Chapter 13
Data Mining Driven Rule Based Expert System for Medical Billing Compliance: A Case Study

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ABSTRACT
Most of the data mining projects generate information (summarized in the form of graphs and charts) for business executives and decision makers; however it leaves to the choice of decision makers either to use it or disregard it. The manual use of the extracted knowledge limits the effectiveness of data mining technology considerably. This chapter proposes an architecture, in which data mining module is utilized to provide continuous supply of knowledge to a rule based expert system. Proposed approach solves the knowledge acquisition problem of rule based systems and also enhances effective utilization of data mining techniques (i.e. by supplying extracted knowledge to rule based system for automated use). The chapter describes the details of a data mining driven rule based expert system applied in medical billing domain. Main modules of the system along with the final analysis of performance of the system have also been presented.

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INTRODUCTION

It was in early 2009, manager of a medical billing company was concerned about the implementation of special instructions given by medical providers (clients of the company) regarding their medical bills. There were approximately 500 special instructions in the form of conditions and associated actions (e.g. apply modifier 76 in a medical bill if diagnosis code 708.47 is used in it). Fact that billing codes and rules are quarterly updated made the problem worse. It was not possible for the team working on billing software – which was a desktop application – to encode those conditions and actions in the billing software. So the task was assigned to two different teams (each with two members) in parallel. One team used conventional programming technique and developed a ‘Claim Scrubber’. The Scrubber had initially 250 special instructions implemented as part of code. The Scrubber with 250 checks was quickly moved to production by integrating it with Electronic Medical Record (EMR) – prime software - of the company. The second team was a bit slow, only developed an inference engine of a Rule Based System (RBS) using structured query language (U. Abdullah, Sawar, & Ahmed, 2009). So, the RBS with just 50 special instructions (implemented in the form of production rules) was integrated with billing software which was being used by data entry operators of the company.

In 2009, both software, were operational in their specific places (i.e. Scrubber in EMR and RBS in billing software). RBS team gradually added more rules to its system, while Scrubber team was finding it difficult to maintain existing ones. After six month, (i.e. around Aug 2009), the Claim Scrubber has 30 new checks added to it (total 280), while RBS has 145 new rules (total 195) (Umair Abdullah, Jamil Sawar, & Ahmed, 2009). Moreover, RBS was found to be more flexible, dynamic and logically powerful as compared to the Scrubber (Umair Abdullah et al., 2009). Therefore, by the end of year 2009, the Scrubber was abandoned – replaced by RBS. As of today – after five years – RBS has approximately 2500 productions rules with two teams working on it; one team of programmers for maintaining/extending the code of RBS and the second team is of domain experts, responsible for maintaining the knowledge base of the RBS. Now, in the medical billing company no medical claim is submitted to insurance without sign-off from the RBS. User interface of the RBS has been enhanced by provision of a Knowledge Editor (Umair Abdullah, Ahmed, & Sawar, 2012), which allows the domain experts to edit, update, and manage production rules by themselves. Knowledge acquisition process (i.e. adding new rules) has been speed-up by the implementation of a data mining module (Umair Abdullah, Ahmed, Asghar, & Zafar, 2014).

Success of RBS has not been a simple straight forward process. Various issues came along, and were resolved by RBS team to make the system successful. These issues have been presented in generalized form, along with the proposed solution in the next section.

PROBLEM STATEMENT

Raw data – of any application domain – coming from multiple heterogeneous sources need to be processed for the implementation of business rules according to the business need/logic. Implementing business logic with the help of conventional programming techniques is not feasible. Proposed solution for the implementation of business logic is in the form of a Rule Based System (RBS) module integrated with main data processing software.

Domain experts having knowledge of business rules coordinate with RBS developers for the editing, debugging, updating and management of rules. This coordination requirement leads to the problem of