The PSU Software Engineering Senior Capstone

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Every PSU Computer Science graduate must enroll in our two-term Software Engineering Capstone the last year of their degree program. The goal of the Capstone is to provide students with a realistic software development experience that utilizes, as much as possible, the skills and knowledge acquired during the first three years of their program. The PSU Software Engineering Capstone has a part of PSU Computer Science degrees for over ten years.

Currently, the Software Engineering Capstone is offered in two cycles. Once cycle begins in late September and goes through mid-March (Fall and Winter quarters). The other cycle begins in mid-March and goes until August (Spring and Summer quarters).

We actively solicit software development projects from the community for use in the Capstone.

The Capstone Project

Since most of our students will be working in teams to provide complete solutions for a wide range of customers after graduation, our goal is for the Capstone to have the following characteristics:

- *Team oriented* – Most software developers work in teams since most projects are far too large, and require too many different skills for any single person to manage on their own. We try to build familiarity among our students for this mode of development both in the Capstone as well as many of their other classes throughout the program.
- *Full-lifecycle* – In order to better understand the process of developing software, it is important for students to understand and experience the entire process of developing a customer solution: requirements, design, implementation and testing. We require that our Capstone projects support this goal by being complete solutions, and not simply being a component of a larger project being undertaken by the sponsor. For example, projects consisting of simply testing a product that a customer has built or performing maintenance on an existing product are probably not suitable as a Capstone project.
- *Customer-driven* – We want our Capstone students to solve customer problems. At the same time, because of the length of the Capstone (under six months), too much time cannot be spent in concept development. Therefore it is important that customers have a fairly well-developed concept of the product they would like to be built. One way we accomplish this is by having potential customers present their concept to the class during "selection week" when each team is choosing the project they would like to pursue. Keeping with the customer-driven focus of the Capstone, we require that each team meet with their customer at least once a month during the project, but encourage more frequent meetings. This requires a significant time commitment from the customer as well as from the Capstone team.

- *Success-oriented* – While the Capstone provides an opportunity for students to exercise the skills and knowledge they have acquired over the last three years, it also serves as a significant confidence building exercise. Many of our students have never experienced professional software development, and a successful experience with the Capstone can help give them the confidence they'll need in getting a job after graduation, and performing successfully in their career. As a three credit class, we expect Capstone students to each average nine to twelve hours working on their project. With a four or five member team, this translates into approximately one full-time developer over the life of the project. The Capstone instructor will work with potential customers in scoping their concept so it can be successfully taken through the development process by a student team during the six month Capstone experience.

Getting Involved in the Capstone Experience

We encourage members of the community to get involved by providing meaningful projects for our students to develop. The first step is to contact the Capstone coordinator, Warren Harrison at warren@cs.pdx.edu. This usually results in a meeting during which the project is scoped and evaluated for its suitability as a Capstone project. While we are looking for projects that meet the goals described above, we also want to make sure that our students have an opportunity to exercise their technical skills. Therefore, projects that simply consist of creating an organization's website, or evaluating commercial software packages are usually not appropriate for the Capstone.

If the project seems appropriate, and it looks to have a clearly defined, and manageable scope, the customer is invited to make a 20-minute "vision presentation" during "selection week." This is usually held the fourth week of the first term in the cycle (earlier weeks are used for team building and skill development). Based on this "concept presentation" and follow-up with the customer, teams select their top 3 choices. The final project assignments are based on a team's top choices, the skills of the team members, etc. Usually we try to have twice as many vision presentations as teams so students have a range of choices. Note that this means a sponsor has a 50% chance of having their project selected.

Intellectual Property Issues

We strongly encourage our teams to create open source projects that can be freely distributed and used by others. At the same time, we strongly discourage projects in which the sponsor expects to receive ownership of the team's creative works. If an open source model is not appropriate, we have found a much more equitable situation is for the sponsor to receive a non-exclusive, royalty free license to use and modify the results of the team's efforts, while allowing the students to continue to make use of their work after they complete the project.

In the event a sponsor absolutely requires ownership of the creative work of the students at the end of the project, they must deposit a minimum (the team may negotiate for a greater amount) of $15,000 in an escrow account. These funds are to be distributed to the

team at the end of the project, should the sponsor elect to take ownership of the work. This protects the sponsor from "buying a pig in a poke" should the project not turn out as expected, while providing minimal compensation to the team members for their intellectual property, each of whom may pay over $2,400 for the six credit Capstone sequence. The funds are expected to be deposited in the escrow account prior to work being started on the project, and distributed to the team prior to delivery of the work products.

Separate from the issue of intellectual property , teams may receive confidential or protected information from the sponsor. We encourage sponsors to ask team members to sign *reasonable* Nondisclosure Agreements (NDAs) that cover information that the sponsor *provides* the team. However, NDAs that restrict student use of concepts, methods, processes, algorithms or data *they* produce are unacceptable without compensation. Sponsors are encouraged to minimize the amount of confidential information provided to students by releasing information on a "need to know" basis, anonymizing databases for testing, restricting access to corporate intranets, etc.

Non-compete agreements are *never* acceptable.

The Capstone Schedule

During the first half of the cycle, students are engaged in team building and skill (both technical and non-technical) development. Once projects are selected, teams are tasked with eliciting project requirements from their customer and drawing up a project plan by the end of the first term in the cycle. This is culminated with an oral presentation of the project plan to the rest of the class during Finals week.

During the second half of the cycle, teams meet with the Capstone instructor on a weekly basis to report on their progress, make projections for the following week, etc. This keeps them on task and allows problems to be addressed early on before they become crises. Each member of the team must attend each weekly status meeting unless they have made prior arrangements. The end of the project is marked with a final oral presentation to the collective sponsors as well as interested members of the public (many team members bring their families) in March or August.

Students are assigned an "IP" (In Progress) grade for the first term of the cycle, and their final grade is applied to both terms at the end of the cycle. Students that complete the first term, but not the second, of a specific cycle, will not receive a grade for either term and will need to re-register for another complete cycle later.

Caveats

We like to caution customers that these ***are*** students, and our goal is a good educational experience first, and a product the customer is happy with second. So if students run into unexpected problems, the customer becomes unresponsive, etc., as long as they're followed the process and schedule we agreed on during project planning, the

team is meeting our expectations. For that reason, we don't encourage Capstone projects that are mission critical, or would otherwise cause hardship if they don't get completed.

The Capstone webpage is at:

http://www.cs.pdx.edu/~warren/Capstone/