CHAPTER 1

About us

Five year's ago, in the ASCII hacklab in Amsterdam a few women sat talking about why there are so few women interested in computers. The result of these ponderings was the Gender Changer Academy – a school for learning and teaching computer related stuff in a peer setting, with fun, and without worries about breaking anything or asking stupid questions. Tali, Sara, brbr and Sisi gave the first course in January 2000 in the PUSCII in Utrecht. Since then there have been lots of courses with women from all over the world joining in, juggling jargon and opening up pc's.

We had all worked with computers in one way or another, using text processing programs and surfing the internet, but none of us had tried to look inside of that mysterious thing, the pc, let alone try and install an operating system. What started out as a self-help group has now grown into a well-known group of female nerds.

What is a Gender Changer?

A gender changer can be different things.

Technically speaking a gender changer is a small device, an adapter that changes the `sex' of a computer cable, device or port. It has two sides, a side with holes or pins, and another side with holes or pins. The term was coined in a male tech setting. The side with holes is referred to as the female part and the side with pins is the male part. A gender changer is used when a cable doesn't fit onto a port.

In the figurative sense we see a gender changer as a graduate of the Gender Changer Academy or as someone who wants to change the way the world perceives things. A `genderchanger' or a `gender changer' makes any connection a possibility. At the Gender Changer Academy it is our aim to make gender irrelevant when it comes to access to knowledge, computers and technology. Where else can women get such great, open and affordable information about hardware and other animals in this world?

Why a Hardware Course?

Of course women work a lot with computers! They write and print all those business letters; keep-up the spreadsheets and databases necessary in organisations; surf the net; design websites and so on and so forth. But just like with cars, for example, women generally know less about what is under `the hood' of this piece of equipment. We want women to be able to speak the speak when buying parts in a shop. We want women to be able to upgrade their own pc's instead of relying on their brothers, boyfriends or a technician. And finally, we want people to migrate their pc's from Window$ to Linux and other Free and Open Source software. However, one needs a little more of a basic understanding to be able to do this. The hardware course sets the foundation for further exploration.

Hardware is a mystery, may seem difficult, but in fact is a lot of fun!

Playing is a way to get to know how stuff works. It is hands-on practice in an environment free of worry about breaking expensive stuff that encourages learning. Knowing how it works, being able to interact with it gives one a sense of control and independence. Secretaries of today should have a toolkit to be able to Do It Themselves; a new millennium witchbag.

Why for women only?

It's true that there are a lot of men who don't know much about computers. And it's also true that the ASCII is open for everyone's questions, i.e. women are also welcome. However there still are very few women that walk into the ASCII and very few women involved in the ICT sector. We

decided to do something about it and start small. We know that it's more fun when you get together with like minded people like for example your friends. When a woman has a tech question she has few peers around to answer it. So she turns to a male friend. That can work out fine but we've also heard of experiences where it wasn't very constructive. Hopefully one day all this will have changed but for the time being we're going to keep doing it this way.

Disclaimer

The Gender Changers giving the courses can be beginners or experts or something in between. The reason we do what we do is to learn new things and to share what we know with others. We believe that co-operative and experiential learning is the best. There is little difference between the teachers and the students, and that everyone is a participant in one way or another.

We hope that the course material and the course itself will grow and improve each time we give it. If you have a contribution to make or a chapter to add please feel free to contact us: teachers@genderchangers.org.

This reader is work in progress and only with input and criticism can it progress and become more complete. We would like the reader to become a good reference, but it will not likely ever be a complete hardware guide.

The most important thing to get from the course is the confidence to just pick-up a screwdriver, open your pc and replace that hardware!

About the Course

We give classes in basic computer hardware. We cover computer parts, the difference between memory and storage, what master and slave mean, and the BIOS. It will be very hands-on demolition and re-construction, with quite a bit of repetition. We weave in some history of computer hardware and women and technology. A GNU/Linux install party and an excursion to a computer-fare are intended follow-ups to the course. We encourage the use of second hand computer parts and free and open source products like GNU/Linux. You can do almost anything with a computer without actually having to buy software, and if you are really resourceful you can get hardware for cheap and often even for free. The classes are given in English mostly and are for women only. As the GCA grows, so will our course selection, so stay tuned to http://genderchangers.org.

During the course there is usually a 1 to 4 teacher/student ratio. The course lasts four weeks, once a week from 19.30-22.00. There is officially a 15 minute break in the middle, but usually only the teachers take a break. We ask a donation (ie not compulsory) of 2 euro per person per evening.

About the ASCII - http://scii.nl

ASCII stands for Amsterdam Subversive Code for Information Interchange and provides free computer facilities and internet access. It is a non-commercial and Microsoft-free workspace run by volunteers who have varying levels of computer experience and expertise. The machines in the ASCII have either been salvaged or donated and then re-built and installed with the free and open source operating system GNU/Linux. Your operating system is your personal choice and you should know that there ARE choices out there.

One of ASCII's aims is to demonstrate the fact that `out-dated' ware is often perfectly suitable for the average computer user to surf the net, send and receive email and do word processing and other basic functions. However, computer stores, manufacturers and Microsoft would have the user believe otherwise. The computers at the café are not only re-assembled for local use in the café, the intention is also to build machines for the computer needy.

As far as we know, it was the first squatted hacklab in the world. Anyone can come in, check their email, have a cup of coffee, surf the web, have some more coffee and ask tech questions. The ASCII also offers scanner and printer services, streams a live radio news hour every Friday and so

much more.

The Future of the GCA

WORLD DOMINATION and we want it now!

We have lots of dreams about the future; more courses if we can find the people power, more paper handouts, some art, hardware jewelry, performances, and a women's tech lounge.

Since 2001 we organize the annual /etc aka Eclectic Tech Carnival – a hack gathering of female geeks, the GCA on the road, a week's worth of computer related workshops, skill share festival. http://eclectictechcarnival.org

Last but not least, we have our own server, the Systerserver, run by women only, in support of women's and feminist projects.

CHAPTER 2

FREE / OPEN

You may have seen the term FLOSS around. It stands for Free/Libre Open Source Software. The reason for the distinction between free and libre is because the English term is ambivalent: it can mean either free as in free beer, or free as in freedom of speech.

`Open' means that something is known, is published, out in the open public domain. In other words the recipe, formula, code is not secret or locked up in a safe. It also means that there is no patent or copyright on it.

Why are trademarks, patents and copyright necessary? They say because research and development costs are so high that if individuals, companies, universities or governments are not assured of returns on that investment they lose the incentive to innovate.

A patent is a set of exclusive rights granted by a government to an inventor or applicant for a limited amount of time (normally maximum 20 years from the filing date, depending on extension). The patent grants the patent owner the right to exclude others from making, using, selling, or offering to sell the invention.

Copyright is a type of legal protection for people who express ideas and information in certain forms; it designates ownership. The most common forms are: writing, imagery and music. Copyright protects the form or way an idea or information is expressed, not the idea or information itself. It is closely associated with Intellectual Property. Copyright lasts seventy years after the death of the creator of the work. During the period of copyright no one may copy and circulate a copyrighted work without first obtaining permission and paying a license fee for doing so.

Proprietary means that something is privately, exclusively owned and controlled. In the computer industry, proprietary is the opposite of open.

Trademarks, patents and copyright are ways to protect (intellectual) property from use by *others*, implying camps: the haves and the have-nots.

Why do we find patents and copyright problematic? They're brought as a means of protection from misuse. Misuse indeed: a way of keeping the powerful in power, making money at the expense of others, and preventing people from freedom of choice and freedom of adjusting it to their own needs. In addition it keeps products from evolving. Peer review is the best way to find bugs, weaknesses and so on. Preventing that means keeping ourselves in the dark.

Finally, nothing is unique to one person or company. Everything is built on the work of others, in a particular context. No one lives and works in a vacuum. And no human has ever created mineral, plant or animal. An example of the worst kind of patent tyranny comes from pharmaceutical industry that raid the forest and oceans and claim sole ownership of for example a cactus sap from the Namib dessert.

SOURCE

`Source' refers to the programming code that makes up a script, application or piece of software. An analogy of an open source product is a pot of peanut butter. On the label you can see whether the ingredients include salt, sugar, coloring, preservatives or animal products. This information allows the consumer to make a slightly more informed decision about what peanut butter to buy. Consumer behavior is already far too influenced by aesthetics (i.e. label design) and availability (marketing). Sales people are not the experts on products, although they are often approached as if they were.

When buying software one wants to make an informed decision just like in the situation of the pot of

peanut butter. Open source goes beyond the label on the jar of peanut butter in its `openness'. Open source software gives the consumer not only the ingredients, but also the recipe. Open source stands for access for all. It invites people to participate in the development and creative process of a product. It reflects a spirit of D.I.Y. and of cooperation, of collectivity and community. There is less money to be made with open source products: one only pays for the organization of making and distributing the installation CD's, reference materials and other services such as consulting or maintenance.

Within the movement there is a definite divide between the Free Software camp and the Open Source camp. The former is more ideology in essence while the later are more practical. Free software does not have a high market value. It scares of the business-world. Whereas Open Source emphasizes the fact that the quality of software will be better if it is open to peer review and cooperative development.

Useful links for understanding more of the Free, Open Source ideology are:
http://www.gnu.org
http://www.fsf.org
http://www.opensource.org

CHAPTER 3

How a computer works

A computer is basically a big calculator PLUS some more. The fancy dress includes the fact that it can store stuff and that it can do much more complicated calculations a lot quicker than calculators. Computers can perform complex and repetitive procedures quickly, precisely and reliably and can quickly store and retrieve large amounts of data.

The physical components from which a computer is constructed (electronic circuits and input/output devices) are known as "hardware". Most computers have four types of hardware component: CPU, input, output and memory/storage. The CPU (central processing unit) executes programs ("software") which tell the computer what to do. Input and output (I/O) devices allow the computer to communicate with the user and the outside world. There are several kinds of memory/storage - fast, expensive, short term memory (e.g. RAM) to hold intermediate results, and slower, cheaper, long-term memory /storage (e.g. magnetic disk and magnetic tape) to hold programs and data between jobs.

The command line is the shared ground between human and machine. When we type in an instruction, in code, and there are different languages that the computer understands, we get a reply. There is also a different way of communicating with the computer. Instead of the command line one can use a graphical user interface (GUI), the point and click cascading window layers system.

The noun "program" describes a single, complete and more-or-less self-contained list of instructions, often stored in a single file, whereas "code" and "software" are uncountable nouns describing some number of instructions which may constitute one or more programs or part thereof. Most programs, however, rely heavily on various kinds of operating system software for their execution.

Data gets processed in numerical form which are expressed in a binary system; binary digits, or bits are 0 and 1. Binary digits are easily expressed in the computer circuitry by the presence (1) or absence (0) of a current or a voltage. A series of eight consecutive bits is called a byte; the eight-bit byte permits 256 alphanumeric characters, and such an arrangement is called a single-byte character set (SBCS). The de facto standard for this representation is the extended ASCII character set.

You probably know that a gigabyte is bigger than a megabyte or a transfer rate in megabits per second is faster than one in kilobits per second, but you may not know how much bigger and how much faster. Let's try and sort out these tidbits.

Bit (b). A bit is short for BInary digiT. It is the smallest unit of information on a computer. All digital data inside a computer is represented using a binary number system where each number and character is comprised of 0's and 1's.

Byte (B). Eight bits of information is one byte, which is short for binary term. A byte is the amount of memory space it takes for the computer to store one character, such as the letter "A."

Kilobyte (KB). In the binary notation system, 1 KB equals 1,024 bytes. You will often see KB's used to measure system memory cache on a central processing unit (CPU).

Megabyte (MB). In binary terms, 1 MB is equal to 1,048,576 bytes, or 1,024 kilobytes. Old hard drives are measured in MB's, but today RAM is what you most often see measured in megabytes.

Gigabyte (GB). One gigabyte is equal to 1,073,741,824 bytes or 1,024 megabytes. Most hard drives today are measured in gigabytes such as 10 to 30 GB, but some hard disks can hold up to 73 GB of information.

Terabyte (TB). One terabyte is equal to 1,099,511,627,776 bytes or 1,024 gigabytes. As storage demands increase, we may see more terabyte sized hard drives in the future.

Storage Capacity - Whether you store data on diskettes or directly on your hard drive it is important to know how much space is available to fill with your important documents, multi-media files or programs.

Transfer Speeds - Where storage is measured in bytes, transfer speeds are measured in bits per second (bps). One of the most important things to know these days is how fast you can get information from a modem or over a network. Some early modems transferred data at a rate of 300bps, but today's modems transfer data at 56,600bps and newer technologies such as ISDN, ADSL and cable modems can transfer data in terms of megabits per second. In short, kilobits per second (Kbps) is 1,024 bits or 128 bytes transferred in one second and megabits per second (Mbps) is 1,048,576 or 131,072 bytes transferred in one second.

Test yourself:
How long does it take to transfer a 5 MB file over a 56.6 modem?
How long does it take to transfer a 5 MB file over a 14.4 modem?
How important is it to you to have a fast download rate?

Processing Speed - the basic unit used for denoting processing speeds is a Hertz (Hz), but nowadays things are so fast that they are measured in megahertz (MHz) which is equal to 1 million cycles per second. CPU's these days range from 400 MHz to 750 MHz and are getting faster all the time.

CHAPTER 4

Electricity

Units in electricity

The three most basic units in electricity are voltage (V), current (I) and resistance (r). Voltage is measured in volts, current is measured in amps and resistance is measured in ohms.

A neat analogy to help understand these terms is a system of plumbing pipes. The voltage is equivalent to the water pressure, the current is equivalent to the flow rate, and the resistance is like the pipe size.

There is a basic equation in electrical engineering that states how the three terms relate. It says that the current is equal to the voltage divided by the resistance.

$$I = V/r$$

Let's see how this relation applies to the plumbing system. Let's say you have a tank of pressurized water connected to a hose that you are using to water the garden.

What happens if you increase the pressure in the tank? You probably can guess that this makes more water come out of the hose. The same is true of an electrical system: Increasing the voltage will make more current flow. Let's say you increase the diameter of the hose and all of the fittings to the tank. You probably guessed that this also makes more water come out of the hose. This is like decreasing the resistance in an electrical system, which increases the current flow.

Electrical power is measured in watts. In an electrical system power (P) is equal to the voltage multiplied by the current.

$$P = VI$$

The water analogy still applies. Take a hose and point it at a waterwheel like the ones that were used to turn grinding stones in watermills. You can increase the power generated by the waterwheel in two ways. If you increase the pressure of the water coming out of the hose, it hits the waterwheel with a lot more force and the wheel turns faster, generating more power. If you increase the flow rate, the waterwheel turns faster because of the weight of the extra water hitting it.

Electrical power

Electrical power is the rate at which electrical energy is converted to another form, such as motion, heat, or an electromagnetic field. The common symbol for power is the uppercase letter P. The standard unit is the watt, symbolized by W. In utility circuits, the kilowatt (kW) is often specified instead; 1 kW = 1000 W.

One watt is the power resulting from an energy dissipation, conversion, or storage process equivalent to one joule per second. When expressed in watts, power is sometimes called wattage. The wattage in a direct current (DC) circuit is equal to the product of the voltage in volts and the current in amperes. This rule also holds for low-frequency alternating current (AC) circuits in which energy is neither stored nor released. At high AC frequencies, in which energy is stored and released (as well as dissipated or converted), the expression for power is more complex.

Less technically, regular household appliances use DC and the power outlet in the wall is AC. The computer's power supply converts AC from the wall to DC for the computer.

CHAPTER 5

Tools for Demolition and Reconstruction

It is a good idea to collect a few basic tools before you tear apart your computer. The tools don't need to be fancy. The newer and more expensive the computer and its parts are, the more careful you may want to be with your computer. Here at the Gender Changer Academy it is not our goal to destroy computer hardware, but we do not want you to be afraid of breaking something. 'Breaking' something is a lesson not to be forgotten. Remember to ground yourself (discharging any small electrical current in your body) by touching something metal like your chassis or power supply.

Screwdrivers -a flathead (-) and a phillips (+) no 1 screwdriver are a must. One can magnetize the screw driver, which can be very useful in fishing out the little lost screws deep down in a dark corner. Note: floppies can be damaged by magnetic fields.

Egg box for the screws - keeps your screws separate and in order.

Pen and Paper - keep track of what you have dismantled.

Pen light torch - allows you to see the small print on the motherboard.

Antistatic bracelet - this cool little thing keeps you grounded at all times.

Extractors and tweezers – To fish out the little lost screws, or remove a BIOS. They say they're easier to use than fingers or shaking the case up-side-down. However, I never use these. I don't find them easy or practical at all. My little female fingers are far better at manipulating hardware….

CHAPTER 6

The BUS

A `bus` is the route along which data is transported. The width of the data bus, i.e. the number of parallel connectors, and its clock rate determine its data rate (the number of bytes per second which it can carry. This is one of the factors limiting a computer's performance. Most current microprocessors have 32-bit busses both internally and externally. 100 or 133 megahertz bus clock rates are common. The bus clock is typically slower than the processor clock.

The term is almost certainly derived from the electrical engineering term "bus bar" - a substantial, rigid power supply conductor to which several connections are made. This was once written "'bus bar" as it was a contraction of "omnibus bar" - a connection bar "for all", by analogy with the passenger omnibus - a conveyance "for all".

ISA, PCI, IDE and USB are types of bus design.

The USB or universal serial bus is used for many types of devices such as printers, modems, joysticks, scanners, zip drives, external hard drives, etc. The USB transfers data faster than the serial ports and parallel port and also has an important advantage that you can remove and add devices to the USB when the system is running. It can also support up to 127 devices at the same time through daisy-chaining (connecting each device to itself with a USB cable).

Sockets, Ports, Connectors, Cables

A socket is where there's a virtual and hardware connection between processes. Similarly an interface is a boundary across which two systems communicate. An interface might be a hardware connector used to link to other devices, or it might be a convention used to allow communication between two software systems, for example a graphical user interface: GUI.

Connectors are often called 'ports'. A port is a logical channel or channel endpoint in a communications system. A genderchanger is an adaptor (type of connector) which fits onto for example a serial or parallel port. Serial ports have a COM1- generally for a mouse, and COM2- generally for fax or modem. The PS/2 port and connector, otherwise know as mini-DIN (Deustche Industrie Norm) is usually for the keyboard, and uses the ISA bus. ALL VERY CONFUSING HEY!? Oh well. The parallel port is mostly used for the printer. The basic difference between serial and parallel is that data travels in serie in the former and in parallel in the latter.

We find cables outside as well as inside the computer. There are basically two types of cable: one for power supply/electricity and the other is for data transport. These two types themselves also have all sorts of variations on the theme, something which one just gets used to. It all has to do with when in time something was developed and by what manufacturer in what part of the world....

Flat Ribboned Cables

These cables are used between floppy, hard disk drives or cd-rom etc. One edge of the cable is generally red or marked with red dots. The red edge marks pin-hole number one and this should be connected to the corresponding pin number one on the IDE bus. The IDE bus is generally on the motherboard. The other end of the cable goes into the IDE device (hard drive or cd-rom) and again you should look for pin number one. No damage can be done if these cables are not connected properly, but nothing will work. New IDE cables and computers are now being manufactured so they only go in one way, so have a look to see what yours is like.

Monitor

The monitor is an output device. It visually tells you what the computer is doing so that you can react with more input. Your monitor can either get its power by sharing your computers powers supply, or by plugging directly into the wall socket. We think the wall is better for two reasons. First, your power supply should last longer if it is not supplying power to your monitor. Second, if you have a sleepy monitor it is better that you turn it on first (in order to see when to enter the BIOS).

There are two main types of monitors: cathode-ray tube (CRT) monitors and liquid crystal displays (LCD). The former works the same as a TV, and it emits radiation and all that good stuff. The latter is relatively new technology, very expensive, but better for your health and your electricity bill.

You will spend a lot of time looking at your monitor, so it might be a good reason to invest. Also monitors last a long time, so you can invest and keep it even when you need to upgrade other parts. Larger monitors generally support high resolutions and high refresh rates. This gives you less eyestrain. The refresh rate is the number of times per second that your computer screen is re-drawn and is measured in hertz (Hz). You don't want anything less than 60 Hz, or you will get a head ache. Resolution is the number of pixels displayed on the screen. Moving from 800x600 to 1,600x1,200 results in a fourfold increase in relative display size. Note that pixel is not the same as dots per inch (DPI) which is a value for on paper and not for on a screen

Keyboard

Keyboards were originally part of terminals which were separate peripheral devices that performed both input and output and communicated with the computer via a serial line. Today a keyboard is more likely to be connected directly to the processor, allowing the processor to scan it and detect which key or keys are currently pressed. Keyboards vary in the keys they have, most have keys to generate the ASCII character set as well as various function keys and special purpose keys, e.g. reset or volume control. The typing keys are the section of the keyboard that contain the letter keys, generally laid out in the same style that was common for typewriters. This layout, known as QWERTY for the first six letters in the layout, was originally designed to slow down fast typists by making the arrangement of the keys somewhat awkward! The reason that typewriter manufacturers did this was because the mechanical arms that imprinted each character on the paper could jam together if the keys were pressed too rapidly. Because it has been long established as a standard, and people have become accustomed to the QWERTY configuration, manufacturers developed keyboards for computers using the same layout, even though jamming is no longer an issue. Critics of the QWERTY layout have adopted another layout, Dvorak, that places the most commonly used letters in the most convenient arrangement.

Pointing device, e.g. mouse

The most commonly used computer pointing device, first introduced by Douglas Engelbart in 1968. Mice broke onto the public stage with the introduction of the Apple Macintosh in 1984. In the beginning there was no need to point because computers used crude interfaces like teletype machines or punch cards for data entry. The early text terminals did nothing more than emulate a teletype (using the screen to replace paper), so it was many years (well into the 1960s and early 1970s) before arrow keys were found on most terminals. Full screen editors were the first things to take real advantage of the cursor keys, and they offered humans the first crude way to point. Light pens were used on a variety of machines as a pointing device for many years, and graphics tablets, joy sticks and various other devices were also popular in the 1970s. Since the introduction of the mouse it seems like non nerd users have stopped using the keyboard. Mouse use is more simplified than keyboard use. It is more cramped, single same sort of movements and hence more chance of getting repetitive strain injury from it. We recommend as much switching between different movements as possible, see also chapter on health.

Chassis

A chassis (pronounced TCHA-see or SHA-see) is the physical frame or structure of an automobile, an airplane, a desktop computer, or other multi-component device. Case is very similar in meaning, but tends to connote the protective aspect of the frame rather than its structure. People tend to

choose one term or the other. The rest of this definition uses chassis but applies as well to the term case. Both terms (and casing) are derived from the Latin word for box. The plural form is also chassis.

For a computer, the chassis houses the main electronic components, including the power supply, motherboard, a basic speaker, power switch and a few LED's (light emitting diodes). Typically, there is room for a hard disk drive, floppy drive and a CD-ROM drive. The IBM PC chassis for its XT computers set an early de facto standard for a chassis configuration (sometimes referred to as the form factor). The desktop computer has since evolved through the AT model, the mini-AT, and the small-footprint PC. A later development was the vertical or tower chassis configuration, designed to be placed under a desk. Nowadays, we have mini-towers, midi-towers, full-towers and much more. The outer dimensions of a chassis are said to form its footprint. The more room you have inside your chassis, the easier it is to keep your system cool. The chassis is rapidly becoming somewhat of a fashion statement. Sisi and I recently saw a chassis that looked more like a food processor than it did a personal computer.

Buying considerations:
ATX (desktop or tower: mini, midi, maxi, and server), AT cases are the older models
Power supply, ranges from 200 to 300 watts, for an AMD processor you need at least 250W that is also AMD approved.
Low noise, re-cooling or fan?
Easy to open and close?
Enough knobs, well placed, on the front? A real reset button on the front?
USB openings on the front? Can be very handy
Does it stand on two feet?
A lot of space inside? Enough places for extra devices?
Of what material is it made? Does this matter?
Design
A UPS device (Un-interruptable Power Supply) against power surges. In case the Electricity supply crashes you have about 15 minutes of power supply stored to save and shut down.

The chassis, keyboard and the monitor are pretty much what we generally visualize as a computer. The mouse, though not essential in principle, is essential in practice for the modern day GUI or graphical user interface. A mouse isn't needed, for example, in a command line or text driven environment, and it is not needed when adjusting hardware settings in the computer's BIOS (basic input output system) which we will get to a little later.

The following external devices connect in some way or another to the motherboard or main board, inside the chassis through ports and buses that are basically places where we can plug things in. The different ports look different and have different functions and take different kinds of cables and connectors.

Motherboard

A motherboard or main board is the physical arrangement in a computer that contains the computer's basic circuitry and components. On the typical motherboard, the circuitry is imprinted or affixed to a firm planar surface and usually manufactured in a single step. The most common motherboard design in desktop computers today is the AT, based on the IBM AT motherboard. A more recent motherboard specification, ATX, improves on the AT design. In both the AT and ATX designs, the computer components included in the motherboard are:
Co-processors or chipset
Memory
BIOS
Expansion slots (PCI or ISA)
Interconnecting circuitry (bus)

The Microprocessor or Central Processing Unit (CPU) can be obtained separately. Additional components can be added to a motherboard through its expansion slots. The electronic interface

between the motherboard and the smaller boards or cards in the expansion slots is called the bus.

Central Processing Unit (CPU)

The CPU is the main microprocessor of a computer. It plugs into a socket on the motherboard. The central processing unit in a computer contains the logic circuitry that performs the instructions of a computer's programs.

A microprocessor (or simply 'processor' for short) is a microchip, a calculator. It's sometimes called a logic chip. It is the "engine" that goes into motion when you turn your computer on. A microprocessor is designed to perform arithmetic and logic operations that make use of small number-holding areas called registers. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design. When the computer is turned on, the CPU (the main microprocessor) is designed to get the first instruction from the Basic Input/Output System (BIOS) that comes with the computer as part of its memory. After that, the BIOS, or the operating system that the BIOS loads into computer memory, or an application program is "driving" the microprocessor, giving it instructions to perform.

Generally the CPU is located on the motherboard and is hidden under a heat sink and/or fan. The processor does a lot of work and gets very hot and must be cooled. Often while testing out hardware the fan is left off, so keep on eye on how hot your CPU gets and connect the fan as soon as you are ready to assemble other things. To get at the CPU you have to remove the heat sink and or fan and then lift a lever. Be careful with pins while removing and replacing the CPU. It only goes one way. If you bend the pins, you may ruin your CPU.

Chipset

If the CPU is your computer's brain, the motherboard is your computer's back bone and the chipset is your computer's heart. If your motherboard is the most important piece of computer hardware you will purchase, the chipset is the most important part of it. The chipset defines almost everything about the system. Physically, the chipset is the set of microprocessors that are integrated into the motherboard and can't be removed or upgraded. When you want to upgrade your chipset, you need to upgrade your motherboard which basically means you could potentially be changing your entire system.

The chipset controls the system and its capabilities and is the hub of all data transfer. The chipset controls the flow of bits that travel between the CPU, system memory, and the motherboard bus. It dictates the data to the memory controller, real-time clock, keyboard and mouse controller, secondary cache controller, DMA controller, PCI bridge and the EIDE controller. All data must go through the chipset and all components talk to the CPU through the chipset. To make order of all this chatting the chipset makes use of the DMA controller and the bus controller.
http://www.hardwarecentral.com has detailed information on kinds of chipsets and advantages and disadvantages.

Chipsets have compatibility requirements for CPU's, so it is important to know what kind of chipset you have and make an informed choice about the chipset you want on a new motherboard.
http://www.geek.com/procspec/chipsets/chipsetkey.htm
has an excellent chart of specs on chipsets to help sort things out.

Memory and Storage

Memory and storage get muddles up a lot. They work together but are a bit different. Basically the hard disk, disks, cd´s, dvd´s, magnetic tape etc are all forms of permanent, physical storage spaces. Then in addition there is memeory....

Memory is the electronic holding place for instructions and data that your computer's microprocessor can reach quickly. When your computer is in normal operation, its memory usually

contains the main parts of the operating system and some or all of the application programs and related data that are being used. There are also different types of memory: ROM, RAM, cache, and virtual memory.

Memory is often used as a shorter synonym for random access memory (RAM). This kind of memory is located on one or more microchips that are physically close to the microprocessor in your computer. Most desktop and notebook computers sold today include at least 16 megabytes of RAM (which is really the minimum to be able to install an operating system). They are upgradeable, so you can add more when your computer runs really slowly. The more RAM you have, the less frequently the computer has to access instructions and data from the more slowly accessed hard disk form of storage. Memory should be distinguished from storage, or the physical medium that holds the much larger amounts of data that won't fit into RAM and may not be immediately needed there. Storage devices include hard disks, floppy disks, CD-ROMs, and tape backup systems. The terms auxiliary storage, auxiliary memory, and secondary memory have also been used for this kind of data repository. RAM is temporary memory and is erased when you turn off your computer, so remember to save your work to a permanent form of storage space like those mentioned above before exiting programs or turning off your computer.

Additional kinds of integrated and quickly accessible memory are read-only memory (ROM), programmable ROM (PROM), and erasable programmable ROM (EPROM). These are used to keep special programs and data, such as the BIOS, that need to be in your computer all the time. ROM is "built-in" computer memory containing data that normally can only be read, not written to (hence the name read-only). ROM contains the programming that allows your computer to be "booted up" or regenerated each time you turn it on. Unlike a computer's random access memory (RAM), the data in ROM is not lost when the computer power is turned off. The ROM is sustained by a small long-life battery in your computer called the CMOS battery. If you ever do the hardware setup procedure with your computer, you effectively will be writing to ROM.

Another kind of memory is Cache memory. There are many levels of cache memory, but most often references to cache memory refer to the secondary cache or L2cache. Cache memory is used in many parts of the modern PC to enhance system performance by acting as a buffer to recently used information. We will talk about the secondary cache, but other kinds of cache have the same basic principle in mind. The system cache is placed between the CPU and the RAM.

The system cache is responsible for a great deal of the system performance improvement of today's PCs. The cache is a buffer of sorts between the very fast processor and the relatively slow memory that serves it. (The memory is not really that slow, it's just that the processor is much faster.) The presence of the cache allows the processor to do its work while waiting for memory far less often than it otherwise would.

Computer science has found that in general, a processor is much more likely to need information it has recently used, rather than a random piece of information stored somewhere.

Hard Disk

Size: in gigabytes, made up of heads, sectors and tracks
RPM: revs (revolutions) per minute: 5400, 7200
Noise level: dB (decibels)
Type of bus, interface: IDE or SCSI

(expansion) Slots and (daughter) Cards

The great think about computers is that they are modular. Like lego you can easily build and break down, add and subtract parts, fit it to your own taste.

Located on the motherboard are a series of slots. Some are short and ivory and they are the newer PCI slots. Some are longer and black or brown and they are the older ISA slots. There are some expansion slots that are even older and you might see some motherboards around with such slots,

but you are unlikely to buy a new or a relatively new-used motherboard with these really old expansion slots.

Expansion slots are connected to the circuitry of the motherboard through the BUS. The function of the expansion slots are to add daughter cards (also know as cards) to expand the capabilities of your computer's motherboard. Some motherboards may integrate directly what other motherboards do with an expansion slot. For example, the keyboard, mouse plug into ports that are directly integrated into the motherboard. Whereas many mother boards use an expansion slot to insert a graphic card which is then connected to a monitor. Some motherboards have on board support for monitors. For many things (and in principle almost anything) can be connected to the motherboard through an expansion slot with the correct type of card. The following are some cards that are common to computers today. Since they generally all look alike to beginners, we have included some obvious features that make it easier to recognize a card.

Input/Output card
Actually, the input/output cards are not so common today, but were used in older computers to connect hard disks and floppy drives where the motherboard didn't have onboard IDE support. The typical feature of this card would be no holes to the outside and obvious looking IDE buses on the card.

Graphics, monitor or video card
The monitor plugs into the graphic card (also known as VGA card), so you can see what is happening (or not happening) on your computer. A graphic card will have one rounded trapezoid looking 15-pin (holes lined up in three rows not two) female connector.

Sound card
A sound card is needed when you want to attach some decent speakers to your computer to play music or video. The little internal speaker is really only cable of making beeps sound good. A sound card will have generally have little round holes with audio-in, line out and microphone engraved near them and also a 15-pin (holes lined up in two rows not 3) for connecting something other than speakers (anyone know what?).

Modem card (internal)
An internal modem takes the shape of a card and then the telephone line is plugged into the modem card. The obvious feature of a modem is the telephone plug which will nicely fit a telephone line. Some modems are combination telephone and answering machine devices and can have space for 2 lines and small round holes for a speaker and microphone. I have heard that combi- devices are a bit more difficult to configure.

Network card
Just like the name, a network card enables a computer to connect to other computers with a network cable. A network card will typically have an RJ45 plug which looks like a telephone jack, but is larger, and it will also have a protruding round connector for a UTP ethernet cable.

BIOS

The BIOS (basic input/output system) is the program a personal computer's microprocessor uses to get the computer system started after you turn it on. It also manages data flow between the computer's operating system and attached devices such as the hard disk, video adapter, keyboard, mouse, and printer.

The story of BIOS starts at the end of the seventies, when Intel Corp. introduced two new types of microprocessors, the 8086 and the 8088. IBM Corp. decided to develop a compact and "cheap" computer system for the home and office use, based on the Intel 8088 microprocessor. IBM made contact with a small and young company in Seattle, Microsoft, in order to develop the means to control this computer system. Both companies agreed, that the operating system should be divided

into two parts. The one part, the Basic Input/Output System, should form a part of the hardware, and would be added to the computer as ROM. The other part, the actual operating system, would be available on disk, and should be loaded into RAM during boot-up.

The BIOS consists of basically four parts:

1. The Power-On-Self-Test
The Power-On-Self-Test or POST contains a series of diagnostics routines that test the various system components, initialize certain data structures and finally boot up the system. POST consists of various test- and initialization routines for the on-board hardware and expansion cards such as the video adapter. If a failure is detected this can be made known by:

One or more audible beeps, the so-called beep codes; get your beep code reference at http://www.bioscentral.com/

An error message presented on screen;
A checkpoint code, sent to one of the system's output ports.

When all tests have been performed and components have been initialized, control is transferred to the Bootstrap Loader, to load the available operating system on disk.

2. The BIOS Setup Utility
The BIOS Setup Utility can be used to enter, modify and store system configuration data. Several screens are available to define simple and more or less advanced system characteristics, such as hard disk and floppy disk types, date, time, memory wait states, DMA clock, power management, etc.

All BIOS's provide a Setup Utility, either built into ROM or on disk. This Setup Utility allows users to modify the basic system configuration. Data entered in Setup are stored in battery-backed RAM (CMOS-RAM). Nowadays, the BIOS Setup Utility is divided into various sections. In known cases the Setup Utility can consist of numerous setup screens, one for each peripheral device, such as the MR BIOS.

3. Internal Diagnostics
Internal diagnostics in the past consisted of extensive setup diagnostic utilities to check the various components of the system. If available in present BIOS's, the Internal Diagnostics will only contain a Hard Disk Utility, providing low level format, auto interleave and media analysis.

4. The System BIOS
The System BIOS provides the so-called Interrupt Service Routines (ISRs) which are available during the time the system is powered on. The ISRs perform fundamental services necessary to let the system operate correctly. Instructions from the operating system and/or application software are translated to commands that can be understood by the system hardware.

CHAPTER 7

Do It Yourself

What do you want?

Before you decide what you want you need to determine your needs. A little bit of planning can save you a lot of headaches caused buy computer sales people. You know what you need, they don't.

PLAN what will you use your PC for? Web Page Design, Desktop Publishing, Word processing, Internet surfing, email, making music, playing games???? If you will be doing Web Page publishing, you might want to invest in a new big monitor, for example.

ASSESS what do you already have, if anything, and is it possible to recycle parts into your new PC?

BUDGET how much do you want to spend? And STICK to it. If your budget is only 600 euro you might want to re-assess the need for a big hard disk.

PLAN some more. If you already have a computer, which ones do you want to replace and which should you recycle. If you follow this plan you will buy new pats that are compatible with your old parts and get a nice new computer that matches your needs and your budget.

What to recycle or what can be got second hand:

Diskette drives. Few advances have taken place in recent years, so it is likely you can use your old floppy, or easily save by finding one second hand.

Hard Disk Drives (HDD). Many advances have and continue to take place in the technology of hard drives, so it is likely something you would replace or buy new. Hard drives less than a year old are still really good. The most important specs for a hard drive are: interface type (IDE, EIDE, SCSI), spindle speed and cache size. Also important is the data transfer rate and access time.

Motherboard and CPU. For real upgrading you don't want to recycle the motherboard and CPU. However, if you are really on a shoestring budget and are planning to run Linux with command line interface instead of Windows and all the graphics that go along with it, I understand that you can get away with a lot less computer of a computer. This makes the determining your needs a very important step! It is your motherboard and CPU and their compatibility where you get the most noticeable increases in speed and power. If you are not interested in a new motherboard or CPU, you should consider replacing some components of your current machine rather than building a whole new machine. If you are building everything from second hand parts, you will most likely be starting with the Motherboard and CPU and building up from there.

RAM. The older RAM chips don't necessarily contain the newest architecture and may not fit in a new motherboard, so depending on what motherboard you get will determine whether you can recycle you old RAM.

Video Card. These have seen major improvements in features in recent years. You may want a new one, because a Video card with its own cache and image processing capabilities will free your CPU up for much more important processing. If you have a really fast CPU, but not such a good video card, your computer will appear sluggish when doing intensive graphics such as in games. Some old video cards are permanently attached tot he motherboard, so this may determine whether or not you can recycle it.

Exterior Components. Recyding things like the case are a big money saver.

Input devices. No major changes have happened to keyboards and mouses, and these devices are generally very compatible, so they are easy to recyde and to get second hand. Depending on how often you use your computer, you may want to consider ergonomic design of either the mouse or the keyboard, but a good desk and chair may be what your really need.

Monitor. Unless you need a new big monitor for say graphic design or web page publishing, you may want to keep your old one, or keep tot he second hand market to keep your budget concentrating on the important processing improvements on the inside of your computer. You must make sure your monitor is compatible with your video card.

Money saving tips:

Shop around because prices vary and also check return policies and the level of customer support a store offers.

Consider Lesser-known brands. Well-known brands are generally more expensive. Lesser-known brands may have a higher component failure rate, but you can use the internet to check with other users about reliability of lesser-known brands.

Don't always buy the newest. Stuff that is less 6 months old costs significantly more and usually has only marginal improvements. Determine the specifications that are most important for your computing needs.

Where can you get it?

Computer Fairs, eg the PC Dump Dag in the Netherlands
Second hand computer stores
Buy on the internet
Local stores
Trade with friends
Test out the stuff you find on the street

CHAPTER 8

HEALTH ISSUES
Computers can cause damage to people and to the environment.

The Human's first?

If you're going to work with computers a lot you should keep the following health factors in mind: eyes, ears, muscles, skeleton, lungs, circulation, harmony. We don't as yet have crisp references to facts and research but we have all heard of the side effects of looking at a video display unit too long, especially cathode ray tube monitors. The same applies to listening to the continuous whirring, buzzing sounds of the computer fans and electronics. Also keep in mind that if you're inside a lot you're getting lots of stale, smokey, toxic, germ filled, recycled air.

In addition the case for all that sitting around is not strong. Repetitive Strain Injuries (RSI) comes from not varying ones movements enough. It's the result of physical and mental stress. Not only minimal use of just one type of pointing device cause RSI but other stress factors also play a role: negative atmosphere on the work-floor, personal problems, and so on. One can imagine that discontent means taut muscles, which means less blood flow to the brains which means headaches. We encourage switching from mouse to keyboard and back. Try to make more use of command line programs, not only graphic user interfaces that need pointing devices, like Windows. Of course tense and monotonous use of a keyboard can also cause RSI.

Being a computer worker often means having a serious deficiency in physical activity. We at the ASCII encourage you to jump up now, in the name the skeleton, the muscles and the circulation of bodily fluids. Dance a little caribbean jig and jive around the rest of the people in your space. It also stimulates social interaction and laughter.

The Environment last?

Computers are made up all sorts of not so natural ingredients: petroleum based plastics, lead, CFCs, halogen and (heavy) metals! These are mined in a destructive manner to say te least and are very damaging once discarded. These by-products ooze back into the earth and the air if not treated right. When you have no use for your old computer devices anymore, please don't throw them out on the street, waste dump or landfill. They need to be deconstructed appropriately. And harass those responsible to act up now.

A lot of computer devices are still in the prototype phase. They have a relative low durability. Every week devices devaluate because a new and improved, faster, smaller, bigger, prettier version comes on the market. This is the sad ad bad news for the environment...

We found an organisation on the web which offers more information on these issues: www.svtc.or: the Silicon Valley Toxics Coalition which has a Clean Computer Campaign aimed at influencing policy and development around green design and eco-labelling of computer product.

CHAPTER 9

FAIR TRADE

We were wondering about the money flow around computer hardware. When we pay for the parts we didn't get given as gifts or dragged from the streets in real recycling revalueing style, to whom does that cash go? We wonder where the motherboards get made, who makes them and what are the labour wages and conditions like? There's a sneeking suspicion that these mobos (motherboards) are made by people in the poorest, weakest countries of the world, by women and children with fine fingers and motoric skills. At this point we do not have any statistics to back this idea. But our general belief is that whenever consuming something one should question its origins, not only in the case of agricultural or textile prodcts like bananas or nike shoes....

Organisations following these issues are OXFAM and the Schone Kleren Kampanje: Clean Clothes Campaign.

BIBLIOGRAPHY

Praktijkboek, Het bouwen van een eigen pc,
Victor Peters, Sybex Uitgeverij, 2000.

Praktijkboek, EHBO voor de pc, Rob van Kempen, Sybex Uitgeverij, 2000

Your very own motherboard Manual. It doesn't come with a new or second hand pc, only when you buy a motherboard alone. You should be able to find your motherboard manual on the Internet, however even this can be difficult. Just like software, hardware is also member of the "closed source" mentality. Free the Hardware specs we say!

We found a lot on the Internet.

LINKS

www.wikipedia.org
Revolutionary, it has made a lot of other sites obsolete. One of the most famous examples of information can not be confined to a patent or an intellectual property label. Information is a combined effort, and it evolves.

www.google.com
Use the command "define:" in google and it will list definitions collected from a whole range of sites, eg define:processor and so on.
Use the 'Images' function in google to find pictures of hardware.

www.tweakers.net
A very good Dutch site for hardware reviews and price comparisons.

www.slashdot.org
The news and opinion site for nerds.

http://www.stud.ntnu.no/~shane/dokumentasjon/commandline.html
In the Beginning there was the Command Line, Neal Stephenson, 1999.
A history of operating systems, by Neal Stephenson, the author of such novels as Snow Crash and Cryptonomicon.

http://www.pctechguide.com
If you can ignore the flash and banners and pink then there is lots of info to be read. It is written in easy-to-understand English :)

http://www.howstuffworks.com
With this site I started out my learning process. Especially the images and diagrams are useful.

http://www.wimsbios.com
For information about the BIOS

http://www.utdallas.edu/pretext/PT2.1/haynes/intro.html
An article/short story by Cynthia Haynes in the magazine Pre/Text

http://ftp.arl.army.mil/ftp/historic-computers
hhistorical computer images including the famous "first four" photo, which is used on the cover of his reader

HOMEWORK

Upgrading or Building your own computer

The purpose of this homework is to understand how computer use should be reflected in your computer hardware. What you use your computer for such as surfing the internet, doing heavy graphics, sound and video editing, playing games or serving a network all tax the hardware of a computer in different areas. The system's performance can be enhanced a great deal if you put importance on the parts that will be doing the most work. Therefore, before deciding what you want in computer hardware it is a good idea to first decide what you want to do with your computer.

Entering a computer store can be a very confusing process. Often you don't get to look at things or touch them. They are either kept behind glass or hidden in a flashy coloured box. It is a good idea to know what you are looking for before you go to one; or at least be prepared to ask questions and do not feel pressured to buy. Don't buy something if you don't know what you are buying, and always make sure there is a good return policy.

There are three main things that general users use their computers for:
Browsing and general office use (text-processing, layout, a bit of graphics);
Multi-media use (graphic design, sound editing, video-editing);
Gaming (fast moving detailed graphics / imaging).

With this in mind, we would like you to investigate what components are most important for each type of machine. Use the internet, ask friends or even visit a computer store to get information. If you go to a computer store, tell the sales person that you will be using your computer for one of the above uses and see what they suggest.

The Internet Machine (and general office type use):
What components are most important? Accessing the internet and doing some multi-tasking between an internet browser and other applications will be the user's main functions. Where should you concentrate your budget?

The Multi-Media machine:
This machine will have to do lots of multi-tasking, image processing and video and sound editing. What parts will be most important for this type of machine.

The Gaming machine:
The owner of this machine will spend 60 to 70 percent of his or her computing time playing games. What type of hardware is most likely to boost the performance of the games.