The Information Society

During the last few years the rapid development of information technologies has caused dramatic changes within our society. The massive digitalization (multimedia) and global linking (internet) of human knowledge are offering gigantic masses of information to every member of our society – as far as he/she has the necessary technical equipment and personal skills to access this reservoir. The retrieval of really valuable information concerning a specific topic and the assessment of its seriousness, authenticity, completeness or reliability are requiring a certain background knowledge about the internal structure of the used networks and the basic mechanisms of information transfer. In order to offer own websites and manage the personal access rights, one has to be informed about the structure of the World Wide Web. In order to choose the appropriate search engine for a specific task, to interpret the results correctly and to ensure that his/her own site is found by others, one has to know the fundamental working principles of the different search engines.

The progressive miniaturization, efficiency, power and cheapness of microprocessors has led to a their broad usage as control systems in a multitude of complex machines from washers to cameras, from cars to aircrafts. The possible risks as well as the future chances of these techniques can only be judged by those who are informed about the principal limitations of every form of automatic information processing.

Today nearly all offices, even most of the children’s rooms are containing personal computers, which are offering a computing power that was reserved to mainframes some years ago and thus are forming very complex, efficient and productive tools. Their application is reaching from processing of texts to communication over the internet, from tax declarations to electronic banking, from video cutting to the production of Music-CDs, from “edutainment” programs to fascinating computer games. A competent, responsible and economic application of these machines requires deep knowledge about their inner structure and their working principles. Only the know-how about the features of the file system enables us to manage the mass of our private and professional data. Only the knowledge of the storage size of a video film allows us to estimate, how many and which films can be processed simultaneously. Only the understanding of the working principles of computer viruses prevents us from confusing their real dangers with the numerous rumors about their abilities. Therefore the real mastery of the modern information technologies is equivalent with the disposal over a systematic knowledge about the structure, working and construction principles, possibilities and limitations of IT-Systems.

“Informatics” (not exactly synonymous with “Computer Science” in its literal meaning) as the “science of automatic processing of information” offers numerous elements of this knowledge, concerning the representation and processing of information in general as well as the inner structure, the working and construction principles of IT-Systems. These concepts did not lose anything of their actuality and usefulness over decades and many generations of IT-Systems. They are also helpful when it comes to structure complex systems in general, within as well as outside of the field of IT. As an example we could mention the treatment and description of synthetic (formal) languages (e.g. formula of all kinds) or hierarchic structures (e.g. family trees, biologic classifications), the decomposition of complex systems into a set of components (organization of companies) or the coordination of chronological parallel processes (e.g. production or booking processes, collaborations of all kinds).

Additionally the science of “Informatics” has developed a precise terminology which allows us to represent and communicate information about IT (and other) systems clearly and understandably (in contrast to the cryptic idioms and acronyms of the “technofreaks”).

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INFORMATICS AS MANDATORY SUBJECT AT SECONDARY SCHOOLS

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The Duty of the Schools

At least our secondary schools are forced to react on this evolution in order to fulfil their duty, the general and vocational education of young people, which means the optimal preparation of their students for a life in the information age. The future members of the information society will need efficient, economic and reliable strategies to find digitally represented information within global networks, to interpret and to present them to other people. They will have to solve highly complex problems with the collaborative usage of a variety of IT-Systems (1.).

The mastery of IT-Systems plays the major role in information retrieval as well as in problem solving. Therefore, of course, all students (as well as all teachers) need unhindered access to computers and networks and, of course, will have to acquire basic user skills of IT-Systems. But in our opinion this is not sufficient to meet the challenges of the information age, because pure user skills are not transferable from one type of system to another nor from one class of problems to another and therefore will become rapidly obsolete. They are restricted to the user interface and do not allow insights in the system. This leads to an emotional attitude towards IT-Systems. They are loved or hated instead of looked at as what they really are: human artefacts with very limited intelligence and possibilities (2.).

These drawbacks of drilling pure user skills (e.g. “computer licenses”) can be overcome only by imparting certain basic concepts of IT within a mandatory subject (called “Informatics”, see 3.), similar to the traditional subject of physics, which offers e.g. basic knowledge about the mechanic and thermodynamic working principles of car engines (without leading the students to of a driving license by drilling driving skills) or to the subject of biology, which imparts know-how about the principles of living systems (e.g. animals).

Beyond the mastery of IT-Systems a systematic education in informatics will generally contribute to the ability of the students to make their living in a highly complex, variedly linked social environment (3.). Informatical techniques and skills will help them to prepare their tax declarations and judge its results (e.g. algorithms), to understand political processes and connections (e.g. data flows, subsystems), or manage data and documents of all kinds (hierarchical systems).

Like the knowledge and skills that are imparted within traditional subjects (e.g. mathematics, physics, languages or chemistry), the subject matter of informatics requires high pedagogical and didactical abilities on the side of the teacher as well as some efforts and devotion on the side of the students. Both of these conditions can only be achieved by implementing informatics as an independent, mandatory subject which ensures a specific teacher education at university level as well as the equality with other subjects concerning the efforts of the students. Of course the existence of this subject does not bother the use of IT in other subjects in order to improve learning processes.

Informatics as a Subject: Principles

Of course it is not appropriate to teach “informatics” at secondary schools using adapted scientific curricula from the University. According to our argumentation concerning the duties of our schools (see above) we have to ask ourselves, which informatical skills and concepts will help our students to understand and master IT-Systems, to structure complex systems in general and to navigate in global information spaces (see 4.).

Beside these criteria we have to respect some general restrictions which apply to all subjects. The taught concepts and skills should be valuable and applicable to the students for a long time (which means for decades), should have a broad field of application even outside the area of IT and finally should be teachable respecting the age level of the students.

Concerning the teaching methods the subject of informatics is offering, more than any other subject, a very modern and student-oriented learning style: the intensive problem-oriented usage of computers forces teamwork, group-teaching, project work and product-orientation (see 3.).
First Level (Age of 11–13)

During this first period of systematic education in Informatics the students are predominantly working on documents, which are produced and processed using a variety of different standard software packages. While designing graphics and texts, managing files using file systems, transporting documents with E-Mail, linking them into hypertext structures and programming simple machines like virtual or real robots (e.g. Karel the Robot, see 5. or LEGO® Mindstorms, see 6.) they thoroughly analyse the used data structures and processes. Thus they are acquiring first insights into basic principles of the digitalization, linking and automatic processing of information.

By analysing the data structures they detect, that every document consists of specific objects with specific attributes and methods which are typical for the considered type of application. For example the documents of a word processor contain paragraphs with specific margin width or line spacing, which themselves contain characters with specific font type, font size or color. Using this scheme allows the students to understand, describe and compare a variety of phenomenons in the context of IT-Systems.

Of course all this learning processes have to be realized playfully and with emphasis on concrete tasks (e.g. the production of invitations for a birthday party), respecting the age of the students. Nevertheless we lay the foundations of a systematic terminology during this period by working as precisely and systematically as possible. This terminology will also be very helpful when it comes to use IT-Systems in order to enhance learning processes in the following years.

Second Level (Age of 14–16)

This stage starts with the extension of the students knowledge about digital representation of information by applying and analysing vector oriented graphic programs and data base systems, e.g. producing, managing and presenting the schedule of a railway station. Afterwards we investigate the principles of automatic processing of information: automatons, algorithms, programs and processes are examined and applied, e.g. by simulating ticket machines, money tellers, traffic control systems or production processes. The next learning step is established by the decomposition of complex systems into a set of simpler subsystems (“divide and conquer”) and the examination of the data flows between the subsystems, e.g. investigating flight booking or money transfer systems or en- and decryption of information. Finally the students direct their attention to communication processes between technical object, which opens deep insights into the working principles of computer networks or cellular phone systems.

All these systems are described and structured by using a specific kind of plans (called “informatic models‘, see $.) , which play within the context of IT-Systems a similar role as plans outlining walls or installations in the context of architecture. The usage of these plans (e.g. showing data structures, algorithms, subsystems or communication processes) enables the students to describe, understand and communicate exactly every essential feature of the system. While developing and simulating systems according to these plans the students apply a variety of software tools, from flow charters to simple programming environments. In this sense the practical work with the computer forms a major part of the education in Informatics.

Of course the students will discuss also social relevant aspects of the human-computer interaction, e.g. data security, access rights or economic consequences. Nevertheless these topics should be treated as well by other scholar subjects like Economy or Social Science.

Methodically we make heavy use of large learning projects, which allows the students to detect the multiple linking and applications of the just learned concepts while working on a concrete task and constructing their own products.
Third Level (Age of 17–19)

This level of education is characterized all over Germany by different systems of optional courses. There are no mandatory subjects at this stage, except for essential ones like German language, mathematics or English. One of the eligible courses in this context is should be Informatics, offering an extension of the basic knowledge that was acquired before by all students.

As a foundation of all following concepts we start by investigating recursive data structures like lists or trees, which are of great importance not only within the context of Informatics. Following we work with formal languages and grammars, constructing and simulating accepting automaton, e.g. describing and testing E-mail addresses or Uniform Resource Locators (URLs). The next step is formed by examining mechanisms to synchronize parallel processes which operate on common resources by simulating e.g. booking systems, money transfer processes or collaborations on common documents. Finally we direct our attention on the principal and technical limitations of automatic information processing, caused by noncomputability or high computing complexity of some problems.

References


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