Transformers for Self-Improving Job Shop Scheduling

The professorship for bioinformatics at TUM Campus Straubing for Biotechnology and Sustainability is looking for a motivated candidate for a master's thesis with the topic

"Transformers for Self-Improving Job Shop Scheduling".

Combinatorial Optimization plays a critical role in many real-world applications in fields as diverse as logistics, manufacturing, genomics, and synthetic biology. The NP-hard nature of these problems and their complex variations make them exceptionally difficult to solve. Traditional methods typically rely on exact algorithms and heuristics based on decades of research. However, they struggle with scalability and adaptability to other problems. To overcome these limitations, the success of deep learning has led to the emergence of **Neural Combinatorial Optimization (NCO)**, which departs from traditional methods to leverage the generalization capabilities of neural networks. Here, neural networks are trained to generate near-optimal solutions by learning from data without manually crafting algorithmic rules.

Job Shop Scheduling is one such complex problem that is receiving much attention from the NCO community. It stems from manufacturing and involves scheduling a set of jobs on a set of machines so that the time required to complete all jobs is minimized.

Based on recent methods in NCO that were devised at our professorship, we are looking for a master's thesis that pushes our state-of-the-art results even further, with a focus on **extending and refining our existing Transformer-based network architecture.**

During your thesis, you will learn to understand Transformers in detail – the main building block of modern language models!

Your tasks:

- Literature research on recent advances in NCO.
- Based on published work in our lab and with our guidance, you will extend or re-design an existing Transformer-based network architecture for the Job Shop Scheduling problem.
- Perform ablation studies to better understand the relative importance of neural network design choices.

Your skills:

- You are close to finishing your master's degree, preferably in computer science, mathematics, data science or a related field.
- Good mathematical background.
- Good programming knowledge and skills in Python.
- First experience with deep learning and basic neural network architectures.
- First hands-on experience with PyTorch.
- Not afraid to work through the math in research papers.
- Ability to work and learn new topics autonomously.
- Proactive, goal-oriented, and communicative way of working
- Good language competence in English, written as well as spoken

Contact:

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