# Chapter 1
# Introduction

> … the soul never thinks without an image (Aristotle, *De Anima* Book III, Part 7).

> The illiterates of the future will be the people who know nothing of photography rather than those who are ignorant of the art of writing (László Moholy-Nagy 1932, quoted in Jeffrey 2006, 111).

Images have been part of human society, psychology and imagination since the earliest times, before the dawn of written language. In the closing stages of the twentieth century, digital images emerged as the dominant medium to capture, create, store, share and disseminate visual information. For those working in the information profession, such as librarians, archivists, curators, knowledge managers and information specialists, understanding our changing information environment and changing approach to image-based material can facilitate the creation of, access to, and long-term sustainability of digital image material.

This chapter explores some basic underpinnings which inform the rest of the book: What do we mean by 'image', and why are they so important to humans? What are digital images, how are they created, and for that matter, what is meant by the term 'digital'? This text focuses on issues surrounding bitmaps, rather than vector graphics, and the reasons for this approach are explained, as is why such a text (with a focus on issues pertinent to information professionals) is necessary. Finally, an overview of the remaining content of the book is presented, detailing its scope and aims.

## Images

The creation of images has been a human activity since the beginning of human society: our early ancestors painted or carved rocks with depictions of their lifestyles and beliefs. Rocks are not very portable, however, and humans like to share their images, and the knowledge contained within them. Much investment in technology has focused on the ability to create, replicate and disseminate visual information, from early print materials, to later attempts at photography and the ability to capture 'an artificial imitation or representation of the external form of any object' (OED 1989a) via means of recording patterns of light. Indeed, the OED definition of 'image' includes light as a particular source of images: an image can be:

> An optical appearance or counterpart of an object, such as is produced by rays of light either reflected as from a mirror, refracted as through a lens, or falling on a surface after passing through a small aperture (ibid.).

The complete definition of an 'image' is wide, however, and there is no room in this book to address the complex philosophical, historical and linguistic debate regarding what images actually are: as well as the physical manifestation of light falling on photosensitive paper or light-sensitive arrays:

> We speak of pictures, statues, optical illusions, maps, diagrams, dreams, hallucinations, spectacles, projections, poems, patterns, memories, and even ideas as images, and the sheer diversity of this list would seem to make any systematic unified understanding impossible (Mitchell 1984, 504).

The focus of this book is the image at its most literal: 'a graphic, pictorial representation: a concrete material object' (ibid. 521), a 'non-moving representation of visual information' (Anderson et al. 2006, 7) which has a physical manifestation, even if it is just a file which resides on a computer's hard drive or on a web server.

Two-dimensional images are an important means of communication, source of information, and focus of both social interaction and scholarly activity in modern society. Images play an important role in cultural and social history, can contain valuable historical information, and are used more and more in academic research, which aims to study culture in its widest sense: focusing on artefacts and cultural produce. It is becoming popular for interpretations of visual material to be incorporated into academic reasoning: this is partly to do with the more exotic or interdisciplinary themes emerging in modern research 'like the history of smells, or witchcraft. Studying themes like this, all sorts of sources, previously not often used by historians – images, literature, plays – are consulted' (van den Berg 1992, 8).

Digital images are now the media of choice for creating, sharing, accessing and manipulating image material. Digitization projects in libraries, archives, museums and other 'memory institutions' are merrily creating image representations of their holdings for display, sharing and distribution via the Internet. Individuals are creating, manipulating, utilizing and sharing vast collections of digital images in ways which would not have been possible with traditional photographic media. The increasing prevalence and pervasive nature of digital imaging technologies requires engagement and understanding by those working within the information sector.

### Images and Humans

The word 'image' stems from the Latin *imaginem* or the later French *imagene*, expressing ideas of imitation, copy and likeness, but also of thought, conception and imagination. This reflects the fact that the human perception and understanding of images is both a physiological and conceptual process. It is not entirely understood how the human eye-brain system functions.

Physically, the vertebrate eye is complex. Light passes through the opening in the front of the eye, the pupil, and the lens focuses the image on the retina, a sheet of layers of neural tissues that line the back of the eyeball. Photoreceptors generate a neural signal when they detect light, and this signal is sent via the optic nerve to the brain (Gregory 1998; Livingstone 2002). What happens next is not clear:

> The eye is a simple optical instrument. With internal images projected from objects in the outside world, it is Plato's cave with a lens. The brain is the engine of understanding. There is nothing closer to our intimate experiences, yet the brain is less understood and more mysterious than a distant star (Gregory 1998, 1).

Human perceptual and cognitive systems have limited capacities for processing information, but much of it is devoted to dealing with visual input. Being biological systems, and not identical, the cortex area devoted to processing images varies greatly from human to human (Andrews et al. 1997), but a relatively large proportion of brain activity, estimated at above 50 per cent, is devoted to vision. Research into how we see, perceive and interpret the world around us, and our reaction to images, is wide, varied and spans an interdisciplinary reach encompassing psychology, biology, physiology, chemistry, physics, philosophy and beyond (Bruce et al., 1996, introduce many of the theories and debates postulated so far). What is certainly true is that the human brain can process complex visual information quickly, it does so by various mechanisms which are not fully understood, and that humans can be stimulated in various emotional, intellectual, physical and behavioural ways by imagery and image content (Lang et al. 1993, 1998). Our enjoyment of visual art is an extension of this complex physical and perceptual activity (Molnar 1997; Livingstone 2002). 'We humans like images: our brains are specially adapted to interpret them' (Trefethen and Embree 2005, 8): it is little wonder, then, that the ease of producing, manipulating and disseminating them afforded by digital media and networks has resulted in an exponential increase in image material for personal and cultural consumption.

It is important to note that the human visual system suffers from many limitations. It can detect light and interpret the consequences of light stimulus – within a specific range of wavelengths – but has limited ability to perceive certain colours, being more sensitive to green and yellow, then red, rather than blue. Small variations in colour are virtually impossible for the human eye to detect: our visual system merges small details into a unified whole, being set up to view the global information of a scene or a smooth, continuous tone image, rather than individual constituent properties. The human visual system is much more sensitive to changes in luminance (light) values than changes in colour. Additionally, individuals perceive colour differently. Colour blindness affects 8 per cent of men and less than 1 per cent of women (Birch 2001, 33), where some individuals see certain pairs of colours as being identical, those with normal vision would see them as different, but aside from this, the perception of colour is subjective:

> the similarities and differences between your experience of red and mine lie somewhere between the classes of cells activated in our retinas, thalamuses, and visual cortices, and the similarities between the memories activated in our frontal lobes (Livingstone 2002, 33).

Computer digital imaging and multimedia technologies often exploit these limitations in the human visual system, or try and recreate human perceptual processes, in order to present material to us effectively. For example, computer monitors generate colours by mixing three additive primaries of red, green and blue light onto small, individual points on the screen. The refresh rate with which the screen is repainted varies from 1/25th to 1/80th of a second, depending on the device, which is enough to fool an eye into seeing a still image, or continuous motion if the image is changing frame by frame. The size of the individual points is set to be below our perception threshold, so we see a continuous tone image. Our visual systems blend the image chromatically, spatially and temporally:

> Chromatically in that we do not see only various shades of red, blue, and green, but all the colours in between. Our visual systems blend colours … Spatially, because the individual pixels are too small to be resolved by the photoreceptor spacing in our retinas, unless we are looking very closely at a very large monitor … [and] Temporally in that we see neither the scan pattern nor the fact that the image is presented at a rate of thirty frames per second … a rate our visual systems are unable to resolve (Livingstone 2002, 192).

In addition to this, certain approaches to compressing images, which make file sizes smaller (see pp. 50–58) exploit the way the human eye system deals with variation in colour and replicates this mathematically. JPEG compression, in particular, was designed to discard colour information that the human eye just does not readily perceive (see pp. 76–79), efficiently creating a smaller file which looks much like the original. The way that digital imaging technologies work is closely related to our own physiology and physical limitations.

## Defining 'Digital'

The ordinary, or 'real' world of our senses, exists in a continuous flowing stream of signals across time and often space. A sound, a movement, a photographic print or a line drawn from a pencil all exist in analogue, where a varying signal represents a continuous range of values. In order to record, copy, transmit or analyse such a complex signal using computational power, it is necessary to translate this into a form which is more simple, predictable and processable. All telecommunication systems have one thing in common: the information to be sent is converted into signals, which can be transmitted and reassembled on reception, to be converted into something we can perceive as a fair copy of the original.

Digital systems are those which rely on a sequence of discreet numeric values, rather than the unconstrained and continually varying qualities of analogue signals. Numeric values are used in digital systems for processing, display, transmission and input: often sampling values from analogue sources. The term 'digital' comes from the Latin for finger *digitus*, as these systems use counting and discreet, or separate and distinct, numeric values for calculating, reflecting the way we often use our own fingers for counting or, as was common in the past, as a unit of measurement.

The most common digital systems are those used in computing and electronics which rely on the binary numeric system. This is a system which represents all numbers using only two symbols, typically 0 and 1. This is represented in a fairly straightforward manner in electrical or optical systems: typically 1 is denoted by an electronic pulse present, 0 by its absence. A string of zeroes and ones can represent numbers (1 is 'one'; 10 represents 'two'; 11 represents 'three'; 100 represents 'four'; etc.). These zeroes and ones are known as binary digits, or more commonly as the shortened derivation: 'bits'. Any number of bits can be combined to represent a set of values. A set of 8 bits is called a 'byte' (a unit settled on in the 1960s due to the popularity of 8-bit microprocessors). A long string of bytes, such as an entire file, is often referred to as a 'data stream'.

Strings of bits can represent text: text encoding formats assign a set of binary numbers to represent letters of a language alphabet. The ASCII (American Standard Code for Information Interchange) is a standardized 7-bit character code for the transmission of data, which describes the codes of the 128 different characters which can be described in 7 bits: from 0000000 to 1111111. The character D, for example, is number 68 in the specification, so is represented in the binary string 01000100. As long as the computer can recognize this binary string as ASCII it can process and display large strings of bits as 'plain text' (the operating system will usually examine the file and determine what format it is and how it should be displayed).

Strings of bits can also represent images. The overall purpose of this book is to describe in detail how this functions; but for the moment, imagine a black and white chessboard. If we take white to be 1 and black to be 0, the chessboard could be represented by a string of bits, from the top left white square: 1010101001010101 … etc. This creates a 'bitmap': the bits of the data stream are mapped, one by one, to colours in the image. As long as the computer had some way of knowing that 8 bits represented one line (the 'scan line' length, which is the type of information provided within a file header in an image format, see p. 65), then a representation of the chessboard could be stored in bits and easily copied and transmitted to other computers and painted onto computer screens. An alternative way to store graphical data would be to use ASCII text to create a list of instructions to a computer 'One white square. Then one black square. Repeated four times. Next row. One black square …' etc. A program could read this set of instructions and paint the resulting image onto the screen in a series of shapes called vectors (see pp. 7–8). However, describing photographic content in this manner is complex, and the sampling method of describing an image as solidly toned squares is most useful for complex image data.

Strings of bits can also represent sound and moving images: as the information to be represented grows more complex, more bits are required to represent it, and more complex mechanisms are used to store, display and process the information contained within the data stream.

Providing numeric, textual, image, sound and video-based data in digital format, whether they have been translated from an analogue signal into bits or 'born digital' by being created with computational technologies in the first place, has various advantages. These strings of bits can be easily replicated, transmitted, accessed and processed. Saving the data in a structured, predetermined format means it may be device independent and can be transferred from system to system with minimal problems. Data can be manipulated by dedicated computer programs, allowing new versions of the information to be generated. Data can also be processed: mathematically sorted through to show hidden relationships, new arrangements, different views and expanded, contracted or concatenated knowledge.

It should be noted that digital is not always best, and that there is still a place for analogue technologies in this world. Analogue devices pre-date digital and are still effective in representing information: wristwatches, gas meters, odometers in cars, etc. Human eyes and ears can sometimes distinguish between continuous analogue signals and bit by bit digital approximations. Digital media are at their most effective when their constituent parts – samples – are not detectable by human senses.

## The Digital Image

A digital image is a representation of an image stored in numerical form, for potential display, manipulation or dissemination via computer technologies. Digital images store graphical information in small, discontinuous, non-homogenous, numerical elements.

On one level, a digital image is like any other computer data file: just a long code of ones and zeroes, using information as its raw material. Digital images are captured through a process of creating, storing and manipulating numbers in a computer. Once created, this sequence of numbers becomes infinitely malleable, but is usually rendered into visual form which the human eye can see. Output devices generate a representation of the image data from the mathematical detail contained within a file – although the majority of output devices (screens, prints) are actually analogue.

There are more complex three-dimensional imaging technologies – but we shall concentrate on two-dimensional images. In particular, this text concentrates on bitmap, or raster, images: those which consist of discreet numerical units called 'pixels' (see pp. 35–37) which combine to make a continuous tone image, rather than vector graphics which consist of a set of instructions to the computer regarding spatial primitives (squares, circles, etc.) and how these relate to one another. Bitmap graphics are by far the most popular type of image used to create representations of objects for use in memory institutions, they are the type of image output by digital cameras, and are the most popular types of image on the Internet.

## Types of Digital Images: Vector and Bitmapped Graphics

There are two distinct classes of digital images: vector graphics and bitmap images. Although digitization projects and cultural and heritage institutions will be most likely to produce and deal with bitmap images (and the focus of this book is on their growing prevalence and use) it is useful to contrast and understand the different function of the two types of images and to see why bitmaps are the preferred format for storing photographic and detailed pictorial information.

Vector graphics were the first type of computer graphic to be implemented in the 1950s. They use a series of geometric drawing commands, such as lines, curves or shapes and solid or graduated colour, to represent an image (for example, draw a green triangle inside a blue rectangle and fill the triangle body in green), giving precise mathematical descriptions of the position, size and relationship of the different components. Computer monitors and laser printers can display vector graphics by redrawing this mathematical representation (all early computer displays drew images onto Cathode Ray Tube monitors following these type of instructions, using a 'random scan display') but the format has two main drawbacks. Images of paintings and photographs would require tens of thousands of drawing commands to represent them in vector format – can you imagine trying to describe a Jackson Pollok painting or an ancient document, in terms of lines and shapes? Determining which commands to use to represent the painting or document would be a monumental task. Second, complex vector images take a long time to display and have very large file sizes. They also function best on vectored output display devices, such as plotters and random-scan displays: if displayed on raster devices (the majority of today's display technologies, which paint the picture onto the screen scan line by scan line and pixel by pixel), they need high resolution displays to display them as effectively and the processing power to 'render' the image onto the raster display: where a two-dimensional bitmap image is computed, pixel by pixel, from a chosen viewpoint of the vector image.

There are benefits to vector formats, and they are the approach of choice for creating representations of objects and space in fields such as product design, architecture, engineering, construction, geography and archaeology. They are the basis of Geographical Information Systems and certain Virtual Reality systems. Because each line or shape is defined and drawn individually from others, it is easy for drawing programs to add, delete and modify individual elements without disrupting other elements of the image. Because the image is composed of defined objects, vector graphics can be scaled up or down with no effect on the image's quality: they are scale independent. It is also simple to perform transformations, where the position or direction of the viewpoint is changed, creating new views of the scene, changing such features as perspective and scale, and enlarging or shrinking the image seamlessly. Vector graphics are good for images requiring spot colour, when a uniform colour is used in a defined region, such as in images of logos or diagrams, where one colour floods an entire area. Images created in vector format can be rendered to create a bitmap image at the desired scale and size (it is almost impossible to create a vector description of a bitmap image, however, as it is difficult to define instructions to reconstruct an image from its bitmap representation). Vector graphics are entirely suited to images which consist of simple shapes, such as charts, graphs, logos and diagrams, and are useful for architectural, engineering and archaeological plans which map spatial data.

The alternative approach to image representation is to use a bitmap, also referred to as raster representation. The image is broken into a grid by the capture device, with the light value (lightness, darkness or colour) of each piece of the grid – a pixel – recorded individually.[1] The resulting two-dimensional array of numerical values, where each array element represents a colour to be displayed at a specific location, could easily be displayed, copied and transmitted. Bitmap representation is by far the most commonly used digital imaging method nowadays: it is interesting to note that the increased emphasis on bitmap graphics technology, from the 1980s onwards, corresponds to the massive upwards shift in the output of digital image information. Bitmaps are relatively easy to implement and, within limits, work for any image: they can record just about any conceivable image or view of a scene since any image can be broken up into a grid (and as far as the human eye is concerned, if that grid is small enough we see it as a continuous tone image).

There are various advantages to using bitmapped images. First: image quality. Bitmap representation works well for images with complex variations in colours, shades or shapes, such as photographs, paintings or screenshots (modern computer

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1 In older usage, the terms pixelmap, graymap and pixmap were also used to describe images which had many bits of colour data assigned to each individual pixel, with the term bitmap referring to an array or 'map' of single bits, each bit corresponding to a pixel. Nowadays, the term 'bitmap' refers to an array of pixels, whatever the type, and the bit depth (see pp. 44–49) specifies the size of memory devoted to colour information of the pixel.

screen displays originate in bitmap format and are therefore most easily recorded in the same way). Additionally, the representation translates well to output devices, such as screens, projectors and printers. High resolution images – when the grid is made suitably small, containing thousands, or even millions, of individual colour samples – are capable of capturing minute, complex or pictorial detail. Bitmap image data is easily captured, shared and disseminated.

One drawback of bitmap representation is the size of files produced: colour and high resolution image files can require many megabytes of memory to process and display (see pp. 49–50), and manipulating such large volumes of data can also place heavy demands on the processing power of the device handling the image. For that reason, the issue of how to make the file sizes smaller through compression techniques (see pp. 50–58) is a very significant issue when dealing with bitmap formats. A further drawback is their lack of flexibility: bitmap data must be manipulated at an individual colour sample level. It is not possible to decide to 'change the colour of that dog to black': each individual pixel has to be selected manually. Individual pixels have no intrinsic connection to each other, and the computer retains no contextual information regarding shape. A final problem is found when resizing bitmap images: changing the image size can change the image in an unacceptable manner. For example, if an image is enlarged the individual pixels can become large enough to reveal themselves, producing blocky representation (called pixelation, aliasing or stair-casing). This can be avoided by inserting or deleting pixel information through a mathematical operation called interpolation (see pp. 38–40).

Neither bitmap nor vector graphics methods are better than the other: they simply have different functions and uses. Vector representation has many more limitations, but is more efficient and flexible for many applications. Desktop application programs (such as word-processing software) are increasingly able to deal with both vector and bitmap images, and some metafile formats (such as PDF, see pp. 95–96) can deal with both types of data in the same file. However, the majority of digital images created by the home or professional user are bitmaps. Memory institutions creating digital image representations of documents and artefacts will be doing so using bitmap formats. The majority of images appearing online are bitmaps. Bitmap formats are the representation of choice for complex, pictorial, detailed and image information. As a result, this text focuses on bitmap images.

## The Creation of Digital Images

Due to changes in the information environment, including the lowering costs of computing and digital imaging technologies, and the increase in available network speeds (see Chapter 2), digital images have become the most popular way to share and disseminate both personal and institutional image information. Bitmap images can be created in two fundamental ways. They can be 'born digital': existing only in digital format after being captured on digital imaging equipment, such as cameras, mobile phones and webcams, or created using a digital imaging software package. Alternatively, they can be the result of 'digitization', where a representation of an analogue object is captured (via camera or scanner) to provide a surrogate, digital image of the picture, document or artefact in question:

> digitisation is the method of creating a digital image from an original book or manuscript utilising an electronic capture process. A digital camera (one equipped with an electronic light-sensitive device in place of the photographic film) captures the optical characteristics of an original. It records the data, not on chemical-based photo-sensitive film but in an electronic file format. The resulting data file can be enhanced for various desired visual effects, is easily stored in databases, can be reproduced multiple times without generational degradation of quality, and can easily and quickly be transmitted across the Internet to anywhere in the world (Grycz 2006, 33).

Digitization, then, involves the creation of a binary representation of an object which already exists, rather than the creation of new and novel pictorial information:

> Digitization is a process which is cannibalising and regurgitating photographic (and other) imagery, allowing the production of simulations of simulations (Willis 1990, 199).

Most personal digital image collections (see Chapter 6) are born digitally: produced by increasingly affordable and pervasive digital camera technologies. Digitization of cultural and heritage image-based material is predominantly an institutional effort (see Chapter 5), although there are plenty of individuals scanning-in old photo albums, or creating digital image representations of their personal collections (see Chapter 6). Digitization of archival, manuscript, photographic and pictorial information is commonly undertaken by memory institutions to facilitate access to their collections (see Chapter 5) and although other media, such as sound and moving images, can be digitized, the most common output of digitization programs is digital images and their corresponding documentation (see Chapter 7). As a result, those working in the information industry, undertaking digitization initiatives and dealing with digital images, should be aware of the many issues surrounding the creation, appropriation, use and usefulness of digital images themselves.

## Why 'Digital Images for the Information Professional'?

The creation, storage and transmission of digital image data is a focus of much effort in cultural institutions, and changes in technology and the information environment are having a profound impact in many areas. Cultural heritage is becoming readily available to a wider audience, holding potential for both teaching and research. Additionally, imaging technologies are becoming increasingly popular in general society, and there is a need to understand how people are using the technology outside institutional boundaries, so that we can communicate using the same technology within our institutions. Those working within the information community also have a role to play in educating the general public about the sustainability and fragility of their digital image collections (see Chapter 6). The 'information professional': an individual managing, developing and deploying information services within an organization or community, is now faced with rapid developments in technology and corresponding changes in society, which have to be understood, accommodated and often facilitated:

> Technology today does not evolve in a clear linear pattern. It shifts and mutates in great leaps and bounds, and often in unexpected directions. Because of this, the future holds more questions than answers … How will these advances change our notion of what photography can or should be? What will happen as modeling software becomes increasingly capable of generating photo-realistic imagery that cannot be distinguished in any way from real life? The only things we can be sure of is that the human desire to understand the world through representation will propel the process of making images through greater and greater changes in the years to come (Lipkin 2005, 10).

There is a clear need for the information professional to be aware of these technological developments, and the flow of digital image information that accompanies it. Understanding digital imaging technologies is the first step to being able to create, use, store and provide access to digital images with confidence in our changing information landscape.

In many ways, this book was born out of frustration: for those working with digital images in the library, archive, museum and information sector there are various texts detailing the management and managerial aspects of digital imaging projects (see pp. 137–139 for further reading) but often these texts place little focus on the actual medium commonly used to present and provide image data which emanates from a digitization initiative. This book aims to provide an overview of different, pertinent aspects of digital images which will be of relevance to those working with digital media environments, providing a common understanding of the principles and issues that pertain to the creation and distribution of both individual digital images and digital image archives as a whole.

This book aims to provide a basic, thorough, outline of digital image technologies and related issues, placing the processes in their historical and contextual framework, explaining common methods and standards, using a vocabulary and approach that librarians, archivists and other information professionals will understand.

## Chapter Overview

This chapter has introduced definitions of imaging, digital technologies and introduced the focus of the text: digital, bitmapped images, which are a subject of interest for those in the information profession due to the growth in use of digital imaging technologies in today's society.

Chapter 2 provides an overview of the history of digital imaging technology. Although digital images have seemed to become popular relatively recently, the technology has been in development for a surprisingly long time, and this chapter demonstrates how the culmination of years of research into imaging, home computing and networking technologies has led, in recent years, to an exponential increase in digital image content being made available, by both institutions and the general public.

Chapter 3 looks at the digital image in detail, examining important features of bitmapped graphics, such as pixels, resolution, interpolation, bit depth, compression and image manipulation. An understanding of these basic technological underpinnings is necessary to frame the topics presented in the remainder of the book, and this chapter aims to approach these topics in such a way as to explain them thoroughly, without recourse to obfuscating technological or mathematical jargon.

Chapter 4 explores digital image file formats and how digital image information is created, stored and rendered by computing systems. The chapter discusses why file formats are necessary, why so many image file formats came to be in existence, and the difference between proprietary and non-proprietary formats. The most popular bitmap image formats used within memory institutions (GIF, PNG, JPEG and TIFF) are discussed in detail, to give an understanding of how and why these became the formats of choice. Additional information is presented about less commonly used formats which may also be of interest to projects dealing with legacy data or dealing with newer, digital camera-based formats.

Chapter 5 provides an overview of how digital images have been used within the library, archive and cultural and heritage sector. In particular, the developing and changing role of digitization within memory institutions is explored, with an emphasis on the creation of digital image surrogates. Current issues regarding the use and usefulness of digital images are explored, as is the approach of institutions to new and developing imaging and Internet technologies.

Chapter 6 discusses the growth in use of digital imaging technologies by the general public, exploring the changing information environment and the transforming role of photography in modern society. In particular, the nature and role of personal collections of digital images is explored. However, the long-term viability of many of these collections is questionable, and this chapter also seeks to explore the role that information professionals may have in educating and informing the general public about the long-term sustainability of their digital image collections.

Chapter 7 examines the type of information which should be stored alongside digital imaging files to aid in their management, long-term sustainability and retrieval: image metadata. Particular emphasis is given to available metadata schemas which are used to describe digital images, and the structured vocabularies and terminologies which can be used to describe the content of images to facilitate use of digital collections. These are juxtaposed with alternative means of searching and retrieving images: folksonomies (tags) and Content Based Image Retrieval techniques.

The final section of the book, Chapter 8, scopes current issues in digital imaging which are pertinent to those working within the information profession. The essential, yet complex issue of colour reproduction and accuracy is addressed, giving pointers to best practice in creating image surrogates which faithfully represent original documents or artefacts. This leads on to issues of quality, and the ways in which institutions may control, or benchmark, digital image fidelity and accuracy. Wider issues regarding digital image manipulation and the changing information environment are presented. Legal issues, such as copyright and rights management are explored. Finally, questions of sustainability and the longevity of digital image collections are noted.

This text is geared towards the type of questions an information professional may ask about the technologies detailed, and framed in such a way as to be of use in library, archive, cultural and heritage information environments. Technologies in common use are given preference over those at the 'leading edge'. Pointers to reference material, appropriate guidelines, standards and applications in the relevant information sectors are given throughout the text where necessary. In addition, each chapter provides further reading and references, for those who wish to learn more about specific topics.