

INFOSYS 330

ASSIGNMENT 3

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Section One

This proposal is a recommendation to the Decision Support System incorporating machine intelligence for NZ Merino Apparel. The purpose of this proposal is to recommend the best possible Decision Support System for all staff, most notably the Inventory Director. The Inventory Director will find it beneficial that the system will cover key areas related to his role within the company. The system will incorporate; managing information effectively to improve storing and delivery, a 'just in time' inventory system and addressing the most optimal storage space layout for the company's storage facility. Information is key to making business decisions, the system will be focused on keeping the information accurate and efficient to make it easier for the Inventory Director to make decisions regarding storing and delivery. 'Just in time' inventory is a strategy that focuses on only receiving necessary goods and meeting customer demands, the system will incorporate this idea for the company to increase in efficiency, decrease in wastage and satisfy customer demands. The storage facility will be key to the company's progress and success; having the best possible layout will reduce costs, save time and maximize efficiency. My proposed solution will help make it easier for the Inventory Director to come up with solutions to tackle the aforementioned problems.

Section Two

Inventory Director

Role

The Inventory Director will oversee the inventory and delivery side of the company. The Inventory Director will be the spearhead for the company's stock and delivery management. His work will be mainly focused on the directing NZMA's storage facility and operations related to it. He will have specialised staff working under him, but he will be making most if not all of the high-level decisions related to delivery and inventory.

Key Decisions

Evaluate Suppliers

The Inventory Director is the main line of communication between the company and their suppliers. The Inventory Director will always look to find the cheapest possible service whilst maintaining a high standard of product quality and availability. Product quality is essential as it is related to product durability, product performance and customer satisfaction. Product availability will also be a focus as it revolves around the idea of having only the necessary supplies and goods at the specific time. The availability of merino products will be very hard to manage as it has its main purpose is to keep the user warm. Hence, merino will be very popular during winter season and product supply be in higher demand. The Inventory Director must obtain information about all suitable suppliers in case any problems with their current suppliers or opportunities with potential suppliers arise.

Manage Staffing

The main purpose of merino is to keep the user warm and comfortable. Hence, demand for merino will be in higher during the winter season. The Inventory Director should look to allocate staff accordingly. In relation to allocation of staff, the Inventory Director will investigate trends and patterns with their product demand and popularity. It is a given that some stores are busier than others, the Inventory Director should look at assigning staff at these specific stores. The Inventory Director should also look at the long-term potential of their stores as change is inevitable and assigning suitable staff will be key in the development of those specific stores. The Inventory Director will also have an input in hiring staff for the inventory department and their floor-level staff. Once the Inventory Director has found suitable staff, they will also have an input in training these new staff. The Inventory Director will look for measures and procedures that will help their new staff learn skills and settle into the working environment.

Optimize Facility Layout

NZMA's storage facility will be a critical success factor for the company. The Inventory Director will deal with the challenges of storage space and efficiently using it. Optimizing the storage facility will allow the business to maximize efficiency, minimize labour and reduce costs. It is key to optimize space because it would be easier to store and remove their products. The Inventory Director should look to allocate products in high demand at the spaces easiest to access. T the information

about stock levels must be kept accurate, having wrong information could result in having too many of the same product. There must also be information about deliveries to specific branches or distributors, having this information will allow the storage facility to plan what products they need to deliver. The Inventory Director will keep on top of specific times where certain products will be in high demand and should plan accordingly. For this case, a good example of this is during the winter season; NZMA should look to store more of their products during this season. Having too many of the same product may have an unnecessary negative effect. The Inventory Director will look to only store products that are necessary, factoring known trends, patterns and possibilities.

Key Performance Indicators (KPI)

Inventory Turnover

Inventory turnover is the ratio showing how many times a product has been sold and replaced within a specific time. It is essential to keep this information as it tells the company has an excessive inventory in relation to its sales. With this information, they can adjust the materials they get to make their products and capacity of their products. Also, they can pick up trends and patterns with this information, they may be able to see when a certain product sells very quickly.

Customer satisfaction levels

‘Customer satisfaction levels’ is the measure to see if online orders have been consistently received and how long it took for the delivery to come. This is an essential piece of information as it has the focus of meeting customer demands. This measure can serve as feedback and the Inventory Director should adjust accordingly.

Order cycle/lead time

‘Order cycle/lead time’ measures the time a customer places an order to when they receive the product(s) in the order. This will be essential as the Inventory Director will be able to see how productive their storage facility, how efficient their delivery system is and how reliable the company’s delivery drivers are.

Order pick, pack and ship accuracy

The ‘order pick, pack and ship accuracy’ is the process of locating inventory and packing the ordered items for shipment to fulfil customer orders. Sometimes, the wrong items have been packed or there is not enough or none of the ordered product. This information should reveal which parts of the storage facility are its strengths and weaknesses. This information relies on accuracy of information to save time, labour and money.

Supplier Quality Index

The supplier quality index is a measure to show how well the company’s current suppliers are performing. This index measures how many orders are received in time, how often the company must return materials due to mistakes or inaccuracy and the quality of the materials and goods that arrive. This measure will help the company pinpoint costs that can be minimised or eliminated and improvements.

Essential Information

The Inventory Director must keep accurate information on several main things; supplier information, trends, customer orders and inventory levels. Supplier information will be key in saving costs and maintaining product quality. Keeping track of other potential suppliers will be beneficial when problems with the current one arises. Knowing about trends about their products will aid in business decisions. The Inventory Director will be able to reduce products that don't sell as expected and increase production on products that sell well at a specific time. A good example to follow is increasing the production of chocolates during Easter. Customer orders is an essential piece of information, because there wouldn't be a business without customers. Being unable to fulfil customer orders may result in a loss of them. Customer orders need inventory levels to be accurate. 'Inventory levels' is the most important piece of information for the company to have, they are a measure of how well particular branches are doing and how well the storage facility can accommodate to these branches and other orders.

The Problems & Requirement Analysis

The Problems

- **Managing information effectively** to improve efficiency of storing and delivery of goods
- How can we adopt a **'just in time' delivery system?**
- How do you address inadequate **storage space and optimize storage layout?**

Requirement Analysis

1. Effective Management of Information
 - a. Inventory Director should be able to maintain inventory levels
 - b. Inventory Director should be able to maintain information about current and potential suppliers
 - c. Inventory Director should be able to ask for more information from the Stock Manager
 - d. Inventory Director should be able to view information about their products' sales
 - e. Inventory Director should be able to ask Store Manager for information about sales at their branch
2. 'Just in time' delivery system
 - a. Inventory Director should be able to view past, current and future orders
 - b. Inventory Director should be able to ask for Store Managers' information about in-store customer orders
 - c. Inventory Director should be able to maintain current and future orders
3. Optimize storage space and layout
 - a. Inventory Director should be able to maintain the floor layout of the storage facility
 - b. Inventory Director should be able to devise a proposal for CEO

SECTION THREE

Rule-Based Systems (RBS)

RBS is a system of given data/pre-defined knowledge and uses rules with the main task of solving given problems. RBS has a 'rule-base', a database of rules. Rules have only one definition/interpretation and cover space problem. The main purpose of RBS is to assign value(s) to an attribute(s).

How it works/Syntax

- We are given a facts/assertions table
- We are given a rules table, rules are divided into two parts:
 - Antecedent (IF): description of the situation
 - Conclusion (THEN): action
- RBS follows deductive inference; the conclusion (THEN) always follows the stated antecedents (IF).
 - If the IF is True, THEN will be valid
 - But, the conclusion isn't necessarily True
- Two ways of managing deductive inference
 - Forward Chaining
 - A logical process that uses known facts/assertions to generate more facts/assertions using pre-determined conditions to find a solution
 - Data -> Decision
 - Backward Chaining
 - A logical process that reveals unknown truths from known facts/assertions to determine initial conditions
 - Decision -> Data

Advantages of RBS

- Cost-Efficient
- Only requires specifying small pieces of information
- Accurate Results – this is due to the predefined rules
- Separates knowledge about the situation from the process of applying it
- Justified outcome(s)

Disadvantages of RBS

- Need a lot of experts – who can articulate their knowledge
- Need a lot of time – 60%-70% of development time is acquiring rules
- Need a lot of memory
- Difficulty during very complex or subtle problems, it cannot make intelligent decisions. Hence, it will not adapt to the situation
- Potentially may encounter a lack in rules – difficult to come up with rules
- Complex domains, this requires a lot of time and analysis

Decisions Trees

Decision trees is a decision support tool that implements decisions, rules and consequences into a tree-like model or a flowchart-like structure. It is a very good way to show an algorithm with condition control statements. The proposed system will be structured like a Decision Tree to make it easier for the Inventory Director to understand how and why they got to a solution.

Classification

- Assigning objects to one of several possible categories
 - John – Boy or Girl?
- Used for both predictive and descriptive modelling situations
- Only have a binary output
 - Yes or no
- Influence
 - Classifying attribute may influence input attributes
 - Dependent Variable
 - Relatable to Backward Chaining
 - Input attributes may influence the classifying attribute
 - Independent Variable

How it works/Syntax

- Root node - symbolises a situation
- Branches of that node - possible outcomes of that situation
- Leaf nodes – decision taken after all inputs
- Path from root to leaf/output variable – represents classifying attribute
- Input variable – what the classifying attribute depends on

Advantages of Decision trees

- Decision trees can work with numeric inputs
- Classes are pre-defined/facts
- Data is ambiguous – only one interpretation

Disadvantages of Decisions trees

- Some decision trees need all attributes to be categorical
- Instability – one small change can have a large change on the tree
- Expectation-Based – irrational expectations can lead to flaws and errors in the decision tree

Genetic Algorithm (GA)

GA is a data mining method used to find sub-optimal solutions. GA is based on Charles Darwin's theory on evolution. The main idea of GA is mating two members of a population in hopes of producing something better, in this case better solutions.

How it works/Syntax

- Gene – smallest unit of GA
- Chromosome – series of Genes providing a solution
 - Chromosomes do not understand the problem
- Decoder – program module that checks how 'good' a problem is
 - The decoder is intelligent enough to understand what makes a good problem
 - The decoder converts a chromosome into a solution
- Fitness Function – program module that determines which chromosome solutions are good
- Selection – stage during GA where individual chromosomes are chosen from a population for breeding
- 'Bad' chromosomes are discarded from the solution
- Trying new solutions by changing the chromosomes by:
 - Crossover – combines genetic data of two parents to make offspring
 - Mutation – alters one or more gene values in a chromosome, the solution may change

Advantages of GA

- Flexibility of use –
 - Many ways to evaluate a problem
 - Can decode more than one problem using same GA
- Can be used to examine complex problems
- One may choose one good solution from a wide variety
- Solution population knows how to adapt and improve over time

Disadvantages

- Possible doubts over how good a solution is, may not be the optimal solution
- It is hard to think of a learning process which reflects what we want the algorithm to do
- Time-consuming

Justification of Chosen Solution(s) – RBS & Decision Trees & GA

RBS

NZMA's Inventory Director will find RBS an easy system to implement as it follows pre-defined rules. The information will be kept very accurate if RBS were to be used, this is because of the pre-defined rules that have been set. Accuracy of information is also reinforced by the idea of having one definite interpretation for each rule or fact within the database. Hence, the Inventory Director will have answered its problem of effective management of information. One scenario that will help the 'Just in time' delivery is that, RBS can set the system to recognize when a product is running low at a certain branch or at the storage facility. The system will recommend if and when the Inventory Director should deliver to a certain branch or ask for more raw materials to be delivered to their storage facility. Another scenario may be, the system would be set to recognise that a sale is coming up and the system will recommend if and when the Inventory Director should bulk up on certain products NZMA can set-up a feedback system where it takes input between yes or no questions about the company's delivery performance. To elaborate, a customer may be asked questions like 'did your delivery come before or when expected', 'was your delivery in perfect condition upon time of arrival' amongst other questions. Implementing RBS will make it easier for customer to generate feedback. Also, the Inventory Director will have an easier time making understanding the data provided from the feedback and making decisions accordingly. Another advantage of RBS is that each outcome is justified. With forward chaining, we use known facts to generate unknown facts to come up with a solution. Whilst backward chaining, we are given a hypothesis and we try to prove this hypothesis by revealing the initial conditions by use of known facts.

Decision Trees

RBS and decision trees share the same logic and concept. RBS will be structured by use of Decision Trees. Decision trees is a very good way to show problems with an IF-THEN structure. The whole purpose of Decision in this situation is to visualize how we got to a certain solution to the given problem. The Inventory Director will find it easier to see and understand how they got to a specific solution.

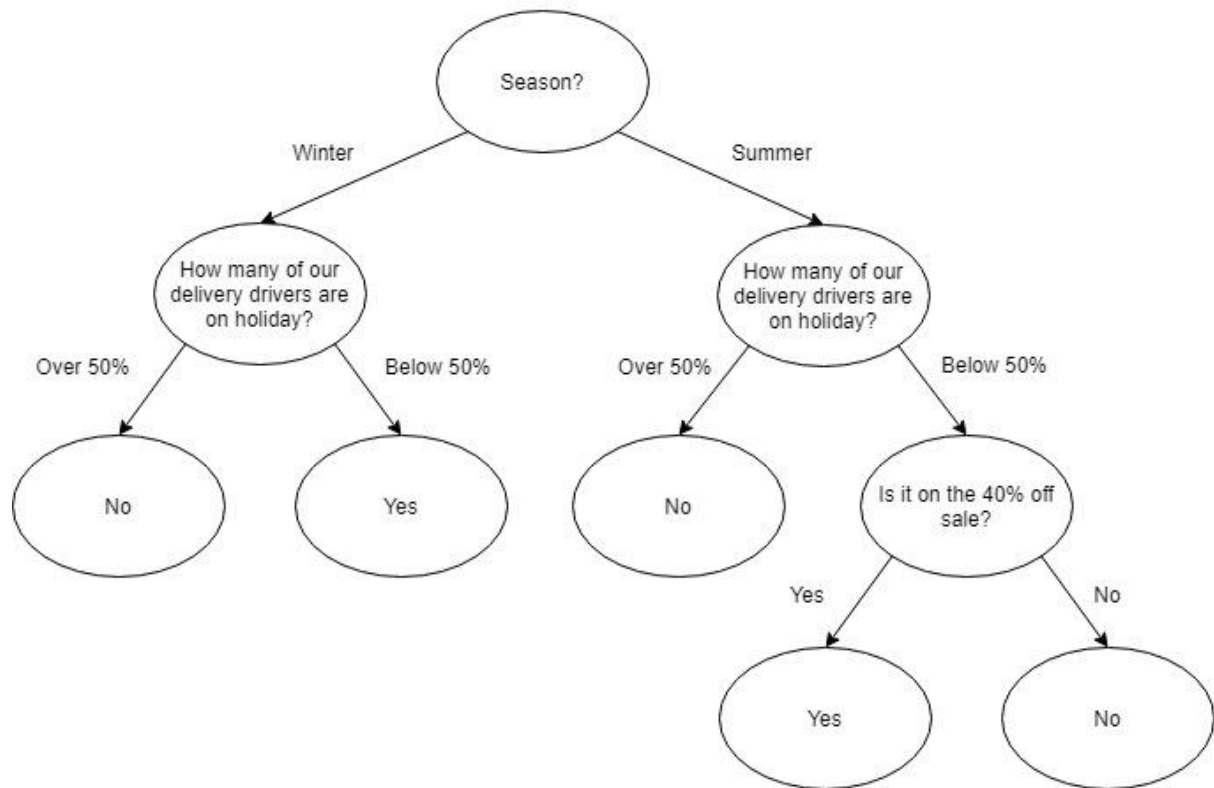
GA

RBS have several flaws and disadvantages, namely being unable to come up with new rules and its scalability or ability to adapt. GA's main purpose in this situation is to come up with new potential rules for RBS with the steps mentioned in Section 3 (How it works), GA will help the company adapt. GA will take chromosomes from the storage space and layout dataset and attempt to come up with better layouts for the storage facility. GA will also take some of the current problems from the Effective Management of Information and 'Just in time' delivery system datasets to try and introduce better problems and solutions. The only major disadvantage of GA is that there could be some doubts to whether the proposed solution is 'good', in this situation there would always be consultation with the CEO with regards to high-level decisions.

Examples

Example of Decision Tree

Should we store more of X in the storage facility?



Decision Trees work like Forward Chaining which is a way to manage inference, we use facts to generate more facts.

In this example, we are given the facts:

- It is summer
- Below 50% of drivers are on holiday

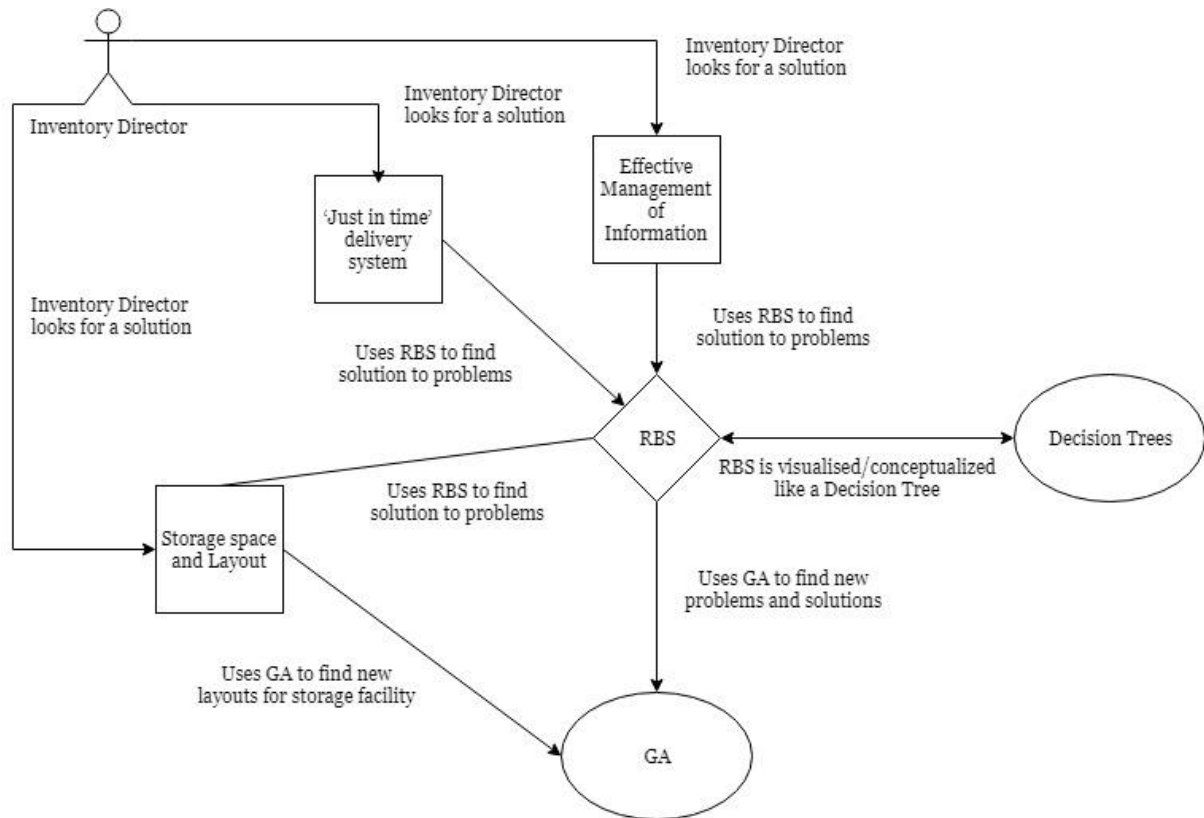
Given these facts:

- Season is classified as Winter
- Delivery drivers on holiday is classified as Below 50%

Hence, the system will recommend that 'Yes' we should store more of product X in the storage facility.

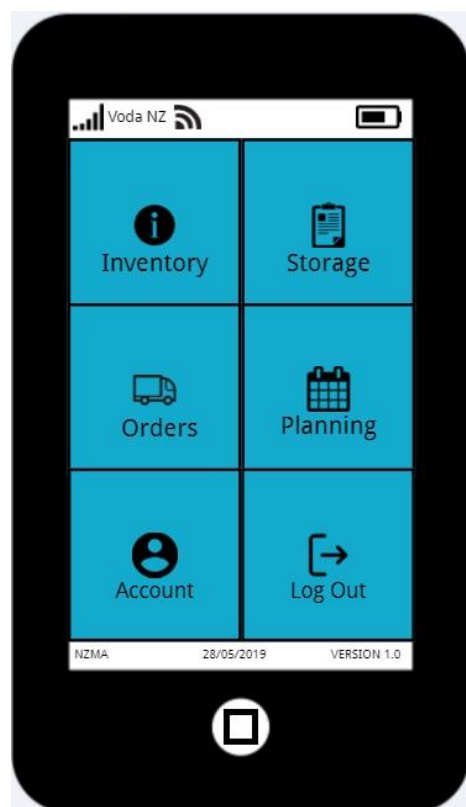
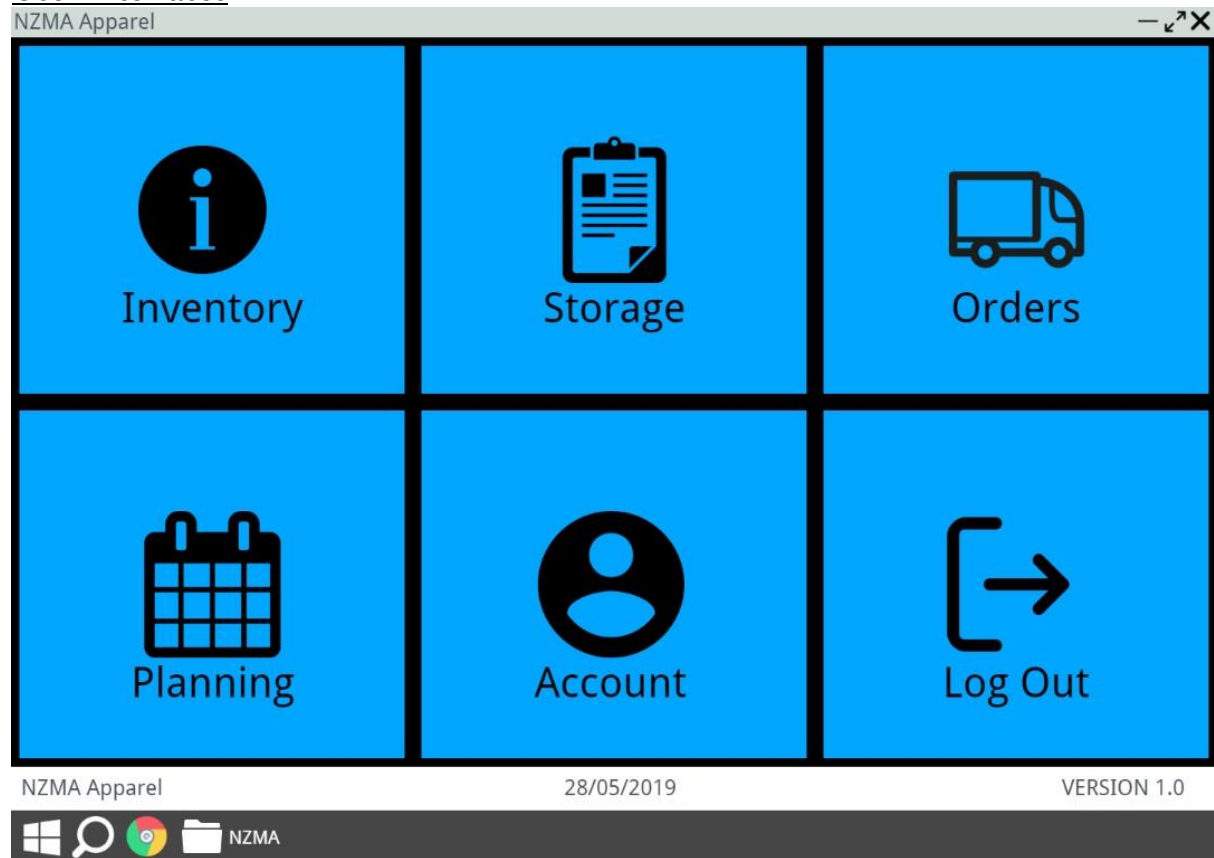
SECTION FOUR

Dimension	Target Solution	RBS	Decision Trees	GA
Accuracy	High	Yes	Yes	Yes
Response Time	Moderate	No	Yes	Yes
Scalability	Moderate	Maybe	Maybe	Yes
Ease of use	Moderate	Yes	Yes	Yes
Independence from Experts	Moderate	No	Yes	Yes
Development Speed	Low	No	Maybe	Yes
Accessibility	High	Yes	Yes	Maybe



Conceptual Diagram

User Interfaces



Example of Backward Chaining

Assertions

A0. Daryl uses a crossbow

A1. Daryl has a dog

Rules

P0. IF X uses a crossbow
AND X has a dog
THEN X doesn't die during season 10

P1. IF X uses a gun
AND X has a cat
THEN X dies during season 10

P2. IF X doesn't die during season 10
THEN X will come back in season 11

P3. IF X dies during season 10
THEN X won't come back in season 11



Backward Chaining can be best demonstrated by Depth-First Search (DFS). DFS traverses down left-most side of the tree and works its way up.

Steps:

1. Our hypothesis (root) is 'Daryl will come back in season 11.'
2. We try to match an antecedent(s) (IF) in our assertion list
 - a. If there is a match - we are done, we have proven it
 - b. If there is no match we go to step 3
3. We find a conclusion (THEN) that matches with the case
 - a. Rule 2's conclusion matches with the hypothesis
 - b. We add the antecedents of Rule 2 into the tree and it becomes our new hypothesis
4. Repeat step 2
 - a. If there is a match - we are done, we have proven it
 - b. There is no match - we repeat step 3
5. Repeat step 3
 - a. Rule 1's conclusion matches with the new hypothesis (IF X doesn't die during season 10)
 - b. Rule 1's antecedents become our new hypothesis (IF X uses a crossbow AND X has a dog)
6. Repeat step 2
 - a. There is a match - both IF X uses a crossbow AND X has a dog are in our assertion list
 - b. That must mean rule 2 is true because the conclusion (THEN) of rule 0 has been proven
7. We have proven that Daryl will come back in season 11

SECTION FIVE

Conclusion

I believe that my proposed solution will help NZMA's Inventory Director solve their problems/challenges with Effective Management of Information, 'Just in time' delivery system and the storage facility's space and layout. The use of RBS, Decision Trees and GA will aid the Inventory Director in their key decisions and responsibilities. These BI tools will respectively do their parts in making the Inventory Director's job easier to understand and perform. RBS will be the system providing solutions for problems that the Inventory Director meets. Decision Trees will visualize how a certain solution is obtained. Lastly, GA will be used to further improve our existing problems and solutions and is the focal point of the solutions ability to adapt to change. With the use of these Business Intelligence tools, the Inventory Director will have an easier time finding solutions for problems, meeting KPIs and meeting requirements.