Information technology – lecture 9

Representation of computer data.
ASCII and UNICODE.
Text files versus binary files.

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Different data types

1. numbers
2. text
3. audio
4. images and graphics
5. video

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Analog versus digital information

analog information – infinite number of values,

digital information – finite set of values.

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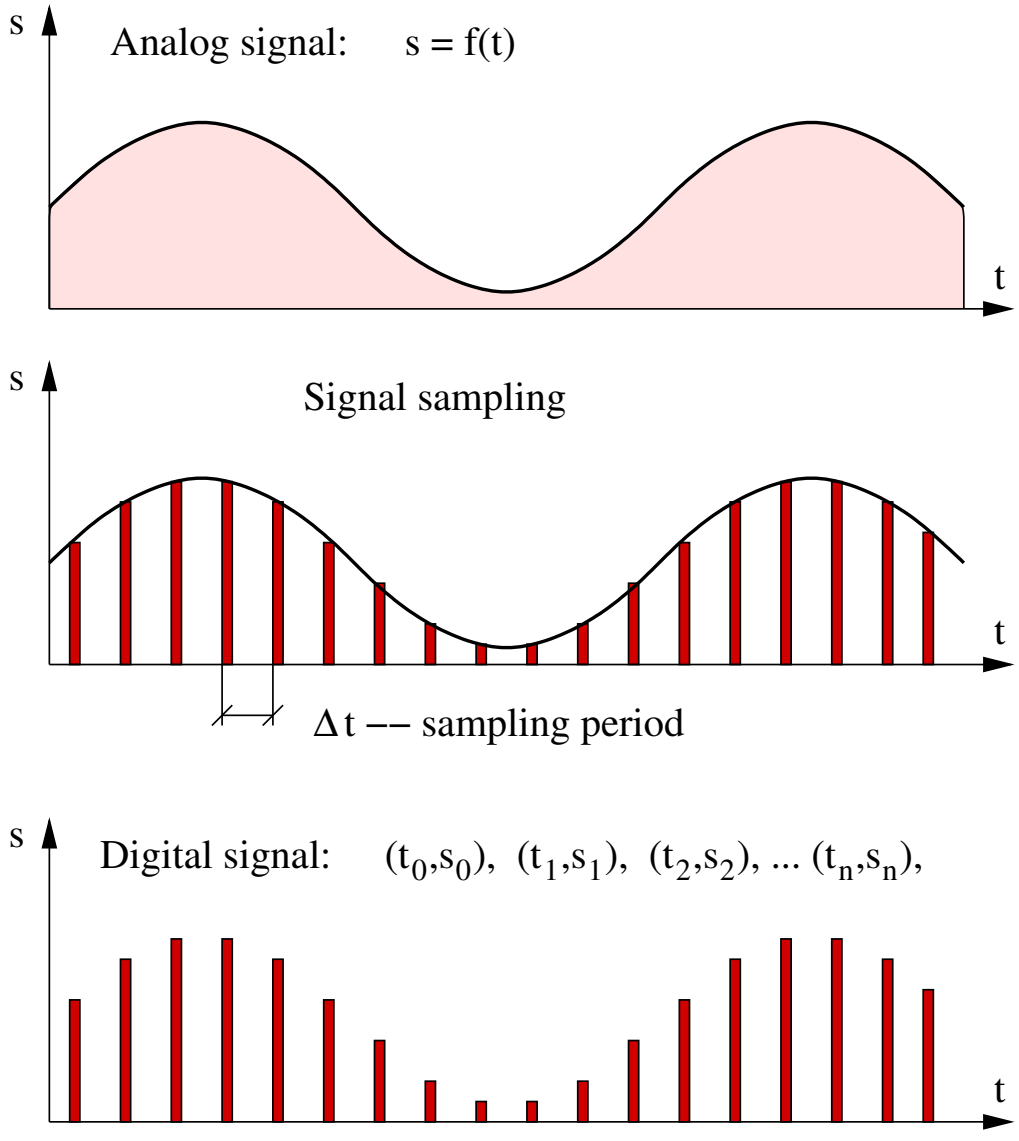
Discretisation example – sampling signals



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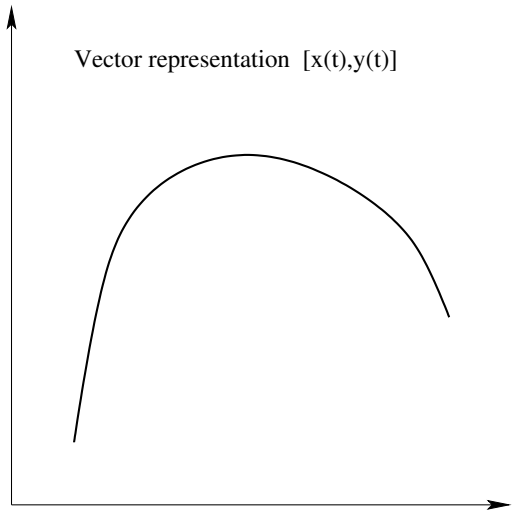
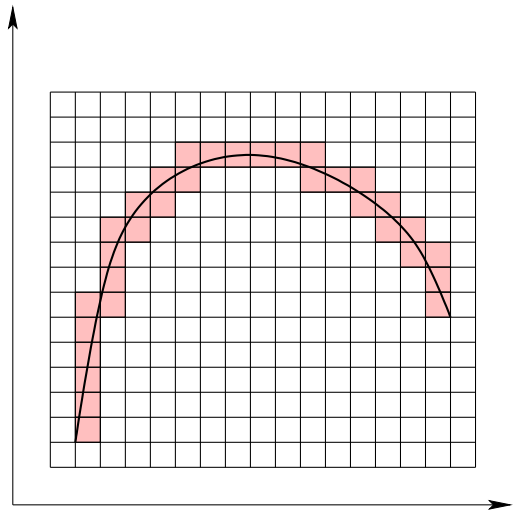
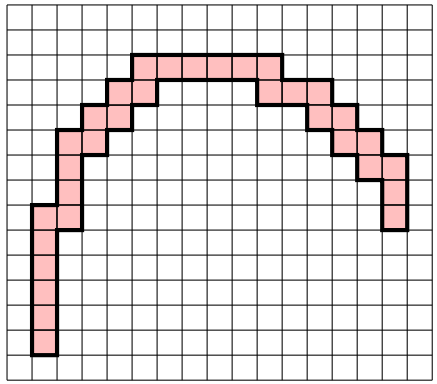
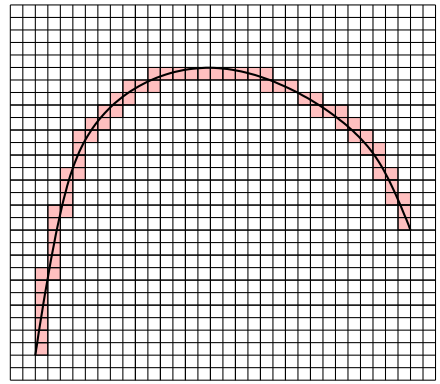
Vector versus raster graphics





Raster representation





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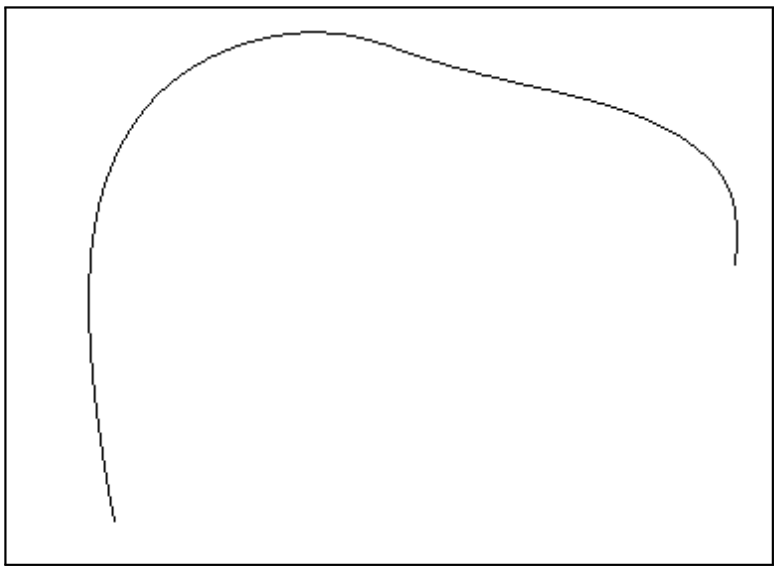
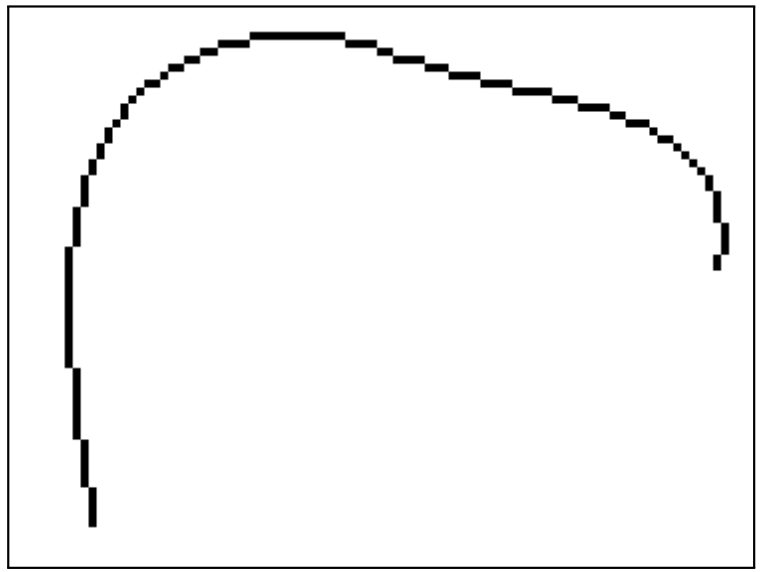
Sampling curve at different resolutions





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Space utilisation of various graphic file formats

File	Size [B]	Description
Vector formats		
avb.fig	289	FIG image text, version 3.2
avb.svg	1978	SVG Scalable Vector Graphics image
avb.eps	4764	PostScript document text
Raster formats		
avb.gif	997	GIF 358x263 8-bit PseudoClass 2c 997b
avb.png	2496	PNG image data, 358 x 263, 8-bit/color RGB
avb.jpg	4591	JPEG 358x263 8-bit PseudoClass 256c
avb.tif	566136	TIFF image data, little-endian

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Details of FIG format

```
#FIG 3.2 Produced by xfig version 3.2.5b
Landscape
Center
Metric
A4
100.00
Single
-2
1200 2
3 2 0 1 0 7 50 -1 -1 0.000 0 0 0 4
 765 4185 1170 1035 4365 1215 5220 2340
 0.000 -1.000 -1.000 0.000
```

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Data compression

By data compression we understand reducing the amount of space needed to store a piece of data.

lossless compression – class of data compression algorithms that allow to store data without loss of information. Lossless graphic formats: PNG, TIFF.

lossy compression – by approximating the original data some information is lost but in exchange for better compression rates. Lossy graphic formats: GIF, JPEG.

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Binary representation of data

Computers can only manipulate information that is encoded in a sequence of bits of a finite length.

bit – basic information unit, the amount of information that can be stored by a digital device having only two distinct states.

byte – ordered sequence of bits (usually 8)

word – a unit of data specific for a particular computer architecture

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Numbers

Number categories

- natural numbers
- integer numbers
- rational numbers
- real numbers

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Positional notation

Let:
$\beta \in N, \beta >= 2$ – the base
x_k – digits, $0 <= x_k < \beta$ with $k = -m, \ldots, n$

Notation:

$$x_\beta = (-1)^s [x_n x_{n-1} \ldots x_1 x_0 \, . \, x_{-1} x_{-2} \ldots x_{-m}] \quad x_n \neq 0$$

Interpretation:

$$x_\beta = (-1)^s \left(\sum_{k=-m}^{k=n} x_k \beta^k \right)$$

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Endianness

The way of ordering individually addressable sub-units, that is words, bytes, bits. In most cases endianness refers to the order of bytes within a word. Two most common ways:

little-endian – increasing significance with increasing memory address

big-endian – opposite, most significant byte first.

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Representing text

Character set – list of characters and the codes to represent them.
The two most popular standards:

- ASCII
- Unicode

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ASCII

American Standard Code for Information Interchange (ASCII) – originally 7 bit character set (128 characters). The extended version (8 bit character set) called extended ASCII (high ASCII, Latin-1 Extended ASCII) allows to include special characters, for instance accented letters, thus allowing to handle character sets for languages other than English.

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Unicode

A standard for encoding, representation and handling of text, that includes most of the world's languages. Unicode defines various encodings:

- UTF-8 – a 8 bit, variable width encoding (ASCII compatible), uses 1 to 4 octets (bytes) for each character.
- UTF-16 – a 16 bit, variable width encoding, uses one or two 16-bit code units.
- UTF-32 – a 32 bit, fixed-width encoding.

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Plain text files versus binary files

plain text file – the contents of the file is readable as textual material without much processing

binary file – the content of the file must be read by a program that interprets it according to some specified binary file format. When opened in a text editor one gets usually unintelligible display of textual characters.

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