criteo

The Smart Marketer's Guide to

Machine Learning

Contents

Welcome to the second machine age.

For decades, the rise of machines — and what that means for humans — has been a hot topic.

Future predictions range from apocalyptic (robots will destroy the human race!) to utopian (robots will make everything about our lives better). But intelligent machines have already become an integral part of our lives, quietly inserting themselves into our daily routines. We talk to them in our homes (Alexa, what's today's forecast?), they tell us what movies we might like (thanks, Netflix), and pretty soon they'll be driving us to and fro (see you soon, Waymo).

Far from titanium skeletons with menacing red eyes, or human replicas with wires and microchips just below the surface, these machines are invisible and yet all around us — in our smart devices, powering our Google searches, and helping us to do and achieve more than ever before.

One of the most important developments that's driving the artificial intelligence (AI) boom is machine learning. Machine learning has applications far and wide, like enabling the highly personalized marketing that's possible today. Yet many haven't heard of it, or don't understand it, or even fear it.

As Marie Curie once said, "Nothing in life is to be feared, it is only to be understood."

Let's demystify machine learning and find out how it's impacting today's world, including commerce marketing.

What exactly is machine learning?

Machine Learning (ML)

mach.ine / learn.ing

Machine learning (ML) is a form of artificial intelligence (AI) that enables computers to learn without explicit programming. Instead of telling a computer everything it needs to know to complete a task, ML can enable a computer to essentially "figure it out for itself", using data to learn. The more data a computer is fed, the more it learns and the smarter it gets, improving its accuracy and ability to complete tasks over time.

Google Brain, Google's artificial intelligence research project, was one of the first to successfully use ML to identify an object — specifically an image of a cat. The research team built a neural network of 16,000 computer processors and showed it 10 million random images from YouTube as a training exercise. They then showed it 20,000 different items and found that, without being told what a cat is, the network began correctly identifying all the cat images. The important point here is that the data was unlabeled. There were no images labeled "cat", no programs explaining what a cat looks like. The system honed in on cats without ever being told to do so.

Machine learning is exciting because it makes it possible to analyze huge amounts of data and take action with a speed and precision that humans simply can't match. Like setting bids or making trades in milliseconds...or looking at 10 million pictures and identifying which ones are cats.

What's the difference between AI and ML?

AI (Artificial Intelligence)

ar·ti·fi·cial / in·tel·li·gence

The capability of a machine to imitate intelligent human behavior. AI is often broken into two groups: applied and general.

Applied AI

(sometimes referred to as Vertical AI or Narrow AI)

"Smart" systems that address a specific need, like trading stocks, or personalizing ads.

General AI

(also known as Strong AI or Full AI)

Systems or devices which can handle any task that a human being can. These are more akin to the droids depicted in sci-fi movies, and the subject of most of our conjectures about the future.

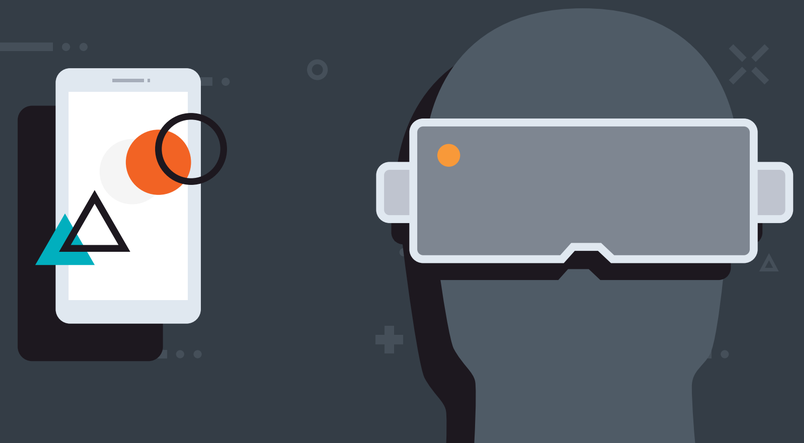
Machine Learning is a subset of AI

ML is powering much of the development in the AI field, including things like image recognition and Natural Language Processing.

Deep Learning

Deep Learning is a subset of ML and is largely responsible for the ML and AI advances we've seen over the last few years. It's also responsible for growth in augmented reality and virtual reality technologies because of its impact on image and speech recognition.

Deep Learning is the cutting-edge technology that's inspired by the structure of the human brain and uses artificial neural networks to process data similar to the way neurons do in our brains. It involves feeding massive amounts of data through the neural network to "train" the system to accurately classify the data. Today's supercomputers and the rise of Big Data have helped make Deep Learning a reality.



A note about AR and VR

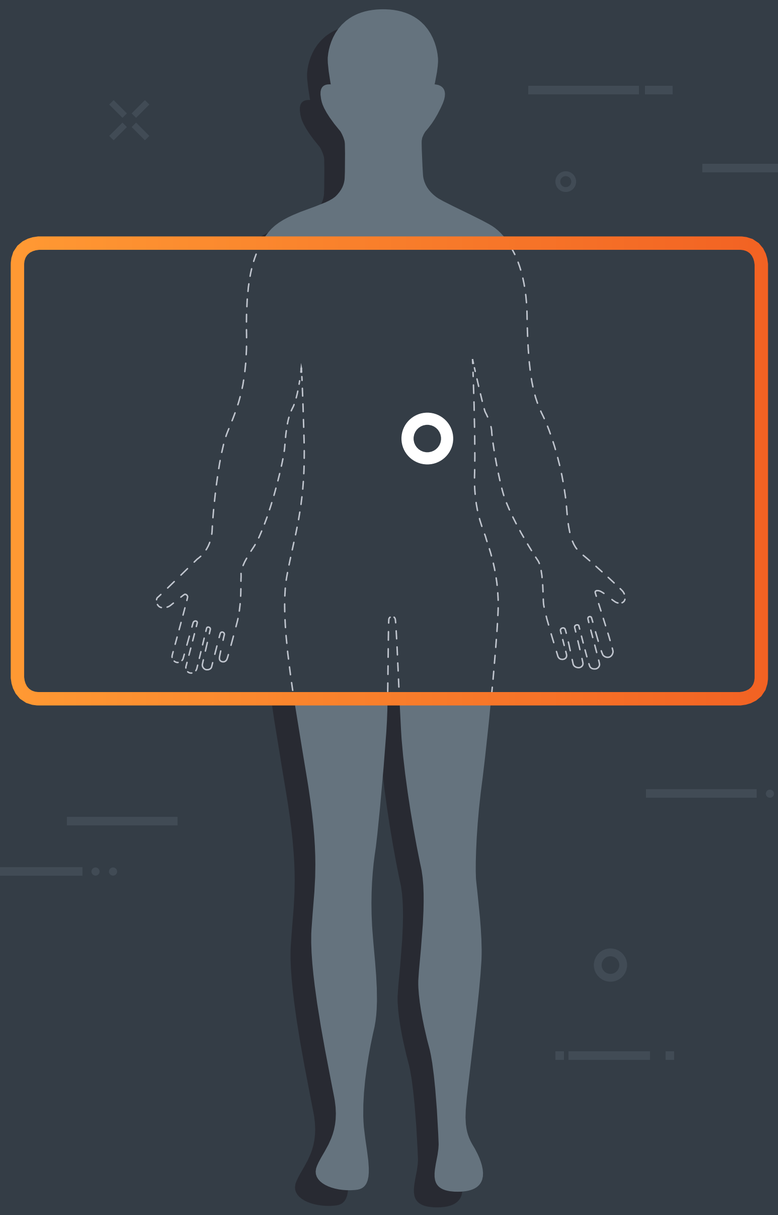
Augmented reality (AR) and virtual reality (VR) have been making a big splash in the marketing world for a few years now. These formats are more challenging to execute well, but can have a huge impact due to their more visceral, emotional nature. As far as immersive brand experiences go, nothing beats being able feel the content as if it were yours already. From trying on digital diamonds, to wandering around your potential new kitchen, look for AR and VR marketing tactics to grow even more in the future.

How's machine learning being used today?

Machine learning has been making advances in a variety of industries. Here are five of the most important uses of ML today...

Medical Diagnosis

ML systems are being used to review medical images and look for tumors, and make diagnoses from the pathology reports.[1] One study showed that a computer found 52% of the cancers as much as a year before the patients were officially diagnosed.[2]

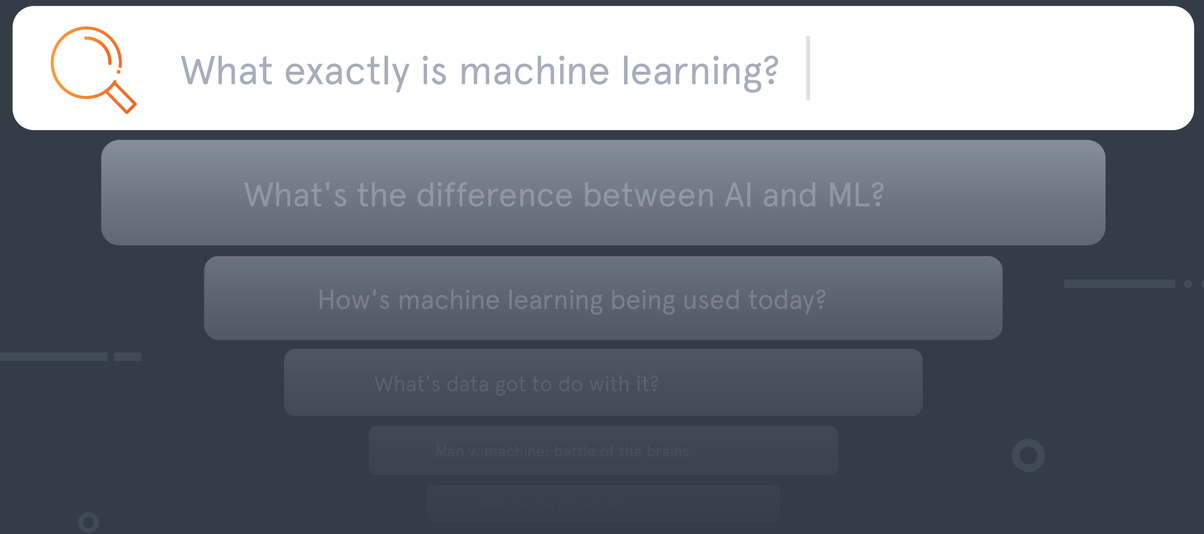


Natural Language Processing (NLP)

ML systems are getting better and better at understanding human language and responding in kind. Some applications of NLP include machine translation, speech recognition, and sentiment analysis.

Online Search

Search engines use machine learning to improve their search results, constantly learning from shoppers' behavior to deliver a better experience each time they search.

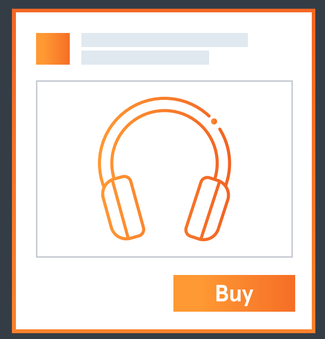


Smart Cars

These cars use ML not only to drive themselves, but to also learn about their owner's preferences and automatically adjust settings based on their likes and dislikes.

Marketing Personalization

Machine learning helps retailers analyze huge data sets about their shoppers and deliver personalized communications for each individual based on their behaviors, purchases, and preferences. As more is learned about each shopper, the system gets better at predicting the right products, the right ads, and the right bids.



What's data got to do with it?

In the machine learning world, data is everything.

Successful ML requires mountains of data to "train" the system.

Just as a human baby learns from the world around it, an ML system learns from the data it receives. The more it gets, the more it learns. In recent years, great strides have only been possible because of new technologies and a vast amount of data collection, enabling scientists to scale up in a way that wasn't feasible before.

Here's what it took for Google Brain to identify a cat:

- **16,000**
  Computer processors
- **1 Billion**
  Connections (nodes) in the artificial neural network
- **10 Million**
  YouTube videos
- **3 Days**
  of "training"

And that's still not even close to what the human brain has to work with:

- **~86 Billion**
  Neurons
- **~100 Trillion**
  Synapses

Let's look at the importance of data using a marketing personalization example.

There are typically seven creative ad elements that can be personalized: images, taglines, name, formatting, color, copy, and call to action.

There are multiple devices that ads must be formatted for (desktop, mobile, and tablet), thousands of publishers and ad exchanges, and more than a billion shoppers, each with their own preferences.

All together, that results in trillions of possible ad variations. *

No human could possibly handle that level of personalization. But machine learning can. ML systems can analyze all the data we have on shoppers, combine that with specific device requirements, publisher formats and brand guidelines, and create a totally customized ad for an individual shopper in milliseconds.

Man v. Machine: Battle of the Brains

Much has been made of the superiority of artificial intelligence. It's faster, error-free, and unbiased. But do machines really do everything better than humans?

Can machines be creative?

The arts

The short answer: No. Machines simply don't have the imagination and most importantly, the emotions that inspire truly transcendent masterpieces. Google's Project Magenta is trying to solve this problem, but the AI-created music and art are light years from what humans can create. The songs are simplistic and without feeling. The pictures are interesting, but lack a sense of purpose and so, fail to move the viewer. Empathy and unpredictability are part of what allows the human brain to ebb and flow with creativity, producing results that may be technically "imperfect" but far from superior.

Will machines make us obsolete?

Non-creative work

Naturally, as machines have advanced and automation has accelerated, some humans are worried about what that means for their occupations.

Fear Not.

It is likely that machines will take over many routine or analytical jobs. Professions that require precision, exactitude, and unfailing attention to detail are natural fits. But as above, when it comes to bringing passion and intuitive "hunch" ideas, machines will continue to play a supporting role.

This was confirmed in the Criteo-sponsored IDC white paper, "Can Machines be Creative? How Technology is Transforming Marketing Personalization and Relevance":

> Machine learning will play a larger and more pivotal role in advertising by augmenting human creativity and by providing marketing relevance through personalization at a scale that humans cannot achieve alone. *

The future will be less about losing jobs and more about redefining them.

And if some predictions are right (and we're all paid the Universal Basic Income that some Silicon Valley execs are calling for), AI will free up more time for us to think big and be creative. And the payoff can be huge.

Smart marketers will win the game...

Machine learning also removes tedious data preparation and analysis work to free up creative staff to work on creative ideas, fueled by a flow of relevant, real-time behavioral data. Creative staff will continue to provide the 'base' creative content, using machines to deliver relevant personalized communications at scale. *

...by letting machines come in for the assist.

Creative staff will still create the source content assets, and machine learning technologies will combine the creative variables into a compelling mix within an advertisement frame to maximize relevancy and encourage customer engagement. *

* "Can Machines Be Creative? How Technology is Transforming Marketing Personalization and Relevance" by IDC, sponsored by Criteo, July '17.

Machines, Man...or Together?

Find out which brain wins when it comes to handling certain jobs.

Machines

Driver

Machine-driven cars are proving to be safer. In 2016, Google's self-driving cars logged 636,000 miles and only required 124 human interventions, and a 2016 Virginia Tech Transportation Institute study reported that the crash rate for self-driving cars was lower.

Cashiers / Sales Associates

Repetitive, predictable jobs are more at risk. In 2016, a cell phone store in Tokyo was staffed entirely with robots[5], and the CEO of Taco Bell's parent company said machines could replace human workers in ten years.[6]

Man

Therapist

The emotion and relationship building required for this job are outside of AI's scope currently. Empathy is required to develop trust between therapist and patient, and this is something AI simply can't do today.

Writer, artist, musician

Creative jobs are safe...for now. Google's Project Magenta is working on using AI to create art and music, but more in a supporting role.

Together

Doctor

ML is proving to be very good at analyzing patient data and providing routine diagnoses. Humans are still needed to treat emergencies, provide complex diagnoses, and do a long list of other tasks that robots can't yet.

Marketer

ML refines personalized advertising creative content delivered over time, but it all starts with concepts and designs from us. *

What does the future hold?

Everyone has their thoughts on how AI powered by machine learning will impact our future.

If AI can help us as a society to not only save the environment, cure disease and explore the universe, but also better understand ourselves — well, that may prove one of the greatest discoveries of them all.

Demis Hassabis
Co-Founder & CEO, DeepMind

We have the opportunity in the decades ahead to make major strides in addressing the grand challenges of humanity. AI will be the pivotal technology in achieving this progress.

Ray Kurzweil
Author, Inventor, Futurist

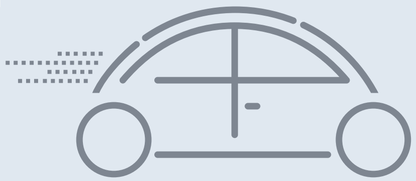
What I see is an AI first world. And for every customer ... to be able to get a whole another [sic] generation of productivity out of artificial intelligence, machine learning and deep learning.

Marc Benioff
CEO, Salesforce

There’s no question that ML and AI will continue to grow and play an ever-larger role in our lives. But how much and how soon remains to be seen.

Here's a possible timeline of what's to come thanks to ML:

Happening soon

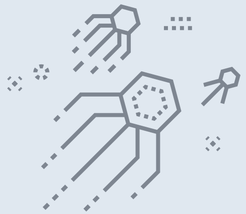


- **Your morning commute, navigated by a robot.**
  Safer, driverless cars mean less stress (no more fighting for a parking spot!).
- **Your retirement plan, mapped out by a robot.**
  The smartest investments, customized just for you.
- **Your lunch salad, tossed by a robot.**
  Finally, the perfect amount of dressing, every single time.
- **Your Sunday football game, refereed by a robot.**
  More accurate penalties and foul calls for the win.

Coming eventually

- **Your house, cleaned by Rosie the Robot.**
  Hello, floors that sparkle!
- **Your vitals, checked by a virtual doctor.**
  Looking good, Smiles Davis.
- **Scientific research, conducted by bots.**
  Who knows what discoveries lie in the mountains of data that have been compiled over the years?
- **Space and the deep ocean, explored by bots.**
  Finally, we can unlock the secrets of the last of the uncharted territories!

Happening someday...maybe



- **Your body, cured from the inside by nanobots.**
  Fewer surgeries and invasive treatments makes for happier, healthier patients.
- **Climate change, solved by AI.**
  Perhaps we won’t have to move to the moon, after all.
- **Humans and robots merge into superhuman cyborgs.**
  Will this be better...or worse? You decide.

3 Brands Using Machine Learning in Cool Ways

In today's competitive retail landscape, relevance at scale is the name of the game, and machine learning is here to win it for brands.

Machine learning technology has the ability to dig through huge data sets to uncover insights about trends, preferences, and even future predictions about what would be the next best interaction between consumers and companies.

We've picked out three brands using machine learning to better connect with shoppers. Here's how they're putting big data into action to personalize experiences across channels.

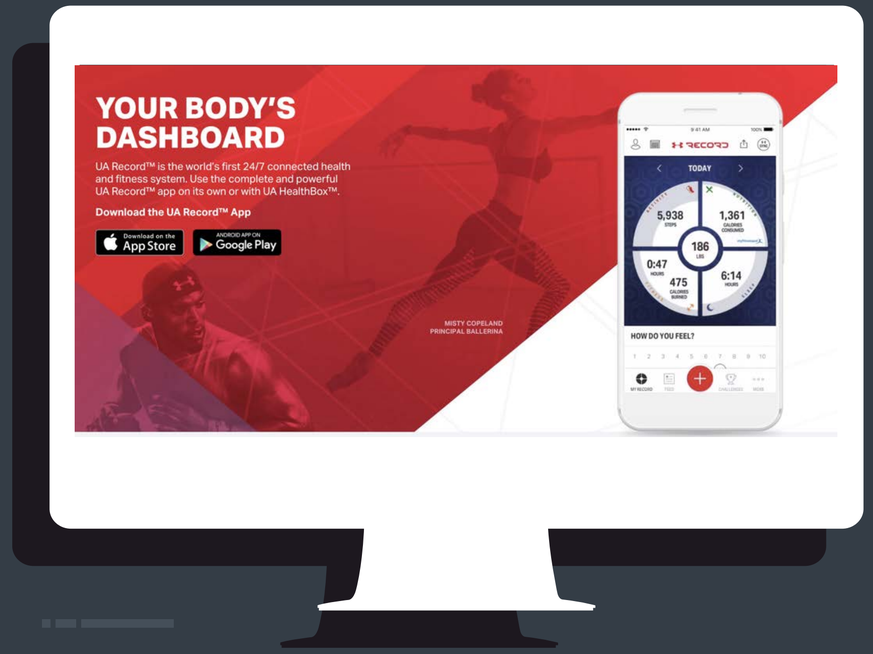
UNDER ARMOUR

Under Armour

Under Armour integrated machine learning into Record, the apparel brand's fitness app. By tracking a user's health based on data from several sources (third-party apps, smart watches, data entered by users directly, and more), the app is able to provide personalized diet and exercise advice to users.

> "It will base its coaching on the results of other people who have similar health/fitness profiles, as well as data pulled from things like nutritional databases, physiological, and behavioral data," wrote Business Insider.

The app also factors in things like steps, nutrition, sleep patterns, and workout stats, such as heart rate, pace, distance, and calorie burn.



Effectively a mobile personal trainer, the UA app is a valuable, customized resource that users can use with just a few simple taps. The more you use it, the more it gets to know you, and the better it can customize recommendations to your particular goals.

Mazda

Mazda utilized machine learning to find the right influencers to promote a new car, the CX-5, at the SXSW festival in Austin.

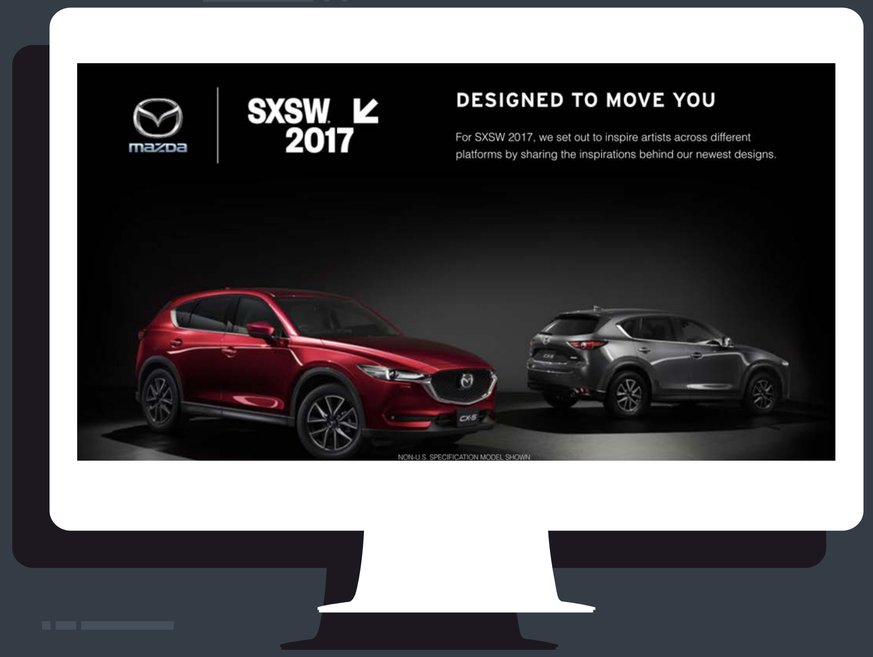
The Japanese automotive brand worked with Influential, a company that leverages IBM's Watson AI technology to identify artistic extroverts (the perfect personas to connect with the festival's fan base) on social media.

Machine learning technology scanned posts across social media networks, looking for the right people with the right indicators, such as exclamation points and emojis.

For SXSW, four people were selected to cruise around Austin in the CX-5 and hang out in a branded Mazda Studio, then post about the experience on Twitter, Instagram, and Facebook.

LEARN MORE:

Would you survive in a tech-less world? Find out with this interactive quiz.



This data-centric approach to influencer marketing allowed Mazda personalize content to better engage with a very specific crowd, one that they knew leaned more creative — given that SXSW celebrates music, film, and tech, among other innovative ideas — than a general audience segment.

The North Face

The North Face uses a digital personal assistant, Fluid's Expert Personal Shopper (XPS), to help make recommendations to online shoppers, build out profiles based on their interests, and create a personalized user experience.

XPS extends the outdoor clothing retailer's welcoming and helpful in-store reputation to the digital realm. By using machine learning, the brand can simultaneously collect data to inform website iterations and future products.

The North Face also delivers a highly personalized shopping experience called "Shop with IBM Watson" to website users.

After downloading the mobile app, shoppers can speak into their smartphones to access the technology. Just as a salesperson can help customers select the best option for their needs, this virtual assistant asks users questions, learns from their responses, and offers relevant products to satisfy their preferences.

The ROI of Machine Learning

The predictive nature of machine learning is what makes it such a powerful tool for commerce marketers. ML allows brands to use past and present customer data to project future behavior and trends.

On the sales side, machine learning models can predict the most relevant time to offer products (e.g. when a shopper is most likely to buy seasonal items).

In terms of operations, machine learning can help retailers estimate how much inventory to stock during peak sales times (like Black Friday, Cyber Monday, etc) compared to the rest of the year.

As a result, machine learning models help cut back on unnecessary spend (like wasted ad dollars and leftover products) while optimizing marketing efforts to anticipate customer needs. Taken together, this leads to increased revenue and higher profit margins for brands.

How Criteo Helps Marketers with Machine Learning

If you've made it this far, you already know what machine learning is, and how machines are learning, optimizing, and impacting more and more businesses, from the automotive industry to healthcare. And while the technology might eventually drive us to work (smart cars) and identify diseases early on (medical diagnosis), they'll never replace humans entirely.

When it comes to commerce, it's up to marketers to think carefully about how to harness machine learning capabilities to build better customer experiences.

Below, we'll unpack how the shopping journey has evolved, the key to keeping pace with consumers' rising expectations, and how Criteo technology can help you deliver the best experiences to your shoppers.

Shopping in the Past: Fewer Touchpoints, Shorter Journeys

Digital marketing has gotten crowded and complicated. Back in the early 2000s, the average consumer typically used two touch points when buying an item and only 7% used more than four. There were no smartphones, tablets, or social media. When you wanted to buy something, you would order online and wait a long time – or just go to a store.

Shopping Now and in the Future: All Omnichannel, All the Time

Today's shoppers are omnishoppers. They're browsing online and trying on in-store, or finding something in-store that they'll compare prices for online, from different devices. This means that for most marketers today, the challenges they face all come down to finding the right audience, engaging them with personalized content, and driving them back to their stores to complete a purchase.

Personalized Connections with Shoppers Hinge on Data

When it comes to personalization, machine learning enables retailers and brands to comb through and analyze huge data sets about their shoppers. From that data, the technology can help deliver customized offers to individual shoppers based on their behaviors, purchases, and preferences.

But when you only have access to limited touchpoints and data, conversions are hard to track and siloed data doesn't allow for a single view of the shopper journey. Criteo solves for these issues with Criteo Shopper Graph, the Criteo Engine, and Kinetic Design. **Let's take a look.**

Access the World's Largest Open Data Set with Criteo Shopper Graph

Most retailers and brands can't figure out where shoppers run off to after they visit them online because their data is limited — solely informed by those who've actually stopped by their site. After these shoppers leave, they become nearly impossible to track.

Criteo provides solutions for the entire shopper journey — acquisition, conversion, and re-engagement — and each is powered by three different data collectives from the Criteo Shopper Graph:

IDENTITY GRAPH

Identity Graph contains over 2 billion cross-device, same-device, and online IDs enabling the on-boarding and activation of audiences and offline transaction data.

INTEREST MAP

Driven by the analysis of over one hundred twenty shopping signals for each shopper as they browse and buy, Interest Map links shopper interest to your product catalog.

MEASUREMENT DATA

Measurement Data empowers conversions and sales tracking across retailers, including closed-loop measurement of offline sales driven by online interactions.

It doesn't matter if you don't have the same amount of data as the tech giants. Working with Criteo lets you tap into insights from a massive amount of data:

- $600+ billion in transactional sales each day
- 1.4 billion monthly shopper interactions
- 17,000+ retailer and publisher websites

Access to this pool of data can enhance analytics, attribution, website personalization, and more. Best of all, it's available at no extra fee.

Achieve Real-time Creative Optimization with the Criteo Engine

What if your ad could change in real time — according to what your shopper wanted — and predict what your shopper wanted next? That's called dynamic creative optimization, and Criteo technology can make it happen.

Criteo's Real-time Creative Optimization (RTCO) is a patent-pending machine learning technology which uses real-time contextual awareness and behavioral data from 1.4B+ monthly active shoppers to select and optimize ad creative at a granular level for each individual shopper and context.

RTCO is a component of Kinetic Design, which, along with advanced Predictive Bidding technology and Product Recommendations, forms the Criteo Engine. RTCO is fed by a machine-based brand framework which contains an advertiser's brand guidelines, creative elements, and imagery.

Once creative is selected and optimized for the shopper and context, the final ad is rendered in real-time to suit the device and available inventory. RTCO (and the Criteo Engine as a whole) benefits from continual growth of the Criteo Shopper Graph — the more data available, the better the predictions and optimizations that are made.

With proven benefits, dynamic creative optimization is a powerful marketing tool, providing an unmissable opportunity for advertisers to improve their campaigns and drive results.

Get Beautiful Performance with Kinetic Design

Criteo's Kinetic Design offering serves visually stunning ads in line with brand requirements, with the highest level of one-to-one creative personalization for individual shoppers across devices, channels, and formats. The result is increased engagement and conversion. In fact, a recent enhancement to our Kinetic Design unlocked up to 12% more sales for Criteo advertisers, giving them more design flexibility and performance.

That said, maintaining a brand's integrity and aesthetic still requires the human touch. One of the lesser-known aspects of Criteo's unique position in the marketplace is that we have a global team of 80+ designers that leverage elements of our Kinetic Design technology to produce creative that millions of shoppers click on every day.

Using Composer, a feature of Criteo's Kinetic Design technology, our team develops quality creatives that form the foundation of an expansive layout library. A suite of over 60+ foundational layouts are paired expertly with different verticals and other specific requirements. When combined with Kinetic Design's Layout Crossover feature, which combines elements from different layouts to form new ones, plus a full range of color and style options, the library expands to display up to 17 trillion potential design combinations.

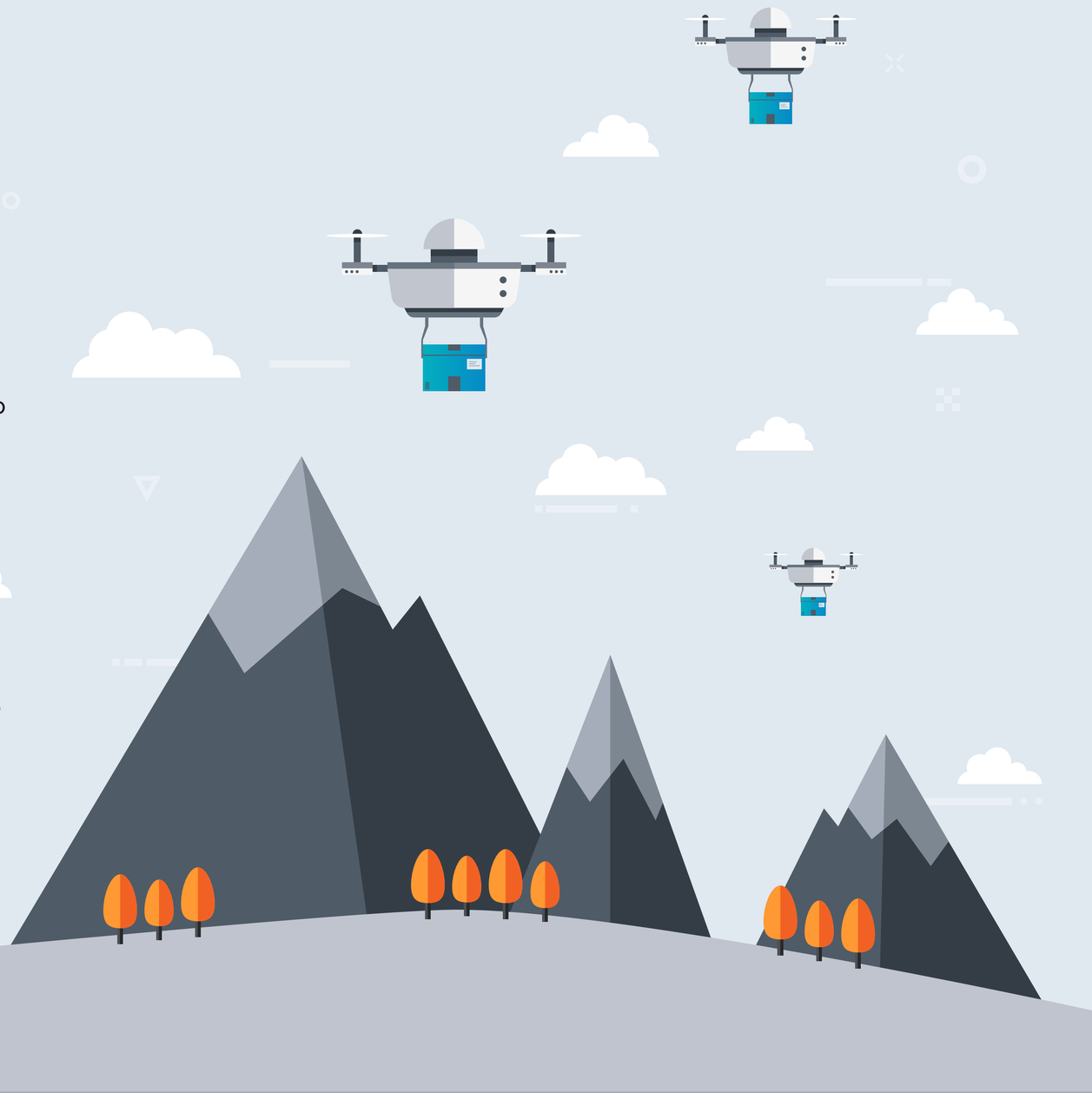
Criteo's Machine Learning for Success in Data-Driven Marketing

From producing trillions of dynamic ad variations to being able to format and personalize them across platforms in milliseconds, Criteo's cutting-edge machine learning technology can help you create campaign relevance for individual shoppers at scale, driving better engagement, deeper connections, and more brand value.

There's a lot of uncertainty around ML and AI, but if history has taught us anything, it's that humans are exceptionally good at adapting.

Machine learning should not be seen as a threat, but rather as an opportunity to create positive change. For marketers, the union of machine learning's efficiency with man's creativity is helping to create better brand experiences for shoppers at scale. Doctors can use ML to provide better care for their patients, scientists can use it to make new discoveries, communities can use it to solve problems—and that's only scratching the surface.

TLDR:
It's gonna be OK. Maybe even better than before.



Congratulations! You've mastered the basics of machine learning.

Ready for more?

Check out Criteo's industry reports and Criteo Insights for the latest research, reports, and guides.

About Criteo

To learn more about how Criteo drives sales and profits for thousands of brands, retailers, and publishers worldwide, visit Criteo.com/about.

* "Can Machines Be Creative? How Technology is Transforming Marketing Personalization and Relevance" by IDC, sponsored by Criteo, July '17.

[1] https://www.nytimes.com/2016/12/14/magazine/the-great-ai-awakening.html

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