**Selected Algorithms for the project: A Machine learning approach for forest fires.**

[**Bayes net.**](https://www.bayesserver.com/docs/introduction/bayesian-networks/)

The Bayesian Networks, are Probabilistic Graphical Models, they can create: diagnostic models, causal models, decision making, prediction, etc. [[1].](#_References)

Therefore, the Bayes Net, is considered as a useful tool, in prediction and detection area, of wildfires fires. Consequently, it follows a brief reference, of two papers.

* The specific algorithms, were used, in study: *A Bayesian network model for prediction and analysis of possible forest fires causes,* in 2020. The study was conducted in Mugla, of Turkey. The model showed, that the most effective factors, on forest fires ignition, were: the month, and the temperature [[2].](#_References)
* In 2021, it was published, in MDPI, the survey: *A Bayesian Network – Based Information Fusion Combined with DNNS for Robust Video Fire Detection.* The combination,Regional – Convolutional Neural Network (R – CNN), Long – Short term memory (LSTM), and Bayesian Net, proved that the last one, not only improves the detection accuracy, of forest / wildfires∙ but also simplifies decision making [[3].](#_References)

[**Naïve Bayes**](https://www.ibm.com/topics/naive-bayes)

The Naïve Bayes is a supervised machine learning algorithm, used for classification tasks. This classifier, uses principles of probability in order to perform classification tasks [[4].](#_References)

One of the strong points, the algorithm, is amenable to improvements, and modifications, as to achieve better results in research, such as the forest wildfires prediction.

* A proportional modification was found in the following research, which was published in MDPI*: Towards Fire prediction Accuracy Enhancements by Leveraging an Improved Naïve Bayes Algorithm.* In the aforementioned paper, there was an evolutionary algorithm, the Double Weighted Naïve Bayes with Compensation Coefficient (DWCNB)∙ which compared with Naïve Bayes, and Double Weighted Naïve Bayes. The results showed a prediction accuracy of 98.13%, higher than Naïve Bayes for 5.08%, and respectively 2.52% than Double weighted Naïve Bayes. [[5].](#_References)
* In a recent research, 2024, in Turkey, it was used different algorithms so as to extract the highest accuracy, for forest / wildfires. The paper, was: *Predicting forest fire vulnerability using machine learning approaches in the Mediterranean region: a case study in Turkiye*. The study compared: Naïve Bayes, Decision Tree, Random Forest, Neural Networks, and Support Vector machines. The Random Forest algorithm, yielded the highest accuracy, while Naïve Bayes performed consistently, albeit lower than Random Forest, and Decision Tree [[6].](#_References)

**Logistic Regression**

Like the previous algorithm, Logistic Regression, works also with machine learning classification, and used to predict probabilities. This (ML) technique used in data sets with many features [[7].](#_References)

The Logistic Regression, is widely used in natural hazards, such as fire modeling by estimating, the probability of occurrences, according to the following survey: *A Survey of Machine Learning Algorithms based Forest Fires Prediction and Detection* [[8]](#_References)

* In China, 2013, it was used the Logistic Regression, to predict forest /wildfires ignition. The global accuracy, was about the 85.7%. However, in the paper, it was pointed out, that the results concerned one province, of China∙ each country happens to have different results due to geographical and climatic differences [[8].](#_References)
* In Portugal, 2001, Logistic Regression was compared to Neural Network, for fire occurrence prediction. Logistic Regression reported a 78.8% prediction for occurrence, and 74% prediction for non – occurrence of fire. While the neural Network, had 75.7% for event prediction, and 87.8% for non – event fire [[8].](#_References)

[**Multilayer Perceptron (MLP)**](https://www.sciencedirect.com/topics/computer-science/multilayer-perceptron)

The Multilayer Perceptron is a commonly used Neural Network. It composed of multiple layers, and contains a set of perception elements known as neurons. It is used in forecasting models, and image pattern recognition [[9].](#_References)

* In a Chinese province, in 2022, was conducted the research: *Using Multilayer Perceptron to Predict Forest Fires in Jiangxi Province, Southeast China*. In this paper, several models were studied for the occurrence of forest fires. ROC plots were used to compare results from: (MLP), Logistic, and SVM. The (MLP) model scored the highest percentage, compared to the rest. Precisely, (MLP) scored 0.984, Logistic 0.933, and SVM 0.974 [[10].](#_References)
* In another province of China, in 2012, a comparison was made between (MLP) and RBNF, in the study: *Estimation of the burned area in forest fires using computational intelligence techniques.* Their finding showed 65% accuracy using humidity and wind speed, as features∙ while RBFN presented poor performance [[8].](#_References)

[**J48**](https://www.bitsathy.ac.in/data-mining-algorithms/)

J48, belongs to the Decision Tree algorithm family, in supervised learning. Creates a decision tree, which breaks into subsets. It used in risk analysis, pattern recognition and makes predictions [[11].](#_References)

* Ο J48, was selected among with Random Forest (RF), adaboostM1, and Bagging, in Algeria, 2020, for the project: *Predicting Forest Fires in Algeria using Data Mining Techniques: Case study of the Decision Tree Algorithm.* Although, the results showed best performance, with adaBoostM1 (84.21%), the researchers do not recommend it due it needs significant resources and effort to be translated to hardware implementation. Therefore, they recommend J48 with accuracy (82,89%). The (RF) came up to (72,36%), and Bagging to (78,94%) [[12].](#_References)
* In a study, to Slovenia, 2005, the J48, had the lowest result. Specifically, on the paper: *Learning to Predict Forest Fires with Different data Mining Techniques*, highlighted the Bagging, as the most efficient∙ in relation to Logistic Regression, Random Forest, J48, και Boosting [[13].](#_References)

[**Random Forest**](https://www.ibm.com/topics/random-forest)

Random Forest is a popular machine learning algorithm. Its ease of use and flexibility, in handles classification and regression problems, in more precise predictions, fueled its commonly adoption [[14].](#_References)

* In MDPI, 2023, it was published, the paper: *Forest – Fire – Risk Prediction based on Random Forest and Backpropagation Neural Network of Heihe Area in Heilongjiang Province, China.* There was a comparison, in the research, among the Random Forest, and the backpropagation Neural Network (BPNN). Both methods, were found suitable for predicting forest / wildfires. The (RF) prediction range between 87,91% - 88,98%, while the (BPNN) accuracy was 86,01% and 86,94% [[15].](#_References)
* Random Forest, presented satisfactory results also in this research: *Using GIS and random Forest to identify fire drivers in a forest city, Yichun, China.* The forecast, for a fire outbreak, meteorological data ranged from 71,2% to 76,5%. The prediction, from combined factors, had a higher percentage among 80,78% - 84,8%. The AUC value, based on meteorological factors, were 0,740 – 0,807 indicating a moderated model fit. On the other hand, the value with combined factors showed an excellent fit, with the model 0,886 – 0,906 [[16].](#_References)

**References**

[[1] Bayes Server Learning Center. Bayesian networks – an Introduction. *What are Bayesian Networks.*](#Α1)

[Retrieved from: https://www.bayesserver.com/docs/introduction/bayesian-networks/](#Α1)

[[2] Volkan, Sevink., Omer, Kucuk., Merih, Goltas. Forest Ecology and Management, volume 457, 1 February, 2020. *A Bayesian network model for prediction and analysis of possible forest fires causes.*](../../../../Downloads/%5B2%5D%20Volkan,%20Sevink.,%20Omer,%20Kucuk.,%20Merih,%20Goltas.%20Forest%20Ecology%20and%20Management,%20volume%20457,%201%20February,%202020.%20A%20Bayesian%20network%20model%20for%20prediction%20and%20analysis%20of%20possible%20forest%20fires%20causes.%20Retrieved%20from:%20https://www.sciencedirect.com/science/article/abs/pii/S0378112719311776)

[Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S0378112719311776](../../../../Downloads/%5B2%5D%20Volkan,%20Sevink.,%20Omer,%20Kucuk.,%20Merih,%20Goltas.%20Forest%20Ecology%20and%20Management,%20volume%20457,%201%20February,%202020.%20A%20Bayesian%20network%20model%20for%20prediction%20and%20analysis%20of%20possible%20forest%20fires%20causes.%20Retrieved%20from:%20https://www.sciencedirect.com/science/article/abs/pii/S0378112719311776)

[[3] Byoungjun, Kim., Joonwhoan, Lee. Artificial Intelligence and machine Learning in Software Engineering, Article. *A Bayesian Network – Based Information Fusion Combined with DNNS for Robust Video Fire Detection.*](../../../../Downloads/%5B3%5D%20Byoungjun,%20Kim.,%20Joonwhoan,%20Lee.%20Artificial%20Intelligence%20and%20machine%20Learning%20in%20Software%20Engineering,%20Article.%20A%20Bayesian%20Network%20–%20Based%20Information%20Fusion%20Combined%20with%20DNNS%20for%20Robust%20Video%20Fire%20Detection.Retrieved%20from:%20https://www.mdpi.com/2076-3417/11/16/7624)

[*Retrieved from: https://www.mdpi.com/2076-3417/11/16/7624*](../../../../Downloads/%5B3%5D%20Byoungjun,%20Kim.,%20Joonwhoan,%20Lee.%20Artificial%20Intelligence%20and%20machine%20Learning%20in%20Software%20Engineering,%20Article.%20A%20Bayesian%20Network%20–%20Based%20Information%20Fusion%20Combined%20with%20DNNS%20for%20Robust%20Video%20Fire%20Detection.Retrieved%20from:%20https://www.mdpi.com/2076-3417/11/16/7624)

[[4] IBM. *What Are Naïve Bayes Classifiers?*](#Α4)

[Retrieved from: https://www.ibm.com/topics/naive-bayes](#Α4)

[[5] Liang, Shu., Haigen, Zhang., Yingmin, You., Yonghao, Cui., Wei, Chen. *Towards Fire prediction Accuracy Enhancements by Leveraging an Improved Naïve Bayes Algorithm.* Symmetry, volume 13 (4), p.p 530, 2021.](../../../../Downloads/%5B5%5D%20Liang,%20Shu.,%20Haigen,%20Zhang.,%20Yingmin,%20You.,%20Yonghao,%20Cui.,%20Wei,%20Chen.%20Towards%20Fire%20prediction%20Accuracy%20Enhancements%20by%20Leveraging%20an%20Improved%20Naïve%20Bayes%20Algorithm.%20Symmetry,%20volume%2013%20(4),%20p.p%20530,%202021.%20Retrieved%20from:%20https://www.mdpi.com/2073-8994/13/4/530)

[Retrieved from: https://www.mdpi.com/2073-8994/13/4/530](../../../../Downloads/%5B5%5D%20Liang,%20Shu.,%20Haigen,%20Zhang.,%20Yingmin,%20You.,%20Yonghao,%20Cui.,%20Wei,%20Chen.%20Towards%20Fire%20prediction%20Accuracy%20Enhancements%20by%20Leveraging%20an%20Improved%20Naïve%20Bayes%20Algorithm.%20Symmetry,%20volume%2013%20(4),%20p.p%20530,%202021.%20Retrieved%20from:%20https://www.mdpi.com/2073-8994/13/4/530)[Α7](#Α7)

[[6] M, I, Purnama., I, N, S, Jaya., L, Syafina., H, O, Coban., M, Raihan. IOP Conference Series: earth and Environmental Science. 1315 (2024) 012056. *Predicting forest fire vulnerability using machine learning approaches in the Mediterranean region: a case study in Turkiye*.](#Α8)

[Retrieved from: https://www.researchgate.net/publication/379072305\_Predicting\_forest\_fire\_vulnerability\_using\_machine\_learning\_approaches\_in\_The\_Mediterranean\_Region\_a\_case\_study\_of\_Turkiye](#Α8)

[[7] Sonia Jessica. Tech Bogger., 15/07/2022. Machine Learning, article. How Does Logistic Regression Work?](#Α10)

[Retrieved from: https://www.kdnuggets.com/2022/07/logistic-regression-work.html](#Α10)

[[8] Faroudja Abid. Fire technology, 57, pp. 559 – 590, 2021. *A Survey of Machine Learning Algorithms based Forest Fires Prediction and Detection.*](#Α14)

[9] Science Direct. Computer Science, Multilayer Perceptron.

Retrieved from: <https://www.sciencedirect.com/topics/computer-science/multilayer-perceptron>

[[10] Keke, Gao., Zhongke, Feng., Shan, Wang. Discrete Dynamics in Nature and Society, volume 2022. Using Multlayer Perceptron to Predict Forest Fires in Jiangxi Province, Southeast China. 2022.](#Α20)

[Retrieved from: https://www.researchgate.net/publication/361284129\_Using\_Multilayer\_Perceptron\_to\_Predict\_Forest\_Fires\_in\_Jiangxi\_Province\_Southeast\_China](#Α20)

[11] J, Biju. Bannari Amman. Institute of Technology. Classification by tree – based Data Mining Algorithms. 2023.

Retrieved from: <https://www.bitsathy.ac.in/data-mining-algorithms/>

[[12] Faroudja, Abid., Nouma, Izeboudjen. Advanced Intelligent Systems for Sustainable Development (AI2SD’2019). *Predicting Forest Fires in Algeria using Data Mining Techniques: Case study of the Decision Tree Algorithm. 2020.*](#Α25)

[Retrieved from: https://www.researchgate.net/publication/339062373\_Predicting\_Forest\_Fire\_in\_Algeria\_Using\_Data\_Mining\_Techniques\_Case\_Study\_of\_the\_Decision\_Tree\_Algorithm](#Α25)

[[13] Daniela, Stojanova., Pance, Panov., Andrej, Kobler., Saso, Dzeroski., Katerina, Taskova. *Learning to Predict Forest Fires with Different data Mining Techniques*. 2005.](#Α27)

[Retrieved from: https://www.researchgate.net/publication/228527438\_Learning\_to\_predict\_forest\_fires\_with\_different\_data\_mining\_techniques](#Α27)

[[14] IBM. What is random forest?](#Α29)

[Retrieved from: https://www.ibm.com/topics/random-forest](#Α29)

[[15] Chao, Gao., Honglei, Lin., Haiqing, Hu. Forest Ecology and Management. Forests 2023, volume 14 (2), pp. 170. *Forest – Fire – Risk Prediction based on Random Forest and Backpropagation Neural Network of Heihe Area in Heilongjiang Province, China.*](#Α31)

[Retrieved from: https://www.mdpi.com/1999-4907/14/2/170](#Α31)

[[16] Zhangwen, Su., Haiqing, Hu., Guangyu, Wang., Yuanfan, Ma., Xiajie, Yang., Futao, Guo. Geomatics, Natural Hazards and Risk. Volume 9, issue 1, 2018. *Using GIS and random Forest to identify fire drivers in a forest city, Yichun, China.*](#Α33)

[Retrieved from: https://www.tandfonline.com/doi/full/10.1080/19475705.2018.1505667#abstract](#Α33)