



BLUELIFE  
LEVERAGE THE POWER OF AI

# Reinforcement Learning

*Executive Briefing*



WHAT IS REINFORCEMENT  
LEARNING

# Welcome to the course!

Reinforcement Learning is an extremely powerful exponential technology which has helped companies gain the upper hand in a huge variety of situations – from Google cutting down their electricity bill by 40%, to Alibaba increasing their advertising ROI by 240%!

In this short Executive Briefing course, you will get a bird's eye view of the field of Reinforcement Learning, understand how it works and why it's one of the most disruptive technologies which can take **operations, marketing** and even **innovation** to the next level.

**And all of that under 30 minutes!**

Then come on in, and let's tackle Reinforcement Learning!

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# Introduction to the course

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# Welcome to this Executive Briefing course

an incredibly important area of Artificial Intelligence (AI).

Here's how this course is structured :

1

During the first part of the course, we will learn what RL is, especially in relation to other areas of Machine Learning (ML) like Supervised and Unsupervised Learning.

2

Then, we will compare it to how humans learn and discover some fascinating similarities.

3

Next, we will find out about the advantages of RL.

4

Then we will dive into a specific area where it's making a huge splash: Marketing.

5

Then we will dive into a specific area where it's making a huge splash: Marketing.

6

After that's done, we will consider 10 practical examples of companies using RL to gain real, tangible results.

As you can tell, I'm excited about this  
**so let's get started!**

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# 01

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## What is Reinforcement Learning?

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**There are three main groups of algorithms in ML:**  
**Unsupervised Learning, Supervised Learning and Reinforce RL.**  
**It can be valuable to appreciate the differences:**

### Unsupervised Learning

is used for discovery of new patterns. For example, clustering of customers into groups based on their similarities.

The core principle here is that the resulting groups did not exist prior, but rather are suggested by the machine in the process.

### Supervised Learning

is when we teach a machine to search and identify patterns that we have seen before. For example, classification of pictures of dogs and cats into the two categories “dogs” and “cats”.

First, we show the algorithm thousands of already labelled images so it can extract features that are essential to dogs and features that are essential to cats. After this the algorithm will be able to categorise new images as either of “dogs” or of “cats”. The difference of this approach to unsupervised learning is that we have to first provide the labelled data for the algorithm to learn.

### Reinforcement Learning ( RL )

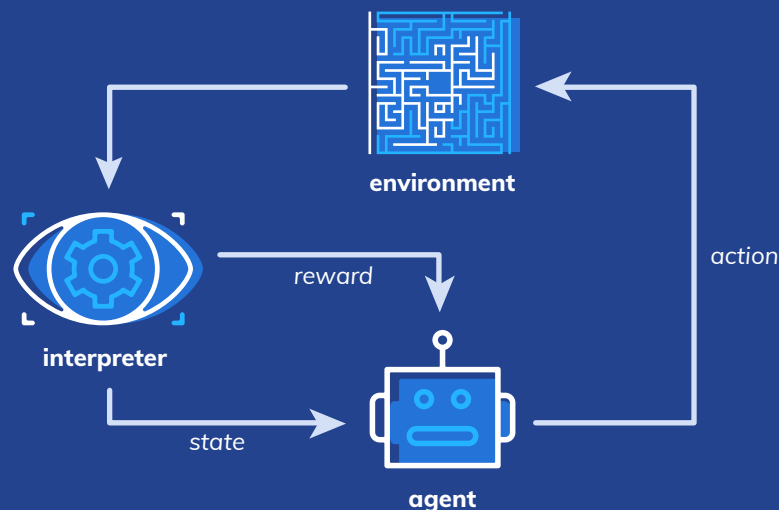
is something entirely different. RL is an area of ML where an imaginary agent is being presented with a problem and is being rewarded with a “+1” for finding a solution to the problem or punished with a “-1” for not finding a solution.

Unlike with Supervised Learning, the agent is not given instructions on how to perform the task. Instead, it performs random actions and interacts with its environment. It learns through trial and error which actions are good and which actions are bad.

An example of this is how robots learn to walk.

Some robots are pre-programmed how to walk, however the more recent models master this skill through RL. They don’t have a pre-set if/else rule-based algorithm. Instead, they have a reward system built into them which gives them positive rewards when they take a step forward maintaining balance and a negative reward when they fall over. That way, by exploring different possible actions that are available to it, the robot dog can learn how to walk forward.

In fact, this method can not only teach robots how to walk, it can even teach robots how to play soccer!



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# Reinforcement Learning in Humans

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## RL is surprisingly similar to real life

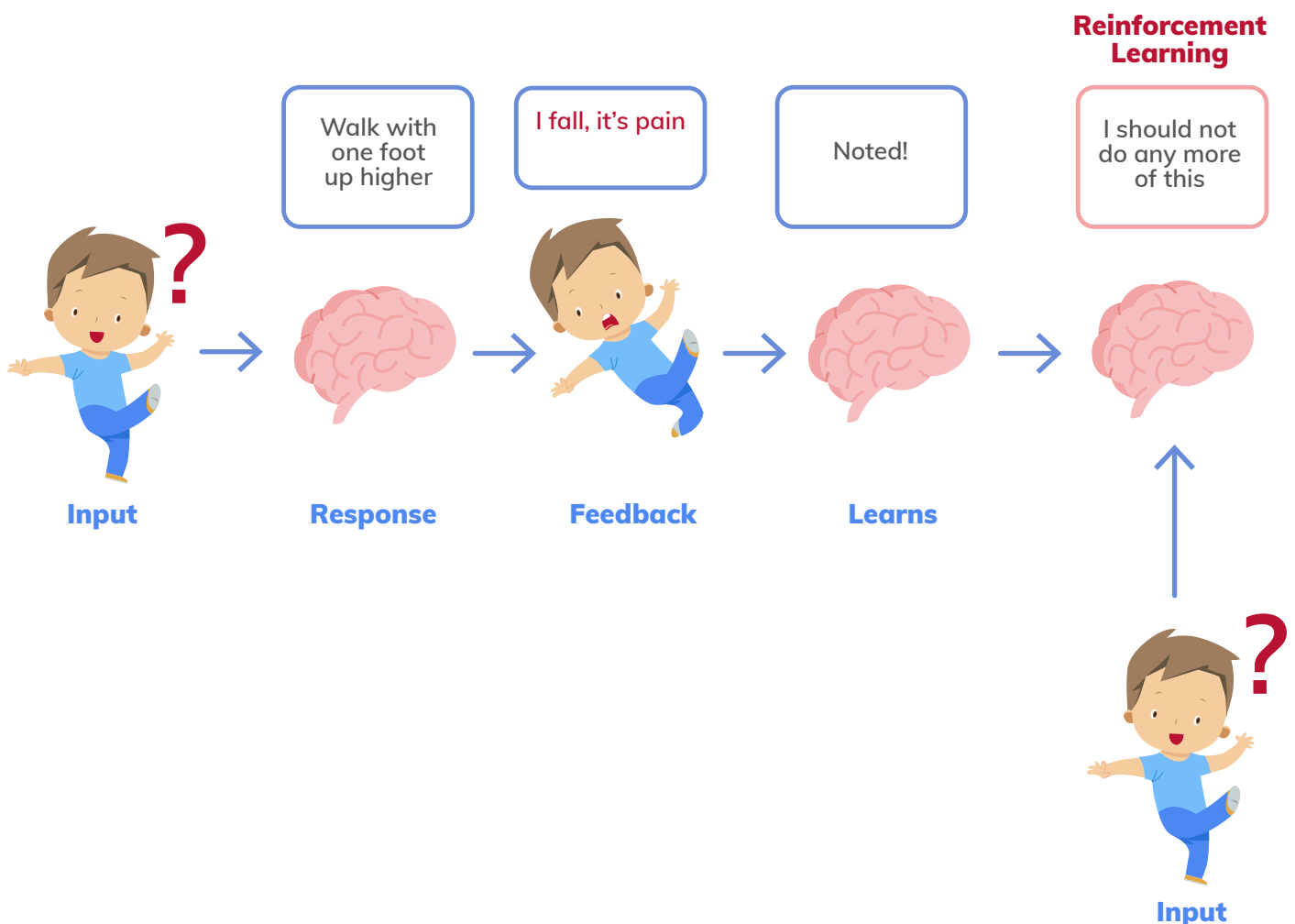
We, humans, use it all the time. Take for example when a baby learns to walk. When it first begins to learn to walk, it falls over, it hurts itself and its nervous system sends a pain signal into the brain. Pain is a concept that is generated inside our body. It doesn't exist outside of our minds – it's nothing more than an electrical signal in your brain.

It's something that your brain made up for you to train you to not fall over more. So when a baby falls over, it gets feedback from the environment, which is incorporated into the algorithm which is in its brain, and it turns it into pain and the baby learns:

*"I should not do any more of that. That action which I did of putting my right foot on my bum or something while standing on my left foot leads to falling over, leads to pain, so I'm not going to do any more of that."*

On the other hand, if the baby manages to take a few steps forward and grabs a shiny object this leads to a positive emotion – for example, joy. Joy is a positive reward in the baby's brain, so it learns to do more of those kinds of steps that lead to this result.

RL is based on exactly the same principles, and because of that – because it is so similar to the way our own intelligence works – out of all existing algorithms, RL is the closest we have gotten to true AI.



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# Advantages of Reinforcement Learning

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Recently, I interviewed John Lanford who works at Microsoft Research and, with over 50 published research papers, is recognized as one of the world's leading researchers in the space of RL.

You can find this interview in :  
[episode number 275 of the SuperDataScience podcast.](#)



One of my most exciting takeaways from the conversation with John is that RL is the future of ML. Why? Here's a quote from John:



*There are many situations where you just can't label data effectively, you have to learn from rewards.*



And, since Supervised Learning relies on large labelled datasets, RL has a much higher scope of application than any form of Supervised Learning.

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That is **the number one advantage of RL: It doesn't require large labelled datasets.**

This is a huge advantage because, as the amount of data in the world grows, it is becoming ever more costly to label it for all required applications.

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**The second advantage: RL is innovative.** Supervised Learning is where the algorithm learns to imitate whoever provided the data set. The algorithm can learn to do the task as well as (or better than) the teacher but can never learn a completely new approach to solving the problem. On the other hand, RL algorithms can come up with entirely new solutions that were never even considered by humans.

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**The third advantage: RL is bias-resistant.** If there's bias in the way the data is labelled, Supervised Learning algorithms will pick it up. In this sense, RL algorithms are better tools to find solutions free from bias or discrimination.

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**The fourth advantage: On-line learning.** RL runs in real-time. RL combines exploration (when the machine tests new approaches on the fly to find better solutions) and exploitation (when the machine exploits the best solutions which it has already found). This means that it can bring results while improving at the same time. Other algorithms would require re-training and re-deployment. RL just keeps going.

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**The fifth advantage: RL is goal-oriented.** RL can be used for a sequence of actions. While Supervised Learning is mostly used in an input->output manner, RL can be used for tasks with objectives – such as robots playing soccer or self-driving cars getting to their destinations.

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## Reinforcement Learning in Marketing: 5 Applications

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**Because of its  
“on-line learning”  
advantage – the ability to  
auto-correct on the fly –  
RL’s most popular current  
business application is,  
perhaps, within marketing.**

Virtually any business could benefit from cutting-edge tech in its marketing and that’s why in this video we will look into 5 examples of how RL will revolutionize the way we do marketing. Even if you don’t apply these methods right away, they are a great set of tools to keep in the back of your mind for the future.

### **Use-Case #1 CREATING PERSONALIZED**

RL can dynamically take into account customers’ specific preferences, needs, and behaviour to ensure they get high-quality recommendations that resonate with them. This is, effectively, like a recommender engine which you would find at Netflix but with the added benefit that it can learn real-time and adjust its recommendations in real-time based on the success it’s having.

This might not be as relevant in the case of Netflix, where the environment is less dynamic – what shows are available, and what people watch doesn’t drastically change from day-to-day. However, it is very relevant in e-commerce, where thousands of new items are appearing every hour and hundreds of thousands of customers are shopping every day. That’s why Alibaba is already trialling these methods.

### **Use-Case #2 OPTIMIZING ADVERTISING BUDGETS**

Understanding which advertisements bring the best ROI is incredibly complex, often impossible to achieve with conventional means. Not only are you trying to cross-reference effectiveness data with various factors that influence each individual customer, you’re also trying to do that in real-time, constantly.

Once again, we see Alibaba leading the field, using RL to optimise advertising bids. The algorithm matches known user preferences and the context of the advertisement to rank each advertising slot and determine the optimal bid.

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### **Use-Case #3 SELECTING THE BEST CONTENT FOR ADVERTISEMENTS**

RL blows A-B testing out-of-the water! A-B testing is static – you have to wait until the end of the test to see the results. Whereas RL works on-the-fly, which means that it can find the most optimal content much quicker and start showing it to customers sooner. This minimizes the amount of times non-optimal content is displayed, thereby maximizing revenue.

That's one of the reasons why Baidu, the Chinese equivalent to Google, deployed a deep RL algorithm, called Moonrise which lead to significant improvements in search relevance and ad performance.

### **Use-Case #5 PREDICTING CUSTOMERS' RESPONSES TO PRICE PLAN CHANGES**

By using inverse RL we can observe consumer behaviour and estimate what their reward function looks like. In other words, what goals are they pursuing when shopping:  
are they trying to save money or buy the high-end brands?  
What quality / price ratio is the optimal for them?  
What level of service do they find optimal?  
What features are most desirable?  
Once this information is obtained the company can use it to innovate its product or marketing.

### **Use-Case #4 INCREASING CUSTOMER LIFETIME VALUE**

RL allows a company to focus on optimising the lifetime value of a customer, rather than on short-term revenue results. Adobe researchers proposed an algorithm to display personalised ads to existing customers.

The algorithm can analyse the customer's perceived preferences to ensure they aren't overwhelmed by advertisements for services they don't need. While that might have increased the number of clicks in the short term, this comprehensive approach nurtures a customer and maximises their lifetime value.



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## 5 – 10 Use-Cases – with Real Results



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## Google, AlphaGO

Try out open source software such as R and Python, and leverage these publicly available tools to gain momentum in your Machine Learning practice.

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## Google, Energy management

Google implemented Deep Mind's system of neural networks trained on different operating scenarios and parameters to reduce the amount of energy they use for cooling their server centre by up to 40%.

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As we have discussed, marketing is one of the most common applications of RL in today's business world, and the following examples show tangible results from this world :

## Decision Service, Advertising

Decision Service – is a contextual learning service to improve existing advertising systems. It uses RL to achieve a click-through rate improvement of 25-30%, and a revenue lift of 18%.

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## Trendyol, Email advertising

Trendyol – is an email automation tool that distinguishes which messages will be most relevant to which customers. With the help of RL they were able to achieve 30% lift in click-through rates, 62% lift in response rates, 130% lift in conversion rates.

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## Alibaba, Display ad bidding advertising

As discussed in the previous section, Alibaba developed a system to quantify how likely a customer is to click on a particular ad, based on their preferences, the context, and the ad itself. This ability to calculate how much each advertisement is worth allowed them to increase ROI by 240% without increasing the advertising budget.

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## ELECTA, Energy management

Scientists from ELECTA, the largest research group on electrical energy systems in the Benelux, developed an RL system to optimise hot water control systems. Applying the system to a set of 32 houses, it reduced energy consumption by around 20% with no loss of comfort reported by the occupants.

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## Fanuc + Tesla, Manufacturing

Robotics giant Fanuc develops robots that quickly learn to perform new tasks, including sorting products or delivering them to the right place or person. That might sound boring, but Tesla uses 160 of them in their factory. Using RL, these robots can achieve 90% accuracy on new tasks overnight – almost the same as if an expert were to program it.

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## Unnamed company, Inventory management

Inventory management is a delicate process of seeking the balance between keeping enough stock in the warehouse to ensure the business keeps moving and making sure the stock doesn't drain the business of its cash reserves. An unnamed company that incorporated a RL-powered inventory management system saw a 32% reduction in costs across the operation.

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## Cambridge University, Healthcare

Due to the nature of the field, AI has mostly entered healthcare in the form of supervised learning, intending to replicate the work of medical professionals as closely as possible. However, recent work with RL has shown that it's possible to improve on the existing methods. Researchers from Cambridge developed a RL algorithm that improves treatment policies for patients with sepsis.

Right now, we might find it difficult to follow the recommendation of a computer program over that of a doctor, these algorithms are already proven to be more accurate than doctors and will soon be saving lives.

## Tesla + Google + others, Self-driving cars

One of the most hyped-up areas where RL is bound to make a big splash is enabling self-driving cars. With Tesla, Google and other major players entering the arena, it is predicted that by 2040, 95% of all new vehicles sold will be fully autonomous.

Not only is this an enormous market, it will help dramatically improve our quality of life – we currently spend 3 years of our lives in transit and 1.25 million lives are lost every year due to traffic accidents. Accidents which can largely be avoided by a powerful algorithm that doesn't get tired, doesn't make mistakes, sees everything and reacts in milliseconds.

So, there we go – those were our 10 examples of real-world applications of RL that have brought real, tangible results. I hope that you found this useful and hopefully it inspires some ideas about how you can use RL in your business to get ahead in your industry.

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Recap

**Congratulations** on making it to the end of this course and learning about this amazing technology! Let's recap what we have discussed:

- 1 We learned what Reinforcement Learning is and how it compares to supervised, unsupervised, and even human learning patterns.
- 2 We then discovered the numerous advantages Reinforcement Learning has over other types of learning.
- 3 Then we learned about how it's making a huge splash in marketing, which is a natural fit for the technology.
- 4 Finally, we saw 10 use cases where Reinforcement Learning allowed a company to make an incredible leap forward, either in terms of revenue, savings, reach, or even saving human lives.

So, there we go, I hope you enjoyed this journey into the World of Reinforcement Learning.

If you would like to learn more about our work, you can find us at [www.bluelife.ai](http://www.bluelife.ai) – and I look forward to seeing you inside our other Executive Briefing courses where we deconstruct exponential technologies in under 30 minutes.

# Hungry for **more**?

Find us at [www.bluelife.ai](http://www.bluelife.ai),  
where you can join us on our other courses  
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