

When Should you Offer an Upgrade: Online Upgrading Mechanisms for Resource Allocation

In this work, we study an upgrading scheme for online resource allocation problems. We work in a sequential setting, where at each round a request for a resource arrives and the decision-maker has to decide whether to accept it (and thus, offer the resource) or reject it. The resources are ordered in terms of their value. If the decision-maker decides to accept the request, they can offer an upgrade-for-a-fee to the next more valuable resource. This fee is dynamically decided based on the currently available resources. After the upgrade-for-a-fee option is presented to the requester, they can either accept it, get upgraded, and pay the additional fee, or reject it and maintain their originally allocated resource. We take the perspective of the decision-maker and wish to design upgrading mechanisms in a way that simultaneously maximizes revenue and minimizes underutilization of resources. Both of these desiderata are encapsulated in a notion of regret that we define, and according to which we measure our algorithms' performance. We present a fast algorithm that achieves $O(\log T)$ regret. Finally, we implemented our algorithm utilizing data from a real hotel and estimated our upgrading mechanism would increase the annual revenue by over 17%.