Coding and solutions

Team ID	PNT2022TMID41774
Project Name	Emerging Methods For Early Detection of Forest fires Detection
Maximum Marks	2 Marks

Utilization of Algorithms:

- To devise an algorithm which can help to detect forest fire in its early stage.To implement forest fire detection system using small and cheap sensor nodes. To make the probability of false alarms reduced. To build a system which is energy efficient in distributed environment and also efficient in performance.
- The operator provides the algorithm with a dataset that includes inputs and outputs, and the algorithm must find a method to determine how to reach at those inputs and outputs.

$$c(x,y,f(x))= \begin{cases} \text{if } y*f(x) > 0 \\ y*f(x), \text{ else} \end{cases}$$

$$c(x,y,f(x)) = (1 - y*f(x))_+$$

$$min_w \lambda \parallel w \parallel^2 + \sum_{i=1}^{n} (1 - y_i \langle x_i, w \rangle)_+$$

The loss function for SVM:

Gradients:

$$\frac{\delta}{\delta w_k} \lambda \parallel w \parallel^2 = 2\lambda w_k$$

$$\frac{\delta}{\delta w_k} (1 - y_i \langle x_i, w \rangle)_+ = \begin{cases} 0, & \text{if } y_i \langle x_i, w \rangle \geq 1 \\ -y_i x_{ik}, & \text{else} \end{cases}$$

Gradient Update—No misclassification:

$$w = w - \alpha \cdot (2\lambda w)$$

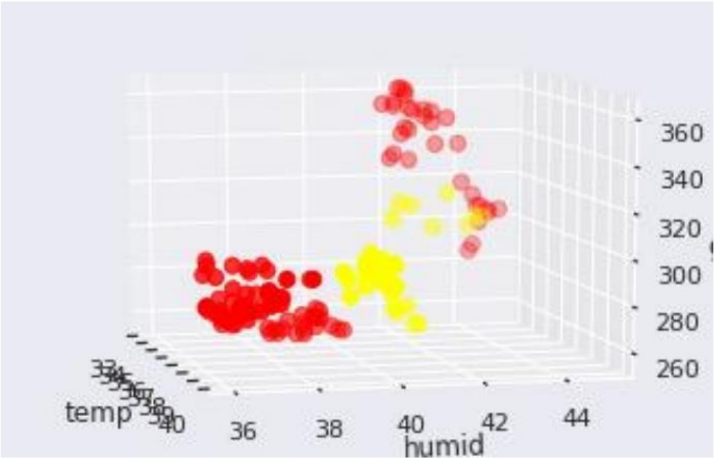
$$w = w + \alpha \cdot (y_i \cdot x_i - 2\lambda w)$$

Gradient Update—Misclassification:

A. SVM Algorithm:

No Fire Fire Present The classification report generated by the SVM algorithm gives an idea about accuracy of the algorithm.

The result of SVM algorithm is discussed below:



Visualization of Dataset

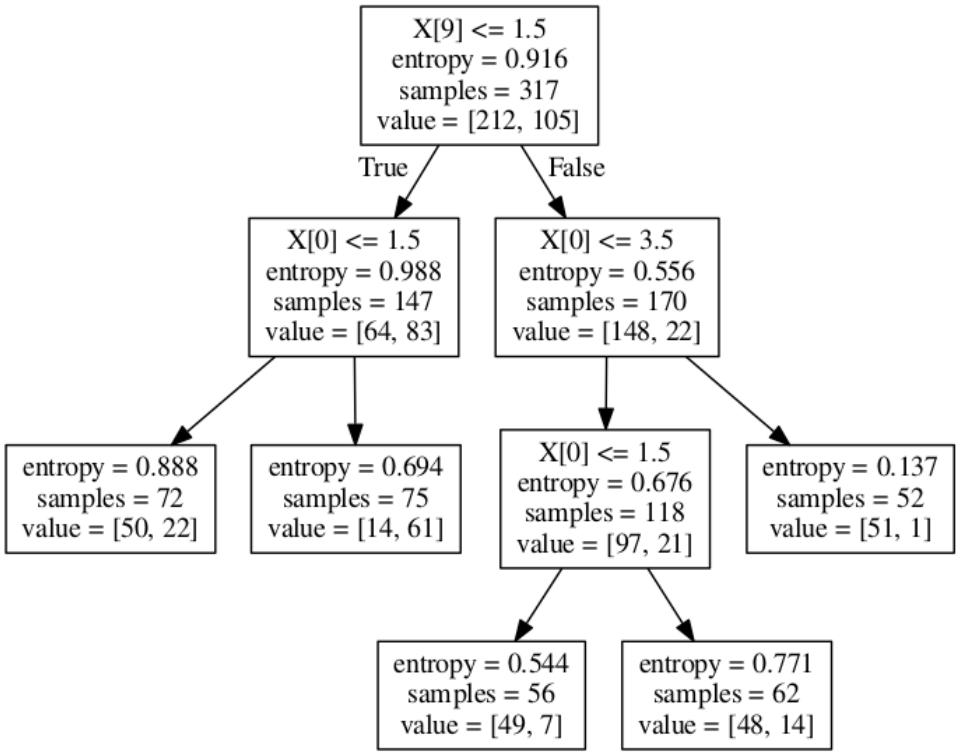
	precision	recall	f1-score	support
0	0.54	0.78	0.64	55
1	0.76	0.51	0.61	73
accuracy			0.62	128
macro avg	0.65	0.64	0.62	128
weighted avg	0.66	0.62	0.62	128

Classification Report for SVM

B. Decision Tree Algorithm:

The model generated by this algorithm is as follows

Decision Tree Model:



	precision	recall	f1-score	support
0	0.98	1.00	0.99	52
1	1.00	0.96	0.98	28
accuracy			0.99	80
macro avg	0.99	0.98	0.99	80
weighted avg	0.99	0.99	0.99	80

Decision Tree Algorithm

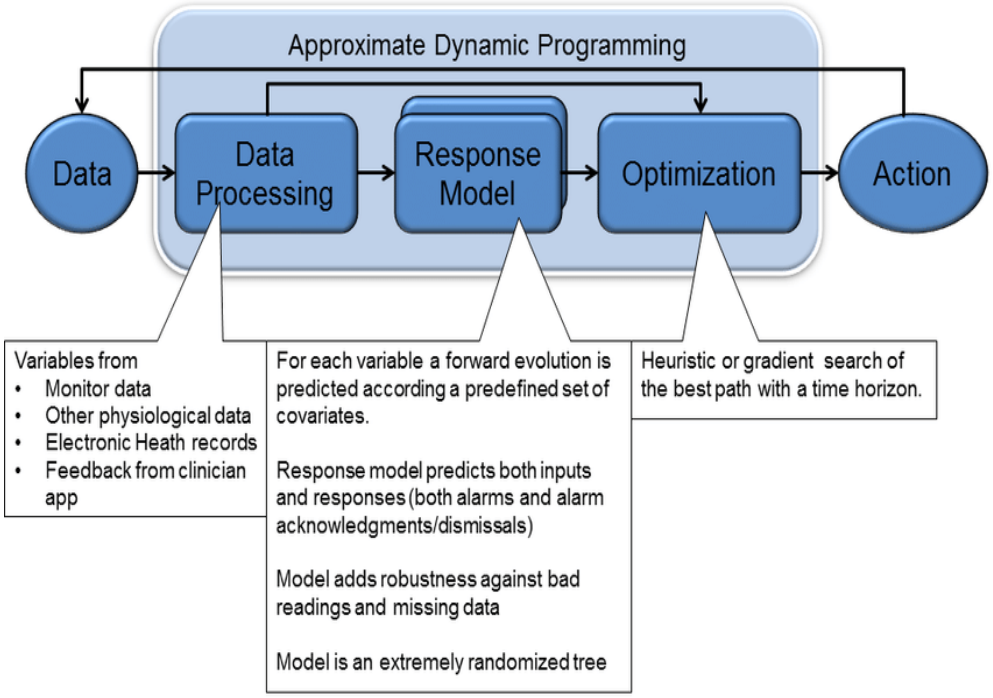
Dynamic Programming:

- ✓ "The term dynamic programming refers to a collection of algorithms which can be used to compute optimal policies given a perfect model of the environment as a Markov decision process."

$$Qk+1(s,a) = s'T(s,a,s')[R(s,a,s') + \max a' Q(s', a')]$$

  - Value iteration algorithms
  - Policy iteration algorithms

- Policy search algorithms



Optimization:

✓ Utilization forecasting is a technique that applies ML algorithms to produce daily usage forecasts for all utilization across CPUs, physical and virtual servers, disks, storage, bandwidth, and other network elements, enabling networking teams to manage resources proactively.

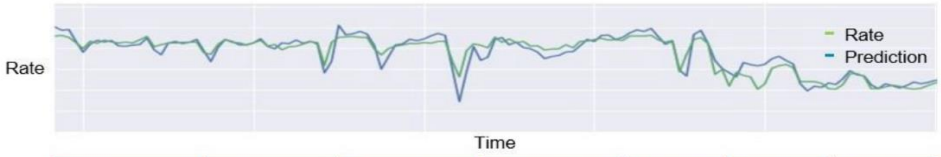
Machine learning for production optimization

1. **Predictive algorithm :**
   - Given historical data, learn model to predict the production rate given a set of operator controllable variables.
2. **Optimization :**
   - Utilizing the predictive power of the machine learning algorithm, perform a multivariate optimization with aim of increasing production rates.
3. **Actionable output :**
   - Advice operators on which control variables to adjust in order to maximize production.

Predictive algorithm

Optimization

Actionable output:
Predicted ~2 % increase in production rate



Control variable:	Pressure controller 4	Flow rate controller 17	Temperature controller	Control valve 9	Control valve 17	Control valve 22
Old settings	17 bar	230 m3/h	120 c	40 %	72 %	14 %
New setting	19 bar	240 m3/h	134 c	44 %	65 %	18 %