



Research Engineer Intern - Optimisation/RL/OR

March 2022 (starting date flexible). 6 month internship.

Industrial supervisor: Rebecca Jeffers.

Send applications to: r.jeffers@instadeep.com

REQUIREMENTS

- Theoretical and practical knowledge in the fields of mathematical programming (specifically combinatorial problems and mixed integer programming) and reinforcement learning.
- Python programming:
 - Knowledge of best practices (use of type hints (mypy), testing (pytest), etc.)
 - Numpy (and how to exploit vectorization and broadcasting)
 - Experience with any of the following libraries would be of great advantage: pulp, pyomo
- The ability to communicate results clearly in presentations and reports.
- Experience/knowledge of industrial and/or open source solvers such as coin, cplex, gurobi, SCIP would be an advantage.
- An awareness of DL tools such as pytorch, tensorflow or jax.

ABOUT INSTADEEP

InstaDeep Ltd is an industry leader in developing decision-making industrial artificial intelligence products for major global clients in Europe, the US, Africa, and the Middle East. We leverage our extensive know-how in GPU-accelerated computing, deep learning, and reinforcement learning to solve existing problems across a range of industries. Our expertise spans research, product and solution development, allowing the whole end-to-end solution to be developed in-house across our teams in Paris, the US, Lagos, Cape Town, Dubai, and Tunis.

The firm's hands-on approach to research, combined with a broad spectrum of clients, ensures an exciting and rewarding environment in which to work and thrive. InstaDeep has also developed collaborations with global leaders in the Artificial intelligence ecosystem, such as DeepMind, Nvidia, and Intel. After a Series B fundraiser, InstaDeep is partnered with industry leaders and backed by world-renowned technology companies, including BioNTech, Google, and Deutsche Bahn.

ABOUT THE DEEPPACK PRODUCT

DeepPack is an AI-Powered 3D Packing Software that delivers tangible bin packing volume and cost savings while seamlessly integrating many different operational constraints (<https://www.deeppack.ai/>). The product is being continually improved by adding new features requested by clients partaking in our [Early Access Programme](#) and improving performance by working closely with InstaDeep's expert research engineers.



INTERNSHIP AIMS

The bin-packing problem is well known in logistics, operations research and optimisation. The 1D problem is NP-hard, and the challenge only increases in higher dimensions. InstaDeep uses reinforcement learning (RL) methods to solve this challenging problem in a short amount of time. Preliminary work resulted in a NeurIPS Deep RL workshop publication (<https://arxiv.org/abs/1807.01672>). Since then, the DeepPack product has evolved to use more recent and sophisticated RL methods. InstaDeep has also developed a simplified open source bin packing environment for experimentation with new ideas (<https://github.com/instadeepai/jumanji/tree/main/jumanji/environments/combinatorial/binpack>).

Reinforcement learning for the bin-packing problem has many advantages:

- Once a model is trained on many example instances, a feasible solution can be found rapidly (almost instantly) to a new problem.
- The RL agent learns the most appropriate heuristics based on real data, removing some human biases from the decisions that can be found in other heuristic solutions.
- Generalisation techniques allow the model to handle a wide range of different problems.

Exact optimisation techniques such as branch and bound, branch and cut or branch and price have some of the following advantages:

- They provide bounds on the optimality of the solution (guaranteeing its quality)
- Modelling global coupling constraints is trivial

The aim of this internship is to explore the combination of RL/ML techniques and exact optimisation techniques to obtain the advantages of both methods.