

AN APPROACH TO ASSESSMENT OF CROSS CUTTING FUNCTIONALITY IN LEGACY SOFTWARE SYSTEMS

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There are various ways to characterize a nature of the crosscutting functionality (CF) and it's impact to object-oriented programming (OOP) style. To assess an impact, which CF makes to a structure of legacy software system (LSS) during it's evolution in maintenance, we propose to evaluate some quantitative facets of CF problem. To reach this goal it is proposed to perform next three steps [1]:

Step 1: Localize source code belonged to a particular CF in a given LSS. Although exists several source code analysis tools for CF localization, e.g., tool CIDE [1], this problem remains really complicated for automation and demands an expert in code structure and business-logic of an appropriate LSS.

Step 2: Calculate a specific crosscutting weight ratio of a particular CF in the system indicated as CF_{ratio} . This coefficient shows a ratio between OOP-classes, "damaged" by a particular CF and all OOP-classes included in the system, or it's projection, e.g. business logic realization without subordinate classes of a framework. This coefficient possible to represent as

$$CF_{ratio} = \frac{C_{cf}}{C_{cf} + C} , \quad (1)$$

where C_{cf} – number of classes in LSS, "damaged" with CF, C – number of classes free of CF. Obviously, that $CF_{ratio} \in [0;1]$, and if $CF_{ratio} = 0$, it means a particular functionality is not crosscutting; and if $CF_{ratio} = 1$, it means all classes are "damaged" with a particular CF.

Step 3: Calculate a residual crosscutting ratio indicated as RCR_{ratio} . This metric, based on DOS (Degree of Scattering) value, proposed in [14], namely "...DOS value is normalized to be between 0 (completely localized) and 1 (completely delocalized, uniformly distributed)". Nevertheless this metrics does not allow to asses "damage" degree, done by a particular CF, therefore we propose to refine DOS-metric in following way

$$RCR_{ratio} = DOS \cdot CF_{ratio} , \quad (2)$$

where DOS – Degree of Scattering; CF_{ratio} – specific crosscutting weight ratio of a particular CF. Similarly to CF_{ratio} , $RCR_{ratio} \in [0;1]$, if $RCR_{ratio} = 0$, it means that CF is localized in a separate module and it is no more crosscutting; if $RCR_{ratio} = 1$, it means that CF effects a whole system and is uniformly distributed.

To automate this approach and to compute the metrics given in formulas (1)-(2) the appropriate CASE-tool is implemented and tested successfully.

References:

1. Tkachuk, M. Models, Methods and Tools for Effectiveness Estimation of Post Object-Oriented Technologies in Software Maintenance / M.Tkachuk, K.Nagorniy and R.Gamzayev // V.Yakovyna et al. (Eds.): ICTERI-2015: Revised Selected Papers, Series title: Communications in Computer and Information Science, Vol. 594: Springer-Verlag Berlin Heidelberg, 2016. – pp. 20-37.