byte is the run length - the number of repeating characters. The second byte is the repeating character or value. So the 5 byte run 'AAAAA' could be represented in two bytes as '5A'.
tracing	Conversion of a bitmap graphic into a vector graphic.
vector graphics	Graphics that are defined by mathematical descriptions of lines and shapes.

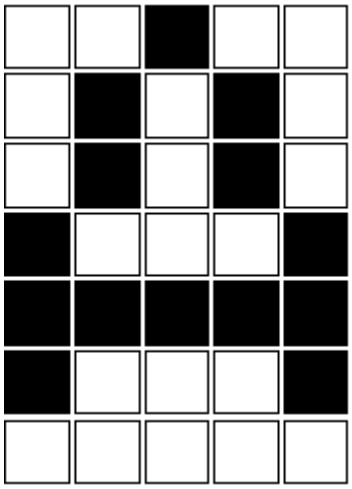
2. Theory

2.1 Introduction

Bitmap and vector graphics are two different types of images used in both print and digital display. Although there are many occasions where the content of vector and bitmap graphics can overlap or appear to be the same, they are very different in terms of their data storage and image representation, which have distinct properties and purposes.

2.2 Bitmap graphics

Bitmap graphics are basically an image file which is made up of very small dots (pixels), each of which can be a different colour. With enough pixels all combined together, a person viewing it will see a picture (an image). The bitmap format is very effective at representing images which are reflective of the real world – for example, photographs.



The image above is an example of a bitmap. In the early days of image creation, a graphic could only be displayed in monochrome (black and white). To represent an image, the computer simply switches pixels on and off, each pixel being a single bit. In the image, the letter 'A' is represented by turning off some pixels (bits) and leaving others on, creating a map. In terms of a bitmap this is represented by:

1	1	**0**	1	1
1	**0**	1	**0**	1
1	**0**	1	**0**	1
0	1	1	1	**0**
0	**0**	**0**	**0**	**0**
0	1	1	1	**0**
1	1	1	1	1

The 0s in this example have been highlighted simply to make them more obvious. This example would be used on a monochrome screen which is displaying black text on a white background. To display white text on a black screen, the bits are reversed.

Using a bitmap like this makes the representation of data in terms of an image very simple, however monochrome graphics are not the most visually appealing.

Modern screens and computer systems can display many more colours, however the principle is still the same. Rather than only using a single bit per pixel to create the map, more modern

graphics use more bits per pixel. The increased number of bits allows more data per pixel so that an increased number of colours per pixel can be represented. Colour on a computer screen is generated by combining varying levels of red, green and blue, called ‘channels’, therefore when representing a colour image, the number of bits available per pixel must be split equally into three – an equal amount of data being given to each channel.

Number of bits per channel	Number of colours
1	2 (black and white)
2	4
3	8
4	16
5	32
6	64
8	256
12	4096

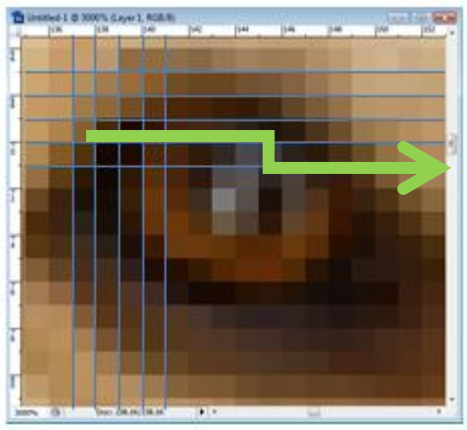
Modern computer screens don’t normally refer to the number of bits per channel, but combine the three channels together to give a total number of bits per pixel. For modern computer images this is often 24 bits – 8 bits per channel x 3 channels (Red, Green, Blue).

Number of bits available for Red channel	Number of bits available for Green channel	Number of bits available for Blue channel	Combined number of bits per pixel
8	8	8	24

Total number of different reds that 8 bits can represent	Total number of different greens that 8 bits can represent	Total number of different blues that 8 bits can represent	Combined number of colours per pixel
256	256	256	16.7M (256 x 256 x 256)

Having more bits per pixel means that you can display a greater number of colours per pixel (the ‘colour depth’) which means that an image can look more realistic. The image is still just a map of bits, however, and if you zoom into it you will see that map – all of the individual pixels shown as individual dots on the screen, each one represented by a set amount of data.

This can be demonstrated if we zoom into the eye of the dog image and look at one individual pixel, producing an effect called pixellation.



Red channel level	Green channel level	Blue channel level
215	75	170
11010111	01001011	10101010

If we look at one individual pixel and ask a graphics application such as Adobe Photoshop to give us the exact Red, Green and Blue (RGB) values for that pixel, it will show us that the pixel highlighted above has a value of R215, G75, B170. Each of these values is 8 bits of binary (1 byte). When combined together this adds up to 24 bits needed to represent the individual colour for that pixel.

2.3 Resolution

The 'resolution' of an image can have various meanings. A high resolution image can simply mean that it is physically big – a large number of pixels. A good example of this would be a high resolution digital SLR camera. A 12.1 megapixel camera, for example, takes images that are 4000 by 3000 pixels which might be called high resolution. However, to be more meaningful, the number of pixels needs to be combined with a value of measurement over which those pixels (dots) are placed. The measurement value typically used is an inch. A 300 dots per inch (dpi) image has 300 pixels (dots) in a line taking up 1 inch on the page. A 100 dpi image has 100 pixels (dots) in a line taking up 1 inch on the page. At these resolutions the naked eye may not be able to discern the difference between them, but technically the 300 dpi image is of a higher resolution than the 100 dpi image. Taking this into consideration, describing a camera of 12.1 megapixels as high resolution isn't strictly true: it depends on the final resolution in terms of the dpi at which the image it creates is being displayed.

2.4 File size

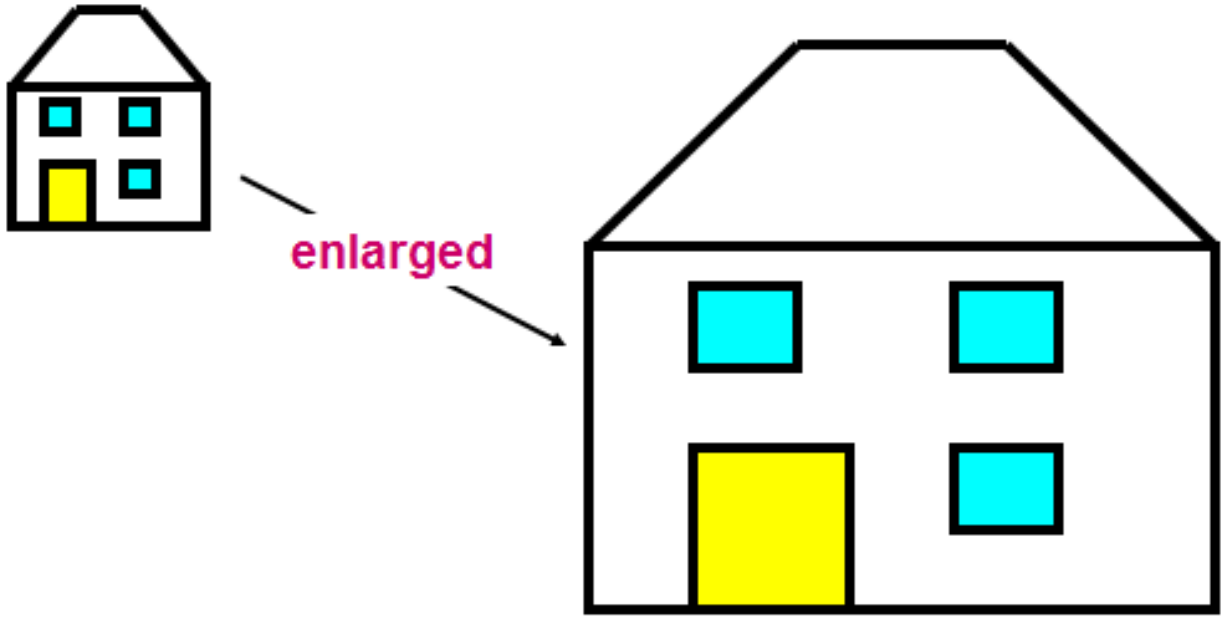
Since a computer has to store information about every single pixel, the file sizes of bitmap images are comparatively large, meaning they take up more storage space on the computer, and can take longer to load when you want to view or edit them. They can be compressed to make file sizes smaller, but this is often at the expense of some of the pixel data, which means the image will lose quality and could appear "blocky".

2.5 Vector graphics

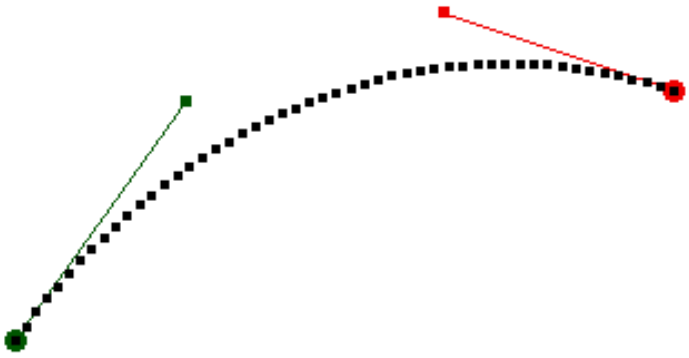
Vector graphics work in a completely different way to bitmap graphics. Rather than being a map of bits representing which pixel is switched on and which is not, and for those switched on, what colour they represent, a vector graphic is a mathematical description of an image. Vector graphics are made up of lines and shapes combined together to form an image. The coordinates of these lines and shapes are all stored as mathematical data: start and end points to lines, their thickness and the colour. The start and end points of each line are called 'nodes'. The values for these nodes – the mathematical position of them within the image – are described by a relative distance from the origin – for example the top left hand corner of the image. This way, when the image is being drawn on the screen, once the computer knows the position of the origin on the screen (set by where the user places the image), all the other points can be calculated. To draw a line on the screen, the computer only needs to know the start point, end point, colour and thickness of the line

– it can then work out all of the points in between and draw the line. This significantly reduces the file size needed for an image. Whereas in the bitmap image of the dog in section 2.2 each pixel requires 24 bits of stored data, with a vector image the computer calculates each pixel relative to the start, end, colour and thickness data meaning that significantly less data needs to be stored.

An additional advantage of vector graphics is that the lines and shapes can be scaled and grouped very easily. When a vector image is scaled, all the points are recalculated relative to the origin and value of the scale and then redrawn on the screen or page. This means a vector image will always stay smooth regardless of how much it is enlarged.



Vector images do not only use straight lines – they can also use ‘Bezier curves’ to represent curved lines:



In the above image a curved line is represented by four nodes: the green node on the left is the start of the line; the red node on the right is the end of the line; the two nodes in the middle of the image are ‘Bezier handles’ which ‘bend’ the line. A good way to explain this is to imagine that these handles are like magnets. The line is drawn starting from the green end node, but is first attracted towards the green handle node and then attracted towards the red handle node before finishing at the red end node.

Moving the handle nodes will bend the line in different directions. As each node and handle is a mathematical value relative to the origin, the line will always remain smooth regardless of how you move the nodes, because the position is recalculated and the line redrawn each time. This means that vector graphics are referred to as being ‘resolution independent’: the resolution of the device

displaying or printing them doesn't matter because the graphics are recalculated and redrawn each time they are scaled, moved or displayed and that redraw is at the resolution of the displaying (or printing) device. Vector graphics are very effective for representing line art images such as logos.

2.5.1 Why don't we use vector graphics for everything?

Put simply, vector graphics don't work as efficiently when an image contains a lot of data.

Looking at the examples of bitmap and vector images above, the vector image on the right is made up of simple lines and shapes. Each line requires stored data for the start and end points, thickness and colour. The bits in between each of these points are calculated at the time of display. The bitmap image on the left[i] uses pixels and has data associated with each one. If you tried to represent the left hand image as a vector, almost every individual pixel would need to be represented as one line, because of the image's complexity, with data to store its start point, end point, thickness and colour. This is considerably more data per pixel than just the RGB value, making it much less efficient.

It is possible using programs like Adobe Illustrator or CorelDraw to convert a bitmap image to a vector (known as 'tracing'). This does a reasonable job of converting each pixel into vector data by using a threshold to choose how close the RGB values of adjoining pixels need to be in order for the computer to view them as 'the same' and therefore create a shape rather than trying to create a single line per pixel. The threshold value set when the trace is performed will affect how good the trace is in terms of image detail.

2.5.2 Why can vector images look 'blocky' on the screen?

This can be answered using the information on resolution in section 2.3 above. A screen is a bitmap display device; it uses pixels (dots). The resolution of a screen is described partly by the size in terms of pixels (for example 1024 pixels by 768 pixels), but also in terms of the number of dots per inch (dpi). Screen technology has improved from 72 dpi, typical of cathode ray tube monitors, to around 300 dpi used in Apply Mac Retina displays. On a lower resolution screen, with a lower dpi, you can see the dots. A vector image is drawn on the screen (this is called 'rasterised') at the resolution of that screen. On a lower resolution screen, you will see dots in the rasterised vector graphic.

2.6 How are vector and bitmap graphics used in practice?

Because of their different qualities, vector and bitmap graphics are used for different purposes. A vector graphic, represented by lines and shapes, is more suitable for 'simpler' images such as maps and logos which are typically bold, simple and striking. (The word 'simple' is used here to describe the complexity of the image detail and not the aesthetic appeal of the image). Bitmap images are used whenever there is a need for an image to show a realistic representation of something in the real world, for example a photograph. The two types of graphics are often used in combination, for example a vector logo over the top of a bitmap photo, to gain the benefits of each graphics format.

3. Graphics creation tasks

3.1 Vector images

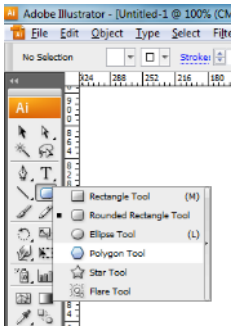
To demonstrate different tools in vector applications, an effective way is to draw a repeating symmetrical shape which primarily uses straight lines. A good example of this is a snowflake. This example will enable you to draw a snowflake and then place it onto a gradient background with text to create a greetings card.

3.1.1 Use node editing

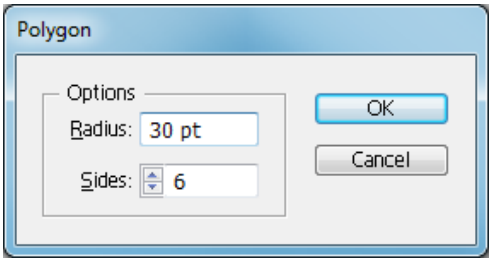
Adobe Illustrator

As explained in section 2.4, vector graphics are made up of lines and shapes which in turn are made up of nodes. The hexagon in the graphic above is just six nodes with the mathematical instruction to draw a joining line between them. The line on the right is the same, but only needs two nodes. This is going to be the basis of our image.

Click and hold on the ‘Shape’ tool in the toolbar on the left and select ‘Polygon Tool’

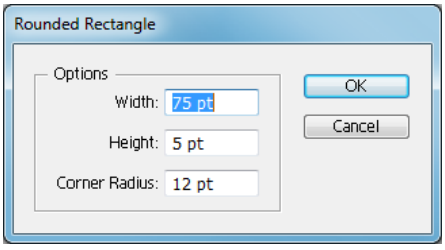


Click in the middle of your page. This will display the options for a Polygon. Set the Radius to 30 and the Sides to 6. Click OK to draw your polygon. In the path bar at the top of the screen, set the Stroke to 10. This will thicken up the line.



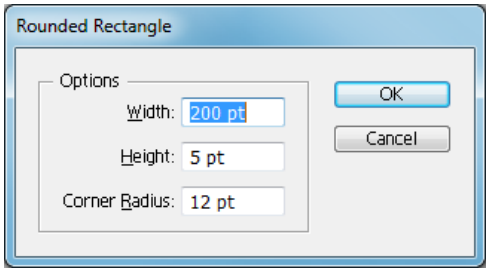
Click and hold on the ‘Shape’ tool again and select ‘Rounded Rectangle’.

Click on the right hand corner of your polygon. This will display the options for a rounded rectangle. Set the Width to 200, the Height to 5 and the Corner Radius to 12.



With ‘Rounded Rectangle’ selected, use the cursor keys to shuffle it into place on the edge of the polygon, so you get something similar to the image on the right:

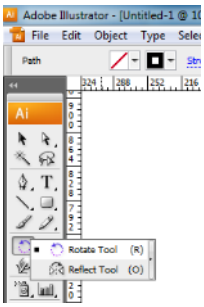
Click on the ‘Shape’ tool again in the main toolbar and then click to put another, smaller, rounded rectangle onto your page, but this time with a Width of 75, Height of 5 and Corner Radius of 12.



3.1.2 Use rotation and place an item

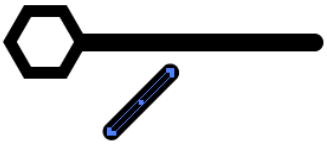
Adobe Illustrator

In the main toolbar, click and hold on the Rotate Tool and make sure that ‘Rotate Tool’ is selected.

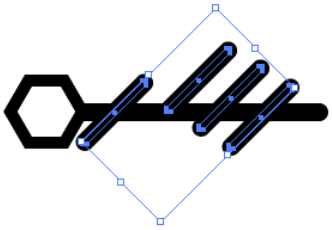
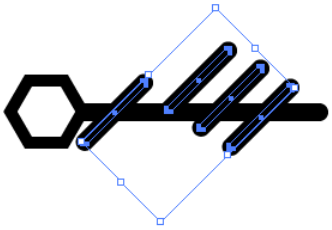


Hold down the ‘Shift’ key on the keyboard and then click on the smaller shape you have drawn and rotate it round by one step. You should have something which looks similar to the image on the left below.

Now use the cursor keys to shuffle the smaller piece into place so that it looks similar to the image on the right.

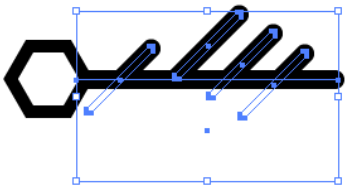


3.1.3 Use selection tools to select parts of an image

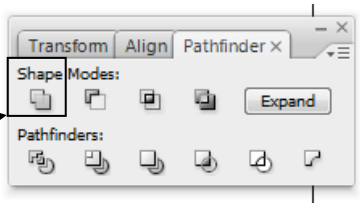
Adobe Illustrator

Copy and paste the smaller shape three more times and use the cursor keys or mouse to shuffle them around into the pattern you want to have for your snowflake. Something similar to the image on the right produces a nice effect. The 'pattern' is only the bit which appears ON TOP of the line. In the next step we are going to cut off underneath the line. Select all four of your 'branches' by clicking on the first one, holding down 'Shift' on the keyboard and selecting the others.  

3.1.4 Use crop tools to crop part of an image

Adobe Illustrator

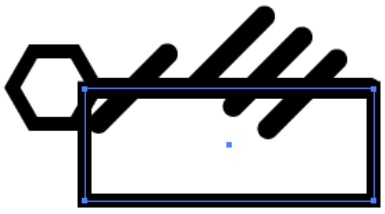


Click on the Windows menu at the top of the screen and select ‘Pathfinder’. This will display the Pathfinder menu.

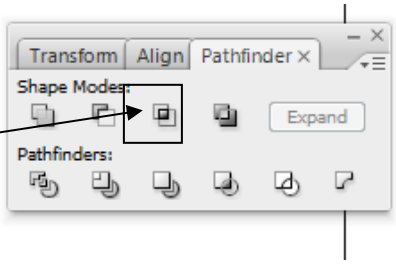


With the four branches still selected, click the ‘Unite’ button. This will combine the branches into one shape.

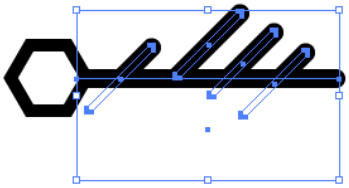
Draw a normal rectangle over the top of the lower half of your branches so it looks similar to the image on the right. You are going to use this to cut the branches. Make sure it covers the whole of your branches.



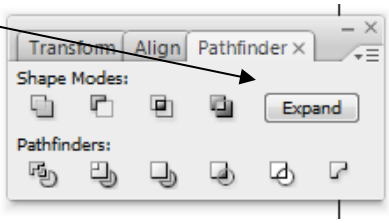
Make sure that your rectangle is selected, then hold down ‘Shift’ on the keyboard and select your branches. (Both the rectangle and the branches have to be selected for this step to work.) Click the ‘Minus Front’ button in the Pathfinder menu.



This will chop off the bottom half of the branches. It should now look a bit like a key.

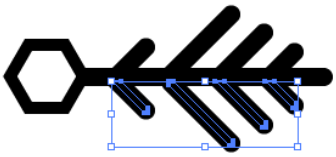


Make sure that the branches are selected, and click the ‘Expand’ button in the Pathfinder menu. Now we need to do the other side of the branch.

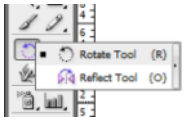


3.1.5 Use grouping or merging tools

Adobe Illustrator

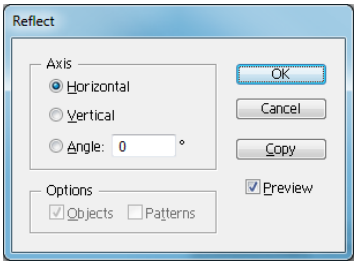


Click and hold on the Rotate Tool in the toolbar and select ‘Reflect Tool’.

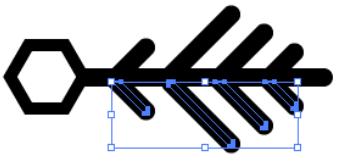


Hold down the ‘Alt’ key on the keyboard and click on the branches of your snowflake.

Make sure that the ‘Horizontal’ option is selected and then click ‘Copy’. (Just clicking ‘OK’ will not make a duplicate.)

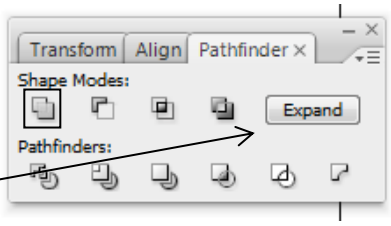


Use the cursor keys to shuffle the lower branches into place underneath the top ones. You should have something similar to the image on the right.



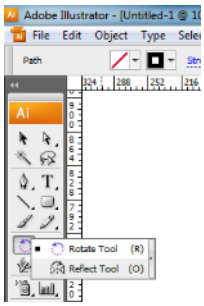
Hold down ‘Shift’ on the keyboard and select the upper branches AND the original rounded rectangle that you made (this can be a little tricky to do). Make sure you DON’T select the polygon.

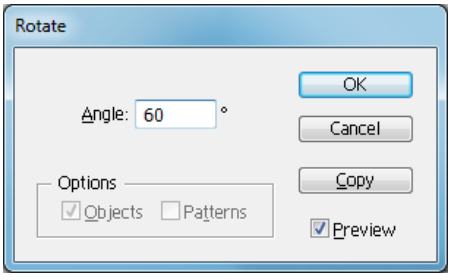
Making sure that you have got all three parts selected, click the ‘Unite’ button in the Pathfinder menu.
Then click the ‘Expand’ button to build the shape.



When you click on your branch now you will see that it is all one shape which makes it easier to work with.

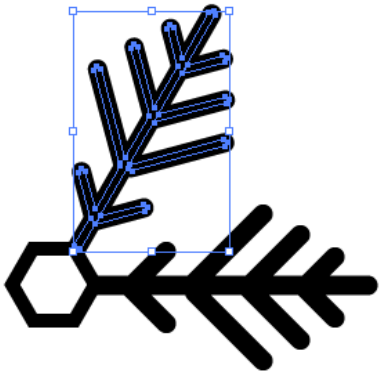
Click on the Rotate Tool in the main menu and then hold down the ‘Alt’ key and click on the branch you just made. In the Rotate menu, put Angle to ‘60’ and click ‘Copy’. This will make a copy of your branch, but rotated for the next corner in the polygon. Repeat this process until all six corners are done. Use the mouse and cursor keys to shuffle the branches into place.





You should now have a finished snowflake!

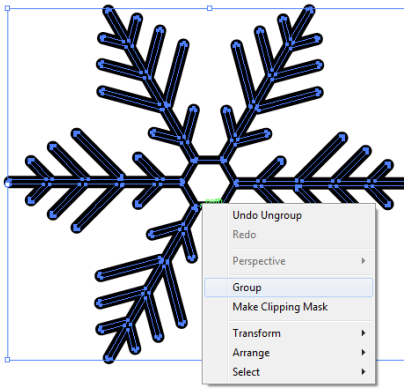
You can use the same technique for drawing trees and other decorations.



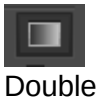
3.1.6 Use colour gradients and use fill tools to colour items

Adobe Illustrator

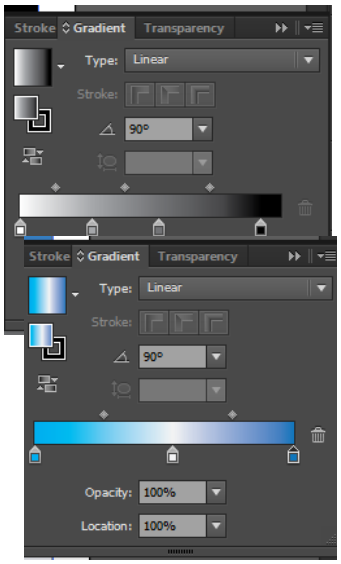
Now it is time to put our snowflake over the top of a wintery background. Click on the Selection menu and choose ‘Select All’. This will select all of your snowflake. Then right click and choose ‘Group’ to combine your snowflake into one object. This will make it easier to work with.



Click on the Rectangle Tool in the toolbox on the left hand side of the screen (keyboard shortcut: M) and draw a box over most of your page. This will become the background.



Double click on the Gradient Tool in the toolbox on the left hand side of the screen (keyboard shortcut: G). This will display the Gradient tab. Change the ‘Type’ to ‘Linear’ and the ‘Angle’ to ‘90’. This will give us a top to bottom gradient.



Underneath the colour gradient rectangle in the middle of the tab you will see small colour boxes. These are the colours of the gradient. You can drag them around to change the main colour points of the gradient. If you double click on one of the small colour boxes you can change the colour selected at that point in the gradient.

Change the colours and positions to match the image on the right. The exact colour isn't really important if you prefer to use different colours.

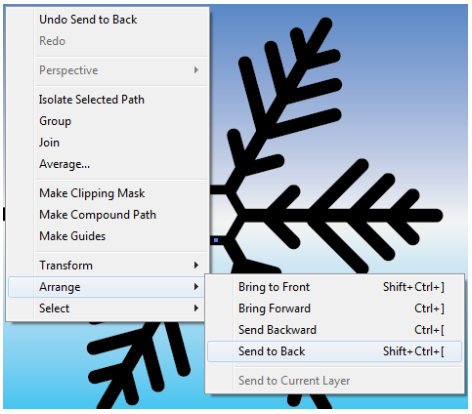
You should see that the box you drew earlier has changed to a colour gradient.

3.1.7 Use layers to overlap items

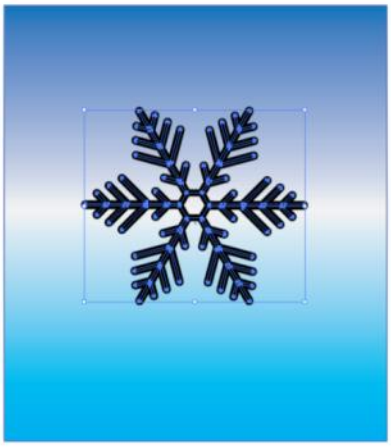
Adobe Illustrator

Select the rectangle you have just created and then right click on it. From the Context menu which appears, select 'Arrange' and then 'Send to Back'. This will put the gradient box behind the snowflake image.

Layers in vector graphics applications work in the same way as in other applications, with different images appearing on top of each other. You can use the Arrange menu to change the order of these in order to create the effect you need.



3.1.8 Use transform tools to resize

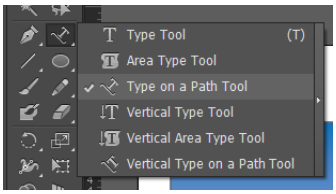
Adobe Illustrator

 To ‘Transform’ an object in Illustrator choose the Selection Tool in the toolbox on the left hand side of the screen (keyboard shortcut: V) and then click on your snowflake. Because you grouped it earlier on it should select as one object. Click and drag on the white ‘Select’ handle in the bottom right hand corner of the snowflake. If you hold down the ‘Shift’ key on the keyboard this will ensure that the object’s proportions stay the same. If you hold down the ‘Alt’ key at the same time, the scale will originate from the centre of the snowflake

3.1.9 Fit text to a path

Adobe Illustrator


Choose the Ellipse Tool in the toolbox on the left hand side of the screen (keyboard shortcut: L) and draw a circle above your snowflake. Hold down the ‘Shift’ key on the keyboard to ensure that the circle is uniform. Don’t worry that it fills with a solid colour – this will be corrected in a moment.

Choose ‘Type on a Path Tool’ from the toolbox on the left hand side of the screen. To select this, click and hold on the Type Tool in the toolbox to display the additional options.

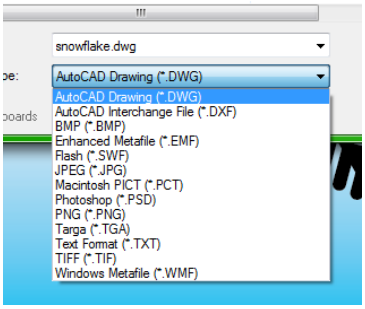


Imagining that your circle is a clock face, click on the edge of the circle at roughly the 9 p.m. mark. This will be where your text will start. Type in ‘Season’s Greetings’. This technique for typing on a path works with any shape. If the text does not line up as you expected you can rotate the circle using the Selection Tool to get the text to the angle you would like.

3.1.10 Save an image in different file formats

Adobe Illustrator

When you are happy with your greetings card you can save it as an Illustrator file. This will retain all of its editable nodes. Unfortunately, however, not many applications can open or use Illustrator files, therefore it may be useful to save the document in a different file format. To do this, click on the File menu and choose 'Export'.



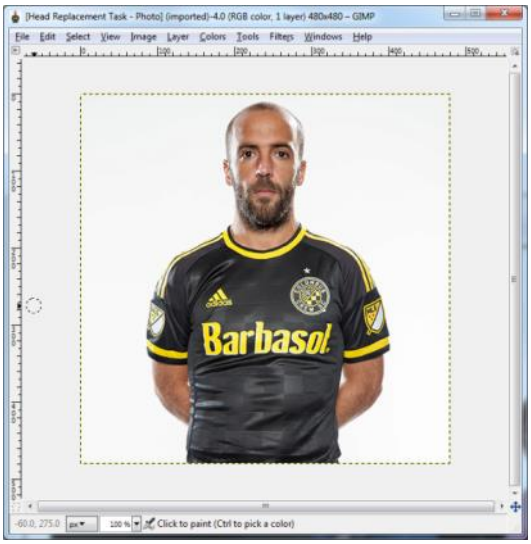
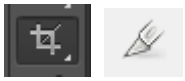
In the 'Save as Type' dropdown menu you have a number of different choices, depending on the destination of the image you have just created. A brief table of the advantages of disadvantages of some of the main formats is shown below:

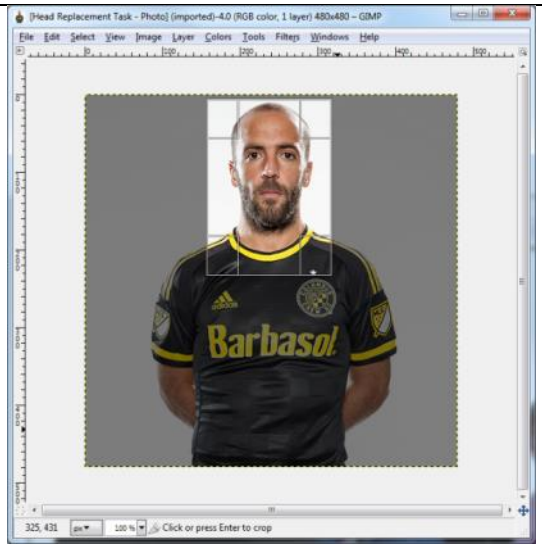
Format	Advantage	Disadvantage
.wmf / .emf	Very good, generic vector file formats which can be viewed by most Windows applications.	These formats are getting a little old and may not accurately represent more complex vector graphics.
.eps	Generic vector format, typically used for printing.	Some lower-end applications may not be able to open them.

3.2 Bitmap images

To demonstrate different tools using bitmap images, these tasks use the example of 'head replacement' – putting one person's head onto another person's body. This can be an excellent task for learners to undertake, especially if they have been allowed to take their own photographs as the source material. To use this idea, learners must first find a background image – the person they want to 'put their head onto' – for example bands, famous people, or cartoon characters. They must also take a photograph of themselves to use. To make the image most effective, they should attempt to match the angle and lighting of the original background image. This will make the final composition look more realistic.

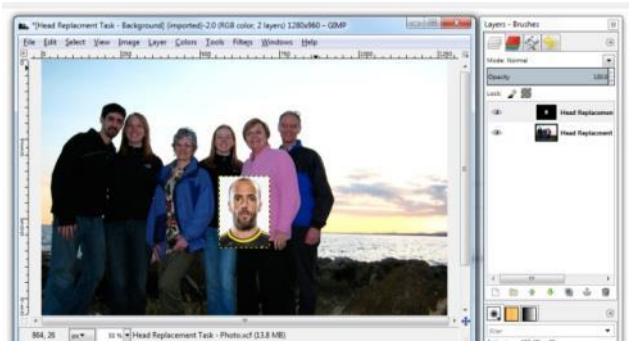
3.2.1 Use crop tools to crop a picture

Adobe Photoshop	GIMP
	
Shown here is our example head shot[ii]. The area around the outside of the photo is not needed and can be cropped from the picture using the cropping tool.  In Photoshop, click the Crop Tool in the toolbar on the left hand side of the screen (keyboard shortcut: C). In GIMP, click the Crop Tool in the toolbox (keyboard shortcut: Shift + C).	



Use the white handles to crop the image down to the area you need. Be careful not to crop too far and remove parts of the image which you still need. When you are happy with your crop, press the 'Enter' key on the keyboard to accept it. In GIMP you will need to save your file at this point under a new name so that it can be layered in the next task.

3.2.2 Use layers to overlap items

Adobe Photoshop	GIMP
	

Load the image that you want to place your 'head' onto (the example here is a group photo[iii]). At the top of the screen in Photoshop you will see tabs – one for each image which has been loaded. Click on your 'head-shot' image, choose 'Select All' from the Selection menu and then copy and paste your 'head-shot' image onto your 'group shot' image. This will use layers which are shown on the right hand side of the screen. To make your graphic easier to work with, you can rename your layers by double clicking on the current layer name.

In GIMP click on the 'File' menu and select 'Open as Layers' and then choose the image which you saved in the previous task.

An effective way of describing layers is to imagine that each one is a piece of acetate sheet placed one on top of another. The image at the top of the pile of sheets is the one you can see, and overlaps and obscures anything behind it. Where there is no image, you can see the layer underneath. In the above example you can see that the 'head-shot' does not take up the full width of the group shot image underneath it, therefore it overlaps and obscures only part of it. This means that you can create a multi-layer image using component parts. The benefit of this is that each layer is individually editable without being destructive to layers above or below, which makes editing more powerful.

3.2.3 Use selection tools to select parts of an image

Adobe Photoshop	GIMP
	

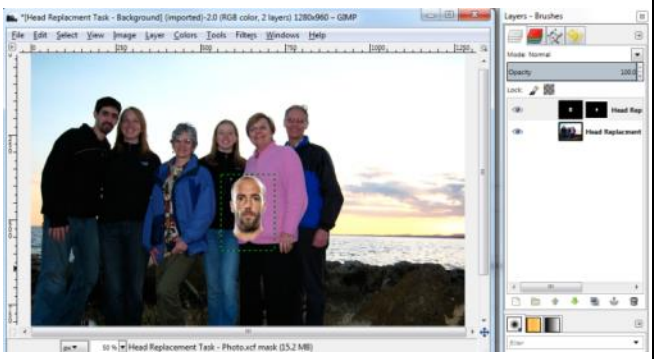
There are multiple selection tools in graphics applications to help you to select part of the image. These include 'marquee' tools (typically both round and rectangular) and 'lasso' tools (typically freeform, but can also be polygonal and magnetic).

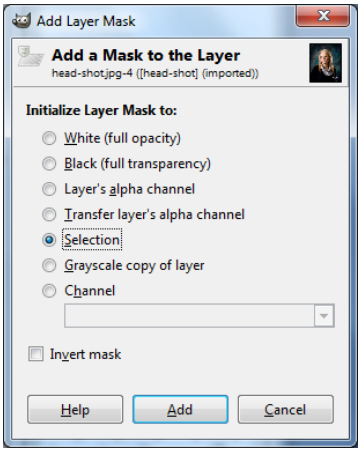
Most applications also have a 'magic wand' tool which can select large areas of single or similar colour using a tolerance setting for how close the range of colours need to be to each other.

To make our 'head-shot' work we need to remove the background so that you can see the layer underneath. If the image you are using has a solid background then you can use the 'magic wand' to do this. For this example, this will work because the background is white.

If the source material has a textured background, then you will need to use different tools. In Photoshop, click the Lasso Tool in the toolbar on the left hand side of the screen (keyboard shortcut: L). In GIMP it is called the 'Free Selection Tool' (keyboard shortcut: F). Draw around the head in your head shot to select it, making sure that the shirt is not selected. To do this effectively requires some practice and a steady hand.

3.2.4 Use masking tools

Adobe Photoshop	GIMP
	



With the head shot selected, click the ‘Layer Mask’ button at the bottom of the ‘Layers’ tab on the right hand side of the screen in Photoshop. In GIMP, right click on the layer and select ‘Add Layer Mask’, and then choose ‘Selection’ from the list of options to initialise the layer mask. Click ‘Add’ to confirm. This will add a grayscale layer mask to our ‘head-shot’ as can be seen in the example above: where the layer mask is black, the layer is transparent, where it is white, the layer is opaque. The layer mask can be painted on using normal brush tools. Painting in grey creates a semi-transparent section of the layer.

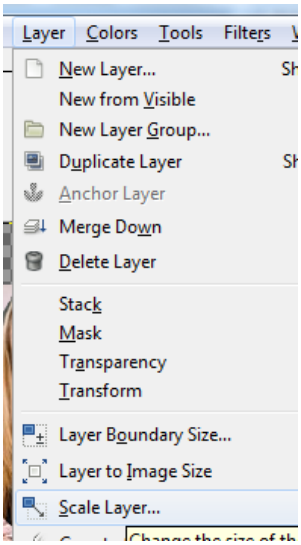
The benefit of masking tools is that they allow you to remove parts of an image/layer but in a non-destructive way: although those parts of the image are not shown, they are still there and can be ‘unmasked’ by removing the layer mask or painting back in the parts that you need. This is considerably more powerful than using the Eraser Tool which is destructive.

You can choose between working on the layer mask for an individual layer, or the actual layer itself. To work on the layer itself, click on the small thumbnail in the layer on the right hand side of the screen. To work on the layer mask, click on the small black and white mask thumbnail. The selected option is highlighted.

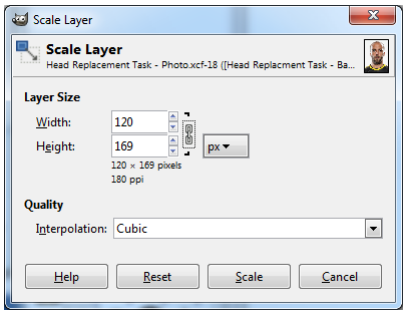
3.2.5 Resize an image, use rotation and place an item

Adobe Photoshop	GIMP
	

The final part of our head replacement is to scale and rotate the picture of the head shot so that it fits correctly on the background.



In Photoshop, click on the Edit menu and select 'Free Transform' (keyboard shortcut: CTRL + T). Using the square handles on each corner, scale the picture of the head down so that it is the correct size for the background. To make sure that the picture's proportions stay the same, hold down the 'Shift' key on the keyboard while doing this. To rotate the head shot, move the cursor near to one of the corner handles of the transform square. As the cursor moves towards the handle it will change the curved icon. Clicking at this point will allow you to rotate the image around the centre point of the transform square.

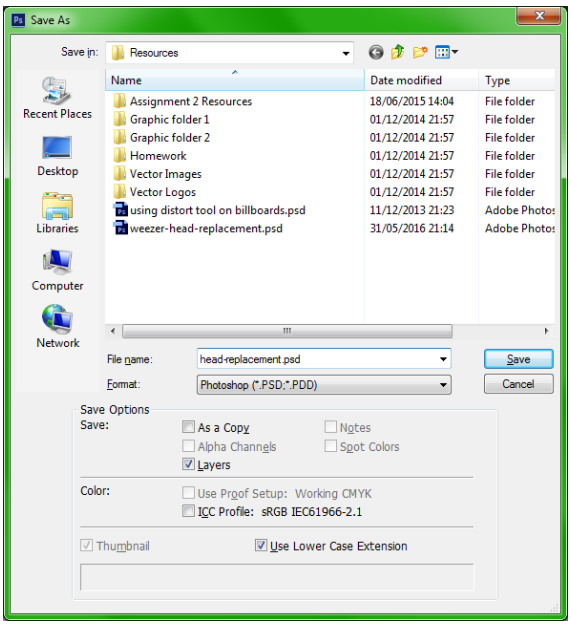
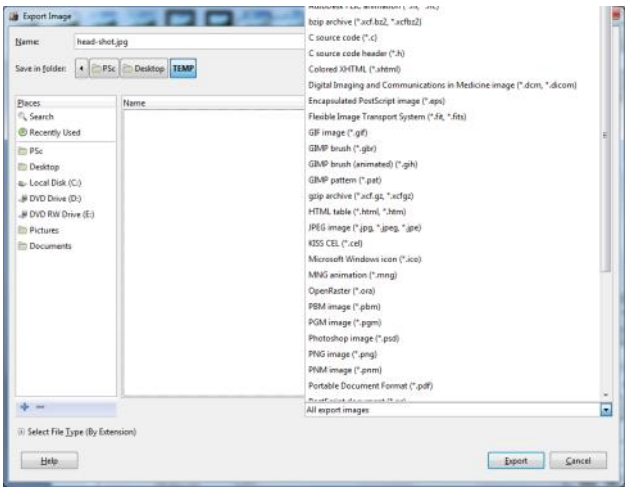


In GIMP, click on the Layer menu and select 'Scale Layer'. Enter the new size you would like the layer to be – for this example, about 120 pixels in width is fine. Once your head shot layer has been scaled, use the Move Tool in the toolbox (keyboard shortcut: M) to move the head shot layer into place.

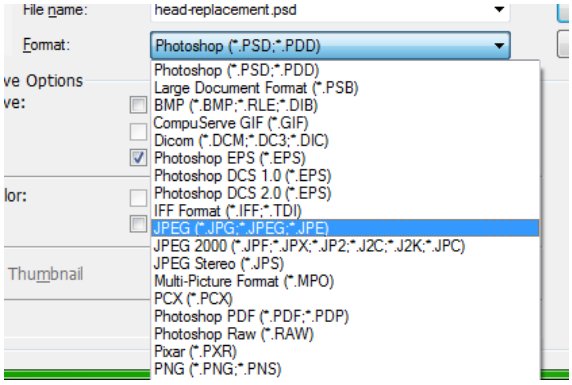
To change the point the image rotates around, click on the small circle in the middle of the transform square and move it. This is the centre of the rotation.

When you are happy, press 'Enter' on the keyboard to place the image. Use the paintbrush on the layer mask for the head shot to paint out any parts which you don't want.

3.2.6 Save an image in different file formats

Adobe Photoshop	GIMP
	

To save our final image, in Photoshop, click on the File menu and select 'Save As'. This will display a save dialogue and ask you where you would like to save your file. In GIMP, select 'Export Image'. Click the Format dropdown menu to choose the file format you would like to use.



Different graphics applications have different available formats, both native and generic. A brief table of the advantages and disadvantages of some of the main formats is shown below:

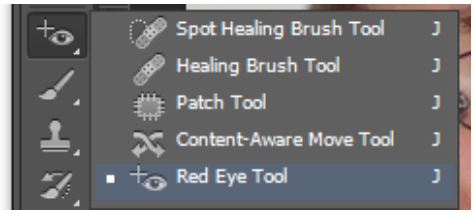
Format	Advantage	Disadvantage
.bmp	Generic format, can be opened/viewed by most applications.	Can use run length encoding to compress the file (lossless), but generally doesn't compress well.
.jpg	Compresses very well and is a generic format which can be opened/viewed by most applications.	Uses lossy compression which is destructive.
.png	Compresses well and can display up to 48-bit colour.	Some applications can't open this format.
.gif	Can be used for animation.	Can only use 8-bit colour.

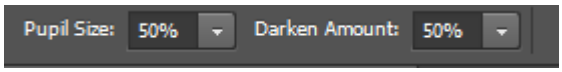
3.2.7 Use tools to remove red eye

Adobe Photoshop	GIMP
	

Red eye[iv] is a simple problem to fix in most modern graphics applications.

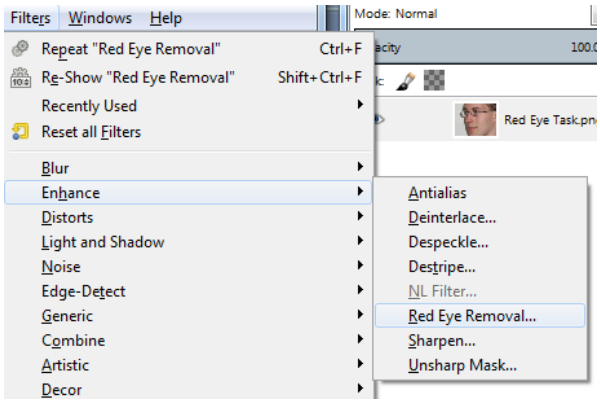
In Photoshop, click on the Healing Tool in the toolbox on the left hand side of the screen (keyboard shortcut: J) and select 'Red Eye Tool' from the submenu.





At the top of the screen the red eye tool options will appear. These allow you to adjust the size of the pupil relative to the rest of the eye and how much you want to darken the eye by, expressed as a percentage. The default settings will usually achieve the effect you want, but if not you can adjust these settings to suit. Drag a box over one of the eyes, making sure that you cover the whole of the eye. This should remove the red eye. If it does not, you may need to undo and try again, selecting a different amount of the pupil.

In GIMP, click on the Rectangular Selection Tool in the toolbox (keyboard shortcut: R) and drag a box over one of the eyes. Then click on the Filters menu, choose 'Enhance' then 'Red Eye Removal' from the submenu.



The settings in GIMP are similar to those in Photoshop: they adjust how much you want to darken the eye and the size of the pupil.

3.2.8 Use tools to improve parts of an image (including: blend, replicate, retouch)

Adobe Photoshop	GIMP
 v	

Graphics applications have many tools to retouch and improve images. Good tasks to demonstrate this include correcting an old photo to remove scratches, or painting a reflection of someone out of a mirror to create a spooky image. Both of these examples use the 'Rubber Stamp' / 'Clone' tool to replicate and retouch part of any image. This example involves removing unwanted elements of a photo.

In Photoshop, select the Clone Stamp Tool from the toolbox on the left hand side of the screen (keyboard shortcut: S). In GIMP, use the Clone Tool from the toolbox (keyboard shortcut: C).

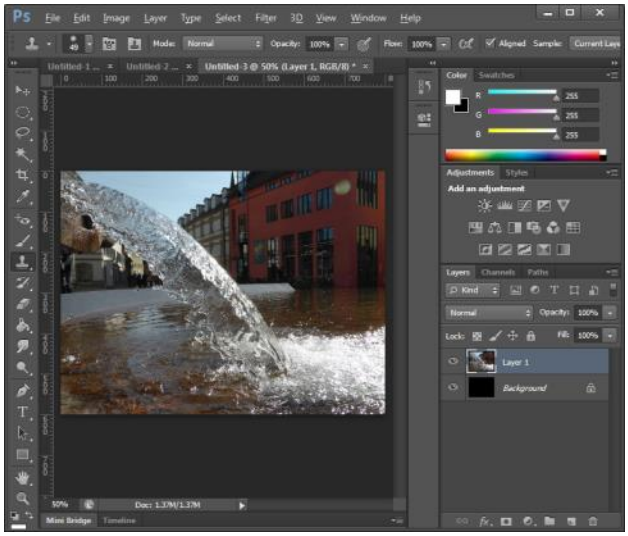
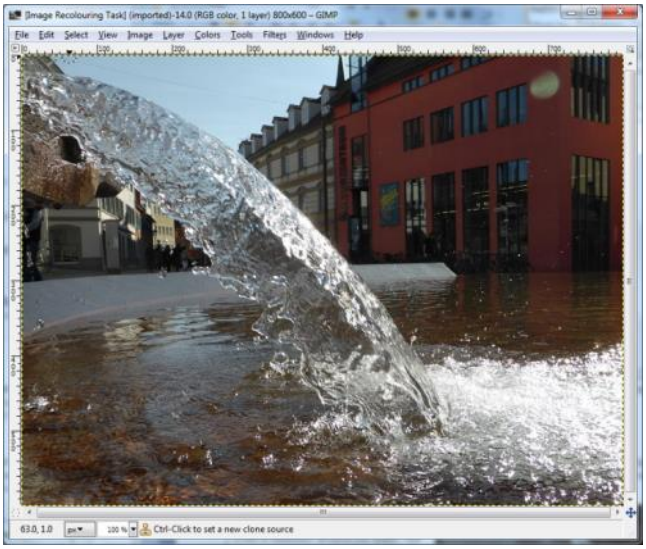
Use the Settings tools which appear at the top of the screen in Photoshop or in the Tool Options in GIMP to ensure that the brush size is not too big for the image you are working with.

In Photoshop, hold down 'Alt' on the keyboard and click the mouse on one of the corners of a brick join in the image, ensuring that you are a reasonable distance away from the element you want to remove. In GIMP the process is the same, but instead hold down the 'Ctrl' key. This is the Originating Point – the point in the image which you want to 'Replicate' from. The reason for using a corner of a brick is that it makes it much easier to line up the replication.

Move the cursor to another corner brick join near to the element you want to remove and click and paint. You should see a copy of the originally selected point being painted over the newly selected point. If you have lined up your two corners correctly the bricks should line up.

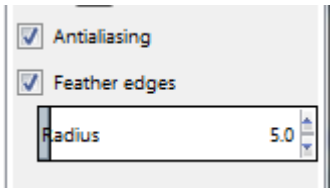
Although this technique works on any image, having a replicating background such as a brick wall makes the process much easier to practise on. The trick to making it work is ensuring that the two points accurately line up. You may have to select an 'Originating Point' multiple times to complete the process.

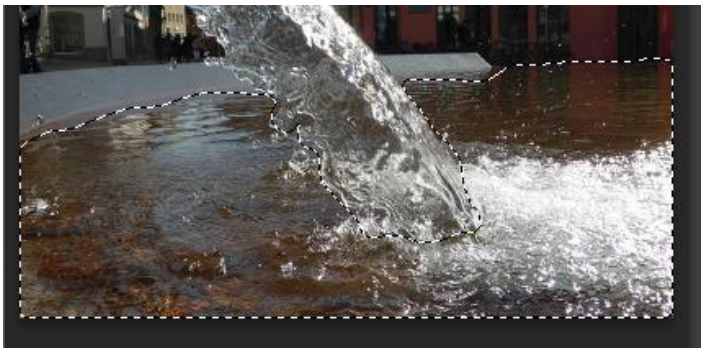
3.2.9 Use colour gradients, and filters (including: blur, distort, sharpen), change the opacity of an image

Adobe Photoshop	GIMP
	

Graphics applications often have hundreds of different filters which can be applied to an image, many of which can be applied together. In this example we are going to change the colour of the water[vi].

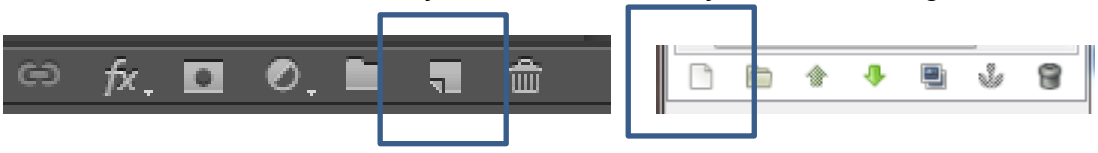
Select the Lasso Tool from the toolbox on the left hand side of the screen. In Photoshop, at the top of the screen change the Feather edges Radius to 5 and ensure that 'Antialiasing' is switched on. In GIMP the settings are the same, but are in the Tool Options at the bottom of the toolbox.



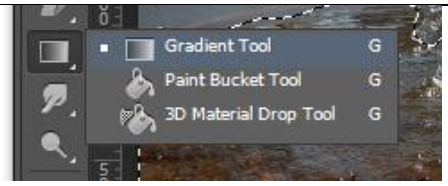


Draw a selection around the water, but do not include the water cascade. You do not need to be completely accurate with this.

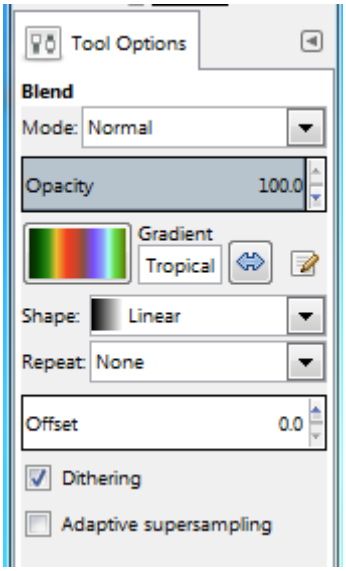
In Photoshop, click the New Layer button at the bottom of the Layers tab on the right hand side of the screen. In GIMP, the New Layer button is in the Layers tab on the right of the screen.



In Photoshop, click and hold on the Fill Tool in the toolbar on the left hand side of the screen. Select 'Gradient Tool' from the submenu (keyboard shortcut: G).

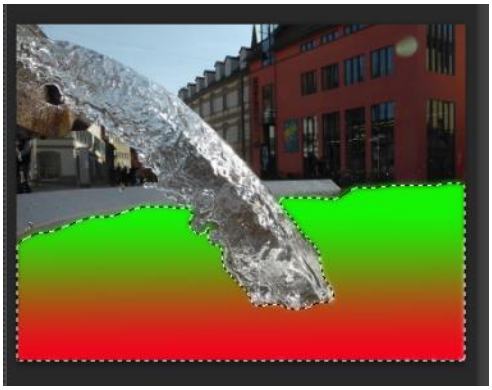


In GIMP, click the Blend Tool (keyboard shortcut: L) to display the gradient options. Either use one of the existing gradients or click the small pen icon on the right hand side of the Tool Options to create your own gradient.

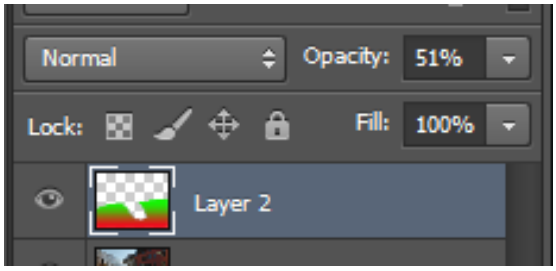


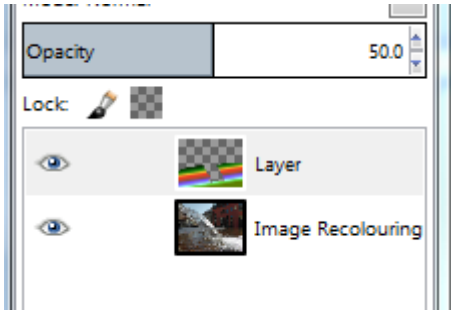
The gradient in Photoshop is from the foreground colour to the background colour, shown in the colour swatches towards the bottom of the toolbox. Double click on each of these to set the start and end colours for your gradient.

Click and drag your gradient onto the water. It should only fill the space in the newly created layer.

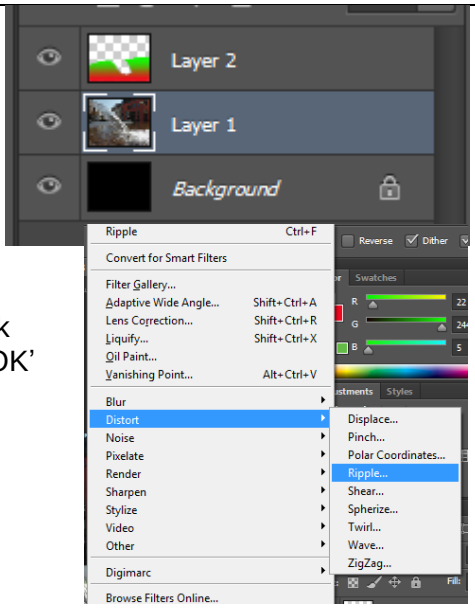


To make the image look more realistic, change the 'Opacity' of the newly created water layer to around 50% so that it becomes partially transparent.





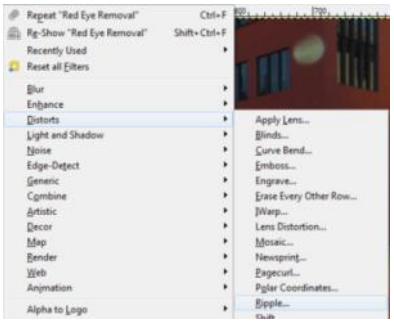
Click back on the original image layer.



In Photoshop, click on the Filter menu and select ‘Distort’ and then ‘Ripple’ from the submenu.

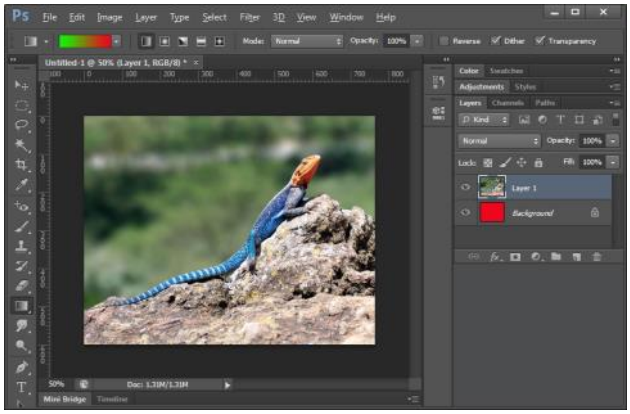
Adjust the options to add ripple to your water to make it look more turbulent. When you are happy with the effect, click ‘OK’

In GIMP, the settings are very similar:



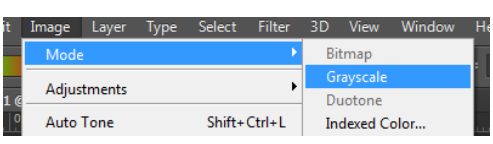
3.2.10 Convert between colour, duotone and black and white images

Adobe Photoshop



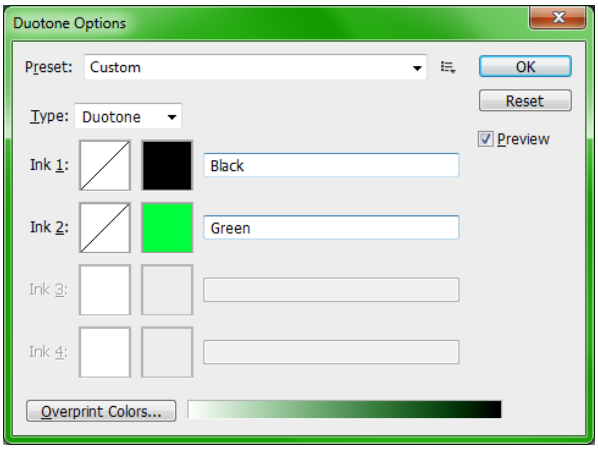
Graphics applications often support different colour depths, enabling you to create custom effects. One of these effects involves adjusting the number of colours or tones which are available to display the image.

Using the lizard image[vii], click on the Image menu and select ‘Mode’, then ‘Grayscale’ from the submenu. Photoshop may ask if you if you want to flatten the image if it is multi-layered and will ask you to confirm that you want to remove all of the colour data.



Click again on the Image menu and select ‘Mode’, but this time choose ‘Duotone’ from the submenu.

A duotone is a reproduction of an image, but only using two colours – typically black and one other. This gives the image a hue of the colour you have chosen. This effect was typically used in newspaper and cartoon prints to give an image a hint of colour, but without the cost of a full colour print. Full colour printing is more common in modern print, but duotone is still an effective option.



The colours can be set to the learner's preference, however in this example, Duotone has been set to Black and Green, which colours the lizard image with a green hue.

4. Further resources

https://photographylife.com/camera-resolution-explained

Image and camera resolution explained.

http://www.freedigitalphotos.net/

Huge library of digital stock photography.

https://www.gimp.org/docs/

Help documentation for GIMP.

https://www.vectorstock.com/free-vectors

Free vector images.

http://www.brandsoftheworld.com/

Vector logos of companies from all over the world.

5. Further study

While vector and bitmap graphics have their own uses, they can be combined together to make very effective images. Learners can review some of the stock photos available at the link below to see if they can combine two different images together. This works well to combine logos into a bitmap image, as well as to create unusual vector environments and place photographs of people into them.

http://www.istockphoto.com/article_view.php?ID=489

It is recommended that learners be encouraged to research the following questions independently:

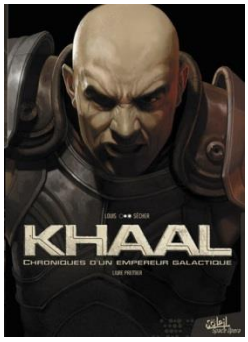
1. Summarise the key differences between bitmap and vector graphics.
2. Describe the different attributes and uses of the commonly-used file types for both bitmap and vector images.
3. Harry has been given an old photograph to restore, which has tears in the edges, marks on the surface, and is faded in places. Should he use bitmap or vector graphics software for this task, and why?
4. Elsbeth wants to draw cartoon versions of her friends, which she plans to use for a big poster, and small badges. Should she use bitmap or vector graphics software for this task, and why?
5. What are some situations/applications where bitmap and vector graphics can be combined?

The following pages contain worksheets and additional graphics tasks that can be used to extend and consolidate learners' knowledge of graphics.

Name:_____

Target audience:

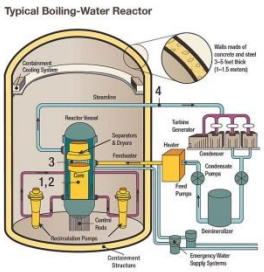
Explain what you think the target audience is for this image? Who is it aimed at and why?



viii

Purpose:

What is the purpose of this image? Explain why you think this. Explain if you think it is a vector or bitmap and give reasons for why the author might use that file format.



ix

Research task:

Explain the Rule of Thirds. Use the example image below to help your explanation

x

Name:_____

Image file types

File type	Description	Bitmap or Vector?
.fhd	.fhd files are created in Adobe Freehand and are used to create drawings, illustrations and page layouts using shapes and lines.	Vector
.png		
.gif		
.bmp		
.jpg		
.svg		
.tif		
.psd		
.cdr		

Graphics tasks

These tasks are designed to be undertaken as a learning process covering most of the objectives listed at the start of this document. Learners should be encouraged to use the tasks to explore the menu items and tools available in the image manipulation software.

Often there is more than one way to satisfy the requirements of the task. At first, the exercises should be about exploring a variety of options and not about determining the most efficient methods.

<table>
<tr>
<td>Task 1

1. Open the Red-eye.jpeg image and use the relevant tools to remove the red eyes.
2. Change the size of the image to 600px wide, with constrained proportions.
3. Export as a .png file.</td>
<td>Task 2

1. Open the Crowd-at-concert.jpeg image, and type the words “LIVE TONIGHT”. Choose an appropriate size and font, change colour to red and position centrally near the top of the image.
2. Type the words “Sold out!”, choose a suitable font in a smaller size than “LIVE TONIGHT”, and position the new text so that it overlaps the end of the previous text, at an angle.
3. Create a semi-opaque spiral gradient on the image.</td>
</tr>
<tr>
<td>Task 3

1. Open the Guitars.jpeg image and crop the “Flying V” guitar (the one on the left) from the image.
2. Using the relevant tools, first get rid of the background, then create a larger, blurred version of the guitar and position it behind the original and offset slightly so that it looks like a shadow.
3. Place both of these at the top left corner of the image, at a 45 degree angle.</td>
<td>Task 4

1. Create a white border around the image. First increase the canvas size to 1750 px wide, with constrained proportions.
2. Then create a completely white background layer behind the rest of the components of the image.
3. Save the image as a .jpeg, at 75% quality.</td>
</tr>
<tr>
<td>Task 5

1. Open Eiffel_Tower.jpeg image, and improve it by increasing the sharpness.
2. Use the relevant tools to remove the clouds from the image, so that the sky looks clear.
3. Create a duotone version of the image, and export as a .png file.</td>
<td>Task 6

1. Open original Eiffel_Tower.jpeg image, and make it black and white.
2. Using the relevant tools, apply a filter of your choosing to the image.
3. Export in a 32-bit bitmap (.bmp) format.</td>
</tr>
<tr>
<td colspan="2">Image files provided: - Red-eye.jpeg[xi], Crowd-at-concert.jpeg, Guitars.jpeg, Eiffel_Tower.jpeg[xii].</td>
</tr>
</table>

Image sources

All images are the author's own except for those listed below:

[i] Lots of cakes. From [http://flickr.com/photos/jujuly25/370986806/ Flickr]

[ii] Ctaske (Own work) [CC BY-SA 4.0 (http://creativecommons.org/licenses/by-sa/4.0)], via Wikimedia Commons

[iii] Andrew Malone (Group shot) [CC BY 2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons

[iviv] http://photoshop-tutorial.org/photo-effects/how-to-remove-red-eye/

[v] FiddleStix1217 (Own work) [CC BY-SA 4.0 (http://creativecommons.org/licenses/by-sa/4.0)], via Wikimedia Commons

[vi] MartinThoma (Own work) [CC0], via Wikimedia Commons

[vii] Chris_huh (Own work) [GFDL (http://www.gnu.org/copyleft/fdl.html) or CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0/)], via Wikimedia Commons

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