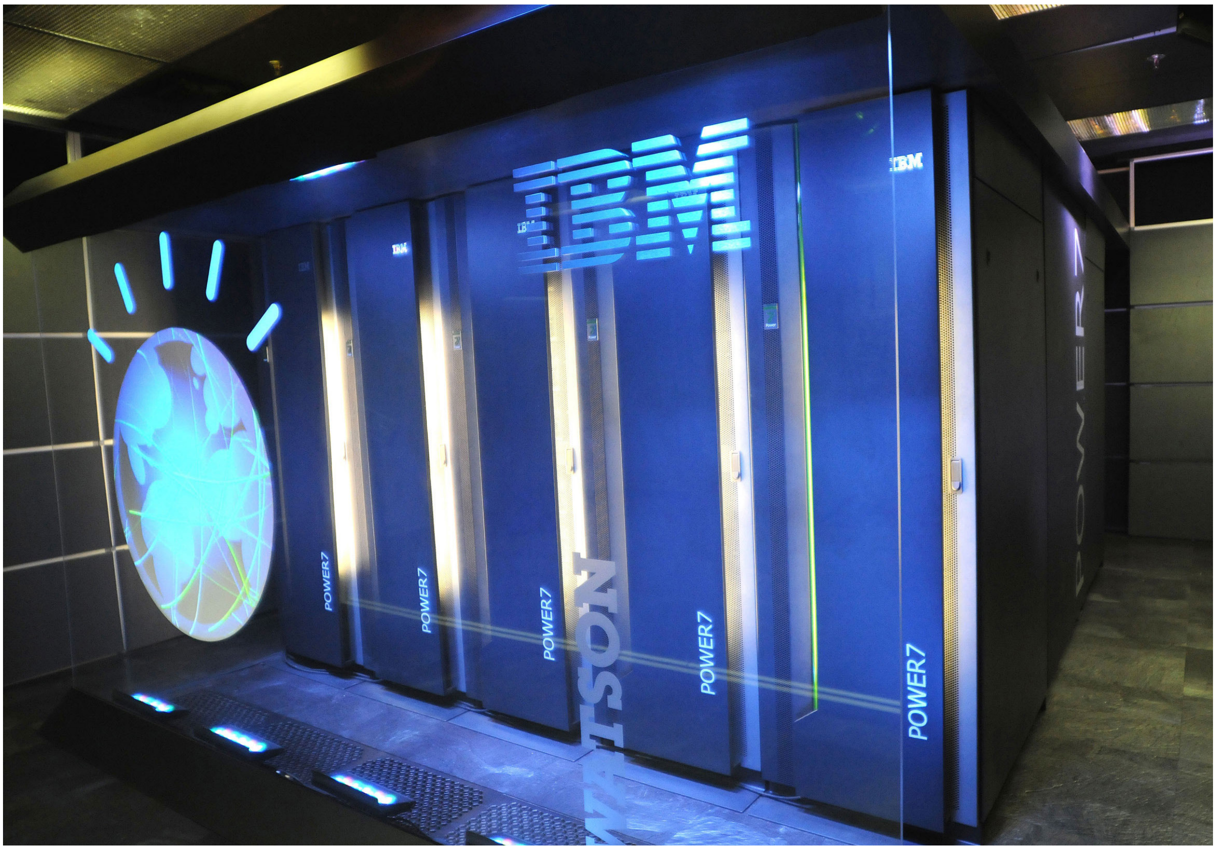
SERVICE CONTROL TOWERS

MAN VS MACHINE

The possibilities of automating operational exception handling

While increasing amounts of ordering processes have been automated in the last decade, human planners are still often employed as a fallback mechanism for exceptional situations in inventory management. Within his research Pim Schultz explored the potential of Artificial Intelligence (AI) to increase the efficiency of operational exception handling at IBM's service parts management.



MOTIVATION

The operational service parts planning department at IBM uses a mix of automated systems and human expertise to manage their service parts inventory. These systems automate a large portion of the ordering process and aid the planners in their inventory management tasks. One way these systems aid the planner by alerting them when an abnormal situation is detected in a service part's inventory. Examples of such a situation could be a projected stock-out or a failure in the automatic ordering process. The planner is then required to undertake action to handle the exception.

IBM argues that there is potential for efficiency gain using AI related technologies to automate standard exception handling. Planners can then focus their efforts on solving the harder cases.

MACHINE-LEARNING VS COGNITIVE COMPUTING

We explored two AI approaches, cognitive computing and machine learning. In exploring the strengths and weaknesses of each, we realized that cognitive computing would be an ill-fitting solution to IBM's problem.

The strengths of cognitive computing compared to traditional machine-learning methods are the ability to process large amounts of unstructured data sources such as scientific papers or images and the ability to interact with users through natural language.

The majority of the data present at IBM's operational exception handling environment appeared to be stored in structured databases. Interviews with users revealed little need for natural language interaction with the system. We have therefore decided to apply machine-learning.

PREDICTING A PLANNER'S ACTIONS

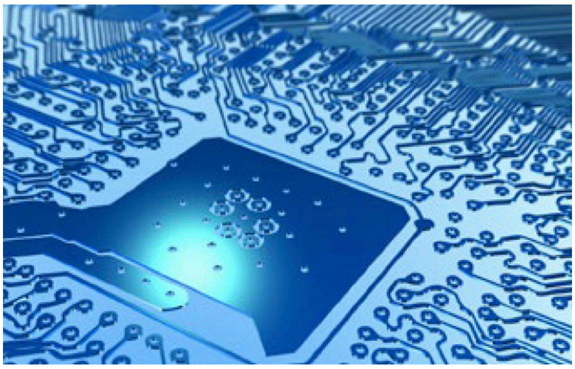
We focused on a single exception type out of the 40 types present in IBM's systems. This exception alerts on a projected inventory shortage. As a response, a planner often creates a new order, adjusts the size of an existing order, or expedites an order.

We have compared seven machine-learning algorithms to predict planner's decisions. As input, we used 580 sets of contextual service part information and the actual planner's action. Four of the seven machine-learning models achieved similar average prediction accuracies of 54-57%.

Machine-learning algorithm	Accuracy %
C5.0	57
QUEST	54
Bayesian networks	<1
Neural networks	<1
CHAID	56
C&R	55
Random trees	19

CATEGORY PERFORMANCE

Some categories of service parts were predicted very well by the model, such as cheap service parts with a short new buy lead-time having a prediction accuracy of 88%. Other categories scored worse, such as service parts with a repair ordering option having a prediction accuracy of 30%.
The machine-learning models generated decision rules. One such rule was to always order a new buy order when a service part has value less than €86. Since more than 60% of the service parts in the dataset are valued below €86, applying this simple rule of thumb can increase the efficiency of the exception handling process considerably.



MEASURING DECISION IMPACT

In creating our models, we assumed that all of the planner's actions are correct. In practice, not every action leads to the desired result due to the unpredictable nature of service parts management. To analyze the impact of a planner's decision, we measured the changes in a service part's inventory position. We found that in 46% of the cases, the planner's intervention was successful. Comparing the results of the actual actions to the predictions of the model, we found that a correctly predicted action does not always lead to a good result and a wrongly predicted action does not always lead to a bad result.

CONCLUDING REMARKS

In situations where decisions are made based upon large amounts of structured data, machine-learning tools can be used for automation. Further research will determine if rules of thumb can be discovered for other exceptions and what the effect of the actions suggested by the model which differ from those taken by the planner will be. Current models are not ready for automation but their results can be used as a second opinion for the human planners.

Insights gained

Machine learning traditionally performs well in areas where the outcome of situation is certain. For instance, you can definitely say that a certain pattern represents cancer cells. In this study the machine is learning from parts statuses and planner actions while there is no certainty that the action taken is correct. It is learning to mimick the planner's behaviour - assuming that behaviour is consistent.
When selecting only the behaviours leading to a 'good result', it could be the right behaviour or it could be that the planner got lucky.
So, when considering machine learning, it is important to understand this complexity. Understand whether you know how to select the correct examples that the machine should learn from.

Topsector Logistiek

FACTS

Student	Pim Schultz (pschultz1990@gmail.com)
University	University of Twente
Supervisors	Matthieu van der Heijden (m.c.vanderheijden@utwente.nl)
	Jaap Hazewinkel (hazewinkel@nl.ibm.com)
Company	IBM Nederland B.V. (IBM)

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