TEACHING COMPUTATIONAL MATHEMATICS IN THE REAL-TIME MODE

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This study was partially supported by the project granted by Teknikbrostiftelsen, Gothenburg, Sweden (2002). The purpose of the project was to create non-standard codes, tools, and facilities together with the written materials (compendiums, textbooks) in order to simplify and improve teaching of applied and numerical mathematics so that the teachers and the students could be able to work in the classes in the real-time mode.

Nowadays there are practically no mathematical courses in which Computer Algebra Systems (CAS) programs, such as "Mathematica", Maple, and TI-89/92, are not used to some extent. However, generally the usage of these programs is reduced to illustration of computing processes: calculation of integrals, differentiation, solution of various equations etc. This is obtained by usage of standard command of type: Solve[…] in "Mathematica"

At the same time the main difficulties arise at teaching nonconventional mathematical courses such as Coding theory, Discrete mathematics, Cryptography, Scientific computing, which are gaining the increasing popularity now. Now it is impossible to imagine a modern engineer not having basic knowledge in Discrete mathematics, Cryptography, Coding theory. Digital processing of signals (digital sound, digital TV) have been introduced in our lifes.

The authors developed a non-standard, methodical-oriented course where hands-on sessions could add substantial understanding in the introduction of mentioned mathematical concepts.

In the course of preparing and performing the work within the frame of the project, the compendiums [1—4] were written. These sources are available on the web (see homepages www.ingvet.kau.se/~youri and www.ingvet.kau.se/~igor) and are used in the following courses at the Karlstad university: Numerical methods with MATLAB MAA 308, Matematical models MATA 18, Applied analysis MAB 200, MAC 200, MAB 505, Civil engineer program, Advanced Numerical methods (PhD-level), and some others.

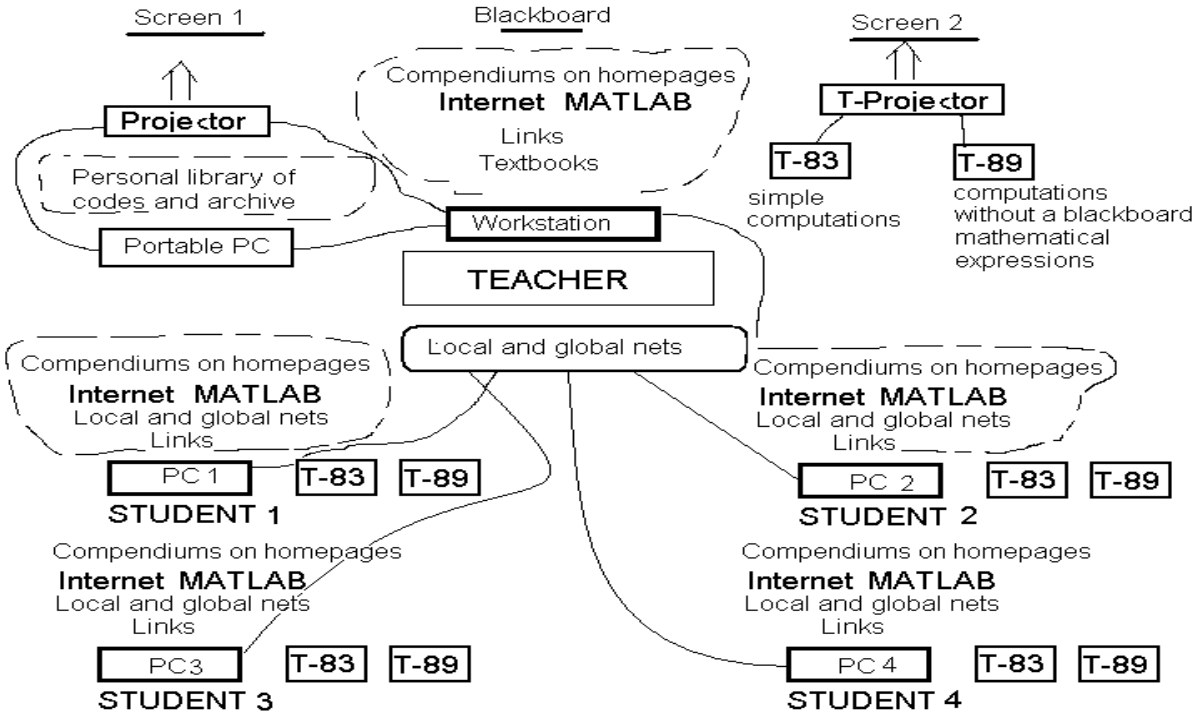
They give insight into the most important mathematical and numerical methods and algorithms, including (a) interpolation and spline-interpolation,

(b) numerical solution of nonlinear equations, and (c) numerical solution of initial and boundary value problems for ordinary differential equations (DEs) and some partial DEs (heat and wave equations and the Laplace and Poisson equations in a rectangle). The theoretical material serves as foundations for algorithms and codes which satisfy the following conditions: (1) make it possible a *combined* use of MATLAB, calculators that support graphics (TI-83 and TI-89), as well as some other popular mathematical software (e.g., MATHEMATICA); (2) can be used *in the real-time* computational mode (according to the scheme below); and (3) are sufficiently *simple and transparent* so that both teachers and students can easily use them in practical computations. The codes implement basic numerical methods contained in compendiums; the latter provide many graphical illustrations and detailed solutions to approximately 120 problems taken partially from other popular university textbooks on numerical analysis (e.g., [5] and [6]).

The students learn basics of numerical analysis and apply them when solving typical problems. Computations are performed directly in the classes using TI calculators, portable PCs, desktops, workstations, and facilities of the local and global nets, including internet connections that enable one in particular to look into the corresponding chapter(s) of a compendium on the screen. Students can also present the results of small computational projects (obtained personally or in small groups).

The proposed approach proves to be very useful for distance education.

Teaching in the real-time mode is performed according to the following scheme:



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