ARTIFICIAL INTELLIGENCE
Project

Rakesh Kumar Mahato
RKM190000

Task-1: Design and Create a Knowledge Base

- Supermarket is a place which owns different items to sell to customers.
- A customer is a person.
- A person can come and purchase items from a supermarket.
- Safeway is one of the supermarkets.
- Safeway is located in North Berkeley.
- There are different kinds of items in a supermarket.
- The items can be food items or personal care items.
- A supermarket can own items either by producing in-house or by purchasing from outside market and dealers.
- Items in Safeway are owned by Safeway Corporation.
- A person can be a child or an adult.
- If a person is not a child, he is adult.
- If a person is a child is not an adult.
- A child can carry maximum 1 quantity of items.
- An adult can carry maximum 5 quantity of items.
- If a person can carry max quantity 1, he cannot carry 2 quantities and can carry 1 quantity.
- If a person can carry max quantity 2, he cannot carry 3 quantities and can carry 2 quantity.
- If a person can carry max quantity 3, he cannot carry 4 quantities and can carry 3 quantity.
- If a person can carry max quantity 4, he cannot carry 5 quantities and can carry 4 quantity.
- If a person can carry max quantity 5, he cannot carry 6 quantities and can carry 5 quantity.
- If a person can carry 6 quantity he can carry 5 quantity.
- If a person can carry 5 quantity he can carry 4 quantity.
- If a person can carry 4 quantity he can carry 3 quantity.
- If a person can carry 3 quantity he can carry 2 quantity.
- If a person can carry 2 quantity he can carry 1 quantity.
- If a person cannot carry 1 quantity he cannot carry 2 quantity.
- If a person cannot carry 2 quantity he cannot carry 3 quantity.
- If a person cannot carry 3 quantity he cannot carry 4 quantity.
- If a person cannot carry 4 quantity he cannot carry 5 quantity.
- If a person cannot carry 5 quantity he cannot carry 6 quantity.
- If a person can carry a quantity, he can carry all quantities less than that.
- If a person cannot carry a quantity, he cannot carry quantity more that.
- If a person purchases an item, he can carry it.
- If a person purchases an item of some quantity, he has at least that much quantity of the item .
- If a person has at least some quantity of item he has at least a quantity less than that.
- Safeway has at least 20 tomatoes.
- John purchases two quantity of tomatoes.
- Tomato is a veggie.
- John is a person.

- Mary is a person.
- Mary purchases four quantity of tomatoes.
- Meat is a food item.
- Veggie is a food item.
- All food items are items.
- Mary was purchasing at the same time as John.
- If two person are at the same time and buy the same item from Safeway then they see each other.
- Safeway purchases 30 tomato from outside market.
- Safeway purchases 20 deodorant from a dealer.
- Safeway purchases 15 chicken from outside market.
- Safeway purchases 15 ground beef outside market.
- Safeway makes 10 pizza in house.
- Safeway makes 10 cake in house.
- If Safeway makes items in house, then it owns the item and the items are made in the supermarket.
- If supermarket purchases items from outside, then it is not made in house.
- If John buys a food item, he will eat it.
- All items that are owned by a supermarket is sold by the supermarket.
- If a person buys an item he brings either money or a credit card to purchase.
- John has money m1.
- M1 is money.
- CC is credit card.
- If a person has money and purchases an item, he has less money than the previous amount.
- Z is a staff member.
- John shops from Safeway.
- Staff is a person.
- Person B is other people to person A if A is not equal to B.
- For a purchase to happen there are always staff members to facilitate the transaction.
- John buys one quantity of ground beef.
- Ground beef is a type of beef.
- Beef is a type of meat.
- If a person eats meat, he is not vegetarian.
- Items in Safeway are owned by Safeway Corporation.
- Place in the neighborhood is called next door.
- John fills gas in the Shell station.
- Shell station is in the neighborhood of Safeway.
- If a person fills gas from a gas station the gas station has gas.
- Shell station is a gas station.
- if a person buys an item it fits in his car trunk.
- Chicken is a type of meat.
- Pizza is a food item.
- Cake is a food item.
- Similar categories of items are kept in same area.

- For purchase, cash money or credit card is needed.
- John and Mary are customers.
- Safeway makes 20 quantity of bread.
- Safeway makes 10 quantity of muffin.
- Bread is a food item.
- Muffin is a food item.
- If a person has at least 6 quantity, he has at least 5 quantity.
- If a person has at least 5 quantity, he has at least 4 quantity.
- If a person has at least 4 quantity, he has at least 3 quantity.
- If a person has at least 3 quantity, he has at least 2 quantity.
- If a person has at least 2 quantity, he has at least 1 quantity.
- If a person brings a car to supermarket, he parks in the parking lot.
- Supermarket has different aisles to keep different items.
- Safeway keeps cooking items.
- Safeway keeps fruits.
- Perishable items need to be kept in refrigerator.
- Edible items are kept in food section.
- Bulbs and batteries are kept in electronics section.
- If there are many customers, there is a queue.
- If the item quantities are more than 5, need to get a trolley.

Task-2: Convert your KB to First Order Logic

- `all x all y all q (SuperMarket(x) & Item(y) & Owns(x,y,q) -> Sells(x,y)).`
- `all x (Customer(x) -> Person(x)).`
- `A person can come and purchase items from a supermarket.`
- `SuperMarket(Safeway).`
- `Location(Safeway,NorthBerkley).`
- `all x all y all q (Purchase(x,y,q) & SuperMarket(x) -> Owns(x,y,q) & -MadeIn(x,y)).`
- `all x all y all q (MadeInhouse(x,y,q) & SuperMarket(x) -> Owns(x,y,q) & MadeIn(x,y)).`
- `all x all y all q (SuperMarket(x) & Item(y) & Owns(x,y,q) -> Sells(x,y)).`
- `Purchase(Safeway, Deodrant,20).`
- `Purchase(Safeway, Tomato,30).`
- `Purchase(Safeway, GroundBeef,15).`
- `Purchase(Safeway, Chicken,15).`
- `MadeInhouse(Safeway, Pizza, 10).`
- `MadeInhouse(Safeway, Cake, 10).`
- `MadeInhouse(Safeway, Bread, 20).`
- `MadeInhouse(Safeway, Muffin, 10).`
- `FoodItem(Bread).`

- FoodItem(Muffin).
- all x all y all q (Owns(x,y,q) & SuperMarket(Safeway) ->
  owns(SafewayCorporation,y)).
- all x (Child(x) -> Person(x)).
- all x (Adult(x) -> Person(x)).
- all x (Person(x) -> Child(x) | Adult(x)).
- all x (Child(x) <-> -Adult(x)).
- all x (-Child(x) <-> Adult(x)).
- all x (Child(x) -> CanCarryMaxQty(x,1)).
- all x (Adult(x) -> CanCarryMaxQty(x,5)).
- all x (CanCarryMaxQty(x,1) -> -CanCarry(x,2) & CanCarry(x,1)).
- all x (CanCarryMaxQty(x,2) -> -CanCarry(x,3) & CanCarry(x,2)).
- all x (CanCarryMaxQty(x,3) -> -CanCarry(x,4) & CanCarry(x,3)).
- all x (CanCarryMaxQty(x,4) -> -CanCarry(x,5) & CanCarry(x,4)).
- all x (CanCarryMaxQty(x,5) -> -CanCarry(x,6) & CanCarry(x,5)).
- all x (CanCarry(x,6) -> CanCarry(x,5)).
- all x (CanCarry(x,5) -> CanCarry(x,4)).
- all x (CanCarry(x,4) -> CanCarry(x,3)).
- all x (CanCarry(x,3) -> CanCarry(x,2)).
- all x (CanCarry(x,2) -> CanCarry(x,1)).
- all x (-CanCarry(x,1) -> -CanCarry(x,2)).
- all x (-CanCarry(x,2) -> -CanCarry(x,3)).
- all x (-CanCarry(x,3) -> -CanCarry(x,4)).
- all x (-CanCarry(x,4) -> -CanCarry(x,5)).
- all x (-CanCarry(x,5) -> -CanCarry(x,6)).
- all x all y all q (Purchase(x,y,q) & Item(y) -> CanCarry(x,q)).
- all x all q(CanCarryMax(x,q) -> CanCarry(x,q)).
- all x all y all q (Purchase(x,y,q) & Item(y) -> AtLeast(x,y,q)).
- all x all y (AtLeast(x,y,6) -> AtLeast(x,y,5)).
- all x all y (AtLeast(x,y,5) -> AtLeast(x,y,4)).
- all x all y (AtLeast(x,y,4) -> AtLeast(x,y,3)).
- all x all y (AtLeast(x,y,3) -> AtLeast(x,y,2)).
- all x all y (AtLeast(x,y,2) -> AtLeast(x,y,1)).
- Purchase(John, GroundBeef,1).
- Purchase(John, Tomato,2).
- Beef(GroundBeef).
- Person(John).
- Person(Mary).
- Veggie(Tomato).
- Purchase(Mary, Tomato,4).
- all x (Veggie(x) -> FoodItem(x)).
- all x (Beef(x) -> Meat(x)).
- all x (Meat(x) -> FoodItem(x)).
- all x (FoodItem(x) -> Item(x)).
- all x (Deodrant(x) -> PersonalCare(x)).
- all x (PersonalCare(x) -> Item(x)).

- all x (Child(x) -> Person(x)).
- all x (Adult(x) -> Person(x)).
- all x all y (Eats(x,y) & Meat(y) -> -Vegetarian(x)).
- SameTime(John, Mary).
- all x all y all z (SameTime(x,y) & Buys(x,z) & Buys(y,z) -> Sees(x,y) & Sees(y,x)).
- all x all y all q ((Purchase(x,y,q)) & Item(y) -> Buys(x,y) & Has(x,y) & Quantity(x,y,q)).
- all x all y all q(Purchase(x,y,q) & FoodItem(y) -> Eats(x,y)).
- all x all y (Buys(x,y) -> (Bring(x,m) & Money(m)) | (Bring(x,c)& CreditCard(c))).
- Purchase(Safeway, Deodrant,20).
- Purchase(Safeway, Tomato,30).
- Purchase(Safeway, GroundBeef,15).
- Purchase(Safeway, Chicken,15).
- MadeInhouse(Safeway, Pizza, 10).
- MadeInhouse(Safeway, Cake, 10).
- MadeInhouse(Safeway, Bread, 20).
- MadeInhouse(Safeway, Muffin, 10).
- FoodItem(Bread).
- FoodItem(Muffin).
- all x all y all q (Purchase(x,y,q) & SuperMarket(x) -> Owns(x,y,q) & -MadeIn(x,y)).
- all x all y all q (MadeInhouse(x,y,q) & SuperMarket(x) -> Owns(x,y,q) & MadeIn(x,y)).
- all x all y all q (SuperMarket(x) & Item(y) & Owns(x,y,q) -> Sells(x,y)).
- all x all y all q(Purchase(x,y,q) & FoodItem(y) -> Eats(x,y)).
- CreditCard(cc).
- Money(m).
- HasMoney(John,m1).
- Money(m1).
- all x all y all q (Purchase(x,y,q) & HasMoney(x,m1) & Money(m1) -> HasMoney(x,m2) & Money(m2) & LessThan(m2,m1)).
- all x exists y (SuperMarket(x) -> NextDoor(x,y) & GasStation(y)).
- HasGas(ShellStation).
- GasStation(ShellStation).
- all x all y exists z (Buys(x,y) -> OtherPeople(x,z) & Staff(z)).
- all x (Staff(x) -> Person(x)).
- ShopFrom(John,Safeway).
- FillsGas(John).
- all x all y all q (Owns(x,y,q) & SuperMarket(Safeway) -> owns(SafewayCorporation,y)).
- all x all y (Buys(x,y) -> FitInCarTrunkOf(y,x)).
- all x all y(SameCategory(x,y) -> SameArea(x,y)).
- all x all y(BringsCarToSupermarket(x,y) -> ParksInParkingLot(x,y)).