A

Discussion of Quiz 3 (10/14/2003).

(1) <u>Much</u> Better.

(2) Not Good Enough.

Problems:

(1) Several students seem not to know binary numbers.
I checked: you <u>have</u> had them in CIS 113.

(2) Students try to <u>memorize</u> without <u>understanding</u>.
Try the other way around.

Number Systems:

1. Decimal

6031 means

$$1 + 3*10 + 0*100 + 6*1000$$

$$= 1*10^0 + 3*10^1 + 0*10^2 + 6*10^3.$$

2. n-ary

Choose a <u>basis</u> n.

$d_{k-1}\ d_{k-2}\ d_{k-3} \cdots d_1\ d_0$ stands for

$$d_0 * n^0 + d_1 * n^1 + \cdots + d_{k-1} * n^{k-1}$$

$$= \sum_{i=0}^{k-1} d_i * n^i$$

Aside: $\forall$ all d_i <u>integer</u>,

$$0 \le d_i \le n-1.$$

Examples:

10-ary is same as decimal.

8-ary is same as octal.

16-ary is same as Hexadecimal. (IBM!)
(Hexa dee).

ϕ	1	2	3	4	5	6	7	8	9	10
										A

11	12	13	14	15
B	C	D	E	F

Two digits per byte

$1AB\phi = 0*1 + 11*16 + 10*254 + 1*4096$

2-ary : <u>binary</u>.

Hexadee: 1F = 0001 1111
etc

Binary.

0	=	ϕ
1	=	1
2	=	1 ϕ
3	=	1 1
4	=	1 0 0
5	=	1 0 1
6	=	1 1 0
7	=	1 1 1
8	=	1 0 0 0

etc

This was "among humans".
Now "among computers":

Computer Representation:

k bit representation.

"unsigned int".

Leading zeros explicitly there.

0: | 0 | 0 | . . . | 0 |

1: | 0 | . . . | 0 | 1 |

2: | 0 | . . . | 0 | 1 | 0 |

etc.

? | 1 | 1 | . . . | 1 | 1 |

k bits.

(1) $1 + 2 + 4 + 8 + \cdots + 2^{k-1} = \frac{2^k - 1}{2 - 1} = 2^k - 1.$

(2) <u>One more</u> would be k+1 bits.

(<u>IF</u> we had space for one more bit !).

| 1 | 0 | 0 | . . . | 0 | 2^k

k bits :

(1) 2^k different possible combinations.

(2) in "unsigned int" :

values $0, 1, 2, \ldots, 2^k - 1$.

2^k <u>different values</u>.

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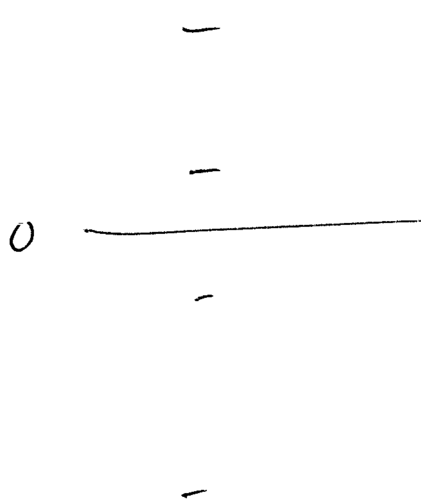
(3) "Non-linear representation"
as in PCM.

k bits :

2^k <u>levels</u>



Map
binary number ⟺ Level :
one-to-one.
Optimal map : out of scope
For this course!

Binary, Representation in Computer.
<u>Signed</u> int. k bits.

(1) (k-1) bits for "unsigned int".
k-th bit for sign.
"Makes sense", but not convenient.

(2) Two's complement. ← (!)
Used mostly.

(3) One's complement.
Only in IP checksum?

You have seen two's complement in
CIS 113.
<u>And</u> in CIS 451:
pp 77 - 81 of these notes.
one's complement only in these notes.
(example)

Understand,

Do not memorize.

For example:

$$\left(\frac{S}{N} \text{ in dB}\right) = 10 * \log_{10}\left(\frac{S}{N}\right)$$

Shannon:

Max data rate =

$$H * \log_2\left(1 + \frac{S}{N}\right)$$

H : Frequency Range in Hz
Frequency Width in Hz
Bandwidth in Hz.

Know this ↑.

Derive translation as needed

Another Example.

"Show this version of stop & wait is bad".

① The problem is that without sequence numbers the destination does not know *which* frame it just got.

(Fair amount of credit, but this is *not* an example).

② How to generate an *example*?

Think of "simple cases".

(i) Data Frame Lost.

(ii) ACK Lost.

(iii) D.FRAME/ACK delayed

Understand stop & wait well enough that you can *generate* an example.