ID-3 Algorithm Example:

Ex: Given Data Set.

Sl No	Weather	Mood	Study
1	Sunny	Happy	Yes
2	Rainy	Sad	No
3	Sunny	Sad	Yes
4	Rainy	Happy	Yes

(1) Calculate Entropy of dataset (D) for target attribute 'Study'.

$$\text{Entropy}(D) = -\sum_{i=1}^{n} P_i \log_2(P_i)$$

$$= -P(\text{yes}) \cdot \log_2(P(\text{yes})) - P(\text{No}) \cdot \log_2(P(\text{No}))$$

$$= -3/4 \times \log_2(3/4) - 1/4 \cdot \log_2(1/4)$$

$$\simeq 0.811$$

(2) Calculate Information Gain for Attribute = Weather.

(a) Entropy of Weather = Sunny.

$$E[\text{Sunny}] = -2/2 \log_2(2/2) - 0/2 \cdot \log_2(0/2)$$

$$= 0$$

(b) Entropy of Weather = Rainy.

$$E[\text{Rainy}] = -1/2 \cdot \log(1/2) - 1/2 \log(1/2)$$

$$= 1.$$

~~Information Gain~~

$$\text{Avg Entropy}[\text{weather}] = P[\text{sunny}] \times E(\text{Sunny}) + P[\text{Rainy}] \times E[\text{Rainy}]$$

$$= 2/4 \times 0 + 2/4 \times 1 = 0.5$$

Information Gain (weather) = E[D] − E[weather]

= 0.811 − 0.5

= 0.311

(3) Calculate Information Gain of Attribute = Mood.

(a) Entropy of Mood = Happy

$E[Happy] = -2/2 \log(2/2) - 0/2 \cdot \log(0/2)$

= 0.

(b) Entropy of Mood = Sad.

$E[sad] = -1/2 \log(1/2) - 1/2 \log(1/2)$

= 1.

Avg Entropy [Mood] = P[Happy] × E[Happy] + P(sad) * E[sad]

$= 2/4 \times 0 + 2/4 \times 1$

= 0.5

Information Gain [Mood] = E[D] − E[Mood]

= 0.811 − 0.5

= 0.311

(4) Since Gain of Weather & Mood attributes are same. Choose any one attribute as Splitting attribute.

Based on this we have following Decision Tree constructed.