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Assignment 10. Computer Science Research and Development

Human Support Robot

1. Introduction

Over the past decade, interest and development on artificial intelligence has grown and made huge progress on applying into different areas, such as the music industry, self-driving cars, diagnosing cancers in the medical industry or predicting effective ways of marketing based on collected data (Maynez, 2019). However, human support robot is an inseparable topic when one is referring to the discussion and exploration of the knowledge of artificial intelligence. According to Kevin Buckland's article about Toyota's intention to implement and put domestic robots out available for the market due to the increasing numbers of the aging population in Japan. The company is attempting to develop and build a household robot which is capable of providing assistance to seniors who are living alone such as loading the washing machines, moving or lifting heavy objects, cleaning or sweeping the floor, etc. Elderly who specifically and frequently require for long term care and monitoring are likely to benefit from the assistance provided from the household robots. The analyst from Toyota has mentioned that there have been several significant experimenting success and researches on the applications of robots in reality. One of successful case is the company has created a robot that is capable to play a trumpet during an actual performance with an orchestra. Another interesting research is the

newest human robot called T-HR3 which is intended to serve as lifesavers when it comes to searching in dangerous disaster area. However, the biggest problem and concern is that the added functions and capabilities increase the robot's volume and weight. Therefore, this has decrease the safety level of the robots for the users. The doubt of safety and reliability have become a setback when it comes to introduce domestic robots into the medical fields and home for providing assistance services. (Buckland 2018).

2. Research

Nowadays, household robots that are available on the market such as robotic vacuum and robotic lawnmower are still quite different from the expected, ideal human support robots that are capable to think critically and understand human emotions. According to one of the research based on the cognitive developmental robotics (CDS), the goal of the research is pointing out how CDS would be considered as a new approach when one is referring to the design of humanoid robots. Two main components are embedded in the design approach of CDS. The first component is defining the proper way to implement the robot's brain that allows for the self-learning process to take place properly. One of the common learning process for new information would be reinforcement learning which is rewarding for the correct behaviors that are randomly picked among the sets of possible inputs. The rewarding process increases the probability of the positive actions in the future. According to the researchers on CDR, a better approach to increase the speed of the learning process of the robots would be robot shaping which is allowing the robots to learn the basics first. The process of first introducing simple and easy tasks for the robots to work with and gradually increase the level of difficulty speeds up the entire development process of the robots' brain. However, different implementation and sizes of

the robot's brain also affect the collected data and output. The second component is designing a proper learning environment which encourages the robot's brain to be able to develop cognitively. Based on the research article, there are mainly three types of learning environment which are stationary environment and environment that involves passive agents or extra active agents. For stationary environment, the robot relies on its own sensing input devices to receive and collect the input data. In the case of passive agents, agents could be either stationary or moving according to different scenarios of actions of the robots. When the environment consists of other active agents, it is usually account as noise or interrupts during the process. The researchers mentions an algorithm that could relate both the implementation of the robot's brain and the learning environment. The layout of the algorithm is first allowing the robot to learn with the smallest set of input for a certain period. If the output is one of the desired behavior during the learning process, the level of the complexity for the task will be increase. On the other hand, level of the dimensionality will be increased when there are no desired output. In this way, the robot is being provided with a larger exploring area during the learning process (Asada, 2001).

In the research of algorithms of machine learning, the four most common algorithms are linear regression model, logistic regression model, naive Bayes, classification and regression trees. For linear regression model, the equation contains input variable x and output variable y. The goal of the analysis is find the accurate coefficients that fit the relationship between the two variables. For example, we need to find the most suitable values for the coefficients B0 and B1 in this equation : $y = B0 + B1 * x$ during analysis. Below is the attached graph for reference (Le, 2018)

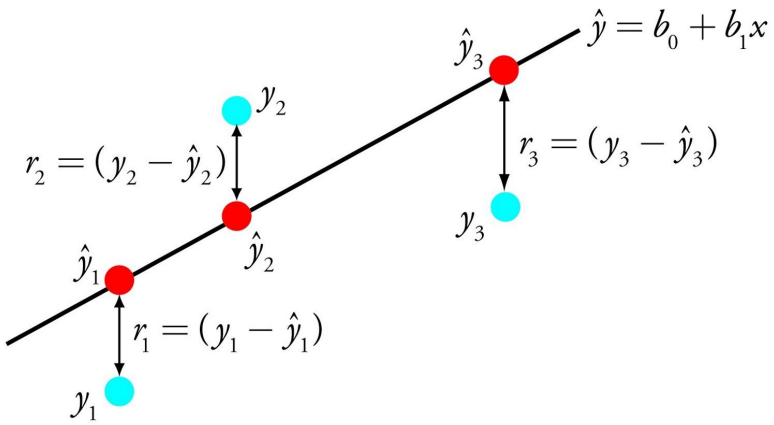

Figure 1. Linear Regression Model (Le, 2018)

For logistic regression, the model is intended to solve for binary classification problems. The goal of the model is to calculate the correct and appropriate weights which could be applied to a specific input variable. The weights are represented as coefficients of the logistic function. The function itself map the provided input values into the numeric range that starts at 0 and ends at 1. The advantage of this model is that one could conclude that if certain input values are less than a numeric value such as 0.5, then output a correspond numeric value that is within the range between 0 and 1. For example, if the input value is less than 0.4 then the output value would be 1. The model works the best when outliers and close input values are removed from the data set. Below is the example graph for reference (Le, 2018)

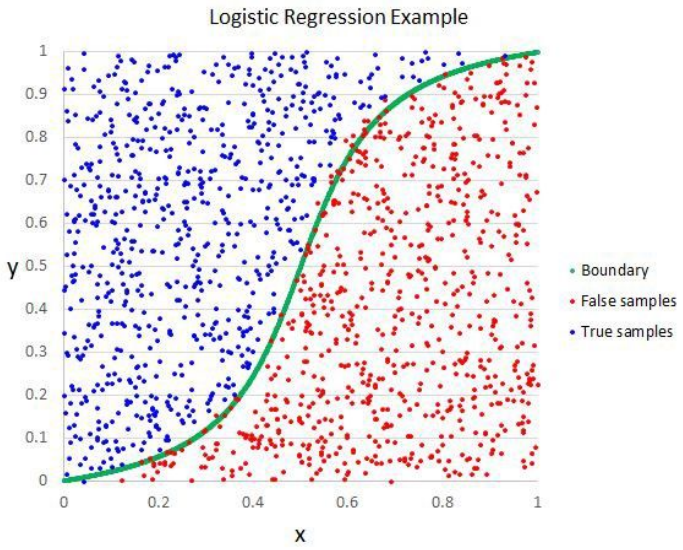

Figure 2. Logistic Regression Model (Le, 2018)

For naive Bayes, the input data set is used to calculate two different probabilities which are probability of the class and the conditional probability of the class. Conditional probability is referring that the probability of the event given another event has already happened. In this case, it would be the conditional probability of a class given certain input values x. However, there is one assumption that is there exists an independent relationship between the input variables. Below is the example diagram for reference (Le, 2018)

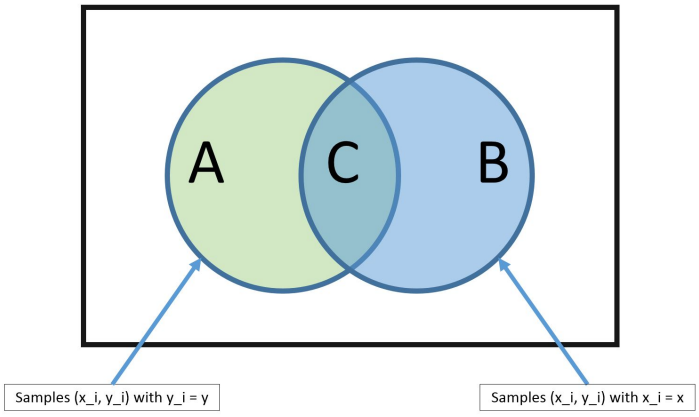

Figure 3. Naive Bayes Model (Le, 2018)

For classification and regression tree, the model is being represented as a binary tree which is mainly used for model predicting in machine learning. On the tree, each input variable is being represented as a node. On each node, there is an output variable that stores the predicted value to guide for the next node to move, except the root node and leaf node. The root node is the first node of the tree and the leaf nodes are the bottom nodes of each branch of the tree. The advantage of the model is it is a relatively fast algorithm. Below is the example diagram for reference (Le, 2018)

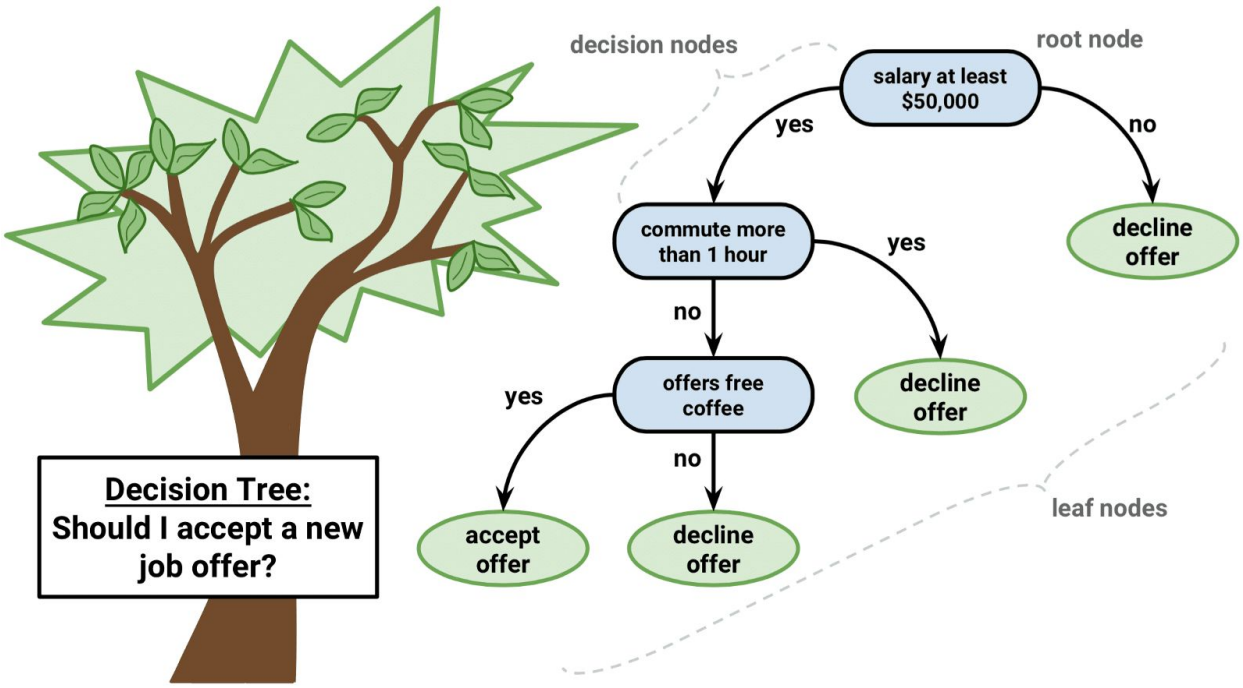

Figure 4. Regression Trees (Le, 2018)

According to an IEEE research article about an human support robot called TWENDY-ONE, the robot is being created in the Sugano Laboratory of Waseda University at Japan in 2009. The intention of the creation of the robot is to provide care and support for seniors and people who have disability. The structure of the robot is divided into three different sections which are head, hands and arms. For the robot head, it is composed with two large cameras and a

sensor for receiving information from the surroundings. For the hands, each of them is composed with four fingers and implemented with force sensors which allow the robot to be able to handle and pick up different shapes of objects. For the robot's arms, they are being covered with special silicon material that could reduce the stress and shock when it comes to interact with the user or surroundings. There are four major functions of the robots when it comes to provide assistance to the user. First, it is being designed to provide support and force when the user is trying to sit up in order to get out of bed. Second, the robot is able to provide help when the user needs to move to the wheelchair by following the user's motion path. Third, the robot could provide assistance when the user is in the process of making breakfast. Fourth, the robot could lift up a tray with substances on it and carry it to the user. Below are some pictures about the robot from research article (Iwata, Sugano, 2009).

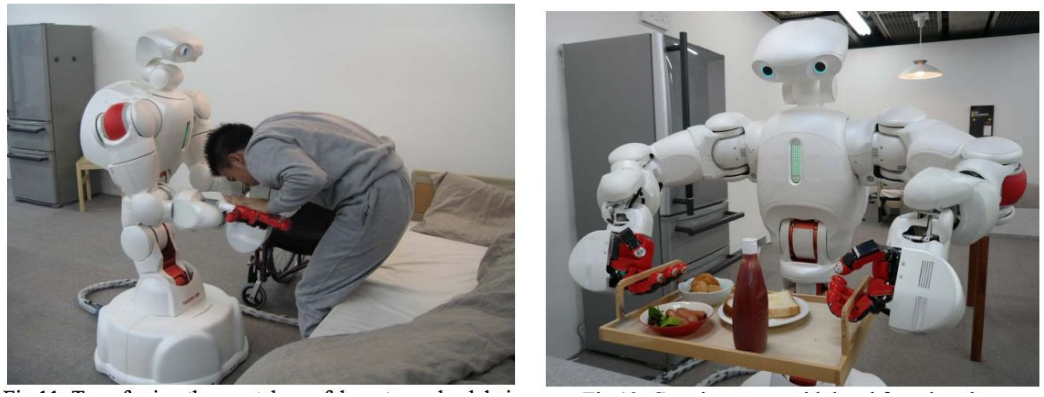

Figure 5. Robot assistance pictures (Iwata, Sugano, 2009)

Figure 6. Robot assistance pictures (Iwata, Sugano, 2009)

3. Conclusion

Due to the advanced development of robots and AI, some people might think that robots are gonna replaced a lot of human jobs and cause unemployment in the future. Personally, I think the main difference between human and robots is our innate creativity. As long as human keep updating with fundamental concepts and algorithms, this way could improve the creativity level which then make us differentiate from the AI.

At the same time, we as human should always broaden our perspective on intelligence and try to develop and pay close attention to skills which make us different from the machines.

Citations

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Toyota Robot at Toyota Kaikan. Digital Image. *Wikimedia Commons*. 24 February 2006. https://commons.wikimedia.org/wiki/File:Toyota_Robot_at_Toyota_Kaikan_f.jpg.