**Necessary Formulas:**

1. Gini Index, G= 1 –∑ pi2 |;i = 1 to k, where k = number of classes.
2. Average Gini Index, GNew = 1 – (1/N) ∑ Vij2/Sj |;

i = 1 to k, where k = number of classes and

j = 1 to n, where n = number of unique values for an attribute

1. Reduction in Gini Index, Rg = GStart – GNew

**Iteration 1 (For Selecting the Root Node)**

There are 4 instances with classification 1, 5 instances with classification 2 and 15 instances with classification 3. So, p1 = (4/24), p2 = (5/24) and p3 = (15/24).

***GStart = 1 – (p12 + p22 + p32)***

***= 1 – ((4/24)2 + (5/24)2 + (15/24)2)***

***= 0.5382***

Now, we need to calculate GNew for each of the attributes.

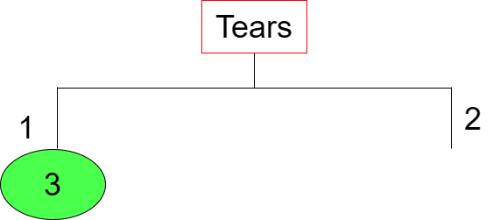
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| **Frequency Table for Age**   |  |  |  |  | | --- | --- | --- | --- | |  | Age = 1 | Age = 2 | Age = 3 | | Class 1 | 2 | 1 | 1 | | Class 2 | 2 | 2 | 1 | | Class 3 | 4 | 5 | 6 | | Sum | 8 | 8 | 8 | | |  |  |  | | --- | --- | --- | | Age = 1 | : | (22 + 22 + 42)/8 = 3 | | Age = 2 | : | (12 + 22 + 52)/8 = 3.75 | | Age = 3 | : | (12 + 12 + 62)/8 = 4.75 | |  |  |  | | GNew (Age) | = | 1 – (3 + 3.75 + 4.75)/24 | |  | = | 0.5208 | |
| **Frequency Table for SpecRx**   |  |  |  | | --- | --- | --- | |  | SpecRx = 1 | SpecRx = 2 | | Class 1 | 3 | 1 | | Class 2 | 2 | 3 | | Class 3 | 7 | 8 | | Sum | 12 | 12 | | |  |  |  | | --- | --- | --- | | SpecRx = 1 | : | (32 + 22 + 72)/12 = 5.1667 | | SpecRx = 2 | : | (12 + 32 + 82)/12 = 6.1667 | |  |  |  | | GNew (SpecRx) | = | 1 – (5.1667 + 6.1667)/24 | |  | = | 0.5278 | |
| **Frequency Table for Astig**   |  |  |  | | --- | --- | --- | |  | Astig = 1 | Astig = 2 | | Class 1 | 0 | 4 | | Class 2 | 5 | 0 | | Class 3 | 7 | 8 | | Sum | 12 | 12 | | |  |  |  | | --- | --- | --- | | Astig = 1 | : | (02 + 52 + 72)/12 = 6.1667 | | Astig = 2 | : | (42 + 02 + 82)/12 = 6.6667 | |  |  |  | | GNew (SpecRx) | = | 1 – (6.1667 + 6.6667)/24 | |  | = | 0.4653 | |
| **Frequency Table for Tears**   |  |  |  | | --- | --- | --- | |  | Tears = 1 | Tears = 2 | | Class 1 | 0 | 4 | | Class 2 | 0 | 5 | | Class 3 | 12 | 3 | | Sum | 12 | 12 | | |  |  |  | | --- | --- | --- | | Tears = 1 | : | (02 + 02 + 122)/12 = 12 | | Tears = 2 | : | (42 + 52 + 32)/12 = 4.1667 | |  |  |  | | GNew (SpecRx) | = | 1 – (12 + 4.1667)/24 | |  | = | 0.3264 | |

Rg (Age) = GStart – GNew (Age) = 0.5382 – 0.5208 = 0.0174

Rg (SpecRx) = GStart – GNew (SpecRx) = 0.5382 – 0.5278 = 0.0104

Rg (Astig) = GStart – GNew (Astig) = 0.5382 – 0.4653 = 0.0729

Rg (Tears) = GStart – GNew (Tears) = 0.5382 – 0.3264 = **0.2118**



**Iteration 2 (For Branch Tears = 2)**

There are 4 instances with classification 1, 5 instances with classification 2 and 3 instances with classification 3. So, p1 = (4/12), p2 = (5/12) and p3 = (3/12).

***GStart = 1 – (p12 + p22 + p32)***

***= 1 – ((4/12)2 + (5/12)2 + (3/12)2)***

***= 0.6528***

Now, we need to calculate GNew for each of the attributes.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Frequency Table for Age**   |  |  |  |  | | --- | --- | --- | --- | |  | Age = 1 | Age = 2 | Age = 3 | | Class 1 | 2 | 1 | 1 | | Class 2 | 2 | 2 | 1 | | Class 3 | 0 | 1 | 2 | | Sum | 4 | 4 | 4 | | |  |  |  | | --- | --- | --- | | Age = 1 | : | (22 + 22 + 02)/4 = 2 | | Age = 2 | : | (22 + 22 + 12)/4 = 2.25 | | Age = 3 | : | (02 + 12 + 22)/4 = 1.25 | |  |  |  | | GNew (Age) | = | 1 – (2 + 2.25 + 1.25)/12 | |  | = | 0.5417 | |
| **Frequency Table for SpecRx**   |  |  |  | | --- | --- | --- | |  | SpecRx = 1 | SpecRx = 2 | | Class 1 | 3 | 1 | | Class 2 | 2 | 3 | | Class 3 | 1 | 2 | | Sum | 6 | 6 | | |  |  |  | | --- | --- | --- | | SpecRx = 1 | : | (32 + 22 + 12)/6 = 2.3333 | | SpecRx = 2 | : | (12 + 32 + 22)/6 = 2.3333 | |  |  |  | | GNew (SpecRx) | = | 1 – (2.3333 + 2.3333)/12 | |  | = | 0.6111 | |
| **Frequency Table for Astig**   |  |  |  | | --- | --- | --- | |  | Astig = 1 | Astig = 2 | | Class 1 | 0 | 4 | | Class 2 | 5 | 0 | | Class 3 | 1 | 2 | | Sum | 6 | 6 | | |  |  |  | | --- | --- | --- | | Astig = 1 | : | (02 + 52 + 12)/6 = 4.3333 | | Astig = 2 | : | (42 + 02 + 22)/6 = 3.3333 | |  |  |  | | GNew (SpecRx) | = | 1 – (4.3333 + 3.3333)/12 | |  | = | 0.3611 | |

Rg (Age) = GStart – GNew (Age) = 0.6528 – 0.5417 = 0.1111

Rg (SpecRx) = GStart – GNew (SpecRx) = 0.6528 – 0.6111 = 0.0417

Rg (Astig) = GStart – GNew (Astig) = 0.6528 – 0.3611 = **0.2917**



**Iteration 3 (For Branch Astig = 1)**

There are 5 instances with classification 2 and 1 instance with classification 3. So, p1 = (5/6) and p2 = (1/6).

***GStart = 1 – (p12 + p22 + p32)***

***= 1 – ((5/6)2 + (1/6)2 + (0/6)2)***

***= 0.2778***

Now, we need to calculate GNew for each of the attributes.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Frequency Table for Age**   |  |  |  |  | | --- | --- | --- | --- | |  | Age = 1 | Age = 2 | Age = 3 | | Class 1 | 0 | 0 | 0 | | Class 2 | 2 | 2 | 1 | | Class 3 | 0 | 0 | 1 | | Sum | 2 | 2 | 2 | | |  |  |  | | --- | --- | --- | | Age = 1 | : | (02 + 22 + 02)/2 = 2 | | Age = 2 | : | (02 + 22 + 02)/2 = 2 | | Age = 3 | : | (02 + 12 + 12)/2 = 1 | |  |  |  | | GNew (Age) | = | 1 – (2 + 2 + 1)/6 | |  | = | 0.1667 | |
| **Frequency Table for SpecRx**   |  |  |  | | --- | --- | --- | |  | SpecRx = 1 | SpecRx = 2 | | Class 1 | 0 | 0 | | Class 2 | 2 | 3 | | Class 3 | 1 | 0 | | Sum | 3 | 3 | | |  |  |  | | --- | --- | --- | | SpecRx = 1 | : | (02 + 22 + 12)/3 = 1.6667 | | SpecRx = 2 | : | (02 + 32 + 02)/3 = 3 | |  |  |  | | GNew (SpecRx) | = | 1 – (1.6667 + 3)/6 | |  | = | 0.2222 | |

Rg (Age) = GStart – GNew (Age) = 0.2778 – 0.1667 = **0.1111**

Rg (SpecRx) = GStart – GNew (SpecRx) = 0.2778 – 0.2222 = 0.0556

A diagram of a number of people

AI-generated content may be incorrect.

**Iteration 4 (For Branch Astig = 2)**

There are 4 instances with classification 1 and 2 instance with classification 3. So, p1 = (4/6) and p2 = (2/6).

***GStart = 1 – (p12 + p22 + p32)***

***= 1 – ((4/6)2 + (2/6)2 + (0/6)2)***

***= 0.4444***

Now, we need to calculate ENew for each of the attributes.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Frequency Table for Age**   |  |  |  |  | | --- | --- | --- | --- | |  | Age = 1 | Age = 2 | Age = 3 | | Class 1 | 2 | 1 | 1 | | Class 2 | 0 | 0 | 0 | | Class 3 | 0 | 1 | 1 | | Sum | 2 | 2 | 2 | | |  |  |  | | --- | --- | --- | | Age = 1 | : | (22 + 02 + 02)/2 = 2 | | Age = 2 | : | (12 + 02 + 12)/2 = 1 | | Age = 3 | : | (12 + 02 + 12)/2 = 1 | |  |  |  | | GNew (Age) | = | 1 – (2 + 1 + 1)/6 | |  | = | 0.3333 | |
| **Frequency Table for SpecRx**   |  |  |  | | --- | --- | --- | |  | SpecRx = 1 | SpecRx = 2 | | Class 1 | 3 | 1 | | Class 2 | 0 | 0 | | Class 3 | 0 | 2 | | Sum | 3 | 3 | | |  |  |  | | --- | --- | --- | | SpecRx = 1 | : | (32 + 02 + 02)/3 = 3 | | SpecRx = 2 | : | (12 + 02 + 22)/3 = 1.6667 | |  |  |  | | GNew (SpecRx) | = | 1 – (3 + 1.6667)/6 | |  | = | 0.2222 | |

Rg (Age) = GStart – GNew (Age) = 0.4445 – 0.3333 = 0.1112

Rg (SpecRx) = GStart – GNew (SpecRx) = 0.4445 – 0.2222 = **0.2223**

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AI-generated content may be incorrect.