Information

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Information

- Signal

- Message (Nachricht)

- Information

Signal as a function of time

- **Analog (Continuous)**
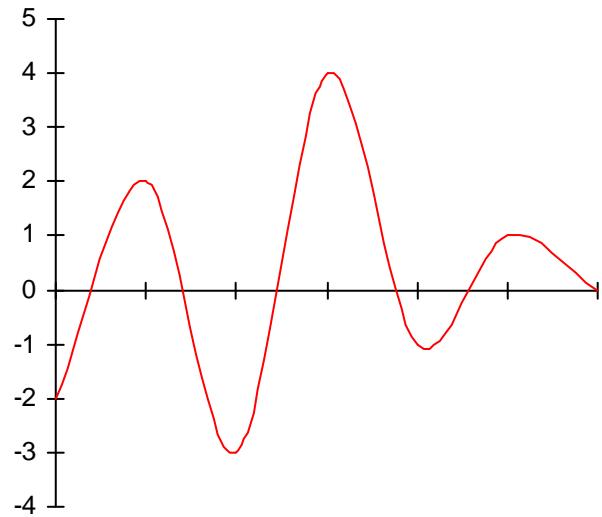
 - Continuous-time systems: radio, TV, car, etc.

- **Digital (Discrete)**
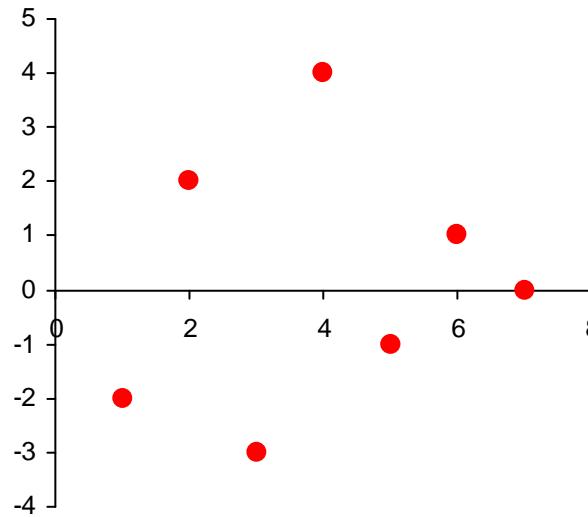
  - Discrete-time systems: PC games, Matlab, Mathematica, etc.

Analog vs. Digital Signal

- **Analog Signal**
  - Continuous flow
  - Arbitrary precision
  - Expensive

- **Digital Signal**
  - Discrete flow
  - Limited precision
  - Less expensive

Messages

- Language

  - Syntax ← representation

  - Semantics ← meaning

- Example of languages

  - (x+1)/(x-1)
  - for (int i=0; i<n; i++)
  - 101011100
  - happy man

Syntax

- **Alphabet:** symbols of a language
  - Examples:

    {a | b | c | …| z}

    {0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}

    {+ | - | * | / | < | >| = }

    Binary Alphabet

    { ☺| ☹}

    {♀| ♂}
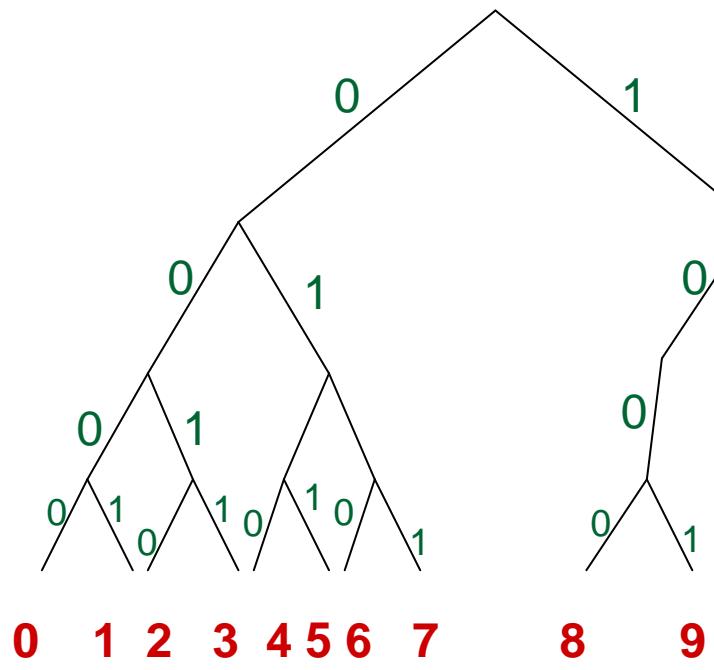
    {0 | 1} ⟵ **Binary Numbers / Bits**

   { T| F}

- **Code:** sequence of alphabet symbols
  - Encoding
  - Decoding

Binary Code

0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001

Code Tree
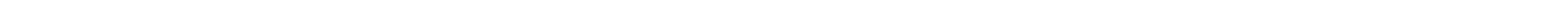
Code Length and Data Representation

- $N = 2^L$

  L … (binary) codeword's length

  N … Number of different words

- $L = ld\ N$

Signed and Unsigned Integers

- **Unsigned integers** on L bits range over:

$$0, \ldots, 2^L - 1$$

  (ganze Zahlen ohne Vorzeichen)

- **Signed integers** on L bits range over:

$$-(2^{L-1} - 1), \ldots, 2^{L-1} - 1 \qquad \text{(with +/- 0)}$$

  (ganze Zahlen mit Vorzeichen)

  one sign bit (the most significant bit):
  - 0 for positive
  - 1 for negative

Exercise

- **Signed integers** of how many **decimal digits** can be represented in a binary code of **8 bits of length**?

(Auf wie viele Dezimalziffern genau können ganze Zahlen mit Vorzeichen in einem binären Code der Länge 8 bit dargestellt werden?)