

CS534 - HW 1

Keith Chester

Due date: June 12 2022

Problem 1

In problem 1, we are tasked with creating a recursive and linear time agent for following propositional logic statements. The work associated with this problem can be found in **problem1.py**.

Problem 2

In this problem we are exploring a first-order logical knowledge base and writing out logical expressions utilizing it. The knowledge base is represented as:

- $\text{CopyOf}(d, a)$ - Predicate - Disk d is a copy of album a
- $\text{Owns}(p, d)$ - Predicate - Person p owns disk d
- $\text{Sings}(p, s, a)$ - Predicate - Album a includes a recording of song s sung by person p
- $\text{Wrote}(p, s)$ - Person p wrote song s

We are also injecting the following constants:

- McCartney - a person
- Gershwin - a person
- BHoliday - a person
- Joe - a person
- EleanorRigby - a song
- TheManILove - a song
- Revolver - an album

Within this, we express the following statements using first-order logic:

- (a) $\text{Wrote}(\text{Gershwin}, \text{TheManILove})$
- (b) $\neg \text{Wrote}(\text{Gershwin}, \text{EleanorRigby})$
- (c) $\text{Wrote}(\text{Gershwin}, \text{TheManILove}) \vee \text{Wrote}(\text{McCartney}, \text{TheManILove})$
- (d) $\exists s \text{Wrote}(\text{Joe}, s)$
- (e) $\exists d \text{Owns}(\text{Joe}, \text{CopyOf}(d, \text{Revolver}))$
- (f) $\forall s \text{Sings}(\text{McCartney}, s, \text{Revolver}) \Rightarrow \text{Wrote}(\text{McCartney}, s)$
- (g) $\forall s \text{Sings}(p, s, \text{Revolver}) \neg \text{Wrote}(\text{Gershwin}, s)$
- (h) $\forall s \text{Wrote}(\text{Gershwin}, s) \Rightarrow \text{Sings}(p, s, a)$

- (i) $\exists a \forall s \text{Sings}(p, s, a) \text{Wrote}(\text{Joe}, s)$
- (j) $\exists d, a \text{Owns}(\text{Joe}, \text{CopyOf}(d, a)) \wedge \text{Sings}(\text{BHoliday}, s, a)$
- (k) $\exists d_i \text{CopyOf}(d_i, a) \forall a \text{Sings}(\text{McCartney}, a, s) \wedge \forall \text{Owns}(\text{Joe}, d)$
- (l) $\exists d \text{CopyOf}(d, a) \forall a \text{Sings}(\text{BHoliday}, s, a) \wedge \text{Owns}(\text{Joe}, d)$

Problem 3

In this question, we are looking at the following table of three binary input attributes, and a singular binary output:

Example	A_1	A_2	A_3	Output y
x_1	1	0	0	0
x_2	1	0	1	0
x_3	0	1	0	0
x_4	1	1	1	1
x_5	1	1	0	1

a.

Using the Gini Index, we aim to create a decision tree for this data.

b.

Now we utilize Information Gain to create a decision tree for this data.

Problem 4

In this section, we consider the following data input with six inputs and a singular target output:

Example	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}
x_1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
x_2	0	0	0	1	1	0	0	1	1	0	1	0	1	1
x_3	1	1	1	0	1	0	0	1	1	0	0	0	1	1
x_4	0	1	0	0	1	0	0	1	0	1	1	1	0	1
x_5	0	0	1	1	0	1	1	0	1	1	0	0	1	0
x_6	0	0	0	1	0	1	0	1	1	0	1	1	1	0
T	1	1	1	1	1	1	0	1	0	0	0	0	0	0