Crime Data Mining: An Overview and Case Studies

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Abstract. The concern about national security has increased significantly since the 9/11 attacks. However, information overload hinders the effective analysis of criminal and terrorist activities. Data mining applied in the context of law enforcement and intelligence analysis holds the promise of alleviating such problems. In this paper, we review crime data mining techniques and present four case studies done in our ongoing COPLINK project.

1. Introduction

The concern about national security has increased significantly since the terrorist attacks on September 11, 2001. Intelligence agencies such as the CIA and FBI are actively collecting and analyzing information to investigate terrorists' activities. Local law enforcement agencies have also become more alert to criminal activities in their own jurisdictions. One challenge to law enforcement and intelligence agencies is the difficulty of analyzing large volumes of data involved in criminal and terrorist activities. Data mining holds the promise of making it easy, convenient, and practical to explore very large databases for organizations and users. In this paper, we review data mining techniques applied in the context of law enforcement and intelligence analysis, and present four case studies done in our ongoing COPLINK project (Hauck et al., 2002).

2. An Overview of Crime Data Mining

It is useful to review crime data mining in two dimensions: (1) crime types and security concerns and (2) crime data mining approaches and techniques.

2.1 Crime Types and Security Concerns

Crime is defined as "an act or the commission of an act that is forbidden, or the omission of a duty that is commanded by a public law and that makes the offender liable to punishment by that law" (Webster Dictionary). An act of crime encompasses a wide range of activities, ranging from simple violation of civic duties (e.g., illegal parking) to internationally organized crimes (e.g., the 9/11 attacks). Table 1 summarizes the different types of crimes in increasing degree of public influence. Note that both local and national law enforcement and security agencies are facing many similar challenges.

2.2 Crime Data Mining Approaches and Techniques

Data mining is defined as the identification of interesting structure in data, where structure designates patterns, statistical or predictive models of the data, and relationships among parts of the data (Fayyad & Uthurusamy, 2002). Data mining in the context of crime and intelligence analysis for national security is still a young field. The following describes our applications of different techniques in crime data mining. *Entity extraction* has been used to automatically identify person, address, vehicle, narcotic drug, and personal properties from police narrative reports (Chau et al., 2002). *Clustering techniques* such as "concept space" have been used to automatically associate different objects (such as persons, organizations, vehicles) in crime records (Hauck et al., 2002). *Deviation detection* has been applied in fraud detection, network intrusion detection, and other crime analyses that involve tracing abnormal activities. *Classification* has been used to detect email spamming and find authors who send out unsolicited emails (de Vel et al., 2001). *String comparator* has been used to detect deceptive information

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