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A Framework for Secure Information Flow Analysis in Web Applications

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Abstract : Huge amounts of data and personal information are being sent to and retrieved from web applications on daily basis. Every application has its own confidentiality and integrity policies. Violating these policies can have broad negative impact on the involved company's financial status, while enforcing them is very hard even for the developers with good security background. In this paper, we propose a framework that enforces security-by-construction in web applications. Minimal developer effort is required, in a sense that the developer only needs to annotate database attributes by a security class. The web application code is then converted into an intermediary representation, called Extended Program Dependence Graph (EPDG). Using the EPDG, the provided annotations are propagated to the application code and run against generic security enforcement rules that were carefully designed to detect insecure information flows as early as they occur. As a result, any violation in the data's confidentiality or integrity policies is reported. As a proof of concept, two PHP web applications, Hotel Reservation and Auction, were used for testing and validation. The proposed system was able to catch all the existing insecure information flows at their source. Moreover and to highlight the simplicity of the suggested approaches vs. existing approaches, two professional web developers assessed the annotation tasks needed in the presented case studies and provided a very positive feedback on the simplicity of the annotation task.

Keywords : web applications security, secure information flow, program dependence graph, database annotation
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