At the Chair of **Logistics and Supply Chain Management** of TUM School of Management we are looking for an interested and qualified student to conduct his/her

Master thesis

on the topic:

Application of Deep Reinforcement Learning to Multi-Sourcing Strategies in Inventory Control

Advances in the field of Big Data and Deep Reinforcement Learning (DRL) [2] [4] have paved the way for solutions to previously intractable problems with respect to large scale optimization in dynamic programming. One area that is experiencing renewed interest is the application of DRL to open problems in inventory control. We focus primarily on the problem of dual/multi-sourcing in the face of service disruptions.

Analytical methods have already provided optimal and near optimal solutions to ideal dual sourcing problems [7], however, the potential to extend the solutions to multiple suppliers or supply chains subject to service disruption is under-investigated. The problem is largely intractable when we are presented with any increase in state-action space, and therefore approximation methods from deep learning are being applied by researchers to obtain near optimal solutions to more realistic multi-sourcing environments [1].

This research project aims to apply state-of-the-art methods in Deep Reinforcement Learning ie. Deep Q learning [2], Policy Gradient Learning [5], and Actor Critic Methods [6] (and all of their variations [3]), to study their effect on providing tractable approximate solutions to the multi-sourcing problem in inventory control.

As a Master's student, there will be opportunities to share your work in upcoming Workshops hosted by both our Chair and the Munich Data Science Institute. Furthermore, strong support will be provided alongside you as PhD students will work in parallel on similar topics and approaches.

What you are expected to do:

- Literature review on relevant fields of study
- Strong skills in mathematical analysis, particularly in methods of dynamic programming.
- Implementation of deep learning models in Pytorch, or Tensorflow.
- Systematic comparison of selected model performances, and analysis of results and implications.

Requirements:

The thesis is for students of the Master degree students at TUM from the fields of Mathematics, Elektrotechnik, Informatik, and Management. Experience with Python, namely PyTorch, or any Deep Learning pacakge is a plus. The thesis should be written in English.

Begin: **as soon as possible**

Advisor: Larkin Liu

Application: Email with curriculum vitae and transcript of records to logtheses.log@mgt.tum.de

References:

[1] Gijsbrechts, Joren, et al. "Can deep reinforcement learning improve inventory management? performance on dual sourcing, lost sales and multi-echelon problems." Manufacturing & Service Operations Management (2021).

[2] Mnih, Volodymyr, et al. "Playing atari with deep reinforcement learning." arXiv preprint arXiv:1312.5602 (2013).

[3] Van Hasselt, Hado, Arthur Guez, and David Silver. "Deep reinforcement learning with double q-learning." Proceedings of the AAAI conference on artificial intelligence. Vol. 30. No. 1. 2016.

[4] Powell, Warren B. "From reinforcement learning to optimal control: A unified framework for sequential decisions." Handbook of Reinforcement Learning and Control. Springer, Cham, 2021. 29-74.

[5] Schulman, John, et al. "Proximal policy optimization algorithms." arXiv preprint arXiv:1707.06347 (2017).

[6] Konda, Vijay, and John Tsitsiklis. "Actor-critic algorithms." Advances in neural information processing systems 12 (1999).

[7] Klosterhalfen, Steffen, Gudrun Kiesmüller, and Stefan Minner. "A comparison of the constant-order and dual-index policy for dual sourcing." International Journal of Production Economics 133.1 (2011): 302-311.