#### What is Crop Recommendation?

Crop recommendation are suggestions about crops that are given to agriculturalists based on factors such as:

* pH values
* Type of soil
* Nutrient contents of the soil
* Climate
* Historical crop yields

The main objective is to provide crop suggestions that will yield maximum profit.

Crop recommendation is important in agriculture as it empowers farmers to make informed decisions about suitable crops for their land and climate conditions.

As the global population increases, the need to produce more food becomes imperative.

Machine Learning techniques can help in effectively automating the crop recommendation process, which is usually manual, to enable farmers to optimize their yield from the lands while simultaneously maintaining soil fertility and replenishing of essential nutrients.

Some of the machine learning algorithms that can be used for crop recommendation include:

* Logistic Regression
* Decision Tree Classifier
* Random Forest Classifier
* KNN Classifier
* Support Vector Machine (SVM) Classifier
* Naives Bayes

**Interesting things I learnt during the project**

* Pivot tables using pandas
* Normalization and Standardization
* Gamma parameter in SVC

*By applying the same normalization technique used on the training set to the testing set, we ensure that the model’s predictions are consistent with real-world scenarios.*

**Errors and warnings encountered:**

***ConvergenceWarning: lbfgs failed to converge (status=1):***

***STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.***

Research:

**lbfgs** stand for: "Limited-memory Broyden–Fletcher–Goldfarb–Shanno Algorithm". It is one of the solvers' algorithms provided by Scikit-Learn Library.

The term limited-memory simply means it stores only a few vectors that represent the gradients approximation implicitly. It has better convergence on relatively small data sets.

Algorithm convergence:

In the case of iterative algorithms, they are said to converge when their candidate solutions for each iteration tend to get closer and closer to the desired solution.

An iterative algorithm is said to converge when as the iterations proceed the output gets closer and closer to a specific value. In some circumstances, an algorithm will diverge; its output will undergo larger and larger oscillations, never approaching a useful result.

Some tips to try (out of many) that might help the algorithm to converge are:

* Increase the *number of iterations*
* Try a *different optimizer*: Look [here](https://stackoverflow.com/questions/38640109/logistic-regression-python-solvers-defintions/52388406#52388406);
* Scale your data: Look [here](https://scikit-learn.org/stable/modules/preprocessing.html);
* Add engineered features: Look [here](https://machinelearningmastery.com/discover-feature-engineering-how-to-engineer-features-and-how-to-get-good-at-it/);
* Data pre-processing: Look [here - use case](https://datascience.stackexchange.com/questions/80421/very-low-cross-val-score-for-regression-with-big-corr-between-feature-and-res/80422#80422) and [here](https://towardsdatascience.com/feature-engineering-for-machine-learning-3a5e293a5114);
* Add more data: Look [here](https://www.quora.com/How-do-you-determine-sample-size-for-machine-learning-classification/answer/Yahya-Almardeny).

Source(https://stackoverflow.com/questions/62658215/convergencewarning-lbfgs-failed-to-converge-status-1-stop-total-no-of-iter)

**References**

1. Smart Farming: Crop Recommendation using Machine Learning with Challenges and Future Ideas: Devendra Dahiphale, Pratik Shinde, Koninika Patil, and Vijay Dahiphale