

Basic concepts of software engineering and maintenance

G. Giuliani International Centre for Theoretical Physics -
Trieste Earth System Physics Section

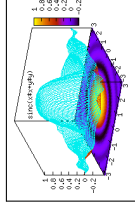
ICTP - Earth System Physics Section

Advanced School on Scientific Software Development
Trieste, 20 Feb - 2 Mar 2012



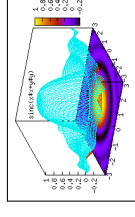
Is Software part of Science?

- ▶ What Science is About



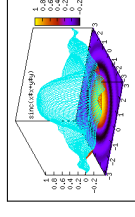
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- ▶ What Science is About
 - ▶ Try to understand Reality



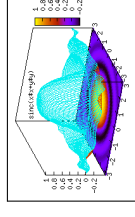
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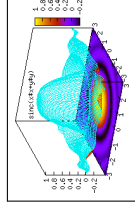
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 - ▶ Collect information as numerical values
 - ▶ Build knowledge on it with analysis and models



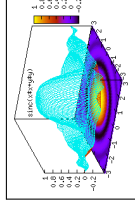
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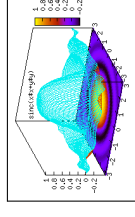
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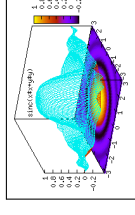
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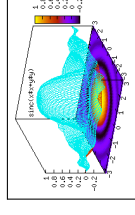
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 - ▶ Software development is not science for itself



The Scientific Problem

- ▶ The Scientist aims to understand the reality



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 - ▶ The Scientist is happy with publications



The Software

- ▶ Software for science is...



The Software

- ▶ Software for science is...
 - ▶ Data Digitalization and Storage



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 - ▶ Data Digitalization and Storage
 - ▶ Numerical Algorithms and Packages



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- ▶ Is there a Good Way to write Scientific Software ?



The wrong way of writing scientific software

- ▶ I will just have to do it once



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- ▶ Nobody cares on how I do get to the answer, I will never share this with others



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- ▶ The resources I have is what everybody have
- ▶ The data format is secondary, I know what they are
- ▶ The precision I need in result is the one the computer uses
- ▶ Software professionals are just overestimated freaks



The Scientist as a programmer

- ▶ Poor knowledge of the Hardware



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- ▶ Poor knowledge of the System Software



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- ▶ Poor knowledge of the System Software
- ▶ Poor knowledge of the Tools
- ▶ Usually little money but lot of manpower
- ▶ Usually forced to someone else best choices
- ▶ Very conservative, low sharing attitude



Software Engineering

- ▶ Design solution under constraint



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 - ▶ Understanding the computer



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 - ▶ Understanding the problem



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 - ▶ Understanding the problem
 - ▶ Fit the two together and choose the right tools
 - ▶ Standards in both coding and data
 - ▶ Documentation of code and algorithm
 - ▶ Test on different platforms
 - ▶ Check possible failures
 - ▶ Whenever possible, seek for help



Understand the computer

- ▶ Mathematic is declarative (What is knowledge)



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- ▶ Computer Science is imperative (How to knowledge)



Understand the computer

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 - ▶ We need a language to describe process



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- ▶ Computer resources: economics of the calculation



Understand the problem

- ▶ Think with Data Structures



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 - ▶ Design Data Structures and access functions to them



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- ▶ Design a flow diagram of the program and write it down

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- ▶ Evaluate the requirements for the execution

Why You should follow coding standard

- ▶ You can understand Your own programs



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- ▶ You can understand Your own programs
- ▶ Someone else can understand Your own programs



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- ▶ You spare time in the long run: Science must be reproducible



Why You should use a revision control system

- ▶ You can follow the development of the program



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- ▶ You can follow the development of the program
- ▶ You can develop the program in a team



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- ▶ You can calculate easily efforts required



Why You should plan testing

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- ▶ You may want to find problems and bugs
- ▶ You want simple tools to follow program flow



Why You should have a Software Forge

- ▶ What is a Collaborative Development Environment?



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Scientific codebases

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- ▶ Is writing from scratch always worth the task?
- ▶ Mix of public domain, free software and commercial solutions
- ▶ Commercial environments and tools for research: more the possible outcome, more the commercial
- ▶ Which policy should be used to develop scientific software?

Thank You !

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