Chapter 2
Reinforcement Learning for Online Optimization of Banner Format and Delivery

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ABSTRACT
In our Internet-connected world, online advertising has grown into one of the most successful advertising channels, since users spend an important amount of time browsing the web. Among the different types of online advertising (emails, games, etc.), we are particularly interested in contextual ads using rich media banners that display motion and exploit sensory information such as video, audio, animation etc. Once the various banners of an ad campaign are produced, a legitimate question arises for a web marketer: among various options, and for the same banner content, what is the optimal banner format and delivery policy?

In this chapter, we deal with three main problems a web marketer can be confronted with: the right format among those available (e.g. text, image, video, interactive, etc.), the right time to display a banner during a user browsing session (e.g. at the beginning, at the end or when salient events are detected, etc.) and the right sequence of banners to display (that takes into account the format and the time problem). We show that these problems share common points. These points fit well within the reinforcement learning framework: a "trial-and-error" process can be used to dynamically determine an advertising policy that...
INTRODUCTION

Today, online advertising has grown into one of the most successful advertising channels, since browsing the web has become a daily activity for a majority of users. Website owners call on the experience of marketers or online advertising agencies in order to design, produce and deploy ad campaigns (see for example (Marketing Sherpa, 2008) or (McCoy et al., 2007) if you are interested in this process).

Among the different types of online advertising (emails, games, etc.), we are particularly interested in contextual ads using rich media banners. In fact, on a commercial website, contextual ads are used to drive users and transform their navigation into a transaction. Traditionally, the banner’s content has been presented in the form of text and hyperlinks. Recent studies such as (Rosenkrans, 2009) have shown the benefits of using rich media for displaying motion and exploit sensory information such as video, audio, animation etc. Rich media content is considered more attractive since it can grab users’ attention easily and can also leave stronger memories (Mei et al., 2007). Rich media naturally fights the banner blindness problem, when users tend to completely ignore banners. These are some of the reasons that made rich media advertising very popular.

Unfortunately, some sites make excessive use of it, leading to the commonly called ad overload problem. The overabundance of banners or the poor targeting of ad campaigns make sometimes the user navigation on a web site difficult or unenjoyable. Moreover, users tend to learn (by reinforcement...) how to avoid clicking on banners, since they can lead to unwanted content, which is clearly contrary to the aim of the ad campaign.

Once the various banners of an ad campaign are produced, a legitimate question arises (Baccot et al., 2009): among various options, and for the same banner content, what is the optimal banner format and delivery policy?

In this chapter, we intentionally put aside the banner content issue and consider it (as other authors, like Hauser et al. in 2009) as a separate question. Thus, the problem is how to take into account three classical dimensions of a banner seen as a hypermedia document:

- the logical and spatial layout. The logical layout includes the different elements (and their links) that can be inserted in a banner (e.g. an image, or an image with a caption, a video etc.) whereas the spatial layout gives the way these elements are presented (e.g. a caption above or below the image).
- the level of interactivity of banners. Basic or more complex banners may be available, enabling users to click, scroll, type etc.
- the timing of delivery: the instants when banners are added. Adding them at very specific times (e.g. when the user level of interest falls) can increase their effectiveness and therefore their click-through rate (CTR).

A variety of options for designing and delivering the banners are available. Obviously, the
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