
GMIT
INSTITIÚID TEICNEOLAÍOCHTA NA GAILLIMHE-MAIGH EO
GALWAY-MAYO INSTITUTE OF TECHNOLOGY

NUMBER SYSTEMS AND BINARY NUMBERS

ALL COMPUTER DATA IS STORED/PROCESSED AS BINARY NUMBERS

!MATH WARNING!

- Today's lecture contains trace amounts of arithmetic and algebra
- Please be advised that calculators will be allowed (and that you probably won't need them)

OVERVIEW/QUESTIONS

- What gives a number its value?
- What is a number system?
- What's a binary number?
- What kind of numbers do computers store and manipulate?

TYPES OF NUMBER

- Natural Numbers
  - Zero and any number obtained by repeatedly adding one to it.
  - Examples: 100, 0, 45645, 32
- Negative Numbers
  - A value less than 0
  - Denoted with a '–' sign
  - Examples: -24, -1, -45645, -32

TYPES OF NUMBER

- Integers
  - Set of natural and negative numbers
  - Examples: 249, 0, -45645, -32
- Real numbers
  - Numbers that have decimal representations and have a finite or infinite sequence of digits to the right of the decimal point.
  - They can be positive, negative, or zero.

NUMBERING SYSTEMS

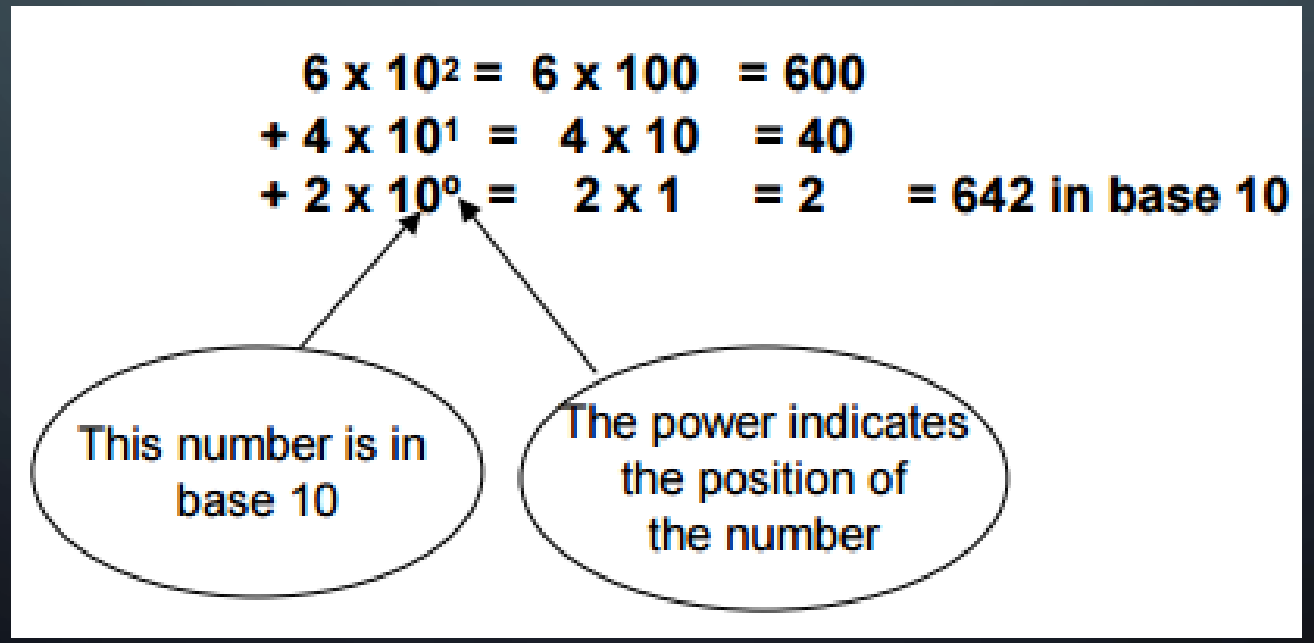
- A numbering system assigns meaning to the position of the numeric symbols.
- For example, consider this set of symbols:
  - 642
  - What number is it?
  - Why?

NUMBERING SYSTEMS

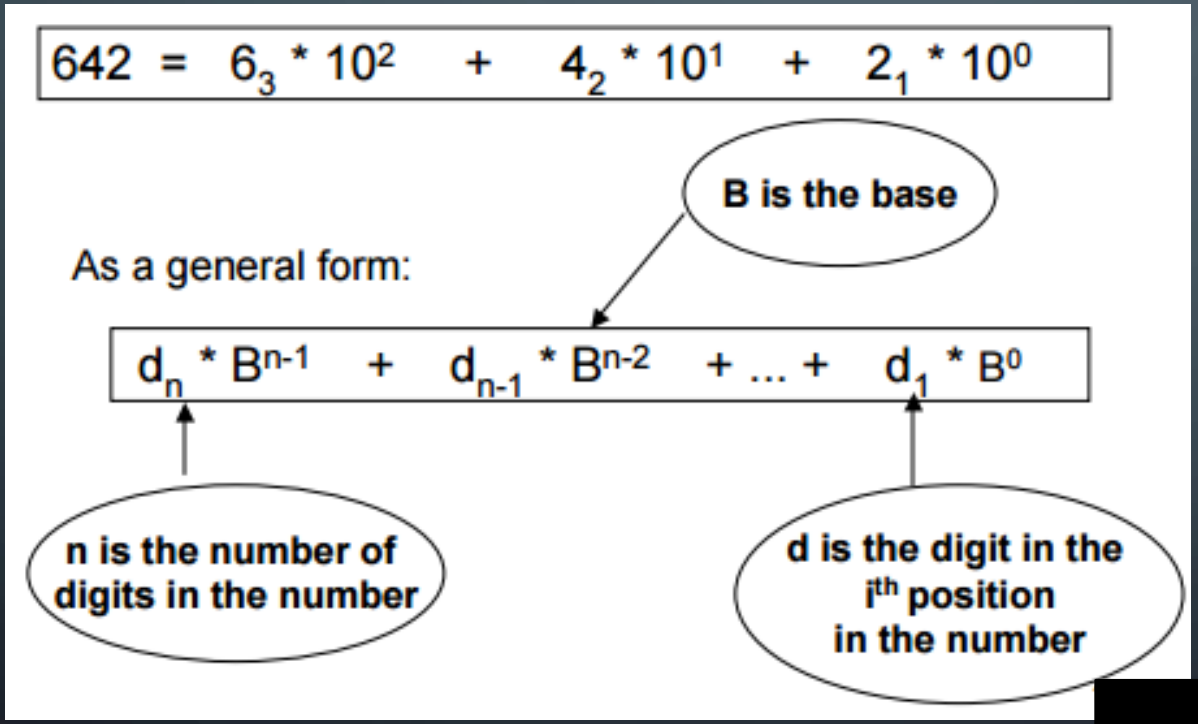
- It depends on the numbering system.
  - 642 is 600 + 40 + 2 in BASE 10
- The base of a number determines the number of digits (e.g. symbols) and the value of digit positions

POSITIONAL NOTATION

- Continuing with our example…
- 642 in base 10 positional notation is:



POSITIONAL NOTATION



BINARY NUMBERS

- Digital computers are made up of electronic circuits, which have exactly 2 states: on and off.
- Computers use a numbering system which has exactly 2 symbols, representing on and off.
- 0V and 5V (3.3V)

BINARY NUMBERS

- Decimal is base 10 and has 10 digits:
  - 0,1,2,3,4,5,6,7,8,9
- Binary is base 2 and has 2, so we use only 2 symbols:
  - 0,1
- For a given base, valid numbers will include digits in that base, ranging from 0 up to (but not including) the base.

BINARY NUMBERS AND COMPUTERS

- A binary digit or bit can take on only these two values.
  - Low Voltage = 0
  - High Voltage = 1
- Binary numbers are built by concatenating a string of bits together.
  - Example: 10101010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