CSD1100

Encoding.
Roman numerals.
Positional system

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Encoding

- Encoding is the process of converting the input from one format to another one
- Formats:
  - Speaking languages
  - Writing languages
    - Morse code
    - Numbers
  - Visual languages
    - Flags
    - Traffic signs and lights
- Different formats have different uses
  - In lecture
  - In PC

English Language

- A book written using the English language consist of chapter that consist of paragraph that consist of statement that consist of words that are constructed using a character or a symbol set.
- The character or symbol set consist of alphabet letters and some special characters such as the space, exclamation mark, period, comma, etc…
- Basically, a language is a code that uses the alphabet and the concept of using a combination of characters to encode a word is the process of coding the words.
- For example: the word "hello" consists of four characters: 'h', 'e', 'l', and 'o'.
- In order to converse, read, or write using the English language, once must study the language itself (vocabulary, grammar, etc…).

Morse code

- Morse code is named after Samuel Morse, one of the inventors of the telegraph.
- The Morse alphabet became a worldwide standard in 1865. It has been widely used in the maritime world until the end of the 20th century.
- The Morse alphabet is designed so that the most frequent letters in the English alphabet has the shortest codes. (This makes transmission much faster than if all letters would have equal length codes.)
- Morse code is said to be a binary code because it deals only with dots and dashes only.

INTERNATIONAL MORSE CODE

a	· —	n	— ·	á	· — — · —	8 — — — · ·
b	— · · ·	o	— — —	ä	· — · —	9 — — — — ·
c	— · — ·	p	· — — ·	é	· · — · ·	0 — — — — —
d	— · ·	q	— — · —	ñ	— — · — —	, — — · · — — (comma)
e	·	r	· — ·	ö	— — — ·	. · — · — · — (period)
f	· · — ·	s	· · ·	ü	· · — —	? · · — — · · (question mark)
g	— — ·	t	—	1	· — — — —	" · — · · — · (quotation marks)
h	· · · ·	u	· · —	2	· · — — —	: — — — · · · (colon)
i	· ·	v	· · · —	3	· · · — —	; · — — — — · (apostrophe)
j	· — — —	w	· — —	4	· · · · —	- — · · · · — (hyphen)
k	— · —	x	— · · —	5	· · · · ·	/ — · · — · (slash)
l	· — · ·	y	— · — —	6	— · · · ·	(— · — — · (left parenthesis)
m	— —	z	— — · ·	7	— — · · ·	) — · — · — (right parenthesis)

Numbers

- The same way, we needed to encode words. We need also to encode numbers in order to be able to communicate values.

- The answer to the next questions requires numbers:
  - How old are you?
  - How tall are you?
  - How far is it?
  - Etc…

Numbering Systems

- Our civilization was based on buying and selling goods, by doing business between cultures.
- For example a farmer having ten cows he would have represented them with a drawing of a cow followed by 10 scratch marks.
- A better way to represent this was by introducing the numbering system that is of two types:
  - **Non positional:**
    - The Roman numbering system
  - **Positional:**
    - The Hindu-Arabic numbering system

Non positional numbering system

- Ex: The Roman Numbering System
- It is still used in our days as chapter numbers, clocks, dates on monuments, movies copyright notice…

Roman symbol	Name	Arabic Value
I	*unus*	1
V	*quinque*	5
X	*decem*	10
L	*quinquaginta*	50
C	*centum*	100
D	*quingenti*	500
M	*mile*	1,000

Roman Numbering System

- For example,
  - the number III means 3,
  - VI is 6,
  - XXXI is 31,
  - CDXLVIII is 448,
  - MCMXCVIII is 1998.

- Difficult to read.
- Better than counting sticks or pebbles.
- Easy to add (+).
- Difficult to multiply (*) and divide (/).

Positional to Roman

I	V	X	L	C	D	M
1	5	10	50	100	500	1000

$$42 = 50 - 10 + 1 + 1 = XLII$$
$$2015 = 1000 + 1000 + 10 + 5 = MMXV$$

Positional Numbering System

- Early number systems all have one thing in common. They require someone to write down many symbols to record a single number and create new symbols for each larger number.
- A positional system allows you to reuse the same symbols, by assigning the symbols different values based on their position in the sequence.
- Several civilisations developed positional notation independently, including the Babylonians, the Chinese and the Aztecs.
- By the 7th Century, Indian mathematicians had perfected a decimal (or base ten) positional system, which could represent any number with only ten unique symbols. Over the next few centuries, Arab merchants, scholars and conquerors began to spread it into Europe.
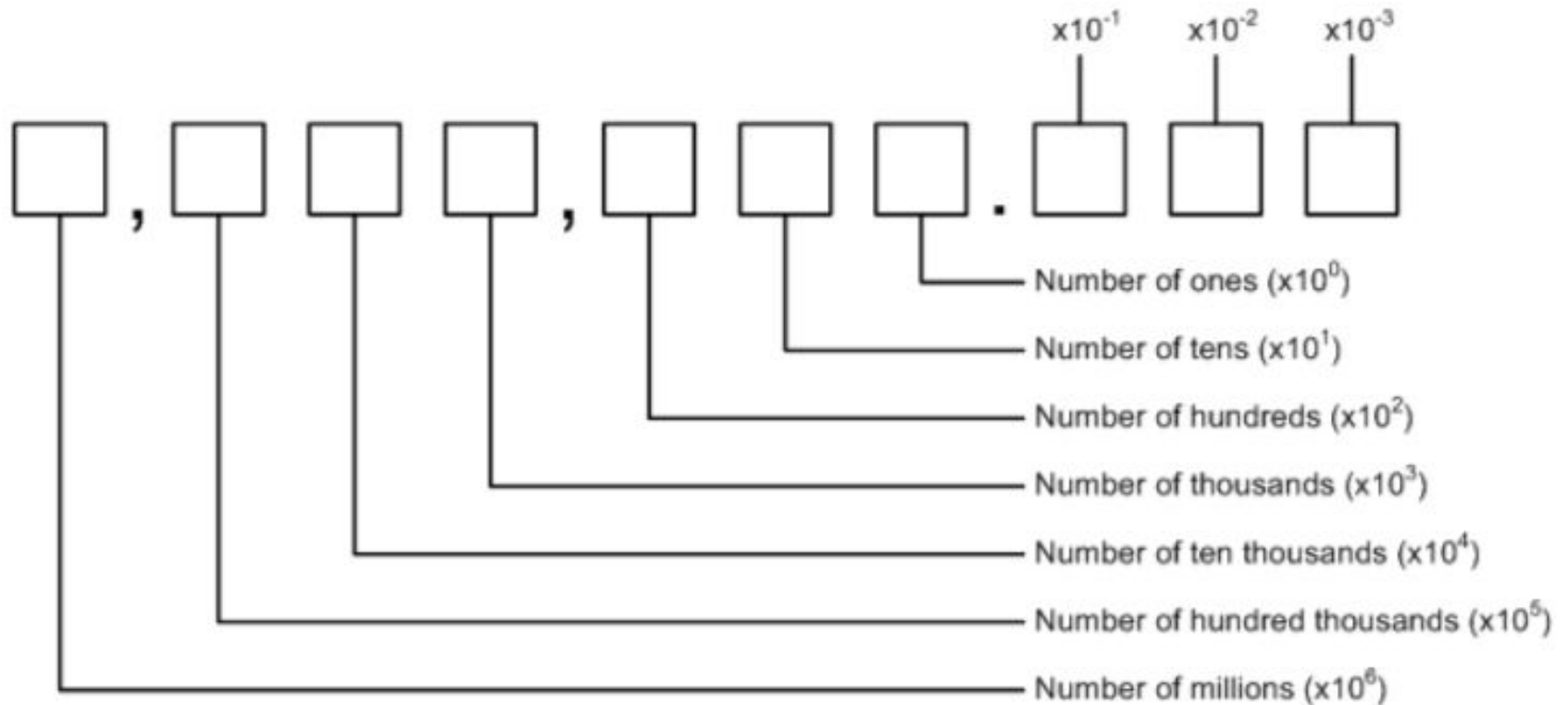
Positional Numbering System

- Modern decimal positional system uses special unique "digits"

  0 1 2 3 4 5 6 7 8 9

- Digits are combined into a sequence
- A weight is given to each digit in the number depending on the position of the digit in the number.
  - The digit '1' in the number 130 and the digit '1' in the number 12 have different meaning. In the first it indicates how many hundreds are in 130; whereas it indicates how many tens are in 12.
- No symbol for the number 10.
- 'Zero' is introduced to support the system.

Positional Numbering System

Positional Numbering System

- Advantages of the Hindu-Arabic system:
  - Can represent any number using only a combination of up to 10 symbols.
  - Easy to read any number no matter how complex it is.
  - Easy to add (+), subtract (-), multiply (*) and divide (/).

- Positional numbering systems are classified according to the total number of unique digits the numbering system uses.
- In other words, the **base or radix** of a system indicates how many unique symbols the numbering system uses.
- For example, Decimal system is a base 10 numbering system because it uses 10 unique symbols.