Profound Algorithms (PAL)

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The joint research project SIMBA addresses the development, accumulation, and evaluation of fine-grained, distributed, multimedia modules on key concepts of computer science particularly with regard to specific learning interests of women. The key concepts are general accepted topics of computer science selected based on the following criteria: gender specificity, relevance in various subject areas of computer science, suitability as curricular guideline, relevance for the personal environment of the learner, and relevance in the historical development of computer science. The developed components should be usable in curricula of computer science and more applied subjects in education, advanced vocational training, and online learning.

In the sub-project on profound algorithms, we replace the usual proceeding—to design algorithms on an abstract level and to apply them to one special problem—by the following approach. A complex, difficult problem is simplified step by step to a level where it can be solved easily. Then we run backward through the sequence of reductions and solve all these problems until we can present the solution of the original problem. There are two critical points: to elaborate an adequate and precise model of the original problem and to formulate its complicated solution as a program.

In a first module, this process is applied to the backtrack algorithm. The considered complex problem is a filling-problem (to cover a land for building with houses). This problem is reduced iteratively to the general knapsack problem, subset sum, and the partition problem. The simplest problem is solved using backtracking. Then the algorithmic solution is applied in reverse order until the original filling problem is solved.

In this way we develop a module "backtracking" that contains more material than is used in a normal course. But derivatives of this large module can be extracted for several other courses and it is possible to extract good animated compact components of this module and to use it as a (small) ingredient in any other presentation.

In the next semesters we will work out six modules concerning fundamental structures of algorithms. Each module will consist of 200 to 300 (partly animated) pages. We will evaluate its effectiveness in two courses for the second and the fourth semester in the faculty of computer science.