

# Research Interest and PhD Topics

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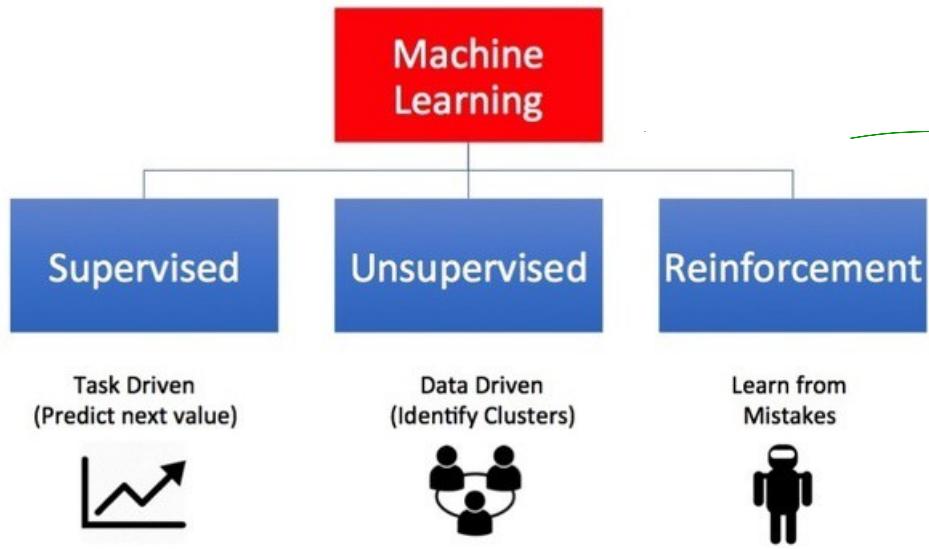
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# Research Interest

- New Theory of **Learning** and **Planing** for Sequential Decision Making (**PhD topic 1 + 2**)
  - Reinforcement learning
  - Planning under uncertainty (Partially observable Markov decision process)
- **Applications**
  - Autonomous systems (**PhD topic 3**): e.g. conversational agents (chatbot: Phone-based Personal Assistants like SIRI, Cortana, Google Now )
  - Human-robot interaction (**PhD topic 4**)

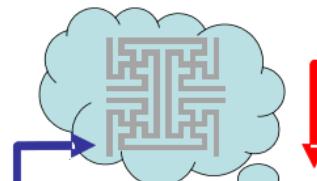
# PhD Topic 1: Theory of Learning for Sequential Decision Making

Focus: Deep reinforcement learning using Bayesian neural networks



Reinforcement learning

internal state



learning rate  $\alpha$   
inverse temperature  $\beta$   
discount rate  $\gamma$



environment



action

observation



Application of RL in Autonomous Driving

# PhD Topic 2: Theory of Planing for Sequential Decision Making

**Focus:** Planning under partial observability/feedback, imperfect sensing, noisy signals etc. (using **Bayesian inference, deep learning**)



# An example application: AlphaZero

DeepMind's AlphaZero teaches itself to beat humans at chess, Go and Shogi

Web Log: Experts believe AI will soon be able to play video games like Minecraft

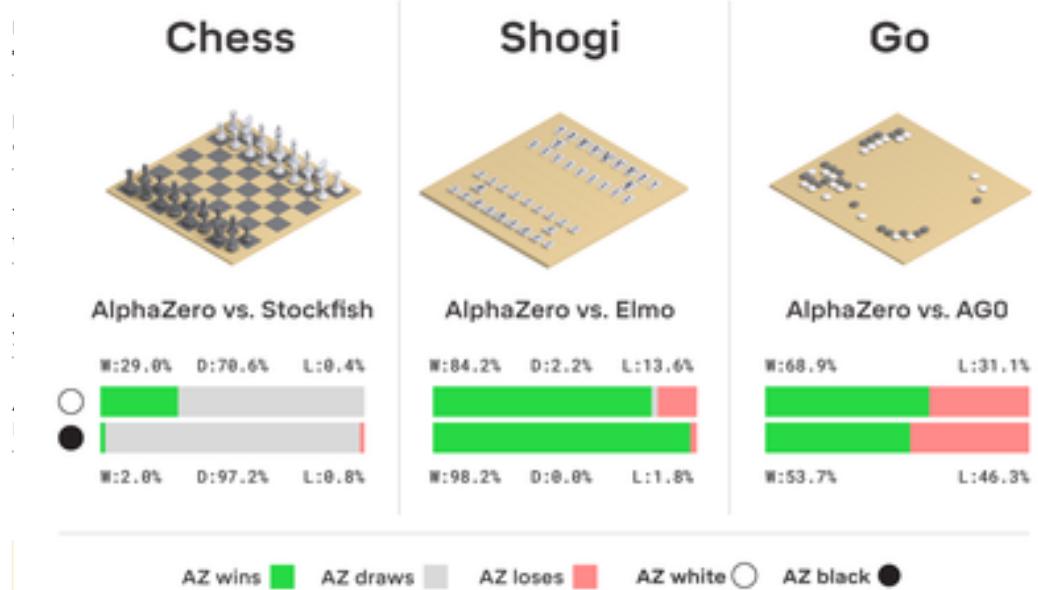
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Marie Boran



Alphabet-owned AI company DeepMind's AlphaZero system taught itself to outwit DeepMind's own specialised system for playing Go.

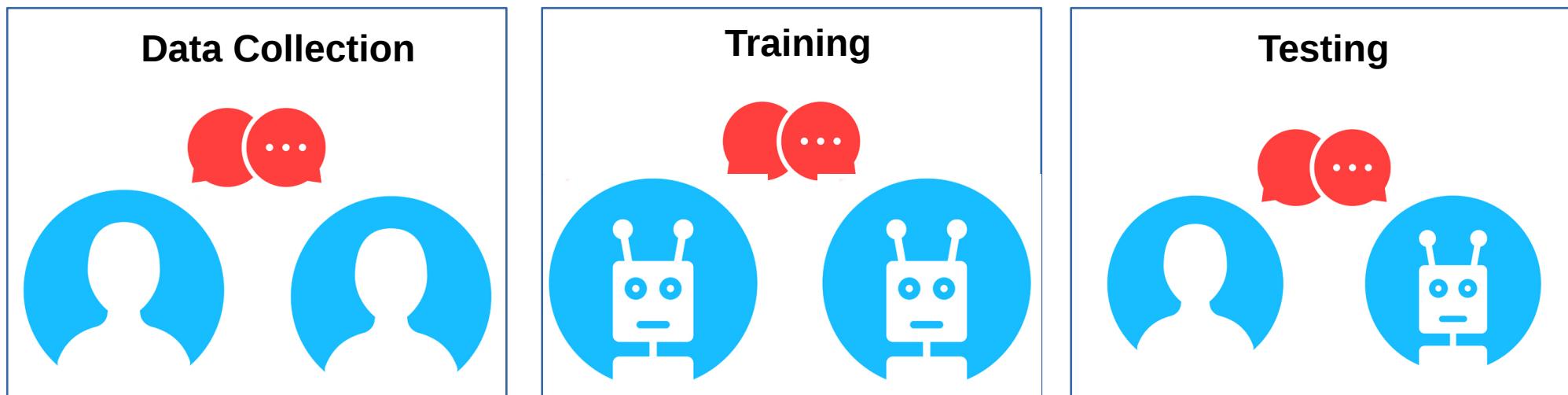
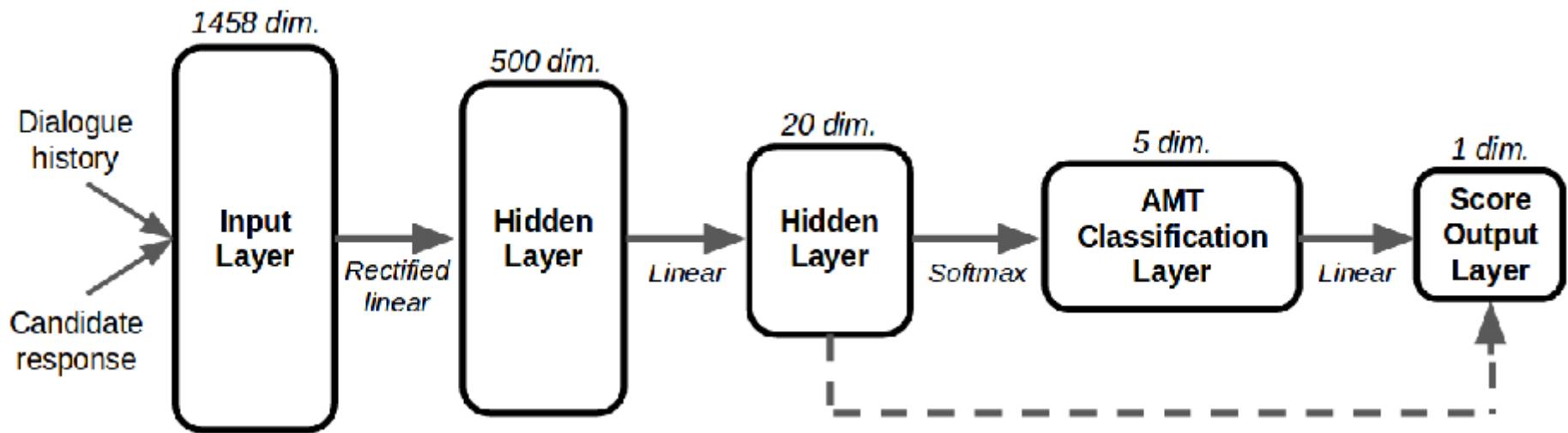
Last year the Alphabet-owned AI company DeepMind revealed to the world a system called AlphaZero that taught itself to outwit DeepMind's own



**Key algorithms: Reinforcement learning (self-play) and AI planning (plan into the future)**

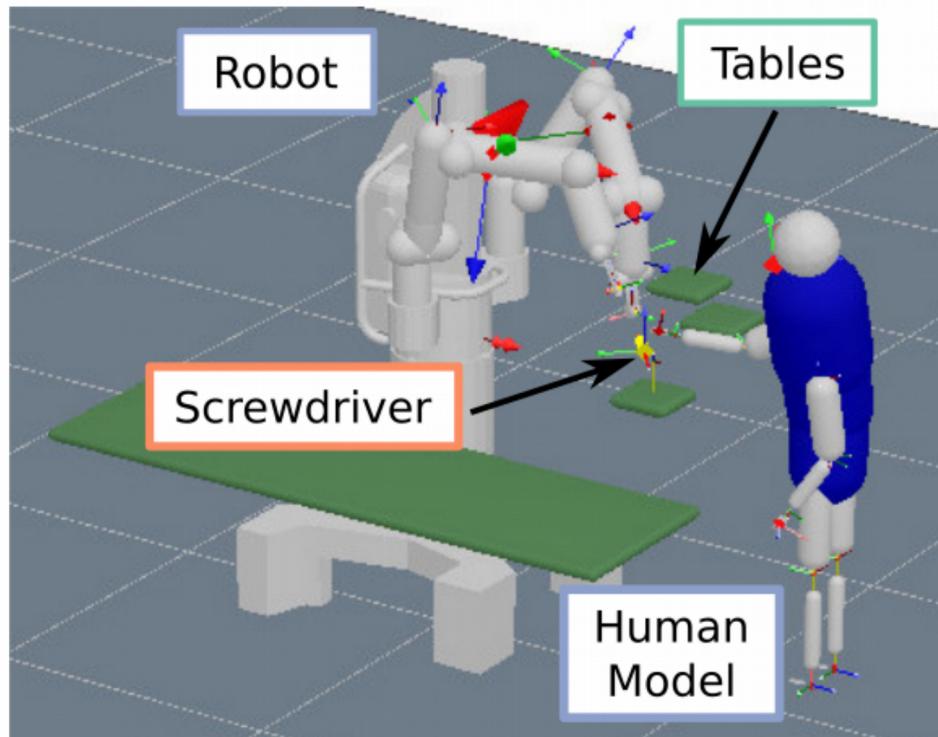
# PhD Topic 3: Training **chatbot** in the wild

Focus: imitation learning, sequence-to-sequence and deep reinforcement learning



# PhD Topic 4: Human-Robot Interaction

**Focus:** Deep reinforcement learning, AI planning, and robot control



Agent

Object

Environment

**Robotic platform: Simulation and a physical Baxter robot platform at (i-AMS, QUB)**