

TUTORIAL: A SPIRAL APPROACH TO A PROJECTS-ORIENTED SOFTWARE ENGINEERING COURSE

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The authors recently completed the development and implementation of a project-oriented two-semester software engineering course. Partially funded by a Defense Advanced Research Project Agency (DARPA) grant, the course covers all aspects of the software development process while providing students with meaningful project experiences. All materials, including lecture notes, detailed examples, and instructor guidelines are available from DARPA. The two semesters are tightly coupled and integrate theory and practice in a spiral form; mimicking a real-world software engineering process. The course is built around three projects which differ in several significant ways: size, complexity, team structure, artifacts provided and delivered, and development methodologies. The projects are carefully choreographed to provide varied team experiences and allow each student to function in a variety of roles and responsibilities. Our experience should be of particular interest to anyone managing student team projects.

In the first five weeks the students are rapidly introduced to the fundamental principles of software engineering and, while working in teams, they complete a modest development project. Despite the introduction of sound software engineering principles, the simplicity of the project allows student teams to concentrate on the end product rather than the development process and still achieve a modicum of success.

As the first project nears completion, a second, extended project with a real customer is introduced. It spans both semesters and requires revisiting concepts in depth that were merely touched upon in the first project. The large project is also a vehicle to introduce and utilize new concepts, such as detailed design and configuration management. The students are provided with guidelines for design methods and formal reviews. The use of a real customer provides the opportunity to study more complex requirements and exposes students to problems which were not apparent in the small project. The added complexity, introduced by size, real customer, and intricate requirements, demands the use of more effective controlling disciplines and increased attention to the software process.

The third project requires the students to perform maintenance on an existing large software system. To mimic the typical industrial situation, these maintenance tasks are assigned while the students are still working on the large project. These tasks provide yet another opportunity to revisit and reinforce significant software engineering concepts, but this time from a maintenance perspective. Maintenance is treated as a complete software development task. Students can now understand the long-term benefits of following good software engineering practices.

We have found this spiral approach to be an effective teaching and learning tool. The project framework provides a series of passes through the software development process, each

pass adding to a body of common student experiences to which subsequent passes can refer. By the middle of the first semester students, individually and in teams, have begun accumulating their own "war stories"; some positive, some negative. This personalized knowledge provides a solid base for more advanced concepts and for classroom discussion.

The purpose of this tutorial is to share lessons learned during the development and initial offerings of the course, and is intended for faculty who will be teaching project-oriented courses or would like to manage projects in their classes. Particular attention will be given to the selection of appropriate projects, the management of such projects, and the careful coordination of project activities with lectures. Course materials will be provided, including a detailed syllabus, project management plans and course management aids including team organization models. The entire turn-key course is available through DARPA. The work was supported in part by the U.S. Army Research Office.