Artificial Intelligence/Machine Learning in PsycheConvergence and EdConvergence

Cognitive Convergence is Subject Matter Expert in Office 365, Dynamics 365, SharePoint, Project Server, Artificial Intelligence Practices, Machine Learning practices, Power Platform: Power Apps-Power BI-Power Automate-Power Virtual Agents.

Our Microsoft Office 365 Consulting, Add-in Development, Customization, Integration services and solutions, can help companies maximize business performance, overcoming market challenges, achieving profitability, and providing best customer

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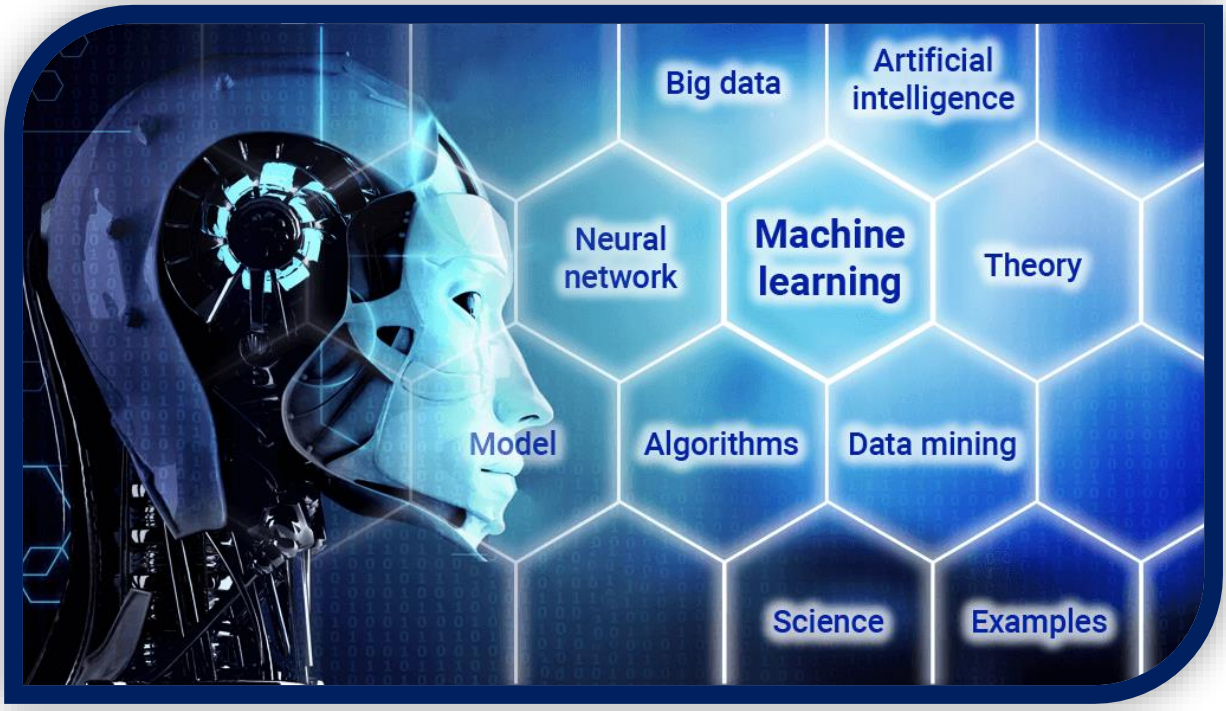
OBJECTIVE

This case study is written to give a brief introduction about the Artificial Intelligence and Machine Learning patterns and practices, cloud model, Frameworks and Elements used by Cognitive Convergence. Cognitive Convergence products EdConvergence and PsycheConvergence are fine examples of implementing AI/ML tools.

INTRODUCTION

There are so many ways Artificial Intelligence and Machine Learning can be used behind the scenes to impact every day's life. What is Artificial Intelligence and Machine Learning? Machine Learning is a subset of Artificial Intelligence. Artificial Intelligence involves the use of machines to perform intelligent tasks that are performed by human being. It involves problem solving, learning, reasoning, social intelligence, and general intelligence. On the other hand, Machine Learning is a way to answer those questions which are difficult for human beings to answer with human intellect. A machine can easily answer the questions which are sometimes difficult for human beings such as: "How much or how many?", "Which Category or group?", "Anything weird or abnormal?", "What options should we take?", "Predict a case", and so on. We will discuss how AI and ML are used in every day's life to enhance and optimize the operations and rely on patterns and inference without using explicit instructions.



ARTIFICIAL INTELLIGENCE ELEMENTS

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, Natural Language Processing (NLP), speech recognition, Machine/Computer Vision, etc. Some important elements of Artificial Intelligence are discussed below:

Learning

Learning processes of AI focus on acquiring data and creating rules about turning the data into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task. Learning is distinguished into a number of different forms. Simplest form is trial-and-error. Sophisticated modern techniques enable programs to generalise complex rules from data using different learning techniques.

Reasoning

After learning of different algorithms and creating rules, the next phase of Artificial Intelligence is Reasoning. The reasoning processes are designed to choose the right algorithm to reach a desired outcome. Reasoning involves drawing inferences appropriate and relevant to the task or situation in hand. One of the hardest problems confronting AI is that of giving computers the ability to distinguish the relevant from the irrelevant.

Self-Correction

Self-Correction process is an aspect of Artificial Intelligence designed to continually fine-tune algorithms and ensure they provide the most accurate results possible. AI system does not make any error or mistake in its processes or solution, it always follows the self-correction and self-enhancement feature.

Problem Solving

Artificial Intelligence is widely used for Problem solving. A problem-solving refers to a state where we wish to reach to a definite goal from a present state or condition. In AI, problem solving has the following steps:

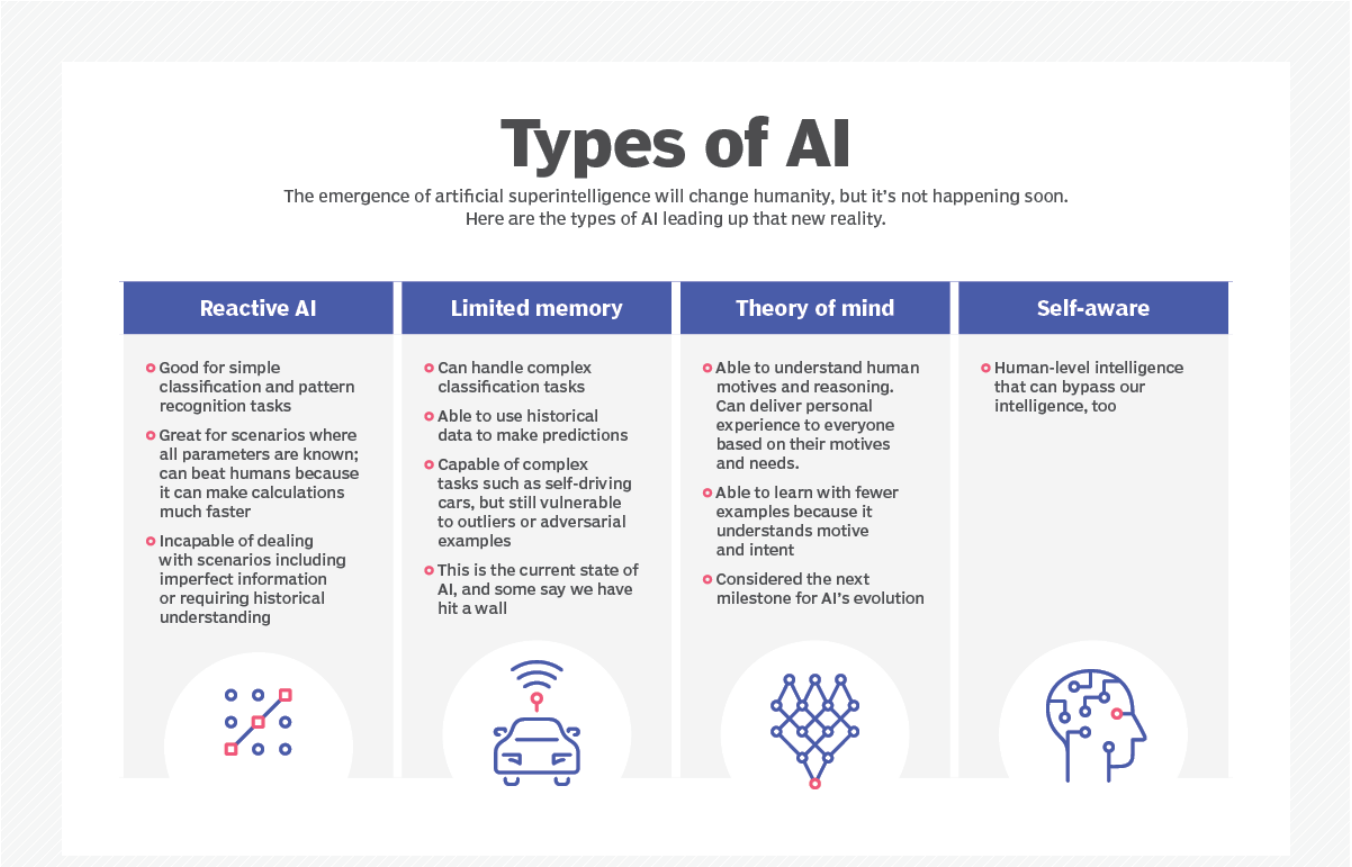
- Goal Formulation
- Problem Formulation
- Initial State
- Actions
- Transition Model
- Goal Test
- Path Cost

Perception

In perception the environment is scanned by means of various sense-organs, real or artificial, and processes internal to the perceiver analyses the scene into objects and their features and relationships. Analysis is complicated by the fact that one and the same object may present many different appearances on different occasions, depending on the angle from which it is viewed, whether parts of it are projecting shadows, and so on. AI perception is well advanced to enable self-controlled devices such as a car to moderate speed on roads, a mobile robot, etc.

Language Understanding and Processing

A language is a system of signs having meaning by convention. AI uses these meaning to extract information and generate results for prediction and manipulation. AI makes use of grammatical rules and syntax to understand the meaning of written text or sometimes, images. AI automates a lot of tasks from text recognition to speech recognition to image recognition and perform the required actions.



MACHINE LEARNING ELEMENTS

Machine learning is an essential part of Artificial Intelligence. With the help of machine learning, AI can learn new things and hence able to enhance itself with the help of learning experience. Machine learning works in two significant steps:

- **Accessing and learning from data -** Machine learning first fetches data from various sources, with the help of which it learns several things from that data.
- **Using data and enhancing it -** Once the machine learning system has learned various processes from that data., the next work would be to use that data, and the working process keeps on enhancing with the help of work experience.

Following are the components of Machine Learning. All machine learning algorithms are combinations of these components.

Representation

Representation in ML means how to represent knowledge. Examples include decision trees, sets of rules, instances, graphical models, neural networks, support vector machines, model ensembles and others. Representation of the data is created to provide the model with a useful vantage point into the data's key qualities. That is, to train a model, ML requires to choose the set of features that best represent the data.

Evaluation

Evaluation in Machine learning is the way to evaluate candidate programs (hypotheses). Examples include accuracy, prediction and recall, squared error, likelihood, posterior probability, cost, margin, entropy k-L divergence and others.

Optimization

Optimization in Machine Learning is the way candidate programs are generated known as the search process. For example, combinatorial optimization, convex optimization, constrained optimization, etc. Optimization is the problem of finding a set of inputs to an objective function that results in a maximum or minimum function evaluation. It is the challenging problem that underlies many machine learning algorithms, from fitting logistic regression models to training artificial neural networks.

Types of Machine Learning:

There are 3 major types of Machine Learning:

Supervised Learning

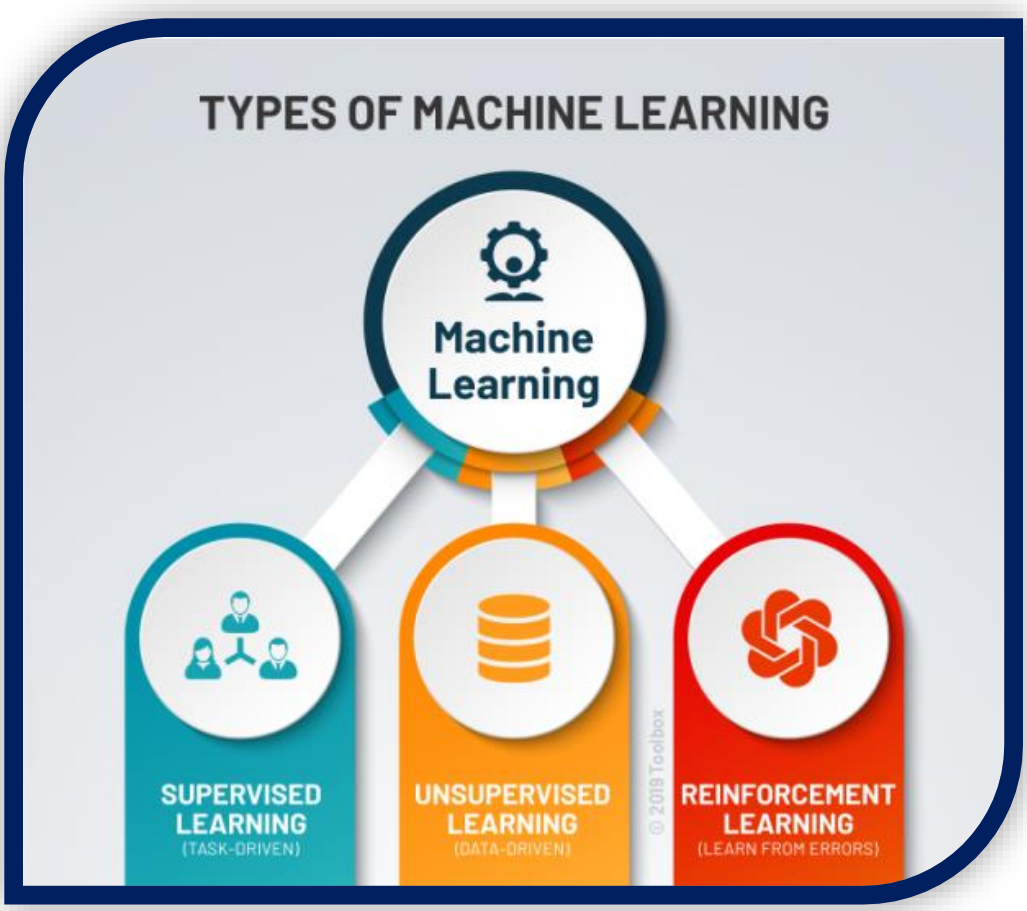
In supervised learning, the machine is given an input based on which, the output is calculated. It majorly includes classification problems. (Which group/category?)

Unsupervised Learning

In unsupervised learning, there are no labels or correct outputs. The task is to discover the structure of the data. For example, grouping similar items to form “clusters”, or reducing the data to a small number of important “dimensions”. Data visualization can also be considered unsupervised learning.

Reinforcement Learning

It is Commonly used in situations where an AI agent like a self-driving car must operate in an environment and where feedback about good or bad choices is available with some delay. Rewards from a sequence of actions. AI types like it, it is the most ambitious type of learning.



APPLICATIONS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Artificial Intelligence and Machine Learning are widely used around the globe to perform a lot of machine intelligent actions. Machine Learning is widely being used for the automation of predictive analytics with its subset Deep Learning. Some other applications of Machine Learning involve following:

AI/ML in Natural Language Processing (NLP)

NLP is the processing of human -- and not computer -- language by a computer program. NLP tasks include text translation, sentiment analysis and speech recognition. Current approaches to NLP are based on machine learning.

AI/ML in Pattern Recognition

It is a branch of machine learning that focuses on identifying patterns in data. It is the automated recognition of patterns and regularities in data. It has applications in statistical data analysis, signal processing, image analysis, information retrieval, bioinformatics, data compression, computer graphics and machine learning.

AI/ML in Robotics

Robotics is a field of engineering focused on the design and manufacturing of robots. Robots are often used to perform tasks that are difficult for humans to perform or perform consistently.

AI/ML in Healthcare

The built AI/ML system understands natural language and is capable of responding to questions asked of it. The system mines patient data and other available data sources to form a hypothesis, which it then presents with a confidence scoring schema.

AI/ML in Education

AI can automate grading, assess students, and adapt to their needs, helping them work at their own pace. AI tutors can provide additional support to students, ensuring they stay on track. AI could change where and how students learn, perhaps even replacing some teachers.

AI/ML in Business

Machine learning algorithms are being integrated into analytics and customer relationship management (CRM) platforms to uncover information on how to better serve customers. Chatbots have been incorporated into websites to provide immediate service to customers. Automation of job positions has also become a talking point among academics and IT analysts.

AI/ML in Transportation

In addition to AI's fundamental role in operating autonomous vehicles, AI technologies are used in transportation to manage traffic, predict flight delays, and make ocean shipping safer and more efficient.

AI/ML in Security

AI and machine learning are at the top of the buzzword list security vendors use today to differentiate their offerings. Those terms also represent truly viable technologies. Artificial intelligence and machine learning in cybersecurity products are adding real value for security teams looking for ways to identify attacks, malware and other threats.

AI/ML in Banking

Banks are successfully employing chatbots to make their customers aware of services and offerings and to handle transactions that don't require human intervention. AI virtual assistants are being used to improve and cut the costs of compliance with banking regulations. Banking organizations are also using AI to improve their decision-making for loans, and to set credit limits and identify investment opportunities.

ARTIFICIAL INTELLIGENCE/MACHINE LEARNING CLOUD MODEL

Artificial Intelligence as a Service (AIaaS)

Artificial Intelligence as a Service - AIaaS allows individuals and companies to experiment with AI for various business purposes and sample multiple platforms before making a commitment. Because hardware, software and staffing costs for AI can be expensive, many vendors are including AI components in their standard offerings or providing access to artificial intelligence as a service (AIaaS) platforms.

The top cloud computing platforms are all betting big on democratizing artificial intelligence. Over the past three years, Amazon, Google, and Microsoft have made significant investments in artificial intelligence (AI) and machine learning. The cloud makes it easy for enterprises to experiment with

machine learning capabilities and scale up as projects go into production and demand increases. AWS, Microsoft Azure, and Google Cloud Platform offer many machine learning options that do not require deep knowledge of AI, machine learning theory, or a team of data scientists.

AI/ML Tools for Cloud

The main offerings in this category involves the following:

	Amazon	Microsoft Azure	Google
Image Recognition	Rekognition Image	Computer Vision API Custom Vision Service Face API Emotion API Content Moderator	Vision API AutoML Vision
Video Analysis	Rekognition Video	Computer Vision API Video Indexer Content Moderator	Video Intelligence
Speech to Text	Transcribe	Bing Speech API Custom Speech Service Speaker Recognition API	Speech API
Text to Speech	Polly	Bing Speech API	Text-to-Speech API
Translation	Translate	Translator Text API	Translation API
Language Analysis	Comprehend	Text Analytics API Content Moderator Language Understanding Web Language Model API Linguistic Analysis API	Natural Language API
Chatbot	Lex	Azure Bot Service	Dialogflow

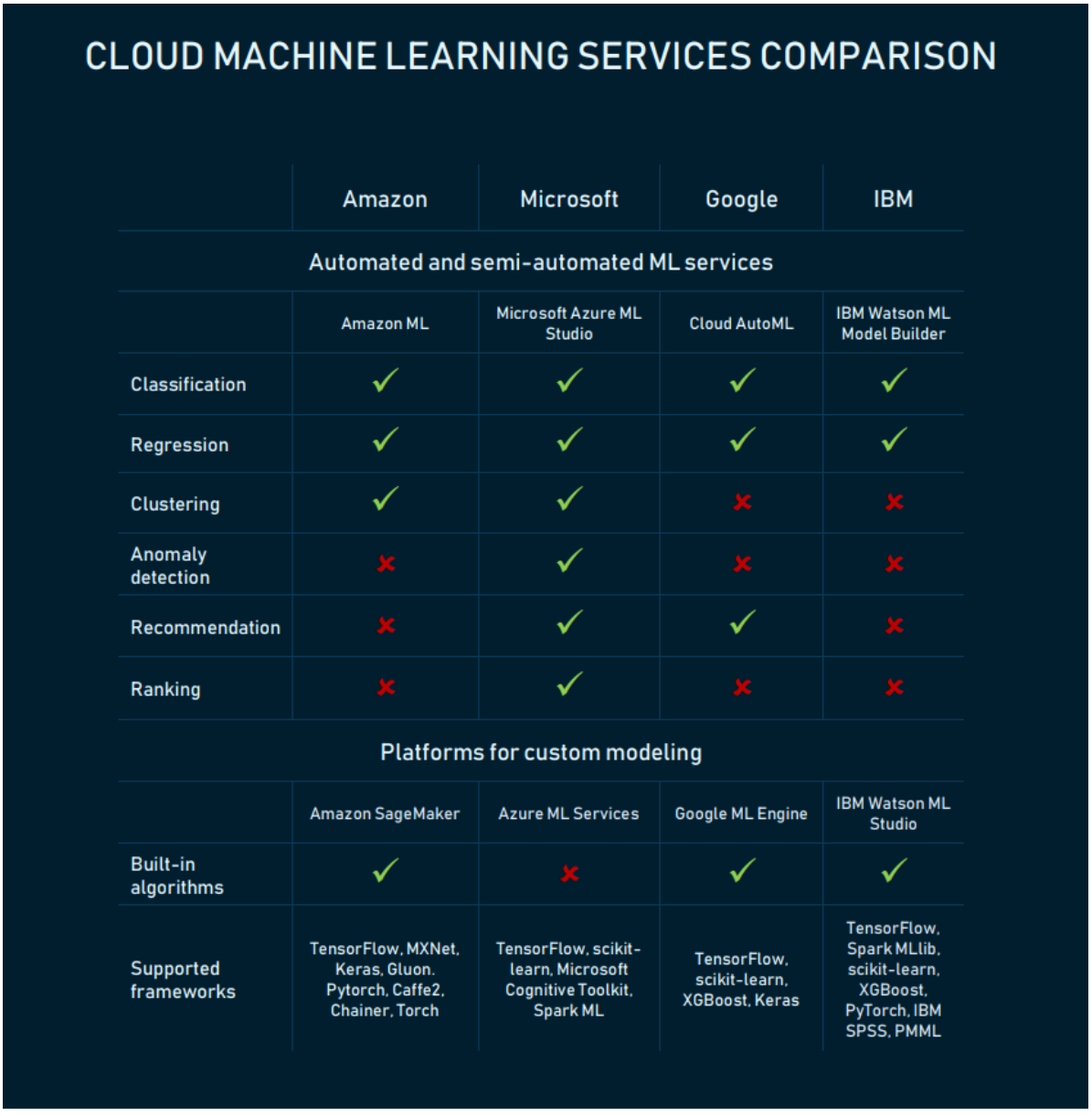
Machine learning as a service (MLaaS)

It is an umbrella definition of various cloud-based platforms that cover most infrastructure issues such as data pre-processing, model training, and model evaluation, with further prediction. Prediction results can be bridged with your internal IT infrastructure through REST APIs.

Amazon Machine Learning services, Azure Machine Learning, Google Cloud AI, and IBM Watson are four leading cloud MLaaS services that allow for fast model training and deployment.

Machine Learning Services for custom predictive analytics tasks:

There are some automated and semi-automated ML Services that Amazon, Microsoft, IBM, and Google provide to perform different tasks related to Artificial Intelligence in applications. Other than that, these 4 big companies also provide support to some of the AI/ML Frameworks/Platforms for custom modelling.



ARTIFICIAL INTELLIGENCE/MACHINE LEARNING PLATFORMS/FRAMEWORKS

Artificial Intelligence Frameworks involves the use of machines to perform the tasks that are performed by human beings. The platforms/frameworks simulate the cognitive functions that are performed by human minds such as Problem Solving, Learning, Reasoning, Social Intelligence, and General Intelligence. Some of the important and mostly used frameworks are listed below. A few of them are used in EdConvergence and PsycheConvergence products.

- → Google AI Platform
- → Microsoft Azure
- → Dialogflow
- → Theano
- → Keras
- → Scikit Learn
- → MLlib (Apache Spark)
- → TensorFlow
- → Rainbird
- → Microsoft CNTK
- → Accord.NET
- → Caffe
- → Azure ML Studio
- → Receptiviti

Framework Comparison

A brief comparison of these frameworks is given below:

Platforms	Best Features	Cloud based	Pros	Cons
Google AI Platform	Sentiment Analysis Spam Detection Recommendation system Purchase prediction	Yes	State-of-the-art security Convenient pricing Long-term use guaranteed	Harder Customization of existing modules Big debugging time
TensorFlow	Auto Differentiation Image recognition Use Deep neural networks Natural Language processing Handwritten digit classification	Yes, on AWS	Open source High computational power Well-documented manuals	Lacks Mobile ARM support Lacks visualization board Lacks pre-trained models
Microsoft Azure	Digital Marketing Mobile E-commerce Cloud Migration Big Data and Analytics Disaster Recovery	Yes	Mobile enabled Support for all languages Support for all Operating systems	Less speed
Rainbird	Visual User Interface Controlled Learning Algorithms Smart Data Import Natural Language Processing RBLang Analytics and Insights Smarter Decision Making	No	Efficiency Promotes innovation Turns insights into actions	No major cons

Platforms	Best Features	Cloud based	Pros	Cons
Theano	Python Library Support for large data Dynamic Code generation Unit Testing Compiler for Mathematical Expressions	No	Accuracy Efficient support for all the data-intensive applications Efficiently optimized for CPU and GPU	No updates Low-level Bugs on AWS
Dialogflow	Machine Leaning Integrations Conversation Support Cross-Platform Support	Yes	Multi-Lingual Support High Performance Any platform and location Build voice and test-based conversational apps	Not flexible as a platform Limited webhooks and integrations More time consuming with manual tasks
Microsoft CNTK	Text, Message, and voice remodeling Hyperparameter tuning Supervised Learning Reinforcement	No	Best efficiency Flexible Allows for distributed training Supports C++, C#, Java, Python	Implemented in new language (NDL) Lack of visualization
Accord.NET	.NET Machine Learning Framework Audio Processing Image Processing Numerical Optimization Artificial Neural Networks Computer Vision	No	Well documented framework Supported by active development team	Not well known Slower in performance
Keras	Neural Network models High level of abstraction	Yes	User friendly Easily extensible Works seamlessly with Theano and TensorFlow	Not an efficient independent framework Problem in lowlevel API
Scikit Learn	Math-Science Algorithms Machine Learning tasks (clustering, classification, regression, etc.) Feature Extraction	Yes	Easy to use Versatile and handy Free to use Elaborated API documentation	Not good for in-depth learning Not best with GPU
Caffe	Deep learning Image Processing Extended support for MATLAB	No	Massive speed Highly efficient Already preloaded datasets	Sparse documentation Limited long-term growth
Azure ML Studio	Predictive Modeling Anomaly Detection Text analytic Support Support for R Scripts	Yes	Intuitive graphical Interface High-performance computing Efficient to deploy model as web service Centralized platform	Difficult to integrate data
MLlib (Apache Spark)	All Machine Learning Algorithms Lower-level optimization Languages: R, Python, Java, Scala	Yes	Very fast for large scale data Available for many languages Easily pluggable	Plugged with Hadpoop only Steep learning curve
Receptiviti	Emotional Intelligence Decision-making Emotions in real-time AI and Bots Marketing and Engagement Sales and Customer Care	No	Human capital management Talent identification	Organizational risks

ARTIFICIAL INTELLIGENCE/MACHINE LEARNING FOR ASP.NET MVC

Microsoft's .NET enables the much technical support that offers the user with the ability to use the web with a smooth interoperable interface for computational devices. It comprises servers, such as Web-based data storage, and device storage. The .NET platform is a great platform, and it is something that has been undergoing constant revision to ensure the best experience for its programmers.

ASP.NET is an ideal choice to blend Artificial intelligence with, so as in the EdConvergence and Psycheconvergence products. ASP.NET cloud deployment support makes it the best choice to add AI and ML in applications.

There are some services offered by Microsoft that enable development teams to integrate AI into ASP.NET applications. Integration of ML code in .NET also enables to receive everything from a single source. Such services are briefly described:

1. **Microsoft Cognitive Services**: It is a collection of APIs that helps leverage the robust artificial intelligence algorithms. Developed by consummate experts and specialists from domains. They include computer vision, knowledge extraction, natural language processing, web search, and computer speech, among others. Suffice it to say that it is an excellent provision to help integrate Artificial Intelligence into ASP.NET application.
2. **Bot Framework**: It is a handy framework that allows development and integration of intelligent and perceptive bots. They help engage and interact with users irrespective of their location, using leading services such as Facebook, Slack, Telegram, Skype, and more.
3. **Azure Machine Learning**: A cloud computing app launched roughly a decade and previously referred to as Windows Azure. Introduced with the objective of helping developers create, test, and manage applications and services via global data centers led by Microsoft. The Azure Machine Learning service falls under the purview of the Cortana Intelligence Suite which facilitates predictive analytics as well as interaction with data via natural language and speech using Cortana.
4. **Cognitive .NET Development Services**: It allows the inclusion of intelligent features, such as speech recognition, sentiment, and emotion detection, among others.

Infuse Machine Learning and Artificial Intelligence in .NET Applications

Already, NET is equipped with everything one needs for building smarter applications, through infusing AI and machine learning for on-device and cloud scenarios. One could use the pre-built models with Core ML for Xamarin, Cognitive Services or generate and consume own models built with

- Azure Machine Learning
- Deep learning libraries such as

- TensorFlow
- CNTK
- Accord.NET

There are other frameworks also, which support AI/ML code to be implemented under ASP.NET standards using different libraries.

ML.NET

ML.NET is a free, open-source, cross-platform machine learning framework made specifically for .NET developers. With ML.NET, developers can develop and integrate custom machine learning models into .NET applications, without needing prior machine learning experience.

ML.NET is an extensible platform, with tooling in Visual Studio as well as a cross-platform CLI, that powers recognized Microsoft features like Windows Hello, Bing Ads, PowerPoint Design Ideas, and more.

This model specifies the steps needed to transform the input data into a prediction. ML.NET enables to train a custom model by specifying an algorithm or import pre-trained TensorFlow and ONNX models. It has extensive support for many other frameworks.

Examples of predictions with ML.NET

→ Classification/Categorization
→ Regression/Predict continuous values
→ Anomaly Detection
→ Recommendations
→ Time series/sequential data
→ Image classification

ARTIFICIAL INTELLIGENCE/MACHINE LEARNING IN EDCONVERGENCE

Artificial Intelligence and Machine Learning are extensively being applied in EdTech domain, from categorization/classification to implementing Artificial Intelligence by reading student's mind and guidance to students, parents, and teachers.

→ Artificial Intelligence is being used to check the skills and the learning abilities of each student and provide them with a personalized curriculum.

→ A smart algorithm analyzes the way each student interacts with learning material and gather this data into reports so that we can get insights into the learning abilities of each student.

→ Another way machine learning is used in this domain is by grouping students and teachers according to their needs and availability.

→ Through Machine Learning, Student's performance is predicted by identifying and learning each student's weakness and suggest ways to improve, such as additional practice tests, etc.

→ Each student, teacher and parent are updated with recent news and posts relevant to them for better communication and up-to-date information.

→ ML used for detection of new trends and topics that best matches to a person and eliminate those topics which are not related.

ARTIFICIAL INTELLIGENCE/MACHINE LEARNING IN PHYCHECONVERGENCE

Artificial Intelligence and Machine Leaning is widely being used and are planned to be used in future in medical domain. AI is becoming directly in-charge of our welfare through digital doctors and nurses. Mental health is a special case, in which every human is different, and the health cannot be diagnosed through some blood samples or other tests. It is a study of Psychotherapy that assists patients to become aware and change their behavior when facing an immediate emotional conflict, and to implement a transformation process through actions of listening, observing, increasing awareness, and making interventions. So, these actions can be automated using Artificial Intelligence and Machine Learning, so as in PsycheConvergence product by Cognitive Convergence.

→ Through ML, Machine learns from patient's data and its history, search results etc. and can identify similar type of recommendations of doctors which can lead to better experience.

→ Automate the action for listening and extracting useful information by applying patterns and practices that are used by Psychologists/Psychiatrists

→ Enhance psychotherapy with computer-implemented tools.

→ Implementation of cathartic method, the free association method, and the psychoanalytic research method through Machine Learning and AI tools.

→ Raise self-awareness to the patient about the condition he/she is going through

→ Therapeutic frameworks, systemic interventions, and analytic approaches keep in their theoretical foundation’s rules and spatio-temporal dispositions that refer to the algorithmic methodological cure.

→ Classifications according to the Differentiation of Self Scale and the Operational Adaptive Diagnostic Scale can also be obtained automatically from a pre-established set of questions.