

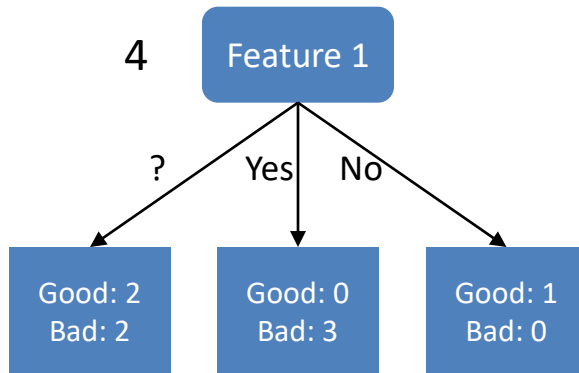


# Decision Tree

**Industrial AI Lab.**  
**Prof. Seungchul Lee**

# Feature Test

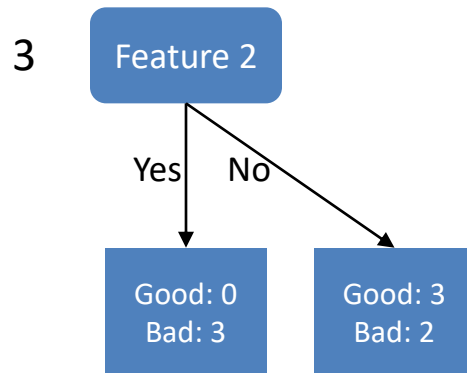
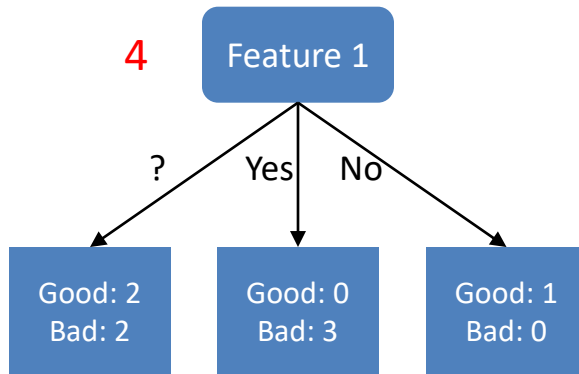
- Feature test in the first level



Feature 1	Feature 2	Feature 3	Feature 4	output
?	Yes	Low	Medium	Bad
Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
?	No	Medium	Low	Good
Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

# Feature Test

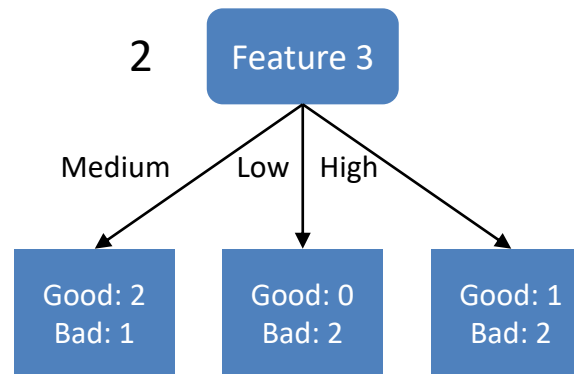
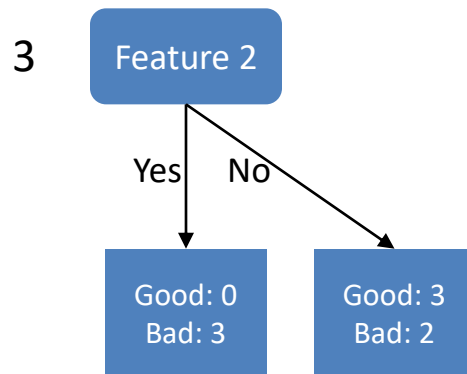
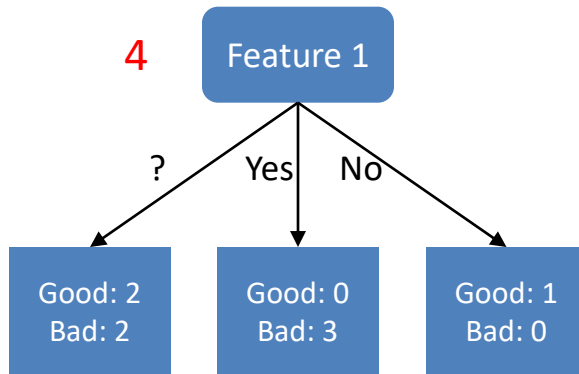
- Homogeneous set in the first level



Feature 1	Feature 2	Feature 3	Feature 4	output
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Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
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Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
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# Feature Test

- Homogeneous set in the first level

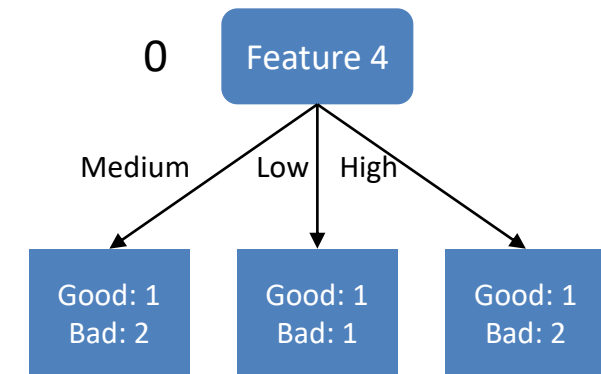
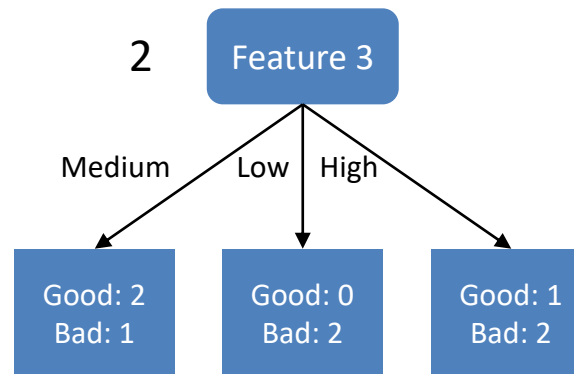
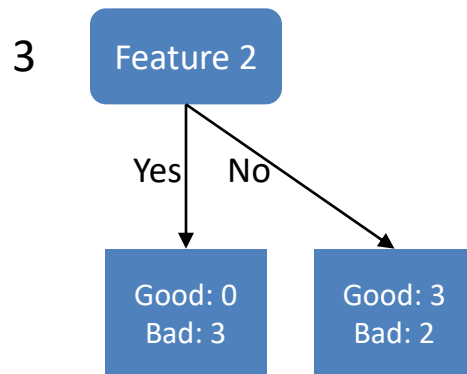
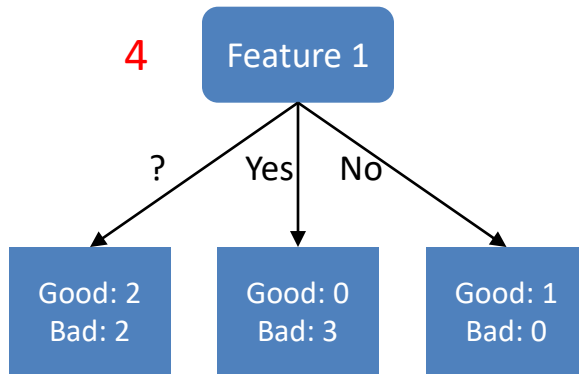


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Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
?	No	Medium	Low	Good
Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

# Feature Test

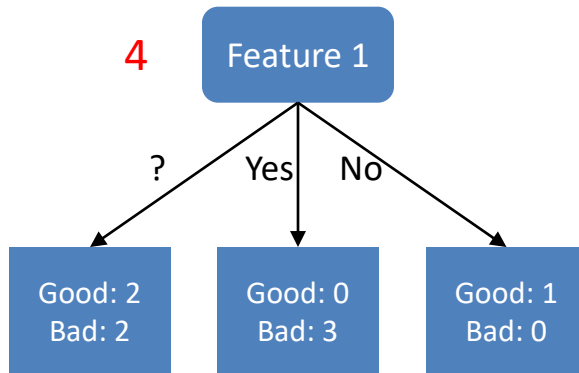
- Homogeneous set in the first level

Feature 1	Feature 2	Feature 3	Feature 4	output
?	Yes	Low	Medium	Bad
Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
?	No	Medium	Low	Good
Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad



# Feature Test

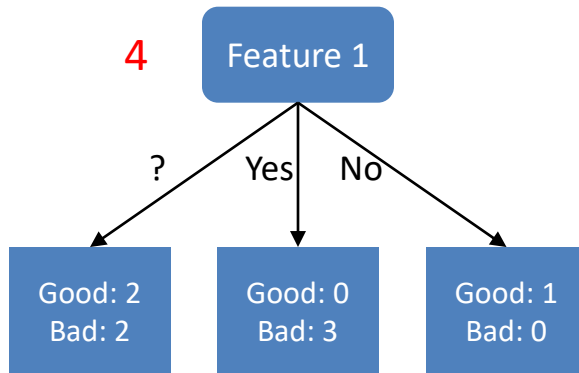
- Homogeneous set in the first level



Feature 1	Feature 2	Feature 3	Feature 4	output
?	Yes	Low	Medium	Bad
Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
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Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

# Feature Test

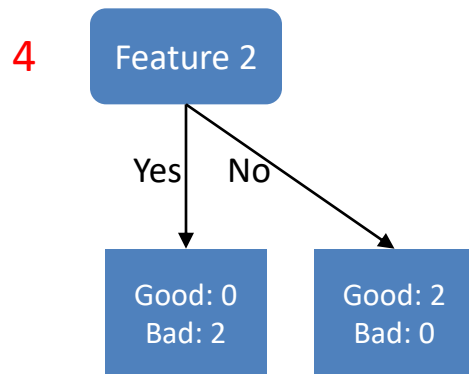
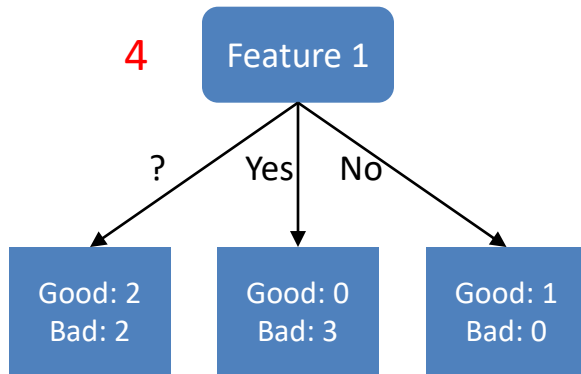
- Homogeneous set in the second level



Feature 1	Feature 2	Feature 3	Feature 4	output
?	Yes	Low	Medium	Bad
Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
?	No	Medium	Low	Good
Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

# Feature Test

- Homogeneous set in the second level

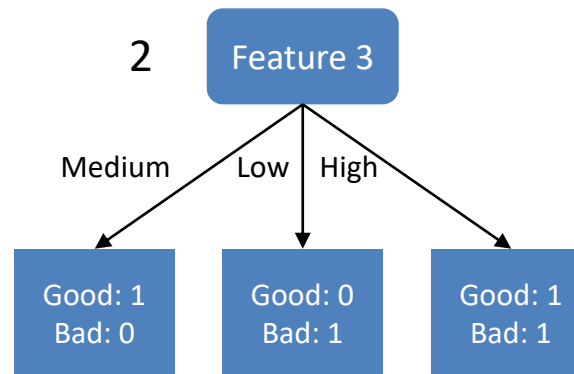
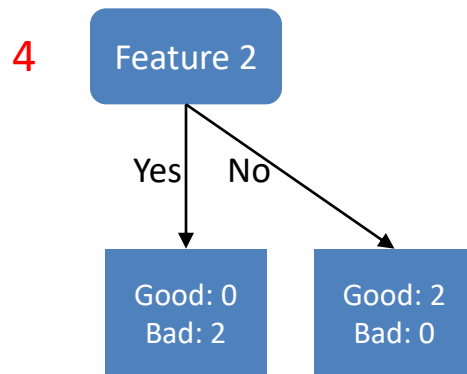
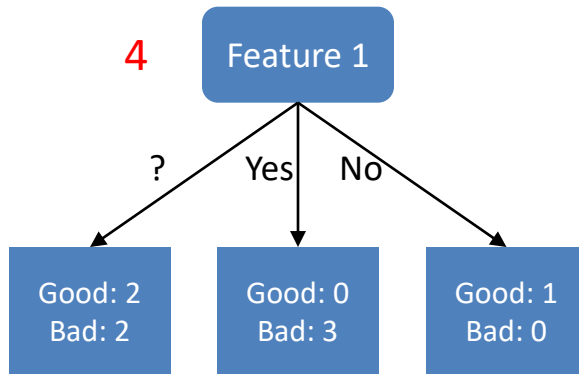


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?	No	High	Medium	Good
No	No	Medium	High	Good
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Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
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# Feature Test

- Homogeneous set in the second level

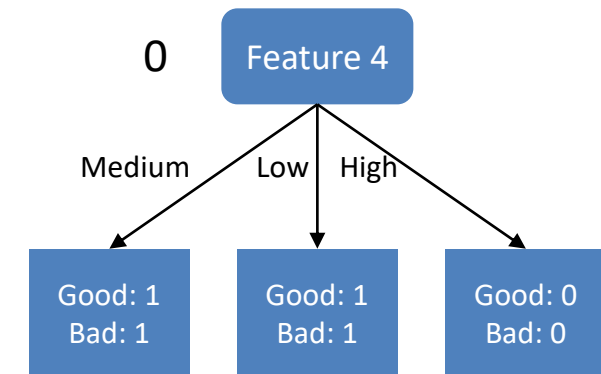
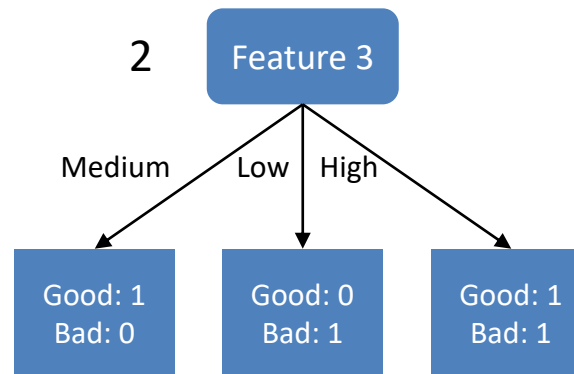
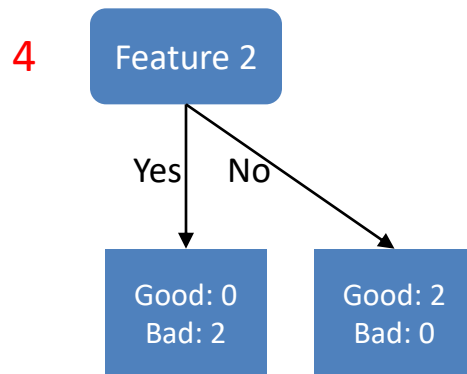
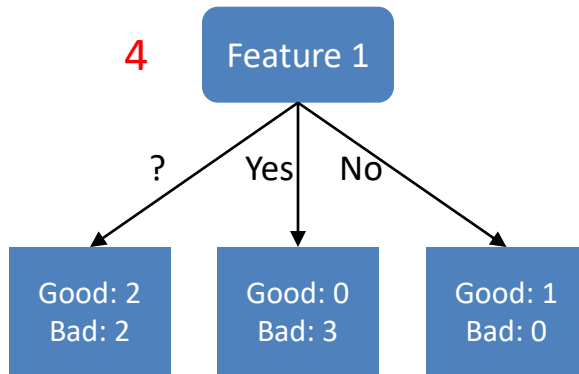


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Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

# Feature Test

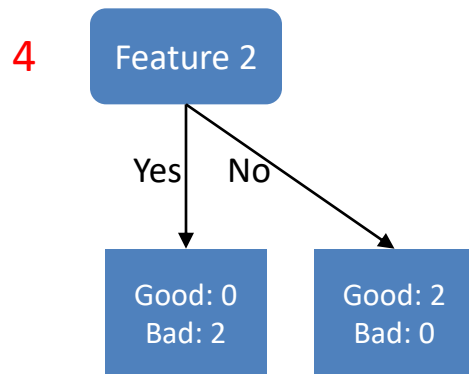
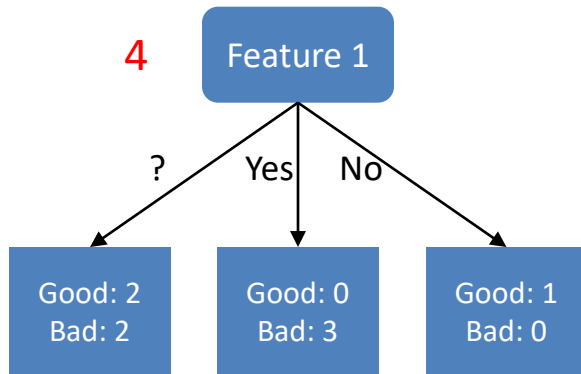
- Homogeneous set in the second level

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# Feature Test

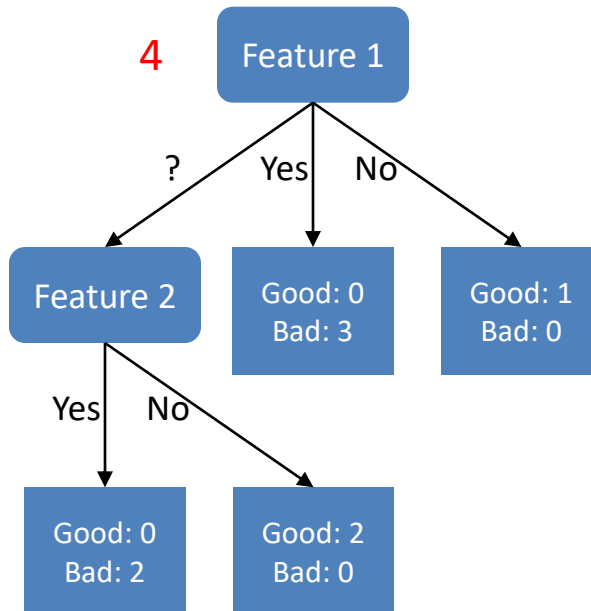
- Homogeneous set in the second level



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?	Yes	Low	Medium	Bad
Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
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Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

# Feature Test

- Decision tree



Feature 1	Feature 2	Feature 3	Feature 4	output
?	Yes	Low	Medium	Bad
Yes	Yes	High	Medium	Bad
?	No	High	Medium	Good
No	No	Medium	High	Good
?	No	Medium	Low	Good
Yes	No	Low	High	Bad
Yes	No	Medium	High	Bad
?	Yes	High	Low	Bad

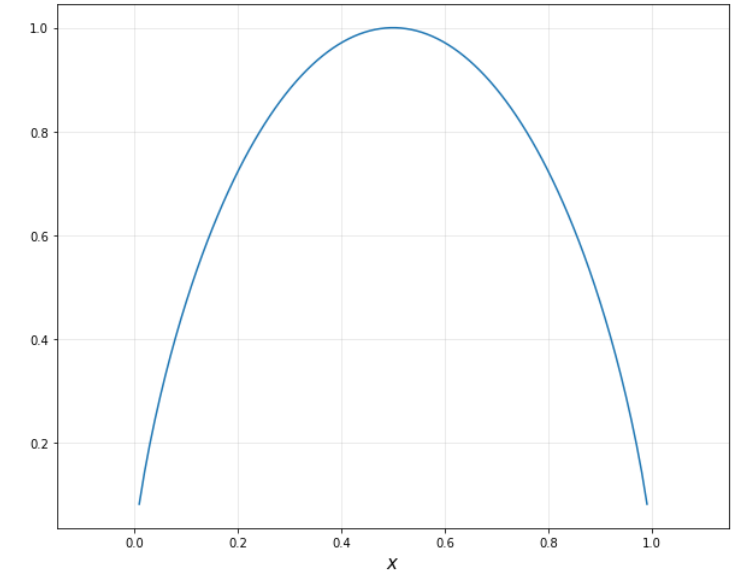
- Issue: a large data set will be most likely to produce zero homogeneous set

# Disorder

- Disorder of single set

$$D = -x \log_2 x - (1 - x) \log_2 (1 - x)$$

$$D = -\frac{G}{T} \log_2 \frac{G}{T} - \frac{B}{T} \log_2 \frac{B}{T}$$



# Quality of Test

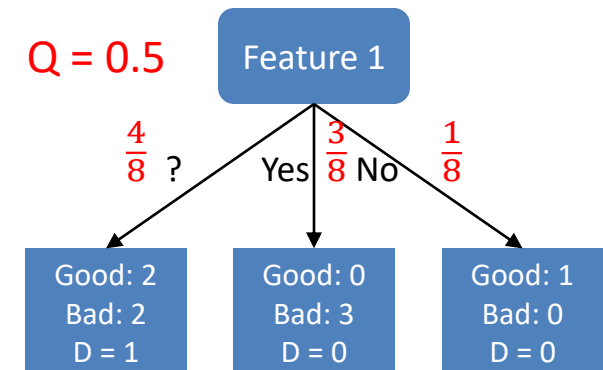
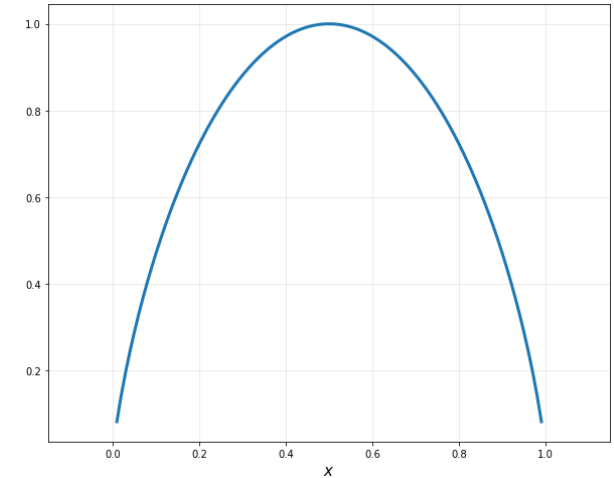
- Disorder of single set

$$D = -x \log_2 x - (1 - x) \log_2 (1 - x)$$

$$D = -\frac{G}{T} \log_2 \frac{G}{T} - \frac{B}{T} \log_2 \frac{B}{T}$$

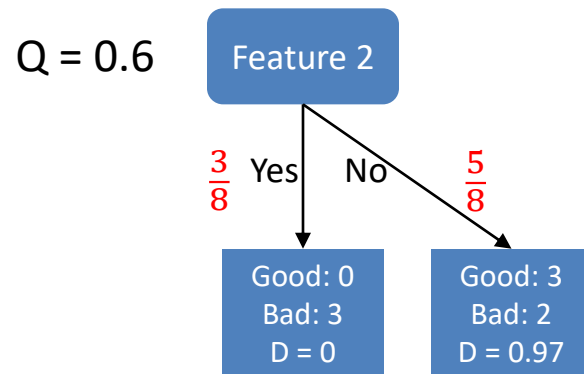
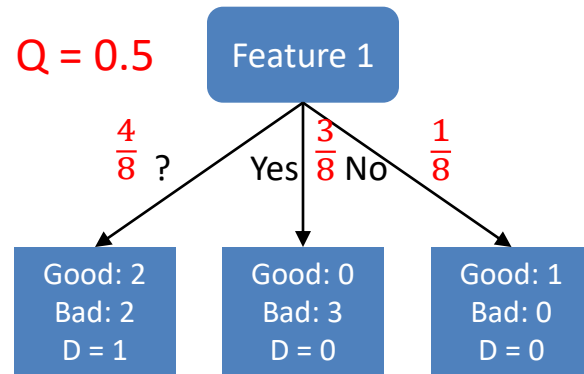
- Quality of test

$$Q(\text{test}) = \sum D(\text{set}) \times \frac{\# \text{ of samples in set}}{\# \text{ of samples in all sets}}$$



# Quality

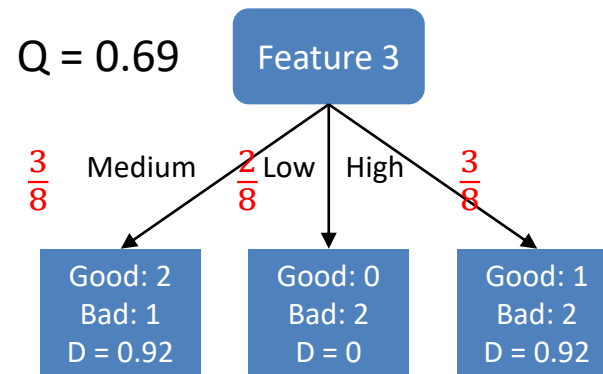
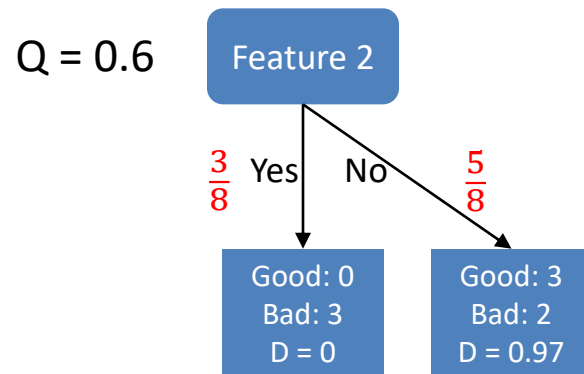
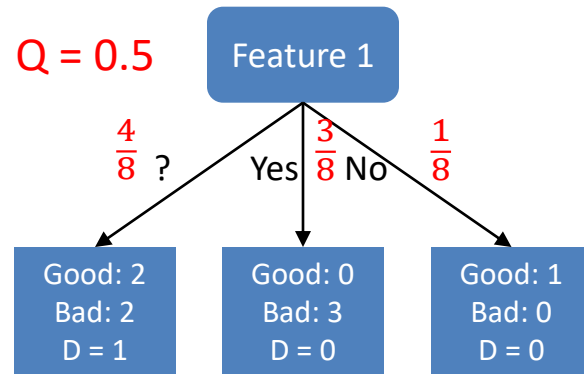
- Quality of test in the first level



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- Quality of test in the first level



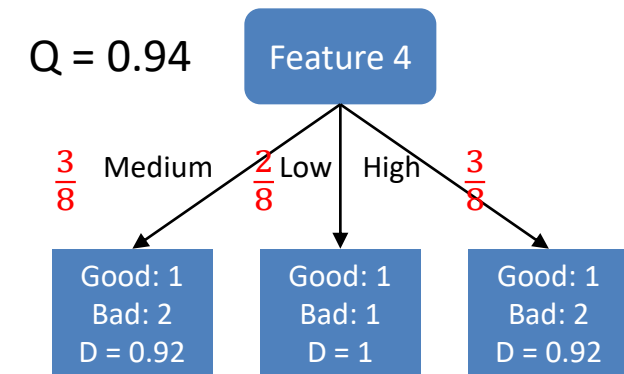
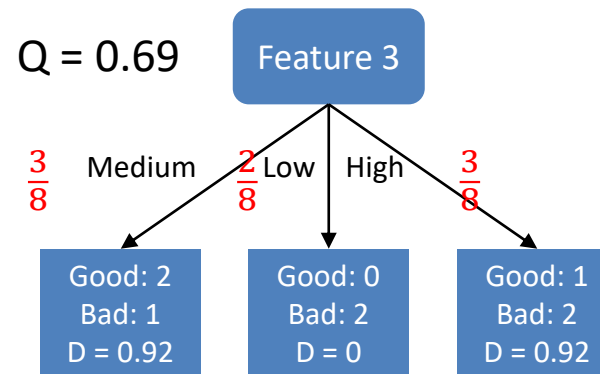
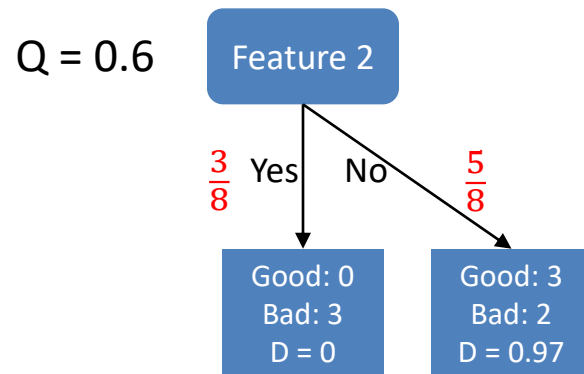
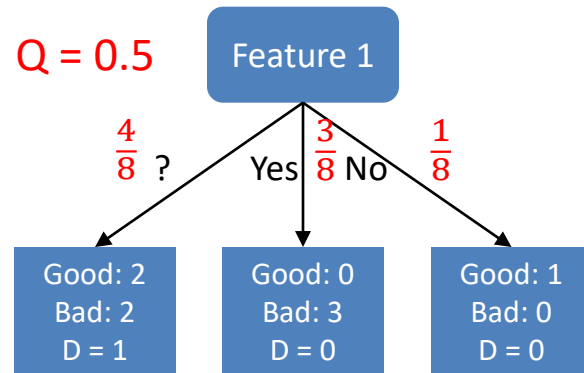
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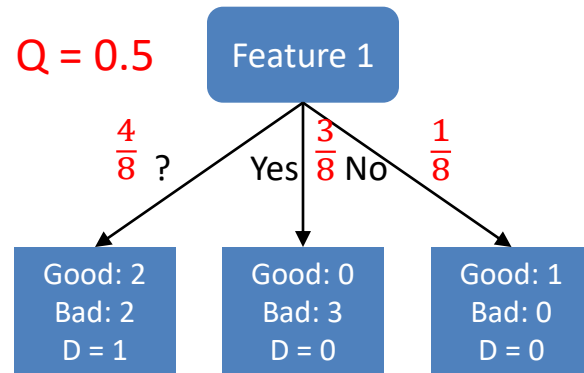
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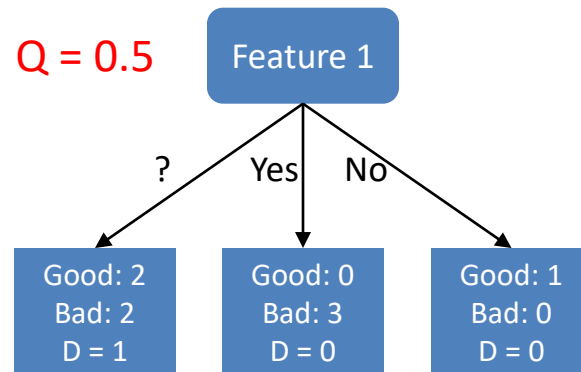
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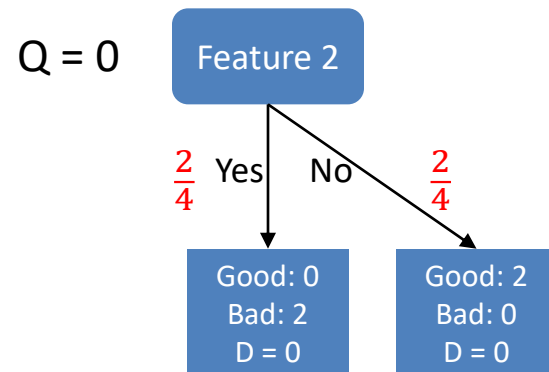
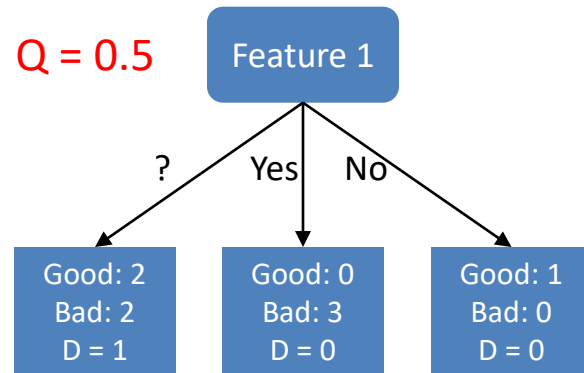
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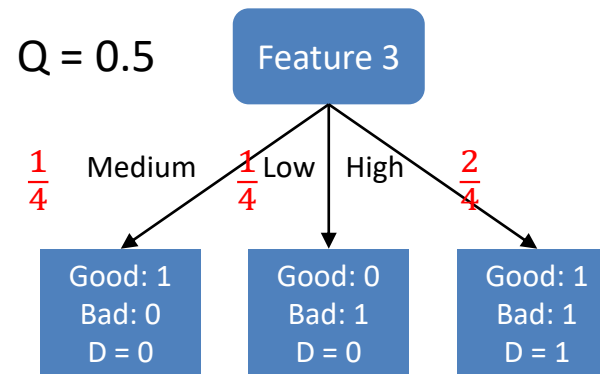
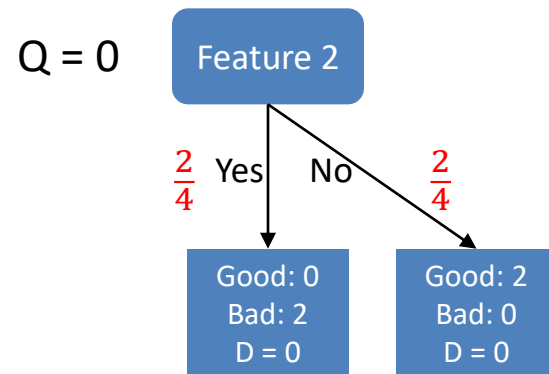
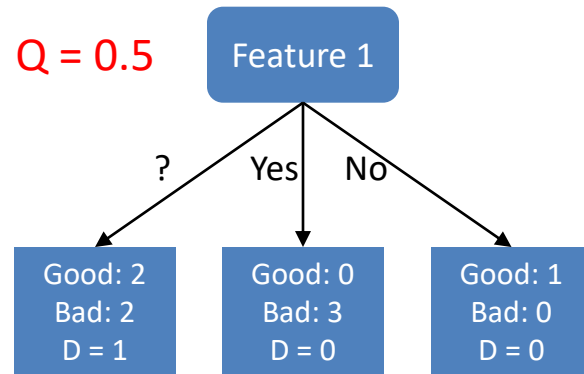
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