InstaDeep™

Leader in Decision-Making AI

September 2022

Self-play AI (Reinforcement Learning) vs. Pattern detection (Machine Learning)

Garry Kasparov, “chess” World champion defeated by AI

Lee Sedol, “Go” World champion while being by defeated AI

Reinforcement Learning is an AI that learns actively via “self-play” and at some point is learned well enough to autonomously take the best possible decision for solving your problem
⇒ We now bring this new breed of “Decision-Making AI” to the world of supply chain & logistics!

InstaDeep: EMEA Leader in AI

Founded in 2014, HQ in London

10 Offices

237 Employees

Decision-Making products: delivering AI-driven efficiencies for advanced enterprise customers

Three Pillars Differentiate InstaDeep

Solving complex challenges for top tier international customers

BIONTECH, Google, TOTAL, DB BAHN, GEICO, salomon

Access to top Talent. Partner with leading Universities

Massachusetts Institute of Technology, UNIVERSITY OF MICHIGAN, UNIVERSITY OF OXFORD, UCL, SCIENCES SORBONNE UNIVERSITÉ, ÉCOLE POLYTECHNIQUE

Cutting-edge AI Research. Joint R&D work with elite partners

DeepMind, Google Developers Experts, NVIDIA, intel, ICLR, NEURAL INFORMATION PROCESSING SYSTEMS

* 5 InstaDeepers out of 171 Google ML Dev Experts globally

Google Cloud Partner, NVIDIA ELITE PARTNER, AI 100 CBINSIGHTS 2020, AI 100 CBINSIGHTS 2021, AI 100 CBINSIGHTS 2022, intel AI Builders, endeavor ENTREPRENEUR

InstaDeep™

Recent News!

BioNTech, **Google** and **Deutsche Bahn** are investors

Early Warning System for Covid-19 variants (with BioNTech)

"More than 10,000 novel variant sequences are discovered every week and human experts simply cannot cope with complex data at this scale," said Karim Beguir, co-founder and chief executive of UK-based InstaDeep. "For the first time, high-risk variants could be detected on the spot, potentially saving months of precious time."

How AI tool will help detection of coronavirus variants of concern

Difference in days between early warning system detection date and WHO designation of the variant as high-risk

Sources: BioNTech, InstaDeep

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FT FINANCIAL TIMES

DER SPIEGEL

CNBC AFRICA

THE HILL

FORTUNE

REUTERS

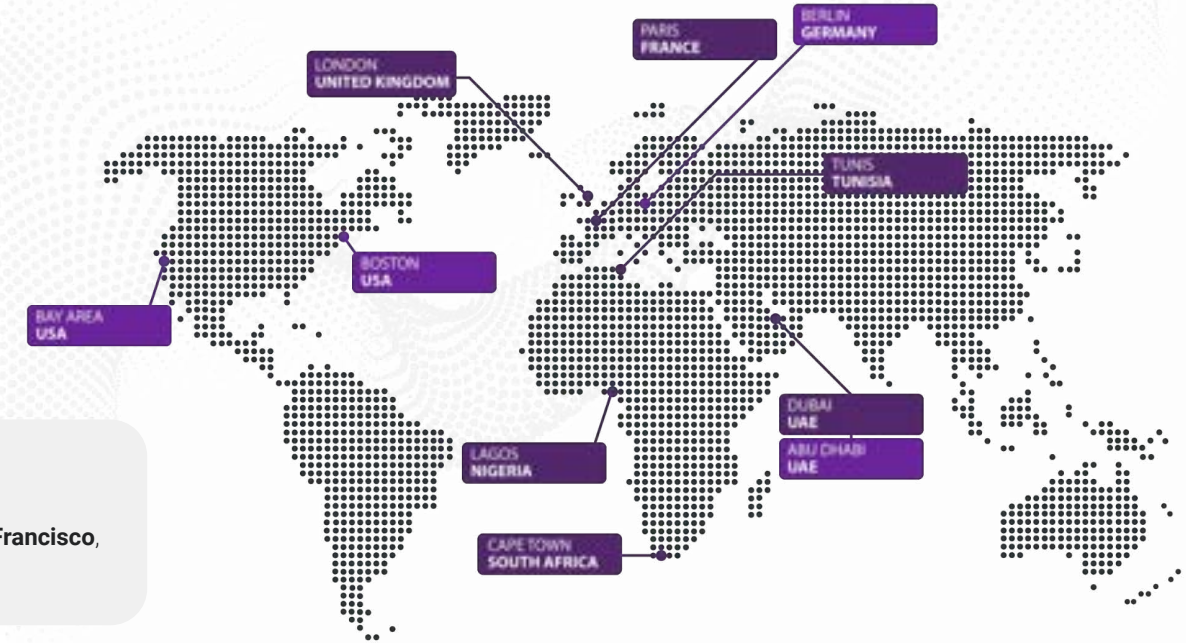
InstaDeep™

Talent! AI Research, Engineering, Software & Infrastructure

128 **AI Research & Engineering**
ML Engineers, Research Engineers
Research Scientist, Data Scientists

38 **High Performance Engineering**
HPC Engineers Software Engineers
DevOps Specialists

29 **Insights & Visualisation**
UX/UI Designers, Unity Developers
Storage & CC Engineers



Expansion:

4 new locations opened: **San Francisco**, **Boston**, **Berlin** and **Abu-Dhabi**

InstaDeep™

Our Value Proposition

InstaDeep is one of a very few companies **innovating** in AI research while **practically deploying** machine learning in the real world.

We deliver value with our

1. **Decision-Making AI Technology leveraging Reinforcement Learning**
2. **HPC & ML / RL Infrastructure Expertise**
3. **Ability to deploy for real-world Problems across Verticals**

Benefits of Decision-Making AI for Logistics

1

Address highly Complex Business Constraints

Many challenges in this domain are multi-objective, sequential decision-making problems that ML alone can not solve

2

Real-Time Decisions in Dynamic Environments

Real-life business operations are subject to uncertainty and change - RL agents can adapt to previously unseen situations

3

No Need for Massive Amounts of Training Data

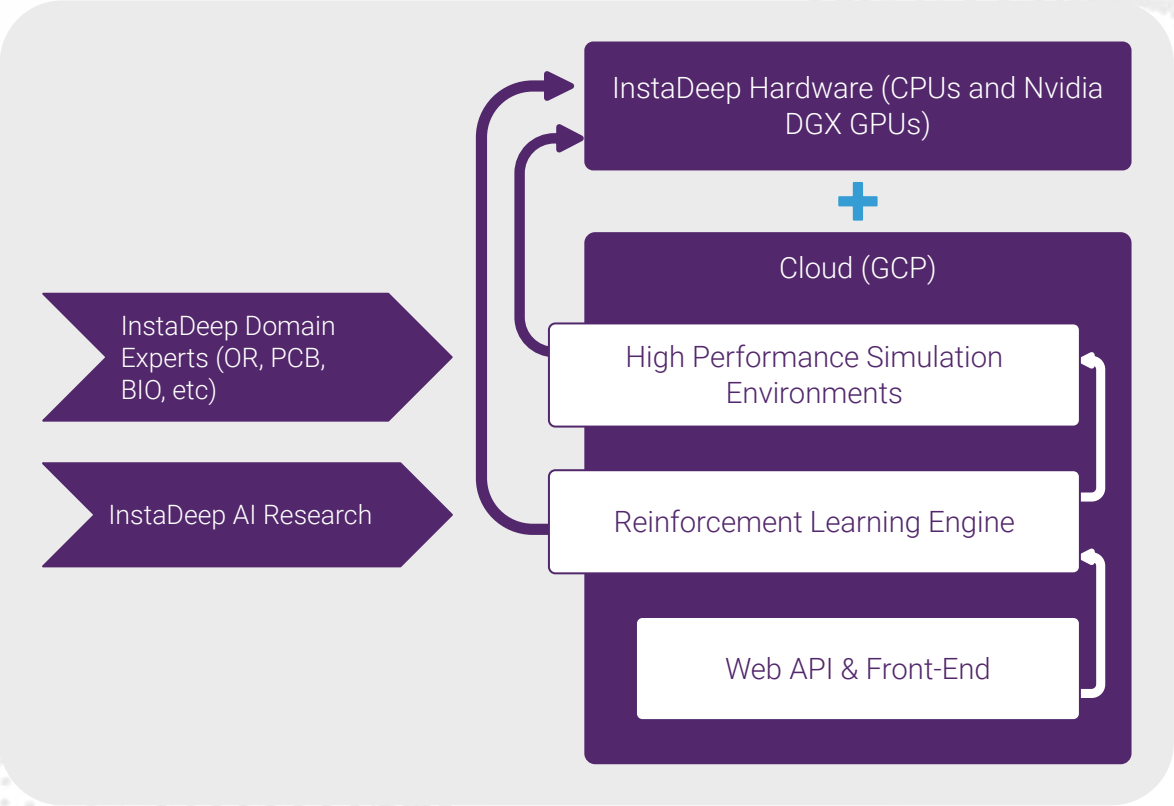
Digital twin simulators generate required labelled data for RL algorithms to learn from and optimize decision-making

4

Actionable AI

Shift operating model from reactive and prognostic to being proactive by training expert AI systems that take decisions

Our Cutting-edge Engine for Decision-Making AI



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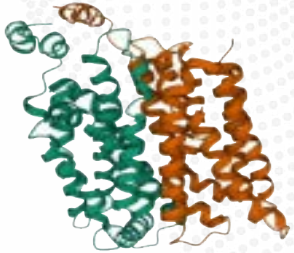
Products: Deep**Chain**™, Deep**PCB**™, Deep**Pack**™, Deep**Rail**™

Productizing with our Decision Making Technology

InstaDeep's Decision Making Technology + **Domain Expertise** = **Scalable Products**

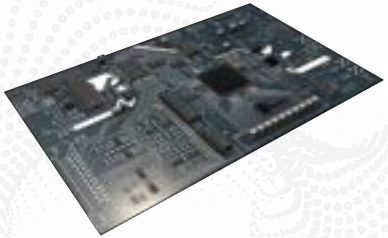
DeepChain™
(Drug/Vaccine Design)



Design new candidate cures and vaccines with AI and BioInformatics

Accelerates drug development cycles saving time, money & lives

DeepPCB™
(Hardware/IOT)



Route complex printed circuit boards in less than 24 hours

Accelerates the product cycle in IOT and consumer electronics

DeepPack™
(Logistics/Supply Chain)

Pack items more efficiently to improve supply chain logistics

Save money on transport costs for large shipments

DeepRail™
(Fleet Management)

Optimize train scheduling and mobility fleet management

Reduces passenger delays, better yields on infrastructure projects

RL Model Innovation - Solving the 3D Bin Packing Problem

In 2018, our R&D team delivered fundamental **AI innovation on Bin Packing**, leading to a NeurIPS Deep RL workshop publication with results on 2D/3D settings.

Our work was **publicly praised by David Silver** (inventor of AlphaGo, Google DeepMind) as a use case of RL in real life*.

Our R&D has since developed Deep**Pack**™: an AI-powered product solving **container loading problems** for logistics/supply chain.

Ranked Reward: Enabling Self-Play Reinforcement Learning for Combinatorial Optimization

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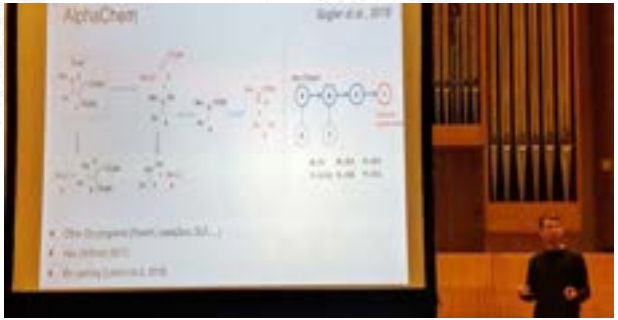
Published at NeurIPS 2018
Deep Reinforcement Learning Workshop



*David Silver mentions InstaDeep's Bin Packing in his use cases of AI presentation (Aug 2018)

DeepPack™

Logistics Product Use Case:

DeepPack™: Pack Items more efficiently and save on your logistics costs

LOOKING FOR A ULD PARTNER!

The Bin Packing Problem

Packing a set of items into **fixed-size bins** while **minimizing a cost** function e.g. number of bins required, surface of the packing

Constraints include:

- Prevent items from overlapping
- Gravity and the need for a physical support
- Limited rotations
- Packing stability and weight distribution

InstaDeep™

DeepPack™ : World-First AI-Based 3D Cargo Packing Software

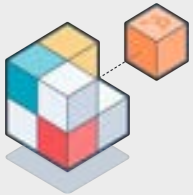
To efficiently pack containers, pallets and boxes

- Single & Multi Container
- More than 5K items per load plan
- More than 50 different shapes
- Adapts to any operational constraint

DeepPack™ : Why is it Differentiated?

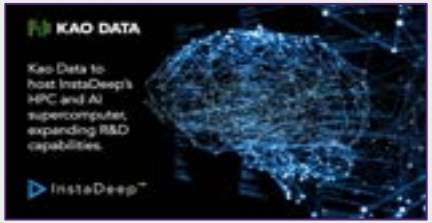
Flexible

- Plug-and-play system for constraints management: our decision-making engine **can easily integrate additional constraints and requirements**
- Complete **flexibility** on the **optimisation objectives**



Scalable

- Has its own **state of the art ML infrastructure**: cluster of NVIDIA DGX and A100 supercomputers
- Leverages our cutting-edge library for **large scale training** of AI algorithms



Smart

- **Learns from first principles** through interactions with real time instances.
- Not biased by handcrafted **heuristics**
- **Ongoing online learning** to make further improvements at deployment, and **well suited** to **changes in data distribution** over time

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Other RL Use Cases in Logistics

Inventory Management - Dynamic Planning

Where to stock and how much to stock?

Goal: Optimise inventory management for more robustness against dynamically shifting consumer demand

Solution:

- AI-powered solution encompassing **supply and demand side inputs** (**incl. accurate demand forecasting**) and logistics constraints (warehouses, distribution centers, routes, etc)
- Simultaneous optimization for multiple objectives, e.g. **minimizing costs** for restocking, holding, fulfillment and transportation
- **Cut losses and waste (and increase sales)** due to overstocking (or understocking

Features:

- Multi-Constraint problem that takes into account current inventory levels, in-transit quantities, stock limitations and upcoming supply, among other factors, including historical data sets

AI Technique:

- A **Deep Multi-Agent RL approach** where a simulator can implement all operational constraints of warehouses and delivery network. The RL agent then learns to take the right actions in order to fulfil stock planning objectives

Inventory Management - Picking Optimisation

Increasing and shifting customer demand putting strain on order fulfilment speed

Goal: Optimize multi-order picking strategy to increase handling and fulfilment speed as well as efficiency

Solution:

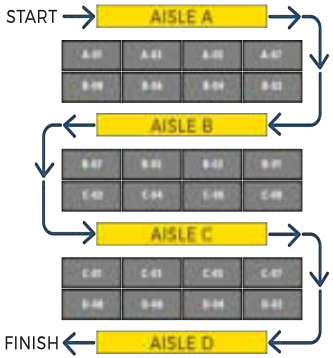
- AI-powered solution to help create picking strategies to **maximize rate of order fulfilment** and customer satisfaction
- The system can simultaneously be optimized for multiple objectives, e.g. **minimizing the per picking tour cost, inventory cost or space utilized**

Features:

- Add any additional constraints for the AI system to work out
- Squeeze in any extra unexpected incoming pick tickets with small time windows even if a sorter is filled

AI Technique:

- An **RL approach** where a simulation on an abstract model of the warehouse enables testing of multiple picking strategies and scenarios without having to issue instructions to associates.
- This simulator is then used to train an RL algorithm to create an optimal picking solution.



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Transportation - Dynamic Fleet Management

Deploy fleets for maximum customer satisfaction

Goal: Improve fleet utilization and match customer orders more efficiently, while saving operating costs

Solution:

- AI-powered solution for achieving the **maximum number of successful timely re-allocations of underutilized resources (e.g. trucks)**
- The system can find the **best allocation policy** for any given demand and supply and **maximize the value of shipments** made

Features:

- Multi-Constraint problem taking into account standard lifecycle management data of the fleet incl. from telematics

AI Technique:

- A **Deep Multi-Agent RL approach** where a simulator can implement all operational constraints of the network and fleet. The RL agent learns to take the right actions to fulfil the delivery objectives based on stochastic demand.

Transportation - Dynamic Vehicle Routing

Make fast changes to routes and tasks in response to dynamic events

Goal: Dynamically optimise route selection for shipments across large networks with critical time and resource constraints

Solution:

- AI-powered routing solution for **achieving the maximum number of successful deliveries** per day
- The system can be optimized for delivery time to ensure **satisfaction of customer SLAs**, also enabling fuel cost saving thanks to higher efficiency

Features:

- **Instantaneous re-routing** in response to shifts in plan
- Multi-Constraint problem taking into account available vehicle capacity, distance between customers, fleet size, disruptions, amongst others

AI Technique:

- A **Deep RL approach** where a simulator can implement all operational constraints of the network and fleet. The RL agent learns to take the right actions to fulfil the delivery objectives based on a stochastic demand.
- RL leveraging **Active Search** on multiple instances to absorb any disruption in the short term and maximising long term rewards across all deliveries.

Air Freight - Capacity Allocation Management

Make better container capacity allocation decisions, create more transparency and offer better service

Goal: Optimise capacity management to increase client retention and avoid losses in times of constrained resources

Solution:

- **AI-powered solution** with inputs from **demand side** (customer) and **supply side** (container capacity) while accounting for strong fluctuations
- **Maximise available freight capacity for brokerage and the rate of successful allocations** in line with customer SLAs while **obtaining better rates** and conditions from shipping lines, on the other end
- **Integrated solution** for allocation (short-term) and planning (mid-term)
- Optimize the same model for **multiple objectives,** like SLA fulfillment, profit maximisation, or capacity utilisation efficiency, among others

Features:

- **Multi-Constraint problem** taking into account time horizons, frequency of transports, container and vehicle capacity and disruptions, amongst others

AI Technique:

- **Deep Reinforcement Learning approach:** A simulator implements all operational constraints. The RL agent learns to take the right actions to fulfil allocation objectives and adapts to previously unseen situations or demand fluctuations.

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Service Delivery Framework

Our ethos is a **collaborative approach** where we encourage **knowledge-sharing** and regular check-ins.

- Hands-on approach to understand your business challenges, iterate with you to reach results.
- Project can be **de-risked** by defining intermediate **milestones**.
- Start with a Pilot Project and increase gradually **only** upon us delivering **material results** at each step.

Our Goal is to deliver results and accelerate your AI & Digital transformation journey

InstaDeep™

Annex - Research & Infrastructure

September 2022

AI Research: Leader in Reinforcement Learning

Publications

InstaDeep has reached the **milestone** of being **published in all major ML conferences** (**NeurIPS, ICLR, ICML**). We intend to keep this steady, across-the-year, high-quality publication throughput.

- One accepted paper at **ICLR 2022**, coming from our sponsorship at Oxford University
- One accepted paper at **ICML 2022** on the use of JAX for fast population-based training

InstaDeep Research is publishing in **Nature** journals, the most prestigious journals in the world.

- One paper published in **Nature Communications**, a collaboration with Imperial College London.
- First publication on **Quantum Machine Learning** in **Nature Machine Intelligence**, a collaboration with Oxford University

The recently created research track on **Quality-Diversity** already yields great outcomes.

- **2 papers** accepted at **GECCO**, the main conference in the field – as well as one workshop paper.
- InstaDeep signed an **agreement with Imperial College London** to sponsor a PhD on this topic.

nature machine intelligence

nature communications

NEURAL INFORMATION PROCESSING SYSTEMS

ICLR

ICML
International Conference On Machine Learning

GECCO

Expertise in ML Infrastructure

- InstaDeep is a certified **Service Delivery Partner (SDP)** for Nvidia and one of **only** two AI **Elite Partners** in EMEA, and one out of six worldwide.
- InstaDeep operates its own cluster of **NVIDIA DGX** GPUs, including the latest A100 and is an expert user of related software stack, including **Jarvis** (for NLP) and **NEMO**.
- InstaDeep has proven expertise implementing end-to-end projects on **supercomputers** using thousands of Nvidia GPU nodes.
- This **infrastructure expertise** is available to our customers and can help **save costs** vs. cloud computing.