Q: Guess the word ?

→ Decision Tree
→ Binary Search Tree
→ Huffman Coding

Agenda.

- Setting
- Hierarchical Decisions
- Interpretability in Classification
- Representation
- Practical aspects : DT
  - Impurities
  - Categorical data
  - Categorical features
  - Time, Space Complexity
  - Overfitting, Control
  - Feature importance

* Hierarchical Decisions

Q: Categorical Features - c_1, c_2, c_3

Q: Hierarchical Decisions

① $c_1 = c_2 \rightarrow 2c_3$

② $c_1 = c_2 \rightarrow 2c_3$

③ $c_1 = c_2 \rightarrow 2c_3$

$F_3 = 2^{c_1} \times 2^{c_2} \times 2^{c_3}$

$F_2 = 2^{c_1} \times 2^{c_2}$, $2^{c_1} \times 2^{c_3}$, $2^{c_2} \times 2^{c_3}$ . . . . . .

Choice, whichever will give you more 2^c

Here → Feature binary

$(0 \rightarrow 0), (1 \rightarrow 1), (0 \rightarrow 1), (1 \rightarrow 0)$ . . . .

Tree → Decision

'Hierarchical' 'Split' → Decision?

Age ≤ 5 yrs age $\leq$ 5 (numerical)

* Interpretability, Vs Overfitting.

Case 1: → a lot of x_i's (depth → large)

← depth = 5

Q: why does DT overfit when $d \uparrow$ & large $\rightarrow d$?

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$x_3 = 0.1$
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$x_{998} = 98.5$
$x_{999} = 98.6$
$x_{1000} = 98.7$

Decision Stump.

$d \uparrow \rightarrow$ depth $= 1$

Shallow tree : underfits
Deep tree : overfits
depth → hyperparameter.

* Tree Construction

→ Tree (conditions)
→ Max depth = 3 . . . 3 ?? !!
→ Max depth, Impurity
→ Δ in x_i's → Tree
→ Decision Tree

* Geometrical Representation. (Decision Boundary)

"Axis-Parallel Boundary"

Tree
$x_1 \geq 0$
$x_2 \geq 0$
$x_1 \geq 0$
$x_2 \geq 0$
$x_1 \geq 0$
$x_2 \geq 0$