









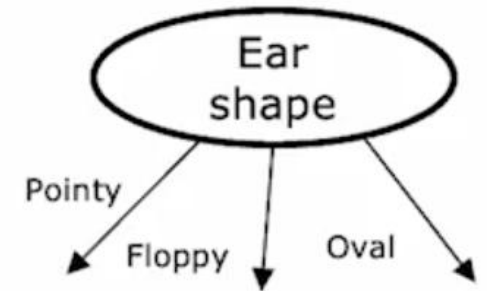


DECISION TREE LEARNING










○ Features with three possible values

	Ear shape (x_1)	Face shape (x_2)	Whiskers (x_3)	Cat (y)
	Pointy	Round	Present	1
	Oval	Not round	Present	1
	Oval	Round	Absent	0
	Pointy	Not round	Present	0
	Oval	Round	Present	1
	Pointy	Round	Absent	1
	Floppy	Not round	Absent	0
	Oval	Round	Absent	1
	Floppy	Round	Absent	0
	Floppy	Round	Absent	0













One hot Encoding

	Ear shape	Pointy ears	Floppy ears	Oval ears	Face shape	Whiskers	Cat
	Pointy				Round	Present	1
	Oval				Not round	Present	1
	Oval				Round	Absent	0
	Pointy				Not round	Present	0
	Oval				Round	Present	1
	Pointy				Round	Absent	1
	Floppy				Not round	Absent	0
	Oval				Round	Absent	1
	Floppy				Round	Absent	0
	Floppy				Round	Absent	0



One hot Encoding

Ear-shape		Pointy ears	Floppy ears	Oval ears	Face shape	Whiskers	Cat
	Pointy	1	0	0	Round	Present	1
	Oval	0	0	1	Not round	Present	1
	Oval	0	0	1	Round	Absent	0
	Pointy	1	0	0	Not round	Present	0
	Oval	0	0	1	Round	Present	1
	Pointy	1	0	0	Round	Absent	1
	Floppy	0	1	0	Not round	Absent	0
	Oval	0	0	1	Round	Absent	1
	Floppy	0	1	0	Round	Absent	0
	Floppy	0	1	0	Round	Absent	0













○ One hot Encoding

- If a categorical feature can take on k values, create k binary features (0 or 1 valued).

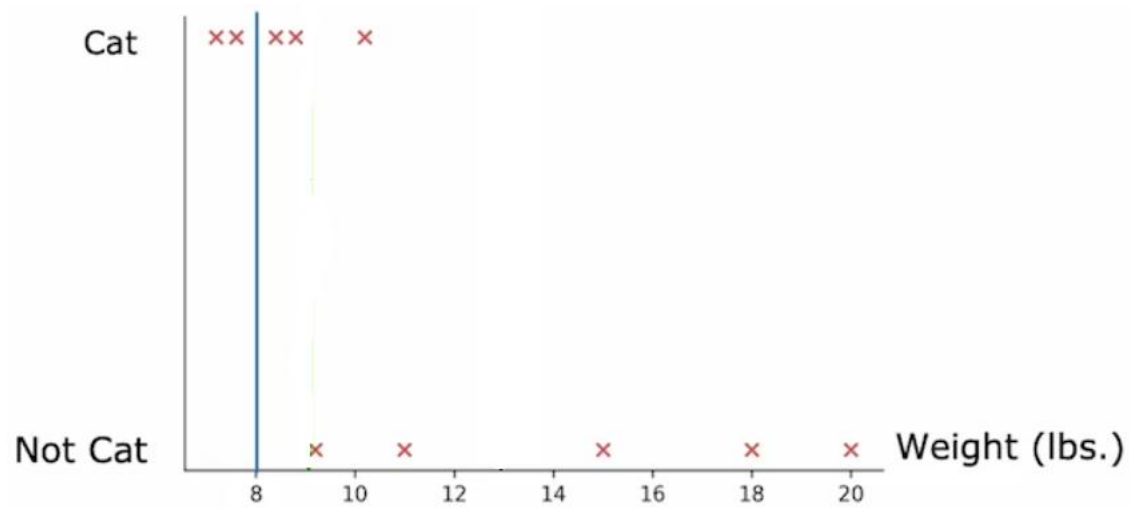


Continues features

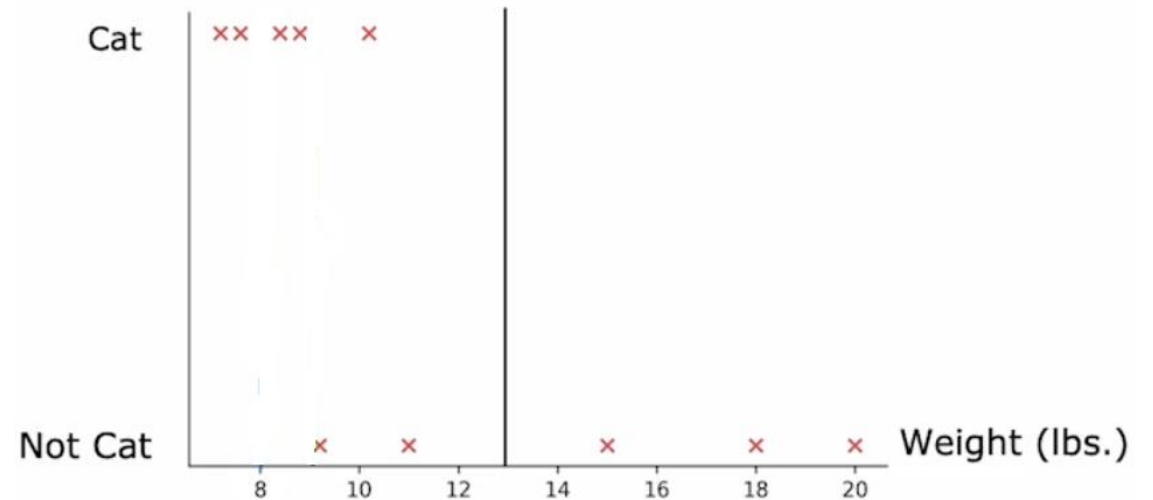
	Ear shape	Face shape	Whiskers	Weight (lbs.)	Cat
	Pointy	Round	Present	7.2	1
	Floppy	Not round	Present	8.8	1
	Floppy	Round	Absent	15	0
	Pointy	Not round	Present	9.2	0
	Pointy	Round	Present	8.4	1
	Pointy	Round	Absent	7.6	1
	Floppy	Not round	Absent	11	0
	Pointy	Round	Absent	10.2	1
	Floppy	Round	Absent	18	0
	Floppy	Round	Absent	20	0



○ Splitting on a continuous variable



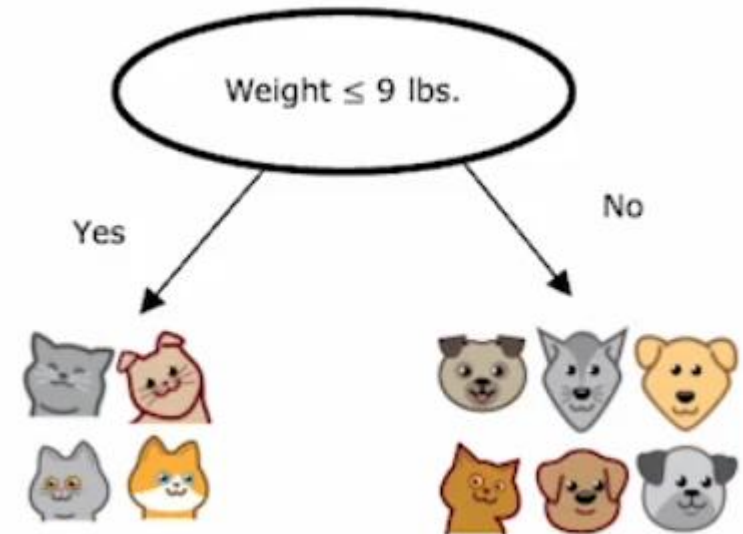
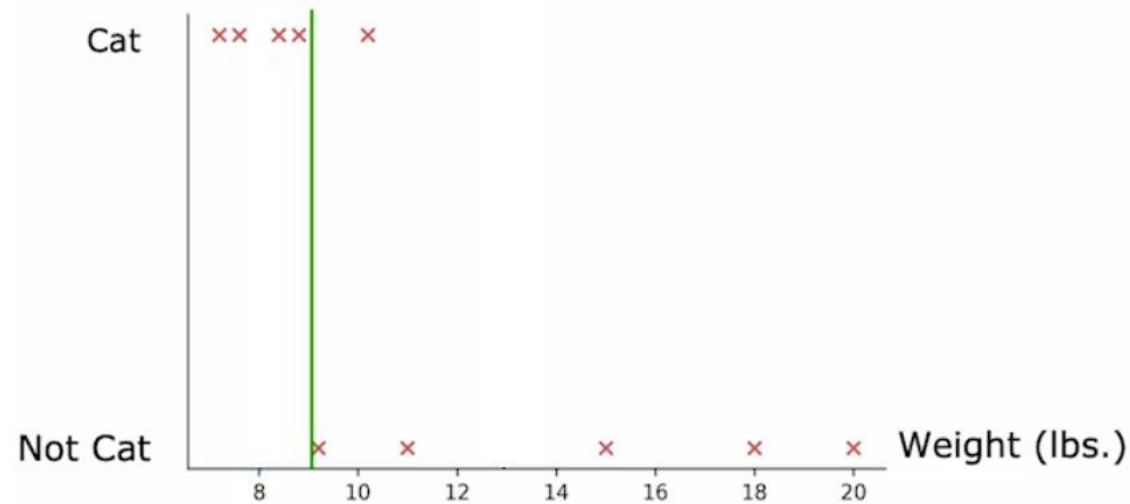
$$H(0.5) - \left(\frac{2}{10} H\left(\frac{2}{2}\right) + \frac{8}{10} H\left(\frac{3}{8}\right) \right) = 0.24$$



$$H(0.5) - \left(\frac{7}{10} H\left(\frac{5}{7}\right) + \frac{3}{10} H\left(\frac{0}{3}\right) \right) = 0.40$$













○ Splitting on a continuous variable



$$H(0.5) - \left(\frac{4}{10} H\left(\frac{4}{10}\right) + \frac{6}{10} H\left(\frac{6}{10}\right) \right) = 0.61$$

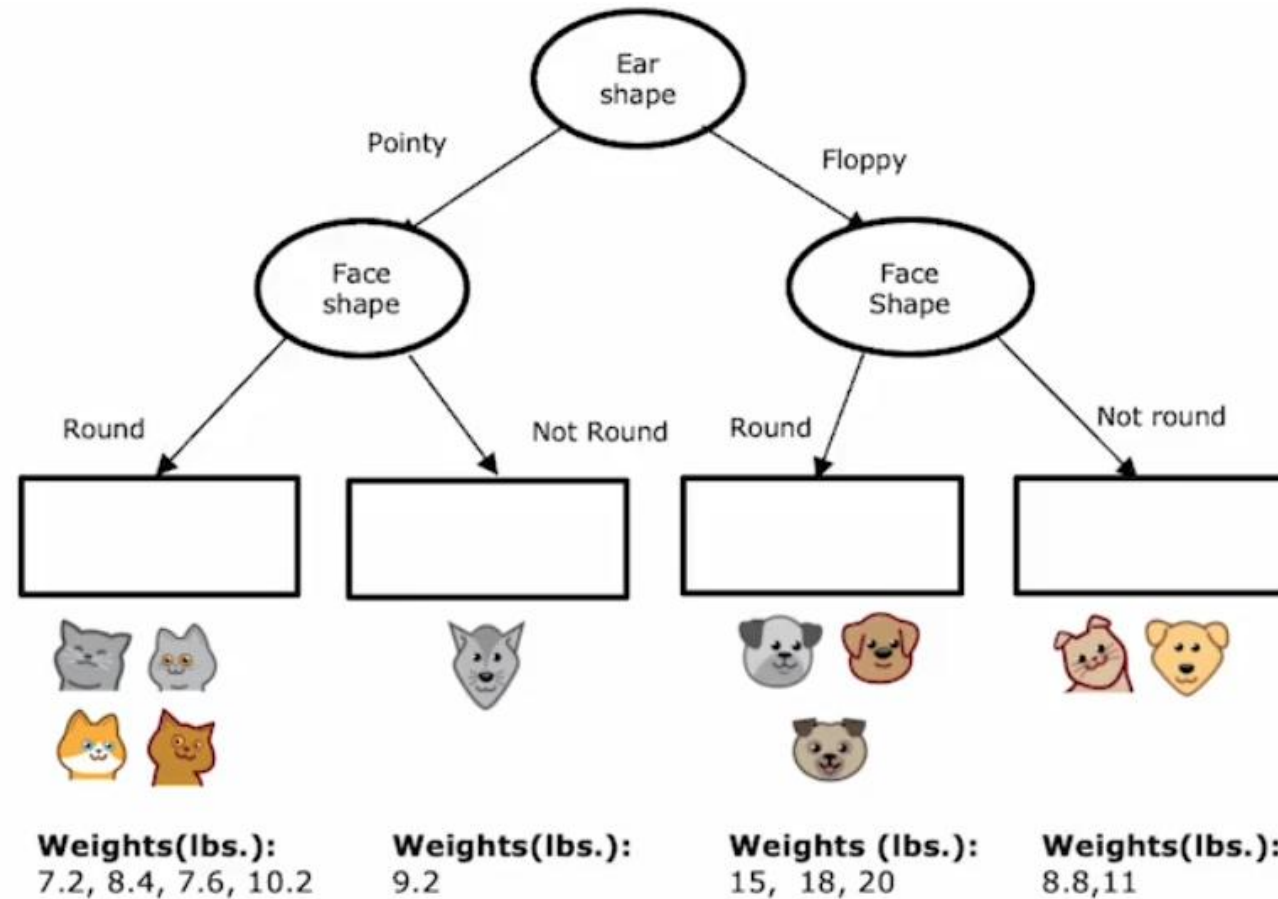


○ Regression with Decision Trees: Predicting a number

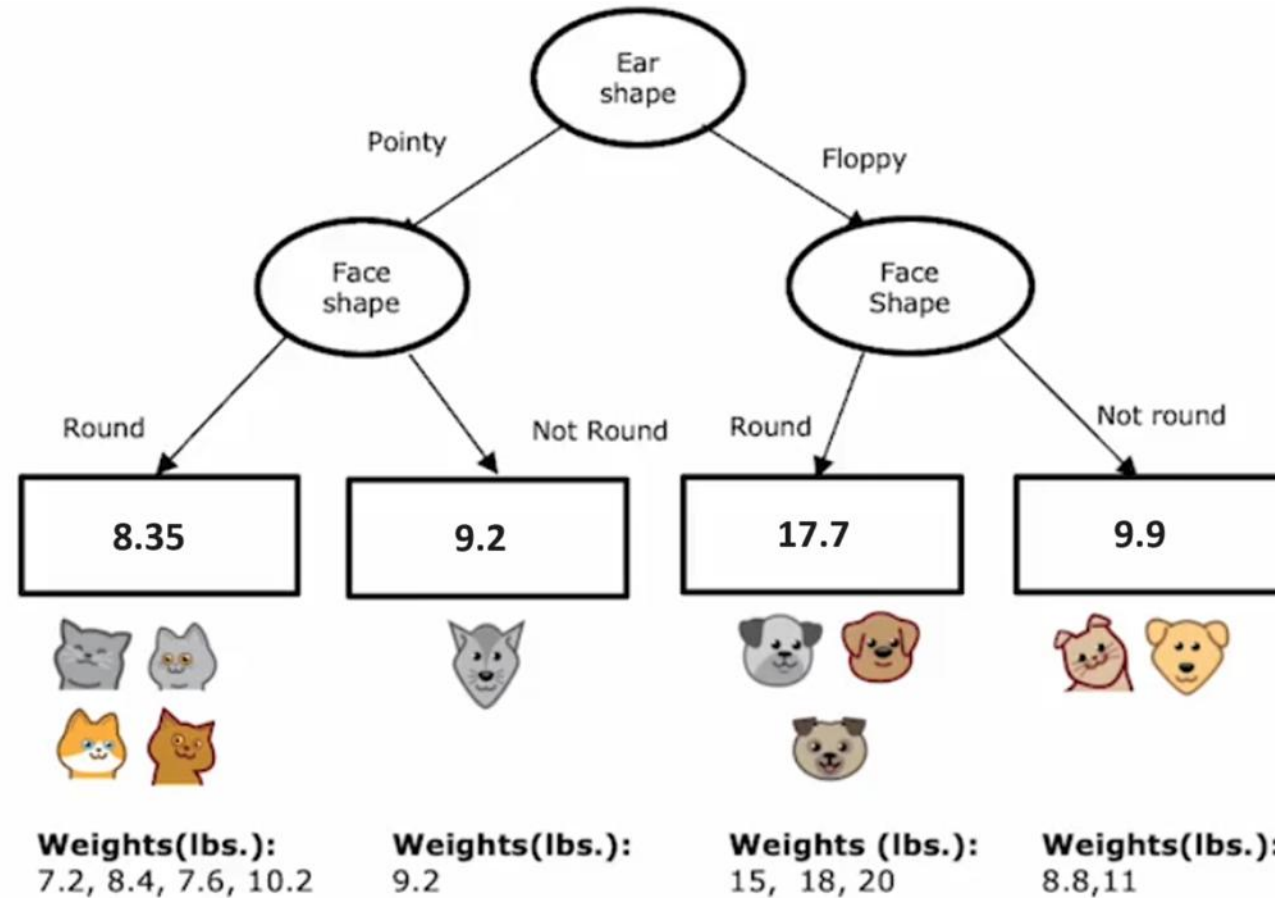
	Ear shape	Face shape	Whiskers	Weight (lbs.)
	Pointy	Round	Present	7.2
	Floppy	Not round	Present	8.8
	Floppy	Round	Absent	15
	Pointy	Not round	Present	9.2
	Pointy	Round	Present	8.4
	Pointy	Round	Absent	7.6
	Floppy	Not round	Absent	11
	Pointy	Round	Absent	10.2
	Floppy	Round	Absent	18
	Floppy	Round	Absent	20



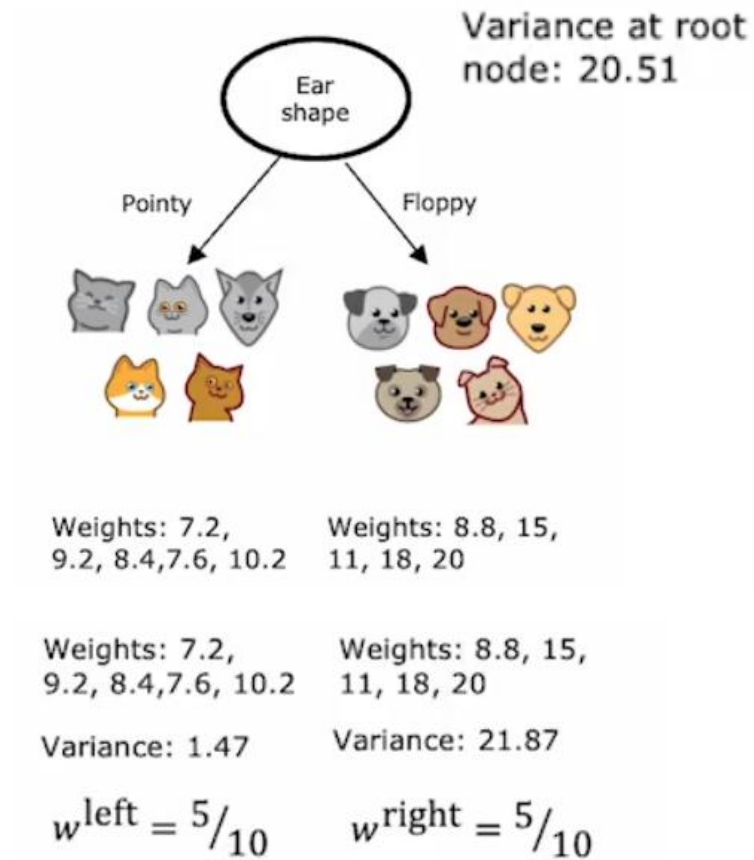
Regression with Decision Trees



Regression with Decision Trees

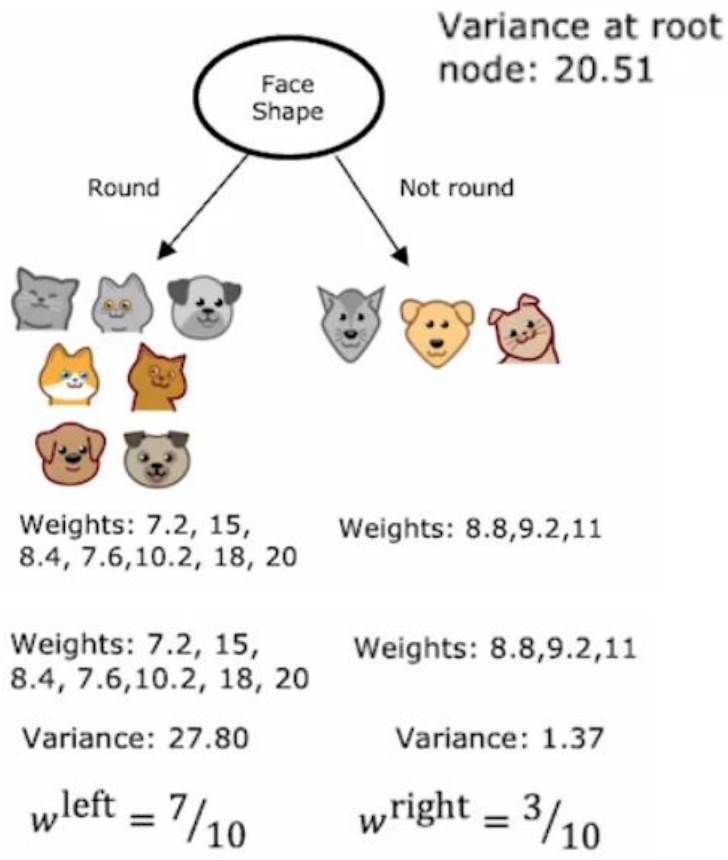


Choosing a Split



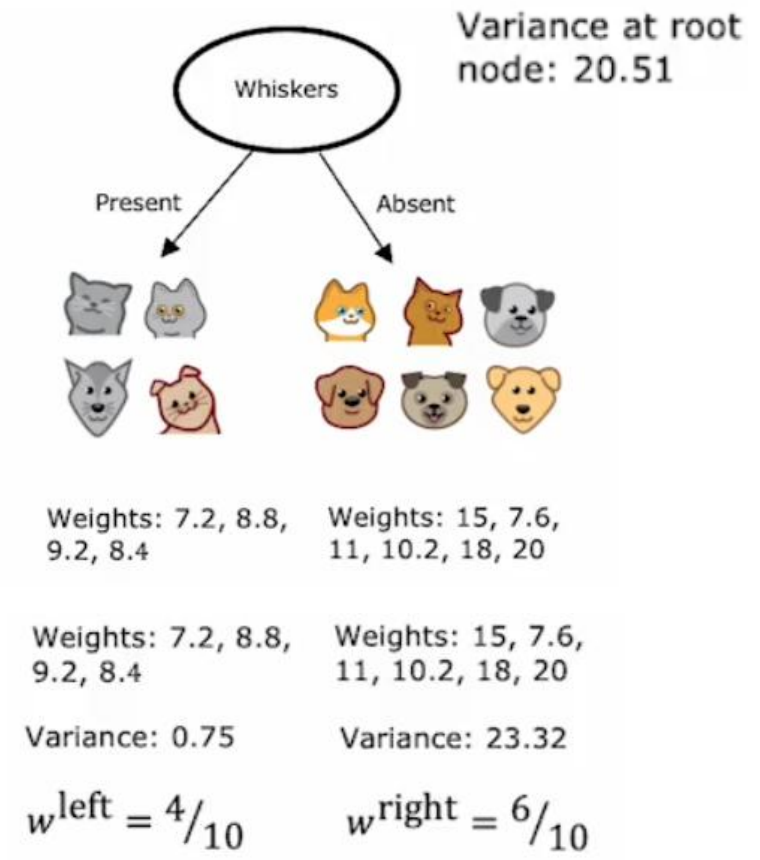
$$20.51 - \left(\frac{5}{10} * 1.47 + \frac{5}{10} * 21.87 \right)$$

$$= 8.84$$



$$20.51 - \left(\frac{7}{10} * 27.80 + \frac{3}{10} * 1.37 \right)$$

$$= 0.64$$



$$20.51 - \left(\frac{4}{10} * 0.75 + \frac{6}{10} * 23.32 \right)$$

$$= 6.22$$