Automation of Marketing Models

In 2016, the ongoing tug-of-war between human capability and that of machines reached a critical turning point in the realm of image recognition. As recently as 2010, machine algorithms had a 30% error rate when attempting to identify images from ImageNet, a large database of over 10 million obscure images, lagging well behind the stagnant 5% human error rate. By 2016, however, machines had made such strides in their image recognition capabilities that the error rate had dropped to 4% for the best systems, thus edging out the human eye for the first time in history.¹

Image recognition provides just one example of how artificial intelligence (AI) has progressed over the past several years and how quickly it will continue to evolve. What do these advances mean for businesses, and, more specifically, how will they help brands market their goods and services to new customers?

Marketing and Artificial Intelligence

The most basic definition of marketing is a conversation between a business and its customers, both existing and potential, with the end goal of ultimately creating customer value and appropriating some of that value for the firm.² One way of achieving this is through the process of segmentation, where marketers split consumers into distinct groups and base their strategies on what would appeal to each specific group. This process has allowed marketers to create targeted strategies that are more effective because they are tailored to the particular needs and wants of a segment based on surveys and focus groups.

The advancement of the internet and the shift of the consumer marketplace into the online world have opened up vast amounts of customer-specific information. The sheer quantity of this data allows a marketer to theoretically personalize the firm’s strategy to each individual consumer,³ leading to increased efficiency. However, this excess of available data also creates new problems examining not only how to decipher it and sort the relevant information from the noise, but also how to implement so many different marketing strategies at once. This is where the advances in AI come into play and have the potential to change the landscape of the marketing field. In this regard, the goals of this technical note are threefold: to provide a basic understanding of AI and its recent advancements, to explore how AI is currently involved in marketing, and to discuss the future potential of this partnership.


History

The term AI was first introduced in 1956 at an academic conference, but the idea of a machine that could “think” for itself had already been around for some time. Although most people equate AI with science fiction and thus expect drastic advancements in the field, there has been much progress in what AI systems can do and their incorporation into the world around us. The three areas in which AI has progressed the most since its conception are search algorithms, machine-learning algorithms, and integrating statistical analysis into the world at large.4

One of the main driving forces that shaped the field of AI and arguably kept it from remaining a purely theoretical field was the Turing test, created by Alan Turing, an English mathematician, in the 1950s. The object of Turing’s “imitation game” was for an interrogator to distinguish which response to a single question came from a man and which came from a machine, based solely on the content of the responses (without physical clues). Although there are many problems with the Turing test, some of which were discussed by Turing himself, the test and various versions of it continue to be one of the questions the AI field seeks to answer.

Between the excitement around a new field and the future prediction of sentient machines, AI received large amounts of initial funding. However, with high expectations derived from the influence of science fiction and no specific goals attached to the funding, financiers soon became disappointed with the lack of progress and pulled their funding. This led to what is commonly called the AI Winter of the 1970s, which finally came to its conclusion when there was some appreciation for the commercial value of AI. One of the first initiatives proving this value came in 1981, when Digital Equipment Corporation (DEC) started using R1, an expert system that helped configure orders for new computer systems. An expert system was a form of AI that used a knowledge base received from field experts to solve a much more specific problem. The system’s commercial success brought funding back to the field. By 1986, it was estimated that R1 saved DEC an estimated $40 million annually.5 Since then, AI research has advanced quite a bit, albeit in less obviously noticeable ways, and continues to evolve.

Basics

“AI” is generally used to encompass any situation in which machines accomplish tasks in a “smart” manner.6 Because the term has been around for a long time, newer terms have developed that are more specific to the application of AI as the field has progressed. One such example is machine learning (ML), which describes the process wherein machines are given datasets and asked “to learn for themselves”7 in order to make predictions in the real world using specifically designed algorithms. ML is considered a subset of AI and has evolved in many ways due to the emergence of the internet and access to much larger quantities of data.8 ML is currently the fastest-growing field of AI9 and is thus generating a significant amount of interest from all sectors. Embedded within ML is an even more specific term that is currently being used, deep learning (DL).

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Essentially, DL is the application of ML to complex problems; however, the machine is also equipped with the ability to learn from its mistakes and assess its own probability of reaching a correct result. (For a visual representation of these concepts, see Figure 1.)

One example that can be used to illustrate the evolution of AI is IBM’s Watson. This computer was initially designed to address the challenge of beating humans at the game Jeopardy!, with the hopes of eventually developing technology that could find answers in unstructured data more effectively than existing search engines. The basic idea of a computer that could beat a human at a strategic game is an example of some of the initial challenges AI sought to solve. However, Jeopardy! is an incredibly complex game in that it requires the machine to understand the nuances of human language with respect to how the clues are often written. Thus the first step Watson would need to take when faced with a game clue would be to analyze the language and understand it before searching for an answer. Watson’s ability to understand what the clue is asking is an example of ML; the computer is equipped with algorithms that analyze the various ways in which the question can be interpreted and then search the vast amounts of data available to Watson for plausible answers. Considering the penalty a player faces for an incorrect answer, Watson must therefore be confident in its response before buzzing in. This is where DL comes in. Watson uses a second set of algorithms that finds evidence to support or refute its possible answers and rank them, while also limiting its offering of an answer to the instances where it is confident in its response. As underlined by this example, the more complex the problem becomes, the more intricate the machine’s programming becomes.

Figure 1. Categories within AI.

Before we look at some existing applications of ML, we must understand how this concept is different from predictive analytics, if at all. Technically speaking, ML is a subfield of both computer science and AI, whereas a statistical model is derived from pure mathematics. The CEO of Edvancer Eduventures, Aatash Shah, clarifies:

ML: an algorithm that can learn from data without relying on rules-based programming.

Statistical Modeling: a formalization of relationships between variables in the data in the form of mathematical equations.12

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As statistician Larry Wasserman further explains on his blog, the same concepts are described by different terminology in the two fields. (See Figure 2 for an illustration of statistics and ML terms.)

Figure 2. Terminology across ML and statistics.

<table>
<thead>
<tr>
<th>Machine Learning</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning</td>
<td>Estimation/Fitting</td>
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<tr>
<td>Hypothesis Testing</td>
<td>Confirmatory Data Analysis</td>
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<tr>
<td>Example/Instance</td>
<td>Data Point</td>
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<td>Network/Graph</td>
<td>Model</td>
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<td>Weights</td>
<td>Parameters</td>
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<td>Supervised Learning</td>
<td>Regression/Classification</td>
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<tr>
<td>Unsupervised Learning</td>
<td>Clustering</td>
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<td>Feature</td>
<td>Covariate</td>
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<td>Label</td>
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If we put the derivative and terminology distinctions aside, it is clear that both of these fields are concerned with answering the same question: How can we learn from data? Furthermore, as we continue to advance in these different branches of predictive modeling, the lines begin to blur even more. For example, self-learning is just an advancement of humans manipulating different variables when conducting a regression analysis. Therefore, collaboration and overlap between these two disciplines result in better predictability and decision-making and are being tackled through the study of data science.

Initial predictions of the importance of marketing technology led to a boom in the development of marketing software based on statistical programming such as R, Python, and SQL. However, marketing software penetration across industries was minimal; in fact, by 2015, it was at less than 5%.13 This failure to capitalize on such an opportunity may be attributed to the fact that many companies focused on increasing the efficiency of a task while not realizing that the task itself may not remain an effective tool. For example, brands initially bought software to compose and manage regular Facebook posts;14 but in 2014, Facebook began curtailing posts from brands,15 thus eliminating the utility of such software. As we will see later in this note, instead of a focus on online posts for consumers, there was a subsequent shift toward creating chatbots that interacted with Facebook’s Messenger platform and took advantage of more recent advances in DL.16

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technological trend in marketing. Benefits of Aster include integrating big data analytics with a single interface that is user friendly and helps companies uncover insights from their data at an optimized speed.17

Analytics Techniques

The purpose of analytics can be either descriptive, predictive, or prescriptive. Descriptive analytics refers to data explorations to summarize historic information. Typical questions answered by descriptive analytics include: What happened?; When, where, and how often did something happen?; Why did something happen?; and Is a certain event abnormal? For example, Hilton may be interested in knowing the percentage of rooms booked in a property during the holiday season, the percentage of bookings that came through TripAdvisor, the number of Facebook posts made by customers about their stay, the value of a friend on the customers’ Facebook network, and whether the drop in bookings in a certain property in March is consistent with historic trends and with trends in other properties in that region. Network graphs are one interesting descriptive technique that firms are using to map customers’ social relationships and learn about better customer targets for seeding viral marketing campaigns. The descriptive analytics are represented in the lower left of Figure 3 below. Pivot tables, correlations, histograms, and data visualizations are other good examples of descriptive analytics.

Figure 3. Intersection of analytics and ML.

Predictive analytics refers to methods that allow managers to forecast outcomes or answers, “What will happen at different levels of inputs?” Continuing the Hilton example, the hotel chain may want to predict a property’s level of occupancy based on historic occupancy rates, the chain’s characteristics such as star rating (five stars, four stars, and so on), TripAdvisor reviews, local events, or property features. Firms can use decision trees or an ensemble of decision trees, called random forests, for this purpose. Lasso regressions allow managers to automatically select a smaller set of effective predictors from a large set of candidate variables with a specific

goal of improving predictions across several possible samples of data. For example, managers at Hilton can also use Lasso regressions to predict occupancy rates similar to decision trees.

Hilton would also be interested in knowing whether a customer is likely to continue booking rooms in their properties or switch to other hotel chains or lodging options, such as Starwood or Airbnb. Neural networks and DL extensions of neural networks provide managers with a mechanism to incorporate all the information about the customer’s interactions with the brand, including type of booking, trip type (e.g., business or leisure), day of week of the visit, customer loyalty status, trends in customer bookings, customer demographics (e.g., age or income), property manager ratings, and customer preference for the food in the hotel, in order to predict customer retention. The ML techniques have primarily focused on building better predictive models capable of harnessing several variables available to managers to forecast a particular event. Image classifiers and translation algorithms made popular by Google also use DL algorithms. These algorithms are also called self-learning because they are capable of updating the model specification based on new data without human intervention.

The final analytics technique is prescriptive analytics. This technique is useful when managers are interested in answering the following questions: Why is something happening? and What is the best course of action to maximize the key performance metric? While a Hilton manager is interested in predicting customer churn, he or she might also want to know if certain special offers available for the company’s platinum-level members, such as lounge access, are effective in building customer retention. While predictive models can predict an event, they are weak in connecting if a certain promotion is causally linked to the outcome, such as customer retention. This prevents management from designing better offers to maximize retention. This is where prescriptive analytics, such as multiple linear regression or logistic regression (binomial or ordinal), can be useful. These techniques are less of a black box and are able to deduce the marginal effect of each individual treatment or marketing campaign on outcomes such as customer retention. The drawback of these techniques is that they are not amenable to handling a large number of independent variables, and the predictive power of these techniques are typically lower than predictive analytics techniques.

Genetic algorithms are optimization methods that overlap both prescriptive and predictive analytics techniques. They are based on Darwin’s theory of evolution and use this concept to identify characteristics of a solution that has the highest probability of survival. This is a highly parallel search technique that can be used to search for both the best model formulation and parameters that maximize a solution. For example, genetic algorithms can be applied to design the optimal marketing resource allocation across different media channels such as television, radio, paid search, display, Facebook, print, YouTube, and mobile, and the level of discount provided for a product.

One way to improve the performance of prescriptive models (and sometimes even predictive models) is to build a separate model for different customer segments. The first step in this process would be to identify customer segments. K-means clustering can be used to identify segments in the data using different customer demographics and psychographics. Latent class models allow managers to combine k-means segmentation and regression models into an ensemble.

Growth in customer reviews, blogs, and Facebook posts have provided managers a plethora of textual information that can be summarized by natural language processing to get sentiment scores. These sentiment scores can then be used in predictive or prescriptive models. For example, Hilton can use natural language processing to obtain sentiment scores for each property. These sentiment scores can then be used to predict occupancy rates or customer retention.
Existing Applications

The Hilton example provides evidence of some ways AI is currently helping businesses refine their marketing processes. From an enterprise-wide perspective, there are four main areas in which AI is being used in business today: improvement of customer service, workload automation and predictive maintenance, effective data management and analytics, and improvement in marketing and advertising.\(^\text{18}\) The key advancement regarding customer service has been the chatbot, which was discussed earlier and is predicted to replace the 1-800 number in coming years.\(^\text{19}\) Initially, chatbots operated by recognizing cue words or phrases and responding with preprogrammed responses. With the evolution of ML, they are now much more capable of evolving beyond the limitations caused by preprogramming and responding appropriately to user requests. Additionally, with messaging apps overtaking the use of social media, more businesses are creating chatbots. In some cases, as evidenced by the 1-800-Flowers example, the consumer can place an order using a chatbot within a messaging app, thus bringing the retail experience to the virtual world and increasing the convenience for the consumer.\(^\text{20}\) Facebook’s Messenger platform is currently exploring partnerships with various companies to take advantage of the many possibilities chatbots present in both customer service and e-commerce.\(^\text{21}\)

Aside from embracing chatbots and exploring their evolution, Facebook has taken advantage of AI in many other ways. One of Facebook’s greatest strengths is the vast amount of data it collects from its many users. The company has developed an AI tool called DeepText, which uses DL to figure out the meaning of words contextually from their conversations and then direct users toward products they might be interested in. This is just one way Facebook continues to use targeted advertising, in which the company uses DL to sift through the data gathered about each user to generate ads relevant to the individual’s likes. Another way in which Facebook is using DL is with DeepFace, a tool that uses facial recognition to identify people in photos. However, this tool has been controversial given the privacy concerns it raises by being able to recognize people in high-resolution crowd images.\(^\text{22}\)

Facebook is not the only example of how AI is being used in marketing through targeted advertising and content curation. Netflix uses AI to generate recommendations for users based on their viewing history. Amazon also uses AI to suggest other products that a consumer might be interested in based on purchase and search history. Under Armour has partnered with IBM’s Watson to personalize its own services. The partnership combines user data from Under Armour’s Record app with third-party data on fitness and nutrition to generate personalized training and nutrition regimens. This also allows the company to individualize its marketing strategy based on the user’s activity.\(^\text{23}\)

The shift of the marketplace to the internet has not only vastly increased the amount of data available to businesses, but it has also led to a greater number of choices for consumers. With a seemingly endless supply of firms competing for a finite number of consumers, buyers need some way to sift through their options. One increasingly popular way is through the experiences of fellow consumers. This is where social media and the ease of communicating with other buyers become very important, along with various ways to share consumer


\(^{19}\) https://techcrunch.com/2016/04/12/agents-on-messenger/.


\(^{21}\) https://techcrunch.com/2016/04/12/agents-on-messenger/.


ratings. Thus a triangle of conversations is created, with communication occurring between all three vertices (as shown in Figure 4 below).

![Figure 4: Model of consumer-brand conversations.](source: Created by authors.)

**Potential Applications**

As discussed above, advances in AI combined with the changing consumer landscape have already significantly altered the marketing field. Yet the AI field is still evolving and developing, suggesting that there are more changes to come. One such possibility is the shift from marketing being a conversation between two people to a conversation solely between a person and a machine. This seems like a natural progression given the current culture of turning to Siri, Alexa, or even Google to answer any question. Since these AI forms are already answering most of our questions, it is only natural that they will eventually be equipped with marketing strategies themselves to bring products forward that match specific consumer needs. In this ongoing machine-human conversation, it seems that bots will become increasingly more prevalent. One advantage to the bots is that they can reduce the time between a consumer query and the answer to their questions, creating a more streamlined and efficient process.

Although the above examples may seem to indicate AI will be replacing marketers, in reality it will allow the marketing teams to skip the boring or more rote aspects of marketing and focus on the creative aspects. Additionally, the speed with which machines can accomplish such routine tasks will accelerate marketing and sales in general. With AI equipped to respond to various changes in consumer behavior, the market will be able to adjust more rapidly, thus leading to adaptive pricing strategies. Furthermore, AI could customize human interaction when it comes to business-to-business marketing by matching the most suitable salesperson to a particular client based on the data it acquires about each party.

One example that suggests a partnership between machines and humans might be the key to effective marketing in the future can be seen in the example of Udacity, an online education service for professionals. After building the company, the founder noticed some chatroom salespeople were good at selling programs...
and some were not. The data compiled from a set of chatroom transcripts was then fed into an ML algorithm, which revealed certain patterns of words and phrases that were the most successful in generating a sale. The company decided to build a bot that would advise its salespeople, urging them to try a certain phrase or suggest a specific course when customers asked common questions, but allowing the salespeople to rely on their own judgment for more obscure customer issues.25

While the possibilities of AI seem endless, there are also real concerns to be addressed alongside the field's advancement. As previously mentioned, Facebook has already faced controversy over the invasiveness of its DeepFace technology. By allowing AI access to such vast amounts of data about ourselves, are we eliminating the possibility of privacy? Whose responsibility is it to protect the privacy of individuals, or at least to inform them of the possible repercussions of putting information on the internet where it might be accessed by a form of AI? Is there such a thing as too much access to data for AI?

Some of the benefits to the automation of marketing were pointed out in this note. Are there any disadvantages?

Suggested Additional Reading


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