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How long should we test? - a dynamic model

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Abstract

Software maintenance and testing activities consume most of software project resources. This fact motivates research in the field of planning, estimating and tracking maintenance and testing resources.

An approach for modelling maintenance and testing effort has been suggested recently by Calzolari et.al. [1]. This model considers as prey the software faults which cause environmental needs and corrective actions. Predators are the testers or developers observing and removing the prey. The dynamical change of the number of faults in the testing process or after release shows similarities to predator-prey competition.

Similar models was introduced in the literature previously. Lehman et.al. [2],[3] used dynamic models to describe the evolution of relevant software engineering metrics. Those models were successful in describing the changing of the size of software systems among releases.

The main problem with the proposed dynamic model is that it is hard to estimate the number of residual faults in a software system by knowing only the number of faults found during testing. It is also difficult to estimate the initial value of the residual faults. Test managers are interested in estimating these values to be able to plan human resources needed for testing.

A linear system of differential equations modelling the underlying phenomena is given and analyzed in this paper. Our contribution is to provide a method for estimation of initial values of the proposed linear model and by considering the realistic assumption that only one state variable is measurable, a linear observer is designed for the on-line estimation of the residual faults. Finally, the theory is applied on real data in order to show how the model helps test managers in answering the question in the title.

Key Words and Phrases: Software testing, effort estimation, system theory, differential equations.

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