



# Machine Learning

## for Mobile Advertising

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## Introduction

With the global increase of mobile and internet penetration and the growing number of apps installed on mobile devices, a vast amount of data is available for mobile marketers. Through Machine Learning (ML) powered advertising platforms, marketers are now able to use Machine Learning to leverage data effectively and connect with their target audience. But what does ML really mean for mobile advertising?

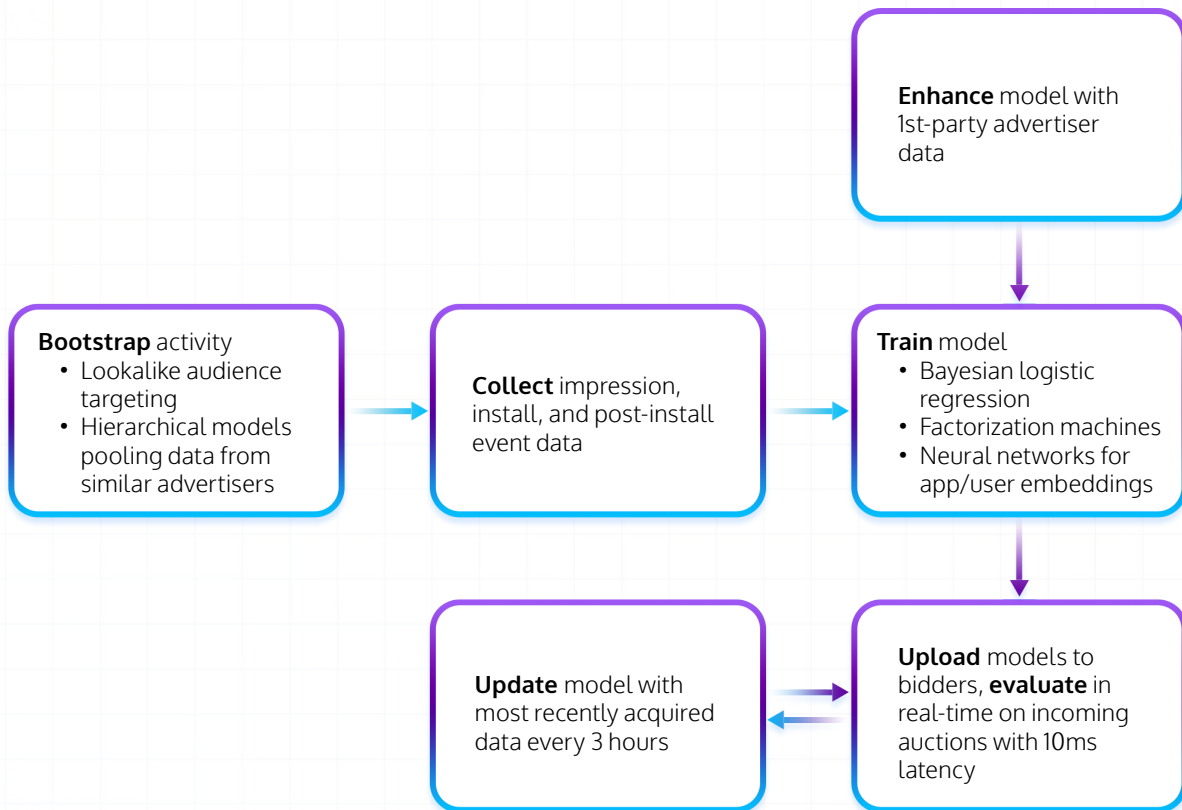
Machine learning systems can automatically learn and improve from experience without being explicitly programmed. They help advertisers automate optimization and targeting at scale.

This whitepaper aims to provide an understanding of the role of machine learning in mobile advertising and unpack the impact machine learning models could have on your next mobile programmatic campaign with Aarki.

# How does Machine Learning really work?

Machine learning involves analyzing vast amounts of information and finding patterns to predict the next action or behavior. This includes a generalized process with wash-and-repeat steps for continuous improvement: data collection, model training, testing, learning and enhancing.

Below is the generalized machine learning process we at Aarki use for campaign optimization:



Machine learning algorithms leverage users' historical data to predict probability of future behavior. The algorithms can determine whether a user's actions are likely to result in a conversion. The customized models of each campaign are developed around the specific campaign goals such as return on investment (ROI), cost per install (CPI) or other specific actions like registrations, purchases or game level reached. These models work in conjunction with Aarki's bid optimization. In a real-time bidding setting, it is crucial to predict the expected revenue, cost per install, and other metrics from a particular ad impression. We convert these return on ad spend (ROAS), CPI or other campaign goals to a cost per thousand impressions (CPM) bid to ensure we acquire the user at the right price to meet overall campaign objectives.

Now that we have talked about the general process for ML that we do, let's talk about certain specifics of our approaches at Aarki.

# Advanced feature engineering of machine learning models

To provide a prediction of user behavior and to achieve the desired campaign goals, machine learning models are trained using a number of features:



## Post-install Behavior

Here we extract behavior features from user profiles to capture in-app engagement and spend. This also allows us to identify correlations of behavior between similar titles.



## Conversion Delay

Aarki models an expected number of purchases as well as the time it takes for the user to convert. We use incomplete install cohorts to model early stages of the purchase funnel.



## Active User

This measures a user's „interest“ or „activity“ from the user profile and allows us to quantify a metric based on recency, frequency and / or monetization.



## App Embeddings

Using neural network embeddings, we at Aarki can establish a similarity metric within the app space, quantifying the similarity of two apps.

With the continuous improvements in understanding user behavior and the growing amount of data available, data scientists and engineers at Aarki can further train and elaborate the models for more accurate predictive analytics.





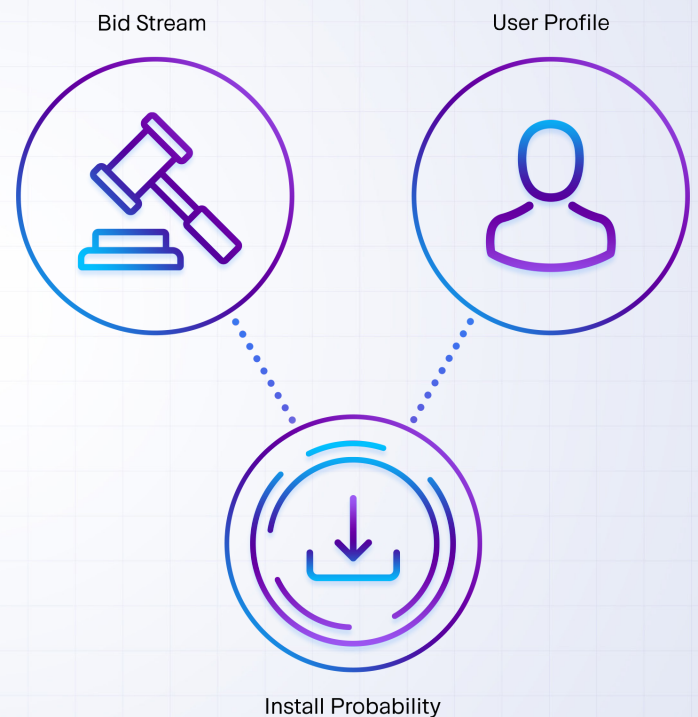
## Models for superior campaign performance

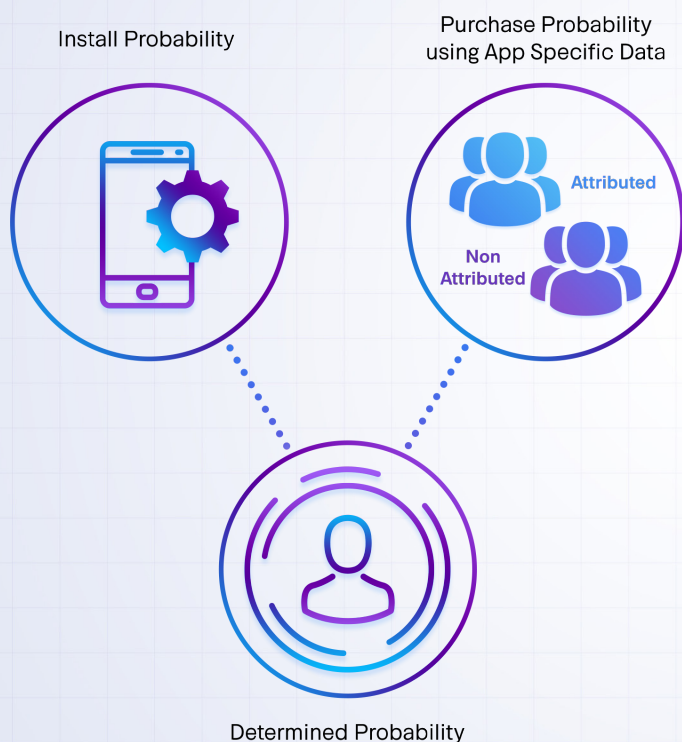
To strategically optimize campaigns from paying low CPI to generating high ROI, we have developed various ML models to effectively learn user behavior that delivers scale at an optimal cost and return. Some of our models include Install Optimization, Multiplicative, and Pointwise Mutual Information.

## Install optimization model

Install optimization is one of the steps of Aarki's setup for user acquisition campaigns. It uses a model focused on delivering reasonable cost per install (CPI) and generating volume. We then monitor installs to see how they convert to the desired post-install event, which is used to measure campaign performance.

The goal is to predict the install probability using a generalized linear machine learning algorithm combined with features derived from the auction, geographic and temporal context. In addition, user profile data is incorporated with historic ad responses and in-app behavior.





## Multiplicative model

The Multiplicative model gives us the opportunity to directly use predictions from a model trained on non-attributed event data. Advertiser's non-attributed event data is used to model the post-install conversion funnel; independently Aarki-attributed data is used to model the impression-to-install funnel. These predictions are multiplied at bid time, giving approximation for user in-app spend and ad revenue.

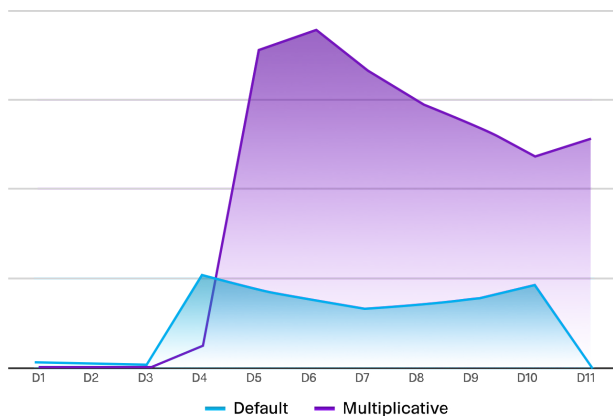
To determine the value of the Multiplicative algorithm, we analyzed a programmatic advertising campaign for a game app over a period of 11 days. The advertiser aimed to acquire the highest quality users based on purchase and install data, at an optimal cost per install (CPI). Using the advertiser's attributed and non-attributed purchase and install data, we leveraged the Aarki's proprietary Multiplicative algorithm to optimize for return on investment (ROI).



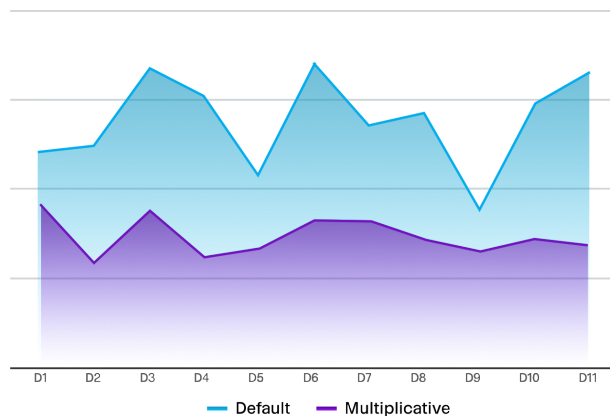
During the first few days, when the algorithm was still adjusting, the ROI was low. However, we saw a huge increase in ROI on Day 5 and were able to sustain it for the rest of the duration of the campaign. Overall, we saw **4x increase in ROI with the Multiplicative algorithm**.

The Multiplicative algorithm also had a positive impact on CPI. Since the first day of leveraging the algorithm, a strong CPI performance was achieved and maintained. Overall, we saw an **87.26% decrease in average CPI from Multiplicative**.

Positive impact on ROI

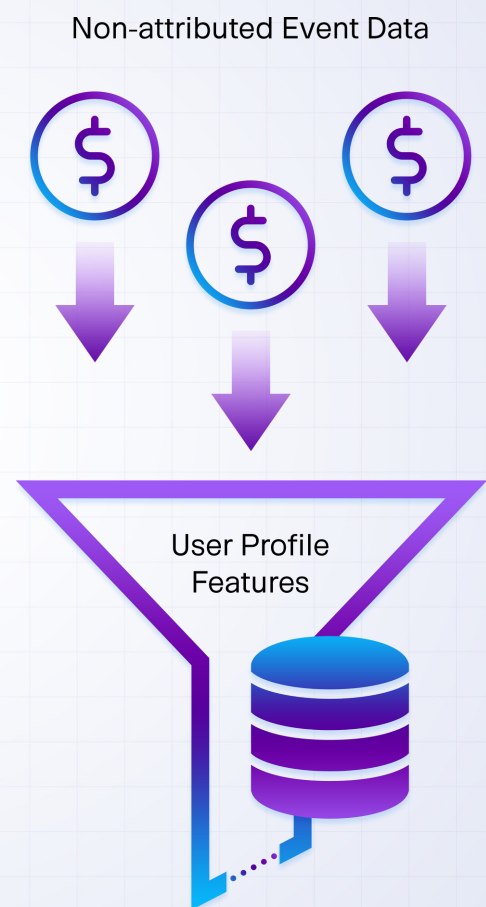


Positive impact on CPI



## Pointwise Mutual Information (PMI) model

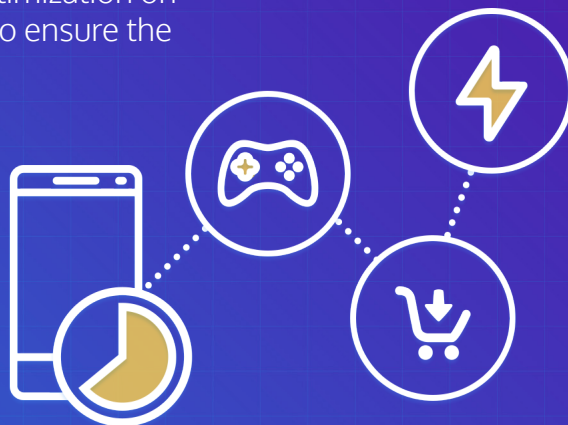
The Pointwise Mutual Information model allows us to effectively model Aarki-specific user conversion funnels while pre-training on non-attributed event data. The advertiser's non-attributed event data is used to compute pairwise correlations between user profile features and in-app purchase events. These correlations are then used to "warm up" features in a direct optimization model, which predicts purchase probability at impression time.





## Machine learning models for retargeting campaigns

At Aarki, we also work with across large scale retargeting campaigns to reactivate lapsed users for our advertisers. We have built custom retargeting models that leverage in-app activity data from before a user has lapsed to inform user conversion prediction and predicted post engagement activity. This is combined with bid optimization on a per user/per impression level and creative selection to ensure the optimal bid and creative selection per auction.





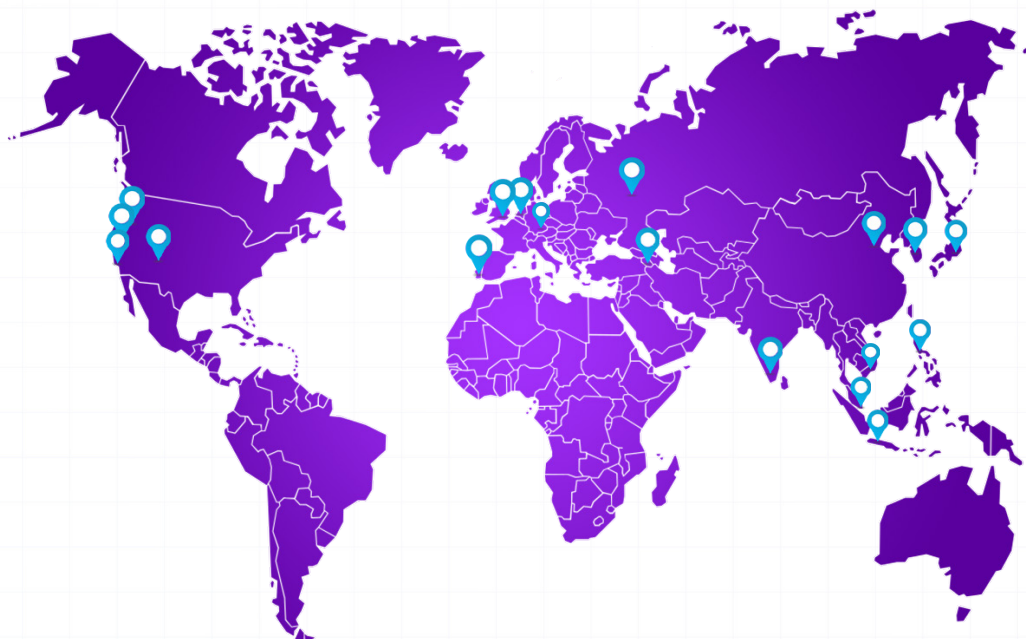


## Why Aarki for your next mobile programmatic campaign

Get high returns from your marketing budget with an AI-powered demand-side platform. Aarki's programmatic advertising platform, **Aarki Encore**, uses proprietary machine learning algorithms to target users valuable to the advertiser. Tied with Aarki's proprietary creative suite, **Aarki Studio**, our creative team can produce highly personalized ads that dynamically optimize messaging to an individual user at ad serving time. Both **Aarki Encore** and **Aarki Studio** are integrated with AI-powered media optimization to ensure advertising is not only personalized, but also optimized for efficiency at scale.

# About Aarki

Aarki helps companies grow and re-engage their mobile users, using machine learning (AI), big data, and engaging creative. We strive to deliver performance at scale across various marketing objectives to meet the target ROI (return on investment). Our data offer deep insights into user intent and usage habits. To drive performance, we activate our data assets through proprietary machine learning algorithms and engage users in real-time with personalized creative.



Aarki has been recognized by The American Business Awards, Red Herring 100, Internet Advertising Competition, Deloitte's Technology Fast 500, The Drum Advertising Awards US, Horizon Interactive Awards, Effective Mobile Marketing Awards, The Wires by Exchange Wire, and Artificial Intelligence Excellence Awards.

For more information, please visit [www.aarki.com](http://www.aarki.com) or follow us on Twitter: @aarkimobile.

