Artificial intelligence and advertising

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Abstract:
Artificial intelligence has played a key role in the growth of digital advertising. Techniques using machine learning with, as input, vast quantities of data on cybernauts' behavior patterns have been used to customize the "advertising experience" and thus produce huge gains in performance. This holds especially for search engines and for the banners displayed on Web sites. Advertising still has much room for improvement: AI is currently limited to a function of execution. It is far from being able to devise highly developed marketing strategies on its own.

Digital advertising has stimulated the rapid growth of the new technological giants, such as Google and Facebook. Artificial intelligence (AI) has played a key role in this. At a smaller scale, it is also the key to Criteo's success.[1]

Before delving into details about AI in advertising, let us start by recalling advertising's objective. To simplify, advertising seeks to generate sales of products or services. We usually distinguish campaigns of a "branding" type, for boosting the image of a brand in expectation of additional income in the long run from sales, and so-called "direct response" campaigns for generating income in the short run that is directly linked to the campaign itself. An example in the branding category is the TV ads for Pepsi during the Superbowl in the United States. The campaign's success is measured through polls on the perception of the Pepsi brand by consumers, the supposition being that a positive image will later lead to in-store sales. On the contrary, a catalog sent by the post office with coupons for reductions falls in the direct marketing category. The measurement of its success is the additional sales generated during the coupons' period of validity.

In both cases, the question crops up: how effective is the ad? Is its impact on par with the investment? To find an answer, it is necessary to be able to measure, and then optimize, this impact. John Wanamaker (1838-1922), a pioneer in marketing, used to say, "*Half the money I spend on advertising is wasted; the trouble is I don't know which half.*"

Advertising on the Internet has upended the playing board, at least for direct marketing, since its impact is measurable on a very granular scale. It is possible to know in real time the income corresponding to the ads seen by each cybernaut, and thus to optimize ad campaigns and measure the changes right away. This feedback loop, coupled with gigantic quantities of data, opens a perfect playing field for AI, which, given the number of parameters and combinations to take into account, can optimize much better than humans.

Since technology offers this possibility, it is worthwhile customizing, or personalizing, the "advertising experience" for each of the millions of cybernauts in order to maximize the impact — no use displaying an ad for diapers to someone who does not have a baby! Each cybernaut's browsing interests must be detected. This signals a revolution compared with what used to be possible via advertising channels, such as newspapers, radio or television.

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[1] This article has been translated from French by Noal Mellott (Omaha Beach, France).

The type of AI used in advertising is machine learning. It involves algorithms for digesting colossal quantities of evidence about the past interactions between cybernauts and the advertisements they have seen, the goal being to learn what will be more effective in the future. This does not involve intelligence in the usual sense but, instead, relies on very sophisticated, awesomely effective statistical procedures.

On algorithms and people

Let us dwell awhile on this idea of AI, in particular on the distribution of tasks between algorithms and human intelligence. In advertising, AI is a devoted servant with an exceptional computational capacity (somewhat comparable to the autistic character played by Dustin Hoffman in *Rain Man*), but it takes no initiatives. It does what it is told to do; and the responsibility for setting its objectives is left to human intelligence. It is, therefore, crucial to choose the right objective — a thornier issue than it seems to be.

To start, we can say that, with a given advertising budget, the goal is to maximize sales. This brings up several questions.

The first question is ATTRIBUTION: how to link a sale on an e-business website to the advertising campaign that generated it? Imagine that the e-business has launched at the same time several campaigns: commercials on television and radio, advertising banners on the Internet, etc. A person might be exposed to more than one ad campaign. If he ends up buying the product, how to know which of these campaigns is the origin of the sale? No one has yet been able to answer this question. The advertising industry uses arbitrary rules for settling this question of attribution, rules that take account of the chronology of interactions between the cybernaut and the ad. For on-line banners, a widespread rule, called the "post-click rule", is to attribute a sale to the most recent ad banner on which the person has clicked.

To proceed with this problem, what TIME FRAME is to be used to attribute a sale to an ad? Should we take account of the sales made up to 24 hours after the click, or up to seven days, or thirty days? Here too, there is no absolute rule; but the choice of the time frame will significantly affect the ad's perceived value. A very long period could be used to take account of the long-term value of a new customer; but we realize that the longer the period between a sale and the "consumption" of the ad, the harder it is to believe that the ad generated the sale. Since a period much too long would be needed to measure an ad's impact and optimize it, the time frame is usually set to a few days.

Another problem: how to INCREMENT sales in relation to ads? Might a cybernaut who has bought a product after exposure to its ad, not have purchased it anyway — even in the absence of advertising? Might he have bought it a little later? In other words, are the sales generated by advertising (as measured by the post-click rule) incremental? To make sure, perform two tests where subjects are divided into two groups, the one exposed to the ad but not the other; and then compare the total sales figures of each group. The difference is the ad's actual impact. This test helps us check whether the ad's impact is close to its measured value. However this is a statistical test on a large population; it does not help us optimize an ad campaign for individuals as such.

These few examples illustrate the complexity of measuring an advertising campaign's success and setting its objectives. Nor have we mentioned marketing strategies at a higher level. Should we concentrate on current customers with the aim of making them loyal and make more purchases? Or on winning new customers? AI does not currently answer these questions. It is content with executing as best possible an advertisement once humans have set the objectives and methods for measuring the campaign's success. This is already a lot!

Examples of AI and advertising

Search-engine marketing

Google, a pioneer in on-line advertising, introduced in October 2001 an advertising system that had made a fortune: AdWords. The idea is simple: an advertiser inserts a short text for an ad in the column to the right of the search engine's findings. The key words to be detected must be set, and Google then uploads the ad for display to the cybernauts who use them. This was the beginning of targeted on-line advertising. The relevance of an ad to the consumer was unparalleled: type in "camera", and only ads for cameras will pop up. But Google did not stop innovating; it went on to introduce a revolutionary business model.

Instead of being paid for each display of an ad, Google collected a payment only if a cybernaut clicked on the ad; this is called "cost per click" (CPC). The expected return from an ad simply equals CPC times CTR (the "click-through rate"). Calculating CTR is, therefore, crucial for optimizing the placing of ads. If twenty advertisers are competing for the key word "diaper(s)", it is in Google's interest to display the ad that will have the highest CTR. Google can thus optimize its income and maximize the ad's relevance to the cybernaut.

How to estimate CTR on ads corresponding to millions of different key words? For sure, this click-through rate depends on several parameters: specific key words, the ad's position on the web page, its text, the relation between the ad and the key word typed by cybernauts, the number of visitors on the website displaying the ad, the time of the year, etc. Billions of distinct combinations are possible. This problem is hard enough without adding that CTR is low (in the one percent range) and, therefore, that the positive events that generate income do not occur often. To measure CTR experimentally, thousands of printouts would be needed for each combination of parameters.

This sort of problem is perfect for supervised machine learning based on samples. Each display of an ad is positive (1) if the user has clicked but negative (0) if the ad is not clicked. The AI algorithm can be trained using millions of samples, the goal being to reduce the errors between predictions and observations. It suffices to record all displays of an ad and all the clicks in order to provide a stream of new samples as input into the algorithm. The latter can thus naturally adapt to new ads, new key words or even behavioral patterns.

Display advertising

The targeting techniques originally developed by search engines have been expanded into what is called "display advertising" in reference to the advertising inserts displayed on line. Nowadays, most of the ads you see day after day on line have been bought at an auction. When offering a place for an ad, a website will let the spot in real time to the advertiser who offers the most. Dozens of companies, such as Criteo, have a few dozen milliseconds to place a bid and hopefully win the spot for an ad. The winner is allowed to display his ad to cybernauts.

AI sharpens an advertiser's competitive edge under condition that he can estimate the expected return for each spot on a very fine scale and in real time! It is important not only to estimate the amount for a bid very fast but also to update estimates in real time. Let us say that you are displaying an ad to a cybernaut who does not click on it. Two seconds later, you have the opportunity to display the same ad to him again. Knowing that he did not click the first time, the expected return from a second display is much less. AI algorithms are very effective and yield excellent results under such trying conditions.

Personalizing ads

Besides predicting how much to bid for a display spot, it would be worthwhile to directly generate messages in line with the cybernaut's interests. Criteo has popularized this technique. AI can help set parameters in real time as a function of the context. For example, we can optimize the number of products shown in an on-line banner, the products themselves, photos of the products, texts about them, colors, type of animation, the presence or absence of the price or of coupons, etc. AI satisfies all our whims and continues optimizing as long as data are pumped into it.

Beyond algorithms, the Web giants are fighting to acquire proprietary data. If Facebook knows my friends and my hometown, it will probably have a competitive advantage for targeting ads compared with rivals who lack this information.

What can advertising expect from AI?

AI is now everywhere; its range of applications, expanding day after day. Newsfeeds on Twitter or Facebook are updated from the interactions of millions of cybernauts. Google's results are also continuously improved with user feedback. Algorithms are personalizing and steering e-mail campaigns. AI is now prepared to help us detect fraudulent practices or to know whether the same cybernaut is present on two different computers. AI also helps us work out complex bidding strategies by, for example, calculating how potential competitors will bid (instead of estimating only an ad's expected returns).

AI, in particular deep learning, is still making spectacular progress. These techniques are now being applied to improve the quality of advertising messages and calculate bids for ad spots.

Beyond the improvement of existing algorithms, AI still has ample room to advance before claiming to fully replace human beings. AI could, for example, learn to measure and optimize an ad's real impact in terms of incremental sales in a time frame corresponding to the customer's life span — rather than being satisfied with imperfect measurements that are easier to make. It could also define high-level marketing strategies, even in branding. In this case it would change completely the work of directors of marketing, but this still seems a long ways off.