# D:WAVE

Recruit Communications: Applying Quantum Computing to Digital Marketing

A Case Story

"Working on the optimization of the TV advertising allocation problem, we used the D-Wave system to maximize viewers who recognize a brand. We got a better result with D-Wave compared to the conventional method."
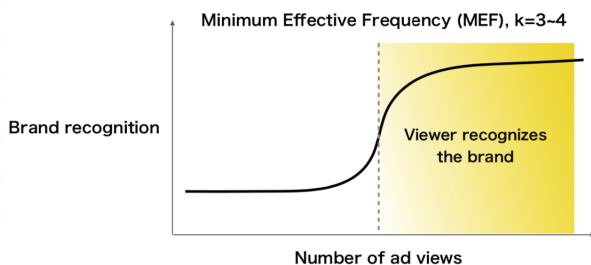
Kotaro Tanahashi
Machine Learning Engineer,
Recruit Communications

Advertising expenditures by advertising media
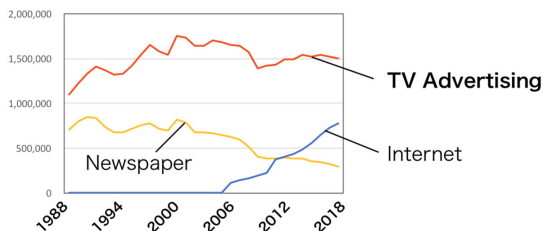
**TV ads has still big share
while Internet advertising is rapidly growing.**

Recognition of TV ads suddenly increases when the number of ad views exceeds the threshold (or MEF)

* Note: This project was transferred to Recruit Co.,Ltd.

Right User, Right Time, Right Message

Recruit Communications* provides a wide variety of online services including job search, travel, dining, hotel reservations and more. Analytics play a key role in helping optimize their marketing efforts in keeping with the company's guiding principle: **Right User, Right Time, Right Message**. Using the power of quantum annealing, Recruit has blazed a new trail in the world of sales and marketing. In 2017, they announced a first-of-its-kind collaboration with D-Wave aimed at optimizing marketing, advertising, and communications technologies and strategies.

One of Recruit's first projects focused on optimizing the allocation of television ads to promote brand awareness. Traditional optimization methods are built around allocating ads to TV programs to maximize the total expected number of views within the budget. The goal is to reach individual viewers enough times to push them over a tipping point (called the Minimum Effective Frequency, or MEF) past which brand recognition increases suddenly and dramatically.

Typically, advertisers simply select programs with the highest expected view rates per dollar. However, the relationship between view rates and brand recognition can be unpredictable and is influenced by countless factors. Recruit sought a more direct way to identify and reach the maximum number of viewers who could be nurtured to the MEF point within the budget.

The research team learned that controlling the similarity between selected programs improved their ability to cultivate brand recognition in individual viewers. Using the algorithm which grew out of the discovery, Recruit was also able to devise a formula to increase the accuracy of view estimations. Combining both methods significantly increased their ability to identify a target viewer population and engage them with greater efficiency and less expense.

An Expanding Quantum Portfolio: Machine Learning in Marketing

With the success of their initial project, Recruit has continued to expand its portfolio of early quantum applications. One project focused on improving the accuracy of machine learning methods which influence marketing technology, such as recommendation systems. Such systems, by nature, involve a highly complex set of computations based on a number of "features" associated with each user—for example, gender, browser type, or OS type.

MATCHING MODEL
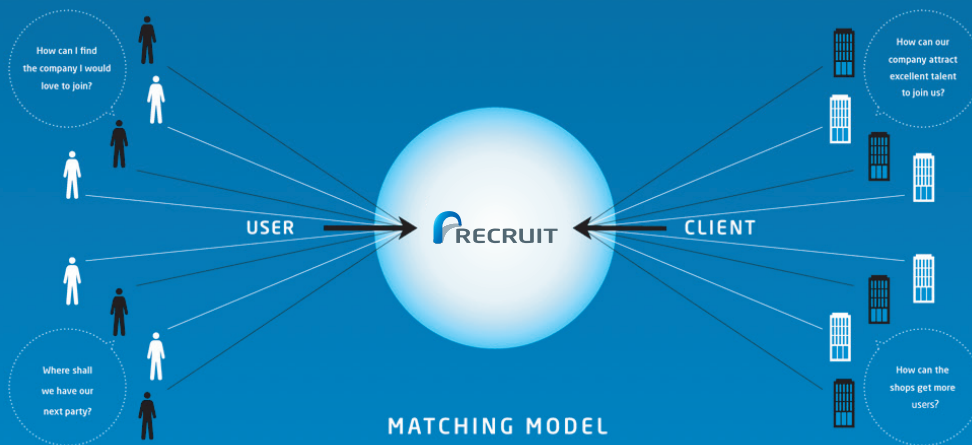
Existing methods used on classical computers to identify relevant features—such as L1 Regularized Logistic Regression (L1LR) and Feature Selection by Random Forest (RFFS)—are only able to deal in approximates due to the high computational cost of addressing these combinatorial problems.

Researchers set out to develop an algorithm that could handle true data values by weeding out the features with the weakest significance and finding the minimum number of remaining features which could be used and still yield high quality results. When programmed into D-Wave's 2000Q™ quantum computer, Recruit's method required only 10% of the weak classifiers needed by RFFS to yield consistently better, more accurate results. The D-Wave system also showed consistently better results across various data sets, as well as better optimizations results overall.

Discovering the Optimal Order

Another problem Recruit explored is how to determine the optimal order for ranking search results on a hotel reservation website. On e-commerce sites, separate lists are created for each search segment (area, number of people, price range, etc.) and are updated daily based on an algorithm designed to maximize sales. However, traditional computing methods aren't able to account for certain factors that impact sales, such as the need to present a robust range of options for customers to choose from.

On hotel reservation sites, most people make their selection from the list screen, and rank order plays a significant role in determining click rates. As such, existing algorithms designed for classical computing systems tend to focus on making popular options easy to find, rather than determining the ideal mix of factors to appeal to each individual customer. Recruit's research aimed to develop an algorithm that could account for *both* items' sales scores and diversity within segments. Their results clearly demonstrated that accounting for both factors resulted in better performance than considering sales score alone.

"With D-Wave, we observed a +1% sales uplift in our web services."

Recruit is continuing to explore how D-Wave's quantum system can benefit their business, and enhance their **Principle of Digital Marketing: Right User, Right Time, Right Message.**

D-Wave is the leader in the development and delivery of quantum computing systems, software, and services.

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