COMP 9318 Assignment 1

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Question 1

1. Complete data cube of R.

Location	Time	Item	SUM(Quantity)
Sydney	2005	PS2	1400
Sydney	2005	ALL	1400
Sydney	2006	PS2	1500
Sydney	2006	Wii	500
Sydney	2006	ALL	2000
Sydney	ALL	PS2	2900
Sydney	ALL	Wii	500
Sydney	ALL	ALL	3400
Melbourne	2005	XBox 360	1700
Melbourne	2005	ALL	1700
Melbourne	ALL	XBox 360	1700
Melbourne	ALL	ALL	1700
ALL	2005	PS2	1400
ALL	2006	PS2	1500
ALL	2006	Wii	500
ALL	2005	XBox 360	1700
ALL	2005	ALL	3100
ALL	2006	ALL	2000
ALL	ALL	PS2	2900
ALL	ALL	Wii	500
ALL	ALL	XBox 360	1700
ALL	ALL	ALL	5100

2. SQL statement that computes the same result.

```
SELECT Location, Time, Item, SUM(Quatity)
FROM R
GROUP BY Location, Time, Item
UNION ALL
SELECT Location, Time, ALL, SUM(Quatity)
FROM R
GROUP BY Location, Time
UNION ALL
SELECT Location, ALL, Item, SUM(Quatity)
FROM R
GROUP BY Location, Item
UNION ALL
SELECT ALL, Time, Item, SUM(Quatity)
FROM R
GROUP BY Time, Item
UNION ALL
SELECT ALL, ALL, Item, SUM(Quatity)
FROM R
GROUP BY  Item
UNION ALL
SELECT ALL, Time, ALL, SUM(Quatity)
FROM R
GROUP BY Time
UNION ALL
SELECT Location, ALL, ALL, SUM(Quatity)
FROM R
GROUP BY Location
UNION ALL
SELECT ALL, ALL, ALL, SUM(Quatity)
FROM R
```

3. The result of the query in a tabular form.

Location	Time	Item	SUM(Quantity)
Sydney	2006	ALL	2000
Sydney	ALL	PS2	2900
ALL	2005	ALL	3100
ALL	2006	ALL	2000
ALL	ALL	PS2	2900
Sydney	ALL	ALL	3400
ALL	ALL	ALL	5100

4. MOLAP cube

- $f(x) = 9 \cdot f_{Location}(x) + 3 \cdot f_{Time}(x) + f_{Item}(x)$:

Location	Time	Item	SUM(Quantity)	f(x) as ArrayIndex
1	1	1	1400	13
1	1	0	1400	12
1	2	1	1500	16
1	2	3	500	18
1	2	0	2000	15
1	0	1	2900	10
1	0	3	500	12
1	0	0	3400	9
2	1	2	1700	23
2	1	0	1700	21
2	0	2	1700	20
2	0	0	1700	18
0	1	1	1400	4
0	2	1	1500	7
0	2	3	500	9
0	1	2	1700	5
0	1	0	3100	3
0	2	0	2000	6
0	0	1	2900	1
0	0	3	500	3
0	0	2	1700	2
0	0	0	5100	0

- $f(x) = 16 \cdot f_{Location}(x) + 4 \cdot f_{Time}(x) + f_{Item}(x)$:

Location	Time	Item	SUM(Quantity)	f(x) as ArrayIndex
1	1	1	1400	21
1	1	0	1400	20
1	2	1	1500	25
1	2	3	500	27
1	2	0	2000	24

Location	Time	Item	SUM(Quantity)	f(x) as ArrayIndex
1	0	1	2900	17
1	0	3	500	19
1	0	0	3400	16
2	1	2	1700	38
2	1	0	1700	36
2	0	2	1700	34
2	0	0	1700	32
0	1	1	1400	5
0	2	1	1500	9
0	2	3	500	11
0	1	2	1700	6
0	1	0	3100	4
0	2	0	2000	8
0	0	1	2900	1
0	0	3	500	3
0	0	2	1700	2
0	0	0	5100	0

- We should choose $f(x) = 16 \cdot f_{Location}(x) + 4 \cdot f_{Time}(x) + f_{Item}(x)$.
- Because the ArrayIndex should not be repeated, or we can not recover Location, Time, Item values by ArrayIndex. $f(x) = 9 \cdot f_{Location}(x) + 3 \cdot f_{Time}(x) + f_{Item}(x)$ has repeat ArrayIndex 3, 12 and 18.
- Result MOLAP cube:

f(x) as ArrayIndex	SUM(Quantity)
21	1400
20	1400
25	1500
27	500
24	2000
17	2900
19	500
16	3400

f(x) as ArrayIndex	SUM(Quantity)
38	1700
36	1700
34	1700
32	1700
5	1400
9	1500
11	500
6	1700
4	3100
8	2000
1	2900
3	500
2	1700
0	5100

Question 2

(1) Construct a decision tree using Gini index

Step 1. Consider 4 features: Gender, Smokes, Chest pain, Cough, compute Gini index index

- Gender:

Gender \ Lung Cancer	Yes	No
Female	1	1
Male	3	1

$$Gini(Gender) = \frac{2}{6} * Gini(1,1) + \frac{4}{6} * Gini(3,1) = 0.42$$

- Smokes:

Smokes \ Lung Cancer	Yes	No
Yes	3	0
No	1	2

$$Gini(Smokes) = \frac{3}{6} * Gini(3,0) + \frac{3}{6} * Gini(1,2) = 0.22$$

- Chest pain:

Chest pain \ Lung Cancer	Yes	No
Yes	2	2
No	2	0

$$Gini(Chestpain) = \frac{4}{6} * Gini(2,2) + \frac{2}{6} * Gini(2,0) = 0.33$$

- Cough:

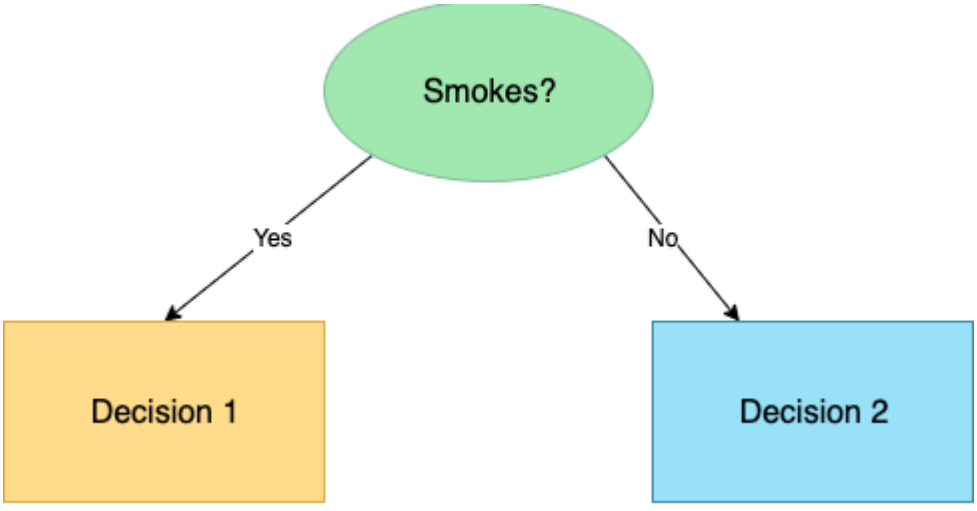
Cough \ Lung Cancer	Yes	No
Yes	2	2
No	2	0

$$Gini(Cough) = \frac{4}{6} * Gini(2,2) + \frac{2}{6} * Gini(2,0) = 0.33$$

So the step 1 Gini result shows as following

Feature	Gini index
Gender	0.42
Smokes	0.22
Chest pain	0.33
Cough	0.33

From the table above, Smokes which provides the smallest Gini index choose to split the node, Now after step 1 the decision shows below:

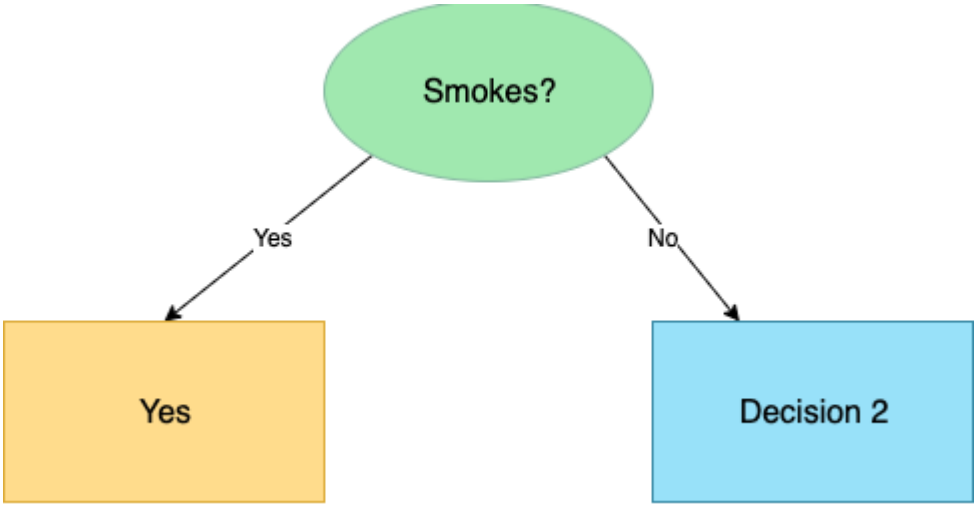


Step 2. Consider Smokes=Yes

extract *Smokes=Yes* from original dataset

Patient ID	Gender	Smokes	Chest pain	Cough	Lung Cancer
1	Female	Yes	Yes	Yes	Yes
2	Male	Yes	No	Yes	Yes
5	Male	Yes	Yes	No	Yes

- All Lung cancer are **Yes**
- After stpe 2 the decision tree shows below:



Step 2. Consider Smokes=No

extract *Smokes=No* from original dataset

Patient ID	Gender	Smokes	Chest pain	Cough	Lung Cancer
3	Male	No	No	No	Yes
4	Female	No	Yes	Yes	No
6	Male	No	Yes	Yes	No

Consider 3 features: Gender, Chest pain, Cough, compute Gini index index

- Gender:

Gender \ Lung Cancer	Yes	No
Female	0	1
Male	1	1

$$Gini(Gender) = \frac{1}{3} * Gini(0,1) + \frac{2}{3} * Gini(1,1) = 0.33$$

- Chest pain:

Chest pain \ Lung Cancer	Yes	No

Chest pain \ Lung Cancer	Yes	No
Yes	0	2
No	1	0

$$Gini(Chestpain) = \frac{2}{3} * Gini(0,2) + \frac{1}{3} * Gini(1,0) = 0$$

- Cough:

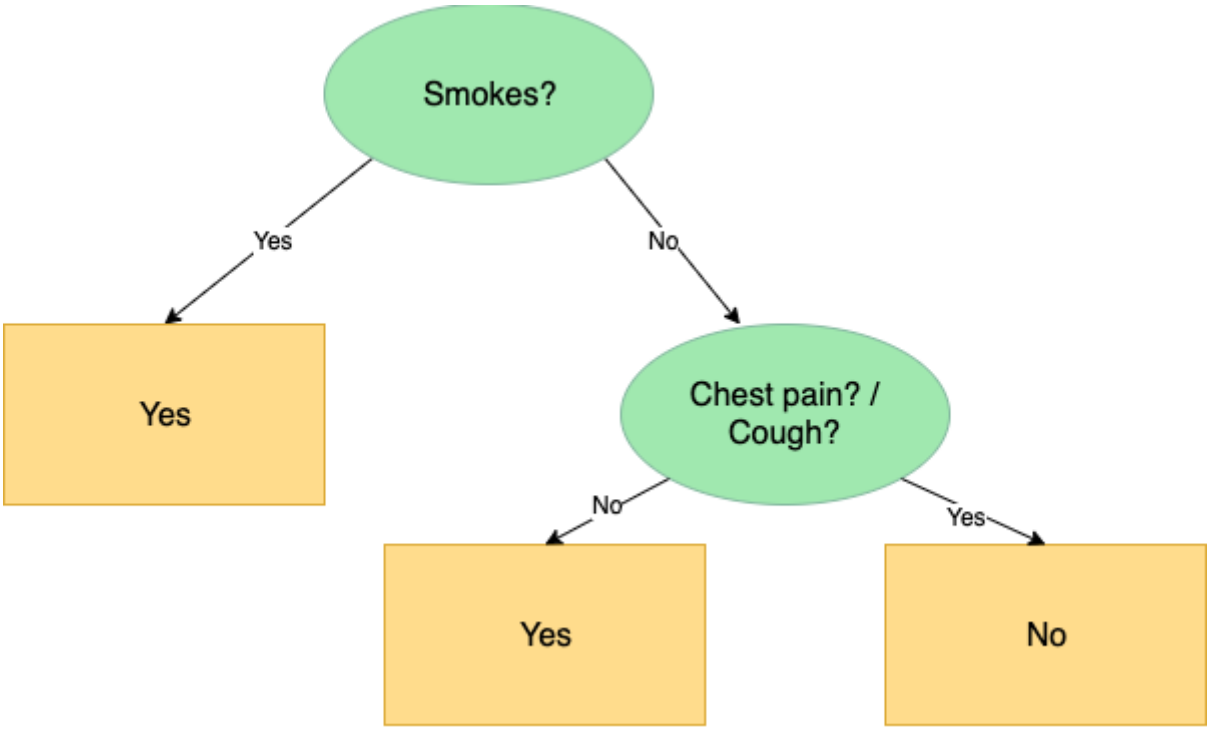
Cough \ Lung Cancer	Yes	No
Yes	0	2
No	1	0

$$Gini(Cough) = \frac{2}{3} * Gini(0,2) + \frac{1}{3} * Gini(1,0) = 0$$

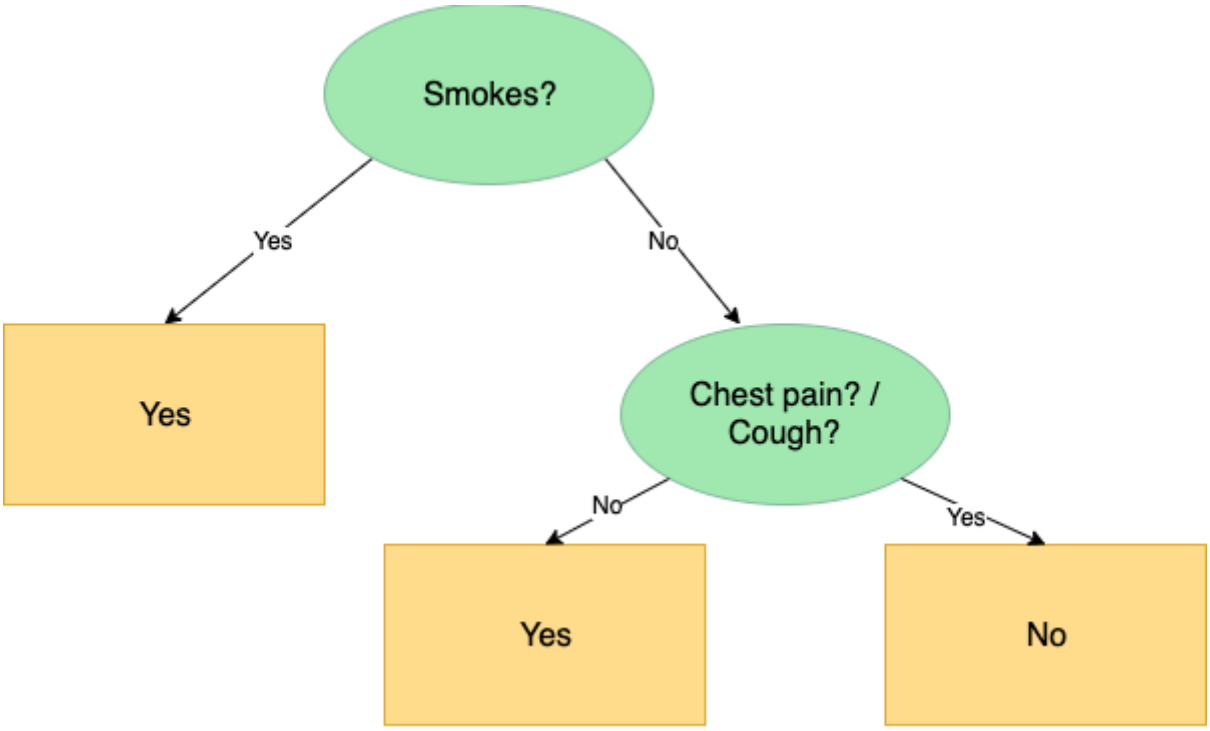
So the step 1 Gini result shows as following

Feature	Gini index
Gender	0.33
Chest pain	0
Cough	0

From the table above, Chest pain or cough which provide the smallest Gini index choose to split the node, Now after step 3 the decision shows below:



Final decision tree



(2) Translate decision tree into decision rules.

```
IF Smokes='Yes' THEN Lung Cancer = 'Yes'

IF Smokes='No' AND (Chest pain='No' or Cough='No') THEN Lung Cancer =
'Yes'

IF Smokes='No' AND (Chest pain='Yes' or Cough='Yes') THEN Lung Cancer =
'No'
```

Question 3

(1)