Raster Images: Scanned, Born Digital, and Printed

What is a Raster?

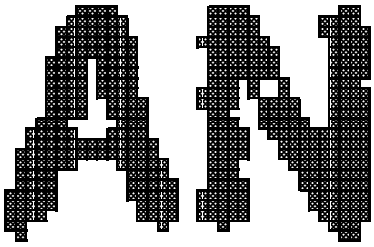
This image (a laser printed page) is a raster of pixels. A raster is a grid or array of pixels (PICture ELements) or pels (Picture ELements) that reproduce an image.

Pixels

The pixels most commonly used to represent images as a computer file are of a uniform size and shape. They do not overlap (they are non-imbricated), and they abut (touch) adjacent pixels on all four sides. All the pixels use the same digital representation of the portion of the image they represent. In this case, each pixel is represented as either a one (white) or a zero (black).

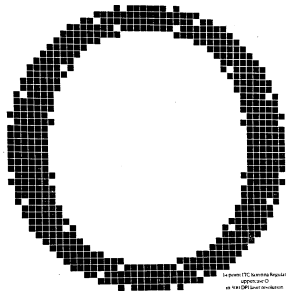
Pixel Shape

Some years ago almost all pixels in computing were standardized on a square shape. Hexagonal pixels have been used in modeling economic geography. Rectangular pixels are still used in video. For document imaging only square pixels are used.



Pixels of Scanned Text

Pixels of actual scanned text form irregular edges, but are a useable analogue of the characters on the scanned documents.

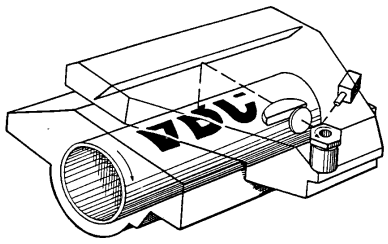


Crafted Edge Character 'O' (Outline Font)

Some documents are created using a word processor, rather than being scanned from a paper original. To laser print a document created using a word processor, the laser printer must create the raster image for each character.

For each printed letter, the laser printer accesses the outline of the character from a character font library. The laser printer then adjusts the size of the character outline to match the size of the character being printed (for example: 10 point, 12 point, or 72 point type, etc.) Then the laser printer fills in the character with pixels as shown above (for a capital 'O').

Outline fonts are based on the mathematical foundation of the Adobe PostScript PDL (Page Description Language) which is the basis for the Adobe PDF language (Portable Document Format).



Mechanism of a Laser Printer

The dotted line in this picture represents a ray of light traveling from the laser to the drum of a laser printer. The light leaves the laser and is reflected from a rotating hexagonal (six sided) prism (mirror) (polygon). The rotation is shown by a curved arrow. The laser beam is then reflected by a second, fixed, mirror, onto the drum of the laser printer. As the prism mirror rotates the laser beam moves across the drum from end to end. (This effect can be tested with a laser pointer and a small mirror.) The laser is turned on to reproduce black pixels and off to reproduce white pixels. The drum rotates (shown by a curved arrow) to place the laser printed rows of pixels side by side in a raster image on the drum.

The drum of a laser printer operates in exactly the same way that a photosensitive drum in a xerographic copier operates. When light falls on the drum, it causes the surface of the drum to attract black toner. The toner is then transferred to paper as the drum rotates and the paper passes under the drum. After the toner is transferred to the paper, the toner is fused to the paper by heat and pressure, creating a copy.

(Laser printers in which the laser light causes the drum to attract toner are called black writers. On some printers the laser light causes the drum to stop attracting toner. These laser printers are called white writers.)

Because the toner is almost pure carbon, the xerographic copy, or laser printed copy, will last as long as the paper. This print life is over 3 hundred years if the print is made on acid free paper.

Inverse Table of Periodicity

Customary Units	Number	Equivalent Customary Units	Number of Common Units	Common Units	Number	Hertz Range	Power of 10
electron frequency (at C, the speed of light)	2.454	picometers	1,200,000,000,000,000,000	hertz	1.20	exahertz	18
fiber optic wavelength (carrier frequency)	1,500	nanometers (=1.5 um)	230,000,000,000,000	hertz	230.00	terahertz	12
microprocessor clock rate (cycle time)	1	billion clock cycles/sec.	1,000,000,000	hertz	1.00	gigahertz	9
Computer RAM (Random Access Memory)	50	nanoseconds	20,000,000	hertz	20.00	megahertz	6
magnetic disk access time (12,000 RPM)	5	milliseconds	200	hertz	200.00	hertz	0
jukebox access (picker) (1 to 5 seconds)	1	second	1	hertz	1.00	hertz	0
second (1 hertz = 1 cycle per second)	1	second	1	seconds	1.00	hertz	0
minute	60	seconds	60	seconds	16.67	millihertz	-3
hour	60	minutes	3,600	seconds	277.78	microhertz	-6
day	24	hours	86,400	seconds	11.57	microhertz	-6
week	7	days	604,800	seconds	1.65	microhertz	-6
month	1/12	year	2,629,800	seconds	380.26	nanohertz	-9
year	365.25	days	31,557,600	seconds	31.69	nanohertz	-9
year	1	year	1	years	31.69	nanohertz	-9
decade	1	ten years	10	years	3.17	nanohertz	-9
century	1	hundred years	100	years	316.90	picohertz	-12
millennium	1	thousand years	1,000	years	31.69	picohertz	-12
precession of the Zodiac	1	rotation	26,000	years	1.22	picohertz	-12
million years	1	million years	1,000,000	years	31.69	femtohertz	-15
billion years	1	billion years	1,000,000,000	years	31.69	attohertz	-18
period of the universe (postulated)	1	period	85,000,000,000	years	372.80	zeptohertz	-21