

Doubly weighted rooted trees and computer security systems

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Abstract

We consider an abstract *computer security model (CSM)* $M = (T, C, P)$ where T is a rooted tree T with $n \in \mathbb{N}$ non-root vertices, and C and P are multisets containing n penetrations costs and n prizes respectively. We study the problem of assigning the penetration costs to the edges and the prizes to the non-rooted vertices of T that minimizes the total prize that an attacker can acquire given a limited budget. For a general tree T we show that it is not possible to develop an optimal security system (i.e. constructing an optimal defence for a given computer network is hard). However, a *P-model* (resp. a *C-model*), where the penetrations costs (resp. the prizes) are constant, does possess an optimal security system if and only if T is (i) a rooted path, (ii) a rooted star, (iii) a rooted 3-caterpillar, or (iv) a rooted 4-spider.

Keywords: rooted tree, doubly weighted tree, graph minors, computer security.