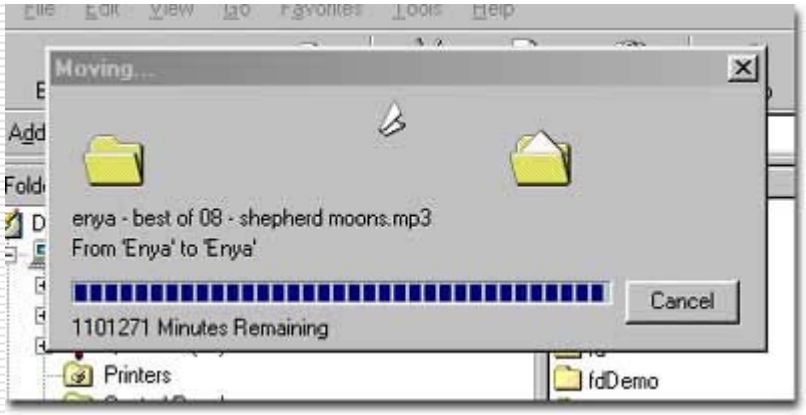
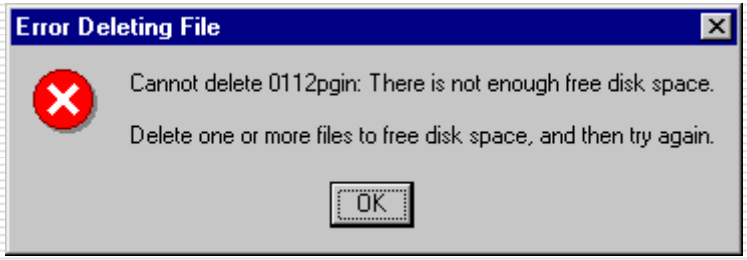
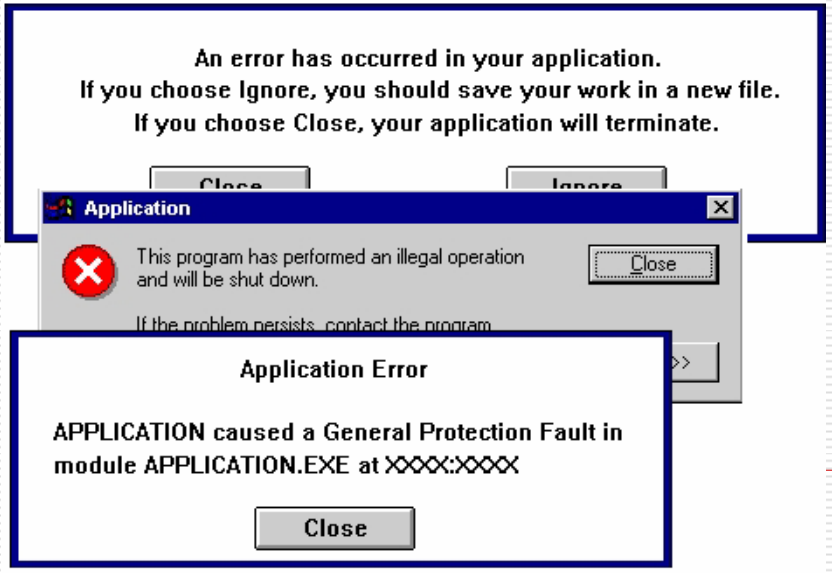
Why do computers sometimes crash?

Presentation by Christian Klukas for the UNIcert IV certificate

Software bugs...







During the preparation of this presentation…

Sometimes 49,7 days have a special meaning…

Overview of my presentation

- What is a computer?
- What types of errors can occur?
- Numerical representation of numbers
- The reaction of the OS on software bugs
- What can be done?
  - Choosing the right hardware, operating system and applications
- Discussion

What is a computer?

- A computer is a collection of different hardware pieces.
- The CPU is the brain and controls all operations.
- The hard drive stores all software and data.
- RAM, or memory, is the area where programs run.
- The “motherboard” connects all the pieces together.
- Printers, disk drives, monitors, mice, keyboards, speakers, and scanners are all hardware that connect to the computer.

The PC

- Drawing at the board:
  - The PC consisting of: HD, CPU, RAM, Motherboard
  - The CPU consisting of general purpose arithmetic and arithmetic coprocessor each of them with Registers (AX, BX, CX, ...)
  - Registers consist either of 8/16/32 or even 64bit

The purpose of the CPU

- The CPU is the “core” of your PC
- It controls the complete PC and performs nearly all computing tasks
- Many different architectures where developed, the “Intel x86” compatibles gained the biggest market share in the PC market
- PowerPC architecture used by Apple Macintosh computers
- The CPU performs very simple operations like “move data” or “multiply this two numbers”
- Today the CPU also has an build in mathematical co-processor which performs mathematical operations like “sinus” at a high speed

The Operating System…

- …enables the user to load and save files
- …loads and executes additional applications
- …contains tools for basic tasks
- …becomes more and more complex
- There are three main common OSs: Windows (market share well above 90%), MacOS and Unix
- A lot of OSs are now obsolete and not used anymore: NextStep, OS/2, AmigaOS, …
- …enables application developers to work at a higher level (e.g. “draw a line” or “create window”)

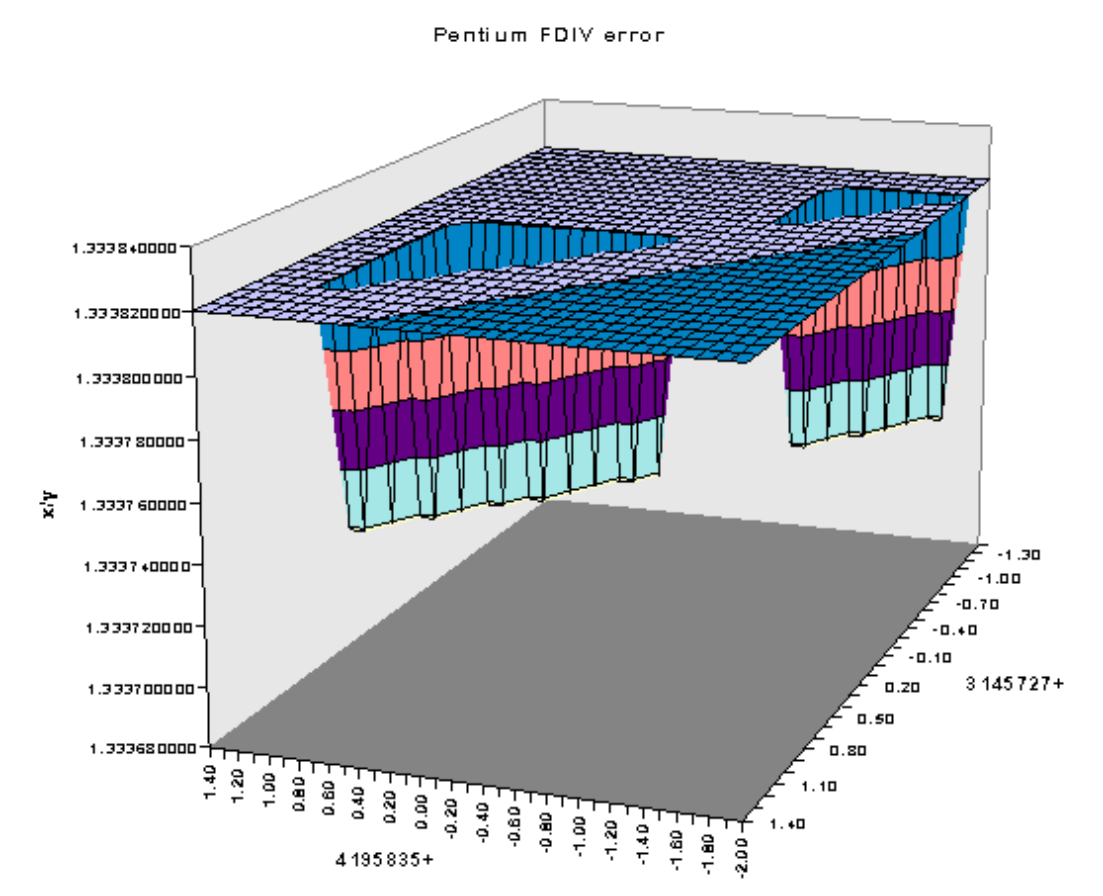
What kind of errors can occur?

- Hardware failures
  - Caused by over heating
  - Caused by design failures
  - Caused by other reasons like rough transportation or a bad electricity system
  - Can cause the computer to stop operating or can cause false calculations and crashes of PC applications or the OS
- Software bugs
  - Always “by design”
  - Unexpected user input, untested parts of the application, unexpected environment like low disk space
- False assumptions
  - Generally the PC does what you told it to do
  - Often it is important to understand the limitations of the PC

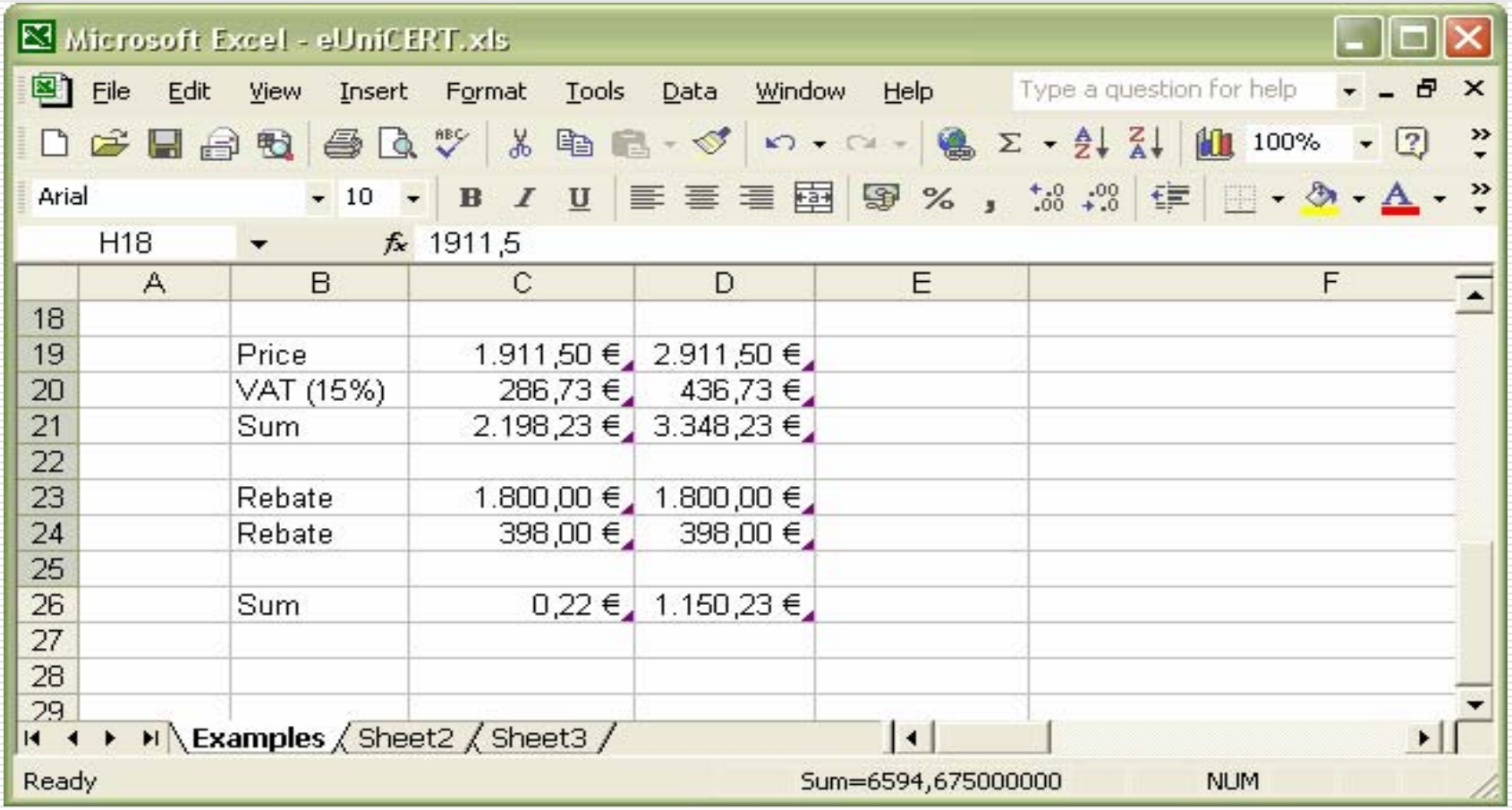
Hardware failures

- On October 30, 1994, Professor Thomas Nicely of Lynchburg College reported a bug in the Pentium floating-point unit?. He reported that certain division operations returned a value which was wrong by a very small amount.
  - Intel at first denied that the problem existed. Later, Intel claimed that it was not serious and would not affect most users; however, if you could prove that you were affected, Intel would replace your processor. Finally, public outcry forced Intel to agree to replace all flawed Pentium processors, at huge cost to the company.
- This bug was soon to be fixed. As a result only first Intel Pentium processors (60 – 90 MHz) had this problem
- You can check to see if your Pentium has the FDIV bug by entering the following formula in the Windows calculator: (4195835 / 3145727) * 3145727 – 4195835, result should be 0, faulty result: 256

The result of the fDiv bug visualized

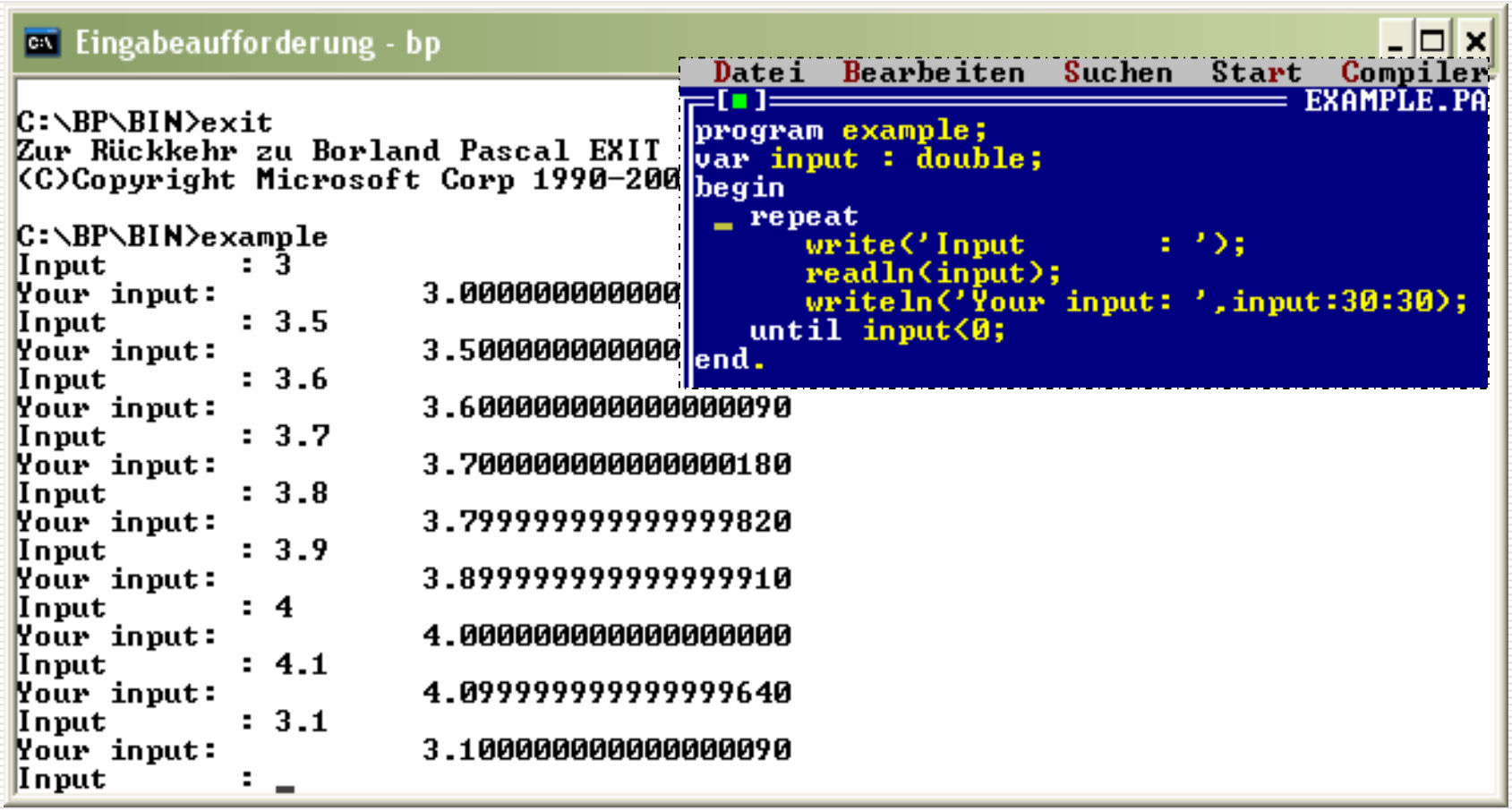


Numerical representation of numbers and its problems – Example 1

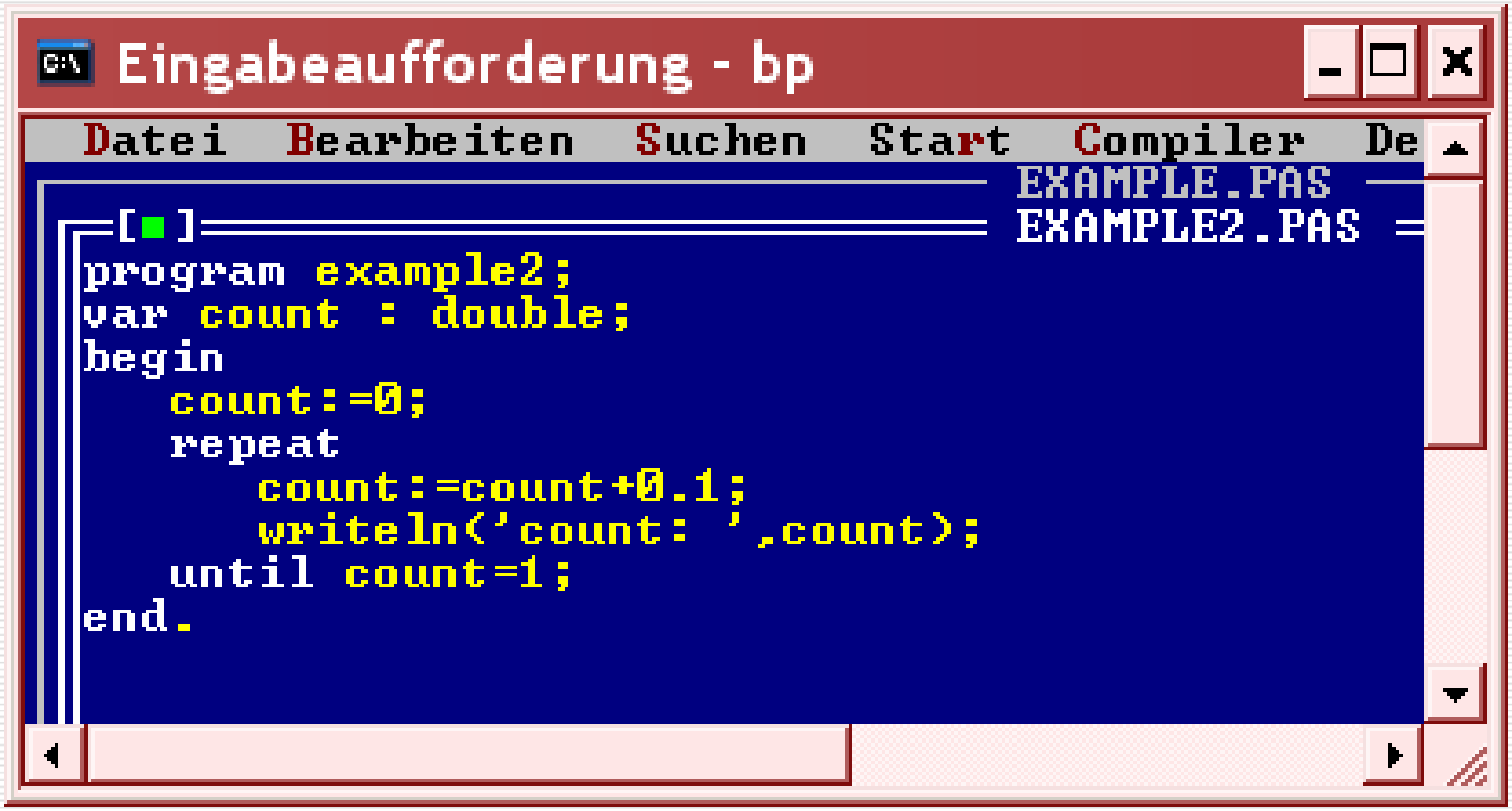


	A	B	C	D	E	F
18						
19		Price	1.911,50 €	2.911,50 €		
20		VAT (15%)	286,73 €	436,73 €		
21		Sum	2.198,23 €	3.348,23 €		
22						
23		Rebate	1.800,00 €	1.800,00 €		
24		Rebate	398,00 €	398,00 €		
25						
26		Sum	0,22 €	1.150,23 €		
27						
28						
29						

Numerical representation of numbers and its problems – example 2



Numerical representation of numbers and its problems – example 3



How does the OS react on typical application bugs?

	Long computation	False memory access	Bad software-installation	Bad hardware driver
Win 3.x Mac OS	OS and all apps stop responding	OS crashes	OS may not work any more	OS may not work any more
Win 95	Other apps may run unaffected	Memory protection partly implemented, OS may rarely crash	- ,, -	- ,, -
Windows 2000, Mac OS X	Other apps remain unaffected	Memory protection fully implemented, no problem for the OS	Partly secured, OS becomes rarely unstable	- ,, -
Windows XP	- ,, -	- ,, -	OS remains unaffected	Driver can be disabled

What can be done?

- Choosing the “right”
  - Hardware
  - Operating system
  - Applications
- “Work around” the problem
- Create backups, save your work

Choosing the “right” hardware

- Mass productions have to be error free in order to prevent major support problems for the producer
  - E.g. Dell, IBM, HP but also Aldi!
  - Problems can be expected when buying a PC at little stores or at the super market
- Business products are often more reliable and have often better support
  - E.g. laser printers from HP
- Intel P4 has a build in thermal control while the AMD Athlon will be destroyed in case of a CPU-fan failure

Choosing the “right” operating system

- New OS include corrections for problems found in older versions
- The newer OS works with new hardware like video cameras
- But: newer OS requires better hardware
- For the average home user Windows is a good choice. Windows XP gives home users the stability of the Windows NT line
- The new Apple Macintosh OS “Mac OS X” is improved and is also a good (but expensive) choice
- Linux is too complicated for a average PC user

Choosing the “right” applications

- New versions bring new features
- If a application does not work very good, a new version will probably correct the issues
- If a given program works good there is no need to upgrade or replace the application
- Before buying the product use “test-versions”, ask friends or search on the internet forums for suggestions

Finally Bill Gates PC crashes too…

- He made these comments in an interview with CBBC Newsround Press Pack reporter, 15-year-old Sarah Laughton:

- **Sarah:** And finally, does your computer ever crash?
- **Bill:** Oh definitely, believe me I get to the bottom of it every time and that's part of the passion that I and a lot of Microsoft people have is we want to make a tool that we want to use ourselves and we know from our own use we can make it a lot better and a lot more reliable.

Discussion

- What do you do in case of computer problems?
  - Do you use Computer Hotlines, Friends, Internet, Books?
  - User manuals?
  - Build-in help system?
- Does your PC makes more trouble than it is worth? Or does it increase your productivity?
- Which applications or operating systems do crash more often? Is Microsoft the worst?