

Capturing and optimising digital images for research

Practical workbook

Aims and Learning Objectives

The aim of this course is to explore the procedures of image capture using a scanner and to optimise the resulting digital images using Serif PhotoPlus (or similar image editing package).

On completion of the course, you will be able to:

- understand colour rendition issues;
- understand the digitisation process;
- set scanning parameters adequately for the intended output;
- capture images using a scanner;
- crop images;
- correct perspective problems;
- adjust the tone and colours of images;
- sharpen images;
- scale images;
- use four different graphic file formats for the right purpose.

Document information

Course files

When working in the Computer Centre training rooms save your personal filestore (go to **Start \ Computer** and under **Network Location** look for your username and double click on it).

Related documentation

Other related documents are available from the web at:

<http://www.bristol.ac.uk/is/learning/resources/resources-by-topic-all.html#images>



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Introduction

There is little doubt that the use of digital images in learning, teaching and research projects is growing. Typical uses include: supporting lectures and other presentations; creating web-based instruction and creating digital image archives. Another aspect of digital images is that they can be delivered on a variety of supports: PowerPoint, web, image database, CD-ROM and print. It is therefore important to be familiar with image digitisation processes in order to obtain images that are 'fit for purpose'.

Scanners provides a means for converting analogue images to digital, allowing them to be manipulated and enhanced on a computer using a graphics package such as Adobe Photoshop or Serif PhotoPlus.

This course shows you how to make better use of your scanner and apply image enhancement techniques using Serif PhotoPlus, an image editor for which the University has a site licence.

Prerequisites

This course assumes that you are familiar with the use of a computer keyboard and mouse, and with the Windows environment.

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Task 1 Scanning an image

Objectives To obtain a scan from a traditional film image.

Comments It is important to set the scanning parameters adequately for the intended image output. For example if you want to make an A4 print, you will need to scan the original at a setting that provides enough information for a good print at that size. Conversely if you scan an image for a website less information will be required.

Preparing to scan

1.1 Prepare the scanner:

- Connect the USB cable from the scanner to a free USB slot on the front panel of your computer.

Note The Canon CanoScan Lide 200 gets its power from the computer via the supplied USB cable.

1.2 Prepare the original:

- Check the condition of the photograph handed out to you, handle it with care, by its sides (avoid touching the surface with your fingers) and check that it is clean – gently blow off any obvious dust or hair-like particles if necessary.

Note This is the first step towards a quality scan. The more you keep the original image in good condition and clean, the better the digital image and the less retouching it will need.

1.3 Place the image in the scanner:

- Lift the scanner lid and place the photograph facing down on the glass, at least 1 cm away from the edges and upside down.
- Close the lid.

Starting the scanning process

1.4 Open PhotoPlus X5 and the scanning software:

- Press the **Start** button (bottom left of the screen) select **All Programs / Serif PhotoPlus / PhotoPlus X5**.
- In the Startup Wizard, in the **Create** column, select **Import From Twain**, then choose **CanoScan LiDE 200 14.0 (32-32)** and click **Select**.

Note Alternatively, if you can't see the Wizard Startup, open the **File** menu and choose **Import / Acquire**.

You should now see the **ScanGear** scanner driver, showing the scanner 'bed' (where you can preview your scan) on the left and the settings options on the right (Figure 1).

1.5 Preview your scan:

The scanning software that comes with your scanner usually provides a number of adjustable settings. By default ScanGear opens in **Basic Mode** which offers limited features. However, in order to obtain better results it is recommended to switch to **Advanced Mode**.

- In the settings pane on the right, select the **Advanced Mode** tab and click **OK** when prompted.
- Next click on the blue **Preview** button at the bottom of the settings pane.

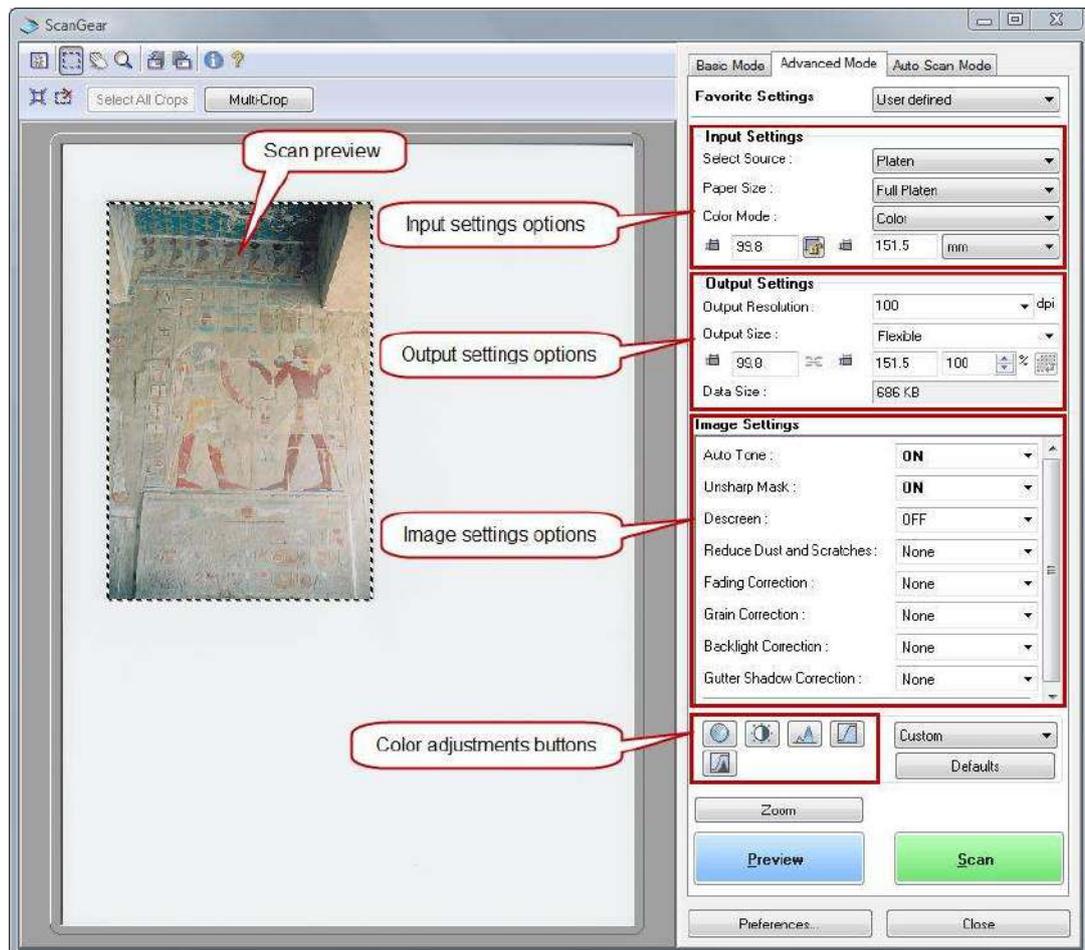


Figure 1 – ScanGear scan preview and Advanced Mode settings options

Scanner software like ScanGear usually offers settings (Figure 1) relating to:

- the type of original you are scanning (**Input Settings**) – e.g. photograph, plain text or printed materials from magazines or newspapers,
- the type of output you want (**Output Settings**) – e.g. high quality print, website or PowerPoint presentation, publication,
- image correction options (**Image Settings**) such as brightness optimisation (Auto Tone), sharpening (Unsharp Mask), descreening (used for scanning photos from books and magazines), etc,
- colour adjustment options such as saturation/colour balance, brightness/contrast levels and curves adjustments.

Only the first two concern us at this stage, image correction and colour adjustment settings will be set to **OFF** – except for **Unsharp Mask** that will be set to **ON** – or not used, because they are better corrected in a dedicated image editing package like PhotoPlus.

1.6 Set the **Input Settings** options:

This is where you set the type of artwork (e.g. a colour photograph, a black and white photograph, a drawing, a newspaper page, etc) you are scanning. Depending on the type there are three main colour modes to be aware of:

Color : this mode is suitable for scanning colour documents such as photographs. It captures 24-bit of data per pixel (i.e. 256 levels (8-bit) each of R(ed), G(reen), and B(lue)) to reproduce the full spectrum of 16.7 million colors. 24/8 bit output is the standard mode for scanning colour photographs and is good enough for most uses.

However if you require extra quality (e.g. for very high quality print), you may want to change this to 48-bit (i.e. 16 bit per channel). Click on the **Preferences** button at the bottom, then select the **Scan** tab and check the **Enable 48/16 bit Output** option.

Grayscale : this mode is suitable for scanning black and white photographs, or to create black and white images. It captures 8-bit bits of data per pixel (i.e. 256 shades of gray, including black and white at the extremes).

If scanning a black and white photograph original, you may get better results setting the output type to **Colors**. This gives you three times more information to work with than **Grayscale**. While this introduces colour into the scan, you can convert it to black and white afterwards or desaturate in PhotoPlus.

Black and White : this mode is suitable for document containing a maximum of two colours (usually black and white) without any tonal variations in between. A typical example are line art images.

- Leave the **Select Source** and **Paper Size** options to their default settings (i.e. **Platen** and **Full Platen** respectively) and make sure **Color Mode** is set to **Color**.

1.7 Set the **Output Settings** options:

Output Resolution and **Output Size** are complementary settings which are normally dictated by the use to which the resulting scanned image will be put.

Output Resolution is particularly relevant to print output: it determines the number of pixels in a specific area and is usually expressed in pixels per inch (ppi) or dots per inch (dpi). For example, a resolution of 300 ppi is usually recommended for a high quality print on an inkjet printer.

Output Size allows you to control size (expressed either in pixels, inches or millimetres) of the scanned image.

If the scanned image is destined to be viewed on a computer screen (e.g. on the web or in a PowerPoint presentation), then the pixel dimension is all you need to know, the **Output Resolution** is irrelevant and is best set to 100.

However, for print output you need to care both for the resolution and size because together they help determine the real life dimensions of the image expressed in inches or millimetres. For example, if you wanted to print your scanned image at a size of 297 x 210 mm (A4 size) at a resolution of 300 ppi (the recommended resolution for obtaining a quality print on an inkjet printer), you would need to make sure the scanned image pixel size is 3507 x 2480 pixels.

See Appendix B for further information on resolution and image size for printing.

- Experiment with different **Output Resolution** and **Output Size** settings and try to understand what it means (note the changes to the **Data Size** field). You may also want to change the size unit to **pixels** in the **Input Settings** options.

For this task, we will assume that you want to use the present image in a PowerPoint presentation, so:

- Set the **Output Resolution** to **100**, then set the **Output Size** to **Flexible** and type **400** in the % box below (Figure 2).



Figure 2 - Output settings for Egypt image scan

The **Output Size** width and height should be something like 1600 pixels in width x 2400 pixels in height (or thereabouts).

Note If in doubt as to the pixel dimension and/or resolution that you need, aim to get a high quality scan – as a rule of thumb, 3500 x 2500 pixels will allow you to comfortably print up to A4 on an inkjet printer. From this master version you can then make smaller ones for using on the web or in PowerPoint.

1.8 Set the **Image Settings** options:

- Set all options to **OFF** or **None**.

1.9 Start scanning:

- Click on the **Scan** button.

The scanner will start scanning – depending on the resolution, this may take some time.

1.10 Save your scanned image:

Your scanned image now appears in the PhotoPlus workspace. Assuming we want to keep our scan for future use we will save it as a TIF file.

TIF (or **TIFF**) is a universal and 'lossless' (i.e. all image information is preserved, as opposed to 'lossy' compression formats which result in lost data and quality) image compression format, suitable for archiving and high quality work. However it generates large files and is therefore not suitable for the web and other screen display uses.

- Go to the **File** menu and choose **Export Optimizer**.
- In the **Format** option, choose **Tagged Image File**, then in the **Pixel Format** option, choose **24-bit RGB** and leave all other options as they are.
- Click on the **Export** button and in the **Export** dialogue box, first navigate to the course folder located in your personal UoB filestore (i.e. **O:\UoB Training Materials\scanning**), then in the **File name** field type in **egypt-mural-original** and press **Save**.

Task 2 Cropping and correcting perspective problems

Objectives To crop an image and correct perspective problems.

Comments Cropping consists of selecting the area of an image that you want to keep and eliminating the outer crop area. Using the PhotoPlus **Crop Tool** and **Deform Tool** you will learn to correct perspective problems such as the vanishing vertical edges of a building photographed from ground level.

Simple cropping operation

2.1 Define the crop area:

- In the **Toolbox**, select the **Crop Tool**¹. 
- Click in the top left corner of the area you want to select and drag towards the bottom right to mark out the area that you want to keep (crop marquee). Notice how the area outside the crop selection dims.
- Adjust the crop marquee to cover an area similar to that in Figure 3:

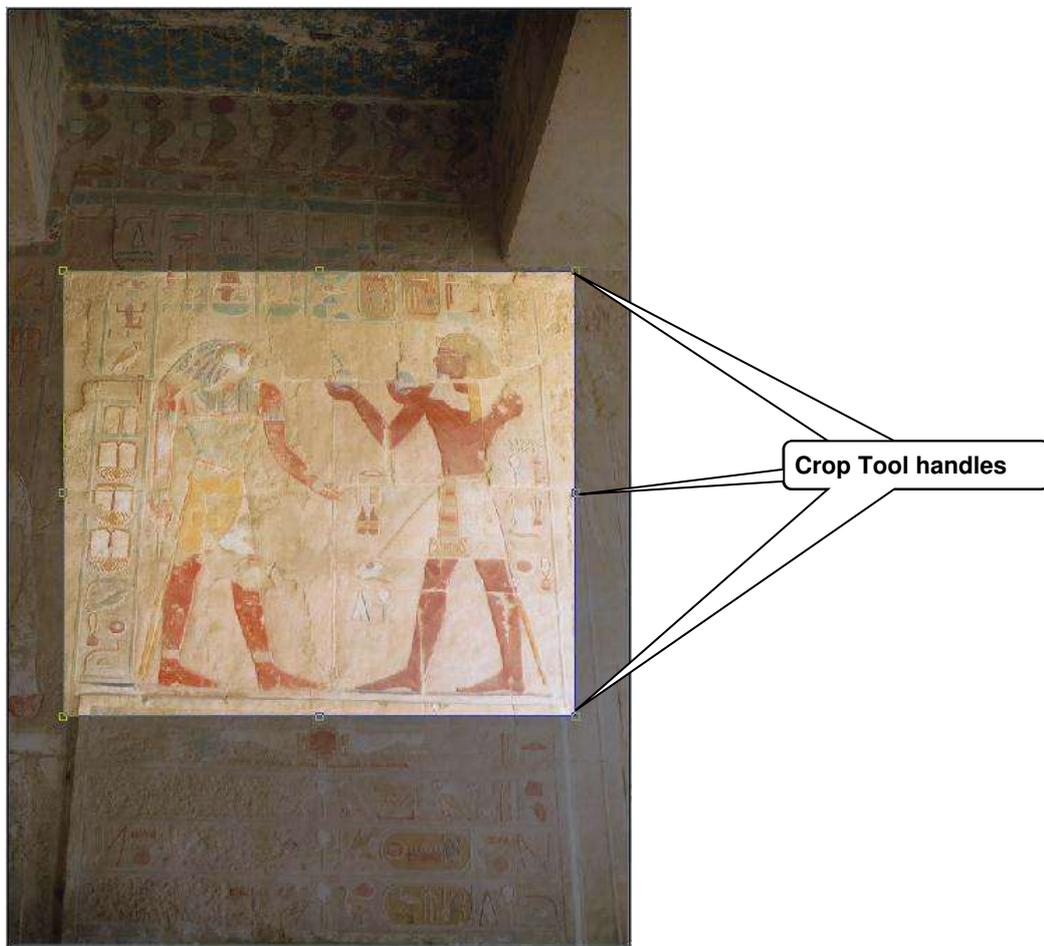


Figure 3 – the crop marquee in the image window

If you need to reposition the crop marquee, place the cursor inside the marquee – it will change to a white cross – and drag.

2.2 Commit the crop:

- When you are satisfied with the position and size of the crop marquee, double-click in the crop marquee or click the **OK** button² in the context toolbar. 

Correcting perspective problems

2.3 Correct the perspective:

- In the **Toolbox** select the **Deform Tool**³. 
- Press the **<Ctrl>** key and with the mouse click the top left corner handle and drag it outward to straighten the skewed vertical line on the left in the image (Figure 4).

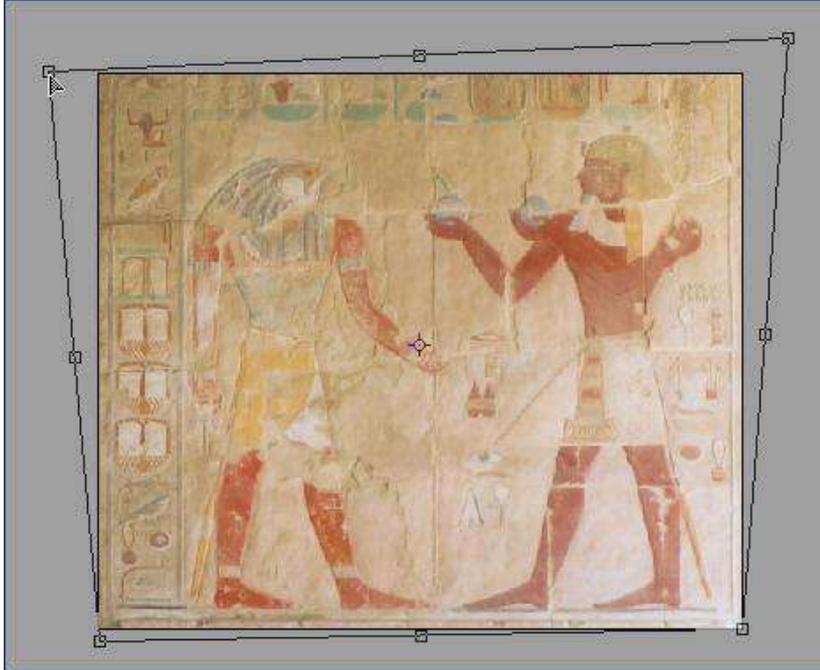


Figure 4 – Correcting perspective with the Deform Tool

- Repeat, using the other corner handles to correct the right side vertical line and level the bottom and top horizontal lines in the image.
- Once you are satisfied with your selection, commit the perspective correction by selecting the **Move Tool**⁴ in the toolbox. 

Your image should now have perfect vertical and horizontal lines, as illustrated in Figure 5:



Figure 5 – Cropped image after perspective correction

Note This operation can be fiddly, particularly with images that do not have clear vertical and horizontal lines. Trial and error and a little patience should overcome any difficulty!

2.4 Save your cropped image:

- Go to the **File** menu and choose **Export Optimizer**.
- In the **Format** option, choose **Tagged Image File**, then in the **Pixel Format** option, choose **24-bit RGB** and leave all other options as they are.
- Click on the **Export** button and in the **Export** dialogue box, first navigate to the course folder located on **O:\UoB Training Materials\scanning**, then in the **File name** field type in ***egypt-mural-cropped*** and press **Save**.

Task 3 Adjusting overall tone and colour

Objectives To make basic image corrections using PhotoPlus's image correction tools.

Comments Once you have cropped your image, the next thing you will want to do is improve its appearance. For example it may lack contrast, have a colour cast, be too bright, or displays any combination of these faults.

Interpreting an image

3.1 Before making any adjustment, it is important to be able to analyse the image you are working on.

We can use our eyes to make subjective judgements about how the picture looks, but we can also use the image histogram, which is useful for evaluating the kinds of image adjustments that may be needed.

- Look for the **Histogram** tab among the **Studio** tabs on the right.

Note If you can't see the **Histogram** tab see, open the **Window** menu (in the top menu bar) then select **Studio Tabs > Histogram Tab**.

- Click the **Tab Menu** button at the top right of the tab and select **Show Statistics**.
- Click it again and select **RGB** – this option shows the distribution of composite RGB values, rather than individual colour channels (e.g. **Red Channel**) or all three separate channels (**All Colours**).

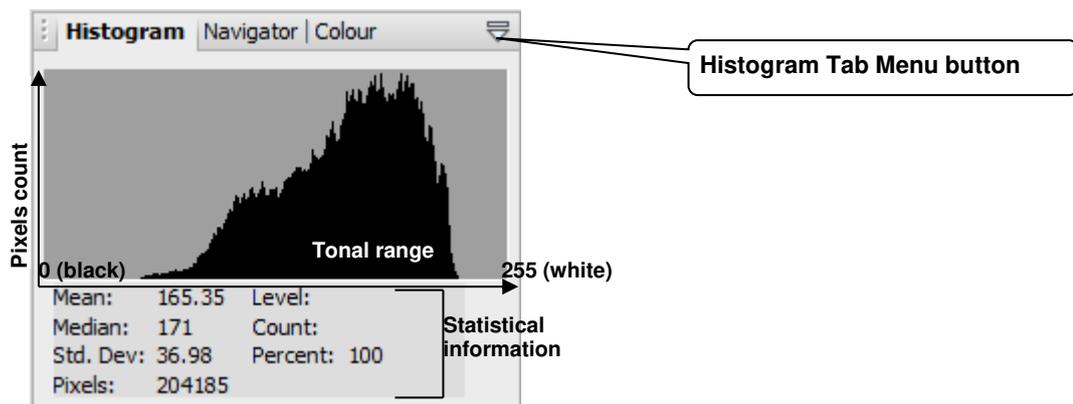


Figure 6 – Histogram tab with statistical information

- What does the information provided by the **Histogram** tell you about the current image?

Adjusting brightness and contrast with Levels

3.2 Create a **Levels** adjustment layer:

- Look for the **Layers** tab in the bottom palette on the right (it should already be active) and click on the **New Adjustment Layer** icon⁵ in the bottom taskbar, and select **Levels**.



This will open the **Levels** adjustment layer (Figure 7).

3.3 Resetting the input shadow and highlight levels:

- Take a minute or so to look at the Figure 7 and read the description.

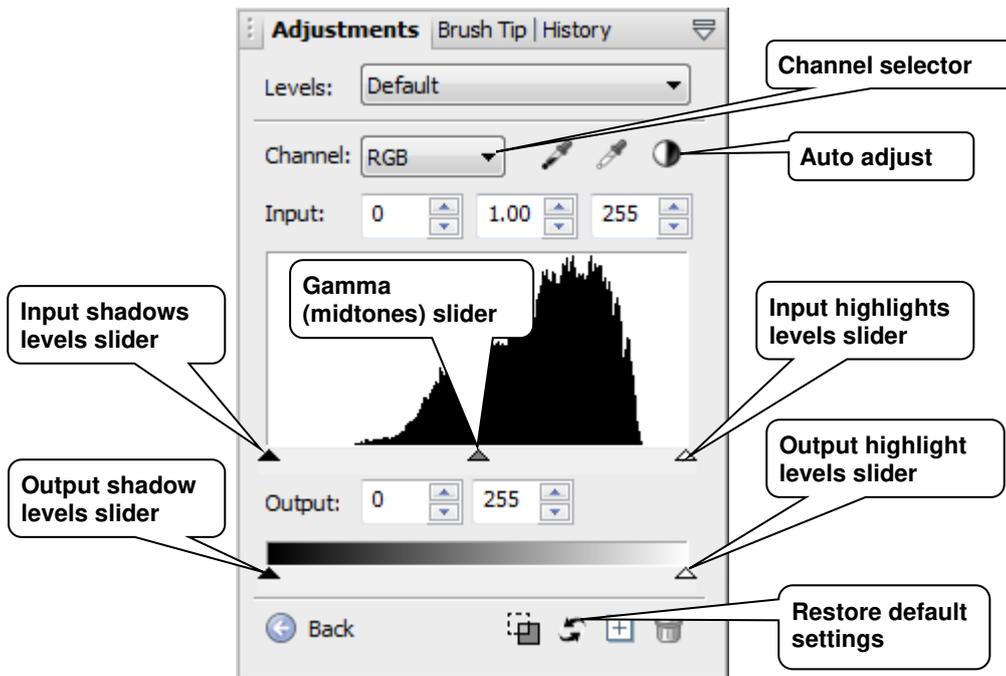


Figure 7 – Levels adjustment layer dialogue box

Input Levels

- The **Input** sliders and entry boxes allow you to increase the contrast by adjusting the input **shadows** and **highlights**.
- The **Gamma** slider and entry box work on the image midtones and allow you to adjust the relative image brightness between the shadows and highlights (drag the slider left to lighten and right to darken the image).

Output Levels

The **Output** sliders allow you to reduce the tonal range (contrast) in an image. It is best not to touch these because they inevitably result in loss of data in the shadows and highlights – unless you deliberately want to reduce the output contrast.

The histogram in Figure 7 shows that the image has a limited tonal range which explains the lack of contrast; in other words it is lacking in shadows and highlights. So the first adjustment we are going to make is reset the darkest shadow and lightest highlights points for each of the RGB colour channels.

- Make sure the **Preview** box in the bottom right is checked so you can see the changes taking place.
- In the dropdown **Channel** selector, select **Red**.
- First drag the **Shadows input slider** to the right and set it just before you see some shadow detail in the image (i.e. where the histogram starts). Then drag the **Highlights input slider** to the left and set it just before you see some highlight detail.
- Repeat the previous step for the **Green** and **Blue** channels and click **OK** once you are satisfied.

Notice how these changes have affected the **RGB** histogram in the **Histogram** tab (Figure 8):

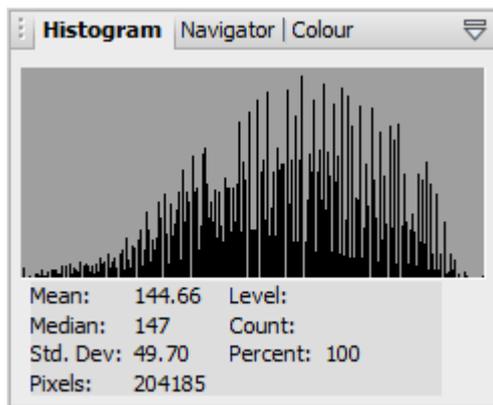


Figure 8 – Image histogram after Levels changes

You should now have a better spread of pixel levels between shadows and highlights, but notice how some information has been lost at some levels (hence the comb-like effect).

Adjusting the colour balance with Levels

3.4 In the previous task, we used the **Levels** adjustments on individual channels to correct the overall contrast of the image. We are now going to use the same tool to correct colour casts.

- Create a new **Levels** adjustment layer above the one you created in the previous task (just make sure it is selected before creating a new layer).

At this point you need to decide whether your image has a colour cast and if yes, which colour. So let's say your picture looks bluish:

- Go to the **Channel** menu and select the **Red** channel.
- Move the **Gamma slider** slightly to the left as in Figure 9:

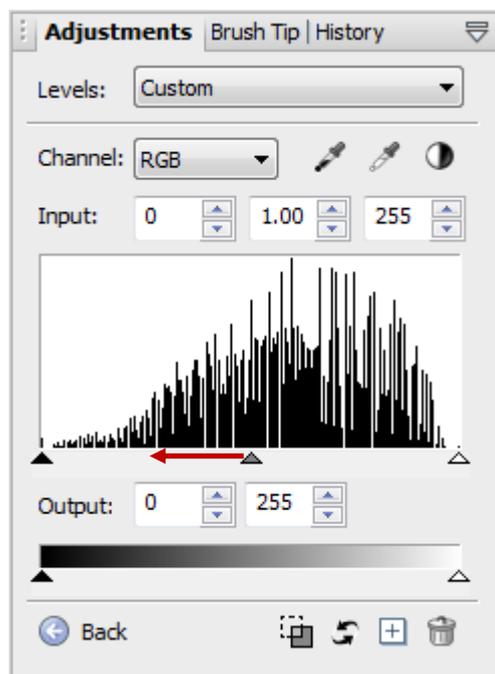


Figure 9 – Correcting a blue cast using Levels

If your image has a different colour cast, use the following table to decide which channel to use:

Colour cast:	Use the colour channel:	Move the Gamma slider:	Colour added:
Red	Red	Right	Cyan
Green	Green	Right	Magenta
Blue	Blue	Right	Yellow
Cyan	Red	Left	Red
Magenta	Green	Left	Green
Yellow	Blue	Left	Blue

Note When dealing with black and white photographs, you don't need to adjust each colour channel separately. To correct the overall contrast and brightness you can use the composite **RGB** channel instead. Use the **Input** sliders to improve the overall contrast, and then the **Gamma** slider to correct the brightness.

Alternative colour adjustments with Colour Balance

3.5 Create a **Colour Balance** adjustment layer:

- First disable the second **Levels** layer (the one you used to adjust colours in the previous task) by clicking on the eye next to it.
- In the **Layers** tab click on the **New Adjustment Layer** icon in the bottom taskbar, and select **Colour Balance** (Figure 10).

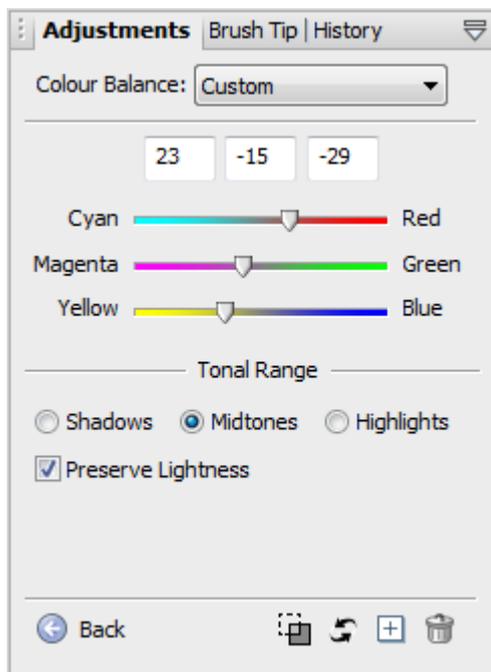


Figure 10 – Colour Balance dialog box

- Make sure **Preview** is selected and start working on the **Midtones** and then move on to the **Shadows** and **Highlights**. Also experiment with the **Preserve Lightness** option in the bottom left.
- Observe the changes to your image as you do this and click **OK** once you are satisfied with the results.

- Now compare the results with the first method by disabling/enabling the second **Level layer** and the **Colour Balance** Layer.

3.6 Save your image in the Adobe Photoshop (PSD) format:

- Go to the **File** menu and choose **Export**.
- In the **Export** dialogue box, navigate to **O:\UoB Training Materials\scanning** if necessary. In the **File name** field type ***egypt-mural-cropped-adjustments*** and in the **Save as type** field select **PhotoShop (*.psd)**. Press **Save**.

Note We recommend that you use the Adobe Photoshop format (.PSD) in preference of the native PhotoPlus Pictures format (.SPP) because it is more widely used and it will then enable you to open your working files in Photoshop CS or Element (as well as many other image editing applications) if you want to.

However if you are not bothered about this you can save your working files in the PhotoPlus native format by going to **Files / Save as** and selecting **PhotoPlus Pictures (*.Spp)** as the file type.

Both .PSD or .SPP will preserve all image information, such as multiple layers, masks, etc which otherwise would be lost. This means you can carry on working on the image at a later time.

Task 4 Sharpening an image

Objectives To sharpen an image.

Comments Most digital photographs – and particularly those resulting from scanning – need some degree of sharpening to bring out detail. PhotoPlus provides four sharpening filters – **Sharpen**, **Sharpen More**, **Sharpen Edges** and **Unsharp Mask**. **Unsharp Mask** is the one that gives the most control.

See <http://www.cambridgeincolour.com/tutorials/unsharp-mask.htm> and <http://www.cambridgeincolour.com/techniques/image-sharpening.htm> for more detailed information on sharpening.

The **Unsharp Mask** works by increasing the contrast between pixels next to one another. Unlike tone and colour adjustments, **Unsharp Mask** is applied to the **Background** layer (or even better a copy of the **Background** layer), that is the layer containing the original image.

Creating a Background copy

4.1 Create a copy of the **Background** layer:

Note Creating a copy of your background image protects the original image because it is easier to delete a layer rather than undo changes to the background image.

- In the **Layers** palette, select the **Background** layer and right-click on it. Then select **Duplicate** (this option can also be found in the **Layers** menu at the top).
- In the **Duplicate Layer** dialogue box accept the suggested name (**Background Copy**) and press **OK** (Figure 11).

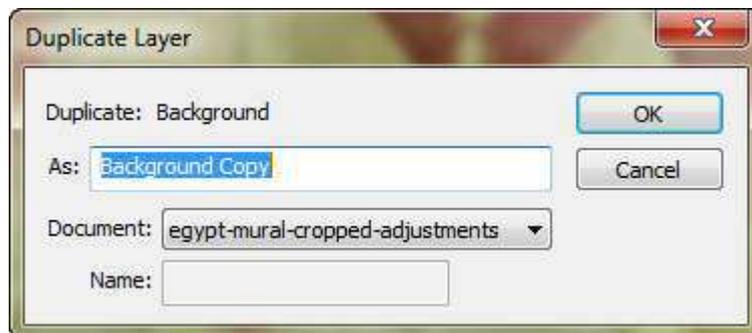


Figure 11 - Duplicate Layer dialogue box

Applying the Unsharp Mask

4.2 Sharpen the image:

- Make sure the **Background Copy** layer is selected and in the **Effects** menu, choose **Sharpen / Unsharp Mask**.
- In the **Unsharp Mask** dialogue box (Figure 12) you can set three settings:
 - **Amount** controls the amount of sharpening applied to the edges (1% to 500%). Values up to 50% produce subtle effects; values between 50% and 250% produce moderate effects. A good starting point is often a value of 100%.
 - **Radius** controls the size of the edges you wish to enhance, where a smaller radius enhances smaller-scale detail. Values of up to 2.0 produce acceptable sharpening.

- **Threshold** controls the amount of contrast between pixels an area must have before it will be modified. Use a low value to apply the filter more generally throughout the image. For example it allows you to sharpen more defined edges while leaving more subtle edges unaffected.

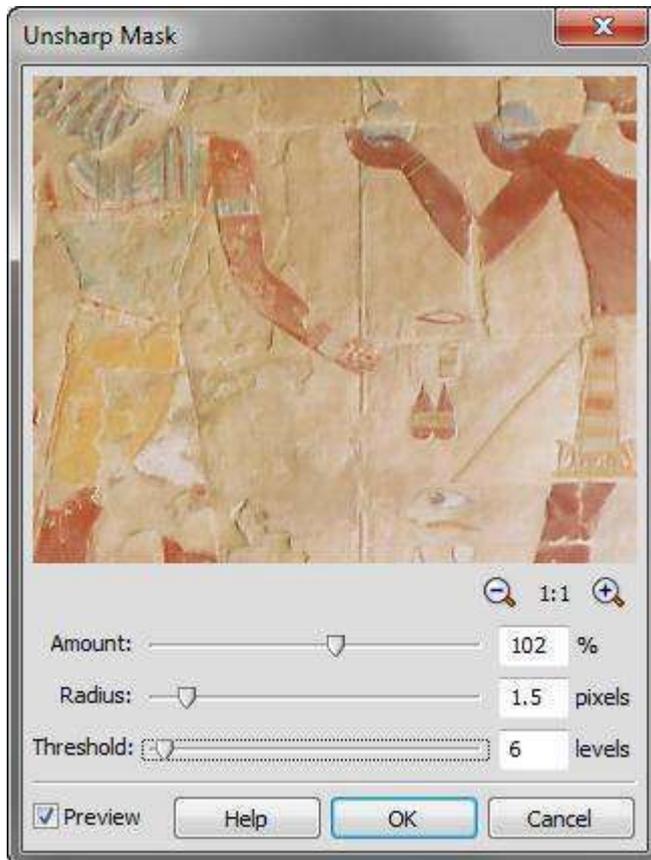


Figure 12 – Unsharp Mask settings in the Filter Gallery

Note A good method is first to set the **Amount** to **100%** and the **Threshold** to **0**. Then experiment with the **Radius** and finally adjust the **Amount** if necessary before finishing with the **Threshold** if needed. You may require a few iterations before finding a satisfying result.

- Experiment with the different settings described above and observe the changes to the image.

As a general rule, apply an amount of between **200%** and **300%**, a radius of between **0.5** and **2.0**, and a threshold of between **0** and **10**.

Note Sharpening for output should be applied at the end of the process and after the image has been resized to the final print size.

4.3 Save your image:

- Go to **File / Export** and replace the **egypt-mural-cropped-adjustments** with the new one (make sure it is saved in the **PhotoShop (*.psd)** format).

Merging layers

4.4 Make a copy of the image:

- Open the **Image** menu at the top and select **Duplicate**. Accept the suggested name **egypt-mural-cropped-adjustmentsCopy**.
- Close **egypt-mural-cropped-adjustments.Spp**.

4.5 Merge the visible layers:

- Make sure either the **Colour Balance** layer or the second **Levels** layer is disabled by clicking on the eye icon next to it (remember that we used both methods to achieve the same effect, so keep the one that gave the best results).
- Open the **Layers** menu at the top and select **Merge / Merge Visible**. Then delete the remaining hidden layer.

4.6 Save this image as a TIFF:

- Go to the **File** menu and choose **Export Optimizer**.
- In the **Format** option, choose **Tagged Image File**, then in the **Pixel Format** option, choose **24-bit RGB** and leave all other options as they are.
- Click on the **Export** button and in the **Export** dialogue box, first navigate to the course folder located on **O:\UoB Training Materials\scanning**, then in the **File name** field type in **egypt-mural-cropped-adjustments** and press **Save**.

Task 5 Resampling an image

Objectives To resize and/or resample an image.

Comments There are times when you will want to modify the size of an image (for example to create a version of your image for the web). This is done through a process called **interpolation** (also known as **resampling**). Image interpolation consists in estimating the value (colour and intensity) of new pixels based on the values of existing surrounding pixels.

See <http://www.cambridgeincolour.com/tutorials/image-resize-for-web.htm> for downsizing an image and <http://www.cambridgeincolour.com/tutorials/digital-photo-enlargement.htm> for digitally enlarging an image.

Resampling down

Resampling down consists in discarding pixels and results in a smaller file size. Use this method when downsizing images for the Web and email.

5.1 Prepare to resample the image:

- Go to the **Image** menu at the top and select **Image Size** to open the **Image Size** dialogue box (Figure 13).

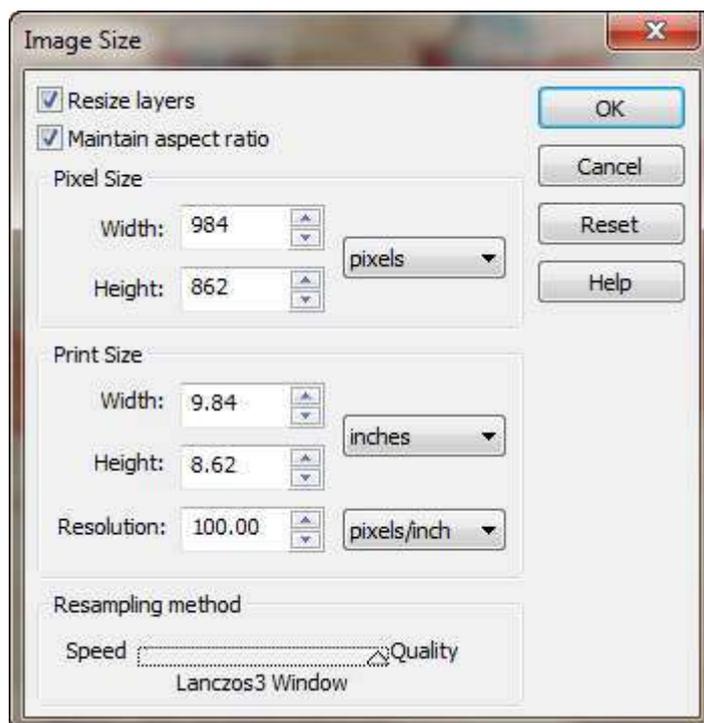


Figure 13 – Image Size dialogue box

- Check that **Maintain aspect ratio** is also selected.

5.2 Resize the image:

- Under the **Pixel Size** options, set the **Width** to **300** pixels. The **Height** will automatically be adjusted to preserve the aspect ratio.
- Under **Resampling Method**, slide the cursor completely to the right, until you see **Lanczos3 Window**, and press **OK**.

Note As a general rule, when resampling photographs, use **Lanczos3 Window** for best quality. **Bicubic interpolation** is the next best method, followed by **Bilinear interpolation** and **Nearest pixel** being the most basic.

5.3 Apply some sharpening:

After downsizing your image you may want to apply a small amount of sharpening.

- Create a copy of the background layer as in task 4.1.
- Use the **Unsharp Mask** as explained in task 4.2, setting the **Amount** to about **120** and the **Radius** between **0.2** and **0.5**. Leave the **Threshold** to **0**.

5.4 Save the thumbnail image as a JPEG:

- Go to **File / Export Optimizer**.
- In the **Export Optimizer** dialogue box (Figure 14), select **JPEG** as the **Format** and leave the **Lossless** and **Matte** options unchecked.

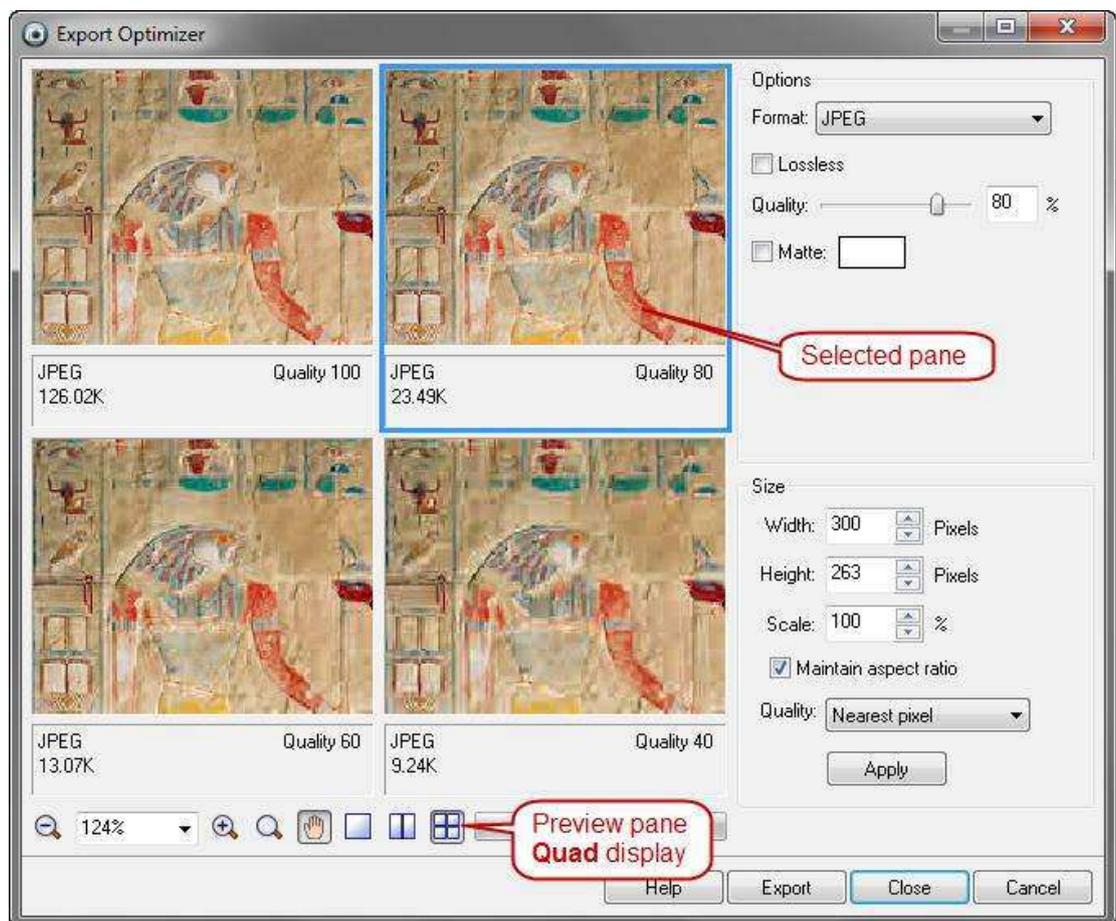


Figure 14 - Export Optimizer settings

- Change the preview option from single pane to four panes by pressing the **Quad** view icon⁸.



Now use the 4 preview panes to compare different compression levels:

- Select the top left pane and change the **Quality** option to **100%**, then select the top right pane and set the **Quality** to **80%**. Repeat with the bottom left and bottom right pane, setting the **Quality** to **60%** and **40%**.
- Compare the different panes by zooming in (look for the zoom in icon⁹) and focusing on a detail of the image. Notice the deterioration in the image and also the reduction in file size as the quality decreases.



Notice in particular how a 20% reduction in quality (from 100% to 80%) results in an over 500% reduction in file size (from 126Kb down to 23.5Kb)!

Note In most cases 80% quality will achieve the best compromise between quality and file size for web display.

- Finally, select the 80% quality pane (you will see a blue frame around the selected pane) and press **Export**. In the **Export** dialogue box, first navigate to the course folder located on **O:\UoB Training Materials\scanning**, then in the **File name** field type in **egypt-mural-thumb** and press **Save**.

Setting the print size of an image

You can also use the **Image Size** dialogue box to set the print size of an image using different resolutions without resampling it.

- Reopen **Egypt-mural-cropped-adjustments.tif** and go to **Image / Image Size**.
- In the **Image Size** dialogue box, uncheck the **Resize layers** option and notice how the **Pixel Size** and **Resampling method** options are now uneditable (Figure 15):

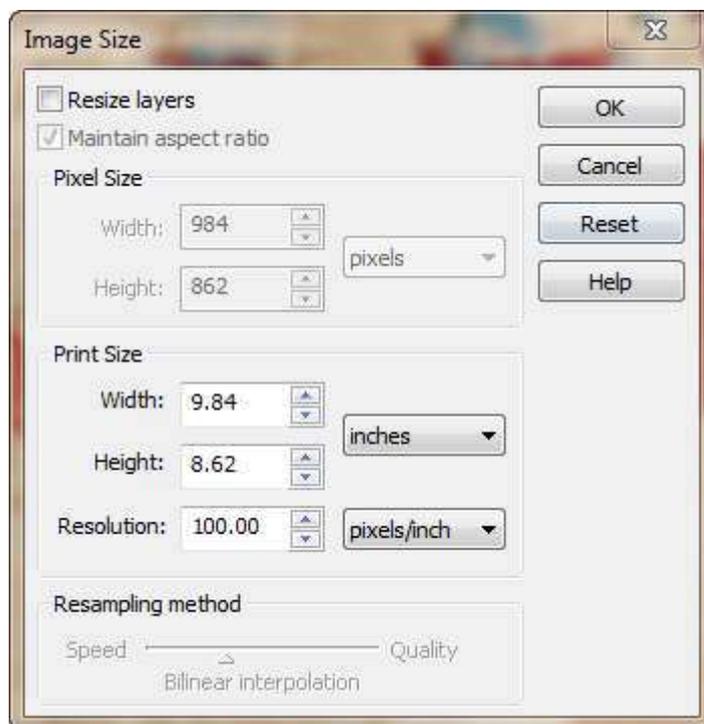


Figure 15 - Image Size dialogue box with the resampling options off

- In the **Print Size** options, change the **Resolution** (for example try 200 and 300 pixels/inch) to see the changes to the **Width** and **Height** dimensions (the default unit is **inches**, but you can change it to **centimetres** if you prefer).
- Choose a resolution other than **100** and press **OK**.
- Go to **File / Print** and in the **Print Studio** dialogue box, open the **Layout** option on the left, and in the **Size** drop down select **Image Print Size**.

Appendix A Image file formats

For most digital imaging purposes, and in the context of this practical workbook, you need to be aware of four image file formats: TIFF, JPG, SPP and GIF

- **TIFF:** The most common cross-platform format for images. TIFF is the format of choice for scanned images and archival purposes because it keeps all image data intact. On the minus side, TIFF generate large files and is not suitable for the Web.
- **PSD:** This is the Adobe Photoshop's format, and although it is proprietary to Adobe, it has become something of a standard and is widely supported by other image editing applications (including Serif PhotoPlus). It can be used as an alternative to TIFF for archiving purposes. The main advantage of saving in this format is that it preserves all working layers, which can be useful for future editing.
- **JPEG:** This is one of two standard compression formats used for preparing images for the Web (the other one being **GIF**). It offers a smaller file size than **TIFF** and is the format of choice to compress photographic images for the Web. Another big advantage is that it allows for different levels of compression which can be balanced against file size.
- **GIF:** This is the other image file format used for preparing images for the Web. It is an 8-bit (i.e. 256) colour display mode that indexes specific colours to each of the 256 (or fewer) numeric values. This makes it unsuitable for photographic (i.e. continuous tone) images that potentially contain millions of colours. Therefore it works best with simple images containing block colours, such as logos, graphics, etc. Finally GIF support transparency, which can be useful on the Web.

Other image file formats you should be aware of include:

- **SPP:** This is Serif PhotoPlus's proprietary format, which is unlikely to be supported by other applications. Therefore we suggest that you use Photoshop's PSD format instead.
- **PNG:** The Portable Network Graphics format is an open standard that combines the benefits of JPEG and GIF. As such it is very flexible and perfectly suitable for the Web. However it is not as widely used as either.
- **BMP:** Also known as bitmap, is a high quality format similar in purpose to TIFF. However it is proprietary to Microsoft and for this reason the open standard TIFF should be preferred instead.

Further reading:

- JISC Digital Media – Choosing a File Format for Digital Still Images (<http://www.jiscdigitalmedia.ac.uk/stillimages/advice/choosing-a-file-format-for-digital-still-images/>)
- Cambridge in colour – Image types: JPEG and TIFF files (<http://www.cambridgeincolour.com/tutorials/imagetypes.htm>)
- Scantips - Image File Formats - TIF, JPG, PNG, GIF Which to use? (<http://www.scantips.com/basics09.html>)

Appendix B Resolution and image size for printing

Pixel size	Megapixels	RGB size (MB)	CMYK size (MB)	Print size at:	
				150 ppi	300 ppi
1600 x 1200	2	6	7.5	11 x 8 inch (28 x 20 cm)	5.5 x 4 inch (14 x 10 cm)
2400 x 1800	4.3	12.5	16.5	16 x 12 inch (40 x 30 cm)	8 x 6 inch (20 x 15 cm)
3000 x 2000	6	17.5	23.5	20 x 13 inch (51 x 33 cm)	10 x 6.5 inch (25 x 16.5 cm)
3500 x 2500	8.75	25	33.5	23 x 17 inch (58.5 x 43 cm)	11.5 x 8.5 inch (29 x 21.5 cm)

Table 1 – comparison of pixel resolution, megapixels, megabyte file size and print output dimensions at different resolutions in inches (and centimetres)

Output use	Screen ruling	x 1.5 Standard quality output resolution	x 2 High quality output resolution
Newspaper	65 – 100 lpi	97 – 150 ppi	130 – 200 ppi
Books	120 – 150 lpi	160 – 225 ppi	240 – 300 ppi
Colour magazine	150 – 175 lpi	225 – 262 ppi	300 – 350 ppi
Art book/magazine	175 – 250 lpi	262 – 375 ppi	300 – 500 ppi
Photo quality inkjet printer	150 – 300 lpi	225 – 450 ppi	300 – 600 ppi

Table 2 – rule of thumb screen resolutions for common print devices at lpi x 1.5 and x 2 quality factors

Example

Say you want to print a high quality A4 photograph on an inkjet printer:

A4 size = Width 8.268 x Length 11.693 inches (21 x 29.7 cm)

Printer resolution = 200 lpi

Quality factor = x 1.5

Print length x Printer resolution x Quality factor = number of pixels required in length

$11.693 \times 200 \times 1.5 \approx 3500$ pixels in length

Print width x printer resolution x Quality factor = number of pixels required in width

$8.268 \times 200 \times 1.5 \approx 2480$ pixels in width

Appendix C Further resources

A collection of links to useful digital imaging resources is available at:

<http://delicious.com/uobittraining/scanning>

It is kept up to date and added to as new resources are found.