

HW 3-P

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Question 1

Root node (Level 0)

Attribute number: 1

A_{True} = 21

B_{True} = 88

A_{False} = 51

B_{False} = 40

True Probability = 0.545

False Probability = 0.455

True Entropy = 0.7070040649747601

False Entropy = 0.9894340222202263

Remainder A = 0.8355096955214472

Entropy Attribute = 0.9426831892554922

Attribute number: 2

A_{True} = 55

B_{True} = 60

A_{False} = 17

B_{False} = 68

True Probability = 0.575

False Probability = 0.425

True Entropy = 0.9986359641585718

False Entropy = 0.7219280948873623

Remainder A = 0.8810351197183077

Entropy Attribute = 0.9426831892554922

Attribute number: 3

A_{True} = 48

BTrue = 86
AFalse = 24
BFalse = 42
True Probability = 0.67
False Probability = 0.33
True Entropy = 0.9411864371816835
False Entropy = 0.9456603046006402
Remainder A = 0.9426628134299393
Entropy Attribute = 0.9426831892554922

Attribute number: 4

ATrue = 48
BTrue = 12
AFalse = 24
BFalse = 116
True Probability = 0.3
False Probability = 0.7
True Entropy = 0.7219280948873623
False Entropy = 0.6609623351442085
Remainder A = 0.6792520630671547
Entropy Attribute = 0.9426831892554922

Attribute number: 5

ATrue = 18
BTrue = 99
AFalse = 54
BFalse = 29
True Probability = 0.585
False Probability = 0.415
True Entropy = 0.6193821946787638
False Entropy = 0.9335289015212996
Remainder A = 0.7497530780184161
Entropy Attribute = 0.9426831892554922

Attribute number: 6

ATrue = 18
BTrue = 69
AFalse = 54
BFalse = 59

True Probability = 0.435
False Probability = 0.565
True Entropy = 0.7355085815538398
False Entropy = 0.9985872364932767
Remainder A = 0.8841480215946216
Entropy Attribute = 0.9426831892554922

Attribute number: 7

ATrue = 61
BTrue = 44
AFalse = 11
BFalse = 84
True Probability = 0.525
False Probability = 0.475
True Entropy = 0.9810077194625308
False Entropy = 0.5171354891896202
Remainder A = 0.7606684100828983
Entropy Attribute = 0.9426831892554922

Attribute number: 8

ATrue = 65
BTrue = 102
AFalse = 7
BFalse = 26
True Probability = 0.835
False Probability = 0.165
True Entropy = 0.9642953539833812
False Entropy = 0.7455178428108287
Remainder A = 0.9281970646399099
Entropy Attribute = 0.9426831892554922

A count = 72 B count = 128
Information gain = [0.10717349373404506, 0.06164806953718449, 2.0375825552920723e-05, 0.2634311261883375, 0.19293011123707615, 0.058535167660870635, 0.1820147791725939, 0.014486124615582296]
Maximum of information gain = 0.2634311261883375

4 th attribute will be the root node which is nothin but level 0.

True node split (Level 1)

Attribute number: 1

ATrue = 15

BTrue = 9

AFalse = 33

BFalse = 3

True Probability = 0.4

False Probability = 0.6

True Entropy = 0.9544340029249649

False Entropy = 0.41381685030363374

Remainder A = 0.6300637113521662

Entropy Attribute = 0.7219280948873623

Attribute number: 2

ATrue = 37

BTrue = 4

AFalse = 11

BFalse = 8

True Probability = 0.6833333333333333

False Probability = 0.31666666666666665

True Entropy = 0.4612160405139095

False Entropy = 0.9819407868640977

Remainder A = 0.6261122101914691

Entropy Attribute = 0.7219280948873623

Attribute number: 3

ATrue = 34

BTrue = 6

AFalse = 14

BFalse = 6

True Probability = 0.6666666666666666

False Probability = 0.3333333333333333

True Entropy = 0.6098403047164004

False Entropy = 0.8812908992306927

Remainder A = 0.7003238362211645

Entropy Attribute = 0.7219280948873623

Attribute number: 5

ATrue = 11
BTrue = 9
AFalse = 37
BFalse = 3
True Probability = 0.3333333333333333
False Probability = 0.6666666666666666
True Entropy = 0.9927744539878084
False Entropy = 0.38431154412649704
Remainder A = 0.5871325140802675
Entropy Attribute = 0.7219280948873623

Attribute number: 6

ATrue = 8
BTrue = 9
AFalse = 40
BFalse = 3
True Probability = 0.2833333333333333
False Probability = 0.7166666666666667
True Entropy = 0.9975025463691153
False Entropy = 0.3650551896402848
Remainder A = 0.54424860738012
Entropy Attribute = 0.7219280948873623

Attribute number: 7

ATrue = 41
BTrue = 4
AFalse = 7
BFalse = 8
True Probability = 0.75
False Probability = 0.25
True Entropy = 0.4327501587887541
False Entropy = 0.9967916319816366
Remainder A = 0.5737605270869748
Entropy Attribute = 0.7219280948873623

Attribute number: 8

ATrue = 45
BTrue = 11
AFalse = 3
BFalse = 1
True Probability = 0.9333333333333333
False Probability = 0.06666666666666667
True Entropy = 0.7147274731317892
False Entropy = 0.8112781244591328
Remainder A = 0.7211641832202788
Entropy Attribute = 0.7219280948873623

A True count = 48 B True count = 12
Information gain = [0.10717349373404506, 0.06164806953718449, 2.0375825552920723e-05, 0.2634311261883375, 0.19293011123707615, 0.058535167660870635, 0.1820147791725939, 0.014486124615582296]
Maximum of information gain = 0.17767948750724227

6 th attribute will be the node of True split of the root node which will be at level 2.

False node split (Level 1)

Attribute number: 1

ATrue = 6
BTrue = 79
AFalse = 18
BFalse = 37
True Probability = 0.6071428571428571
False Probability = 0.39285714285714285
True Entropy = 0.3681150054280774
False Entropy = 0.9121156307204276
Remainder A = 0.5818295367929293
Entropy Attribute = 0.6609623351442085

Attribute number: 2

ATrue = 18
BTrue = 56
AFalse = 6

BFalse = 60
True Probability = 0.5285714285714286
False Probability = 0.4714285714285714
True Entropy = 0.8003922080453356
False Entropy = 0.4394969869215134
Remainder A = 0.6302558895155337
Entropy Attribute = 0.6609623351442085

Attribute number: 3

ATrue = 14
BTrue = 80
AFalse = 10
BFalse = 36
True Probability = 0.6714285714285714
False Probability = 0.32857142857142857
True Entropy = 0.6071716548713029
False Entropy = 0.7553754125614288
Remainder A = 0.6558671752552013
Entropy Attribute = 0.6609623351442085

Attribute number: 5

ATrue = 7
BTrue = 90
AFalse = 17
BFalse = 26
True Probability = 0.6928571428571428
False Probability = 0.30714285714285716
True Entropy = 0.37395136668121065
False Entropy = 0.9681647320759548
Remainder A = 0.5564597574810249
Entropy Attribute = 0.6609623351442085

Attribute number: 6

ATrue = 10
BTrue = 60
AFalse = 14
BFalse = 56
True Probability = 0.5
False Probability = 0.5

True Entropy = 0.5916727785823275
False Entropy = 0.7219280948873623
Remainder A = 0.6568004367348449
Entropy Attribute = 0.6609623351442085

Attribute number: 7

ATrue = 20
BTrue = 40
AFalse = 4
BFalse = 76
True Probability = 0.42857142857142855
False Probability = 0.5714285714285714
True Entropy = 0.9182958340544896
False Entropy = 0.28639695711595625
Remainder A = 0.5572107615181847
Entropy Attribute = 0.6609623351442085

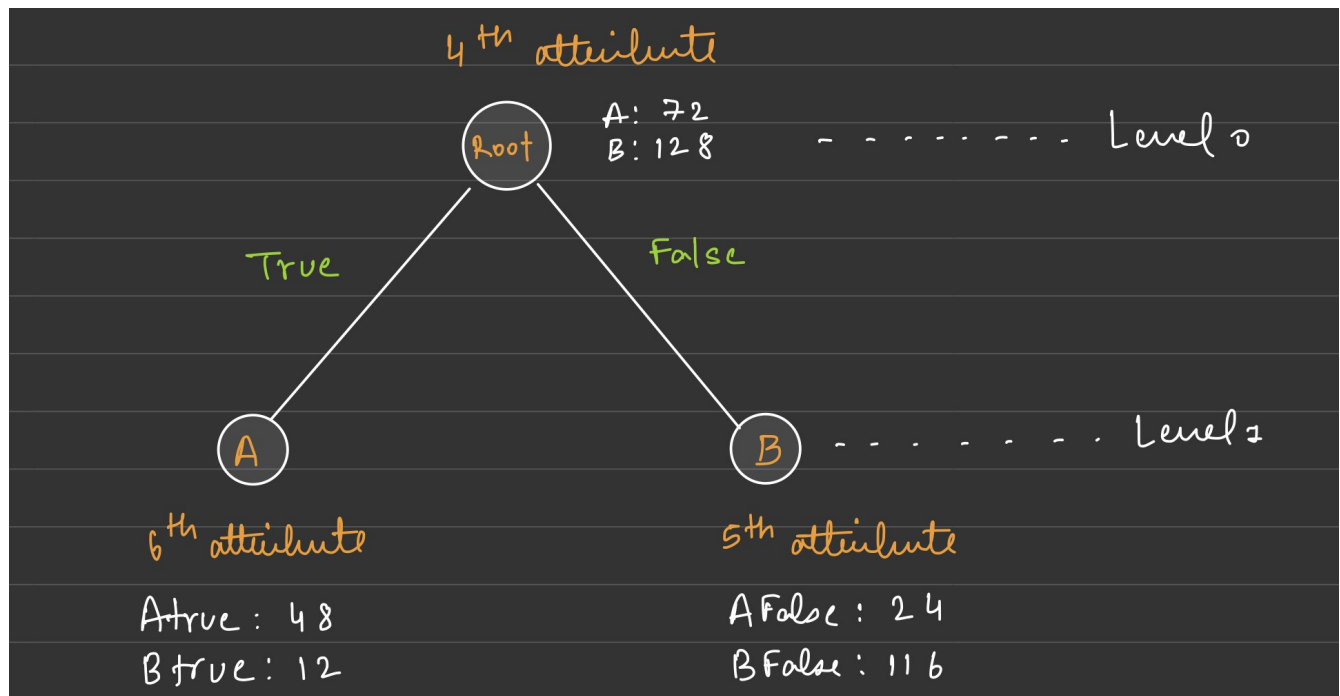
Attribute number: 8

ATrue = 20
BTrue = 91
AFalse = 4
BFalse = 25
True Probability = 0.7928571428571428
False Probability = 0.20714285714285716
True Entropy = 0.680471054135434
False Entropy = 0.5787946246321198
Remainder A = 0.6594095080240332
Entropy Attribute = 0.6609623351442085

A False count = 24 B False count = 116
Information gain = [0.10717349373404506, 0.06164806953718449, 2.0375825552920723e-05, 0.2634311261883375, 0.19293011123707615, 0.058535167660870635, 0.1820147791725939, 0.014486124615582296]
Maximum of information gain = 0.1045025776631836

5 th attribute will be the node of False split of the root node which will be at level 2.

Question 2



As we can see above, 4th Attribute becomes the first stump of our decision tree. First stump is nothing but the root of our decision tree.

Consider two splits (True split, False split) for our root node.

Node A (A True count = 48 B True count = 12) will be the node of True split as A True count is maximum for that split.

Node B (A False count = 24 B False count = 116) will be the node of False split as B False count is maximum for that split.

3. Initial weight

There are altogether 200 data samples provided.

Initial weight = $1/200$
= **0.005**

1. Error rate for first stump

$$\begin{aligned}\text{Error} &= \text{Incorrect number data of A} * \text{Initial weight} + \text{Incorrect number data of B} * \text{Initial weight} \\ &= 12 * 0.005 + 24 * 0.005 \\ &= \mathbf{0.18}\end{aligned}$$

2. Hypothesis weight

$$\begin{aligned}\text{Hypothesis weight} &= \ln((1 - \text{error}) / \text{error}) \\ &= \ln((1 - 0.18) / 0.18) \\ &= \mathbf{1.52}\end{aligned}$$

4. New weights of each example correctly classified

Incorrectly classified weight remains unchanged and it is nothing but the initial weight.

$$\text{Incorrectly classified weight} = \text{Initial weight} = \mathbf{0.005}$$

$$\begin{aligned}\text{Correctly classified weight} &= \text{Initial weight} * (\text{error} / (1 - \text{error})) \\ &= 0.005 * (0.18 / (1 - 0.18)) \\ &= \mathbf{0.0010975}\end{aligned}$$