Introduction to Programming

Bertrand Meyer

ETH Zurich, October 2003 – February 2004

German version of lecture slides

Folien für diese und alle weiteren Vorlesungseinheiten werden von nun an auch in Deutsch verfügbar sein.

Sie können die deutschen Folien auf der Webseite der Vorlesung finden.

Language

- Das war die erste deutsche Folie dieser Vorlesung
- Das ist die letzte deutsche Folie dieser Vorlesung

Choose your language

- Exercise sessions (Übungsgruppen) are available in German, English and, if we get enough requests, French.
- Choose an exercise session (i.e. an assistant) in your preferred language
- Languages spoken by assistants: German (several varieties), French, some Italian, Polish, Turkish

Goals of the course

After successfully taking this course, you will:

- Know the key concepts of programming.
- Master your first programming language: Eiffel.
- Understand basic hardware and software tools.
- Know basic concepts of design, implementation and maintenance of large software systems ("software engineering").

Teaching staff

Bertrand Meyer

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- E-mail: Bertrand.Meyer@inf.ethz.ch
- Office: RZ J6
- Secretary: Ruth Bürkli, (01) 632-5277

The assistants

8

- Volkan Arslan
- Benno Baumgartner
- Till Bay
- Susanne Cech
- Jörg Derungs
- Peter Farkas
- Michael Gomez
- Piotr Nienaltowski
- Michela Pedroni
- Matthias Sala
- Gabor Szabo
- Tobias Widmer
- Karine Arnout

Exercise sessions

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Most groups have two sessions a week:
- Monday, 15:00 – 16:00, various rooms
- Tuesday, 13:00 – 15:00, various rooms

One group has instead of the Tuesday session a session on
- Wednesday, 14:00 – 16:00

Two groups have a single session:
- Tuesday, 15:00 – 18:00

Choose your session according to preferred language, schedule constraints, and availability

Registration lists will circulate in a few moments

Volkan Arslan

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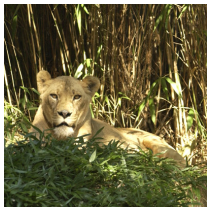
Mailing list: lions@se.inf.ethz.ch



- E-mail: Volkan.Arslan@inf.ethz.ch
- Office: RZ J3
- Phone: 01/ 632 44 70
- Language: German (English)
- Rooms:
  - Monday: ML F39 (15:00 – 16:00)
  - Tuesday: ETZ E9 (13:00 – 15:00)

Benno Baumgartner

11

Mailing list: bees@se.inf.ethz.ch

- E-mail: benno@student.ethz.ch
- Language: German (English)
- Rooms:
  - Monday: ETZ K91 (15:00 – 16:00)
  - Tuesday: HG D7.2 (13:00 – 15:00)

Till Bay

12

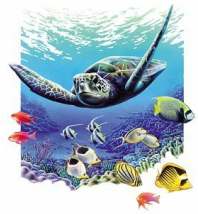
Mailing list: dragonflies@se.inf.ethz.ch

- E-mail: till.bay@inf.ethz.ch
- Office: RZ J22
- Phone: 01/ 632 76 33
- Language: German (French, English)
- Rooms:
  - Monday: ML H37.1 (15:00 – 16:00)
  - Tuesday: ML D13 (13:00 – 15:00)

Susanne Cech

13

Mailing list: turtles@se.inf.ethz.ch

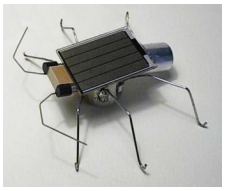


- E-mail: scech@inf.ethz.ch
- Office: RZ J5
- Phone: 01/ 632 79 36
- Languages: German (English)
- Rooms:
  - Monday: LEC C14 (15:00 – 16:00)
  - Tuesday: HG F3 (13:00 – 15:00)

Jörg Derungs

14

Mailing list: ants@se.inf.ethz.ch



- E-mail: derungs@inf.ethz.ch
- Office: CLW B3
- Phone: 01/ 632 74 06
- Language: German (English, French)
- Rooms:
  - Monday: ETZ H91 (15:00 – 16:00)
  - Tuesday: ML H44 (13:00 – 15:00)

Peter Farkas

15

Mailing list: mice@se.inf.ethz.ch

- E-mail: pefarkas@student.ethz.ch
- Language: German (English)
- Room:
  - Tuesday: IFW A34 (15:00 – 18:00)

Michael Gomez

16

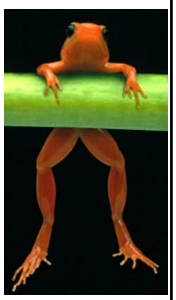
Mailing list: cows@se.inf.ethz.ch

- E-mail: gomezm@student.ethz.ch
- Languages: German
- Rooms:
  - Monday: ML J37.1 (15:00 – 16:00)
  - Tuesday: ML J34.3 (13:00 – 15:00)

Piotr Nienaltowski

17

Mailing list: frogs@se.inf.ethz.ch



- E-mail: Piotr.Nienaltowski@inf.ethz.ch
- Office: RZ J3
- Phone: 01/ 632 44 68
- Languages: French (English)
- Rooms:
  - Monday: IFW A32.1 (15:00 – 16:00)
  - Tuesday: ETZ K91 (13:00 – 15:00)

Michela Pedroni

18

Mailing list: lizards@se.inf.ethz.ch

- E-mail: michela.pedroni@inf.ethz.ch
- Office: RZ J22
- Phone: 01/ 632 76 84
- Languages: German (English)
- Rooms:
  - Monday: ML H34.3 (15:00 – 16:00)
  - Tuesday: HG F5 (13:00 – 15:00)

Matthias Sala

19

Mailing list: cats@se.inf.ethz.ch

- E-mail: salam@student.ethz.ch
- Languages: German (English)
- Rooms:
  - Monday: IFW A36 (15:00 – 16:00)
  - Wednesday: HG E22 (14:00 – 16:00)

Gabor Szabo

20

Mailing list: dogs@se.inf.ethz.ch

- E-mail: Gabor.Szabo@inf.ethz.ch
- Office: CLW B2
- Phone: 01/ 632 73 97
- Languages: English
- Room:
  - Tuesday: IFW D42 (15:00 – 18:00)

Tobias Widmer

21

Mailing list: ducks@se.inf.ethz.ch

- E-mail: Tobias.Widmer@id.ethz.ch
- Languages: German (English, Italian)
- Rooms:
  - Monday: ML J34.1 (15:00 – 16:00)
  - Tuesday: LEC C18 (13:00 – 15:00)

Karine Arnout

22

- E-mail: karine.arnout@inf.ethz.ch
- Office: RZ J4
- Phone: 01/ 632 4723
- Languages: French (English)

Exercise sessions

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Registration lists will circulate now

Choose your session according to preferred language, schedule constraints, and availability

About me

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- At ETH for two years
- In industry for most of my career
- Founded *Eiffel Software* in Santa Barbara, California, in 1985. Still "Chief Architect" of the company.
- Published a number of books, in particular *Object-Oriented Software Construction* (2nd edition: 1997)
- Plan: help the industry build the best software possible

Practical information

Schedule

Lectures:
- Monday, 13:00 – 15:00, HG E7
- Tuesday, 10:00 – 12:00, HG E7

Exercise sessions:
- Monday, 15:00 – 16:00, various rooms
- Tuesday, 13:00 – 15:00, various rooms

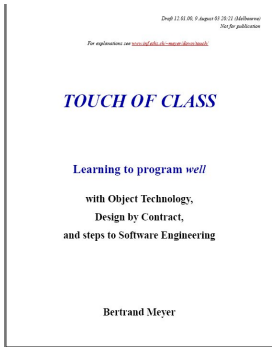
or (for two groups)
- Tuesday, 15:00 – 18:00

or (for one group)
- Monday, 15:00 – 16:00
- Wednesday, 14:00 – 16:00

Course material

- Course page:
  http://se.inf.ethz.ch/teaching/37-001
  → Check it at least twice a week
  English version available, but German one is more up to date
- Lecture material:
  - Lecture slides
  - Textbook: *Touch of Class* (draft)
    Available electronically from course page
- Exercise material:
  - Exercise sheets
  - Master solutions

Touch of class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Not for publication

For explanations see www.inf.ethz.ch/~meyer/dbon/touch/

TOUCH OF CLASS

Learning to program *well*

with Object Technology,
Design by Contract,
and steps to Software Engineering

Bertrand Meyer

Electronic forums

Discussion forums:
- Help forum for the whole course:
  http://se.inf.ethz.ch/teaching/ws2003/37-001/forum/
- Mailing list for each group

Advice and rules:
- Use the forums and mailing lists! Learning to program is hard: take advantage of every help you can get.
- Don't be shy. There are no stupid questions.
- Criticism welcome, but always be polite to every participant and observe the etiquette.

To email the whole teaching team (professor and assistants):

intro-assi@se.inf.ethz.ch

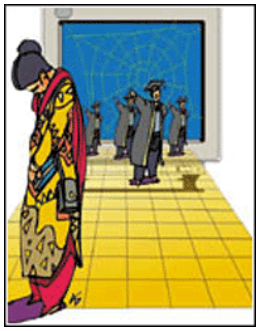
Office hours

RZ J22
Friday 14:00 – 16:00

Exercise sessions

- Make sure to attend all sessions
- Do all exercises (you'll need them, see "Testat")

Mailing list for women students



Mailing list*:

chicks@se.inf.ethz.ch

*Note for outside readers of these slides: the name was chosen by the (women) assistants in charge of this group, as the natural complement to the animal names of other groups. Its implicit tone is of course not derogatory but gently humorous. We are dead serious about increasing the representation of women in computing and supporting women students. The Department of Computer Science has an active *Frauenförderung* (advancement of women) initiative which we encourage you to visit at http://www.frauen.inf.ethz.ch/ .

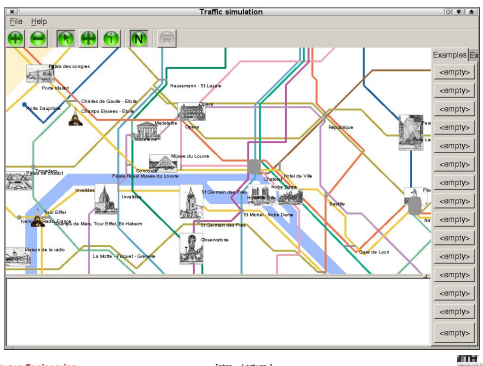
Exercises, "Testat" regulations

- "Testat": Needed for admittance to fall exam.
- Exercises:
  - 7 weekly exercises
  - 2 classroom exercises
  - 1 project exercise
- To get the "Testat" you need to have done at least:
  - 6 weekly exercises
  - 1 classroom exercise
  - 1 project exercise
  - Must show serious effort to address the questions
  - Must have filled out questionnaire
- Military services or illness ⇨ contact your assistant.

The TRAFFIC software

- The text book and exercises rely on the TRAFFIC software
- Application domain: Transportation system in a city
- EiffelStudio download:
  http://www.eiffel.com/downloads/
- TRAFFIC software download:
  http://se.inf.ethz.ch/teaching/ws2003/37-001/downloads/

You'll discover TRAFFIC



Warning

- The course under this form is new.
- We're also all new to this!
- The material is still being written and expanded.

SO:

- Not everything will be perfect from our side.
- The software (TRAFFIC) probably has mistakes ("bugs"), and the textbook too.

BUT:

- We will correct our mistakes, as quickly as we can.
- If you try something, don't blame the software first. It may be doing just what you told it to.

Lecture 1: The industry of pure ideas

Software engineers build machines

- You can't touch, kick or drop our machines: they're immaterial
- But they are machines anyway
- We call them programs or systems

To operate (or run or execute) a program you need a physical machine: a computer

- Computers and related devices: hardware
- Programs and associated intellectual value: software

Software everywhere

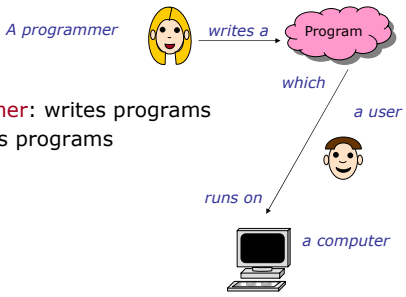
- Banking: manage millions of account
- Trading: decide to sell or buy
- Transportation: control trains, track planes...
  - Today's cars have millions of lines of program code
- Travel: air, train, hotel reservations
- Government: manage taxes, track laws...
- Health care: keep health record, control devices
- Education
- Entertainment
- Information
- etc.

Computers

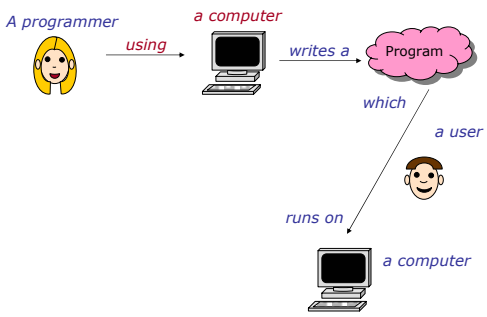
- Computers are universal machines. They execute the program that you feed them
- The only limit is your imagination
- The good news:
  - Your computer will do exactly what your program says

Working with a computer

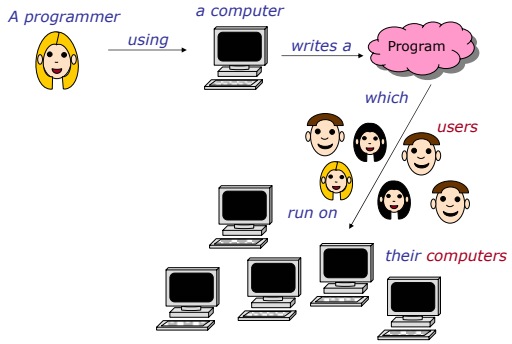
- Programmer: writes programs
- User: runs programs



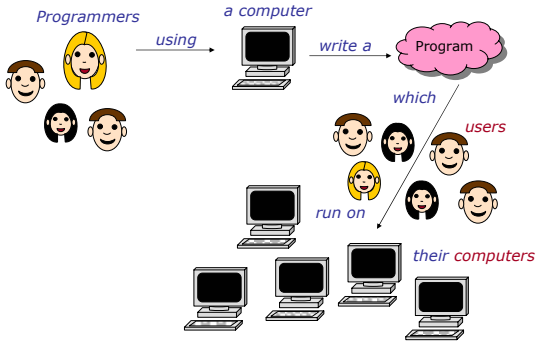
Working with a computer



Working with a computer



Working with a computer

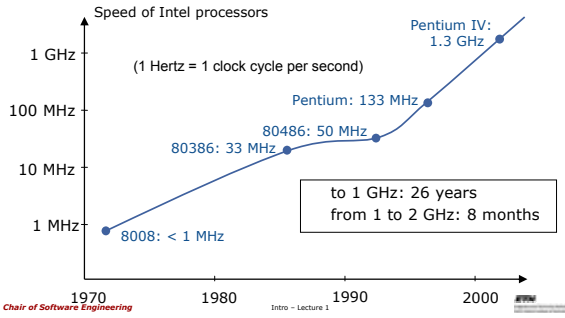


Computers

- Computers are universal machines. They execute the program that you feed them.
- The only limit is your imagination.
- The good news:
  - Your computer will do exactly what your program says.
  - It will do it very fast.

Moore's "Law"

- Approximate doubling of computer power, for comparable price, every eighteen months



Common myths and excuses

- "Computers are intelligent"

  Fact: Computers are neither intelligent nor stupid. They execute programs devised by humans. These programs reflect the intelligence of their authors.

  The basic computer operations are extremely elementary (store this value, add these two numbers).

- "The computer has crashed"
- "The computer doesn't allow this"
- "The computer lost your record"
- "The computer messed up your record"

Computers don't make mistakes *....

- Programs don't make mistakes either
- Programmers do make mistakes

*Actually, hardware can malfunction, but this is much more rare than program errors

Computers

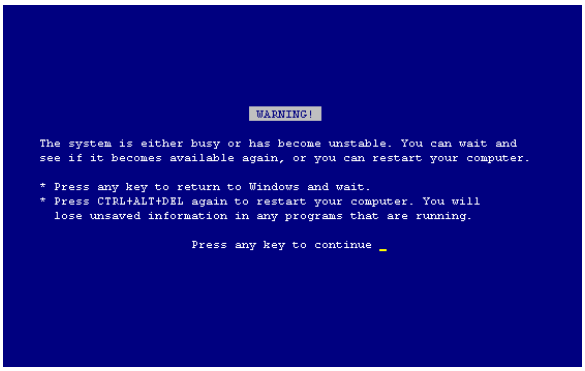
- Computers are universal machines. They execute the program that you feed them
- The only limit is your imagination and your carefulness
- The good news:
  - Your computer will do exactly what your program says
  - It will do it very fast
- The bad news:
  - Your computer will do exactly what your program says
  - It will do it very fast

Writing software is tough

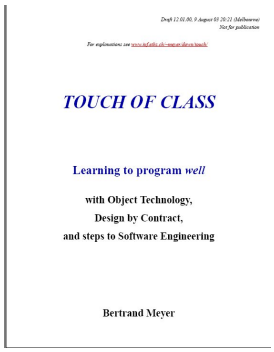
- Programs "crash"
- Programs that don't crash don't necessarily work
- Badly functioning programs have killed people, e.g. in medical devices
- Ariane 5 rocket, 1996: $10 billion lost because of a simple program error

- Programmers are responsible for the good functioning of their programs
- The purpose of this course is to teach you not just programming but good programming

The "Blue Screen Of Death"

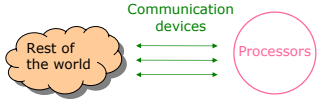


Learning to program *well*



What computers do

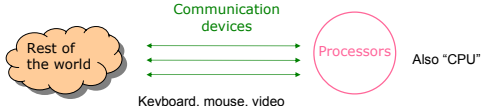
- Storage and retrieval
- Operations
- Communication



- Storage and retrieval ⇨ memories
- Operations ⇨ processors
- Communication ⇨ communication devices

Memories, processors and communication devices are the hardware.

General organization



Keyboard, mouse, video display, network connector...

"Core" memory, disks...

"Persistent" or not

Information and data

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- Data: collections of symbols held in a computer
- Information: interpretation of data for human purposes

- Information is what you want, e.g. a text or music
- Data is how it is encoded for the computer, e.g. MP3 audio format

Information and data processing

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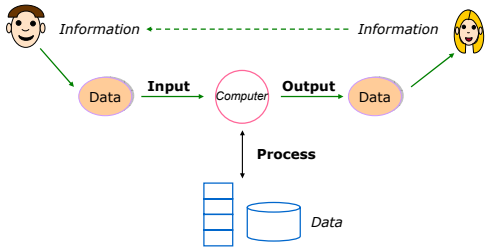
- Data is stored in memory
- Input devices produce data from information
- Output devices produce information from data



Computers come in all sizes, colors, flavors

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Computers everywhere

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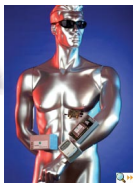
- Banks
- Airplanes, cars…
- Washing machines
- Cell phones (70% of value)
- Printers
- Tomorrow: your shirt…





Computers

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- Computers are universal machines. They execute the program that you feed them.


+ Program = Specialized machine

(Universal machine)

Where's the program?

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- Stored-program computer: the program is in memory. "Executable data".
- The computer, with the help of some basic programs (operating system) knows how to find your program in memory to execute it.
- A program can appear in memory in different forms:
  - Source: human-readable form (programming language).
  - Target form, machine code, object form: form executable by the computer.

Compilers transform source text to machine code.

Software Engineering

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Writing software that's

- Correct
  Does what it's supposed to!
- Extendible
  Easy to change!
- Readable
  by humans!
- Reusable
  Don't reinvent the wheel!
- Robust
  React appropriately to errors

Size of operating systems (source)

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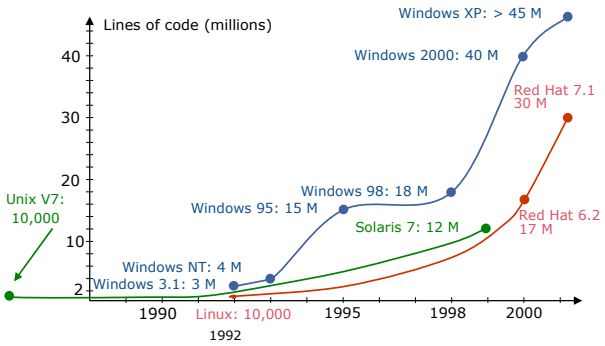

In other application areas

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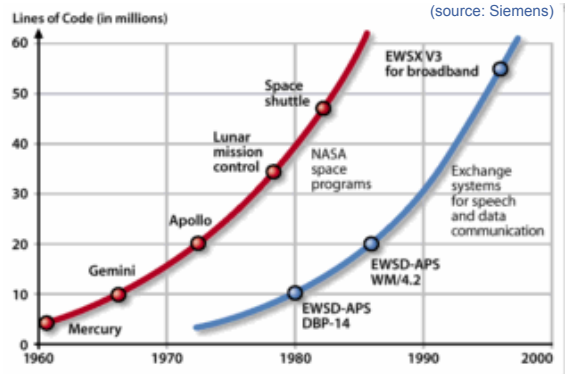

Writing software is tough

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Programs crash, etc.

Writing software is fun

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Design and build your own machines

Exert your creativity and imagination

Programs save lives and help make the world better

Experience the feeling of a program that you wrote, and that works

For next week

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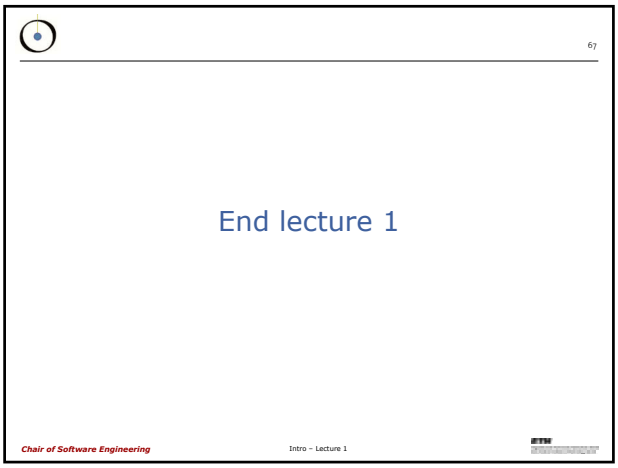
- Read chapter 1 of *Touch of Class*
- Recommended: start reading chapter 2 and slides for next lecture (available Wednesday)


67
End lecture 1
Chair of Software Engineering
Intro – Lecture 1