3.2 目标驱动的需求分析定量化

Letier 等人[8]提出,用贝叶斯概率网络模型描述不确定性需求的量化软件体系机构的风险属性.Liaskos 等人[9]提出,用 AHP 方法从成对比较的因素中抽取特征量化目标关联度,从而控制定性目标关联的主观性.这两类方法提示,需求分析定量化是一个趋势.只不过在需求端量化容易脱离问题框架的范畴,从而无法将软件程序行为和抽象目标行为紧密结合起来.如果从目标模型生成行为模型[10]固然可以连带分析对应的行为模型的风险,但是由于模型驱动方法的抽象层次落差,在缺乏细节变换支持的前提下,仍然无法像从面向对象设计模型到 Java 代码那样保证完全自动的双向变换[11].

3.3 移动AppStore大数据分析

数以百万计的移动 APP 为软件工程提供了大量的数据.对 APP 需求的行为分析目前还在起步阶段,但是这方面代码分析的工作已经存在不少.除了代码之外,AppStore 的用户反馈机制也为需求工程提供了很多自然语言需求的素材.目前,已经有一些研究工作关注这些自然语言描述中体现出来的需求以及跨 APP 需求之间的主题上的联系,值得关注[12].在一定意义上,这也是从用户的角度分析需求的间接反映.

3.4 安全和私密性的风险和论证

安全需求分析方面的工作很多[13],其中,定量的相对较少.即使是侧重于安全需求风险分析论证的近期工作[14],也需要借助预先分类的领域知识,如 CAPEC,CWE 等,由领域专家引导.Pasquale 等人将安全需求的效用函数定义为由模糊因果网络导出[15],从而为自适安全性提供环境依据,这和基于概率模型的需求分析有所异同,但其本质上也是一种需要专家建立的小模型.

Yang 等人[6]确实用理论概率模型来提供私密性风险和社交好处权衡的依据,但是还没有针对个人和软件行为分析和论证私密性需求.Calikli 等人[16]从个人和集体行为的差异和模式,通过自动归纳推理推导出一些启发式规则,用于推荐合理的私密性策略.这些方法跟统计机器学习的区别在于,这些学习到的规则是可以加以合理解释的.

4 结语和展望

本文提出了大数据需求分析时常常被忽视的思路,即借助能够清楚解释的符号化代数模型来反映大数据的需求.由此,基于问题框架的思路,结合抽象目标状态,对软件行为和使用者行为统一建立定量概率模型.从分析参数化和个性化的需求入手,本文提出的代数分析算法能够根据符号化参数计算总体风险或成本绩效,并根据系统和环境的变化和约束前提下推荐最优的参数值.

展望当前软件正在向社会化发展,全面整合人、机、物,因此除了对软件本身,也需要对相关联的人、机、物的行为模式有全面定量的认识.传统需求分析的代数模型方法能否弥补单纯数据驱动的大数据分析的不足之处,也还需要进一步深入研究.

References:

[1] Zave P, Jackson M. Four dark corners of requirements engineering. ACM Trans. on Software Engineering and Methodology, 1997, 6(1):1−30. [doi: 10.1145/237432.237434]

[2] Jackson M. Problem Frames: Analyzing and Structuring Software Development Problems. ACM Press, 2001.

[3] Jackson M. System behaviours and problem frames: Concepts, concerns and the role of formalisms in the development of cyber-physical systems. In: Proc. of the Dependable Software Systems Engineering. 2015. 79−104.

[4] Yu Y, Wang YQ, Mylopoulos J, Liaskos S, Lapouchnian A, Leite JCSP. Reverse engineering goal models from legacy code. In: Proc. of the 13th Int'l Conf. on Requirements Engineering (RE 2005). 2005. 363−372. [doi: 10.1109/RE.2005.61]

[5] Nhlabatsi A, Tun TT, Khan N, Yu Y, Bandara AK, Khan KM, Nuseibeh B. Why can't I do that? Tracing adaptive security decisions. EAI Endorsed Trans. on Self-Adaptive Systems, 2015,1(1):1−16. [doi: 10.4108/sas.1.1.e1]

[6] Yang M, Yu Y, Bandara AK, Nuseibeh B. Adaptive sharing for online social networks: Atrade-Off between privacy risk and social benefit. In: Proc. of the 13th IEEE Int'l Conf. on Trust, Security and Privacy in Computing and Communications (TrustCom 2014). 2014. 45−52. [doi: 10.1109/TrustCom.2014.10]

[7] Kwiatkowska M, Norman G, Parker D. PRISM 4.0: Verification of probabilistic real-time systems. In: Proc. of the 23rd Int'l Conf. on Computer Aided Verification (CAV 2011). 2011. 585−591. [doi: 10.1007/978-3-642-22110-1_47]

[8] Letier E, Stefan D, Barr ET. Uncertainty, risk, and information value in software requirements and architecture. In: Proc. of the 36th Int'l Conf. on Software Engineering (ICSE 2014). 2014. 883−894. [doi: 10.1145/2568225.2568239]

[9] Liaskos S, Jalman R, Aranda J. On eliciting contribution measures in goal models. In: Proc. of the 20th Int'l Conf. on Requirements Engineering (RE 2012). 2012. 221−230. [doi: 10.1109/RE.2012.6345808]

[10] Yu Y, Lapouchnian A, Liaskos S, Mylopoulos J, Leite JCSP. From goals to high-variability software design. In: Proc. of the 17th Int'l Symp. on Methodologies for Intelligent System (ISMIS 2008). 2008. 1−16. [doi: 10.1007/978-3-540-68123-6_1]

[11] Yu Y, Lin Y, Hu Z, Hidaka S, Kato H, Montrieux L. Maintaining invariant traceability through bidirectional transformations. In: Proc. of the 34th Int'l Conf. on Software Engineering (ICSE 2014). 2014. 540−550. [doi: 10.1109/ICSE.2012.6227162]

[12] Sarro F, Al-Subaihin AA, Harman M, Jia Y, Martin W, Zhang Y. Feature lifecycles as they spread, migrate, remain, and die in App stores. In: Proc. of the 23rd Int'l Conf. on Requirements Engineering (RE 2015). 2015. 76−85. [doi: 10.1109/RE.2015.7320410]

[13] Nhlabatsi A, Nuseibeh B, Yu Y. Security requirements engineering for evolving software systems: A survey. Int'l Journal of Social Sciences and Education, 2010,1(1):54−73. [doi: 10.4018/jsse.2010102004]

[14] Yu Y, Franqueira VNL, Tun TT, Wieringa R, Nuseibeh B. Automated analysis of security requirements through risk-based argumentation. Journal of Systems and Software, 2015,106:102−116. [doi: 10.1016/j.jss.2015.04.065]

[15] Pasquale L, Spoletini P, Salehie M, Cavallaro L, Nuseibeh B. Automating trade-off analysis of security requirements. Requirement Engineering, 2016,21(4):481−504. [doi: 10.1007/s00766-015-0229-z]

[16] Çalikli G, Law M, Bandara AK, Russo A, Dickens L, Price BA, Stuart A, Levine M, Nuseibeh B. Privacy dynamics: learning privacy norms for social software. In: Proc. of the 11th Int'l Symp. on Software Engineering for Adaptive and Self-Managing Systems (SEAMS 2016). 2016. 47−56. [doi: 10.1145/2897053.2897063]

俞一峻(1972－),男,上海人,高级讲师,主要研究领域为软件维护,需求工程.

刘春(1982－),男,讲师,CCF 专业会员,主要研究领域为需求工程.