Chapter 3
Adapting Rewards to Encourage Creativity

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ABSTRACT

Creativity drives innovation and improves the quality of products, problem solving skills, information technology solutions and entrepreneurship. Curriculum standards for CS education typically lack the emphasis and coverage to promote or encourage creative approaches to Software Engineering, focusing on technological solutions rather than innovative design. As a result, creativity is not directly rewarded. This chapter discusses the development of a multi-agent system to apportion rewards for creative contributions to collaborative and group problem solving among students in a software projects course. Encouraging creativity in a classroom team environment, especially for software development, needs a collaboration framework that combines idea management with a motivating reward system. Their multi-agent reward system works directly with the idea capture and visualization portion of SEREBRO, a Web application that combines social networking with software product development tools to foster creativity. The authors discuss the multi-agent reward system and an initial evaluation of its use in a computer science course.

INTRODUCTION

Given the current economic situation, renewed focus has been placed on creativity to generate novel solutions to organizational problems that drive competition and improve the quality of life. When a team of professionals, whether local or virtual, assume the development responsibility, creative effort on the part of the individual members of the teams must lead to overall creative performance. Creative effort is a pro-active pursuit of new ideas and approaches to improve one's creative performance. Creative performance is the extent to which a person develops novel and useful solutions to applied problems in pursuit of work goals (Hirst, 2009). According to the investment theory of creativity (Sternberg & Lubart, 1995), individuals decide whether to use their resources to generate new ideas, evaluate those ideas, and then sell those ideas to others. Challenges to encouraging creative effort include allowing for cross-fertilization of ideas, rewarding both bursty and sustained efforts to provide novel input, and providing feedback consistent with the individual's progress toward achieving task goals. Our research targets certain malleable factors that affect creativity, such as incentives, motivation, and rewards.

Software engineering is the process of designing and developing a software product. It often involves teams, oriented around specific tasks for communication, planning, modelling, construction, and deployment (Pressman, 2009). Each task corresponds to a set of work products, or artefacts, which include customer requirements, documentation, designs, code, and packaging. To improve output quality, each task should embody creative contributions.

Fostering creativity among software engineering teams poses unique challenges. First, though liberal arts and science courses have creative and critical thinking components, there is less attention paid to creativity in the computing curriculum. Second, sharing ideas among team members is dependent on the openness of the team members, their availability, and student competencies with respect to designing and developing the various components (interface, processing, databases, etc.) that comprise the software (Ambler, 2002). Third, creativity is often not directly rewarded. Even when ideas are explored and captured in idea management tools (BrainBank, 1999; Spigit, 2009), in general only the resulting artefacts are examined by supervisors and customers. Since creative performance is not credited to the participants and is not made explicit as an artifact itself, there is limited motivation to engage in it.

The Senior Software Projects class is a capstone course in the Computer Science curricula at the University of Tulsa. To recognize and reward creative contributions by team members in the class, we designed and implemented a Web application, SEREBRO (R. Gamble, et. al., 2009), for use in the class that captures and relates ideas as they are generated, guides the creative design process toward required project artifacts and milestones, and rewards those who contribute to the project's creative elements.

In this chapter, we discuss the design, implementation, and experimentation of a multi-agent reward system based on reinforcement learning and reputation management that works with information captured and interrelated by SEREBRO. We analyze the effectiveness of the reward system against a set of creativity metrics that are computed by SEREBRO and are determined by peer and expert review. We correlate an experiment using the complete reward system within SEREBRO with an experiment using only a single reward to illustrate the effect of providing multiple, direct rewards to team members.

In the background section we discuss the theory behind creativity, existing tools for creative support, and the reward foundations upon which SEREBRO is built. Following the background, we provide a brief overview of SEREBRO. The remaining sections define our multi-agent reward system and architecture operating within

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