Introduction

- 1 minute

Introduction

Nowadays, we?re inundated with reports of cyberattacks and their ramifications. We hear about attacks on global supply chains that have major economic consequences. Almost routinely, we find out that cybercriminals have stolen the personal information of millions of consumers through platforms used on a daily basis. Sometimes, we even hear about vital government and health services being blocked and extorted for ransom.

Introduction

Cyberattacks continuously evolve. Cybersecurity is an important, expanding field in a world where companies and institutions are racing to move and maintain their businesses online. Throughout this module, you'll get a foundational understanding of basic cybersecurity concepts.

Introduction

By the end of this module, you'll be able to:

Introduction

- Describe the basic threat landscape.

- Describe different types of malware.

- Describe basic mitigation strategies.

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Describe what is cybersecurity

- 3 minutes

Describe what is cybersecurity

People, organizations, and governments are routinely falling victim to cyberattacks. We constantly hear references to concepts like cybersecurity, cyberattacks, cybercriminals, and more. This can all sound daunting and difficult to grasp. To protect yourself and those around you, you'll need to have a basic understanding of these concepts.

What is a cyberattack?

A cyberattack is commonly defined as an attempt to gain illegal access to a computer or computer system to cause damage or harm. But only thinking of computers or computer systems, in a traditional sense, is limiting. The reality is that a cyberattack can occur on almost any modern digital device. The impact can range from an inconvenience for an individual to global economic and social disruption.

What is a cyberattack?

An attacker can use people, computers, phones, applications, messages, and system processes to carry out an attack. Individuals, organizations, institutions, and governments can be victims of an attack. These attackers might:

What is a cyberattack?

- Lock data and processes, and demand a ransom.

- Remove vital information to cause serious harm.

- Steal information.

- Publicly expose private information.

- Stop vital business processes and systems from running, to cause disruption and malfunction.

What is a cyberattack?

With cyberattacks continuously evolving, it's important for you to remember that attackers don't exclusively need a computer to carry out an attack. Also, attacks can vary widely in their nature and scope. Any digitally connected device or entity can be used as part of an attack, or be subject to an attack.

What is a cybercriminal?

A cybercriminal is anyone who carries out a cyberattack. Cybercriminals can be:

What is a cybercriminal?

- A single person or a group of people.

- An organization for hire.

- A government entity.

What is a cybercriminal?

Cybercriminals can be located anywhere, including embedded inside an organization or institution, to cause damage from within.

What is cybersecurity?

Cybersecurity refers to technologies, processes, and training that help protect systems, networks, programs, and data from cyberattacks, damage, and unauthorized access. Cybersecurity enables you to achieve the following goals:

What is cybersecurity?

What is cybersecurity?

- Confidentiality: Information should only be visible to the right people.
- Integrity: Information should only be changed by the right people or processes.
- Availability: Information should be visible and accessible whenever needed.

What is cybersecurity?

This is commonly referred to as theConfidentiality, Integrity, Availability(CIA) model in the context of cybersecurity. Throughout the rest of this module, you'll learn about the types of attacks that cybercriminals use to disrupt these goals, and cause harm. You'll also see some basic threat mitigation strategies.

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Describe the threat landscape

- 7 minutes

Describe the threat landscape

You've now learned about cyberattacks, cybercriminals, and cybersecurity. But you'll also need to understand the means cybercriminals can use to carry out attacks and achieve their aims. To do this, you'll learn about concepts like the threat landscape, attack vectors, security breaches, and more.

What is the threat landscape?

Whether an organization is large or small, the entirety of the digital landscape with which it interacts represents an entry point for a cyberattack. These can include:

What is the threat landscape?

- Email accounts
- Social media accounts
- Mobile devices
- The organization's technology infrastructure
- Cloud services
- People

What is the threat landscape?

Collectively, these are referred to as the threat landscape. Notice that the threat landscape can cover more than just computers and mobile phones. It can include any elements that are owned or managed by an organization, or some that are not. As you'll learn next, criminals will use any means they can to mount and carry out an attack.

What are attack vectors?

An attack vector is an entry point or route for an attacker to gain access to a system.

What are attack vectors?

What are attack vectors?

Email is perhaps the most common attack vector. Cybercriminals will send seemingly legitimate emails that result in users taking action. This might include downloading a file, or selecting a link that will compromise their device. Another common attack vector is through wireless networks. Bad actors will often tap into unsecured wireless networks at airports or coffee shops, looking for vulnerabilities in the devices of users who access the wireless network. Monitoring social media accounts, or even accessing devices that are left unsecured, are other commonly used routes for cyberattacks. However, you should know that attackers don?t need to rely on any of these. They can use a variety of less obvious attack vectors. Here are some examples:

What are attack vectors?

- Removable media. An attacker can use media such as USB drives, smart cables, storage cards, and more to compromise a device. For example, attackers might load malicious code into USB devices that are subsequently provided to users as a free gift, or left in public spaces to be found. When they're plugged in, the damage is done.
- Browser. Attackers can use malicious websites or browser extensions to get users to download malicious software on their devices, or change a user's browser settings. The device can then become compromised, providing an entry point to the wider system or network.
- Cloud services. Organizations rely more and more on cloud services for day-to-day business and processes. Attackers can compromise poorly secured resources or services in the cloud. For example, an attacker could compromise an account in a cloud service, and gain control of any resources or services accessible to that account. They could also gain access to another account with even more permissions.

- Insiders. The employees of an organization can serve as an attack vector in a cyberattack, whether intentionally or not. An employee might become the victim of a cybercriminal who impersonates them as a person of authority to gain unauthorized access to a system. This is a form of social engineering attack. In this scenario, the employee serves as an unintentional attack vector. In some cases, however, an employee with authorized access may use it to intentionally steal or cause harm.

What are security breaches?

Any attack that results in someone gaining unauthorized access to devices, services, or networks is considered a security breach. Imagine a security breach as similar to a break-in where an intruder (attacker) successfully breaks into a building (a device, application, or network).

What are security breaches?

Security breaches come in different forms, including the following:

Social engineering attacks

It's common to think about security breaches as exploiting some flaw or vulnerability in a technology service or piece of equipment. Likewise, you might believe that security breaches only happen because of vulnerabilities in technology. But that?s not the case. Attackers can use social engineering attacks to exploit or manipulate users into granting them unauthorized access to a system.

Social engineering attacks

In social engineering, impersonation attacks happen when an unauthorized user (the attacker), aims to gain the trust of an authorized user by posing as a person of authority to access a system from some nefarious activity. For example, a cybercriminal might pretend to be a support engineer to trick a user into revealing their password to access an organization?s systems.

Browser attacks

Whether on a desktop, laptop, or phone, browsers are an important access tool for the internet. Security vulnerabilities in a browser can have a significant impact because of their pervasiveness. For example, suppose a user is working on an important project with a looming deadline. They want to figure out how to solve a particular problem for their project. They find a website that they believe will provide a solution.

Browser attacks

The website asks the user to make some changes to their browser settings so they can install an add-on. The user follows the instructions on the website. Unknown to them, the browser is now compromised. This is a browser modifier attack, one of many different types used by cybercriminals. An attacker can now use the browser to steal information, monitor user behavior, or compromise a device.

Password attacks

A password attack is when someone attempts to use authentication for a password-protected account to gain unauthorized access to a device or system. Attackers often use software to speed up the process of cracking and guessing passwords. For example, suppose an attacker has somehow discovered someone's username for their work account.

Password attacks

The attacker then tries a vast number of possible password combinations to access the user?s account. The password only has to be correct once for the attacker to get access. This is known as a brute force attack and is one of many ways in which a cybercriminal can use password attacks.

What are data breaches?

A data breach is when an attacker successfully gains access or control of data. Using the intruder example, this would be similar to that person getting access to, or stealing, vital documents and information inside the building:

What are data breaches?

What are data breaches?

When an attacker achieves a security breach, they'll often want to target data, because it represents vital information. Poor data security can lead to an attacker gaining access and control of data. This can lead to serious consequences for the victim, whether that is a person, organization, or even a government. This is because the victim's data could be abused in many ways. For example, it can be held as ransom or used to cause financial or reputational harm.

Describe malware

- 4 minutes

Describe malware

You've heard about terms like malware, viruses, worms, and so on. But what do these things mean? Is a virus a worm? Exactly what does malware do? These are just some of the basic concepts you?ll learn about in this unit.

What is malware?

Malware comes from the combination of the words malicious and software. It?s a piece of software used by cybercriminals to infect systems and carry out actions that will cause harm. This could include stealing data or disrupting normal usage and processes.

What is malware?

Malware has two main components:

What is malware?

- Propagation mechanism

- Payload

What is a propagation mechanism?

Propagation is how the malware spreads itself across one or more systems. Here are a few examples of common propagation techniques:

What is a propagation mechanism?

Virus

Most of us are already familiar with this term. But what does it actually mean? First, let?s think about viruses in nontechnical terms. In biology, for example, a virus enters the human body, and once inside, can spread and cause harm. Technology-based viruses depend on some means of entry, specifically a user action, to get into a system. For example, a user might download a file or plug in a USB device that contains the virus, and contaminates the system. You now have a security breach.

Worm

In contrast to a virus, a worm doesn't need any user action to spread itself across systems. Instead, a worm causes damage by finding vulnerable systems it can exploit. Once inside, the worm can spread to other connected systems. For example, a worm might infect a device by exploiting a vulnerability in an application that runs on it. The worm can then spread across other devices in the same network and other connected networks.

Trojan

A trojan horse attack gets its name from classical history, where soldiers hid inside a wooden horse that was presented as a gift to the Trojans. When the Trojans brought the wooden horse into their city, the soldiers emerged from hiding and attacked. In the context of cybersecurity, a trojan is a type of malware that pretends to be a genuine piece of software. When a user installs the program, it can pretend to be working as advertised, but the program also secretly performs malicious actions such as stealing information.

What is a payload?

The payload is the action that a piece of malware performs on an infected device or system. Here are some common types of payload:

What is a payload?

- Ransomwareis a payload that locks systems or data until the victim has paid a ransom. Suppose there's an unidentified vulnerability in a network of connected devices. A cybercriminal can exploit this to access and then encrypt all files across this network. The attacker then demands a ransom in return for decrypting the files. They might threaten to remove all of the files if the ransom hasn't been paid by a set deadline.
- Spywareis a type of payload that spies on a device or system. For example, the malware may install keyboard scanning software on a user's device, collect password details, and transmit them back to the attacker, all without the user's knowledge.

- Backdoors: A backdoor is a payload that enables a cybercriminal to exploit a vulnerability in a system or device to bypass existing security measures and cause harm. Imagine that a cybercriminal infiltrates a software developing company and leaves some code that allows them to carry out attacks. This becomes a backdoor that the cybercriminal could use to hack into the application, the device it's running on, and even the organization's and customers' networks and systems.
- Botnetis a type of payload that joins a computer, server, or another device to a network of similarly infected devices that can be controlled remotely to carry out some nefarious action. A common application of botnet malware is crypto-mining (often referred to as crypto-mining malware). In this case, the malware connects a device to a botnet that consumes the device's computing power to mine or generate cryptocurrencies. A user might notice their computer is running slower than normal and getting worse by the day.

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Describe basic mitigation strategies

- 4 minutes

Describe basic mitigation strategies

You've learned that there are many different types of cyberattack. But how do you defend your organization against cybercriminals? There are several different ways that you can keep cyberattackers at bay, from multifactor authentication to improved browser security, and by informing and educating users.

What is a mitigation strategy?

A mitigation strategy is a measure or collection of steps that an organization takes to prevent or defend against a cyberattack. This is usually done by implementing technological and organizational policies and processes designed to protect against attacks. Here are some of the many different mitigation strategies available to an organization:

Multifactor authentication

Traditionally, if someone's password or username is compromised, this allows a cybercriminal to gain control of the account. But multifactor authentication was introduced to combat this.

Multifactor authentication

Multifactor authentication works by requiring a user to provide multiple forms of identification to verify that they are who they claim to be. The most common form of identification used to verify or authenticate a user is a password. This represents something the user knows.

Multifactor authentication

Two other authentication methods provide something the useris, such as a fingerprint or retinal scan (a biometric form of authentication), or provide something the userhas, such as a phone, hardware key, or other trusted device. Multifactor authentication employs two or more of these forms of proof to verify a valid user.

Multifactor authentication

For example, a bank might require a user to provide security codes sent to their mobile device, in addition to their username and password, to access their online account.

Browser security

We all rely on browsers to access the internet to work and carry out our daily tasks. As you've learned earlier, attackers can compromise poorly secured browsers. A user might download a malicious file or install a malicious add-on that can compromise the browser, the device and even propagate itself into an organization's systems. Organizations can protect against these types of attacks by implementing security policies that:

Browser security

- Prevent the installation of unauthorized browser extensions or add-ons.
- Only allow permitted browsers to be installed on devices.
- Block certain sites using web content filters.
- Keep browsers up to date.

Educate users

Social engineering attacks rely on the vulnerabilities of humans to cause harm. Organizations can defend against social engineering attacks by educating their staff. Users should learn how to recognize malicious content they receive or encounter, and know what to do when they spot something suspicious. For example, organizations can teach users to:

Educate users

- Identify suspicious elements in a message.
- Never respond to external requests for personal information.

- Lock devices when they're not in use.

- Only store, share, and remove data according to the organization's policies.

Threat intelligence

The threat landscape can be vast. Organizations might have many attack vectors that are all possible targets for cybercriminals. This means that organizations need to take as many measures as possible to monitor, prevent, defend against attacks, and even identify possible vulnerabilities before cybercriminals use them to carry out attacks. In short, they need to use threat intelligence.

Threat intelligence

Threat intelligence enables an organization to collect systems information, details about vulnerabilities, information on attacks, and more. Based on its understanding of this information, the organization can then implement policies for security, devices, user access, and more, to defend against cyberattacks. The collection of information to gain insights, and respond to cyberattacks, is known as threat intelligence.

Threat intelligence

Organizations can use technological solutions to implement threat intelligence across their systems. These are often threat intelligent solutions that can automatically collect information, and even hunt and respond to attacks and vulnerabilities.

Threat intelligence

These are just some of the mitigation strategies that organizations can take to protect against cyberattacks. Mitigation strategies enable an organization to take a robust approach to cybersecurity. This will ultimately protect the confidentiality, integrity, and availability of information.

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Knowledge check

- 1 minute

Knowledge check

Choose the best response for each of the questions below.

Check your knowledge

What are the three goals of cybersecurity?

Check your knowledge

Conformity, identity, and authorization.

Check your knowledge

Confidentiality, integrity, and availability.

Check your knowledge

Confidentiality, identity, authorization.

Check your knowledge

Which type of attack employs malicious websites or browser extensions to get users to download malicious software on their devices, or change a user's browser settings, providing an entry point to the wider system or network.

Check your knowledge

Social Engineering.

Check your knowledge

Browser.

Check your knowledge

Password.

Check your knowledge

Which mitigation strategy uses the principle of something the user is and has?

Check your knowledge

Threat intelligence.

Check your knowledge

Browser security.

Check your knowledge

Multifactor authentication.

Check your knowledge

You must answer all questions before checking your work.

Check your knowledge

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Summary and resources

- 1 minute

Summary and resources

In this module, you've learned about concepts like cyberattacks, cybersecurity, the threat landscape, and malware. You've also seen how to mitigate against cyberattacks.

Summary and resources

You've learned that cybercriminals use cyberattacks to gain illegal access to, or control over, devices, systems, and data. They can then compromise the confidentiality, integrity, or availability of information (the CIA model).

Summary and resources

Also, you've seen that cybersecurity is how you protect and maintain the confidentiality, integrity, and availability of information. This is because cybersecurity enables you to implement mitigation strategies that you can use to protect against cyberattacks.

Summary and resources

Now you've completed this module, you should be able to:

Summary and resources

- Describe the basic threat landscape.
- Describe different types of malware.
- Describe basic mitigation strategies.

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Tableau Tutorial

Tableau is a data visualization tool or business intelligence tool which analyzes and shows data in a chart or report fastly. It is very easy to use, because it does not require any programming skill.

Tableau Tutorial

Our Tableau Tutorial includes all topics of Tableau such as What is Tableau, introduction, history, applications, advantages and disadvantages, tools, working, architecture, versions, desktop workspace, navigation, data sorting, sort data, replacing data source, data connection with database, alternatives, visualizations, filter data in tableau etc.

Prerequisite

To learn Tableau, you must have the basic knowledge of HTML and CSS.

Audience

Our Tableau Tutorial is designed to help beginners and professionals.

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What is Data Visualization?

Today's data visualization tools go beyond the charts and graphs used in the Microsoft Excel spreadsheet, which displays the data in more sophisticated ways such as dials and gauges, geographic maps, heat maps, pie chart, and fever chart.

What makes Data Visualization Effective?

Effective data visualization are created by communication, data science, and design collide. Data visualizations did right key insights into complicated data sets into meaningful and natural.

What makes Data Visualization Effective?

American statistician and Yale professorEdward Tuftebelieve useful data visualizations consist of ?complex ideas communicated with clarity, precision, and efficiency.

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Data visualization have some more specialties such as:

Importance of Data Visualization

- Data visualization can identify areas that need improvement or modifications.

- Data visualization can clarify which factor influence customer behavior.

- Data visualization helps you to understand which products to place where.

- Data visualization can predict sales volumes.

Importance of Data Visualization

Data visualization tools have been necessary for democratizing data, analytics, and making data-driven perception available to workers throughout an organization. They are easy to operate in comparison to earlier versions of BI software or traditional statistical analysis software. This guide to a rise in lines of business implementing data visualization tools on their own, without support from IT.

Why Use Data Visualization?

- To make easier in understand and remember.

- To discover unknown facts, outliers, and trends.

- To visualize relationships and patterns quickly.

- To ask a better question and make better decisions.

- To competitive analyze.

- To improve insights.

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next ?? prevTop 10 Data Visualization ToolsThere are tools which help you to visualize all your data in a few minutes. They are already there; only you need to do is to pick the right data visualization tool as per your requirements.Data visualization allows you to interact with data.Google,Apple,Facebook, andTwitterall ask better a better question of their data and make a better business decision by using data visualization.Here are the top 10 data visualization tools that help you to visualize the data:1. TableauTableau is a data visualization tool. You can create graphs, charts, maps, and many other graphics.A tableau desktop app is available for visual analytics. If you don't want to install tableau software on your desktop, then a server solution allows you to visualize your reports online and on mobile.A cloud-hosted service also is an option for those who want the server solution but don't want to set up manually. The customers of Tableau include Barclays, Pandora, and Citrix.2. InfogramInfogram is also a data visualization tool. It has some simple steps to process that:First, you choose among many templates, personalize them with additional visualizations like maps, charts, videos, and images.Then you are ready to share your visualization.Infogram supports team accounts for journalists and media publishers, branded designs of classroom accounts for educational projects, companies, and enterprises.An infogram is a representation of information in a graphic format designed to make the data easily understandable in a view. Infogram is used to quickly communicate a message, to simplify the presentation of large amounts of the dataset, to see data patterns and relationships, and to monitor changes in variables over time.Infogram abounds in almost any public environment such as traffic signs, subway maps, tag clouds, musical scores, and weather charts, among a huge number of possibilities.3. ChartblocksChartblocks is an easy way to use online tool which required no coding and builds visualization from databases, spreadsheets, and live feeds.Your chart is created under the hood inhtml5by using the powerful JavaScript libraryD3.js. Your visualizations is responsive and compatible with any screen size and device. Also, you will be able to embed your charts on any web page, and you can share it on Facebook and Twitter.4. DatawrapperDatawrapper is an aimed squarely at publisher and journalist.The Washington Post, VOX, The Guardian, BuzzFeed, The Wall Street JournalandTwitteradopts it.Datawrapper is easy visualization tool, and it requires zero codings. You can upload your data and easily create and publish a map or a chart. The custom layouts to integrate your visualizations perfectly on your site and access to local area maps are also available.5. PlotlyPlotly will help you to create a slick and sharp chart in just a few minutes or in a very short time. It also starts from a simple spreadsheet.The guys use Plotly at Google and also by theUS Air Force, GojiandThe New York University.Plotly is very user-friendly visualization tool which is quickly started within a few minutes. If you are a part of a team of developers that wants to have a crack, an API is available for JavaScript and Python languages.6. RAWRAW creates the missing link between spreadsheets and vector graphics on its home page.Your Data can come fromGoogle

Docs, Microsoft Excel, Apple Numbers, or a simple comma-separated list.Here the kicker is that you can export your visualization easily and have a designer to make it look sharp. RAW is compatible with Inkscape, Adobe Illustrator, and Sketch. RAW is very easy to use and get quick results.7. Visual.lyVisual.ly is a visual content service. It has a dedicated data visualization service and their impressive portfolio that includes work forNike, VISA, Twitter, Ford, The Huffington post, and the national geographic.By a streamlined online process, you can find entire outsource your visualizations to a third-party where you describe your project and connected with a creative team that will stay with you for the entire duration of the project.Visual.ly sends you an email notification for all the event you are hitting, and also it will give you constant feedback to your creative team. Visual.ly offer their distribution network for showcasing your project after it's completed.8. D3.jsD3.js is a best data visualization library for manipulating documents. D3.js runs on JavaScript, and it usesCSS,html, andSVG. D3.js is an open-source and applies a data-driven transformation to a webpage. It's only applied when data is inJSONandXMLfile.D3.js emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a single framework and combining powerful visualization components.D3.js is as powerful as it is a cutting-edge library, so it comes with no pre-built charts and only IE9+ supports this library.9. Ember ChartsEmber charts are based on the ember.js and D3.js framework, and it uses the D3.js under the hood. It also applied when the data is inJSONandXMLfile.It includes a bar, time series, pie, and scatter charts which are easy to extend and modify. These chart components represent our thoughts on best practices in chart presentation and interactivity.The team behind Ember Charts is also the same that created Ember.js. It puts a lot of focus on best practices and interactivity. Error handling is very graceful, and your app will not crash after finding irrelevant data or corrupt data.10. NVD3NVD3 is a project that attempts to build reusable charts and components. This project is to keeps all your charts neat and customizable.NDV3 is a simpler interface on the top of the D3.js and keeps all of its powerful features under the hood.The front end engineers develop NDV3, and they use their insight into charting technology. This charting technology is used to provide powerful analytics to clients in the financial industry.Next TopicHistory of Tableau? prevnext ?

Top 10 Data Visualization Tools

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Top 10 Data Visualization Tools

Here are the top 10 data visualization tools that help you to visualize the data:

1. Tableau

Tableau is a data visualization tool. You can create graphs, charts, maps, and many other graphics.

1. Tableau

A tableau desktop app is available for visual analytics. If you don't want to install tableau software on your desktop, then a server solution allows you to visualize your reports online and on mobile.

1. Tableau

A cloud-hosted service also is an option for those who want the server solution but don't want to set up manually. The customers of Tableau include Barclays, Pandora, and Citrix.

2. Infogram

Infogram is also a data visualization tool. It has some simple steps to process that:

2. Infogram

- First, you choose among many templates, personalize them with additional visualizations like maps, charts, videos, and images.

- Then you are ready to share your visualization.

- Infogram supports team accounts for journalists and media publishers, branded designs of classroom accounts for educational projects, companies, and enterprises.

2. Infogram

An infogram is a representation of information in a graphic format designed to make the data easily understandable in a view. Infogram is used to quickly communicate a message, to simplify the presentation of large amounts of the dataset, to see data patterns and relationships, and to monitor changes in variables over time.

2. Infogram

Infogram abounds in almost any public environment such as traffic signs, subway maps, tag clouds, musical scores, and weather charts, among a huge number of possibilities.

3. Chartblocks

Chartblocks is an easy way to use online tool which required no coding and builds visualization from databases, spreadsheets, and live feeds.

3. Chartblocks

Your chart is created under the hood inhtml5by using the powerful JavaScript libraryD3.js. Your visualizations is responsive and compatible with any screen size and device. Also, you will be able to embed your charts on any web page, and you can share it on Facebook and Twitter.

4. Datawrapper

Datawrapper is an aimed squarely at publisher and journalist.The Washington Post, VOX, The Guardian, BuzzFeed, The Wall Street JournalandTwitteradopts it.

4. Datawrapper

Datawrapper is easy visualization tool, and it requires zero codings. You can upload your data and easily create and publish a map or a chart. The custom layouts to integrate your visualizations perfectly on your site and access to local area maps are also available.

5. Plotly

Plotly will help you to create a slick and sharp chart in just a few minutes or in a very short time. It also starts from a simple spreadsheet.

5. Plotly

The guys use Plotly at Google and also by theUS Air Force, GojiandThe New York University.

5. Plotly

Plotly is very user-friendly visualization tool which is quickly started within a few minutes. If you are a part of a team of developers that wants to have a crack, an API is available for JavaScript and Python languages.

6. RAW

RAW creates the missing link between spreadsheets and vector graphics on its home page.

6. RAW

Your Data can come fromGoogle Docs, Microsoft Excel, Apple Numbers, or a simple comma-separated list.

6. RAW

Here the kicker is that you can export your visualization easily and have a designer to make it look sharp. RAW is compatible with Inkscape, Adobe Illustrator, and Sketch. RAW is very easy to use and get quick results.

7. Visual.ly

Visual.ly is a visual content service. It has a dedicated data visualization service and their impressive portfolio that includes work forNike, VISA, Twitter, Ford, The Huffington post, and the national geographic.

7. Visual.ly

By a streamlined online process, you can find entire outsource your visualizations to a third-party where you describe your project and connected with a creative team that will stay with you for the entire duration of the project.

7. Visual.ly

Visual.ly sends you an email notification for all the event you are hitting, and also it will give you constant feedback to your creative team. Visual.ly offer their distribution network for showcasing your project after it's completed.

8. D3.js

D3.js is a best data visualization library for manipulating documents. D3.js runs on JavaScript, and it usesCSS,html, andSVG. D3.js is an open-source and applies a data-driven transformation to a webpage. It's only applied when data is inJSONandXMLfile.

8. D3.js

D3.js emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a single framework and combining powerful visualization components.

8. D3.js

D3.js is as powerful as it is a cutting-edge library, so it comes with no pre-built charts and only IE9+ supports this library.

9. Ember Charts

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The front end engineers develop NDV3, and they use their insight into charting technology. This charting technology is used to provide powerful analytics to clients in the financial industry.

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History of Tableau

Tableau appears in the era when there were already established companies like Cognos, Microsoft Excel, Business Objects, etc. It managed to climb the success chart with $3.8 billion of current market value.

History of Tableau

Since then, the company is growing day by day.

History of Tableau

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What made Tableau Popular?

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What made Tableau Popular?

The main features that led Tableau Software to achieve success are-

What made Tableau Popular?

- Powered by VizQL language, which makes it more flexible to pull data from any source.

- Provide Facility to the user with n number of visualization tools to customize the Tableau reports.

- All the complicated graphs and maps can be prepared with drags and drops method.

- Tableau data visualizations can be inserted with multiple platforms.

- It can analyze and display the data in real-time.

What made Tableau Popular?

Some recently introduced versions of Tableau have the following features:

What made Tableau Popular?

Tableau 9.0

What made Tableau Popular?

- Smart maps

- Instant visual feedback

- Cashing and consolidation

- Scalable and faster tableau server

What made Tableau Popular?

Tableau 10.0

What made Tableau Popular?

- Cluster analysis

- Cross-database join

- Self-service at scale

- Multiple device support

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Advantages of Tableau

- Data Visualization:-Tableau is a data visualization tool, and provides complex computation, data blending, and dashboarding for creating beautiful data visualizations.

- Quickly Create Interactive Visualization:-Users can create a very interactive visual by using drag n drop functionalities of Tableau.

- Comfortable in Implementation:-Many types of visualization options are available in Tableau, which enhances the user experience. Tableau is very easy to learn in comparison to Python. Who don't have any idea about coding, they also can quickly learn Tableau.

- Tableau can Handle Large Amounts of Data:-Tableau can easily handle millions of rows of data. A large amount of data can create different types of visualization without disturbing the performance of the dashboards. As well as, there is an option in Tableau where the user can make 'live' to connect different data sources like SQL, etc.

- Use of other Scripting Language in Tableau:-To avoid the performance issues and to do complex table calculations in Tableau, users can includePythonorR. Using Python Script, user can remove the load of the software by performing data cleansing tasks with packages. However, Python is not a native scripting language accepted by Tableau. So you can import some of the packages or visuals.

- Mobile Support and Responsive Dashboard:-Tableau Dashboard has an excellent reporting feature that allows you to customize dashboard specifically for devices like a mobile or laptops. Tableau automatically understands which device is viewing the report by the user and make adjustments to ensure that accurate report is delivered to the right device.

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Tools of Tableau

A list of Tableau tools:

Tools of Tableau

- Tableau Desktop
- Tableau Public
- Tableau Online
- Tableau Server
- Tableau Reader

Tools of Tableau

Data analytics in Tableau is classified into two parts:-

Tools of Tableau

- Developer Tools:-The Tableau tools which are used for development such as the creation of charts, dashboards, report generation and visualization are known as developer's tools. Tableau Desktop and the Tableau Public, are the example of this type.
- Sharing Tools:-The role of these tools are sharing the reports, visualizations, and dashboards that were created using the developer tools. The Tableau tools that fall into this category are Tableau

Server, Tableau Online, and Tableau Reader.

Tools of Tableau

Let's see all the Tools one by one:

Tableau Desktop

Tableau Desktop has a rich feature set and allows us to code and customize reports. Right from creating the reports, charts to blending them all to form a dashboard, all the necessary work is created in Tableau Desktop.

Tableau Desktop

For live data analysis, Tableau Desktop establish connectivity between the Data Warehouse and other various types of files. The dashboards and the workbooks created here can be either shared locally or publicly.

Tableau Desktop

Based on the connectivity to the publishing option and data sources, Tableau Desktop is also classified into two parts-

Tableau Desktop

- Tableau Desktop Personal:-The personal version of the Tableau desktop keeps the workbook private, and the access is limited. The workbooks can't be published online. So, it should be distributed either offline or in Tableau public.
- Tableau Desktop Professional:-It is similar to Tableau desktop. The main difference is that the workbooks created in the Tableau desktop can be published online or in Tableau server. In the professional version, there is full access to all sorts datatypes. It is best for those who want to publish their workbook in Tableau server.

Tableau Public

This Tableau version is specially built for cost-effective users. The word 'Public' means that the created workbooks cannot be saved locally. They should be kept on the Tableau's public cloud, which can be accessed and viewed by anyone.

Tableau Public

There is no privacy of the files saved on the cloud, so anyone can access and download the same data. This version is the best for them who want to share their data with the general public and for the individuals who want to learn Tableau.

Tableau Online

Its functionality is similar to the tableau server, but data is stored on the servers that hosted on the cloud, which is maintained by the Tableau group.

Tableau Online

There is no storage limit on the data which is published in the Tableau Online. Tableau Online creates a direct link over 40 data sources who are hosted in the cloud such as theHive, MySQL, Spark SQL, Amazon Aurora, and many more.

Tableau Online

To be published, both Tableau Server and Tableau online require the workbooks that are created by Tableau Desktop. Data that flow from the web applications say Tableau Server and Tableau Online also supportGoogle AnalyticsandSalesforce.com.

Tableau Server

The software is correctly used to share the workbooks, visualizations, which is created in the Tableau Desktop application over the organization. To share dashboards in the Tableau Server, you should first publish your workbook in the Tableau Desktop. Once the workbook has been uploaded to the server, it will be accessible only to the authorized users.

Tableau Server

It's not necessary that the authorized users have the Tableau Server installed on their machine.

They only require the login credentials by which they can check reports by the web browser. The security is very high in Tableau server, and it is beneficial for quick and effective sharing of data.

Tableau Server

The admin of the organization has full control over the server. The organization maintains the hardware and the software.

Tableau Reader

Tableau Reader is a free tool which allows us to view the visualizations and workbooks, which is created using Tableau Desktop or Tableau Public. The data can be filtered, but modifications and editing are restricted. There is no security in Tableau Reader as anyone can view workbook using Tableau Reader.

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next ?? prevTableau ArchitectureTableau Server is designed to connect many data tiers. It can connect clients from Mobile, Web, and Desktop. Tableau Desktop is a powerful data visualization tool. It is very secure and highly available.It can run on both the physical machines and virtual machines. It is amulti-process,multi-user, andmulti-threadedsystem.Providing such powerful features requires unique architecture.The different layers used in Tableau server are given in the following architecture diagram:-Let's study about the different component of the Tableau architecture:1. Data server:-The primary component of Tableau Architecture is the Data sources which can connect to it.Tableau can connect with multiple data sources. It can blend the data from various data sources. It can connect to anexcel file, database, and aweb applicationat the same time. It can also make the relationship between different types of data sources.2. Data connector:-The Data Connectors provide an interface to connect external data sources with the Tableau Data Server.Tableau has in-built SQL/ODBC connector. This ODBC Connector can be connected with any databases without using their native connector. Tableau desktop has an option to select both extract and live data. On the uses basis, one can be easily switched between live and extracted data.Real-time data or live connection:Tableau can be connected with real data by linking to the external database directly. It uses the infrastructure existing database by sending dynamicmultidimensional expressions (MDX)and SQL statements. This feature can be used as a linking between the live data and Tableau rather than importing the data. It makes optimized and a fast database system. Mostly in other enterprises, the size of the database is large, and it is updated periodically. In these cases, Tableau works as a front-end visualization tool by connecting with the live data.Extracted or in-memory data:Tableau is an option to extract the data from external data sources. We make a local copy in the form of Tableau extract file. It can remove millions of records in the Tableau data engine with a single click. Tableau's data engine uses storage such asROM, RAM, andcachememory to process and store data. Using filters, Tableau can extract a few records from a large dataset. This improves performance, especially when we are working on massive datasets. Extracted data allows the users to visualize the data offline, without connecting to the data source.3. Components of Tableau server:Different types of component of the Tableau server are:Application serverVizQL serverData serverA. Application server:The application server is used to provide the authorizations and authentications. It handles the permission and administration for mobile and web interfaces. It gives a guarantee of security by recording each session id on Tableau Server. The administrator is configuring the default timeout of the session in the server.B. VizQL server:VizQL server is used to convert the queries from the data source into visualizations. Once the client request is forwarded to the VizQL process, it sends the query directly to the data source retrieves information in the form of images. This visualization or image is presented for the users. Tableau server creates a cache of visualization to reduce the load time. The cache can be shared between many users who have permission to view the visualization.C. Data server:Data server is used to store and manage the data from external data sources. It is a central data management system. It providesdata security, metadata management, data connection, driver requirements, and data storage. It stores the related details of data set likecalculated fields, metadata, groups, sets, andparameters. The data source can extract the data as well as make live connections with external data sources.4. Gateway:The gateway directed the requests from users to Tableau components. When the client sends a request, it is forwarded to the external load balancer for processing. The gateway works as a distributor of processes to different components. In case of absence of external load balancer, the gateway also works as a load balancer. For single server configuration, one gateway or primary server manages all the processes. For multiple server configurations, one physical system works as a primary server, and others are used as worker servers. Only one machine is used as a primary server in Tableau Server environment.5. Clients:The visualizations and dashboards in Tableau server can be edited and viewed using different clients. Clients area web browser, mobile applications, andTableau Desktop.Web Browser:Web browsers likeGoogle Chrome, Safari, andFirefoxsupport the Tableau server. The visualization and contents in the dashboard can be edited by using these web browser.Mobile Application:The dashboard from the server can be interactively visualized using mobile application and browser. It is used to edit and view the contents in the workbook.Tableau Desktop:Tableau desktop is a business analytics tool. It is used toview, create, andpublishthe dashboard in Tableau server. Users can access the various data source and build visualization in Tableau desktop.Next TopicTableau-data-warehouse? prevnext ?

Tableau Architecture

Tableau Server is designed to connect many data tiers. It can connect clients from Mobile, Web, and Desktop. Tableau Desktop is a powerful data visualization tool. It is very secure and highly available.

Tableau Architecture

It can run on both the physical machines and virtual machines. It is amulti-process,multi-user, andmulti-threadedsystem.

Tableau Architecture

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Tableau Architecture

The different layers used in Tableau server are given in the following architecture diagram:-

Tableau Architecture

Let's study about the different component of the Tableau architecture:

Tableau Architecture

1. Data server:-The primary component of Tableau Architecture is the Data sources which can connect to it.

Tableau Architecture

Tableau can connect with multiple data sources. It can blend the data from various data sources. It can connect to anexcel file, database, and aweb applicationat the same time. It can also make the relationship between different types of data sources.

Tableau Architecture

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Tableau Architecture

3. Components of Tableau server:Different types of component of the Tableau server are:

Tableau Architecture

- Application server
- VizQL server
- Data server

Tableau Architecture

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Tableau Architecture

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Tableau Architecture

5. Clients:The visualizations and dashboards in Tableau server can be edited and viewed using different clients. Clients area web browser, mobile applications, andTableau Desktop.

Tableau Architecture

- Web Browser:Web browsers likeGoogle Chrome, Safari, andFirefoxsupport the Tableau server. The visualization and contents in the dashboard can be edited by using these web browser.

- Mobile Application:The dashboard from the server can be interactively visualized using mobile application and browser. It is used to edit and view the contents in the workbook.
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Users can construct visually appealing and interactive dashboards that provide insights into the data housed in the warehouse by connecting Tableau to a data warehouse.Tableau's key features in the context of a data warehouse:Data Integration:Tableau can connect to a variety of data sources, including data warehouses, and simply combine the data for analysis.Visualization:Tableau's strengths lay in its data visualisation skills. It enables users to generate charts, graphs, maps, and other visualisations to make data easier to understand and act on.Interactivity:Users can create interactive dashboards that allow data exploration and filtering, making it easier to get insights and answer questions.Real-time Analysis:Tableau may be used to perform real-time analysis of data housed in a data warehouse, offering current insights.Sharing and Collaboration:Tableau makes it simple to share reports and dashboards with colleagues and stakeholders, ensuring that insights are broadly available.A Tableau Data Warehouse, in short, is the usage of Tableau as a tool for visualising and analysing data housed in a data warehouse. With this combination, businesses can acquire useful insights and make data-driven decisions.What is the function of a data warehouse in Tableau?When utilising Tableau for data analysis and visualisation, a data warehouse is essential. Tableau's use of a data warehouse provides various advantages and functionalities:Centralized Data Storage:Data warehouses combine and store data from multiple sources in an organised fashion, serving as a central repository for all of your organization's data. This centralization makes data access and management easier.Data Cleansing and Transformation:Processes for cleaning and transforming data are frequently included in data warehouses to ensure data quality and consistency. Tableau can simply analyse this clean and converted data.High Performance:Data warehouses are optimised for query performance and can efficiently manage massive datasets. When Tableau connects to a data warehouse, the optimised database structure allows for faster query execution.Historical Data:Historical data is often stored in data warehouses, allowing users to do time-series analysis and follow changes over time.Scalability:Data warehouses may be scaled up to accommodate greater data quantities as data volumes expand. Tableau's scalability means that it can continue to analyse and visualise data as your organization's data requirements grow.Security and access control:Data warehouses have strong security features that allow organisations to regulate who can access and edit data. When connecting to the data warehouse, Tableau can inherit these security features.Real-Time Data Access:Real-time or near-real-time data access is supported by several current data warehouses. This feature enables Tableau to analyse the most recent data available, ensuring that decisions are made based on current knowledge.Data Exploration and Visualization:Tableau excels in producing interactive and visually appealing data visualisations. It can connect to the data warehouse and enable users to generate dashboards, reports, and charts to study and visualise the data.Ad Hoc Analysis:When users connect Tableau to a data warehouse, they can conduct ad hoc analysis, explore data, and answer questions on the fly. This adaptability gives business users the ability to make data-driven decisions.In summary, using a data warehouse in Tableau lays the groundwork for data management, integration, and high-performance analysis. By leveraging Tableau's sophisticated data visualisation and reporting capabilities on top of a centralised and well-organized data source, it helps organisations to make educated decisions.ConclusionIn short, Tableau and data warehouses together provide a powerful solution for analysing and visualizing data. Tableau connects to data warehouses, allowing users to extract, transform, and create interactive visualizations from centralized, well-structured data sources. This combination streamlines data analysis, enhances data quality, and supports data-driven decision-making.Next TopicTableau-big-data? prevnext ?

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- Interactivity:Users can create interactive dashboards that allow data exploration and filtering, making it easier to get insights and answer questions.

- Real-time Analysis:Tableau may be used to perform real-time analysis of data housed in a data warehouse, offering current insights.

- Sharing and Collaboration:Tableau makes it simple to share reports and dashboards with colleagues and stakeholders, ensuring that insights are broadly available.

What is mean by Tableau Data Warehouse?

A Tableau Data Warehouse, in short, is the usage of Tableau as a tool for visualising and analysing data housed in a data warehouse. With this combination, businesses can acquire useful insights and make data-driven decisions.

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- High Performance:Data warehouses are optimised for query performance and can efficiently manage massive datasets. When Tableau connects to a data warehouse, the optimised database structure allows for faster query execution.

- Historical Data:Historical data is often stored in data warehouses, allowing users to do time-series analysis and follow changes over time.

- Scalability:Data warehouses may be scaled up to accommodate greater data quantities as data volumes expand. Tableau's scalability means that it can continue to analyse and visualise data as your organization's data requirements grow.

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extract file even further.Parallel Processing:Tableau can use multi-core processors and parallel processing to conduct computations and queries more effectively, which is important for huge data sets.Data Blending:Tableau supports data blending, which allows you to integrate data from numerous sources. This can be beneficial when working with big data sets spread across multiple databases or files.Live and Extract Connection Options:Tableau provides live and extract connections to data sources for real-time analysis, as well as extract connections for increased performance. Users can select the type of connection based on their specific requirements and the amount of the data set.Server Scalability:When adopting Tableau Server or Tableau Online, the infrastructure may be scaled to support huge user bases and data volumes. This ensures that even while dealing with large amounts of data, the system stays responsive.In summary, Tableau handles huge data sets via in-memory processing, data extract optimisation, data source filtering, aggregation, and other performance-enhancing approaches. These features help users to quickly interact with and visualise massive data sets, allowing them to derive insights from their data even when dealing with large amounts of information.ConclusionTableau Big Data, in a nutshell, is the use of Tableau, a data visualisation and analysis tool, to easily deal with and get insights from huge and complicated datasets, such as those generally associated with big data technology. It provides connection, data processing, and performance optimisation capabilities, making it an invaluable tool for visualising and comprehending large amounts of data.Next TopicTableau-data-science?
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Introduction Tableau uses XML (eXtensible Markup Language) files for various purposes, such as saving workbooks, dashboards, and data source definitions. Here are some key XML files associated with Tableau: TWB (Tableau Workbook): File Extension: .twb Description: This XML file contains the workbook metadata, including worksheets, dashboards, calculated fields, and...

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The application enables for data filtering, sorting, and drilling down, assisting users in gaining insights and discovering intriguing elements of the data.Data Cleaning and Transformation:Cleaning and transforming data is an important stage in data science, and Tableau provides tools for doing so. It can be used by data scientists to reshape, pivot, and connect data from diverse sources.Rapid Prototyping:Tableau allows data scientists to easily create and test various data visualisations and hypotheses. It enables iterative data exploration, which is useful in the early stages of a data science project.Collaboration and communication:Through interactive dashboards and reports, Tableau makes it simple to share insights with stakeholders. Data scientists can work with business teams and decision-makers to successfully communicate their findings.Integration with Data Sources:Tableau can connect to a wide variety of data sources, including databases, spreadsheets, cloud services, and big data platforms. This adaptability enables data scientists to work with data from a variety of platforms.Advanced Analytics:Tableau also integrates with statistical and machine learning technologies, enabling data scientists to incorporate advanced analytics and predictive modelling into their data visualisations and dashboards.To summarise, Tableau is not a data science tool in and of itself, but it is an important tool in the data scientist's toolbox for data exploration, visualisation, and communication. It assists data scientists with extracting insights from data and effectively communicating their findings so that data-driven decisions can be made.Applications on Tableau Data scienceTableau, a data visualisation and business intelligence tool, is widely used in data science for a wide range of purposes. Tableau is used by data scientists to analyse, visualise, and discuss their findings. Tableau is commonly used in data science for the following reasons:Exploratory Data Analysis (EDA):Tableau is used by data scientists to perform exploratory data analysis (EDA) by constructing various charts, graphs, and visualisations to understand the structure and features of the data. This aids in the identification of patterns, outliers, and trends in the data.Data Cleaning and Preprocessing:By filtering, aggregating, and manipulating data, Tableau can clean and preprocess it. Tableau is frequently used by data scientists to prepare data for modelling and analysis.Data Visualization:Tableau specialises at creating interactive and informative data visualisations such as bar charts, scatter plots, heat maps, and others. These visualisations are used by data scientists to deliver data insights to stakeholders.Dashboard Development:Data scientists can use Tableau to create interactive dashboards that integrate numerous visualisations and provide a comprehensive perspective of the data. Dashboards are useful for non-technical stakeholders and decision-makers.Dashboard Creation:Tableau may be integrated with statistical and machine learning tools to construct predictive models. It is used by data scientists to visually represent model outputs and predictions, making it easier to discuss results.Predictive Analytics:Tableau may be integrated with statistical and machine learning tools to construct predictive models. It is used by data scientists to visually represent model outputs and predictions, making it easier to discuss results.Geospatial Analysis:Tableau provides geospatial features, allowing data scientists to build maps and do geospatial analysis, which is useful in applications such as location-based marketing, logistics, and real estate analysis.Time Series Analysis:Tableau is well-suited for analysing time series data, such as stock prices, weather data, or sales trends. Time-based visualisations and forecasts can be created by data scientists.A/B Testing Analysis:Data scientists use Tableau to analyse the results of A/B testing and visualise the influence of various variables on user behaviour.Anomaly Detection:Tableau provides geospatial features, allowing data scientists to build maps and do geospatial analysis, which is useful in applications such as location-based marketing, logistics, and real estate analysis.Tableau's adaptability and user-friendly interface make it an important tool for data scientists to use to explore data, convey discoveries, and drive data-driven decision-making throughout organisations. It can be used in conjunction with other data science tools and platforms to generate complete data solutions.ConclusionIn short, Tableau is a versatile data visualization and business intelligence tool commonly used by data scientists for tasks like data exploration, visualization, dashboard creation, and data communication. It aids in making data-driven decisions by providing a user-friendly platform to analyze and present data effectively.Next TopicTableau-consulting? prevnext ?

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- Data Exploration:Tableau is used by data scientists to quickly study massive datasets. The application enables for data filtering, sorting, and drilling down, assisting users in gaining insights and discovering intriguing elements of the data.

- Data Cleaning and Transformation:Cleaning and transforming data is an important stage in data science, and Tableau provides tools for doing so. It can be used by data scientists to reshape, pivot, and connect data from diverse sources.

- Rapid Prototyping:Tableau allows data scientists to easily create and test various data visualisations and hypotheses. It enables iterative data exploration, which is useful in the early stages of a data science project.

- Collaboration and communication:Through interactive dashboards and reports, Tableau makes it simple to share insights with stakeholders. Data scientists can work with business teams and decision-makers to successfully communicate their findings.

- Integration with Data Sources:Tableau can connect to a wide variety of data sources, including databases, spreadsheets, cloud services, and big data platforms. This adaptability enables data scientists to work with data from a variety of platforms.

- Advanced Analytics:Tableau also integrates with statistical and machine learning technologies, enabling data scientists to incorporate advanced analytics and predictive modelling into their data visualisations and dashboards.

What is Tableau Data Science?

To summarise, Tableau is not a data science tool in and of itself, but it is an important tool in the data scientist's toolbox for data exploration, visualisation, and communication. It assists data scientists with extracting insights from data and effectively communicating their findings so that data-driven decisions can be made.

Applications on Tableau Data science

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- Geospatial Analysis:Tableau provides geospatial features, allowing data scientists to build maps and do geospatial analysis, which is useful in applications such as location-based marketing, logistics, and real estate analysis.

- Time Series Analysis:Tableau is well-suited for analysing time series data, such as stock prices, weather data, or sales trends. Time-based visualisations and forecasts can be created by data scientists.
- A/B Testing Analysis:Data scientists use Tableau to analyse the results of A/B testing and visualise the influence of various variables on user behaviour.
- Anomaly Detection:Tableau provides geospatial features, allowing data scientists to build maps and do geospatial analysis, which is useful in applications such as location-based marketing, logistics, and real estate analysis.

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Conclusion

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Tableau dashboards and reports operate efficiently. Tableau experts can improve performance by optimising queries, data connectivity, and display design.Troubleshooting and Support:If an organisation finds problems using Tableau, experts can give troubleshooting and support services to resolve issues and keep the system running smoothly.Bespoke Development:To address specific needs, certain organisations may require bespoke development or extensions within Tableau. Tableau experts can aid in the development of customised solutions to meet specific requirements.Tableau consulting services can be extremely beneficial to organisations that wish to take use of Tableau's features but lack in-house knowledge. These consultants have expertise in data visualisation, data analysis, and Tableau, allowing organisations to gain useful insights from their data and make data-informed decisions.Advantages of a Tableau ConsultantIn summary, Tableau provides the following main benefits:Data visualisation and business intelligence tool that is simple to use.Data integration features that are versatile.A wide range of interactive and configurable visualisations are available.Support for real-time data.Scalability for various business sizes.Features that are mobile-friendly and collaborative.Access control and strict security.A helpful user community and resources.Options for integrating with other tools.Capabilities for predictive analytics.Pricing alternatives to fit a variety of budgets.A thriving ecosystem of add-ons and extensions.Disadvantages of Tableau ConsultantIn summary, Tableau has the following drawbacks:Expensive, particularly for larger organisations.Significant system resources are required.The learning curve for advanced features is steep.ETL functionality is limited.Limitations on data volume and source.Customization is complicated.Upgrades pose compatibility issues.Complexity of real-time data integration.Predictive analytics capabilities are limited.Data governance issues.Write-back capabilities are limited.The refresh times for data extracts can be quite long.Possible vendor lock-in.ConclusionTo summarise, Tableau is a sophisticated data visualisation and business intelligence application with various benefits such as ease of use, data integration, interactive visualisations, and strong community support. However, it has a number of drawbacks, including cost, resource requirements, a learning curve, and limitations in data management and analytics capabilities. When adopting Tableau for their data analysis and reporting needs, organisations should carefully analyse their specific needs and priorities.Next TopicAdvanced-visualisations-in-tableau? prevnext ?

What is mean by Tableau Consulting?

The practise of seeking professional advice and services from specialists or consultants who specialise in Tableau, a sophisticated data visualisation and business intelligence (BI) application, is referred to as Tableau Consulting. Tableau is used to produce dynamic and intelligent data visualisations, dashboards, and reports, making it a valuable tool for organisations that want to effectively analyse and present their data.

What is mean by Tableau Consulting?

Tableau consultants provide a variety of services to assist businesses and organisations in making the best use of Tableau software. Among these services are:

What is mean by Tableau Consulting?

- Implementation:Consultants can help with the installation and implementation of Tableau within an organisation, ensuring that it is integrated with the relevant data sources and systems. They can assist with the development of the first data models and structures required for effective data visualisation.

- Data Preparation:Data preparation is an important phase in the Tableau process. Consultants can assist in cleaning, converting, and structuring data for visualisation and analysis.

- Dashboard and Report Design:Tableau consultants excel at creating interactive, visually appealing dashboards and reports. They can design data visualisations that allow people to examine data, spot trends, and make data-driven decisions.

- Dashboard and Report Design:Many Tableau consulting firms offer training and workshops to educate organisations on how to utilise Tableau efficiently. This training can be tailored to an organization's employees' individual needs and skill levels.

- Data Preparation:A critical stage in the Tableau process is data preparation. Consultants can help with data cleaning, conversion, and structuring for visualisation and analysis.

- Best Practices:Tableau consultants are experts in creating interactive, visually appealing dashboards and reports. They can create data visualisations that enable users to explore data, identify trends, and make data-driven decisions.

- Performance Optimization:Many Tableau consulting firms provide training and workshops to teach businesses how to use Tableau effectively. This training can be adapted to the particular needs and skill levels of an organization's personnel.

- Best Practises:Tableau consultants provide assistance on best practises for data visualisation, data modelling, and data security. They can assist businesses in developing plans for sustaining and improving their Tableau environment.

- Performance Optimization:Performance optimisation is essential for ensuring that Tableau dashboards and reports operate efficiently. Tableau experts can improve performance by optimising queries, data connectivity, and display design.

- Troubleshooting and Support:If an organisation finds problems using Tableau, experts can give troubleshooting and support services to resolve issues and keep the system running smoothly.

- Bespoke Development:To address specific needs, certain organisations may require bespoke development or extensions within Tableau. Tableau experts can aid in the development of customised solutions to meet specific requirements.

What is mean by Tableau Consulting?

Tableau consulting services can be extremely beneficial to organisations that wish to take use of Tableau's features but lack in-house knowledge. These consultants have expertise in data visualisation, data analysis, and Tableau, allowing organisations to gain useful insights from their data and make data-informed decisions.

Advantages of a Tableau Consultant

In summary, Tableau provides the following main benefits:

Advantages of a Tableau Consultant

- Data visualisation and business intelligence tool that is simple to use.

- Data integration features that are versatile.

- A wide range of interactive and configurable visualisations are available.

- Support for real-time data.

- Scalability for various business sizes.

- Features that are mobile-friendly and collaborative.

- Access control and strict security.

- A helpful user community and resources.

- Options for integrating with other tools.

- Capabilities for predictive analytics.

- Pricing alternatives to fit a variety of budgets.

- A thriving ecosystem of add-ons and extensions.

Disadvantages of Tableau Consultant

In summary, Tableau has the following drawbacks:

Disadvantages of Tableau Consultant

- Expensive, particularly for larger organisations.

- Significant system resources are required.

- The learning curve for advanced features is steep.

- ETL functionality is limited.

- Limitations on data volume and source.

- Customization is complicated.

- Upgrades pose compatibility issues.

- Complexity of real-time data integration.

- Predictive analytics capabilities are limited.

- Data governance issues.

- Write-back capabilities are limited.

- The refresh times for data extracts can be quite long.

- Possible vendor lock-in.

Conclusion

To summarise, Tableau is a sophisticated data visualisation and business intelligence application with various benefits such as ease of use, data integration, interactive visualisations, and strong community support. However, it has a number of drawbacks, including cost, resource requirements, a learning curve, and limitations in data management and analytics capabilities. When adopting Tableau for their data analysis and reporting needs, organisations should carefully analyse their specific needs and priorities.

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Users can easily customise the appearance of visualisations.The version of Tableau UsedTableau Public is a free version of Tableau, which is available on the official website of Tableau. This version of Tableau provides a variety of features, including creating dashboards and stories and utilising different forms of data files like CSV, text, Excel and many others. It gives access to almost all of the features of the software. The Tableau public offers a drag-and-drop feature to add features in order to make interactive charts and graphs. It provides high-performance visualisation and various advanced visualisation options. The main difference is that this version is less secure than the other paid versions, as workbooks go public when the user saves them. Moreover, it gives limited data availability compared to other paid versions of the Tableau.Visualisations with TableauTableau provides a huge variety of charts and graphs, which helps to visualise and analyse the data to get insights from them. The most basic visualisations made with tableau are:Bar ChartHeat MapHistogramPie ChartGantt ChartLine ChartBox PlotScatter PlotThere are many other basic charts and graphs made with the help of Tableau. The additional feature of Tableau is that it offers the ability to create advanced visualisations (charts or graphs), which help analyse the data in a better and more effective way.The following article guides about different advanced visualisations in Tableau, the process and steps for creating them and the uses of each graph and chart.Here is the list of the most effective advanced visualisations made using Tableau:Donut ChartWord CloudsLollipop ChartsNested Bar ChartsPareto ChartsArea ChartsRadial ChartsBullet ChartWaterfall ChartsMotion ChartsDonut ChartA Donut Chart is a type of pie chart but with a hole in the centre. In donut charts, cumulative data can be added, which may show different categories in pie charts. Basically, a donut chart is a hollow circular chart that has an empty space in the centre and the labels can be added in between the donut. These labels show the values which are used for comparing the segments.Method to create Donut ChartTo make a donut chart, there is a need for two different pie charts. The most simple dataset that can be used for working in Tableau is Sample-Superstore. It is in the form of xls, which provides different details about different products like sales, profit, category, subcategory, etc.Steps for donut chart:Step 1: Create pie chartsIn the rows section, write AVG(0) and click enter.Again, write the same command.As a result, it gives 2 different axes in the workbook.Step 2: Modifying Pie Chart 1Click on the first feature AVG(0) in the Marks section.Choose the pie chart from the drop-down menu of the Marks section.Add the 'Category' dimension in the Color card in the Marks section.Now, add the 'Sales' to the Angle card (One can choose different dimensions like profit, discount, etc.)For better analyses, add the 'Sales' to the label card.Users can make different changes, like adding more features to it, like sub-categories, discounts, etc., or a percentage of any feature, which can also be displayed using the Quick Table Calculation section.Step 3: Modifying Pie Chart 2Click on the second feature 'AVG(0).Choose the Circle chart from the drop-down menu. It will make a circle.Change its colour to white. This will make the hole in the donut chart.Now, add the 'Sales' feature to the Labels card.Step 4: Combining both charts to make the donut chartRight-click the second feature AVG(0) in the row section, and click the 'Dual Axis'. Then, adjust the size of the white circle for a better understanding and look.This is how the donut chart will look like:Word CloudA word cloud is a visual display of textual data that highlights the most frequently occurring words or phrases within a particular dataset. Another frequent name for it is a tag cloud. The most important keywords or tags from a website are frequently shown in this kind of chart, where the size and colour of each word indicate how frequently or how important it appears in the data. Stated differently, word clouds offer a graphical representation of the most prevalent terms or topics present in a specific collection of text or information.Method to create Word CloudStep 1: Choosing appropriate featuresFor a word cloud, a categorical variable and a numerical variable are needed.Here, the 'Region' and 'Sub-category' features are used as categorical values. The 'Sales' feature is used as the numerical variable.Step 2: Selecting the cards in the Marks sectionDrop the Region to the text and colour card.Move the Sales to the size card.To make it more interactive, add more categorical values to the text card; here, a sub-category is added to the text card.As an output, it will give a heat map containing different sections in different colours.Step 4: Converting the heat map to the word cloud.Change the 'Automatic' drop-down menu to the 'Text' one. It will give a word cloud focussing on the keywords of the data features chosen, differentiated by different colours and sizes.This is what a word map looks like:Nested Bar ChartsA nested bar chart, which is also sometimes referred to as a stacked bar chart, is a graphical representation of data that consists of multiple bar segments stacked on top of each other. This type of chart is commonly used to show the relationship between different categories or groups. In a nested bar chart, each bar represents a different category, and the length of each segment within the bar indicates the contribution of a specific sub-category to the overall total. By using a nested bar chart, it is easy to compare and contrast the contributions of different sub-categories within each category, making it a useful tool for data analysis and visualisation.Method of Creating Nested Bar ChartStep 1: Make a detailed bar chartAdd the 'Category' and 'Sub-Category' features to the rows section.Include "Measure Values" in the section on columns. Maintain the Sales, Profit, and Discount figures in the measure.Step 2: Modifying the bar chart to create a stacked appearanceTo display bars of various sizes based on the value, add the "measure names" to the "Size" card in the Marks section.Now, update the "Colour" card with the "measure names." Modify the colour scheme to improve visibility and comprehension.Step 3: Modify the layoutTurn off the "Stack Marks" option by going to the analysis option.Adapt the bars' size accordingly.The Nested Bar Chart looks like this:Pareto ChartAn 80/20 rule, also referred to as the Pareto Principle, is illustrated graphically in a Pareto chart. It is a graphical representation of the relationship between causes and effects that combines a bar chart and a line chart. About 80% of the effects result from 20% of the causes, according to the Pareto Principle. A Pareto chart shows that a small number of categories account for the majority of the total, with the remaining categories having a much smaller influence. Using the chart, the most important contributing factors are determined and given priority for improvement.Process to make Pareto ChartStep 1: Creating a bar chartAdd the 'Sales' to the rows and the 'Sub-Category' to the columns.Sort the Sub-category by choosing the Sort option.Choose the Descending option in Sort order.Choose Field in the Sort by option.As a result, it will give the bar chart in the Descending format (from highest sales to lowest).Step 2: Add a line chartDrag the Sales features to the right side of the window till a dotted line appears.Click the SUM(Sales) (2) and choose the Line type in the marks card.As a result, it will give a bar chart following a line chart at the top ends of the bars.Step 3: Formatting the Pareto ChartClick on the Add Table Calculation option from the second SUM(Sales) attribute present on the row pane.Now, add the running total to the primary calculation table of the SUM(Sales).Select the Running total as the Calculation type.Next, Add the secondary calculation and select the Present of Total.It will change the position of the line chart placed on the bar chart.Step 5: Adjusting the Pareto ChartChange the colour of the line chart and the bar chart from the Colours Section of the Marks Card.The resultant Pareto Chart is:Area ChartAn effective tool for visualising quantitative data over a given time periods is an area chart. It's a great way to see the cumulative total of several different data series and how each one affects the total. The purpose of the chart is to show coloured regions that lie between each data series' line and the axis. This gives each component's relative proportions a clear visual representation. A better grasp of the trends and patterns in the data is provided by the shaded areas, which make it simple to see how each data set changes over time and how it affects the total.The process of making an Area ChartStep 1: Adding features to the base chartAdd the 'Order Date' to the column section.Choose the Month option from the drop-down option, which shows the Date in the month format. (MONTH(Order Date)).Now, add the Quantity to the rows.It will give a line chart.Step 2: Adjusting Marks CardChange the drop-down menu of Marks card to Area.Add Ship Mode to the colour card.Add region to the label cardAdd Subcategory to the detail card.Now, change the colour to make it more interactive.Here is the resultant Area Chart:Bullet ChartA bullet chart is a graphical data representation used to show the progress of a single metric, like sales or revenue, towards a particular target or goal. Compared to conventional bar charts, this kind of bar chart was created expressly to offer more context and detail. Bullet charts are a useful tool for performance tracking and analysis because they make it easy for users to determine whether a metric is on track to meet goals by using color-coded ranges and markers.Method to create Bullet ChartAdd Profit measure to the column section.Add Sub-category to the row section.Add Sales to the label option of the marks card.Choose the bullet graph from the Show Me section.The Discount measure can also be added to the label card for more detailing.Here is the final Bullet Chart:Lollipop ChartA lollipop chart is a special form of facts visualisation that effectively blends the elements of a dot plot and a bar chart. Displaying personal records points with their distribution or common values is a commonplace application for this powerful tool. A vertical line typically called the 'lollipop stick', which represents a numerical axis, makes up the chart. A circular marker or dot designating a particular fact point appears at the end of every line. In this way, by emphasizing users' values and displaying their distribution and shape, the lollipop chart gives a clean, visible depiction of complicated data sets.How to Make a Lollipop Chart?Step 1: Base of the Lollipop ChartsAdd the 'Region' and the 'Category' feature to the Columns section.Add 'Sum(Profit)' to the rows section.Duplicate the 'Sum(Profit)' feature in the rows section.As a result, it gives 2 different graphs on the same axis.Step 2: Change the axis and modify the chartSelect the 2ndfeature SUM(Profit) and choose the dual axis.In the marks card, change the shape of the SUM(Profit) (2) to circle.Add 'mark labels' in the 1stSUM(Profit) from the Label card in the marks section; it will write the profit of each category.Adjust the size of the bar and the circle to give it a shape like a lollipop.Change the colour of the chart to make it more interactive.This is what the bullet chart looks like:Waterfall ChartThe cumulative effect of sequentially introduced positive and negative values is commonly shown using a waterfall chart, which is a graphical representation of data. Users can better understand how individual contributions-both positive and negative-add up to a total by using this kind of chart, which is particularly useful for visualising the impact of various factors on an initial value. Waterfall charts are an invaluable tool for anyone seeking to gain deeper insights into their data, as they offer a clear and intuitive means of analysing complex data sets.The process to create a Waterfall ChartFirst, add the Sub-Category to the Rows section and the Sales Measure to the Column area. A bar graph is what it will produce.Using the Sort option in the subcategory and selecting Field under the Sort by option, step two involves sorting the bar graph in descending order.Step 3: Incorporate Quick Table Calculation and choose the running total option in the row section.Next, Select the Gantt Bars located on the Marks card in step four.Fifth, change the chart's size. The sales measure can now be modified by dragging it to the marks card and adding a (-) sign. It will be -SUM([Sales]).Step 7: Change the colour to make it more interactive.The resultant graph will look like a waterfall falling from upwards to downwards direction. Here is the resultant graph:ConclusionTableau is a robust tool for data visualisation that offers a multitude of chart types and customisation choices to its users. This tool makes it simple for users to design and modify visualisations to suit their needs. Tableau's flexibility enables users to analyse and present data in a way that is interesting and meaningful. Users are able to create visually appealing and informative data presentations that effectively communicate their message thanks to the wide range of chart types and customisation options available.Next TopicTableau-hyper-support-resources? prevnext ?

Advanced Visualisations in Tableau

Tableau is a robust business intelligence (BI) and data visualisation platform that lets users connect to multiple data sources, make shareable and interactive dashboards, and extract insights from their data. Tableau is widely used in various industries and organisations to analyse, visualise, and comprehend complex datasets.

Advanced Visualisations in Tableau

Numerous data sources, such as databases, spreadsheets, cloud-based data, and web data connectors, can be connected to Tableau. In addition to data extracts for offline analysis, it supports live connections. Tableau offers data transformation, shaping, and cleaning tools. To better meet their needs for analysis, users can modify and organise their data. Tableau provides a drag-and-drop interface to enable the creation of a wide range of interactive visualisations, such as maps, bar charts, line charts, scatter plots, and more. Users can easily customise the appearance of visualisations.

The version of Tableau Used

Tableau Public is a free version of Tableau, which is available on the official website of Tableau. This version of Tableau provides a variety of features, including creating dashboards and stories and utilising different forms of data files like CSV, text, Excel and many others. It gives access to almost all of the features of the software. The Tableau public offers a drag-and-drop feature to add features in order to make interactive charts and graphs. It provides high-performance visualisation and various advanced visualisation options. The main difference is that this version is less secure than the other paid versions, as workbooks go public when the user saves them. Moreover, it gives limited data availability compared to other paid versions of the Tableau.

Visualisations with Tableau

Tableau provides a huge variety of charts and graphs, which helps to visualise and analyse the data to get insights from them. The most basic visualisations made with tableau are:

Visualisations with Tableau

- Bar Chart
- Heat Map
- Histogram
- Pie Chart
- Gantt Chart
- Line Chart
- Box Plot
- Scatter Plot

Visualisations with Tableau

There are many other basic charts and graphs made with the help of Tableau. The additional feature of Tableau is that it offers the ability to create advanced visualisations (charts or graphs), which help analyse the data in a better and more effective way.

Visualisations with Tableau

The following article guides about different advanced visualisations in Tableau, the process and steps for creating them and the uses of each graph and chart.

Visualisations with Tableau

Here is the list of the most effective advanced visualisations made using Tableau:

Visualisations with Tableau

- Donut Chart
- Word Clouds

- Lollipop Charts

- Nested Bar Charts

- Pareto Charts

- Area Charts

- Radial Charts

- Bullet Chart

- Waterfall Charts

- Motion Charts

Donut Chart

A Donut Chart is a type of pie chart but with a hole in the centre. In donut charts, cumulative data can be added, which may show different categories in pie charts. Basically, a donut chart is a hollow circular chart that has an empty space in the centre and the labels can be added in between the donut. These labels show the values which are used for comparing the segments.

Donut Chart

Method to create Donut Chart

Donut Chart

To make a donut chart, there is a need for two different pie charts. The most simple dataset that can be used for working in Tableau is Sample-Superstore. It is in the form of xls, which provides different details about different products like sales, profit, category, subcategory, etc.

Donut Chart

Steps for donut chart:

Donut Chart

Step 1: Create pie charts

Donut Chart

- In the rows section, write AVG(0) and click enter.

- Again, write the same command.

- As a result, it gives 2 different axes in the workbook.

Donut Chart

Step 2: Modifying Pie Chart 1

Donut Chart

- Click on the first feature AVG(0) in the Marks section.

- Choose the pie chart from the drop-down menu of the Marks section.

- Add the 'Category' dimension in the Color card in the Marks section.

- Now, add the 'Sales' to the Angle card (One can choose different dimensions like profit, discount, etc.)

- For better analyses, add the 'Sales' to the label card.

Donut Chart

Users can make different changes, like adding more features to it, like sub-categories, discounts, etc., or a percentage of any feature, which can also be displayed using the Quick Table Calculation section.

Donut Chart

Step 3: Modifying Pie Chart 2

Donut Chart

- Click on the second feature 'AVG(0).

- Choose the Circle chart from the drop-down menu. It will make a circle.

- Change its colour to white. This will make the hole in the donut chart.

- Now, add the 'Sales' feature to the Labels card.

Donut Chart

Step 4: Combining both charts to make the donut chart

Donut Chart

Right-click the second feature AVG(0) in the row section, and click the 'Dual Axis'. Then, adjust the size of the white circle for a better understanding and look.

Donut Chart

This is how the donut chart will look like:

Word Cloud

A word cloud is a visual display of textual data that highlights the most frequently occurring words or phrases within a particular dataset. Another frequent name for it is a tag cloud. The most important keywords or tags from a website are frequently shown in this kind of chart, where the size and colour of each word indicate how frequently or how important it appears in the data. Stated differently, word clouds offer a graphical representation of the most prevalent terms or topics present in a specific collection of text or information.

Word Cloud

Method to create Word Cloud

Word Cloud

Step 1: Choosing appropriate features

Word Cloud

- For a word cloud, a categorical variable and a numerical variable are needed.

- Here, the 'Region' and 'Sub-category' features are used as categorical values. The 'Sales' feature is used as the numerical variable.

Word Cloud

Step 2: Selecting the cards in the Marks section

Word Cloud

- Drop the Region to the text and colour card.

- Move the Sales to the size card.

- To make it more interactive, add more categorical values to the text card; here, a sub-category is added to the text card.

Word Cloud

As an output, it will give a heat map containing different sections in different colours.

Word Cloud

Step 4: Converting the heat map to the word cloud.

Word Cloud

Change the 'Automatic' drop-down menu to the 'Text' one. It will give a word cloud focussing on the keywords of the data features chosen, differentiated by different colours and sizes.

Word Cloud

This is what a word map looks like:

Nested Bar Charts

A nested bar chart, which is also sometimes referred to as a stacked bar chart, is a graphical representation of data that consists of multiple bar segments stacked on top of each other. This type of chart is commonly used to show the relationship between different categories or groups. In a nested bar chart, each bar represents a different category, and the length of each segment within the bar indicates the contribution of a specific sub-category to the overall total. By using a nested bar chart, it is easy to compare and contrast the contributions of different sub-categories within each category, making it a useful tool for data analysis and visualisation.

Nested Bar Charts

Method of Creating Nested Bar Chart

Nested Bar Charts

Step 1: Make a detailed bar chart

Nested Bar Charts

- Add the 'Category' and 'Sub-Category' features to the rows section.
- Include "Measure Values" in the section on columns. Maintain the Sales, Profit, and Discount figures in the measure.

Nested Bar Charts

Step 2: Modifying the bar chart to create a stacked appearance

Nested Bar Charts

- To display bars of various sizes based on the value, add the "measure names" to the "Size" card in the Marks section.
- Now, update the "Colour" card with the "measure names." Modify the colour scheme to improve visibility and comprehension.

Nested Bar Charts

Step 3: Modify the layout

Nested Bar Charts

- Turn off the "Stack Marks" option by going to the analysis option.
- Adapt the bars' size accordingly.

Nested Bar Charts

The Nested Bar Chart looks like this:

Pareto Chart

An 80/20 rule, also referred to as the Pareto Principle, is illustrated graphically in a Pareto chart. It is a graphical representation of the relationship between causes and effects that combines a bar chart and a line chart. About 80% of the effects result from 20% of the causes, according to the Pareto Principle. A Pareto chart shows that a small number of categories account for the majority of the total, with the remaining categories having a much smaller influence. Using the chart, the most important contributing factors are determined and given priority for improvement.

Pareto Chart

Process to make Pareto Chart

Pareto Chart

Step 1: Creating a bar chart

Pareto Chart

- Add the 'Sales' to the rows and the 'Sub-Category' to the columns.

- Sort the Sub-category by choosing the Sort option.

- Choose the Descending option in Sort order.

- Choose Field in the Sort by option.

Pareto Chart

As a result, it will give the bar chart in the Descending format (from highest sales to lowest).

Pareto Chart

Step 2: Add a line chart

Pareto Chart

- Drag the Sales features to the right side of the window till a dotted line appears.

- Click the SUM(Sales) (2) and choose the Line type in the marks card.

Pareto Chart

As a result, it will give a bar chart following a line chart at the top ends of the bars.

Pareto Chart

Step 3: Formatting the Pareto Chart

Pareto Chart

- Click on the Add Table Calculation option from the second SUM(Sales) attribute present on the row pane.

- Now, add the running total to the primary calculation table of the SUM(Sales).Select the Running total as the Calculation type.

- Select the Running total as the Calculation type.

- Next, Add the secondary calculation and select the Present of Total.

Pareto Chart

- Select the Running total as the Calculation type.

Pareto Chart

It will change the position of the line chart placed on the bar chart.

Pareto Chart

Step 5: Adjusting the Pareto Chart

Pareto Chart

- Change the colour of the line chart and the bar chart from the Colours Section of the Marks Card.

Pareto Chart

The resultant Pareto Chart is:

Area Chart

An effective tool for visualising quantitative data over a given time periods is an area chart. It's a great way to see the cumulative total of several different data series and how each one affects the total. The purpose of the chart is to show coloured regions that lie between each data series' line and the axis. This gives each component's relative proportions a clear visual representation. A better grasp of the trends and patterns in the data is provided by the shaded areas, which make it simple to see how each data set changes over time and how it affects the total.

Area Chart

The process of making an Area Chart

Area Chart

Step 1: Adding features to the base chart

Area Chart

- Add the 'Order Date' to the column section.

- Choose the Month option from the drop-down option, which shows the Date in the month format. (MONTH(Order Date)).

- Now, add the Quantity to the rows.

Area Chart

It will give a line chart.

Area Chart

Step 2: Adjusting Marks Card

Area Chart

- Change the drop-down menu of Marks card to Area.

- Add Ship Mode to the colour card.

- Add region to the label card

- Add Subcategory to the detail card.

- Now, change the colour to make it more interactive.

Area Chart

Here is the resultant Area Chart:

Bullet Chart

A bullet chart is a graphical data representation used to show the progress of a single metric, like sales or revenue, towards a particular target or goal. Compared to conventional bar charts, this kind of bar chart was created expressly to offer more context and detail. Bullet charts are a useful tool for performance tracking and analysis because they make it easy for users to determine whether a metric is on track to meet goals by using color-coded ranges and markers.

Bullet Chart

Method to create Bullet Chart

Bullet Chart

- Add Profit measure to the column section.
- Add Sub-category to the row section.
- Add Sales to the label option of the marks card.
- Choose the bullet graph from the Show Me section.
- The Discount measure can also be added to the label card for more detailing.

Bullet Chart

Here is the final Bullet Chart:

Lollipop Chart

A lollipop chart is a special form of facts visualisation that effectively blends the elements of a dot plot and a bar chart. Displaying personal records points with their distribution or common values is a commonplace application for this powerful tool. A vertical line typically called the 'lollipop stick', which represents a numerical axis, makes up the chart. A circular marker or dot designating a particular fact point appears at the end of every line. In this way, by emphasizing users' values and displaying their distribution and shape, the lollipop chart gives a clean, visible depiction of complicated data sets.

Lollipop Chart

How to Make a Lollipop Chart?

Lollipop Chart

Step 1: Base of the Lollipop Charts

Lollipop Chart

- Add the 'Region' and the 'Category' feature to the Columns section.

- Add 'Sum(Profit)' to the rows section.

- Duplicate the 'Sum(Profit)' feature in the rows section.

Lollipop Chart

As a result, it gives 2 different graphs on the same axis.

Lollipop Chart

Step 2: Change the axis and modify the chart

Lollipop Chart

- Select the 2ndfeature SUM(Profit) and choose the dual axis.

- In the marks card, change the shape of the SUM(Profit) (2) to circle.

- Add 'mark labels' in the 1stSUM(Profit) from the Label card in the marks section; it will write the profit of each category.

- Adjust the size of the bar and the circle to give it a shape like a lollipop.

- Change the colour of the chart to make it more interactive.

Lollipop Chart

This is what the bullet chart looks like:

Waterfall Chart

The cumulative effect of sequentially introduced positive and negative values is commonly shown using a waterfall chart, which is a graphical representation of data. Users can better understand how individual contributions-both positive and negative-add up to a total by using this kind of chart, which is particularly useful for visualising the impact of various factors on an initial value. Waterfall charts are an invaluable tool for anyone seeking to gain deeper insights into their data, as they offer a clear and intuitive means of analysing complex data sets.

Waterfall Chart

The process to create a Waterfall Chart

Waterfall Chart

First, add the Sub-Category to the Rows section and the Sales Measure to the Column area. A bar graph is what it will produce.

Waterfall Chart

Using the Sort option in the subcategory and selecting Field under the Sort by option, step two involves sorting the bar graph in descending order.

Waterfall Chart

Step 3: Incorporate Quick Table Calculation and choose the running total option in the row section.

Waterfall Chart

Next, Select the Gantt Bars located on the Marks card in step four.

Waterfall Chart

Fifth, change the chart's size. The sales measure can now be modified by dragging it to the marks card and adding a (-) sign. It will be -SUM([Sales]).

Waterfall Chart

Step 7: Change the colour to make it more interactive.

Waterfall Chart

The resultant graph will look like a waterfall falling from upwards to downwards direction. Here is the resultant graph:

Conclusion

Tableau is a robust tool for data visualisation that offers a multitude of chart types and customisation choices to its users. This tool makes it simple for users to design and modify visualisations to suit their needs. Tableau's flexibility enables users to analyse and present data in a way that is interesting and meaningful. Users are able to create visually appealing and informative data presentations that effectively communicate their message thanks to the wide range of chart types and customisation options available.

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Tableau XML

Introduction Tableau uses XML (eXtensible Markup Language) files for various purposes, such as saving workbooks, dashboards, and data source definitions. Here are some key XML files associated with Tableau: TWB (Tableau Workbook): File Extension: .twb Description: This XML file contains the workbook metadata, including worksheets, dashboards, calculated fields, and...

Tableau XML

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Advantages of Tableau Data Visualization:- Tableau is a data visualization tool, and provides complex computation, data blending, and dashboarding for creating beautiful data visualizations. Quickly Create Interactive Visualization:- Users can create a very interactive visual by using drag n drop functionalities of Tableau. Comfortable in Implementation:- Many types of...

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? Tableau is the fastly growing and powerful data visualization tool. Tableau is a business intelligence tool which helps us to analyze the raw data in the form of the visual manner; it may be a graph, report, etc. Example: - If you have any data like...

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Certification:Tableau offers training and certification programs, including courses that cover working with data in Tableau, which may include Hyper-related topics.Tableau TrainingTableau Conference (TC) Videos:Sessions from Tableau Conferences often cover a wide range of topics, including Hyper. You can find recorded sessions on the Tableau YouTube channel.Tableau YouTube ChannelTableau Server and Tableau Online Documentation:If you're working with Tableau Server or Tableau Online and dealing with Hyper extracts, refer to the documentation specific to these components.Tableau Server DocumentationTableau Online DocumentationRemember to check the official Tableau website and documentation regularly for updates and new resources. If you encounter specific challenges or have questions, the Tableau Community is a great place to seek assistance from the vibrant Tableau user community.ApplicationsCertainly! Here's a quick guide on how you might use Tableau Hyper and relevant resources:1. Integration with Tableau Desktop:Create Hyper extracts in Tableau Desktop to leverage the in-memory data engine for fast analytics.Optimize performance by understanding how Tableau Hyper works and applying best practices.2. Automation and Programmability:Utilize the Tableau Hyper API to programmatically interact with Hyper files. This can be useful for automating data preparation, transformation, or extract creation processes.Refer to the [Tableau Hyper API Documentation](https://help.tableau.com/current/api/hyper_api/en-us/index.html) for guidance on using the API.3. Community Collaboration:Engage with the Tableau Community forums to ask questions, share insights, and collaborate with other users facing similar challenges. The [Tableau Community](https://community.tableau.com) is a valuable resource.4. Code Samples and Projects:Explore the [Tableau GitHub Repository](https://github.com/tableau) for code samples and projects related to Tableau, including Hyper. This can provide insights into how others have implemented solutions using Hyper.Remember to tailor your use of Tableau Hyper based on your specific needs, whether it's optimizing performance in Tableau Desktop, automating workflows with the Hyper API, or managing Hyper extracts in a server environment. The resources provided should help you navigate different aspects of working with Tableau Hyper effectively.AdvantagesTableau Hyper, as the in-memory data engine used by Tableau, provides several advantages that contribute to the platform's performance, scalability, and analytical capabilities. Here are some key advantages of using Tableau Hyper:In-Memory Processing:Hyper employs in-memory processing, allowing for fast data access and analysis. Data is loaded into memory, leading to quicker query responses and improved dashboard interactivity.High Performance:Hyper is designed for high performance, enabling users to work with large datasets efficiently. It facilitates rapid data aggregation, filtering, and computation, resulting in speedy visualizations.Data Compression:Hyper uses advanced compression techniques to reduce the storage footprint of data. This allows for efficient storage of large datasets without compromising query performance.Columnar Storage:Hyper stores data in a columnar format, which enhances query performance, especially for analytics and aggregations. This format is well-suited for analytical workloads commonly found in business intelligence scenarios.Parallel Processing:Hyper supports parallel processing, allowing multiple operations to be executed simultaneously. This parallelism contributes to faster data processing and analysis.Scalability:Hyper's architecture is designed for scalability. It can efficiently handle increasing amounts of data and user concurrency, making it suitable for both small-scale deployments and large enterprise environments.Compatibility with Tableau Ecosystem:Hyper is an integral part of the Tableau ecosystem, working seamlessly with other Tableau products and services. This compatibility ensures a cohesive analytics environment and smooth interactions between different Tableau components.Enhanced Data Engine for Extracts:Hyper serves as the enhanced data engine for Tableau extracts, enabling better data processing and storage capabilities compared to traditional Tableau Data Engine (TDE) files.In summary, Tableau Hyper provides a robust foundation for data processing and analysis within the Tableau ecosystem. Its in-memory processing, high performance, data compression, and compatibility with Tableau products contribute to an efficient and user-friendly analytics experience.DisadvantagesWhile Tableau Hyper offers numerous advantages, it's essential to consider potential disadvantages and challenges associated with its use:1. Resource Intensive:Hyper's in-memory processing can be resource-intensive, especially when working with large datasets. Users might experience increased memory and CPU usage, potentially impacting system performance.2. Memory Requirements:Working with large datasets in-memory may require significant RAM (Random Access Memory) resources. Users should ensure that their hardware configurations meet the memory requirements for optimal performance.3. Learning Curve:Transitioning from traditional databases to an in-memory engine like Hyper may involve a learning curve for users and administrators. Understanding the nuances of in-memory processing and optimization techniques might be necessary.4. Limited Disk I/O Optimization:While Hyper excels in in-memory operations, it may not be as optimized for disk I/O (Input/Output) operations. This can affect scenarios where frequent read or write operations to disk are required.5. Extract Refresh Times:Extracting and refreshing large datasets can take longer in Hyper, especially if data sources are remote or there are complex transformations involved. This can impact the timeliness of data updates in Tableau extracts.6. Storage Requirements:Although Hyper employs data compression, the storage requirements for Hyper extracts can still be significant, especially for very large datasets. Users should be mindful of storage constraints when working with extensive datasets.It's important to note that the perceived disadvantages can vary depending on the specific use case, organization's requirements, and the characteristics of the data being analyzed. Careful consideration of these factors can help organizations make informed decisions when incorporating Tableau Hyper into their analytics workflows.ConclusionIn short, Tableau Hyper offers high-performance, in-memory data processing, seamlessly integrated with Tableau analytics. Its advantages include fast analytics, scalability, and compatibility. However, potential challenges include resource intensity and considerations around storage. Organizations should weigh these factors to make informed decisions aligning with their specific analytics needs and infrastructure capabilities.Next TopicTableau-xml? prevnext ?

Introduction

Tableau Hyper is the in-memory data engine used by Tableau for fast data analytics and visualization. If you're looking for resources to support your work with Tableau Hyper, here are some valuable references:

Introduction

Tableau Hyper API Documentation:

Introduction

The official Tableau Hyper API documentation provides comprehensive information about using the Hyper API to interact with Hyper files programmatically.

Introduction

Tableau Hyper API Documentation

Introduction

Tableau Hyper Documentation:

Introduction

The general Tableau documentation includes information about working with Hyper files, Hyper extracts, and optimizing performance.

Introduction

Tableau Hyper Documentation

Introduction

Tableau Community:

Introduction

The Tableau Community forums are an excellent resource for getting help, asking questions, and sharing knowledge with other Tableau users and experts.

Introduction

Tableau Community

Introduction

Tableau GitHub Repository:

Introduction

The Tableau GitHub repository provides access to various Tableau-related projects and code samples, including some related to Hyper.

Introduction

Tableau GitHub Repository

Introduction

Tableau Blog:

Introduction

The Tableau blog often features articles and posts related to Hyper, providing insights, tips, and best practices.

Introduction

Tableau Blog

Introduction

Tableau Training and Certification:

Introduction

Tableau offers training and certification programs, including courses that cover working with data in Tableau, which may include Hyper-related topics.

Introduction

Tableau Training

Introduction

Tableau Conference (TC) Videos:

Introduction

Sessions from Tableau Conferences often cover a wide range of topics, including Hyper. You can find recorded sessions on the Tableau YouTube channel.

Introduction

Tableau YouTube Channel

Introduction

Tableau Server and Tableau Online Documentation:

Introduction

If you're working with Tableau Server or Tableau Online and dealing with Hyper extracts, refer to the documentation specific to these components.

Introduction

- Tableau Server Documentation
- Tableau Online Documentation

Introduction

Remember to check the official Tableau website and documentation regularly for updates and new resources. If you encounter specific challenges or have questions, the Tableau Community is a great place to seek assistance from the vibrant Tableau user community.

Applications

Certainly! Here's a quick guide on how you might use Tableau Hyper and relevant resources:

Applications

1. Integration with Tableau Desktop:

Applications

- Create Hyper extracts in Tableau Desktop to leverage the in-memory data engine for fast analytics.
- Optimize performance by understanding how Tableau Hyper works and applying best practices.

Applications

2. Automation and Programmability:

Applications

- Utilize the Tableau Hyper API to programmatically interact with Hyper files. This can be useful for automating data preparation, transformation, or extract creation processes.

- Refer to the [Tableau Hyper API Documentation](https://help.tableau.com/current/api/hyper_api/en-us/index.html) for guidance on using the API.

Applications

3. Community Collaboration:

Applications

- Engage with the Tableau Community forums to ask questions, share insights, and collaborate with other users facing similar challenges. The [Tableau Community](https://community.tableau.com) is a valuable resource.

Applications

4. Code Samples and Projects:

Applications

- Explore the [Tableau GitHub Repository](https://github.com/tableau) for code samples and projects related to Tableau, including Hyper. This can provide insights into how others have implemented solutions using Hyper.

Applications

Remember to tailor your use of Tableau Hyper based on your specific needs, whether it's optimizing performance in Tableau Desktop, automating workflows with the Hyper API, or managing Hyper extracts in a server environment. The resources provided should help you navigate different aspects of working with Tableau Hyper effectively.

Advantages

Tableau Hyper, as the in-memory data engine used by Tableau, provides several advantages that contribute to the platform's performance, scalability, and analytical capabilities. Here are some key advantages of using Tableau Hyper:

Advantages

In-Memory Processing:

Advantages

Hyper employs in-memory processing, allowing for fast data access and analysis. Data is loaded into memory, leading to quicker query responses and improved dashboard interactivity.

Advantages

High Performance:

Advantages

Hyper is designed for high performance, enabling users to work with large datasets efficiently. It facilitates rapid data aggregation, filtering, and computation, resulting in speedy visualizations.

Advantages

Data Compression:

Advantages

Hyper uses advanced compression techniques to reduce the storage footprint of data. This allows for efficient storage of large datasets without compromising query performance.

Advantages

Columnar Storage:

Advantages

Hyper stores data in a columnar format, which enhances query performance, especially for analytics and aggregations. This format is well-suited for analytical workloads commonly found in business intelligence scenarios.

Advantages

Parallel Processing:

Advantages

Hyper supports parallel processing, allowing multiple operations to be executed simultaneously. This parallelism contributes to faster data processing and analysis.

Advantages

Scalability:

Advantages

Hyper's architecture is designed for scalability. It can efficiently handle increasing amounts of data and user concurrency, making it suitable for both small-scale deployments and large enterprise environments.

Advantages

Compatibility with Tableau Ecosystem:

Advantages

Hyper is an integral part of the Tableau ecosystem, working seamlessly with other Tableau products and services. This compatibility ensures a cohesive analytics environment and smooth interactions between different Tableau components.

Advantages

Enhanced Data Engine for Extracts:

Advantages

Hyper serves as the enhanced data engine for Tableau extracts, enabling better data processing and storage capabilities compared to traditional Tableau Data Engine (TDE) files.

Advantages

In summary, Tableau Hyper provides a robust foundation for data processing and analysis within the Tableau ecosystem. Its in-memory processing, high performance, data compression, and compatibility with Tableau products contribute to an efficient and user-friendly analytics experience.

Disadvantages

While Tableau Hyper offers numerous advantages, it's essential to consider potential disadvantages and challenges associated with its use:

Disadvantages

1. Resource Intensive:

Disadvantages

- Hyper's in-memory processing can be resource-intensive, especially when working with large datasets. Users might experience increased memory and CPU usage, potentially impacting system performance.

Disadvantages

2. Memory Requirements:

Disadvantages

- Working with large datasets in-memory may require significant RAM (Random Access Memory) resources. Users should ensure that their hardware configurations meet the memory requirements for optimal performance.

Disadvantages

3. Learning Curve:

Disadvantages

- Transitioning from traditional databases to an in-memory engine like Hyper may involve a learning curve for users and administrators. Understanding the nuances of in-memory processing and optimization techniques might be necessary.

Disadvantages

4. Limited Disk I/O Optimization:

Disadvantages

- While Hyper excels in in-memory operations, it may not be as optimized for disk I/O (Input/Output) operations. This can affect scenarios where frequent read or write operations to disk are required.

Disadvantages

5. Extract Refresh Times:

Disadvantages

- Extracting and refreshing large datasets can take longer in Hyper, especially if data sources are remote or there are complex transformations involved. This can impact the timeliness of data updates in Tableau extracts.

Disadvantages

6. Storage Requirements:

Disadvantages

- Although Hyper employs data compression, the storage requirements for Hyper extracts can still be significant, especially for very large datasets. Users should be mindful of storage constraints when working with extensive datasets.

Disadvantages

It's important to note that the perceived disadvantages can vary depending on the specific use case, organization's requirements, and the characteristics of the data being analyzed. Careful consideration of these factors can help organizations make informed decisions when incorporating Tableau Hyper into their analytics workflows.

Conclusion

In short, Tableau Hyper offers high-performance, in-memory data processing, seamlessly integrated with Tableau analytics. Its advantages include fast analytics, scalability, and compatibility. However, potential challenges include resource intensity and considerations around storage. Organizations should weigh these factors to make informed decisions aligning with their specific analytics needs and infrastructure capabilities.

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Tableau XML

Introduction Tableau uses XML (eXtensible Markup Language) files for various purposes, such as saving workbooks, dashboards, and data source definitions. Here are some key XML files associated with Tableau: TWB (Tableau Workbook): File Extension: .twb Description: This XML file contains the workbook metadata, including worksheets, dashboards, calculated fields, and...

Tableau XML

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History of Tableau

Until the early 21st century, the Database were used to produce numbers and data. It's the job of IT professionals to analyze the data and create reports. Tableau was founded by Pat Hanrahan, Christian Chabot, and Chris Stolte from Stanford University in 2003. The main idea behind...

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It's a highly compressed and efficient columnar store format for analytics.These files can be opened and viewed using a text editor, but modifying them manually is not recommended unless you have a good understanding of the Tableau XML structure. The XML files store the configuration and metadata information of your Tableau work, and making incorrect changes could lead to corruption or data loss.ApplicationsTableau XML files are primarily used for storing metadata, configurations, and definitions related to Tableau workbooks, dashboards, data sources, and other components. Here are some common uses for Tableau XML files:1. Workbook Storage (TWB):Use: TWB files store the metadata and configuration of a Tableau workbook. They include information about worksheets, dashboards, calculated fields, and connections to data sources.Scenario: When you save a Tableau workbook without extracting data, it is saved as a TWB file.2. Packaged Workbooks (TWBX):Use: TWBX files are packaged workbooks that include both the workbook (TWB) and the associated data source. They are used for sharing Tableau workbooks with others while preserving the data.Scenario: When you want to share a Tableau workbook and its data with others, you can save it as a TWBX file.3. Data Extract Storage (TDE):Use: TDE files store data extracts created in Tableau. They are binary files optimized for Tableau's performance.Scenario: When you create a data extract in Tableau, it is saved as a TDE file.4. Tableau Bookmarks (TBM):Use: TBM files store Tableau bookmarks, which are reusable, shareable snippets of a Tableau workbook.Scenario: When you want to save and share a specific view or configuration of a Tableau workbook, you can use a TBM file.5. Data Extract Information (TDEINFO):Use: TDEINFO files accompany TDE files and contain additional information about the extract, such as schema and indexing details.Scenario: They are used to provide supplementary information about the associated TDE file.6. Custom SQL Calculations (TDIMENSION, TDMEASURE, TDATTRIBUTE):Use: These XML files are generated when you export a single field from Tableau as a custom SQL calculation.Scenario: When you create a custom SQL calculation in Tableau, these files may be generated to store information about the calculation.7. Tableau Hyper Data Extracts (HYPER):Use: HYPER files are the default file format for Tableau Data Extracts (starting from Tableau 10.5). They are highly compressed and efficient columnar store formats for analytics.Scenario: When you create a data extract in newer versions of Tableau, it is saved as a HYPER file.These XML files play a crucial role in storing and organizing the elements of Tableau workbooks and data extracts, facilitating data analysis and visualization. They are essential for sharing, collaboration, and maintaining the integrity of Tableau projects.AdvantagesTableau XML, specifically related to Tableau workbooks and data sources, provides a way to interact with and manipulate Tableau files programmatically. Here are some advantages of using Tableau XML:Automation and Scripting:XML files can be manipulated using scripts and automation tools. This is particularly useful for repetitive tasks, such as updating data connections or modifying workbook settings across multiple Tableau files.Version Control:XML files can be versioned using version control systems like Git. This allows teams to track changes made to Tableau workbooks and data sources over time, facilitating collaboration and ensuring that everyone is working with the latest version.Customization:Tableau XML allows for customization of workbooks and data sources beyond the capabilities of the Tableau user interface. This can include fine-tuning parameters, adjusting formatting, or implementing specific business logic not easily achieved through the standard Tableau interface.Integration with Other Systems:XML can be used to integrate Tableau files with other systems and applications. This is particularly relevant when Tableau is part of a larger data ecosystem, and data or metadata needs to be exchanged between Tableau and other tools.Bulk Updates:XML provides a way to make bulk updates to multiple Tableau files simultaneously. This is beneficial for managing large-scale Tableau deployments where changes need to be propagated across numerous workbooks or data sources.Scripted

Deployment:XML manipulation allows for scripted deployment of Tableau assets. This is useful for automating the deployment process, ensuring consistency, and reducing the likelihood of human errors during deployment.DisadvantagesWhile Tableau XML provides several advantages, there are also some potential disadvantages and considerations associated with directly manipulating XML files:Complexity:Working with XML directly requires a good understanding of the Tableau XML schema and structure. The complexity can increase with the sophistication of the workbook or data source, making it challenging for users who are not familiar with XML.Error-Prone:Manually editing XML files introduces the risk of errors, typos, or syntax mistakes. A small mistake in the XML structure can lead to corrupted Tableau files, making it important to approach XML manipulation with caution.Lack of Validation:Unlike changes made through the Tableau user interface or supported APIs, direct XML manipulation may bypass certain validation processes. This means that changes made in the XML might not be thoroughly validated for compatibility, potentially leading to unexpected behaviour or issues.Limited Documentation:While Tableau provides documentation on its XML structure, it might not cover every detail or corner case. Users may find themselves relying on trial and error or community support for more complex scenarios.Version Compatibility:Tableau XML structure may evolve with new software releases. Directly manipulating XML files created with one version of Tableau in a different version may result in compatibility issues or unexpected behaviour.No Undo Functionality:Unlike the Tableau user interface, which often provides undo functionality, changes made directly to XML files may not have an easy undo mechanism. Users should be cautious and consider creating backups before making extensive modifications.Security Risks:Direct XML manipulation could potentially introduce security risks if not done securely. For example, exposing sensitive information in the XML or making incorrect changes to permissions could compromise the security of Tableau workbooks and data sources.Not User-Friendly:For users who are not comfortable with XML or prefer a user-friendly interface, direct manipulation of XML files may be a less accessible or less intuitive method of making changes to Tableau assets.While Tableau XML can be a powerful tool for advanced users and automation scenarios, it's essential to carefully weigh the advantages and disadvantages. In many cases, Tableau's provided tools, APIs, and user interface may offer safer and more user-friendly alternatives for achieving specific tasks. Users should choose the method that best aligns with their expertise and the complexity of the task at hand.ConclusionIn short, Tableau XML offers powerful automation and customization capabilities, enabling users to script changes, version control, and perform bulk updates. However, its complexity, error-prone nature, and potential lack of validation make it less user-friendly and riskier compared to using Tableau's standard tools and interfaces. Users should carefully consider their expertise, task complexity, and the availability of alternative methods before opting for direct XML manipulation.Next TopicSailing-to-byzantium-poem-summary-and-analysis? prevnext ?

Introduction

Tableau uses XML (eXtensible Markup Language) files for various purposes, such as saving workbooks, dashboards, and data source definitions. Here are some key XML files associated with Tableau:

TWB (Tableau Workbook):

File Extension:.twb

TWB (Tableau Workbook):

Description: This XML file contains the workbook metadata, including worksheets, dashboards, calculated fields, and connections to data sources. It does not store the data itself but references the data source.

TWBX (Tableau Packaged Workbook):

File Extension:.twbx

TWBX (Tableau Packaged Workbook):

Description: This is a packaged workbook that includes both the workbook (TWB) and the data source. It is essentially a zip file containing a TWB file and the associated data extracts.

TDE (Tableau Data Extract):

File Extension:.tde

TDE (Tableau Data Extract):

Description: This file format is used to store extracts of data from a data source. It is a binary file that is optimized for Tableau's performance.

TBM (Tableau Bookmark):

File Extension:.tbm

TBM (Tableau Bookmark):

Description: This XML file is used to save a Tableau bookmark, which is a reusable, shareable snippet of a Tableau workbook.

TDEINFO:

File Extension:.tdeinfo

TDEINFO:

Description: This file accompanies TDE files and contains information about the extract, such as the schema and indexing details.

TDIMENSION, TDMEASURE, TDATTRIBUTE:

File Extensions:.tdimension, .tdmeasure, .tdattribute

TDIMENSION, TDMEASURE, TDATTRIBUTE:

Description: These XML files are generated when you export a single field from Tableau as a custom SQL calculation.

TBM(Tableau Bookmark):

File Extension:.tbm

TBM(Tableau Bookmark):

Description: This XML file is used to save a Tableau bookmark, which is a reusable, shareable snippet of a Tableau workbook.

HYPER (Tableau Hyper Data Extract):

File Extension:.hyper

HYPER (Tableau Hyper Data Extract):

Description: Starting from Tableau 10.5, Hyper is the default file format for Tableau Data Extracts. It's a highly compressed and efficient columnar store format for analytics.

HYPER (Tableau Hyper Data Extract):

These files can be opened and viewed using a text editor, but modifying them manually is not recommended unless you have a good understanding of the Tableau XML structure. The XML files store the configuration and metadata information of your Tableau work, and making incorrect changes could lead to corruption or data loss.

Applications

Tableau XML files are primarily used for storing metadata, configurations, and definitions related to Tableau workbooks, dashboards, data sources, and other components. Here are some common uses for Tableau XML files:

Applications

1. Workbook Storage (TWB):

Applications

- Use: TWB files store the metadata and configuration of a Tableau workbook. They include information about worksheets, dashboards, calculated fields, and connections to data sources.
- Scenario: When you save a Tableau workbook without extracting data, it is saved as a TWB file.

Applications

2. Packaged Workbooks (TWBX):

Applications

- Use: TWBX files are packaged workbooks that include both the workbook (TWB) and the associated data source. They are used for sharing Tableau workbooks with others while preserving the data.
- Scenario: When you want to share a Tableau workbook and its data with others, you can save it as a TWBX file.

Applications

3. Data Extract Storage (TDE):

Applications

- Use: TDE files store data extracts created in Tableau. They are binary files optimized for Tableau's performance.
- Scenario: When you create a data extract in Tableau, it is saved as a TDE file.

Applications

4. Tableau Bookmarks (TBM):

Applications

- Use: TBM files store Tableau bookmarks, which are reusable, shareable snippets of a Tableau workbook.
- Scenario: When you want to save and share a specific view or configuration of a Tableau workbook, you can use a TBM file.

Applications

5. Data Extract Information (TDEINFO):

Applications

- Use: TDEINFO files accompany TDE files and contain additional information about the extract, such as schema and indexing details.

- Scenario: They are used to provide supplementary information about the associated TDE file.

Applications

6. Custom SQL Calculations (TDIMENSION, TDMEASURE, TDATTRIBUTE):

Applications

- Use: These XML files are generated when you export a single field from Tableau as a custom SQL calculation.

- Scenario: When you create a custom SQL calculation in Tableau, these files may be generated to store information about the calculation.

Applications

7. Tableau Hyper Data Extracts (HYPER):

Applications

- Use: HYPER files are the default file format for Tableau Data Extracts (starting from Tableau 10.5). They are highly compressed and efficient columnar store formats for analytics.

- Scenario: When you create a data extract in newer versions of Tableau, it is saved as a HYPER file.

Applications

These XML files play a crucial role in storing and organizing the elements of Tableau workbooks and data extracts, facilitating data analysis and visualization. They are essential for sharing, collaboration, and maintaining the integrity of Tableau projects.

Advantages

Tableau XML, specifically related to Tableau workbooks and data sources, provides a way to interact with and manipulate Tableau files programmatically. Here are some advantages of using

Tableau XML:

Advantages

- Automation and Scripting:

Advantages

XML files can be manipulated using scripts and automation tools. This is particularly useful for repetitive tasks, such as updating data connections or modifying workbook settings across multiple Tableau files.

Advantages

- Version Control:

Advantages

XML files can be versioned using version control systems like Git. This allows teams to track changes made to Tableau workbooks and data sources over time, facilitating collaboration and ensuring that everyone is working with the latest version.

Advantages

- Customization:

Advantages

Tableau XML allows for customization of workbooks and data sources beyond the capabilities of the Tableau user interface. This can include fine-tuning parameters, adjusting formatting, or implementing specific business logic not easily achieved through the standard Tableau interface.

Advantages

- Integration with Other Systems:

Advantages

XML can be used to integrate Tableau files with other systems and applications. This is particularly relevant when Tableau is part of a larger data ecosystem, and data or metadata needs to be exchanged between Tableau and other tools.

Advantages

- Bulk Updates:

Advantages

XML provides a way to make bulk updates to multiple Tableau files simultaneously. This is beneficial for managing large-scale Tableau deployments where changes need to be propagated across numerous workbooks or data sources.

Advantages

- Scripted Deployment:

Advantages

XML manipulation allows for scripted deployment of Tableau assets. This is useful for automating the deployment process, ensuring consistency, and reducing the likelihood of human errors during deployment.

Disadvantages

While Tableau XML provides several advantages, there are also some potential disadvantages and considerations associated with directly manipulating XML files:

Disadvantages

- Complexity:

Disadvantages

Working with XML directly requires a good understanding of the Tableau XML schema and structure. The complexity can increase with the sophistication of the workbook or data source, making it challenging for users who are not familiar with XML.

Disadvantages

- Error-Prone:

Disadvantages

Manually editing XML files introduces the risk of errors, typos, or syntax mistakes. A small mistake in the XML structure can lead to corrupted Tableau files, making it important to approach XML manipulation with caution.

Disadvantages

- Lack of Validation:

Disadvantages

Unlike changes made through the Tableau user interface or supported APIs, direct XML manipulation may bypass certain validation processes. This means that changes made in the XML might not be thoroughly validated for compatibility, potentially leading to unexpected behaviour or issues.

Disadvantages

- Limited Documentation:

Disadvantages

While Tableau provides documentation on its XML structure, it might not cover every detail or corner case. Users may find themselves relying on trial and error or community support for more complex scenarios.

Disadvantages

- Version Compatibility:

Disadvantages

Tableau XML structure may evolve with new software releases. Directly manipulating XML files created with one version of Tableau in a different version may result in compatibility issues or unexpected behaviour.

Disadvantages

- No Undo Functionality:

Disadvantages

Unlike the Tableau user interface, which often provides undo functionality, changes made directly to XML files may not have an easy undo mechanism. Users should be cautious and consider creating backups before making extensive modifications.

Disadvantages

- Security Risks:

Disadvantages

Direct XML manipulation could potentially introduce security risks if not done securely. For example, exposing sensitive information in the XML or making incorrect changes to permissions could compromise the security of Tableau workbooks and data sources.

Disadvantages

- Not User-Friendly:

Disadvantages

For users who are not comfortable with XML or prefer a user-friendly interface, direct manipulation of XML files may be a less accessible or less intuitive method of making changes to Tableau assets.

Disadvantages

While Tableau XML can be a powerful tool for advanced users and automation scenarios, it's essential to carefully weigh the advantages and disadvantages. In many cases, Tableau's provided tools, APIs, and user interface may offer safer and more user-friendly alternatives for achieving specific tasks. Users should choose the method that best aligns with their expertise and the complexity of the task at hand.

Conclusion

In short, Tableau XML offers powerful automation and customization capabilities, enabling users to script changes, version control, and perform bulk updates. However, its complexity, error-prone nature, and potential lack of validation make it less user-friendly and riskier compared to using Tableau's standard tools and interfaces. Users should carefully consider their expertise, task complexity, and the availability of alternative methods before opting for direct XML manipulation.

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Reinforcement Learning TutorialOur Reinforcement learning tutorial will give you a complete overview of reinforcement learning, including MDP and Q-learning. In RL tutorial, you will learn the below topics:What is Reinforcement Learning?Terms used in Reinforcement Learning.Key features of Reinforcement Learning.Elements of Reinforcement Learning.Approaches to implementing Reinforcement Learning.How does Reinforcement Learning Work?The Bellman Equation.Types of Reinforcement Learning.Reinforcement Learning Algorithm.Markov Decision Process.What is Q-Learning?Difference between Supervised Learning and Reinforcement Learning.Applications of Reinforcement Learning.Conclusion.What is Reinforcement Learning?Reinforcement Learning is a feedback-based Machine learning technique in which an agent learns to behave in an environment by performing the actions and seeing the results of actions. For each good action, the agent gets positive feedback, and for each bad action, the agent gets negative feedback or penalty.In Reinforcement Learning, the agent learns automatically using feedbacks without any labeled data, unlikesupervised learning.Since there is no labeled data, so the agent is bound to learn by its experience only.RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such asgame-playing, robotics, etc.The agent interacts with the environment and explores it by itself. The primary goal of an agent in reinforcement learning is to improve the performance by getting the maximum positive rewards.The agent learns with the process of hit and trial, and based on the experience, it learns to perform the task in a better way. Hence, we can say that"Reinforcement learning is a type of machine learning method where an intelligent agent (computer program) interacts with the environment and learns to act within that."How a Robotic dog learns the movement of his arms is an example of Reinforcement learning.It is a core part ofArtificial intelligence, and allAI agentworks on the concept of reinforcement learning. Here we do not need to pre-program the agent, as it learns from its own experience without any human intervention.Example:Suppose there is an AI agent present within a maze environment, and his goal is to find the diamond. The agent interacts with the environment by performing some actions, and based on those actions, the state of the agent gets changed, and it also receives a reward or penalty as feedback.The agent continues doing these three things (take action, change state/remain in the same state, and get feedback), and by doing these actions, he learns and explores the environment.The agent learns that what actions lead to positive feedback or rewards and what actions lead to negative feedback penalty. As a positive reward, the agent gets a positive point, and as a penalty, it gets a negative point.Terms used in Reinforcement LearningAgent():An entity that can perceive/explore the environment and act upon it.Environment():A situation in which an agent is present or surrounded by. In RL, we assume the stochastic environment, which means it is random in nature.Action():Actions are the moves taken by an agent within the environment.State():State is a situation returned by the environment after each action taken by the agent.Reward():A feedback returned to the agent from the environment to evaluate the action of the agent.Policy():Policy is a strategy applied by the agent for the next action based on the current state.Value():It is expected long-term retuned with the discount factor and opposite to the short-term reward.Q-value():It is mostly similar to the value, but it takes one additional parameter as a current action (a).Key Features of Reinforcement LearningIn RL, the agent is not instructed about the environment and what actions need to be taken.It is based on the hit and trial process.The agent takes the next action and changes states according to the feedback of the previous action.The agent may get a delayed reward.The environment is stochastic, and the agent needs to explore it to reach to get the maximum positive rewards.Approaches to implement Reinforcement LearningThere are mainly three ways to implement reinforcement-learning in ML, which are:Value-based:The value-based approach is about to find the optimal value function, which is the maximum value at a state under any policy. Therefore, the agent expects the long-term return at any state(s) under policy ?.Policy-based:Policy-based approach is to find the optimal policy for the maximum future rewards without using the value function. In this approach, the agent tries to apply such a policy that the action performed in each step helps to maximize the future reward.The policy-based approach has mainly two types of policy:Deterministic:The same action is produced by the policy (?) at any state.Stochastic:In this policy, probability determines the produced action.Model-based:In the model-based approach, a virtual model is created for the environment, and the agent explores that environment to learn it. There is no particular solution or algorithm for this approach because the model representation is different for each environment.Elements of Reinforcement LearningThere are four main elements of Reinforcement Learning, which are given below:PolicyReward SignalValue FunctionModel of the environment1) Policy:A policy can be defined as a way how an agent behaves at a given time. It maps the perceived states of the environment to the actions taken on those states. A policy is the core element of the RL as it alone can define the behavior of the agent. In some cases, it may be a simple function or a lookup table, whereas, for other cases, it may involve general computation as a search process. It could be deterministic or a stochastic policy:For deterministic policy: a = ?(s)For stochastic policy: ?(a | s) = P[At =a | St = s]2) Reward Signal:The goal of reinforcement learning is defined by the reward signal. At each state, the environment sends an immediate signal to the learning agent, and this signal is known as areward signal. These rewards are given according to the good and bad actions taken by the agent. The agent's main objective is to maximize the total number of rewards for good actions. The reward signal can change the policy, such as if an action selected by the agent leads to low reward, then the policy may change to select other actions in the future.3) Value Function:The value function gives information about how good the situation and action are and how much reward an agent can expect. A reward indicates theimmediate signal for each good and bad action, whereas a value function specifiesthe good state and action for the future. The value function depends on the reward as, without reward, there could be no value. The goal of estimating values is to achieve more rewards.4) Model:The last element of reinforcement learning is the model, which mimics the behavior of the environment. With the help of the model, one can make inferences about how the environment will behave. Such as, if a state and an action are given, then a model can predict the next state and reward.The model is used for planning, which means it provides a way to take a course of action by considering all future situations before actually experiencing those situations. The approaches for solving the RL problemswith the help of the modelare termed as themodel-based approach. Comparatively, an approachwithout using a modelis called amodel-free approach.How does Reinforcement Learning Work?To understand the working process of the RL, we need to consider two main things:Environment:It can be anything such as a room, maze, football ground, etc.Agent:An intelligent agent such as AI robot.Let's take an example of a maze environment that the agent needs to explore. Consider the below image:In the above image, the agent is at the very first block of the maze. The maze is consisting of an S6block, which is awall, S8afire pit, and S4adiamond block.The agent cannot cross the S6block, as it is a solid wall. If the agent reaches the S4block, then get the+1 reward;if it reaches the fire pit, then gets-1 reward point. It can take four actions: move up, move down, move left, and move right.The agent can take any path to reach to the final point, but he needs to make it in possible fewer steps. Suppose the agent considers the pathS9-S5-S1-S2-S3, so he will get the +1-reward point.The agent will try to remember the preceding steps that it has taken to reach the final step. To memorize the steps, it assigns 1 value to each previous step. Consider the below step:Now, the agent has successfully stored the previous steps assigning the 1 value to each previous block. But what will the agent do if he starts moving from the block, which has 1 value block on both sides? Consider the below diagram:It will be a difficult condition for the agent whether he should go up or down as each block has the same value. So, the above approach is not suitable for the agent to reach the destination. Hence to solve the problem, we will use theBellman equation, which is the main concept behind reinforcement learning.The Bellman EquationThe Bellman equation was introduced by the MathematicianRichard Ernest Bellman in the year 1953, and hence it is called as a Bellman equation. It is associated with dynamic programming and used to calculate the values of a decision problem at a certain point by including the values of previous states.It is a way of calculating the value functions in dynamic programming or environment that leads to modern reinforcement learning.The key-elements used in Bellman equations are:Action performed by the agent is referred to as "a"State occurred by performing the action is "s."The reward/feedback obtained for each good and bad action is "R."A discount factor is Gamma "?."The Bellman equation can be written as:V(s) = max [R(s,a) + ?V(s`)]Where,V(s)= value calculated at a particular point.R(s,a) = Reward at a particular state s by performing an action.? = Discount factorV(s`) = The value at the previous state.In the above equation, we are taking the max of the complete values because the agent tries to find the optimal solution always.So now, using the Bellman equation, we will find value at each state of the given environment. We will start from the block, which is next to the target block.For 1st block:V(s3) = max [R(s,a) + ?V(s`)], here V(s')= 0 because there is no further state to move.V(s3)= max[R(s,a)]=> V(s3)= max[1]=>V(s3)= 1.For 2nd block:V(s2) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 1, and R(s, a)= 0, because there is no reward at this state.V(s2)= max[0.9(1)]=> V(s)= max[0.9]=>V(s2) =0.9For 3rd block:V(s1) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 0.9, and R(s, a)= 0, because there is no reward at this state also.V(s1)= max[0.9(0.9)]=> V(s3)= max[0.81]=>V(s1) =0.81For 4th block:V(s5) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 0.81, and R(s, a)= 0, because there is no reward at this state also.V(s5)= max[0.9(0.81)]=> V(s5)= max[0.81]=>V(s5) =0.73For 5th block:V(s9) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 0.73, and R(s, a)= 0, because there is no reward at this state also.V(s9)= max[0.9(0.73)]=> V(s4)= max[0.81]=>V(s4) =0.66Consider the below image:Now, we will move further to the 6thblock, and here agent may change the route because it always tries to find the optimal path. So now, let's consider from the block next to the fire pit.Now, the agent has three options to move; if he moves to the blue box, then he will feel a bump if he moves to the fire pit, then he will get the -1 reward. But here we are taking only positive rewards, so for this, he will move to upwards only. The complete block values will be calculated using this formula. Consider the below image:Types of Reinforcement learningThere are mainly two types of reinforcement learning, which are:Positive ReinforcementNegative ReinforcementPositive Reinforcement:The positive reinforcement learning means adding something to increase the tendency that expected behavior would occur again. It impacts positively on the behavior of the agent and increases the strength of the behavior.This type of reinforcement can sustain the changes for a long time, but too much positive reinforcement may lead to an overload of states that can reduce the consequences.Negative Reinforcement:The negative reinforcement learning is opposite to the positive reinforcement as it increases the tendency that the specific behavior will occur again by avoiding the negative condition.It can be more effective than the positive reinforcement depending on situation and behavior, but it provides reinforcement only to meet minimum behavior.How to represent the agent state?We can represent the agent state using theMarkov Statethat contains all the required information from the history. The State St is Markov state if it follows the given condition:P[St+1 | St] = P[St+1 | S1,......, St]The Markov state follows theMarkov property, which says that the future is independent of the past and can only be defined with the present. The RL works on fully observable environments, where the agent can observe the environment and act for the new state. The complete process is known as Markov Decision process, which is explained below:Markov Decision ProcessMarkov Decision Process or MDP, is used toformalize the reinforcement learning problems. If the environment is completely observable, then its dynamic can be modeled as aMarkov Process. In MDP, the agent constantly interacts with the environment and performs actions; at each action, the environment responds and generates a new state.MDP is used to describe the environment for the RL, and almost all the RL problem can be formalized using MDP.MDP contains a tuple of four elements (S, A, Pa, Ra):A set of finite States SA set of finite Actions ARewards received after transitioning from state S to state S', due to action a.Probability Pa.MDP usesMarkov property, and to better understand the MDP, we need to learn about it.Markov Property:It says that"If the agent is present in the current state S1, performs an action a1 and move to the state s2, then the state transition from s1 to s2 only depends on the current state and future action and states do not depend on past actions, rewards, or states."Or, in other words, as per Markov Property, the current state transition does not depend on any past action or state. Hence, MDP is an RL problem that satisfies the Markov property. Such as in aChess game, the players only focus on the current state and do not need to remember past actions or states.Finite MDP:A finite MDP is when there are finite states, finite rewards, and finite actions. In RL, we consider only the finite MDP.Markov Process:Markov Process is a memoryless process with a sequence of random states S1, S2, ..., Stthat uses the Markov Property. Markov process is also known as Markov chain, which is a tuple (S, P) on state S and transition function P. These two components (S and P) can define the dynamics of the system.Reinforcement Learning AlgorithmsReinforcement learning algorithms are mainly used in AI applications and gaming applications. The main used algorithms are:Q-Learning:Q-learning is anOff policy RL algorithm, which is used for the temporal difference Learning. The temporal difference learning methods are the way of comparing temporally successive predictions.It learns the value function Q (S, a), which means how good to take action "a" at a particular state "s."The below flowchart explains the working of Q- learning:State Action Reward State action (SARSA):SARSA stands forState Action Reward State action, which is anon-policytemporal difference learning method. The on-policy control method selects the action for each state while learning using a specific policy.The goal of SARSA is to calculate theQ ? (s, a) for the selected current policy ? and all pairs of (s-a).The main difference between Q-learning and SARSA algorithms is thatunlike Q-learning, the maximum reward for the next state is not required for updating the Q-value in the table.In SARSA, new action and reward are selected using the same policy, which has determined the original action.The SARSA is named because it uses the quintupleQ(s, a, r, s', a').Where,s: original statea: Original actionr: reward observed while following the statess' and a': New state, action pair.Deep Q Neural Network (DQN):As the name suggests, DQN is aQ-learning using Neural networks.For a big state space environment, it will be a challenging and complex task to define and update a Q-table.To solve such an issue, we can use a DQN algorithm. Where, instead of defining a Q-table, neural network approximates the Q-values for each action and state.Now, we will expand the Q-learning.Q-Learning Explanation:Q-learning is a popular model-free reinforcement learning algorithm based on the Bellman equation.The main objective of Q-learning is to learn the policy which can inform the agent that what actions should be taken for maximizing the reward under what circumstances.It is anoff-policy RLthat attempts to find the best action to take at a current state.The goal of the agent in Q-learning is to maximize the value of Q.The value of Q-learning can be derived from the Bellman equation. Consider the Bellman equation given below:In the equation, we have various components, including reward, discount factor (?), probability, and end states s'. But there is no any Q-value is given so first consider the below image:In the above image, we can see there is an agent who has three values options, V(s1), V(s2), V(s3). As this is MDP, so agent only cares for the current state and the future state. The agent can go to any direction (Up, Left, or Right), so he needs to decide where to go for the optimal path. Here agent will take a move as per probability bases and changes the state. But if we want some exact moves, so for this, we need to make some changes in terms of Q-value. Consider the below image:Q- represents the quality of the actions at each state. So instead of using a value at each state, we will use a pair of state and action, i.e., Q(s, a). Q-value specifies that which action is more lubricative than others, and according to the best Q-value, the agent takes his next move. The Bellman equation can be used for deriving the Q-value.To perform any action, the agent will get a reward R(s, a), and also he will end up on a certain state, so the Q -value equation will be:Hence, we can say that,V(s) = max [Q(s, a)]The above formula is used to estimate the Q-values in Q-Learning.What is 'Q' in Q-learning?The Q stands forqualityinQ-learning, which means it specifies the quality of an action taken by the agent.Q-table:A Q-table or matrix is created while performing the Q-learning. The table follows the state and action pair, i.e., [s, a], and initializes the values to zero. After each action, the table is updated, and the q-values are stored within the table.The RL agent uses this Q-table as a reference table to select the best action based on the q-values.Difference between Reinforcement Learning and Supervised LearningThe Reinforcement Learning and Supervised Learning both are the part of machine learning, but both types of learnings are far opposite to each other. The RL agents interact with the environment, explore it, take action, and get rewarded. Whereas supervised learning algorithms learn from the labeled dataset and, on the basis of the training, predict the output.The difference table between RL and Supervised learning is given below:Reinforcement LearningSupervised LearningRL works by interacting with the environment.Supervised learning works on the existing dataset.The RL algorithm works like the human brain works when making some decisions.Supervised Learning works as when a human learns things in the supervision of a guide.There is no labeled dataset is presentThe labeled dataset is present.No previous training is provided to the learning agent.Training is provided to the algorithm so that it can predict the output.RL helps to take decisions sequentially.In Supervised learning, decisions are made when input is given.Reinforcement Learning ApplicationsRobotics:RL is used inRobot navigation, Robo-soccer, walking, juggling, etc.Control:RL can be used foradaptive controlsuch as Factory processes, admission control in telecommunication, and Helicopter pilot is an example of reinforcement learning.Game Playing:RL can be used inGame playingsuch as tic-tac-toe, chess, etc.Chemistry:RL can be used for optimizing the chemical reactions.Business:RL is now used for business strategy planning.Manufacturing:In various automobile manufacturing companies, the robots use deep reinforcement learning to pick goods and put them in some containers.Finance Sector:The RL is currently used in the finance sector for evaluating trading strategies.Conclusion:From the above discussion, we can say that Reinforcement Learning is one of the most interesting and useful parts of Machine learning. In RL, the agent explores the environment by exploring it without any human intervention. It is the main learning algorithm that is used in Artificial Intelligence. But there are some cases where it should not be used, such as if you have enough data to solve the problem, then other ML algorithms can be used more efficiently. The main issue with the RL algorithm is that some of the parameters may affect the speed of the learning, such as delayed feedback. | Reinforcement Learning | Supervised Learning | RL works by interacting with the environment. | Supervised learning works on the existing dataset. | The RL algorithm works like the human brain works when making some decisions. | Supervised Learning works as when a human learns things in the supervision of a guide. | There is no labeled dataset is present | The labeled dataset is present. | No previous training is provided to the learning agent. | Training is provided to the algorithm so that it can predict the output. | RL helps to take decisions sequentially. | In Supervised learning, decisions are made when input is given.

Reinforcement Learning | Supervised Learning

RL works by interacting with the environment. | Supervised learning works on the existing dataset.

The RL algorithm works like the human brain works when making some decisions. | Supervised Learning works as when a human learns things in the supervision of a guide.

There is no labeled dataset is present | The labeled dataset is present.

No previous training is provided to the learning agent. | Training is provided to the algorithm so that it can predict the output.

RL helps to take decisions sequentially. | In Supervised learning, decisions are made when input is given.

Reinforcement Learning Tutorial

Our Reinforcement learning tutorial will give you a complete overview of reinforcement learning, including MDP and Q-learning. In RL tutorial, you will learn the below topics:

Reinforcement Learning Tutorial

- What is Reinforcement Learning?
- Terms used in Reinforcement Learning.
- Key features of Reinforcement Learning.
- Elements of Reinforcement Learning.
- Approaches to implementing Reinforcement Learning.
- How does Reinforcement Learning Work?
- The Bellman Equation.
- Types of Reinforcement Learning.
- Reinforcement Learning Algorithm.
- Markov Decision Process.
- What is Q-Learning?
- Difference between Supervised Learning and Reinforcement Learning.
- Applications of Reinforcement Learning.
- Conclusion.

What is Reinforcement Learning?

- Reinforcement Learning is a feedback-based Machine learning technique in which an agent learns to behave in an environment by performing the actions and seeing the results of actions. For each good action, the agent gets positive feedback, and for each bad action, the agent gets negative feedback or penalty.

- In Reinforcement Learning, the agent learns automatically using feedbacks without any labeled data, unlikesupervised learning.

- Since there is no labeled data, so the agent is bound to learn by its experience only.

- RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such asgame-playing, robotics, etc.

- The agent interacts with the environment and explores it by itself. The primary goal of an agent in reinforcement learning is to improve the performance by getting the maximum positive rewards.

- The agent learns with the process of hit and trial, and based on the experience, it learns to perform the task in a better way. Hence, we can say that"Reinforcement learning is a type of machine learning method where an intelligent agent (computer program) interacts with the environment and learns to act within that."How a Robotic dog learns the movement of his arms is an example of Reinforcement learning.

- It is a core part ofArtificial intelligence, and allAI agentworks on the concept of reinforcement learning. Here we do not need to pre-program the agent, as it learns from its own experience without any human intervention.

- Example:Suppose there is an AI agent present within a maze environment, and his goal is to find the diamond. The agent interacts with the environment by performing some actions, and based on those actions, the state of the agent gets changed, and it also receives a reward or penalty as feedback.

- The agent continues doing these three things (take action, change state/remain in the same state, and get feedback), and by doing these actions, he learns and explores the environment.

- The agent learns that what actions lead to positive feedback or rewards and what actions lead to negative feedback penalty. As a positive reward, the agent gets a positive point, and as a penalty, it gets a negative point.

Terms used in Reinforcement Learning

- Agent():An entity that can perceive/explore the environment and act upon it.

- Environment():A situation in which an agent is present or surrounded by. In RL, we assume the stochastic environment, which means it is random in nature.

- Action():Actions are the moves taken by an agent within the environment.

- State():State is a situation returned by the environment after each action taken by the agent.

- Reward():A feedback returned to the agent from the environment to evaluate the action of the agent.

- Policy():Policy is a strategy applied by the agent for the next action based on the current state.

- Value():It is expected long-term retuned with the discount factor and opposite to the short-term reward.

- Q-value():It is mostly similar to the value, but it takes one additional parameter as a current action (a).

Key Features of Reinforcement Learning

- In RL, the agent is not instructed about the environment and what actions need to be taken.

- It is based on the hit and trial process.

- The agent takes the next action and changes states according to the feedback of the previous action.

- The agent may get a delayed reward.

- The environment is stochastic, and the agent needs to explore it to reach to get the maximum positive rewards.

Approaches to implement Reinforcement Learning

There are mainly three ways to implement reinforcement-learning in ML, which are:

Approaches to implement Reinforcement Learning

- Value-based:The value-based approach is about to find the optimal value function, which is the maximum value at a state under any policy. Therefore, the agent expects the long-term return at any state(s) under policy ?.
- Policy-based:Policy-based approach is to find the optimal policy for the maximum future rewards without using the value function. In this approach, the agent tries to apply such a policy that the action performed in each step helps to maximize the future reward.The policy-based approach has mainly two types of policy:Deterministic:The same action is produced by the policy (?) at any state.Stochastic:In this policy, probability determines the produced action.
- Deterministic:The same action is produced by the policy (?) at any state.
- Stochastic:In this policy, probability determines the produced action.
- Model-based:In the model-based approach, a virtual model is created for the environment, and the agent explores that environment to learn it. There is no particular solution or algorithm for this approach because the model representation is different for each environment.

Approaches to implement Reinforcement Learning

- Deterministic:The same action is produced by the policy (?) at any state.
- Stochastic:In this policy, probability determines the produced action.

Elements of Reinforcement Learning

There are four main elements of Reinforcement Learning, which are given below:

Elements of Reinforcement Learning

- Policy
- Reward Signal
- Value Function
- Model of the environment

Elements of Reinforcement Learning

1) Policy:A policy can be defined as a way how an agent behaves at a given time. It maps the perceived states of the environment to the actions taken on those states. A policy is the core element of the RL as it alone can define the behavior of the agent. In some cases, it may be a simple function or a lookup table, whereas, for other cases, it may involve general computation as a search process. It could be deterministic or a stochastic policy:

Elements of Reinforcement Learning

For deterministic policy: a = ?(s)For stochastic policy: ?(a | s) = P[At =a | St = s]

Elements of Reinforcement Learning

2) Reward Signal:The goal of reinforcement learning is defined by the reward signal. At each state, the environment sends an immediate signal to the learning agent, and this signal is known as areward signal. These rewards are given according to the good and bad actions taken by the agent. The agent's main objective is to maximize the total number of rewards for good actions. The reward signal can change the policy, such as if an action selected by the agent leads to low reward, then the policy may change to select other actions in the future.

Elements of Reinforcement Learning

3) Value Function:The value function gives information about how good the situation and action are and how much reward an agent can expect. A reward indicates theimmediate signal for each good and bad action, whereas a value function specifiesthe good state and action for the future. The value function depends on the reward as, without reward, there could be no value. The goal of estimating values is to achieve more rewards.

Elements of Reinforcement Learning

4) Model:The last element of reinforcement learning is the model, which mimics the behavior of the environment. With the help of the model, one can make inferences about how the environment will behave. Such as, if a state and an action are given, then a model can predict the next state and reward.

Elements of Reinforcement Learning

The model is used for planning, which means it provides a way to take a course of action by considering all future situations before actually experiencing those situations. The approaches for solving the RL problemswith the help of the modelare termed as themodel-based approach. Comparatively, an approachwithout using a modelis called amodel-free approach.

How does Reinforcement Learning Work?

To understand the working process of the RL, we need to consider two main things:

How does Reinforcement Learning Work?

- Environment:It can be anything such as a room, maze, football ground, etc.
- Agent:An intelligent agent such as AI robot.

How does Reinforcement Learning Work?

Let's take an example of a maze environment that the agent needs to explore. Consider the below image:

How does Reinforcement Learning Work?

In the above image, the agent is at the very first block of the maze. The maze is consisting of an S6block, which is awall, S8afire pit, and S4adiamond block.

How does Reinforcement Learning Work?

The agent cannot cross the S6block, as it is a solid wall. If the agent reaches the S4block, then get the+1 reward;if it reaches the fire pit, then gets-1 reward point. It can take four actions: move up, move down, move left, and move right.

How does Reinforcement Learning Work?

The agent can take any path to reach to the final point, but he needs to make it in possible fewer steps. Suppose the agent considers the pathS9-S5-S1-S2-S3, so he will get the +1-reward point.

How does Reinforcement Learning Work?

The agent will try to remember the preceding steps that it has taken to reach the final step. To memorize the steps, it assigns 1 value to each previous step. Consider the below step:

How does Reinforcement Learning Work?

Now, the agent has successfully stored the previous steps assigning the 1 value to each previous block. But what will the agent do if he starts moving from the block, which has 1 value block on both sides? Consider the below diagram:

How does Reinforcement Learning Work?

It will be a difficult condition for the agent whether he should go up or down as each block has the same value. So, the above approach is not suitable for the agent to reach the destination. Hence to solve the problem, we will use theBellman equation, which is the main concept behind reinforcement learning.

The Bellman Equation

The Bellman equation was introduced by the MathematicianRichard Ernest Bellman in the year 1953, and hence it is called as a Bellman equation. It is associated with dynamic programming and used to calculate the values of a decision problem at a certain point by including the values of previous states.

The Bellman Equation

It is a way of calculating the value functions in dynamic programming or environment that leads to modern reinforcement learning.

The Bellman Equation

The key-elements used in Bellman equations are:

The Bellman Equation

- Action performed by the agent is referred to as "a"

- State occurred by performing the action is "s."

- The reward/feedback obtained for each good and bad action is "R."

- A discount factor is Gamma "?."

The Bellman Equation

The Bellman equation can be written as:

The Bellman Equation

Where,

The Bellman Equation

V(s)= value calculated at a particular point.

The Bellman Equation

R(s,a) = Reward at a particular state s by performing an action.

The Bellman Equation

? = Discount factor

The Bellman Equation

V(s`) = The value at the previous state.

The Bellman Equation

In the above equation, we are taking the max of the complete values because the agent tries to find the optimal solution always.

The Bellman Equation

So now, using the Bellman equation, we will find value at each state of the given environment. We will start from the block, which is next to the target block.

The Bellman Equation

For 1st block:

The Bellman Equation

V(s3) = max [R(s,a) + ?V(s`)], here V(s')= 0 because there is no further state to move.

The Bellman Equation

V(s3)= max[R(s,a)]=> V(s3)= max[1]=>V(s3)= 1.

The Bellman Equation

For 2nd block:

The Bellman Equation

V(s2) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 1, and R(s, a)= 0, because there is no reward at this state.

The Bellman Equation

V(s2)= max[0.9(1)]=> V(s)= max[0.9]=>V(s2) =0.9

The Bellman Equation

For 3rd block:

The Bellman Equation

V(s1) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 0.9, and R(s, a)= 0, because there is no reward at this state also.

The Bellman Equation

V(s1)= max[0.9(0.9)]=> V(s3)= max[0.81]=>V(s1) =0.81

The Bellman Equation

For 4th block:

The Bellman Equation

V(s5) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 0.81, and R(s, a)= 0, because there is no reward at this state also.

The Bellman Equation

V(s5)= max[0.9(0.81)]=> V(s5)= max[0.81]=>V(s5) =0.73

The Bellman Equation

For 5th block:

The Bellman Equation

V(s9) = max [R(s,a) + ?V(s`)], here ?= 0.9(lets), V(s')= 0.73, and R(s, a)= 0, because there is no reward at this state also.

The Bellman Equation

V(s9)= max[0.9(0.73)]=> V(s4)= max[0.81]=>V(s4) =0.66

The Bellman Equation

Consider the below image:

The Bellman Equation

Now, we will move further to the 6thblock, and here agent may change the route because it always tries to find the optimal path. So now, let's consider from the block next to the fire pit.

The Bellman Equation

Now, the agent has three options to move; if he moves to the blue box, then he will feel a bump if he moves to the fire pit, then he will get the -1 reward. But here we are taking only positive rewards, so for this, he will move to upwards only. The complete block values will be calculated using this formula. Consider the below image:

Types of Reinforcement learning

There are mainly two types of reinforcement learning, which are:

Types of Reinforcement learning

- Positive Reinforcement

- Negative Reinforcement

Types of Reinforcement learning

Positive Reinforcement:

Types of Reinforcement learning

The positive reinforcement learning means adding something to increase the tendency that expected behavior would occur again. It impacts positively on the behavior of the agent and increases the strength of the behavior.

Types of Reinforcement learning

This type of reinforcement can sustain the changes for a long time, but too much positive reinforcement may lead to an overload of states that can reduce the consequences.

Types of Reinforcement learning

Negative Reinforcement:

Types of Reinforcement learning

The negative reinforcement learning is opposite to the positive reinforcement as it increases the tendency that the specific behavior will occur again by avoiding the negative condition.

Types of Reinforcement learning

It can be more effective than the positive reinforcement depending on situation and behavior, but it provides reinforcement only to meet minimum behavior.

How to represent the agent state?

We can represent the agent state using theMarkov Statethat contains all the required information from the history. The State St is Markov state if it follows the given condition:

How to represent the agent state?

The Markov state follows theMarkov property, which says that the future is independent of the past and can only be defined with the present. The RL works on fully observable environments, where the agent can observe the environment and act for the new state. The complete process is known as Markov Decision process, which is explained below:

Markov Decision Process

Markov Decision Process or MDP, is used toformalize the reinforcement learning problems. If the environment is completely observable, then its dynamic can be modeled as aMarkov Process. In MDP, the agent constantly interacts with the environment and performs actions; at each action, the environment responds and generates a new state.

Markov Decision Process

MDP is used to describe the environment for the RL, and almost all the RL problem can be formalized using MDP.

Markov Decision Process

MDP contains a tuple of four elements (S, A, Pa, Ra):

Markov Decision Process

- A set of finite States S
- A set of finite Actions A
- Rewards received after transitioning from state S to state S', due to action a.
- Probability Pa.

Markov Decision Process

MDP usesMarkov property, and to better understand the MDP, we need to learn about it.

Markov Property:

It says that"If the agent is present in the current state S1, performs an action a1 and move to the state s2, then the state transition from s1 to s2 only depends on the current state and future action and states do not depend on past actions, rewards, or states."

Markov Property:

Or, in other words, as per Markov Property, the current state transition does not depend on any past action or state. Hence, MDP is an RL problem that satisfies the Markov property. Such as in aChess game, the players only focus on the current state and do not need to remember past actions or states.

Markov Property:

Finite MDP:

Markov Property:

A finite MDP is when there are finite states, finite rewards, and finite actions. In RL, we consider only the finite MDP.

Markov Process:

Markov Process is a memoryless process with a sequence of random states S1, S2, ..., Stthat uses the Markov Property. Markov process is also known as Markov chain, which is a tuple (S, P) on state S and transition function P. These two components (S and P) can define the dynamics of the system.

Reinforcement Learning Algorithms

Reinforcement learning algorithms are mainly used in AI applications and gaming applications. The main used algorithms are:

Reinforcement Learning Algorithms

- Q-Learning:Q-learning is anOff policy RL algorithm, which is used for the temporal difference Learning. The temporal difference learning methods are the way of comparing temporally successive predictions.It learns the value function Q (S, a), which means how good to take action "a" at a particular state "s."The below flowchart explains the working of Q- learning:

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Reinforcement Learning Algorithms

- State Action Reward State action (SARSA):SARSA stands forState Action Reward State action, which is anon-policytemporal difference learning method. The on-policy control method selects the action for each state while learning using a specific policy.The goal of SARSA is to calculate theQ ?(s, a) for the selected current policy ? and all pairs of (s-a).The main difference between Q-learning and SARSA algorithms is thatunlike Q-learning, the maximum reward for the next state is not required for updating the Q-value in the table.In SARSA, new action and reward are selected using the same policy, which has determined the original action.The SARSA is named because it uses the quintupleQ(s, a, r, s', a').Where,s: original statea: Original actionr: reward observed while following the statess' and a': New state, action pair.

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- Deep Q Neural Network (DQN):As the name suggests, DQN is aQ-learning using Neural networks.For a big state space environment, it will be a challenging and complex task to define and update a Q-table.To solve such an issue, we can use a DQN algorithm. Where, instead of defining a Q-table, neural network approximates the Q-values for each action and state.

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Reinforcement Learning Algorithms

Now, we will expand the Q-learning.

Q-Learning Explanation:

- Q-learning is a popular model-free reinforcement learning algorithm based on the Bellman equation.

- The main objective of Q-learning is to learn the policy which can inform the agent that what actions should be taken for maximizing the reward under what circumstances.

- It is anoff-policy RLthat attempts to find the best action to take at a current state.

- The goal of the agent in Q-learning is to maximize the value of Q.

- The value of Q-learning can be derived from the Bellman equation. Consider the Bellman equation given below:

Q-Learning Explanation:

In the equation, we have various components, including reward, discount factor (?), probability, and end states s'. But there is no any Q-value is given so first consider the below image:

Q-Learning Explanation:

In the above image, we can see there is an agent who has three values options, V(s1), V(s2), V(s3).

As this is MDP, so agent only cares for the current state and the future state. The agent can go to any direction (Up, Left, or Right), so he needs to decide where to go for the optimal path. Here agent will take a move as per probability bases and changes the state. But if we want some exact moves, so for this, we need to make some changes in terms of Q-value. Consider the below image:

Q-Learning Explanation:

Q- represents the quality of the actions at each state. So instead of using a value at each state, we will use a pair of state and action, i.e., Q(s, a). Q-value specifies that which action is more lubricative than others, and according to the best Q-value, the agent takes his next move. The Bellman equation can be used for deriving the Q-value.

Q-Learning Explanation:

To perform any action, the agent will get a reward R(s, a), and also he will end up on a certain state, so the Q -value equation will be:

Q-Learning Explanation:

Hence, we can say that,V(s) = max [Q(s, a)]

Q-Learning Explanation:

The above formula is used to estimate the Q-values in Q-Learning.

Q-Learning Explanation:

What is 'Q' in Q-learning?

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The Q stands forqualityinQ-learning, which means it specifies the quality of an action taken by the agent.

Q-table:

A Q-table or matrix is created while performing the Q-learning. The table follows the state and action pair, i.e., [s, a], and initializes the values to zero. After each action, the table is updated, and the q-values are stored within the table.

Q-table:

The RL agent uses this Q-table as a reference table to select the best action based on the q-values.

Difference between Reinforcement Learning and Supervised Learning

The Reinforcement Learning and Supervised Learning both are the part of machine learning, but both types of learnings are far opposite to each other. The RL agents interact with the environment, explore it, take action, and get rewarded. Whereas supervised learning algorithms learn from the labeled dataset and, on the basis of the training, predict the output.

Difference between Reinforcement Learning and Supervised Learning

The difference table between RL and Supervised learning is given below:

Difference between Reinforcement Learning and Supervised Learning

Reinforcement Learning | Supervised Learning

RL works by interacting with the environment. | Supervised learning works on the existing dataset.

The RL algorithm works like the human brain works when making some decisions. | Supervised Learning works as when a human learns things in the supervision of a guide.

There is no labeled dataset is present | The labeled dataset is present.

No previous training is provided to the learning agent. | Training is provided to the algorithm so that it can predict the output.

RL helps to take decisions sequentially. | In Supervised learning, decisions are made when input is given.

Reinforcement Learning Applications

- Robotics:RL is used inRobot navigation, Robo-soccer, walking, juggling, etc.

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- Control:RL can be used foradaptive controlsuch as Factory processes, admission control in telecommunication, and Helicopter pilot is an example of reinforcement learning.

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- Game Playing:RL can be used inGame playingsuch as tic-tac-toe, chess, etc.

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- Chemistry:RL can be used for optimizing the chemical reactions.

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- Business:RL is now used for business strategy planning.

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- Manufacturing:In various automobile manufacturing companies, the robots use deep reinforcement learning to pick goods and put them in some containers.

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- Finance Sector:The RL is currently used in the finance sector for evaluating trading strategies.

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Reinforcement Learning Applications

- RL can be used for optimizing the chemical reactions.

Reinforcement Learning Applications

- RL is now used for business strategy planning.

Reinforcement Learning Applications

- In various automobile manufacturing companies, the robots use deep reinforcement learning to pick goods and put them in some containers.

Reinforcement Learning Applications

- The RL is currently used in the finance sector for evaluating trading strategies.

Conclusion:

From the above discussion, we can say that Reinforcement Learning is one of the most interesting and useful parts of Machine learning. In RL, the agent explores the environment by exploring it without any human intervention. It is the main learning algorithm that is used in Artificial Intelligence. But there are some cases where it should not be used, such as if you have enough data to solve the problem, then other ML algorithms can be used more efficiently. The main issue with the RL algorithm is that some of the parameters may affect the speed of the learning, such as delayed feedback.

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Regression and classification models, clustering techniques, hidden Markov models, and various sequential models will all be covered.What is Machine LearningIn the real world, we are surrounded by humans who can learn everything from their experiences with their learning capability, and we have computers or machines which work on our instructions. But can a machine also learn from experiences or past data like a human does? So here comes the role ofMachine Learning.Introduction to Machine LearningA subset of artificial intelligence known as machine learning focuses primarily on the creation of algorithms that enable a computer to independently learn from data and previous experiences. Arthur Samuel first used the term "machine learning" in 1959. It could be summarized as follows:Without being explicitly programmed, machine learning enables a machine to automatically learn from data, improve performance from experiences, and predict things.Machine learning algorithms create a mathematical model that, without being explicitly programmed, aids in making predictions or decisions with the assistance of sample historical data, or training data. For the purpose of developing predictive models, machine learning brings together statistics and computer science. Algorithms that learn from historical data are either constructed or utilized in machine learning. The performance will rise in proportion to the quantity of information we provide.A machine can learn if it can gain more data to improve its performance.How does Machine Learning workA machine learning system builds prediction models, learns from previous data, and predicts the output of new data whenever it receives it. The amount of data helps to build a better model that accurately predicts the output, which in turn affects the accuracy of the predicted output.Let's say we have a complex problem in which we need to make predictions. Instead of writing code, we just need to feed the data to generic algorithms, which build the logic based on the data and predict the output. Our perspective on the issue has changed as a result of machine learning. The Machine Learning algorithm's operation is depicted in the following block diagram:Features of Machine Learning:Machine learning uses data to detect various patterns in a given dataset.It can learn from past data and improve automatically.It is a data-driven technology.Machine learning is much similar to data mining as it also deals with the huge amount of the data.Need for Machine LearningThe demand for machine learning is steadily rising. Because it is able to perform tasks that are too complex for a person to directly implement, machine learning is required. Humans are constrained by our inability to manually access vast amounts of data; as a result, we require computer systems, which is where machine learning comes in to simplify our lives.By providing them with a large amount of data and allowing them to automatically explore the data, build models, and predict the required output, we can train machine learning algorithms. The cost function can be used to determine the amount of data and the machine learning algorithm's performance. We can save both time and money by using machine learning.The significance of AI can be handily perceived by its utilization's cases, Presently, AI is utilized in self-driving vehicles, digital misrepresentation identification, face acknowledgment, and companion idea by Facebook, and so on. Different top organizations, for example, Netflix and Amazon have constructed AI models that are utilizing an immense measure of information to examine the client interest and suggest item likewise.Following are some key points which show the importance of Machine Learning:Rapid increment in the production of dataSolving complex problems, which are difficult for a humanDecision making in various sector including financeFinding hidden patterns and extracting useful information from data.Classification of Machine LearningAt a broad level, machine learning can be classified into three types:Supervised learningUnsupervised learningReinforcement learning1) Supervised LearningIn supervised learning, sample labeled data are provided to the machine learning system for training, and the system then predicts the output based on the training data.The system uses labeled data to build a model that understands the datasets and learns about each one. After the training and processing are done, we test the model with sample data to see if it can accurately predict the output.The mapping of the input data to the output data is the objective of supervised learning. The managed learning depends on oversight, and it is equivalent to when an understudy learns things in the management of the educator. Spam filtering is an example of supervised learning.Supervised learning can be grouped further in two categories of algorithms:ClassificationRegression2) Unsupervised LearningUnsupervised learning is a learning method in which a machine learns without any supervision.The training is provided to the machine with the set of data that has not been labeled, classified, or categorized, and the algorithm needs to act on that data without any supervision. The goal of unsupervised learning is to restructure the input data into new features or a group of objects with similar patterns.In unsupervised learning, we don't have a predetermined result. The machine tries to find useful insights from the huge amount of data. It can be further classifieds into two categories of algorithms:ClusteringAssociation3) Reinforcement LearningReinforcement learning is a feedback-based learning method, in which a learning agent gets a reward for each right action and gets a penalty for each wrong action. The agent learns automatically with these feedbacks and improves its performance. In reinforcement learning, the agent interacts with the environment and explores it. The goal of an agent is to get the most reward points, and hence, it improves its performance.The robotic dog, which automatically learns the movement of his arms, is an example of Reinforcement learning.Note:We will learn about the above types of machine learning in detail in later chapters.History of Machine LearningBefore some years (about 40-50 years), machine learning was science fiction, but today it is the part of our daily life. 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What is Machine Learning

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A machine learning system builds prediction models, learns from previous data, and predicts the output of new data whenever it receives it. The amount of data helps to build a better model that accurately predicts the output, which in turn affects the accuracy of the predicted output.

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- Decision making in various sector including finance

- Finding hidden patterns and extracting useful information from data.

Classification of Machine Learning

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Classification of Machine Learning

- Supervised learning

- Unsupervised learning

- Reinforcement learning

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The field of machine learning has made significant strides in recent years, and its applications are numerous, including self-driving cars, Amazon Alexa, Catboats, and the recommender system. It incorporates clustering, classification, decision tree, SVM algorithms, and reinforcement learning, as well as unsupervised and supervised learning.

Machine Learning at present:

Present day AI models can be utilized for making different expectations, including climate expectation, sickness forecast, financial exchange examination, and so on.

Prerequisites

Before learning machine learning, you must have the basic knowledge of followings so that you can easily understand the concepts of machine learning:

Prerequisites

- Fundamental knowledge of probability and linear algebra.
- The ability to code in any computer language, especially in Python language.
- Knowledge of Calculus, especially derivatives of single variable and multivariate functions.

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- Na?ve Bayes Classifier

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Interview Questions

next ?? prevApplications of Machine learningMachine learning is a buzzword for today's technology, and it is growing very rapidly day by day. We are using machine learning in our daily life even without knowing it such as Google Maps, Google assistant, Alexa, etc. Below are some most trending real-world applications of Machine Learning:1. Image Recognition:Image recognition is one of the most common applications of machine learning. It is used to identify objects, persons, places, digital images, etc. The popular use case of image recognition and face detection is,Automatic friend tagging suggestion:Facebook provides us a feature of auto friend tagging suggestion. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with name, and the technology behind this is machine learning'sface detectionandrecognition algorithm.It is based on the Facebook project named "Deep Face," which is responsible for face recognition and person identification in the picture.2. Speech RecognitionWhile using Google, we get an option of "Search by voice," it comes under speech recognition, and it's a popular application of machine learning.Speech recognition is a process of converting voice instructions into text, and it is also known as "Speech to text", or "Computer speech recognition." At present, machine learning algorithms are widely used by various applications of speech recognition.Google assistant,Siri,Cortana, andAlexaare using speech recognition technology to follow the voice instructions.3. Traffic prediction:If we want to visit a new place, we take help of Google Maps, which shows us the correct path with the shortest route and predicts the traffic conditions.It predicts the traffic conditions such as whether traffic is cleared, slow-moving, or heavily congested with the help of two ways:Real Time locationof the vehicle form Google Map app and sensorsAverage time has takenon past days at the same time.Everyone who is using Google Map is helping this app to make it better. It takes information from the user and sends back to its database to improve the performance.4. Product recommendations:Machine learning is widely used by various e-commerce and entertainment companies such asAmazon,Netflix, etc., for product recommendation to the user. Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning.Google understands the user interest using various machine learning algorithms and suggests the product as per customer interest.As similar, when we use Netflix, we find some recommendations for entertainment series, movies, etc., and this is also done with the help of machine learning.5. Self-driving cars:One of the most exciting applications of machine learning is self-driving cars. Machine learning plays a significant role in self-driving cars. Tesla, the most popular car manufacturing company is working on self-driving car. It is using unsupervised learning method to train the car models to detect people and objects while driving.6. Email Spam and Malware Filtering:Whenever we receive a new email, it is filtered automatically as important, normal, and spam. We always receive an important mail in our inbox with the important symbol and spam emails in our spam box, and the technology behind this is Machine learning. Below are some spam filters used by Gmail:Content FilterHeader filterGeneral blacklists filterRules-based filtersPermission filtersSome machine learning algorithms such asMulti-Layer Perceptron,Decision tree, andNaïve Bayes classifierare used for email spam filtering and malware detection.7. Virtual Personal Assistant:We have various virtual personal assistants such asGoogle assistant,Alexa,Cortana,Siri. As the name suggests, they help us in finding the information using our voice instruction. These assistants can help us in various ways just by our voice instructions such as Play music, call someone, Open an email, Scheduling an appointment, etc.These virtual assistants use machine learning algorithms as an important part.These assistant record our voice instructions, send it over the server on a cloud, and decode it using ML algorithms and act accordingly.8. Online Fraud Detection:Machine learning is making our online transaction safe and secure by detecting fraud transaction. Whenever we perform some online transaction, there may be various ways that a fraudulent transaction can take place such asfake accounts,fake ids, andsteal moneyin the middle of a transaction. So to detect this,Feed Forward Neural networkhelps us by checking whether it is a genuine transaction or a fraud transaction.For each genuine transaction, the output is converted into some hash values, and these values become the input for the next round. For each genuine transaction, there is a specific pattern which gets change for the fraud transaction hence, it detects it and makes our online transactions more secure.9. Stock Market trading:Machine learning is widely used in stock market trading. In the stock market, there is always a risk of up and downs in shares, so for this machine learning'slong short term memory neural networkis used for the prediction of stock market trends.10. Medical Diagnosis:In medical science, machine learning is used for diseases diagnoses. With this, medical technology is growing very fast and able to build 3D models that can predict the exact position of lesions in the brain.It helps in finding brain tumors and other brain-related diseases easily.11. Automatic Language Translation:Nowadays, if we visit a new place and we are not aware of the language then it is not a problem at all, as for this also machine learning helps us by converting the text into our known languages. Google's GNMT (Google Neural Machine Translation) provide this feature, which is a Neural Machine Learning that translates the text into our familiar language, and it called as automatic translation.The technology behind the automatic translation is a sequence to sequence learning algorithm, which is used with image recognition and translates the text from one language to another language.Next TopicMachine learning Life cycle? prevnext ?

Applications of Machine learning

Machine learning is a buzzword for today's technology, and it is growing very rapidly day by day. We are using machine learning in our daily life even without knowing it such as Google Maps, Google assistant, Alexa, etc. Below are some most trending real-world applications of Machine Learning:

1. Image Recognition:

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1. Image Recognition:

Facebook provides us a feature of auto friend tagging suggestion. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with name, and the technology behind this is machine learning'sface detectionandrecognition algorithm.

1. Image Recognition:

It is based on the Facebook project named "Deep Face," which is responsible for face recognition and person identification in the picture.

2. Speech Recognition

While using Google, we get an option of "Search by voice," it comes under speech recognition, and it's a popular application of machine learning.

2. Speech Recognition

Speech recognition is a process of converting voice instructions into text, and it is also known as

"Speech to text", or "Computer speech recognition." At present, machine learning algorithms are widely used by various applications of speech recognition.Google assistant,Siri,Cortana, andAlexaare using speech recognition technology to follow the voice instructions.

3. Traffic prediction:

If we want to visit a new place, we take help of Google Maps, which shows us the correct path with the shortest route and predicts the traffic conditions.

3. Traffic prediction:

It predicts the traffic conditions such as whether traffic is cleared, slow-moving, or heavily congested with the help of two ways:

3. Traffic prediction:

- Real Time locationof the vehicle form Google Map app and sensors
- Average time has takenon past days at the same time.

3. Traffic prediction:

Everyone who is using Google Map is helping this app to make it better. It takes information from the user and sends back to its database to improve the performance.

4. Product recommendations:

Machine learning is widely used by various e-commerce and entertainment companies such asAmazon,Netflix, etc., for product recommendation to the user. Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning.

4. Product recommendations:

Google understands the user interest using various machine learning algorithms and suggests the product as per customer interest.

4. Product recommendations:

As similar, when we use Netflix, we find some recommendations for entertainment series, movies, etc., and this is also done with the help of machine learning.

5. Self-driving cars:

One of the most exciting applications of machine learning is self-driving cars. Machine learning plays a significant role in self-driving cars. Tesla, the most popular car manufacturing company is working on self-driving car. It is using unsupervised learning method to train the car models to detect people and objects while driving.

6. Email Spam and Malware Filtering:

Whenever we receive a new email, it is filtered automatically as important, normal, and spam. We always receive an important mail in our inbox with the important symbol and spam emails in our spam box, and the technology behind this is Machine learning. Below are some spam filters used by Gmail:

6. Email Spam and Malware Filtering:

- Content Filter
- Header filter
- General blacklists filter
- Rules-based filters
- Permission filters

6. Email Spam and Malware Filtering:

Some machine learning algorithms such asMulti-Layer Perceptron,Decision tree, andNaïve Bayes classifierare used for email spam filtering and malware detection.

7. Virtual Personal Assistant:

We have various virtual personal assistants such asGoogle assistant,Alexa,Cortana,Siri. As the name suggests, they help us in finding the information using our voice instruction. These assistants can help us in various ways just by our voice instructions such as Play music, call someone, Open an email, Scheduling an appointment, etc.

7. Virtual Personal Assistant:

These virtual assistants use machine learning algorithms as an important part.

7. Virtual Personal Assistant:

These assistant record our voice instructions, send it over the server on a cloud, and decode it using ML algorithms and act accordingly.

8. Online Fraud Detection:

Machine learning is making our online transaction safe and secure by detecting fraud transaction. Whenever we perform some online transaction, there may be various ways that a fraudulent transaction can take place such asfake accounts,fake ids, andsteal moneyin the middle of a transaction. So to detect this,Feed Forward Neural networkhelps us by checking whether it is a genuine transaction or a fraud transaction.

8. Online Fraud Detection:

For each genuine transaction, the output is converted into some hash values, and these values become the input for the next round. For each genuine transaction, there is a specific pattern which gets change for the fraud transaction hence, it detects it and makes our online transactions more secure.

9. Stock Market trading:

Machine learning is widely used in stock market trading. In the stock market, there is always a risk of up and downs in shares, so for this machine learning'slong short term memory neural networkis used for the prediction of stock market trends.

10. Medical Diagnosis:

In medical science, machine learning is used for diseases diagnoses. With this, medical technology is growing very fast and able to build 3D models that can predict the exact position of lesions in the brain.

10. Medical Diagnosis:

11. Automatic Language Translation:

Nowadays, if we visit a new place and we are not aware of the language then it is not a problem at all, as for this also machine learning helps us by converting the text into our known languages. Google's GNMT (Google Neural Machine Translation) provide this feature, which is a Neural Machine Learning that translates the text into our familiar language, and it called as automatic translation.

11. Automatic Language Translation:

The technology behind the automatic translation is a sequence to sequence learning algorithm, which is used with image recognition and translates the text from one language to another language.

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next ?? prevMachine learning Life cycleMachine learning has given the computer systems the abilities to automatically learn without being explicitly programmed. But how does a machine learning system work? So, it can be described using the life cycle of machine learning. Machine learning life cycle is a cyclic process to build an efficient machine learning project. The main purpose of the life cycle is to find a solution to the problem or project.Machine learning life cycle involves seven major steps, which are given below:Gathering DataData preparationData WranglingAnalyse DataTrain the modelTest the modelDeploymentThe most important thing in the complete process is to understand the problem and to know the purpose of the problem. Therefore, before starting the life cycle, we need to understand the problem because the good result depends on the better understanding of the problem.In the complete life cycle process, to solve a problem, we create a machine learning system called "model", and this model is created by providing "training". But to train a model, we need data, hence, life cycle starts by collecting data.1. Gathering Data:Data Gathering is the first step of the machine learning life cycle. The goal of this step is to identify and obtain all data-related problems.In this step, we need to identify the different data sources, as data can be collected from various sources such asfiles,database,internet, ormobile devices. It is one of the most important steps of the life cycle. The quantity and quality of the collected data will determine the efficiency of the output. The more will be the data, the more accurate will be the prediction.This step includes the below tasks:Identify various data sourcesCollect dataIntegrate the data obtained from different sourcesBy performing the above task, we get a coherent set of data, also called as adataset. It will be used in further steps.2. Data preparationAfter collecting the data, we need to prepare it for further steps. Data preparation is a step where we put our data into a suitable place and prepare it to use in our machine learning training.In this step, first, we put all data together, and then randomize the ordering of data.This step can be further divided into two processes:Data exploration:It is used to understand the nature of data that we have to work with. We need to understand the characteristics, format, and quality of data.A better understanding of data leads to an effective outcome. In this, we find Correlations, general trends, and outliers.Data pre-processing:Now the next step is preprocessing of data for its analysis.3. Data WranglingData wrangling is the process of cleaning and converting raw data into a useable format. It is the process of cleaning the data, selecting the variable to use, and transforming the data in a proper format to make it more suitable for analysis in the next step. It is one of the most important steps of the complete process. Cleaning of data is required to address the quality issues.It is not necessary that data we have collected is always of our use as some of the data may not be useful. In real-world applications, collected data may have various issues, including:Missing ValuesDuplicate dataInvalid dataNoiseSo, we use various filtering techniques to clean the data.It is mandatory to detect and remove the above issues because it can negatively affect the quality of the outcome.4. Data AnalysisNow the cleaned and prepared data is passed on to the analysis step. This step involves:Selection of analytical techniquesBuilding modelsReview the resultThe aim of this step is to build a machine learning model to analyze the data using various analytical techniques and review the outcome. It starts with the determination of the type of the problems, where we select the machine learning techniques such asClassification,Regression,Cluster analysis,Association, etc. then build the model using prepared data, and evaluate the model.Hence, in this step, we take the data and use machine learning algorithms to build the model.5. Train ModelNow the next step is to train the model, in this step we train our model to improve its performance for better outcome of the problem.We use datasets to train the model using various machine learning algorithms. Training a model is required so that it can understand the various patterns, rules, and, features.6. Test ModelOnce our machine learning model has been trained on a given dataset, then we test the model. In this step, we check for the accuracy of our model by providing a test dataset to it.Testing the model determines the percentage accuracy of the model as per the requirement of project or problem.7. DeploymentThe last step of machine learning life cycle is deployment, where we deploy the model in the real-world system.If the above-prepared model is producing an accurate result as per our requirement with acceptable speed, then we deploy the model in the real system. But before deploying the project, we will check whether it is improving its performance using available data or not. The deployment phase is similar to making the final report for a project.Next TopicInstalling Anaconda and Python? prevnext ?

Machine learning Life cycle

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Machine learning Life cycle

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Machine learning Life cycle

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- Data preparation
- Data Wrangling
- Analyse Data
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- Missing Values

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Python program in Spyder IDE.Open Spyder IDE, it will look like the below image:Write your first program, and save it using the .py extension.Run the program using the triangleRunbutton.You can check the program's output on console pane at the bottom right side.Step- 4: Close the Spyder IDE.Next TopicArtificial intelligence vs Machine learning? prevnext ?

Installing Anaconda and Python

To learn machine learning, we will use the Python programming language in this tutorial. So, in order to use Python for machine learning, we need to install it in our computer system with compatibleIDEs (Integrated Development Environment).

Installing Anaconda and Python

In this topic, we will learn to install Python and an IDE with the help ofAnaconda distribution.

Installing Anaconda and Python

Anaconda distribution is a free and open-source platform for Python/R programming languages. It can be easily installed on any OS such as Windows, Linux, and MAC OS. It provides more than 1500 Python/R data science packages which are suitable for developing machine learning and deep learning models.

Installing Anaconda and Python

Anaconda distribution provides installation of Python with various IDE's such asJupyter Notebook,Spyder,Anaconda prompt,etc. Hence it is a very convenient packaged solution which you can easily download and install in your computer. It will automatically install Python and some basic IDEs and libraries with it.

Installing Anaconda and Python

Below some steps are given to show the downloading and installing process of Anaconda and IDE:

Step-1: Download Anaconda Python:

- To download Anaconda in your system, firstly, open your favorite browser and type Download

Anaconda Python, and then click on the first link as given in the below image. Alternatively, you can directly download it by clicking on this link, https://www.anaconda.com/distribution/#download-section.

Step-1: Download Anaconda Python:

- After clicking on the first link, you will reach to download page of Anaconda, as shown in the below image:

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- Now select the second option, and click oninstall.

Step- 2: Install Anaconda Python (Python 3.7 version):

- Once the installation gets complete, click onNext.

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Step- 3: Open Anaconda Navigator

- After successful installation of Anaconda, use Anaconda navigator to launch a Python IDE such as Spyder and Jupyter Notebook.

- To open Anaconda Navigator, click on window Keyand search for Anaconda navigator, and click on it. Consider the below image:

Step- 3: Open Anaconda Navigator

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Step- 3: Open Anaconda Navigator

Run your Python program in Spyder IDE.

Step- 3: Open Anaconda Navigator

- Open Spyder IDE, it will look like the below image:

Step- 3: Open Anaconda Navigator

- Write your first program, and save it using the .py extension.

- Run the program using the triangleRunbutton.

- You can check the program's output on console pane at the bottom right side.

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These two technologies are the most trending technologies which are used for creating intelligent systems.Although these are two related technologies and sometimes people use them as a synonym for each other, but still both are the two different terms in various cases.On a broad level, we can differentiate both AI and ML as:AI is a bigger concept to create intelligent machines that can simulate human thinking capability and behavior, whereas, machine learning is an application or subset of AI that allows machines to learn from data without being programmed explicitly.Below are some main differences between AI and machine learning along with the overview of Artificial intelligence and machine learning.Artificial IntelligenceArtificial intelligence is a field of computer science which makes a computer system that can mimic human intelligence. It is comprised of two words "Artificial" and "intelligence", which means "a human-made thinking power." Hence we can define it as,Artificial intelligence is a technology using which we can create intelligent systems that can simulate human intelligence.The Artificial intelligence system does not require to be pre-programmed, instead of that, they use such algorithms which can work with their own intelligence. It involves machine learning algorithms such as Reinforcement learning algorithm and deep learning neural networks. AI is being used in multiple places such as Siri, Google, AlphaGo, AI in Chess playing, etc.Based on capabilities, AI can be classified into three types:Weak AIGeneral AIStrong AICurrently, we are working with weak AI and general AI. The future of AI is Strong AI for which it is said that it will be intelligent than humans.Machine learningMachine learning is about extracting knowledge from the data. It can be defined as,Machine learning is a subfield of artificial intelligence, which enables machines to learn from past data or experiences without being explicitly programmed.Machine learning enables a computer system to make predictions or take some decisions using historical data without being explicitly programmed. Machine learning uses a massive amount of structured and semi-structured data so that a machine learning model can generate accurate result or give predictions based on that data.Machine learning works on algorithm which learn by it's own using historical data. It works only for specific domains such as if we are creating a machine learning model to detect pictures of dogs, it will only give result for dog images, but if we provide a new data like cat image then it will become unresponsive. Machine learning is being used in various places such as for online recommender system, for Google search algorithms, Email spam filter, Facebook Auto friend tagging suggestion, etc.It can be divided into three types:Supervised learningReinforcement learningUnsupervised learningKey differences between Artificial Intelligence (AI) and Machine learning (ML):Artificial IntelligenceMachine learningArtificial intelligence is a technology which enables a machine to simulate human behavior.Machine learning is a subset of AI which allows a machine to automatically learn from past data without programming explicitly.The goal of AI is to make a smart computer system like humans to solve complex problems.The goal of ML is to allow machines to learn from data so that they can give accurate output.In AI, we make intelligent systems to perform any task like a human.In ML, we teach machines with data to perform a particular task and give an accurate result.Machine learning and deep learning are the two main subsets of AI.Deep learning is a main subset of machine learning.AI has a very wide range of scope.Machine learning has a limited scope.AI is working to create an intelligent system which can perform various complex tasks.Machine learning is working to create machines that can perform only those specific tasks for which they are trained.AI system is concerned about maximizing the chances of success.Machine learning is mainly concerned about accuracy and patterns.The main applications of AI areSiri, customer support using catboats, Expert System, Online game playing, intelligent humanoid robot, etc.The main applications of machine learning areOnline recommender system,Google search algorithms,Facebook auto friend tagging suggestions, etc.On the basis of capabilities, AI can be divided into three types, which are,Weak AI,General AI, andStrong AI.Machine learning can also be divided into mainly three types that areSupervised learning,Unsupervised learning, andReinforcement learning.It includes learning, reasoning, and self-correction.It includes learning and self-correction when introduced with new data.AI completely deals with Structured, semi-structured, and unstructured data.Machine learning deals with Structured and semi-structured data.Next TopicHow to get datasets for Machine Learning? prevnext ? | Artificial Intelligence | Machine learning | Artificial intelligence is a technology which enables a machine to simulate human behavior. | Machine learning is a subset of AI which allows a machine to automatically learn from past data without programming explicitly. | The goal of AI is to make a smart computer system like humans to solve complex problems. | The goal of ML is to allow machines to learn from data so that they can give accurate output. | In AI, we make intelligent systems to perform any task like a human. | In ML, we teach machines with data to perform a particular task and give an accurate result. | Machine learning and deep learning are the two main subsets of AI. | Deep learning is a main subset of machine learning. | AI has a very wide range of scope. | Machine learning has a limited scope. | AI is working to create an intelligent system which can perform various complex tasks. | Machine learning is working to create machines that can perform only those specific tasks for which they are trained. | AI system is concerned about maximizing the chances of success. | Machine learning is mainly concerned about accuracy and patterns. | The main applications of AI areSiri, customer support using catboats, Expert System, Online game playing, intelligent humanoid robot, etc. | The main applications of machine learning areOnline recommender system,Google search algorithms,Facebook auto friend tagging suggestions, etc. | On the basis of capabilities, AI can be divided into three types, which are,Weak AI,General AI, andStrong AI. | Machine learning can also be divided into mainly three types that areSupervised learning,Unsupervised learning, andReinforcement learning. | It includes learning, reasoning, and self-correction. | It includes learning and self-correction when introduced with new data. | AI completely deals with Structured, semi-structured, and unstructured data. | Machine learning deals with Structured and semi-structured data.

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Machine learning

- Supervised learning
- Reinforcement learning
- Unsupervised learning

Key differences between Artificial Intelligence (AI) and Machine learning (ML):

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In building ML applications, datasets are divided into two parts:Training dataset:Test DatasetNote: The datasets are of large size, so to download these datasets, you must have fast internet on your computer.Training Dataset and Test Dataset:In machine learning, datasets are ordinarily partitioned into two sections: the training dataset and the test dataset. The training dataset is utilized to prepare the machine learning model, while the test dataset is utilized to assess the model's exhibition. This division surveys the model's capacity, to sum up to inconspicuous data. It is fundamental to guarantee that the datasets are representative of the issue space and appropriately split to stay away from inclination or overfitting.Popular sources for Machine Learning datasetsBelow is the list of datasets which are freely available for the public to work on it:1. Kaggle DatasetsKaggle is one of the best sources for providing datasets for Data Scientists and Machine Learners. 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These datasets can be accessed through AWS resources but provided and maintained by different government organizations, researches, businesses, or individuals.Anyone can analyze and build various services using shared data via AWS resources. The shared dataset on cloud helps users to spend more time on data analysis rather than on acquisitions of data.This source provides the various types of datasets with examples and ways to use the dataset. It also provides the search box using which we can search for the required dataset. Anyone can add any dataset or example to theRegistry of Open Data on AWS.The link for the resource is https://registry.opendata.aws/.4. Google's Dataset Search EngineGoogle's Dataset Web index helps scientists find and access important datasets from different sources across the web. It files datasets from areas like sociologies, science, and environmental science. 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Computer Vision DatasetsVisual data provides multiple numbers of the great dataset that are specific to computer visions such as Image Classification, Video classification, Image Segmentation, etc. Therefore, if you want to build a project on deep learning or image processing, then you can refer to this source.The link for downloading the dataset from this source is https://www.visualdata.io/.9. Scikit-learn datasetScikit-learn, a well-known machine learning library in Python, gives a few underlying datasets to practice and trial and error. These datasets are open through the sci-kit-learn Programming interface and can be utilized for learning different machine-learning calculations. Scikit-learn offers both toy datasets, which are little and improved, and genuine world datasets with greater intricacy. Instances of sci-kit-learn datasets incorporate the Iris dataset, the Boston Lodging dataset, and the Wine dataset.The link to download datasets from this source is https://scikit-learn.org/stable/datasets/index.html.Data Ethics and Privacy:Data ethics and privacy are basic contemplations in machine learning projects. It is fundamental to guarantee that data is gathered and utilized morally, regarding privacy freedoms and observing pertinent regulations and guidelines. Data experts ought to go to lengths to safeguard data privacy, get appropriate assent, and handle delicate data mindfully. Assets, for example, moral rules and privacy structures can give direction on keeping up with moral practices in data assortment and use.Conclusion:In conclusion, datasets structure the groundwork of effective machine-learning projects. Understanding the various kinds of datasets, the significance of data pre-processing, and the job of training and testing datasets are key stages towards building powerful models. By utilizing well-known sources, for example, Kaggle, UCI Machine Learning Repository, AWS, Google's Dataset Search, Microsoft Datasets, and government datasets, data researchers and specialists can get to an extensive variety of datasets for their machine learning projects. It is fundamental to consider data ethics and privacy all through the whole data lifecycle to guarantee mindful and moral utilization of data. With the right datasets and moral practices, machine learning models can accomplish exact predictions and drive significant bits of knowledge.Next TopicData Preprocessing? prevnext ? | Country | Age | Salary | Purchased | India | 38 | 48000 | No | France | 43 | 45000 | Yes | Germany | 30 | 54000 | No | France | 48 | 65000 | No | Germany | 40 | | Yes | India | 35 | 58000 | Yes

Country	Age	Salary	Purchased
India	38	48000	No
France	43	45000	Yes
Germany	30	54000	No
France	48	65000	No
Germany	40		Yes
India	35	58000	Yes

How to get datasets for Machine Learning

The field of ML depends vigorously on datasets for preparing models and making precise predictions. Datasets assume a vital part in the progress of AIML projects and are fundamental for turning into a gifted information researcher. In this article, we will investigate the various sorts of datasets utilized in AI and give a definite aid on where to track down them.

What is a dataset?

A datasetis a collection of data in which data is arranged in some order. A dataset can contain any data from a series of an array to a database table. Below table shows an example of the dataset:

What is a dataset?

Country	Age	Salary	Purchased
India	38	48000	No
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What is a dataset?

A tabular dataset can be understood as a database table or matrix, where each column corresponds to aparticular variable,and each row corresponds to thefields of the dataset.The most supported file type for a tabular dataset is"Comma Separated File,"orCSV.But to store a "tree-like data," we can use the JSON file more efficiently.

Types of data in datasets

- Numerical data:Such as house price, temperature, etc.
- Categorical data:Such as Yes/No, True/False, Blue/green, etc.
- Ordinal data:These data are similar to categorical data but can be measured on the basis of comparison.

Types of datasets

Machine learning incorporates different domains, each requiring explicit sorts of datasets. A few normal sorts of datasets utilized in machine learning include:

Image Datasets:

Image datasets contain an assortment of images and are normally utilized in computer vision tasks such as image classification, object detection, and image segmentation.

Image Datasets:

Examples :

Image Datasets:

- ImageNet

- CIFAR-10

- MNIST

Text Datasets:

Text datasets comprise textual information, like articles, books, or virtual entertainment posts. These datasets are utilized in NLP techniques like sentiment analysis, text classification, and machine translation.

Text Datasets:

Examples :

Text Datasets:

- Gutenberg Task dataset

- IMDb film reviews dataset

Time Series Datasets:

Time series datasets include information focuses gathered after some time. They are generally utilized in determining, abnormality location, and pattern examination.Examples :

Time Series Datasets:

- Securities exchange information

- Climate information

- Sensor readings.

Tabular Datasets:

Tabular datasets are organized information coordinated in tables or calculation sheets. They contain lines addressing examples or tests and segments addressing highlights or qualities. Tabular datasets are utilized for undertakings like relapse and arrangement. The dataset given before in the article is an illustration of a tabular dataset.

Need of Dataset

- Completely ready and pre-handled datasets are significant for machine learning projects.

- They give the establishment to prepare exact and solid models. Notwithstanding, working with enormous datasets can introduce difficulties regarding the board and handling.

- To address these difficulties, productive information the executive's strategies and are expected to handle calculations.

Data Pre-processing:

Data pre-processing is a fundamental stage in preparing datasets for machine learning. It includes changing raw data into a configuration reasonable for model training. Normal pre-processing procedures incorporate data cleaning to eliminate irregularities or blunders, standardization to scale data inside a particular reach, highlight scaling to guarantee highlights have comparative ranges, and taking care of missing qualities through ascription or evacuation.

Data Pre-processing:

During the development of the ML project, the developers completely rely on the datasets. In building ML applications, datasets are divided into two parts:

Data Pre-processing:

- Training dataset:
- Test Dataset

Training Dataset and Test Dataset:

In machine learning, datasets are ordinarily partitioned into two sections: the training dataset and the test dataset. The training dataset is utilized to prepare the machine learning model, while the test dataset is utilized to assess the model's exhibition. This division surveys the model's capacity, to sum up to inconspicuous data. It is fundamental to guarantee that the datasets are representative of the issue space and appropriately split to stay away from inclination or overfitting.

Popular sources for Machine Learning datasets

Below is the list of datasets which are freely available for the public to work on it:

1. Kaggle Datasets

Kaggle is one of the best sources for providing datasets for Data Scientists and Machine Learners. It allows users to find, download, and publish datasets in an easy way. It also provides the opportunity to work with other machine learning engineers and solve difficult Data Science related tasks.

1. Kaggle Datasets

Kaggle provides a high-quality dataset in different formats that we can easily find and download.

1. Kaggle Datasets

The link for the Kaggle dataset is https://www.kaggle.com/datasets.

2. UCI Machine Learning Repository

The UCI Machine Learning Repository is an important asset that has been broadly utilized by scientists and specialists beginning around 1987. It contains a huge collection of datasets sorted by machine learning tasks such as regression, classification, and clustering. Remarkable datasets in the storehouse incorporate the Iris dataset, Vehicle Assessment dataset, and Poker Hand dataset.

2. UCI Machine Learning Repository

The link for the UCI machine learning repository is https://archive.ics.uci.edu/ml/index.php.

3. Datasets via AWS

We can search, download, access, and share the datasets that are publicly available via AWS resources. These datasets can be accessed through AWS resources but provided and maintained by different government organizations, researches, businesses, or individuals.

3. Datasets via AWS

Anyone can analyze and build various services using shared data via AWS resources. The shared dataset on cloud helps users to spend more time on data analysis rather than on acquisitions of data.

3. Datasets via AWS

This source provides the various types of datasets with examples and ways to use the dataset. It also provides the search box using which we can search for the required dataset. Anyone can add any dataset or example to theRegistry of Open Data on AWS.

3. Datasets via AWS

The link for the resource is https://registry.opendata.aws/.

4. Google's Dataset Search Engine

Google's Dataset Web index helps scientists find and access important datasets from different sources across the web. It files datasets from areas like sociologies, science, and environmental science. Specialists can utilize catchphrases to find datasets, channel results in light of explicit standards, and access the datasets straightforwardly from the source.

4. Google's Dataset Search Engine

The link for the Google dataset search engine is https://toolbox.google.com/datasetsearch.

5. Microsoft Datasets

The Microsoft has launched the"Microsoft Research Open data"repository with the collection of free datasets in various areas such asnatural language processing, computer vision, and domain-specific sciences.It gives admittance to assorted and arranged datasets that can be significant for machine learning projects.

5. Microsoft Datasets

The link to download or use the dataset from this resource is https://msropendata.com/.

6. Awesome Public Dataset Collection

Awesome public dataset collection provides high-quality datasets that are arranged in a well-organized manner within a list according to topics such as Agriculture, Biology, Climate, Complex networks, etc. Most of the datasets are available free, but some may not, so it is better to check the license before downloading the dataset.

6. Awesome Public Dataset Collection

The link to download the dataset from Awesome public dataset collection is https://github.com/awesomedata/awesome-public-datasets.

7. Government Datasets

There are different sources to get government-related data. Various countries publish government data for public use collected by them from different departments.

7. Government Datasets

The goal of providing these datasets is to increase transparency of government work among the people and to use the data in an innovative approach. Below are some links of government datasets:

7. Government Datasets

- Indian Government dataset
- US Government Dataset
- Northern Ireland Public Sector Datasets
- European Union Open Data Portal

8. Computer Vision Datasets

Visual data provides multiple numbers of the great dataset that are specific to computer visions such as Image Classification, Video classification, Image Segmentation, etc. Therefore, if you want to build a project on deep learning or image processing, then you can refer to this source.

8. Computer Vision Datasets

The link for downloading the dataset from this source is https://www.visualdata.io/.

9. Scikit-learn dataset

Scikit-learn, a well-known machine learning library in Python, gives a few underlying datasets to practice and trial and error. These datasets are open through the sci-kit-learn Programming interface and can be utilized for learning different machine-learning calculations. Scikit-learn offers both toy datasets, which are little and improved, and genuine world datasets with greater intricacy. Instances of sci-kit-learn datasets incorporate the Iris dataset, the Boston Lodging dataset, and the Wine dataset.

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Data ethics and privacy are basic contemplations in machine learning projects. It is fundamental to guarantee that data is gathered and utilized morally, regarding privacy freedoms and observing pertinent regulations and guidelines. Data experts ought to go to lengths to safeguard data privacy, get appropriate assent, and handle delicate data mindfully. Assets, for example, moral rules and privacy structures can give direction on keeping up with moral practices in data assortment and use.

Conclusion:

In conclusion, datasets structure the groundwork of effective machine-learning projects. Understanding the various kinds of datasets, the significance of data pre-processing, and the job of training and testing datasets are key stages towards building powerful models. By utilizing well-known sources, for example, Kaggle, UCI Machine Learning Repository, AWS, Google's Dataset Search, Microsoft Datasets, and government datasets, data researchers and specialists can get to an extensive variety of datasets for their machine learning projects. It is fundamental to consider data ethics and privacy all through the whole data lifecycle to guarantee mindful and moral utilization of data. With the right datasets and moral practices, machine learning models can accomplish exact predictions and drive significant bits of knowledge.

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- Simple Linear Regression
- Multiple Linear Regression
- Backward Elimination
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- K-NN Algorithm
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Interview Questions

next ?? prevData Preprocessing in Machine learningData preprocessing is a process of preparing the raw data and making it suitable for a machine learning model. It is the first and crucial step while creating a machine learning model.When creating a machine learning project, it is not always a case that we come across the clean and formatted data. And while doing any operation with data, it is mandatory to clean it and put in a formatted way. So for this, we use data preprocessing task.Why do we need Data Preprocessing?A real-world data generally contains noises, missing values, and maybe in an unusable format which cannot be directly used for machine learning models. Data preprocessing is required tasks for cleaning the data and making it suitable for a machine learning model which also increases the accuracy and efficiency of a machine learning model.It involves below steps:Getting the datasetImporting librariesImporting datasetsFinding Missing DataEncoding Categorical DataSplitting dataset into training and test setFeature scaling1) Get the DatasetTo create a machine learning model, the first thing we required is a dataset as a machine learning model completely works on data. The collected data for a particular problem in a proper format is known as thedataset.Dataset may be of different formats for different purposes, such as, if we want to create a machine learning model for business purpose, then dataset will be different with the dataset required for a liver patient. So each dataset is different from another dataset. To use the dataset in our code, we usually put it into a CSVfile. However, sometimes, we may also need to use an HTML or xlsx file.What is a CSV File?CSV stands for "Comma-Separated Values" files; it is a file format which allows us to save the tabular data, such as spreadsheets. It is useful for huge datasets and can use these datasets in programs.Here we will use a demo dataset for data preprocessing, and for practice, it can be downloaded from here, "https://www.superdatascience.com/pages/machine-learning. For real-world problems, we can download datasets online from various sources such as https://www.kaggle.com/uciml/datasets, https://archive.ics.uci.edu/ml/index.php etc.We can also create our dataset by gathering data using various API with Python and put that data into a .csv file.2) Importing LibrariesIn order to perform data preprocessing using Python, we need to import some predefined Python libraries. These libraries are used to perform some specific jobs. There are three specific libraries that we will use for data preprocessing, which are:Numpy:Numpy Python library is used for including any type of mathematical operation in the code. It is the fundamental package for scientific calculation in Python. It also supports to add large, multidimensional arrays and matrices. So, in Python, we can import it as:import numpy as nmHere we have usednm, which is a short name for Numpy, and it will be used in the whole program.Matplotlib:The second library ismatplotlib, which is a Python 2D plotting library, and with this library, we need to import a sub-librarypyplot. This library is used to plot any type of charts in Python for the code. It will be imported as below:import matplotlib.pyplot as mptHere we have used mpt as a short name for this library.Pandas:The last library is the Pandas library, which is one of the most famous Python libraries and used for importing and managing the datasets. It is an open-source data manipulation and analysis library. It will be imported as below:Here, we have used pd as a short name for this library. Consider the below image:3) Importing the DatasetsNow we need to import the datasets which we have collected for our machine learning project. But before importing a dataset, we need to set the current directory as a working directory. To set a working directory in Spyder IDE, we need to follow the below steps:Save your Python file in the directory which contains dataset.Go to File explorer option in Spyder IDE, and select the required directory.Click on F5 button or run option to execute the file.Note:We can set any directory as a working directory, but it must contain the required dataset.Here, in the below image, we can see the Python file along with required dataset. Now, the current folder is set as a working directory.read_csv() function:Now to import the dataset, we will useread_csv() function of pandas library, which is used to read acsvfile and performs various operations on it. Using this function, we can read a csv file locally as well as through an URL.We can use read_csv function as below:data_set= pd.read_csv('Dataset.csv')Here,data_setis a name of the variable to store our dataset, and inside the function, we have passed the name of our dataset. Once we execute the above line of code, it will successfully import the dataset in our code. We can also check the imported dataset by clicking on the sectionvariable explorer, and then double click ondata_set. Consider the below image:As in the above image, indexing is started from 0, which is the default indexing in Python. We can also change the format of our dataset by clicking on the format option.Extracting dependent and independent variables:In machine learning, it is important to distinguish the matrix of features (independent variables) and dependent variables from dataset. In our dataset, there are three independent variables that areCountry, Age, andSalary, and one is a dependent variable which isPurchased.Extracting independent variable:To extract an independent variable, we will useiloc[ ]method of Pandas library. It is used to extract the required rows and columns from the dataset.x= data_set.iloc[:,:-1].valuesIn the above code, the first colon(:) is used to take all the rows, and the second colon(:) is for all the columns. Here we have used :-1, because we don't want to take the last column as it contains the dependent variable. So by doing this, we will get the matrix of features.By executing the above code, we will get output as:[['India' 38.0 68000.0]

['France' 43.0 45000.0]

['Germany' 30.0 54000.0]

['France' 48.0 65000.0]

['Germany' 40.0 nan]

['India' 35.0 58000.0]

['Germany' nan 53000.0]

['France' 49.0 79000.0]

['India' 50.0 88000.0]

['France' 37.0 77000.0]]As we can see in the above output, there are only three variables.Extracting dependent variable:To extract dependent variables, again, we will use Pandas .iloc[] method.y=

data_set.iloc[:,3].valuesHere we have taken all the rows with the last column only. It will give the array of dependent variables.By executing the above code, we will get output as:Output:array(['No', 'Yes', 'No', 'No', 'Yes', 'Yes', 'No', 'Yes', 'No', 'Yes'],

dtype=object)Note:If you are using Python language for machine learning, then extraction is mandatory, but for R language it is not required.4) Handling Missing data:The next step of data preprocessing is to handle missing data in the datasets. If our dataset contains some missing data, then it may create a huge problem for our machine learning model. Hence it is necessary to handle missing values present in the dataset.Ways to handle missing data:There are mainly two ways to handle missing data, which are:By deleting the particular row:The first way is used to commonly deal with null values. In this way, we just delete the specific row or column which consists of null values. But this way is not so efficient and removing data may lead to loss of information which will not give the accurate output.By calculating the mean:In this way, we will calculate the mean of that column or row which contains any missing value and will put it on the place of missing value. This strategy is useful for the features which have numeric data such as age, salary, year, etc. Here, we will use this approach.To handle missing values, we will useScikit-learnlibrary in our code, which contains various libraries for building machine learning models. Here we will useImputerclass ofsklearn.preprocessinglibrary. Below is the code for it:#handling missing data (Replacing missing data with the mean value)

```
from sklearn.preprocessing import Imputer
imputer= Imputer(missing_values ='NaN', strategy='mean', axis = 0)
#Fitting imputer object to the independent variables x.
imputer= imputer.fit(x[:, 1:3])
#Replacing missing data with the calculated mean value
x[:, 1:3]= imputer.transform(x[:, 1:3])Output:array([['India', 38.0, 68000.0],
    ['France', 43.0, 45000.0],
    ['Germany', 30.0, 54000.0],
    ['France', 48.0, 65000.0],
```

['Germany', 40.0, 65222.22222222222],

['India', 35.0, 58000.0],

['Germany', 41.111111111111114, 53000.0],

['France', 49.0, 79000.0],

['India', 50.0, 88000.0],

['France', 37.0, 77000.0]], dtype=objectAs we can see in the above output, the missing values have been replaced with the means of rest column values.5) Encoding Categorical data:Categorical data is data which has some categories such as, in our dataset; there are two categorical variable,Country, andPurchased.Since machine learning model completely works on mathematics and numbers, but if our dataset would have a categorical variable, then it may create trouble while building the model. So it is necessary to encode these categorical variables into numbers.For Country variable:Firstly, we will convert the country variables into categorical data. So to do this, we will useLabelEncoder()class frompreprocessinglibrary.#Catgorical data

#for Country Variable

from sklearn.preprocessing import LabelEncoder

label_encoder_x= LabelEncoder()

x[:, 0]= label_encoder_x.fit_transform(x[:, 0])Output:Out[15]:

array([[2, 38.0, 68000.0],

[0, 43.0, 45000.0],

[1, 30.0, 54000.0],

[0, 48.0, 65000.0],

[1, 40.0, 65222.22222222222],

[2, 35.0, 58000.0],

[1, 41.111111111111114, 53000.0],

[0, 49.0, 79000.0],

[2, 50.0, 88000.0],

[0, 37.0, 77000.0]], dtype=object)Explanation:In above code, we have importedLabelEncoderclass ofsklearn library. This class has successfully encoded the variables into digits.But in our case, there are three country variables, and as we can see in the above output, these variables are encoded into 0, 1, and 2. By these values, the machine learning model may assume that there is some correlation between these variables which will produce the wrong output. So to remove this issue, we will usedummy encoding.Dummy Variables:Dummy variables are those variables which have values 0 or 1. The 1 value gives the presence of that variable in a particular column, and rest variables become 0. With dummy encoding, we will have a number of columns equal to the number of categories.In our dataset, we have 3 categories so it will produce three columns having 0 and 1 values. For Dummy Encoding, we will useOneHotEncoderclass ofpreprocessinglibrary.#for Country Variable

```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
label_encoder_x= LabelEncoder()
x[:, 0]= label_encoder_x.fit_transform(x[:, 0])
#Encoding for dummy variables
onehot_encoder= OneHotEncoder(categorical_features= [0])
x= onehot_encoder.fit_transform(x).toarray()Output:array([[0.00000000e+00, 0.00000000e+00, 1.00000000e+00, 3.80000000e+01,
        6.80000000e+04],
       [1.00000000e+00, 0.00000000e+00, 0.00000000e+00, 4.30000000e+01,
        4.50000000e+04],
       [0.00000000e+00, 1.00000000e+00, 0.00000000e+00, 3.00000000e+01,
        5.40000000e+04],
       [1.00000000e+00, 0.00000000e+00, 0.00000000e+00, 4.80000000e+01,
        6.50000000e+04],
       [0.00000000e+00, 1.00000000e+00, 0.00000000e+00, 4.00000000e+01,
        6.52222222e+04],
       [0.00000000e+00, 0.00000000e+00, 1.00000000e+00, 3.50000000e+01,
```

5.80000000e+04],

[0.00000000e+00, 1.00000000e+00, 0.00000000e+00, 4.11111111e+01,

5.30000000e+04],

[1.00000000e+00, 0.00000000e+00, 0.00000000e+00, 4.90000000e+01,

7.90000000e+04],

[0.00000000e+00, 0.00000000e+00, 1.00000000e+00, 5.00000000e+01,

8.80000000e+04],

[1.00000000e+00, 0.00000000e+00, 0.00000000e+00, 3.70000000e+01,

7.70000000e+04]])As we can see in the above output, all the variables are encoded into numbers 0 and 1 and divided into three columns.It can be seen more clearly in the variables explorer section, by clicking on x option as:For Purchased Variable:labelencoder_y= LabelEncoder() y= labelencoder_y.fit_transform(y)For the second categorical variable, we will only use labelencoder object ofLableEncoderclass. Here we are not usingOneHotEncoderclass because the purchased variable has only two categories yes or no, and which are automatically encoded into 0 and 1.Output:Out[17]: array([0, 1, 0, 0, 1, 1, 0, 1, 0, 1])It can also be seen as:6) Splitting the Dataset into the Training set and Test setIn machine learning data preprocessing, we divide our dataset into a training set and test set. This is one of the crucial steps of data preprocessing as by doing this, we can enhance the performance of our machine learning model.Suppose, if we have given training to our machine learning model by a dataset and we test it by a completely different dataset. Then, it will create difficulties for our model to understand the correlations between the models.If we train our model very well and its training accuracy is also very high, but we provide a new dataset to it, then it will decrease the performance. So we always try to make a machine learning model which performs well with the training set and also with the test dataset. Here, we can define these datasets as:Training Set:A subset of dataset to train the machine learning model, and we already know the output.Test set:A subset of dataset to test the machine learning model, and by using the test set, model predicts the output.For splitting the dataset, we will use the below lines of code:from sklearn.model_selection import train_test_split x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.2, random_state=0)Explanation:In the above code, the first line is used for splitting arrays of the dataset into random train and test subsets.In the second line, we have used four variables for our output that arex_train:features for the training datax_test:features for testing datay_train:Dependent variables for training datay_test:Independent variable for testing dataIntrain_test_split() function, we have passed four parameters in which first two are for arrays of data, andtest_sizeis for specifying the size of the test set. The test_size maybe .5, .3, or .2, which tells the dividing ratio of training and testing sets.The last parameterrandom_stateis used to set a seed for a random generator so that you always get the same result, and the most used value for this is 42.Output:By executing the above code, we will get 4 different variables, which can be seen under the variable explorer section.As we can see in the above image, the x and y variables are divided into 4 different variables with corresponding values.7) Feature ScalingFeature scaling is the final step of data preprocessing in machine learning. It is a technique to standardize the independent variables of the dataset in a specific range. In feature scaling, we put our variables in the same range and in the same scale so that no any variable dominate the other variable.Consider the below dataset:As we can see, the age and salary column values are not on the same scale. A machine learning model is based onEuclidean distance, and if we do not scale the variable, then it will cause some issue in our machine learning model.Euclidean distance is given as:If we compute any two values from age and salary, then salary values will dominate the age values, and it will produce an incorrect result. So to remove this issue, we need to perform feature scaling for machine learning.There are two ways to perform feature scaling in machine learning:StandardizationNormalizationHere, we will use the standardization method for our dataset.For feature scaling, we will importStandardScalerclass ofsklearn.preprocessinglibrary as:from sklearn.preprocessing import StandardScalerNow, we will create the object ofStandardScalerclass for independent variables or features. And then we will fit and transform the training dataset.st_x= StandardScaler()

x_train= st_x.fit_transform(x_train)For test dataset, we will directly applytransform()function instead offit_transform()because it is already done in training set.x_test= st_x.transform(x_test)Output:By executing the above lines of code, we will get the scaled values for x_train and x_test as:x_train:x_test:As we can see in the above output, all the variables are scaled between values -1 to 1.Note:Here, we have not scaled the dependent variable because there are only two values 0 and 1. But if these variables will have more range of values, then we will also need to scale those variables.Combining all the steps:Now, in the end, we can combine all the steps together to make our complete code more understandable.# importing libraries

```
import numpy as nm

import matplotlib.pyplot as mtp

import pandas as pd


#importing datasets

data_set= pd.read_csv('Dataset.csv')


#Extracting Independent Variable

x= data_set.iloc[:, :-1].values


#Extracting Dependent variable

y= data_set.iloc[:, 3].values


#handling missing data(Replacing missing data with the mean value)

from sklearn.preprocessing import Imputer

imputer= Imputer(missing_values ='NaN', strategy='mean', axis = 0)


#Fitting imputer object to the independent varibles x.

imputer= imputer.fit(x[:, 1:3])


#Replacing missing data with the calculated mean value
```

```
x[:, 1:3]= imputer.transform(x[:, 1:3])


#for Country Variable
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
label_encoder_x= LabelEncoder()
x[:, 0]= label_encoder_x.fit_transform(x[:, 0])


#Encoding for dummy variables
onehot_encoder= OneHotEncoder(categorical_features= [0])
x= onehot_encoder.fit_transform(x).toarray()


#encoding for purchased variable
labelencoder_y= LabelEncoder()
y= labelencoder_y.fit_transform(y)


# Splitting the dataset into training and test set.
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.2, random_state=0)


#Feature Scaling of datasets
from sklearn.preprocessing import StandardScaler
st_x= StandardScaler()
x_train= st_x.fit_transform(x_train)
x_test= st_x.transform(x_test)
```

In the above code, we have included all the data preprocessing steps together. But there are some steps or lines of code which are not necessary for all machine learning models. So we can exclude them from our code to make it reusable for all models.Next TopicSupervised Machine Learning? prevnext ?

Data Preprocessing in Machine learning

Data preprocessing is a process of preparing the raw data and making it suitable for a machine learning model. It is the first and crucial step while creating a machine learning model.

Data Preprocessing in Machine learning

When creating a machine learning project, it is not always a case that we come across the clean and formatted data. And while doing any operation with data, it is mandatory to clean it and put in a formatted way. So for this, we use data preprocessing task.

Why do we need Data Preprocessing?

A real-world data generally contains noises, missing values, and maybe in an unusable format which cannot be directly used for machine learning models. Data preprocessing is required tasks for cleaning the data and making it suitable for a machine learning model which also increases the accuracy and efficiency of a machine learning model.

Why do we need Data Preprocessing?

It involves below steps:

Why do we need Data Preprocessing?

- Getting the dataset
- Importing libraries
- Importing datasets
- Finding Missing Data
- Encoding Categorical Data
- Splitting dataset into training and test set
- Feature scaling

1) Get the Dataset

To create a machine learning model, the first thing we required is a dataset as a machine learning model completely works on data. The collected data for a particular problem in a proper format is known as thedataset.

1) Get the Dataset

Dataset may be of different formats for different purposes, such as, if we want to create a machine learning model for business purpose, then dataset will be different with the dataset required for a liver patient. So each dataset is different from another dataset. To use the dataset in our code, we usually put it into a CSVfile. However, sometimes, we may also need to use an HTML or xlsx file.

What is a CSV File?

CSV stands for "Comma-Separated Values" files; it is a file format which allows us to save the tabular data, such as spreadsheets. It is useful for huge datasets and can use these datasets in programs.

What is a CSV File?

Here we will use a demo dataset for data preprocessing, and for practice, it can be downloaded from here, "https://www.superdatascience.com/pages/machine-learning. For real-world problems, we can download datasets online from various sources such as https://www.kaggle.com/uciml/datasets, https://archive.ics.uci.edu/ml/index.php etc.

What is a CSV File?

We can also create our dataset by gathering data using various API with Python and put that data into a .csv file.

2) Importing Libraries

In order to perform data preprocessing using Python, we need to import some predefined Python libraries. These libraries are used to perform some specific jobs. There are three specific libraries that we will use for data preprocessing, which are:

2) Importing Libraries

Numpy:Numpy Python library is used for including any type of mathematical operation in the code. It is the fundamental package for scientific calculation in Python. It also supports to add large, multidimensional arrays and matrices. So, in Python, we can import it as:

2) Importing Libraries

Here we have usednm, which is a short name for Numpy, and it will be used in the whole program.

2) Importing Libraries

Matplotlib:The second library ismatplotlib, which is a Python 2D plotting library, and with this library, we need to import a sub-librarypyplot. This library is used to plot any type of charts in Python for the code. It will be imported as below:

2) Importing Libraries

Here we have used mpt as a short name for this library.

2) Importing Libraries

Pandas:The last library is the Pandas library, which is one of the most famous Python libraries and used for importing and managing the datasets. It is an open-source data manipulation and analysis library. It will be imported as below:

2) Importing Libraries

Here, we have used pd as a short name for this library. Consider the below image:

3) Importing the Datasets

Now we need to import the datasets which we have collected for our machine learning project. But before importing a dataset, we need to set the current directory as a working directory. To set a working directory in Spyder IDE, we need to follow the below steps:

3) Importing the Datasets

- Save your Python file in the directory which contains dataset.

- Go to File explorer option in Spyder IDE, and select the required directory.

- Click on F5 button or run option to execute the file.

Note:We can set any directory as a working directory, but it must contain the required

Here, in the below image, we can see the Python file along with required dataset. Now, the current folder is set as a working directory.

Note:We can set any directory as a working directory, but it must contain the required

read_csv() function:

Note:We can set any directory as a working directory, but it must contain the required

Now to import the dataset, we will useread_csv() function of pandas library, which is used to read acsvfile and performs various operations on it. Using this function, we can read a csv file locally as well as through an URL.

Note:We can set any directory as a working directory, but it must contain the required

We can use read_csv function as below:

Note:We can set any directory as a working directory, but it must contain the required

Here,data_setis a name of the variable to store our dataset, and inside the function, we have passed the name of our dataset. Once we execute the above line of code, it will successfully import the dataset in our code. We can also check the imported dataset by clicking on the sectionvariable explorer, and then double click ondata_set. Consider the below image:

Note:We can set any directory as a working directory, but it must contain the required

As in the above image, indexing is started from 0, which is the default indexing in Python. We can also change the format of our dataset by clicking on the format option.

Note:We can set any directory as a working directory, but it must contain the required

Extracting dependent and independent variables:

Note:We can set any directory as a working directory, but it must contain the required

In machine learning, it is important to distinguish the matrix of features (independent variables) and dependent variables from dataset. In our dataset, there are three independent variables that areCountry, Age, andSalary, and one is a dependent variable which isPurchased.

Note:We can set any directory as a working directory, but it must contain the required

Extracting independent variable:

Note:We can set any directory as a working directory, but it must contain the required

To extract an independent variable, we will useiloc[ ]method of Pandas library. It is used to extract the required rows and columns from the dataset.

Note:We can set any directory as a working directory, but it must contain the required

In the above code, the first colon(:) is used to take all the rows, and the second colon(:) is for all the columns. Here we have used :-1, because we don't want to take the last column as it contains the dependent variable. So by doing this, we will get the matrix of features.

Note:We can set any directory as a working directory, but it must contain the required

By executing the above code, we will get output as:

Note:We can set any directory as a working directory, but it must contain the required

As we can see in the above output, there are only three variables.

Note:We can set any directory as a working directory, but it must contain the required

Extracting dependent variable:

Note:We can set any directory as a working directory, but it must contain the required

To extract dependent variables, again, we will use Pandas .iloc[] method.

Note:We can set any directory as a working directory, but it must contain the required

Here we have taken all the rows with the last column only. It will give the array of dependent variables.

Note:We can set any directory as a working directory, but it must contain the required

By executing the above code, we will get output as:

Note:We can set any directory as a working directory, but it must contain the required

Output:

4) Handling Missing data:

The next step of data preprocessing is to handle missing data in the datasets. If our dataset contains some missing data, then it may create a huge problem for our machine learning model. Hence it is necessary to handle missing values present in the dataset.

4) Handling Missing data:

Ways to handle missing data:

4) Handling Missing data:

There are mainly two ways to handle missing data, which are:

4) Handling Missing data:

By deleting the particular row:The first way is used to commonly deal with null values. In this way, we just delete the specific row or column which consists of null values. But this way is not so efficient and removing data may lead to loss of information which will not give the accurate output.

4) Handling Missing data:

By calculating the mean:In this way, we will calculate the mean of that column or row which contains any missing value and will put it on the place of missing value. This strategy is useful for the features which have numeric data such as age, salary, year, etc. Here, we will use this approach.

4) Handling Missing data:

To handle missing values, we will useScikit-learnlibrary in our code, which contains various libraries for building machine learning models. Here we will useImputerclass ofsklearn.preprocessinglibrary. Below is the code for it:

4) Handling Missing data:

Output:

4) Handling Missing data:

As we can see in the above output, the missing values have been replaced with the means of rest column values.

5) Encoding Categorical data:

Categorical data is data which has some categories such as, in our dataset; there are two categorical variable,Country, andPurchased.

5) Encoding Categorical data:

Since machine learning model completely works on mathematics and numbers, but if our dataset would have a categorical variable, then it may create trouble while building the model. So it is necessary to encode these categorical variables into numbers.

5) Encoding Categorical data:

For Country variable:

5) Encoding Categorical data:

Firstly, we will convert the country variables into categorical data. So to do this, we will useLabelEncoder()class frompreprocessinglibrary.

5) Encoding Categorical data:

Output:

5) Encoding Categorical data:

Explanation:

5) Encoding Categorical data:

In above code, we have importedLabelEncoderclass ofsklearn library. This class has successfully encoded the variables into digits.

5) Encoding Categorical data:

But in our case, there are three country variables, and as we can see in the above output, these variables are encoded into 0, 1, and 2. By these values, the machine learning model may assume that there is some correlation between these variables which will produce the wrong output. So to remove this issue, we will usedummy encoding.

5) Encoding Categorical data:

Dummy Variables:

5) Encoding Categorical data:

Dummy variables are those variables which have values 0 or 1. The 1 value gives the presence of that variable in a particular column, and rest variables become 0. With dummy encoding, we will have a number of columns equal to the number of categories.

5) Encoding Categorical data:

In our dataset, we have 3 categories so it will produce three columns having 0 and 1 values. For Dummy Encoding, we will useOneHotEncoderclass ofpreprocessinglibrary.

5) Encoding Categorical data:

Output:

5) Encoding Categorical data:

As we can see in the above output, all the variables are encoded into numbers 0 and 1 and divided into three columns.

5) Encoding Categorical data:

It can be seen more clearly in the variables explorer section, by clicking on x option as:

5) Encoding Categorical data:

For Purchased Variable:

5) Encoding Categorical data:

For the second categorical variable, we will only use labelencoder object ofLableEncoderclass. Here we are not usingOneHotEncoderclass because the purchased variable has only two categories yes or no, and which are automatically encoded into 0 and 1.

5) Encoding Categorical data:

Output:

5) Encoding Categorical data:

It can also be seen as:

6) Splitting the Dataset into the Training set and Test set

In machine learning data preprocessing, we divide our dataset into a training set and test set. This is one of the crucial steps of data preprocessing as by doing this, we can enhance the performance of our machine learning model.

6) Splitting the Dataset into the Training set and Test set

Suppose, if we have given training to our machine learning model by a dataset and we test it by a completely different dataset. Then, it will create difficulties for our model to understand the correlations between the models.

6) Splitting the Dataset into the Training set and Test set

If we train our model very well and its training accuracy is also very high, but we provide a new dataset to it, then it will decrease the performance. So we always try to make a machine learning model which performs well with the training set and also with the test dataset. Here, we can define these datasets as:

6) Splitting the Dataset into the Training set and Test set

Training Set:A subset of dataset to train the machine learning model, and we already know the output.

6) Splitting the Dataset into the Training set and Test set

Test set:A subset of dataset to test the machine learning model, and by using the test set, model predicts the output.

6) Splitting the Dataset into the Training set and Test set

For splitting the dataset, we will use the below lines of code:

6) Splitting the Dataset into the Training set and Test set

Explanation:

6) Splitting the Dataset into the Training set and Test set

- In the above code, the first line is used for splitting arrays of the dataset into random train and test subsets.

- In the second line, we have used four variables for our output that arex_train:features for the training datax_test:features for testing datay_train:Dependent variables for training datay_test:Independent variable for testing data

- x_train:features for the training data

- x_test:features for testing data

- y_train:Dependent variables for training data

- y_test:Independent variable for testing data

- Intrain_test_split() function, we have passed four parameters in which first two are for arrays of data, andtest_sizeis for specifying the size of the test set. The test_size maybe .5, .3, or .2, which tells the dividing ratio of training and testing sets.

- The last parameterrandom_stateis used to set a seed for a random generator so that you always get the same result, and the most used value for this is 42.

6) Splitting the Dataset into the Training set and Test set

- x_train:features for the training data

- x_test:features for testing data

- y_train:Dependent variables for training data

- y_test:Independent variable for testing data

6) Splitting the Dataset into the Training set and Test set

Output:

6) Splitting the Dataset into the Training set and Test set

By executing the above code, we will get 4 different variables, which can be seen under the variable explorer section.

6) Splitting the Dataset into the Training set and Test set

As we can see in the above image, the x and y variables are divided into 4 different variables with corresponding values.

7) Feature Scaling

Feature scaling is the final step of data preprocessing in machine learning. It is a technique to standardize the independent variables of the dataset in a specific range. In feature scaling, we put our variables in the same range and in the same scale so that no any variable dominate the other variable.

7) Feature Scaling

Consider the below dataset:

7) Feature Scaling

As we can see, the age and salary column values are not on the same scale. A machine learning model is based onEuclidean distance, and if we do not scale the variable, then it will cause some issue in our machine learning model.

7) Feature Scaling

Euclidean distance is given as:

7) Feature Scaling

If we compute any two values from age and salary, then salary values will dominate the age values, and it will produce an incorrect result. So to remove this issue, we need to perform feature scaling for machine learning.

7) Feature Scaling

There are two ways to perform feature scaling in machine learning:

7) Feature Scaling

Standardization

7) Feature Scaling

Normalization

7) Feature Scaling

Here, we will use the standardization method for our dataset.

7) Feature Scaling

For feature scaling, we will importStandardScalerclass ofsklearn.preprocessinglibrary as:

7) Feature Scaling

Now, we will create the object ofStandardScalerclass for independent variables or features. And then we will fit and transform the training dataset.

7) Feature Scaling

For test dataset, we will directly applytransform()function instead offit_transform()because it is already done in training set.

7) Feature Scaling

Output:

7) Feature Scaling

By executing the above lines of code, we will get the scaled values for x_train and x_test as:

7) Feature Scaling

x_train:

7) Feature Scaling

x_test:

7) Feature Scaling

As we can see in the above output, all the variables are scaled between values -1 to 1.

Note:Here, we have not scaled the dependent variable because there are only two val

Combining all the steps:

Note:Here, we have not scaled the dependent variable because there are only two val

Now, in the end, we can combine all the steps together to make our complete code more understandable.

Note:Here, we have not scaled the dependent variable because there are only two val

In the above code, we have included all the data preprocessing steps together. But there are some steps or lines of code which are not necessary for all machine learning models. So we can exclude them from our code to make it reusable for all models.

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next ?? prevSupervised Machine LearningSupervised learning is the types of machine learning in which machines are trained using well "labelled" training data, and on basis of that data, machines predict the output. The labelled data means some input data is already tagged with the correct output.In supervised learning, the training data provided to the machines work as the supervisor that teaches the machines to predict the output correctly. It applies the same concept as a student learns in the supervision of the teacher.Supervised learning is a process of providing input data as well as correct output data to the machine learning model. The aim of a supervised learning algorithm is tofind a mapping function to map the input variable(x) with the output variable(y).In the real-world, supervised learning can be used forRisk Assessment, Image classification, Fraud Detection, spam filtering, etc.How Supervised Learning Works?In supervised learning, models are trained using labelled dataset, where the model learns about each type of data. Once the training process is completed, the model is tested on the basis of test data (a subset of the training set), and then it predicts the output.The working of Supervised learning can be easily understood by the below example and diagram:Suppose we have a dataset of different types of shapes which includes square, rectangle, triangle, and Polygon. Now the first step is that we need to train the model for each shape.If the given shape has four sides, and all the sides are equal, then it will be labelled as aSquare.If the given shape has three sides, then it will be labelled as atriangle.If the given shape has six equal sides then it will be labelled ashexagon.Now, after training, we test our model using the test set, and the task of the model is to identify the shape.The machine is already trained on all types of shapes, and when it finds a new shape, it classifies the shape on the bases of a number of sides, and predicts the output.Steps Involved in Supervised Learning:First Determine the type of training datasetCollect/Gather the labelled training data.Split the training dataset into trainingdataset, test dataset, and validation dataset.Determine the input features of the training dataset, which should have enough knowledge so that the model can accurately predict the output.Determine the suitable algorithm for the model, such as support vector machine, decision tree, etc.Execute the algorithm on the training dataset. Sometimes we need validation sets as the control parameters, which are the subset of training datasets.Evaluate the accuracy of the model by providing the test set. If the model predicts the correct output, which means our model is accurate.Types of supervised Machine learning Algorithms:Supervised learning can be further divided into two types of problems:1. RegressionRegression algorithms are used if there is a relationship between the input variable and the output variable. It is used for the prediction of continuous variables, such as Weather forecasting, Market Trends, etc. Below are some popular Regression algorithms which come under supervised learning:Linear RegressionRegression TreesNon-Linear RegressionBayesian Linear RegressionPolynomial Regression2. ClassificationClassification algorithms are used when the output variable is categorical, which means there are two classes such as Yes-No, Male-Female, True-false, etc.Spam Filtering,Random ForestDecision TreesLogistic RegressionSupport vector MachinesNote: We will discuss these algorithms in detail in later chapters.Advantages of Supervised learning:With the help of supervised learning, the model can predict the output on the basis of prior experiences.In supervised learning, we can have an exact idea about the classes of objects.Supervised learning model helps us to solve various real-world problems such asfraud detection, spam filtering, etc.Disadvantages of supervised learning:Supervised learning models are not suitable for handling the complex tasks.Supervised learning cannot predict the correct output if the test data is different from the training dataset.Training required lots of computation times.In supervised learning, we need enough knowledge about the classes of object.Next TopicUnsupervised Machine Learning? prevnext ?

Supervised Machine Learning

Supervised learning is the types of machine learning in which machines are trained using well "labelled" training data, and on basis of that data, machines predict the output. The labelled data means some input data is already tagged with the correct output.

Supervised Machine Learning

In supervised learning, the training data provided to the machines work as the supervisor that teaches the machines to predict the output correctly. It applies the same concept as a student learns in the supervision of the teacher.

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Supervised learning is a process of providing input data as well as correct output data to the machine learning model. The aim of a supervised learning algorithm is tofind a mapping function to map the input variable(x) with the output variable(y).

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Types of supervised Machine learning Algorithms:

1. Regression

Types of supervised Machine learning Algorithms:

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Types of supervised Machine learning Algorithms:

- Linear Regression
- Regression Trees
- Non-Linear Regression
- Bayesian Linear Regression
- Polynomial Regression

Types of supervised Machine learning Algorithms:

2. Classification

Types of supervised Machine learning Algorithms:

Classification algorithms are used when the output variable is categorical, which means there are two classes such as Yes-No, Male-Female, True-false, etc.

Types of supervised Machine learning Algorithms:

Spam Filtering,

Types of supervised Machine learning Algorithms:

- Random Forest
- Decision Trees
- Logistic Regression
- Support vector Machines

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- Supervised learning models are not suitable for handling the complex tasks.
- Supervised learning cannot predict the correct output if the test data is different from the training dataset.
- Training required lots of computation times.
- In supervised learning, we need enough knowledge about the classes of object.

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next ?? prevUnsupervised Machine LearningIn the previous topic, we learned supervised machine learning in which models are trained using labeled data under the supervision of training data. But there may be many cases in which we do not have labeled data and need to find the hidden patterns from the given dataset. So, to solve such types of cases in machine learning, we need unsupervised learning techniques.What is Unsupervised Learning?As the name suggests, unsupervised learning is a machine learning technique in which models are not supervised using training dataset. Instead, models itself find the hidden patterns and insights from the given data. It can be compared to learning which takes place in the human brain while learning new things. It can be defined as:Unsupervised learning is a type of machine learning in which models are trained using unlabeled dataset and are allowed to act on that data without any supervision.Unsupervised learning cannot be directly applied to a regression or classification problem because unlike supervised learning, we have the input data but no corresponding output data. The goal of unsupervised learning is tofind the underlying structure of dataset, group that data according to similarities, and represent that dataset in a compressed format.Example:Suppose the unsupervised learning algorithm is given an input dataset containing images of different types of cats and dogs. The algorithm is never trained upon the given dataset, which means it does not have any idea about the features of the dataset. The task of the unsupervised learning algorithm is to identify the image features on their own. Unsupervised learning algorithm will perform this task by clustering the image dataset into the groups according to similarities between images.Why use Unsupervised Learning?Below are some main reasons which describe the importance of Unsupervised Learning:Unsupervised learning is helpful for finding useful insights from the data.Unsupervised learning is much similar as a human learns to think by their own experiences, which makes it closer to the real AI.Unsupervised learning works on unlabeled and uncategorized data which make unsupervised learning more important.In real-world, we do not always have input data with the corresponding output so to solve such cases, we need unsupervised learning.Working of Unsupervised LearningWorking of unsupervised learning can be understood by the below diagram:Here, we have taken an unlabeled input data, which means it is not categorized and corresponding outputs are also not given. Now, this unlabeled input data is fed to the machine learning model in order to train it. Firstly, it will interpret the raw data to find the hidden patterns from the data and then will apply suitable algorithms such as k-means clustering, Decision tree, etc.Once it applies the suitable algorithm, the algorithm divides the data objects into groups according to the similarities and difference between the objects.Types of Unsupervised Learning Algorithm:The unsupervised learning algorithm can be further categorized into two types of problems:Clustering: Clustering is a method of grouping the objects into clusters such that objects with most similarities remains into a group and has less or no similarities with the objects of another group. Cluster analysis finds the commonalities between the data objects and categorizes them as per the presence and absence of those commonalities.Association: An association rule is an unsupervised learning method which is used for finding the relationships between variables in the large database. It determines the set of items that occurs together in the dataset. Association rule makes marketing strategy more effective. Such as people who buy X item (suppose a bread) are also tend to purchase Y (Butter/Jam) item. A typical example of Association rule is Market Basket Analysis.Note: We will learn these algorithms in later chapters.Unsupervised Learning algorithms:Below is the list of some popular unsupervised learning algorithms:K-means clusteringKNN (k-nearest neighbors)Hierarchal clusteringAnomaly detectionNeural NetworksPrinciple Component AnalysisIndependent Component AnalysisApriori algorithmSingular value decompositionAdvantages of Unsupervised LearningUnsupervised learning is used for more complex tasks as compared to supervised learning because, in unsupervised learning, we don't have labeled input data.Unsupervised learning is preferable as it is easy to get unlabeled data in comparison to labeled data.Disadvantages of Unsupervised LearningUnsupervised learning is intrinsically more difficult than supervised learning as it does not have corresponding output.The result of the unsupervised learning algorithm might be less accurate as input data is not labeled, and algorithms do not know the exact output in advance.Next TopicSupervised vs Unsupervised Learning? prevnext ?

Unsupervised Machine Learning

In the previous topic, we learned supervised machine learning in which models are trained using labeled data under the supervision of training data. But there may be many cases in which we do not have labeled data and need to find the hidden patterns from the given dataset. So, to solve such types of cases in machine learning, we need unsupervised learning techniques.

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- Unsupervised learning is helpful for finding useful insights from the data.

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- Unsupervised learning works on unlabeled and uncategorized data which make unsupervised learning more important.

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Working of Unsupervised Learning

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- Clustering: Clustering is a method of grouping the objects into clusters such that objects with most similarities remains into a group and has less or no similarities with the objects of another group. Cluster analysis finds the commonalities between the data objects and categorizes them as per the presence and absence of those commonalities.
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Unsupervised Learning algorithms:

Below is the list of some popular unsupervised learning algorithms:

Unsupervised Learning algorithms:

- K-means clustering

- KNN (k-nearest neighbors)

- Hierarchal clustering

- Anomaly detection

- Neural Networks

- Principle Component Analysis

- Independent Component Analysis

- Apriori algorithm

- Singular value decomposition

Advantages of Unsupervised Learning

- Unsupervised learning is used for more complex tasks as compared to supervised learning because, in unsupervised learning, we don't have labeled input data.

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Disadvantages of Unsupervised Learning

- Unsupervised learning is intrinsically more difficult than supervised learning as it does not have corresponding output.

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Supervised Learning

- Regression Analysis

- Linear Regression

- Simple Linear Regression

- Multiple Linear Regression

- Backward Elimination

- Polynomial Regression

Classification

- Classification Algorithm

- Logistic Regression

- K-NN Algorithm

- Support Vector Machine Algorithm

- Na?ve Bayes Classifier

Miscellaneous

- Classification vs Regression

- Linear Regression vs Logistic Regression

- Decision Tree Classification Algorithm

- Random Forest Algorithm

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- Association Rule Learning

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So to identify the image in supervised learning, we will give the input data as well as output for that, which means we will train the model by the shape, size, color, and taste of each fruit. Once the training is completed, we will test the model by giving the new set of fruit. The model will identify the fruit and predict the output using a suitable algorithm.Unsupervised Machine Learning:Unsupervised learning is another machine learning method in which patterns inferred from the unlabeled input data. The goal of unsupervised learning is to find the structure and patterns from the input data. Unsupervised learning does not need any supervision. Instead, it finds patterns from the data by its own.Learn moreUnsupervised Machine LearningUnsupervised learning can be used for two types of problems:ClusteringandAssociation.Example:To understand the unsupervised learning, we will use the example given above. So unlike supervised learning, here we will not provide any supervision to the model. We will just provide the input dataset to the model and allow the model to find the patterns from the data. With the help of a suitable algorithm, the model will train itself and divide the fruits into different groups according to the most similar features between them.The main differences between Supervised and Unsupervised learning are given below:Supervised LearningUnsupervised LearningSupervised learning algorithms are trained using labeled data.Unsupervised learning algorithms are trained using unlabeled data.Supervised learning model takes direct feedback to check if it is predicting correct output or not.Unsupervised learning model does not take any feedback.Supervised learning model predicts the output.Unsupervised learning model finds the hidden patterns in data.In supervised learning, input data is provided to the model along with the output.In unsupervised learning, only input data is provided to the model.The goal of supervised learning is to train the model so that it can predict the output when it is given new data.The goal of unsupervised learning is to find the hidden patterns and useful insights from the unknown dataset.Supervised learning needs supervision to train the model.Unsupervised learning does not need any supervision to train the model.Supervised learning can be categorized inClassificationandRegressionproblems.Unsupervised Learning can be classified inClusteringandAssociationsproblems.Supervised learning can be used for those cases where we know the input as well as corresponding outputs.Unsupervised learning can be used for those cases where we have only input data and no corresponding output data.Supervised learning model produces an accurate result.Unsupervised learning model may give less accurate result as compared to supervised learning.Supervised learning is not close to true Artificial intelligence as in this, we first train the model for each data, and then only it can predict the correct output.Unsupervised learning is more close to the true Artificial Intelligence as it learns similarly as a child learns daily routine things by his experiences.It includes various algorithms such as Linear Regression, Logistic Regression, Support Vector Machine, Multi-class Classification, Decision tree, Bayesian Logic, etc.It includes various algorithms such as Clustering, KNN, and Apriori algorithm.Note: The supervised and unsupervised learning both are the machine learning methods, and selection of any of these learning depends on the factors related to the structure and volume of your dataset and the use cases of the problem.Next TopicRegression Analysis in Machine learning? prevnext ? | Supervised Learning | Unsupervised Learning | Supervised learning algorithms are trained using labeled data. | Unsupervised learning algorithms are trained using unlabeled data. | Supervised learning model takes direct feedback to check if it is predicting correct output or not. | Unsupervised learning model does not take any feedback. | Supervised learning model predicts the output. | Unsupervised learning model finds the hidden patterns in data. | In supervised learning, input data is provided to the model along with the output. | In unsupervised learning, only input data is provided to the model. | The goal of supervised learning is to train the model so that it can predict the output when it is given new data. | The goal of unsupervised learning is to find the hidden patterns and useful insights from the unknown dataset. | Supervised learning needs supervision to train the model. | Unsupervised learning does not need any supervision to train the model. | Supervised learning can be categorized inClassificationandRegressionproblems. | Unsupervised Learning can be classified inClusteringandAssociationsproblems. | Supervised learning can be used for those cases where we know the input as well as corresponding outputs. | Unsupervised learning can be used for those cases where we have only input data and no corresponding output data. |

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Difference between Supervised and Unsupervised Learning

Supervised and Unsupervised learning are the two techniques of machine learning. But both the techniques are used in different scenarios and with different datasets. Below the explanation of both learning methods along with their difference table is given.

Supervised Machine Learning:

Supervised learning is a machine learning method in which models are trained using labeled data. In supervised learning, models need to find the mapping function to map the input variable (X) with the output variable (Y).

Supervised Machine Learning:

Supervised learning needs supervision to train the model, which is similar to as a student learns things in the presence of a teacher. Supervised learning can be used for two types of problems:ClassificationandRegression.

Supervised Machine Learning:

Learn moreSupervised Machine Learning

Supervised Machine Learning:

Example:Suppose we have an image of different types of fruits. The task of our supervised learning model is to identify the fruits and classify them accordingly. So to identify the image in supervised learning, we will give the input data as well as output for that, which means we will train the model by the shape, size, color, and taste of each fruit. Once the training is completed, we will test the model by giving the new set of fruit. The model will identify the fruit and predict the output using a suitable algorithm.

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Unsupervised Machine Learning:

The main differences between Supervised and Unsupervised learning are given below:

Unsupervised Machine Learning:

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next ?? prevRegression Analysis in Machine learningRegression analysis is a statistical method to model the relationship between a dependent (target) and independent (predictor) variables with one or more independent variables. More specifically, Regression analysis helps us to understand how the value of the dependent variable is changing corresponding to an independent variable when other independent variables are held fixed. It predicts continuous/real values such astemperature, age, salary, price,etc.We can understand the concept of regression analysis using the below example:Example:Suppose there is a marketing company A, who does various advertisement every year and get sales on that. The below list shows the advertisement made by the company in the last 5 years and the corresponding sales:Now, the company wants to do the advertisement of $200 in the year 2019and wants to know the prediction about the sales for this year. So to solve such type of prediction problems in machine learning, we need regression analysis.Regression is asupervised learning techniquewhich helps in finding the correlation between variables and enables us to predict the continuous output variable based on the one or more predictor variables. It is mainly used forprediction, forecasting, time series modeling, and determining the causal-effect relationship between variables.In Regression, we plot a graph between the variables which best fits the given datapoints, using this plot, the machine learning model can make predictions about the data. In simple words,"Regression shows a line or curve that passes through all the datapoints on target-predictor graph in such a way that the vertical distance between the datapoints and the regression line is minimum."The distance between datapoints and line tells whether a model has captured a strong relationship or not.Some examples of regression can be as:Prediction of rain using temperature and other factorsDetermining Market trendsPrediction of road accidents due to rash driving.Terminologies Related to the Regression Analysis:Dependent Variable:The main factor in Regression analysis which we want to predict or understand is called the dependent variable. It is also calledtarget variable.Independent Variable:The factors which affect the dependent variables or which are used to predict the values of the dependent variables are called independent variable, also called as apredictor.Outliers:Outlier is an observation which contains either very low value or very high value in comparison to other observed values. An outlier may hamper the result, so it should be avoided.Multicollinearity:If the independent variables are highly correlated with each other than other variables, then such condition is called Multicollinearity. It should not be present in the dataset, because it creates problem while ranking the most affecting variable.Underfitting and Overfitting:If our algorithm works well with the training dataset but not well with test dataset, then such problem is calledOverfitting. And if our algorithm does not perform well even with training dataset, then such problem is calledunderfitting.Why do we use Regression Analysis?As mentioned above, Regression analysis helps in the prediction of a continuous variable. There are various scenarios in the real world where we need some future predictions such as weather condition, sales prediction, marketing trends, etc., for such case we need some technology which can make predictions more accurately. So for such case we need Regression analysis which is a statistical method and used in machine learning and data science. Below are some other reasons for using Regression analysis:Regression estimates the relationship between the target and the independent variable.It is used to find the trends in data.It helps to predict real/continuous values.By performing the regression, we can confidently determine themost important factor, the least important factor, and how each factor is affecting the other factors.Types of RegressionThere are various types of regressions which are used in data science and machine learning. Each type has its own importance on different scenarios, but at the core, all the regression methods analyze the effect of the independent variable on dependent variables. Here we are discussing some important types of regression which are given below:Linear RegressionLogistic RegressionPolynomial RegressionSupport Vector RegressionDecision Tree RegressionRandom Forest RegressionRidge RegressionLasso Regression:Linear Regression:Linear regression is a statistical regression method which is used for predictive analysis.It is one of the very simple and easy algorithms which works on regression and shows the relationship between the continuous variables.It is used for solving the regression problem in machine learning.Linear regression shows the linear relationship between the independent variable (X-axis) and the dependent variable (Y-axis), hence called linear regression.If there is only one input variable (x), then such linear regression is calledsimple linear regression. And if there is more than one input variable, then such linear regression is calledmultiple linear regression.The relationship between variables in the linear regression model can be explained using the below image. Here we are predicting the salary of an employee on the basis ofthe year of experience.Below is the mathematical equation for Linear regression:Y= aX+bHere, Y = dependent variables (target variables),X= Independent variables (predictor variables),a and b are the linear coefficientsSome popular applications of linear regression are:Analyzing trends and sales estimatesSalary forecastingReal estate predictionArriving at ETAs in traffic.Logistic

Regression:Logistic regression is another supervised learning algorithm which is used to solve the classification problems. Inclassification problems, we have dependent variables in a binary or discrete format such as 0 or 1.Logistic regression algorithm works with the categorical variable such as 0 or 1, Yes or No, True or False, Spam or not spam, etc.It is a predictive analysis algorithm which works on the concept of probability.Logistic regression is a type of regression, but it is different from the linear regression algorithm in the term how they are used.Logistic regression usessigmoid functionor logistic function which is a complex cost function. This sigmoid function is used to model the data in logistic regression. The function can be represented as:f(x)= Output between the 0 and 1 value.x= input to the functione= base of natural logarithm.When we provide the input values (data) to the function, it gives the S-curve as follows:It uses the concept of threshold levels, values above the threshold level are rounded up to 1, and values below the threshold level are rounded up to 0.There are three types of logistic regression:Binary(0/1, pass/fail)Multi(cats, dogs, lions)Ordinal(low, medium, high)Polynomial Regression:Polynomial Regression is a type of regression which models thenon-linear datasetusing a linear model.It is similar to multiple linear regression, but it fits a non-linear curve between the value of x and corresponding conditional values of y.Suppose there is a dataset which consists of datapoints which are present in a non-linear fashion, so for such case, linear regression will not best fit to those datapoints. To cover such datapoints, we need Polynomial regression.In Polynomial regression, the original features are transformed into polynomial features of given degree and then modeled using a linear model.Which means the datapoints are best fitted using a polynomial line.The equation for polynomial regression also derived from linear regression equation that means Linear regression equation Y= b0+ b1x, is transformed into Polynomial regression equation Y= b0+b1x+ b2x2+ b3x3+.....+ bnxn.Here Y is thepredicted/target output, b0, b1,... bnare the regression coefficients. x is ourindependent/input variable.The model is still linear as the coefficients are still linear with quadraticNote:This is different from Multiple Linear regression in such a way that in Polynomial regression, a single element has different degrees instead of multiple variables with the same degree.Support Vector Regression:Support Vector Machine is a supervised learning algorithm which can be used for regression as well as classification problems. So if we use it for regression problems, then it is termed as Support Vector Regression.Support Vector Regression is a regression algorithm which works for continuous variables. Below are some keywords which are used inSupport Vector Regression:Kernel:It is a function used to map a lower-dimensional data into higher dimensional data.Hyperplane:In general SVM, it is a separation line between two classes, but in SVR, it is a line which helps to predict the continuous variables and cover most of the datapoints.Boundary line:Boundary lines are the two lines apart from hyperplane, which creates a margin for datapoints.Support vectors:Support vectors are the datapoints which are nearest to the hyperplane and opposite class.In SVR, we always try to determine a hyperplane with a maximum margin, so that maximum number of datapoints are covered in that margin.The main goal of SVR is to consider the maximum datapoints within the boundary lines and the hyperplane (best-fit line) must contain a maximum number of datapoints. Consider the below image:Here, the blue line is called hyperplane, and the other two lines are known as boundary lines.Decision Tree Regression:Decision Tree is a supervised learning algorithm which can be used for solving both classification and regression problems.It can solve problems for both categorical and numerical dataDecision Tree regression builds a tree-like structure in which each internal node represents the "test" for an attribute, each branch represent the result of the test, and each leaf node represents the final decision or result.A decision tree is constructed starting from the root node/parent node (dataset), which splits into left and right child nodes (subsets of dataset). These child nodes are further divided into their children node, and themselves become the parent node of those nodes. Consider the below image:Above image showing the example of Decision Tee regression, here, the model is trying to predict the choice of a person between Sports cars or Luxury car.Random forest is one of the most powerful supervised learning algorithms which is capable of performing regression as well as classification tasks.The Random Forest regression is an ensemble learning method which combines multiple decision trees and predicts the final output based on the average of each tree output. The combined decision trees are called as base models, and it can be represented more formally as:g(x)= f0(x)+ f1(x)+ f2(x)+....Random forest usesBagging or Bootstrap Aggregationtechnique of ensemble learning in which aggregated decision tree runs in parallel and do not interact with each other.With the help of Random Forest regression, we can prevent Overfitting in the model by creating random subsets of the dataset.Ridge Regression:Ridge regression is one of the most robust versions of linear regression in which a small amount of bias is introduced so that we can get better long term predictions.The amount of bias added to the model is known asRidge Regression penalty. We can compute this penalty term by multiplying with the lambda to the squared weight of each individual features.The equation for ridge regression will be:A general linear or polynomial regression will fail if there is high collinearity between the independent variables, so to solve such problems, Ridge regression can be used.Ridge regression is a regularization technique, which is used to reduce the complexity of the model. It is also called asL2 regularization.It helps to solve the problems if we have more parameters than samples.Lasso Regression:Lasso regression is another regularization technique to reduce the complexity of the model.It is similar to the Ridge Regression except that penalty term contains only the absolute weights instead of a square of weights.Since it takes absolute values, hence, it can shrink the slope to 0, whereas Ridge Regression can only shrink it near to 0.It is also called asL1 regularization. The equation for Lasso regression will be:Next TopicLinear Regression? prevnext ?

Regression Analysis in Machine learning

Regression analysis is a statistical method to model the relationship between a dependent (target) and independent (predictor) variables with one or more independent variables. More specifically, Regression analysis helps us to understand how the value of the dependent variable is changing corresponding to an independent variable when other independent variables are held fixed. It predicts continuous/real values such astemperature, age, salary, price,etc.

Regression Analysis in Machine learning

We can understand the concept of regression analysis using the below example:

Regression Analysis in Machine learning

Example:Suppose there is a marketing company A, who does various advertisement every year and get sales on that. The below list shows the advertisement made by the company in the last 5 years and the corresponding sales:

Regression Analysis in Machine learning

Now, the company wants to do the advertisement of $200 in the year 2019and wants to know the prediction about the sales for this year. So to solve such type of prediction problems in machine learning, we need regression analysis.

Regression Analysis in Machine learning

Regression is asupervised learning techniquewhich helps in finding the correlation between variables and enables us to predict the continuous output variable based on the one or more predictor variables. It is mainly used forprediction, forecasting, time series modeling, and determining the causal-effect relationship between variables.

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In Regression, we plot a graph between the variables which best fits the given datapoints, using this plot, the machine learning model can make predictions about the data. In simple words,"Regression shows a line or curve that passes through all the datapoints on target-predictor graph in such a way that the vertical distance between the datapoints and the regression line is minimum."The distance between datapoints and line tells whether a model has captured a strong relationship or not.

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Some examples of regression can be as:

Regression Analysis in Machine learning

- Prediction of rain using temperature and other factors
- Determining Market trends
- Prediction of road accidents due to rash driving.

Terminologies Related to the Regression Analysis:

- Dependent Variable:The main factor in Regression analysis which we want to predict or understand is called the dependent variable. It is also calledtarget variable.

- Independent Variable:The factors which affect the dependent variables or which are used to predict the values of the dependent variables are called independent variable, also called as apredictor.

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- Multicollinearity:If the independent variables are highly correlated with each other than other variables, then such condition is called Multicollinearity. It should not be present in the dataset, because it creates problem while ranking the most affecting variable.

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As mentioned above, Regression analysis helps in the prediction of a continuous variable. There are various scenarios in the real world where we need some future predictions such as weather condition, sales prediction, marketing trends, etc., for such case we need some technology which can make predictions more accurately. So for such case we need Regression analysis which is a statistical method and used in machine learning and data science. Below are some other reasons for using Regression analysis:

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Types of Regression

There are various types of regressions which are used in data science and machine learning. Each type has its own importance on different scenarios, but at the core, all the regression methods analyze the effect of the independent variable on dependent variables. Here we are discussing some important types of regression which are given below:

Types of Regression

- Linear Regression
- Logistic Regression
- Polynomial Regression
- Support Vector Regression
- Decision Tree Regression
- Random Forest Regression
- Ridge Regression
- Lasso Regression:

Linear Regression:

- Linear regression is a statistical regression method which is used for predictive analysis.
- It is one of the very simple and easy algorithms which works on regression and shows the relationship between the continuous variables.
- It is used for solving the regression problem in machine learning.
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- If there is only one input variable (x), then such linear regression is calledsimple linear regression. And if there is more than one input variable, then such linear regression is calledmultiple linear regression.

- The relationship between variables in the linear regression model can be explained using the below image. Here we are predicting the salary of an employee on the basis ofthe year of experience.

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- Below is the mathematical equation for Linear regression:

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Here, Y = dependent variables (target variables),X= Independent variables (predictor variables),a and b are the linear coefficients

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Some popular applications of linear regression are:

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- Analyzing trends and sales estimates
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- f(x)= Output between the 0 and 1 value.
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Support Vector Regression:

Here, the blue line is called hyperplane, and the other two lines are known as boundary lines.

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- It can solve problems for both categorical and numerical data

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Decision Tree Regression:

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- The equation for ridge regression will be:

Ridge Regression:

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Interview Questions

next ?? prevLinear Regression in Machine LearningLinear regression is one of the easiest and most popular Machine Learning algorithms. It is a statistical method that is used for predictive analysis. Linear regression makes predictions for continuous/real or numeric variables such assales, salary, age, product price,etc.Linear regression algorithm shows a linear relationship between a dependent (y) and one or more independent (y) variables, hence called as linear regression. Since linear regression shows the linear relationship, which means it finds how the value of the dependent variable is changing according to the value of the independent variable.The linear regression model provides a sloped straight line representing the relationship between the variables. Consider the below image:Mathematically, we can represent a linear regression as:y= a0+a1x+ ?Here,Y= Dependent Variable (Target Variable)X= Independent Variable (predictor Variable)a0= intercept of the line (Gives an additional degree of freedom)a1 = Linear regression coefficient (scale factor to each input value).? = random errorThe values for x and y variables are training datasets for Linear Regression model representation.Types of Linear RegressionLinear regression can be further divided into two types of the algorithm:Simple Linear Regression:If a single independent variable is used to predict the value of a numerical dependent variable, then such a Linear Regression algorithm is called Simple Linear Regression.Multiple Linear regression:If more than one independent variable is used to predict the value of a numerical dependent variable, then such a Linear Regression algorithm is called Multiple Linear Regression.Linear Regression LineA linear line showing the relationship between the dependent and independent variables is called aregression line. A regression line can show two types of relationship:Positive Linear Relationship:If the dependent variable increases on the Y-axis and independent variable increases on X-axis, then such a relationship is termed as a Positive linear relationship.Negative Linear Relationship:If the dependent variable decreases on the Y-axis and independent variable increases on the X-axis, then such a relationship is called a negative linear relationship.Finding the best fit line:When working with linear regression, our main goal is to find the best fit line that means the error between predicted values and actual values should be minimized. The best fit line will have the least error.The different values for weights or the coefficient of lines (a0, a1) gives a different line of regression, so we need to calculate the best values for a0and a1to find the best fit line, so to calculate this we use cost function.Cost function-The different values for weights or coefficient of lines (a0, a1) gives the different line of regression, and the cost function is used to estimate the values of the coefficient for the best fit line.Cost function optimizes the regression coefficients or weights. It measures how a linear regression model is performing.We can use the cost function to find the accuracy of themapping function, which maps the input variable to the output variable. This mapping function is also known asHypothesis function.For Linear Regression, we use theMean Squared Error (MSE)cost function, which is the average of squared error occurred between the predicted values and actual values. It can be written as:For the above linear equation, MSE can be calculated as:Where,N=Total number of observationYi = Actual value(a1xi+a0)= Predicted value.Residuals:The distance between the actual value and predicted values is called residual. If the observed points are far from the regression line, then the residual will be high, and so cost function will high. If the scatter points are close to the regression line, then the residual will be small and hence the cost function.Gradient Descent:Gradient descent is used to minimize the MSE by calculating the gradient of the cost function.A regression model uses gradient descent to update the coefficients of the line by reducing the cost function.It is done by a random selection of values of coefficient and then iteratively update the values to reach the minimum cost function.Model Performance:The Goodness of fit determines how the line of regression fits the set of observations. The process of finding the best model out of various models is calledoptimization. It can be achieved by below method:1. R-squared method:R-squared is a statistical method that determines the goodness of fit.It measures the strength of the relationship between the dependent and independent variables on a scale of 0-100%.The high value of R-square determines the less difference between the predicted values and actual values and hence represents a good model.It is also called acoefficient of determination,orcoefficient of multiple determinationfor multiple regression.It can be calculated from the below formula:Assumptions of Linear RegressionBelow are some important assumptions of Linear Regression. These are some formal checks while building a Linear Regression model, which ensures to get the best possible result from the given dataset.Linear relationship between the features and target:Linear regression assumes the linear relationship between the dependent and independent variables.Small or no multicollinearity between the features:Multicollinearity means high-correlation between the independent variables. Due to multicollinearity, it may difficult to find the true relationship between the predictors and target variables. Or we can say, it is difficult to determine which predictor variable is affecting the target variable and which is not. So, the model assumes either little or no multicollinearity between the features or independent variables.Homoscedasticity Assumption:Homoscedasticity is a situation when the error term is the same for all the values of independent variables. With homoscedasticity, there should be no clear pattern distribution of data in the scatter plot.Normal distribution of error terms:Linear regression assumes that the error term should follow the normal distribution pattern. If error terms are not normally distributed, then confidence intervals will become either too wide or too narrow, which may cause difficulties in finding coefficients.It can be checked using theq-q plot. If the plot shows a straight line without any deviation, which means the error is normally distributed.No autocorrelations:The linear regression model assumes no autocorrelation in error terms. If there will be any correlation in the error term, then it will drastically reduce the accuracy of the model. Autocorrelation usually occurs if there is a dependency between residual errors.Next TopicSimple Linear Regression? prevnext ?

Linear Regression in Machine Learning

Linear regression is one of the easiest and most popular Machine Learning algorithms. It is a statistical method that is used for predictive analysis. Linear regression makes predictions for continuous/real or numeric variables such assales, salary, age, product price,etc.

Linear Regression in Machine Learning

Linear regression algorithm shows a linear relationship between a dependent (y) and one or more independent (y) variables, hence called as linear regression. Since linear regression shows the linear relationship, which means it finds how the value of the dependent variable is changing according to the value of the independent variable.

Linear Regression in Machine Learning

The linear regression model provides a sloped straight line representing the relationship between the variables. Consider the below image:

Linear Regression in Machine Learning

Mathematically, we can represent a linear regression as:

Linear Regression in Machine Learning

Here,

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Y= Dependent Variable (Target Variable)X= Independent Variable (predictor Variable)a0= intercept of the line (Gives an additional degree of freedom)a1 = Linear regression coefficient (scale factor to each input value).? = random error

Linear Regression in Machine Learning

The values for x and y variables are training datasets for Linear Regression model representation.

Types of Linear Regression

Linear regression can be further divided into two types of the algorithm:

Types of Linear Regression

- Simple Linear Regression:If a single independent variable is used to predict the value of a numerical dependent variable, then such a Linear Regression algorithm is called Simple Linear Regression.

- Multiple Linear regression:If more than one independent variable is used to predict the value of a numerical dependent variable, then such a Linear Regression algorithm is called Multiple Linear Regression.

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A linear line showing the relationship between the dependent and independent variables is called aregression line. A regression line can show two types of relationship:

Linear Regression Line

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Linear Regression Line

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Finding the best fit line:

When working with linear regression, our main goal is to find the best fit line that means the error between predicted values and actual values should be minimized. The best fit line will have the least error.

Finding the best fit line:

The different values for weights or the coefficient of lines (a0, a1) gives a different line of regression, so we need to calculate the best values for a0and a1to find the best fit line, so to calculate this we use cost function.

Cost function-

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For the above linear equation, MSE can be calculated as:

Cost function-

Where,

Cost function-

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Cost function-

Residuals:The distance between the actual value and predicted values is called residual. If the observed points are far from the regression line, then the residual will be high, and so cost function will high. If the scatter points are close to the regression line, then the residual will be small and hence the cost function.

Gradient Descent:

- Gradient descent is used to minimize the MSE by calculating the gradient of the cost function.

- A regression model uses gradient descent to update the coefficients of the line by reducing the cost function.

- It is done by a random selection of values of coefficient and then iteratively update the values to reach the minimum cost function.

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The Goodness of fit determines how the line of regression fits the set of observations. The process of finding the best model out of various models is calledoptimization. It can be achieved by below method:

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Model Performance:

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- It measures the strength of the relationship between the dependent and independent variables on a scale of 0-100%.

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- It is also called acoefficient of determination,orcoefficient of multiple determinationfor multiple regression.

- It can be calculated from the below formula:

Assumptions of Linear Regression

Below are some important assumptions of Linear Regression. These are some formal checks while building a Linear Regression model, which ensures to get the best possible result from the given dataset.

Assumptions of Linear Regression

- Linear relationship between the features and target:Linear regression assumes the linear relationship between the dependent and independent variables.

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next ?? prevSimple Linear Regression in Machine LearningSimple Linear Regression is a type of Regression algorithms that models the relationship between a dependent variable and a single independent variable. The relationship shown by a Simple Linear Regression model is linear or a sloped straight line, hence it is called Simple Linear Regression.The key point in Simple Linear Regression is that thedependent variable must be a continuous/real value. However, the independent variable can be measured on continuous or categorical values.Simple Linear regression algorithm has mainly two objectives:Model the relationship between the two variables.Such as the relationship between Income and expenditure, experience and Salary, etc.Forecasting new observations.Such as Weather forecasting according to temperature, Revenue of a company according to the investments in a year, etc.Simple Linear Regression Model:The Simple Linear Regression model can be represented using the below equation:y= a0+a1x+ ?Where,a0= It is the intercept of the Regression line (can be obtained putting x=0)a1= It is the slope of the regression line, which tells whether the line is increasing or decreasing.? = The error term. (For a good model it will be negligible)Implementation of Simple Linear Regression Algorithm using

PythonProblem Statement example for Simple Linear Regression:Here we are taking a dataset that has two variables: salary (dependent variable) and experience (Independent variable). The goals of this problem is:We want to find out if there is any correlation between these two variablesWe will find the best fit line for the dataset.How the dependent variable is changing by changing the independent variable.In this section, we will create a Simple Linear Regression model to find out the best fitting line for representing the relationship between these two variables.To implement the Simple Linear regression model in machine learning using Python, we need to follow the below steps:Step-1: Data Pre-processingThe first step for creating the Simple Linear Regression model isdata pre-processing. We have already done it earlier in this tutorial. But there will be some changes, which are given in the below steps:First, we will import the three important libraries, which will help us for loading the dataset, plotting the graphs, and creating the Simple Linear Regression model.import numpy as nm
import matplotlib.pyplot as mtp
import pandas as pdNext, we will load the dataset into our code:data_set= pd.read_csv('Salary_Data.csv')By executing the above line of code (ctrl+ENTER), we can read the dataset on our Spyder IDE screen by clicking on the variable explorer option.The above output shows the dataset, which has two variables: Salary and Experience.Note:In Spyder IDE, the folder containing the code file must be saved as a working directory, and the dataset or csv file should be in the same folder.After that, we need to extract the dependent and independent variables from the given dataset. The independent variable is years of experience, and the dependent variable is salary. Below is code for it:x= data_set.iloc[:, :-1].values
y= data_set.iloc[:, 1].valuesIn the above lines of code, for x variable, we have taken -1 value since we want to remove the last column from the dataset. For y variable, we have taken 1 value as a parameter, since we want to extract the second column and indexing starts from the zero.By executing the above line of code, we will get the output for X and Y variable as:In the above output image, we can see the X (independent) variable and Y (dependent) variable has been extracted from the given dataset.Next, we will split both variables into the test set and training set. We have 30 observations, so we will take 20 observations for the training set and 10 observations for the test

set. We are splitting our dataset so that we can train our model using a training dataset and then test the model using a test dataset. The code for this is given below:# Splitting the dataset into training and test set.

from sklearn.model_selection import train_test_split

x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 1/3, random_state=0)By executing the above code, we will get x-test, x-train and y-test, y-train dataset. Consider the below images:Test-dataset:Training Dataset:For simple linear Regression, we will not use Feature Scaling. Because Python libraries take care of it for some cases, so we don't need to perform it here. Now, our dataset is well prepared to work on it and we are going to start building a Simple Linear Regression model for the given problem.Step-2: Fitting the Simple Linear Regression to the Training Set:Now the second step is to fit our model to the training dataset. To do so, we will import theLinearRegressionclass of thelinear_modellibrary from thescikit learn. After importing the class, we are going to create an object of the class named as aregressor. The code for this is given below:#Fitting the Simple Linear Regression model to the training dataset

from sklearn.linear_model import LinearRegression

regressor= LinearRegression()

regressor.fit(x_train, y_train)In the above code, we have used afit()method to fit our Simple Linear Regression object to the training set. In the fit() function, we have passed the x_train and y_train, which is our training dataset for the dependent and an independent variable. We have fitted our regressor object to the training set so that the model can easily learn the correlations between the predictor and target variables. After executing the above lines of code, we will get the below output.Output:Out[7]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)Step: 3. Prediction of test set result:dependent (salary) and an independent variable (Experience). So, now, our model is ready to predict the output for the new observations. In this step, we will provide the test dataset (new observations) to the model to check whether it can predict the correct output or not.We will create a prediction vectory_pred, andx_pred, which will contain predictions of test dataset, and prediction of training set respectively.#Prediction of Test and

Training set result

y_pred= regressor.predict(x_test)

x_pred= regressor.predict(x_train)On executing the above lines of code, two variables named y_pred and x_pred will generate in the variable explorer options that contain salary predictions for the training set and test set.Output:You can check the variable by clicking on the variable explorer option in the IDE, and also compare the result by comparing values from y_pred and y_test. By comparing these values, we can check how good our model is performing.Step: 4. visualizing the Training set results:Now in this step, we will visualize the training set result. To do so, we will use the scatter() function of the pyplot library, which we have already imported in the pre-processing step. Thescatter () functionwill create a scatter plot of observations.In the x-axis, we will plot the Years of Experience of employees and on the y-axis, salary of employees. In the function, we will pass the real values of training set, which means a year of experience x_train, training set of Salaries y_train, and color of the observations. Here we are taking a green color for the observation, but it can be any color as per the choice.Now, we need to plot the regression line, so for this, we will use theplot() functionof the pyplot library. In this function, we will pass the years of experience for training set, predicted salary for training set x_pred, and color of the line.Next, we will give the title for the plot. So here, we will use thetitle()function of thepyplotlibrary and pass the name ("Salary vs Experience (Training Dataset)".After that, we will assign labels for x-axis and y-axis usingxlabel() and ylabel() function.Finally, we will represent all above things in a graph using show(). The code is given below:mtp.scatter(x_train, y_train, color="green")

mtp.plot(x_train, x_pred, color="red")

mtp.title("Salary vs Experience (Training Dataset)")

mtp.xlabel("Years of Experience")

mtp.ylabel("Salary(In Rupees)")

mtp.show()Output:By executing the above lines of code, we will get the below graph plot as an output.In the above plot, we can see the real values observations in green dots and predicted values are covered by the red regression line. The regression line shows a correlation between the dependent and independent variable.The good fit of the line can be observed by calculating the difference between actual values and predicted values. But as we can see in the aboveplot, most of the observations are close to the regression line, hence our model is good for the training set.Step: 5. visualizing the Test set results:In the previous step, we have visualized the performance of our model on the training set. Now, we will do the same for the Test set. The complete code will remain the same as the above code, except in this, we will use x_test, and y_test instead of x_train and y_train.Here we are also changing the color of observations and regression line to differentiate between the two plots, but it is optional.#visualizing the Test set results

mtp.scatter(x_test, y_test, color="blue")

mtp.plot(x_train, x_pred, color="red")

mtp.title("Salary vs Experience (Test Dataset)")

mtp.xlabel("Years of Experience")

mtp.ylabel("Salary(In Rupees)")

mtp.show()Output:By executing the above line of code, we will get the output as:In the above plot, there are observations given by the blue color, and prediction is given by the red regression line. As we can see, most of the observations are close to the regression line, hence we can say our Simple Linear Regression is a good model and able to make good predictions.Next TopicMultiple Linear Regression? prevnext ?

Simple Linear Regression in Machine Learning

Simple Linear Regression is a type of Regression algorithms that models the relationship between a dependent variable and a single independent variable. The relationship shown by a Simple Linear Regression model is linear or a sloped straight line, hence it is called Simple Linear Regression.

Simple Linear Regression in Machine Learning

The key point in Simple Linear Regression is that thedependent variable must be a continuous/real value. However, the independent variable can be measured on continuous or categorical values.

Simple Linear Regression in Machine Learning

Simple Linear regression algorithm has mainly two objectives:

Simple Linear Regression in Machine Learning

- Model the relationship between the two variables.Such as the relationship between Income and expenditure, experience and Salary, etc.

- Forecasting new observations.Such as Weather forecasting according to temperature, Revenue of a company according to the investments in a year, etc.

Simple Linear Regression Model:

The Simple Linear Regression model can be represented using the below equation:

Simple Linear Regression Model:

Where,

Simple Linear Regression Model:

a0= It is the intercept of the Regression line (can be obtained putting x=0)a1= It is the slope of the regression line, which tells whether the line is increasing or decreasing.? = The error term. (For a good model it will be negligible)

Implementation of Simple Linear Regression Algorithm using Python

Problem Statement example for Simple Linear Regression:

Implementation of Simple Linear Regression Algorithm using Python

Here we are taking a dataset that has two variables: salary (dependent variable) and experience (Independent variable). The goals of this problem is:

Implementation of Simple Linear Regression Algorithm using Python

- We want to find out if there is any correlation between these two variables

- We will find the best fit line for the dataset.

- How the dependent variable is changing by changing the independent variable.

Implementation of Simple Linear Regression Algorithm using Python

In this section, we will create a Simple Linear Regression model to find out the best fitting line for representing the relationship between these two variables.

Implementation of Simple Linear Regression Algorithm using Python

To implement the Simple Linear regression model in machine learning using Python, we need to follow the below steps:

Implementation of Simple Linear Regression Algorithm using Python

Step-1: Data Pre-processing

Implementation of Simple Linear Regression Algorithm using Python

The first step for creating the Simple Linear Regression model isdata pre-processing. We have already done it earlier in this tutorial. But there will be some changes, which are given in the below steps:

Implementation of Simple Linear Regression Algorithm using Python

- First, we will import the three important libraries, which will help us for loading the dataset, plotting the graphs, and creating the Simple Linear Regression model.

Implementation of Simple Linear Regression Algorithm using Python

- Next, we will load the dataset into our code:

Implementation of Simple Linear Regression Algorithm using Python

By executing the above line of code (ctrl+ENTER), we can read the dataset on our Spyder IDE screen by clicking on the variable explorer option.

Implementation of Simple Linear Regression Algorithm using Python

The above output shows the dataset, which has two variables: Salary and Experience.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

- After that, we need to extract the dependent and independent variables from the given dataset. The independent variable is years of experience, and the dependent variable is salary. Below is code for it:

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In the above lines of code, for x variable, we have taken -1 value since we want to remove the last column from the dataset. For y variable, we have taken 1 value as a parameter, since we want to extract the second column and indexing starts from the zero.

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By executing the above line of code, we will get the output for X and Y variable as:

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In the above output image, we can see the X (independent) variable and Y (dependent) variable has been extracted from the given dataset.

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- Next, we will split both variables into the test set and training set. We have 30 observations, so we will take 20 observations for the training set and 10 observations for the test set. We are splitting our dataset so that we can train our model using a training dataset and then test the model using a test dataset. The code for this is given below:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

By executing the above code, we will get x-test, x-train and y-test, y-train dataset. Consider the below images:

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Test-dataset:

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Training Dataset:

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- For simple linear Regression, we will not use Feature Scaling. Because Python libraries take care of it for some cases, so we don't need to perform it here. Now, our dataset is well prepared to work on it and we are going to start building a Simple Linear Regression model for the given problem.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Step-2: Fitting the Simple Linear Regression to the Training Set:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Now the second step is to fit our model to the training dataset. To do so, we will import theLinearRegressionclass of thelinear_modellibrary from thescikit learn. After importing the class, we are going to create an object of the class named as aregressor. The code for this is given below:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

In the above code, we have used afit()method to fit our Simple Linear Regression object to the training set. In the fit() function, we have passed the x_train and y_train, which is our training dataset for the dependent and an independent variable. We have fitted our regressor object to the training set so that the model can easily learn the correlations between the predictor and target variables. After executing the above lines of code, we will get the below output.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Output:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Step: 3. Prediction of test set result:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

dependent (salary) and an independent variable (Experience). So, now, our model is ready to predict the output for the new observations. In this step, we will provide the test dataset (new observations) to the model to check whether it can predict the correct output or not.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

We will create a prediction vectory_pred, andx_pred, which will contain predictions of test dataset, and prediction of training set respectively.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

On executing the above lines of code, two variables named y_pred and x_pred will generate in the variable explorer options that contain salary predictions for the training set and test set.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Output:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

You can check the variable by clicking on the variable explorer option in the IDE, and also compare the result by comparing values from y_pred and y_test. By comparing these values, we can check how good our model is performing.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Step: 4. visualizing the Training set results:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Now in this step, we will visualize the training set result. To do so, we will use the scatter() function of the pyplot library, which we have already imported in the pre-processing step. Thescatter () functionwill create a scatter plot of observations.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

In the x-axis, we will plot the Years of Experience of employees and on the y-axis, salary of employees. In the function, we will pass the real values of training set, which means a year of experience x_train, training set of Salaries y_train, and color of the observations. Here we are taking a green color for the observation, but it can be any color as per the choice.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Now, we need to plot the regression line, so for this, we will use theplot() functionof the pyplot library. In this function, we will pass the years of experience for training set, predicted salary for training set x_pred, and color of the line.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Next, we will give the title for the plot. So here, we will use thetitle()function of thepyplotlibrary and pass the name ("Salary vs Experience (Training Dataset)".

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

After that, we will assign labels for x-axis and y-axis usingxlabel() and ylabel() function.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Finally, we will represent all above things in a graph using show(). The code is given below:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Output:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

By executing the above lines of code, we will get the below graph plot as an output.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

In the above plot, we can see the real values observations in green dots and predicted values are covered by the red regression line. The regression line shows a correlation between the dependent and independent variable.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

The good fit of the line can be observed by calculating the difference between actual values and predicted values. But as we can see in the aboveplot, most of the observations are close to the regression line, hence our model is good for the training set.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Step: 5. visualizing the Test set results:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

In the previous step, we have visualized the performance of our model on the training set. Now, we will do the same for the Test set. The complete code will remain the same as the above code, except in this, we will use x_test, and y_test instead of x_train and y_train.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Here we are also changing the color of observations and regression line to differentiate between the two plots, but it is optional.

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

Output:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

By executing the above line of code, we will get the output as:

Note:In Spyder IDE, the folder containing the code file must be saved as a working di

In the above plot, there are observations given by the blue color, and prediction is given by the red regression line. As we can see, most of the observations are close to the regression line, hence we can say our Simple Linear Regression is a good model and able to make good predictions.

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Interview Questions

next ?? prevMultiple Linear RegressionIn the previous topic, we have learned about Simple Linear Regression, where a single Independent/Predictor(X) variable is used to model the response variable (Y). But there may be various cases in which the response variable is affected by more than one predictor variable; for such cases, the Multiple Linear Regression algorithm is used.Moreover, Multiple Linear Regression is an extension of Simple Linear regression as it takes more than one predictor variable to predict the response variable. We can define it as:Multiple Linear Regression is one of the important regression algorithms which models the linear relationship between a single dependent continuous variable and more than one independent variable.Example:Prediction of CO2emission based on engine size and number of cylinders in a car.Some key points about MLR:For MLR, the dependent or target variable(Y) must be the continuous/real, but the predictor or independent variable may be of continuous or categorical form.Each feature variable must model the linear relationship with the dependent variable.MLR tries to fit a regression line through a multidimensional space of data-points.MLR equation:In Multiple Linear Regression, the target variable(Y) is a linear combination of multiple predictor variables x1, x2, x3, ...,xn. Since it is an enhancement of Simple Linear Regression, so the same is applied for the multiple linear regression equation, the equation becomes:Y= b₀+b₁x₁+ b₂x₂+ b₃x₃+...... bnxn .... (a)Where,Y= Output/Response variableb0, b1, b2, b3, bn....= Coefficients of the model.x1, x2, x3, x4,...= Various Independent/feature variableAssumptions for Multiple Linear Regression:Alinear relationshipshould exist between the Target and predictor variables.The regression residuals must benormally distributed.MLR assumes little orno multicollinearity(correlation between the independent variable) in data.Implementation of Multiple Linear Regression model using Python:To implement MLR using Python, we have below problem:Problem Description:We have a dataset of50 start-up companies. This dataset contains five main information:R&D Spend, Administration Spend, Marketing Spend, State, and Profit for a financial year. Our goal is to create a model that can easily determine which company has a maximum profit, and which is the most affecting factor for the profit of a company.Since we need to find the Profit, so it is the dependent variable, and the other four variables are independent variables. Below are the main steps of deploying the MLR model:Data Pre-processing StepsFitting the MLR model to the training setPredicting the result of the test setStep-1: Data Pre-processing Step:The very first step isdata pre-processing, which we have already discussed in this tutorial. This process contains the below steps:Importing libraries:Firstly we will import the library which will help in building the model. Below is the code for it:# importing libraries

import numpy as nm

import matplotlib.pyplot as mtp

import pandas as pdImporting dataset:Now we will import the dataset(50_CompList), which contains all the variables. Below is the code for it:#importing datasets

data_set= pd.read_csv('50_CompList.csv')Output:We will get the dataset as:In above output, we can clearly see that there are five variables, in which four variables are continuous and one is categorical variable.Extracting dependent and independent Variables:#Extracting Independent and dependent Variable

x= data_set.iloc[:, :-1].values

y= data_set.iloc[:, 4].valuesOutput:Out[5]:array([[165349.2, 136897.8, 471784.1, 'New York'],

[162597.7, 151377.59, 443898.53, 'California'],

[153441.51, 101145.55, 407934.54, 'Florida'],

[144372.41, 118671.85, 383199.62, 'New York'],

[142107.34, 91391.77, 366168.42, 'Florida'],

[131876.9, 99814.71, 362861.36, 'New York'],

[134615.46, 147198.87, 127716.82, 'California'],

[130298.13, 145530.06, 323876.68, 'Florida'],

[120542.52, 148718.95, 311613.29, 'New York'],

[123334.88, 108679.17, 304981.62, 'California'],

[101913.08, 110594.11, 229160.95, 'Florida'],

[100671.96, 91790.61, 249744.55, 'California'],

[93863.75, 127320.38, 249839.44, 'Florida'],

[91992.39, 135495.07, 252664.93, 'California'], [119943.24, 156547.42, 256512.92, 'Florida'],

[114523.61, 122616.84, 261776.23, 'New York'],

[78013.11, 121597.55, 264346.06, 'California'],

[94657.16, 145077.58, 282574.31, 'New York'],

[91749.16, 114175.79, 294919.57, 'Florida'],

[86419.7, 153514.11, 0.0, 'New York'],

[76253.86, 113867.3, 298664.47, 'California'],

[78389.47, 153773.43, 299737.29, 'New York'],

[73994.56, 122782.75, 303319.26, 'Florida'],

[67532.53, 105751.03, 304768.73, 'Florida'],

[77044.01, 99281.34, 140574.81, 'New York'],

[64664.71, 139553.16, 137962.62, 'California'],

[75328.87, 144135.98, 134050.07, 'Florida'],

[72107.6, 127864.55, 353183.81, 'New York'],

[66051.52, 182645.56, 118148.2, 'Florida'],

[65605.48, 153032.06, 107138.38, 'New York'],

[61994.48, 115641.28, 91131.24, 'Florida'],

[61136.38, 152701.92, 88218.23, 'New York'],

[63408.86, 129219.61, 46085.25, 'California'],

[55493.95, 103057.49, 214634.81, 'Florida'],

[46426.07, 157693.92, 210797.67, 'California'],

[46014.02, 85047.44, 205517.64, 'New York'],

[28663.76, 127056.21, 201126.82, 'Florida'],

[44069.95, 51283.14, 197029.42, 'California'],

[20229.59, 65947.93, 185265.1, 'New York'],

[38558.51, 82982.09, 174999.3, 'California'],

[28754.33, 118546.05, 172795.67, 'California'], [27892.92, 84710.77, 164470.71, 'Florida'],

[23640.93, 96189.63, 148001.11, 'California'],

[15505.73, 127382.3, 35534.17, 'New York'],

[22177.74, 154806.14, 28334.72, 'California'],

[1000.23, 124153.04, 1903.93, 'New York'],

[1315.46, 115816.21, 297114.46, 'Florida'],

[0.0, 135426.92, 0.0, 'California'],

[542.05, 51743.15, 0.0, 'New York'],

[0.0, 116983.8, 45173.06, 'California']], dtype=object)As we can see in the above output, the last column contains categorical variables which are not suitable to apply directly for fitting the model. So we need to encode this variable.Encoding Dummy Variables:As we have one categorical variable (State), which cannot be directly applied to the model, so we will encode it. To encode the categorical variable into numbers, we will use theLabelEncoderclass. But it is not sufficient because it still has some relational order, which may create a wrong model. So in order to remove this problem, we will useOneHotEncoder, which will create the dummy variables. Below is code for it:#Catgorical data

from sklearn.preprocessing import LabelEncoder, OneHotEncoder

labelencoder_x= LabelEncoder()

x[:, 3]= labelencoder_x.fit_transform(x[:,3])

onehotencoder= OneHotEncoder(categorical_features= [3])

x= onehotencoder.fit_transform(x).toarray()Here we are only encoding one independent variable, which is state as other variables are continuous.Output:As we can see in the above output, the state column has been converted into dummy variables (0 and 1).Here each dummy variable column is corresponding to the one State. We can check by comparing it with the original dataset. The first column corresponds to theCalifornia State, the second column corresponds to theFlorida State, and the third column corresponds to theNew York State.Note:We should not use all the dummy variables at the same time, so it must be 1 less than the total number of dummy variables, else it will create a dummy variable trap.Now, we are writing a single line of code just to avoid the dummy variable trap:#avoiding the dummy variable trap:

x = x[:, 1:]If we do not remove the first dummy variable, then it may introduce multicollinearity in the model.As we can see in the above output image, the first column has been removed.Now we will split the dataset into training and test set. The code for this is given below:# Splitting the dataset into training and test set.

from sklearn.model_selection import train_test_split

x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.2, random_state=0)The above code will split our dataset into a training set and test set.Output:The above code will split the dataset into training set and test set. You can check the output by clicking on the variable explorer option given in Spyder IDE. The test set and training set will look like the below image:Test set:Training set:Note:In MLR, we will not do feature scaling as it is taken care by the library, so we don't need to do it manually.Step: 2- Fitting our MLR model to the Training set:Now, we have well prepared our dataset in order to provide training, which means we will fit our regression model to the training set. It will be similar to as we did inSimple Linear Regressionmodel. The code for this will be:#Fitting the MLR model to the training set:

from sklearn.linear_model import LinearRegression

regressor= LinearRegression()

regressor.fit(x_train, y_train)Output:Out[9]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)Now, we have successfully trained our model using the training dataset. In the next step, we will test the performance of the model using the test dataset.Step: 3- Prediction of Test set results:The last step for our model is checking the performance of the model. We will do it by predicting the test set result. For prediction, we will create ay_predvector. Below is the code for it:#Predicting the Test set result;

y_pred= regressor.predict(x_test)By executing the above lines of code, a new vector will be generated under the variable explorer option. We can test our model by comparing the predicted values and test set values.Output:In the above output, we have predicted result set and test set. We can check model performance by comparing these two value index by index. For example, the first index has a predicted value of103015$profit and test/real value of103282$profit. The difference is only of267$, which is a good prediction, so, finally, our model is completed here.We can also check the score for training dataset and test dataset. Below is the code for it:print('Train Score: ', regressor.score(x_train, y_train))

print('Test Score: ', regressor.score(x_test, y_test))Output:The score is:Train Score: 0.9501847627493607

Test Score: 0.9347068473282446The above score tells that our model is 95% accurate with the training dataset and 93% accurate with the test dataset.Note:In the next topic, we will see how we can improve the performance of the model using theBackward Eliminationprocess.Applications of Multiple Linear Regression:There are mainly two applications of Multiple Linear Regression:Effectiveness of Independent variable on prediction:Predicting the impact of changes:Next TopicBackward Elimination? prevnext ?

Multiple Linear Regression

In the previous topic, we have learned about Simple Linear Regression, where a single Independent/Predictor(X) variable is used to model the response variable (Y). But there may be various cases in which the response variable is affected by more than one predictor variable; for such cases, the Multiple Linear Regression algorithm is used.

Multiple Linear Regression

Moreover, Multiple Linear Regression is an extension of Simple Linear regression as it takes more than one predictor variable to predict the response variable. We can define it as:

Multiple Linear Regression

Example:

Multiple Linear Regression

Prediction of CO2emission based on engine size and number of cylinders in a car.

Multiple Linear Regression

Some key points about MLR:

Multiple Linear Regression

- For MLR, the dependent or target variable(Y) must be the continuous/real, but the predictor or independent variable may be of continuous or categorical form.

- Each feature variable must model the linear relationship with the dependent variable.

- MLR tries to fit a regression line through a multidimensional space of data-points.

MLR equation:

In Multiple Linear Regression, the target variable(Y) is a linear combination of multiple predictor variables x1, x2, x3, ...,xn. Since it is an enhancement of Simple Linear Regression, so the same is applied for the multiple linear regression equation, the equation becomes:

MLR equation:

Where,

MLR equation:

Y= Output/Response variable

MLR equation:

b0, b1, b2, b3, bn....= Coefficients of the model.

MLR equation:

x1, x2, x3, x4,...= Various Independent/feature variable

Assumptions for Multiple Linear Regression:

- Alinear relationshipshould exist between the Target and predictor variables.

- The regression residuals must benormally distributed.

- MLR assumes little orno multicollinearity(correlation between the independent variable) in data.

Implementation of Multiple Linear Regression model using Python:

To implement MLR using Python, we have below problem:

Implementation of Multiple Linear Regression model using Python:

Problem Description:

Implementation of Multiple Linear Regression model using Python:

We have a dataset of50 start-up companies. This dataset contains five main information:R&D Spend, Administration Spend, Marketing Spend, State, and Profit for a financial year. Our goal is to create a model that can easily determine which company has a maximum profit, and which is the most affecting factor for the profit of a company.

Implementation of Multiple Linear Regression model using Python:

Since we need to find the Profit, so it is the dependent variable, and the other four variables are independent variables. Below are the main steps of deploying the MLR model:

Implementation of Multiple Linear Regression model using Python:

- Data Pre-processing Steps

- Fitting the MLR model to the training set

- Predicting the result of the test set

Implementation of Multiple Linear Regression model using Python:

Step-1: Data Pre-processing Step:

Implementation of Multiple Linear Regression model using Python:

The very first step isdata pre-processing, which we have already discussed in this tutorial. This process contains the below steps:

Implementation of Multiple Linear Regression model using Python:

- Importing libraries:Firstly we will import the library which will help in building the model. Below is the code for it:

Implementation of Multiple Linear Regression model using Python:

- Importing dataset:Now we will import the dataset(50_CompList), which contains all the variables. Below is the code for it:

Implementation of Multiple Linear Regression model using Python:

Output:We will get the dataset as:

Implementation of Multiple Linear Regression model using Python:

In above output, we can clearly see that there are five variables, in which four variables are continuous and one is categorical variable.

Implementation of Multiple Linear Regression model using Python:

- Extracting dependent and independent Variables:

Implementation of Multiple Linear Regression model using Python:

Output:

Implementation of Multiple Linear Regression model using Python:

Out[5]:

Implementation of Multiple Linear Regression model using Python:

As we can see in the above output, the last column contains categorical variables which are not suitable to apply directly for fitting the model. So we need to encode this variable.

Implementation of Multiple Linear Regression model using Python:

Encoding Dummy Variables:

Implementation of Multiple Linear Regression model using Python:

As we have one categorical variable (State), which cannot be directly applied to the model, so we will encode it. To encode the categorical variable into numbers, we will use theLabelEncoderclass. But it is not sufficient because it still has some relational order, which may create a wrong model. So in order to remove this problem, we will useOneHotEncoder, which will create the dummy variables. Below is code for it:

Implementation of Multiple Linear Regression model using Python:

Here we are only encoding one independent variable, which is state as other variables are continuous.

Implementation of Multiple Linear Regression model using Python:

Output:

Implementation of Multiple Linear Regression model using Python:

As we can see in the above output, the state column has been converted into dummy variables (0 and 1).Here each dummy variable column is corresponding to the one State. We can check by comparing it with the original dataset. The first column corresponds to theCalifornia State, the second column corresponds to theFlorida State, and the third column corresponds to theNew York State.

Note:We should not use all the dummy variables at the same time, so it must be 1 les

- Now, we are writing a single line of code just to avoid the dummy variable trap:

Note:We should not use all the dummy variables at the same time, so it must be 1 les

If we do not remove the first dummy variable, then it may introduce multicollinearity in the model.

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As we can see in the above output image, the first column has been removed.

Note:We should not use all the dummy variables at the same time, so it must be 1 les

- Now we will split the dataset into training and test set. The code for this is given below:

Note:We should not use all the dummy variables at the same time, so it must be 1 les

The above code will split our dataset into a training set and test set.

Note:We should not use all the dummy variables at the same time, so it must be 1 les

Output:The above code will split the dataset into training set and test set. You can check the output by clicking on the variable explorer option given in Spyder IDE. The test set and training set will look like the below image:

Note:We should not use all the dummy variables at the same time, so it must be 1 les

Test set:

Note:We should not use all the dummy variables at the same time, so it must be 1 les

Training set:

Step: 2- Fitting our MLR model to the Training set:

Now, we have well prepared our dataset in order to provide training, which means we will fit our regression model to the training set. It will be similar to as we did inSimple Linear Regressionmodel. The code for this will be:

Step: 2- Fitting our MLR model to the Training set:

Output:

Step: 2- Fitting our MLR model to the Training set:

Now, we have successfully trained our model using the training dataset. In the next step, we will test the performance of the model using the test dataset.

Step: 3- Prediction of Test set results:

The last step for our model is checking the performance of the model. We will do it by predicting the test set result. For prediction, we will create ay_predvector. Below is the code for it:

Step: 3- Prediction of Test set results:

By executing the above lines of code, a new vector will be generated under the variable explorer option. We can test our model by comparing the predicted values and test set values.

Step: 3- Prediction of Test set results:

Output:

Step: 3- Prediction of Test set results:

In the above output, we have predicted result set and test set. We can check model performance by comparing these two value index by index. For example, the first index has a predicted value of103015$profit and test/real value of103282$profit. The difference is only of267$, which is a good prediction, so, finally, our model is completed here.

Step: 3- Prediction of Test set results:

- We can also check the score for training dataset and test dataset. Below is the code for it:

Step: 3- Prediction of Test set results:

Output:The score is:

Step: 3- Prediction of Test set results:

The above score tells that our model is 95% accurate with the training dataset and 93% accurate with the test dataset.

Applications of Multiple Linear Regression:

There are mainly two applications of Multiple Linear Regression:

Applications of Multiple Linear Regression:

- Effectiveness of Independent variable on prediction:

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Interview Questions

next ?? prevWhat is Backward Elimination?Backward elimination is a feature selection technique while building a machine learning model. It is used to remove those features that do not have a significant effect on the dependent variable or prediction of output. There are various ways to build a model in Machine Learning, which are:All-inBackward EliminationForward SelectionBidirectional EliminationScore ComparisonAbove are the possible methods for building the model in Machine learning, but we will only use here the Backward Elimination process as it is the fastest method.Steps of Backward EliminationBelow are some main steps which are used to apply backward elimination process:Step-1:Firstly, We need to select a significance level to stay in the model. (SL=0.05)Step-2:Fit the complete model with all possible predictors/independent variables.Step-3:Choose the predictor which has the highest P-value, such that.If P-value >SL, go to step 4.Else Finish, and Our model is ready.Step-4:Remove that predictor.Step-5:Rebuild and fit the model with the remaining variables.Need for Backward Elimination: An optimal Multiple Linear Regression model:In the previous chapter, we discussed and successfully created our Multiple Linear Regression model, where we took4 independent variables (R&D spend, Administration spend, Marketing spend, and state (dummy variables)) and one dependent variable (Profit). But that model is not optimal, as we have included all the independent variables and do not know which independent model is most affecting and which one is the least affecting for the prediction.Unnecessary features increase the complexity of the model. Hence it is good to have only the most significant features and keep our model simple to get the better result.So, in order to optimize the performance of the model, we will use the Backward Elimination method. This process is used to optimize the performance of the MLR model as it will only include the most affecting feature and remove the least affecting feature. Let's start to apply it to our MLR model.Steps for Backward Elimination method:We will use the same model which we build in the previous chapter of MLR. Below is the complete code for it:# importing libraries

```
import numpy as nm
import matplotlib.pyplot as mtp
import pandas as pd

#importing datasets
data_set= pd.read_csv('50_CompList.csv')
```

```
#Extracting Independent and dependent Variable
x= data_set.iloc[:, :-1].values
y= data_set.iloc[:, 4].values

#Catgorical data
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
labelencoder_x= LabelEncoder()
x[:, 3]= labelencoder_x.fit_transform(x[:,3])
onehotencoder= OneHotEncoder(categorical_features= [3])
x= onehotencoder.fit_transform(x).toarray()

#Avoiding the dummy variable trap:
x = x[:, 1:]



# Splitting the dataset into training and test set.
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.2, random_state=0)

#Fitting the MLR model to the training set:
from sklearn.linear_model import LinearRegression
regressor= LinearRegression()
regressor.fit(x_train, y_train)

#Predicting the Test set result;
y_pred= regressor.predict(x_test)
```

#Checking the score

print('Train Score: ', regressor.score(x_train, y_train))

print('Test Score: ', regressor.score(x_test, y_test))From the above code, we got training and test set result as:Train Score: 0.9501847627493607

Test Score: 0.9347068473282446The difference between both scores is 0.0154.Note: On the basis of this score, we will estimate the effect of features on our model after using the Backward elimination process.Step: 1- Preparation of Backward Elimination:Importing the library:Firstly, we need to import thestatsmodels.formula.apilibrary, which is used for the estimation of various statistical models such as OLS(Ordinary Least Square). Below is the code for it:import statsmodels.api as smfAdding a column in matrix of features:As we can check in our MLR equation (a), there is one constant term b0, but this term is not present in our matrix of features, so we need to add it manually. We will add a column having values x0= 1 associated with the constant term b0.To add this, we will useappendfunction ofNumpylibrary (nm which we have already imported into our code), and will assign a value of 1. Below is the code for it.x = nm.append(arr = nm.ones((50,1)).astype(int), values=x, axis=1)Here we have used axis =1, as we wanted to add a column. For adding a row, we can use axis =0.Output:By executing the above line of code, a new column will be added into our matrix of features, which will have all values equal to 1. We can check it by clicking on the x dataset under the variable explorer option.As we can see in the above output image, the first column is added successfully, which corresponds to the constant term of the MLR equation.Step: 2:Now, we are actually going to apply a backward elimination process. Firstly we will create a new feature vectorx_opt, which will only contain a set of independent features that are significantly affecting the dependent variable.Next, as per the Backward Elimination process, we need to choose a significant level(0.5), and then need to fit the model with all possible predictors. So for fitting the model, we will create aregressor_OLSobject of new classOLSofstatsmodelslibrary. Then we will fit it by using thefit()method.Next we needp-valueto compare with SL value, so for this we will usesummary()method to get the summary table of all the values. Below is the code for it:x_opt=x [:, [0,1,2,3,4,5]]

regressor_OLS=sm.OLS(endog = y, exog=x_opt).fit()

regressor_OLS.summary()Output:By executing the above lines of code, we will get a summary table. Consider the below image:In the above image, we can clearly see the p-values of all the variables. Herex1, x2 are dummy variables, x3 is R&D spend, x4 is Administration spend, and x5 is Marketing spend.From the table, we will choose the highest p-value, which is for x1=0.953 Now, we have the highest p-value which is greater than the SL value, so will remove the x1 variable (dummy variable) from the table and will refit the model. Below is the code for it:x_opt=x[:, [0,2,3,4,5]]

regressor_OLS=sm.OLS(endog = y, exog=x_opt).fit()

regressor_OLS.summary()Output:As we can see in the output image, now five variables remain. In these variables, the highest p-value is 0.961. So we will remove it in the next iteration.Now the next highest value is 0.961 for x1 variable, which is another dummy variable. So we will remove it and refit the model. Below is the code for it:x_opt= x[:, [0,3,4,5]]

regressor_OLS=sm.OLS(endog = y, exog=x_opt).fit()

regressor_OLS.summary()Output:In the above output image, we can see the dummy variable(x2) has been removed. And the next highest value is .602, which is still greater than .5, so we need to remove it.Now we will remove the Admin spend which is having .602 p-value and again refit the model.x_opt=x[:, [0,3,5]]

regressor_OLS=sm.OLS(endog = y, exog=x_opt).fit()

regressor_OLS.summary()Output:As we can see in the above output image, the variable (Admin spend) has been removed. But still, there is one variable left, which ismarketing spendas it has a high p-value(0.60). So we need to remove it.Finally, we will remove one more variable, which has .60 p-value for marketing spend, which is more than a significant level.Below is the code for it:x_opt=x[:, [0,3]]

regressor_OLS=sm.OLS(endog = y, exog=x_opt).fit()

regressor_OLS.summary()Output:As we can see in the above output image, only two variables are left. So only theR&D independent variableis a significant variable for the prediction. So we can now predict efficiently using this variable.Estimating the performance:In the previous topic, we have calculated the train and test score of the model when we have used all the features variables. Now we will check the score with only one feature variable (R&D spend). Our dataset now looks like:Below is the code for Building Multiple Linear Regression model by only using R&D spend:# importing libraries

```
import numpy as nm
import matplotlib.pyplot as mtp
import pandas as pd

#importing datasets
data_set= pd.read_csv('50_CompList1.csv')

#Extracting Independent and dependent Variable
x_BE= data_set.iloc[:, :-1].values
y_BE= data_set.iloc[:, 1].values



# Splitting the dataset into training and test set.
from sklearn.model_selection import train_test_split
x_BE_train, x_BE_test, y_BE_train, y_BE_test= train_test_split(x_BE, y_BE, test_size= 0.2, random_state=0)

#Fitting the MLR model to the training set:
from sklearn.linear_model import LinearRegression
regressor= LinearRegression()
regressor.fit(nm.array(x_BE_train).reshape(-1,1), y_BE_train)
```

#Predicting the Test set result;

y_pred= regressor.predict(x_BE_test)

#Cheking the score

print('Train Score: ', regressor.score(x_BE_train, y_BE_train))

print('Test Score: ', regressor.score(x_BE_test, y_BE_test))Output:After executing the above code, we will get the Training and test scores as:Train Score: 0.9449589778363044

Test Score: 0.9464587607787219As we can see, the training score is 94% accurate, and the test score is also 94% accurate. The difference between both scores is.00149. This score is very much close to the previous score, i.e.,0.0154, where we have included all the variables.We got this result by using one independent variable (R&D spend) only instead of four variables. Hence, now, our model is simple and accurate.Next TopicMachine Learning Polynomial Regression? prevnext ?

What is Backward Elimination?

Backward elimination is a feature selection technique while building a machine learning model. It is used to remove those features that do not have a significant effect on the dependent variable or prediction of output. There are various ways to build a model in Machine Learning, which are:

What is Backward Elimination?

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- Bidirectional Elimination
- Score Comparison

What is Backward Elimination?

Above are the possible methods for building the model in Machine learning, but we will only use here the Backward Elimination process as it is the fastest method.

Steps of Backward Elimination

Below are some main steps which are used to apply backward elimination process:

Steps of Backward Elimination

Step-1:Firstly, We need to select a significance level to stay in the model. (SL=0.05)

Steps of Backward Elimination

Step-2:Fit the complete model with all possible predictors/independent variables.

Steps of Backward Elimination

Step-3:Choose the predictor which has the highest P-value, such that.

Steps of Backward Elimination

- If P-value >SL, go to step 4.

- Else Finish, and Our model is ready.

Steps of Backward Elimination

Step-4:Remove that predictor.

Steps of Backward Elimination

Step-5:Rebuild and fit the model with the remaining variables.

Need for Backward Elimination: An optimal Multiple Linear Regression model:

In the previous chapter, we discussed and successfully created our Multiple Linear Regression model, where we took4 independent variables (R&D spend, Administration spend, Marketing spend, and state (dummy variables)) and one dependent variable (Profit). But that model is not optimal, as we have included all the independent variables and do not know which independent model is most affecting and which one is the least affecting for the prediction.

Need for Backward Elimination: An optimal Multiple Linear Regression model:

Unnecessary features increase the complexity of the model. Hence it is good to have only the most significant features and keep our model simple to get the better result.

Need for Backward Elimination: An optimal Multiple Linear Regression model:

So, in order to optimize the performance of the model, we will use the Backward Elimination method. This process is used to optimize the performance of the MLR model as it will only include the most affecting feature and remove the least affecting feature. Let's start to apply it to our MLR model.

Steps for Backward Elimination method:

We will use the same model which we build in the previous chapter of MLR. Below is the complete code for it:

Steps for Backward Elimination method:

From the above code, we got training and test set result as:

Steps for Backward Elimination method:

The difference between both scores is 0.0154.

Note: On the basis of this score, we will estimate the effect of features on our model a

Step: 1- Preparation of Backward Elimination:

Note: On the basis of this score, we will estimate the effect of features on our model a

- Importing the library:Firstly, we need to import thestatsmodels.formula.apilibrary, which is used for the estimation of various statistical models such as OLS(Ordinary Least Square). Below is the code for it:

Note: On the basis of this score, we will estimate the effect of features on our model a

- Adding a column in matrix of features:As we can check in our MLR equation (a), there is one constant term b0, but this term is not present in our matrix of features, so we need to add it manually. We will add a column having values x0= 1 associated with the constant term b0.To add this, we will useappendfunction ofNumpylibrary (nm which we have already imported into our code), and will assign a value of 1. Below is the code for it.

Note: On the basis of this score, we will estimate the effect of features on our model a

Here we have used axis =1, as we wanted to add a column. For adding a row, we can use axis =0.

Note: On the basis of this score, we will estimate the effect of features on our model a

Output:By executing the above line of code, a new column will be added into our matrix of features, which will have all values equal to 1. We can check it by clicking on the x dataset under the variable explorer option.

Note: On the basis of this score, we will estimate the effect of features on our model a

As we can see in the above output image, the first column is added successfully, which corresponds to the constant term of the MLR equation.

Note: On the basis of this score, we will estimate the effect of features on our model a

Step: 2:

Note: On the basis of this score, we will estimate the effect of features on our model a

- Now, we are actually going to apply a backward elimination process. Firstly we will create a new feature vectorx_opt, which will only contain a set of independent features that are significantly affecting the dependent variable.

- Next, as per the Backward Elimination process, we need to choose a significant level(0.5), and then need to fit the model with all possible predictors. So for fitting the model, we will create aregressor_OLSobject of new classOLSofstatsmodelslibrary. Then we will fit it by using thefit()method.

- Next we needp-valueto compare with SL value, so for this we will usesummary()method to get the summary table of all the values. Below is the code for it:

Note: On the basis of this score, we will estimate the effect of features on our model a

Output:By executing the above lines of code, we will get a summary table. Consider the below image:

Note: On the basis of this score, we will estimate the effect of features on our model a

In the above image, we can clearly see the p-values of all the variables. Herex1, x2 are dummy variables, x3 is R&D spend, x4 is Administration spend, and x5 is Marketing spend.

Note: On the basis of this score, we will estimate the effect of features on our model a

From the table, we will choose the highest p-value, which is for x1=0.953 Now, we have the highest p-value which is greater than the SL value, so will remove the x1 variable (dummy variable) from the table and will refit the model. Below is the code for it:

Note: On the basis of this score, we will estimate the effect of features on our model a

Output:

Note: On the basis of this score, we will estimate the effect of features on our model a

As we can see in the output image, now five variables remain. In these variables, the highest p-value is 0.961. So we will remove it in the next iteration.

Note: On the basis of this score, we will estimate the effect of features on our model a

- Now the next highest value is 0.961 for x1 variable, which is another dummy variable. So we will remove it and refit the model. Below is the code for it:

Note: On the basis of this score, we will estimate the effect of features on our model a

Output:

Note: On the basis of this score, we will estimate the effect of features on our model a

In the above output image, we can see the dummy variable(x2) has been removed. And the next highest value is .602, which is still greater than .5, so we need to remove it.

Note: On the basis of this score, we will estimate the effect of features on our model a

- Now we will remove the Admin spend which is having .602 p-value and again refit the model.

Note: On the basis of this score, we will estimate the effect of features on our model a

Output:

Note: On the basis of this score, we will estimate the effect of features on our model a

As we can see in the above output image, the variable (Admin spend) has been removed. But still, there is one variable left, which ismarketing spendas it has a high p-value(0.60). So we need to remove it.

Note: On the basis of this score, we will estimate the effect of features on our model a

- Finally, we will remove one more variable, which has .60 p-value for marketing spend, which is more than a significant level.Below is the code for it:

Note: On the basis of this score, we will estimate the effect of features on our model a

Output:

Note: On the basis of this score, we will estimate the effect of features on our model a

As we can see in the above output image, only two variables are left. So only theR&D independent variableis a significant variable for the prediction. So we can now predict efficiently using this variable.

Estimating the performance:

In the previous topic, we have calculated the train and test score of the model when we have used all the features variables. Now we will check the score with only one feature variable (R&D spend). Our dataset now looks like:

Estimating the performance:

Below is the code for Building Multiple Linear Regression model by only using R&D spend:

Estimating the performance:

Output:

Estimating the performance:

After executing the above code, we will get the Training and test scores as:

Estimating the performance:

As we can see, the training score is 94% accurate, and the test score is also 94% accurate. The difference between both scores is.00149. This score is very much close to the previous score, i.e.,0.0154, where we have included all the variables.

Estimating the performance:

We got this result by using one independent variable (R&D spend) only instead of four variables. Hence, now, our model is simple and accurate.

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next ?? prevML Polynomial RegressionPolynomial Regression is a regression algorithm that models the relationship between a dependent(y) and independent variable(x) as nth degree polynomial. The Polynomial Regression equation is given below:y= b0+b1x1+ b2x12+ b2x13+...... bnx1nIt is also called the special case of Multiple Linear Regression in ML. Because we add some polynomial terms to the Multiple Linear regression equation to convert it into Polynomial Regression.It is a linear model with some modification in order to increase the accuracy.The dataset used in Polynomial regression for training is of non-linear nature.It makes use of a linear regression model to fit the complicated and non-linear functions and datasets.Hence,"In Polynomial regression, the original features are converted into Polynomial features of required degree (2,3,..,n) and then modeled using a linear model."Need for Polynomial Regression:The need of Polynomial Regression in ML can be understood in the below points:If we apply a linear model on alinear dataset, then it provides us a good result as we have seen in Simple Linear Regression, but if we apply the same model without any modification on anon-linear dataset, then it will produce a drastic output. Due to which loss function will increase, the error rate will be high, and accuracy will be decreased.So for such cases,where data points are arranged in a non-linear fashion, we need the Polynomial Regression model. We can understand it in a better way using the below comparison diagram of the linear dataset and non-linear dataset.In the above image, we have taken a dataset which is arranged non-linearly. So if we try to cover it with a linear model, then we can clearly see that it hardly covers any data point. On the other hand, a curve is suitable to cover most of the data points, which is of the Polynomial model.Hence,if the datasets are arranged in a non-linear fashion, then we should use the Polynomial Regression model instead of Simple Linear Regression.Note:A Polynomial Regression algorithm is also called Polynomial Linear Regression because it does not depend on the variables, instead, it depends on the coefficients, which are arranged in a linear fashion.Equation of the Polynomial Regression Model:Simple Linear Regression equation: y = b0+b1x ....(a)Multiple Linear Regression equation: y= b0+b1x+ b2x2+ b3x3+....+ bnxn.........(b)Polynomial Regression equation: y= b0+b1x + b2x2+ b3x3+....+ bnxn..........(c)When we compare the above three equations, we can clearly see that all three equations are Polynomial equations but differ by the degree of variables. The Simple and Multiple Linear equations are also Polynomial equations with a single degree, and the Polynomial regression equation is Linear equation with the nth degree. So if we add a degree to our linear equations, then it will be converted into Polynomial Linear equations.Note:To better understand Polynomial Regression, you must have knowledge of Simple Linear Regression.Implementation of Polynomial Regression using Python:Here we will implement the Polynomial Regression using Python. We will understand it by comparing Polynomial Regression model with the Simple Linear Regression model. So first, let's understand the problem for which we are going to build the model.Problem Description:There is a Human Resource company, which is going to hire a new candidate. The candidate has told his previous salary 160K per annum, and the HR have to check whether he is telling the truth or bluff. So to identify this, they only have a dataset of his previous company in which the salaries of the top 10 positions are mentioned with their levels. By checking the dataset available, we have found that there is anon-linear relationship between the Position levels and the salaries. Our goal is to build aBluffing detector regressionmodel, so HR can hire an honest candidate. Below are the steps to build such a model.Steps for Polynomial Regression:The main steps involved in Polynomial Regression are given below:Data Pre-processingBuild a Linear Regression model and fit it to the datasetBuild a Polynomial Regression model and fit it to the datasetVisualize the result for Linear Regression and Polynomial Regression model.Predicting the output.Note:Here, we will build the Linear regression model as well as Polynomial Regression to see the results between the predictions. And Linear regression model is for reference.Data Pre-processing Step:The data pre-processing step will remain the same as in previous regression models, except for some changes. In the Polynomial Regression model, we will not use feature scaling, and also we will not split our dataset into training and test set. It has two reasons:The dataset contains very less information which is not suitable to divide it into a test and training set, else our model will not be able to find the correlations between the salaries and levels.In this model, we want very accurate predictions for salary, so the model should have enough information.The code for pre-processing step is given below:# importing libraries

```
import numpy as nm
import matplotlib.pyplot as mtp
import pandas as pd

#importing datasets
data_set= pd.read_csv('Position_Salaries.csv')

#Extracting Independent and dependent Variable
x= data_set.iloc[:, 1:2].values
y= data_set.iloc[:, 2].values
```

Explanation:In the above lines of code, we have imported the important Python libraries to import dataset and operate on it.Next, we have imported the dataset 'Position_Salaries.csv', which contains three columns (Position, Levels, and Salary), but we will consider only two columns (Salary and Levels).After that, we have extracted the dependent(Y) and independent variable(X) from the dataset. For x-variable, we have taken parameters as [:,1:2], because we want 1 index(levels), and included :2 to make it as a matrix.Output:By executing the above code, we can read our dataset as:As we can see in the above output, there are three columns present (Positions, Levels, and Salaries). But we are only considering two columns because Positions are equivalent to the levels or may be seen as the encoded form of Positions.Here we will predict the output for level6.5because the candidate has 4+ years' experience as a regional manager, so he must be somewhere between levels 7 and 6.Building the Linear regression model:Now, we will build and fit the Linear regression model to the dataset. In building polynomial regression, we will take the Linear regression model as reference and compare both the results. The code is given below:#Fitting the Linear Regression to the dataset

from sklearn.linear_model import LinearRegression

lin_regs= LinearRegression()

lin_regs.fit(x,y)In the above code, we have created the Simple Linear model usinglin_regsobject ofLinearRegressionclass and fitted it to the dataset variables (x and y).Output:Out[5]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)Building the Polynomial regression model:Now we will build the Polynomial Regression model, but it will be a little different from the Simple Linear model. Because here we will usePolynomialFeaturesclass ofpreprocessinglibrary. We are using this class to add some extra features to our dataset.#Fitting the Polynomial regression to the dataset

from sklearn.preprocessing import PolynomialFeatures

poly_regs= PolynomialFeatures(degree= 2)

x_poly= poly_regs.fit_transform(x)

lin_reg_2 =LinearRegression()

lin_reg_2.fit(x_poly, y)In the above lines of code, we have usedpoly_regs.fit_transform(x), because first we are converting our feature matrix into polynomial feature matrix, and then fitting it to the Polynomial regression model. The parameter value(degree= 2) depends on our choice. We can choose it according to our Polynomial features.After executing the code, we will get another matrixx_poly, which can be seen under the variable explorer option:Next, we have used another LinearRegression object, namelylin_reg_2, to fit ourx_polyvector to the linear model.Output:Out[11]: LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)Visualizing the result for Linear regression:Now we will visualize the result for Linear regression model as we did in

Simple Linear Regression. Below is the code for it:#Visulaizing the result for Linear Regression model

mtp.scatter(x,y,color="blue")

mtp.plot(x,lin_regs.predict(x), color="red")

mtp.title("Bluff detection model(Linear Regression)")

mtp.xlabel("Position Levels")

mtp.ylabel("Salary")

mtp.show()Output:In the above output image, we can clearly see that the regression line is so far from the datasets. Predictions are in a red straight line, and blue points are actual values. If we consider this output to predict the value of CEO, it will give a salary of approx. 600000$, which is far away from the real value.So we need a curved model to fit the dataset other than a straight line.Visualizing the result for Polynomial RegressionHere we will visualize the result of Polynomial regression model, code for which is little different from the above model.Code for this is given below:#Visulaizing the result for Polynomial Regression

mtp.scatter(x,y,color="blue")

mtp.plot(x, lin_reg_2.predict(poly_regs.fit_transform(x)), color="red")

mtp.title("Bluff detection model(Polynomial Regression)")

mtp.xlabel("Position Levels")

mtp.ylabel("Salary")

mtp.show()In the above code, we have taken lin_reg_2.predict(poly_regs.fit_transform(x), instead of x_poly, because we want a Linear regressor object to predict the polynomial features matrix.Output:As we can see in the above output image, the predictions are close to the real values. The above plot will vary as we will change the degree.For degree= 3:If we change the degree=3, then we will give a more accurate plot, as shown in the below image.SO as we can see here in the above output image, the predicted salary for level 6.5 is near to 170K$-190k$, which seems that future employee is saying the truth about his salary.Degree= 4:Let's again change the degree to 4, and now will get the most accurate plot. Hence we can get more accurate results by increasing the degree of Polynomial.Predicting the final result with the Linear Regression model:Now, we will predict the final output using the Linear regression model to see whether an employee is saying truth or bluff. So, for this, we will use thepredict()method and will pass the value 6.5. Below is the code for it:lin_pred = lin_regs.predict([[6.5]])

print(lin_pred)Output:[330378.78787879]Predicting the final result with the Polynomial Regression model:Now, we will predict the final output using the Polynomial Regression model to compare with Linear model. Below is the code for it:poly_pred = lin_reg_2.predict(poly_regs.fit_transform([[6.5]]))

print(poly_pred)Output:[158862.45265153]As we can see, the predicted output for the Polynomial Regression is [158862.45265153], which is much closer to real value hence, we can say that future employee is saying true.Next TopicClassification Algorithm? prevnext ?

ML Polynomial Regression

- Polynomial Regression is a regression algorithm that models the relationship between a dependent(y) and independent variable(x) as nth degree polynomial. The Polynomial Regression equation is given below:

ML Polynomial Regression

- It is also called the special case of Multiple Linear Regression in ML. Because we add some polynomial terms to the Multiple Linear regression equation to convert it into Polynomial Regression.
- It is a linear model with some modification in order to increase the accuracy.
- The dataset used in Polynomial regression for training is of non-linear nature.
- It makes use of a linear regression model to fit the complicated and non-linear functions and datasets.
- Hence,"In Polynomial regression, the original features are converted into Polynomial features of required degree (2,3,..,n) and then modeled using a linear model."

Need for Polynomial Regression:

The need of Polynomial Regression in ML can be understood in the below points:

Need for Polynomial Regression:

- If we apply a linear model on alinear dataset, then it provides us a good result as we have seen in Simple Linear Regression, but if we apply the same model without any modification on anon-linear dataset, then it will produce a drastic output. Due to which loss function will increase, the error rate will be high, and accuracy will be decreased.

- So for such cases,where data points are arranged in a non-linear fashion, we need the Polynomial Regression model. We can understand it in a better way using the below comparison diagram of the linear dataset and non-linear dataset.

Need for Polynomial Regression:

- In the above image, we have taken a dataset which is arranged non-linearly. So if we try to cover it with a linear model, then we can clearly see that it hardly covers any data point. On the other hand, a curve is suitable to cover most of the data points, which is of the Polynomial model.

- Hence,if the datasets are arranged in a non-linear fashion, then we should use the Polynomial Regression model instead of Simple Linear Regression.

Equation of the Polynomial Regression Model:

Simple Linear Regression equation: y = b0+b1x   ....(a)

Equation of the Polynomial Regression Model:

Multiple Linear Regression equation: y= b0+b1x+ b2x2+ b3x3+....+ bnxn.........(b)

Equation of the Polynomial Regression Model:

Polynomial Regression equation: y= b0+b1x + b2x2+ b3x3+....+ bnxn..........(c)

Equation of the Polynomial Regression Model:

When we compare the above three equations, we can clearly see that all three equations are Polynomial equations but differ by the degree of variables. The Simple and Multiple Linear equations are also Polynomial equations with a single degree, and the Polynomial regression equation is Linear equation with the nth degree. So if we add a degree to our linear equations, then it will be converted into Polynomial Linear equations.

Implementation of Polynomial Regression using Python:

Here we will implement the Polynomial Regression using Python. We will understand it by comparing Polynomial Regression model with the Simple Linear Regression model. So first, let's understand the problem for which we are going to build the model.

Implementation of Polynomial Regression using Python:

Problem Description:There is a Human Resource company, which is going to hire a new candidate. The candidate has told his previous salary 160K per annum, and the HR have to check whether he is telling the truth or bluff. So to identify this, they only have a dataset of his previous company in which the salaries of the top 10 positions are mentioned with their levels. By checking the dataset available, we have found that there is anon-linear relationship between the Position levels and the salaries. Our goal is to build aBluffing detector regressionmodel, so HR can hire an honest candidate. Below are the steps to build such a model.

Steps for Polynomial Regression:

The main steps involved in Polynomial Regression are given below:

Steps for Polynomial Regression:

- Data Pre-processing
- Build a Linear Regression model and fit it to the dataset
- Build a Polynomial Regression model and fit it to the dataset
- Visualize the result for Linear Regression and Polynomial Regression model.
- Predicting the output.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Data Pre-processing Step:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

The data pre-processing step will remain the same as in previous regression models, except for some changes. In the Polynomial Regression model, we will not use feature scaling, and also we will not split our dataset into training and test set. It has two reasons:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

- The dataset contains very less information which is not suitable to divide it into a test and training set, else our model will not be able to find the correlations between the salaries and levels.
- In this model, we want very accurate predictions for salary, so the model should have enough information.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

The code for pre-processing step is given below:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Explanation:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

- In the above lines of code, we have imported the important Python libraries to import dataset and operate on it.
- Next, we have imported the dataset 'Position_Salaries.csv', which contains three columns (Position, Levels, and Salary), but we will consider only two columns (Salary and Levels).
- After that, we have extracted the dependent(Y) and independent variable(X) from the dataset. For x-variable, we have taken parameters as [:,1:2], because we want 1 index(levels), and included :2 to make it as a matrix.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

By executing the above code, we can read our dataset as:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

As we can see in the above output, there are three columns present (Positions, Levels, and Salaries). But we are only considering two columns because Positions are equivalent to the levels or may be seen as the encoded form of Positions.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Here we will predict the output for level6.5because the candidate has 4+ years' experience as a regional manager, so he must be somewhere between levels 7 and 6.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Building the Linear regression model:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Now, we will build and fit the Linear regression model to the dataset. In building polynomial regression, we will take the Linear regression model as reference and compare both the results. The code is given below:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

In the above code, we have created the Simple Linear model usinglin_regsobject ofLinearRegressionclass and fitted it to the dataset variables (x and y).

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Building the Polynomial regression model:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Now we will build the Polynomial Regression model, but it will be a little different from the Simple

Linear model. Because here we will usePolynomialFeaturesclass ofpreprocessinglibrary. We are using this class to add some extra features to our dataset.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

In the above lines of code, we have usedpoly_regs.fit_transform(x), because first we are converting our feature matrix into polynomial feature matrix, and then fitting it to the Polynomial regression model. The parameter value(degree= 2) depends on our choice. We can choose it according to our Polynomial features.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

After executing the code, we will get another matrixx_poly, which can be seen under the variable explorer option:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Next, we have used another LinearRegression object, namelylin_reg_2, to fit ourx_polyvector to the linear model.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Visualizing the result for Linear regression:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Now we will visualize the result for Linear regression model as we did in Simple Linear Regression. Below is the code for it:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

In the above output image, we can clearly see that the regression line is so far from the datasets. Predictions are in a red straight line, and blue points are actual values. If we consider this output to predict the value of CEO, it will give a salary of approx. 600000$, which is far away from the real value.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

So we need a curved model to fit the dataset other than a straight line.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Visualizing the result for Polynomial Regression

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Here we will visualize the result of Polynomial regression model, code for which is little different from the above model.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Code for this is given below:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

In the above code, we have taken lin_reg_2.predict(poly_regs.fit_transform(x), instead of x_poly, because we want a Linear regressor object to predict the polynomial features matrix.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

As we can see in the above output image, the predictions are close to the real values. The above plot will vary as we will change the degree.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

For degree= 3:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

If we change the degree=3, then we will give a more accurate plot, as shown in the below image.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

SO as we can see here in the above output image, the predicted salary for level 6.5 is near to 170K$-190k$, which seems that future employee is saying the truth about his salary.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Degree= 4:Let's again change the degree to 4, and now will get the most accurate plot. Hence we can get more accurate results by increasing the degree of Polynomial.

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Predicting the final result with the Linear Regression model:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Now, we will predict the final output using the Linear regression model to see whether an employee is saying truth or bluff. So, for this, we will use thepredict()method and will pass the value 6.5. Below is the code for it:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Predicting the final result with the Polynomial Regression model:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Now, we will predict the final output using the Polynomial Regression model to compare with Linear model. Below is the code for it:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

Output:

Note:Here, we will build the Linear regression model as well as Polynomial Regressio

As we can see, the predicted output for the Polynomial Regression is [158862.45265153], which is much closer to real value hence, we can say that future employee is saying true.

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next ?Artificial Intelligence (AI) TutorialThe Artificial Intelligence tutorial provides an introduction to AI which will help you to understand the concepts behind Artificial Intelligence. In this tutorial, we have also discussed various popular topics such as History of AI, applications of AI, deep learning, machine learning, natural language processing, Reinforcement learning, Q-learning, Intelligent agents, Various search algorithms, etc.Our AI tutorial is prepared from an elementary level so you can easily understand the complete tutorial from basic concepts to the high-level concepts.What is Artificial Intelligence (AI)?In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day.Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines.The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting, etc.AI is one of the fascinating and universal fields of Computer science which has a great scope in future. AI holds a tendency to cause a machine to work as a human.Artificial Intelligence is composed of two wordsArtificialandIntelligence, where Artificial defines"man-made,"and intelligence defines"thinking power", hence AI means"a man-made thinking power."So, we can define AI as:"It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions."Artificial Intelligence exists when a machine can have human based skills such as learning, reasoning, and solving problemsWith Artificial Intelligence you do not need to preprogram a machine to do some work, despite that you can create a machine with programmed algorithms which can work with own intelligence, and that is the awesomeness of AI.It is believed that AI is not a new technology, and some people says that as per Greek myth, there were Mechanical men in early days which can work and behave like humans.Why Artificial Intelligence?Before Learning about Artificial Intelligence, we should know that what is the importance of AI and why should we learn it. Following are some main reasons to learn about AI:With the help of AI, you can create such software or devices which can solve real-world problems very easily and with accuracy such as health issues, marketing, traffic issues, etc.With the help of AI, you can create your personal virtual Assistant, such as Cortana, Google Assistant, Siri, etc.With the help of AI, you can build such Robots which can work in an environment where survival of humans can be at risk.AI opens a path for other new technologies, new devices, and new Opportunities.Goals of Artificial IntelligenceFollowing are the main goals of Artificial Intelligence:Replicate human intelligenceSolve Knowledge-intensive tasksAn intelligent connection of perception and actionBuilding a machine which can perform tasks that requires human intelligence such as:Proving a theoremPlaying chessPlan some surgical operationDriving a car in trafficCreating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.History of AIThroughout history, people have been intrigued by the idea of making non-living things smart. In ancient times, Greek stories mentioned gods creating clever machines, and in Egypt, engineers made statues move. Thinkers likeAristotle and Ramon Llulllaid the groundwork for AI by describing how human thinking works using symbols.In the late 1800s and early 1900s, modern computing started to take shape. Charles Babbage and Ada Lovelace designed machines that could be programmed in the 1830s. In the 1940s, John Von Neumann came up with the idea of storing computer programs. At the same time, Warren McCulloch and Walter Pitts started building the basics of neural networks.The1950sbrought us modern computers, letting scientists dig into machine intelligence.Alan Turing'sTuring test became a big deal in computer smarts. The term "artificial intelligence" was first used in a 1956 Dartmouth College meeting,where they introduced the first AI program, the Logic Theorist.The following years had good times and bad times for AI, called "AI Winters." In the 1970s and 1980s, we hit limits with computer power and complexity. But in the late 1990s, things got exciting again. Computers were faster, and there was more data.IBM's Deep Bluebeating chess champion Garry Kasparov in 1997 was a big moment.The 2000s started a new era with machine learning, language processing, and computer vision. This led to cool new products and services. The 2010s saw AI take off with things like voice assistants and self-driving cars. Generative AI, which makes creative stuff, also started getting big.In the 2020s, generative AI likeChatGPT-3andGoogle's Bardgrabbed everyone's attention. These models can create all sorts of new things when you give them a prompt, like essays or art. But remember, this tech is still new, and there are things to fix, like making sure it doesn't make things up.What Comprises to Artificial Intelligence?Artificial Intelligence is not just a part of computer science even it's so vast and requires lots of other factors which can contribute to it. To create the AI first we should know that how intelligence is composed, so the Intelligence is an intangible part of our brain which is a combination ofReasoning, learning, problem-solving perception, language understanding, etc.To achieve the above factors for a machine or software Artificial Intelligence requires the following discipline:MathematicsBiologyPsychologySociologyComputer ScienceNeurons StudyStatisticsTypes of Artificial IntelligenceArtificial Intelligence can be categorized in several ways, primarily based on two main criteria: capabilities and functionality.AI Type 1: Based on CapabilitiesWeak AI or Narrow AI:Narrow AI, also known as Weak AI, is like a specialist in the world of Artificial Intelligence. Imagine it as a virtual expert dedicated to performing one specific task with intelligence. For example, think of Apple's Siri. It's pretty smart when it comes to voice commands and answering questions, but it doesn't understand or do much beyond that. Narrow AI operates within strict limits, and if you ask it to step outside its comfort zone, it might not perform as expected. This type of AI is everywhere in today's world, from self-driving cars to image recognition on your smartphone.BM's Watson is another example of Narrow AI. It's a supercomputer that combines Expert Systems, Machine Learning, and Natural Language Processing, but it's still a specialist. It's excellent at crunching data and providing insights but doesn't venture far beyond its defined tasks.General AI:General AI, often referred to as Strong AI, is like the holy grail of artificial intelligence. Picture it as a system that could do any intellectual task with the efficiency of a human. General AI aims to create machines that think and learn like humans, but here's the catch: there's no such system in existence yet. Researchers worldwide are working diligently to make it a reality, but it's a complex journey that will require significant time and effort.Super AI:Super AI takes AI to another level entirely. It's the pinnacle of machine intelligence, where machines surpass human capabilities in every cognitive aspect. These machines can think, reason, solve puzzles, make judgments, plan, learn, and communicate independently. However, it's important to note that Super AI is currently a hypothetical concept. Achieving such a level of artificial intelligence would be nothing short of revolutionary, and it's a challenge that's still on the horizon.AI Type 2: Based on FunctionalityReactive Machines:Reactive Machines represent the most basic form of Artificial Intelligence. These machines live in the present moment and don't have memories or past experiences to guide their actions. They focus solely on the current scenario and respond with the best possible action based on their programming. An example of a reactive machine is IBM's Deep Blue, the chess-playing computer, and Google's AlphaGo, which excels at the ancient game of Go.Limited Memory:Limited Memory machines can remember some past experiences or data but only for a short period. They use this stored information to make decisions and navigate situations. A great example of this type of AI is seen in self-driving cars. These vehicles store recent data like the speed of nearby cars, distances, and speed limits to safely navigate the road.Theory of Mind:Theory of Mind AI is still in the realm of research and development. These AI systems aim to understand human emotions and beliefs and engage in social interactions much like humans. While this type of AI hasn't fully materialized yet, researchers are making significant strides toward creating machines that can understand and interact with humans on a deeper, more emotional level.Self-Awareness:Self-Awareness AI is the future frontier of Artificial Intelligence. These machines will be extraordinarily intelligent, possessing their own consciousness, emotions, and self-awareness. They'll be smarter than the human mind itself. However, it's crucial to note that Self-Awareness AI remains a hypothetical concept and does not yet exist in reality. Achieving this level of AI would be a monumental leap in technology and understanding.Advantages of Artificial IntelligenceFollowing are some main advantages of Artificial Intelligence:High Accuracy with less errors:AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.High-Speed:AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.High reliability:AI machines are highly reliable and can perform the same action multiple times with high accuracy.Useful for risky areas:AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.Digital Assistant:AI can be very useful to provide digital assistant to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.Useful as a public utility:AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.Enhanced Security:AI can be very helpful in enhancing security, as It can detect and respond to cyber threats in real time, helping companies protect their data and systems.Aid in Research:AI is very helpful in the research field as it assists researchers by processing and analyzing large datasets, accelerating discoveries in fields such as astronomy, genomics, and materials science.Disadvantages of Artificial IntelligenceEvery technology has some disadvantages, and thesame goes for Artificial intelligence. Being so advantageous technology still, it has some disadvantages which we need to keep in our mind while creating an AI system. Following are the disadvantages of AI:High Cost:The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.Can't think out of the box:Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.No feelings and emotions:AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.Increase dependency on machines:With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.No Original Creativity:As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.Complexity:Making and keeping AI systems can be very complicated and need a lot of knowledge. This can make it hard for some groups or people to use them.Job Concerns:As AI gets better, it might take away not just basic jobs but also some skilled ones. This worries people about losing jobs in different fields.Challenges of AIArtificial Intelligence offers incredible advantages, but it also presents some challenges that need to be addressed:Doing the Right Thing:AI should make the right choices, but sometimes it doesn't. It can make mistakes or do things that aren't fair. We need to teach AI to be better at making good choices.Government and AI:Sometimes, governments use AI to keep an eye on people. This can be a problem for our freedom. We need to make sure they use AI in a good way.Bias in AI:AI can sometimes be a bit unfair, especially when it comes to recognizing people's faces. This can cause problems, especially for people who aren't like the majority.AI and Social Media:What you see on social media is often decided by AI. 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Artificial Intelligence (AI) Tutorial

The Artificial Intelligence tutorial provides an introduction to AI which will help you to understand the concepts behind Artificial Intelligence. In this tutorial, we have also discussed various popular topics such as History of AI, applications of AI, deep learning, machine learning, natural language processing, Reinforcement learning, Q-learning, Intelligent agents, Various search algorithms, etc.

Artificial Intelligence (AI) Tutorial

Our AI tutorial is prepared from an elementary level so you can easily understand the complete tutorial from basic concepts to the high-level concepts.

What is Artificial Intelligence (AI)?

In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day.

What is Artificial Intelligence (AI)?

Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines.The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting, etc.

What is Artificial Intelligence (AI)?

AI is one of the fascinating and universal fields of Computer science which has a great scope in future. AI holds a tendency to cause a machine to work as a human.

What is Artificial Intelligence (AI)?

Artificial Intelligence is composed of two wordsArtificialandIntelligence, where Artificial defines"man-made,"and intelligence defines"thinking power", hence AI means"a man-made thinking power."

What is Artificial Intelligence (AI)?

So, we can define AI as:

What is Artificial Intelligence (AI)?

Artificial Intelligence exists when a machine can have human based skills such as learning, reasoning, and solving problems

What is Artificial Intelligence (AI)?

With Artificial Intelligence you do not need to preprogram a machine to do some work, despite that you can create a machine with programmed algorithms which can work with own intelligence, and that is the awesomeness of AI.

What is Artificial Intelligence (AI)?

It is believed that AI is not a new technology, and some people says that as per Greek myth, there were Mechanical men in early days which can work and behave like humans.

Why Artificial Intelligence?

Before Learning about Artificial Intelligence, we should know that what is the importance of AI and why should we learn it. Following are some main reasons to learn about AI:

Why Artificial Intelligence?

- With the help of AI, you can create such software or devices which can solve real-world problems very easily and with accuracy such as health issues, marketing, traffic issues, etc.
- With the help of AI, you can create your personal virtual Assistant, such as Cortana, Google Assistant, Siri, etc.
- With the help of AI, you can build such Robots which can work in an environment where survival of humans can be at risk.
- AI opens a path for other new technologies, new devices, and new Opportunities.

Goals of Artificial Intelligence

Following are the main goals of Artificial Intelligence:

Goals of Artificial Intelligence

- Replicate human intelligence
- Solve Knowledge-intensive tasks
- An intelligent connection of perception and action
- Building a machine which can perform tasks that requires human intelligence such as:Proving a theoremPlaying chessPlan some surgical operationDriving a car in traffic
- Proving a theorem
- Playing chess
- Plan some surgical operation
- Driving a car in traffic

- Creating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.

Goals of Artificial Intelligence

- Proving a theorem

- Playing chess

- Plan some surgical operation

- Driving a car in traffic

History of AI

- Throughout history, people have been intrigued by the idea of making non-living things smart. In ancient times, Greek stories mentioned gods creating clever machines, and in Egypt, engineers made statues move. Thinkers likeAristotle and Ramon Llulllaid the groundwork for AI by describing how human thinking works using symbols.

- In the late 1800s and early 1900s, modern computing started to take shape. Charles Babbage and Ada Lovelace designed machines that could be programmed in the 1830s. In the 1940s, John Von Neumann came up with the idea of storing computer programs. At the same time, Warren McCulloch and Walter Pitts started building the basics of neural networks.

- The1950sbrought us modern computers, letting scientists dig into machine intelligence.Alan Turing'sTuring test became a big deal in computer smarts. The term "artificial intelligence" was first used in a 1956 Dartmouth College meeting,where they introduced the first AI program, the Logic Theorist.

- The following years had good times and bad times for AI, called "AI Winters." In the 1970s and 1980s, we hit limits with computer power and complexity. But in the late 1990s, things got exciting again. Computers were faster, and there was more data.IBM's Deep Bluebeating chess champion Garry Kasparov in 1997 was a big moment.

- The 2000s started a new era with machine learning, language processing, and computer vision. This led to cool new products and services. The 2010s saw AI take off with things like voice assistants and self-driving cars. Generative AI, which makes creative stuff, also started getting big.

- In the 2020s, generative AI likeChatGPT-3andGoogle's Bardgrabbed everyone's attention. These models can create all sorts of new things when you give them a prompt, like essays or art. But remember, this tech is still new, and there are things to fix, like making sure it doesn't make things up.

What Comprises to Artificial Intelligence?

Artificial Intelligence is not just a part of computer science even it's so vast and requires lots of other factors which can contribute to it. To create the AI first we should know that how intelligence is composed, so the Intelligence is an intangible part of our brain which is a combination ofReasoning, learning, problem-solving perception, language understanding, etc.

What Comprises to Artificial Intelligence?

To achieve the above factors for a machine or software Artificial Intelligence requires the following discipline:

What Comprises to Artificial Intelligence?

- Mathematics
- Biology
- Psychology
- Sociology
- Computer Science
- Neurons Study
- Statistics

Types of Artificial Intelligence

Artificial Intelligence can be categorized in several ways, primarily based on two main criteria: capabilities and functionality.

AI Type 1: Based on Capabilities

- Weak AI or Narrow AI:Narrow AI, also known as Weak AI, is like a specialist in the world of Artificial Intelligence. Imagine it as a virtual expert dedicated to performing one specific task with intelligence. For example, think of Apple's Siri. It's pretty smart when it comes to voice commands and answering questions, but it doesn't understand or do much beyond that. Narrow AI operates within strict limits, and if you ask it to step outside its comfort zone, it might not perform as expected. This type of AI is everywhere in today's world, from self-driving cars to image recognition on your smartphone.BM's Watson is another example of Narrow AI. It's a supercomputer that combines Expert Systems, Machine Learning, and Natural Language Processing, but it's still a specialist. It's excellent at crunching data and providing insights but doesn't venture far beyond its defined tasks.
- General AI:General AI, often referred to as Strong AI, is like the holy grail of artificial intelligence. Picture it as a system that could do any intellectual task with the efficiency of a human. General AI aims to create machines that think and learn like humans, but here's the catch: there's no such system in existence yet. Researchers worldwide are working diligently to make it a reality, but it's a complex journey that will require significant time and effort.
- Super AI:Super AI takes AI to another level entirely. It's the pinnacle of machine intelligence, where machines surpass human capabilities in every cognitive aspect. These machines can think, reason, solve puzzles, make judgments, plan, learn, and communicate independently. However, it's important to note that Super AI is currently a hypothetical concept. Achieving such a level of artificial intelligence would be nothing short of revolutionary, and it's a challenge that's still on the horizon.

AI Type 2: Based on Functionality

- Reactive Machines:Reactive Machines represent the most basic form of Artificial Intelligence. These machines live in the present moment and don't have memories or past experiences to guide their actions. They focus solely on the current scenario and respond with the best possible action based on their programming. An example of a reactive machine is IBM's Deep Blue, the chess-playing computer, and Google's AlphaGo, which excels at the ancient game of Go.

- Limited Memory:Limited Memory machines can remember some past experiences or data but only for a short period. They use this stored information to make decisions and navigate situations. A great example of this type of AI is seen in self-driving cars. These vehicles store recent data like the speed of nearby cars, distances, and speed limits to safely navigate the road.
- Theory of Mind:Theory of Mind AI is still in the realm of research and development. These AI systems aim to understand human emotions and beliefs and engage in social interactions much like humans. While this type of AI hasn't fully materialized yet, researchers are making significant strides toward creating machines that can understand and interact with humans on a deeper, more emotional level.
- Self-Awareness:Self-Awareness AI is the future frontier of Artificial Intelligence. These machines will be extraordinarily intelligent, possessing their own consciousness, emotions, and self-awareness. They'll be smarter than the human mind itself. However, it's crucial to note that Self-Awareness AI remains a hypothetical concept and does not yet exist in reality. Achieving this level of AI would be a monumental leap in technology and understanding.

Advantages of Artificial Intelligence

Following are some main advantages of Artificial Intelligence:

Advantages of Artificial Intelligence

- High Accuracy with less errors:AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.
- High-Speed:AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.
- High reliability:AI machines are highly reliable and can perform the same action multiple times with high accuracy.
- Useful for risky areas:AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.
- Digital Assistant:AI can be very useful to provide digital assistant to the users such as AI

technology is currently used by various E-commerce websites to show the products as per customer requirement.

- Useful as a public utility:AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.
- Enhanced Security:AI can be very helpful in enhancing security, as It can detect and respond to cyber threats in real time, helping companies protect their data and systems.
- Aid in Research:AI is very helpful in the research field as it assists researchers by processing and analyzing large datasets, accelerating discoveries in fields such as astronomy, genomics, and materials science.

Disadvantages of Artificial Intelligence

Every technology has some disadvantages, and thesame goes for Artificial intelligence. Being so advantageous technology still, it has some disadvantages which we need to keep in our mind while creating an AI system. Following are the disadvantages of AI:

Disadvantages of Artificial Intelligence

- High Cost:The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.
- Can't think out of the box:Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.
- No feelings and emotions:AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.
- Increase dependency on machines:With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.
- No Original Creativity:As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

- Complexity:Making and keeping AI systems can be very complicated and need a lot of knowledge. This can make it hard for some groups or people to use them.

- Job Concerns:As AI gets better, it might take away not just basic jobs but also some skilled ones. This worries people about losing jobs in different fields.

- Doing the Right Thing:AI should make the right choices, but sometimes it doesn't. It can make mistakes or do things that aren't fair. We need to teach AI to be better at making good choices.

- Government and AI:Sometimes, governments use AI to keep an eye on people. This can be a problem for our freedom. We need to make sure they use AI in a good way.

- Bias in AI:AI can sometimes be a bit unfair, especially when it comes to recognizing people's faces. This can cause problems, especially for people who aren't like the majority.

- AI and Social Media:What you see on social media is often decided by AI. But sometimes, AI shows things that aren't true or are kind of mean. We need to make sure AI shows the right stuff.

- Legal and Regulatory Challenges:The rapid evolution of AI has outpaced the development of comprehensive laws and regulations, leading to uncertainty about issues like liability and responsibility.

- Transformers:Google found a better way to train AI using lots of regular computers with special chips called GPUs. This discovery made transformers possible. Transformers help AI learn from data that doesn't have labels, like teaching a computer to understand language.

- Hardware Improvements:Companies like Nvidia improved the inner workings of these GPUs. They made them really good at handling the math AI needs to do. This teamwork between better hardware, smarter AI software, and computer data centers made AI a million times better! Nvidia is also working with companies that offer cloud computing to make it easier for others to use this powerful AI.

- GPTs:Before, if a company wanted to use AI, they had to start from scratch, which was expensive and time-consuming. Now, companies like OpenAI, Nvidia, Microsoft, and Google offer pre-trained AI models. These models can be fine-tuned for specific tasks at a lower cost and with less effort. It's like buying a ready-made cake and adding your own frosting instead of baking the whole cake from scratch. This helps companies use AI faster and with less risk.

- AI in the Cloud:Using AI can be tricky because it needs lots of data work. Big cloud companies likeAWS, Google, Microsoft, IBM, andOracleare making it easier. They're offering AI services that help with the hard parts, like getting data ready, building AI models, and putting them into apps.

- Advanced AI for Everyone:Some groups are making really smart AI models and sharing them.OpenAI, for example, has models that are good at chatting, understanding language, making images, and writing code. Nvidia is another, and they're not tied to one cloud company. Many others are making special AI models for different jobs and industries. It's like having a library of powerful tools for lots of different tasks.

- Any computer language such as C, C++, Java, Python, etc.(knowledge of Python will be an advantage)

- Knowledge of essential Mathematics such as derivatives, probability theory, etc.

Disadvantages of Artificial Intelligence

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Challenges of AI

Artificial Intelligence offers incredible advantages, but it also presents some challenges that need to be addressed:

Challenges of AI

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AI Tools and Services

AI tools and services are advancing quickly, and this progress can be linked back to a significant moment in 2012 when the AlexNet neural network came onto the scene. This marked the start of a new era for high-performance AI, thanks to the use of GPUs and massive data sets. The big shift was the ability to train neural networks using huge amounts of data on multiple GPU cores simultaneously, making it a more scalable process.

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Our AI tutorial is designed specifically for beginners and also included some high-level concepts for professionals.

Problems

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next ?? prevApplications of AIArtificial Intelligence has various applications in today's society. It is becoming essential for today's time because it can solve complex problems with an efficient way in multiple industries, such as Healthcare, entertainment, finance, education, etc. AI is making our daily life more comfortable and fast.Following are some sectors which have the application of Artificial Intelligence:1. AI in AstronomyAutomated Celestial Object Identification:AI systems can automatically identify and classify celestial objects in astronomical images, aiding in discovering new stars, galaxies, and other cosmic phenomena. In simple words, AI can spot and sort out things in space by looking at pictures. It's like having a cosmic detective that finds new stars, galaxies, and other mysterious objects without human help.Exoplanet Hunting:AI helps astronomers find planets outside our solar system by looking at lots of data. It can notice tiny changes in the light from stars, which tell us there might be planets around them, such as those caused by exoplanet transits.Analyzing Space Information:AI plays a crucial role in the study of space. It assists scientists by carefully examining vast amounts of complex data gathered from space observations. This helps astronomers uncover sophisticated patterns, unusual phenomena, and connections that might be otherwise very difficult to notice. Essentially, AI acts as a dedicated assistant, sifting through the cosmic data haystack to find the valuable needles of knowledge.Watching Space Events in Real-time:AI-powered tools can keep a constant eye on the night sky, looking out for sudden happenings like exploding stars (supernovae) or bursts of powerful gamma rays. This allows scientists to quickly study these events in more detail when they occur.Making Telescopes Smarter:AI is like a brain for telescopes. It helps them work better by changing their settings on the fly. For example, if the weather gets cloudy or if scientists want to study something specific in space, AI can adjust the telescope to get the best results. It's like having a telescope that can think and adapt to the situation.2. AI in HealthcareHelping Doctors See Inside the Body Better:AI is like a super helper for doctors when they look at pictures of the inside of a patient's body, like X-rays or MRIs. It uses smart algorithms to find things like problems, tumors, or broken bones very accurately. This means doctors can figure out what's going on faster and more accurately, which is great for patients and for better diagnosis.Detecting Health Problems Early:AI acts as a health detective. It looks at your health information to find out if you might get certain diseases in the future. When it sees a high risk, doctors can step in early to help you stay healthy. This is really important for conditions like diabetes and heart problems because catching them at this time means better treatment and less trouble for the patient.Developing Medications Quickly and Cost-Effectively:AI acts like a super scientist in the lab. It uses certain algorithms to predict how different chemicals can fight diseases. This helps us make new medicines much quicker and at a low cost. So people can get the treatments they need sooner, and it doesn't cost as much money to manufacture them.Personalized Treatment Plans:AI looks at your health information, like your genes, what happened to you before, and how you've responded to treatments. Then, it makes a special plan just for you. This means your treatment works better and doesn't give you as many problems. It's like having a personalized health coach, which helps in avoiding complications caused by improperly prescribed medicine.Managing Hospital Functions and Resources:AI acts like a manager for hospitals. It helps with things like when patients come in, where to put resources like doctors and supplies, and how to make sure everything runs well. It can even guess how many patients might come in ahead of time, so hospitals use their staff and resources in the best way possible.3. AI in GamingSmart Game Characters:AI is like the brains behind game characters that aren't controlled by players. They make these characters, called NPCs, act more like real people or clever enemies. They can learn from what players do and change their behavior, which makes games more exciting and lifelike. Imagine playing a game where the bad guys learn and adapt to your moves - that's what AI does.Creating Game Worlds with AI:AI can make parts of video games all on its own. It can create levels, maps, and places to explore without people having to make them by hand. This means games can have bigger and more interesting worlds because AI does a lot of the work, kind of like a game world builder. It helps game developers, too.Making Games Look and Feel Real:AI helps to make games look and act more like the real world. They create graphics that look just like the things we see, and they make how things move in games feel realistic, like in real life. They even guess what players might do next so the game looks smooth and natural.4. AI in FinanceIdentifying and Prevention of Fraud:AI keeps an eye on bank transactions all the time. They act like super detectives who can spot strange things happening with money, like someone using a credit card in a weird way. When they see something fishy, they raise the alarm and help the bank stop bad people from stealing money. This happens really fast, without needing people to check every transaction.Automated Trading:AI helps a skilled trader who works automatically. It uses various algorithms to swiftly buy and sell stocks while analyzing all the market information. This boosts trading strategies, making investments more efficient and profitable.Risk Control:AI helps in examining lots of data to check how risky something is, like giving out loans or making investments. It looks at things like whether someone can pay back a loan or how safe an investment is. This helps banks and investment firms make smarter choices so they don't lose money and can help others save and grow their money.5. AI in Data SecurityAnamoly Detection:AI works as a digital detective. It looks at big piles of data and watches for anything strange or out of the ordinary, like someone sneaking into a digital vault or trying to steal secrets. When it sees something fishy, it raises the alarm, helping to keep important data safe from cyber-attacks.Predicting Threats:AI looks at past troubles and keeps an eye on new dangers that are popping up. By doing this, it can predict what bad things might happen in the future, like a security breach or a cyberattack. This way, companies can get ready in advance to protect their important data, sort of like putting up a strong fortress before any attack happens.Automated Safety Response:AI acts like a digital guardian that can respond when there's trouble. If it sees something bad happening, like a cyberattack, it can automatically take action. It might isolate the part that's under attack. This way, it keeps your important stuff safe in the digital world.6. AI in Social MediaSmart Suggestions:AI helps as a guide on social media. It watches what you like and what you do, and then it suggests things you might enjoy, like posts, videos, or ads. It acts as someone who knows your tastes and shows you stuff you're really into, making your social media experience more enjoyable and personalized.Virtual Assistants and Chatbots:AI chatbots and virtual assistants act as digital helpers on social media. They're quick to respond and can talk to you just like a real person. 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This makes things faster, cheaper, and better quality, like having a super factory manager.Voice Recognition:AI-driven voice recognition systems allow drivers to control various functions in their vehicles, such as navigation, music, and communication, using natural language.9. AI in Robotics:Self-Moving Robots:AI makes robots really smart at moving around on their own. It's like giving them a built-in GPS and a clever brain. They can figure out where to go and how to get there without bumping into things or needing a person to show them the way. This helps them do tasks like delivering packages or exploring places on their own, making them super independent.Object Recognition and Manipulation:AI gives robots sharp eyes and clever hands. It helps them see objects clearly and then pick them up and move them just right. This is super useful, especially in places like warehouses, where they can do things like sorting and packing items accurately.Collaboration of Humans and Robots:AI makes it possible for robots to be great team players with people. They can work alongside humans, helping out and learning from them. If a person does something, the robot can understand and follow their lead. This makes workplaces safer and more efficient, like having a trusty robot colleague who understands and supports you.10. AI in EntertainmentRecommendation of Content:AI looks at what customers have liked before, such as movies or music, and suggests new things that they might enjoy. It's like having a personal entertainment guide, making their experience more enjoyable by offering just what they like.AI as a Creative Assistant:AI acts as a creative sidekick for artists and creators. It can make music, art, and videos or help improve what they create. 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This way, the animals are well taken care of, and the farm can run smoothly. It's like having a watchful friend for the animals, making sure they're okay and the farm works better.12. AI in E-commercePersonalized Product Suggestions:AI looks at what you've looked at and bought before and suggests things you might really like. It's like having a personal shopper who knows your style, making your online shopping more fun and helping you discover new things you might want to buy.

Plus, it's great for the store because it helps them sell more, and as a customer, it saves your time.Managing Inventory:AI takes care of a store's shelves. It predicts how much of each product people will buy and automatically orders more when needed. In this manner, there exists an optimal balance of products, preventing excessive stock that ties up funds while also ensuring an adequate supply to prevent customers from leaving without making a purchase.Dynamic Pricing:Artificial intelligence dynamically adjusts pricing according to demand, market competition, and inventory levels, ensuring customers receive optimal value while enhancing the store's profitability.13. AI in education:Education Content Creation:AI acts as a teaching assistant for educators. It helps them make things like quizzes, lesson plans, and study materials. This makes teaching easier and better because educators have more time for students, and the materials are top-notch. It's like having a super-efficient helper who does the paperwork, leaving teachers more time to inspire students.Virtual Learning Assistants:AI is there to answer questions, explain things, and offer help whenever students need it, day or night. This makes learning easier and more fun because students have someone to turn to whenever they're stuck. It also takes some pressure off teachers because AI can handle common questions, leaving more time for personalized teaching.Automated Assessment and Instant Feedback:AI acts like a super-speedy homework checker. It looks at your assignments and tests and gives you grades and feedback right away. This aids in gauging your progress and pinpointing areas for potential enhancement. Furthermore, it alleviates some of your teacher's grading responsibilities, allowing them to dedicate more time to teaching rather than paper evaluation.Customized Learning Routes:AI figures out what you're good at and where you might need extra help. Then, it gives you the right stuff to learn and the best way to learn it. This makes learning easier and more fun.ConclusionThe applications of AI are vast and diverse, touching nearly every aspect of our lives. From healthcare to finance, astronomy to gaming, and transportation to entertainment, AI is reshaping industries and propelling us into a future where the possibilities seem limitless. As AI continues to advance, its impact on society is poised to grow, promising increased efficiency, better decision-making, and innovative solutions to some of our most pressing challenges. Embracing and responsibly harnessing the power of AI will be key to unlocking its full potential and ensuring a brighter future for all.Next TopicHistory of AI? prevnext ?

Applications of AI

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Applications of AI

Following are some sectors which have the application of Artificial Intelligence:

1. AI in Astronomy

- Automated Celestial Object Identification:AI systems can automatically identify and classify celestial objects in astronomical images, aiding in discovering new stars, galaxies, and other cosmic phenomena. In simple words, AI can spot and sort out things in space by looking at pictures. It's like having a cosmic detective that finds new stars, galaxies, and other mysterious objects without human help.
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2. AI in Healthcare

- Helping Doctors See Inside the Body Better:AI is like a super helper for doctors when they look at pictures of the inside of a patient's body, like X-rays or MRIs. It uses smart algorithms to find things like problems, tumors, or broken bones very accurately. This means doctors can figure out what's going on faster and more accurately, which is great for patients and for better diagnosis.
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next ?? prevTypes of Artificial Intelligence:Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on capabilities and based on functionally of AI. Following is flow diagram which explain the types of AI.AI type-1: Based on Capabilities1. Weak AI or Narrow AI:Narrow AI is a type of AI which is able to perform a dedicated task with intelligence.The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.Apple Siriis a good example of Narrow AI, but it operates with a limited pre-defined range of functions.IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.2. General AI:General AI is a type of intelligence which could perform any intellectual task with efficiency like a human.The idea behind the general AI to make such a system which could be smarter and think like a human by its own.Currently, there is no such system exist which could come under general AI and can perform any task as perfect as a human.The worldwide researchers are now focused on developing machines with General AI.As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.3. Super AI:Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties. It is an outcome of general AI.Some key characteristics of strong AI include capability include the ability to think, to reason,solve the puzzle, make judgments, plan, learn, and communicate by its own.Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.Artificial Intelligence type-2: Based on functionality1. Reactive MachinesPurely reactive machines are the most basic types of Artificial Intelligence.Such AI systems do not store memories or past experiences for future actions.These machines only focus on current scenarios and react on it as per possible best action.IBM's Deep Blue system is an example of reactive machines.Google's AlphaGo is also an example of reactive machines.2. Limited MemoryLimited memory machines can store past experiences or some data for a short period of time.These machines can use stored data for a limited time period only.Self-driving cars are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.3. Theory of MindTheory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.4. Self-AwarenessSelf-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.These machines will be smarter than human mind.Self-Awareness AI does not exist in reality still and it is a hypothetical concept.Next TopicTypes of Agents? prevnext ?

Types of Artificial Intelligence:

Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on capabilities and based on functionally of AI. Following is flow diagram which explain the types of AI.

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- Apple Siriis a good example of Narrow AI, but it operates with a limited pre-defined range of functions.

- IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.

- Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.

2. General AI:

- General AI is a type of intelligence which could perform any intellectual task with efficiency like a human.

- The idea behind the general AI to make such a system which could be smarter and think like a human by its own.

- Currently, there is no such system exist which could come under general AI and can perform any task as perfect as a human.

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- As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.

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next ?? prevTypes of AI AgentsAgents can be grouped into five classes based on their degree of perceived intelligence and capability. All these agents can improve their performance and generate better action over the time. These are given below:Simple Reflex AgentModel-based reflex agentGoal-based agentsUtility-based agentLearning agent1. Simple Reflex agent:The Simple reflex agents are the simplest agents. These agents take decisions on the basis of the current percepts and ignore the rest of the percept history.These agents only succeed in the fully observable environment.The Simple reflex agent does not consider any part of percepts history during their decision and action process.The Simple reflex agent works on Condition-action rule, which means it maps the current state to action. Such as a Room Cleaner agent, it works only if there is dirt in the room.Problems for the simple reflex agent design approach:They have very limited intelligenceThey do not have knowledge of non-perceptual parts of the current stateMostly too big to generate and to store.Not adaptive to changes in the environment.2. Model-based reflex agentThe Model-based agent can work in a partially observable environment, and track the situation.A model-based agent has two important factors:Model:It is knowledge about "how things happen in the world," so it is called a Model-based agent.Internal State:It is a representation of the current state based on percept history.These agents have the model, "which is knowledge of the world" and based on the model they perform actions.Updating the agent state requires information about:How the world evolvesHow the agent's action affects the world.3. Goal-based agentsThe knowledge of the current state environment is not always sufficient to decide for an agent to what to do.The agent needs to know its goal which describes desirable situations.Goal-based agents expand the capabilities of the model-based agent by having the "goal" information.They choose an action, so that they can achieve the goal.These agents may have to consider a long sequence of possible actions before deciding whether the goal is achieved or not. Such considerations of different scenario are called searching and planning, which makes an agent proactive.4. Utility-based agentsThese agents are similar to the goal-based agent but provide an extra component of utility measurement which makes them different by providing a measure of success at a given state.Utility-based agent act based not only goals but also the best way to achieve the goal.The Utility-based agent is useful when there are multiple possible alternatives, and an agent has to choose in order to perform the best action.The utility function maps each state to a real number to check how efficiently each action achieves the goals.5. Learning AgentsA learning agent in AI is the type of agent which can learn from its past experiences, or it has learning capabilities.It starts to act with basic knowledge and then able to act and adapt automatically through learning.A learning agent has mainly four conceptual components, which are:Learning element:It is responsible for making improvements by learning from environmentCritic:Learning element takes feedback from critic which describes that how well the agent is doing with respect to a fixed performance standard.Performance element:It is responsible for selecting external actionProblem generator:This component is responsible for suggesting actions that will lead to new and informative experiences.Hence, learning agents are able to learn, analyze performance, and look for new ways to improve the performance.Next TopicIntelligent Agent? prevnext ?

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next ?? prevAgents in Artificial IntelligenceAn AI system can be defined as the study of the rational agent and its environment. The agents sense the environment through sensors and act on their environment through actuators. An AI agent can have mental properties such as knowledge, belief, intention, etc.What is an Agent?An agent can be anything that perceiveits environment through sensors and act upon that environment through actuators. An Agent runs in the cycle ofperceiving,thinking, andacting. An agent can be:Human-Agent:A human agent has eyes, ears, and other organs which work for sensors and hand, legs, vocal tract work for actuators.Robotic Agent:A robotic agent can have cameras, infrared range finder, NLP for sensors and various motors for actuators.Software Agent:Software agent can have keystrokes, file contents as sensory input and act on those inputs and display output on the screen.Hence the world around us is full of agents such as thermostat, cellphone, camera, and even we are also agents.Before moving forward, we should first know about sensors, effectors, and actuators.Sensor:Sensor is a device which detects the change in the environment and sends the information to other electronic devices. An agent observes its environment through sensors.Actuators:Actuators are the component of machines that converts energy into motion. The actuators are only responsible for moving and controlling a system. An actuator can be an electric motor, gears, rails, etc.Effectors:Effectors are the devices which affect the environment. Effectors can be legs, wheels, arms, fingers, wings, fins, and display screen.Intelligent Agents:An intelligent agent is an autonomous entity which act upon an environment using sensors and actuators for achieving goals. An intelligent agent may learn from the environment to achieve their goals. A thermostat is an example of an intelligent agent.Following are the main four rules for an AI agent:Rule 1:An AI agent must have the ability to perceive the environment.Rule 2:The observation must be used to make decisions.Rule 3:Decision should result in an action.Rule 4:The action taken by an AI agent must be a rational action.Rational Agent:A rational agent is an agent which has clear preference, models uncertainty, and acts in a way to maximize its performance measure with all possible actions.A rational agent is said to perform the right things. AI is about creating rational agents to use for game theory and decision theory for various real-world scenarios.For an AI agent, the rational action is most important because in AI reinforcement learning algorithm, for each best possible action, agent gets the positive reward and for each wrong action, an agent gets a negative reward.Note: Rational agents in AI are very similar to intelligent agents.Rationality:The rationality of an agent is measured by its performance measure. Rationality can be judged on the basis of following points:Performance measure which defines the success criterion.Agent prior knowledge of its environment.Best possible actions that an agent can perform.The sequence of percepts.Note: Rationality differs from Omniscience because an Omniscient agent knows the actual outcome of its action and act accordingly, which is not possible in reality.Structure of an AI AgentThe task of AI is to design an agent program which implements the agent function. The structure of an intelligent agent is a combination of architecture and agent program. It can be viewed as:Agent = Architecture + Agent programFollowing are the main three terms involved in the structure of an AI agent:Architecture:Architecture is machinery that an AI agent executes on.Agent Function:Agent function is used to map a percept to an action.f:P* ? AAgent program:Agent program is an implementation of agent function. An agent program executes on the physical architecture to produce function f.PEAS RepresentationPEAS is a type of model on which an AI agent works upon. When we define an AI agent or rational agent, then we can group its properties under PEAS representation model. It is made up of four words:P:Performance measureE:EnvironmentA:ActuatorsS:SensorsHere performance measure is the objective for the success of an agent's behavior.PEAS for self-driving cars:Let's suppose a self-driving car then PEAS representation will be:Performance:Safety, time, legal drive, comfortEnvironment:Roads, other vehicles, road signs, pedestrianActuators:Steering, accelerator, brake, signal, hornSensors:Camera, GPS, speedometer, odometer, accelerometer, sonar.Example of Agents with their PEAS representationAgentPerformance measureEnvironmentActuatorsSensors1. Medical

DiagnoseHealthy patientMinimized costPatientHospitalStaffTestsTreatmentsKeyboard(Entry of symptoms)2. Vacuum CleanerCleannessEfficiencyBattery lifeSecurityRoomTableWood floorCarpetVarious obstaclesWheelsBrushesVacuum ExtractorCameraDirt detection sensorCliff sensorBump SensorInfrared Wall Sensor3. Part -picking RobotPercentage of parts in correct bins.Conveyor belt with parts,BinsJointed ArmsHandCameraJoint angle sensors.Next TopicAgent Environment? prevnext ? | Agent | Performance measure | Environment | Actuators | Sensors | 1. Medical Diagnose | Healthy patientMinimized cost | PatientHospitalStaff | TestsTreatments | Keyboard(Entry of symptoms) | 2. Vacuum Cleaner | CleannessEfficiencyBattery lifeSecurity | RoomTableWood floorCarpetVarious obstacles | WheelsBrushesVacuum Extractor | CameraDirt detection sensorCliff sensorBump SensorInfrared Wall Sensor | 3. Part -picking Robot | Percentage of parts in correct bins. | Conveyor belt with parts,Bins | Jointed ArmsHand | CameraJoint angle sensors.

Agent	Performance measure	Environment	Actuators	Sensors
1. Medical Diagnose	Healthy patientMinimized cost	PatientHospitalStaff	TestsTreatments	Keyboard(Entry of symptoms)
2. Vacuum Cleaner	CleannessEfficiencyBattery lifeSecurity	RoomTableWood floorCarpetVarious obstacles	WheelsBrushesVacuum Extractor	CameraDirt detection sensorCliff sensorBump SensorInfrared Wall Sensor
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Agents in Artificial Intelligence

An AI system can be defined as the study of the rational agent and its environment. The agents sense the environment through sensors and act on their environment through actuators. An AI agent can have mental properties such as knowledge, belief, intention, etc.

What is an Agent?

An agent can be anything that perceiveits environment through sensors and act upon that environment through actuators. An Agent runs in the cycle ofperceiving,thinking, andacting. An agent can be:

What is an Agent?

- Human-Agent:A human agent has eyes, ears, and other organs which work for sensors and hand, legs, vocal tract work for actuators.

- Robotic Agent:A robotic agent can have cameras, infrared range finder, NLP for sensors and various motors for actuators.

- Software Agent:Software agent can have keystrokes, file contents as sensory input and act on those inputs and display output on the screen.

What is an Agent?

Hence the world around us is full of agents such as thermostat, cellphone, camera, and even we are also agents.

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Before moving forward, we should first know about sensors, effectors, and actuators.

What is an Agent?

Sensor:Sensor is a device which detects the change in the environment and sends the information to other electronic devices. An agent observes its environment through sensors.

What is an Agent?

Actuators:Actuators are the component of machines that converts energy into motion. The actuators are only responsible for moving and controlling a system. An actuator can be an electric motor, gears, rails, etc.

What is an Agent?

Effectors:Effectors are the devices which affect the environment. Effectors can be legs, wheels, arms, fingers, wings, fins, and display screen.

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- The sequence of percepts.

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The task of AI is to design an agent program which implements the agent function. The structure of an intelligent agent is a combination of architecture and agent program. It can be viewed as:

Structure of an AI Agent

Following are the main three terms involved in the structure of an AI agent:

Structure of an AI Agent

Architecture:Architecture is machinery that an AI agent executes on.

Structure of an AI Agent

Agent Function:Agent function is used to map a percept to an action.

Structure of an AI Agent

Agent program:Agent program is an implementation of agent function. An agent program executes on the physical architecture to produce function f.

PEAS Representation

PEAS is a type of model on which an AI agent works upon. When we define an AI agent or rational agent, then we can group its properties under PEAS representation model. It is made up of four words:

PEAS Representation

- P:Performance measure

- E:Environment

- A:Actuators

- S:Sensors

PEAS Representation

Here performance measure is the objective for the success of an agent's behavior.

PEAS for self-driving cars:

Let's suppose a self-driving car then PEAS representation will be:

PEAS for self-driving cars:

Performance:Safety, time, legal drive, comfort

PEAS for self-driving cars:

Environment:Roads, other vehicles, road signs, pedestrian

PEAS for self-driving cars:

Actuators:Steering, accelerator, brake, signal, horn

PEAS for self-driving cars:

Sensors:Camera, GPS, speedometer, odometer, accelerometer, sonar.

Example of Agents with their PEAS representation

Agent | Performance measure | Environment | Actuators | Sensors

1. Medical Diagnose | Healthy patientMinimized cost | PatientHospitalStaff | TestsTreatments | Keyboard(Entry of symptoms)

2. Vacuum Cleaner | CleannessEfficiencyBattery lifeSecurity | RoomTableWood floorCarpetVarious obstacles | WheelsBrushesVacuum Extractor | CameraDirt detection sensorCliff sensorBump SensorInfrared Wall Sensor

3. Part -picking Robot | Percentage of parts in correct bins. | Conveyor belt with parts,Bins | Jointed

ArmsHand | CameraJoint angle sensors.

Example of Agents with their PEAS representation

- Healthy patient

- Minimized cost

Example of Agents with their PEAS representation

- Patient

- Hospital

- Staff

Example of Agents with their PEAS representation

- Tests

- Treatments

Example of Agents with their PEAS representation

- Cleanness

- Efficiency

- Battery life

- Security

Example of Agents with their PEAS representation

- Room

- Table

- Wood floor

- Carpet

- Various obstacles

Example of Agents with their PEAS representation

- Wheels

- Brushes

- Vacuum Extractor

Example of Agents with their PEAS representation

- Camera

- Dirt detection sensor

- Cliff sensor

- Bump Sensor

- Infrared Wall Sensor

Example of Agents with their PEAS representation

- Percentage of parts in correct bins.

Example of Agents with their PEAS representation

- Conveyor belt with parts,

- Bins

Example of Agents with their PEAS representation

- Jointed Arms

- Hand

Example of Agents with their PEAS representation

- Camera

- Joint angle sensors.

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next ?? prevAgent Environment in AIAn environment is everything in the world which surrounds the agent, but it is not a part of an agent itself. An environment can be described as a situation in which an agent is present.The environment is where agent lives, operate and provide the agent with something to sense and act upon it. An environment is mostly said to be non-feministic.Features of EnvironmentAs per Russell and Norvig, an environment can have various features from the point of view of an agent:Fully observable vs Partially ObservableStatic vs DynamicDiscrete vs ContinuousDeterministic vs StochasticSingle-agent vs Multi-agentEpisodic vs sequentialKnown vs UnknownAccessible vs Inaccessible1. Fully observable vs Partially Observable:If an agent sensor can sense or access the complete state of an environment at each point in time then it is a fully observable environment, it is partially observable. For reference, Imagine a chess-playing agent. In this case, the agent can fully observe the state of the chessboard at all times. Its sensors (in this case, vision or the ability to access the board's state) provide complete information about the current position of all pieces. This is a fully observable environment because the agent has perfect information about the state of the world.A fully observable environment is easy as there is no need to maintain the internal state to keep track of the history of the world. For reference, Consider a self-driving car navigating a busy city. While the car has sensors like cameras, lidar, and radar, it can't see everything at all times. Buildings, other vehicles, and pedestrians can obstruct its sensors. In this scenario, the car's environment is partially observable because it doesn't have complete and constant access to all relevant information. It needs to maintain an internal state and history to make informed decisions even when some information is temporarily unavailable.An agent with no sensors in all environments then such an environment is called unobservable. For reference, think about an agent designed to predict earthquakes but placed in a sealed, windowless room with no sensors or access to external data. In this situation, the environment is unobservable because the agent has no way to gather information about the outside world. It can't sense any aspect of its environment, making it completely unobservable.2. Deterministic vs Stochastic:If an agent's current state and selected action can completely determine the next state of the environment, then such an environment is called a deterministic environment. For reference, Chess is a classic example of a deterministic environment. In chess, the rules are well-defined, and each move made by a player has a clear and predictable outcome based on those rules. If you move a pawn from one square to another, the resulting state of the chessboard is entirely determined by that action, as is your opponent's response. There's no randomness or uncertainty in the outcomes of chess moves because they follow strict rules. In a deterministic environment like chess, knowing the current state and the actions taken allows you to completely determine the next state.A stochastic environment is random and cannot be determined completely by an agent. For reference, The stock market is an example of a stochastic environment. It's highly influenced by a multitude of unpredictable factors, including economic events, investor sentiment, and news. While there are patterns and trends, the exact behavior of stock prices is inherently random and cannot be completely determined by any individual or agent. Even with access to extensive data and analysis tools, stock market movements can exhibit a high degree of unpredictability. Random events and market sentiment play significant roles, introducing uncertainty.In a deterministic, fully observable environment, an agent does not need to worry about uncertainty.3. Episodic vs Sequential:In an episodic environment, there is a series of one-shot actions, and only the current percept is required for the action. For example, Tic-Tac-Toe is a classic example of an episodic environment. In this game, two players take turns placing their symbols (X or O) on a 3x3 grid. Each move by a player is independent of previous moves, and the goal is to form a line of three symbols horizontally, vertically, or diagonally. The game consists of a series of one-shot actions where the current state of the board is the only thing that matters for the next move. There's no need for the players to remember past moves because they don't affect the current move. The game is self-contained and episodic.However, in a Sequential environment, an agent requires memory of past actions to determine the next best actions. For example, Chess is an example of a sequential environment. Unlike Tic-Tac-Toe, chess is a complex game where the outcome of each move depends on a sequence of previous moves. In chess, players must consider the history of the game, as the current position of pieces, previous moves, and potential future moves all influence the best course of action. To play chess effectively, players need to maintain a memory of past actions, anticipate future moves, and plan their strategies accordingly. It's a sequential environment because the sequence of actions and the history of the game significantly impact decision-making.4. Single-agent vs Multi-agentIf only one agent is involved in an environment, and operating by itself then such an environment is called a single-agent environment. For example, Solitaire is a classic example of a single-agent environment. When you play Solitaire, you're the only agent involved. You make all the decisions and actions to achieve a goal, which is to arrange a deck of cards in a specific way. There are no other agents or players interacting with you. It's a solitary game where the outcome depends solely on your decisions and moves. In this single-agent environment, the agent doesn't need to consider the actions or decisions of other entities.However, if multiple agents are operating in an environment, then such an environment is called a multi-agent environment. For reference, A soccer match is an example of a multi-agent environment. In a soccer game, there are two teams, each consisting of multiple players (agents). These players work together to achieve common goals (scoring goals and preventing the opposing team from scoring). Each player has their own set of actions and decisions, and they interact with both their teammates and the opposing team. The outcome of the game depends on the coordinated actions and strategies of all the agents on the field. It's a multi-agent environment because there are multiple autonomous entities (players) interacting in a shared environment.The agent design problems in the multi-agent environment are different from single-agent environments.5. Static vs Dynamic:If the environment can change itself while an agent is deliberating then such an environment is called a dynamic environment it is called a static environment.Static environments are easy to deal with because an agent does not need to continue looking at the world while deciding on an action. For reference, A crossword puzzle is an example of a static environment. When you work on a crossword puzzle, the puzzle itself doesn't change while you're thinking about your next move. The arrangement of clues and empty squares remains constant throughout your problem-solving process. You can take your time to deliberate and find the best word to fill in each blank, and the puzzle's state remains unaltered during this process. It's a static environment because there are no changes in the puzzle based on your deliberations.However, for a dynamic environment, agents need to keep looking at the world at each action. For reference, Taxi driving is an example of a dynamic environment. When you're driving a taxi, the environment is constantly changing. The road conditions, traffic, pedestrians, and other vehicles all contribute to the dynamic nature of this environment. As a taxi driver, you need to keep a constant watch on the road and adapt your actions in real time based on the changing circumstances. The environment can change rapidly, requiring your continuous attention and decision-making. It's a dynamic environment because it evolves while you're deliberating and taking action.6. Discrete vs Continuous:If in an environment, there are a finite number of percepts and actions that can be performed within it, then such an environment is called a discrete environment it is called a continuous environment.Chess is an example of a discrete environment. In chess, there are a finite number of distinct chess pieces (e.g., pawns, rooks, knights) and a finite number of squares on the chessboard. The rules of chess define clear, discrete moves that a player can make. Each piece can be in a specific location on the board, and players take turns making individual, well-defined moves. The state of the chessboard is discrete and can be described by the positions of the pieces on the board.Controlling a robotic arm to perform precise movements in a factory setting is an example of a continuous environment. In this context, the robot arm's position and orientation can exist along a continuous spectrum. There are virtually infinite possible positions and orientations for the robotic arm within its workspace. The control inputs to move the arm, such as adjusting joint angles or applying forces, can also vary continuously. Agents in this environment must operate within a continuous state and action space, and they need to make precise, continuous adjustments to achieve their goals.7. Known vs UnknownKnown and unknown are not actually a feature of an environment, but it is an agent's state of knowledge to perform an action.In a known environment, the results of all actions are known to the agent. While in an unknown environment, an agent needs to learn how it works in order to perform an action.It is quite possible for a known environment to be partially observable and an Unknown environment to be fully observable.The opening theory in chess can be considered as a known environment for experienced chess players. Chess has a vast body of knowledge regarding opening moves, strategies, and responses. Experienced players are familiar with established openings, and they have studied various sequences of moves and their outcomes. When they make their initial moves in a game, they have a good understanding of the potential consequences based on their knowledge of known openings.Imagine a scenario where a rover or drone is sent to explore an alien planet with no prior knowledge or maps of the terrain. In this unknown environment, the agent (rover or drone) has to explore and learn about the terrain as it goes along. It doesn't have prior knowledge of the landscape, potential hazards, or valuable resources. The agent needs to use sensors and data it collects during exploration to build a map and understand how the terrain works. It operates in an unknown environment because the results and consequences of its actions are not initially known, and it must learn from its experiences.8. Accessible vs InaccessibleIf an agent can obtain complete and accurate information about the state's environment, then such an environment is called an Accessible environment else it is called inaccessible.For example, Imagine an empty room equipped with highly accurate temperature sensors. These sensors can provide real-time temperature measurements at any point within the room. An agent placed in this room can obtain complete and accurate information about the temperature at different locations. It can access this information at any time, allowing it to make decisions based on the precise temperature data. This environment is accessible because the agent can acquire complete and accurate information about the state of the room, specifically its temperature.For example, Consider a scenario where a satellite in space is tasked with monitoring a specific event taking place on Earth, such as a natural disaster or a remote area's condition. While the satellite can capture images and data from space, it cannot access fine-grained information about the event's details. For example, it may see a forest fire occurring but cannot determine the exact temperature at specific locations within the fire or identify individual objects on the ground. The satellite's observations provide valuable data, but the environment it is monitoring (Earth) is vast and complex, making it impossible to access complete and detailed information about all aspects of the event. In this case, the Earth's surface is an inaccessible environment for obtaining fine-grained information about specific events.Next TopicTuring Test in AI? prevnext ?

Agent Environment in AI

An environment is everything in the world which surrounds the agent, but it is not a part of an agent itself. An environment can be described as a situation in which an agent is present.

Agent Environment in AI

The environment is where agent lives, operate and provide the agent with something to sense and act upon it. An environment is mostly said to be non-feministic.

Features of Environment

As per Russell and Norvig, an environment can have various features from the point of view of an agent:

Features of Environment

- Fully observable vs Partially Observable

- Static vs Dynamic

- Discrete vs Continuous

- Deterministic vs Stochastic

- Single-agent vs Multi-agent

- Episodic vs sequential

- Known vs Unknown

- Accessible vs Inaccessible

1. Fully observable vs Partially Observable:

- If an agent sensor can sense or access the complete state of an environment at each point in time then it is a fully observable environment, it is partially observable. For reference, Imagine a chess-playing agent. In this case, the agent can fully observe the state of the chessboard at all times. Its sensors (in this case, vision or the ability to access the board's state) provide complete information about the current position of all pieces. This is a fully observable environment because the agent has perfect information about the state of the world.

- A fully observable environment is easy as there is no need to maintain the internal state to keep track of the history of the world. For reference, Consider a self-driving car navigating a busy city. While the car has sensors like cameras, lidar, and radar, it can't see everything at all times. Buildings, other vehicles, and pedestrians can obstruct its sensors. In this scenario, the car's environment is partially observable because it doesn't have complete and constant access to all relevant information. It needs to maintain an internal state and history to make informed decisions even when some information is temporarily unavailable.

- An agent with no sensors in all environments then such an environment is called unobservable. For reference, think about an agent designed to predict earthquakes but placed in a sealed, windowless room with no sensors or access to external data. In this situation, the environment is unobservable because the agent has no way to gather information about the outside world. It can't sense any aspect of its environment, making it completely unobservable.

2. Deterministic vs Stochastic:

- If an agent's current state and selected action can completely determine the next state of the environment, then such an environment is called a deterministic environment. For reference, Chess is a classic example of a deterministic environment. In chess, the rules are well-defined, and each move made by a player has a clear and predictable outcome based on those rules. If you move a pawn from one square to another, the resulting state of the chessboard is entirely determined by that action, as is your opponent's response. There's no randomness or uncertainty in the outcomes of chess moves because they follow strict rules. In a deterministic environment like chess, knowing the current state and the actions taken allows you to completely determine the next state.
- A stochastic environment is random and cannot be determined completely by an agent. For reference, The stock market is an example of a stochastic environment. It's highly influenced by a multitude of unpredictable factors, including economic events, investor sentiment, and news. While there are patterns and trends, the exact behavior of stock prices is inherently random and cannot be completely determined by any individual or agent. Even with access to extensive data and analysis tools, stock market movements can exhibit a high degree of unpredictability. Random events and market sentiment play significant roles, introducing uncertainty.
- In a deterministic, fully observable environment, an agent does not need to worry about uncertainty.

3. Episodic vs Sequential:

- In an episodic environment, there is a series of one-shot actions, and only the current percept is required for the action. For example, Tic-Tac-Toe is a classic example of an episodic environment. In this game, two players take turns placing their symbols (X or O) on a 3x3 grid. Each move by a player is independent of previous moves, and the goal is to form a line of three symbols horizontally, vertically, or diagonally. The game consists of a series of one-shot actions where the current state of the board is the only thing that matters for the next move. There's no need for the players to remember past moves because they don't affect the current move. The game is self-contained and episodic.

- However, in a Sequential environment, an agent requires memory of past actions to determine the next best actions. For example, Chess is an example of a sequential environment. Unlike Tic-Tac-Toe, chess is a complex game where the outcome of each move depends on a sequence of previous moves. In chess, players must consider the history of the game, as the current position of pieces, previous moves, and potential future moves all influence the best course of action. To play chess effectively, players need to maintain a memory of past actions, anticipate future moves, and plan their strategies accordingly. It's a sequential environment because the sequence of actions and the history of the game significantly impact decision-making.

4. Single-agent vs Multi-agent

- If only one agent is involved in an environment, and operating by itself then such an environment is called a single-agent environment. For example, Solitaire is a classic example of a single-agent environment. When you play Solitaire, you're the only agent involved. You make all the decisions and actions to achieve a goal, which is to arrange a deck of cards in a specific way. There are no other agents or players interacting with you. It's a solitary game where the outcome depends solely on your decisions and moves. In this single-agent environment, the agent doesn't need to consider the actions or decisions of other entities.
- However, if multiple agents are operating in an environment, then such an environment is called a multi-agent environment. For reference, A soccer match is an example of a multi-agent environment. In a soccer game, there are two teams, each consisting of multiple players (agents). These players work together to achieve common goals (scoring goals and preventing the opposing team from scoring). Each player has their own set of actions and decisions, and they interact with both their teammates and the opposing team. The outcome of the game depends on the coordinated actions and strategies of all the agents on the field. It's a multi-agent environment because there are multiple autonomous entities (players) interacting in a shared environment.
- The agent design problems in the multi-agent environment are different from single-agent

environments.

5. Static vs Dynamic:

- If the environment can change itself while an agent is deliberating then such an environment is called a dynamic environment it is called a static environment.
- Static environments are easy to deal with because an agent does not need to continue looking at the world while deciding on an action. For reference, A crossword puzzle is an example of a static environment. When you work on a crossword puzzle, the puzzle itself doesn't change while you're thinking about your next move. The arrangement of clues and empty squares remains constant throughout your problem-solving process. You can take your time to deliberate and find the best word to fill in each blank, and the puzzle's state remains unaltered during this process. It's a static environment because there are no changes in the puzzle based on your deliberations.
- However, for a dynamic environment, agents need to keep looking at the world at each action. For reference, Taxi driving is an example of a dynamic environment. When you're driving a taxi, the environment is constantly changing. The road conditions, traffic, pedestrians, and other vehicles all contribute to the dynamic nature of this environment. As a taxi driver, you need to keep a constant watch on the road and adapt your actions in real time based on the changing circumstances. The environment can change rapidly, requiring your continuous attention and decision-making. It's a dynamic environment because it evolves while you're deliberating and taking action.

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Its task is to differentiate between humans and other machines based on the responses it receives. This reversal challenges the AI to evaluate the intelligence of others, highlighting its ability to detect artificial intelligence.Multimodal Turing Test:In a world where communication takes many forms, the Multimodal Turing Test assesses AI's capability to understand and respond to various modes of communication concurrently. It examines whether AI can seamlessly process and respond to text, speech, images, and potentially other modes simultaneously. This variation acknowledges the diverse ways we communicate and tests if AI can keep up with our multifaceted interactions.Chatbots to attempt the Turing test:ELIZA:ELIZA was a Natural language processing computer program created by Joseph Weizenbaum. It was created to demonstrate the ability of communication between machine and humans. It was one of the first chatterbots, which has attempted the Turing Test.Parry:Parry was a chatterbot created by Kenneth Colby in 1972. Parry was designed to simulate a person withParanoid schizophrenia(most common chronic mental disorder). Parry was described as "ELIZA with attitude." Parry was tested using a variation of the Turing Test in the early 1970s.Eugene Goostman:Eugene Goostman was a chatbot developed in Saint Petersburg in 2001. This bot has competed in the various number of Turing Test. In June 2012, at an event, Goostman won the competition promoted as largest-ever Turing test content, in which it has convinced 29% of judges that it was a human.Goostman resembled as a 13-year old virtual boy.The Chinese Room Argument:There were many philosophers who really disagreed with the complete concept of Artificial Intelligence. The most famous argument in this list was "Chinese Room."In the year1980, John Searlepresented "Chinese Room" thought experiment, in his paper "Mind, Brains, and Program," which was against the validity of Turing's Test. According to his argument, "Programming a computer may make it to understand a language, but it will not produce a real understanding of language or consciousness in a computer."He argued that Machine such as ELIZA and Parry could easily pass the Turing test by manipulating keywords and symbol, but they had no real understanding of language. So it cannot be described as "thinking" capability of a machine such as a human.Features required for a machine to pass the Turing test:Natural language processing:NLP is required to communicate with Interrogator in general human language like

English.Knowledge representation:To store and retrieve information during the test.Automated reasoning:To use the previously stored information for answering the questions.Machine learning:To adapt new changes and can detect generalized patterns.Vision (For total Turing test):To recognize the interrogator actions and other objects during a test.Motor Control (For total Turing test):To act upon objects if requested.Limitation of Turing TestNot a True Measure of Intelligence:Passing the Turing Test doesn't guarantee genuine machine intelligence or consciousness. Critics, like John Searle's "Chinese Room" argument, contend that a computer can simulate human-like responses without understanding or consciousness.Simplicity of Test Scenarios:The Turing Test primarily focuses on text-based interactions, which might not fully assess a machine's capacity to comprehend and respond to the complexities of the real world.ConclusionThe Turing Test still serves as a pivotal benchmark for assessing AI's conversational skills in today's context. It continues to be instrumental in the development and evaluation of chatbots and virtual assistants. Many companies and developers employ different versions of the test to gauge how well their AI systems can engage in conversation.However, it's worth noting that while the Turing Test maintains its relevance, the AI field has progressed significantly beyond its scope. Modern AI systems leverage advanced natural language processing, machine learning, and deep learning techniques, empowering them to execute tasks much more intricate than imitating human dialogue. AI's applications now span a wide array of fields, from healthcare and finance to autonomous vehicles and image recognition, showcasing its diverse capabilities that extend well beyond mere conversation.Next TopicSearch Algorithms? prevnext ?

Turing Test in AI

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Turing Test in AI

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Turing Test in AI

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Turing Test in AI

The questions and answers can be like:

Turing Test in AI

Interrogator:Are you a computer?

Turing Test in AI

PlayerA (Computer):No

Turing Test in AI

Interrogator:Multiply two large numbers such as (256896489*456725896)

Turing Test in AI

Player A:Long pause and give the wrong answer.

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In this game, if an interrogator would not be able to identify which is a machine and which is human, then the computer passes the test successfully, and the machine is said to be intelligent and can think like a human.

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This curiosity arose from Turing's fascination with the concept of creating thinking machines that exhibit intelligent behavior. He proposed the Turing Test as a practical method to determine if a machine can engage in natural language conversations convincingly, making a human evaluator believe it's human.

History of Turing Test

Turing's work on this test laid the foundation for AI research and spurred discussions about machine intelligence. It provided a framework for evaluating AI systems. Over time, the Turing Test has evolved and remains a topic of debate and improvement. Its historical importance in shaping AI is undeniable, continuously motivating AI researchers and serving as a benchmark for gauging AI advancements.

Variations of the Turing Test

Over the years, different versions of the Turing Test have appeared to overcome its constraints and deliver a more thorough assessment of AI capabilities:

Variations of the Turing Test

- Total Turing Test:This extended version of the Turing Test goes beyond text-based conversations. It assesses the machine's capacity to comprehend and respond to not just words but also visual and physical cues presented by the interrogator. This includes recognizing objects shown to it and taking requested actions in response. Essentially, it examines if the AI can interact with the world in a way that reflects a deeper level of understanding.
- Reverse Turing Test:In a twist on the traditional Turing Test, the roles are reversed here. In this variation, it's the machine that plays the role of the interrogator. Its task is to differentiate between humans and other machines based on the responses it receives. This reversal challenges the AI to evaluate the intelligence of others, highlighting its ability to detect artificial intelligence.
- Multimodal Turing Test:In a world where communication takes many forms, the Multimodal Turing Test assesses AI's capability to understand and respond to various modes of communication concurrently. It examines whether AI can seamlessly process and respond to text, speech, images, and potentially other modes simultaneously. This variation acknowledges the diverse ways we communicate and tests if AI can keep up with our multifaceted interactions.

Chatbots to attempt the Turing test:

ELIZA:ELIZA was a Natural language processing computer program created by Joseph Weizenbaum. It was created to demonstrate the ability of communication between machine and humans. It was one of the first chatterbots, which has attempted the Turing Test.

Chatbots to attempt the Turing test:

Parry:Parry was a chatterbot created by Kenneth Colby in 1972. Parry was designed to simulate a person withParanoid schizophrenia(most common chronic mental disorder). Parry was described as "ELIZA with attitude." Parry was tested using a variation of the Turing Test in the early 1970s.

Chatbots to attempt the Turing test:

Eugene Goostman:Eugene Goostman was a chatbot developed in Saint Petersburg in 2001. This bot has competed in the various number of Turing Test. In June 2012, at an event, Goostman won the competition promoted as largest-ever Turing test content, in which it has convinced 29% of judges that it was a human.Goostman resembled as a 13-year old virtual boy.

The Chinese Room Argument:

There were many philosophers who really disagreed with the complete concept of Artificial Intelligence. The most famous argument in this list was "Chinese Room."

The Chinese Room Argument:

In the year1980, John Searlepresented "Chinese Room" thought experiment, in his paper "Mind, Brains, and Program," which was against the validity of Turing's Test. According to his argument, "Programming a computer may make it to understand a language, but it will not produce a real understanding of language or consciousness in a computer."

The Chinese Room Argument:

He argued that Machine such as ELIZA and Parry could easily pass the Turing test by manipulating keywords and symbol, but they had no real understanding of language. So it cannot be described as "thinking" capability of a machine such as a human.

Features required for a machine to pass the Turing test:

- Natural language processing:NLP is required to communicate with Interrogator in general human language like English.

- Knowledge representation:To store and retrieve information during the test.

- Automated reasoning:To use the previously stored information for answering the questions.

- Machine learning:To adapt new changes and can detect generalized patterns.

- Vision (For total Turing test):To recognize the interrogator actions and other objects during a test.

- Motor Control (For total Turing test):To act upon objects if requested.

Limitation of Turing Test

- Not a True Measure of Intelligence:Passing the Turing Test doesn't guarantee genuine machine intelligence or consciousness. Critics, like John Searle's "Chinese Room" argument, contend that a computer can simulate human-like responses without understanding or consciousness.
- Simplicity of Test Scenarios:The Turing Test primarily focuses on text-based interactions, which might not fully assess a machine's capacity to comprehend and respond to the complexities of the real world.

Conclusion

The Turing Test still serves as a pivotal benchmark for assessing AI's conversational skills in today's context. It continues to be instrumental in the development and evaluation of chatbots and virtual assistants. Many companies and developers employ different versions of the test to gauge how well their AI systems can engage in conversation.

Conclusion

However, it's worth noting that while the Turing Test maintains its relevance, the AI field has progressed significantly beyond its scope. Modern AI systems leverage advanced natural language processing, machine learning, and deep learning techniques, empowering them to execute tasks much more intricate than imitating human dialogue. AI's applications now span a wide array of fields, from healthcare and finance to autonomous vehicles and image recognition, showcasing its diverse capabilities that extend well beyond mere conversation.

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next ?? prevArtificial Intelligence in EducationEducation is an important part of life for everyone, and a good education plays a vital role to have a successful life. In order to improve the education system for the students, there are always a lot of changes happening around the world, ranging from the way of teaching to the type of curriculum. Artificial Intelligence is a thriving technology that is being used in almost every field and is changing the world. One place where artificial intelligence is poised to make big changes is (and in some cases already is) in education.Artificial Intelligence in

Education is developing new solutions for teaching and learning for different situations. Nowadays, AI is being used by different schools and colleges across different countries. AI in education has given a completely new perspective of looking at education to teachers, students, parents, and of course, the educational institutions as well.AI in education is not about humanoid robots as a teacher to replace human teachers, but it is about using computer intelligence to help teachers and students and making the education system much better and effective.In future, the education system will have lots of AI tools that will shape the educational experience of the future. In this topic, we will discuss the impact and application of Artificial Intelligence on Education. To better understand this topic, let's first understand what AIED is?Overview Of AIED(Artificial Intelligence in Education)Artificial Intelligence (AI) is a simulation of human intelligence into a computer machine so that it can think and act like a human. It is a technology that helps a computer machine to think like a human. Artificial Intelligence aims to mimic human behaviour. AI has various uses and applications in different sectors, including education.In the 1970s, AIED has occurred as a specialist area to cover new technology to teaching & learning, specifically for higher education. The main aim of AIED is to facilitate the learners with flexible, personalized, and engaging learning along with the basic automated task. Some popular trends in AIED includeIntelligent tutor systems, smart classroom technologies, adaptive learning, and pedagogical agents.Below diagram shows the relationship between all these trends:Applications/roles of Artificial Intelligence in EducationAutomate basic activities in education with AIIn the education system, there are various activities which take lots of time of teachers such as grading tests and home-works. These tasks require lots of time and effort, while this time could be used in interacting with students, letting them know their errors, teaching new things, and many more.To save this time, Artificial Intelligence can be used. With AI tools, it is possible to automate the grading system for nearly all types of MCQ(Multiple choice questions) and fill-in-the-blank, and they are very close to being able to grade written responses. However, AI is still not possible to truly replace human grading, but it's getting improving day by day. By using AI, teachers will get more time to fill the gap in their classroom rather than investing their time in these tedious tasks.Additional Support for students with AI tutorAs it is obvious that teachers can't be present with students all the time while they study, as teachers in colleges have fixed timings. But each student is not smart enough to grasp all the things at once, and they need additional supports from someone to help them in the understanding study material. This additional support can be provided by the AI tutors.Currently, there are various AI-driven tutoring programs that can help students in learning the basics of mathematics, writing, and other subjects.With these AI programs, students can learn fundamentals, but still, they are not suitable to learn high-level concepts of any subject. In order to learn such complex concepts, students still require a professor. However, in future, it is possible that AI might be able to help students with complex problems also that require analytical thinking and reasoning.Helpful feedback to students and teachers with AI-driven programsAI is not only helping the students to learn the customized course as per their requirements, but it can also give feedback to both the teachers and students about the success level of the course. Some online course providers are currently using such feedback-based AI systems to analyse the progress of the student and also alert the professors for the critical performance issue of the student.These type of AI-driven systems enables the student to get the proper support, and professors can determine the areas of teaching where it requires improvement. Instant feedback to students helps them understand where they are going wrong and how they can do it better.Finding improvement required in course with AIIn the education system, it is very hard to find out the gaps in learning. Teachers have limited time to teach in the classroom, and they may not always know where the students are lacking and what concepts have confused the student. To solve this problem, AI-driven programs can help the education system.Coursera and some other learning platforms are already using AI-driven programs in practice. For example, when a large number of students are found to submit the wrong answer to a homework assignment, the system alerts the teacher and gives future students a customized message that offers hints to the correct answer. Such type of programs helps in filling the gaps while learning that can occur in courses, and also ensures that each student understands the concepts successfully. With AI, instead of waiting for feedback from the professor, students get an immediate system generated response, which helps them to understand a concept and remember their mistakes, and also how to do it correctly the next time around.AI could change the role of the teacher.Teachers always have a critical role in the education system, but this role and its requirement may change with the new technologies. As in the above points, we have already discussed that Artificial Intelligence can automate different tasks such as grading, reports, help students while learning, and may also be an option of real-world tutor in some cases. AI can be included in different aspects of teaching. AI systems can be programmed for providing expertise to students, a place where students can ask their doubts and could take the place of teacher for teaching basis course materials. In such cases, AI could change the role of the teacher as a facilitator.Personalize education with AIThe main aim of Artificial Intelligence in education is not to completely replace teachers. Instead, it aims to act as helping hands for teachers as well as students.AI systems can be programmed to provide personalized learning to students. With personalized learning, each student can have their own way of learning as per their level of understanding and need. By understanding the needs of every student, teachers can come up with a tailor-made study plan for every student. As AI is developing day-by-day, it is possible that machines can identify the facial expressions of students while learning the concepts can understand if they are finding any difficulty in learning, and according to that make changes in the way of teaching. However, currently, such things are not possible, but they might be possible in the near future with AI-Powered machines and software.Generating Smart content with AIWith AI, it is possible to generate smart content in three ways:Digital Lessons:Nowadays, everything is becoming digital, and so the education. Digital learning is being preferred in colleges with customization options, e-books, study guides, bite-sized lessons, and many other things with the help of AI.Information Visualization:Visualizing things rather than listening is much more efficient to understand in a better way and keep in mind for a long time. 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Each student has his own grasping capability, and with the use of universal access, they can learn anywhere and anytime. Students can explore things whenever they want to learn without waiting for the tutor. Moreover, students get the facility of high-quality courses and material from all over the world at their place only without travelling away from their home.Benefits of AI For Students24*7 access to LearningWith AI-driven digital Learning, students can learn anywhere, anytime. Every learner is free to plan their schedule, rather than being linked to a specific place only. Everyone can make their learning easier and effective as per their most productive hours.Better EngagementWith personalized learning, custom tasks, and digital visualisation, the study becomes more interactive and engaging. Personalized learning and great experience with AI-driven programs make students feel much confident and smarter as they can explore many things apart from their syllabus without any hesitation or fear of asking. All these things and new AI technologies are increasing the interest of students in studies.Less PressureWith AI-driven programs and personalized learning, students feel less pressure of studies. AI-enabled virtual assistants help the students whenever they ask a question, with a complete explanation. In the traditional learning methods, a student needs to ask queries in class in front of everyone, which might hesitate some students, and these issues can be resolved with the help of virtual assistants. However, all the questions can't be correctly answered by these virtual assistants. But for basic queries, they can be much helpful that can boost the confidence of each learner and reduce the pressure.Future of AI in EducationAs per the researches, in the near future, AI in education will step in three main ways, which are:Performance personalizationWith day-by-day development in AI technology and computing power, it will be possible to create personalized curricula through collecting and generalizing the information. Various new AI solution such as "Brightspace insights" helps the instructor to track, measure, and monitor the progress of learners, and also help them in this learning journey. It provides a complete picture of the learning journey of a learner across the platform.Violation BiasHuman bias has always remained a hindrance in the education system and also an issue in AI tools. In future, AI in education will find new solutions that can evaluate work and tests exams using established criteria in order to eliminate bias.Combined AssistanceProfessors/teachers in colleges usually have masters in their field and have a degree in specific areas of development. But the administrative work is often a frustrating attempt at rapprochement with students. AI in education can solve this problem in the future with smart classrooms with AI assistance who can provide necessary help to the teachers to give their best.ConclusionArtificial intelligence and its uses in our lives are growing day by day in many segments. In the field of education, AI has started showing its influences and working as a helping tool for both the students and teachers and supporting the learning process. But still, the use of AI in education is not adapted by all the colleges completely, and it will take a long journey to do this. However, studies show that in the near future, AI will have a good impact on the education sector. It is currently transforming the education industry but is yet to show its real potential in education. Further, learning from computer systems can be much helpful, but it is unlikely to fully replacing human teaching in schools and colleges.Next TopicArtificial Intelligence in Agriculture? prevnext ?

Artificial Intelligence in Education

Education is an important part of life for everyone, and a good education plays a vital role to have a successful life. In order to improve the education system for the students, there are always a lot of changes happening around the world, ranging from the way of teaching to the type of curriculum. Artificial Intelligence is a thriving technology that is being used in almost every field and is changing the world. One place where artificial intelligence is poised to make big changes is (and in some cases already is) in education.

Artificial Intelligence in Education

Artificial Intelligence in Education is developing new solutions for teaching and learning for different situations. Nowadays, AI is being used by different schools and colleges across different countries.

AI in education has given a completely new perspective of looking at education to teachers, students, parents, and of course, the educational institutions as well.AI in education is not about humanoid robots as a teacher to replace human teachers, but it is about using computer intelligence to help teachers and students and making the education system much better and effective.In future, the education system will have lots of AI tools that will shape the educational experience of the future. In this topic, we will discuss the impact and application of Artificial Intelligence on Education. To better understand this topic, let's first understand what AIED is?

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Applications/roles of Artificial Intelligence in Education

- Automate basic activities in education with AIIn the education system, there are various activities which take lots of time of teachers such as grading tests and home-works. These tasks require lots of time and effort, while this time could be used in interacting with students, letting them know their errors, teaching new things, and many more.To save this time, Artificial Intelligence can be used. With AI tools, it is possible to automate the grading system for nearly all types of MCQ(Multiple choice questions) and fill-in-the-blank, and they are very close to being able to grade written responses. However, AI is still not possible to truly replace human grading, but it's getting improving day by day. By using AI, teachers will get more time to fill the gap in their classroom rather than investing their time in these tedious tasks.

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- AI could change the role of the teacher.Teachers always have a critical role in the education system, but this role and its requirement may change with the new technologies. As in the above points, we have already discussed that Artificial Intelligence can automate different tasks such as grading, reports, help students while learning, and may also be an option of real-world tutor in some cases. AI can be included in different aspects of teaching. AI systems can be programmed for providing expertise to students, a place where students can ask their doubts and could take the place of teacher for teaching basis course materials. In such cases, AI could change the role of the teacher as a facilitator.
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- Generating Smart content with AIWith AI, it is possible to generate smart content in three ways:Digital Lessons:Nowadays, everything is becoming digital, and so the education. Digital learning is being preferred in colleges with customization options, e-books, study guides, bite-sized

lessons, and many other things with the help of AI.Information Visualization:Visualizing things rather than listening is much more efficient to understand in a better way and keep in mind for a long time. With Artificial Intelligence, the study information can be perceived in new ways of visualization, simulation, web-based study environment.Learning content Updates:Moreover, AI also helps in preparing the content of lessons, keeping information up to date, and make it adaptable as per different learning curves.

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- Ensure Access to Education for Students with Special NeedsLife is full of challenges for those students who have some learning disabilities such as deaf or hard of hearing, visually impaired, etc. Such students may face various difficulties while learning and studying. Moreover, they also need extra care & time. With the adoption of innovative AI technology, there will be new ways of interacting with such students. AI-enabled tools can be successfully trained to help a group of students with special needs.
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Applications/roles of Artificial Intelligence in Education

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- Learning content Updates:Moreover, AI also helps in preparing the content of lessons, keeping information up to date, and make it adaptable as per different learning curves.

Benefits of AI For Students

- 24*7 access to LearningWith AI-driven digital Learning, students can learn anywhere, anytime. Every learner is free to plan their schedule, rather than being linked to a specific place only. Everyone can make their learning easier and effective as per their most productive hours.

- Better EngagementWith personalized learning, custom tasks, and digital visualisation, the study becomes more interactive and engaging. Personalized learning and great experience with AI-driven programs make students feel much confident and smarter as they can explore many things apart from their syllabus without any hesitation or fear of asking. All these things and new AI technologies are increasing the interest of students in studies.

- Less PressureWith AI-driven programs and personalized learning, students feel less pressure of studies. AI-enabled virtual assistants help the students whenever they ask a question, with a complete explanation. In the traditional learning methods, a student needs to ask queries in class in front of everyone, which might hesitate some students, and these issues can be resolved with the help of virtual assistants. However, all the questions can't be correctly answered by these virtual assistants. But for basic queries, they can be much helpful that can boost the confidence of each learner and reduce the pressure.

Future of AI in Education

As per the researches, in the near future, AI in education will step in three main ways, which are:

Future of AI in Education

- Performance personalizationWith day-by-day development in AI technology and computing power, it will be possible to create personalized curricula through collecting and generalizing the information. Various new AI solution such as "Brightspace insights" helps the instructor to track, measure, and monitor the progress of learners, and also help them in this learning journey. It provides a complete picture of the learning journey of a learner across the platform.
- Violation BiasHuman bias has always remained a hindrance in the education system and also an issue in AI tools. In future, AI in education will find new solutions that can evaluate work and tests exams using established criteria in order to eliminate bias.
- Combined AssistanceProfessors/teachers in colleges usually have masters in their field and have a degree in specific areas of development. But the administrative work is often a frustrating attempt at rapprochement with students. AI in education can solve this problem in the future with smart classrooms with AI assistance who can provide necessary help to the teachers to give their best.

Conclusion

Artificial intelligence and its uses in our lives are growing day by day in many segments. In the field of education, AI has started showing its influences and working as a helping tool for both the students and teachers and supporting the learning process. But still, the use of AI in education is not adapted by all the colleges completely, and it will take a long journey to do this. However, studies show that in the near future, AI will have a good impact on the education sector. It is currently transforming the education industry but is yet to show its real potential in education. Further, learning from computer systems can be much helpful, but it is unlikely to fully replacing human teaching in schools and colleges.

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Artificial Intelligence has improved crop production and real-time monitoring, harvesting, processing and marketing. Different hi-tech computer-based systems are designed to determine various important parameters such as weed detection, yield detection, crop quality, and many more.In this topic, we will discuss the impact and application of Artificial Intelligence on Agriculture, along with the challenges in adoption of AI.Challenges in Agriculture using traditional methodsBefore understanding AI impact and application in Agriculture, we must understand what are the challenges in agriculture by using traditional methods, which are given below:In farming, different weather factors such as Rainfall, temperature, and humidity play an important role. Due to pollution, sometimes climate varies abruptly, and hence it becomes difficult for farmers to make proper decisions for harvesting, sowing seeds, and soli preparing.For a better crop, it is necessary that the soil should be productive and have the required nutrition, such as Nitrogen, Phosphorous, and Potassium. If these nutrients are not present in effective way in the soil, then it may lead to poor quality crops. But it is difficult to identify these soil-quality with traditional ways.In the agriculture lifecycle, it is required that we save our crops from weeds. Else it may increase the production cost, and it also absorbs nutrients from the soil. But by traditional ways, identification and prevention of crop from weeds is not efficient.Applications of Artificial Intelligence in AgricultureAs with the traditional methods of Agriculture, there are so many challenges that farmers would face. To solve these challenges, AI is being widely used in this sector. For agriculture, Artificial Intelligence has become a revolutionary technology. It helps the farmers by yielding healthier crops, control pests, soil monitoring, and many more ways. Below are some key applications of Artificial Intelligence in the Agriculture sector:1. Weather & price Forecasting:As we have discussed in challenges that it is difficult for the farmers to take the right decision for harvesting, sowing seeds, and soli preparing due to climate change. But with the help of AI weather forecasting, farmers can have information on weather analysis, and accordingly, they can plan for the type of crop to grow, seeds to sow, and harvesting the crop. With price forecasting, farmers can get a better idea about the price of crops for the next few weeks, which can help them to get maximum profit.2. Health Monitoring of Crops:The quality of crop widely depends on the type of soil and nutrition of the soil. But with the increasing rate of deforestation, the soil quality is degrading day by day, and it is hard to determine it.To resolve this issue, AI has come up with a new application calledPlantix. It was developed byPEATto identify the deficiencies in soil, including plant pests and diseases. With the help of this application, farmers can get an idea to use better fertilizer which can improve the harvest quality. In this app, AI's image recognition technology is used by which farmers can capture the images of plants and get information about the quality.3. Agriculture Robotics:Robotics is being widely used in different sectors, mainly in manufacturing, to perform complex tasks. Nowadays, different AI companies are developing robots to be employed in the Agriculture sector. These AI robots are developed in such a way that they can perform multiple tasks in farming.AI robots are also trained in checking the quality of crops, detect and controlling weeds, and harvesting the crop with faster speed compared to a human.4. Intelligent SprayingWith AI sensors, weed can be detected easily, and it also detects weed affected areas. On finding such areas, herbicides can be precisely sprayed to reduce the use of herbicides and also saves time and crop. There are different AI companies that are building robots with AI and computer vision, which can precisely spray on weeds. The use of AI sprayers can widely reduce the number of chemicals to be used on fields, and hence improves the quality of crops and also saves money.5. Disease DiagnosisWith AI predictions, farmers can get knowledge of diseases easily. With this, they can easily diagnose diseases with proper strategy and on time. It can save the life of plants and farmer's time. To do this, firstly, images of plants are pre-processed using computer vision technology. This ensures that plant images are properly divided into the diseased and non-diseased parts. After detection, the diseased part is cropped and send to the labs for further diagnosis. This technique also helps in the detection of pests, deficiency of nutrients, and many more.6. Precision FarmingPrecision farming is all about "Right place, Right Time, and Right products".The precision farming technique is a much accurate and controlled way that can replace the labour-intensive part of farming to perform repetitive tasks. One example of Precision farming is the identification of stress levels in plants. This can be obtained using high-resolution images and different sensor data on plants. The data obtained from sensors is then fed to a machine learning model as input for stress recognition.AI start-ups in AgricultureBelow is the list of popular start-ups in Agriculture:1. Prospera:It is an Israeli start-up founded in the year 2014. This company creates intelligent solutions for efficient farming. It develops cloud-based solutions that collect all the data from the fields such as soil/water, aerial images, etc. and combine this data with an in-field device. This device is known as the Prospera device, and it makes insights from this data. The device is powered by various sensors and technologies such as computer vision.2. Blue River technology:Blue-River technology is a California-based start-up that has started in the year 2011. It develops next-generation agriculture equipment using AI, computer vision, and robotics technology. This equipment identifies individual plants using computer vision, ML decides action, and with robotics, the action is performed. This helps the farmers to save costs and chemicals in farming.3. FarmBot:Farmbot is an open-source CNC precision farming machine and software package, which is developed to grow crops by anyone at their own place. The complete product "Farmbot" is available at a price of $4000, and it enables anyone to do complete farming ranging from seed plantation to weed detection on their own with the help of a physical bot and open-source software system. It also provides a webapp that can be downloaded on any smartphone or computer system and allows us to manage farming from any place at any time.4. Fasal:The use of AI in the agriculture industry is increasing day by day in various places across the world. However, agriculture holdings per farmer in the poorer region is less compared to the rich region, which is advantageous for automated monitoring as it requires a lesser number of devices with low bandwidth and size to capture the complete agriculture data. In this field, the Indian start-up Fasal is working. It uses affordable sensors and AI to provide real-time data and insights to farmers. With this, farmers can be benefitted from real-time, actionable information relevant to day-to-day operations at the farm. The company's devices are easy to implement for small places. They are developing AI-enabled machines to make precision farming that can be accessible by every farmer.5. OneSoil:Onesoil is an application that is designed to help farmers to take a better decision. This app uses a machine-learning algorithm and computer vision for precision farming. It monitors the crops remotely, identifies problems in the fields, check the weather forecast, and calculate nitrogen, phosphorus, and potassium fertilizer rate, etc.Benefits and Challenges of AI in agricultureAdvantagesAI enables better decision-makingPredictive analytics is really a boon for the agriculture industry. It helps the farmers solving the key challenges of farming, such as analysing the market demands, price forecasting, and finding optimal times for sowing and harvesting the crop. Moreover, AI-powered machines can also determine soil and crop health, provides fertilizer recommendations, monitor the weather, and can also determine the quality of crop. All such benefits of AI in agriculture enable the farmers to make better decisions and do efficient farming.AI brings cost savings.Precision farming using AI-enabled equipment helps the farmers to grow more crops with lesser resources and cost. AI provides the real-time insights to farmers that enables them to take proper decision at each stage of farming. With this correct decision, there is less loss of products and chemicals and efficient use of time and money. Moreover, it also allows the farmers to identify the particular areas that need irrigation, fertilization, and pesticide treatment, which saves excessive use of chemicals on the crop. All these things sum up and result in reduced use of herbicides, better crop quality and high profit with fewer resources.AI reduces labour shortage.There has always been an issue of labour shortage in the agriculture industry. AI can solve this issue with automation in farming. With AI and automation, farmers can get work done without having more people, and some examples are Driverless tractors, smart irrigation and fertilizing systems, smart spraying, vertical farming software, and AI-based robots for harvesting. AI-driven machines and equipment are much faster and accurate compared to human farmhands.Challenges of AI adoption in AgricultureBy seeing the advantages of AI for sustainable farming, implementing this technology may seem like a logical step for every farmer. However, there are still some serious challenges that everyone knows, which are as follows:Lack of familiarity with AI machinesAlthough there are lots of benefits of using AI in agriculture, yet people are not familiar with the use of AI-enabled solutions and equipment across most of the world. To solve the issues, AI companies should provide the basic equipment to farmers, and once they get familiar with them, then provide them with advanced machines.Lack of experience with emerging technologiesThe adoption of AI and emerging technologies in agriculture for developing countries can be a challenging task. It will be very difficult to sell such technologies in the areas where there is no such agricultural technology is being taken into use. In such areas, to use these technologies, farmers need someone's help.Privacy and security issuesAs there are still no clear regulations and policies for using AI, it may raise various legal issues. Further, due to the use of software and the internet, there may also be some privacy and security issues such as cyberattacks and data leaks. All these issues can create a big problem for farm owners or farmers.Conclusion:The future of AI in farming largely depends on the adoption of AI solutions. Although some large-scale researches are in progress and some applications are already in the market, yet industry in agriculture is underserved. Moreover, creating predictive solutions to solve a real challenge faced by farmers in farming is still in progress at an early stage.Next TopicEngineering Applications of Artificial Intelligence? prevnext ?

Artificial Intelligence in Agriculture

Agriculture plays a crucial role in the economic sector for each country. Population around the world is increasing day by day, and so is the demand for food. The traditional methods that are used by the farmers are not sufficient to fulfil the need at the current stage. Hence, some new automation methods are introduced to satisfy these requirements and to provide great job opportunities to many people in this sector. Artificial Intelligence has become one of the most important technologies in every sector, including education, banking, robotics, agriculture, etc. In the agriculture sector, it is playing a very crucial role, and it is transforming the agriculture industry.AI saves the agriculture sector from different factors such as climate change, population growth, employment issues in this field, and food safety.Today's agriculture system has reached at a different level due to AI. Artificial Intelligence has improved crop production and real-time monitoring, harvesting, processing and marketing. Different hi-tech computer-based systems are designed to determine various important parameters such as weed detection, yield detection, crop quality, and many more.

Artificial Intelligence in Agriculture

In this topic, we will discuss the impact and application of Artificial Intelligence on Agriculture, along with the challenges in adoption of AI.

Challenges in Agriculture using traditional methods

Before understanding AI impact and application in Agriculture, we must understand what are the challenges in agriculture by using traditional methods, which are given below:

Challenges in Agriculture using traditional methods

- In farming, different weather factors such as Rainfall, temperature, and humidity play an important role. Due to pollution, sometimes climate varies abruptly, and hence it becomes difficult for farmers to make proper decisions for harvesting, sowing seeds, and soli preparing.
- For a better crop, it is necessary that the soil should be productive and have the required nutrition, such as Nitrogen, Phosphorous, and Potassium. If these nutrients are not present in effective way in the soil, then it may lead to poor quality crops. But it is difficult to identify these soil-quality with traditional ways.
- In the agriculture lifecycle, it is required that we save our crops from weeds. Else it may increase the production cost, and it also absorbs nutrients from the soil. But by traditional ways, identification and prevention of crop from weeds is not efficient.

Applications of Artificial Intelligence in Agriculture

As with the traditional methods of Agriculture, there are so many challenges that farmers would face. To solve these challenges, AI is being widely used in this sector. For agriculture, Artificial Intelligence has become a revolutionary technology. It helps the farmers by yielding healthier crops, control pests, soil monitoring, and many more ways. Below are some key applications of Artificial Intelligence in the Agriculture sector:

Applications of Artificial Intelligence in Agriculture

1. Weather & price Forecasting:As we have discussed in challenges that it is difficult for the farmers

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Applications of Artificial Intelligence in Agriculture

2. Health Monitoring of Crops:

Applications of Artificial Intelligence in Agriculture

The quality of crop widely depends on the type of soil and nutrition of the soil. But with the increasing rate of deforestation, the soil quality is degrading day by day, and it is hard to determine it.

Applications of Artificial Intelligence in Agriculture

To resolve this issue, AI has come up with a new application calledPlantix. It was developed byPEATto identify the deficiencies in soil, including plant pests and diseases. With the help of this application, farmers can get an idea to use better fertilizer which can improve the harvest quality. In this app, AI's image recognition technology is used by which farmers can capture the images of plants and get information about the quality.

Applications of Artificial Intelligence in Agriculture

3. Agriculture Robotics:

Applications of Artificial Intelligence in Agriculture

Robotics is being widely used in different sectors, mainly in manufacturing, to perform complex tasks. Nowadays, different AI companies are developing robots to be employed in the Agriculture sector. These AI robots are developed in such a way that they can perform multiple tasks in farming.

Applications of Artificial Intelligence in Agriculture

AI robots are also trained in checking the quality of crops, detect and controlling weeds, and harvesting the crop with faster speed compared to a human.

Applications of Artificial Intelligence in Agriculture

4. Intelligent Spraying

Applications of Artificial Intelligence in Agriculture

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Applications of Artificial Intelligence in Agriculture

5. Disease Diagnosis

Applications of Artificial Intelligence in Agriculture

With AI predictions, farmers can get knowledge of diseases easily. With this, they can easily diagnose diseases with proper strategy and on time. It can save the life of plants and farmer's time. To do this, firstly, images of plants are pre-processed using computer vision technology. This ensures that plant images are properly divided into the diseased and non-diseased parts. After detection, the diseased part is cropped and send to the labs for further diagnosis. This technique also helps in the detection of pests, deficiency of nutrients, and many more.

Applications of Artificial Intelligence in Agriculture

6. Precision Farming

Applications of Artificial Intelligence in Agriculture

Precision farming is all about "Right place, Right Time, and Right products".The precision farming technique is a much accurate and controlled way that can replace the labour-intensive part of farming to perform repetitive tasks. One example of Precision farming is the identification of stress levels in plants. This can be obtained using high-resolution images and different sensor data on plants. The data obtained from sensors is then fed to a machine learning model as input for stress recognition.

AI start-ups in Agriculture

Below is the list of popular start-ups in Agriculture:

AI start-ups in Agriculture

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AI start-ups in Agriculture

2. Blue River technology:

AI start-ups in Agriculture

Blue-River technology is a California-based start-up that has started in the year 2011. It develops next-generation agriculture equipment using AI, computer vision, and robotics technology. This equipment identifies individual plants using computer vision, ML decides action, and with robotics, the action is performed. This helps the farmers to save costs and chemicals in farming.

AI start-ups in Agriculture

3. FarmBot:

AI start-ups in Agriculture

Farmbot is an open-source CNC precision farming machine and software package, which is developed to grow crops by anyone at their own place. The complete product "Farmbot" is available at a price of $4000, and it enables anyone to do complete farming ranging from seed plantation to weed detection on their own with the help of a physical bot and open-source software system. It also provides a webapp that can be downloaded on any smartphone or computer system and allows us to manage farming from any place at any time.

AI start-ups in Agriculture

4. Fasal:The use of AI in the agriculture industry is increasing day by day in various places across the world. However, agriculture holdings per farmer in the poorer region is less compared to the rich region, which is advantageous for automated monitoring as it requires a lesser number of devices with low bandwidth and size to capture the complete agriculture data. In this field, the Indian start-up Fasal is working. It uses affordable sensors and AI to provide real-time data and insights to farmers. With this, farmers can be benefitted from real-time, actionable information relevant to day-to-day operations at the farm. The company's devices are easy to implement for small places. They are developing AI-enabled machines to make precision farming that can be accessible by every farmer.

AI start-ups in Agriculture

5. OneSoil:Onesoil is an application that is designed to help farmers to take a better decision. This app uses a machine-learning algorithm and computer vision for precision farming. It monitors the crops remotely, identifies problems in the fields, check the weather forecast, and calculate nitrogen, phosphorus, and potassium fertilizer rate, etc.

Advantages

- AI enables better decision-making

Advantages

Predictive analytics is really a boon for the agriculture industry. It helps the farmers solving the key challenges of farming, such as analysing the market demands, price forecasting, and finding optimal times for sowing and harvesting the crop. Moreover, AI-powered machines can also determine soil and crop health, provides fertilizer recommendations, monitor the weather, and can also determine the quality of crop. All such benefits of AI in agriculture enable the farmers to make better decisions and do efficient farming.

Advantages

- AI brings cost savings.

Advantages

Precision farming using AI-enabled equipment helps the farmers to grow more crops with lesser resources and cost. AI provides the real-time insights to farmers that enables them to take proper decision at each stage of farming. With this correct decision, there is less loss of products and chemicals and efficient use of time and money. Moreover, it also allows the farmers to identify the particular areas that need irrigation, fertilization, and pesticide treatment, which saves excessive use of chemicals on the crop. All these things sum up and result in reduced use of herbicides, better crop quality and high profit with fewer resources.

Advantages

- AI reduces labour shortage.

Advantages

There has always been an issue of labour shortage in the agriculture industry. AI can solve this issue with automation in farming. With AI and automation, farmers can get work done without having more people, and some examples are Driverless tractors, smart irrigation and fertilizing systems, smart spraying, vertical farming software, and AI-based robots for harvesting. AI-driven machines and equipment are much faster and accurate compared to human farmhands.

Challenges of AI adoption in Agriculture

By seeing the advantages of AI for sustainable farming, implementing this technology may seem like a logical step for every farmer. However, there are still some serious challenges that everyone knows, which are as follows:

Challenges of AI adoption in Agriculture

- Lack of familiarity with AI machines

Challenges of AI adoption in Agriculture

Although there are lots of benefits of using AI in agriculture, yet people are not familiar with the use of AI-enabled solutions and equipment across most of the world. To solve the issues, AI companies should provide the basic equipment to farmers, and once they get familiar with them, then provide them with advanced machines.

Challenges of AI adoption in Agriculture

- Lack of experience with emerging technologies

Challenges of AI adoption in Agriculture

The adoption of AI and emerging technologies in agriculture for developing countries can be a challenging task. It will be very difficult to sell such technologies in the areas where there is no such agricultural technology is being taken into use. In such areas, to use these technologies, farmers need someone's help.

Challenges of AI adoption in Agriculture

- Privacy and security issues

Challenges of AI adoption in Agriculture

As there are still no clear regulations and policies for using AI, it may raise various legal issues. Further, due to the use of software and the internet, there may also be some privacy and security issues such as cyberattacks and data leaks. All these issues can create a big problem for farm owners or farmers.

Conclusion:

The future of AI in farming largely depends on the adoption of AI solutions. Although some large-scale researches are in progress and some applications are already in the market, yet industry in agriculture is underserved. Moreover, creating predictive solutions to solve a real challenge faced by farmers in farming is still in progress at an early stage.

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These are the best suited electrical motors for industrial robots.Sensor:They provide the ability like see, hear, touch and movement like humans.Sensors are the devices or machines which help to detect the events or changes in the environment and send data to the computer processor. These devices are usually equipped with other electronic devices. Similar to human organs, the electrical sensor also plays a crucial role in Artificial Intelligence & robotics. AI algorithms control robots by sensing the environment, and it provides real-time information to computer processors.Applications of RoboticsRobotics have different application areas. Some of the important applications domains of robotics are as follows:Robotics in defence sectors:The defence sector is undoubtedly the one of the main parts of any country. Each country wants their defence system to be strong. Robots help to approach inaccessible and dangerous zone during war. DRDO has developed a robot namedDakshto destroy life-threatening objects safely. They help soldiers to remain safe and deployed by the military in combat scenarios. Besides combat support, robots are also deployed inanti-submarine operations, fire support, battle damage management, strike missions, and laying machines.Robotics in Medical sectors:Robots also help in various medical fields such as laparoscopy, neurosurgery, orthopaedic surgery, disinfecting rooms, dispensing medication, and various other medical domains.Robotics in Industrial Sector:Robots are used in various industrial manufacturing industries such as cutting, welding, assembly, disassembly, pick and place for printed circuit boards, packaging & labelling, palletizing, product inspection & testing, colour coating, drilling, polishing and handling the materials.Moreover, Robotics technology increases productivity and profitability and reduces human efforts, resulting from lower physical strain and injury. The industrial robot has some important advantages, which are as follows:AccuracyFlexibilityReduced labour chargeLow noise operationFewer production damagesIncreased productivity rate.Robotics in Entertainment:Over the last decade, use of robots is continuously getting increased in entertainment areas. Robots are being employed in entertainment sector, such as movies, animation, games and cartoons. Robots are very helpful where repetitive actions are required. A camera-wielding robot helps shoot a movie scene as many times as needed without getting tired and frustrated. A big-nameDisneyhas launched hundreds of robots for the film industry.Robots in the mining industry:Robotics is very helpful for various mining applications such as robotic dozing, excavation and haulage, robotic mapping & surveying, robotic drilling and explosive handling, etc. A mining robot can solely navigate flooded passages and use cameras and other sensors to detect valuable minerals. Further, robots also help in excavation to detect gases and other materials and keep humans safe from harm and injuries. The robot rock climbers are used for space exploration, and underwater drones are used for ocean exploration.AI technology used in RoboticsComputer VisionRobots can also see, and this is possible by one of the popular Artificial Intelligence technologies named Computer vision.Computer Visionplays a crucial role in all industries like health, entertainment, medical, military, mining, etc.Computer Vision is an important domain of Artificial Intelligence that helps in extracting meaningful information from images, videos and visual inputs and take action accordingly.Natural Language ProcessingNLP (Natural Languages Processing) can be used to give voice commands to AI robots. It creates a strong human-robot interaction. NLP is a specific area of Artificial Intelligence that enables the communication between humans and robots. Through the NLP technique, the robot can understand and reproduce human language. Some robots are equipped with NLP so that we can't differentiate between humans and robots.Similarly, in the health care sector, robots powered by Natural Language Processing may help physicians to observe the decease details and automatically fill in EHR. Besides recognizing human language, it can learn common uses, such as learn the accent, and predict how humans speak.Edge ComputingEdge computing in robots is defined as a service provider of robot integration, testing, design and simulation. Edge computing in robotics provides better data management, lower connectivity cost, better security practices, more reliable and uninterrupted connection.Complex Event ProcessComplex event processing (CEP) is a concept that helps us to understand the processing of multiple events in real time. An event is described as a Change of State, and one or more events combine to define a Complex event. The complex event process is most widely used term in various industries such as healthcare, finance, security, marketing, etc. It is primarily used in credit card fraud detection and also in stock marketing field.For example, the deployment of an airbag in a car is a complex event based on the data from multiple sensors in real-time. This idea is used in Robotics, for example, Event-Processing in Autonomous Robot Programming.Transfer Learning and AIThis is the technique used to solve a problem with the help of another problem that is already solved. In Transfer learning technique, knowledge gained from solving one problem can be implement to solve related problem. We can understand it with an example such as the model used for identifying a circle shape can also be used to identify a square shape.Transfer learning reuses the pre-trained model for a related problem, and only the last layer of the model is trained, which is relatively less time consuming and cheaper. In robotics, transfer learning can be used to train one machine with the help of other machines.Reinforcement LearningReinforcement learning is a feedback-based learning method in machine learning that enables an AI agent to learn and explore the environment, perform actions and learn automatically from experience or feedback for each action. Further, it is also having feature of autonomously learn to behave optimally through hit-and-trail action while interacting with the environment. It is primarily used to develop the sequence of decisions and achieve the goals in uncertain and potentially complex environment. In robotics, robots explore the environment and learn about it through hit and trial. For each action, he gets rewarded (positive or negative). Reinforcement learning provides

Robotics with a framework to design and simulate sophisticated and hard-to-engineer behaviours.Affective computingAffective computing is a field of study that deals with developing systems that can identify, interpret, process, and simulate human emotions. Affective computing aims to endow robots with emotional intelligence to hope that robots can be endowed with human-like capabilities of observation, interpretation, and emotion expression.Mixed RealityMixed Reality is also an emerging domain. It is mainly used in the field of programming by demonstration (PbD). PbD creates a prototyping mechanism for algorithms using a combination of physical and virtual objects.What are Artificially Intelligent Robots?Artificial intelligent robots connect AI with robotics. AI robots are controlled by AI programs and use different AI technologies, such as Machine learning, computer vision, RL learning, etc. Usually, most robots are not AI robots, these robots are programmed to perform repetitive series of movements, and they don't need any AI to perform their task. However, these robots are limited in functionality.AI algorithms are necessary when you want to allow the robot to perform more complex tasks.A warehousing robot might use a path-finding algorithm to navigate around the warehouse. A drone might use autonomous navigation to return home when it is about to run out of battery. A self-driving car might use a combination of AI algorithms to detect and avoid potential hazards on the road. All these are the examples of artificially intelligent robots.What are the advantages of integrating Artificial Intelligence into robotics?The major advantages of artificially intelligent robots are social care. They can guide people, especially come to aid for older people, with chatbot like social skills and advanced processors.Robotics also helps in Agricultural industry with the help of developing AI based robots. These robots reduce the farmer's workload.In Military industry, Military bots can spy through speech and vision detectors, along with saving lives by replacing infantryRobotics also employed in volcanoes, deep oceans, extremely cold places, or even in space where normally humans can't survive.Robotics is also used in medical and healthcare industry as it can also perform complex surgeries that have a higher risk of a mistake by humans, but with a pre-set of instructions and added Intelligence. AI integrated robotics could reduce the number of casualties greatly.Difference in Robot System and AI ProgramsHere is the difference between Artificial Intelligence and Robots:1.

AI ProgramsUsually, we use to operate them in computer-simulated worlds.Generally, input is given in the form of symbols and rules.To operate this, we need general-purpose/Special-purpose computers.2. RobotsGenerally, we use robots to operate in the real physical world.Inputs are given in the form of the analogue signal or in the form of the speech waveform.Also, to operate this, special hardware with sensors and effectors are needed.Next TopicFuture of Artificial Intelligence? prevnext ?

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Robotics is a separate entity in Artificial Intelligence that helps study the creation of intelligent robots or machines. Robotics combines electrical engineering, mechanical engineering and computer science & engineering as they have mechanical construction, electrical component and programmed with programming language. Although, Robotics and Artificial Intelligence both have different objectives and applications, but most people treat robotics as a subset of Artificial Intelligence (AI). Robot machines look very similar to humans, and also, they can perform like humans, if enabled with AI.

Robotics and Artificial Intelligence

In earlier days, robotic applications were very limited, but now they have become smarter and more efficient by combining with Artificial Intelligence. AI has played a crucial role in the industrial sector by replacing humans in terms of productivity and quality. In this article, 'Robotics and Artificial Intelligence, we will discuss Robots & Artificial Intelligence and their various applications, advantages, differences, etc. Let's start with the definition ofArtificial Intelligence (AI)andRobots.

What is Artificial Intelligence?

Artificial Intelligence is defined as the branch of Computer Science & Engineering, which deals with creating intelligent machines that perform like humans. Artificial Intelligence helps to enable machines to sense, comprehend, act and learn human like activities. There are mainly 4 types of Artificial Intelligence:reactive machines, limited memory, theory of mind, and self-awareness.

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Components of Robot

Several components construct a robot, these components are as follows:

Components of Robot

- Actuators:Actuators are the devices that are responsible for moving and controlling a system or machine. It helps to achieve physical movements by converting energy like electrical, hydraulic and air, etc. Actuators can create linear as well as rotary motion.
- Power Supply:It is an electrical device that supplies electrical power to an electrical load. The primary function of the power supply is to convert electrical current to power the load.
- Electric Motors:These are the devices that convert electrical energy into mechanical energy and are required for the rotational motion of the machines.
- Pneumatic Air Muscles:Air Muscles are soft pneumatic devices that are ideally best fitted for robotics. They can contract and extend and operate by pressurized air filling a pneumatic bladder. Whenever air is introduced, it can contract up to 40%.
- Muscles wire:These are made up of nickel-titanium alloy called Nitinol and are very thin in shape. It can also extend and contract when a specific amount of heat and electric current is supplied into it. Also, it can be formed and bent into different shapes when it is in its martensitic form. They can contract by 5% when electrical current passes through them.
- Piezo Motors and Ultrasonic Motors:Piezoelectric motors or Piezo motors are the electrical devices that receive an electric signal and apply a directional force to an opposing ceramic plate. It helps a robot to move in the desired direction. These are the best suited electrical motors for industrial robots.

- Sensor:They provide the ability like see, hear, touch and movement like humans.Sensors are the devices or machines which help to detect the events or changes in the environment and send data to the computer processor. These devices are usually equipped with other electronic devices. Similar to human organs, the electrical sensor also plays a crucial role in Artificial Intelligence & robotics. AI algorithms control robots by sensing the environment, and it provides real-time information to computer processors.

Applications of Robotics

Robotics have different application areas. Some of the important applications domains of robotics are as follows:

Applications of Robotics

- Robotics in defence sectors:The defence sector is undoubtedly the one of the main parts of any country. Each country wants their defence system to be strong. Robots help to approach inaccessible and dangerous zone during war. DRDO has developed a robot namedDakshto destroy life-threatening objects safely. They help soldiers to remain safe and deployed by the military in combat scenarios. Besides combat support, robots are also deployed inanti-submarine operations, fire support, battle damage management, strike missions, and laying machines.
- Robotics in Medical sectors:Robots also help in various medical fields such as laparoscopy, neurosurgery, orthopaedic surgery, disinfecting rooms, dispensing medication, and various other medical domains.
- Robotics in Industrial Sector:Robots are used in various industrial manufacturing industries such as cutting, welding, assembly, disassembly, pick and place for printed circuit boards, packaging & labelling, palletizing, product inspection & testing, colour coating, drilling, polishing and handling the materials.Moreover, Robotics technology increases productivity and profitability and reduces human efforts, resulting from lower physical strain and injury. The industrial robot has some important advantages, which are as follows:AccuracyFlexibilityReduced labour chargeLow noise operationFewer production damagesIncreased productivity rate.

- Accuracy

- Flexibility

- Reduced labour charge

- Low noise operation

- Fewer production damages

- Increased productivity rate.

- Robotics in Entertainment:Over the last decade, use of robots is continuously getting increased in entertainment areas. Robots are being employed in entertainment sector, such as movies, animation, games and cartoons. Robots are very helpful where repetitive actions are required. A camera-wielding robot helps shoot a movie scene as many times as needed without getting tired and frustrated. A big-nameDisneyhas launched hundreds of robots for the film industry.

- Robots in the mining industry:Robotics is very helpful for various mining applications such as robotic dozing, excavation and haulage, robotic mapping & surveying, robotic drilling and explosive handling, etc. A mining robot can solely navigate flooded passages and use cameras and other sensors to detect valuable minerals. Further, robots also help in excavation to detect gases and other materials and keep humans safe from harm and injuries. The robot rock climbers are used for space exploration, and underwater drones are used for ocean exploration.

Applications of Robotics

- Accuracy

- Flexibility

- Reduced labour charge

- Low noise operation

- Fewer production damages

- Increased productivity rate.

Computer Vision

Robots can also see, and this is possible by one of the popular Artificial Intelligence technologies named Computer vision.Computer Visionplays a crucial role in all industries like health, entertainment, medical, military, mining, etc.

Computer Vision

Computer Vision is an important domain of Artificial Intelligence that helps in extracting meaningful information from images, videos and visual inputs and take action accordingly.

Natural Language Processing

NLP (Natural Languages Processing) can be used to give voice commands to AI robots. It creates a strong human-robot interaction. NLP is a specific area of Artificial Intelligence that enables the communication between humans and robots. Through the NLP technique, the robot can understand and reproduce human language. Some robots are equipped with NLP so that we can't differentiate between humans and robots.

Natural Language Processing

Similarly, in the health care sector, robots powered by Natural Language Processing may help physicians to observe the decease details and automatically fill in EHR. Besides recognizing human language, it can learn common uses, such as learn the accent, and predict how humans speak.

Edge Computing

Edge computing in robots is defined as a service provider of robot integration, testing, design and simulation. Edge computing in robotics provides better data management, lower connectivity cost, better security practices, more reliable and uninterrupted connection.

Complex Event Process

Complex event processing (CEP) is a concept that helps us to understand the processing of multiple events in real time. An event is described as a Change of State, and one or more events combine to define a Complex event. The complex event process is most widely used term in various industries such as healthcare, finance, security, marketing, etc. It is primarily used in credit card fraud detection and also in stock marketing field.

Complex Event Process

For example, the deployment of an airbag in a car is a complex event based on the data from multiple sensors in real-time. This idea is used in Robotics, for example, Event-Processing in Autonomous Robot Programming.

Transfer Learning and AI

This is the technique used to solve a problem with the help of another problem that is already solved. In Transfer learning technique, knowledge gained from solving one problem can be implement to solve related problem. We can understand it with an example such as the model used for identifying a circle shape can also be used to identify a square shape.

Transfer Learning and AI

Transfer learning reuses the pre-trained model for a related problem, and only the last layer of the model is trained, which is relatively less time consuming and cheaper. In robotics, transfer learning can be used to train one machine with the help of other machines.

Reinforcement Learning

Reinforcement learning is a feedback-based learning method in machine learning that enables an AI agent to learn and explore the environment, perform actions and learn automatically from experience or feedback for each action. Further, it is also having feature of autonomously learn to behave optimally through hit-and-trail action while interacting with the environment. It is primarily used to develop the sequence of decisions and achieve the goals in uncertain and potentially complex environment. In robotics, robots explore the environment and learn about it through hit and trial. For each action, he gets rewarded (positive or negative). Reinforcement learning provides Robotics with a framework to design and simulate sophisticated and hard-to-engineer behaviours.

Affective computing

Affective computing is a field of study that deals with developing systems that can identify, interpret, process, and simulate human emotions. Affective computing aims to endow robots with emotional intelligence to hope that robots can be endowed with human-like capabilities of observation, interpretation, and emotion expression.

Mixed Reality

Mixed Reality is also an emerging domain. It is mainly used in the field of programming by demonstration (PbD). PbD creates a prototyping mechanism for algorithms using a combination of physical and virtual objects.

What are Artificially Intelligent Robots?

Artificial intelligent robots connect AI with robotics. AI robots are controlled by AI programs and use different AI technologies, such as Machine learning, computer vision, RL learning, etc. Usually, most robots are not AI robots, these robots are programmed to perform repetitive series of movements, and they don't need any AI to perform their task. However, these robots are limited in functionality.

What are Artificially Intelligent Robots?

AI algorithms are necessary when you want to allow the robot to perform more complex tasks.

What are Artificially Intelligent Robots?

A warehousing robot might use a path-finding algorithm to navigate around the warehouse. A drone might use autonomous navigation to return home when it is about to run out of battery. A self-driving car might use a combination of AI algorithms to detect and avoid potential hazards on the road. All these are the examples of artificially intelligent robots.

What are the advantages of integrating Artificial Intelligence into robotics?

- The major advantages of artificially intelligent robots are social care. They can guide people, especially come to aid for older people, with chatbot like social skills and advanced processors.
- Robotics also helps in Agricultural industry with the help of developing AI based robots. These

robots reduce the farmer's workload.

- In Military industry, Military bots can spy through speech and vision detectors, along with saving lives by replacing infantry

- Robotics also employed in volcanoes, deep oceans, extremely cold places, or even in space where normally humans can't survive.

- Robotics is also used in medical and healthcare industry as it can also perform complex surgeries that have a higher risk of a mistake by humans, but with a pre-set of instructions and added Intelligence. AI integrated robotics could reduce the number of casualties greatly.

Difference in Robot System and AI Programs

Here is the difference between Artificial Intelligence and Robots:

1. AI Programs

Usually, we use to operate them in computer-simulated worlds.

1. AI Programs

Generally, input is given in the form of symbols and rules.

1. AI Programs

To operate this, we need general-purpose/Special-purpose computers.

2. Robots

Generally, we use robots to operate in the real physical world.

2. Robots

Inputs are given in the form of the analogue signal or in the form of the speech waveform.

2. Robots

Also, to operate this, special hardware with sensors and effectors are needed.

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It helps developers to organize knowledge for performing tasks such astranslation, automatic summarization, Named Entity Recognition (NER), speech recognition, relationship extraction,andtopic segmentation.History of NLP(1940-1960) - Focused on Machine Translation (MT)The Natural Languages Processing started in the year 1940s.1948- In the Year 1948, the first recognisable NLP application was introduced in Birkbeck College, London.1950s- In the Year 1950s, there was a conflicting view between linguistics and computer science. Now, Chomsky developed his first book syntactic structures and claimed that language is generative in nature.In 1957, Chomsky also introduced the idea of Generative Grammar, which is rule based descriptions of syntactic structures.(1960-1980) - Flavored with Artificial Intelligence (AI)In the year 1960 to 1980, the key developments were:Augmented Transition Networks (ATN)Augmented Transition Networks is a finite state machine that is capable of recognizing regular languages.Case GrammarCase Grammar was developed byLinguist Charles J. Fillmorein the year 1968. Case Grammar uses languages such as English to express the relationship between nouns and verbs by using the preposition.In Case Grammar, case roles can be defined to link certain kinds of verbs and objects.For example:"Neha broke the mirror with the hammer". In this example case grammar identify Neha as an agent, mirror as a theme, and hammer as an instrument.In the year 1960 to 1980, key systems were:SHRDLUSHRDLU is a program written byTerry Winogradin 1968-70. It helps users to communicate with the computer and moving objects. It can handle instructions such as "pick up the green boll" and also answer the questions like "What is inside the black box." The main importance of SHRDLU is that it shows those syntax, semantics, and reasoning about the world that can be combined to produce a system that understands a natural language.LUNARLUNAR is the classic example of a Natural Language database interface system that is used ATNs and Woods' Procedural Semantics. It was capable of translating elaborate natural language expressions into database queries and handle 78% of requests without errors.1980 - CurrentTill the year 1980, natural language processing systems were based on complex sets of hand-written rules. After 1980, NLP introduced machine learning algorithms for language processing.In the beginning of the year 1990s, NLP started growing faster and achieved good process accuracy, especially in English Grammar. In 1990 also, an electronic text introduced, which provided a good resource for training and examining natural language programs. Other factors may include the availability of computers with fast CPUs and more memory. The major factor behind the advancement of natural language processing was the Internet.Now, modern NLP consists of various applications, likespeech recognition, machine translation,andmachine text reading. When we combine all these applications then it allows the artificial intelligence to gain knowledge of the world. Let's consider the example of AMAZON ALEXA, using this robot you can ask the question to Alexa, and it will reply to you.Advantages of NLPNLP helps users to ask questions about any subject and get a direct response within seconds.NLP offers exact answers to the question means it does not offer unnecessary and unwanted information.NLP helps computers to communicate with humans in their languages.It is very time efficient.Most of the companies use NLP to improve the efficiency of documentation processes, accuracy of documentation, and identify the information from large databases.Disadvantages of NLPA list of disadvantages of NLP is given below:NLP may not show context.NLP is unpredictableNLP may require more keystrokes.NLP is unable to adapt to the new domain, and it has a limited function that's why NLP is built for a single and specific task only.Components of NLPThere are the following two components of NLP -1. Natural Language Understanding (NLU)Natural Language Understanding (NLU) helps the machine to understand and analyse human language by extracting the metadata from content such as concepts, entities, keywords, emotion, relations, and semantic roles.NLU mainly used in Business applications to understand the customer's problem in both spoken and written language.NLU involves the following tasks -It is used to map the given input into useful representation.It is used to analyze different aspects of the language.2. Natural Language Generation (NLG)Natural Language Generation (NLG) acts as a translator that converts the computerized data into natural language representation. It mainly involves Text planning, Sentence planning, and Text Realization.Note: The NLU is difficult than NLG.Difference between NLU and NLGNLUNLGNLU is the process of reading and interpreting language.NLG is the process of writing or generating language.It produces non-linguistic outputs from natural language inputs.It produces constructing natural language outputs from non-linguistic inputs.Applications of NLPThere are the following applications of NLP -1. Question AnsweringQuestion Answering focuses on building systems that automatically answer the questions asked by humans in a natural language.2. Spam DetectionSpam detection is used to detect unwanted e-mails getting to a user's inbox.3. Sentiment AnalysisSentiment Analysis is also known asopinion mining. It is used on the web to analyse the attitude, behaviour, and emotional state of the sender. This application is implemented through a combination of NLP (Natural Language Processing) and statistics by assigning the values to the text (positive, negative, or natural), identify the mood of the context (happy, sad, angry, etc.)4. Machine TranslationMachine translation is used to translate text or speech from one natural language to another natural language.Example:Google Translator5. Spelling correctionMicrosoft Corporation provides word processor software like MS-word, PowerPoint for the spelling correction.6. Speech RecognitionSpeech recognition is used for converting spoken words into text. It is used in applications, such as mobile, home automation, video recovery, dictating to Microsoft Word, voice biometrics, voice user interface, and so on.7. ChatbotImplementing the Chatbot is one of the important applications of NLP. It is used by many companies to provide the customer's chat services.8. Information extractionInformation extraction is one of the most important applications of NLP. It is used for extracting structured information from unstructured or semi-structured machine-readable documents.9. Natural Language Understanding (NLU)It converts a large set of text into more formal representations such as first-order logic structures that are easier for the computer programs to manipulate notations of the natural language processing.How to build an NLP pipelineThere are the following steps to build an NLP pipeline -Step1: Sentence SegmentationSentence Segment is the first step for building the NLP pipeline. It breaks the paragraph into separate sentences.Example:Consider the following paragraph -Independence Day is one of the important festivals for every Indian citizen. It is celebrated on the 15th of August each year ever since India got independence from the British rule. The day celebrates independence in the true sense.Sentence Segment produces the following result:"Independence Day is one of the important festivals for every Indian citizen.""It is celebrated on the 15th of August each year ever since India got independence from the British rule.""This day celebrates independence in the true sense."Step2: Word TokenizationWord Tokenizer is used to break the sentence into separate words or tokens.Example:JavaTpoint offers Corporate Training, Summer Training, Online Training, and Winter Training.Word Tokenizer generates the following result:"JavaTpoint", "offers", "Corporate", "Training", "Summer", "Training", "Online", "Training", "and", "Winter", "Training", "."Step3: StemmingStemming is used to normalize words into its base form or root form. For example, celebrates, celebrated and celebrating, all these words are originated with a single root word "celebrate." The big problem with stemming is that sometimes it produces the root word which may not have any meaning.For Example,intelligence, intelligent, and intelligently, all these words are originated with a single root word "intelligen." In English, the word "intelligen" do not have any meaning.Step 4: LemmatizationLemmatization is quite similar to the Stamming. It is used to group different inflected forms of the word, called Lemma. The main difference between Stemming and lemmatization is that it produces the root word, which has a meaning.For example:In lemmatization, the words intelligence, intelligent, and intelligently has a root word intelligent, which has a meaning.Step 5: Identifying Stop WordsIn English, there are a lot of words that appear very frequently like "is", "and", "the", and "a". NLP pipelines will flag these words as stop words.Stop wordsmight be filtered out before doing any statistical analysis.Example:Heis agood boy.Note: When you are building a rock band search engine, then you do not ignore the word "The."Step 6: Dependency ParsingDependency Parsing is used to find that how all the words in the sentence are related to each other.Step 7: POS tagsPOS stands for parts of speech, which includes Noun, verb, adverb, and Adjective. It indicates that how a word functions with its meaning as well as grammatically within the sentences. A word has one or more parts of speech based on the context in which it is used.Example: "Google"something on the Internet.In the above example, Google is used as a verb, although it is a proper noun.Step 8: Named Entity Recognition (NER)Named Entity Recognition (NER) is the process of detecting the named entity such as person name, movie name, organization name, or location.Example: Steve Jobsintroduced iPhone at the Macworld Conference in San Francisco, California.Step 9: ChunkingChunking is used to collect the individual piece of information and grouping them into bigger pieces of sentences.Phases of NLPThere are the following five phases of NLP:1. Lexical Analysis and MorphologicalThe first phase of NLP is the Lexical Analysis. This phase scans the source code as a stream of characters and converts it into meaningful lexemes. It divides the whole text into paragraphs, sentences, and words.2. Syntactic Analysis (Parsing)Syntactic Analysis is used to check grammar, word arrangements, and shows the relationship among the words.Example:Agra goes to the PoonamIn the real world, Agra goes to the Poonam, does not make any sense, so this sentence is rejected by the Syntactic analyzer.3. Semantic AnalysisSemantic analysis is concerned with the meaning representation. It mainly focuses on the literal meaning of words, phrases, and sentences.4. Discourse IntegrationDiscourse Integration depends upon the sentences that proceeds it and also invokes the meaning of the sentences that follow it.5. Pragmatic AnalysisPragmatic is the fifth and last phase of NLP. It helps you to discover the intended effect by applying a set of rules that characterize cooperative dialogues.For Example:"Open the door" is interpreted as a request instead of an order.Why NLP is difficult?NLP is difficult because Ambiguity and Uncertainty exist in the language.AmbiguityThere are the following three ambiguity -Lexical AmbiguityLexical Ambiguity exists in the presence of two or more possible meanings of the sentence within a single word.Example:Manya is looking for amatch.In the above example, the word match refers to that either Manya is looking for a partner or Manya is looking for a match. (Cricket or other match)Syntactic AmbiguitySyntactic Ambiguity exists in the presence of two or more possible meanings within the sentence.Example:I saw the girl with the binocular.In the above example, did I have the binoculars? Or did the girl have the binoculars?Referential AmbiguityReferential Ambiguity exists when you are referring to something using the pronoun.Example:Kiran went to Sunita. She said, "I am hungry."In the above sentence, you do not know that who is hungry, either Kiran or Sunita.NLP APIsNatural Language Processing APIs allow developers to integrate human-to-machine communications and complete several useful tasks such as speech recognition, chatbots, spelling correction, sentiment analysis, etc.A list of NLP APIs is given below:IBM Watson APIIBM Watson API combines different sophisticated machine learning techniques to enable developers to classify text into various custom categories. It supports multiple languages, such as English, French, Spanish, German, Chinese, etc. With the help of IBM Watson API, you can extract insights from texts, add automation in workflows, enhance search, and understand the sentiment. The main advantage of this API is that it is very easy to use.Pricing:Firstly, it offers a free 30 days trial IBM cloud account. You can also opt for its paid plans.Chatbot APIChatbot API allows you to create intelligent chatbots for any service. It supports Unicode characters, classifies text, multiple languages, etc. It is very easy to use. It helps you to create a chatbot for your web applications.Pricing:Chatbot API is free for 150 requests per month. You can also opt for its paid version, which starts from $100 to $5,000 per month.Speech to text APISpeech to text API is used to convert speech to textPricing:Speech to text API is free for converting 60 minutes per month. Its paid version starts form $500 to $1,500 per month.Sentiment Analysis APISentiment Analysis API is also called as 'opinion mining' which is used to identify the tone of a user (positive, negative, or neutral)Pricing:Sentiment Analysis API is free for less than 500 requests per month. Its paid version starts form $19 to $99 per month.Translation API by

SYSTRANThe Translation API by SYSTRAN is used to translate the text from the source language to the target language. You can use its NLP APIs for language detection, text segmentation, named entity recognition, tokenization, and many other tasks.Pricing:This API is available for free. But for commercial users, you need to use its paid version.Text Analysis API by AYLIENText Analysis API by AYLIEN is used to derive meaning and insights from the textual content. It is available for both free as well as paid from$119 per month. It is easy to use.Pricing:This API is available free for 1,000 hits per day. You can also use its paid version, which starts from $199 to S1, 399 per month.Cloud NLP APIThe Cloud NLP API is used to improve the capabilities of the application using natural language processing technology. It allows you to carry various natural language processing functions like sentiment analysis and language detection. It is easy to use.Pricing:Cloud NLP API is available for free.Google Cloud Natural Language APIGoogle Cloud Natural Language API allows you to extract beneficial insights from unstructured text. This API allows you to perform entity recognition, sentiment analysis, content classification, and syntax analysis in more the 700 predefined categories. It also allows you to perform text analysis in multiple languages such as English, French, Chinese, and German.Pricing:After performing entity analysis for 5,000 to 10,000,000 units, you need to pay $1.00 per 1000 units per month.NLP LibrariesScikit-learn:It provides a wide range of algorithms for building machine learning models in Python.Natural language Toolkit (NLTK):NLTK is a complete toolkit for all NLP techniques.Pattern:It is a web mining module for NLP and machine learning.TextBlob:It provides an easy interface to learn basic NLP tasks like sentiment analysis, noun phrase extraction, or pos-tagging.Quepy:Quepy is used to transform natural language questions into queries in a database query language.SpaCy:SpaCy is an open-source NLP library which is used for Data Extraction, Data Analysis, Sentiment Analysis, and Text Summarization.Gensim:Gensim works with large datasets and processes data streams.Difference between Natural language and Computer LanguageNatural LanguageComputer LanguageNatural language has a very large vocabulary.Computer language has a very limited vocabulary.Natural language is easily understood by humans.Computer language is easily understood by the machines.Natural language is ambiguous in nature.Computer language is unambiguous.PrerequisiteBefore learning NLP, you must have the basic knowledge of Python.AudienceOur NLP tutorial is designed to help beginners.ProblemWe assure that you will not find any problem in this NLP tutorial. But if there is any mistake or error, please post the error in the contact form. | NLU | NLG | NLU is the process of reading and interpreting language. | NLG is the process of writing or generating language. | It produces non-linguistic outputs from natural language inputs. | It produces constructing natural language outputs from non-linguistic inputs. | Natural Language | Computer Language | Natural language has a very large vocabulary. | Computer language has a very limited vocabulary. | Natural language is easily understood by humans. | Computer language is easily understood by the machines. | Natural language is ambiguous in nature. | Computer language is unambiguous.

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NLP tutorial provides basic and advanced concepts of the NLP tutorial. Our NLP tutorial is designed for beginners and professionals.

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- History of NLP

- Advantages of NLP

- Disadvantages of NLP

- Components of NLP

- Applications of NLP

- How to build an NLP pipeline?

- Phases of NLP

- Why NLP is Difficult?

- NLP APIs

- NLP Libraries

- Difference between Natural language and Computer language

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(1940-1960) - Focused on Machine Translation (MT)

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History of NLP

1950s- In the Year 1950s, there was a conflicting view between linguistics and computer science. Now, Chomsky developed his first book syntactic structures and claimed that language is generative in nature.

History of NLP

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In the year 1960 to 1980, the key developments were:

History of NLP

Augmented Transition Networks (ATN)

History of NLP

Augmented Transition Networks is a finite state machine that is capable of recognizing regular languages.

History of NLP

Case Grammar

History of NLP

Case Grammar was developed byLinguist Charles J. Fillmorein the year 1968. Case Grammar uses languages such as English to express the relationship between nouns and verbs by using the preposition.

History of NLP

In Case Grammar, case roles can be defined to link certain kinds of verbs and objects.

History of NLP

For example:"Neha broke the mirror with the hammer". In this example case grammar identify Neha as an agent, mirror as a theme, and hammer as an instrument.

History of NLP

In the year 1960 to 1980, key systems were:

History of NLP

SHRDLU

History of NLP

SHRDLU is a program written byTerry Winogradin 1968-70. It helps users to communicate with the computer and moving objects. It can handle instructions such as "pick up the green boll" and also answer the questions like "What is inside the black box." The main importance of SHRDLU is that it shows those syntax, semantics, and reasoning about the world that can be combined to produce a system that understands a natural language.

History of NLP

LUNAR

History of NLP

LUNAR is the classic example of a Natural Language database interface system that is used ATNs and Woods' Procedural Semantics. It was capable of translating elaborate natural language expressions into database queries and handle 78% of requests without errors.

History of NLP

1980 - Current

History of NLP

Till the year 1980, natural language processing systems were based on complex sets of hand-written rules. After 1980, NLP introduced machine learning algorithms for language processing.

History of NLP

In the beginning of the year 1990s, NLP started growing faster and achieved good process accuracy, especially in English Grammar. In 1990 also, an electronic text introduced, which provided a good resource for training and examining natural language programs. Other factors may include the availability of computers with fast CPUs and more memory. The major factor behind the advancement of natural language processing was the Internet.

History of NLP

Now, modern NLP consists of various applications, likespeech recognition, machine translation,andmachine text reading. When we combine all these applications then it allows the artificial intelligence to gain knowledge of the world. Let's consider the example of AMAZON ALEXA, using this robot you can ask the question to Alexa, and it will reply to you.

Advantages of NLP

- NLP helps users to ask questions about any subject and get a direct response within seconds.
- NLP offers exact answers to the question means it does not offer unnecessary and unwanted information.
- NLP helps computers to communicate with humans in their languages.
- It is very time efficient.
- Most of the companies use NLP to improve the efficiency of documentation processes, accuracy of documentation, and identify the information from large databases.

Disadvantages of NLP

A list of disadvantages of NLP is given below:

Disadvantages of NLP

- NLP may not show context.

- NLP is unpredictable

- NLP may require more keystrokes.

- NLP is unable to adapt to the new domain, and it has a limited function that's why NLP is built for a single and specific task only.

Components of NLP

There are the following two components of NLP -

Components of NLP

1. Natural Language Understanding (NLU)

Components of NLP

Natural Language Understanding (NLU) helps the machine to understand and analyse human language by extracting the metadata from content such as concepts, entities, keywords, emotion, relations, and semantic roles.

Components of NLP

NLU mainly used in Business applications to understand the customer's problem in both spoken and written language.

Components of NLP

NLU involves the following tasks -

Components of NLP

- It is used to map the given input into useful representation.

- It is used to analyze different aspects of the language.

Components of NLP

2. Natural Language Generation (NLG)

Components of NLP

Natural Language Generation (NLG) acts as a translator that converts the computerized data into natural language representation. It mainly involves Text planning, Sentence planning, and Text Realization.

Note: The NLU is difficult than NLG.

Difference between NLU and NLG

Note: The NLU is difficult than NLG.

NLU | NLG

NLU is the process of reading and interpreting language. | NLG is the process of writing or generating language.

It produces non-linguistic outputs from natural language inputs. | It produces constructing natural language outputs from non-linguistic inputs.

Applications of NLP

There are the following applications of NLP -

Applications of NLP

1. Question Answering

Applications of NLP

Question Answering focuses on building systems that automatically answer the questions asked by humans in a natural language.

Applications of NLP

2. Spam Detection

Applications of NLP

Spam detection is used to detect unwanted e-mails getting to a user's inbox.

Applications of NLP

3. Sentiment Analysis

Applications of NLP

Sentiment Analysis is also known asopinion mining. It is used on the web to analyse the attitude, behaviour, and emotional state of the sender. This application is implemented through a combination of NLP (Natural Language Processing) and statistics by assigning the values to the text (positive, negative, or natural), identify the mood of the context (happy, sad, angry, etc.)

Applications of NLP

4. Machine Translation

Applications of NLP

Machine translation is used to translate text or speech from one natural language to another natural language.

Applications of NLP

Example:Google Translator

Applications of NLP

5. Spelling correction

Applications of NLP

Microsoft Corporation provides word processor software like MS-word, PowerPoint for the spelling correction.

Applications of NLP

6. Speech Recognition

Applications of NLP

Speech recognition is used for converting spoken words into text. It is used in applications, such as mobile, home automation, video recovery, dictating to Microsoft Word, voice biometrics, voice user interface, and so on.

Applications of NLP

7. Chatbot

Applications of NLP

Implementing the Chatbot is one of the important applications of NLP. It is used by many companies to provide the customer's chat services.

Applications of NLP

8. Information extraction

Applications of NLP

Information extraction is one of the most important applications of NLP. It is used for extracting structured information from unstructured or semi-structured machine-readable documents.

Applications of NLP

9. Natural Language Understanding (NLU)

Applications of NLP

It converts a large set of text into more formal representations such as first-order logic structures that are easier for the computer programs to manipulate notations of the natural language processing.

How to build an NLP pipeline

There are the following steps to build an NLP pipeline -

How to build an NLP pipeline

Step1: Sentence Segmentation

How to build an NLP pipeline

Sentence Segment is the first step for building the NLP pipeline. It breaks the paragraph into separate sentences.

How to build an NLP pipeline

Example:Consider the following paragraph -

How to build an NLP pipeline

Independence Day is one of the important festivals for every Indian citizen. It is celebrated on the 15th of August each year ever since India got independence from the British rule. The day celebrates independence in the true sense.

How to build an NLP pipeline

Sentence Segment produces the following result:

How to build an NLP pipeline

- "Independence Day is one of the important festivals for every Indian citizen."
- "It is celebrated on the 15th of August each year ever since India got independence from the British rule."
- "This day celebrates independence in the true sense."

How to build an NLP pipeline

Step2: Word Tokenization

How to build an NLP pipeline

Word Tokenizer is used to break the sentence into separate words or tokens.

How to build an NLP pipeline

Example:

How to build an NLP pipeline

JavaTpoint offers Corporate Training, Summer Training, Online Training, and Winter Training.

How to build an NLP pipeline

Word Tokenizer generates the following result:

How to build an NLP pipeline

"JavaTpoint", "offers", "Corporate", "Training", "Summer", "Training", "Online", "Training", "and", "Winter", "Training", "."

How to build an NLP pipeline

Step3: Stemming

How to build an NLP pipeline

Stemming is used to normalize words into its base form or root form. For example, celebrates, celebrated and celebrating, all these words are originated with a single root word "celebrate." The big problem with stemming is that sometimes it produces the root word which may not have any meaning.

How to build an NLP pipeline

For Example,intelligence, intelligent, and intelligently, all these words are originated with a single root word "intelligen." In English, the word "intelligen" do not have any meaning.

How to build an NLP pipeline

Step 4: Lemmatization

How to build an NLP pipeline

Lemmatization is quite similar to the Stamming. It is used to group different inflected forms of the word, called Lemma. The main difference between Stemming and lemmatization is that it produces the root word, which has a meaning.

How to build an NLP pipeline

For example:In lemmatization, the words intelligence, intelligent, and intelligently has a root word intelligent, which has a meaning.

How to build an NLP pipeline

Step 5: Identifying Stop Words

How to build an NLP pipeline

In English, there are a lot of words that appear very frequently like "is", "and", "the", and "a". NLP pipelines will flag these words as stop words.Stop wordsmight be filtered out before doing any statistical analysis.

How to build an NLP pipeline

Example:Heis agood boy.

Note: When you are building a rock band search engine, then you do not ignore the w

Step 6: Dependency Parsing

Note: When you are building a rock band search engine, then you do not ignore the w

Dependency Parsing is used to find that how all the words in the sentence are related to each other.

Note: When you are building a rock band search engine, then you do not ignore the w

Step 7: POS tags

Note: When you are building a rock band search engine, then you do not ignore the w

POS stands for parts of speech, which includes Noun, verb, adverb, and Adjective. It indicates that how a word functions with its meaning as well as grammatically within the sentences. A word has one or more parts of speech based on the context in which it is used.

Note: When you are building a rock band search engine, then you do not ignore the w

Example: "Google"something on the Internet.

Note: When you are building a rock band search engine, then you do not ignore the w

In the above example, Google is used as a verb, although it is a proper noun.

Note: When you are building a rock band search engine, then you do not ignore the w

Step 8: Named Entity Recognition (NER)

Note: When you are building a rock band search engine, then you do not ignore the w

Named Entity Recognition (NER) is the process of detecting the named entity such as person name, movie name, organization name, or location.

Note: When you are building a rock band search engine, then you do not ignore the w

Example: Steve Jobsintroduced iPhone at the Macworld Conference in San Francisco, California.

Note: When you are building a rock band search engine, then you do not ignore the w

Step 9: Chunking

Note: When you are building a rock band search engine, then you do not ignore the w

Chunking is used to collect the individual piece of information and grouping them into bigger pieces of sentences.

Phases of NLP

There are the following five phases of NLP:

Phases of NLP

1. Lexical Analysis and Morphological

Phases of NLP

The first phase of NLP is the Lexical Analysis. This phase scans the source code as a stream of characters and converts it into meaningful lexemes. It divides the whole text into paragraphs, sentences, and words.

Phases of NLP

2. Syntactic Analysis (Parsing)

Phases of NLP

Syntactic Analysis is used to check grammar, word arrangements, and shows the relationship among the words.

Phases of NLP

Example:Agra goes to the Poonam

Phases of NLP

Phases of NLP

3. Semantic Analysis

Phases of NLP

Semantic analysis is concerned with the meaning representation. It mainly focuses on the literal meaning of words, phrases, and sentences.

Phases of NLP

4. Discourse Integration

Phases of NLP

Discourse Integration depends upon the sentences that proceeds it and also invokes the meaning of the sentences that follow it.

Phases of NLP

5. Pragmatic Analysis

Phases of NLP

Pragmatic is the fifth and last phase of NLP. It helps you to discover the intended effect by applying a set of rules that characterize cooperative dialogues.

Phases of NLP

For Example:"Open the door" is interpreted as a request instead of an order.

Why NLP is difficult?

NLP is difficult because Ambiguity and Uncertainty exist in the language.

Why NLP is difficult?

Ambiguity

Why NLP is difficult?

There are the following three ambiguity -

Why NLP is difficult?

- Lexical Ambiguity

Why NLP is difficult?

Lexical Ambiguity exists in the presence of two or more possible meanings of the sentence within a single word.

Why NLP is difficult?

Example:

Why NLP is difficult?

Manya is looking for amatch.

Why NLP is difficult?

In the above example, the word match refers to that either Manya is looking for a partner or Manya is looking for a match. (Cricket or other match)

Why NLP is difficult?

- Syntactic Ambiguity

Why NLP is difficult?

Syntactic Ambiguity exists in the presence of two or more possible meanings within the sentence.

Why NLP is difficult?

Example:

Why NLP is difficult?

I saw the girl with the binocular.

Why NLP is difficult?

In the above example, did I have the binoculars? Or did the girl have the binoculars?

Why NLP is difficult?

- Referential Ambiguity

Why NLP is difficult?

Referential Ambiguity exists when you are referring to something using the pronoun.

Why NLP is difficult?

Example:Kiran went to Sunita. She said, "I am hungry."

Why NLP is difficult?

In the above sentence, you do not know that who is hungry, either Kiran or Sunita.

NLP APIs

Natural Language Processing APIs allow developers to integrate human-to-machine communications and complete several useful tasks such as speech recognition, chatbots, spelling correction, sentiment analysis, etc.

NLP APIs

A list of NLP APIs is given below:

NLP APIs

- IBM Watson APIIBM Watson API combines different sophisticated machine learning techniques to enable developers to classify text into various custom categories. It supports multiple languages, such as English, French, Spanish, German, Chinese, etc. With the help of IBM Watson API, you can extract insights from texts, add automation in workflows, enhance search, and understand the sentiment. The main advantage of this API is that it is very easy to use.Pricing:Firstly, it offers a free 30 days trial IBM cloud account. You can also opt for its paid plans.
- Chatbot APIChatbot API allows you to create intelligent chatbots for any service. It supports Unicode characters, classifies text, multiple languages, etc. It is very easy to use. It helps you to create a chatbot for your web applications.Pricing:Chatbot API is free for 150 requests per month. You can also opt for its paid version, which starts from $100 to $5,000 per month.
- Speech to text APISpeech to text API is used to convert speech to textPricing:Speech to text API is free for converting 60 minutes per month. Its paid version starts form $500 to $1,500 per month.
- Sentiment Analysis APISentiment Analysis API is also called as 'opinion mining' which is used to identify the tone of a user (positive, negative, or neutral)Pricing:Sentiment Analysis API is free for less than 500 requests per month. Its paid version starts form $19 to $99 per month.
- Translation API by SYSTRANThe Translation API by SYSTRAN is used to translate the text from the source language to the target language. You can use its NLP APIs for language detection, text segmentation, named entity recognition, tokenization, and many other tasks.Pricing:This API is available for free. But for commercial users, you need to use its paid version.
- Text Analysis API by AYLIENText Analysis API by AYLIEN is used to derive meaning and insights from the textual content. It is available for both free as well as paid from$119 per month. It is easy to use.Pricing:This API is available free for 1,000 hits per day. You can also use its paid version, which starts from $199 to S1, 399 per month.
- Cloud NLP APIThe Cloud NLP API is used to improve the capabilities of the application using

natural language processing technology. It allows you to carry various natural language processing functions like sentiment analysis and language detection. It is easy to use.Pricing:Cloud NLP API is available for free.

- Google Cloud Natural Language APIGoogle Cloud Natural Language API allows you to extract beneficial insights from unstructured text. This API allows you to perform entity recognition, sentiment analysis, content classification, and syntax analysis in more the 700 predefined categories. It also allows you to perform text analysis in multiple languages such as English, French, Chinese, and German.Pricing:After performing entity analysis for 5,000 to 10,000,000 units, you need to pay $1.00 per 1000 units per month.

NLP Libraries

Scikit-learn:It provides a wide range of algorithms for building machine learning models in Python.

NLP Libraries

Natural language Toolkit (NLTK):NLTK is a complete toolkit for all NLP techniques.

NLP Libraries

Pattern:It is a web mining module for NLP and machine learning.

NLP Libraries

TextBlob:It provides an easy interface to learn basic NLP tasks like sentiment analysis, noun phrase extraction, or pos-tagging.

NLP Libraries

Quepy:Quepy is used to transform natural language questions into queries in a database query language.

NLP Libraries

SpaCy:SpaCy is an open-source NLP library which is used for Data Extraction, Data Analysis, Sentiment Analysis, and Text Summarization.

NLP Libraries

Gensim:Gensim works with large datasets and processes data streams.

Difference between Natural language and Computer Language

Natural Language | Computer Language

Natural language has a very large vocabulary. | Computer language has a very limited vocabulary.

Natural language is easily understood by humans. | Computer language is easily understood by the machines.

Natural language is ambiguous in nature. | Computer language is unambiguous.

Prerequisite

Before learning NLP, you must have the basic knowledge of Python.

Audience

Our NLP tutorial is designed to help beginners.

Problem

We assure that you will not find any problem in this NLP tutorial. But if there is any mistake or error, please post the error in the contact form.

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TensorFlow Tutorial

Welcome to the TensorFlow tutorial, TensorFlow tutorial is designed for both beginners and professionals. Our tutorial provides all the basic and advanced concept of machine learning and deep learning concept such as deep neural network, image processing and sentiment analysis.

TensorFlow Tutorial

TensorFlow is one of the famous deep learning framework, developed byGoogleTeam. It is a free and open source software library and designed inPythonprogramming language, this tutorial is designed in such a way that we can easily implement deep learning project on TensorFlow in an easy and efficient way.

Prerequisites

TensorFlow is completely based on Python. So, it is essential to have basic knowledge of Python. Additionally, a good grasp of the above concepts will greatly facilitate your understanding of TensorFlow.

Prerequisites

- fundamental mathematics
- linear algebra
- concepts in artificial intelligence

Audience

Students interested in Python and working on research and development projects involving different machine learning and deep learning techniques may particularly benefit from this lesson. Data scientists, engineers, and developers who want to employ deep learning in their projects might also benefit from it.

Audience

This tutorial's objective is to give a thorough explanation of TensorFlow's objects and methods so that students may become proficient in using them.

Feedback:

This TensorFlow lesson is as accurate and reliable as we can make it. However, if you find any mistakes, have any recommendations for improvement, or want further information on any subject, please don't hesitate to use the contact form to send your comments. We value your opinions very much, and we'll deal with any problems right away.

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They may deal with both structured and unstructured data, including text and pictures, databases, and spreadsheets.A number of sectors, including healthcare, finance, marketing, and more, use the insights and experience gained via data analysis to steer innovation, advise business decisions, and address challenging problems.In short, we can say that data science is all about:Collecting data from a range of sources, including databases, sensors, websites, etc.Making sure data is in a format that can be analyzed while also organizing and processing it to remove mistakes and inconsistencies.Finding patterns and correlations in the data using statistical and machine learning approaches.Developing visual representations of the data to aid in comprehension of the conclusions and insights.Creating mathematical models and computer programs that can classify and forecast based on data.Conveying clear and understandable facts and insights to others.Example:Let's suppose we want to travel from station A to staztion B by car. Now, we need to make some decisions such as which route will be the best route to reach faster at the location, in which route there will be no traffic jam, and which will be cost-effective. All these decision factors will act as input data, and we will get an appropriate answer from these decisions, so this analysis of data is called the data analysis, which is a part of data science.Need for Data Science:Some years ago, data was less and mostly available in a structured form, which could be easily stored in excel sheets, and processed using BI tools.But in today's world, data is becoming so vast, i.e., approximately2.5 quintals bytesof data is generating on every day, which led to data explosion. It is estimated as per researches, that by 2020, 1.7 MB of data will be created at every single second, by a single person on earth. Every Company requires data to work, grow, and improve their businesses.Now, handling of such huge amount of data is a challenging task for every organization. So to handle, process, and analysis of this, we required some complex, powerful, and efficient algorithms and technology, and that technology came into existence as data Science. Following are some main reasons for using data science technology:Every day, the world produces enormous volumes of data, which must be processed and analysed by data scientists in order to provide new information and understanding.To maintain their competitiveness in their respective industries, businesses and organizations must make data-driven choices. Data science offers the methods and tools needed to harvest valuable information from data in order to help decision-making.In many disciplines, including healthcare, economics, and climate research, data science is essential for finding solutions to complicated issues.Data science is now crucial for creating and educating intelligent systems as artificial intelligence and machine learning have grown in popularity.Data science increases productivity and lowers costs in a variety of industries, including manufacturing and logistics, by streamlining procedures and forecasting results.Data science Jobs:As per various surveys, data scientist job is becoming the most demanding Job of the 21st century due to increasing demands for data science. Some people also called it "thehottest job title of the 21st century". Data scientists are the experts who can use various statistical tools and machine learning algorithms to understand and analyze the data.The average salary range for data scientist will be approximately$95,000 to $ 165,000 per annum, and as per different researches, about11.5 millionsof job will be created by the year2026.Types of Data Science JobIf you learn data science, then you get the opportunity to find the various exciting job roles in this domain. The main job roles are given below:Data ScientistData AnalystMachine learning expertData engineerData ArchitectData AdministratorBusiness AnalystBusiness Intelligence Manager1. Data Scientist:A data scientist is in charge of deciphering large, complicated data sets for patterns and trends, as well as creating prediction models that may be applied to business choices. They could also be in charge of creating data-driven solutions for certain business issues.Skill Required:To become a data scientist, one needs skills in mathematics, statistics, programming languages(such as Python, R, and Julia), Machine Learning, Data Visualisation, Big Data Technologies (such as Hadoop), domain expertise(such that the person is capable of understanding data which is related to the domain), and communication and presentation skills to efficiently convey the insights from the data.2. Machine Learning Engineer:A machine learning engineer is in charge of creating, testing, and implementing machine learning algorithms and models that may be utilized to automate tasks and boost productivity.Skill Required:Programming languages like Python and Java, statistics, machine learning frameworks like TensorFlow and PyTorch, big data technologies like Hadoop and Spark, software engineering, and problem-solving skills are all necessary for a machine learning engineer.3. Data Analyst:Data analysts are in charge of gathering and examining data in order to spot patterns and trends and offer insights that may be applied to guide business choices. Creating data visualizations and reports to present results to stakeholders may also fall within the scope of their responsibility.Skill Required:Data analysis and visualization, statistical analysis, database querying, programming in languages like SQL or Python, critical thinking, and familiarity with tools and technologies like Excel, Tableau, SQL Server, and Jupyter Notebook are all necessary for a data analyst.4. Business Intelligence Analyst:Data analysis for business development and improvement is the responsibility of a business intelligence analyst. They could also be in charge of developing and putting into use data warehouses and other types of data management systems.Skill Required:A business intelligence analyst has to be skilled in data analysis and visualization, business knowledge, SQL and data warehousing, data modeling, and ETL procedures, as well as programming languages like Python and knowledge of BI tools like Tableau, Power BI, or QlikView.5. Data Engineer:A data engineer is in charge of creating, constructing, and maintaining the infrastructure and pipelines for collecting and storing data from diverse sources. In addition to guaranteeing data security and quality, they could also be in charge of creating data integration solutions.Skill Required:To create, build, and maintain scalable and effective data pipelines and data infrastructure for processing and storing large volumes of data, a data engineer needs expertise in database architecture, ETL procedures, data modeling, programming languages like Python and SQL, big data technologies like Hadoop and Spark, cloud computing platforms like AWS or Azure, and tools like Apache Airflow or Talend.6. Big Data Engineer:Big data engineers are in charge of planning and constructing systems that can handle and analyze massive volumes of data. Additionally, they can be in charge of putting scalable data storage options into place and creating distributed computing systems.Skilled Required:Big Data Engineers must be proficient in distributed systems, programming languages like Java or Scala, data modeling, database management, cloud computing platforms like AWS or Azure, big data technologies like Apache Spark, Kafka, and Hive, and experience with tools like Apache NiFi or Apache Beam in order to design, build, and maintain large-scale distributed data processing systems for hand.7. Data Architect:Data models and database systems that can support data-intensive applications must be designed and implemented by a data architect. They could also be in charge of maintaining data security, privacy, and compliance.Skill Required:A data architect needs knowledge of database design and modeling, data warehousing, ETL procedures, programming languages like SQL or Python, proficiency with data modeling tools like ER/Studio or ERwin, familiarity with cloud computing platforms like AWS or Azure, and expertise in data governance and security.8. Data Administrator:An organization's data assets must be managed and organized by a data administrator. They are in charge of guaranteeing the security, accuracy, and completeness of data as well as making sure that those who require it can readily access it.Skill Required:A data administrator needs expertise in database management, backup, and recovery, data security, SQL programming, data modeling, familiarity with database platforms like Oracle or SQL Server, proficiency with data management tools like SQL Developer or Toad, and experience with cloud computing platforms like AWS or Azure.9. Business Analyst:A business analyst is a professional who helps organizations identify business problems and opportunities and recommends solutions to those problems through the use of data and analysis.Skill Required:A business analyst needs expertise in data analysis, business process modeling, stakeholder management, requirements gathering and documentation, proficiency in tools like Excel, Power BI, or Tableau, and experience with project management.Prerequisite for Data ScienceNon-Technical Prerequisite:While technical skills are essential for data science, there are also non-technical skills that are important for success in this field. Here are some non-technical prerequisites for data science:Domain knowledge:To succeed in data science, it might be essential to have a thorough grasp of the sector or area you are working in. Your understanding of the data and its importance to the business will improve as a result of this information.Problem-solving skills:Solving complicated issues is a common part of data science, thus, the capacity to do it methodically and systematically is crucial.Communication skills:Data scientists need to be good communicators. You must be able to communicate the insights to others.Curiosity and creativity:Data science frequently entails venturing into unfamiliar territory, so being able to think creatively and approach issues from several perspectives may be a significant skill.Business Acumen:For data scientists, it is crucial to comprehend how organizations function and create value. This aids in improving your comprehension of the context and applicability of your work as well as pointing up potential uses of data to produce commercial results.Critical thinking:In data science, it's critical to be able to assess information with objectivity and reach logical conclusions. This involves the capacity to spot biases and assumptions in data and analysis as well as the capacity to form reasonable conclusions based on the facts at hand.Technical Prerequisite:Since data science includes dealing with enormous volumes of data and necessitates a thorough understanding of statistical analysis, machine learning algorithms, and programming languages, technical skills are crucial. Here are some technical prerequisites for data science:Mathematics and Statistics:Data science is working with data and analyzing it using statistical methods. As a result, you should have a strong background in statistics and mathematics. Calculus, linear algebra, probability theory, and statistical inference are some of the important ideas you should be familiar with.Programming:A fundamental skill for data scientists is programming. A solid command of at least one programming language, such as Python, R, or SQL, is required. Additionally, you must be knowledgeable about well-known data science libraries like Pandas, NumPy, and Matplotlib.Data Manipulation and Analysis:Working with data is an important component of data science. You should be skilled in methods for cleaning, transforming, and analyzing data, as well as in data visualization. Knowledge of programs like Tableau or Power BI might be helpful.Machine Learning:A key component of data science is machine learning. Decision trees, random forests, and clustering are a few examples of supervised and unsupervised learning algorithms that you should be well-versed in. Additionally, you should be familiar with well-known machine learning frameworks like Scikit-learn and TensorFlow.Deep Learning:Neural networks are used in deep learning, a kind of machine learning. Deep learning frameworks like TensorFlow, PyTorch, or Keras should be familiar to you.Big Data Technologies:Large and intricate datasets are a common tool used by data scientists. Big data technologies like Hadoop, Spark, and Hive should be known to you.Databases:The depth of understanding of Databases, such as SQL, is essential for data science to get the data and to work with data.Difference between BI and Data ScienceBI stands for business intelligence, which is also used for data analysis of business information: Below are some differences between BI and Data sciences:CriterionBusiness intelligenceData scienceData SourceBusiness intelligence deals with structured data, e.g., data warehouse.Data science deals with structured and unstructured data, e.g., weblogs, feedback, etc.MethodAnalytical(historical data)Scientific(goes deeper to know the reason for the data report)SkillsStatistics and Visualization are the two skills required for business intelligence.Statistics, Visualization, and Machine learning are the required skills for data science.FocusBusiness intelligence focuses on both Past and present dataData science focuses on past data, present data, and also future predictions.Data Science Components:Data science involves several components that work together to extract insights and value from data. Here are some of the key components of data science:Statistics:Statistics is one of the most important components of data science. Statistics is a way to collect and analyze numerical data in a large amount and find meaningful insights from it.Mathematics:Mathematics is a critical part of data science. Mathematics involves the study of quantity, structure, space, and changes. For a data scientist, knowledge of good mathematics is essential.Domain Expertise:In data science, domain expertise binds data science together. Domain expertise means specialized knowledge or skills in a particular area. In data science, there are various areas for which we need domain experts.Data Collection:Data is gathered and acquired from a number of sources. This can be unstructured data from social media, text, or photographs, as well as structured data from databases.Data Preprocessing:Raw data is frequently unreliable, erratic, or incomplete. In order to remove mistakes, handle missing data, and standardize the data, data cleaning and preprocessing is a crucial steps.Data Exploration and Visualization:This entails exploring the data and gaining insights using methods like statistical analysis and data visualization. To aid in understanding the data, this may entail developing graphs, charts, and dashboards.Data Modeling:In order to analyze the data and derive insights, this component entails creating models and algorithms. Regression, classification, and clustering are a few examples of supervised and unsupervised learning techniques that may be used in this.Machine Learning:Building predictive models that can learn from data is required for this. This might include the increasingly significant deep learning methods, such as neural networks, in data science.Communication:This entails informing stakeholders of the data analysis's findings. Explain the results, and this might involve producing reports, visualizations, and presentations.Deployment and Maintenance:The models and algorithms need to be deployed and maintained when the data science project is over. This may entail keeping an eye on the models' performance and upgrading them as necessary.Tools for Data ScienceFollowing are some tools required for data science:Data Analysis tools:R, Python, Statistics, SAS, Jupyter, R Studio, MATLAB, Excel, RapidMiner.Data Warehousing:ETL, SQL, Hadoop, Informatica/Talend, AWS RedshiftData Visualization tools:R, Jupyter, Tableau, Cognos.Machine learning tools:Spark, Mahout, Azure ML studio.Machine learning in Data ScienceTo become a data scientist, one should also be aware of machine learning and its algorithms, as in data science, there are various machine learning algorithms which are broadly being used. Following are the name of some machine learning algorithms used in data science:RegressionDecision treeClusteringPrincipal component analysisSupport vector machinesNaive BayesArtificial neural networkAprioriWe will provide you some brief introduction for few of the important algorithms here,1. Linear Regression Algorithm:Linear regression is the most popular machine learning algorithm based on supervised learning. This algorithm work on regression, which is a method of modeling target values based on independent variables. It represents the form of the linear equation, which has a relationship between the set of inputs and predictive output. This algorithm is mostly used in forecasting and predictions. Since it shows the linear relationship between input and output variable, hence it is called linear regression.The below equation can describe the relationship between x and y variables:Y= mx+cWhere,y= Dependent variableX= independent variableM= slopeC= intercept.2. Decision Tree:Decision Tree algorithm is another machine learning algorithm, which belongs to the supervised learning algorithm. This is one of the most popular machine learning algorithms. It can be used for both classification and regression problems.In the decision tree algorithm, we can solve the problem, by using tree representation in which, each node represents a feature, each branch represents a decision, and each leaf represents the outcome.Following is the example for a Job offer problem:In the decision tree, we start from the root of the tree and compare the values of the root attribute with record attribute. On the basis of this comparison, we follow the branch as per the value and then move to the next node. We continue comparing these values until we reach the leaf node with predicated class value.3. K-Means Clustering:K-means clustering is one of the most popular algorithms of machine learning, which belongs to the unsupervised learning algorithm. It solves the clustering problem.If we are given a data set of items, with certain features and values, and we need to categorize those set of items into groups, so such type of problems can be solved using k-means clustering algorithm.K-means clustering algorithm aims at minimizing an objective function, which known as squared error function, and it is given as:Where, J(V) => Objective function'||xi- vj||' => Euclidean distance between xiand vj.ci' => Number of data points in ithcluster.C => Number of clusters.4. SVM:The supervised learning technique known as SVM, or support vector machine, is used for regression and classification. The fundamental principle of SVM is to identify the hyperplane in a high-dimensional space that best discriminates between the various classes of data.SVM, to put it simply, seeks to identify a decision boundary that maximizes the margin between the two classes of data. The margin is the separation of each class's nearest data points, known as support vectors, from the hyperplane.The use of various kernel types that translate the input data to a higher-dimensional space where it may be linearly separated allows SVM to be used for both linearly separable and non-linearly separable data.Among the various uses for SVM are bioinformatics, text classification, and picture classification. Due to its strong performance and theoretical assurances, it has been widely employed in both industry and academic studies.5. KNN:The supervised learning technique known as KNN, or k-Nearest Neighbours, is used for regression and classification. The fundamental goal of KNN is to categorize a data point by selecting the class that appears most frequently among the "k" nearest labeled data points in the feature space.Simply said, KNN is a lazy learning method that saves all training data points in memory and uses them for classification or regression whenever a new data point is provided, rather than developing a model manually.The value of "k" indicates how many neighbors should be taken into account for classification when using KNN, which may be utilized for both classification and regression issues. A smoother choice boundary will be produced by a bigger value of "k," whereas a more complicated decision boundary will be produced by a lower value of "k".There are several uses for KNN, including recommendation systems, text classification, and picture classification. Due to its efficacy and simplicity, it has been extensively employed in both academic and industrial research. When working with big datasets can be computationally costly and necessitates the careful selection of the value of "k" and the distance metric employed to determine the separation between data points.6. Naive Bayes:A supervised learning method used for classification and regression analysis is called Naive Bayes. It is founded on the Bayes theorem, a probability theory that determines the likelihood of a hypothesis in light of the data currently available.The term "naive" refers to the assumption made by Naive Bayes, which is that the existence of one feature in a class is unrelated to the presence of any other features in that class. This presumption makes conditional probability computation easier and increases the algorithm's computing efficiency.Naive Bayes utilizes the Bayes theorem to determine the likelihood of each class given a collection of input characteristics for binary and multi-class classification problems. The projected class for the input data is then determined by selecting the class with the highest probability.Naive Bayes has several uses, including document categorization, sentiment analysis, and email spam screening. Due to its ease of use, effectiveness, and strong performance across a wide range of activities, it has received extensive use in both academic research and industry. However, it could not be effective for complicated issues in which the independence assumption is violated.7. Random Forest:A supervised learning system called Random Forest is utilized for regression and classification. It is an ensemble learning technique that mixes various decision trees to increase the model's robustness and accuracy.Simply said, Random Forest builds a number of decision trees using randomly chosen portions of the training data and features, combining the results to provide a final prediction. The characteristics and data used to construct each decision tree in the Random Forest are chosen at random, and each tree is trained independently of the others.Both classification and regression issues may be solved with Random Forest, which is renowned for its excellent accuracy, resilience, and resistance to overfitting. It may be used for feature selection and ranking and can handle huge datasets with high dimensionality and missing values.There are several uses for Random Forest, including bioinformatics, text classification, and picture classification. Due to its strong performance and capacity for handling complicated issues, it has been widely employed in both academic research and industry. For issues involving strongly linked traits or class inequalities, it might not be very effective.8. Logistic Regression:For binary classification issues, where the objective is to predict the likelihood of a binary result (such as Yes/No, True/False, or 1/0), logistic regression is a form of supervised learning technique. It is a statistical model that converts the result of a linear regression model into a probability value between 0 and 1. It does this by using the logistic function.Simply expressed, logistic functions are used in logistic regression to represent the connection between the input characteristics and the output probability. Any input value is converted by the logistic function to a probability value between 0 and 1. Given the input attributes, this probability number indicates the possibility that the binary result will be 1.Both basic and difficult issues may be solved using logistic regression, which can handle input characteristics with both numerical and categorical data. It may be used for feature selection and ranking since it is computationally efficient and simple to understand.How to solve a problem in Data Science using Machine learning algorithms?Now, let's understand what are the most common types of problems occurred in data science and what is the approach to solving the problems. So in data science, problems are solved using algorithms, and below is the diagram representation for applicable algorithms for possible questions:Is this A or B? :We can refer to this type of problem which has only two fixed solutions such as Yes or No, 1 or 0, may or may not. And this type of problems can be solved using classification algorithms.Is this different? :We can refer to this type of question which belongs to various patterns, and we need to find odd from them. Such type of problems can be solved using Anomaly Detection Algorithms.How much or how many?The other type of problem occurs which ask for numerical values or figures such as what is the time today, what will be the temperature today, can be solved using regression algorithms.How is this organized?Now if you have a problem which needs to deal with the organization of data, then it can be solved using clustering algorithms.Clustering algorithm organizes and groups the data based on features, colors, or other common characteristics.Data Science LifecycleThe life-cycle of data science is explained as below diagram.The main phases of data science life cycle are given below:1. Discovery:The first phase is discovery, which involves asking the right questions. When you start any data science project, you need to determine what are the basic requirements, priorities, and project budget. In this phase, we need to determine all the requirements of the project such as the number of people, technology, time, data, an end goal, and then we can frame the business problem on first hypothesis level.2. Data preparation:Data preparation is also known as Data Munging. In this phase, we need to perform the following tasks:Data cleaningData ReductionData integrationData transformation,After performing all the above tasks, we can easily use this data for our further processes.3. Model Planning:In this phase, we need to determine the various methods and techniques to establish the relation between input variables. We will apply Exploratory data analytics(EDA) by using various statistical formula and visualization tools to understand the relations between variable and to see what data can inform us. Common tools used for model planning are:SQL Analysis ServicesRSASPython4. Model-building:In this phase, the process of model building starts. We will create datasets for training and testing purpose. We will apply different techniques such as association, classification, and clustering, to build the model.Following are some common Model building tools:SAS Enterprise

MinerWEKASPCS ModelerMATLAB5. Operationalize:In this phase, we will deliver the final reports of the project, along with briefings, code, and technical documents. This phase provides you a clear overview of complete project performance and other components on a small scale before the full deployment.6. Communicate results:In this phase, we will check if we reach the goal, which we have set on the initial phase. We will communicate the findings and final result with the business team.Applications of Data Science:Image recognition and speech recognition:Data science is currently using for Image and speech recognition. When you upload an image on Facebook and start getting the suggestion to tag to your friends. This automatic tagging suggestion uses image recognition algorithm, which is part of data science.When you say something using, "Ok Google, Siri, Cortana", etc., and these devices respond as per voice control, so this is possible with speech recognition algorithm.Gaming world:In the gaming world, the use of Machine learning algorithms is increasing day by day. EA Sports, Sony, Nintendo, are widely using data science for enhancing user experience.Internet search:When we want to search for something on the internet, then we use different types of search engines such as Google, Yahoo, Bing, Ask, etc. All these search engines use the data science technology to make the search experience better, and you can get a search result with a fraction of seconds.Transport:Transport industries also using data science technology to create self-driving cars. With self-driving cars, it will be easy to reduce the number of road accidents.Healthcare:In the healthcare sector, data science is providing lots of benefits. Data science is being used for tumor detection, drug discovery, medical image analysis, virtual medical bots, etc.Recommendation systems:Most of the companies, such as Amazon, Netflix, Google Play, etc., are using data science technology for making a better user experience with personalized recommendations. Such as, when you search for something on Amazon, and you started getting suggestions for similar products, so this is because of data science technology.Risk detection:Finance industries always had an issue of fraud and risk of losses, but with the help of data science, this can be rescued.Most of the finance companies are looking for the data scientist to avoid risk and any type of losses with an increase in customer satisfaction.Next TopicData Mesh - Rethinking Enterprise Data Architecturenext ? | Criterion | Business intelligence | Data science |

Data Source | Business intelligence deals with structured data, e.g., data warehouse. | Data science deals with structured and unstructured data, e.g., weblogs, feedback, etc. | Method | Analytical(historical data) | Scientific(goes deeper to know the reason for the data report) | Skills | Statistics and Visualization are the two skills required for business intelligence. | Statistics, Visualization, and Machine learning are the required skills for data science. | Focus | Business intelligence focuses on both Past and present data | Data science focuses on past data, present data, and also future predictions.

Criterion | Business intelligence | Data science

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Data Science Tutorial for Beginners

Data Science has become the most demanding job of the 21st century. Every organization is looking for candidates with knowledge of data science. In this tutorial, we are giving an introduction to data science, with data science Job roles, tools for data science, components of data science, application, etc.

Data Science Tutorial for Beginners

So let's start,

What is Data Science?

Data Science is a multidisciplinary field that involves the use of statistical and computational methods to extract insights and knowledge from data. To analyze and comprehend large data sets, it uses techniques from computer science, mathematics, and statistics.

What is Data Science?

Data mining, machine learning, and data visualization are just a few of the tools and methods we frequently employ to draw meaning from data. They may deal with both structured and unstructured data, including text and pictures, databases, and spreadsheets.

What is Data Science?

A number of sectors, including healthcare, finance, marketing, and more, use the insights and experience gained via data analysis to steer innovation, advise business decisions, and address challenging problems.

What is Data Science?

In short, we can say that data science is all about:

What is Data Science?

- Collecting data from a range of sources, including databases, sensors, websites, etc.
- Making sure data is in a format that can be analyzed while also organizing and processing it to remove mistakes and inconsistencies.
- Finding patterns and correlations in the data using statistical and machine learning approaches.
- Developing visual representations of the data to aid in comprehension of the conclusions and insights.
- Creating mathematical models and computer programs that can classify and forecast based on data.
- Conveying clear and understandable facts and insights to others.

Example:

Let's suppose we want to travel from station A to staztion B by car. Now, we need to make some decisions such as which route will be the best route to reach faster at the location, in which route there will be no traffic jam, and which will be cost-effective. All these decision factors will act as input data, and we will get an appropriate answer from these decisions, so this analysis of data is called the data analysis, which is a part of data science.

Need for Data Science:

Some years ago, data was less and mostly available in a structured form, which could be easily stored in excel sheets, and processed using BI tools.

Need for Data Science:

But in today's world, data is becoming so vast, i.e., approximately2.5 quintals bytesof data is generating on every day, which led to data explosion. It is estimated as per researches, that by 2020, 1.7 MB of data will be created at every single second, by a single person on earth. Every Company requires data to work, grow, and improve their businesses.

Need for Data Science:

Now, handling of such huge amount of data is a challenging task for every organization. So to handle, process, and analysis of this, we required some complex, powerful, and efficient algorithms and technology, and that technology came into existence as data Science. Following are some main reasons for using data science technology:

Need for Data Science:

- Every day, the world produces enormous volumes of data, which must be processed and analysed by data scientists in order to provide new information and understanding.
- To maintain their competitiveness in their respective industries, businesses and organizations must make data-driven choices. Data science offers the methods and tools needed to harvest valuable information from data in order to help decision-making.
- In many disciplines, including healthcare, economics, and climate research, data science is essential for finding solutions to complicated issues.
- Data science is now crucial for creating and educating intelligent systems as artificial intelligence

and machine learning have grown in popularity.

- Data science increases productivity and lowers costs in a variety of industries, including manufacturing and logistics, by streamlining procedures and forecasting results.

Data science Jobs:

As per various surveys, data scientist job is becoming the most demanding Job of the 21st century due to increasing demands for data science. Some people also called it "thehottest job title of the 21st century". Data scientists are the experts who can use various statistical tools and machine learning algorithms to understand and analyze the data.

Data science Jobs:

The average salary range for data scientist will be approximately$95,000 to $ 165,000 per annum, and as per different researches, about11.5 millionsof job will be created by the year2026.

Types of Data Science Job

If you learn data science, then you get the opportunity to find the various exciting job roles in this domain. The main job roles are given below:

Types of Data Science Job

- Data Scientist
- Data Analyst
- Machine learning expert
- Data engineer
- Data Architect
- Data Administrator
- Business Analyst
- Business Intelligence Manager

Types of Data Science Job

1. Data Scientist:A data scientist is in charge of deciphering large, complicated data sets for patterns and trends, as well as creating prediction models that may be applied to business choices. They could also be in charge of creating data-driven solutions for certain business issues.

Types of Data Science Job

Skill Required:To become a data scientist, one needs skills in mathematics, statistics, programming languages(such as Python, R, and Julia), Machine Learning, Data Visualisation, Big Data Technologies (such as Hadoop), domain expertise(such that the person is capable of understanding data which is related to the domain), and communication and presentation skills to efficiently convey the insights from the data.

Types of Data Science Job

2. Machine Learning Engineer:A machine learning engineer is in charge of creating, testing, and implementing machine learning algorithms and models that may be utilized to automate tasks and boost productivity.

Types of Data Science Job

Skill Required:Programming languages like Python and Java, statistics, machine learning frameworks like TensorFlow and PyTorch, big data technologies like Hadoop and Spark, software engineering, and problem-solving skills are all necessary for a machine learning engineer.

Types of Data Science Job

3. Data Analyst:Data analysts are in charge of gathering and examining data in order to spot patterns and trends and offer insights that may be applied to guide business choices. Creating data visualizations and reports to present results to stakeholders may also fall within the scope of their responsibility.

Types of Data Science Job

Skill Required:Data analysis and visualization, statistical analysis, database querying, programming in languages like SQL or Python, critical thinking, and familiarity with tools and technologies like Excel, Tableau, SQL Server, and Jupyter Notebook are all necessary for a data analyst.

Types of Data Science Job

4. Business Intelligence Analyst:Data analysis for business development and improvement is the responsibility of a business intelligence analyst. They could also be in charge of developing and putting into use data warehouses and other types of data management systems.

Types of Data Science Job

Skill Required:A business intelligence analyst has to be skilled in data analysis and visualization, business knowledge, SQL and data warehousing, data modeling, and ETL procedures, as well as programming languages like Python and knowledge of BI tools like Tableau, Power BI, or QlikView.

Types of Data Science Job

5. Data Engineer:A data engineer is in charge of creating, constructing, and maintaining the infrastructure and pipelines for collecting and storing data from diverse sources. In addition to guaranteeing data security and quality, they could also be in charge of creating data integration solutions.

Types of Data Science Job

Skill Required:To create, build, and maintain scalable and effective data pipelines and data infrastructure for processing and storing large volumes of data, a data engineer needs expertise in database architecture, ETL procedures, data modeling, programming languages like Python and SQL, big data technologies like Hadoop and Spark, cloud computing platforms like AWS or Azure, and tools like Apache Airflow or Talend.

Types of Data Science Job

6. Big Data Engineer:Big data engineers are in charge of planning and constructing systems that can handle and analyze massive volumes of data. Additionally, they can be in charge of putting

scalable data storage options into place and creating distributed computing systems.

Types of Data Science Job

Skilled Required:Big Data Engineers must be proficient in distributed systems, programming languages like Java or Scala, data modeling, database management, cloud computing platforms like AWS or Azure, big data technologies like Apache Spark, Kafka, and Hive, and experience with tools like Apache NiFi or Apache Beam in order to design, build, and maintain large-scale distributed data processing systems for hand.

Types of Data Science Job

7. Data Architect:Data models and database systems that can support data-intensive applications must be designed and implemented by a data architect. They could also be in charge of maintaining data security, privacy, and compliance.

Types of Data Science Job

Skill Required:A data architect needs knowledge of database design and modeling, data warehousing, ETL procedures, programming languages like SQL or Python, proficiency with data modeling tools like ER/Studio or ERwin, familiarity with cloud computing platforms like AWS or Azure, and expertise in data governance and security.

Types of Data Science Job

8. Data Administrator:An organization's data assets must be managed and organized by a data administrator. They are in charge of guaranteeing the security, accuracy, and completeness of data as well as making sure that those who require it can readily access it.

Types of Data Science Job

Skill Required:A data administrator needs expertise in database management, backup, and recovery, data security, SQL programming, data modeling, familiarity with database platforms like Oracle or SQL Server, proficiency with data management tools like SQL Developer or Toad, and experience with cloud computing platforms like AWS or Azure.

Types of Data Science Job

9. Business Analyst:A business analyst is a professional who helps organizations identify business problems and opportunities and recommends solutions to those problems through the use of data and analysis.

Types of Data Science Job

Skill Required:A business analyst needs expertise in data analysis, business process modeling, stakeholder management, requirements gathering and documentation, proficiency in tools like Excel, Power BI, or Tableau, and experience with project management.

Non-Technical Prerequisite:

While technical skills are essential for data science, there are also non-technical skills that are important for success in this field. Here are some non-technical prerequisites for data science:

Non-Technical Prerequisite:

- Domain knowledge:To succeed in data science, it might be essential to have a thorough grasp of the sector or area you are working in. Your understanding of the data and its importance to the business will improve as a result of this information.
- Problem-solving skills:Solving complicated issues is a common part of data science, thus, the capacity to do it methodically and systematically is crucial.
- Communication skills:Data scientists need to be good communicators. You must be able to communicate the insights to others.
- Curiosity and creativity:Data science frequently entails venturing into unfamiliar territory, so being able to think creatively and approach issues from several perspectives may be a significant skill.
- Business Acumen:For data scientists, it is crucial to comprehend how organizations function and create value. This aids in improving your comprehension of the context and applicability of your work as well as pointing up potential uses of data to produce commercial results.

- Critical thinking:In data science, it's critical to be able to assess information with objectivity and reach logical conclusions. This involves the capacity to spot biases and assumptions in data and analysis as well as the capacity to form reasonable conclusions based on the facts at hand.

Technical Prerequisite:

Since data science includes dealing with enormous volumes of data and necessitates a thorough understanding of statistical analysis, machine learning algorithms, and programming languages, technical skills are crucial. Here are some technical prerequisites for data science:

Technical Prerequisite:

- Mathematics and Statistics:Data science is working with data and analyzing it using statistical methods. As a result, you should have a strong background in statistics and mathematics. Calculus, linear algebra, probability theory, and statistical inference are some of the important ideas you should be familiar with.
- Programming:A fundamental skill for data scientists is programming. A solid command of at least one programming language, such as Python, R, or SQL, is required. Additionally, you must be knowledgeable about well-known data science libraries like Pandas, NumPy, and Matplotlib.
- Data Manipulation and Analysis:Working with data is an important component of data science. You should be skilled in methods for cleaning, transforming, and analyzing data, as well as in data visualization. Knowledge of programs like Tableau or Power BI might be helpful.
- Machine Learning:A key component of data science is machine learning. Decision trees, random forests, and clustering are a few examples of supervised and unsupervised learning algorithms that you should be well-versed in. Additionally, you should be familiar with well-known machine learning frameworks like Scikit-learn and TensorFlow.
- Deep Learning:Neural networks are used in deep learning, a kind of machine learning. Deep learning frameworks like TensorFlow, PyTorch, or Keras should be familiar to you.
- Big Data Technologies:Large and intricate datasets are a common tool used by data scientists. Big data technologies like Hadoop, Spark, and Hive should be known to you.

- Databases:The depth of understanding of Databases, such as SQL, is essential for data science to get the data and to work with data.

Difference between BI and Data Science

BI stands for business intelligence, which is also used for data analysis of business information: Below are some differences between BI and Data sciences:

Difference between BI and Data Science

Criterion | Business intelligence | Data science

Data Source | Business intelligence deals with structured data, e.g., data warehouse. | Data science deals with structured and unstructured data, e.g., weblogs, feedback, etc.

Method | Analytical(historical data) | Scientific(goes deeper to know the reason for the data report)

Skills | Statistics and Visualization are the two skills required for business intelligence. | Statistics, Visualization, and Machine learning are the required skills for data science.

Focus | Business intelligence focuses on both Past and present data | Data science focuses on past data, present data, and also future predictions.

Data Science Components:

Data science involves several components that work together to extract insights and value from data. Here are some of the key components of data science:

Data Science Components:

- Statistics:Statistics is one of the most important components of data science. Statistics is a way to collect and analyze numerical data in a large amount and find meaningful insights from it.

- Mathematics:Mathematics is a critical part of data science. Mathematics involves the study of quantity, structure, space, and changes. For a data scientist, knowledge of good mathematics is essential.

- Domain Expertise:In data science, domain expertise binds data science together. Domain expertise means specialized knowledge or skills in a particular area. In data science, there are various areas for which we need domain experts.

- Data Collection:Data is gathered and acquired from a number of sources. This can be unstructured data from social media, text, or photographs, as well as structured data from databases.

- Data Preprocessing:Raw data is frequently unreliable, erratic, or incomplete. In order to remove mistakes, handle missing data, and standardize the data, data cleaning and preprocessing is a crucial steps.

- Data Exploration and Visualization:This entails exploring the data and gaining insights using methods like statistical analysis and data visualization. To aid in understanding the data, this may entail developing graphs, charts, and dashboards.

- Data Modeling:In order to analyze the data and derive insights, this component entails creating models and algorithms. Regression, classification, and clustering are a few examples of supervised and unsupervised learning techniques that may be used in this.

- Machine Learning:Building predictive models that can learn from data is required for this. This might include the increasingly significant deep learning methods, such as neural networks, in data science.

- Communication:This entails informing stakeholders of the data analysis's findings. Explain the results, and this might involve producing reports, visualizations, and presentations.

- Deployment and Maintenance:The models and algorithms need to be deployed and maintained when the data science project is over. This may entail keeping an eye on the models' performance and upgrading them as necessary.

Tools for Data Science

Following are some tools required for data science:

Tools for Data Science

- Data Analysis tools:R, Python, Statistics, SAS, Jupyter, R Studio, MATLAB, Excel, RapidMiner.

- Data Warehousing:ETL, SQL, Hadoop, Informatica/Talend, AWS Redshift

- Data Visualization tools:R, Jupyter, Tableau, Cognos.

- Machine learning tools:Spark, Mahout, Azure ML studio.

Machine learning in Data Science

To become a data scientist, one should also be aware of machine learning and its algorithms, as in data science, there are various machine learning algorithms which are broadly being used. Following are the name of some machine learning algorithms used in data science:

Machine learning in Data Science

- Regression
- Decision tree
- Clustering
- Principal component analysis
- Support vector machines
- Naive Bayes
- Artificial neural network
- Apriori

Machine learning in Data Science

We will provide you some brief introduction for few of the important algorithms here,

Machine learning in Data Science

1. Linear Regression Algorithm:Linear regression is the most popular machine learning algorithm based on supervised learning. This algorithm work on regression, which is a method of modeling target values based on independent variables. It represents the form of the linear equation, which has a relationship between the set of inputs and predictive output. This algorithm is mostly used in forecasting and predictions. Since it shows the linear relationship between input and output variable, hence it is called linear regression.

Machine learning in Data Science

The below equation can describe the relationship between x and y variables:

Machine learning in Data Science

Where,y= Dependent variableX= independent variableM= slopeC= intercept.

Machine learning in Data Science

2. Decision Tree:Decision Tree algorithm is another machine learning algorithm, which belongs to the supervised learning algorithm. This is one of the most popular machine learning algorithms. It can be used for both classification and regression problems.

Machine learning in Data Science

In the decision tree algorithm, we can solve the problem, by using tree representation in which, each node represents a feature, each branch represents a decision, and each leaf represents the outcome.

Machine learning in Data Science

Following is the example for a Job offer problem:

Machine learning in Data Science

In the decision tree, we start from the root of the tree and compare the values of the root attribute with record attribute. On the basis of this comparison, we follow the branch as per the value and then move to the next node. We continue comparing these values until we reach the leaf node with predicated class value.

Machine learning in Data Science

3. K-Means Clustering:K-means clustering is one of the most popular algorithms of machine learning, which belongs to the unsupervised learning algorithm. It solves the clustering problem.

Machine learning in Data Science

If we are given a data set of items, with certain features and values, and we need to categorize those set of items into groups, so such type of problems can be solved using k-means clustering algorithm.

Machine learning in Data Science

K-means clustering algorithm aims at minimizing an objective function, which known as squared error function, and it is given as:

Machine learning in Data Science

Where, J(V) => Objective function'||xi- vj||' => Euclidean distance between xiand vj.ci' => Number of data points in ithcluster.C => Number of clusters.

Machine learning in Data Science

4. SVM:The supervised learning technique known as SVM, or support vector machine, is used for regression and classification. The fundamental principle of SVM is to identify the hyperplane in a high-dimensional space that best discriminates between the various classes of data.

Machine learning in Data Science

SVM, to put it simply, seeks to identify a decision boundary that maximizes the margin between the two classes of data. The margin is the separation of each class's nearest data points, known as support vectors, from the hyperplane.

Machine learning in Data Science

The use of various kernel types that translate the input data to a higher-dimensional space where it may be linearly separated allows SVM to be used for both linearly separable and non-linearly separable data.

Machine learning in Data Science

Among the various uses for SVM are bioinformatics, text classification, and picture classification. Due to its strong performance and theoretical assurances, it has been widely employed in both industry and academic studies.

Machine learning in Data Science

5. KNN:The supervised learning technique known as KNN, or k-Nearest Neighbours, is used for regression and classification. The fundamental goal of KNN is to categorize a data point by selecting the class that appears most frequently among the "k" nearest labeled data points in the feature space.

Machine learning in Data Science

Simply said, KNN is a lazy learning method that saves all training data points in memory and uses them for classification or regression whenever a new data point is provided, rather than developing a model manually.

Machine learning in Data Science

The value of "k" indicates how many neighbors should be taken into account for classification when using KNN, which may be utilized for both classification and regression issues. A smoother choice boundary will be produced by a bigger value of "k," whereas a more complicated decision boundary will be produced by a lower value of "k".

Machine learning in Data Science

There are several uses for KNN, including recommendation systems, text classification, and picture classification. Due to its efficacy and simplicity, it has been extensively employed in both academic and industrial research. When working with big datasets can be computationally costly and necessitates the careful selection of the value of "k" and the distance metric employed to determine the separation between data points.

Machine learning in Data Science

6. Naive Bayes:A supervised learning method used for classification and regression analysis is called Naive Bayes. It is founded on the Bayes theorem, a probability theory that determines the likelihood of a hypothesis in light of the data currently available.

Machine learning in Data Science

The term "naive" refers to the assumption made by Naive Bayes, which is that the existence of one feature in a class is unrelated to the presence of any other features in that class. This presumption makes conditional probability computation easier and increases the algorithm's computing efficiency.

Machine learning in Data Science

Naive Bayes utilizes the Bayes theorem to determine the likelihood of each class given a collection of input characteristics for binary and multi-class classification problems. The projected class for the input data is then determined by selecting the class with the highest probability.

Machine learning in Data Science

Naive Bayes has several uses, including document categorization, sentiment analysis, and email spam screening. Due to its ease of use, effectiveness, and strong performance across a wide range of activities, it has received extensive use in both academic research and industry. However, it could not be effective for complicated issues in which the independence assumption is violated.

Machine learning in Data Science

7. Random Forest:A supervised learning system called Random Forest is utilized for regression and classification. It is an ensemble learning technique that mixes various decision trees to increase the model's robustness and accuracy.

Machine learning in Data Science

Simply said, Random Forest builds a number of decision trees using randomly chosen portions of the training data and features, combining the results to provide a final prediction. The characteristics and data used to construct each decision tree in the Random Forest are chosen at random, and each tree is trained independently of the others.

Machine learning in Data Science

Both classification and regression issues may be solved with Random Forest, which is renowned for its excellent accuracy, resilience, and resistance to overfitting. It may be used for feature selection and ranking and can handle huge datasets with high dimensionality and missing values.

Machine learning in Data Science

There are several uses for Random Forest, including bioinformatics, text classification, and picture classification. Due to its strong performance and capacity for handling complicated issues, it has been widely employed in both academic research and industry. For issues involving strongly linked traits or class inequalities, it might not be very effective.

Machine learning in Data Science

8. Logistic Regression:For binary classification issues, where the objective is to predict the likelihood of a binary result (such as Yes/No, True/False, or 1/0), logistic regression is a form of supervised learning technique. It is a statistical model that converts the result of a linear regression model into a probability value between 0 and 1. It does this by using the logistic function.

Machine learning in Data Science

Simply expressed, logistic functions are used in logistic regression to represent the connection between the input characteristics and the output probability. Any input value is converted by the logistic function to a probability value between 0 and 1. Given the input attributes, this probability number indicates the possibility that the binary result will be 1.

Machine learning in Data Science

Both basic and difficult issues may be solved using logistic regression, which can handle input characteristics with both numerical and categorical data. It may be used for feature selection and ranking since it is computationally efficient and simple to understand.

How to solve a problem in Data Science using Machine learning algorithms?

Now, let's understand what are the most common types of problems occurred in data science and what is the approach to solving the problems. So in data science, problems are solved using algorithms, and below is the diagram representation for applicable algorithms for possible questions:

How to solve a problem in Data Science using Machine learning algorithms?

Is this A or B? :

How to solve a problem in Data Science using Machine learning algorithms?

We can refer to this type of problem which has only two fixed solutions such as Yes or No, 1 or 0, may or may not. And this type of problems can be solved using classification algorithms.

How to solve a problem in Data Science using Machine learning algorithms?

Is this different? :

How to solve a problem in Data Science using Machine learning algorithms?

We can refer to this type of question which belongs to various patterns, and we need to find odd from them. Such type of problems can be solved using Anomaly Detection Algorithms.

How to solve a problem in Data Science using Machine learning algorithms?

How much or how many?

How to solve a problem in Data Science using Machine learning algorithms?

The other type of problem occurs which ask for numerical values or figures such as what is the time today, what will be the temperature today, can be solved using regression algorithms.

How to solve a problem in Data Science using Machine learning algorithms?

How is this organized?

How to solve a problem in Data Science using Machine learning algorithms?

Now if you have a problem which needs to deal with the organization of data, then it can be solved using clustering algorithms.

How to solve a problem in Data Science using Machine learning algorithms?

Clustering algorithm organizes and groups the data based on features, colors, or other common characteristics.

Data Science Lifecycle

The life-cycle of data science is explained as below diagram.

Data Science Lifecycle

The main phases of data science life cycle are given below:

Data Science Lifecycle

1. Discovery:The first phase is discovery, which involves asking the right questions. When you start any data science project, you need to determine what are the basic requirements, priorities, and project budget. In this phase, we need to determine all the requirements of the project such as the number of people, technology, time, data, an end goal, and then we can frame the business problem on first hypothesis level.

Data Science Lifecycle

2. Data preparation:Data preparation is also known as Data Munging. In this phase, we need to perform the following tasks:

Data Science Lifecycle

- Data cleaning
- Data Reduction
- Data integration
- Data transformation,

Data Science Lifecycle

After performing all the above tasks, we can easily use this data for our further processes.

Data Science Lifecycle

3. Model Planning:In this phase, we need to determine the various methods and techniques to establish the relation between input variables. We will apply Exploratory data analytics(EDA) by using various statistical formula and visualization tools to understand the relations between variable and to see what data can inform us. Common tools used for model planning are:

Data Science Lifecycle

- SQL Analysis Services
- R
- SAS
- Python

Data Science Lifecycle

4. Model-building:In this phase, the process of model building starts. We will create datasets for training and testing purpose. We will apply different techniques such as association, classification, and clustering, to build the model.

Data Science Lifecycle

Following are some common Model building tools:

Data Science Lifecycle

- SAS Enterprise Miner
- WEKA
- SPCS Modeler
- MATLAB

Data Science Lifecycle

5. Operationalize:In this phase, we will deliver the final reports of the project, along with briefings, code, and technical documents. This phase provides you a clear overview of complete project

performance and other components on a small scale before the full deployment.

Data Science Lifecycle

6. Communicate results:In this phase, we will check if we reach the goal, which we have set on the initial phase. We will communicate the findings and final result with the business team.

Applications of Data Science:

- Image recognition and speech recognition:Data science is currently using for Image and speech recognition. When you upload an image on Facebook and start getting the suggestion to tag to your friends. This automatic tagging suggestion uses image recognition algorithm, which is part of data science.When you say something using, "Ok Google, Siri, Cortana", etc., and these devices respond as per voice control, so this is possible with speech recognition algorithm.
- Gaming world:In the gaming world, the use of Machine learning algorithms is increasing day by day. EA Sports, Sony, Nintendo, are widely using data science for enhancing user experience.
- Internet search:When we want to search for something on the internet, then we use different types of search engines such as Google, Yahoo, Bing, Ask, etc. All these search engines use the data science technology to make the search experience better, and you can get a search result with a fraction of seconds.
- Transport:Transport industries also using data science technology to create self-driving cars. With self-driving cars, it will be easy to reduce the number of road accidents.
- Healthcare:In the healthcare sector, data science is providing lots of benefits. Data science is being used for tumor detection, drug discovery, medical image analysis, virtual medical bots, etc.
- Recommendation systems:Most of the companies, such as Amazon, Netflix, Google Play, etc., are using data science technology for making a better user experience with personalized recommendations. Such as, when you search for something on Amazon, and you started getting suggestions for similar products, so this is because of data science technology.
- Risk detection:Finance industries always had an issue of fraud and risk of losses, but with the help of data science, this can be rescued.Most of the finance companies are looking for the data scientist

to avoid risk and any type of losses with an increase in customer satisfaction.

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Data Science Tutorial

next ?? prevData Mesh - Rethinking Enterprise Data ArchitectureIn this age of world, where self-service business intelligence is ruling the field, every business tries to establish itself as an information-driven business. Many businesses are aware of the numerous benefits realized through leverage to make informed decisions. It is the ability to offer customers superior, highly personalized services while also reducing costs and capital being the most appealing.However, businesses are still confronted with a variety of challenges in transitioning into a data-driven strategy and making the most of its full potential. While transferring legacy systems and avoiding legacy culture and prioritizing the management of data in an ever-changing set of business needs are all legitimate challenges, the architecture of the data platform also is a major obstruction.Siloed data warehouses and data lake architectures are limited in their capacities to support an instantaneous stream of data. In turn, they undermine organizations' objectives of scalability and democratization. However, Data Mesh - a revolutionary, new paradigm of architecture that has caused quite the buzz - could help give your data-related goals an opportunity to breathe new life into your data.Let's look a bit closer at the details of Data Mesh and how it could change the way we think about big Data management.What is Data Mesh?Data Mesh essentially refers to breaking down siloes and data lakes into smaller, decentralized parts. Similar to the transition from monolithic software to microservices-based architectures in software development. Data Mesh can be described as a data-centric form of microservices.The term was initially defined in the late 1990s by ThoughtWorks Consultant Zhamak Dehghani as a kind structure for data platforms designed to take advantage of the all-encompassing nature of enterprise data by utilizing a self-service structured, domain-oriented structure.As an innovative idea in architecture and organization, Data Mesh challenges the common belief that large data needs to be centralized to maximize its potential for analysis. If all data isn't stored in one location and centrally managed in order to maximize its full value. In a 180-degree deviation from this old-fashioned belief, Data Mesh claims that big data can be a catalyst for the development of new technologies only if it's distributed to domain owners, which then offer data as a product.To make this possible for this, a fresh version of federated governance needs to be adopted via automated processes to facilitate interoperability among domain-oriented products. The democratization in the use of information is the primary foundation upon which the idea Data Mesh was developed. Data Mesh rests, and it can't be accomplished without decentralization, interoperability, and prioritizing the users the experience.As an architectural concept, Data Mesh holds immense potential for enabling analytics on a large scale by offering access to a growing and fast-growing diverse domain set. Particularly in scenarios that increase consumption like machine learning, analytics, or the development and deployment of data-centric apps.In its essence, Data Mesh seeks to address the weaknesses of traditional platforms, which led to the development of central data lakes or warehouses. Contrasting with monolithic data handling infrastructures that limit the consumption, storage, and processing of data is restricted to a single data lake, Data Mesh supports data distribution to specific domains. The approach of the data-as-a product allows people in different areas to manage the data processing pipelines of their respective domains on their own.The tissue that connects these domains, as well as the data assets that are associated with them, provides an interoperability layer that ensures a consistent format and standard for data. The various pockets of data are connected and joined by the mesh. Thus, the term.Problems that Data Mesh Seeks to Fix:As previously mentioned, the limitations of the traditional data structures have proven to be an important obstruction in businesses' efforts to make the most of the data available to their disposal to make tangible gains in improving business practices and processes. The main challenge is the transformation of massive amounts of data into savvy and actionable information.Data Mesh addresses these concerns by addressing the following obvious flaws in the traditional approach to managing big data:Monolithic Platforms can't keep up:Monolithic data platforms like lakes and warehouses often do not have the range of data sources and the domain-specific structures required to extract important insights from massive chunks of data. In the end, vital information specific to a particular domain gets lost on the centralized systems. 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This is essential since the same set of raw and transformed data is likely to provide value to many different domains. The standardization of data attributes like governance, discoverability, and formation. Metadata specifications allow cross-domain collaboration.Four Core Principles and Logical Architecture of Data MeshData Mesh is a paradigm that is based on four core principles. Each of them is intuitively designed to address the numerous challenges that arise from the traditional centralized approach towards big data management as well as data analysis. This is a review of what these fundamental principles refer to:1. Domain-oriented Decentralized Data Ownership and Architecture:The core of the project is that Data Mesh seeks to decentralize the responsibility for data distribution to the people who work closely with it in hopes of scalability and continuous execution of any modifications. The decomposition and decentralization of data are accomplished by reshaping the data ecosystem, which includes metadata, analytical data, and the underlying computations. Because most companies today are decentralized in accordance with the areas they work within, the decomposition of data is performed on the same line. This is a way to localize the results of change and evolution with respect to the limited context of a particular domain. This is why it's important to create the best system for data ownership distribution.2. Data-as-a-product:One of the biggest problems with monolithic data structures is the significant cost and difficulty in identifying, trusting, interpreting the importance of using high-quality data. The problem could have been exacerbated with Data Meshes considering an increase in the number of data domains had it not been addressed from the beginning. The principle of data as a product was viewed as a viable solution to solving the problems of old data silos as well as their data quality. In this model, analytical data is treated as a product, and those who utilize this data are considered customers. Making use of capabilities like accessibility, understanding, security, and trustworthiness is essential to use data as an item. Therefore, it is an essential element to Data Mesh implementation.3. Self-Serve Data Infrastructure as a Platform:Establishing, deploying, monitoring, accessing, and managing data as a product requires a large infrastructure and the right skills to provide it. Replicating these resources for each domain created using the Data Mesh approach is not feasible. Furthermore, multiple domains may have access to the identical collection of data. To prevent duplication of efforts and resources, a high-level abstraction of infrastructure must be required. 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Mesh architecture for big data management. Is it, however, the best option for you?A simple method to figure out how to determine the Data Mesh score based on the quality of the data as well as the number of data domains as well as data teams, their size, and the bottlenecks that exist in data engineering and governance methods.The more score you have, the higher your score, the more complicated your infrastructure for data and, consequently, the greater the requirement for Data Mesh.ConclusionTechnology-related compatibility is among the most important aspects to be considered by any company's efforts to adopt and implement the Data Mesh-based approach to managing data. To fully embrace the Data Mesh architecture effectively, companies must restructure the data platform, rethink the roles of the domain owners and overhaul their structures in order to make the ownership of data products possible, as well as transition to treat their data analysis as an item.Next TopicPowerful Data Collection Tools in Healthcare? prevnext ?

Data Mesh - Rethinking Enterprise Data Architecture

In this age of world, where self-service business intelligence is ruling the field, every business tries to establish itself as an information-driven business. Many businesses are aware of the numerous benefits realized through leverage to make informed decisions. It is the ability to offer customers superior, highly personalized services while also reducing costs and capital being the most appealing.

Data Mesh - Rethinking Enterprise Data Architecture

However, businesses are still confronted with a variety of challenges in transitioning into a data-driven strategy and making the most of its full potential. While transferring legacy systems and avoiding legacy culture and prioritizing the management of data in an ever-changing set of business needs are all legitimate challenges, the architecture of the data platform also is a major obstruction.

Data Mesh - Rethinking Enterprise Data Architecture

Siloed data warehouses and data lake architectures are limited in their capacities to support an instantaneous stream of data. In turn, they undermine organizations' objectives of scalability and democratization. However, Data Mesh - a revolutionary, new paradigm of architecture that has caused quite the buzz - could help give your data-related goals an opportunity to breathe new life into your data.

Data Mesh - Rethinking Enterprise Data Architecture

Let's look a bit closer at the details of Data Mesh and how it could change the way we think about big Data management.

What is Data Mesh?

Data Mesh essentially refers to breaking down siloes and data lakes into smaller, decentralized parts. Similar to the transition from monolithic software to microservices-based architectures in software development. Data Mesh can be described as a data-centric form of microservices.

What is Data Mesh?

The term was initially defined in the late 1990s by ThoughtWorks Consultant Zhamak Dehghani as a kind structure for data platforms designed to take advantage of the all-encompassing nature of enterprise data by utilizing a self-service structured, domain-oriented structure.

What is Data Mesh?

As an innovative idea in architecture and organization, Data Mesh challenges the common belief that large data needs to be centralized to maximize its potential for analysis. If all data isn't stored in one location and centrally managed in order to maximize its full value. In a 180-degree deviation from this old-fashioned belief, Data Mesh claims that big data can be a catalyst for the development of new technologies only if it's distributed to domain owners, which then offer data as a product.

What is Data Mesh?

To make this possible for this, a fresh version of federated governance needs to be adopted via automated processes to facilitate interoperability among domain-oriented products. The democratization in the use of information is the primary foundation upon which the idea Data Mesh was developed. Data Mesh rests, and it can't be accomplished without decentralization, interoperability, and prioritizing the users the experience.

What is Data Mesh?

As an architectural concept, Data Mesh holds immense potential for enabling analytics on a large scale by offering access to a growing and fast-growing diverse domain set. Particularly in scenarios that increase consumption like machine learning, analytics, or the development and deployment of data-centric apps.

What is Data Mesh?

In its essence, Data Mesh seeks to address the weaknesses of traditional platforms, which led to the development of central data lakes or warehouses. Contrasting with monolithic data handling infrastructures that limit the consumption, storage, and processing of data is restricted to a single data lake, Data Mesh supports data distribution to specific domains. The approach of the data-as-a product allows people in different areas to manage the data processing pipelines of their respective domains on their own.

What is Data Mesh?

The tissue that connects these domains, as well as the data assets that are associated with them, provides an interoperability layer that ensures a consistent format and standard for data. The various pockets of data are connected and joined by the mesh. Thus, the term.

Problems that Data Mesh Seeks to Fix:

As previously mentioned, the limitations of the traditional data structures have proven to be an important obstruction in businesses' efforts to make the most of the data available to their disposal to make tangible gains in improving business practices and processes. The main challenge is the transformation of massive amounts of data into savvy and actionable information.

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To Mesh or Not to Mesh - Which is the Right Choice for Us?

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Conclusion

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Data Science Tutorial

next ?? prevPowerful Data Collection Tools in HealthcareData collection via various tools is one of the major ways healthcare professionals gain new information. As time passes, the data collection process has increased its capabilities to help solve the most critical areas of concern and develop practical solutions for healthcare IT.This approach to solving problems is the main reason for the growth of healthcare players. They've contributed to increasing the appeal of the market through the integration of disparate elements. They've also managed to enhance the process by using the most advanced technology in the field.Research conducted byFrost & Sullivanhas shown Artificial Intelligence healthcare to grow by about 40% by 2021. The most popular demand for this technology has been in data gathering. Due to Artificial Intelligence, Machine Learning, Natural Language Processing, and Blockchain, data collection has become a much easier procedure.From the standpoint of data analytics, collecting data is among the most crucial elements in the entire process. It has been regarded as one of the earliest ways to gather important information. With more data returned to systems, they have better insights and more efficient output overall.The lack of Precise Data and the Availability ProblemIt isn't easy to find a sense of clarity in gathering the correct volume of data. Also, there is a lack of quality in data collection methods currently. There are many errors and biases that computers and human beings are prone to. This includes the way we approach data collection from a results-based standpoint.This happens when we are searching for the correct data, but there's no ready data. This is when sampling errors and confidence interval issues increase as well. It leads to a less robust outcome in the end. It also causes more uncertainty when it comes to the final results. This is detrimental to the healthcare system overall.The availability of data is a major aspect as well. While the data may not be readily available throughout the board but there are certain areas where the information isn't readily accessible in the proper amount. The reason for this is that the samples aren't large enough to carry out. The person who is entering data or the researcher might not be aware of the reason they're taking the data.This can lead to issues that result from the process. In the event that there is a lack of reliable data is present, there is a greater demand for improved tools to collect data to be available in the field.In the healthcare sector, there is a growing need for better data-capturing technology to be developed. This is especially important in the Artificial Intelligence area, as there is a need for greater amounts of data to create more efficient algorithms.Some lapses aren't in the program, so the information does not provide the data. Data must be a part of the digital revolution that is taking place in the health sector currently. This is why research institutes must opt for more data collection tools for health care.Data Collection and Security in HealthcareThere is a bigger issue in the field of data collection concerning security. Even though security procedures are implemented, few of them are reaching out to the more advanced data gathering model. From a data point of view, it's essential to adopt the correct approach to understanding security. Utilizing the most important technologies, such as Blockchain as well as Machine Learning, companies can invest in the long-term accumulation of data points across the board. There are more benefits to using predictive models in this area and the increase in companies getting better ROI.Merck collaborates with Atom wise to enhance the security of its data collection using Deep Learning. It's among the top examples of how data sciences can become more secure with the help of AI or ML. It's also an excellent method to guarantee the longevity of the model of data collection. Utilizing sophisticated tools and analysis, companies such as Merck have managed to continue to be successful. By enhancing their core offering and delivering the most comprehensive solution overall.Data collection is vital. However, staying in compliance with the security protocols is crucial too. The approach to data collection based on a security-first approach is essential. This will give greater protection over the board and create organizations more accountable to all procedures. Because there's always a risk of data theft or data mining problem, organizations must be alert to any threats that might arise in their work. From a security point of view, the Healthcare industry must take the appropriate steps to stop theft from happening.There's a second issue when it comes to data collection that revolves around the security in the method. When the procedure is not open to scrutiny and has many collaborators involved, the data could be susceptible to theft from outside. There is also the chance of altering the process of collecting data as well as problems that could result from validation by an external source. Some instances see the entire captured processes are compromised due to additional information from outside the industry. The business must keep its security measures and establish a more secure environment to ensure improved health.Tools to a better-quality DataThere's a huge benefit in collecting data of higher quality, and that's where tools for data collection are a part of the equation. They are designed to improve our overall process of getting accurate and reliable data from the point of origin. The latest versions made by AI as well as embedded technology can capture greater amounts of data at a quicker rate. It's crucial to determine the Big Data goal and then build from there. The following is a reference.The advent of 5G in the next quarter will improve our capability to use more information. In addition, from a technology perspective, there are important advantages of taking a more technological-oriented approach. Everything from speedier IoT information sharing to better-optimized bandwidth utilization could be accomplished through the use of data capture tools that are more efficient and high-quality. This is why it's crucial to use the correct method when capturing data.Collecting real-world, real-time data through digital technologies will become a fundamental part of the program. This information, in combination with many other data types, will give us an unprecedented ability to better understand the impact of lifestyle and environment on health outcomes and, ultimately, develop better strategies for keeping people healthy in an exact, individualized way.- Eric Dishman, Director of National Institutes of Health (NIH)From a health-sciences standpoint, it is essential to ensure that information is stored in a well-organized method. While there are technological advancements that can help capture the data effectively, policies and expertise should be used correctly too. This will ensure we have a simplified process for collecting the right information in the field. This is the best way to go, as it allows for greater transparency throughout the entire process. Businesses can use the information they collect to ensure no ambiguities in all subject areas.Each tool for data capture comes with its disadvantages and limitations, but it's crucial to keep the stream in transparency as well as accountability throughout the system. This ensures a better quality of data that is captured regardless of the tools employed to accomplish this. In addition, from a research standpoint, it is essential to be equipped with the tools needed to achieve the ultimate objective. When technologies are embedded into space and space systems, there needs greater power in every step of data entry.Enhancing existing Enterprise Data Warehouses (EDW)It is essential to use the correct tools for data collection in healthcare that can work seamlessly together with Enterprise Data Warehouses. This is essential to ensure that compatibility is a priority, especially when working with data houses dating back several decades. It is also essential to thoroughly explore since there are instances where the data has been found to be incorrect or incompatible with the results when there is poor integration. The EDW must be scalable and integrated with the tools already which are used. This is why tools for data collection must be utilized to improve EDW systems.Data collection tools must also be able to guarantee interoperability across systems. There shouldn't be any instances where data is shared in the absence of a need. There are instances where metadata is shared across an encrypted platform, which violates compliance guidelines. This is the reason why the tools used to collect data employed must be scalable and reliable enough to ensure security and compliance.From the point of view of laboratories of research across the globe, the tools for data collection are crucial. The tool we choose to use can influence our research plan in many ways. It could also determine the overall strategy and help our business become more or less in line with standards in the industry. There are no problems with peer reviews and analysis reports if we use the appropriate data gathering tools. This is where the entire range of experiences collide for researchers, and they are able to rely on the information 100 percent completely. This is one of the biggest factors that have shaped the global healthcare analytics market. As nations become more advanced with their data capture capabilities and analysis, they will perform better analysis.Capturing Data better at the SourceThe ability to capture better data directly from the source is crucial. This is accomplished through advanced technology and tools specifically designed to provide the most comprehensive method of working. This allows companies to collect greater amounts of data and creates an ever-changing data centre for analysis as tools improve, as do the methods for capturing data. This leads to more comprehensive data analytics approaches and integrates the most effective methods.Certain technologies harness Blockchain's potential for ensuring that retrieval and the storage of data are more secure. The ability to capture data from the source is also several methods healthcare providers can utilize. This is an extremely efficient way to save information on your dashboard.Another crucial element of the capturing process is the training that's required for maximum effectiveness. Research firms that use the right people for a specific project should ensure using the appropriate technology tools. The key talent should be well-versed enough to recognize the value of the technology used. A further factor to consider is the capacity of the software being utilized. This is a crucial aspect to consider in every healthcare project as there's a significant quantity of information being generated. As data grows, the need for a larger scale emerges that ultimately results in more accurate data collection from the beginning.Ensuring effective data captureThe biggest issue in the healthcare industry is the need for more efficient data collection tools that more efficient methods of data gathering can improve. If researchers have access to certain types of data, there must be a meaningful connection to it. Researchers shouldn't release the data to be examined from a different angle. It is also advisable to ask the right questions when collecting data from the beginning.The issue is to create meaningful connections between these data sets and then utilize them to pinpoint groups of people who require individual treatment. In close collaboration alongside researchers, this has been now beginning to take place in the NHS and is a crucial first step towards individualised medical treatment.- Prof. Gkoutos, University of Birmingham Health ResearchThe most effective approach is to identify the primary issue. If the root of the issue is fully understood and clarified, it can lead to a more precise approach to data capture.

Researchers can pose pertinent questions to patients, who then reply accordingly. These methods can achieve more clarity and less ambiguity. The most important concern areas to ensure effective data capture are: -It is essential to obtain the correct data from research and patient-participants. This is a vital decision to make as the various problems in the Healthcare space can cause mishaps. If we are requesting the right details from patients, it is essential to comprehend the problem being dealt with. A thorough understanding of the key variables makes the recording process straightforward.Staff training in a timely way. Training is the most important thing in the health care industry. It's the distinction between efficiently gathering the correct information. The quality of data available in this field is crucial to create since there are a few ways to recover from the Healthcare sector. Furthermore, when businesses provide sophisticated and costly facilities for research, they use the most advanced technologies. It is essential to have the appropriate researchers to collect the right data.Tech-savvy, able to tackle bugs, errors, or coding. The source manager or the admin must be able to code in error-prone information for more integration and better management. It is essential to know since there are real issues in the Healthcare sector in terms of technological knowledge. There are not enough researchers who can program the correct methods to run simulations on the data that is collected. This can cause workarounds or poorer integration in general.Problems with One-off Solutions or Single Line LeadsA variety of one-off products provide a unique method of data capture. They generally perform similar functions but aren't well integrated into the system being utilized. They also conflict with industry standards sometimes and can be difficult to utilize and leverage. They're always in motion, and the constant research about them can cause problems when scaling up. There could be problems with integration or updates that do not appear on time.Security is an issue in this regard as well. As more and more tools are released on the market, and more tools are released, it becomes increasingly difficult to cover every aspect efficiently. As updates are introduced into the ecosystem, all aspects within the Healthcare domain have to be connected simultaneously. If not, compatibility was an advantage, but it's a weak point today. This is why it's recommended to choose an ecosystem that includes data capture and storage capabilities, as well as cloud-based capabilities.Innovative technologies are making use of the most recent Blockchain technology in healthcare. They're using the most well-known developments for data integration and storage. Blockchain technology is enabling more storage as well as secure retrieval of data, which allows businesses to guarantee better data collection. Blockchain is enabling more substantial innovation in the area as a top tool for collecting data.Data collection isn't always linear. There are numerous sources to refer to and numerous sets of data to examine separately. When projects span several years, it's crucial to use an instrument for data collection that can be cross-compliant across different areas. It's also more effective in terms of scale. If projects grow to cover more territory, the tools for data collection can serve as the bridge between integration and gathering and analysing various sources of information and insight. From a resource standpoint, selecting appropriate systems for data gathering is logical. As research becomes, new tools are being introduced on the market that integrates with the existing technology.Collaboration, Security and AnalyticsIn the Healthcare area, there are instances where errors can arise during the data collection process. It is a result of poor coordination or measures to protect the data that weren't implemented correctly. This makes the process and tool need to be designed to collect data more effectively.It is essential to use the correct format for audits to capture more information in the data collection area. There are times when it is possible to findBotNetsas well asMalwareviruses that be a long time to appear. They transform into ransomware software and cause problems regarding data integrity. From a security perspective, it's crucial to have the appropriate data collection tools to implement more exemplary guidelines.Security is as important to consider along with collaboration. If multiple collaborators are involved within an ecosystem, it is crucial to think about the broad nature of the system. The collaborators shouldn't always have information about research findings. This could lead to data corruption as well as the mixing of various levels of data. A tool to capture data should be designed to be simple enough to allow that the correct amount of data is being displayed and collaboration to be conducted in a way that is based on authorization. If we have the right environment for data collection, the process will become more natural in the longer term to create an even more efficient process.When it is about Analytics, it is possible to use a variety of applications available to help you gain more insight. Analytics has grown to incorporate AI in addition to Machine Learning in the core process. There are a variety of ways to gather the correct amount of information within the domain, as well as Artificial Intelligence tools that can provide useful analytics. The tool that collects data should gather details and utilize AI to improve analysis. A robust tool is an ideal choice for this scenario.ConclusionData collection is one of the primary ways this Healthcare industry has grown in the past. Many fields within space have developed because of the breakthroughs made by core technology. Everything from AI to smart wearables has been improved by using the most appropriate tools for data collection. Data collection has advanced to an extent where there are advanced technologies to collect greater quantity and quality of data. The Enterprise data market, especially in the health sector, has grown significantly due to the increasing quality of data. 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Powerful Data Collection Tools in Healthcare

Data collection via various tools is one of the major ways healthcare professionals gain new information. As time passes, the data collection process has increased its capabilities to help solve the most critical areas of concern and develop practical solutions for healthcare IT.

Powerful Data Collection Tools in Healthcare

This approach to solving problems is the main reason for the growth of healthcare players. They've contributed to increasing the appeal of the market through the integration of disparate elements. They've also managed to enhance the process by using the most advanced technology in the field.

Powerful Data Collection Tools in Healthcare

Research conducted byFrost & Sullivanhas shown Artificial Intelligence healthcare to grow by about 40% by 2021. The most popular demand for this technology has been in data gathering. Due to Artificial Intelligence, Machine Learning, Natural Language Processing, and Blockchain, data collection has become a much easier procedure.

Powerful Data Collection Tools in Healthcare

From the standpoint of data analytics, collecting data is among the most crucial elements in the entire process. It has been regarded as one of the earliest ways to gather important information. With more data returned to systems, they have better insights and more efficient output overall.

The lack of Precise Data and the Availability Problem

It isn't easy to find a sense of clarity in gathering the correct volume of data. Also, there is a lack of quality in data collection methods currently. There are many errors and biases that computers and human beings are prone to. This includes the way we approach data collection from a results-based standpoint.

The lack of Precise Data and the Availability Problem

This happens when we are searching for the correct data, but there's no ready data. This is when sampling errors and confidence interval issues increase as well. It leads to a less robust outcome in the end. It also causes more uncertainty when it comes to the final results. This is detrimental to the healthcare system overall.

The lack of Precise Data and the Availability Problem

The availability of data is a major aspect as well. While the data may not be readily available throughout the board but there are certain areas where the information isn't readily accessible in the proper amount. The reason for this is that the samples aren't large enough to carry out. The person who is entering data or the researcher might not be aware of the reason they're taking the data.

The lack of Precise Data and the Availability Problem

This can lead to issues that result from the process. In the event that there is a lack of reliable data is present, there is a greater demand for improved tools to collect data to be available in the field.

The lack of Precise Data and the Availability Problem

In the healthcare sector, there is a growing need for better data-capturing technology to be developed. This is especially important in the Artificial Intelligence area, as there is a need for greater amounts of data to create more efficient algorithms.

The lack of Precise Data and the Availability Problem

Some lapses aren't in the program, so the information does not provide the data. Data must be a part of the digital revolution that is taking place in the health sector currently. This is why research institutes must opt for more data collection tools for health care.

Data Collection and Security in Healthcare

There is a bigger issue in the field of data collection concerning security. Even though security procedures are implemented, few of them are reaching out to the more advanced data gathering model. From a data point of view, it's essential to adopt the correct approach to understanding security. Utilizing the most important technologies, such as Blockchain as well as Machine Learning, companies can invest in the long-term accumulation of data points across the board. There are more benefits to using predictive models in this area and the increase in companies getting better ROI.

Data Collection and Security in Healthcare

Merck collaborates with Atom wise to enhance the security of its data collection using Deep Learning. It's among the top examples of how data sciences can become more secure with the help of AI or ML. It's also an excellent method to guarantee the longevity of the model of data collection. Utilizing sophisticated tools and analysis, companies such as Merck have managed to continue to be successful. By enhancing their core offering and delivering the most comprehensive solution overall.

Data Collection and Security in Healthcare

Data collection is vital. However, staying in compliance with the security protocols is crucial too. The approach to data collection based on a security-first approach is essential. This will give greater protection over the board and create organizations more accountable to all procedures. Because there's always a risk of data theft or data mining problem, organizations must be alert to any threats that might arise in their work. From a security point of view, the Healthcare industry must take the appropriate steps to stop theft from happening.

Data Collection and Security in Healthcare

There's a second issue when it comes to data collection that revolves around the security in the method. When the procedure is not open to scrutiny and has many collaborators involved, the data could be susceptible to theft from outside. There is also the chance of altering the process of collecting data as well as problems that could result from validation by an external source. Some instances see the entire captured processes are compromised due to additional information from outside the industry. The business must keep its security measures and establish a more secure environment to ensure improved health.

Tools to a better-quality Data

There's a huge benefit in collecting data of higher quality, and that's where tools for data collection are a part of the equation. They are designed to improve our overall process of getting accurate and reliable data from the point of origin. The latest versions made by AI as well as embedded technology can capture greater amounts of data at a quicker rate. It's crucial to determine the Big Data goal and then build from there. The following is a reference.

Tools to a better-quality Data

The advent of 5G in the next quarter will improve our capability to use more information. In addition, from a technology perspective, there are important advantages of taking a more technological-oriented approach. Everything from speedier IoT information sharing to better-optimized bandwidth utilization could be accomplished through the use of data capture tools that are more efficient and high-quality. This is why it's crucial to use the correct method when capturing data.

Tools to a better-quality Data

From a health-sciences standpoint, it is essential to ensure that information is stored in a well-organized method. While there are technological advancements that can help capture the data effectively, policies and expertise should be used correctly too. This will ensure we have a simplified process for collecting the right information in the field. This is the best way to go, as it allows for greater transparency throughout the entire process. Businesses can use the information they collect to ensure no ambiguities in all subject areas.

Tools to a better-quality Data

Each tool for data capture comes with its disadvantages and limitations, but it's crucial to keep the stream in transparency as well as accountability throughout the system. This ensures a better quality of data that is captured regardless of the tools employed to accomplish this. In addition, from a research standpoint, it is essential to be equipped with the tools needed to achieve the ultimate objective. When technologies are embedded into space and space systems, there needs greater power in every step of data entry.

Enhancing existing Enterprise Data Warehouses (EDW)

It is essential to use the correct tools for data collection in healthcare that can work seamlessly together with Enterprise Data Warehouses. This is essential to ensure that compatibility is a priority, especially when working with data houses dating back several decades. It is also essential to thoroughly explore since there are instances where the data has been found to be incorrect or incompatible with the results when there is poor integration. The EDW must be scalable and integrated with the tools already which are used. This is why tools for data collection must be utilized to improve EDW systems.

Enhancing existing Enterprise Data Warehouses (EDW)

Data collection tools must also be able to guarantee interoperability across systems. There shouldn't be any instances where data is shared in the absence of a need. There are instances where metadata is shared across an encrypted platform, which violates compliance guidelines. This is the reason why the tools used to collect data employed must be scalable and reliable enough to ensure security and compliance.

Enhancing existing Enterprise Data Warehouses (EDW)

From the point of view of laboratories of research across the globe, the tools for data collection are crucial. The tool we choose to use can influence our research plan in many ways. It could also determine the overall strategy and help our business become more or less in line with standards in the industry. There are no problems with peer reviews and analysis reports if we use the appropriate data gathering tools. This is where the entire range of experiences collide for researchers, and they are able to rely on the information 100 percent completely. This is one of the biggest factors that have shaped the global healthcare analytics market. As nations become more advanced with their data capture capabilities and analysis, they will perform better analysis.

Capturing Data better at the Source

The ability to capture better data directly from the source is crucial. This is accomplished through advanced technology and tools specifically designed to provide the most comprehensive method of working. This allows companies to collect greater amounts of data and creates an ever-changing data centre for analysis as tools improve, as do the methods for capturing data. This leads to more comprehensive data analytics approaches and integrates the most effective methods.

Capturing Data better at the Source

Certain technologies harness Blockchain's potential for ensuring that retrieval and the storage of data are more secure. The ability to capture data from the source is also several methods healthcare providers can utilize. This is an extremely efficient way to save information on your dashboard.

Capturing Data better at the Source

Another crucial element of the capturing process is the training that's required for maximum effectiveness. Research firms that use the right people for a specific project should ensure using the appropriate technology tools. The key talent should be well-versed enough to recognize the value of the technology used. A further factor to consider is the capacity of the software being utilized. This is a crucial aspect to consider in every healthcare project as there's a significant quantity of information being generated. As data grows, the need for a larger scale emerges that ultimately results in more accurate data collection from the beginning.

Ensuring effective data capture

The biggest issue in the healthcare industry is the need for more efficient data collection tools that more efficient methods of data gathering can improve. If researchers have access to certain types of data, there must be a meaningful connection to it. Researchers shouldn't release the data to be examined from a different angle. It is also advisable to ask the right questions when collecting data from the beginning.

Ensuring effective data capture

The most effective approach is to identify the primary issue. If the root of the issue is fully understood and clarified, it can lead to a more precise approach to data capture. Researchers can pose pertinent questions to patients, who then reply accordingly. These methods can achieve more clarity and less ambiguity. The most important concern areas to ensure effective data capture are: -

Ensuring effective data capture

- It is essential to obtain the correct data from research and patient-participants. This is a vital decision to make as the various problems in the Healthcare space can cause mishaps. If we are requesting the right details from patients, it is essential to comprehend the problem being dealt with. A thorough understanding of the key variables makes the recording process straightforward.
- Staff training in a timely way. Training is the most important thing in the health care industry. It's the distinction between efficiently gathering the correct information. The quality of data available in this field is crucial to create since there are a few ways to recover from the Healthcare sector. Furthermore, when businesses provide sophisticated and costly facilities for research, they use the

most advanced technologies. It is essential to have the appropriate researchers to collect the right data.

- Tech-savvy, able to tackle bugs, errors, or coding. The source manager or the admin must be able to code in error-prone information for more integration and better management. It is essential to know since there are real issues in the Healthcare sector in terms of technological knowledge. There are not enough researchers who can program the correct methods to run simulations on the data that is collected. This can cause workarounds or poorer integration in general.

Problems with One-off Solutions or Single Line Leads

A variety of one-off products provide a unique method of data capture. They generally perform similar functions but aren't well integrated into the system being utilized. They also conflict with industry standards sometimes and can be difficult to utilize and leverage. They're always in motion, and the constant research about them can cause problems when scaling up. There could be problems with integration or updates that do not appear on time.

Problems with One-off Solutions or Single Line Leads

Security is an issue in this regard as well. As more and more tools are released on the market, and more tools are released, it becomes increasingly difficult to cover every aspect efficiently. As updates are introduced into the ecosystem, all aspects within the Healthcare domain have to be connected simultaneously. If not, compatibility was an advantage, but it's a weak point today. This is why it's recommended to choose an ecosystem that includes data capture and storage capabilities, as well as cloud-based capabilities.

Problems with One-off Solutions or Single Line Leads

Innovative technologies are making use of the most recent Blockchain technology in healthcare. They're using the most well-known developments for data integration and storage. Blockchain technology is enabling more storage as well as secure retrieval of data, which allows businesses to guarantee better data collection. Blockchain is enabling more substantial innovation in the area as a top tool for collecting data.

Problems with One-off Solutions or Single Line Leads

Data collection isn't always linear. There are numerous sources to refer to and numerous sets of data to examine separately. When projects span several years, it's crucial to use an instrument for data collection that can be cross-compliant across different areas. It's also more effective in terms of scale. If projects grow to cover more territory, the tools for data collection can serve as the bridge between integration and gathering and analysing various sources of information and insight. From a resource standpoint, selecting appropriate systems for data gathering is logical. As research becomes, new tools are being introduced on the market that integrates with the existing technology.

Collaboration, Security and Analytics

In the Healthcare area, there are instances where errors can arise during the data collection process. It is a result of poor coordination or measures to protect the data that weren't implemented correctly. This makes the process and tool need to be designed to collect data more effectively.

Collaboration, Security and Analytics

It is essential to use the correct format for audits to capture more information in the data collection area. There are times when it is possible to findBotNetsas well asMalwareviruses that be a long time to appear. They transform into ransomware software and cause problems regarding data integrity. From a security perspective, it's crucial to have the appropriate data collection tools to implement more exemplary guidelines.

Collaboration, Security and Analytics

Security is as important to consider along with collaboration. If multiple collaborators are involved within an ecosystem, it is crucial to think about the broad nature of the system. The collaborators shouldn't always have information about research findings. This could lead to data corruption as well as the mixing of various levels of data. A tool to capture data should be designed to be simple enough to allow that the correct amount of data is being displayed and collaboration to be conducted in a way that is based on authorization. If we have the right environment for data collection, the process will become more natural in the longer term to create an even more efficient process.

Collaboration, Security and Analytics

When it is about Analytics, it is possible to use a variety of applications available to help you gain more insight. Analytics has grown to incorporate AI in addition to Machine Learning in the core process. There are a variety of ways to gather the correct amount of information within the domain, as well as Artificial Intelligence tools that can provide useful analytics. The tool that collects data should gather details and utilize AI to improve analysis. A robust tool is an ideal choice for this scenario.

Conclusion

Data collection is one of the primary ways this Healthcare industry has grown in the past. Many fields within space have developed because of the breakthroughs made by core technology. Everything from AI to smart wearables has been improved by using the most appropriate tools for data collection. Data collection has advanced to an extent where there are advanced technologies to collect greater quantity and quality of data. The Enterprise data market, especially in the health sector, has grown significantly due to the increasing quality of data. The insights can be gleaned from this data, becoming increasingly useful to healthcare professionals.

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Data is the lifeblood of many modern applications and projects, driving insights, innovations, and decision-making processes. However, finding high-quality datasets can be a challenge. To help you in your quest for data, we've compiled a list of the top 17 places where you can find...

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Non-Technical Skills in Data Analytics

Within the fast-changing field of data analytics, great specialized skills are basic. Capability in programming languages, statistical analysis, and data visualization instruments is regularly seen as the establishment of a competent information analyst's arsenal. Non-technical abilities, on the other hand, are similarly crucial in guaranteeing...

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Therefore, it becomes necessary for a data analyst to define and understand data with the right set of initial questions and a standardized workflow for the different types of analysis he needs to perform.The following words are from Jeff Leek's fascinating book "The Elements of Data Analytic Style," which broadly categorizes various analysis phases based on the type of question and the outcome expected to be achieved for the particular business need.Descriptive Data AnalysisThe name suggests that this kind of analysis offers basic "descriptions" or summaries about the raw data set accumulated and the observations added to the same.They can be both visual and quantitative, and the data can be depicted using statistics and simple graphs. This summary does not require any further analysis and is utilized as a summary to make sense of the information.Example:Data on segregation of students enrolled in the same course at college:The data could be split into various categories such as numbers, gender, residency age, race, and so on. The information summarizes or groups the data into a fixed set that describes all students and the specific information. It doesn't suggest anything and only provides specifics. Thus, it is a type of descriptive analytics.Exploratory Data AnalysisAnalysis of descriptive data output that is further studied for discoveries patterns, trends, correlations, or inter-relations among different areas of the data in order to develop an interpretation, an idea, or hypotheses. This is the foundation of Exploratory Data Analysis (EDA).In essence, it's expanding over the description data sets and trying to provide a comprehensive overview of the data. According to Dianne Cook, as well as Deborah F. Swayne rightly refer to in their book, "(EDA is) a 'play-in-the-sand' to allow us to find the unexpected and come to some understanding of our data."The main focus isn't always the result of the problem statement; rather, to look at the various elements of data in the first place in order to more intimately.Example:A typical EDA application studies the behaviour of traffic patterns in cities around the world. Although the data gathered may vary in terms of its nature, various surprising discoveries may be discovered like the frequency of accidents that occur at traffic signals, the amount of pollution that is produced on a daily basis because of exhaust emissions from vehicles, and even the rates of traffic congestion in a week. The outcome of the real issue isn't always determined by these findings. The information gathered alongside other data may be helpful to determine the result.Inferential/Quantified Data AnalysisThe distinction between inferential and exploratory analysis could be identified by determining if the analysis offers consistent information across various samples and the ones in the present.Example:Calculating the mean of marks earned by students taking an exam against the difficulty index for 100 students can give valuable information on the students of 100.This data can assist in understanding the quality of the connection between these two dimensions when studying student performance on exams. Although it's impossible to know the reasons for these relationships, there is a way to determine the significance of a certain connection in determining inferential results.Predictive Data AnalysisThe predictive analysis predicts the outcomes that could be expected from a small subset of data from the initial population set. This method of predicting new information is mostly built on quantifiable metrics from the existing data set.Predictive analysis is not able to quantify the relationship between two dimensions as the inferential statistical method. Rather it uses probabilities that they share to predict possible outcomes in the future.Example:Examining the influence and popularity of the nominees running for election to determine the outcome of that election.In this case, we can determine the likelihood of the success of the candidate based on data about issues he discusses as well as his conservative and liberal views, information on his popularity in the state of his residence and so on. While we can estimate a potential outcome based on these data, however, we can't predict the outcome accurately.Causal Data AnalysisMaking modifications to one dimension or measurement to create a conclusive version of a different dimension is the foundation of causal analysis. It is designed to determine the extent and direction the measurement takes in contrast to the previous two. It is a predictive analysis and an inferential one.Example:A randomized clinical trial to determine whether faecal transfer decreases the incidence of infections caused by Clostridium di-facile.Patients in this research were randomly assigned to receive a faecal transfer along with standard care or regular treatment. Based on the results, the researchers found an unambiguous relationship between the outcomes of infections and transplants. Therefore, the study of the causality of patients produced an exact average outcome from raw data.Mechanistic Data AnalysisAlthough causal data provides an accurate average result, the aim isn't just to comprehend that there's an impact of the inferences derived from data but also to understand how the effect is affecting the outcome.An example:Mechanistic analysis that examines the way in which wing design influences the flow of air around a wing, which results in less drag. In the absence of any engineering expertise, mechanical analysis of data is extremely difficult and is rarely done.ConclusionAs we can see, harnessing big-data analytics can bring huge benefits to companies, providing the context of data to tell an even more comprehensive story. By converting complex data sets into actionable intelligence, stakeholders can make better business decisions. 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Workflow of Data Analytics

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next ?? prevLife Cycle Phases of Data AnalyticsIn this tutorial, we're going to talk about the different phases of the life cycle of data analytics, in which we will go over different life cycle phases and then go over them in detail.Life Cycle of Data AnalyticsThe Data analytics lifecycle was designed to address Big Data problems and data science projects. The process is repeated to show the real projects. To address the specific demands for conducting analysis on Big Data, the step-by-step methodology is required to plan the various tasks associated with the acquisition, processing, analysis, and recycling of data.Phase 1: Discovery -The data science team is trained and researches the issue.Create context and gain understanding.Learn about the data sources that are needed and accessible to the project.The team comes up with an initial hypothesis, which can be later confirmed with evidence.Phase 2: Data Preparation -Methods to investigate the possibilities of pre-processing, analysing, and preparing data before analysis and modelling.It is required to have an analytic sandbox. The team performs, loads, and transforms to bring information to the data sandbox.Data preparation tasks can be repeated and not in a predetermined sequence.Some of the tools used commonly for this process include - Hadoop, Alpine Miner, Open Refine, etc.Phase 3: Model Planning -The team studies data to discover the connections between variables. Later, it selects the most significant variables as well as the most effective models.In this phase, the data science teams create data sets that can be used for training for testing, production, and training goals.The team builds and implements models based on the work completed in the modelling planning phase.Some of the tools used commonly for this stage are MATLAB and STASTICA.Phase 4: Model Building -The team creates datasets for training, testing as well as production use.The team is also evaluating whether its current tools are sufficient to run the models or if they require an even more robust environment to run models.Tools that are free or open-source or free tools Rand PL/R, Octave, WEKA.Commercial tools - MATLAB, STASTICA.Phase 5: Communication Results -Following the execution of the model, team members will need to evaluate the outcomes of the model to establish criteria for the success or failure of the model.The team is considering how best to present findings and outcomes to the various members of the team and other stakeholders while taking into consideration cautionary tales and assumptions.The team should determine the most important findings, quantify their value to the business and create a narrative to present findings and summarize them to all stakeholders.Phase 6: Operationalize -The team distributes the benefits of the project to a wider audience. It sets up a pilot project that will deploy the work in a controlled manner prior to expanding the project to the entire enterprise of users.This technique allows the team to gain insight into the performance and constraints related to the model within a production setting at a small scale and then make necessary adjustments before full deployment.The team produces the last reports, presentations, and codes.Open source or free tools such as WEKA, SQL, MADlib, and Octave.Next TopicModel Planning for Data Analytics? prevnext ?

Life Cycle Phases of Data Analytics

In this tutorial, we're going to talk about the different phases of the life cycle of data analytics, in which we will go over different life cycle phases and then go over them in detail.

Life Cycle of Data Analytics

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Phase 1: Discovery -

- The data science team is trained and researches the issue.

- Create context and gain understanding.

- Learn about the data sources that are needed and accessible to the project.

- The team comes up with an initial hypothesis, which can be later confirmed with evidence.

Phase 2: Data Preparation -

- Methods to investigate the possibilities of pre-processing, analysing, and preparing data before analysis and modelling.

- It is required to have an analytic sandbox. The team performs, loads, and transforms to bring information to the data sandbox.

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Phase 3: Model Planning -

- The team studies data to discover the connections between variables. Later, it selects the most significant variables as well as the most effective models.

- In this phase, the data science teams create data sets that can be used for training for testing, production, and training goals.

- The team builds and implements models based on the work completed in the modelling planning phase.

- Some of the tools used commonly for this stage are MATLAB and STASTICA.

Phase 4: Model Building -

- The team creates datasets for training, testing as well as production use.

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In this tutorial, we will talk about models for planning data analytics, where we will discuss all steps of the process one by one.

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Model planning is the third phase of the lifecycle stages of data analytics. This is where the team members decide on methods, methods, and the process it plans to use in the subsequent stage of building models.

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R's -

- The main strength of the company is the ease at which high-quality plots can be created, with mathematical formulas when required.

- The most well-known application of SQL is its base for the creation of dashboards, which are simple to build and use with the tools for reporting.

- To build as well as interact with databases more quickly, SQL has been adapted to a range of tools, each having its own distinct markets, such as Microsoft Access and PostgreSQL.

SQL -

- It's easy to access and is able to create complex models as well as rapid analysis, and it also offers the ability to do a lot of manipulation of data.

- The SQL monitoring of servers in the application manager is presented in a table format, which makes it simple to switch between screens of live data as well as access analytic features.

- Data is accessible in a wide range through the user-friendly interface without having to consider the location of where it's stored.

- Access data quickly and easily with no understanding of the data or the SQL needed to display it.

- Enjoy seamless interfaces between loaders and users without an in-depth understanding of every loader.

- Enhance efficiency by using basic storage options like materialistic perspectives, temporary tables, as well as partitioned tables.

Tableau Public -

- It's a completely free program that connects any data source and connects to corporate web-based information.

- It lets us download the file in various formats.

- The information is available for sharing via social media.

- This is a great source of data for anyone who wants to know the benefits of the tableau.

SAS -

- This is a programming language and programming language that allows data manipulation.
- SAS is simple to manage and access and can be used to study information from a variety of sources.
- SAS creates modules for social media, as well as marketing analytics, which is broadly used in the prospecting of customers.
- It also helps forecast the behaviour of the customer and their communications.

RapidMiner -

- It is a fully integrated system for the field of data science which can perform the analysis of predictive data.
- It also includes advanced analytics like machine learning, data mining, and even data mining, without the requirement for programming.
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next ?? prevReal -Time Analytics in Big DataIn this tutorial, we will explore real-time analytics in big data. We will present an overview of real-time analysis and focus on its function and the advantages of its use. We will discuss the benefits of real-time data analytics. Let's go through it in detail.Real-Time Analytics:In real-time, analysis of data allows users to view, analyse and understand data in the system it's entered. Mathematical reasoning and logic are incorporated into the data, which means it gives users a sense of real-time data to make decisions.Overview:Real-time analytics allows organizations to gain awareness and actionable information immediately or as soon as the data has entered their systems. Analytics responses in real-time are completed within a matter of minutes. They can process a huge amount of data in a short time with high speed and a low response time. For instance, real-time big-data analytics makes use of financial databases to inform traders of decisions. Analytics may be performed on-demand or continuously. On-demand alerts users to results when the user wants them. Users can continuously update their results as events occur. It can also be programmed to respond to specific circumstances automatically. For instance, real-time web analytics could restructure the administrator's page if the load presentation is not within the boundaries of the present.Examples -Examples of real-time customer analytics include the following.Monitoring orders as they take place to trace them better and determine the type of clothing.Continuously modernize customer interactions, such as the number of page views and shopping cart usage, to better understand the etiquette of users.Select customers who are more advanced in their shopping habits in a shop, impacting the decisions in real time.The Operation of Real-time AnalyticsReal-time analytics tools for data analytics can pull or push. Streaming demands that faculty push huge amounts of fast-moving data. If streaming consumes too many resources and isn't an empirical process, data could be moved at intervals between a couple of seconds and hours. The two may occur between business requirements that need to be figured out in order not to interrupt the flow. The time to react for real-time analysis can vary from nearly instantaneous to a few minutes or seconds. The key components of real-time analytics comprise the following.AggregatorBrokerAnalytics engineStream processorBenefits of Real-time AnalyticsMomentum is the primary benefit of real-time analysis of data. The shorter a company has to wait for data from the moment it arrives and is processed, and the business is able to utilize data insights to make changes and make the results of a crucial decision.In the same way, real-time analytics tools allow companies to see how users connect to an item after liberating the product, so there's no problem in understanding the behaviour of users to make the necessary adjustments.Advantages of Real-time Analytics:Real-time analytics provides the benefits over traditional analytics.Create our interactive analytics tools.Transparent dashboards allow users to share information.Monitor behaviour in a way that is customized.Perform immediate adjustments if necessary.Make use of machine learning.Other Benefits:Other advantages and benefits include managing data location, detecting irregularities, enhancing marketing and sales, etc. The following benefits can be useful.Next TopicWhat is a Generative Adversarial Network (GAN)? prevnext ?

Real -Time Analytics in Big Data

In this tutorial, we will explore real-time analytics in big data. We will present an overview of real-time analysis and focus on its function and the advantages of its use. We will discuss the benefits of real-time data analytics. Let's go through it in detail.

Real-Time Analytics:

In real-time, analysis of data allows users to view, analyse and understand data in the system it's entered. Mathematical reasoning and logic are incorporated into the data, which means it gives users a sense of real-time data to make decisions.

Overview:

Real-time analytics allows organizations to gain awareness and actionable information immediately or as soon as the data has entered their systems. Analytics responses in real-time are completed within a matter of minutes. They can process a huge amount of data in a short time with high speed and a low response time. For instance, real-time big-data analytics makes use of financial databases to inform traders of decisions. Analytics may be performed on-demand or continuously. On-demand alerts users to results when the user wants them. Users can continuously update their results as events occur. It can also be programmed to respond to specific circumstances automatically. For instance, real-time web analytics could restructure the administrator's page if the load presentation is not within the boundaries of the present.

Examples -

Examples of real-time customer analytics include the following.

Examples -

- Monitoring orders as they take place to trace them better and determine the type of clothing.
- Continuously modernize customer interactions, such as the number of page views and shopping cart usage, to better understand the etiquette of users.
- Select customers who are more advanced in their shopping habits in a shop, impacting the decisions in real time.

The Operation of Real-time Analytics

Real-time analytics tools for data analytics can pull or push. Streaming demands that faculty push huge amounts of fast-moving data. If streaming consumes too many resources and isn't an empirical process, data could be moved at intervals between a couple of seconds and hours. The two may occur between business requirements that need to be figured out in order not to interrupt the flow. The time to react for real-time analysis can vary from nearly instantaneous to a few minutes or seconds. The key components of real-time analytics comprise the following.

The Operation of Real-time Analytics

- Aggregator

- Broker

- Analytics engine

- Stream processor

Benefits of Real-time Analytics

Momentum is the primary benefit of real-time analysis of data. The shorter a company has to wait for data from the moment it arrives and is processed, and the business is able to utilize data insights to make changes and make the results of a crucial decision.

Benefits of Real-time Analytics

In the same way, real-time analytics tools allow companies to see how users connect to an item after liberating the product, so there's no problem in understanding the behaviour of users to make the necessary adjustments.

Advantages of Real-time Analytics:

Real-time analytics provides the benefits over traditional analytics.

Advantages of Real-time Analytics:

- Create our interactive analytics tools.

- Transparent dashboards allow users to share information.

- Monitor behaviour in a way that is customized.

- Perform immediate adjustments if necessary.

- Make use of machine learning.

Other Benefits:

Other advantages and benefits include managing data location, detecting irregularities, enhancing marketing and sales, etc. The following benefits can be useful.

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Data Science Tutorial

next ?? prevWhat is a Generative Adversarial Network (GAN)Introduction:In this tutorial, we are discussing the Generative Adversarial Network or GAN. GAN is an architecture of Deep Learning. The Generative Adversarial Network consists of two neural networks. These networks are competing with each other in a zero-sum game framework. The Generative Adversarial Networks (GANs) can be described as extremely powerful kinds of neural networks that are employed to aid in Unsupervised Learning. They were created and first introduced in 2014 by Ian J. Goodfellow 2014. GANs are comprised of two neural networks that are in competition with one another and can analyse the changes within a set of data. The Generative Adversarial Network is generated the new data which assembles a few known as data distributions.GANs are a method for generative modelling that uses deep learning methods like CNN (Convolutional Neural Network). Generative modelling is an unsupervised learning method that automatically discovers and learns patterns in input data so that the model can be used for new examples from the original dataset.GANs are a method of training generative modelling by framing the problem as a supervised learning problem and using two sub-models. GANs have two components:Generator:The generator is mainly a convolution neutral network. Generator This is a program that generates new data from real-world images. The main aim of the generator is to generate the output which is mistaken for the real data.Discriminator:The Discriminator is mainly a deconvolution neutral network. Discriminator This compares the images with real-world examples to classify fake and real images. The main aim of the discriminator is to identify the artificial output which is received in the network.When the generator generates false data, the discriminator is distinguish between the artificial data and the original data.ExampleThe Generator generates random images (e.g., The Generator generates some random images (e.g., tables), and then the Discriminator compares these images with real-world table images. Finally, the Generator sends the feedback directly to Generator. See the GAN structure in the following figure.What is the Reason GANs were Invented in the First Place?The Generative Adversarial Network or GAN was invented in the first place. The reason behind that is discussed here. It is well-known that most of the neural networks used in mainstream research are easily misled into misclassifying items by introducing a tiny amount of noise to the data. Surprisingly, the model modified after adding noise has a higher probability of making a mistake than when it has made a good prediction. The reason for this is that machines learn from the smallest amount of data. This is a main drawback as it can be overfitted. The relationship between input and output is almost linear. While the lines of separation between different classes could be linear, they are comprised of linearities, and even minor changes in one point of the feature space could cause data to be classified incorrectly.How does GAN work?Generative Adversarial Networks (GANs) can be broken down into three parts, which are discussed in below -Generative:To learn more about a dynamic model that explains how data are generated using a probabilistic model.Adversarial:The process of training models, is conducted in an adversarial environment.Networks:Make use of deep neural networks to create Artificial Intelligence (AI) algorithms to train for purposes.Previously we told you that GAN has two neutral networks. One is Generator and another is Discriminator. The generator is used to generate false or artificial data.

And on the other hand, the discriminator is used to identify the artificial data. The artificial data is like images, audio, video, etc, which is generated by the generator. These two neutral networks are competing in the training phase. The steps of the generator and discriminator are repeated many numbers of times. And from time to time the result was better than the previous results. In the below diagram, we can visualize this process.The generative model can capture the data distribution. It is tried to maximise the probability of making mistake in the discriminator. So, the discriminator cannot find which is real data and which is artificial data. On the other side, the discriminator is tried to understand which data is received from the training data and which is received from the generator. The Generative Adversarial Network is used to minimax the game. Here the work of the discriminator is to minimize the rewards V(D, G). Another side the generator works to minimize the discriminator rewards and also maximize the loss. The mathematical formula of GAN is given below -V (D,G)=Ex~pdata (x)[log?D(x)]+Ez~pz(z)[log?(1-D(G(z))]The uses terms in the above equation are given below -D = DiscriminatorG = Generatorpdata(x) = real data distributionx = pdata(x) sampleD(x) = Network for Discriminatorp(z) = Generator distributionz = p(z) sampleG(z) = Network for GeneratorWhat is meant by the Generator Model?In this case, when the discriminator is idle then the generator is trained. After that, the Generator is generated the data and by this data, the discriminator is also trained. We can also predict the data and we also use this result for generator training. From time to time the result is better. The generator gets successful to fool the discriminator and then the discriminator does not identify which data is false.What is meant by the Discriminator Model?In this case, when the generator is idle then the Discriminator is trained. In the Discriminator, the network does not backpropagate. The network in Discriminator is mainly done the forward propagation. The Discriminator is mainly trained to find the real data for n epochs. Then it also verified whether it correctly predict the data that is real data or not. The Discriminator is also trained with the generated data from the generator. Then it also verified whether it correctly predicted the data that is artificial data or not.Example:Now we give an example of that how can we generating images of Dogs in the Generative Adversarial Network.Step 1: Training of DiscriminatorThe 1st step is training the Discriminator by using the idle Generator. We discuss the steps below -First, a random noise signal is sent through a generator. This generates useless images that contain noise.(See fig. 2)Discriminator has two inputs. The first is the Generator sample output images, and the second is real-world dog image samples.After comparing the images in fig., The Discriminator then populates certain values (probability). 2. It calculates 0.8 to 0.3 and 0.0.5 for generator output images and 0.1, 9.9, and 0.2 for real-world images.An error can be calculated by comparing the probabilities of generated images with 0 (Zero) and the probabilities of real-word images with 1. (Ex. (Ex.After it has calculated individual errors, it will calculate cumulative loss(loss), which is backpropagated. The weights of the Discriminator can then be adjusted. This is how a Discriminator gets trained.Step 2: Training the GeneratorThe 2nd step is training the Generator by using the idle Discriminator. We discuss the steps below -The loss is propagated back to the Discriminator in step 1. This will allow it to adjust its weights. We must also backpropagate an error, so it can adjust its weights and train itself to produce better images.The Generator generates images that are used to input the Generator.The Discriminator will now use the newly generated images as input. It calculates probabilities such as 0.5, 0.01, and 0.2. (See fig. 2)An error can be calculated by comparing the probabilities of images generated with 1 (One).After it has calculated individual errors, it will calculate cumulative loss(loss), which is backpropagated. The weights of the Generator then are adjusted. This is how Generator gets trained.After a few more iterations, the Generator will start generating images similar to real-world images.What are the types of Generative Adversarial Network or GAN model?There are various types of GAN models or Generative Adversarial Network models. These are given in below -1. Condition GAN:It is one type of GAN. The Condition GAN also represent a CGAN. This GAN has mainly described the deep learning method. In the CGAN, we put some conditional parameters. In the generator, when we add data "X" then it generates its corresponding data. In the CGAN, the labels are put in the input to help the discriminator identify the fake data and the real data.2. Vanilla GAN:It is one of the simplest types of GAN. The Vanilla GAN also represent a VGAN. In the vanilla GAN, the Generator and the Discriminator are very simple and have multilayer perceptron's. The algorithm of the VGAN is also very easy. The VGAN is used to optimization of a mathematical equation which is used in the stochastic gradient descent.3.

Laplacian Pyramid GAN:It is another type of GAN. The Laplacian Pyramid GAN also represent a LAPGAN. The LAPGAN represents the linearly invertible image. This consists of a set of bandpass images which is also residual of low frequency. The images are also spaced an octave apart. In the Laplacian Pyramid GAN, we use multiple numbers of generators and Discriminators. Here we also used the Laplacian pyramid of different levels. High-quality images produced by the LAPGAN. In the first step, the image is always down-sampled in Laplacian Pyramid GAN. After that, the images are upscaled in each layer of the pyramid and then pass the images which have some noise from the CGAN. The images belong in CGAN until it gets the original size.4. Super Resolution GAN:It is another type of Generative Adversarial Network. The Super Resolution GAN also represent an SRGAN. The SRGAN is produce a high-resolution image. In this GAN, the deep neural network is used with the adversarial network. The SRGAN is very much useful for upscaling low-resolution images into high-resolution images. And it is also used to errors minimizing in the images.5. Deep Convolutional GAN:The last type of Generative Adversarial Network or GAN is Deep convolutional GAN. The Deep convolutional GAN also represent a DCGAN. This GAN is most powerful GAN than others. The DCGAN is very popular. Deep convolution GAN is ConvNets in place of multi-layer perceptron's. This is easily implemented without max pooling. The layers of DCGAN are not fully connected.Advantages of Generative Adversarial Network:There are various advantages of Generative Adversarial Network. The advantages are given below -1. Produce high-quality results:GAN produce photorealistic as well as high-quality results for various types of tasks like video synthesis, image synthesis, music synthesis and so on.2. Not supervised learning:GAN has produced unsupervised learning. GAN can be training the data without any condition like it need not any labelled data. GAN can easily make the data for learning unsupervised tasks. In unsupervised learning, there is difficult to obtain the labelled data. So, it used data without labelling.3. Data Generation which is Synthetic:GAN is also generating some new data which is synthetic. It is used to assemble the distribution of known data. This feature helps with various creative applications, augmentation of data and many more.4. Versatile:The Generative Adversarial Network is versatile. It is used for various kinds of tasks like image-to-text synthesis, text-to-image synthesis, image-to-image synthesis, image synthesis, augmentation of data, detected anomalies and many more.Disadvantages of Generative Adversarial Network:There are various disadvantages of Generative Adversarial Networks. The disadvantages are given below -1. Cost for computation:GAN needs to very high computational cost. It requires more computational resources. Due to a large number of computations, the GAN is trained slowly for the large dataset and the high-resolution images.2. Fairness and bias:The Generative Adversarial Network can reflect the unfairness and biases which is present in the training data. It is also leading to biased synthetic data or the leading to discrimination.3. Difficult to trained:The Generative Adversarial Network or GAN is very difficult to train with various kinds of risk like mode of collapse, instability and converge failure.4. Overfitting:The Generative Adversarial Network have the problem of overfitting. The training data and producing synthetic data can be overfitted here. This is similar to the lacking diversity and training data.Interpretability and Accountability:The Generative Adversarial Network is very challenging to ensure accountability and transparency in their application. GAN is opaque and difficult to explain.Applications to GAN:There are various applications of Generative Adversarial Networks. The applications are given below -1. Generating images:The GAN is used to generating the images and picture synthesis. It can create fresh and life like images. The Generative Adversarial Network can make the highly resolute image.2. Super Resolution:The GAN is used to super-resolution images. It is one of the important applications of Generative Adversarial Networks.3. Image Modification:The Generative Adversarial Network is used to modify the image. Resize the images and do another type of modification.4. Photos of real people:The Generative Adversarial Network is used to photos of real people. It is used in practical fields.5. Face Ageing:The Generative Adversarial Network is used to face ageing. It can easily increase or decrease the face ageing of the images.6. Text to image synthesis:The GAN is used to text to image synthesis. This is used to make the image realistic visualisation which comes from the text.7. Image-to-image synthesis:The GAN is used for image-to-image synthesis. It can be used to change the theme of images, change the day to night of the image, can convert real images to drawing images and vice versa, and also can change the style of creativity in the image.Next TopicWhat is Data Analysis?

prevnext ?

Introduction:

In this tutorial, we are discussing the Generative Adversarial Network or GAN. GAN is an architecture of Deep Learning. The Generative Adversarial Network consists of two neural networks. These networks are competing with each other in a zero-sum game framework. The Generative Adversarial Networks (GANs) can be described as extremely powerful kinds of neural networks that are employed to aid in Unsupervised Learning. They were created and first introduced in 2014 by Ian J. Goodfellow 2014. GANs are comprised of two neural networks that are in competition with one another and can analyse the changes within a set of data. The Generative Adversarial Network is generated the new data which assembles a few known as data distributions.

Introduction:

GANs are a method for generative modelling that uses deep learning methods like CNN (Convolutional Neural Network). Generative modelling is an unsupervised learning method that automatically discovers and learns patterns in input data so that the model can be used for new examples from the original dataset.

Introduction:

GANs are a method of training generative modelling by framing the problem as a supervised learning problem and using two sub-models. GANs have two components:

Introduction:

- Generator:The generator is mainly a convolution neutral network. Generator This is a program that generates new data from real-world images. The main aim of the generator is to generate the output which is mistaken for the real data.
- Discriminator:The Discriminator is mainly a deconvolution neutral network. Discriminator This compares the images with real-world examples to classify fake and real images. The main aim of the discriminator is to identify the artificial output which is received in the network.

Introduction:

When the generator generates false data, the discriminator is distinguish between the artificial data and the original data.

Example

The Generator generates random images (e.g., The Generator generates some random images (e.g., tables), and then the Discriminator compares these images with real-world table images. Finally, the Generator sends the feedback directly to Generator. See the GAN structure in the following figure.

What is the Reason GANs were Invented in the First Place?

The Generative Adversarial Network or GAN was invented in the first place. The reason behind that is discussed here. It is well-known that most of the neural networks used in mainstream research are easily misled into misclassifying items by introducing a tiny amount of noise to the data. Surprisingly, the model modified after adding noise has a higher probability of making a mistake than when it has made a good prediction. The reason for this is that machines learn from the smallest amount of data. This is a main drawback as it can be overfitted. The relationship between input and output is almost linear. While the lines of separation between different classes could be linear, they are comprised of linearities, and even minor changes in one point of the feature space could cause data to be classified incorrectly.

How does GAN work?

Generative Adversarial Networks (GANs) can be broken down into three parts, which are discussed in below -

How does GAN work?

- Generative:To learn more about a dynamic model that explains how data are generated using a probabilistic model.

- Adversarial:The process of training models, is conducted in an adversarial environment.

- Networks:Make use of deep neural networks to create Artificial Intelligence (AI) algorithms to train for purposes.

How does GAN work?

Previously we told you that GAN has two neutral networks. One is Generator and another is Discriminator. The generator is used to generate false or artificial data. And on the other hand, the discriminator is used to identify the artificial data. The artificial data is like images, audio, video, etc, which is generated by the generator. These two neutral networks are competing in the training phase. The steps of the generator and discriminator are repeated many numbers of times. And from time to time the result was better than the previous results. In the below diagram, we can visualize this process.

How does GAN work?

The generative model can capture the data distribution. It is tried to maximise the probability of making mistake in the discriminator. So, the discriminator cannot find which is real data and which is artificial data. On the other side, the discriminator is tried to understand which data is received from the training data and which is received from the generator. The Generative Adversarial Network is used to minimax the game. Here the work of the discriminator is to minimize the rewards V(D, G). Another side the generator works to minimize the discriminator rewards and also maximize the loss. The mathematical formula of GAN is given below -

How does GAN work?

The uses terms in the above equation are given below -

How does GAN work?

D = Discriminator

How does GAN work?

G = Generator

How does GAN work?

pdata(x) = real data distribution

How does GAN work?

x = pdata(x) sample

How does GAN work?

D(x) = Network for Discriminator

How does GAN work?

p(z) = Generator distribution

How does GAN work?

z = p(z) sample

How does GAN work?

G(z) = Network for Generator

What is meant by the Generator Model?

In this case, when the discriminator is idle then the generator is trained. After that, the Generator is generated the data and by this data, the discriminator is also trained. We can also predict the data and we also use this result for generator training. From time to time the result is better. The generator gets successful to fool the discriminator and then the discriminator does not identify which data is false.

What is meant by the Discriminator Model?

In this case, when the generator is idle then the Discriminator is trained. In the Discriminator, the network does not backpropagate. The network in Discriminator is mainly done the forward propagation. The Discriminator is mainly trained to find the real data for n epochs. Then it also verified whether it correctly predict the data that is real data or not. The Discriminator is also trained with the generated data from the generator. Then it also verified whether it correctly predicted the data that is artificial data or not.

What is meant by the Discriminator Model?

Example:

What is meant by the Discriminator Model?

Now we give an example of that how can we generating images of Dogs in the Generative Adversarial Network.

Step 1: Training of Discriminator

The 1st step is training the Discriminator by using the idle Generator. We discuss the steps below -

Step 1: Training of Discriminator

- First, a random noise signal is sent through a generator. This generates useless images that contain noise.

- (See fig. 2)

- Discriminator has two inputs. The first is the Generator sample output images, and the second is real-world dog image samples.

- After comparing the images in fig., The Discriminator then populates certain values (probability). 2. It calculates 0.8 to 0.3 and 0.0.5 for generator output images and 0.1, 9.9, and 0.2 for real-world images.

- An error can be calculated by comparing the probabilities of generated images with 0 (Zero) and the probabilities of real-word images with 1. (Ex. (Ex.

- After it has calculated individual errors, it will calculate cumulative loss(loss), which is backpropagated. The weights of the Discriminator can then be adjusted. This is how a Discriminator gets trained.

Step 2: Training the Generator

The 2nd step is training the Generator by using the idle Discriminator. We discuss the steps below -

Step 2: Training the Generator

- The loss is propagated back to the Discriminator in step 1. This will allow it to adjust its weights. We must also backpropagate an error, so it can adjust its weights and train itself to produce better images.

- The Generator generates images that are used to input the Generator.

- The Discriminator will now use the newly generated images as input. It calculates probabilities such as 0.5, 0.01, and 0.2. (See fig. 2)

- An error can be calculated by comparing the probabilities of images generated with 1 (One).

- After it has calculated individual errors, it will calculate cumulative loss(loss), which is backpropagated. The weights of the Generator then are adjusted. This is how Generator gets trained.

Step 2: Training the Generator

After a few more iterations, the Generator will start generating images similar to real-world images.

What are the types of Generative Adversarial Network or GAN model?

There are various types of GAN models or Generative Adversarial Network models. These are given in below -

What are the types of Generative Adversarial Network or GAN model?

1. Condition GAN:

What are the types of Generative Adversarial Network or GAN model?

It is one type of GAN. The Condition GAN also represent a CGAN. This GAN has mainly described the deep learning method. In the CGAN, we put some conditional parameters. In the generator, when we add data "X" then it generates its corresponding data. In the CGAN, the labels are put in the input to help the discriminator identify the fake data and the real data.

What are the types of Generative Adversarial Network or GAN model?

2. Vanilla GAN:

What are the types of Generative Adversarial Network or GAN model?

It is one of the simplest types of GAN. The Vanilla GAN also represent a VGAN. In the vanilla GAN, the Generator and the Discriminator are very simple and have multilayer perceptron's. The algorithm of the VGAN is also very easy. The VGAN is used to optimization of a mathematical equation which is used in the stochastic gradient descent.

What are the types of Generative Adversarial Network or GAN model?

3. Laplacian Pyramid GAN:

What are the types of Generative Adversarial Network or GAN model?

It is another type of GAN. The Laplacian Pyramid GAN also represent a LAPGAN. The LAPGAN represents the linearly invertible image. This consists of a set of bandpass images which is also residual of low frequency. The images are also spaced an octave apart. In the Laplacian Pyramid GAN, we use multiple numbers of generators and Discriminators. Here we also used the Laplacian pyramid of different levels. High-quality images produced by the LAPGAN. In the first step, the image is always down-sampled in Laplacian Pyramid GAN. After that, the images are upscaled in each layer of the pyramid and then pass the images which have some noise from the CGAN. The images belong in CGAN until it gets the original size.

What are the types of Generative Adversarial Network or GAN model?

4. Super Resolution GAN:

What are the types of Generative Adversarial Network or GAN model?

It is another type of Generative Adversarial Network. The Super Resolution GAN also represent an SRGAN. The SRGAN is produce a high-resolution image. In this GAN, the deep neural network is used with the adversarial network. The SRGAN is very much useful for upscaling low-resolution images into high-resolution images. And it is also used to errors minimizing in the images.

What are the types of Generative Adversarial Network or GAN model?

5. Deep Convolutional GAN:

What are the types of Generative Adversarial Network or GAN model?

The last type of Generative Adversarial Network or GAN is Deep convolutional GAN. The Deep convolutional GAN also represent a DCGAN. This GAN is most powerful GAN than others. The DCGAN is very popular. Deep convolution GAN is ConvNets in place of multi-layer perceptron's. This is easily implemented without max pooling. The layers of DCGAN are not fully connected.

Advantages of Generative Adversarial Network:

There are various advantages of Generative Adversarial Network. The advantages are given below -

Advantages of Generative Adversarial Network:

1. Produce high-quality results:

Advantages of Generative Adversarial Network:

GAN produce photorealistic as well as high-quality results for various types of tasks like video synthesis, image synthesis, music synthesis and so on.

Advantages of Generative Adversarial Network:

2. Not supervised learning:

Advantages of Generative Adversarial Network:

GAN has produced unsupervised learning. GAN can be training the data without any condition like it need not any labelled data. GAN can easily make the data for learning unsupervised tasks. In unsupervised learning, there is difficult to obtain the labelled data. So, it used data without labelling.

Advantages of Generative Adversarial Network:

3. Data Generation which is Synthetic:

Advantages of Generative Adversarial Network:

GAN is also generating some new data which is synthetic. It is used to assemble the distribution of known data. This feature helps with various creative applications, augmentation of data and many more.

Advantages of Generative Adversarial Network:

4. Versatile:

Advantages of Generative Adversarial Network:

The Generative Adversarial Network is versatile. It is used for various kinds of tasks like image-to-text synthesis, text-to-image synthesis, image-to-image synthesis, image synthesis, augmentation of data, detected anomalies and many more.

Disadvantages of Generative Adversarial Network:

There are various disadvantages of Generative Adversarial Networks. The disadvantages are given below -

Disadvantages of Generative Adversarial Network:

1. Cost for computation:

Disadvantages of Generative Adversarial Network:

GAN needs to very high computational cost. It requires more computational resources. Due to a large number of computations, the GAN is trained slowly for the large dataset and the high-resolution images.

Disadvantages of Generative Adversarial Network:

2. Fairness and bias:

Disadvantages of Generative Adversarial Network:

The Generative Adversarial Network can reflect the unfairness and biases which is present in the training data. It is also leading to biased synthetic data or the leading to discrimination.

Disadvantages of Generative Adversarial Network:

3. Difficult to trained:

Disadvantages of Generative Adversarial Network:

The Generative Adversarial Network or GAN is very difficult to train with various kinds of risk like mode of collapse, instability and converge failure.

Disadvantages of Generative Adversarial Network:

4. Overfitting:

Disadvantages of Generative Adversarial Network:

The Generative Adversarial Network have the problem of overfitting. The training data and producing synthetic data can be overfitted here. This is similar to the lacking diversity and training data.

Interpretability and Accountability:

The Generative Adversarial Network is very challenging to ensure accountability and transparency in their application. GAN is opaque and difficult to explain.

Applications to GAN:

There are various applications of Generative Adversarial Networks. The applications are given below -

Applications to GAN:

1. Generating images:

Applications to GAN:

The GAN is used to generating the images and picture synthesis. It can create fresh and life like images. The Generative Adversarial Network can make the highly resolute image.

Applications to GAN:

2. Super Resolution:

Applications to GAN:

The GAN is used to super-resolution images. It is one of the important applications of Generative Adversarial Networks.

Applications to GAN:

3. Image Modification:

Applications to GAN:

The Generative Adversarial Network is used to modify the image. Resize the images and do another type of modification.

Applications to GAN:

4. Photos of real people:

Applications to GAN:

The Generative Adversarial Network is used to photos of real people. It is used in practical fields.

Applications to GAN:

5. Face Ageing:

Applications to GAN:

The Generative Adversarial Network is used to face ageing. It can easily increase or decrease the face ageing of the images.

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6. Text to image synthesis:

Applications to GAN:

The GAN is used to text to image synthesis. This is used to make the image realistic visualisation which comes from the text.

Applications to GAN:

7. Image-to-image synthesis:

Applications to GAN:

The GAN is used for image-to-image synthesis. It can be used to change the theme of images, change the day to night of the image, can convert real images to drawing images and vice versa, and also can change the style of creativity in the image.

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In ancient Egypt, for example, tax collectors used data analysis techniques to keep track of the harvests and collect taxes from farmers. The ancient Greeks also used data analysis in their studies of geometry and astronomy.In the 17th century, the invention of the telescope and the microscope enabled scientists to collect more detailed and accurate data, which led to the development of statistics as a formal field of study. In the 18th and 19th centuries, data analysis techniques were used in astronomy, physics, and chemistry to study natural phenomena and develop scientific theories.In the 20th century, the invention of computers revolutionized data analysis, enabling researchers to collect and process large amounts of data more quickly and accurately. The development of statistical software and data visualization tools further enhanced the field of data analysis, making it more accessible to researchers and practitioners in various fields.In recent years, the growth of big data and the Internet of Things has led to the explosion of data, creating new challenges and opportunities for data analysis. Today, data analysis is a critical tool in many fields, including business, healthcare, education, government, and research, and it continues to evolve and advance with new technologies and methods.Data Analysis Tools for ResearchData Analysis tools provide unique features and functionalities that can be useful for researchers depending on their specific research needs and requirements.Excel:Excelis a common research tool because of its adaptability and simplicity. Data cleaning, modification, and analysis are all possible uses for it. 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Here are some examples of data analysis applications in different fields:Business Analytics:In the business world, data analysis is used to analyze customer behavior, optimize marketing campaigns, and improve business operations. For example, companies can use data analysis to identify customer preferences and tailor their products and services to meet those preferences. They can also analyze sales data to identify trends and patterns that inform future sales strategies. Moreover, businesses can use data analysis to optimize their supply chain management, improve logistics, and reduce costs.Healthcare Analytics:Healthcare organizations employ data analytics to enhance patient outcomes, minimize costs, and optimize resource allocation. Hospitals can, for instance, forecast patient readmissions, identify patients who are most likely to experience difficulties and allocate resources efficiently by using data analysis. 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Detecting fraud, forecasting market changes, and seeing potential supply chain problems are a few examples of this.Better resource allocation:By analyzing data, organizations can optimize their resource allocation, identifying areas where resources are underutilized or needed.Challenges of Data AnalysisWhile data analysis can provide many benefits to organizations, several challenges need to be considered. Here are some of the key challenges in data analysis:Data Quality Issues:One of the main challenges in data analysis is ensuring data quality. This can include missing or incomplete data, data inconsistencies, and data accuracy. If the data is of good quality, it can lead to correct insights and decisions.Data Security Concerns:With the increasing amount of data collected and analyzed, data security is becoming a major concern. 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What is Data Analysis?

Data analysis is essential for decision-making in various fields, including business, healthcare, education, government, and research. In business, data analysis helps in market research, customer segmentation, forecasting, and performance evaluation. It assists businesses in identifying their advantages, disadvantages, opportunities, and threats so they may make informed decisions to enhance their operations, services, and goods. Identifying potential markets and new business prospects can also be aided by data analysis.

History of Data Analysis

Data analysis has a long history that dates back to ancient civilizations. In ancient Egypt, for example, tax collectors used data analysis techniques to keep track of the harvests and collect taxes from farmers. The ancient Greeks also used data analysis in their studies of geometry and astronomy.

History of Data Analysis

In the 17th century, the invention of the telescope and the microscope enabled scientists to collect more detailed and accurate data, which led to the development of statistics as a formal field of study. In the 18th and 19th centuries, data analysis techniques were used in astronomy, physics, and chemistry to study natural phenomena and develop scientific theories.

History of Data Analysis

In the 20th century, the invention of computers revolutionized data analysis, enabling researchers to collect and process large amounts of data more quickly and accurately. The development of statistical software and data visualization tools further enhanced the field of data analysis, making it more accessible to researchers and practitioners in various fields.

History of Data Analysis

In recent years, the growth of big data and the Internet of Things has led to the explosion of data, creating new challenges and opportunities for data analysis. Today, data analysis is a critical tool in many fields, including business, healthcare, education, government, and research, and it continues to evolve and advance with new technologies and methods.

Data Analysis Tools for Research

Data Analysis tools provide unique features and functionalities that can be useful for researchers depending on their specific research needs and requirements.

Data Analysis Tools for Research

- Excel:Excelis a common research tool because of its adaptability and simplicity. Data cleaning, modification, and analysis are all possible uses for it. Excel can be used by researchers to produce pivot tables, perform simple statistical studies, and build charts and graphs to represent their data.
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Types of Data Analysis

Although there are many other kinds of data analysis methods, the most common ones include text analysis, statistical analysis, diagnostic analysis, predictive analysis, and prescriptive analysis.

Types of Data Analysis

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Advantages of Data Analysis

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Advantages of Data Analysis

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Challenges of Data Analysis

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Challenges of Data Analysis

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So, you can change things like the background, foreground, or even the style of the images it makes. It's like having a superpower for making and customizing pictures, especially for human faces, where you can adjust the pose, hair colour, or eye colour.StyleGAN model architectureThe StyleGAN model architecture is a progressive growing Generative Adversarial Network (GAN) that underwent five key modifications to enhance performance. These changes were introduced and evaluated incrementally through an ablative study. Here's a breakdown of each of these modifications.Certainly, let's delve even further into the details of the StyleGAN architecture, emphasizing the significance of each modification:Progressive Growing GAN (PGGAN):The progressive growing technique in StyleGAN is a crucial foundation. It starts the training with small, low-resolution images (e.g., 4×4 pixels) and incrementally increases the generator's and discriminator's complexity as training progresses. This step-by-step enlargement of the model improves training stability, helps generate high-quality images, and enables the model to handle larger image sizes seamlessly.Bilinear Sampling for Upsampling:Using bilinear upsampling layers instead of the more common nearest neighbour layers improves image fidelity. Bilinear upsampling involves blending information from nearby pixels, resulting in smoother transitions between pixels and reducing pixelation artefacts. This choice contributes significantly to the realism of the generated images.Mapping Network for Style:Introducing a dedicated mapping network is a key innovation. It takes a random latent vector from the latent space and transforms it into a style vector. This separation of responsibilities enhances the model's interpretability and control. A deep neural network with eight fully connected layers allows for complex style mapping, ensuring the generated images can capture a wide range of styles and features.Adaptive Instance Normalization (AdaIN):AdaIN plays a pivotal role in StyleGAN by incorporating the style vector into different generator layers. This technique standardizes the feature maps to follow a Gaussian distribution and then applies the style vector as a bias term. This means that specific aspects of the style, like brightness or colour, can be adjusted independently for each layer, offering fine-grained control over the appearance of the generated images.Noise Injection:Adding Gaussian noise to each activation map before the AdaIN operations is a subtle yet effective enhancement. It introduces randomness at the level of individual blocks, preventing the model from generating overly deterministic images. This noise helps achieve greater variation and realism in the generated images, making them appear more natural.Mixing Regularization:Mixing regularization introduces an element of controlled randomness during training. By randomly choosing between two latent codes for generating images, the model encourages the network to distribute style information differently across layers. This, in turn, results in images with varying levels of detail and style, enhancing diversity and creativity in the generated content.These modifications collectively transform StyleGAN into a versatile tool for image synthesis, offering unprecedented control over the generation process. It allows for creating of high-resolution, photorealistic images with nuanced style adjustments, making it a valuable asset for various applications, including art, fashion, and computer graphics.How to use StyleGAN?Ever dreamt of crafting lifelike portraits of people who never existed, conjuring breathtaking landscapes from the realms of your imagination, or giving visual form to abstract ideas? StyleGAN grants you the power to do all this and more, offering a gateway to boundless artistic expression. Whether you're an aspiring artist keen to explore new horizons or a tech enthusiast delving into the world of artificial intelligence, StyleGAN provides an innovative avenue to express your creativity.Let's embark on a fascinating journey into the universe of StyleGAN, unveiling its potential and exploring how it's revolutionizing art, design, and research. 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Your Masterpieces:Once StyleGAN works its enchantment, you can save the pictures on your computer, share them with friends, or frame them for display on your wall.Embrace Responsibility:While StyleGAN is powerful, remember that with great power comes great responsibility. Avoid using it to create deceptive content that could harm people or invade their privacy. Be an ethical wizard!Revel in Creative Experimentation:Lastly, creating pictures with StyleGAN is akin to embarking on a thrilling art project. Feel free to play around, experiment, and craft amazing things just for the sheer joy of it.There you have it! Using StyleGAN is like having a creative companion capable of crafting astounding images. How you choose to employ its magic is entirely up to you. Enjoy your artistic adventures!ConclusionIn the boundless realm of creative expression, StyleGAN stands as a beacon, illuminating the path for artists, technophiles, and innovators alike. As we conclude our journey through the captivating world of StyleGAN, it's evident that this innovative tool transcends traditional artistic boundaries, offering a canvas where imagination knows no bounds. By harnessing the power of StyleGAN, you've entered a domain where the fantastical becomes tangible, and the unimaginable finds form. Visually, StyleGAN empowers you to breathe life into the extraordinary.Next TopicWhat is Univariate, Bivariate, and multivariate Analysis in Data Visualisation?? prevnext ?

Introduction

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Let's embark on a fascinating journey into the universe of StyleGAN, unveiling its potential and exploring how it's revolutionizing art, design, and research. Join us as we delve into the extraordinary realm of StyleGAN and witness how it's reshaping the landscape of creative image generation.

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- Get the Right Tools:To harness the magic of StyleGAN, you'll need a computer equipped with a sufficiently powerful graphics card, akin to those used by gamers, as StyleGAN loves to crunch numbers. Install Python, a programming language, along with specialized tools like TensorFlow. These form the foundation that enables StyleGAN to perform its enchanting feats.
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- 5 Categorical Encoding Tricks You Need to Know Today as a Data Scientist

- 5 Ways to Apply Data Science to Real Estate

- 23 Great Pandas Codes for Data Scientists

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- Examples of Correlation in Real Life

- Jupyter Notebook Alternative for Data Scientist

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- 5 Games That Can Help You Improve Your Skills As a Data Scientist

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- Five Ways to Detect Outliers/Anomalies That Every Data Scientist Should Know (Python Code)

- 7 Hyperparameter Optimization Techniques Every Data Scientist Should Know

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- 26 Datasets for your Data Science Project
- Data Engineer vs. Data Scientist
- Data Similarity Metrics
- Some Essential Numerical Summaries in Statistics for Data Science (Theory Python and R)

Data Science Tutorial

next ?? prevWhat is Univariate, Bivariate, and multivariate Analysis in Data Visualisation?IntroductionIn the world of data, it's all about uncovering stories hidden within the numbers. Imagine you have a treasure map, but to find the treasure, you need to understand every clue on that map. That's what data analysis is all about. This article will make it simple and fun as we explore three fundamental ways to dig into data: Univariate, Bivariate, and Multivariate analysis.Think of data analysis as solving puzzles. To start, you need to know why you're solving the puzzle. Are you looking for hidden secrets in the data? Trying to save time? Or maybe you want to impress your friends with cool charts. Whatever your reason, we're here to guide you.As we go on this adventure, remember that we're your friendly tour guides, helping you navigate the data jungle. If you have questions, shout them out in the comments, and we'll be your data detectives!Understanding Different Types of DataBefore we dive into the detective work, let's get acquainted with the different types of data you'll encounter:Categorical Data:This is like sorting things into boxes. Imagine you're sorting people by gender, payment methods, or even zodiac signs. Simple.Numerical Data:Numbers are your friends here. But these numbers can be of two kinds:Discrete Data:Consider these as things you can count in one go. Like counting change in your pocket, students in a class, or your grades.Continuous Data:These numbers go on and on, like the scale of your weight, your height, or the exact time and date of a payment.Now, here's where it gets interesting. Depending on the data type, you should tidy it up. For example, if you have dates and times, you can break them down into simpler parts like the year month, or even categorize them as morning or evening sales. And for those continuous numbers, you can group them into categories, like deciding if someone's "below average/slim," "average," or "above average/obese" by setting some weight ranges.Univariate AnalysisUnivariate analysis is like the solo act in a one-person show. You're looking at just one piece of data at a time. Here's what you do:You ask simple questions about your data, like the average, the most common number, or how spread out the numbers are.You use cool tools like histograms (fancy bar charts), box plots (yes, they look like boxes), or violin plots (which sound more elegant than they look). These help you understand the shape of your data and spot any weird numbers that stand out.For instance, if you're checking the "sepal_length" in a dataset about iris flowers, you're doing a univariate analysis because you're focusing on just one thing.Let's break down the key aspects of univariate analysis in more detail:Visualization:Visualizations are powerful tools for understanding the characteristics of a single variable. Here are some common types of visualizations used in univariate analysis:Histograms:Histograms provide a visual representation of the frequency distribution of a variable. They help you understand the shape and spread of the data.Bar Charts:Bar charts are suitable for displaying categorical data or discrete values. They show the frequency or count of each category or value.Pie Charts:Pie charts are used to represent parts of a whole. They are suitable for showing the distribution of categories as percentages of the total.Box Plots:Box plots, also known as box-and-whisker plots, display the distribution of a variable's data, showing the median, quartiles, and potential outliers.Line Graphs:Line graphs are often used to visualize changes in a variable over time or across ordered categories.Summary Statistics:In addition to visualization, univariate analysis involves calculating summary statistics to quantify various aspects of a single variable:Mean:The mean is the average of all data points and represents the central tendency of the variable.Median:The median is the middle value when data is sorted, providing a measure of central tendency less affected by outliers than the mean.Mode:The mode is the value that occurs most frequently in the dataset.Standard Deviation:The standard deviation measures the spread or variability of the data points around the mean.Quartiles:Quartiles divide the data into four equal parts, helping to understand the distribution and identify potential outliers.Purpose:Univariate analysis serves several important purposes in data analysis:Identifying Outliers:Univariate analysis can help detect extreme values (outliers) that may skew the analysis or indicate errors in the data.Assessing Normality:For many statistical analyses, checking if the data follows a normal distribution is important. Univariate analysis tools like histograms can assist in this assessment.Understanding Characteristics:Univariate analysis provides a basic understanding of a single variable's properties, such as its central tendency and variability.Example:Python codeimport seaborn as sns

```
import matplotlib.pyplot as plt
 #Load a sample dataset
 tips = sns.load_dataset("tips")
# Univariate analysis: Histogram
sns.histplot(tips["total_bill"], kde=True)
 plt.title("Histogram of Total Bill")
plt.xlabel("Total Bill")
plt.ylabel("Frequency")
plt.show()
```

OutputUnivariate analysis of the exam scores provides valuable insights into your student's overall performance and helps you identify any exceptional cases.Bivariate AnalysisNow, imagine you're not alone on this journey. You've got a partner. Bivariate analysis is when you bring two friends (variables) together to see how they get along. Here's the deal:You're the matchmaker, trying to determine if two variables are related. Think of it as setting up a blind date for your data.You use scatter plots, which are like love stories. You put one variable on the x-axis and the other on the y-axis. You know they're close friends if they hold hands and go up or down together. You can also use numbers to measure their proximity, like a love meter for data!For example, in that iris dataset, you might pair up "sepal_length" with "sepal_width" to see if they match.Let's present the key aspects of bivariate analysis in a more humanized and relatable manner:Visualization:Imagine you're a gardener and want to understand how the amount of sunlight (variable 1) affects the growth of your plants (variable 2). Bivariate analysis would be like taking photographs of your garden throughout the day and plotting the amount of sunlight (hours of direct sunlight) on the x-axis and the plant growth (height or size) on the y-axis. The resulting scatter plot would visually show how the two variables interact. Are your plants taller on sunnier days, or is there no clear pattern?Correlation:Think of bivariate analysis as being your detective tool when trying to figure out if there's a connection between two things. In our gardening example, you might suspect that more sunlight leads to better plant growth, but how strong is that connection? The correlation coefficient is like a magnifying glass that helps you quantify the strength and direction of the relationship. If the correlation is positive, it means that as sunlight increases, so does plant growth. If it's negative, it means that as sunlight increases, plant growth decreases. And if it's close to zero, there may be no strong relationship.Purpose:Why do all this in the first place? Well, you want your garden to thrive. Bivariate analysis helps determine if there's a cause-and-effect relationship between sunlight and plant growth. If there is, you can make informed decisions, like optimizing the placement of your plants for better sun exposure. It also helps you identify associations - perhaps you notice that your plants don't grow as well on cloudy days. This insight can guide your gardening practices and lead to healthier plants.Example:In your garden, you decide to keep a gardening journal. You record the number of hours of direct sunlight each day (variable 1) and measure the growth of your plants (variable 2). To perform bivariate analysis, create a scatter plot where each point represents a day in your garden. The x-coordinate is the hours of sunlight, and the y-coordinate is the plant growth. When you look at the scatter plot, the plants tend to be taller on days with more sunlight. You also calculate the correlation coefficient, which confirms a strong positive correlation between sunlight and plant growth. This tells you that sunlight positively influences your plants' growth, reinforcing your gardening strategy to maximize sun exposure for better results.Bivariate analysis involves analyzing the relationship between two variables. You can create scatter, box, or violin plots to visualize the relationship between two variables.Python code# Bivariate analysis: Scatter plot

```
sns.scatterplot(data=tips, x="total_bill", y="tip")
```

```
plt.title("Scatter plot of Total Bill vs. Tip")
plt.xlabel("Total Bill")
plt.ylabel("Tip")
plt.show()
```

OutputMultivariate AnalysisMultivariate analysis is like throwing a big party with lots of variables. You invite more than two friends (variables) to the party. But there's a challenge:You can't see everything at once because it's a big party! So, you use special tools like scatter plot matrices or 3-D models (if you're feeling fancy) to help you understand the relationships among all these friends.Sometimes, you need superpowers like Principal Component Analysis (PCA) to understand everything. Think of it as having a special lens to see through the data chaos.The Data Wizards:Sometimes, you need magic to solve a tough puzzle. In data analysis, that magic comes in the form of advanced techniques. These techniques, like Principal Component Analysis (PCA) or regression, help you uncover even deeper secrets in the data. We'll explore these in future articles, and we promise they're like the coolest magic tricks in the data world!ExampleMultivariate analysis involves analyzing the relationship between more than two variables. You can create pair plots, heatmaps, or parallel coordinate plots to visualize multiple variables simultaneously. These code snippets demonstrate basic univariate, bivariate, and multivariate analysis techniques using Python's popular data visualization libraries. Depending on your specific dataset and research questions, you can customize these visualizations and analysis methods. We used the Seaborn library in this example, which works well with pandas DataFrames. The "tips" dataset is a built-in dataset in Seaborn. You can replace it with your dataset as needed.Python code# Multivariate analysis: Pair plot

```
import seaborn as sns
import matplotlib.pyplot as plt
# Load a sample dataset
tips = sns.load_dataset("tips")
# Check the column names to ensure you're using the correct one
print(tips.columns)
```

Use the correct column name ('gender') in the pairplot

sns.pairplot(data=tips, hue="smoker")

plt.suptitle("Pair plot of Tips Dataset (Colored by smoker)")

plt.show()OutputWhy should anyone learn this analysis?Imagine you're in your kitchen and about to bake a cake. Learning about univariate, bivariate, and multivariate analysis in data visualization is like learning different ways to work with ingredients.Univariate Analysisis like examining each ingredient separately. Before you start, closely examine the flour, sugar, eggs, and cocoa powder one by one. You want to know their characteristics-how much flour you have, how sweet the sugar is, and so on. This helps you understand what each ingredient brings to the cake.Bivariate Analysisis when you start pairing up ingredients to see how they interact. You might mix flour and sugar to understand their sweetness or combine eggs and cocoa powder to see how they affect the cake's colour and texture. It's about understanding how two ingredients work together.Multivariate Analysistakes it a step further. Now, you're not just looking at pairs of ingredients but considering the entire recipe. You're thinking about how flour, sugar, eggs, cocoa powder, and other ingredients combine to make the final cake. It's about understanding the complex relationships between all the ingredients.Just as a chef needs to understand how different ingredients work together to create a delicious dish, a data analyst or scientist needs to understand these analysis techniques to make sense of data effectively. Univariate, bivariate, and multivariate analysis help you "taste" your data, so to speak, and discover its unique flavours and complexities.Which one is better to use?Choosing between these methods is like deciding how to explore a new city. To dive deep into one spot, start with univariate analysis. Bivariate analysis is your ticket if you're curious about the dynamic duo. And if you want to unravel the whole city, with all its streets and neighbourhoods, that's where multivariate analysis comes in.There's no one-size-fits-all. It all depends on your curiosity. You could start with one ingredient, move on to see how two interact, and then dive into the multivariate world if you want to know the whole story. Combining all three methods often gives you the richest, most flavorful understanding of your data. It's like savouring every layer of a delicious dish - each bite tells a different story, and together, they create a culinary masterpiece.Choosing the appropriate analysis method depends on the complexity of the research question and the number of variables involved. Univariate analysis is ideal for understanding individual characteristics, bivariate analysis for exploring two-variable relationships, and multivariate analysis for unravelling intricate patterns involving multiple variables. Each approach offers unique insights into the data and is valuable in different analytical contexts.Importance of Data AnalysisImagine you're a chef preparing a grand feast for a special occasion. Data analysis is like having a secret ingredient that enhances your culinary skills in extraordinary ways.Creating Memorable Experiences:Just as you craft meals to create memorable dining experiences, businesses use data analysis to understand customer preferences. Comanalyzingn creates products and services tailored to individual tastes by analysing what customers like making every interaction special.Learning from Experience:Much like how a seasoned chef learns from experimenting with new recipes, data analysis allows us to learn from past experiences. By analysing historical data, we can understand what worked well and what didn't, making us wiser and more efficient in our future endeavours.Making Informed Choices:As you choose the finest ingredients for your dishes, data analysis helps you make informed decisions. It provides valuable insights, helping individuals and organisations select the best action. It's akin to having a trusted sous chef guiding you to choose the perfect ingredients for your masterpiece.Understanding People:Imagine knowing your guests' favourite dishes before they arrive. Data analysis helps us understand people on a deeper level. In fields like psychology and sociology, it enables us to comprehend human behaviour, making connecting, empathising, and empathising with others easier.Improving Lives:Beyond the culinary world, data analysis impacts healthcare profoundly. Just as a doctor analyzes symptoms to diagnose an illness, data analysis in healthcare helps in early disease detection, personalized treatments, and improving overall patient outcomes, saving lives.Preserving Precious Resources:Imagine you're a caretaker of a lush garden. Data analysis helps wisely use resources, ensuring that water, energy, and time are used efficiently. It's like knowing exactly how much water each plant needs, preserving resources for a sustainable future.Unlocking Creativity:Data analysis isn't just about numbers; it's about creativity, too. Artists, writers, and designers use data analysis to understand trends and audience preferences, inspiring new creations. It's like finding inspiration in the world's collective tastes and preferences, sparking innovative ideas.Data analysis is the magic ingredient that adds flavour, precision, and understanding to our personal and professional lives. It's the tool that empowers us to create, connect, and make the world a better place, one insightful analysis at a time. Top of FormConclusionUnivariate analysis is like looking at one thing at a time.Bivariate analysis pairs up two variables to see if they're buddies.Multivariate analysis is the grand party with many variables; sometimes, you need special tools to handle it.Remember, data analysis is an adventure; we're your trusty guides. So, stay tuned for more articles where we'll dive into these techniques with examples and explore the magic behind data analysis. Until then, happy data exploring!Next TopicWhat is Amazon Glacier? prevnext ?

Introduction

In the world of data, it's all about uncovering stories hidden within the numbers. Imagine you have a treasure map, but to find the treasure, you need to understand every clue on that map. That's what data analysis is all about. This article will make it simple and fun as we explore three fundamental ways to dig into data: Univariate, Bivariate, and Multivariate analysis.

Introduction

Think of data analysis as solving puzzles. To start, you need to know why you're solving the puzzle. Are you looking for hidden secrets in the data? Trying to save time? Or maybe you want to impress your friends with cool charts. Whatever your reason, we're here to guide you.

Introduction

As we go on this adventure, remember that we're your friendly tour guides, helping you navigate the data jungle. If you have questions, shout them out in the comments, and we'll be your data detectives!

Understanding Different Types of Data

Before we dive into the detective work, let's get acquainted with the different types of data you'll encounter:

Understanding Different Types of Data

Categorical Data:This is like sorting things into boxes. Imagine you're sorting people by gender, payment methods, or even zodiac signs. Simple.

Understanding Different Types of Data

Numerical Data:Numbers are your friends here. But these numbers can be of two kinds:

Understanding Different Types of Data

- Discrete Data:Consider these as things you can count in one go. Like counting change in your pocket, students in a class, or your grades.
- Continuous Data:These numbers go on and on, like the scale of your weight, your height, or the exact time and date of a payment.

Understanding Different Types of Data

Now, here's where it gets interesting. Depending on the data type, you should tidy it up. For example, if you have dates and times, you can break them down into simpler parts like the year month, or even categorize them as morning or evening sales. And for those continuous numbers, you can group them into categories, like deciding if someone's "below average/slim," "average," or "above average/obese" by setting some weight ranges.

Univariate Analysis

Univariate analysis is like the solo act in a one-person show. You're looking at just one piece of data at a time. Here's what you do:

Univariate Analysis

- You ask simple questions about your data, like the average, the most common number, or how spread out the numbers are.
- You use cool tools like histograms (fancy bar charts), box plots (yes, they look like boxes), or violin

plots (which sound more elegant than they look). These help you understand the shape of your data and spot any weird numbers that stand out.

Univariate Analysis

For instance, if you're checking the "sepal_length" in a dataset about iris flowers, you're doing a univariate analysis because you're focusing on just one thing.

Univariate Analysis

Let's break down the key aspects of univariate analysis in more detail:

Univariate Analysis

Visualization:Visualizations are powerful tools for understanding the characteristics of a single variable. Here are some common types of visualizations used in univariate analysis:

Univariate Analysis

- Histograms:Histograms provide a visual representation of the frequency distribution of a variable. They help you understand the shape and spread of the data.
- Bar Charts:Bar charts are suitable for displaying categorical data or discrete values. They show the frequency or count of each category or value.
- Pie Charts:Pie charts are used to represent parts of a whole. They are suitable for showing the distribution of categories as percentages of the total.
- Box Plots:Box plots, also known as box-and-whisker plots, display the distribution of a variable's data, showing the median, quartiles, and potential outliers.
- Line Graphs:Line graphs are often used to visualize changes in a variable over time or across ordered categories.

Univariate Analysis

Summary Statistics:In addition to visualization, univariate analysis involves calculating summary statistics to quantify various aspects of a single variable:

Univariate Analysis

- Mean:The mean is the average of all data points and represents the central tendency of the variable.
- Median:The median is the middle value when data is sorted, providing a measure of central tendency less affected by outliers than the mean.
- Mode:The mode is the value that occurs most frequently in the dataset.
- Standard Deviation:The standard deviation measures the spread or variability of the data points around the mean.
- Quartiles:Quartiles divide the data into four equal parts, helping to understand the distribution and identify potential outliers.

Univariate Analysis

Purpose:Univariate analysis serves several important purposes in data analysis:

Univariate Analysis

- Identifying Outliers:Univariate analysis can help detect extreme values (outliers) that may skew the analysis or indicate errors in the data.
- Assessing Normality:For many statistical analyses, checking if the data follows a normal distribution is important. Univariate analysis tools like histograms can assist in this assessment.
- Understanding Characteristics:Univariate analysis provides a basic understanding of a single variable's properties, such as its central tendency and variability.

Example:

Python code

Example:

Output

Example:

Univariate analysis of the exam scores provides valuable insights into your student's overall performance and helps you identify any exceptional cases.

Bivariate Analysis

Now, imagine you're not alone on this journey. You've got a partner. Bivariate analysis is when you bring two friends (variables) together to see how they get along. Here's the deal:

Bivariate Analysis

- You're the matchmaker, trying to determine if two variables are related. Think of it as setting up a blind date for your data.
- You use scatter plots, which are like love stories. You put one variable on the x-axis and the other on the y-axis. You know they're close friends if they hold hands and go up or down together. You can also use numbers to measure their proximity, like a love meter for data!

Bivariate Analysis

For example, in that iris dataset, you might pair up "sepal_length" with "sepal_width" to see if they match.

Bivariate Analysis

Let's present the key aspects of bivariate analysis in a more humanized and relatable manner:

Bivariate Analysis

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Bivariate Analysis

Correlation:Think of bivariate analysis as being your detective tool when trying to figure out if there's a connection between two things. In our gardening example, you might suspect that more sunlight leads to better plant growth, but how strong is that connection? The correlation coefficient is like a magnifying glass that helps you quantify the strength and direction of the relationship. If the correlation is positive, it means that as sunlight increases, so does plant growth. If it's negative, it means that as sunlight increases, plant growth decreases. And if it's close to zero, there may be no strong relationship.

Bivariate Analysis

Purpose:Why do all this in the first place? Well, you want your garden to thrive. Bivariate analysis helps determine if there's a cause-and-effect relationship between sunlight and plant growth. If there is, you can make informed decisions, like optimizing the placement of your plants for better sun exposure. It also helps you identify associations - perhaps you notice that your plants don't grow as well on cloudy days. This insight can guide your gardening practices and lead to healthier plants.

Bivariate Analysis

Example:In your garden, you decide to keep a gardening journal. You record the number of hours of direct sunlight each day (variable 1) and measure the growth of your plants (variable 2). To perform bivariate analysis, create a scatter plot where each point represents a day in your garden. The x-coordinate is the hours of sunlight, and the y-coordinate is the plant growth. When you look at the scatter plot, the plants tend to be taller on days with more sunlight. You also calculate the correlation coefficient, which confirms a strong positive correlation between sunlight and plant growth. This tells you that sunlight positively influences your plants' growth, reinforcing your gardening strategy to maximize sun exposure for better results.

Bivariate Analysis

Bivariate analysis involves analyzing the relationship between two variables. You can create scatter, box, or violin plots to visualize the relationship between two variables.

Bivariate Analysis

Python code

Bivariate Analysis

Output

Multivariate Analysis

Multivariate analysis is like throwing a big party with lots of variables. You invite more than two friends (variables) to the party. But there's a challenge:

Multivariate Analysis

- You can't see everything at once because it's a big party! So, you use special tools like scatter plot matrices or 3-D models (if you're feeling fancy) to help you understand the relationships among all these friends.
- Sometimes, you need superpowers like Principal Component Analysis (PCA) to understand everything. Think of it as having a special lens to see through the data chaos.

Multivariate Analysis

The Data Wizards:Sometimes, you need magic to solve a tough puzzle. In data analysis, that magic comes in the form of advanced techniques. These techniques, like Principal Component Analysis (PCA) or regression, help you uncover even deeper secrets in the data. We'll explore these in future articles, and we promise they're like the coolest magic tricks in the data world!

Example

Multivariate analysis involves analyzing the relationship between more than two variables. You can create pair plots, heatmaps, or parallel coordinate plots to visualize multiple variables simultaneously. These code snippets demonstrate basic univariate, bivariate, and multivariate analysis techniques using Python's popular data visualization libraries. Depending on your specific dataset and research questions, you can customize these visualizations and analysis methods. We used the Seaborn library in this example, which works well with pandas DataFrames. The "tips" dataset is a built-in dataset in Seaborn. You can replace it with your dataset as needed.

Example

Python code

Example

Output

Why should anyone learn this analysis?

Imagine you're in your kitchen and about to bake a cake. Learning about univariate, bivariate, and multivariate analysis in data visualization is like learning different ways to work with ingredients.

Why should anyone learn this analysis?

- Univariate Analysisis like examining each ingredient separately. Before you start, closely examine the flour, sugar, eggs, and cocoa powder one by one. You want to know their characteristics-how much flour you have, how sweet the sugar is, and so on. This helps you understand what each ingredient brings to the cake.
- Bivariate Analysisis when you start pairing up ingredients to see how they interact. You might mix flour and sugar to understand their sweetness or combine eggs and cocoa powder to see how they affect the cake's colour and texture. It's about understanding how two ingredients work together.
- Multivariate Analysistakes it a step further. Now, you're not just looking at pairs of ingredients but considering the entire recipe. You're thinking about how flour, sugar, eggs, cocoa powder, and other ingredients combine to make the final cake. It's about understanding the complex relationships between all the ingredients.

Why should anyone learn this analysis?

Just as a chef needs to understand how different ingredients work together to create a delicious dish, a data analyst or scientist needs to understand these analysis techniques to make sense of data effectively. Univariate, bivariate, and multivariate analysis help you "taste" your data, so to speak, and discover its unique flavours and complexities.

Which one is better to use?

Choosing between these methods is like deciding how to explore a new city. To dive deep into one spot, start with univariate analysis. Bivariate analysis is your ticket if you're curious about the dynamic duo. And if you want to unravel the whole city, with all its streets and neighbourhoods, that's where multivariate analysis comes in.

Which one is better to use?

There's no one-size-fits-all. It all depends on your curiosity. You could start with one ingredient, move on to see how two interact, and then dive into the multivariate world if you want to know the whole story. Combining all three methods often gives you the richest, most flavorful understanding of your data. It's like savouring every layer of a delicious dish - each bite tells a different story, and together, they create a culinary masterpiece.

Which one is better to use?

Choosing the appropriate analysis method depends on the complexity of the research question and the number of variables involved. Univariate analysis is ideal for understanding individual characteristics, bivariate analysis for exploring two-variable relationships, and multivariate analysis for unravelling intricate patterns involving multiple variables. Each approach offers unique insights into the data and is valuable in different analytical contexts.

Importance of Data Analysis

Imagine you're a chef preparing a grand feast for a special occasion. Data analysis is like having a secret ingredient that enhances your culinary skills in extraordinary ways.

Importance of Data Analysis

- Creating Memorable Experiences:Just as you craft meals to create memorable dining experiences, businesses use data analysis to understand customer preferences. Comanalyzingn creates products and services tailored to individual tastes by analysing what customers like making every interaction special.

- Learning from Experience:Much like how a seasoned chef learns from experimenting with new recipes, data analysis allows us to learn from past experiences. By analysing historical data, we can understand what worked well and what didn't, making us wiser and more efficient in our future endeavours.
- Making Informed Choices:As you choose the finest ingredients for your dishes, data analysis helps you make informed decisions. It provides valuable insights, helping individuals and organisations select the best action. It's akin to having a trusted sous chef guiding you to choose the perfect ingredients for your masterpiece.
- Understanding People:Imagine knowing your guests' favourite dishes before they arrive. Data analysis helps us understand people on a deeper level. In fields like psychology and sociology, it enables us to comprehend human behaviour, making connecting, empathising, and empathising with others easier.
- Improving Lives:Beyond the culinary world, data analysis impacts healthcare profoundly. Just as a doctor analyzes symptoms to diagnose an illness, data analysis in healthcare helps in early disease detection, personalized treatments, and improving overall patient outcomes, saving lives.
- Preserving Precious Resources:Imagine you're a caretaker of a lush garden. Data analysis helps wisely use resources, ensuring that water, energy, and time are used efficiently. It's like knowing exactly how much water each plant needs, preserving resources for a sustainable future.
- Unlocking Creativity:Data analysis isn't just about numbers; it's about creativity, too. Artists, writers, and designers use data analysis to understand trends and audience preferences, inspiring new creations. It's like finding inspiration in the world's collective tastes and preferences, sparking innovative ideas.

Importance of Data Analysis

Data analysis is the magic ingredient that adds flavour, precision, and understanding to our personal and professional lives. It's the tool that empowers us to create, connect, and make the world a better place, one insightful analysis at a time. Top of Form

Conclusion

- Univariate analysis is like looking at one thing at a time.
- Bivariate analysis pairs up two variables to see if they're buddies.
- Multivariate analysis is the grand party with many variables; sometimes, you need special tools to handle it.

Conclusion

Remember, data analysis is an adventure; we're your trusty guides. So, stay tuned for more articles where we'll dive into these techniques with examples and explore the magic behind data analysis. Until then, happy data exploring!

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Data scientists establish the framework for the whole process, ensuring that the analysis remains focused and pertinent, by precisely describing the problem.For instance, a retail business would wish to lower customer attrition, whereas a healthcare provider might want to foresee disease outbreaks. Data scientists may set the scene for the whole process and make sure that succeeding processes are purpose-driven by identifying the problem.Step 2: Data CollectionThe next thing to do is collect the needed information once the issue in question has been developed. Several connected sources to collect information exist, including the form of databases, application programming interfaces (web scraping, and sensors in Network of Things (IoT) devices. To guarantee data quality, precision, and quality completeness, collecting information is a laborious endeavor that demands meticulous attention to detail. The proverb "garbage in, garbage out" highlights how crucial this stage is.It is crucial to guarantee data integrity and quality while collecting the data. This entails managing duplicates, and outliers, and handling missing value checks. The importance of careful data gathering cannot be overstated since incomplete or erroneous data might produce incorrect findings.Step 3: Data PreprocessingIt is frequently necessary to clean and prepare raw data before using it for analysis. Handling missing values, eliminating duplicates, and managing outliers are all aspects of data preparation. Data may also need to be translated into an analytically-ready format, which may include feature scaling, text tokenization, or numerical encoding.Handling Missing Data:Choosing whether to fill in or ignore missing information is known as handling missing data.Data scaling:Ensuring that data is distributed evenly throughout a range to avoid one characteristic from overpowering another.Encoding Categorical Variables:Encoding Using categorical variables, machine learning algorithms may convert category input into numerical form.Feature Selection:To minimize dimensionality, choose the analysis's most pertinent characteristics using feature selection.Data preparation is a crucial stage since it creates the framework for precise modeling and result interpretation.Step 4: Exploratory Data Analysis (EDA)It's time to investigate. In exploratory data analysis (EDA), data scientists don their work boots and dive headfirst into the data. Patterns, relationships, and possible insights are shown using statistical methods and visualization tools. The creation and improvement of hypotheses is based on EDA.What stands out in the data as the main trends and outliers?What relationships exist among several variables?What information do visualizations and summary statistics provide?EDA is the first stage in the process of generating hypotheses, which then direct further analysis and feature engineering.Step 5: Feature EngineeringRarely does data arrive in the ideal format for analysis. To improve the predictive ability of the data, new characteristics are developed or current ones are modified. One-hot encoding, creating interactive features, and changing variables mathematically are all examples of techniques.For instance, feature engineering may entail extracting text characteristics like word counts, emotion ratings, or word embeddings for a job involving natural language processing. It could include extracting texture or color elements while analyzing images.Step 6: Model SelectionIt's now time to select the appropriate instrument for the job after thoroughly comprehending the facts. The issue type (classification, regression, clustering) and the properties of the data are key factors in model choice. There are several algorithms to pick from, including support vector machines, neural networks, decision trees, and linear regression.Step 7: Model TrainingUsing a part of the data, sometimes referred to as the training set, chosen models are trained. For performance optimization, model parameters are changed during this stage. The model's generalizability and overfitting are both protected through the use of cross-validation procedures.Step 8: Model EvaluationHow do you determine the quality of your model? The solution is to evaluate models. The effectiveness of the model is evaluated using a variety of measures, including accuracy, precision, recall, and score. Data scientists may improve their models using this phase and, if required, go back and review prior steps of the procedure.Step 9: Model InterpretabilityEven though machine learning models may make precise predictions, they are sometimes referred to as "black boxes." To understand why a model generates particular predictions, model interpretability is essential. Feature significance analysis and SHAP values are two interpretability approaches that aid in illuminating the inner workings of complicated models.Feature Importance:Finding the characteristics that have the greatest impact on model predictions is known as feature importance.SHAP Values:Shapley values offer a mechanism to quantify how much each feature contributes to a prediction.Partial Dependence Plots:Visualizing the link between some features and forecasts while maintaining the stability of other features.Step 10: DeploymentIf a valuable model is restricted to a development environment, it is of no value. Deployment is putting the model into use in a setting where it can make predictions or offer insights in real-time. To do this, it could be necessary to build a web service, integrate the model with current systems, and guarantee scalability and stability.Scalability:Ensuring that the model can analyze enormous amounts of data in real-time or in batches.Integration:Integrating the model with current systems, databases, or online services is referred to as integration.Monitoring:Using monitoring tools to track the performance of the model and find problems or drift.Versioning:Keeping track of several model iterations to enable updates and rollbacks.Step 11: Monitoring and MaintenanceAfter deployment, the work doesn't cease. To make sure models keep performing well, they must be continuously inspected. Model accuracy may be impacted by data drift, modifications in user behavior, or external variables. The model must be updated and maintained often to remain effective.Performance Monitoring:Monitoring the model's performance in the production environment to determine its correctness and dependability.Data Drift Detection:Finding changes in the data distribution that can impact model performance is known as "data drift detection."Model

Retraining:Retraining the model entails periodically feeding it fresh data to help it adjust to evolving trends.Issue Resolution:Taking care of any problems, faults, or atypical behaviors that appear in the production environment.Step 12: Communication and ReportingData science involves more than simply data crunching; it also involves sharing insightful information with stakeholders. A clear, intelligible presentation of findings and ideas is necessary for effective communication. Reports, narrative tactics, and visualizations all aid in bridging the information-decision divide.Visualization:The process of presenting facts in an understandable and instructive manner.Narrative:Creating a narrative that conveys the analysis's context, methods, and consequences.Impact assessment:Impact assessment measures how data-driven decisions affect a company or organization.Feedback Gathering:Gathering comments from interested parties to improve analysis and models.Step 13: Feedback LoopThe data science method must include gathering input from users and stakeholders. Refinements to the model are informed by feedback, which helps identify areas for improvement. With the help of an iterative feedback loop, data science solutions may adapt to changing business requirements.Listening to Stakeholders:actively soliciting input from users, subject-matter experts, and decision-makers.Iterative refinement:Improving models, analysis, and procedures via the use of feedback.Adaptation:Data science pipeline adaptation in response to shifting business goals and requirements.Step 14: Ethical ConsiderationsData scientists have ethical obligations. Responsible data handling, addressing bias and fairness issues, and user privacy protection are essential. To achieve responsible and fair outputs, ethical issues should be included in every step of the data science process.Fairness and Bias:To achieve fair results, biases in data and models must be found and eliminated.Privacy:Data management and analysis must protect sensitive and personally identifiable information (PII).Transparency:Making model choices and data processing procedures visible and comprehensible.Regulatory Compliance:Ensuring adherence to industry standards and legislation governing data protection.Step 15: DocumentationReproducibility and knowledge sharing in data science are based on documentation. Document every stage of the procedure in detail, including data sources, preprocessing, model topologies, and evaluation outcomes. Projects that are thoroughly documented make cooperation and future reference easier.Step 16: Knowledge Sharing and CollaborationData scientists, domain experts, and business stakeholders frequently work together in data science projects. Within the team, sharing ideas, code, and best practices promotes cooperation and makes use of the group's aggregate knowledge.Step 17: Scaling and AutomationOften, scale and automation are required as data science initiatives advance. This might entail developing systems that can effectively handle bigger datasets and more complicated challenges, as well as automating repetitive processes and designing data processing pipelines.Step 18: Continuous LearningData science is a constantly changing discipline. Data scientists need to constantly learn if they want to stay on top. This involves participating in conferences, taking online classes, reading research articles, and attempting new methods and technologies.ConclusionStarting with the characterization of the problem and ending with ongoing improvement, the data science process is intricate and iterative. It requires a wide range of abilities, from communication and ethical issues to modeling and data preparation. Understanding the data science process is essential to unlocking the potential of information and facilitating data-driven choices in a world where data is being used more and more. Organizations may use data to solve issues, make forecasts, and gain an advantage in the current business environment by carefully following these processes.Next TopicNLP for Data Science? prevnext ?

Introduction

The skill of drawing insightful conclusions from enormous and complicated information has become crucial for organizations, researchers, and decision-makers in today's data-driven society. The data science process, a methodical and iterative technique that uses data to produce predictions, find hidden patterns, and guide informed decision-making, is known as this art. We shall take a tour through the data science process in this post, illuminating its essential phases and importance.

Step 1: Problem Definition

Every data science project starts with the same core inquiry: What issue are we trying to address? Understanding the project's objectives and aims, frequently in connection with more general commercial or research objectives, is the first stage. Data scientists establish the framework for the whole process, ensuring that the analysis remains focused and pertinent, by precisely describing the problem.

Step 1: Problem Definition

For instance, a retail business would wish to lower customer attrition, whereas a healthcare provider might want to foresee disease outbreaks. Data scientists may set the scene for the whole process and make sure that succeeding processes are purpose-driven by identifying the problem.

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The next thing to do is collect the needed information once the issue in question has been developed. Several connected sources to collect information exist, including the form of databases, application programming interfaces (web scraping, and sensors in Network of Things (IoT) devices. To guarantee data quality, precision, and quality completeness, collecting information is a laborious endeavor that demands meticulous attention to detail. The proverb "garbage in, garbage out" highlights how crucial this stage is.

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It is crucial to guarantee data integrity and quality while collecting the data. This entails managing duplicates, and outliers, and handling missing value checks. The importance of careful data gathering cannot be overstated since incomplete or erroneous data might produce incorrect findings.

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It is frequently necessary to clean and prepare raw data before using it for analysis. Handling missing values, eliminating duplicates, and managing outliers are all aspects of data preparation. Data may also need to be translated into an analytically-ready format, which may include feature scaling, text tokenization, or numerical encoding.

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- Handling Missing Data:Choosing whether to fill in or ignore missing information is known as handling missing data.

- Data scaling:Ensuring that data is distributed evenly throughout a range to avoid one characteristic from overpowering another.

- Encoding Categorical Variables:Encoding Using categorical variables, machine learning algorithms may convert category input into numerical form.

- Feature Selection:To minimize dimensionality, choose the analysis's most pertinent characteristics using feature selection.

Step 3: Data Preprocessing

Data preparation is a crucial stage since it creates the framework for precise modeling and result interpretation.

Step 4: Exploratory Data Analysis (EDA)

It's time to investigate. In exploratory data analysis (EDA), data scientists don their work boots and dive headfirst into the data. Patterns, relationships, and possible insights are shown using statistical methods and visualization tools. The creation and improvement of hypotheses is based on EDA.

Step 4: Exploratory Data Analysis (EDA)

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- What relationships exist among several variables?

- What information do visualizations and summary statistics provide?

Step 4: Exploratory Data Analysis (EDA)

EDA is the first stage in the process of generating hypotheses, which then direct further analysis and feature engineering.

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Rarely does data arrive in the ideal format for analysis. To improve the predictive ability of the data, new characteristics are developed or current ones are modified. One-hot encoding, creating interactive features, and changing variables mathematically are all examples of techniques.

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For instance, feature engineering may entail extracting text characteristics like word counts, emotion ratings, or word embeddings for a job involving natural language processing. It could include extracting texture or color elements while analyzing images.

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It's now time to select the appropriate instrument for the job after thoroughly comprehending the facts. The issue type (classification, regression, clustering) and the properties of the data are key factors in model choice. There are several algorithms to pick from, including support vector machines, neural networks, decision trees, and linear regression.

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Using a part of the data, sometimes referred to as the training set, chosen models are trained. For performance optimization, model parameters are changed during this stage. The model's generalizability and overfitting are both protected through the use of cross-validation procedures.

Step 8: Model Evaluation

How do you determine the quality of your model? The solution is to evaluate models. The effectiveness of the model is evaluated using a variety of measures, including accuracy, precision, recall, and score. Data scientists may improve their models using this phase and, if required, go back and review prior steps of the procedure.

Step 9: Model Interpretability

Even though machine learning models may make precise predictions, they are sometimes referred to as "black boxes." To understand why a model generates particular predictions, model interpretability is essential. Feature significance analysis and SHAP values are two interpretability approaches that aid in illuminating the inner workings of complicated models.

Step 9: Model Interpretability

- Feature Importance:Finding the characteristics that have the greatest impact on model predictions is known as feature importance.

- SHAP Values:Shapley values offer a mechanism to quantify how much each feature contributes to a prediction.

- Partial Dependence Plots:Visualizing the link between some features and forecasts while maintaining the stability of other features.

Step 10: Deployment

If a valuable model is restricted to a development environment, it is of no value. Deployment is putting the model into use in a setting where it can make predictions or offer insights in real-time. To do this, it could be necessary to build a web service, integrate the model with current systems, and guarantee scalability and stability.

Step 10: Deployment

- Scalability:Ensuring that the model can analyze enormous amounts of data in real-time or in batches.

- Integration:Integrating the model with current systems, databases, or online services is referred to as integration.

- Monitoring:Using monitoring tools to track the performance of the model and find problems or drift.

- Versioning:Keeping track of several model iterations to enable updates and rollbacks.

Step 11: Monitoring and Maintenance

After deployment, the work doesn't cease. To make sure models keep performing well, they must be continuously inspected. Model accuracy may be impacted by data drift, modifications in user behavior, or external variables. The model must be updated and maintained often to remain effective.

Step 11: Monitoring and Maintenance

- Performance Monitoring:Monitoring the model's performance in the production environment to determine its correctness and dependability.

- Data Drift Detection:Finding changes in the data distribution that can impact model performance is known as "data drift detection."

- Model Retraining:Retraining the model entails periodically feeding it fresh data to help it adjust to evolving trends.

- Issue Resolution:Taking care of any problems, faults, or atypical behaviors that appear in the production environment.

Step 12: Communication and Reporting

Data science involves more than simply data crunching; it also involves sharing insightful information with stakeholders. A clear, intelligible presentation of findings and ideas is necessary for effective communication. Reports, narrative tactics, and visualizations all aid in bridging the information-decision divide.

Step 12: Communication and Reporting

- Visualization:The process of presenting facts in an understandable and instructive manner.

- Narrative:Creating a narrative that conveys the analysis's context, methods, and consequences.

- Impact assessment:Impact assessment measures how data-driven decisions affect a company or organization.

- Feedback Gathering:Gathering comments from interested parties to improve analysis and models.

Step 13: Feedback Loop

The data science method must include gathering input from users and stakeholders. Refinements to the model are informed by feedback, which helps identify areas for improvement. With the help of an iterative feedback loop, data science solutions may adapt to changing business requirements.

Step 13: Feedback Loop

- Listening to Stakeholders:actively soliciting input from users, subject-matter experts, and decision-makers.

- Iterative refinement:Improving models, analysis, and procedures via the use of feedback.

- Adaptation:Data science pipeline adaptation in response to shifting business goals and requirements.

Step 14: Ethical Considerations

Data scientists have ethical obligations. Responsible data handling, addressing bias and fairness issues, and user privacy protection are essential. To achieve responsible and fair outputs, ethical issues should be included in every step of the data science process.

Step 14: Ethical Considerations

- Fairness and Bias:To achieve fair results, biases in data and models must be found and eliminated.

- Privacy:Data management and analysis must protect sensitive and personally identifiable information (PII).

- Transparency:Making model choices and data processing procedures visible and comprehensible.

- Regulatory Compliance:Ensuring adherence to industry standards and legislation governing data protection.

Step 15: Documentation

Reproducibility and knowledge sharing in data science are based on documentation. Document every stage of the procedure in detail, including data sources, preprocessing, model topologies, and evaluation outcomes. Projects that are thoroughly documented make cooperation and future reference easier.

Step 16: Knowledge Sharing and Collaboration

Data scientists, domain experts, and business stakeholders frequently work together in data science projects. Within the team, sharing ideas, code, and best practices promotes cooperation and makes use of the group's aggregate knowledge.

Step 17: Scaling and Automation

Often, scale and automation are required as data science initiatives advance. This might entail developing systems that can effectively handle bigger datasets and more complicated challenges, as well as automating repetitive processes and designing data processing pipelines.

Step 18: Continuous Learning

Data science is a constantly changing discipline. Data scientists need to constantly learn if they want to stay on top. This involves participating in conferences, taking online classes, reading research articles, and attempting new methods and technologies.

Conclusion

Starting with the characterization of the problem and ending with ongoing improvement, the data science process is intricate and iterative. It requires a wide range of abilities, from communication and ethical issues to modeling and data preparation. Understanding the data science process is essential to unlocking the potential of information and facilitating data-driven choices in a world where data is being used more and more. Organizations may use data to solve issues, make forecasts, and gain an advantage in the current business environment by carefully following these processes.

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Data Science Tutorial

next ?? prevNLP for Data ScienceIntroductionNatural Language Processing (NLP) is among the one of the most interesting yet challenging fields that makes up the tremendous field of statistical science. The overarching objective of NLP, a branch of the field of artificial intelligence, is to contribute to making as feasible for machines to understand, analyze, and synthesize language that humans speak. Because of the rapid development of computerized text data in the past decade, it saw spectacular growth. Incomplete text has a lot of promise, and this emerging sector offers endless options for companies, scholars, and individuals to discover it. We will explore the foundations of NLP for data science, its applications, major methodologies, and potential applications.The Power of Language in Data ScienceThe increasing popularity of NLP in data science has been attributed to the understanding that text data is a treasure for understanding instead of simply an outcome of human conversation. Unorganized text, like that that exists in emails, reports, customer reviews, and social media posts, takes up a large amount of data worldwide. This textual data can be analyzed to glean significant information, sentiment, trends, and patterns that are essential to making choices. Data scientists may employ NLP to take advantage of this unstructured data and turn it into data that can be put to use.NLPs Core ObjectivesThe main goals of NLP are to comprehend, decipher, and produce human language. The following key tasks, that constitute the foundation of NLP in data science, can be divided into these goals:Tokenization:This is the process of deconstructing text into tokens, which frequently consist of words or phrases. The first process in text analysis is tokenization, which is important for many NLP jobs.Part-of-speech Tagging:Tagging each word in a sentence with its appropriate part of speech, such as a noun, verb, or adjective. For syntactic analysis, this is significant.Named Entity Recognition:Recognition and categorization of named entities in text, including names of individuals, places, organizations, and more, is referred to as recognition of named entities (NER).Sentiment analysis:This is the process that recognizes the text's emotional undertone, which is essential to assessing customer sentiment, brand perception, and other variables.Topic modeling:This is the process of locating and extracting the key themes or subjects from a group of materials. This helps classify and summarize stuff.Text classification:This is the process of classifying text into predetermined categories for purposes including news classification, spam detection, and sentiment analysis.Language generation:The process of producing text that sounds human, as in chatbots and content creation.Machine Translation:Text translation from one language to another, removing barriers to communication across languages and cultures.These goals, along with others, form the basis for several data science applications of NLP.Key Techniques in NLP for Data ScienceOver time, NLP techniques have changed dramatically, largely as a result of developments in deep learning and neural networks.Some of the fundamental methods that support NLP for data science include:Word Embeddings:Words are represented as dense vectors in a continuous vector space by word embeddings like Word2Vec and GloVe. These embeddings record the semantic connections between words and allow algorithms to comprehend the sentence's context.RNNs or Recurrent Neural Networks:As a class of neural networks that perform well with sequential data, RNNs are an obvious choice for NLP applications. They have problems with disappearing gradients and can't grasp dependencies in text data.Long Short-Term Memory (LSTM):LSTMs are a type of RNN designed to address the vanishing gradient problem. They are particularly useful in tasks requiring memory of past words or phrases, such as language generation.Transformer Models:Transformer models, with architectures like BERT and GPT, have revolutionized NLP. They leverage self-attention mechanisms to understand the context of words in a sentence, enabling state-of-the-art results in various NLP tasks.Tokenization Libraries:Libraries like spaCy and NLTK provide tokenization and other text preprocessing functions, making it easier to clean and structure text data for analysis.Pretrained Models:Pretrained models, often available through Hugging Face's Transformers library, have democratized NLP by providing access to powerful language models. These models can be fine-tuned for specific tasks, reducing the need for extensive training data.Metrics for Evaluation:Strong evaluation metrics are crucial in NLP for tasks like text classification and machine translation. Performance is measured using metrics such as the F1 score, BLEU score, and ROUGE score.The Significance of NLP in Data ScienceIt is impossible to overestimate the significance of NLP in data research. Our digital world is brimming with text data, like emails, news articles, social media posts, customer assessments, and more. There is a wealth of information included in this unstructured textual substance, and NLP acts as the link to transform this information into structured, useful information.The primary goals of NLP are:Language Understanding:NLP attempts to make it feasible for machines to comprehend human language. Knowing the meanings of words, phrases, and sentences belongs to this category.Interpreting Language:NLP goes beyond understanding to interpret language by sifting over text to find insights, sentiments, entities, and themes.Language generation:NLP can also be used to generate text that looks like human speech, which has uses in chatbots, publishing, and other areas.NLP uses a variety of approaches and tools to achieve these goals.The Future of NLP in Data ScienceNLP in data science will face both great prospects and difficult obstacles in the future:NLP multimodal:An increasing trend is the blending of text with other media, like pictures and audio. Multimodal NLP promises a richer comprehension of content by taking into account various sources of data at once.Understanding other languages:A rising amount of attention is being paid to NLP models' capacity to comprehend many languages and overcome language barriers. Cross-lingual understanding is facilitated by models like mBERT.Moral Points of View:The importance of ethical considerations increases as NLP models get more potent. The creation and implementation of NLP solutions must take into account difficulties with bias, fairness, and responsible AI.Languages with Few Resources:Low-resource languages are now included in NLP's scope, fostering inclusivity and linguistic communities' access to technology.Single-Event Learning:Few-shot learning makes NLP more affordable and accessible for specialized applications by enabling models to complete tasks with little training data.NLP That Preserves Privacy:It can be difficult to protect user privacy while utilizing the strength of NLP models. It is anticipated that privacy-preserving NLP techniques will become more significant.Applications of NLPs in Data ScienceNumerous sectors and domains have benefited greatly from NLP. Here are a few noteworthy examples:Sentiment AnalysisA crucial NLP application is sentiment analysis, often known as opinion mining. It entails figuring out if text data communicated a good, negative, or neutral mood. Understanding consumer sentiment, industry trends, and brand perception are all benefited by this.Classification of TextText data must be categorized into predetermined categories to be classified. It is frequently employed for tasks like content recommendation, news categorization, and spam detection.NER, or Named Entity RecognitionNER is essential for extracting names of people, locations, organizations, and other named entities from text. This is helpful for a variety of applications, including entity linkage and information retrieval.Virtual assistants and ChatbotsNLP is used by chatbots and virtual assistants to comprehend user requests and provide thoughtful responses. 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It is difficult to overestimate the significance of NLP in this area because it gives data scientists the capacity to understand, interpret, and create human language. Its many uses, which range from categorization of texts and sentiment analysis to healthcare and content recommendation, show its flexibility and how it can address a wide range of real-world issues.Text analysis has become more effective because of NLP's essential techniques, including tokenization, word embeddings, and complex transformer models, but they additionally paved the way for novel approaches. With advances in multimodal NLP, cross-lingual understanding, ethical considerations, and privacy protection, the future of NLP in data science seems promising.NLP remains at the vanguard as we navigate the changing field of data science because it provides a link between the rich world of human language and the data-driven insights that businesses and researchers are looking for. NLP is an essential tool for data scientists because of its significant influence and limitless possibilities.Next TopicSAS for Data Science? prevnext ?

Introduction

Natural Language Processing (NLP) is among the one of the most interesting yet challenging fields that makes up the tremendous field of statistical science. The overarching objective of NLP, a branch of the field of artificial intelligence, is to contribute to making as feasible for machines to understand, analyze, and synthesize language that humans speak. Because of the rapid development of computerized text data in the past decade, it saw spectacular growth. Incomplete text has a lot of promise, and this emerging sector offers endless options for companies, scholars, and individuals to discover it. We will explore the foundations of NLP for data science, its applications, major methodologies, and potential applications.

The Power of Language in Data Science

The increasing popularity of NLP in data science has been attributed to the understanding that text data is a treasure for understanding instead of simply an outcome of human conversation. Unorganized text, like that that exists in emails, reports, customer reviews, and social media posts, takes up a large amount of data worldwide. This textual data can be analyzed to glean significant information, sentiment, trends, and patterns that are essential to making choices. Data scientists may employ NLP to take advantage of this unstructured data and turn it into data that can be put to use.

NLPs Core Objectives

The main goals of NLP are to comprehend, decipher, and produce human language. The following key tasks, that constitute the foundation of NLP in data science, can be divided into these goals:

NLPs Core Objectives

- Tokenization:This is the process of deconstructing text into tokens, which frequently consist of words or phrases. The first process in text analysis is tokenization, which is important for many NLP jobs.
- Part-of-speech Tagging:Tagging each word in a sentence with its appropriate part of speech, such as a noun, verb, or adjective. For syntactic analysis, this is significant.
- Named Entity Recognition:Recognition and categorization of named entities in text, including names of individuals, places, organizations, and more, is referred to as recognition of named entities (NER).
- Sentiment analysis:This is the process that recognizes the text's emotional undertone, which is essential to assessing customer sentiment, brand perception, and other variables.
- Topic modeling:This is the process of locating and extracting the key themes or subjects from a group of materials. This helps classify and summarize stuff.
- Text classification:This is the process of classifying text into predetermined categories for purposes including news classification, spam detection, and sentiment analysis.
- Language generation:The process of producing text that sounds human, as in chatbots and content creation.
- Machine Translation:Text translation from one language to another, removing barriers to communication across languages and cultures.

NLPs Core Objectives

These goals, along with others, form the basis for several data science applications of NLP.

Key Techniques in NLP for Data Science

Over time, NLP techniques have changed dramatically, largely as a result of developments in deep learning and neural networks.

Key Techniques in NLP for Data Science

Some of the fundamental methods that support NLP for data science include:

Key Techniques in NLP for Data Science

- Word Embeddings:Words are represented as dense vectors in a continuous vector space by word embeddings like Word2Vec and GloVe. These embeddings record the semantic connections between words and allow algorithms to comprehend the sentence's context.
- RNNs or Recurrent Neural Networks:As a class of neural networks that perform well with sequential data, RNNs are an obvious choice for NLP applications. They have problems with disappearing gradients and can't grasp dependencies in text data.
- Long Short-Term Memory (LSTM):LSTMs are a type of RNN designed to address the vanishing gradient problem. They are particularly useful in tasks requiring memory of past words or phrases, such as language generation.
- Transformer Models:Transformer models, with architectures like BERT and GPT, have revolutionized NLP. They leverage self-attention mechanisms to understand the context of words in a sentence, enabling state-of-the-art results in various NLP tasks.
- Tokenization Libraries:Libraries like spaCy and NLTK provide tokenization and other text preprocessing functions, making it easier to clean and structure text data for analysis.
- Pretrained Models:Pretrained models, often available through Hugging Face's Transformers library, have democratized NLP by providing access to powerful language models. These models can be fine-tuned for specific tasks, reducing the need for extensive training data.
- Metrics for Evaluation:Strong evaluation metrics are crucial in NLP for tasks like text classification and machine translation. Performance is measured using metrics such as the F1 score, BLEU score, and ROUGE score.

The Significance of NLP in Data Science

It is impossible to overestimate the significance of NLP in data research. Our digital world is brimming with text data, like emails, news articles, social media posts, customer assessments, and more. There is a wealth of information included in this unstructured textual substance, and NLP acts as the link to transform this information into structured, useful information.

The primary goals of NLP are:

- Language Understanding:NLP attempts to make it feasible for machines to comprehend human language. Knowing the meanings of words, phrases, and sentences belongs to this category.
- Interpreting Language:NLP goes beyond understanding to interpret language by sifting over text to find insights, sentiments, entities, and themes.
- Language generation:NLP can also be used to generate text that looks like human speech, which has uses in chatbots, publishing, and other areas.

The primary goals of NLP are:

NLP uses a variety of approaches and tools to achieve these goals.

The Future of NLP in Data Science

NLP in data science will face both great prospects and difficult obstacles in the future:

The Future of NLP in Data Science

- NLP multimodal:An increasing trend is the blending of text with other media, like pictures and audio. Multimodal NLP promises a richer comprehension of content by taking into account various sources of data at once.
- Understanding other languages:A rising amount of attention is being paid to NLP models' capacity to comprehend many languages and overcome language barriers. Cross-lingual understanding is facilitated by models like mBERT.
- Moral Points of View:The importance of ethical considerations increases as NLP models get more potent. The creation and implementation of NLP solutions must take into account difficulties with

bias, fairness, and responsible AI.

- Languages with Few Resources:Low-resource languages are now included in NLP's scope, fostering inclusivity and linguistic communities' access to technology.

- Single-Event Learning:Few-shot learning makes NLP more affordable and accessible for specialized applications by enabling models to complete tasks with little training data.

- NLP That Preserves Privacy:It can be difficult to protect user privacy while utilizing the strength of NLP models. It is anticipated that privacy-preserving NLP techniques will become more significant.

Applications of NLPs in Data Science

Numerous sectors and domains have benefited greatly from NLP. Here are a few noteworthy examples:

Applications of NLPs in Data Science

Sentiment Analysis

Applications of NLPs in Data Science

A crucial NLP application is sentiment analysis, often known as opinion mining. It entails figuring out if text data communicated a good, negative, or neutral mood. Understanding consumer sentiment, industry trends, and brand perception are all benefited by this.

Applications of NLPs in Data Science

Classification of Text

Applications of NLPs in Data Science

Text data must be categorized into predetermined categories to be classified. It is frequently employed for tasks like content recommendation, news categorization, and spam detection.

Applications of NLPs in Data Science

NER, or Named Entity Recognition

Applications of NLPs in Data Science

NER is essential for extracting names of people, locations, organizations, and other named entities from text. This is helpful for a variety of applications, including entity linkage and information retrieval.

Applications of NLPs in Data Science

Virtual assistants and Chatbots

Applications of NLPs in Data Science

NLP is used by chatbots and virtual assistants to comprehend user requests and provide thoughtful responses. They are used in e-commerce, customer service, and other areas to offer effective, round-the-clock assistance.

Applications of NLPs in Data Science

Text Summarization

Applications of NLPs in Data Science

Automatic text summarization, which makes use of NLP, is extremely useful for swiftly removing important information from lengthy documents, research papers, news items, and more.

Applications of NLPs in Data Science

Content Suggestion

Applications of NLPs in Data Science

By recommending pertinent goods or articles based on user behavior and preferences, e-commerce platforms, streaming services, and news websites improve user experience.

Applications of NLPs in Data Science

Medical Care

Applications of NLPs in Data Science

NLP is used in the healthcare industry to examine medical records, extract patient data, and support diagnosis. Additionally, it can aid researchers in processing huge volumes of medical material.

Conclusion

The cornerstone of data science, Natural Language Processing (NLP), allows the transformation of unstructured text data into insightful conclusions. It is difficult to overestimate the significance of NLP in this area because it gives data scientists the capacity to understand, interpret, and create human language. Its many uses, which range from categorization of texts and sentiment analysis to healthcare and content recommendation, show its flexibility and how it can address a wide range of real-world issues.

Conclusion

Text analysis has become more effective because of NLP's essential techniques, including tokenization, word embeddings, and complex transformer models, but they additionally paved the way for novel approaches. With advances in multimodal NLP, cross-lingual understanding, ethical considerations, and privacy protection, the future of NLP in data science seems promising.NLP remains at the vanguard as we navigate the changing field of data science because it provides a link between the rich world of human language and the data-driven insights that businesses and researchers are looking for. NLP is an essential tool for data scientists because of its significant influence and limitless possibilities.

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Data Science Tutorial

next ?? prevData Science in AgricultureIntroductionAgriculture shouldn't be a contrast to how the use of data science has altered other sectors of the economy. The use of information science across agriculture is now recognized as an essential component in contemporary society because issues involving worldwide food security including ecologically sound farming are crucial. To tackle the problems affecting the farming community, this breakthrough discipline combines the use of artificial intelligence, data analysis, and innovative technology.Agriculture has always been vulnerable to uncontrollable elements including the weather, pests, and shifting consumer preferences. Data science, on the other hand, offers a way to optimize all parts of farming, from crop production to animal management, in addition to providing a way to lessen these uncertainties. Farmers and agricultural specialists may make well-informed decisions, maximize yields, cut down on resource waste, and advance ecological sustainability by gathering, processing, and analyzing massive volumes of data.This introduction to data science in agriculture will explore the ways that data-driven techniques are changing conventional agricultural practices in this era of precision agriculture. We will look at how data science approaches are being used for supply chain optimization, soil analysis, crop monitoring, and more, all of which help to boost production and practice responsible resource management.The Role of Data Science in AgricultureAs a diverse discipline, data science includes several methods and instruments for gathering, processing, and analyzing data to derive insightful conclusions and inform decision-making. Data science is crucial in agriculture for streamlining procedures, boosting output, and assuring sustainable practices.Let's explore some important facets of data science's function in agriculture:Precision AgricultureThe profession of precision agriculture, sometimes known as "smart farming," largely utilizes data science. It includes using information from sensors, soil samples, meteorological data, and satellite images to create accurate and site-specific crop management decisions. Farmers may modify their practices, such as planting, watering, and fertilization, to meet the particular requirements of each field or even of individual plants, thanks to data-driven insights. This focused strategy decreases resource use, minimizes environmental effects, and increases agricultural yields.Crop Monitoring and Disease DetectionTo keep track of crop health and spot illnesses early on, data science tools like machine learning and image analysis are used. High-resolution photographs of fields may be taken by drones with cameras, and AI algorithms can examine these images to find symptoms of illness or stress in plants. Early diagnosis enables farmers to make necessary corrections, such as adding pesticides or changing irrigation, to reduce crop loss and boost production.Weather Forecasting and Risk ManagementFor agricultural planning, precise weather forecasts are essential. To give farmers accurate weather forecasts, data science models use historical weather data, satellite observations, and atmospheric models. Farmers may use these projections to make educated choices about pest control, planting, and harvesting. Data-driven risk assessment models may also help with insurance and financial planning, shielding farmers from the negative impacts of unforeseen weather disasters.Supply Chain OptimizationThe agricultural supply chain may be optimized with the help of data science. It makes it easier to distribute goods efficiently from farmers to customers, cutting down on waste and ensuring that fresh stuff gets there on time. Distribution of food is more effective and sustainable when the supply chain is optimized, which includes route optimization, inventory management, and predictive analytics to anticipate demand.Soil Health and Fertility ManagementData science is utilized to evaluate and maintain soil health, a crucial aspect of agriculture. Key characteristics including nutrient levels, pH, and moisture content may be measured using soil sensors and data analytics tools. Farmers can ensure that the soil is fruitful and productive by using the data to analyze choices regarding fertilizer application and soil amendments.Market Analysis and Decision SupportData science has become a tool that is used within farm management; it is also critical for market analysis as well as support for choices. Agriculture and other industry participants have the opportunity to obtain based on information insights into customer habits, and market trends, particularly commodity pricing. With the implementation of this knowledge, managers have a stronger ability to choose commodities and set costs in a way that's likely to maximize profits.Impact of Data Science on AgricultureAgriculture has been significantly and widely impacted by the use of data science in the sector. Let's look at some of the major ways that data science is changing agriculture:Increased Crop YieldsData science has aided in increasing agricultural yields by giving farmers practical insights into crop management. Higher production per acre of land is the consequence of precision agricultural practices that optimize planting density, irrigation, and fertilization using data-driven decision-making.Resource EfficiencyBy minimizing the usage of water, fertilizers, and pesticides, data-driven agriculture enhances resource efficiency. Farmers may minimize waste and lessen their impact on the environment by adjusting these inputs to the particular requirements of crops.SustainabilityModern agriculture has a serious concern for sustainability. By enabling the monitoring of soil health, lowering chemical inputs, and optimizing water use, data science promotes sustainable agricultural practices. This helps agriculture remain sustainable in the long run while reducing environmental damage.Risk MitigationRisks that affect farmers include pests, market changes, and weather-related incidents. There are tools for data science which offer useful risk assessment and management skills, assisting farmers in making decisions that will minimize prospective losses.Improved LivelihoodsThe livelihoods of farmers can be improved through greater agricultural yields and less resource waste. The digital gap in agriculture is being closed by data science, which also makes important resources and information accessible to small-scale farmers.Enhanced Food SafetyData science contributes to the protection of food safety by controlling and overseeing the whole supply chain. Data-driven solutions assist in locating and tracking possible sources of contamination or foodborne diseases from farm to table, resulting in safer food products.Challenges in Implementing Data Science in AgricultureUsing data science in agriculture presents a special set of difficulties and possibilities. Agriculture has historically been a data-intensive business, but the use of contemporary data science approaches can completely change how we produce, manage resources, and guarantee food security. We will quickly examine some of the main difficulties in applying data science in agriculture in this session.Data Collection and QualityThe gathering and quality of data represent one of the main issues in agricultural data science. Large volumes of data are produced by agriculture from a variety of sources, including sensors, satellites, weather stations, and agricultural machinery. However, this data is frequently incorrect, partial, or diverse. Making educated judgments requires making sure that the data is accurate and consistent. Interoperability between various data sources and platforms is also necessary.Data Privacy and SecuritySensitive information is used in agriculture, such as crop yields, soil composition, and farm management techniques. It is essential to safeguard this data from online dangers and unauthorized access. To protect vital information, farmers and agricultural organizations must manage the complexity of data privacy rules and put in place strong security measures. It is difficult to strike a balance between privacy concerns and data sharing for research and innovation.Infrastructure and ConnectivityThere is frequently inadequate infrastructure and internet access in rural regions, where many farms are located, making it difficult to gather and analyze real-time data. Investments in network infrastructure and rural broadband are required to fully utilize data science. Farmers can find it difficult to access and successfully use data-driven products and technology without dependable internet.Data Integration and InteroperabilitySeveral sources, including farm equipment, weather stations, remote sensing, and governmental organizations, provide agricultural data. Integrating and understanding this jumble of data is a major task. To give decision-makers full insights, data science solutions must be able to harmonize and synthesize data from many sources.Scalability and AdaptabilityAgriculture is a dynamic industry with different standards and practices for different climates and crops. Scalable and flexible data science solutions are required for use in various agricultural situations. One solution may not work for everyone, thus customization is sometimes required.In summary, while integrating information science into agriculture presents several fundamental obstacles, it additionally presents enormous possibilities for improving worker efficiency, sustainability, along food security. Governments, cultivators, technologies vendors academics, and elected officials will need to partner together for the purpose to overcome those challenges. The farming community can use the power of data science to address the serious worldwide challenges of food production and sustainability by solving concerns about data quality, anonymity, infrastructure, and skills.Benefits of Data Science in AgricultureIncreased Crop YieldsThe potential for higher agricultural yields is among the most important benefits of data science in agriculture. Farmers may produce more food from the same amount of land by maximizing resource use, figuring out the best times to sow, and taking care of crop health concerns right away.Resource EfficiencyFarmers can use resources more effectively thanks to data science. Precision irrigation and fertilization decrease water and nutrient waste, while targeted and ecologically friendly pest management becomes possible. In addition to saving money, this lessens agriculture's environmental impact.Reduced Environmental ImpactThrough soil deterioration, pesticide and fertilizer runoff, and excessive water consumption, conventional agriculture frequently has a considerable negative influence on the environment. Data science enables more environmentally friendly farming methods, reducing these harmful impacts and fostering ecological harmony.Enhanced ProbabilityData-driven farming practices may significantly increase the profitability of agricultural firms by streamlining processes and reducing losses. Farmers may take advantage of favorable market conditions by making well-informed judgments about when to sell their goods.Climate ResilienceClimate change poses a severe threat to agriculture due to altered weather patterns and an increase in catastrophic occurrences. Farmers are given the tools by data science to more successfully adjust to these developments. For instance, based on long-term climatic projections, planting dates might be changed.Applications of Data Science in AgriculturePrecision AgricultureOne of the best examples of how data science is changing farming is precision agriculture. Farmers can precisely manage their crops by analyzing data from sensors and satellites. They may target pest control, fertilization, and irrigation to particular regions, maximizing resource utilization and boosting crop yields. This minimizes the negative effects on the environment while simultaneously lowering costs.Crop Health MonitoringReal-time crop health monitoring is made possible by data science for farmers. Drone or satellite images can be used to detect early symptoms of illnesses, nutritional deficits, and pests.

Because of this early diagnosis, farmers may make prompt corrections, stopping the spread of illnesses and reducing crop loss.Weather ForecastingFor agriculture, precise weather forecasting is essential. Farmers can rely on accurate weather forecasts thanks to data science models that combine historical weather data, present circumstances, and predictive algorithms. They can grow, harvest, and safeguard their crops against harsh weather occurrences with the use of this knowledge.Supply Chain OptimizationBeyond the farm gate, data science continues. It covers the whole supply chain for agriculture. By evaluating demand, administration, and shipping data, participants might enhance the flow of agricultural products from the agricultural sector to the market. As an outcome, a smaller amount of food is wasted away, transport expenses are cut, and an uninterrupted supply of vegetables and fruits is ensured.Livestock ManagementData science is crucial in livestock production for keeping track of the health and welfare of the animals. Body temperature, eating patterns, and activity patterns are just a few of the factors that sensors can monitor. Farmers are notified when abnormalities are found, allowing for prompt action and stopping the spread of illnesses within the herd.The Future of Data Science in AgricultureAgriculture data science is still in its infancy, but it has enormous promise. The following advancements in the industry can be anticipated as technology develops further:Artificial Intelligence and Machine LearningThe integration of machine learning (ML) along with computational intelligence (AI) is playing an even greater part in crops. Even improved resource efficiency and agricultural yields will result from these technologies' ability to make more complex forecasts and decisions.Big Data IntegrationA comprehensive comprehension of agricultural activities will soon be achievable thanks to the seamless combination of big data from multiple sources, particularly satellites, cameras, sensors, drones, and records from the past. This is going to make it achievable to approach crops in a more comprehensive more based information manner.Climate AdaptionAgriculture will need assistance from data science to adapt to climate change. Predictive models will be used by farmers to foresee shifting weather patterns and make wise choices on crop selection and planting periods.Global CollaborationIn agriculture, teamwork and data sharing will become more crucial. To address global issues like food security and sustainability, farmers and academics from all around the world will work together utilizing data science as a common language.Future Trends and OpportunitiesFuture trends and possibilities in data science are anticipated to influence the agricultural environment in several ways:IoT and Sensor NetworksThe Internet Interconnected Things (IoT) increasingly wireless sensor networks are going to become increasingly significant in the data accumulating process of agriculture. These electronic devices are going to provide instantaneous data on the current condition of the ground, the environmental conditions, and the performance of the equipment, thus allowing for better choices to be made.AI including Machine LearningThe advancement of artificial intelligence (AI) and machine learning is going to end in more sophisticated models of prediction for the supply chain optimized performance, disease verification, and crop oversight. For farmers, these advances in technology are going to get increasingly more accessible as well as user-friendly.Blockchain for TransparencyBlockchain technology can improve the traceability and transparency of the food supply chain. The authenticity and safety of food items from farm to fork may be confirmed by farmers, consumers, and authorities.Climate ResilienceData science will assist farmers in coping with the difficulties brought on by climate change. Proactive measures to handle extreme weather events and altering crop seasons will be made possible by predictive models and climate data analysis.Platforms for CollaborationInitiatives for Platforms for Collaboration and Data Sharing will link farmers, researchers, and industry stakeholders. The exchange of knowledge and best practices will be facilitated by this collaborative approach.ConclusionA potent instrument for the modernization of agriculture is data science. It equips farmers with the knowledge and understanding necessary to maximize crop yield, cut down on resource waste, and improve sustainability. Data-driven agriculture presents a possible answer as the agricultural sector deals with the simultaneous problems of feeding a growing global population and reducing environmental impact.While issues like data accessibility and privacy still exist, these obstacles are expected to be removed by continued technological improvements and data science approaches. As we look to the future, data science will continue to transform agriculture, empowering farmers to successfully manage the challenges of the 21st century and assuring the industry's long-term viability.Next Topic? prevnext ?

Introduction

Agriculture shouldn't be a contrast to how the use of data science has altered other sectors of the economy. The use of information science across agriculture is now recognized as an essential component in contemporary society because issues involving worldwide food security including ecologically sound farming are crucial. To tackle the problems affecting the farming community, this breakthrough discipline combines the use of artificial intelligence, data analysis, and innovative technology.

Introduction

Agriculture has always been vulnerable to uncontrollable elements including the weather, pests, and shifting consumer preferences. Data science, on the other hand, offers a way to optimize all parts of farming, from crop production to animal management, in addition to providing a way to lessen these uncertainties. Farmers and agricultural specialists may make well-informed decisions, maximize yields, cut down on resource waste, and advance ecological sustainability by gathering, processing, and analyzing massive volumes of data.

Introduction

This introduction to data science in agriculture will explore the ways that data-driven techniques are changing conventional agricultural practices in this era of precision agriculture. We will look at how data science approaches are being used for supply chain optimization, soil analysis, crop monitoring, and more, all of which help to boost production and practice responsible resource management.

The Role of Data Science in Agriculture

As a diverse discipline, data science includes several methods and instruments for gathering, processing, and analyzing data to derive insightful conclusions and inform decision-making. Data science is crucial in agriculture for streamlining procedures, boosting output, and assuring sustainable practices.

The Role of Data Science in Agriculture

Let's explore some important facets of data science's function in agriculture:

Precision Agriculture

The profession of precision agriculture, sometimes known as "smart farming," largely utilizes data science. It includes using information from sensors, soil samples, meteorological data, and satellite images to create accurate and site-specific crop management decisions. Farmers may modify their practices, such as planting, watering, and fertilization, to meet the particular requirements of each field or even of individual plants, thanks to data-driven insights. This focused strategy decreases resource use, minimizes environmental effects, and increases agricultural yields.

Crop Monitoring and Disease Detection

To keep track of crop health and spot illnesses early on, data science tools like machine learning and image analysis are used. High-resolution photographs of fields may be taken by drones with cameras, and AI algorithms can examine these images to find symptoms of illness or stress in plants. Early diagnosis enables farmers to make necessary corrections, such as adding pesticides or changing irrigation, to reduce crop loss and boost production.

Weather Forecasting and Risk Management

For agricultural planning, precise weather forecasts are essential. To give farmers accurate weather forecasts, data science models use historical weather data, satellite observations, and atmospheric models. Farmers may use these projections to make educated choices about pest control, planting, and harvesting. Data-driven risk assessment models may also help with insurance and financial planning, shielding farmers from the negative impacts of unforeseen weather disasters.

Supply Chain Optimization

The agricultural supply chain may be optimized with the help of data science. It makes it easier to distribute goods efficiently from farmers to customers, cutting down on waste and ensuring that fresh stuff gets there on time. Distribution of food is more effective and sustainable when the supply chain is optimized, which includes route optimization, inventory management, and predictive analytics to anticipate demand.

Soil Health and Fertility Management

Data science is utilized to evaluate and maintain soil health, a crucial aspect of agriculture. Key characteristics including nutrient levels, pH, and moisture content may be measured using soil sensors and data analytics tools. Farmers can ensure that the soil is fruitful and productive by using the data to analyze choices regarding fertilizer application and soil amendments.

Market Analysis and Decision Support

Data science has become a tool that is used within farm management; it is also critical for market analysis as well as support for choices. Agriculture and other industry participants have the opportunity to obtain based on information insights into customer habits, and market trends, particularly commodity pricing. With the implementation of this knowledge, managers have a stronger ability to choose commodities and set costs in a way that's likely to maximize profits.

Impact of Data Science on Agriculture

Agriculture has been significantly and widely impacted by the use of data science in the sector. Let's look at some of the major ways that data science is changing agriculture:

Impact of Data Science on Agriculture

Increased Crop Yields

Impact of Data Science on Agriculture

Data science has aided in increasing agricultural yields by giving farmers practical insights into crop management. Higher production per acre of land is the consequence of precision agricultural practices that optimize planting density, irrigation, and fertilization using data-driven decision-making.

Impact of Data Science on Agriculture

Resource Efficiency

Impact of Data Science on Agriculture

By minimizing the usage of water, fertilizers, and pesticides, data-driven agriculture enhances resource efficiency. Farmers may minimize waste and lessen their impact on the environment by adjusting these inputs to the particular requirements of crops.

Impact of Data Science on Agriculture

Sustainability

Impact of Data Science on Agriculture

Modern agriculture has a serious concern for sustainability. By enabling the monitoring of soil health, lowering chemical inputs, and optimizing water use, data science promotes sustainable agricultural practices. This helps agriculture remain sustainable in the long run while reducing environmental damage.

Impact of Data Science on Agriculture

Risk Mitigation

Impact of Data Science on Agriculture

Risks that affect farmers include pests, market changes, and weather-related incidents. There are tools for data science which offer useful risk assessment and management skills, assisting farmers in making decisions that will minimize prospective losses.

Impact of Data Science on Agriculture

Improved Livelihoods

Impact of Data Science on Agriculture

The livelihoods of farmers can be improved through greater agricultural yields and less resource waste. The digital gap in agriculture is being closed by data science, which also makes important resources and information accessible to small-scale farmers.

Impact of Data Science on Agriculture

Enhanced Food Safety

Impact of Data Science on Agriculture

Data science contributes to the protection of food safety by controlling and overseeing the whole supply chain. Data-driven solutions assist in locating and tracking possible sources of contamination or foodborne diseases from farm to table, resulting in safer food products.

Challenges in Implementing Data Science in Agriculture

Using data science in agriculture presents a special set of difficulties and possibilities. Agriculture has historically been a data-intensive business, but the use of contemporary data science approaches can completely change how we produce, manage resources, and guarantee food security. We will quickly examine some of the main difficulties in applying data science in agriculture in this session.

Challenges in Implementing Data Science in Agriculture

Data Collection and Quality

Challenges in Implementing Data Science in Agriculture

The gathering and quality of data represent one of the main issues in agricultural data science. Large volumes of data are produced by agriculture from a variety of sources, including sensors, satellites, weather stations, and agricultural machinery. However, this data is frequently incorrect, partial, or diverse. Making educated judgments requires making sure that the data is accurate and consistent. Interoperability between various data sources and platforms is also necessary.

Challenges in Implementing Data Science in Agriculture

Data Privacy and Security

Challenges in Implementing Data Science in Agriculture

Sensitive information is used in agriculture, such as crop yields, soil composition, and farm management techniques. It is essential to safeguard this data from online dangers and unauthorized access. To protect vital information, farmers and agricultural organizations must manage the complexity of data privacy rules and put in place strong security measures. It is difficult to strike a balance between privacy concerns and data sharing for research and innovation.

Challenges in Implementing Data Science in Agriculture

Infrastructure and Connectivity

Challenges in Implementing Data Science in Agriculture

There is frequently inadequate infrastructure and internet access in rural regions, where many farms are located, making it difficult to gather and analyze real-time data. Investments in network infrastructure and rural broadband are required to fully utilize data science. Farmers can find it difficult to access and successfully use data-driven products and technology without dependable internet.

Challenges in Implementing Data Science in Agriculture

Data Integration and Interoperability

Challenges in Implementing Data Science in Agriculture

Several sources, including farm equipment, weather stations, remote sensing, and governmental organizations, provide agricultural data. Integrating and understanding this jumble of data is a major task. To give decision-makers full insights, data science solutions must be able to harmonize and synthesize data from many sources.

Challenges in Implementing Data Science in Agriculture

Scalability and Adaptability

Challenges in Implementing Data Science in Agriculture

Agriculture is a dynamic industry with different standards and practices for different climates and crops. Scalable and flexible data science solutions are required for use in various agricultural situations. One solution may not work for everyone, thus customization is sometimes required.

Challenges in Implementing Data Science in Agriculture

In summary, while integrating information science into agriculture presents several fundamental obstacles, it additionally presents enormous possibilities for improving worker efficiency, sustainability, along food security. Governments, cultivators, technologies vendors academics, and elected officials will need to partner together for the purpose to overcome those challenges. The farming community can use the power of data science to address the serious worldwide challenges of food production and sustainability by solving concerns about data quality, anonymity, infrastructure, and skills.

Benefits of Data Science in Agriculture

Increased Crop Yields

Benefits of Data Science in Agriculture

The potential for higher agricultural yields is among the most important benefits of data science in agriculture. Farmers may produce more food from the same amount of land by maximizing resource use, figuring out the best times to sow, and taking care of crop health concerns right away.

Benefits of Data Science in Agriculture

Resource Efficiency

Benefits of Data Science in Agriculture

Farmers can use resources more effectively thanks to data science. Precision irrigation and fertilization decrease water and nutrient waste, while targeted and ecologically friendly pest management becomes possible. In addition to saving money, this lessens agriculture's environmental impact.

Benefits of Data Science in Agriculture

Reduced Environmental Impact

Benefits of Data Science in Agriculture

Through soil deterioration, pesticide and fertilizer runoff, and excessive water consumption, conventional agriculture frequently has a considerable negative influence on the environment. Data science enables more environmentally friendly farming methods, reducing these harmful impacts and fostering ecological harmony.

Benefits of Data Science in Agriculture

Enhanced Probability

Benefits of Data Science in Agriculture

Data-driven farming practices may significantly increase the profitability of agricultural firms by streamlining processes and reducing losses. Farmers may take advantage of favorable market conditions by making well-informed judgments about when to sell their goods.

Benefits of Data Science in Agriculture

Climate Resilience

Benefits of Data Science in Agriculture

Climate change poses a severe threat to agriculture due to altered weather patterns and an increase in catastrophic occurrences. Farmers are given the tools by data science to more successfully adjust to these developments. For instance, based on long-term climatic projections, planting dates might be changed.

Applications of Data Science in Agriculture

Precision Agriculture

Applications of Data Science in Agriculture

One of the best examples of how data science is changing farming is precision agriculture. Farmers can precisely manage their crops by analyzing data from sensors and satellites. They may target pest control, fertilization, and irrigation to particular regions, maximizing resource utilization and boosting crop yields. This minimizes the negative effects on the environment while simultaneously lowering costs.

Applications of Data Science in Agriculture

Crop Health Monitoring

Applications of Data Science in Agriculture

Real-time crop health monitoring is made possible by data science for farmers. Drone or satellite images can be used to detect early symptoms of illnesses, nutritional deficits, and pests. Because of this early diagnosis, farmers may make prompt corrections, stopping the spread of illnesses and reducing crop loss.

Applications of Data Science in Agriculture

Weather Forecasting

Applications of Data Science in Agriculture

For agriculture, precise weather forecasting is essential. Farmers can rely on accurate weather forecasts thanks to data science models that combine historical weather data, present circumstances, and predictive algorithms. They can grow, harvest, and safeguard their crops against harsh weather occurrences with the use of this knowledge.

Applications of Data Science in Agriculture

Supply Chain Optimization

Applications of Data Science in Agriculture

Beyond the farm gate, data science continues. It covers the whole supply chain for agriculture. By evaluating demand, administration, and shipping data, participants might enhance the flow of agricultural products from the agricultural sector to the market. As an outcome, a smaller amount of food is wasted away, transport expenses are cut, and an uninterrupted supply of vegetables and fruits is ensured.

Applications of Data Science in Agriculture

Livestock Management

Applications of Data Science in Agriculture

Data science is crucial in livestock production for keeping track of the health and welfare of the animals. Body temperature, eating patterns, and activity patterns are just a few of the factors that sensors can monitor. Farmers are notified when abnormalities are found, allowing for prompt action and stopping the spread of illnesses within the herd.

The Future of Data Science in Agriculture

Agriculture data science is still in its infancy, but it has enormous promise. The following advancements in the industry can be anticipated as technology develops further:

The Future of Data Science in Agriculture

Artificial Intelligence and Machine Learning

The Future of Data Science in Agriculture

The integration of machine learning (ML) along with computational intelligence (AI) is playing an even greater part in crops. Even improved resource efficiency and agricultural yields will result from these technologies' ability to make more complex forecasts and decisions.

The Future of Data Science in Agriculture

Big Data Integration

The Future of Data Science in Agriculture

A comprehensive comprehension of agricultural activities will soon be achievable thanks to the seamless combination of big data from multiple sources, particularly satellites, cameras, sensors, drones, and records from the past. This is going to make it achievable to approach crops in a more comprehensive more based information manner.

The Future of Data Science in Agriculture

Climate Adaption

The Future of Data Science in Agriculture

Agriculture will need assistance from data science to adapt to climate change. Predictive models will be used by farmers to foresee shifting weather patterns and make wise choices on crop selection and planting periods.

The Future of Data Science in Agriculture

Global Collaboration

The Future of Data Science in Agriculture

In agriculture, teamwork and data sharing will become more crucial. To address global issues like food security and sustainability, farmers and academics from all around the world will work together utilizing data science as a common language.

Future Trends and Opportunities

Future trends and possibilities in data science are anticipated to influence the agricultural environment in several ways:

Future Trends and Opportunities

IoT and Sensor Networks

Future Trends and Opportunities

The Internet Interconnected Things (IoT) increasingly wireless sensor networks are going to become increasingly significant in the data accumulating process of agriculture. These electronic devices are going to provide instantaneous data on the current condition of the ground, the environmental conditions, and the performance of the equipment, thus allowing for better choices to be made.

Future Trends and Opportunities

AI including Machine Learning

Future Trends and Opportunities

The advancement of artificial intelligence (AI) and machine learning is going to end in more sophisticated models of prediction for the supply chain optimized performance, disease verification, and crop oversight. For farmers, these advances in technology are going to get increasingly more accessible as well as user-friendly.

Future Trends and Opportunities

Blockchain for Transparency

Future Trends and Opportunities

Blockchain technology can improve the traceability and transparency of the food supply chain. The authenticity and safety of food items from farm to fork may be confirmed by farmers, consumers, and authorities.

Future Trends and Opportunities

Climate Resilience

Future Trends and Opportunities

Data science will assist farmers in coping with the difficulties brought on by climate change. Proactive measures to handle extreme weather events and altering crop seasons will be made possible by predictive models and climate data analysis.

Future Trends and Opportunities

Platforms for Collaboration

Future Trends and Opportunities

Initiatives for Platforms for Collaboration and Data Sharing will link farmers, researchers, and industry stakeholders. The exchange of knowledge and best practices will be facilitated by this collaborative approach.

Conclusion

A potent instrument for the modernization of agriculture is data science. It equips farmers with the knowledge and understanding necessary to maximize crop yield, cut down on resource waste, and improve sustainability. Data-driven agriculture presents a possible answer as the agricultural sector deals with the simultaneous problems of feeding a growing global population and reducing environmental impact.

Conclusion

While issues like data accessibility and privacy still exist, these obstacles are expected to be removed by continued technological improvements and data science approaches. As we look to the future, data science will continue to transform agriculture, empowering farmers to successfully manage the challenges of the 21st century and assuring the industry's long-term viability.

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