Unit 6. Invaders of the Planet

Objectives of the unit

At the unit end the student should know

- Scopes of the information system
- Qualities and limits of automated information systems
- What determines the software technology
- The origins of the operating systems
- The main features of Artificial Intelligence

What is the good of computers?

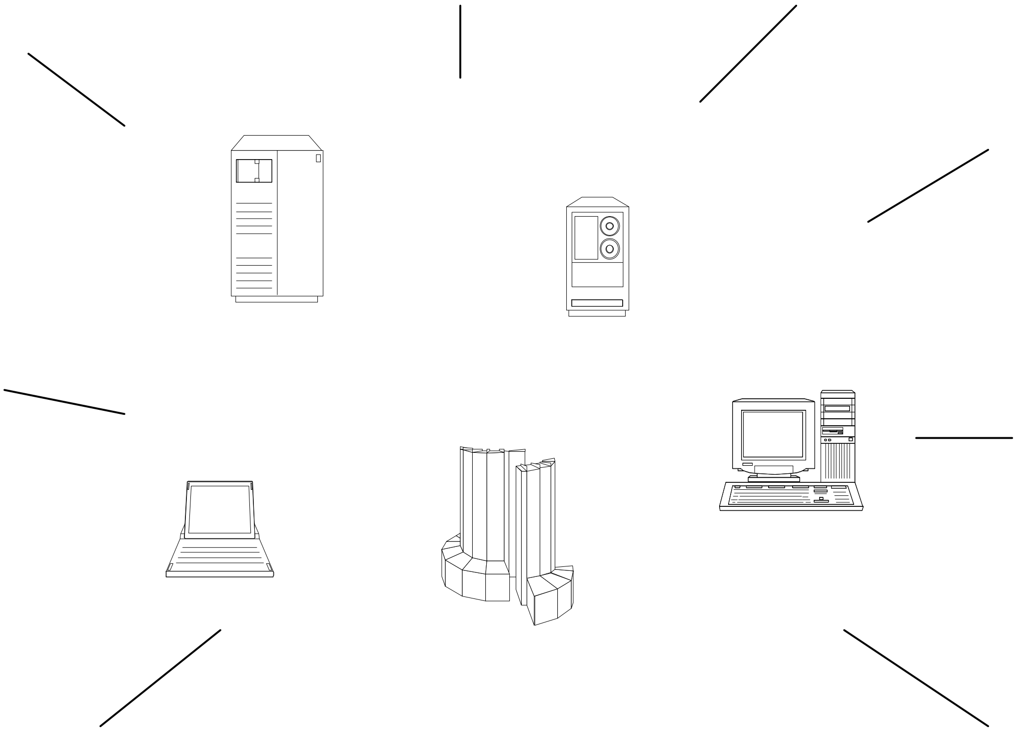


Figure 6-1

Computers are able to carry on any manipulation of the input information by means of the conversion units TR and the processor EL. They are capable of taking on broad and small assignments, and playing odd roles. E.g. the machine works as a tool when it runs an OO application; it takes a whole protocol on when it executes a batch procedure.

Now we pose the following wide-ranging questions: What an information system, notably a computer, is useful for? Why cannot we go without them?

Some authors try to answer with the support of a long list that includes the valuable services performed by modern appliances. But this account is incomplete and never will end because new implementations arise again and again. Besides these limitations, the checklist of the computer usages appears rather trivial. The inventory does not elucidate what causes the computer interventions neither the advantage deriving from them.

Somebody disagree over these inquiries. They presume that this discussion should be assigned to philosophers. In their opinion, broad themes sound alien to technology and seem insignificant on the professional practice. Instead evidence suggests the contrary is true. Short reasoning elucidates poor arguments whereas ample elaboration clarifies the most significant sides of science and technology. Only this way of reasoning makes you aware of the factual possibilities of this innovative field.

What is the good of computers? (contd.)

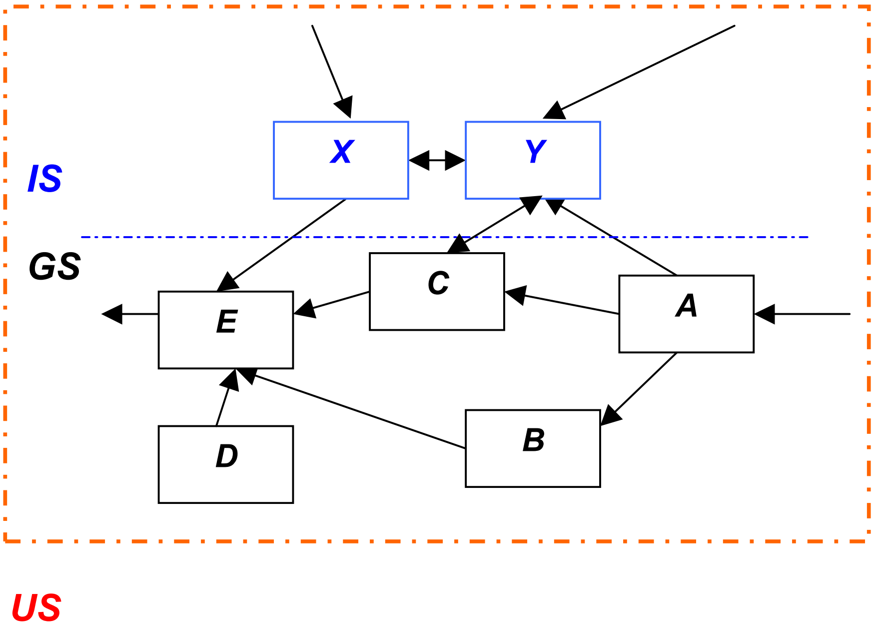


Figure 6-2

Take the **general system** GS, which may be a company, a bank, a plant, an office, a machine or the life of a person. GS is not secluded but cooperates with several entities. GS carries on the operations inside the contest **US (Universe System)** that is the market, the political society, the local community, the habitat etc. US may have heavy influence over GS, namely US is capable of pressing it toward the end or even the full success.

In particular, we consider the case where US changes and creates a variety of obstacles to the general system that comes enable to survive. The new conditions imposed by US make GS as a rigid or obsolete system or a slack organization to the extent that GS may die out.
We omit the general systems which are totally unsuited for the new situations and select those with potential capacities to survive. Why do they risk dying?

They are unable to take specific countermeasures due to a simple defect. GS has sufficient resources but is unable to perceive the new landscape. GS cannot adjust to US due to the incapability of viewing. This defect prevents GS from correcting itself in accordance to the evolution of US. Which is the solution?

There is a specific and infallible remedy from immemorial times. By definition, the information system detects and handles information. IS collects indications from several sources, it locates the problems posed by US. The information system surveys the new situation and provides guidelines. In short IS integrates and adapts GS according to the surrounding circumstances. In such a way IS compensates the deficiencies of GS.

α) - Take as an example the plant, which produces washers. The departments A, B, C, D and E assemble steel plates, electric engines and hoses. The plant brings forth a model that suddenly the consumers do not require and would wind up bankrupt. It unfortunately is unqualified for perceiving the market movements. In order to avoid this failure, the owner prompts the information system X and Y that investigates the market US and addresses the commerce in the right direction.
β) - As a second example, the business H produces and sells a collection of items successfully. All at once a competitor offers similar products at half the price and threatens to push H out of the market. The information system of this company sets up a research that finds suppliers at very favorable costs and can relaunch the sales.

Critical events emphasize the dangerous side of US, but it causes even positive changes. For instance the expansion of the market, availability of funds and tax reduction constitute lucky opportunities to seize. IS perceives also chances and aids GS to exploit them.

Information systems allow general systems to cope with the mutable world.

The present logical framework finds an evident proof in the physical reality. Banks, industries, trades, transport companies and other business have the vital, urgent and daily problem of coping with the environmental dynamics. They are new market trends, the fashions of consumers, new directives from the government, renewed contracts with trade unions, scientific discoveries etc. etc. GS is equipped with a powerful information system which accomplishes a large variety of tasks. We find the bureaucratic apparatus and the editorial staff, the statistical remote survey and the financial accounting office, the web site and the bibliographic support. The information system comprises one person, a single unit or a large organization, humans and equipment collaborate for the same purposes.

What is the good of computers? (contd.)

Figure 6-3

The sudden changes of the universe strain the performances of GS and are capable of destroying it, since millennia people try to foresee the behavior of US, to calculate all that is predictable. Scientists constitute the distinguished class which discovers the rules of US so that mankind is not caught off-guard. The scientific community sets up the hugest information system that directly supports a general system either assists an informational structure.

The precautionary tactics warns to prepare information ahead. The structures of IS are arranged in advance in the physical reality. Institutions and individuals search and store an ample amount of news in the hope of having just in time the pieces necessary to manage a situation. The more they are, the more the support of IS will be solid in front of the changes of US. The responsible take data ahead, so that IS operates on demand and promptly supports GS after the US changes.

Information systems do not improvise and are organized in advance.

The information system gathers a high number of pieces of news even if a very small part will be accessed. People do not take trouble in this investment because this assistance is vital. The huge amount of publications in the libraries provides a significant example. A few books spark the interest of readers and even a lowest percentage really impacts on life, namely on GS. The effects are although so much influential that they make it worthwhile.

Informational resources have cautionary influence upon US besides other advantages. Stored documents avert possible attacks, intrigues and frauds. They will bring essential help against them if they will explode. For instance, collected commercial orders and invoices are capable of deterring trickery and bring evidences in favor of GS in case of dispute. IS helps to surmount obstacles and even wards off dangers.

What is the good of computers? (contd.)

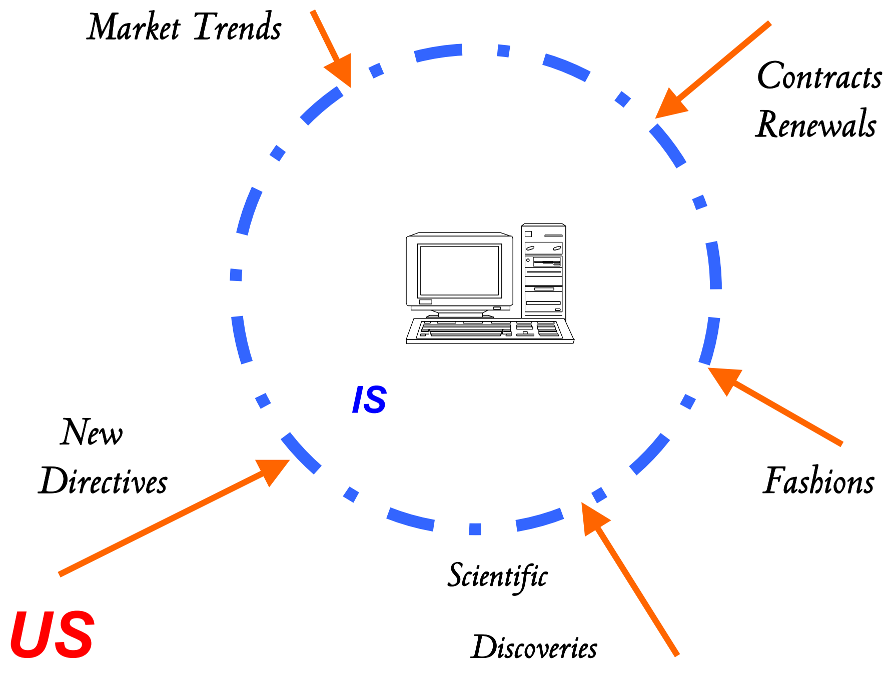


Figure 6-4

Information systems carry on heavy workloads and we find several defects in manual operations. Humans are somewhat imprecise and unreliable when they handle informational items. They are unable to collect, to process and to store as many data as the factual event demands; moreover they are rather tardy and do not produce results in time. Imprecision, small volumes and slowness are the most common shortcomings that have severe impacts. In fact the information system is successful if and only if it is able to contend with US. If IS is bulky, imprecise and slack with respect the environment, it falls short of keeping GS alive.

Machines and especially electronic devices emerge as the best substitutes of humans. The speed and accuracy of operations are evident to everybody. We bring a little example and compare costs and benefits for a sheet compiled by hands (A), by means of the typewrite (B) and by the computer program (C). The advances appear astonishing.

	Time	Costs (approx.)		Product quality
A	1 hour	12 €	for manpower, materials	average
B	¼ hour	3 €	for manpower,materials,machine	fair
C	10 sec	0.05 €	for materials,machine	optimal

Figure 6-3bis

Computer systems aid companies, institutions and individuals to survive the current accidents and grasp the chance in time because they are up to the mark in modern dynamic changes. Present challenges would be totally impossible to win by means of exclusive manual operations.

The extraordinary electronic appliances have not played bare accessory roles in aid of man; instead they ushered in a worldwide movement. They have originated such an ample and radical shifts that we can talk about a “revolution”. We are able to elucidate its dimensions through the lens of history.
During the **industrial revolution** mankind built powerful production systems and passed from artisan standard to industry. These organizations were although rigid. They became cumbersome and frequently manufactured tons of products that the market refused. The **post-Industrial revolution**, staged with computers, promoted flexible and light systems. Companies contended for “quantity” in the industrial revolution; today they do for “quality” and “velocity”. Modern organizations respond to the immediate and sophisticated requirements of US. They operate just in time thanks to ready and precise input information that exclusively computer system can provide.

In conclusion, mechanical apparatus aided the birth of a new generation of systems that successfully survive through intelligent adaptation to the environment. They have so broad impact in the planet that they steered the course of the history.

Fellows

Figure 6-5

Mutability constitutes the chief constraint for information systems and we can argue how the instability of US impacts on technology.

The influence of the universe over the general system GS and in turn over IS operates random and never ends. Once the mechanical information system is installed and has answered today's problems correctly, shortly after it has to surmount a new obstacle. We deduce the ensuing basic feature from the endless and variable pressures of US.

The computer system comes into being in a factory
But cannot be finished here
Since nobody can assign the definitive job to it.
The machine must be completed on site
In front of the sudden events caused by US.

Experience confirms this statement. What we have derived from our logical framework is real. The manufacture of a computer starts in factories, and a second stage finishes the work in accordance to the special duty to fulfill. We have anticipated this technical feature in Chapter 2, now we fully justify it by the interactions US-IS-GS. Two engineering sectors prepare the computer system in succession: the **hardware** and the **software**. The former builds the electronic units which although are incapable of executing a precise job. The latter finishes the setting up through the working program. The software product makes the refinements of the hardware machine that the producer has released as an incomplete form.

Software engineering is complementary
and close to the hardware engineering.

Hardware and software pursue the common goal that is to say the perfect and quick accomplishment of the computer system that aids GS to survive. You cannot grasp the former without the latter and vice versa. This statement denies the common idea which presumes hardware and software as contrasting areas. This bias is groundless because the two sectors lie apart in relation to the methods they apply; however they are strictly bound in point of logic. They work like a couple of fellows and in practice a programmer has to proportion his intervention with the specific hardware appliance.

Fellows (contd.)

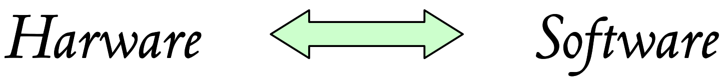


Figure 6-6

The fast modeling of the machine emerges as the basic requirement for the “soft” technology. The unpredictable changes of the world dictate this virtue and the software programming fulfils its duty thanks to the instructions that are written elements namely they are quickly prepared and updated.

Once again history teaches us a lesson.
The users of the first calculator appliances scratched along in the sense that the circuits were reworked by means of exhausting and tardy methods. Specialists fine-tuned the tabulating machines by plugs, jacks and other mechanical instruments that took time. Machines were rigid and unsuited for the rapid changes forced by US.
First K. Zuse in Germany and later Aiken in USA achieved the device controlled by a band with holes. This is a special form of writing and the earliest software program. The band of holes marked the birth of computers in the world. The systems are quickly pliable thanks to writing from then onward.

The basic quality of the software technology consists
Of the fast adjustment of the hardware units through writing.

Once firmly established this overall landscape, you are able to grasp the special cases such as the application programs for leisure that do not control any dynamical GS, the abstract calculations that cannot vary during the time etc. Such cases fall in the special class of the exceptions.

- **Rules**
- **Exceptions**

This classification is fundamental. If you exchange the rules with the exceptions, you will invert the proportions of the facts and lose the intellectual bearings that you have gained through the present book.

The information system undertakes a large variety of jobs. Computer systems should be equipped with a lot of circuits, instead the software technology make the units TR and EL pliable to all the duties and reuse the same devices. The software programming cuts this expensive expansion of the hardware facilities. This advantage causes colossal cost savings to the extent that people take this benefit as the only one brought by the software engineering. People's mind is caught by this economic quality and overcomes the quick changes of US and the connected features the software engineering that we have amply illustrated. In the working environment specialists and managers have scarcely matured the following corollaries of the information system mutability.

- Software is an ever-changing technology that shapes the computer according to the unstable behavior of US. Updates must be repeated from time to time and **the program maintenance is a normal concern**.

- US forces GS to change and GS presses IS in turn. **The production/maintenance of the software programs is a stressing process due to time shortage.** The environmental variations systematically stir up analysts and programmers. Time is the quantity that rules over this technical sector.

These undervalued interventions cause heavy losses and ineffectuality in business that we shall comment later.

Factual Hierarchy

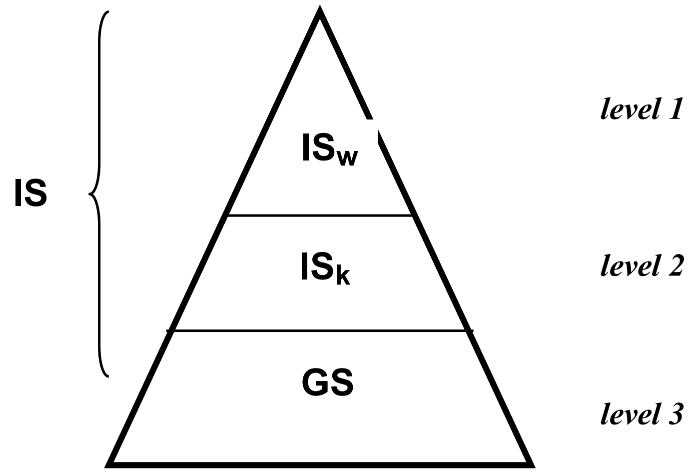


Figure 6-7

The information system collects and processes data, then it provides the guidelines, sometimes it even gives orders. The hierarchical levels in Figure 6-7 express this fundamental property. IS lies on top by virtue of offering constraint to lower levels.

The upper position does not spare the information system from the US influence and also IS must be controlled. The solution is immediate. The information system splits into two subsystems: IS_w checks IS_k and IS_k audits GS.
Limited operations reduce the probabilities of errors and S_w accomplishes fewer tasks than IS_k in order to diminish the risks. In turn IS_k is smaller than GS. For example, the office IS_k controls the factory GS; the management staff IS_w has less individuals and performs a smaller amount of work than IS_k.

The whole hierarchical organization assumes the pyramidal shape.

The pyramid determines the structure of IS and in turn impacts on computer engineering. We have already found significant hierarchical features in the architecture of computers, but they have been introduced through occasional considerations. The pyramid 6-7 confirms the issues in Chapter 2, namely hierarchy is the general and necessary property for the hardware components and the software programs. Hierarchy has a substantial impact and we sum up the effects on both the sectors.

Hierarchical Structure of the Hardware – The scheme 6-7 holds that the auto-control is the essential task for automatic systems. This theoretical statement entails that CU is irreplaceable in a digital machine and not fortuitous.

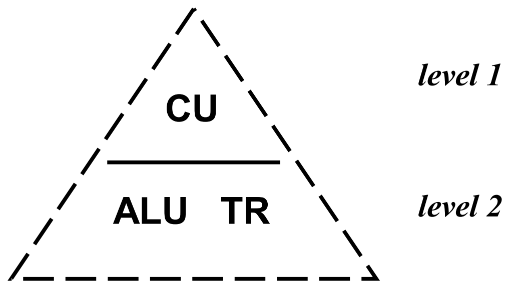


Figure 6-7bis

The pyramid finds evidence in the practice as CU executes fewer operations than those of the other devices do. We have listed the menus in Chapter 4.

Factual Hierarchy (contd.)

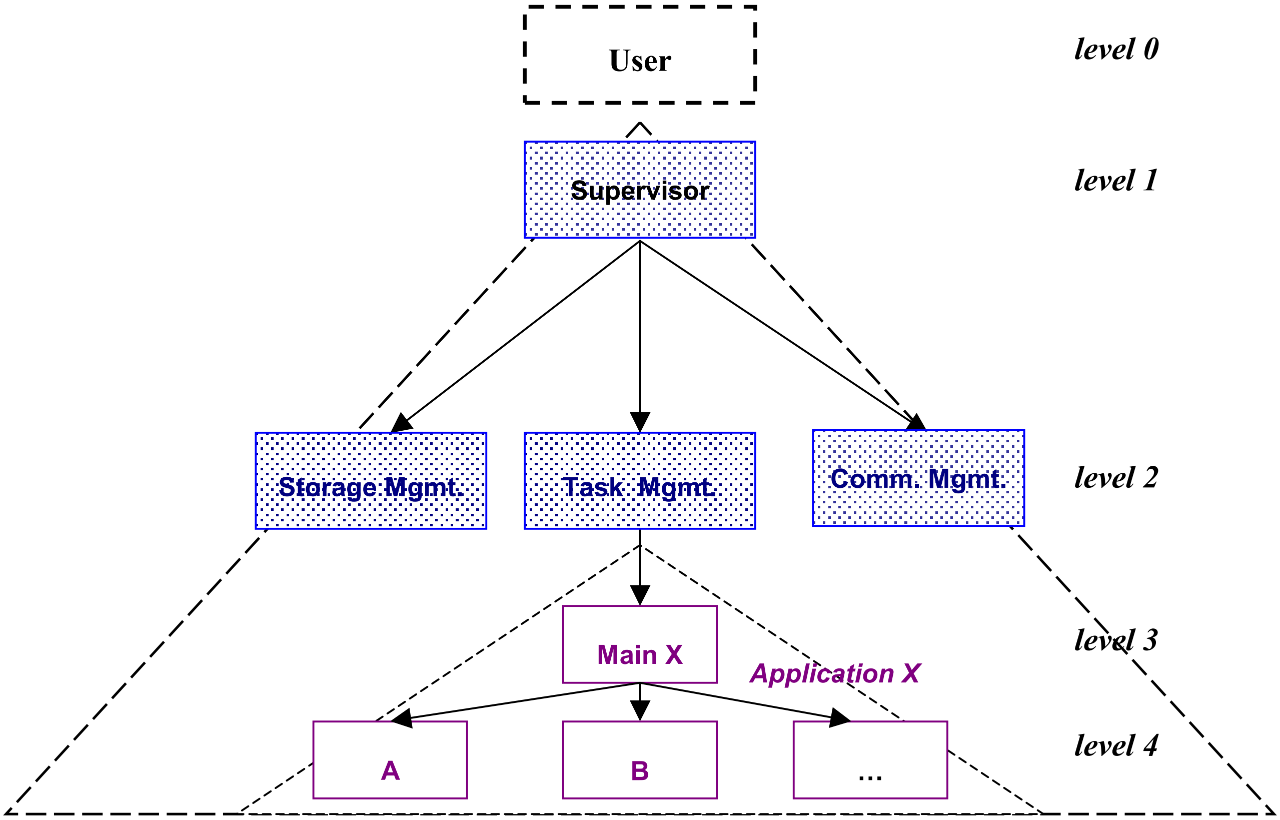


Figure 6-8

Hierarchical Structure of the Software – Different programs can contemporarily run in the computer system. For ease a Cobol procedure, a Basic program and a Java application operate in parallel. A software product has necessarily to manage them because concurrent tasks must share the same resources without conflicts. Which form has this special software product?

It must comply with the general structure presented in Chapter 4. In particular has the main module, named **supervisor,** that works like the module "Main" as a matter of principle. It supervises all the software components and in practice calls for the cooperation of the **storage manager**, the **task manager**, the **program manager**, the **communication manager** etc. which specialize in the conduct of various resources. The supervisor is really the chief manager of the whole system. It takes the control if a critical event occurs and then delegates the management to the specialist software unit. For instance, when the application X is to roll, the supervisor calls the task manager. This module calls the Main X that in turn manages A, B etc.

In conclusion, the whole set of programs assumes the pyramidal shape in Figure 6-8. People manage the resources of the computer through the **operating**

system, namely this software package works under the will of the user who ranks the hierarchical top.

Software technology brings to an end the computer construction. It refines hardware units that are unable to execute a precise job. Figure 6-8 shows the final shape of the machine that the user manages and manipulates; instead Figure 6-7bis exhibits the initial and rough form of the computer system.

The triangle 6-8 is the final and definitive structure of the computer That interacts with the user.

The triangle 6-7bis is the initial and rough form of the machine.

The user chats with the communication manager of the operating system. This module, in turn, cooperates with internal components that lastly are guided by the supervisor. This progressive intervention of the software modules has inspired the idea of *onion* in the mind of some authors.

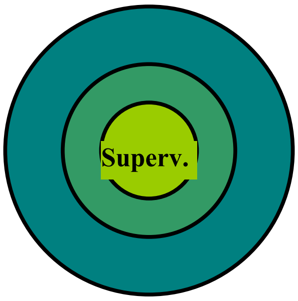
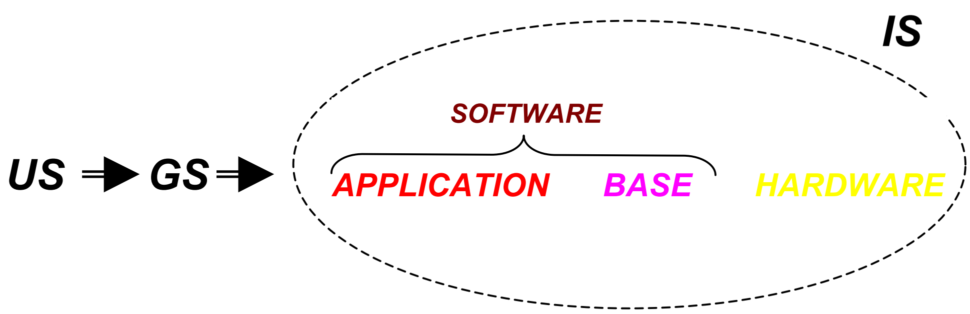


Figure 6-8bis

The operating system and any other software package have the pyramidal structure due to the hierarchical property of the information system. The onion is a stupid interpretation suggested by superficial feelings. This case brings evidence of the blameworthy ignorance that sometimes emerges even in the university lessons.

Linguistic Remark: People call those who execute the orders and are subordinate with the adjectives "*operative*" and "*operating*". We conclude that the term "*operating system*" tells the contrary of the truth. This misleading terminology emerged in the fifties and sounds paradoxical to us. The product appropriately should be titled "*managing system*".

Two Lines of Products, Two Methodologies



	1	2	3
technical contents	**poor**	**rich**	**rich**
people involvement	**heavy**	**modest**	**secondary**
development rate	**pressing**	**appropriate**	**appropriate**

Figure 6-9

The operating system controls the **application program** X, such as a salary computation, a bank account manager, billing of merchandise. The former differs from the latter due to hierarchical constraints but a second fundamental criterion sets them apart.

The operating system constitutes the explanatory example of the software items necessary for the worthy usage of computer systems. It provides a precious aid, nevertheless it does not tackle a precise problem for the GS survival. Thousand software packages share this property and accomplish essential services such as:

- Copy and compression of files,
- Sort and merge of records,
- Backup of data,
- Grant of accesses,
- Calculation of mathematical functions,
- Messages switching in the network,
- Compiling of symbolic programs, etc.

People coined the term "**base software"** to highlight the *basic* assistance which they offer to the application programs and to the users.

The environment US heavily affects on the products 1, instead the items 2 are bound to electronics and the operational research. The universe US, which dictates the algorithms to GS and in turn to IS, produces feeble effects on the base software. This line of products is rather stable whereas applications change fast. We could say they constitute the front-line that US immediately attacks. Operating systems, copiers, editors, music players, packages that run a transmission protocol and many others stay behind the lines. The hardware lies in the coolest hand.

The industrial organizations confirm this theoretical statement portrayed in Figure 6-9. In brief we detail the following characters for the couple of sectors.

1. The progress of technologies leads the evolution of the base software. Sometimes special investigations are driven to develop a product. E.g. scientists found out several algorithm to optimize the sort of a data set such as *the ripple-sort, inversion-sort, bubble-sort, shell-sort, quick-sort*.
This high-level background enables the software factories to manufacture excellent products and to offer them to the world market.
2. Political issues, business evolution and human necessity impact on a software application. Usually in house developers handle this line of products. They have the optimal position to take into account the urgent demands and update the software again and again.
While the previous sector achieves high quality outcomes, this second leaves a great deal to be desired. A high number of severe failures solicited managers to outsource software implementation, but there are still several problems. Robert Glass has recounted many episodes and probably stages as the best reporter of these modern disasters. He has run a column in "*Communications of the ACM*" for years and has written contributions and books on computer calamities.

These flops appear unjustifiable because the targets of the application developers seem reasonable. What are the origins of these strange failures in the application area?

Once again we find the most significant causes of the losses in the educational system. We have marked the different features of 1 and 2, hence they entail rather diverging methodologies for the software design and implementation.
The curricula in high schools and universities although are mostly oriented to the sector 2. Schools educate students to develop base software but they are inadequate for applications. As a consequence they show strange behaviors in the working practice; they adopt the methods peculiar to the area 2 and collapse.

These failures stand as one of the most acute and pressing problems in the computer sector. The full discussion of this argument goes beyond the scopes of the present volume; nevertheless I believe that these pages offer a significant clarification.

Two Lines of Products, Two Methodologies (contd.)

Figure 6-10

People who come out incomplete tuition commonly underestimate the area 1 and exalt the contents of area 2. Conversely the scenario in Figure 6-9 makes evident that the contrary is true.

Sector 1 makes ready the automatic IS that helps GS to cope with the universe US, while products 2 make the premise to this job. The base software plays an ancillary role with respect to the application program which completes the adjustment of the computer hardware.
Sector 1 entails complete engineers instead a specialized technician is enough for 2. The former is to be aware of the whole landscape encompassing human and technical questions, conversely the latter come down to mechanical topics.
We make this example. The naval engineer exploits commodities such as the engines, the propellers, the electronic guide systems and other significant components whose construction may be very challenging. These ones although are bare parts of a project. The chief engineer builds the yacht thanks to his

complete view and competencies: he is familiar with the nature of the seas; he interprets the owners' wishes; he keeps abreast of last technologies etc. Symmetrically the thorough software engineer is fully aware of the environment US and the system GS, and designs the most suitable application package with the support of some purchased products.
The authentic features of the software technology do not emerge at the point 2 that constitutes a preliminary stage, neither the computer system is fully effective with the base software.

In conclusion the changes of US bring about the progressive preparation of computer systems. They originate the hardware and software technologies and, in turn two distinguished areas of the software engineering.

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Artificial Intelligence

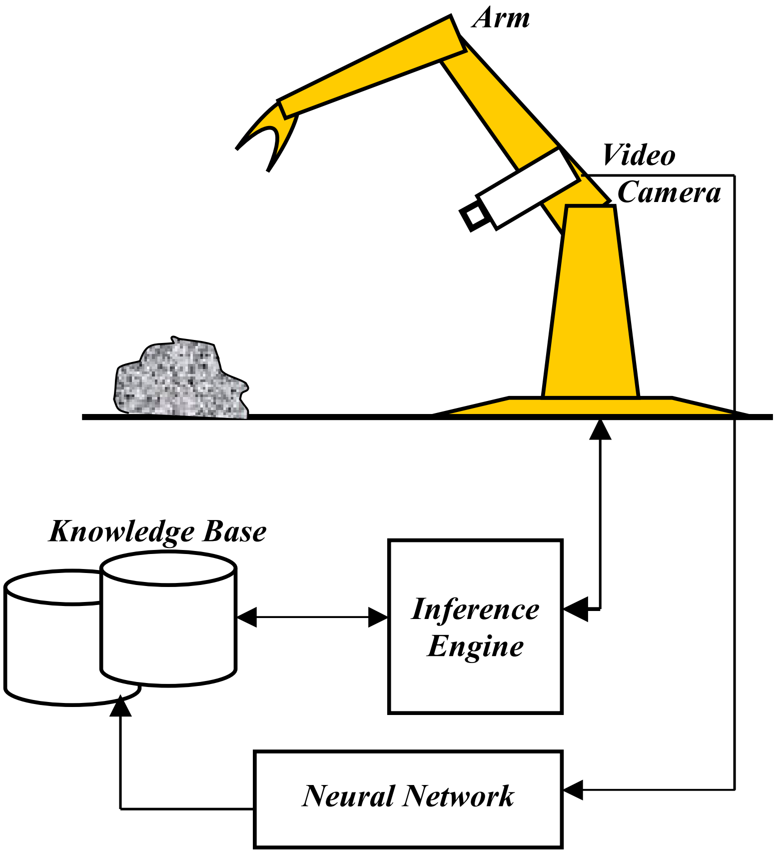


Figure 6-11

The term ***Artificial Intelligence*** (**AI**) marks an innovative field of informatics. It has penetrated into a variety of environments: business, scientific research, industry, medicine, games etc. AI attainment is capable of accomplishing sophisticated tasks such as:

- They take decisions about a business,
- They discover possible frauds,
- They recognize the shapes of objects,
- They summarize a text,
- They substitute workers in a farm,
- They diagnose a disease,
- They proof a theorem,
- They win at chess etc.

AI applications are able to substitute men/women in jobs that need reasoning and evaluations. They either support or automate decision-making in areas which usually require human expertise. E.g. the AI system substitutes the qualified doctor who medicates diabetes and doses the medicine day by day.

AI applies distinguished techniques. The most preeminent are:

a) Expert systems,
b) Neural networks,
c) Logic Programming,
d) Robotics.

They are rather intricate and go beyond the present introduction. As an example we summarize the expert system which has the following components.

- **Knowledge Base** is a repository of factual and heuristic knowledge regarding the sector of intervention. The organization of this base continues to be the biggest bottleneck in building expert systems due to the large amount of data and the special algorithms for inquiry.

- **Inference Engine** is a special program which infers intermediary outcomes and last provides the conclusive answer to the user. We could say that it forms a line of inferences in solving the problem. The inference algorithms can range from the simple If-Then rules to case-based reasoning. Frequently expert systems deal with approximate criteria and uncertain data. Fuzzy Logic is an extremely popular approach to treat such a kind of information. E.g. technicians build fuzzy algorithms to pilot the elevators, to regulate the cameras, to control the washing machines.

The AI applications exploit also traditional resources; e.g. the knowledge base may be arranged as a common file. Engineers combine different techniques and achieve astonishing results. For ease, a neural network is used as a pre-processor which converts signals into symbolic information that the expert systems treats. The inference engine guides the robot to recognize the shape of the product and to manipulate it with care.

Machines versus Human

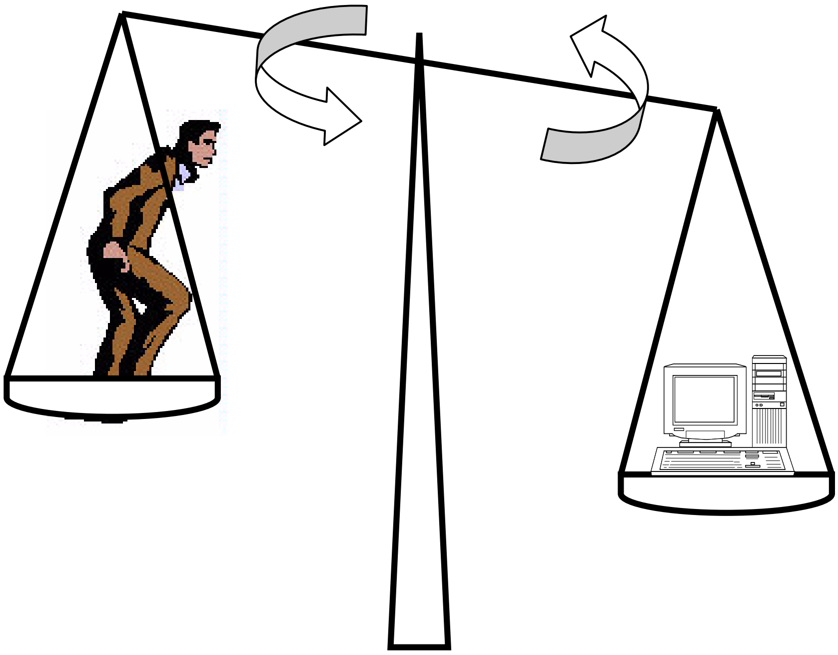


Figure 6-12

The impressive applications in Artificial Intelligence prompt this query: Are computer systems more intelligent than humans?

We cannot provide an immediate answer instead we shall take some steps before the conclusion.

* * *

Vegetables and animals are general systems according to the idea we have introduced. They are influenced by the changing habitat US in which they live, but they comply with two opposite methods to survive.

- The animal is equipped with the neural system which is an efficient information system. This leads the body GS to chase and to eat, to reproduce, to communicate etc. The animal is capable of facing changing situations. The neural system enables the animal to cope with difficulties of world and to seize the opportunities by means of intelligent adaptation.
  The mobility is the natural bent for animals which do not fear novelties and like to get around.

- Vegetables do not have any neural system, hence they do not detect sudden and varied signals and do not react in time. They merely modify according to the seasons during the year. They follow scheduled changes and are unaware of the unpredictable entities of the physical reality. They do not exploit positive chances and do not avoid risks. E.g. if fires threaten a wood, the trees do not escape and incinerate. E.g. a plant does not search its sexual partner instead it forsakes its pollen to the wind that randomly operates.
  The absence of the information system evidently impacts on the static life style of vegetables that neglect fast adjustment to the environment US.

Man and woman belong to the animal kingdom and Nature has equipped them with the most powerful neuro-system. They are capable of surviving in highly variable environment and in between complex situations. People happily inhabit the poles and the deserts, islands and mountains thanks to intelligent adaptation.

In the past mankind did not exploit systematically his best resource which is the mind. Humans preferred wars and blind violence to surmount several obstacles. This attitude has not gone out of fashion, but we could say that actually people incline to tackle the problems by means of the intelligence. The post-industrial revolution, the impressive progress of science and the astonishing development of ICT evidence the support of this propensity in the real life.
We avoid the discussion upon these broad themes for the time being and call your attention to analyze a quality of the human intelligence.

The thorough capability of IS consists in concocting solutions in front of the evolving US. In fact the body GS can survive if the mind IS finds the way-out of the present situation. Challenges refresh again and again. They are unpredictable and **invention is the essential and most demanding peculiarity of the information system.** The human brain proves to be the most powerful system to achieve this duty. Somebody exalts other qualities of the mind but we remind a sentence by Henry Poincaré: "*It is by logic we prove, it is by intuition that we invent".* Fantasy, inventiveness and intuition are excellent capabilities of men/women.

Machines versus Human (contd.)

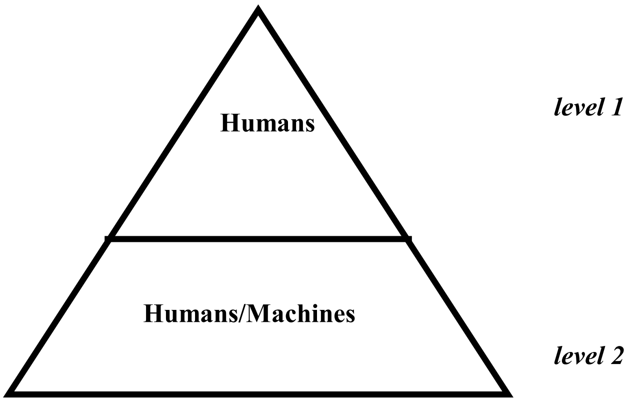


Figure 6-13

There is a second duty for the information system besides imagination.
Nobody knows which informational item will be useful next, hence IS treats a large amount of information as a reasonable and precautionary countermeasure so that the appropriate piece of news will be available at the moment. We have introduced this topic in the first pages of the present chapter. Now we enter into details.

The acquisition of elementary data by means of surveys, reports, pools etc is the first demanding task for organized information systems. The source may be any and IS detects natural information too. The translation into the appropriate expressions constitutes the second necessary operation of the information system. Later IS sums up this large ensemble of news and makes up outlines, totals, synthetic views and summaries. Frequently IS prepares forecasts, it draws hypothetical scenarios etc. IS even takes care of the readiness of these data through easy displays, clear printouts etc.

The unforeseeable behavior of US entails very high production rates and the amount of work to be done is huge. Outcomes must be absolutely accurate and ready to use due to their leading impact on GS. All these commitments are very burdensome for humans and manual information systems prove very poor performances. Mechanical tools (such as the typewriter), rigid machines (such as the tabulating machines) improves the human workload, but only the complete and flexible automatic systems, namely the computer systems, are definitively capable of substituting man and meet the needs.

We bring this case to clarify the high inventiveness and the low operational performances of humans.
A scientist has invented an interesting appliance and needs some mathematical value to the definitive validation of his achievement. The university library keeps the numbers he is seeking for, thus he gets out his room and reaches the library site. He reads the catalogues, then he climbs the bookshelves and picks up the books. He copies the numbers and comes back to his room. All these operations require hours or even some days instead the numbers are available in a few seconds if they are accessible through the Internet. In conclusion the scientist IS has exceptional skills when he is tackling the problems of his area. No machine can compete with him; conversely he is tardy and ineffective on the operational plane. Computer systems show matchless performances.

We conclude that the optimal information system entrusts man charged with directive tasks and machines with operational duties. Human leadership is irreplaceable at the highest level. Men/women are superior to machine on the strategic plane because of their inventiveness. Machines win for better performances in the intermediate and lower levels.

By definition, a machine comes to aid of people and must fulfil the duties assigned by somebody. The rule is valid in our field too. The computer system is never the absolute leader even if it controls human operations; it is always submitted to a human being. Men/women have the ultimate responsibility of the appliance. Executive managers and private owners methodically keep this liability and do not share the leadership neither with animals nor with machines. The most evolved equipment cannot relieve a man/woman of his superior charge. This tenet is also established on the legal plane.

Machines versus Human (contd.)

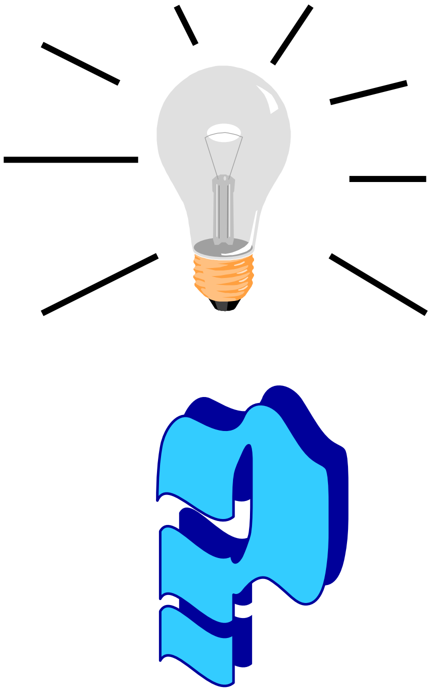


Figure 6-14

Machines are unable to invent. The most sophisticated equipment selects the appropriate answer under a preliminary work program that a man has provided in advance. The ability to discover new ways is the prerequisite hallmark of mankind and this attitude consists with his uppermost position in the pyramid. Machines are unable to invent.
How Artificial Intelligence may be justified? Why do AI applications appear amazing?

People can survive in the most hostile environment as they invent surprising solutions. The human intelligence is unique to originality. Computers cannot compete on this plane. They win on the operational plane and engineers support these manners. For ease they ensure standard input to the machine. The background of the automatic processor is somewhat regular. E.g. the software program is unable to compute false numbers and the calculation of salaries requires the data of the employees are right.

There are also applications that run under generic constraints. For example:

- The bookkeeping computation accepts erroneus data and corrects them by means of crosschecks.

- Common software programs elaborate coded expressions; instead some applications interpret phrases which have a personal significance.
- An elaboration looks into possible irregularities in the accident reports received by the assurance company and reveals the frauds.
- A robot self-learns to work by trials and tests.

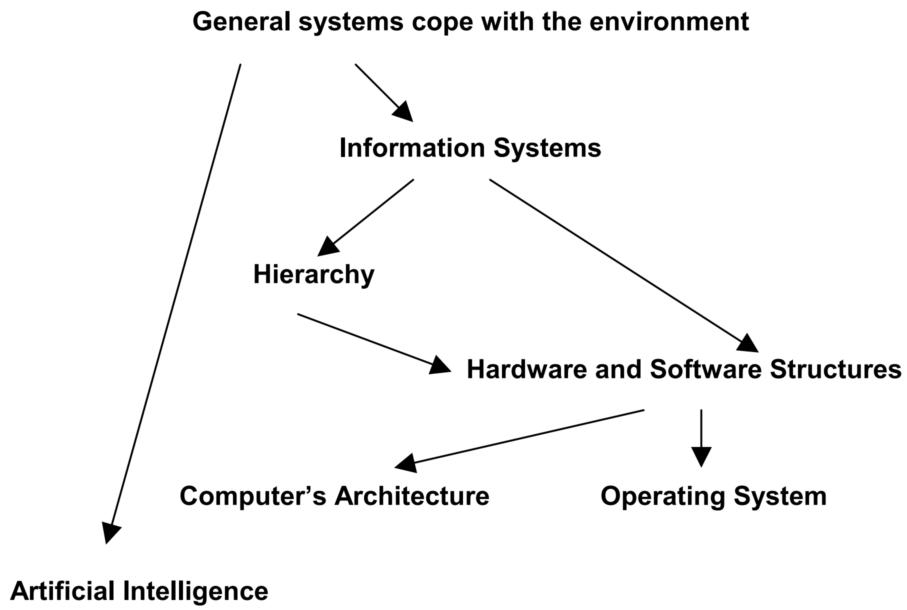
Unrestrained environments force these processes be somewhat sophisticated and specialists group these works under the term "*Artificial Intelligence*". In fact machines that operate under conditions less disciplined than usual imitate humans and exhibit a sort of intelligence.

The title *Artificial Intelligence* diverts although the correct interpretations of the facts. The machine does not invent of its own accord but exploits the resources that man provided in advance by means of its extraordinary operational capability. The AI application works like a huge crossbow that strikes hard thanks to several soldiers who have compressed the crossbow. It releases the energy that was pumped in advance. The computer outperforms a man/woman due to similar mechanism. Take for example Deep Blue, the super-computer built by IBM Corporation. It has won the world chess-champion Kasparov in 1997 thanks to a sophisticated program that a team of specialists has previously set up. They have catalogued the strategies that human players discovered and proved during millions of chess matches. Deep Blue has barely exploited this resource at the speed of light.
A special stag deform people's feeling. Engineers, who previously store information, take a back seat at the end of this task. When the machine operates, it seems totally autonomous and a viewer overlooks the previous human involvement.

Realistic understanding of the technology removes babyish emotions and arouses our interest in developments. Microelectronics register astonishing progress and AI performances will expand in order to meet ever more sophisticate goals in the years to come. These stimulating perspectives fit with the progress of mental prosthesis, which constitutes the next generation of computer systems that we have foreseen for the future in Chapter 5.

Unit 6 Summary

The behaviors of GS, US and IS have a broad impact on technology and make us conscious of the most influential sides of informatics.



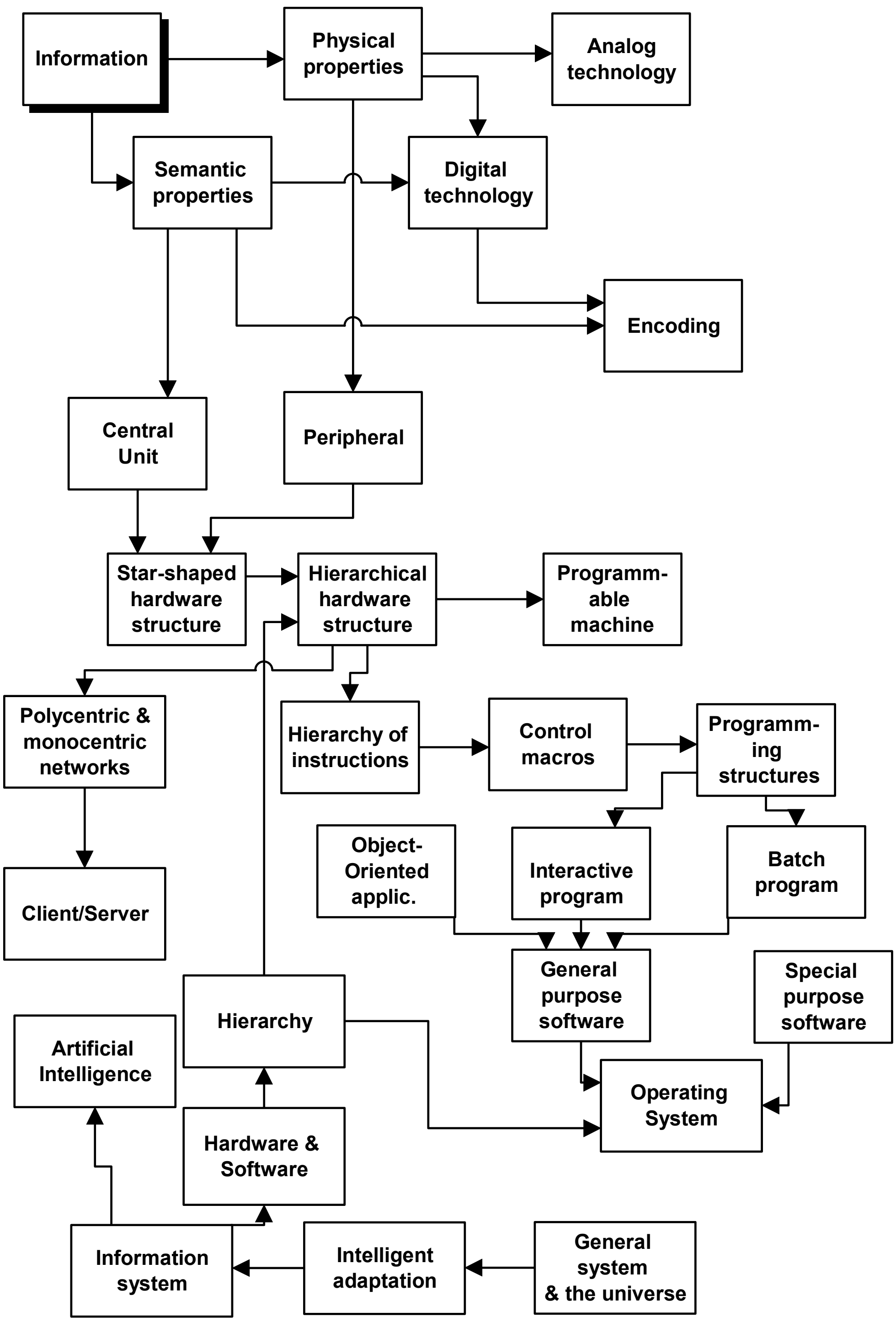
The properties of IS determine the main features of the computer hardware and software. In particular, the hierarchy entails the pyramidal arrangement of the hardware units and the software modules.
We have discussed some characters of the intelligence in man and machines.

Conclusions

This book illustrates the computer science fundamentals which are usually taken as a generic argument. In fact they are currently treated through rather careless and infantile discourses that cause this skeptical opinion. These pages instead consist of a high quality illustration as they have been written after a scientific research.
The terms "scientific research" sometimes bring fantastic scenes to mind and this misunderstanding must be clarified. We explain these studies by the following example. The scientists who are investigating the foundations of nuclear physics seek for the simplest parts of the atom. They do not discover new equipment or powerful machines. They look for the components of matter, which are minute but capable of unveiling the intimate secrets of Nature. They broaden the mankind horizons; similarly our findings deal with the details on computer systems which enable you to discover the whole scenario from the scientific viewpoint.

* * *

We have pointed out a number of particulars. Some ones appear tiny and subtle; others are rougher. All of them emend the blunders that give false accounts of ICT to laymen and to specialists too.
As first we have corrected the impression that bits are abstract numbers, instead they are physical items. Any technology centers on material objects and if you doubt about this detail, your whole knowledge has rotten basis and is unsafe like a building without concrete foundations.
Later we have illustrated spontaneous and artificial information. This complete overview elucidates the characters of analog technologies, which seem blurred even to engineers so far.
We have introduced the semantic qualities of information with simple expressions, whereas technical authors fear this essential topic like a taboo. Semantics introduces the notion of redundancy that fits with both the common sense and the most advanced equations in the field. Instead the limited interpretation in use fires endless disputes.
All the informational manipulations fall into only two groups: conversion and information processing. This qualification finally provides the alphabet for the computer operations that are taken as endless. They justify the star-shaped combination of the hardware units and emend the input-process-output scheme that is the wrong reference still in use.
Hierarchy is the key property of the information system which elucidates several features of computers on the small and large scales. It explains the triangular shape of the hardware appliances and the software packets. It clarifies the difference between monocentric and polycentric networks, it discriminates the software instructions, it highlights the possibility and the limits of the machine in respect to man.
Programming appears an ever-ending topic so far, instead the classification of batch, interactive and object applications provide precise orientations to you. The prototypes support practitioners in daily jobs.
Finally we have discovered the struggle of general systems for surviving and the information system opens the most significant views over our sector. We have argued the contrasting features of base software products and application packages.
We have inferred that machines cannot compete against humans for inventiveness.


Information
Physical properties
Analog technology
Semantic properties
Digital technology
Encoding
Central Unit
Peripheral
Star-shaped hardware structure
Hierarchical hardware structure
Programm-able machine
Polycentric & monocentric networks
Hierarchy of instructions
Control macros
Programm-ing structures
Client/Server
Object-Oriented applic.
Interactive program
Batch program
General purpose software
Special purpose software
Hierarchy
Artificial Intelligence
Operating System
Hardware & Software
Information system
Intelligent adaptation
General system & the universe

Some authors treat these topics in philosophical terms. They provide an insignificant support to technicians and users due to the vagueness of philosophy. Other writers deliver these contents here and there as the pages reflect personal and arbitrary thinking. Instead this book follows a precise and deductive logic that the conceptual map sums up. From the entry point, that is information, we infer the most complex phenomena through detailed and consistent arguments.

You should not underestimate the destructive power of the above commented inaccuracies and errors on the practical plane. A professional can come through an error because only one howler has a feeble impact in the real life. When although the number of doubts and misunderstandings becomes larger, they sway decisions, statements and realizations. As right explanations are logically connected and reinforce one another, so symmetrically one error exacerbates the consequences of the previous mistake. The lack of definitive elucidation enfeebles the practitioner who is short of strength with respect to this long chain of misleading.
Intellectual failing causes improvised professionalism and, in turn, provokes uncountable failures, malfunctions and losses in companies and organizations. This book illuminates the minds and provides a factual support. You may be a programmer or a user, a system engineer or an analyst or a manager; whatever you will do, you will work better than the colleagues will because you have realized much more than those. The realistic and thorough scenario of the computer sector saves you the repetition of errors, which now should appear self-evident.

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