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Empirical Evaluation of a New Coupling Metric: Combining Structural and Semantic Coupling

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Abstract

Coupling, a measure of the interdependence among software entities, is an important property for which many software metrics have been defined. It is widely agreed that the extent of coupling in an object-oriented system has implications for its external quality. Structural and semantic relations between classes can be measured directly from static source code. However, both have limitations. In order to understand which aspects of coupling affect quality or other external attributes of software, this paper presents a new coupling metric for object-oriented systems that analyze structural and semantic relationships between methods and classes. The paper investigates the use of the new proposed coupling metric during change impact analysis, predicting fault-prone and maintainable classes. By comparing the new metric to other coupling metrics, we show that the new metric is a better predictor for classes impacted by changes. The new metric also shows good promise in predicting both external qualities (fault proneness and maintainability).

Keywords

Coupling, metrics, impact analysis, fault proneness, maintainability

Conclusion

In the paper, we defined a new set of coupling metrics that combines structural and semantic relations of software entities. The usefulness of the new coupling metric, SSCM, has been analytically and empirically validated. We empirically studied the new coupling metric in three different applications. Through the three-pronged evaluation, we have shown that the new metric has an application in impact analysis to determine if a change made to one class may have uninvited effects on other classes. Moreover, the new metric is beneficial because it is a good predictor of fault-proneness. Finally, the new metric has shown to be a strong predictor of the maintainability of classes. Overall, these results point to a concrete conclusion that the new coupling metric is useful for developers performing software maintenance. In the future, we will investigate the applications of this new metric in software re-modularization and refactoring.