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Use of Machine Learning for Continuous Improvement and Handling Multi-Dimensional Data in Service Sector

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Abstract

Machine learning is known as a significant pattern of AI that gives an effective allowance to the software applications to become precise at forecasting outcomes without explicitly programmed in doing that. In addition, machine learning is important as this gives service sectors a suitable view of trends in "business operational patterns" and consumer behaviors. Service sectors are mainly known as the healthcare sectors, tourism sectors, and transportation sectors. In several developed countries, AI is maximizing labor productivity by more than 30% in the coming 15 years. The requirement of showing the usage of machine learning and the way it handles the multi-dimensional data have also been shown in this entire work.

Machine learning shows some ways through that it helps in providing improvement to all the service sectors such as enhancing consumer analytics, giving rapid and effective assistance, providing effective personalization, identifying the fraud cases and also enhancing customer experiences. Though, in this research work it has been highlighted that, in terms of implementing ML in service sectors, service sectors are facing several challenges. Moreover, in terms of showing the effectiveness of ML two algorithms with flowcharts have been shown in this work. On the other hand, in this research work, a secondary data collection method has been utilized and a qualitative data analysis method has also been used in this research work. In addition, secondary data resources have been assembled from books, scholarly articles, journals, and newspapers.

Keywords

AI, Machine learning, secondary data resources, Service sectors.

INTRODUCTION

Machine learning can be recognized as an effective pattern of artificial intelligence that provides a better allowance to software applications to become more precise at predicting results instead of being explicitly programmed to do that. In addition, "machine learning algorithms" utilize historical information as input towards predicting latest output values. Machine learning supports service sectors to enhance their logistics through increasing efficiency in each step of storage, shipping and sales procedures. On the other hand, this technology is providing the allowance to all the "forward thinking businesses" to effectively integrate autonomous driving into their fleets. Machine learning helps in managing multi-dimensional data in all the service sectors with the help of some steps and these steps have been shown in this work. In addition, in this research work, the usage of machine learning for constant improvement and process of handling data have been shown through flowcharts, graphs, diagrams, and tables.

LITERATURE REVIEW

Machine learning brings continuous improvement in service sector

Machine learning is necessary as it provides service sectors a view of effective trends in consumer behavior along with "business operational patterns" and helps the establishment of new products. In addition, it can be stated that, in present times, machine learning is increasingly used in logistics, healthcare, transportation and tourism companies. On the other hand, several of the leading companies mainly known as Google, Facebook, Uber all are making machine learning a pivotal part of their business operations [1]. The market share of AI of the IT services sectors in India has reached approximately 51.8% in the year of 2021. It is not unknown that machine learning is the subset of AI therefore, machine learning's market share across the service sectors is also increasing. Moreover, in numerous developed countries, this AI might effectively maximize labor productivity by more than 30% in the upcoming 15 years [2].

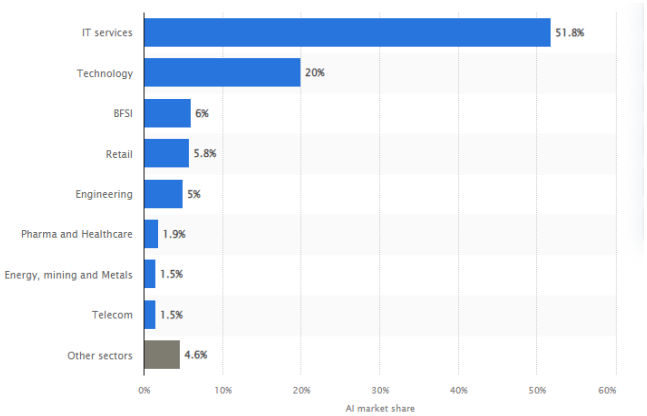

Figure 1. Market share of AI in India [2]

In the service sectors, proper usage of machine learning can bring continuous improvement through providing efficient consumer service. It can be highlighted that there are several ways that machine learning is bringing improvement in service sectors and also enhancing consumer service. These ways have been shown in below:

Offering superior personalization

Machine learning might be utilized to assess several previous interactions with a proper prospect and utilize this effective information to give highly personalized experiences to consumers, and empower effective consumer engagements.

Providing rapid and more effective assistance

Having theaid of "machine learning capabilities" consumers might be able to utilize their natural words and language to illustrate what they require assistance with [3].

Improving consumer analytics

Machine learning pulls information from consumers and utilizes it to effectively predict all the behavioral patterns along with several trends. This can support in identifying and contacting prospects and also help in enhancing sales and improving the consumer experience.

Reaching the right consumers at the appropriate place

As the service sector begins to gain more consumers and gathers more data, this provides a better allowance of *"machine learning tools"* to scrutinize and offer some effective ways to sell products, services and markets that would inevitably attract all the attention of consumers.

Identifying frauds

Fraud cases are growing the concerns for all the service sectors, mainly after the COVID 19 pandemic situation.In addition, machine learning supports guard against all fraud cases and provides an additional layer of protection.

Continuously improving consumer experiences

Machine learning provides a better allowance to programs to always remember and gain knowledge from previous experiences with consumers [4].

Machine learning manage to handle multidimensional data in service sector

Machine learning can be recognized as an effective type of AI software that is aiming to simplify procedure, with more simple programs. In addition, it is more ubiquitous in this modern world, being utilized in nearly several service sectors. Machine learning can be recognized as the large market that is encompassing the majority of this AI software along with projects. This market has been forecasted to expand from approximately 22.6 billion US dollars to nearly 126 billion US dollars by 2025.

Figure 2. Machine Learning [5]

It has been analyzed thatpredictive maintenance is having enormous market focused opportunities along with that ML is known as the innovative solution to this "predictive maintenance implementation". There are few challenges that are increasing barriers in implementing "machine learning algorithms" and these challenges have been effectively identified in table 1. In the result section, some effective utilization of machine learning has been highlighted through the support of two flow charts.

Table 1. Challenges of implementing machine learning

Challenges	Remarks
Getting needed dataset	• Unclear business planning and goal. • Not clear evidence of data that is giving proper value. • Launch of inter-linked machines.
Proper identification of needed data to gather	• Require resources and time to establish all ML solutions. • Selecting incorrect ML algorithms causes loss in price and time.
Improved data	• Selecting an effective method of illustrating the "data driven insights". • Determine a suitable method of illustrating the data [6].
Security	• Safeguarding the admission to crucial equipment. • Proactive approach towards cybersecurity during protecting inter-linked assets.

MATERIALS AND METHODS

In this section, it is necessary to highlight that, in the requirement of highlighting "use of machine learning for continuous improvement and handling multi-dimensional data in the service sector", a secondary data collection procedure has been selected. In addition, the main reason for choosing the secondary data collection method is that it provides authentic information about the research topic and is cost effective [7]. On the other hand, the primary data collection method has not been utilized as it is costly and

requires more time than usual. On the other hand, secondary qualitative analysis has been chosen and these secondary data sources have been gathered from books, scholarly articles, journals, newspapers and some reports.

It is not unknown that service sectors are known as the healthcare sectors, tourism sectors and transportation sectors. Some effective methods have been shown in this section in an effective manner and in this section the data resource along with the "preliminary data processing" have been utilized to effectively predict the task. Furthermore, the approaches of ML feature significant measures utilized in this work and its weaknesses and strengths. "Machine learning methods" have been highlighted in this section in an effective manner [8]. In order to highlight the status of service sectors, an effective establishment of classification model overarch (y) (X) trained on a particular labeled set of proper training examples s, {yi,Xi}Ni=1.

Each of these N examples are representing anyone, where X $\in R^d$ can be recognized as the "d-dimensional vector of predictors" and $\in\{0,1\}$ is another person's outcome, that is encoded as 1 in case that person is diagnosed including that 0 otherwise. In this section, three machine learning methods for predicting the outcomes of the service sectors have been illustrated and these are "penalized logistics regression (LR)", "random forest (RF)", along with "extreme gradient boosting (XGBoost)". In addition, in this work it has been selected to utilize LR along with RF due to their pervasiveness along with accessibility to all the researchers. XGBoost has been selected to also due to its powerful performance in several recent competitions along with subsequent adaptation mainly as the "out of the box classifier of effective choice" [9]. On the other hand, for these methods, a summarization of methodology has been discussed below.

"Penalized Logistics Regression"

Logistic regression helps in training a linear model on the "log-odds ratio" of the result being positive.

$$\log\left(\frac{\Pr(y_i=1|X_i)}{\Pr(y_i=1|X_i)}\right)=\beta^T{}_{X_i}$$

Figure 3. "Penalized Logistics Regression" [9]

There *"β = [β1, βd]"*can be recognized as coefficients related to each predictor. In this analysis, it can be assumed that predictors are effectively standardized towards the unit variance along with mean-considered therefore, the intercept is specifically zero.

In this "standardized logistic regression", the coefficients are selected to maximize this log-likelihood of the main observations. In addition, penalized regression is effectively applied an extra penalty term that is mainly proportional towards the magnitudes of this coefficients, as:

$$\max_{\beta}\left\{\sum_{i=1}^{N}\left[y_i\left(\beta^T{}_{X_i}\right)-\log\left(1+\exp\left(\beta^T{}_{X_i}\right)\right)\right]-\lambda\sum_{j=1}^{d}\|\beta_j\|\right\}$$

Figure 4. "standardized logistic regression" [10]

On the other hand, random forest can be analyzed as an ensemble "machine learning" model that mainly trains numerous decision trees utilizing an amalgamation of bootstrap aggregating along with "random feature selection". Apart from that, in this section, XGBoost can be recognized as an ensemble "machine learning method" depending on gradient boosting of each decision tree [10].

In this section, in the modern world, the size of this AI market globally from 2021 and 2030 has been shown in this section in an effective manner. As per the NMSC, the "global explainable AI market" has been valued at 4.4 billion US billion in the year of 2021. In addition, by the year 2030, this market has been estimated to have a value of approximately 21 billion US dollars.

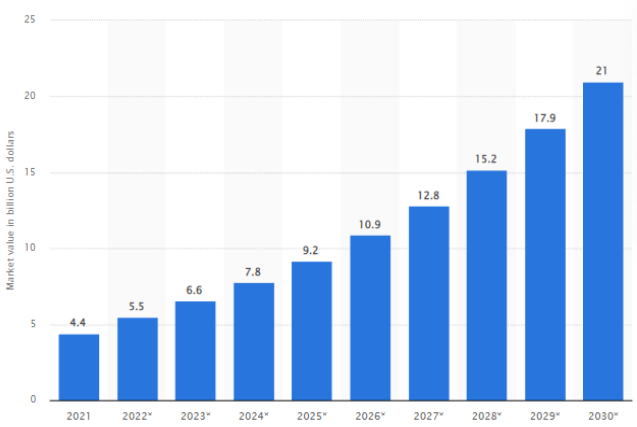

Figure 5. Size of this AI market [11]

Apart from thematerials and methods, the benefits of "machine learning" have been shown in an effective manner. In this section, it can be stated that machine learning helps in wide applications, reducing human intervention, identifying patterns and trends, managing multi-variety information and bringing continuous improvement. Proper utilization of machine learning can support service sectors in bringing continuous improvement. Moreover, there are some disadvantages of this ML such as higher chances of having errors, data acquiring, outcomes interpretation, resource along with timing [11]. On the other hand, proper use of materials and methods are required, otherwise ML cannot bring continuous improvement to the service sectors. Moreover, machine learning supports managing multinational data in the service sectors and this has been highlighted in this section in an effective manner.

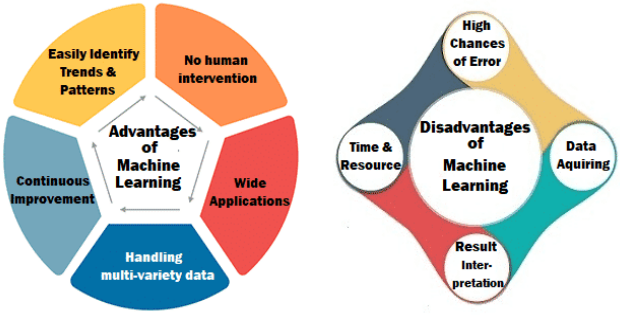

Figure 6. Advantages of ML [11]

RESULTS AND DISCUSSION

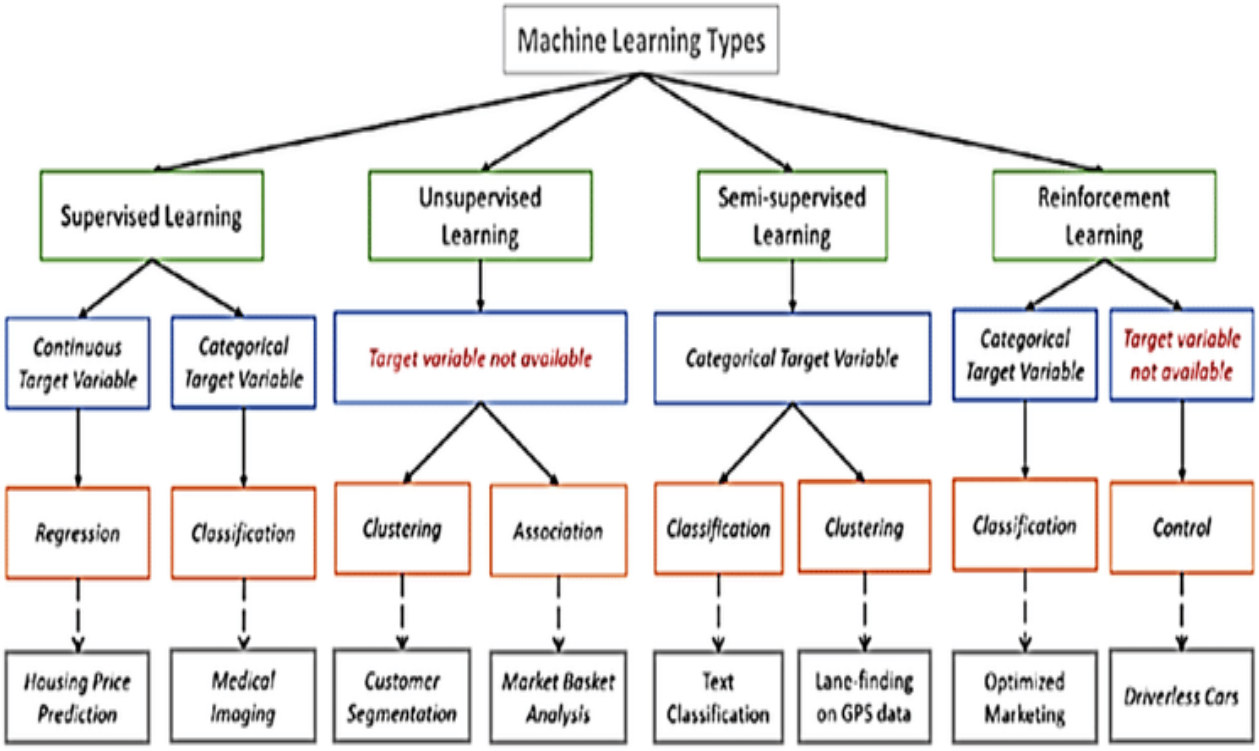

Figure 7. Types of machine learning [12]

In the result section, some effective utilization of machine learning has been highlighted through the support of two flow charts. From this above flowchart, it can be stated that, machine learning has various types such as reinforcement learning, unsupervised learning, supervised learning and semi-supervised learning. In addition, supervised learning has two subsections such as "continuous target variable" and "categorical target variable". On the other hand, unsupervised learning has one subsection that is "target variable is not available", "semi-supervised learning" has one subsection that is "categorical target variable". Apart from that, "reinforcement learning" has two subsections such as "categorical target variable' and "target variable not available" [12]. On the other hand, some subsections have also been shown in this flowchart in an effective manner.

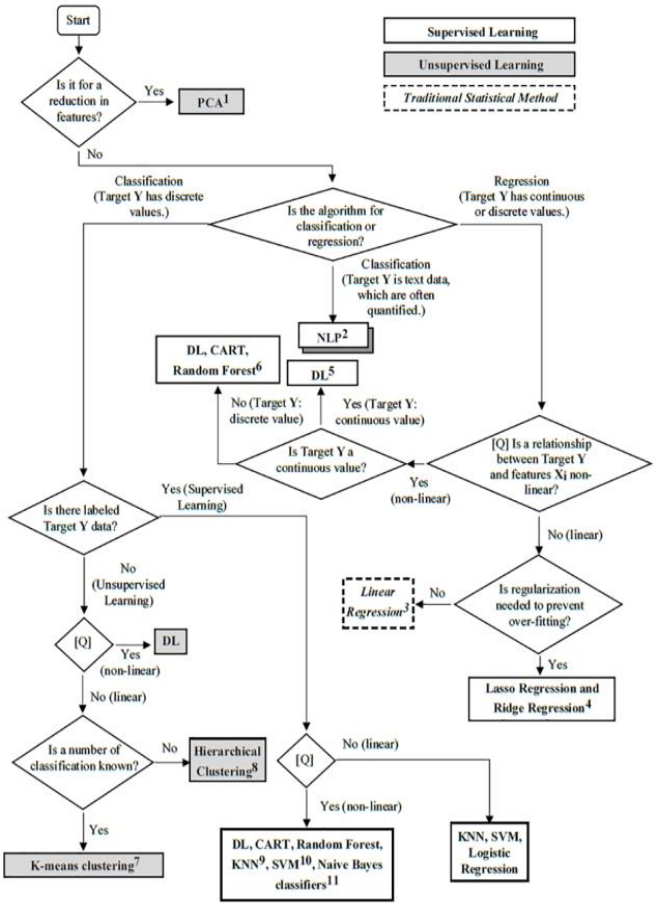

Figure 8. Flow chart of machine learning [12]

From this above figure, it can be stated that there are few types of ML such as supervised learning, and unsupervised learning. In this flowchart some methods have been highlighted such as CART, DI and Random Forest. Apart from that, "K-means clustering" and Hierarchical Clustering have also been shown in an effective manner [13].

Machine learning is necessary in the service sectors as several pieces of multi-dimensional data can be handled and it provides service sectors a proper view of some trends in the behavior of consumers and patterns of business operational and helps in developing new products. On the other hand, training can be recognized as the most significant portion of machine learning and data cleaning can be recognized as the most significant portion of this machine learning [14]. On the contrary, in this result section an effective comparison of the "machine learning technologies" have also been highlighted in terms of gaining a better understanding about machine learning. The "comparison of machine learning technologies" has been shown through the support of the below table.

Table 2. Comparison between "machine learning technologies"

Learning types	**Tasks related to data processing**	**Distinction norm**	**Learning algorithms**	**References**
Supervised learning	Regression or estimation or classification	Statistical classifiers	"Support vector machine"	[15]
		Computational classifiers	"Hidden Markov model"	[16]
			Naive Bayes	
			Bayesian networks	
		Connectionist classifiers	Neutral networks	[17]
Unsupervised learning	Prediction or clustering	Parametric	K-means	[18]

DISCUSSION

In this section, it can be discussed that, machine learning handles the *"multi-dimensional data"* in all the service sectors through acquiring the dataset, encoding the entire categorical data, importing all the critical libraries, importing the dataset and handling along with analyzing the missing values. In this section various comparisons between the *"machine learning technologies"* have been highlighted through a table form. In this table two learning types have been illustrated such as unsupervised learning and supervised learning [19]. Machine learning might be considered as a significant pattern of AI software and it aims to simplify the entire procedure with simple programs. The market of machine learning has been forecasted to increase nearly 22.6 billion US dollars up to 126 billion US dollars by the year of 2025 [20]. In this research, several advantages of machine learning have been shown such as wide applications, identify patterns and trends, and bring constant improvement.

CONCLUSION

In the end it can be concluded that the entire research is showing the usage of machine learning in service sectors and the way it manages all the *"multi-dimensional data"*. There are several ways that machine learning is bringing improvement such as providing superior personalization, giving quick and more beneficial assistance, enhancing customer analytics and proper identification of frauds. In this modern era, usage of machine learning is effectively increasing in tourism, healthcare and transportation companies. This market share of IT and AI in service sectors have reached nearly 51.8% in the year of 2021. The usage of machine learning is increasing in the telecom, engineering, pharma and healthcare, technology, retail, metals and mining organizations and it is handling these sector's *"multi-dimensional data"*.

REFERENCE

[1] Min, Q., Lu, Y., Liu, Z., Su, C. and Wang, B., 2019. Machine learning based digital twin framework for production optimization in petrochemical industry. International Journal of Information Management, 49, pp.502-519.

[2] Sun, S, 2022. AI market share in India in 2021, by industry. [Online]. Available at:https://www.statista.com/statistics/1180858/india-ai-market-share-by-industry/ [Accessed on: 11 September, 2022].

[3] Thormundsson, B, 2022. Machine learning - Statistics & Facts. [Online]. Available at:https://www.statista.com/topics/9583/machine-learning/#dossierKeyfigures [Accessed on: 11 September, 2022].

[4] Gomez, O., Holter, S., Yuan, J. and Bertini, E., 2020, March. ViCE: visual counterfactual explanations for machine learning models. In Proceedings of the 25th International Conference on Intelligent User Interfaces (pp. 531-535).

[5] Liu, Y., Yu, F.R., Li, X., Ji, H. and Leung, V.C., 2020. Blockchain and machine learning for communications and networking systems. ieee communications surveys & tutorials, 22(2), pp.1392-1431.

[6] Çınar, Z.M., Abdussalam Nuhu, A., Zeeshan, Q., Korhan, O., Asmael, M. and Safaei, B., 2020. Machine learning in predictive maintenance towards sustainable smart manufacturing in industry 4.0. Sustainability, 12(19), p.8211.

[7] Zekić-Sušac, M., Mitrović, S. and Has, A., 2021. Machine learning based system for managing energy efficiency of public sector as an approach towards smart cities. International journal of information management, 58, p.102074.

[8] UsugaCadavid, J.P., Lamouri, S., Grabot, B., Pellerin, R. and Fortin, A., 2020. Machine learning applied in production planning and control: a state-of-the-art in the era of industry 4.0. Journal of Intelligent Manufacturing, 31(6), pp.1531-1558.

[9] Tanizaki, T., Hoshino, T., Shimmura, T. and Takenaka, T., 2019. Demand forecasting in restaurants using machine learning and statistical analysis. Procedia CIRP, 79, pp.679-683.

[10] Benbelkacem, S., Kadri, F., Atmani, B. and Chaabane, S., 2019. Machine learning for emergency department management. International Journal of Information Systems in the Service Sector (IJISSS), 11(3), pp.19-36.

[11] Thormundsson, B, 2022. Revenues from the artificial intelligence (AI) software market worldwide from 2018 to 2025(in billion U.S. dollars). [Online]. Available at: https://www.statista.com/statistics/607716/worldwide-artificial-intelligence-market-revenues/ [Accessed on: 11 September, 2022].

[12] Lee, I. and Shin, Y.J., 2020. Machine learning for enterprises: Applications, algorithm selection, and challenges. Business Horizons, 63(2), pp.157-170.

[13] Vamathevan, J., Clark, D., Czodrowski, P., Dunham, I., Ferran, E., Lee, G., Li, B., Madabhushi, A., Shah, P., Spitzer, M. and Zhao, S., 2019. Applications of machine learning in drug discovery and development. Nature reviews Drug discovery, 18(6), pp.463-477.

[14] Graur, D., Aymon, D., Kluser, D., Albrici, T., Thekkath, C.A. and Klimovic, A., 2022. Cachew: Machine learning input data processing as a service. In 2022 USENIX Annual Technical Conference (USENIX ATC 22) (pp. 689-706).

[15] Shehadeh, A., Alshboul, O., Al Mamlook, R.E. and Hamedat, O., 2021. Machine learning models for predicting the residual value of heavy construction equipment: An evaluation of modified decision tree, LightGBM, and XGBoost regression. Automation in Construction, 129, p.103827.

[16] Wu, H., Lubbers, N., Viswanathan, H.S. and Pollyea, R.M., 2021. A multi-dimensional parametric study of variability in multi-phase flow dynamics during geologic CO2 sequestration accelerated with machine learning. Applied Energy, 287, p.116580.

[17] Wan, S., Zhao, Y., Wang, T., Gu, Z., Abbasi, Q.H. and Choo, K.K.R., 2019. Multi-dimensional data indexing and range query processing via Voronoi diagram for internet of things. Future Generation Computer Systems, 91, pp.382-391.

[18] Sengan, S., Kamalam, G.K., Vellingiri, J., Gopal, J., Velayutham, P. and Subramaniyaswamy, V., 2020. Medical information retrieval systems for e-Health care records using fuzzy based machine learning model. Microprocessors and Microsystems, p.103344.

[19] He, R., Li, X., Chen, G., Chen, G. and Liu, Y., 2020. Generative adversarial network-based semi-supervised learning for real-time risk warning of process industries. Expert Systems with Applications, 150, p.113244.

[20] Perera, A.T.D. and Kamalaruban, P., 2021. Applications of reinforcement learning in energy systems. Renewable and Sustainable Energy Reviews, 137, p.110618.