Announcements

Midterm on Friday: Chapters 1-5,7,8,11

Bring: pen/pencil, Photo-Id, alert mind

Tip of the Day: Studying for the MT is best done w/ book+notes, not online.

Digital Representation

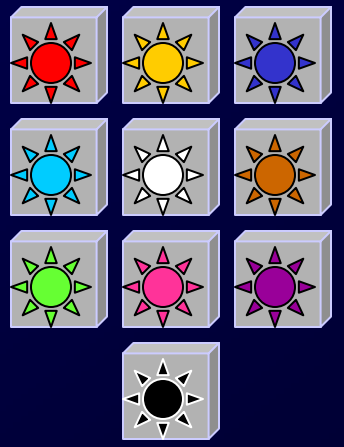
Everyone knows computers use bits and bytes ... but what are they?

© Lawrence Snyder, 2004

Info Representation

Digitization: representing information by any fixed set of symbols

The representation associates one item with each symbol … encode the telephone keypad using ten colors

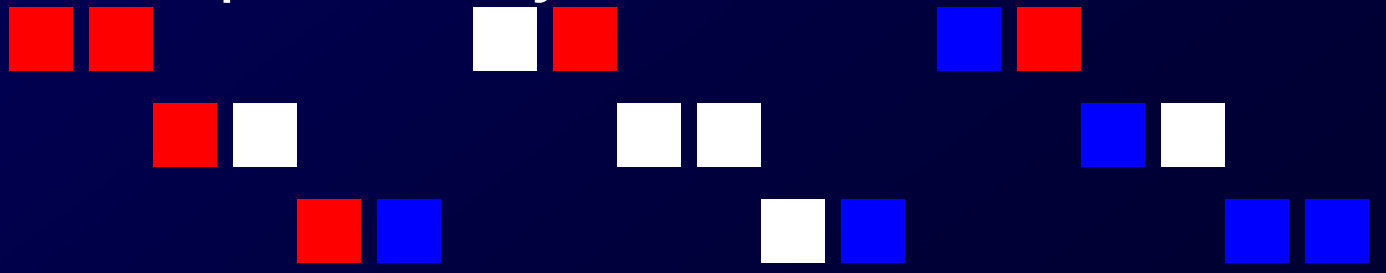


What number is:  ?

Creating Symbols

Often, there are many things to digitize, but too few symbols available

* The solution is to create more symbols by composing patterns ...
* Three patterns make three symbols:
* Pairing them makes 9 symbols; when they are triples, 27 symbols, and ...

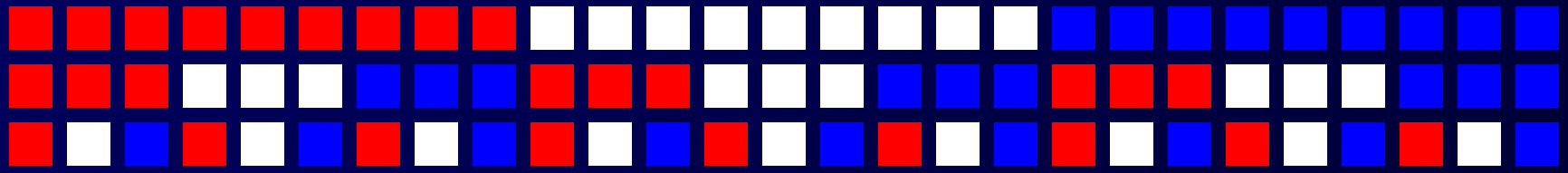


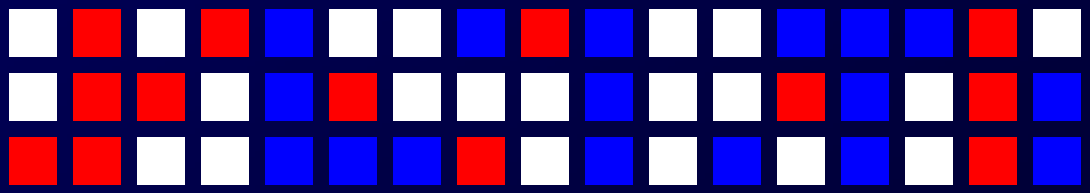
An Encoding

Encode the Latin alphabet

Three pattern ■ □ ■ triples = 27 symbols

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z





Digitize -- encode with symbols

Info in the Physical World

Physical world:

- The most fundamental representation of information is presence/absence of a phenomenon
  - matter, light, magnetism, flow, charge, ...

The PandA representation

  - detect: “Is the phenomenon present?”
  - set: make phenomenon present or absent

Any controllable phenomenon works: define it right

Info in the Logical World

Logical World:

- Information, reasoning, computation are formulated by true/false and logic
  - All men are mortal
  - Aristotle is a man
  - Aristotle is mortal

True and false can be the patterns for encoding information

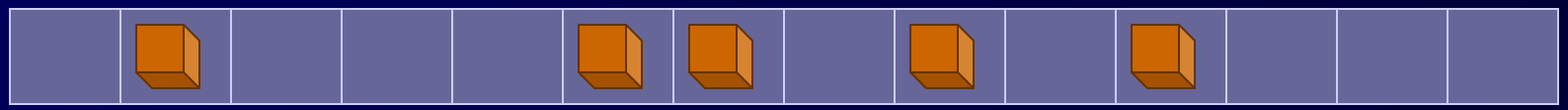
Connect Physical/Logical

The miracle of IT is that physical and logical worlds can be connected

Present represents true / Absent represents false

-- or maybe vice versa, if everyone agrees--

Pavement Memory



false true false false false true true false true false true false false false

0 1 0 0 0 1 1 0 1 0 1 0 0 0

Bits

PandA is a *binary representation* because it uses 2 patterns

Bit -- it's a contraction for "binary digit"

-- a position in space/time capable of being set and detected in 2 patterns

Sherlock Holmes's *Mystery of Silver Blaze* -- a popular example where "absent" gives information ... the dog didn't bark, that is the phenomenon wasn't detected

Bytes

A byte is eight bits treated as a unit

- Adopted by IBM in 1960s
- A standard measure ever since
- Bytes encode the Latin alphabet using ASCII -- the American Standard Code for Information Interchange

0100 0110
0100 1001
0101 0100

ASCII

ASCII	0000 0000	0000 0001	0000 0010	0000 0011	0000 0100	0000 0101	0000 0110	0000 0111	0000 1000	0000 1001	0000 1010	0000 1011	0000 1100	0000 1101	0000 1110	0000 1111
0000	NU	SH	SX	EX	ET	EQ	AK	BL	BS	HT	LF	VT	FF	CR	SO	SI
0001	DL	D1	D2	D3	D4	NK	SY	EB	CN	EM	SB	EC	FS	GS	RS	US
0010		!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
0011	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
0100	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
0101	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
0110	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
0111	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DT
1000	S0	S1	S2	S3	IN	NL	SS	ES	HS	HJ	VS	PD	PU	RI	S2	S3
1001	DC	P1	P2	SE	CC	MW	SP	EP	RS	US	SA	SS	ST	OS	PM	AP
1010	A0	¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬	-	®	¯
1011	°	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿
1100	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
1101	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß

0100 0110
0100 1001
0101 0100

0100 1000 | 0111 0101 | 0111 0011 | 0110 1011 | 0110 1001 | 0110 0101 | 0111 0011 | 0010 0001

Encoding Information

Bits and bytes encode the information, but that's not all

- Tags encode format and some structure in word processors
- Tags encode format and some structure in HTML
- In the *Oxford English Dictionary* tags encode structure and some formatting

OED Entry For Byte

byte (baIt). *Computers*. [Arbitrary, prob. influenced by bit *sb.*[4] and bite *sb.*] A group of eight consecutive bits operated on as a unit in a computer. **1964** ***Blaauw*** & ***Brooks*** in *IBM Systems Jrnl.* III. 122 An 8-bit unit of information is fundamental to most of the formats [of the System/360]. A consecutive group of *n* such units constitutes a field of length *n*. Fixed-length fields of length one, two, four, and eight are termed bytes, halfwords, words, and double words respectively. **1964** *IBM Jrnl. Res. & Developm.* VIII. 97/1 When a byte of data appears from an I/O device, the CPU is seized, dumped, used and restored. **1967** ***P. A. Stark*** *Digital Computer Programming* xix. 351 The normal operations in fixed point are done on four bytes at a time. **1968** *Dataweek* 24 Jan. 1/1 Tape reading and writing is at from 34,160 to 192,000 bytes per second.

<e><hg><hw>byte</hw> <pr><ph>baIt</ph></pr></hg>. <la>Computers</la>. <etym>Arbitrary, prob. influenced by <xr><x>bit</x></xr> <ps>n.<hm>4</hm></ps>and <xr><x>bite</x> <ps>n.</ps> </xr></etym> <s4>A group of eight consecutive bits operated on as a unit in a computer.</s4> <qp><q><qd>1964</qd><a>Blaauw &amp. <a>Brooks <bib>in</bib> <w>IBM Systems Jrnl.</w> <lc>III. 122</lc> <qt>An 8-bit unit of information is fundamental to most of the formats <ed>of the System/360</ed>.&es.A consecutive group of n such units constitutes a field of length n.&es.Fixed-length fields of length one, two, four, and eight are termed bytes, halfwords, words, and double words respectively. </qt></q><q><qd>1964</qd> <w>IBM Jrnl. Res. &amp. Developm.</w> <lc>VIII. 97/1</lc> <qt>When a byte of data appears from an I/O device, the CPU is seized, dumped, used and restored.</qt></q> <q><qd>1967</qd> <a>P. A. Stark <w>Digital Computer Programming</w> <lc>xix. 351</lc> <qt>The normal operations in fixed point are done on four bytes at a time.</qt></q><q><qd>1968</qd> <w>Dataweek</w> <lc>24 Jan. 1/1</lc> <qt>Tape reading and writing is at from 34,160 to 192,000 bytes per second.</qt></q></qp></e>

Summary

IT joins physical & logical domains so physical devices do our logical work

- Symbols represent things 1-to-1
- Create symbols by grouping patterns
- PandA representation is fundamental
- Bit, a place where 2 patterns set/detect
- ASCII is a byte encoding of Latin αbet
- In addition to content, encode structure