

Artificial Intelligence: Current Trends and the Future

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Artificial Intelligence (AI)

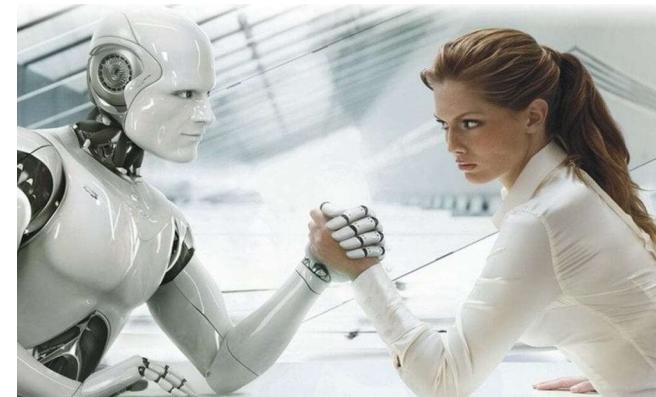
- **Intelligence**
 - “Capacity to **solve new problems** through the use of knowledge”
- **Artificial Intelligence**
 - “Science concerned with building **intelligent machines**, that is, machines that perform tasks that when performed by humans require intelligence”



Weak and Strong AI

- **Weak Artificial Intelligence**

weak AI, also known as narrow AI is artificial intelligence that is focused on one **single narrow task**



- **Strong Artificial Intelligence**

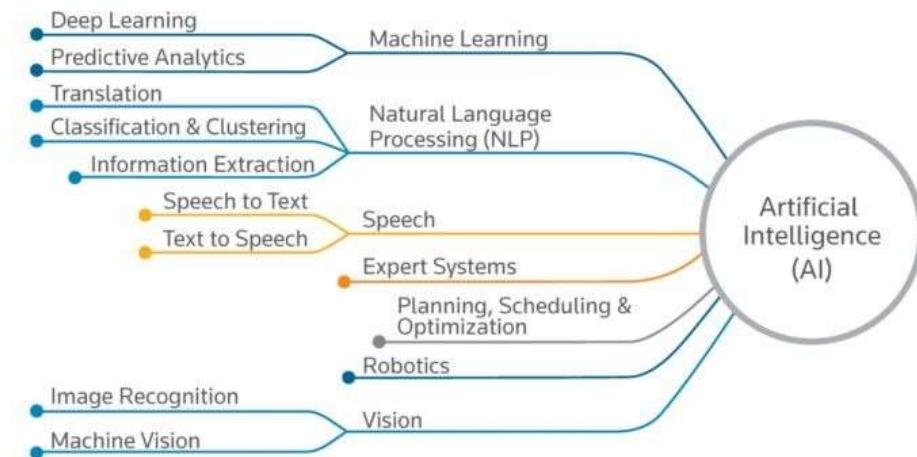
Strong AI or Artificial General Intelligence (AGI) is the intelligence of a machine that could successfully perform **any intellectual task** that a human being can! Science fiction ?



Some Areas of Artificial Intelligence

Some AI Areas:

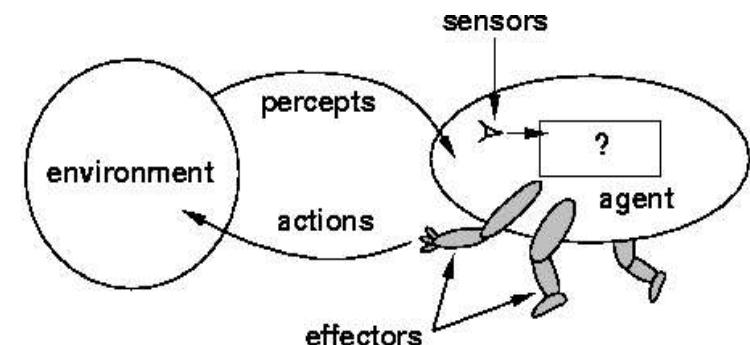
- **Knowledge Representation and Reasoning**
- **Expert Systems**
- **Problem Solving**
- **Planning and Scheduling**
- **Machine Vision**
- **Machine Learning**
- **Natural Language Processing**
- **Intelligent Robotics**



Autonomous Agents and Multi-Agent Systems

Agent:

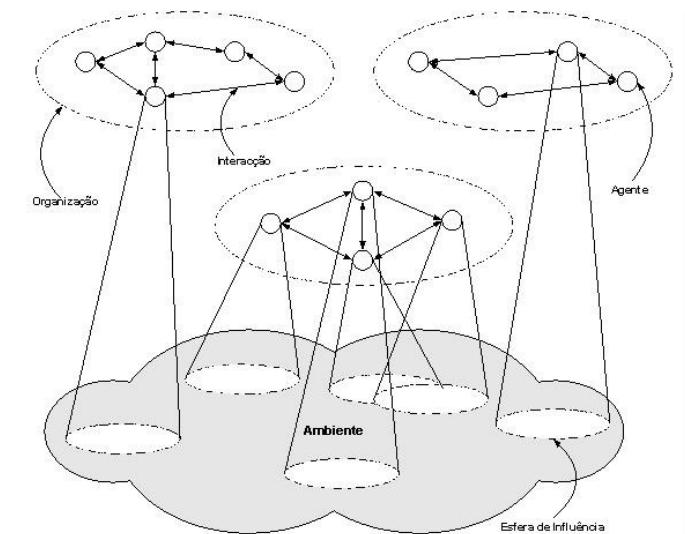
“Computational System, situated in a given **environment**, that has the ability to **perceive** that environment using **sensors** and **act**, in an **autonomous way**, in that environment using its **actuators** to fulfill a given **function**.”



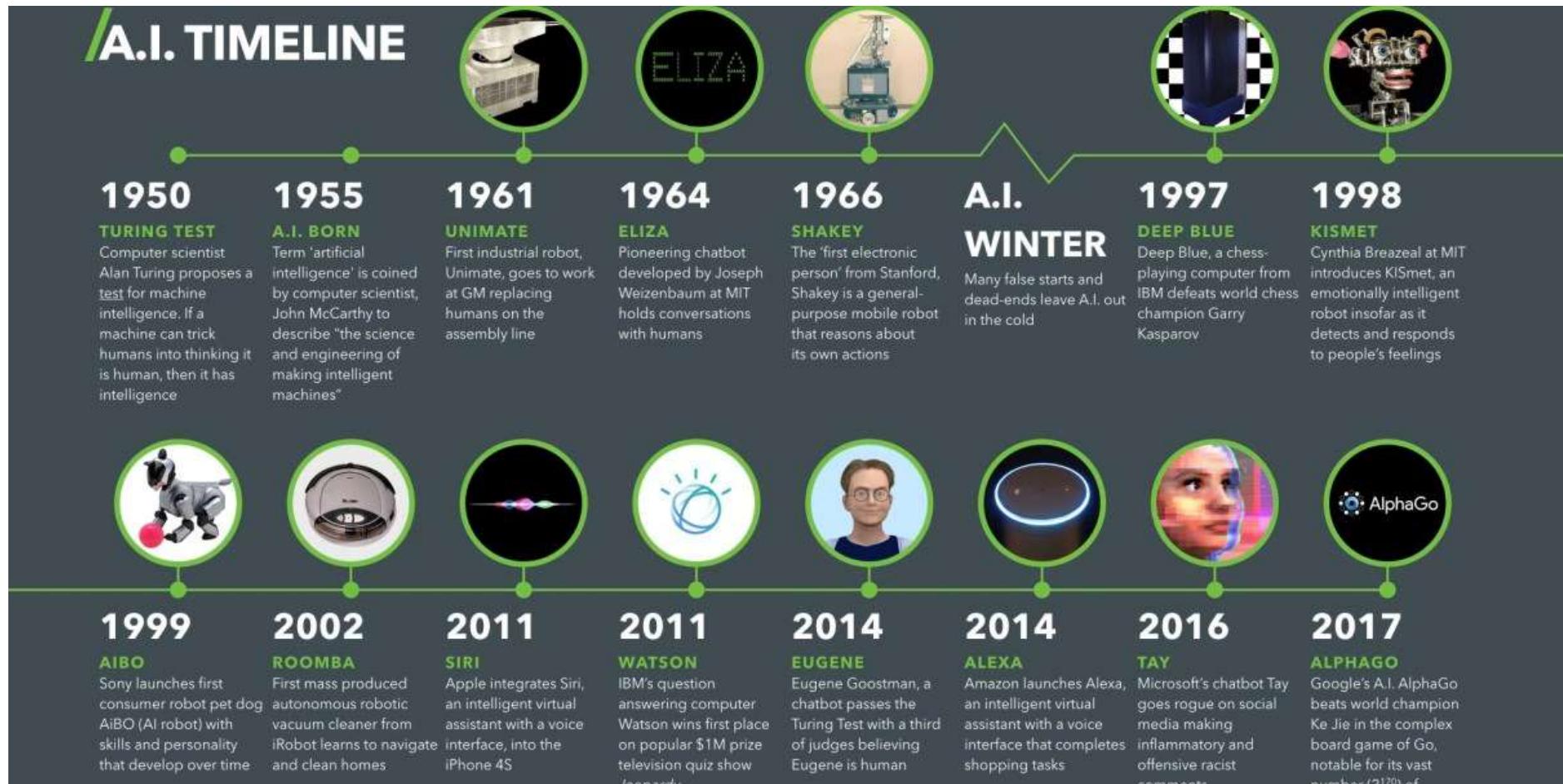
Russel and Norvig, "AI: A Modern Approach", 1995

Multi-Agent System:

- Agents exhibit **autonomous behavior**
- **Interact** with other agents in the system

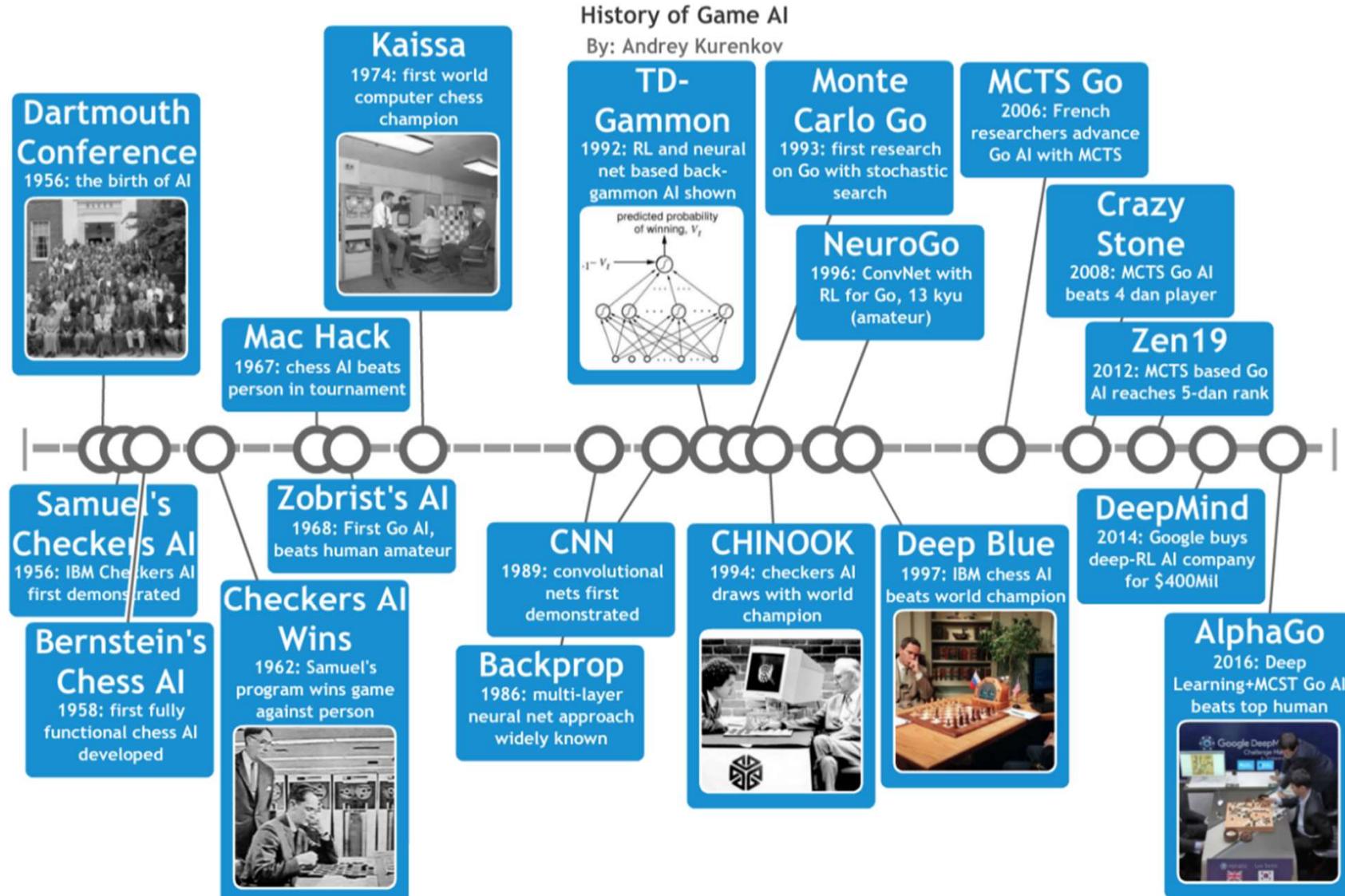


AI Timeline



[Paul Marsden, 2017]

AI Timeline – AI Games



Some Recent AI Successes



Watson defeats Jeopardy champions (2011)



DeepMind achieves human-level performance on many Atari games (2015)



CMU's Libratus defeats top human poker players (2017)



AlphaGo defeats Go champion (2016)

Artificial Intelligence Today



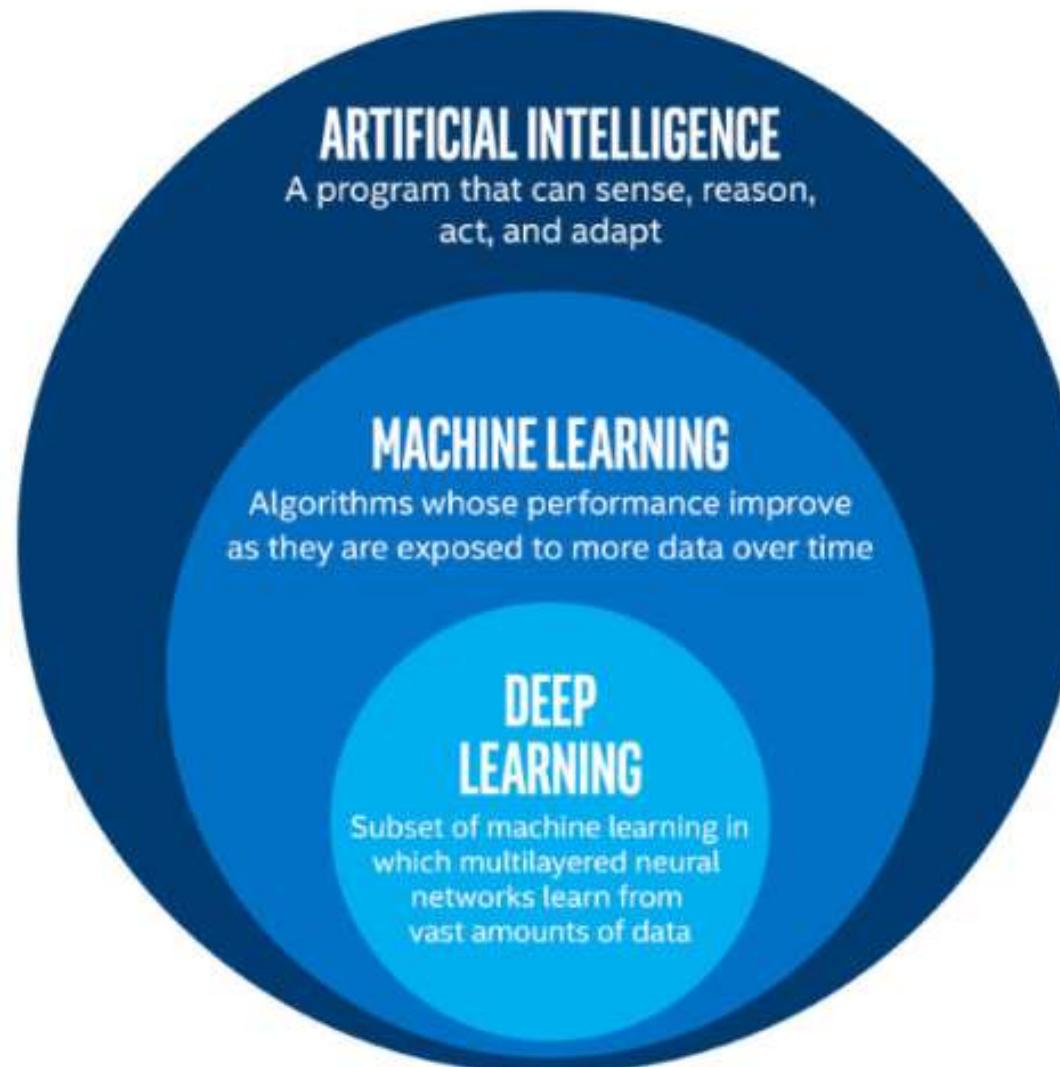
Machine Learning

“Machine learning enables a machine to automatically learn from data, improve performance from experiences, and predict things without being explicitly programmed.”

Arthur Samuel, 1959

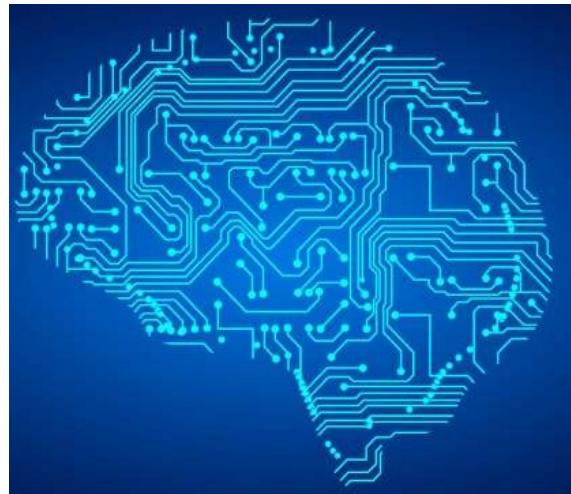


Machine Learning vs. Artificial Intelligence



AI - Machine Learning

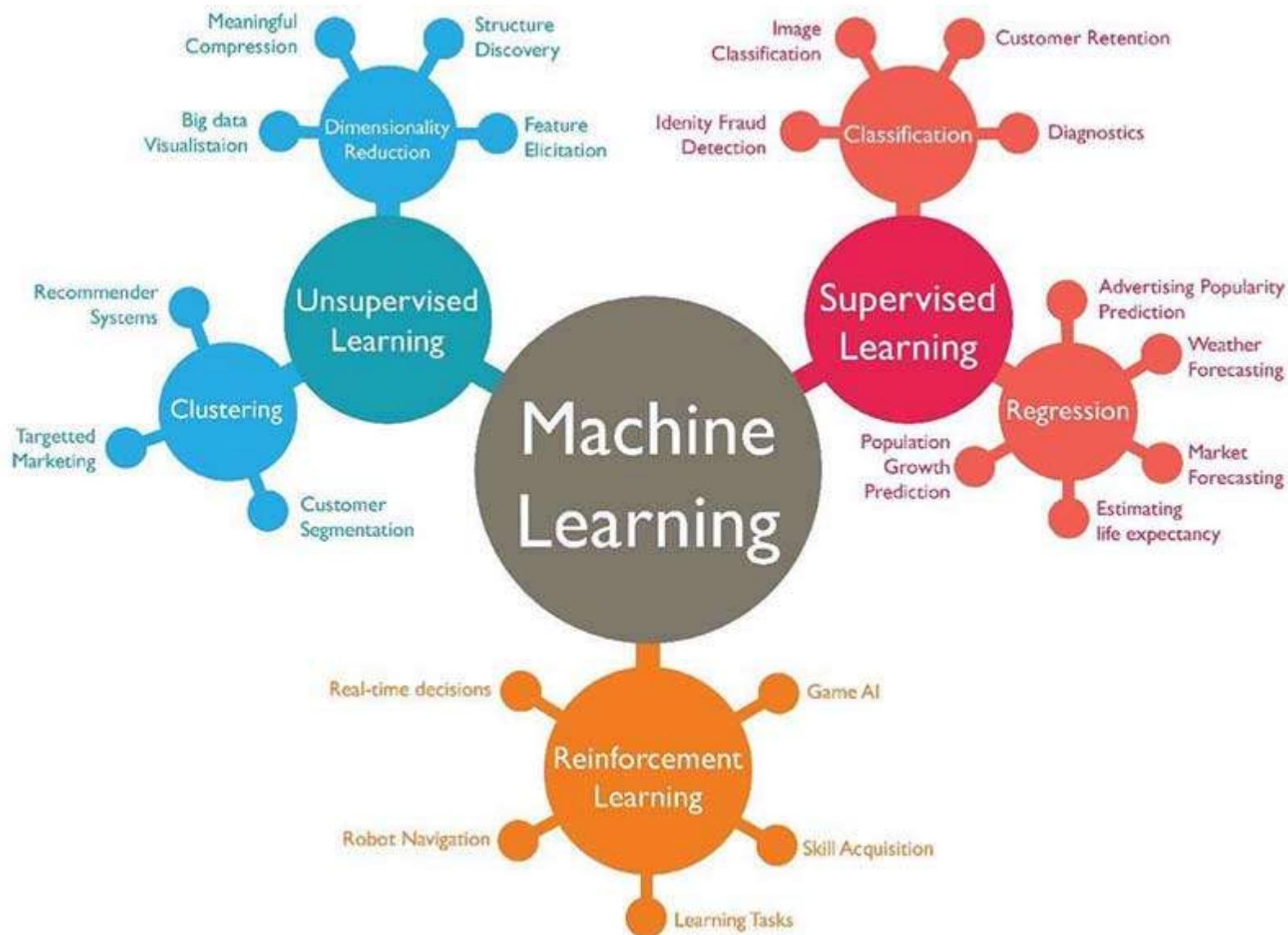
- **Machine learning** is a field of artificial intelligence that gives **computer systems** the **ability to "learn"** (e.g., progressively **improve performance** on a specific task) **from data/results of their actions**, without being explicitly programmed



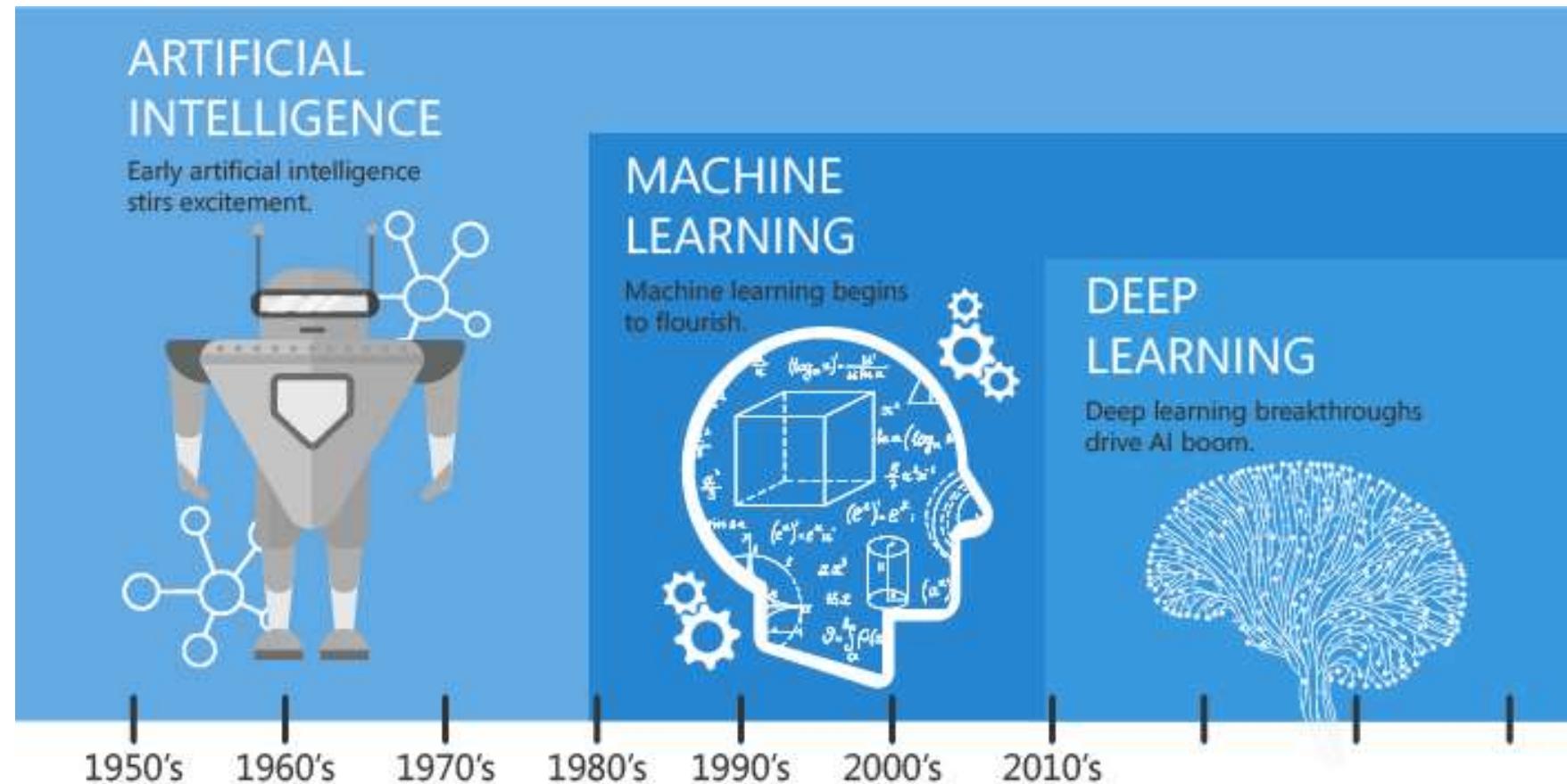
Artificial Intelligence: Machine Learning



AI - Machine Learning



Machine Learning - History



Programming vs Machine Learning

Traditional Programming

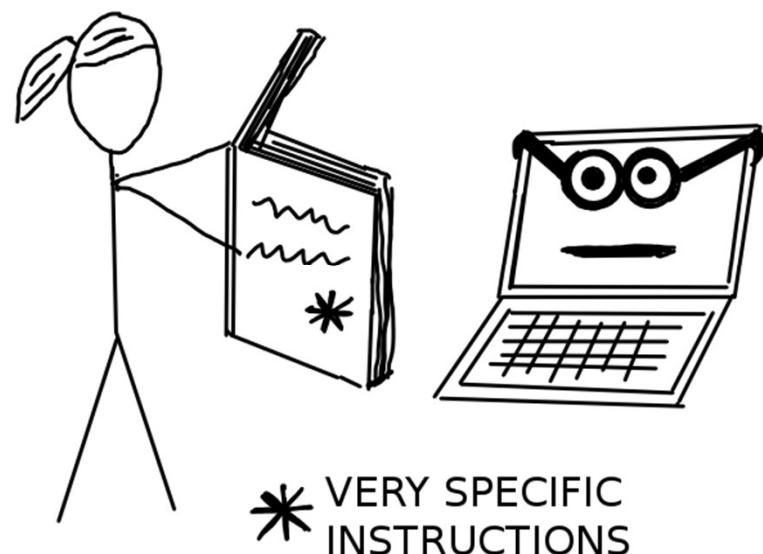


Machine Learning



Programming vs Machine Learning

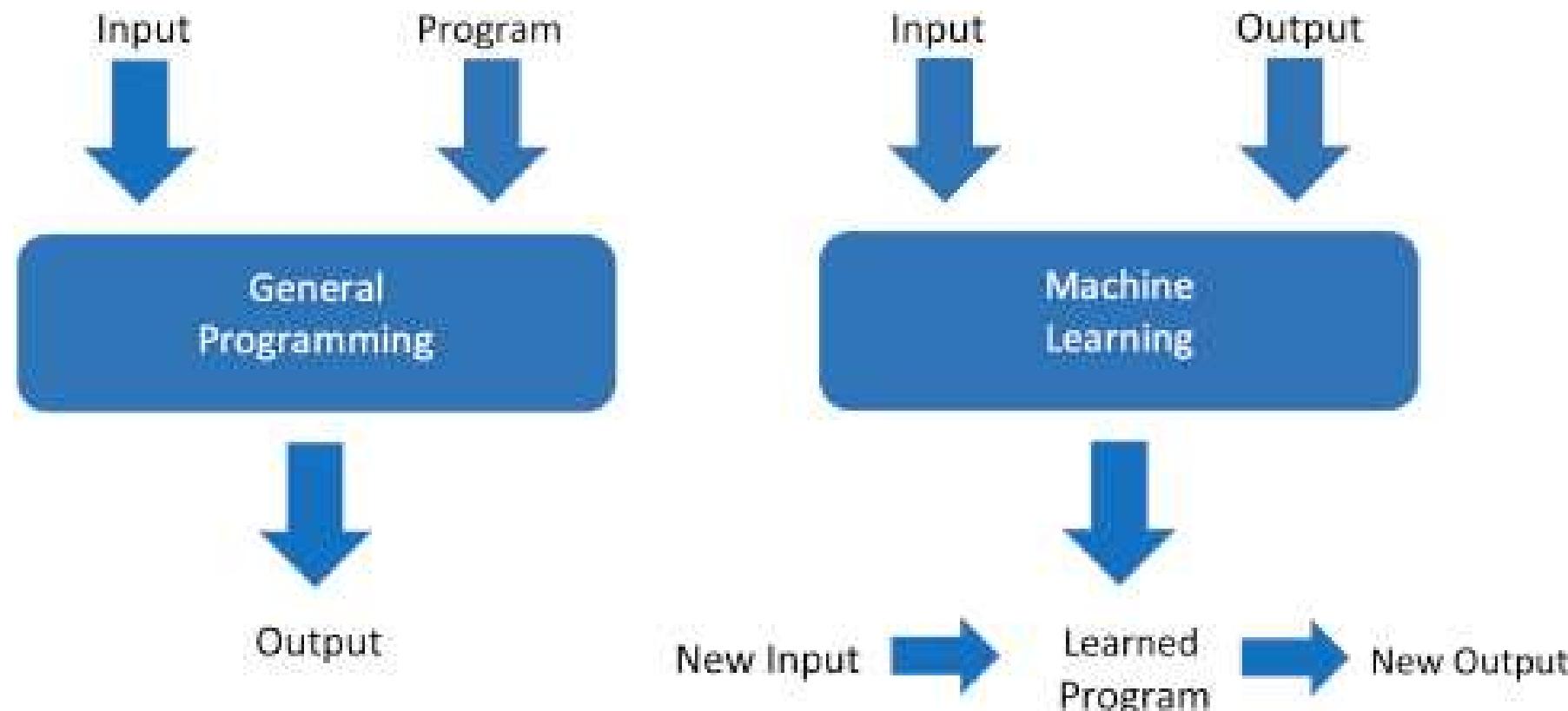
Without Machine Learning



With Machine Learning



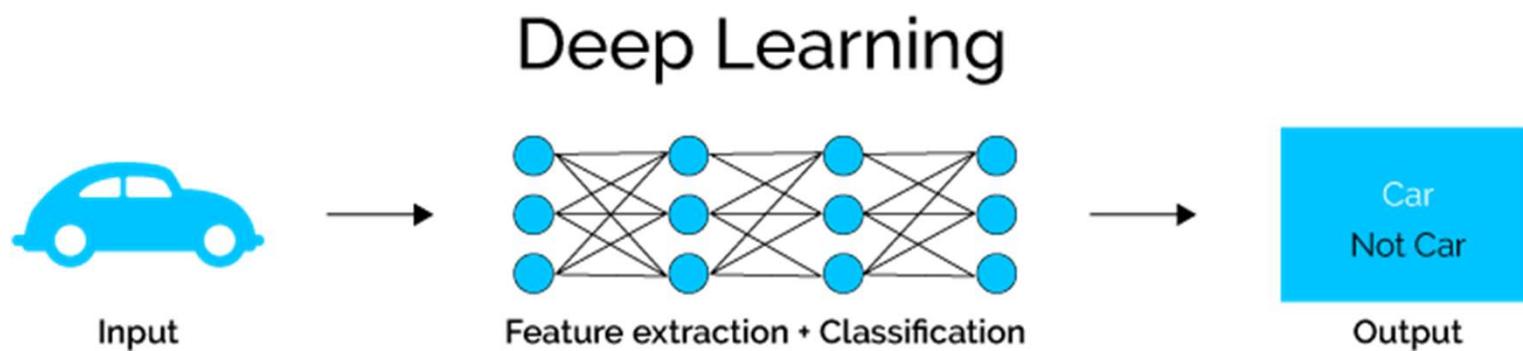
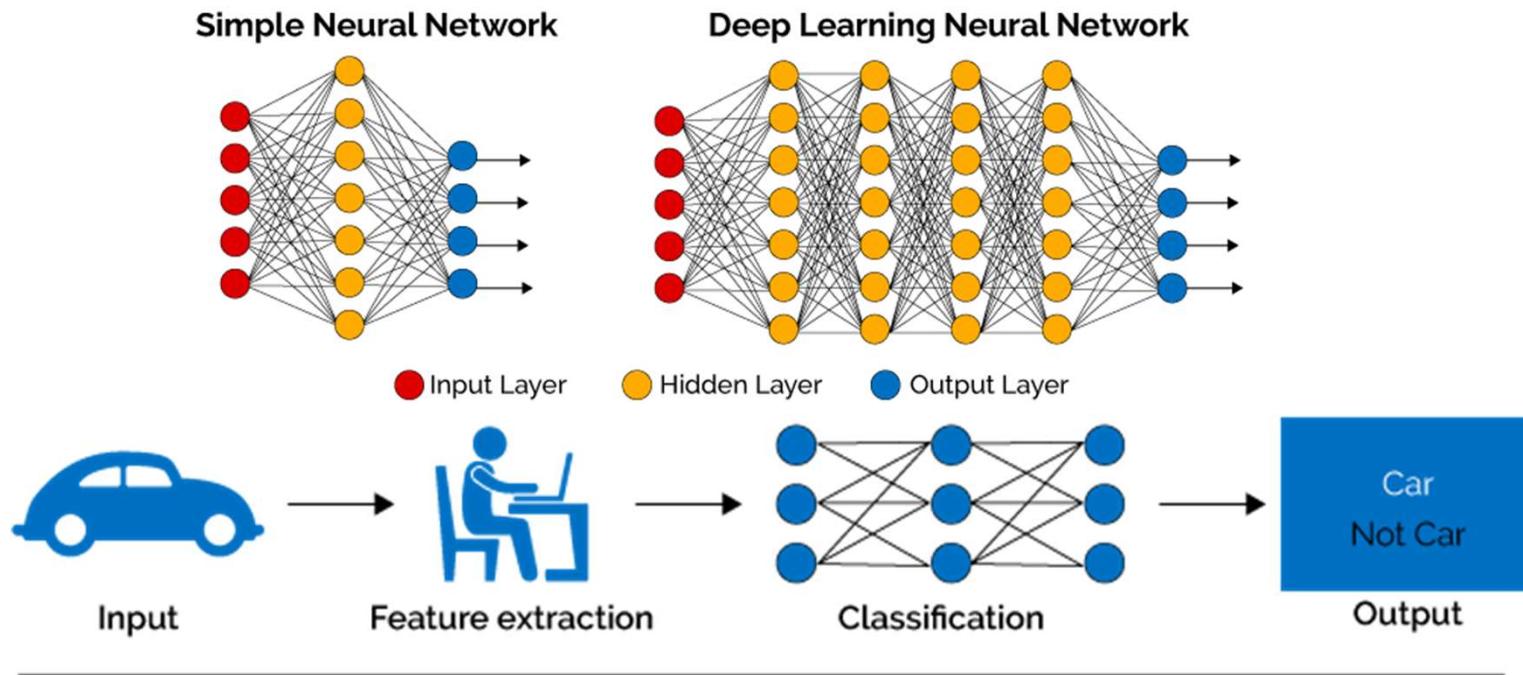
Programming vs Machine Learning



Machine Learning

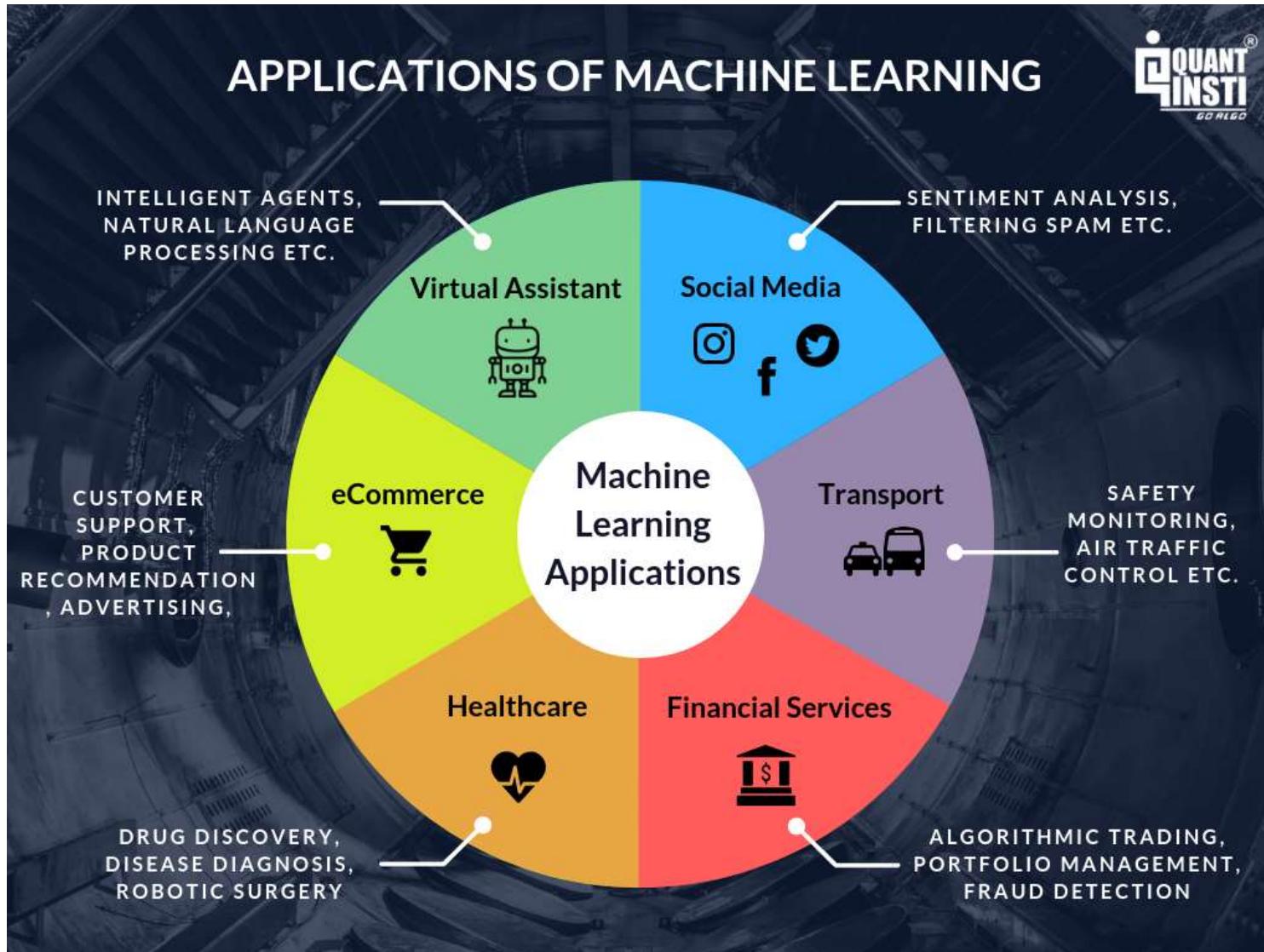


AI - Deep Learning



<https://www.xenonstack.com/blog/static/public/uploads/media/machine-learning-vs-deep-learning.png>

Machine Learning - Applications



AI – Natural Language Processing

- **Machine translation**

- Based on multilingual textual corpora
- Text translation and multilingual real-time conversations



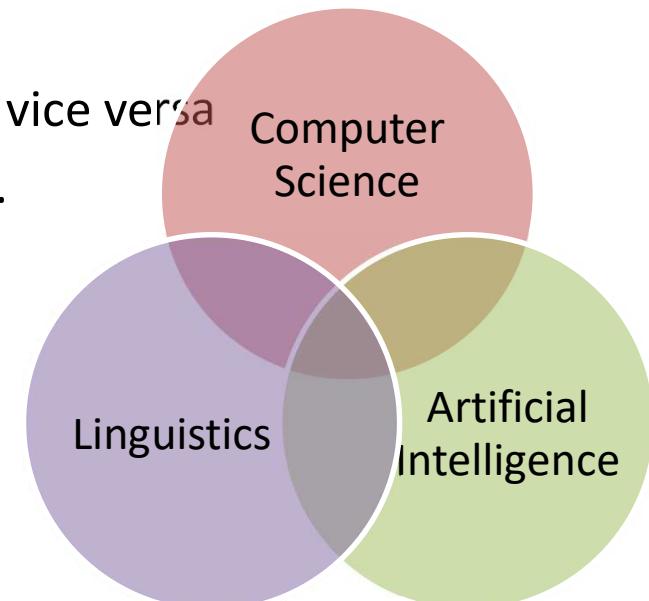
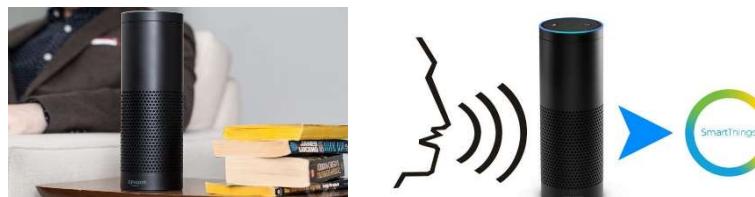
- **Sentiment analysis**

- Determine polarity about specific topics
- Identify trends of public opinion in social media



- **Speech-to-text/text-to-speech**

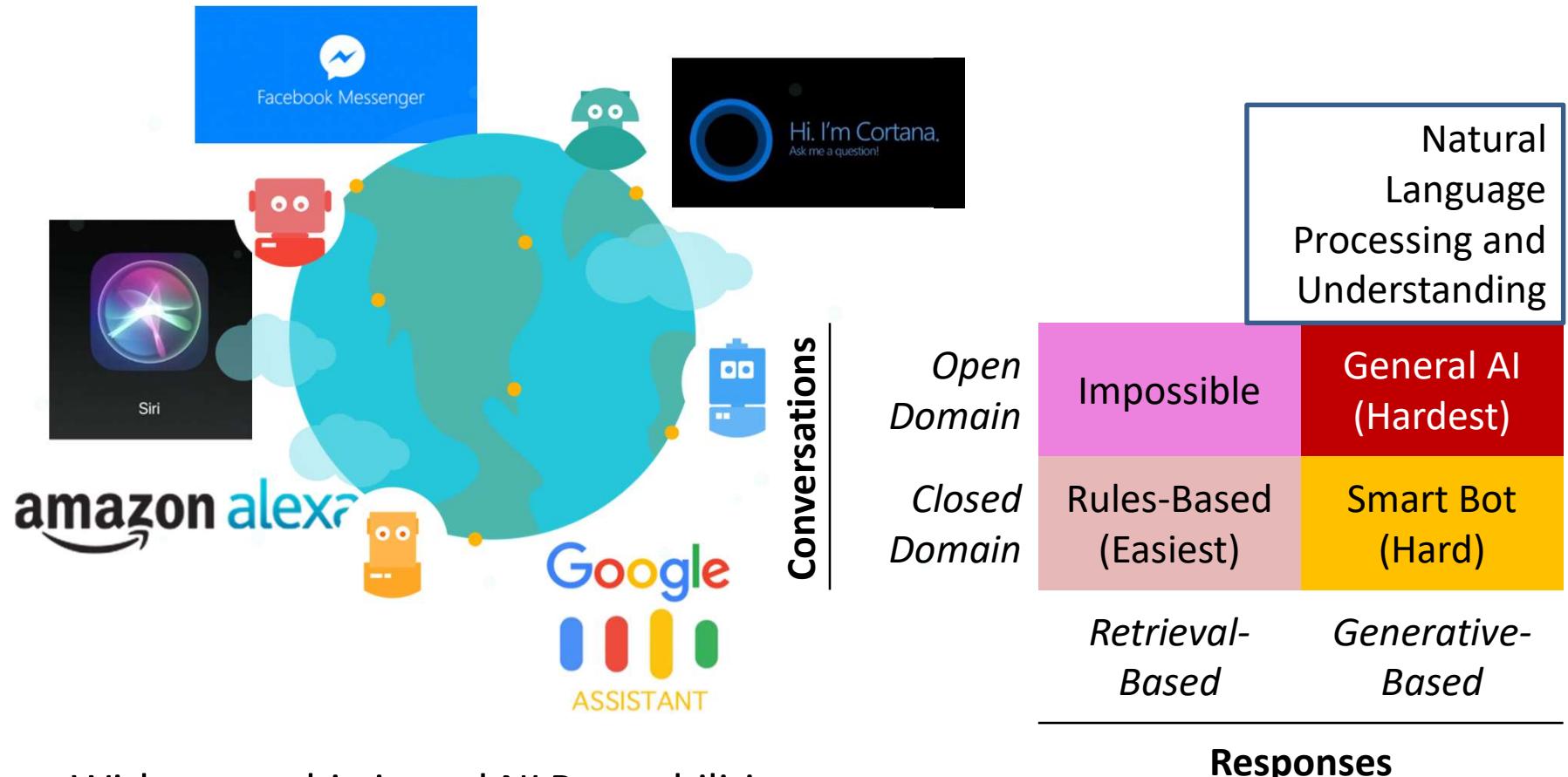
- Convert spoken language to written text and vice versa
- Chatbots, voice control, domotics, readers, ...



AI – NLP: Watson at Jeopardy



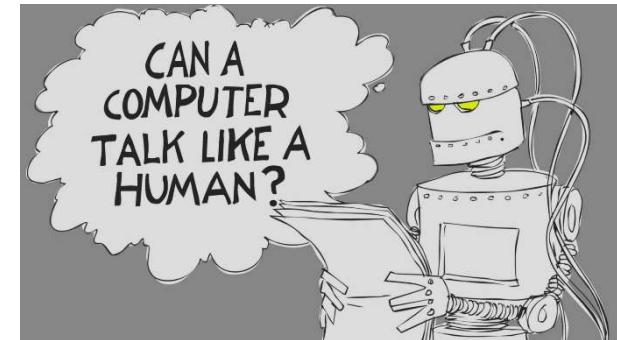
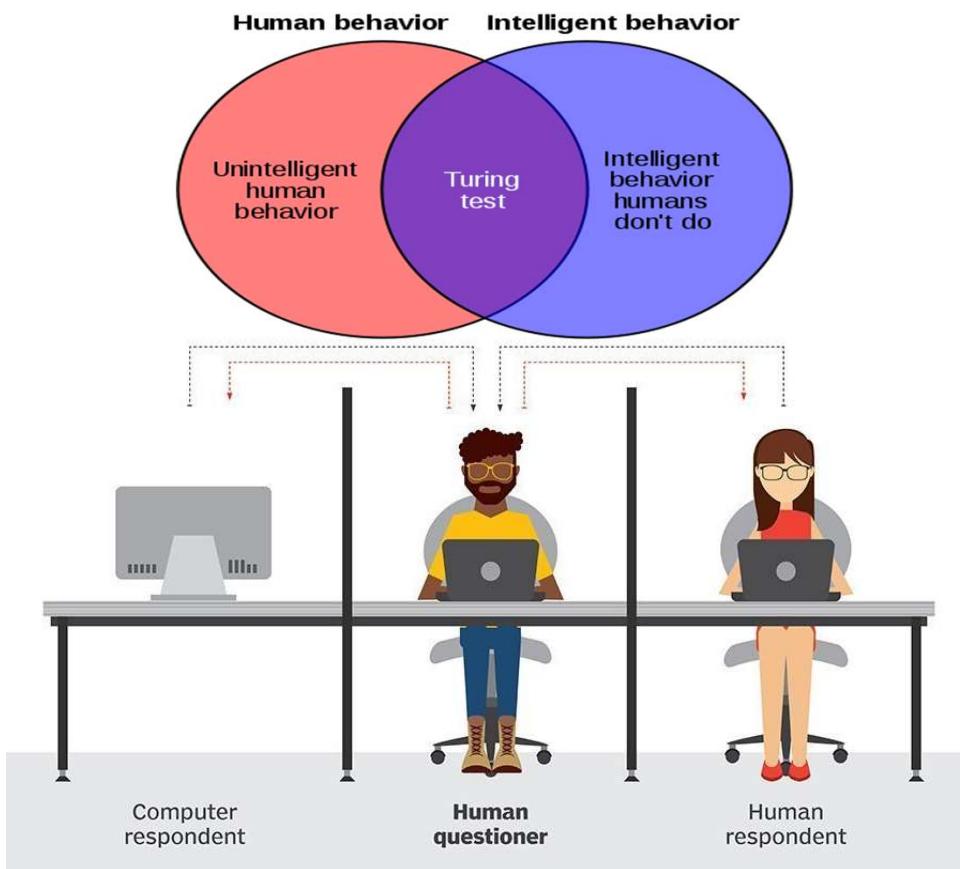
AI – Natural Language Processing



- Without sophisticated NLP capabilities
- Pattern recognition, rule based expression matching, simple machine learning, together with repositories of pre-written sentence templates

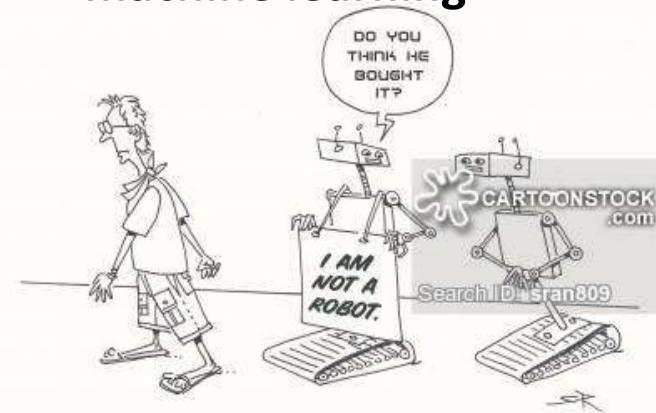
AI: NLP - Turing Test

- Can a Computer Talk like a Human?
- Can a Computer Think like a Human?



Capabilities:

- natural language processing
- knowledge representation
- automated reasoning
- machine learning

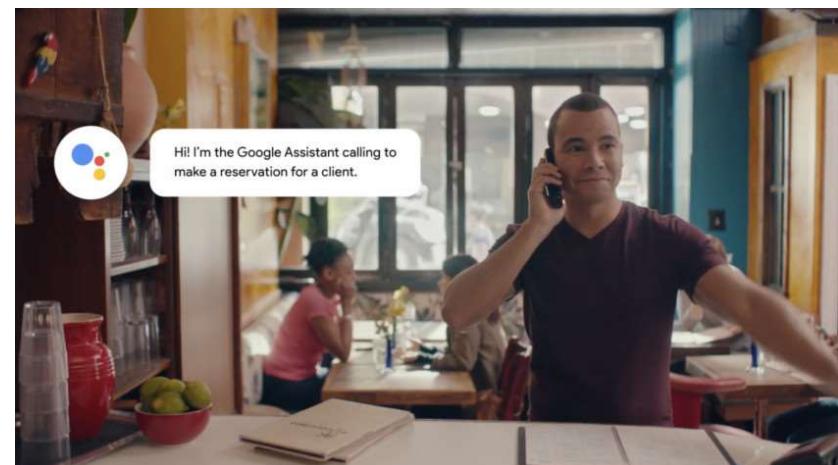
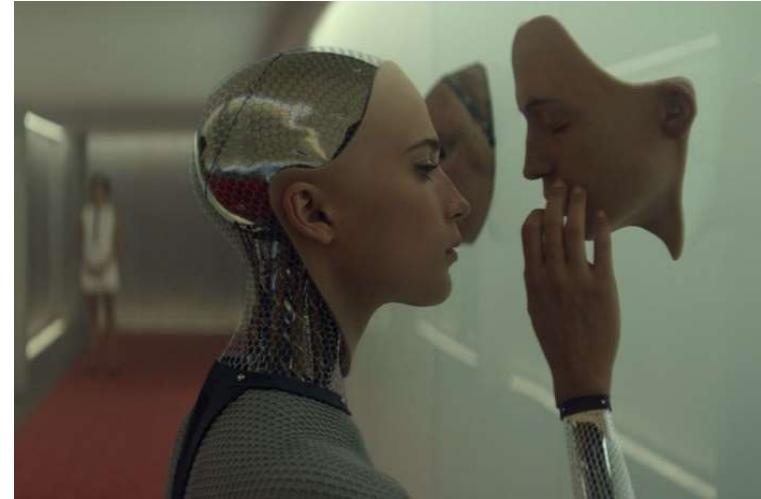


AI: NLP - Turing Test



AI: NLP – Google Assistant

- **Google Assistant with Duplex**
- It allows certain users to **make a restaurant reservation by phone**, but instead of the user speaking directly to the restaurant employee, Google Duplex, with the help of Google Assistant, speaks for the user with an **AI-based, but human sounding, voice**.



AI - Intelligent Robotics

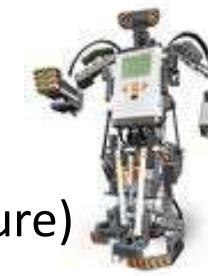
- **Robotics**

- Science and technology for **projecting, building, programming and using Robots**
- Study of **Robotic Agents (with body)**
- Increased Complexity:
 - **Environments:** Dynamic, Inaccessible, Continuous and Non Deterministic!
 - Perception: **Vision, Sensor Fusion**
 - Action: **Robot Control (Humanoids!)**
 - **Robot Architecture** (Physical / Control)
 - **Navigation** in unknown environments
 - **Interaction** with other robots/humans
 - **Multi-Robot Systems**



AI - Current State of Robotics

- **Used to Perform:**
 - Dangerous or difficult **tasks** to be performed directly by humans
 - Repetitive **tasks** that may be performed more efficiently (or cheap) than when performed by humans
- **Robots have moved from manufacturing, industrial applications to:**
 - Domestic Robots (Pets – AIBO, vacuum cleaners)
 - Entertainment robots (social robots)
 - Medical and **personal service** robots
 - Military and surveillance robots
 - Educational robots
 - Intelligent buildings
 - Intelligent vehicles (cars, submarines, airplanes)
 - New industrial applications (mining, fishing, agriculture)
 - Hazardous applications (space exploration, military apps, toxic cleanup, construction, underwater apps)
 - Multi-Robot Applications and Human-Robot Teams!

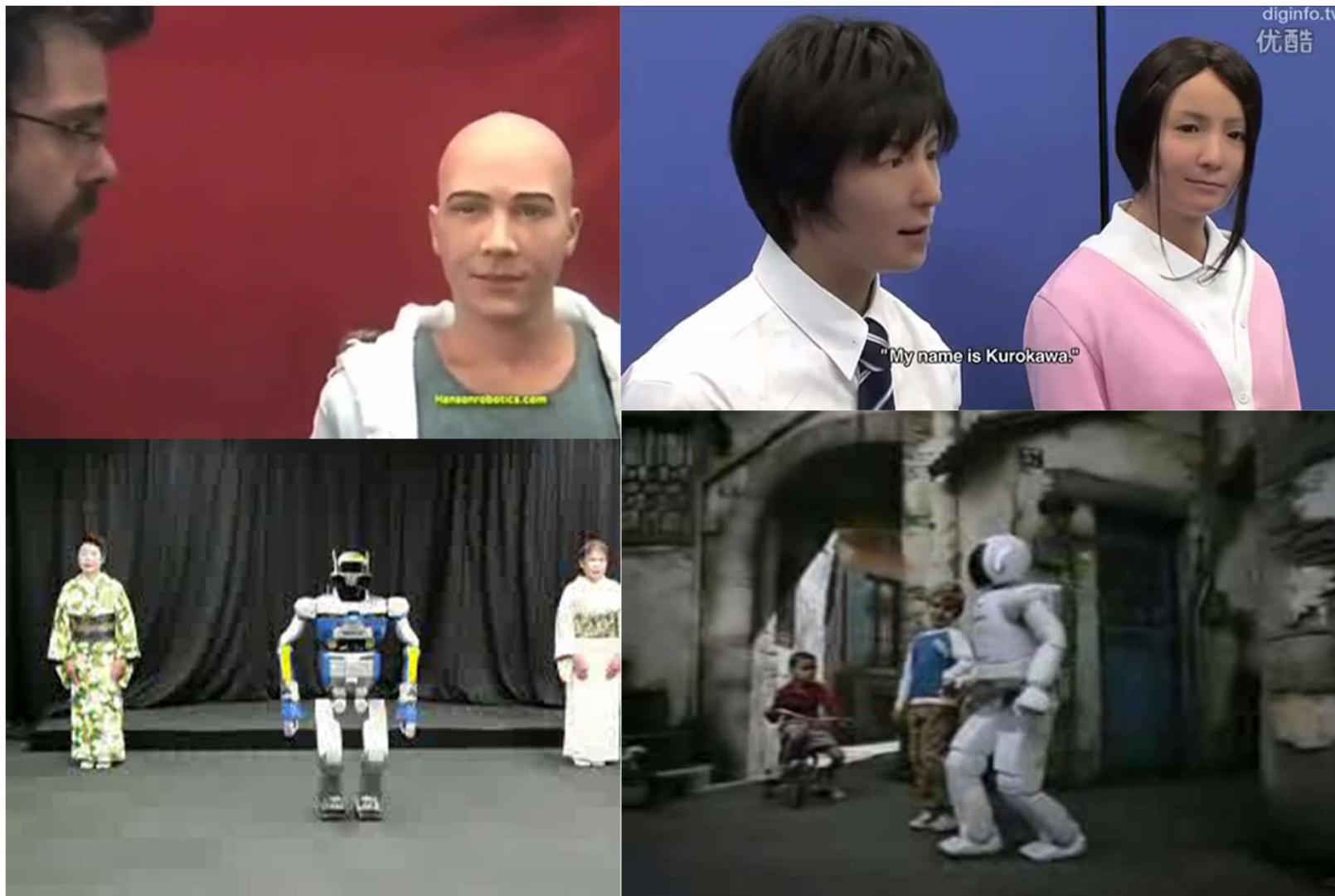


AI - Robotics

- Autonomous driving car (Google)
- Service, mars explor., medical robotics (Motorman, Miimo, Roomba, Oz, Asimo, Nao)
- Exoskeleton (exoAtlete)
- Ambient Assisted Living
- Drones & Delivery (PT ConnectRobotics)
- Military, Assistive, Eldery, ...
- Education, entertainment, ...



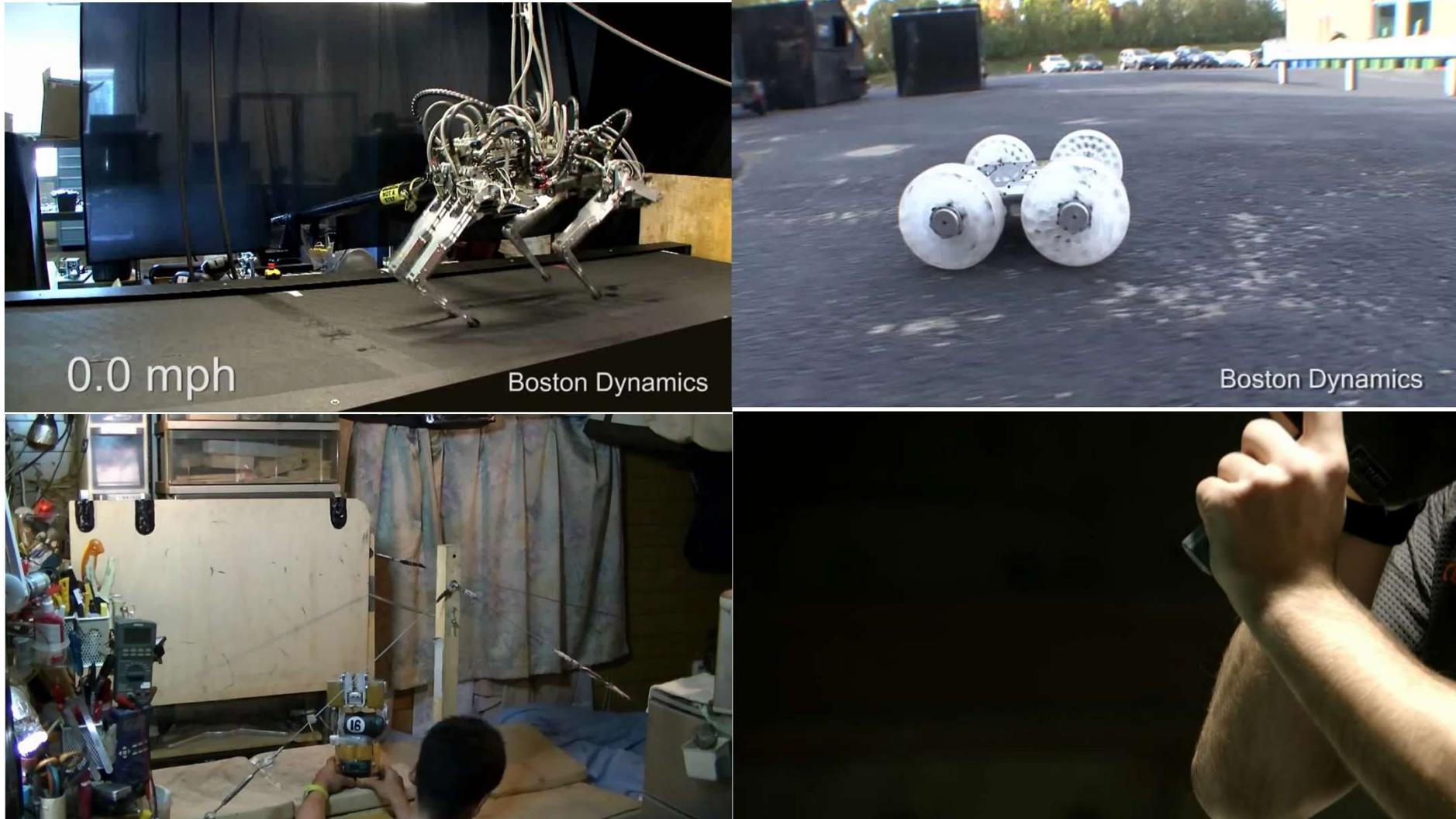
AI - Humanoid Robotics



AI - Robotic Competitions - RoboCup



Current State of Sports' Robotics



AI - Coordination in Multi-Agent Systems

Motivation:

- Agents don't live alone and have to work in a group...
- Human-Computer Interaction
- Multi-Agent Coordination



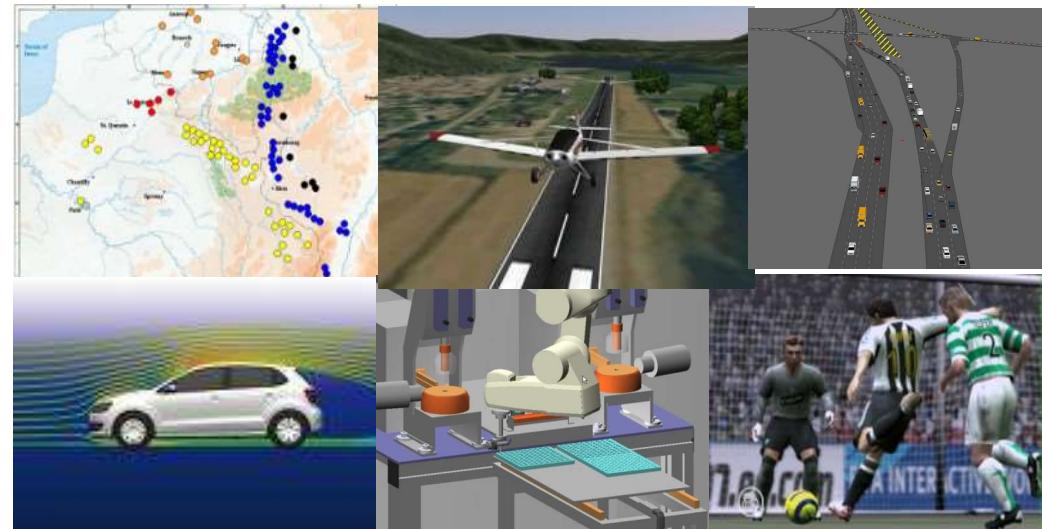
Coordination : “to work in harmony in a group”

- Dependencies in agent actions
- Global constraints
- **No agent**, individually **has enough resources**, information or capacity to execute the task or solve the problem
- **Efficiency**: Information exchange or tasks division
- **Prevent anarchy and chaos**: Partial vision, lack of authority, conflicts, agent's interactions



Agent-Based Simulation

- **Simulation:** Imitation of some real thing, state of affairs, or process, over time, representing certain key characteristics or behaviours of the physical or abstract system
- Applications:
 - Understand system functioning
 - Performance optimization
 - Testing and validation
 - Decision making
 - Training and education
 - Test future/expensive systems
- For complex systems impossible to solve mathematically
- **Agent Based Modeling and Simulation**



Agent-Based Traffic Simulation

Traffic Simulation Manager API:

- Design **traffic-oriented solutions** regardless the simulator used
- Interface over Microscopic Traffic Simulators
- **Multi-Agent System** framework
- Statistics collection module

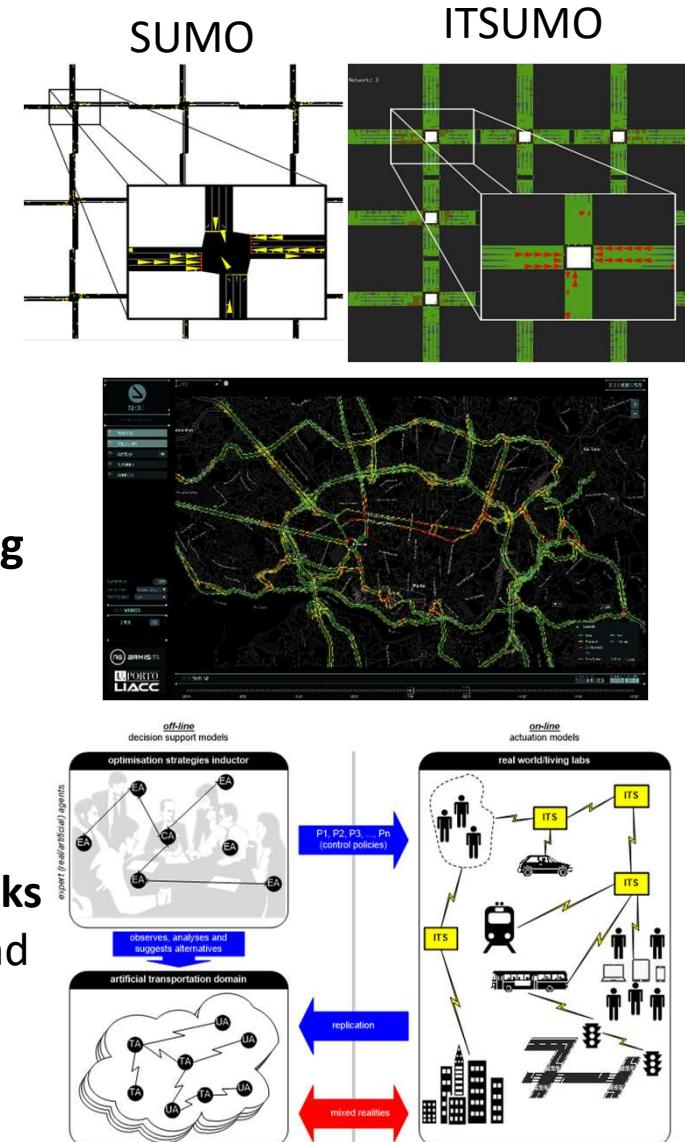
MAS-TER Lab - Artificial Transportation System:

- Integrating different transportation models and solutions in a virtual environment
- Multi-Agent System with **Distributed Computing** and **Virtual Reality**
- Artificial Societies and **Social Simulation**
- Large-scale **distributed simulation**
- HW-, SW-, **Human-in-the-loop** simulation

C-ROADS



- Real-time assessment and **prediction of bottlenecks**
- Definition and evaluation of **dynamic scenarios** and contingency plans
- **Timely information** to road operators and **traffic managers** for better decisions



SIMUSAFE - SIMULATION of behavioural aspects for SAFEr transport

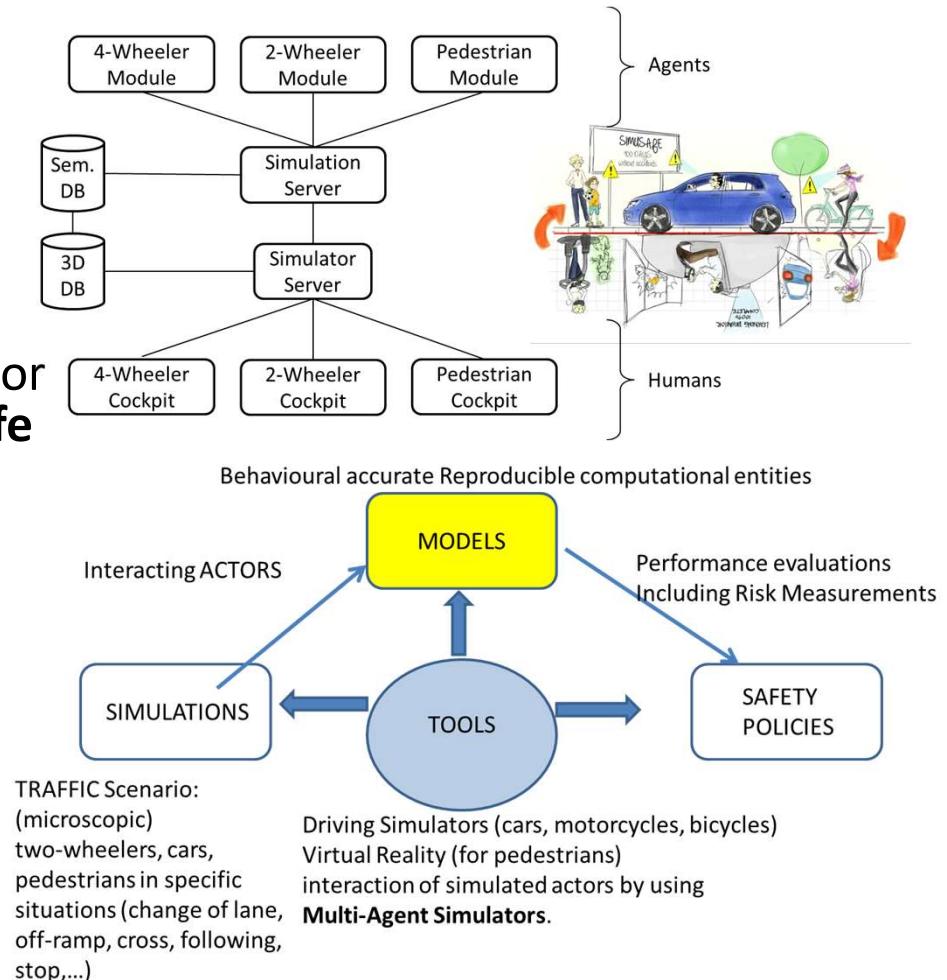


SIMUSAFE aims to **improve driving and traffic simulation technology** to safely assess risk perception and decision making of road users:

- Pedestrians; cyclists; motorcyclists; vehicle drivers

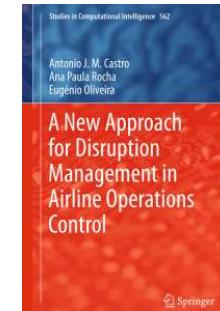
Impact:

- **Reduction of fatal, serious, and minor crashes through mitigation of unsafe transport user behaviour patterns**
- **Economic savings** due to reduction of crashes
- Safer use of vehicles and increased awareness of other users
- **Effective training schemes** based on behavioural models
- Safer integration of new vehicles
- Translation to other transports

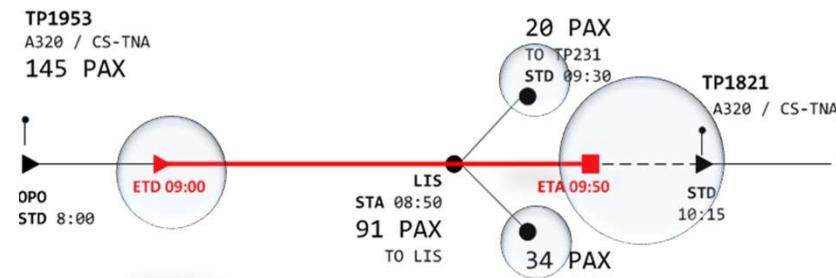


Multi Agent Systems & MASDIMA

- Research in **theoretical and practical aspects of Autonomous Agents and Multi-Agent Systems**
- Design and implementation of models for agent-based system's **interoperability, coordination and decentralized** applications
- Reliable solutions for **distributed** and **decentralized** applications, within **dynamic** environments (cooperative or competitive)
- MASDIMA: Disruption Management in Airline Operations Control



MASDIMA



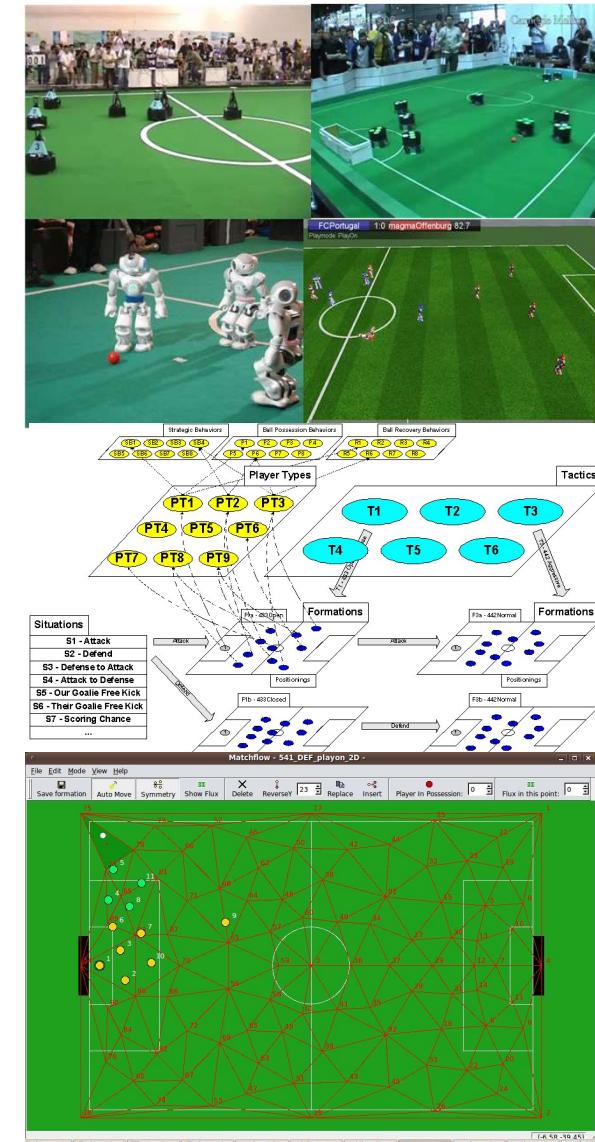
Solution:

Decentralized (MAS)
Integrated (cooperation & negotiation)
Dynamic (agents & learning)



MAS and Coordination for Robotics

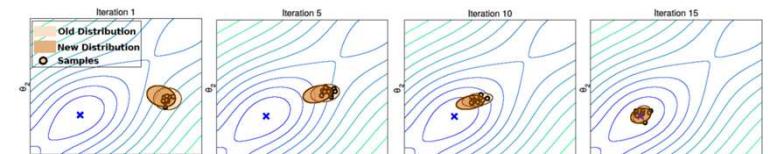
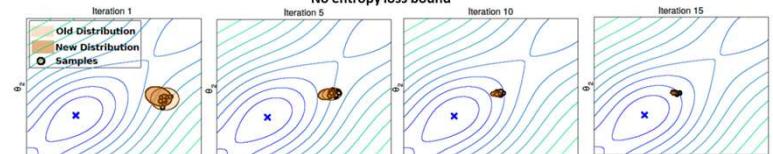
- Coordination and Machine Learning for Robotic Soccer – FC Portugal
- Team Coordination:
 - Strategy, Formations (SBSP/DT), DPRE, Setplays
- Complete Tactical/Formation Framework and Setplay Framework including graphical interfaces
- Generic Coordination Framework/Library:
 - May be used for coordinating any team
 - World State -> High-Level Decision!
 - Enables Research on Low-Level Robotics!
- Methodologies with **competition success (more than 30 awards)** for different robots, cooperative robotic tasks and other domains



Machine Learning for Robotics

- Continuous Black-box Optimization Problems
- Non-Parametric Contextual Stochastic Search
- Trust Region Covariance Matrix Evolution Strategy (**TR-CMAES**), Model-Based Relative Entropy Stochastic Search (**MORE**)
- PPO! PPO2!
- Learn a **non-parametric search distribution** for **multiple tasks** simultaneously
- **Papers at top journals and conferences**
(NIPS2015, GECCO 2016 (2), IROS2016, IJCAI2017, GECCO2017, IJCNN2018, IROS2018)
- **Applications** in RoboCup: Practical/Scientific

- Use Search-Distribution: $\pi(w) = \mathcal{N}(\mu, \Sigma)$
- Objective: Find search distribution $\pi(w)$ that maximizes $J_\pi = \int \pi(w) R(w) dw$



Contextual distribution update:

$$\arg \max_{\pi} \mathbb{E}_{p(s)} \left[\int \pi(w|s) R(s, w) dw \right]$$

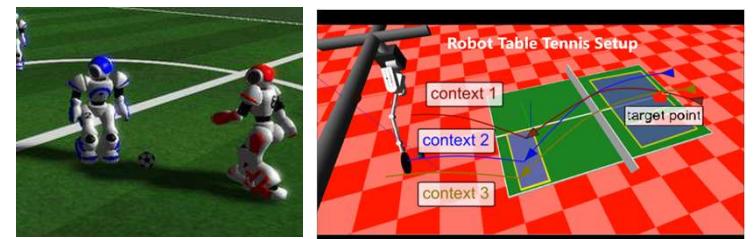
s.t.: $\mathbb{E}_{p(s)} [\text{KL}(\pi(\cdot|s)||\pi_{\text{old}}(\cdot|s))] \leq \epsilon$

3. Bound entropy loss – Controls Step Size of Covariance

$$\underbrace{H(\pi_{\text{old}}) - H(\pi)}_{\text{loss in entropy}} \leq \gamma$$

New distribution: $\pi(w|s) \propto \pi_{\text{old}}(w|s)^{\frac{\eta}{\eta+\omega}} \exp\left(\frac{R(s, w)}{\eta+\omega}\right)$

$\propto \mathcal{N}(s^T M_{\text{new}} + m_{\text{new}}, \Sigma_{\text{new}})$ Compatible Function Approximation



LIACC



U.PORTO
UNIVERSIDADE
DO PORTO



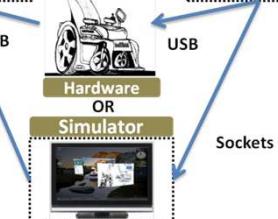
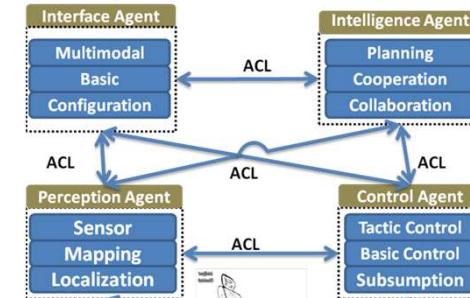
TECHNISCHE
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A Xerox Company

Google DeepMind

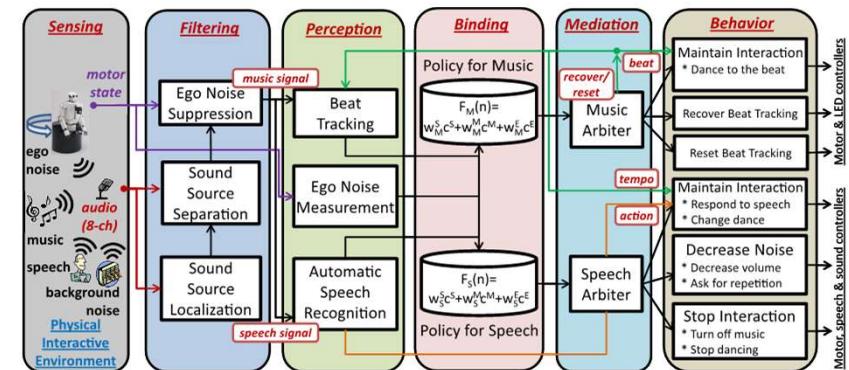
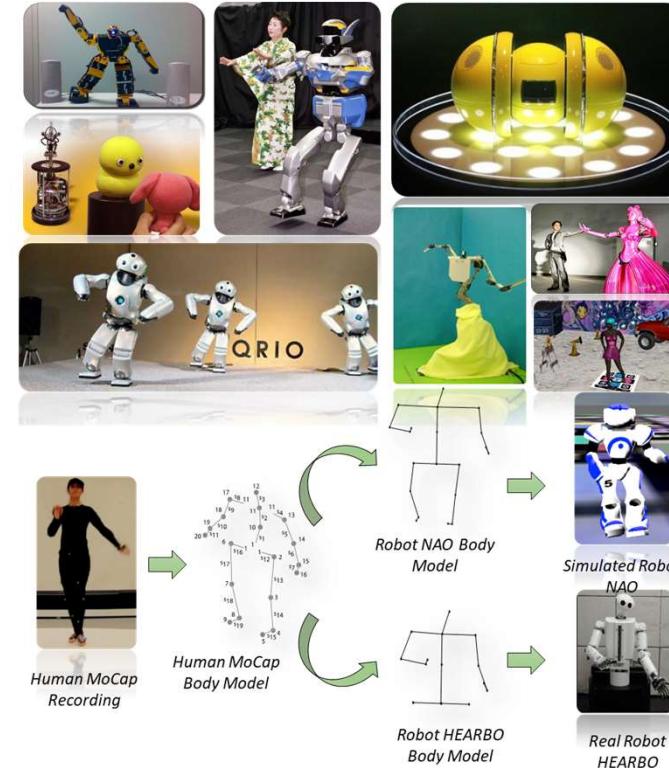
Intelligent Wheelchair with Flexible Multimodal Interface

- Many IWs prototypes and games:
 - User adaptation often **neglected**
 - **Non realistic games**, simple wheelchair model
 - **Rigid Interfaces** adapted to a single user (or group)
- IntellWheels Project:
 - High-level commands through **Multimodal** interface
 - Interface **adapted** to users' characteristics
 - **IntellSim realistic simulator**
 - **Serious Game** for Wheelchair driving integrated with simulator
 - Command language adapted to the user through **automatic and** user profiling
 - **Shared control** with appropriate aid level



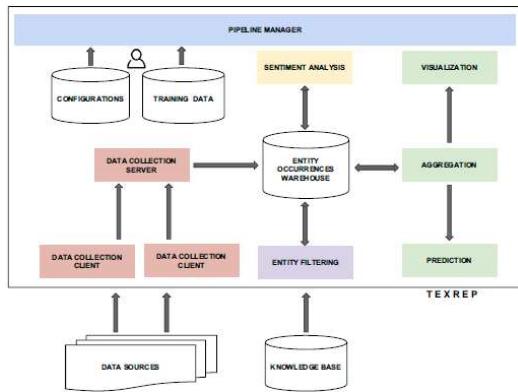
Human-Interactive Robot Dancing

- Robust audio **beat tracking**
- **Robot audition**, sound separation, sound source localization and ego-noise suppression
- Representation and **mapping of human dance movements** (professional dancers)
- Online sensorimotor method for generating **beat-synchronous robot dance**
- Interactive **Robot Dancing Scenario**
- **Conceptual Active Audition Framework for auditory-driven human-robot interaction**
- **USA Patent (2016) - US9378752B2,**
- **Japanese Patent (2016) - JP2013182617A**



Information Retrieval/Text Mining

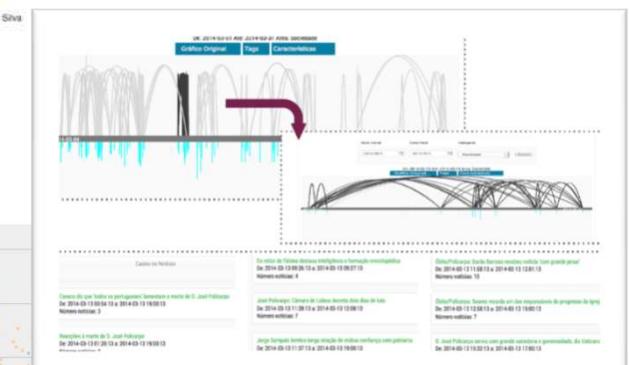
Entity-Centric Search



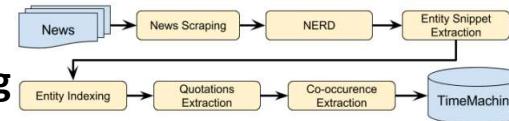
TimeMachine



Connecting the dots between News



Online Reputation Monitoring



POPSTAR: Opinion Mining and Sentiment Analysis

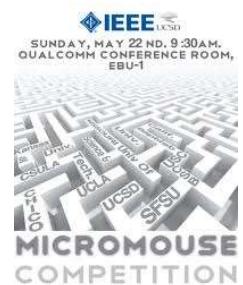
IA.SAE – Artificial Intelligence for Economic and Food Safety
Analysis of electronic complaints, risk analysis and selection of economic agents to be inspected



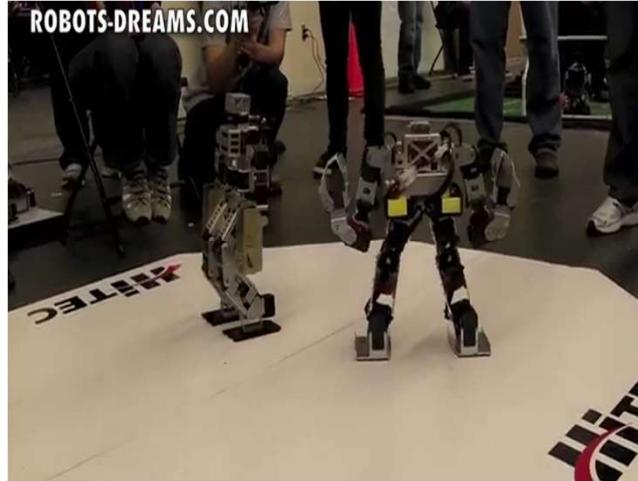
Robotic Games and Competitions



ROBOXOTICA
Festival für Cocktail-Robotik



Robotic Competitions - RoboGames



Robotic Competitions - RoboGames



Robotic Games and Competitions

Benefits

- Research inspiration
 - Hard deadline for creating fully functional system
 - Common platform/problem
 - Exchange of research ideas/solutions
- Continually improving solutions
- Excitement for students/researchers at all levels
- Large number of teams/solutions created
- Encouragement for flexible software/hardware

Dangers

- Obsession with winning
- Domain dependent/ hacked solutions
- Cost escalation
- Difficulty in entering at competitive level
- Restrictive rules
- Invalid evaluation conclusions

Robotic Competitions - RoboCup



RoboCup: Objectives

- Joint International Project:
 - (Distributed) Artificial Intelligence
 - Intelligent Robotics
- Soccer – Central Research Topic:
 - Very complex collective game
 - Huge amount of technologies involved:
 - Autonomous Agents, Multi-Agent/Multi-Robot Systems, Cooperation, Communication, Strategic Reasoning, Robotics, Sensor Fusion, Real-Time Reasoning, Machine Learning, etc

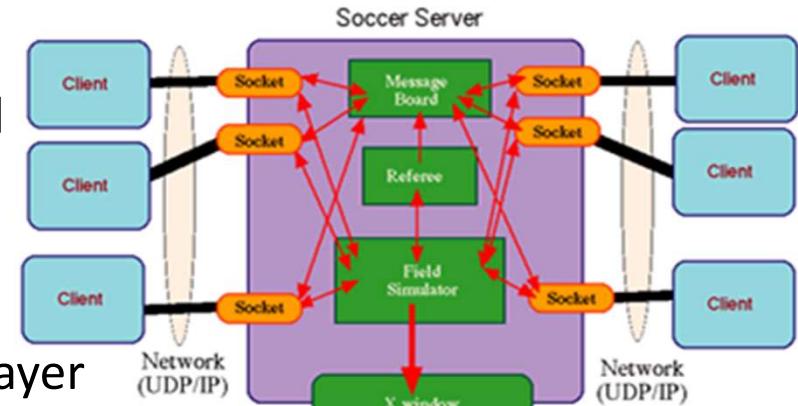


Main Goal:

“By 2050, develop a team of fully autonomous humanoid robots that may win against the human world champion team in soccer!”

RoboCup Leagues: Simulation 2D

- **Virtual Robots** on a 105*68m Virtual Field
- Teams of 11 players plus a coach
- 2D Simulator+Monitor (Client-Server System)
- Robots controlled by different agents
- Agents (player's brains) control a single player
- **Simulator/Server:**
 - **Receives agent commands**
 - **Simulates objects' movement**
 - **Sends perceptions to agents**
- **Simulation Characteristics**
 - **Real-Time** - Human
 - Distributed – 24 Processes
 - **Inaccessible** (hidden), Continuous and Dynamic World
 - **Errors** in: Perception, Movement and Action
 - **Limited Resources** and Communication
 - **Multi-Objective**



Server Architecture

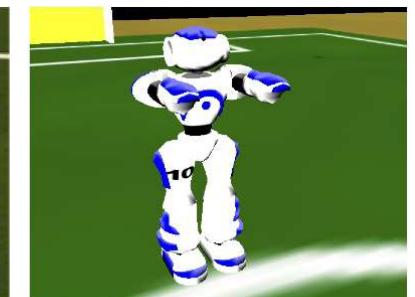


Simulation 3D League (Humanoids)

- Third dimension and complexities from real robots
- **Realistic physics and Robot Model:**
 - Spheres in 2004
 - Humanoids in 2007
 - NAO Robot Model: 2008
 - Heterogeneous Robots: 2013
- **Strong relation with SPL**
- 2 vs 2 -> 6 vs 6 -> 9 vs 9 -> 11 vs 11
- Server/Simulator (**SimSpark**)
 - Updates world state
 - Forces the “**laws of physics**”: collisions, drag, gravity, ...
 - Send sensor information (**perceptors**)
 - Executes actions (**effectors**)
 - Enforces soccer rules – referee
- **Very difficult to create competitive skills by hand!**



(a) real robot



(b) virtual robot



Simulation 3D – Nao model

- Same Robot but completely different skills: Walk, getup, kick

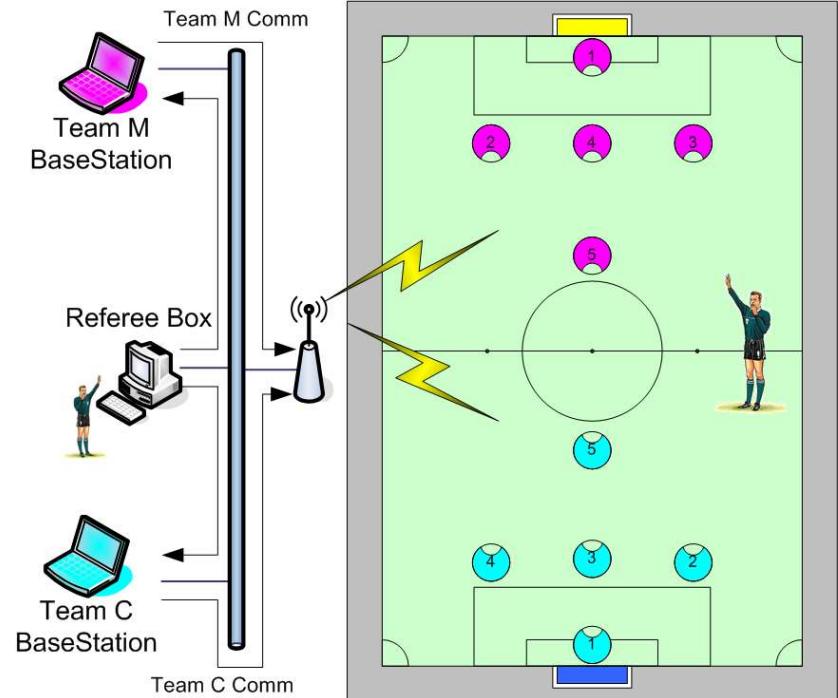


Simulation 3D – Nao model



Middle Size League

- Robots are completely autonomous
- 5 robots per team
- Robots around 50x50cm and 80cm height
- Field 18mx12m, green with white lines
- MSL rules based on official FIFA laws



Middle Size League

- 1998-2007: Very Basic playing! Individual Dribbling!
- 2008: Formations SBSP/High-level playing/Setplays!



Flexible Strategy for RoboCup

- RoboCup Leagues: Simulation 2D, Simulation 3D, Small-Size, Middle-Size, SPL and Search and Rescue
- Applications in four distinct teams:
 - **FC Portugal** (*University of Porto/Aveiro/Minho*)
 - Simulation 2D, Simulation 3D, Coach, MR, Rescue, SPL
 - **CAMBADA** (*University of Aveiro*) – *Prof. Nuno Lau*
 - Middle-Size League, RoboCup@Home
 - **5DPO** (*University of Porto*) – *Prof. A.P.Moreira*
 - Small-Size League, Middle-Size League
 - **Portuguese Team** (*University of Porto/Aveiro/Minho*)
 - SPL – Standard Platform League
- More than 40 awards in International Competitions for these 4 Teams!

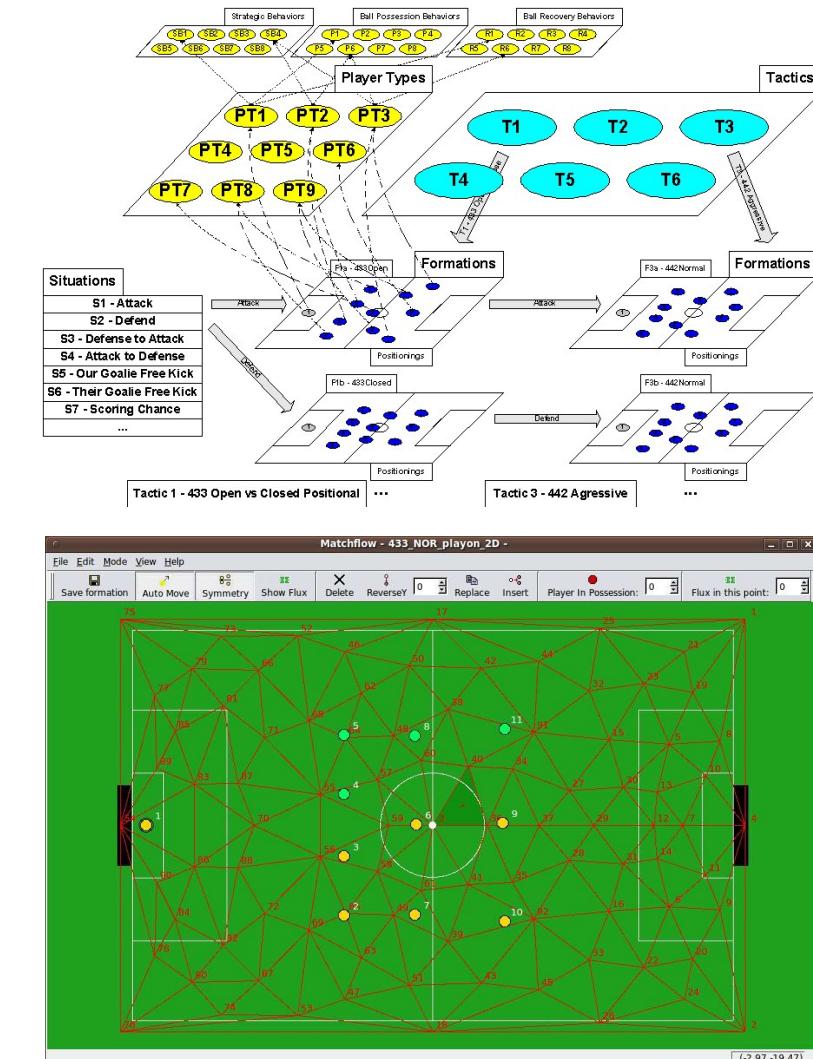
The Coordination Problem

- Coordinate autonomous robots decisions to carry out team tasks as efficiently as possible
- Coordination challenges
 - Strategy
 - Coaching
 - Role assignment
 - Formation
 - Plan execution
 - Interaction
 - Learning
 - Communication

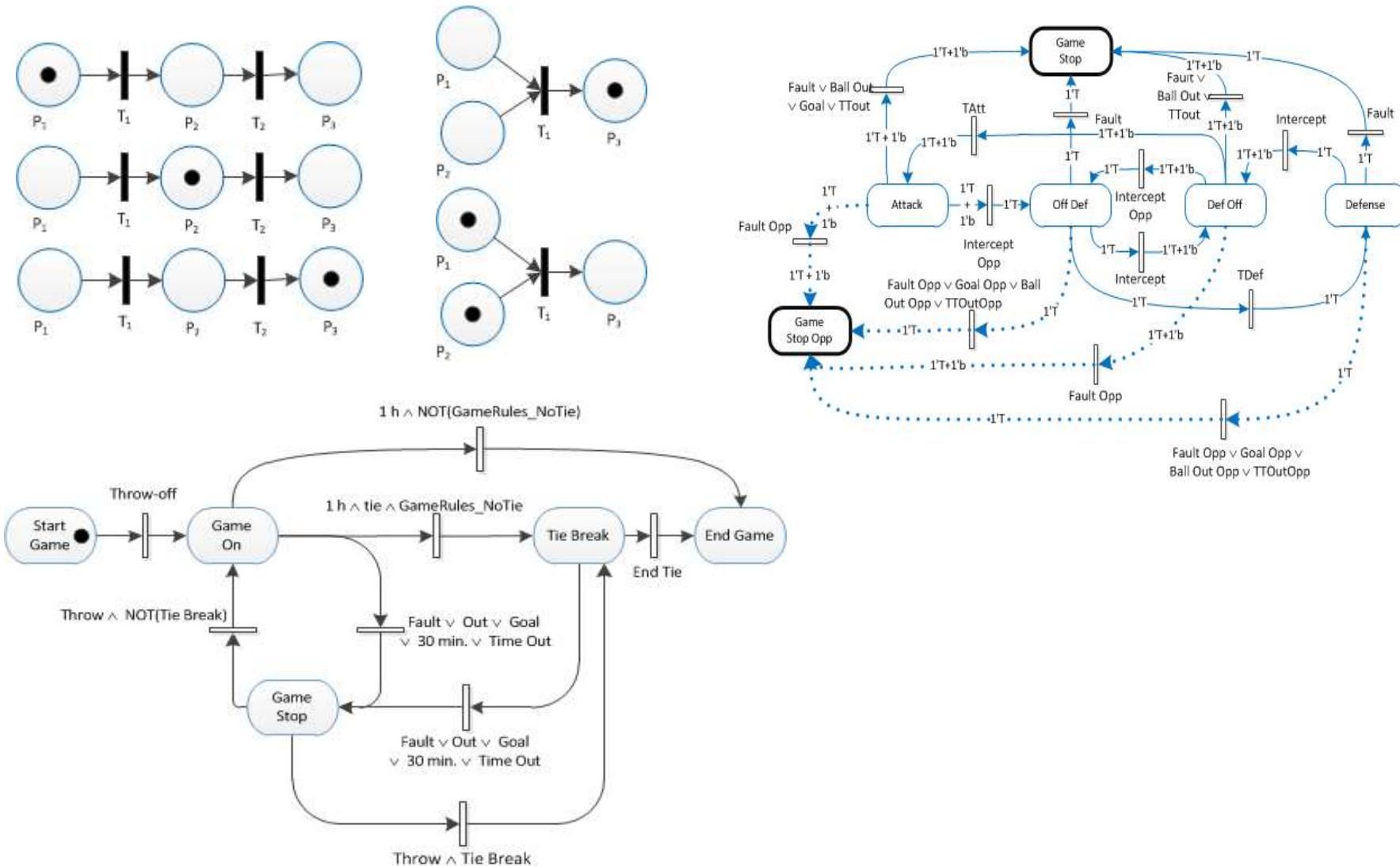


Formalizing Sports' Concepts

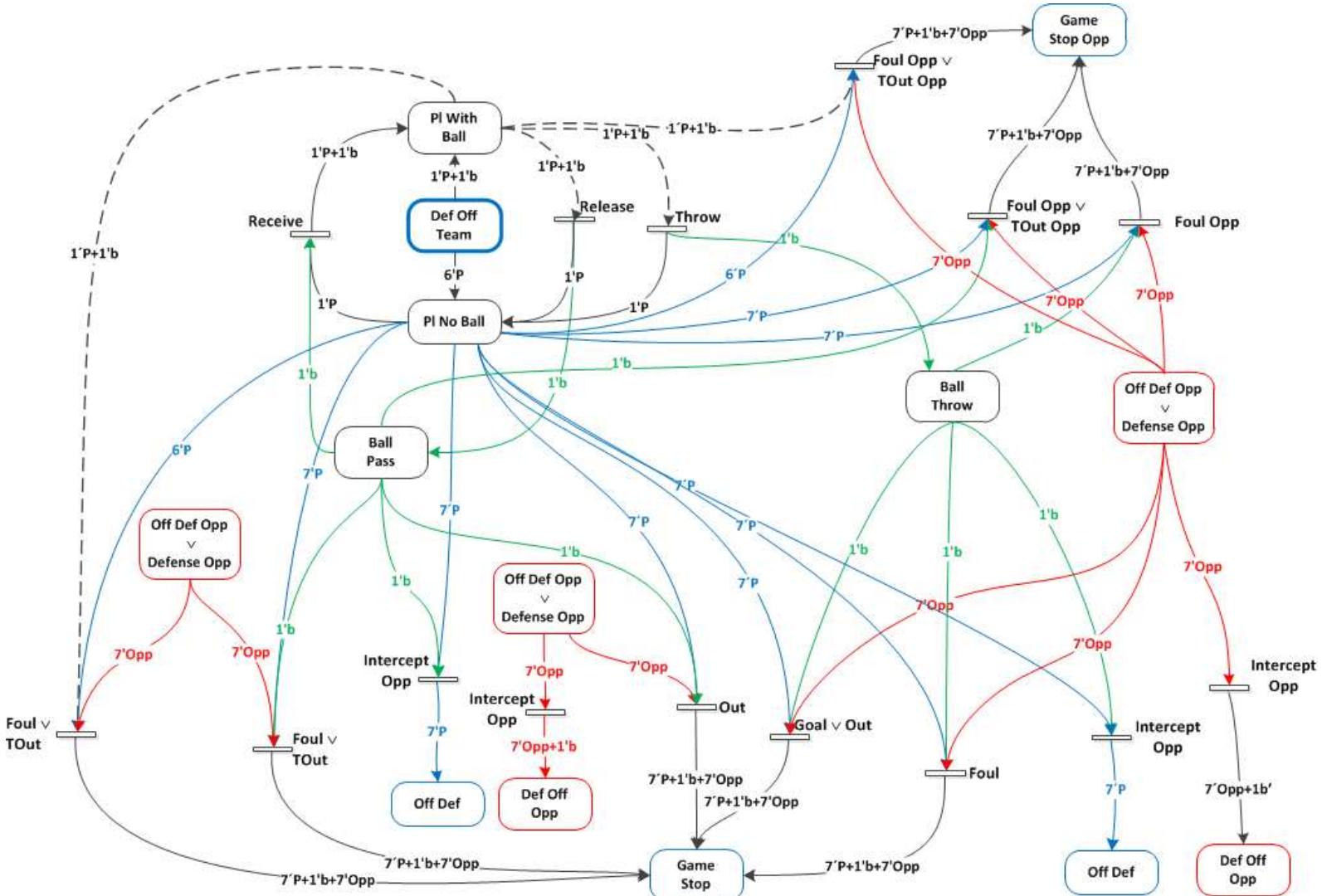
- Team/Collective Behaviour
 - Strategy
 - Tactics
 - Formations
 - Setplays
 - ...
- Player/Individual Behavior
 - Action
 - Pass/Shot
 - Tackle/Interception
 - ...
- Petri Nets
- BNF – Bakus Naur Forms
- SExpressions
- Ontologies
- Logic and Fuzzy Logic
- Data Mining



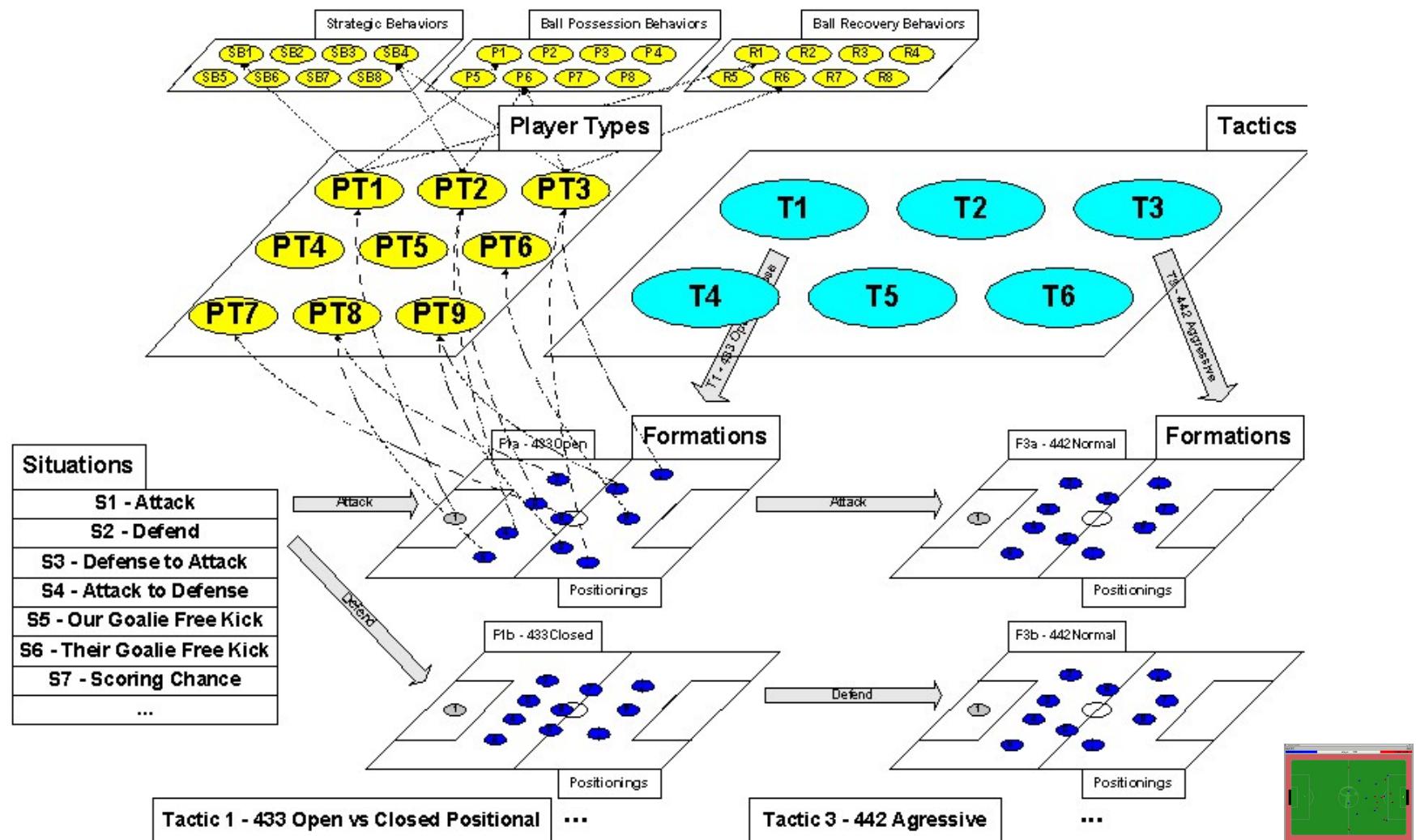
Game Analysis with Petri Nets



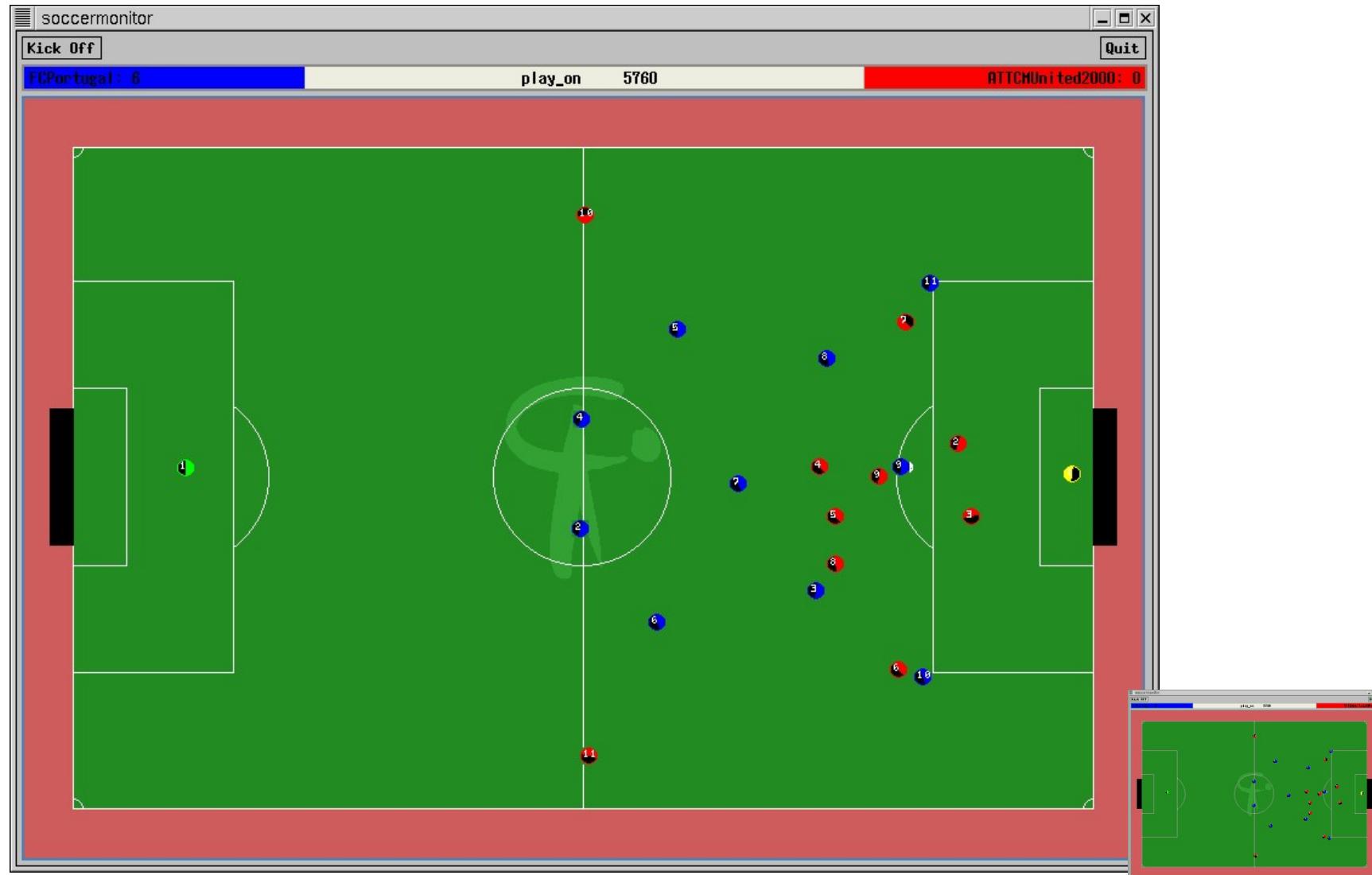
Game Analysis with Petri Nets



Simulation of a Team Strategy



Formations: SBSP vs SPAR and DPRE

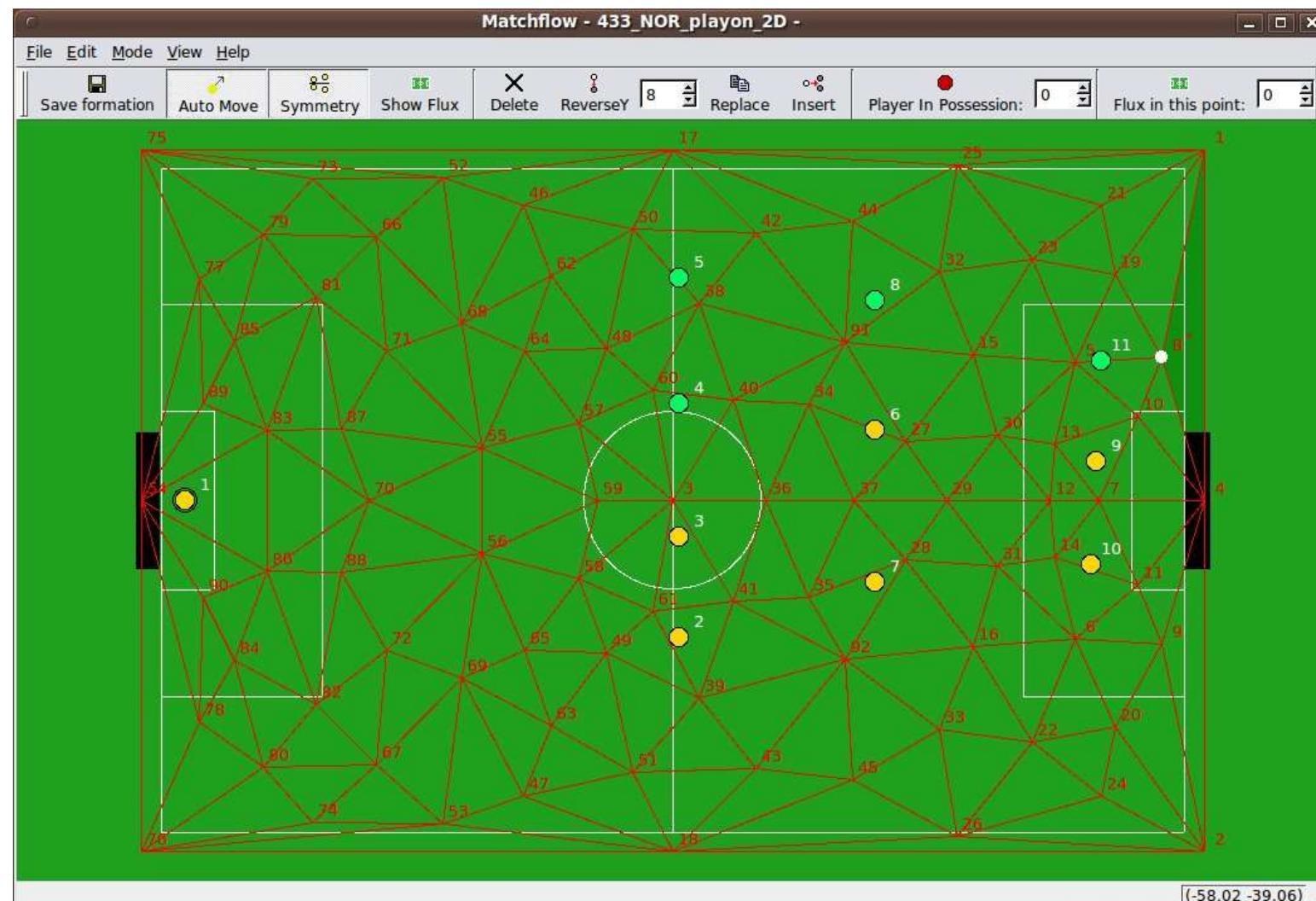


SBSP with Delaunay Triangulation

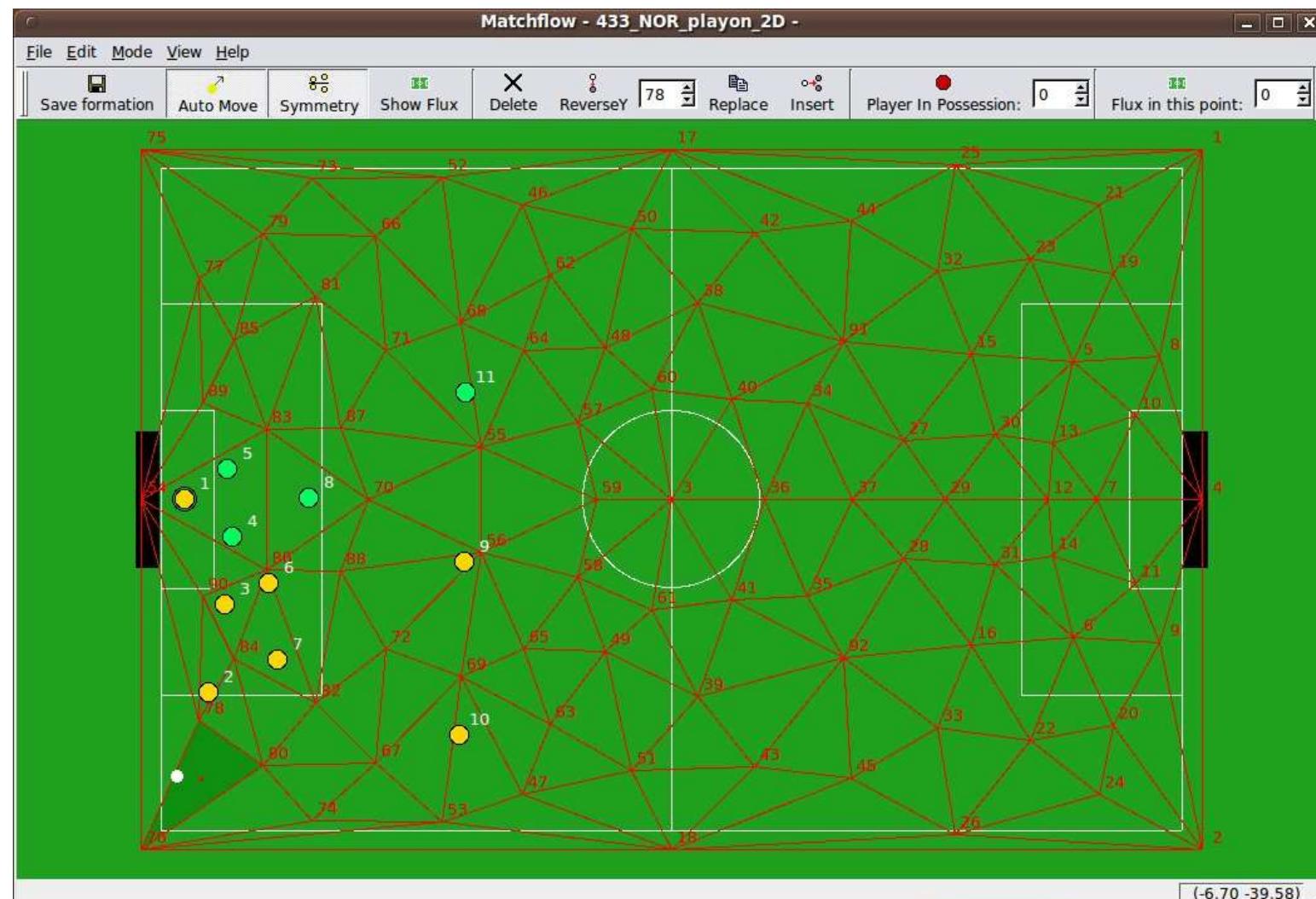


Based on Akiyama, 2007

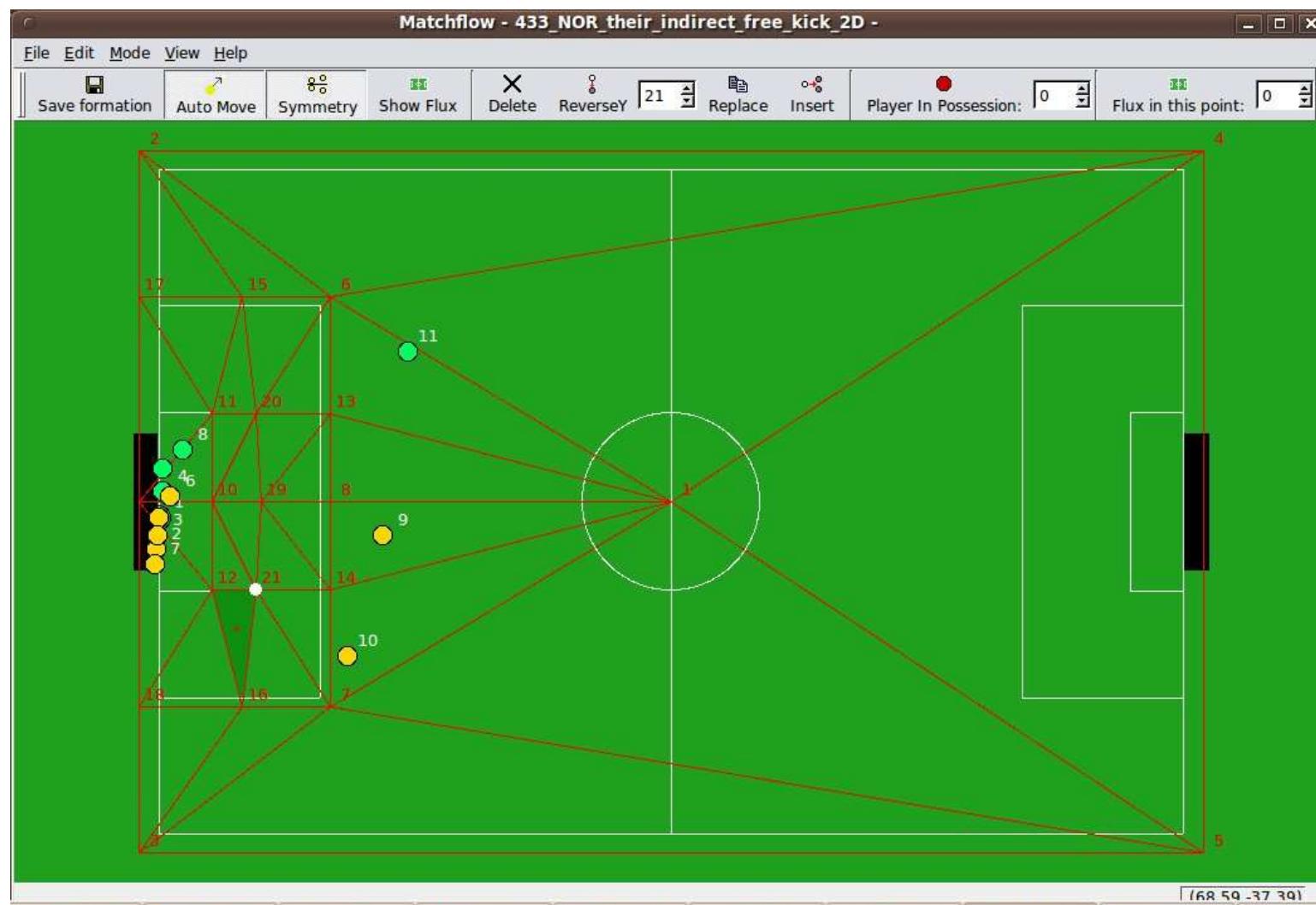
SBSP with Delaunay Triangulation



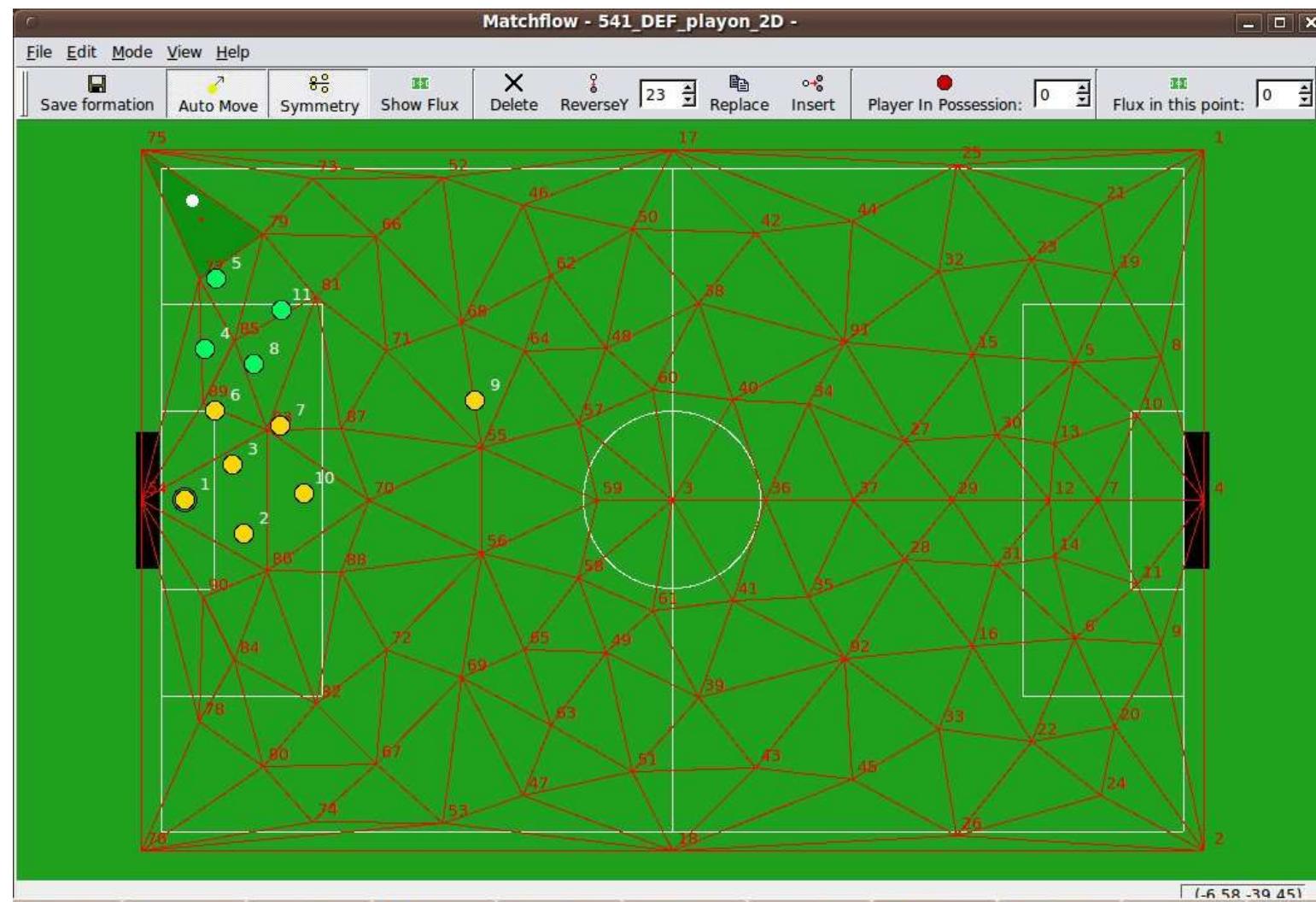
SBSP with Delaunay Triangulation



SBSP with Delaunay Triangulation



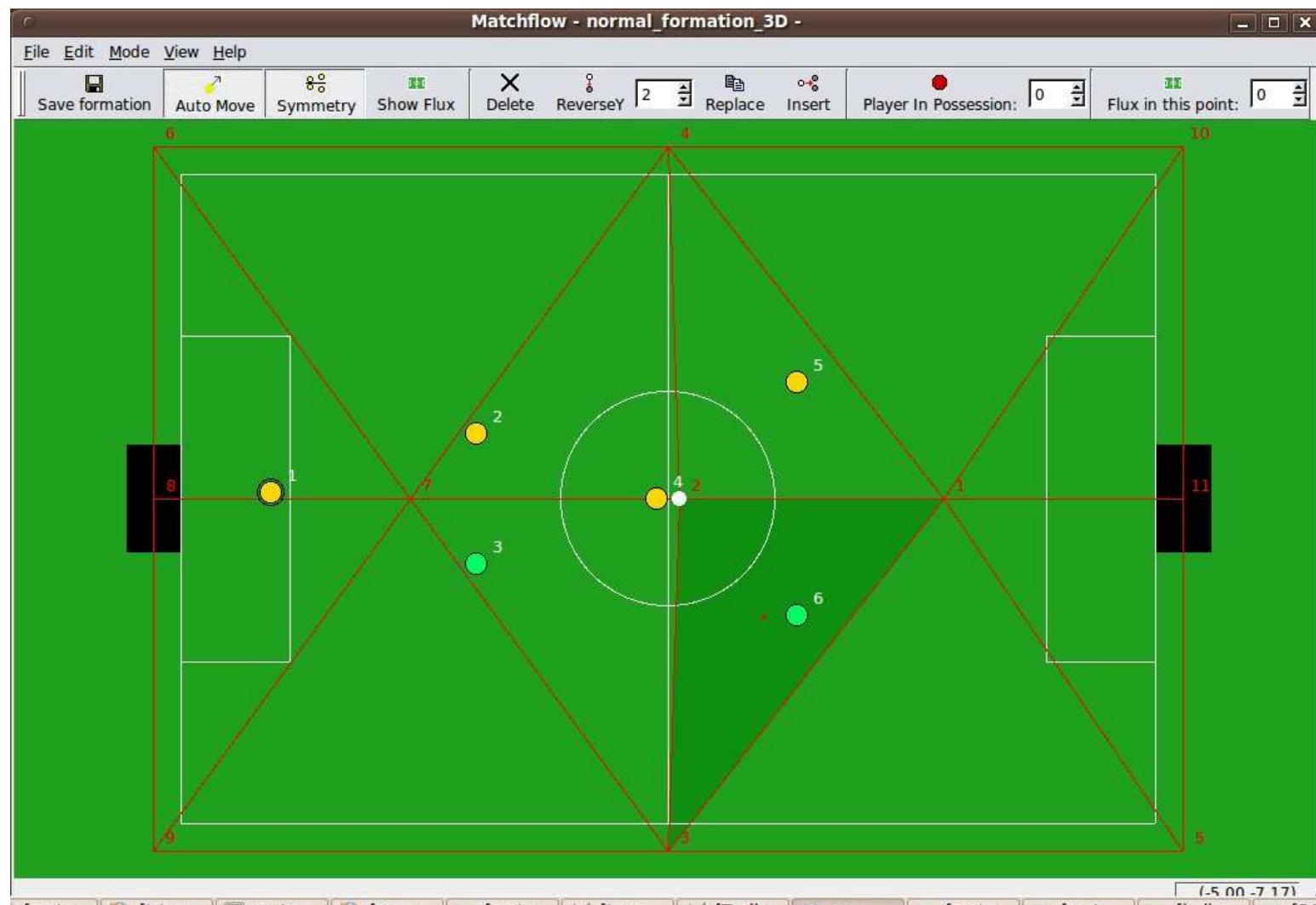
SBSP with Delaunay Triangulation



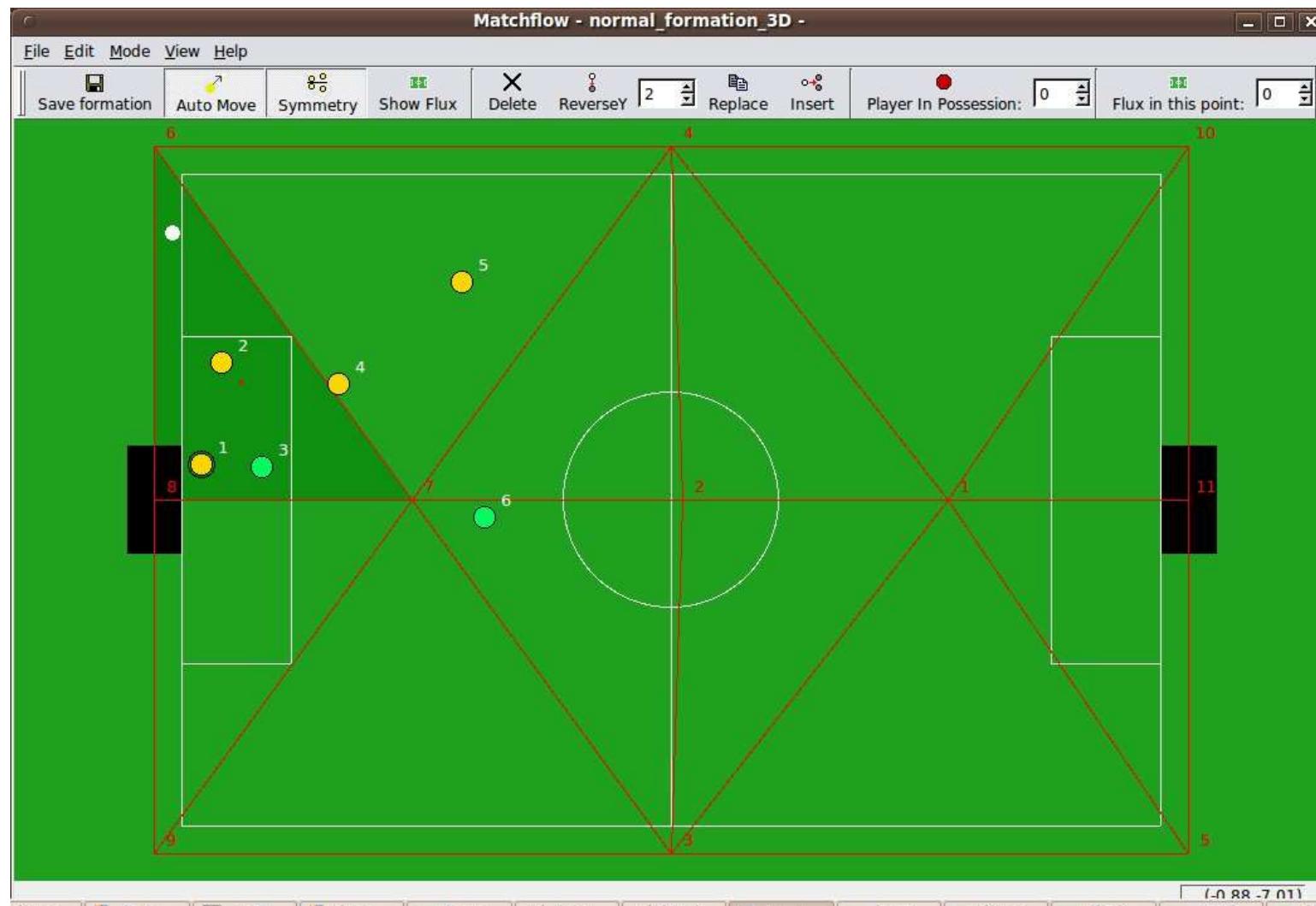
SBSP with Delaunay Triangulation



SBSP with Delaunay Triangulation



SBSP with Delaunay Triangulation



Formations in the MSL

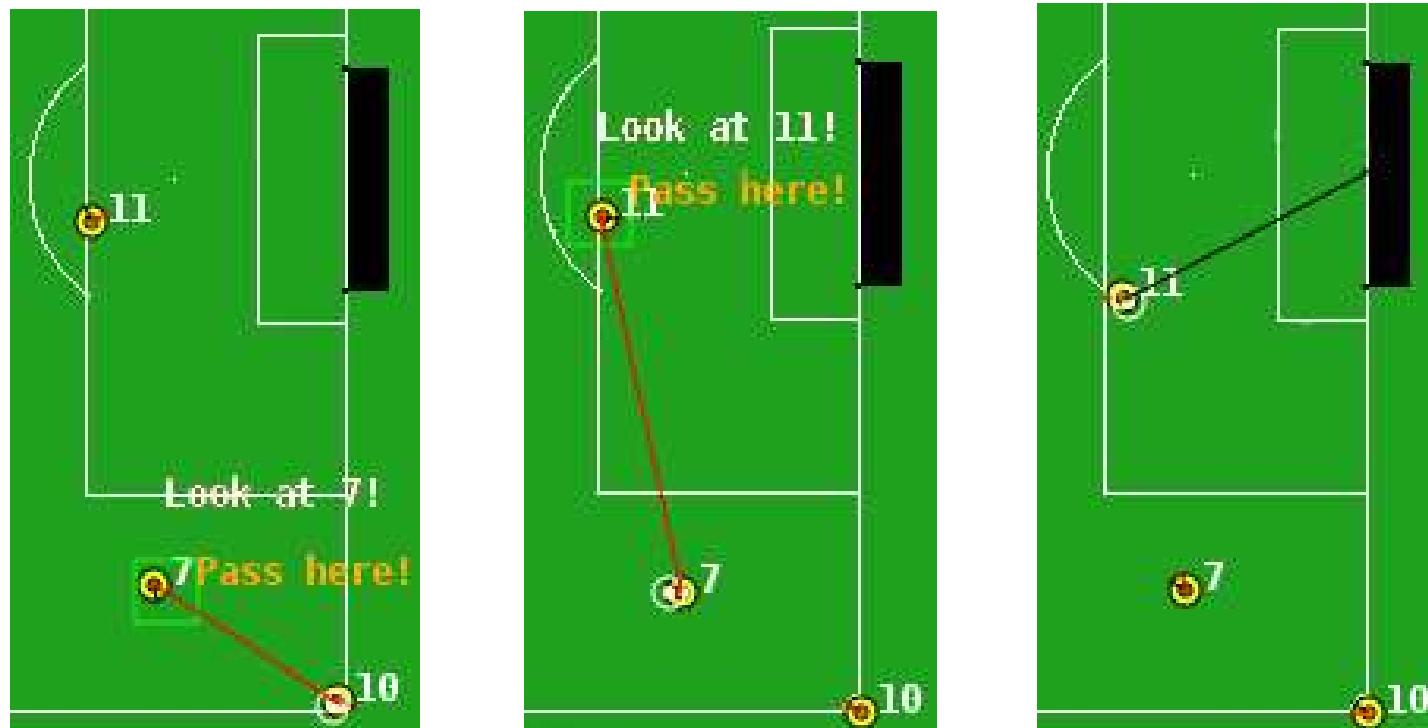


Formations in the MSL



Setplay Example (Sim2D)

Simple, pre-defined but flexible plans, which describe cooperation and coordination between agents/robots



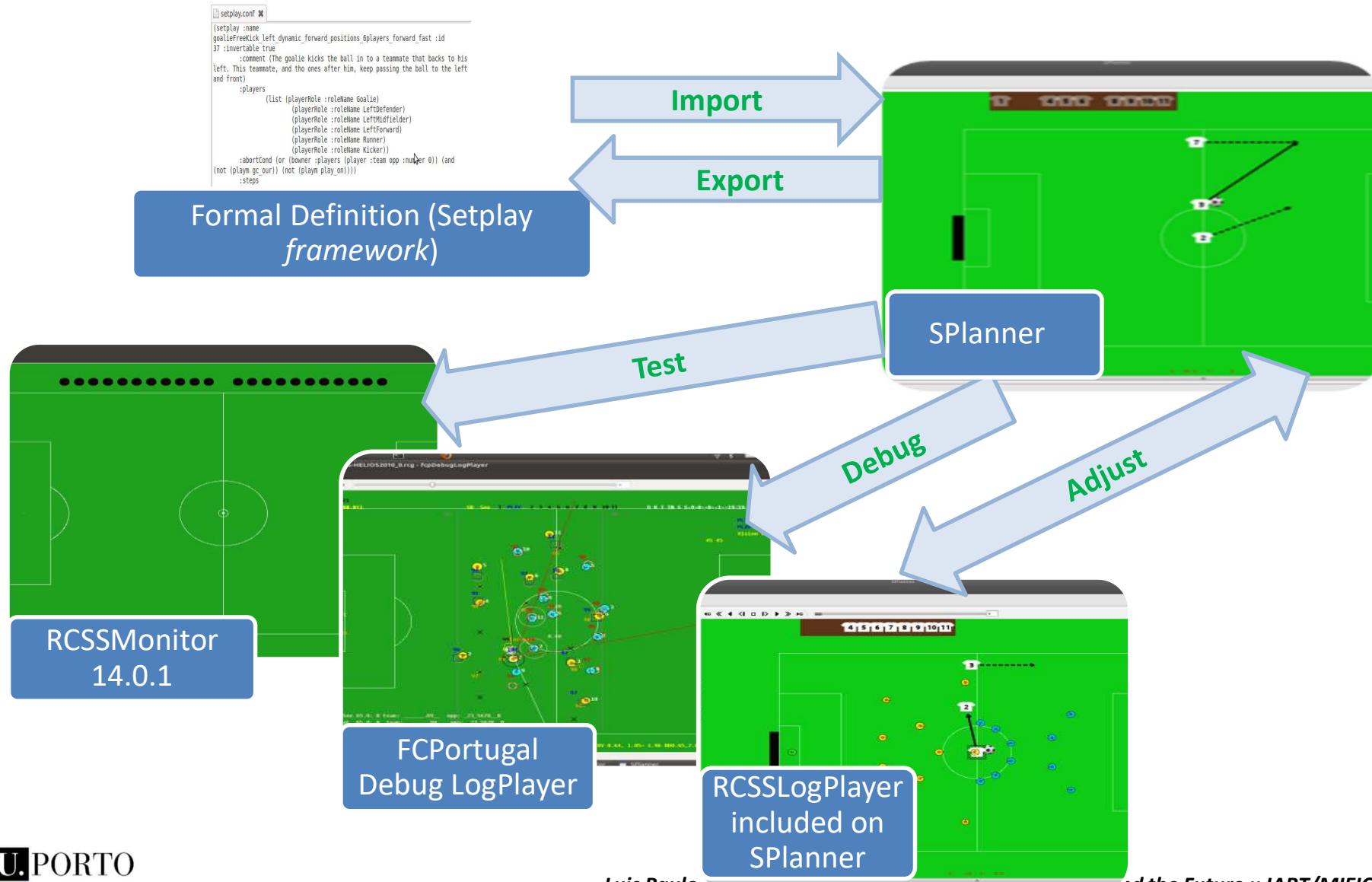
Setplay Definition

```
(setplay :name simpleCorner
  :players (list (playerRole :roleName CornerP)
    (playerRole :roleName receiver) (playerRole
    :roleName shooter))
:steps (seq (step :id 0 :waitTime 15 :abortTime 70
:participants
  (list (at CornerP (pt :x 52 :y 34))
    (at receiver (pt :x 40 :y 25)) (at shooter (pt :x
    36 :y 2)))
:condition (playm fk_our)
:leadPlayer CornerP
:transitions (list
  (nextStep :id 1:condition (canPassPl :from CornerP
  :to receiver)
  :directives (list
    (do :players CornerP :actions (bto :players
    receiver))
    (do :players receiver :actions (receivePass))))))
```

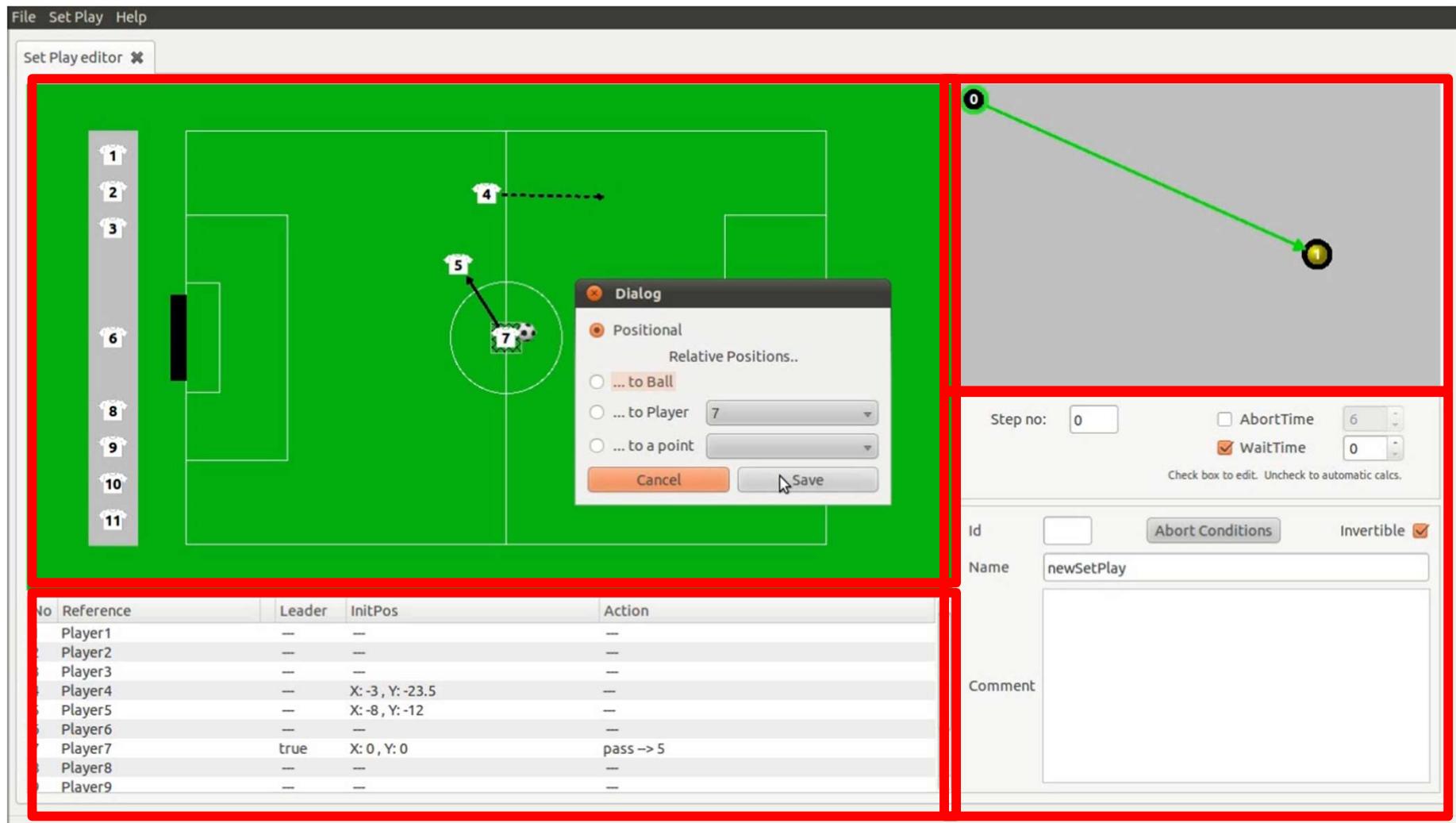
Setplay Definition

```
(step :id 1 :waitTime 5 :abortTime 70
:participants (list (at CornerP (pt :x 52 :y 34)) (at receiver (pt
:x 40 :y 25))
(at shooter (pt :x 36 :y 2)) )
:condition (and (bowner :players receiver) (playm play_on))
:leadPlayer receiver
:transitions (list
(nextStep :id 2
:condition (canPassPl :from receiver :to shooter)
:directives (list
(do :players receiver :actions (bto :players shooter))
(do :players shooter :actions (receivePass))))))
(step :id 2 :abortTime 70
:participants (list (at CornerP (pt :x 52 :y 34)) (at receiver (pt
:x 40 :y 25)) (at shooter (pt :x 36 :y 2)) )
:condition (and (bowner :players shooter) (playm play_on) )
:leadPlayer shooter :transitions (list
(nextStep :id 3 :condition (canShoot :players shooter)
:directives (list
(do :players shooter :actions (shoot)))))))
```

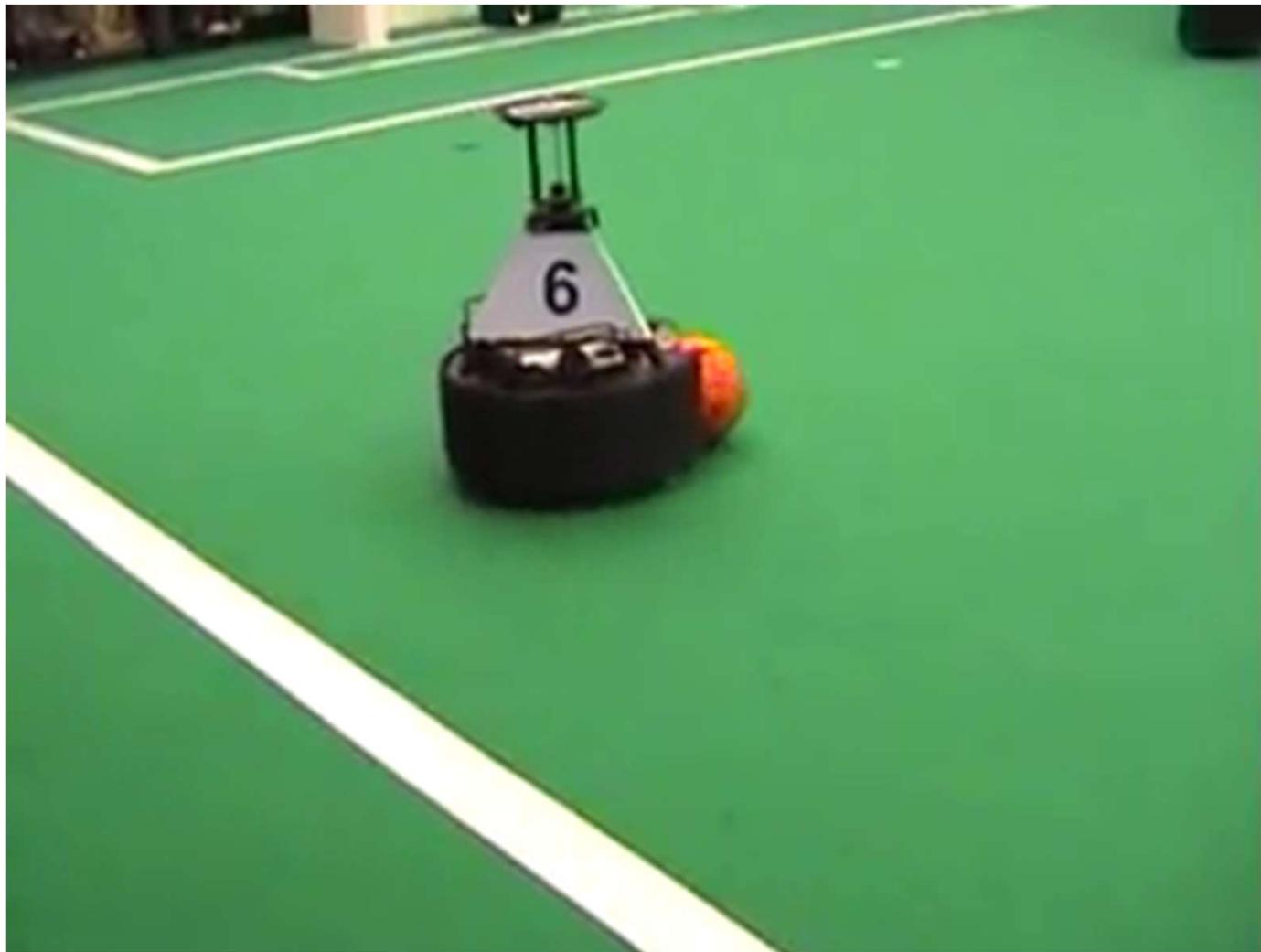
Setplays: Graphical Definition



Setplays: Graphical Definition



SetPlays in the MSL



Machine Learning Motivation

Programming Robots is a hard task:

- **No high-level programming language**
- **Sensors and actuators are noisy**
- **Robotics is moving towards increasingly unstructured environments**

If only robots could learn how to perform tasks by themselves...

⇒ **Machine Learning in Robotics**

Machine Learning in Robotics can be used for:

- **Robot Perception**
- **Robot Decision**
- **Robot Actuation (Behaviors)**
- **Multi-robot Coordination**
- **Adapt Human-Robot Interaction**

Machine Learning Motivation

Table-Tennis

Robots

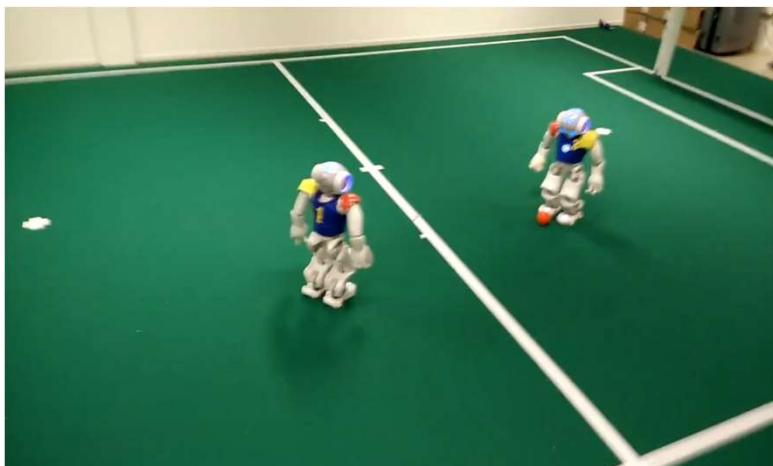


Mülling + Peters

Humans



Robots



Erik Orjehag - LIU H1

Humans



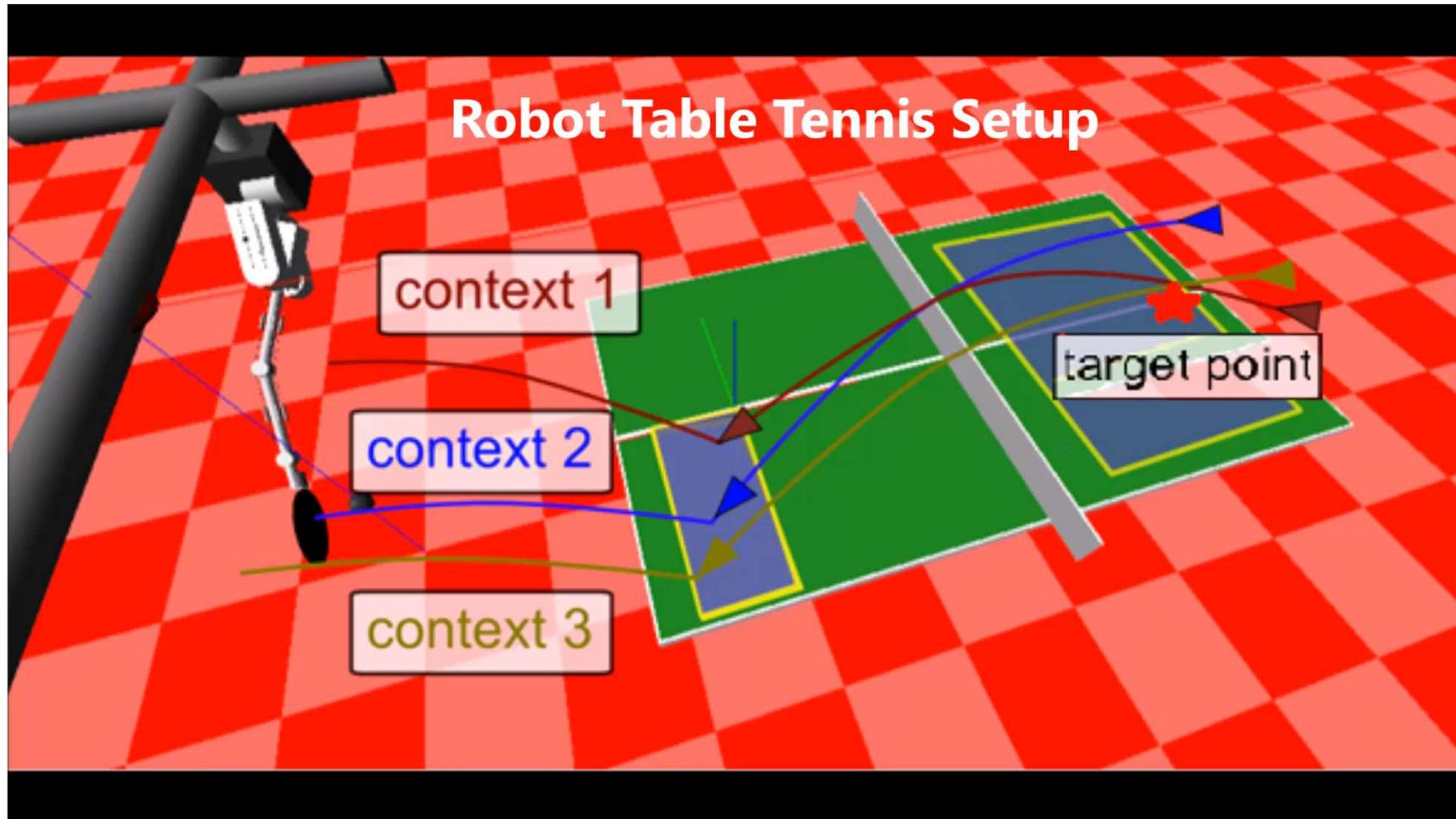
We need **learning** and **adaptation** to improve robot skills!

Machine Learning Motivation

Challenges in Robot Learning

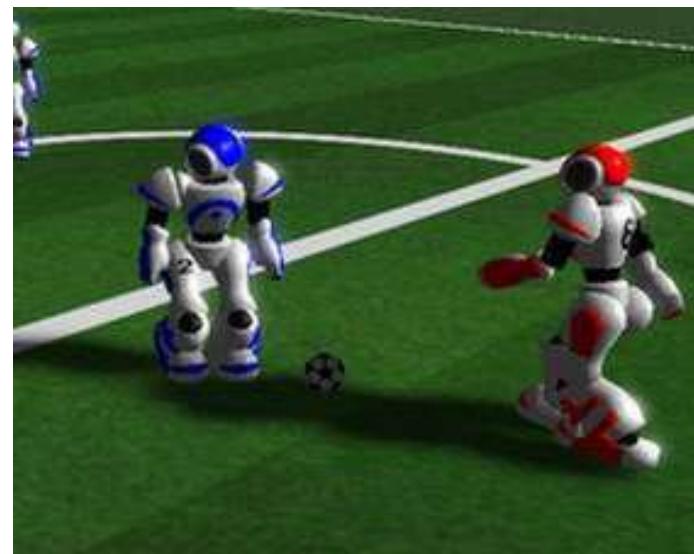
- Cost of experimentation
- Cost of failure
- Limited data
- Generalization
- Curse of dimensionality
- Real time requirements
- Changes in environment
- Changes in task specification

Experiments: Table Tennis

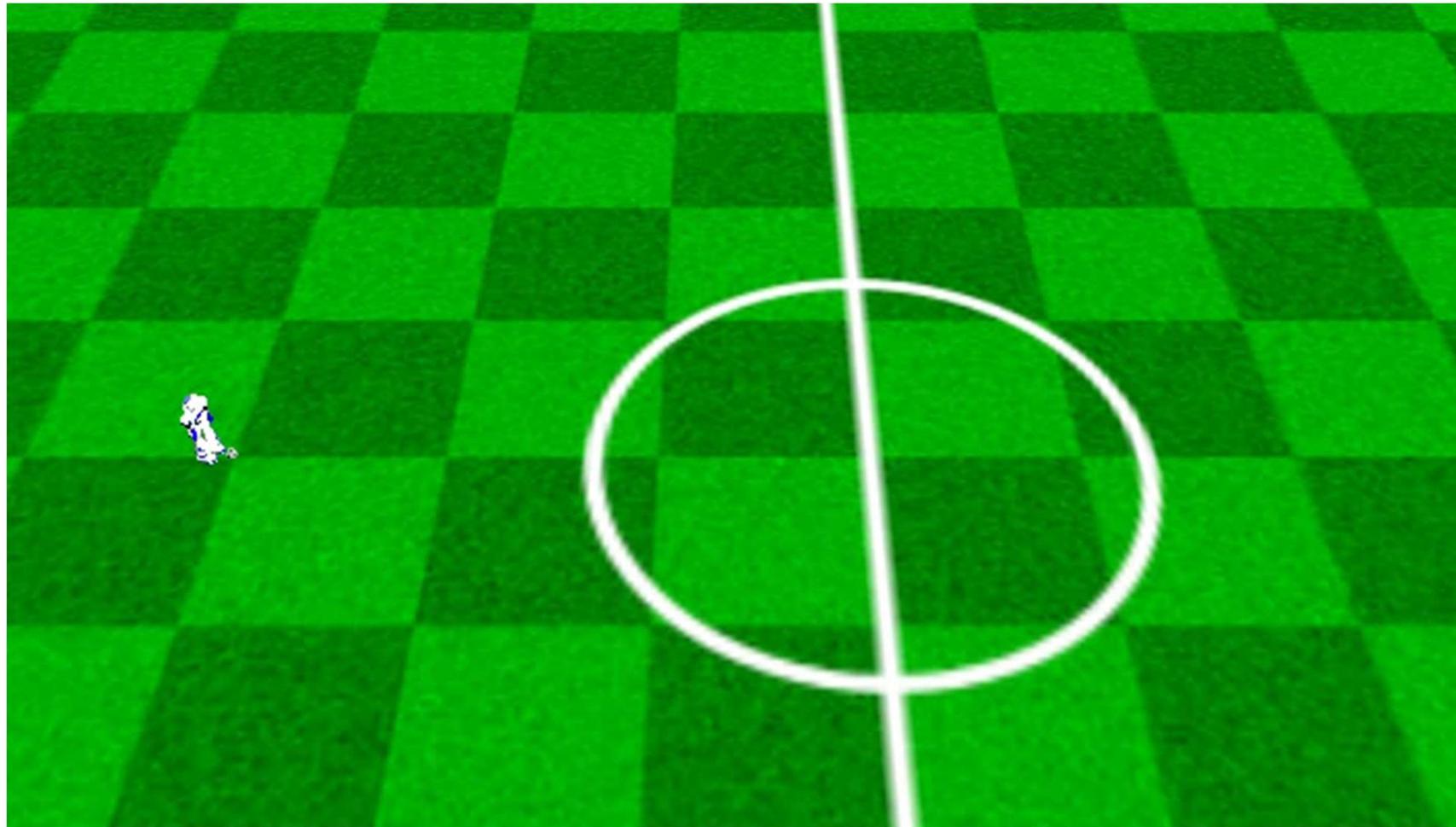


Skill Improvement: Controlled Kick

- **Task**
 - Develop a **kick with controlled kicking distance**
 - From 10 different positions in the soccer field (with distances ranging from 3m to 12m), kick the ball so that it stops in the center of the field
- **Classical approach**
 - Optimize for each distance
- **Contextual approach**
 - Optimize for all distances in a single process
 - Use all data to improve performance
 - Generalize for unknown contexts



Skill Improvement: 20 m Kick



Skill Improvement: 20 m Kick

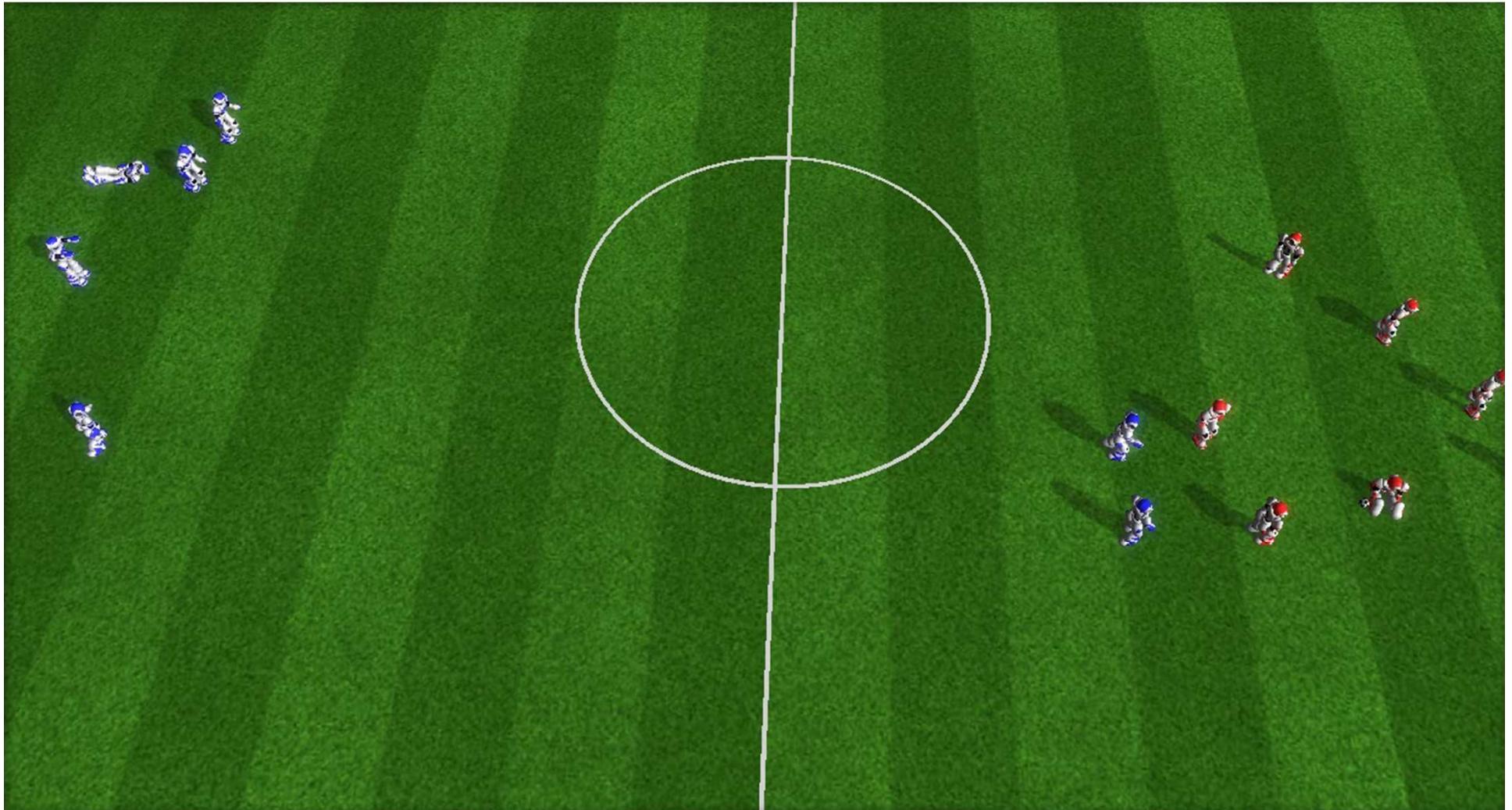


Skill Improvement: Controlled Kick



Abbas Abdolmaleki et al. Learning a Humanoid Kick With Controlled Distance. RoboCup 2016: Robot World Cup, Springer, July 2016

Results – Formation and Kick



Results – Formation and Kick



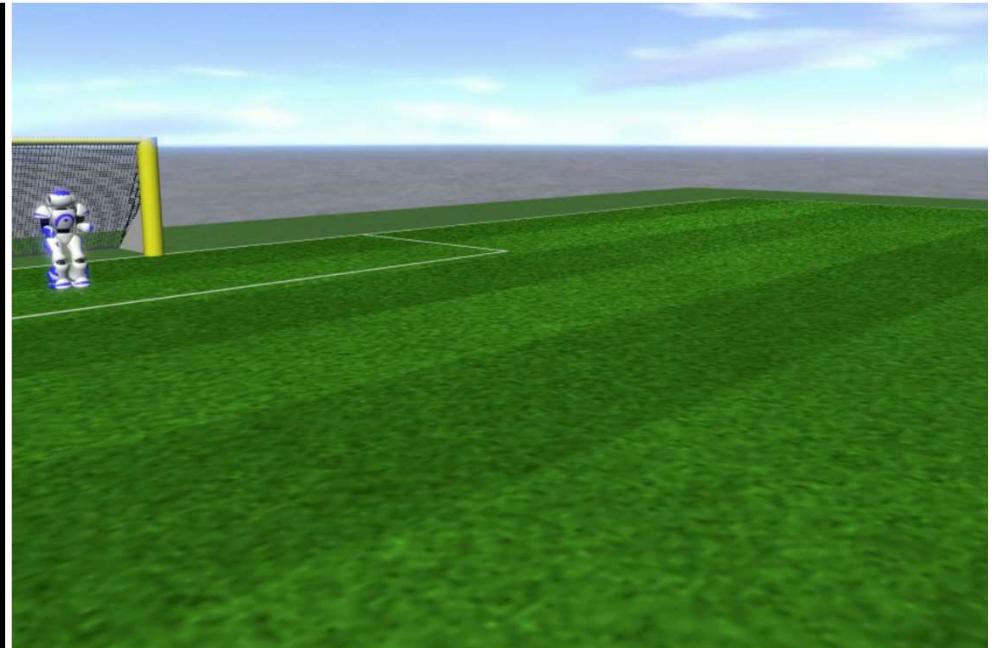
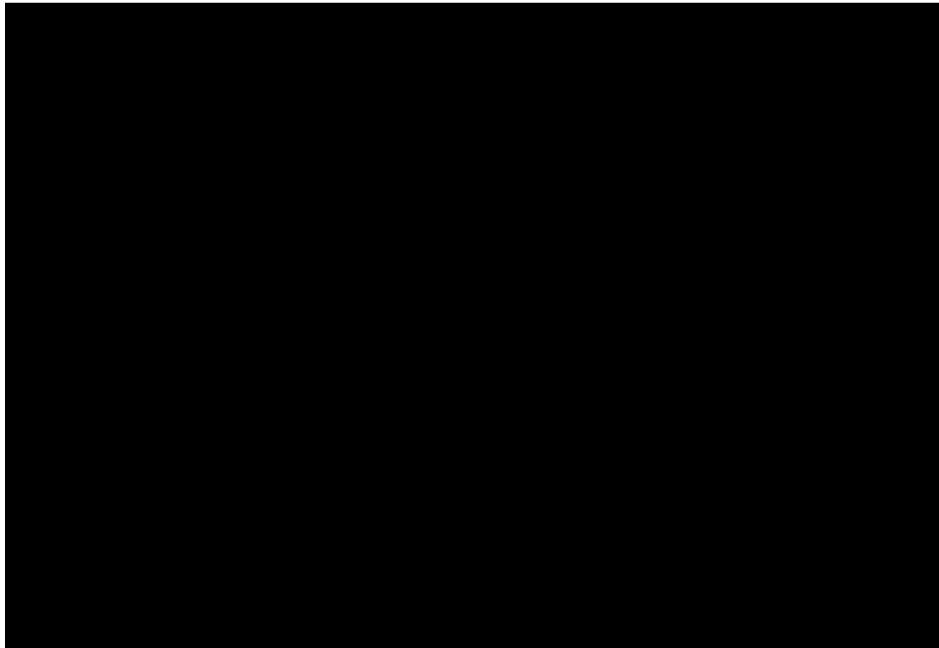
Learning to Walk with PPO

Results

Top Sp.:1.5m/s

v1 v2

Top Sp.:2.5m/s



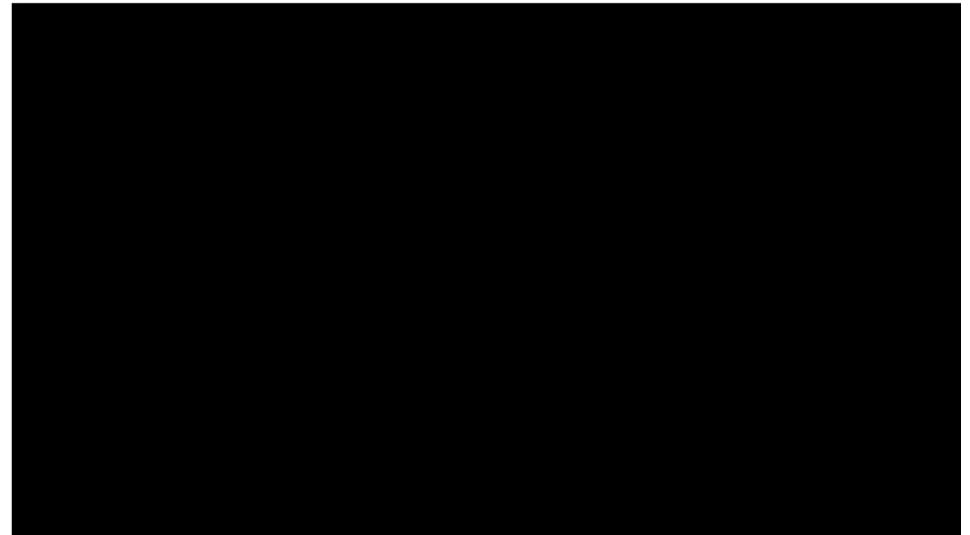
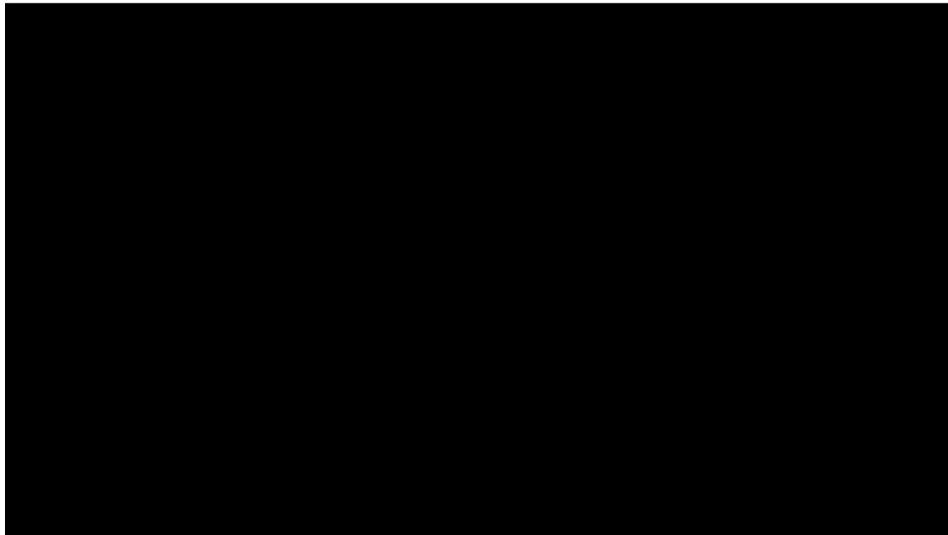
Learning to Walk with PPO

Results

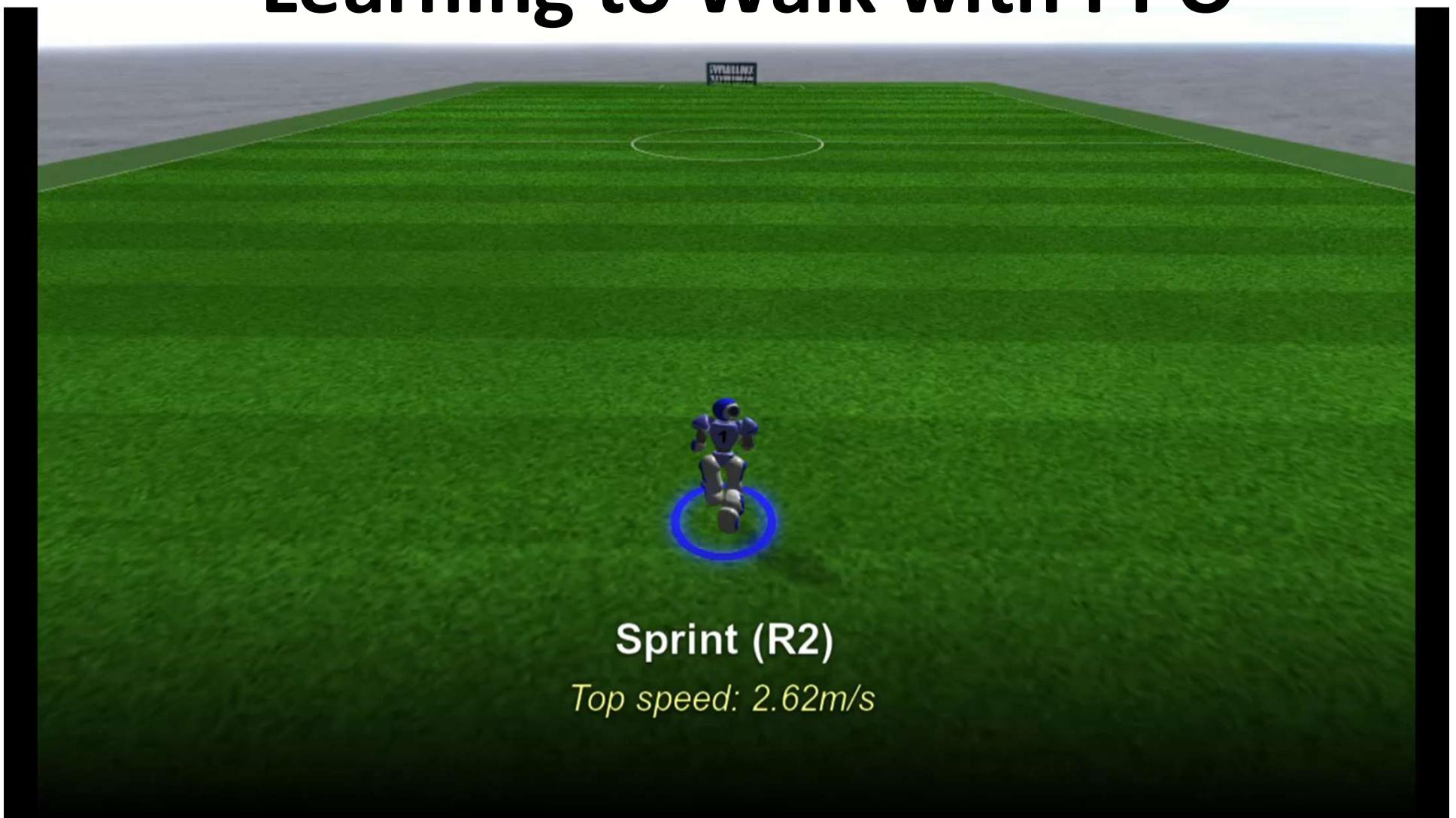
Turn & Run

v1

Dribble



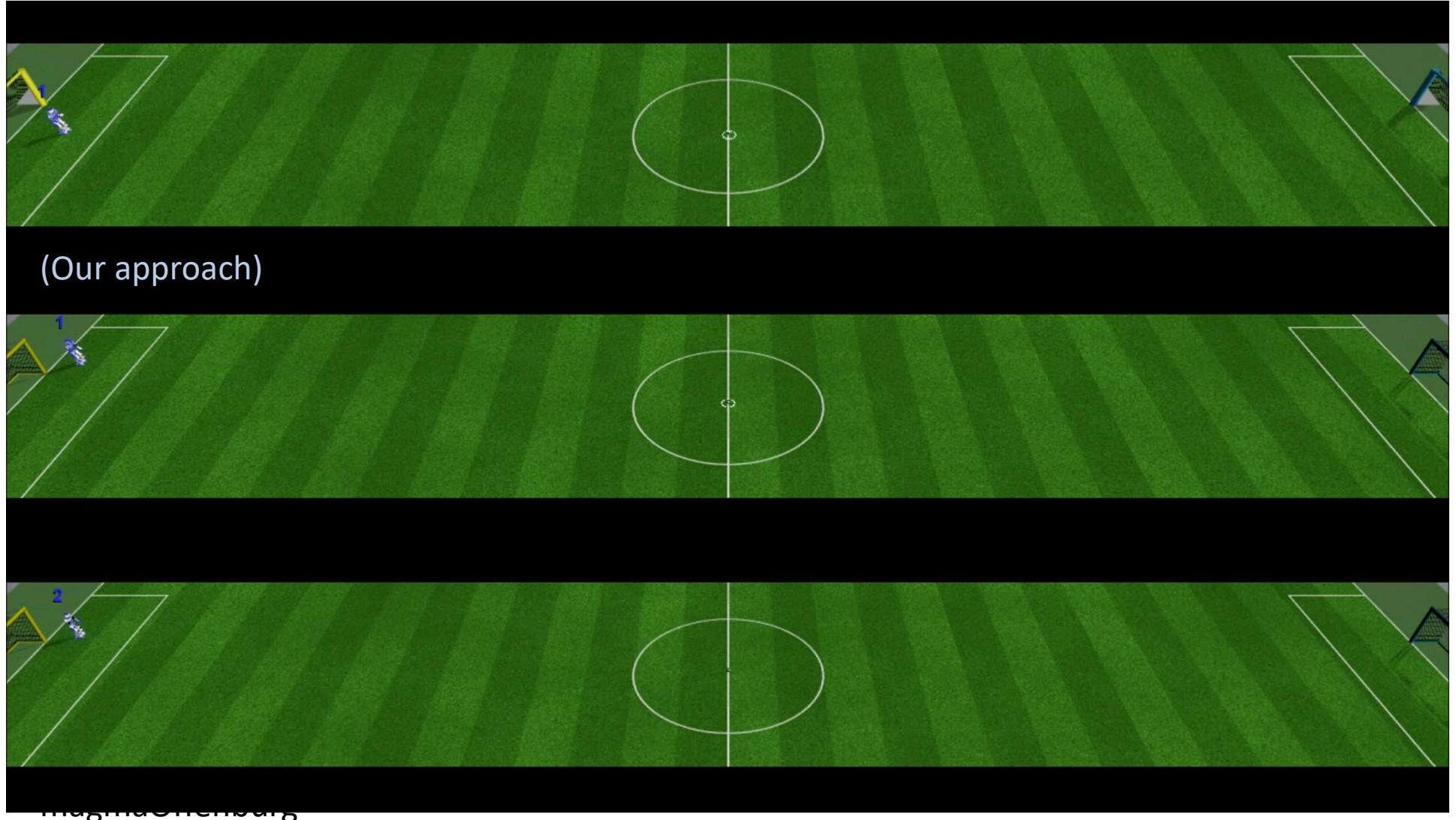
Learning to Walk with PPO



Sprint (R2)

Top speed: 2.62m/s

Learning to Walk with PPO



Learning to Walk with PPO

Future Work



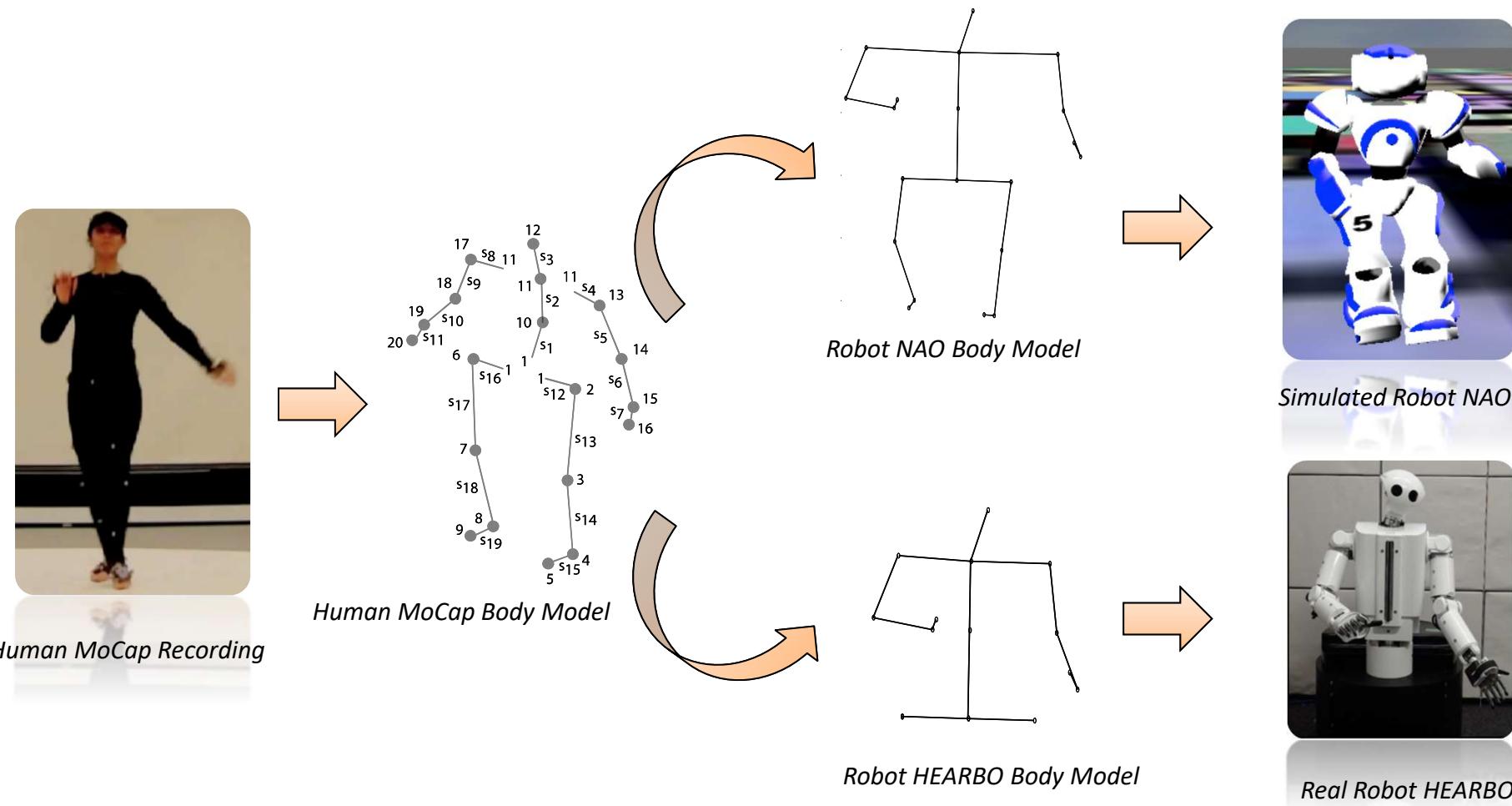
Conclusions

- **Coordination of Teams in Adversarial Environments:**
 - Strategy, Formations (SBSP/DT), DPRE, Setplays
- Complete **Tactical/Formation Framework and Setplay Framework** including graphical interfaces
- **Generic Coordination Framework/Library:**
 - May be used for coordinating any team:
 - World State -> High-Level Decision!
 - Useful for researching on Low-Level Robotics!
- Methodologies with competition success
- Solution from scratch (PPO), Brought a POMDP closer to MDP
- Human-like behaviors, Highly stable sprint,>2x faster than state of the art
- **Different robots, distinct cooperative robotic tasks and also to other domains:** Rescue, surveillance, military apps

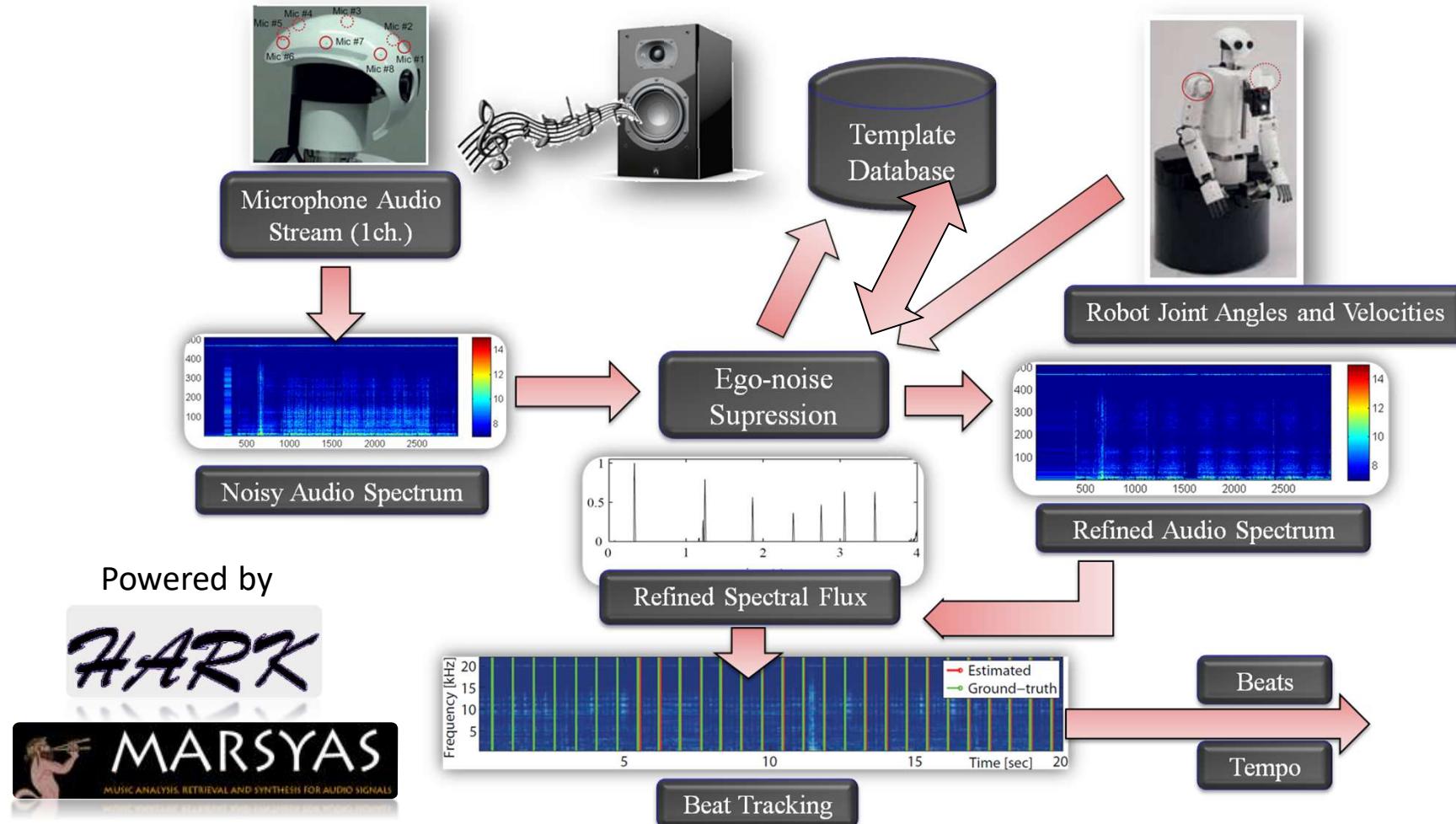
Robot Dancing



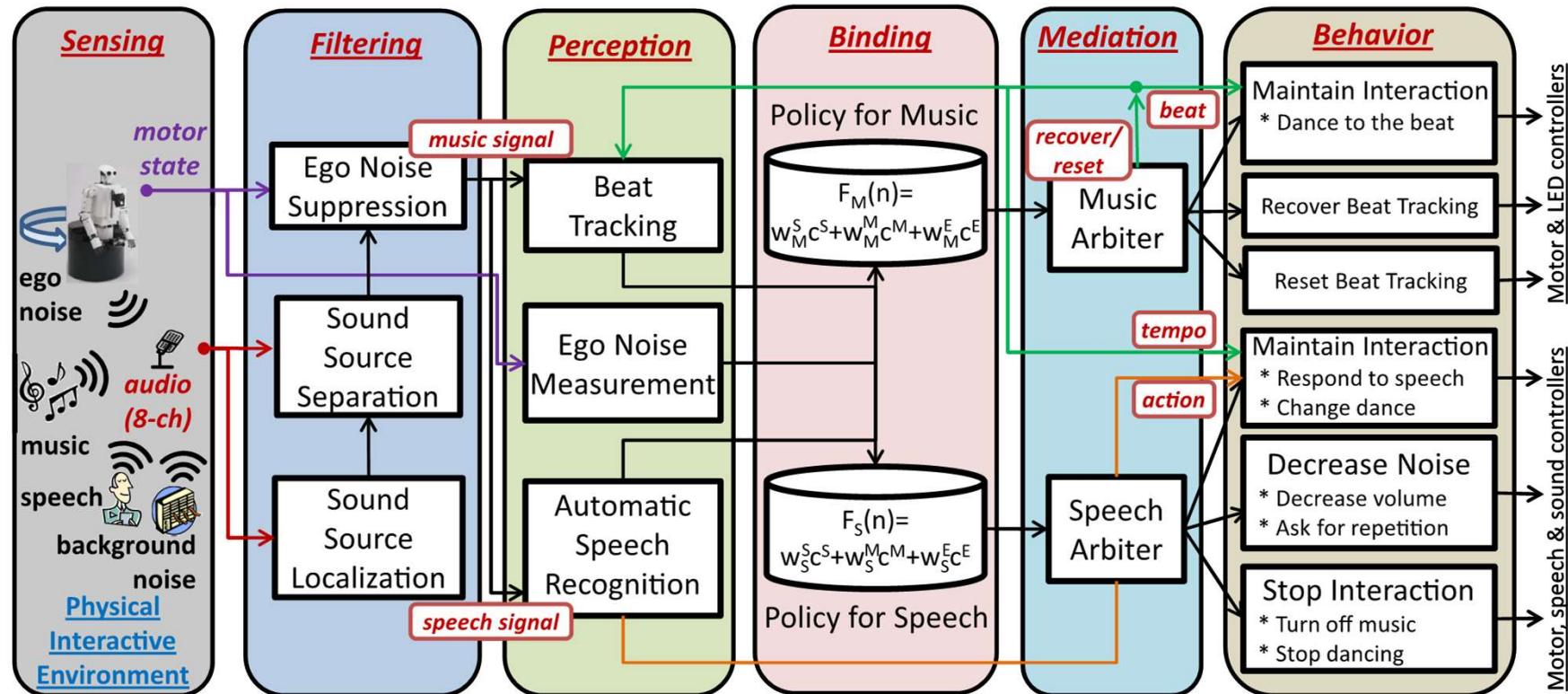
Mapping Samba onto Humanoids



Live Ego Noise-Robust Beat Tracking Demo

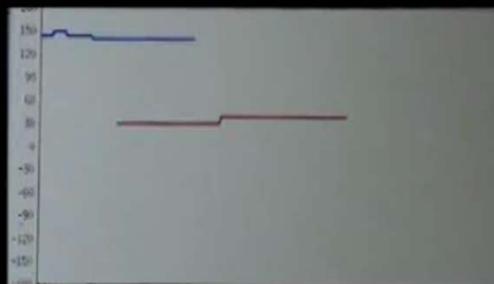


An Active Audition Framework for Auditory-driven HRI



Human-Interactive Robot Dancing Demo

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Sound Localization

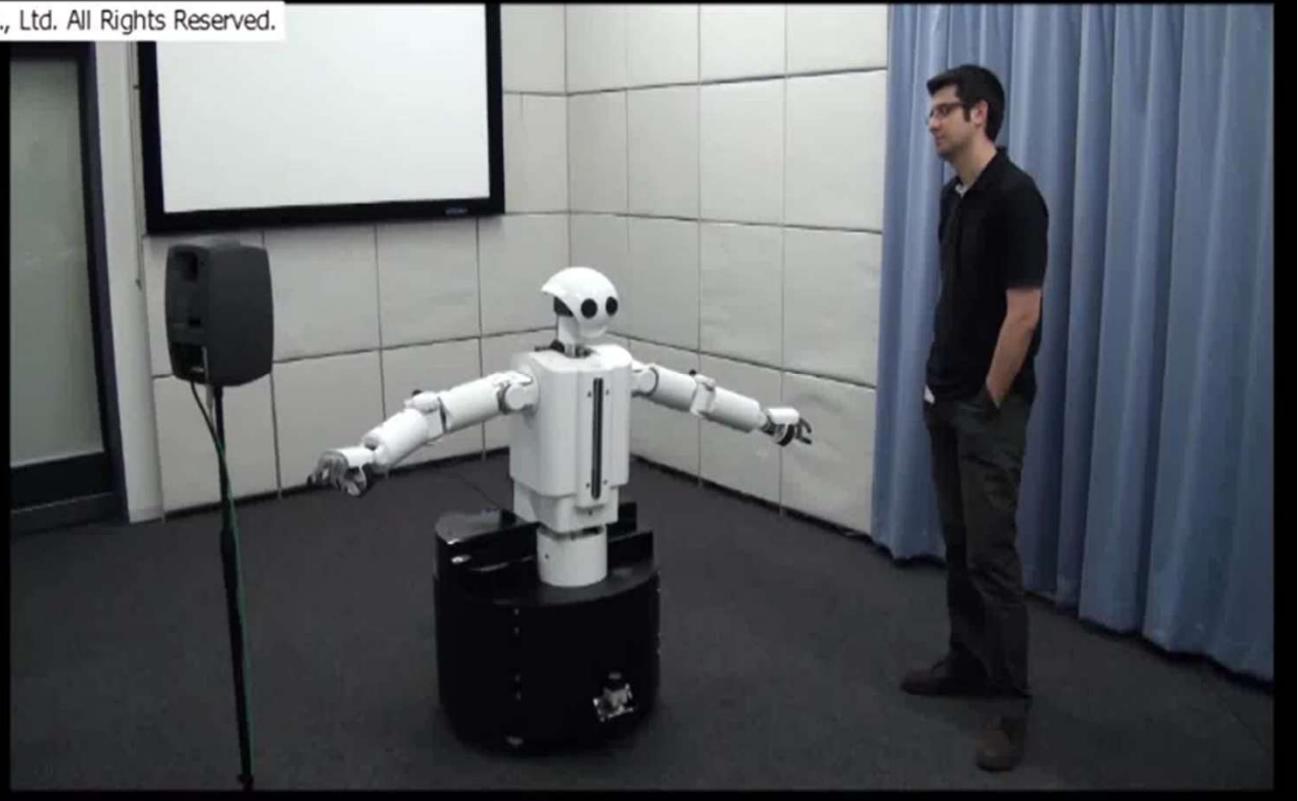
Speech Decision: 0

Maintain Interaction

Music Decision: 0

Maintain Interaction

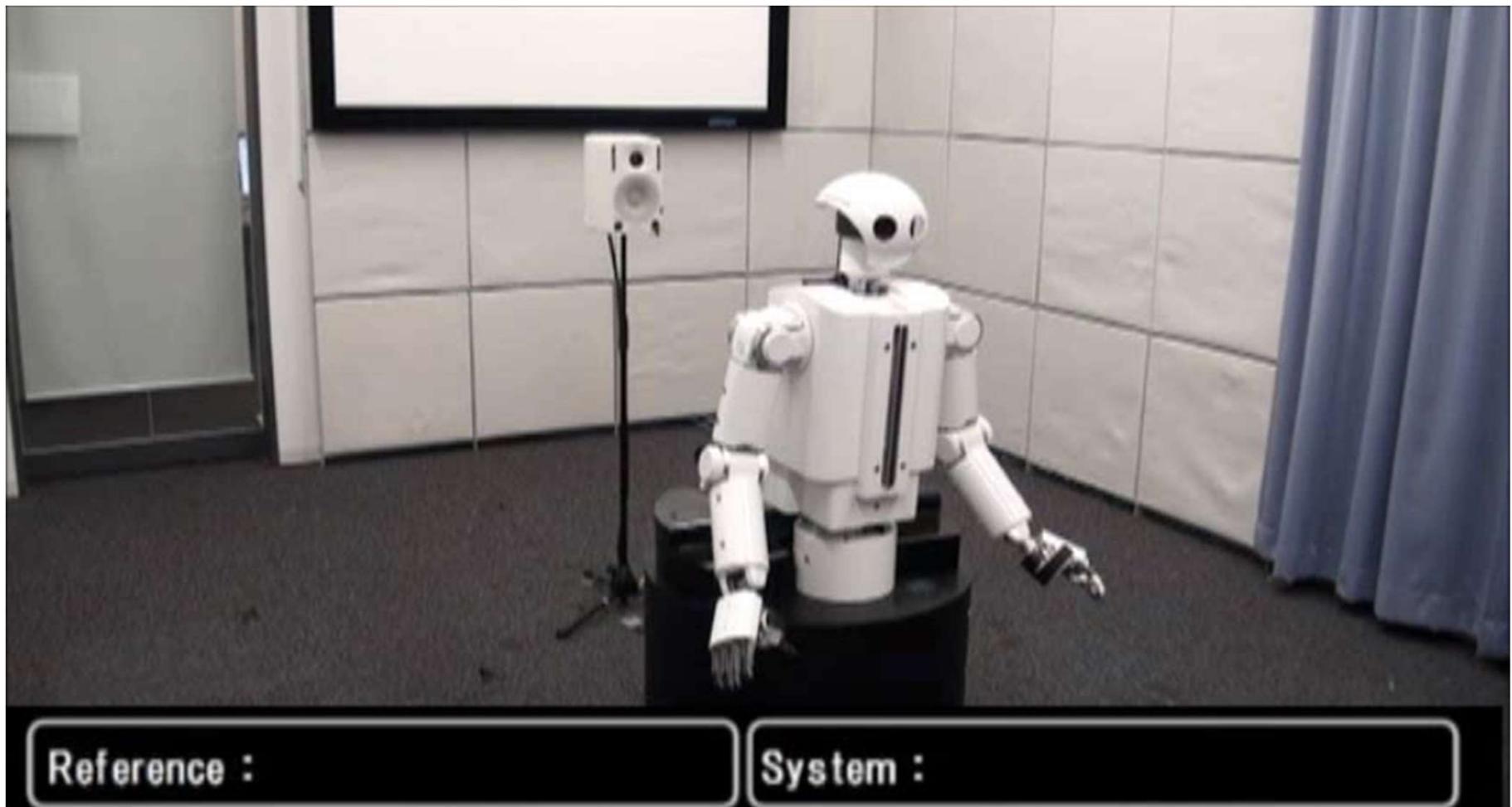
Decision/Behavior



ASR Result



Human-Interactive Robot Dancing Demo



Reference :

System :

Artificial Intelligence and Virtual Reality for Surgery Training

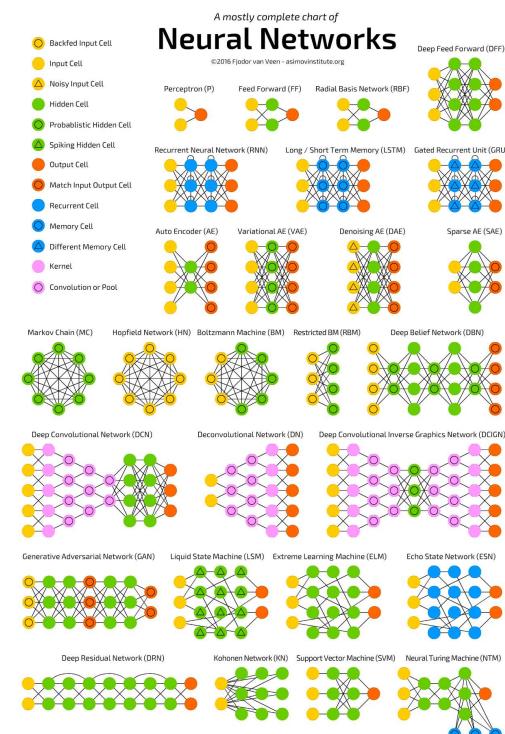
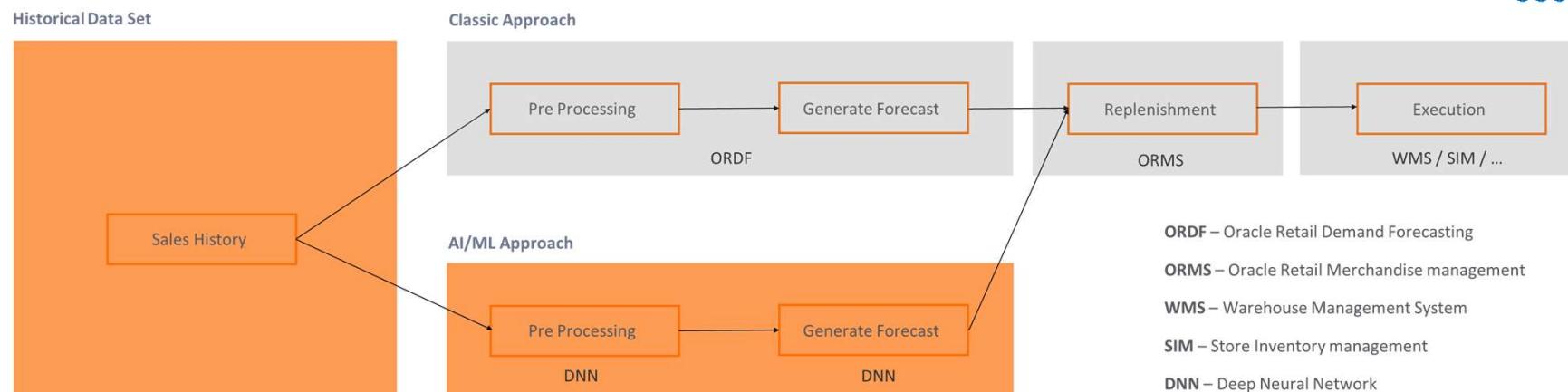
- <https://www.firsttouch-academy.com/>



AutoML em DeepAR para Forecasting no Setor do Retalho

AutoML para diminuir a necessidade de input e parametrização dos modelos baseados em DeepAR para forecasting no retalho

<https://www.retail-consult.com/>





Exemplo:

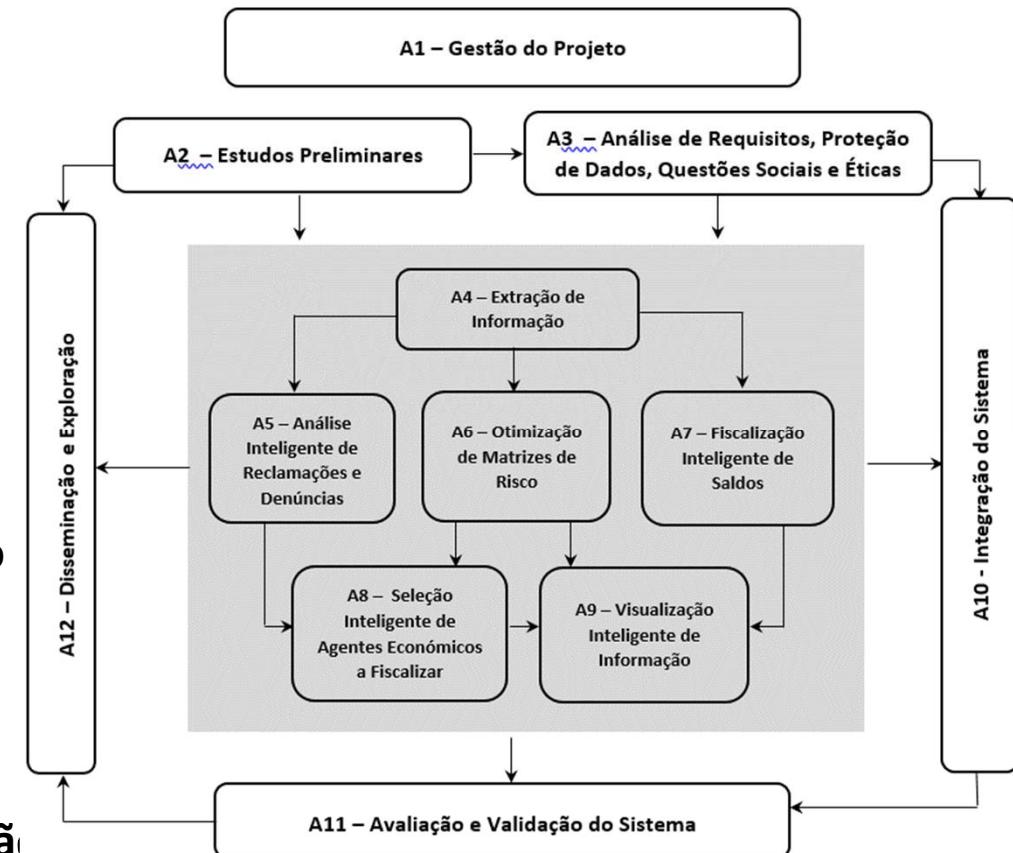
Projeto IA.SAE – Inteligência Artificial na Segurança Alimentar e Económica

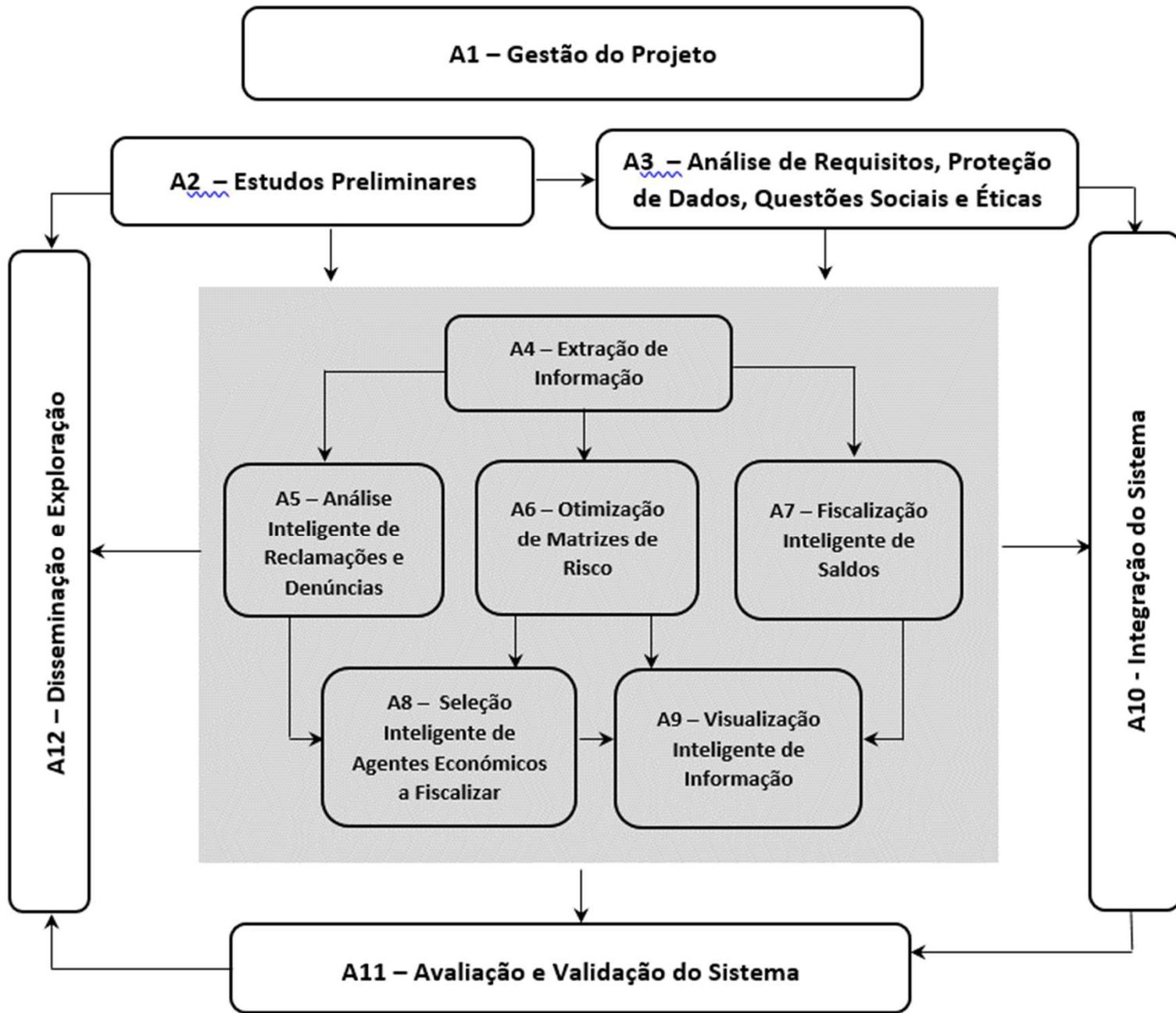


Projeto IA.SAE

Inovação Artificial na Segurança Alimentar e Económica

- Análise de **Risco**, de Denúncias e Reclamações e Seleção de Agentes Económicos a Fiscalizar
- Inteligência Artificial, Otimização, Aprendizagem Computacional, PLN e Dados da ASAE
- Georreferenciamento de agentes económicos
- Análise de reclamações e denúncias, para classificação e priorização
- Matrizes globais de risco baseadas no volume de consumo, taxa de incumprimento, etc.
- Seleção inteligente de agentes económicos a fiscalizar
- Geração flexível de rotas de fiscalização georreferenciadas
- Visualização inteligente de informação
- **Protótipo funcional**, que responda às necessidades de tomada de decisão da







Projeto IA.SAE – Inteligência Artificial na Segurança Alimentar e Económica

Análise de Denúncias e Reclamações utilizando Processamento de Linguagem Natural



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FEUP FACULDADE DE ENGENHARIA/
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PORTUGUESA
ECONOMIA

FCT
Fundação para a Ciéncia e a Tecnologia

MINISTÉRIO DA CIÉNCIA, TECNOLOGIA E ENSINO SUPERIOR

Homepage

Utilize o navegador **Chrome** para uma melhor experiência, particularmente nas fiscalizações e *Nova Entidade*.

Esta aplicação foi criada com o intuito de atingir dois objectivos:



Projeto IA.SAE – Inteligência Artificial na Segurança Alimentar e Económica

Selecção de Agentes Económicos e Geração de Rotas de Fiscalização



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PORTUGUESA**
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MISINÉRIO DA CIÉNCIA, TECNOLOGIA E ENSINO SUPERIOR

The screenshot shows a web application interface. On the left, there is a sidebar with a blurred background image of what appears to be a police vehicle. The sidebar contains a search bar labeled "Pesquisa entidade" and a list of entities:

| ID | Nome | Util. | CAEs | Actividades |
|---------|-----------|-------|-------|-------------|
| 24183 | PROLAG... | 0.005 | 10412 | II.5.2 |
| 679144 | SÁ PIR... | 0.105 | 10412 | II.5.2 |
| 2937520 | ... | 0.14 | 10412 | II.5.3 |
| 3188412 | ... | 0.205 | 10412 | II.5.2 |
| 3210511 | ... | 0.005 | 10412 | II.5.2 |
| 5119746 | ... | 0.005 | 15412 | II.1.1 |
| 5462226 | CAT... | 0.005 | 10412 | IX.20 |

At the bottom of the sidebar, there is a message: "Esta aplicação foi criada com o intuito de atingir os seguintes objetivos:
• Exploração da informação disponível;
• Como uma base de teste, experimentação e aprendizagem." Below this message are two buttons: "Back" and "Gerar rota".

The main content area shows a user profile: "(ester) Ester Esteves - Unidade UO3" and a "Logout" button. To the right of the main content area, there is a large image of a person wearing a dark jacket with "ASAE POLÍCIA" written on it.



Projeto IA.SAE – Inteligência Artificial na Segurança Alimentar e Económica

Visualização Inteligente de Informação e de KPIs



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Homepage

Utilize o navegador **Chrome** para uma melhor experiência, particularmente nas *fiscalizações* e *Nova Entidade*.

Esta aplicação foi criada com o intuito de atingir dois objectivos:

[REDACTED]

Projeto IA.SAE

Inteligência Artificial na Segurança Alimentar e Económica



Fundação para a Ciéncia e a Tecnologia
MINISTÉRIO DA CIÉNCIA, TECNOLOGIA E INovaçõEs

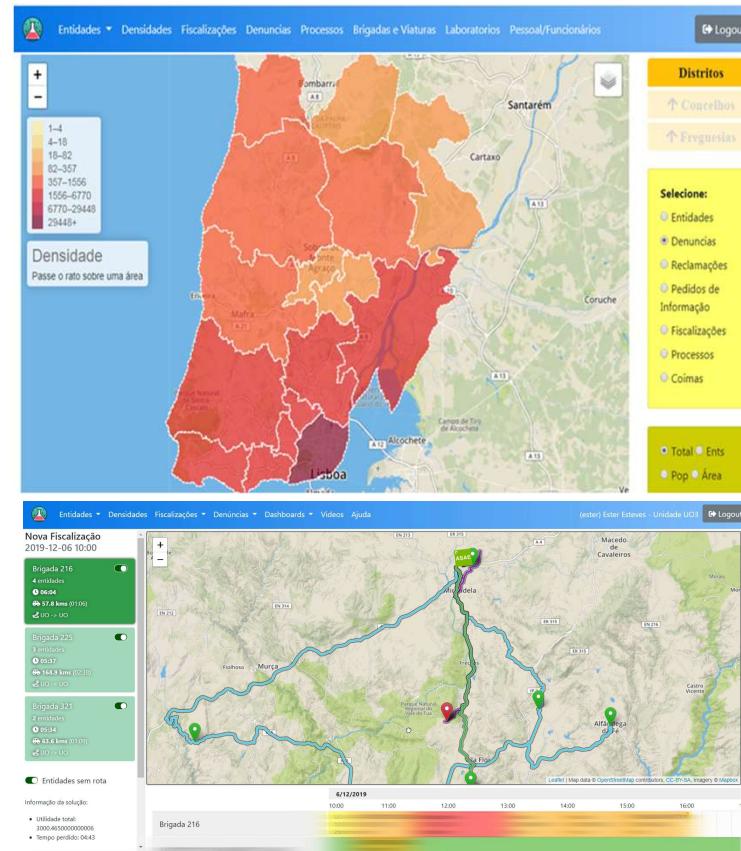
- Apoio à decisão eficaz, baseado em técnicas de Inteligência Artificial
- Dotar os especialistas da ASAE com meios adicionais para aumentar a sua eficiência
- Sensibilizar os agentes económicos para a importância do cumprimento da lei
- Incremento na segurança alimentar e económica nacional
- Incremento da confiança dos consumidores



Laboratório de Inteligência Artificial e Ciéncia de Computadores da Universidade do Porto



Autoridade de Segurança Alimentar e Económica



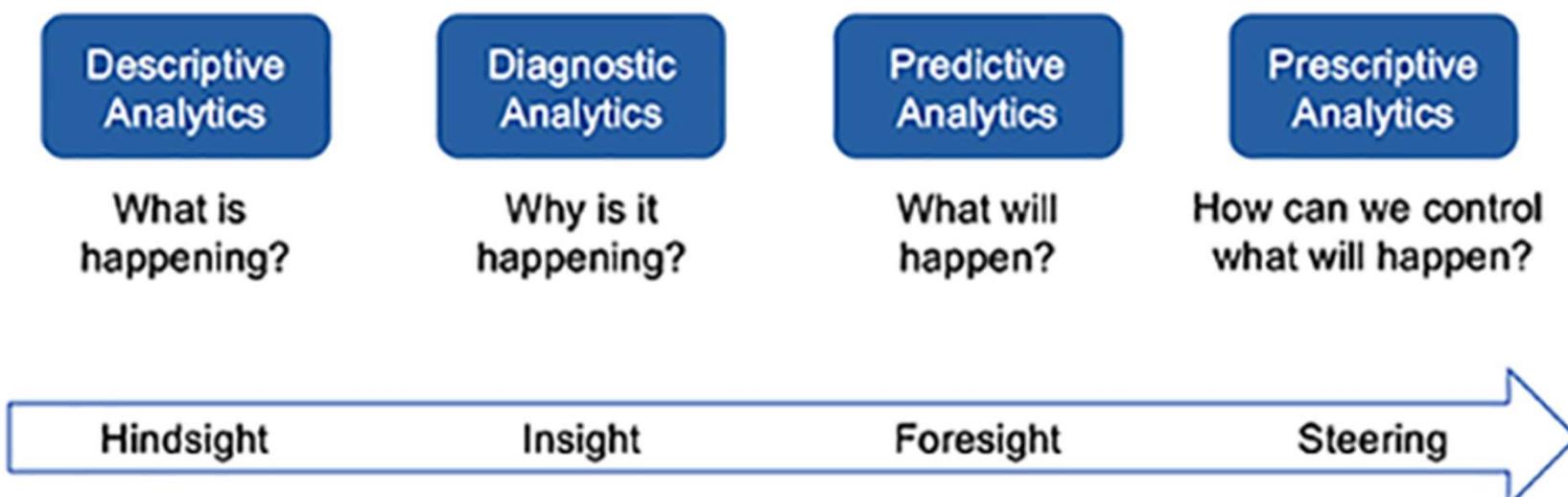
AI Application Area: Health

- Radiology (X-ray, CT, MRI)
- Dermatology (Image)
- Drug/Treatment Discovery
- Risk Identification in Patients
- Primary Care and Screening
- Health Monitoring/Wearables
- Cognitive and Social Rehabilitation
- Physical Rehabilitation
- Patient Interaction with the Health System
- Health Systems Exchange of Information
- Surgical/Medical Robots
- Efficient Resource Allocation in Health
- ...



AI for the Environment

- **Descriptive:** Interprets historical data to determine what happened
- **Diagnostic:** Determines why something has happened using AI
- **Predictive:** Predicts what will happen in the future based on historical data/patterns, external data and AI techniques
- **Prescriptive:** Predicts multiple outcomes for a given scenario based upon actions taken. Steering the user toward the best possible option



AI for Land/Agriculture

- Land is under very high pressure
- Soil pollution, population growth, intensive agriculture, etc
- One third of the earth already depleted, contaminated, pesticide poisoning
- Land cover mapping, species classification,
- AI has the power to make agricultural practices safer for the land and the public health
- Machine Learning, Robotics, Simulation, Decision Making, Optimization
- Analyse farm and weather data, automating and optimizing farming processes
- Organic and land friendly crops



AI for Air/Pollution

- Better monitoring and prediction of Pollution
- Pollution/air quality sources identification
- Reduce harmful emissions on its source
- Intelligent and Green Transportation,
Autonomous Cars
- Ai may help mitigate health risks and assist in drug development related to pollution
- Autonomous ride shares, dynamic bus routing, intelligent traffic lights
- Smart Sensors, Machine Learning, Robotics, Simulation, Decision Making, Optimization



AI for Water

- **Healthy Oceans, Lakes and Rivers**
- **Autonomous Garbage collection (plastic) at the oceans**
- **Intelligent ocean farming (fish and shellfish)**
- **Predict emergence events (storms, tsunamis, hurricanes, ...)**
- **Reducing energy costs, optimizing chemical use for treatment, and enabling proactive asset maintenance**
- **Clean, effective, resilient, sustainable, and cost-effective water management**
- **Smart Sensors, Machine Learning, Robotics, Simulation, Decision Making, Optimization**



AI for Climate Change

- An increasingly variable climate, extreme weather events, rising sea levels, higher global temperatures, and increased ocean acidity threaten human health, infrastructure, and the natural systems we rely on for life itself
- Climate change is one of the biggest challenges facing the planet and It will need strong contribution from AI
- Better climate predictions, Showing the effects of extreme weather, Measuring where carbon is coming from
- Smart Sensors, Machine Learning, Robotics, Simulation, Decision Making, Optimization



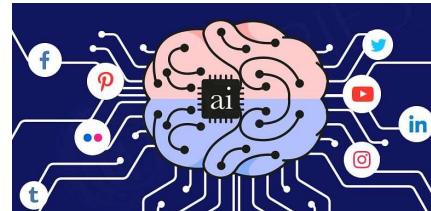
AI for Biodiversity

- Species are going extinct beyond the natural rate by orders of magnitude, driving the decay of key ecosystem services, like pollination, that humans depend upon
- AI is being used to classify animals in real time, to detect people where they shouldn't be, and even to identify and track individual animals and plants throughout their lives
- Environmental decision support systems
- Biodiversity surveillance, tracking, analysis and prediction
- Catastrophe and natural events analysis and prediction
- Machine Learning, Simulation, Decision Making, Optimization



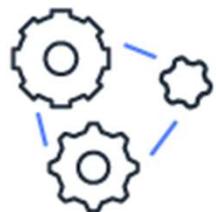
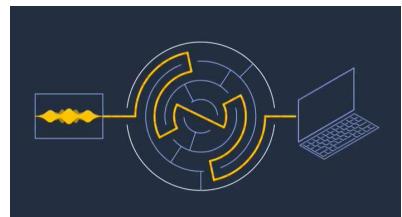
Artificial Intelligence in Digital Media

- Digital Images
- Digital Video
- Digital Audio
- Movie Industry
- Video Games
- Web Pages and Websites
- Social Media
- Digital Data and Databases
- Electronic Documents/Books



Artificial Intelligence in Digital Media

- Amazon Web Services (AWS)



Amazon Lex

Build chatbots to engage customers



Amazon Rekognition

Deep learning-based image and video analysis



Amazon Translate

Fluent translation of text



Amazon Transcribe

Automatic speech recognition



Amazon Polly

Natural sounding text to speech



Amazon Comprehend

Discover insights and relationships in text

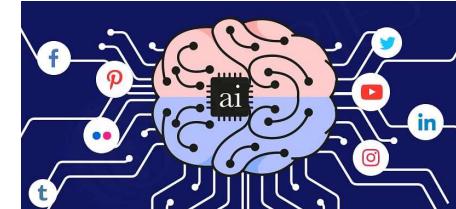
Artificial Intelligence in Video Games

- Generate responsive, adaptive or intelligent behaviours
- Non-player characters (NPCs) with human-like intelligence
- Improve the game-player experience
- Game Balancing/ Dynamic Difficulty Adjustment
- Movement patterns, in-game events based on player's input
- Pathfinding and decision trees for NPCs actions
- Procedural-content generation
- Text to speech and speech recognition
- AI for automatic level generation
- AI opponents for board/strategic games



Artificial Intelligence in Social Media

- **Social Creation and Management**
- **Social Insights**
- **Social Media Advertising**
- **Image/Face Recognition**
- **Fake News/Improper Content Recognition**
- **Personalised User Experience**
- **Advise Contacts/ Job candidates / Matches**
- **AI Powered Chatbots**
- **Social Listening**
- **Sentiment Analysis**
- **Improved Influencer strategies**
- **Increased Security**



Ethics in Artificial Intelligence

- **Ethics of artificial intelligence**

Part of the **ethics of technology specific to robots and other artificially intelligent beings**.

- **“Robot Ethics”**

Refers to the **morality of how humans design, construct, use and treat robots** and other artificially intelligent beings.

It considers both how artificially intelligent beings may be used to **harm humans** and how they may be used to **benefit humans**.

- **"Robot Rights"**

Concept that people should have **moral obligations towards their machines**, similar to human rights or animal rights.

These could include the **right to life and liberty, freedom of thought and expression and equality before the law**.

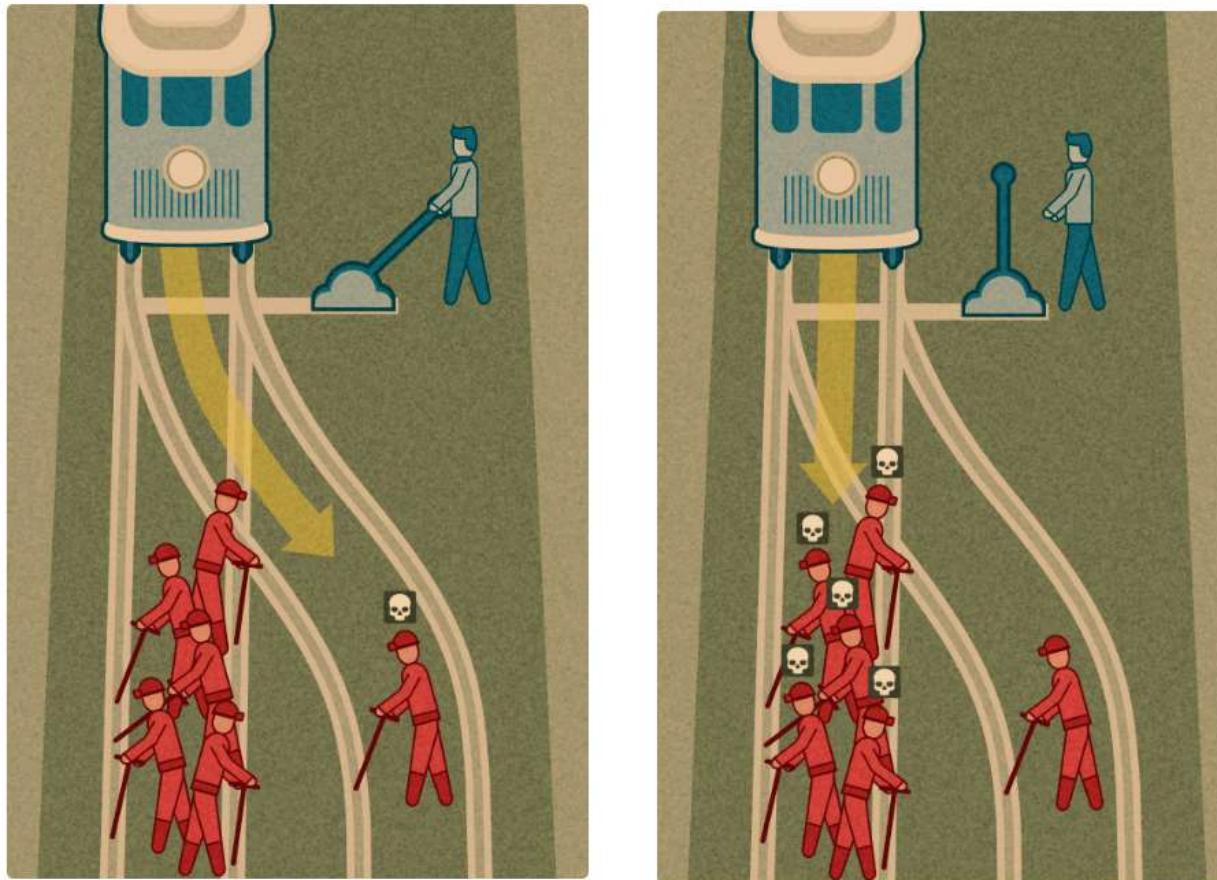
Asimov's Robotic Laws

- The **Three Laws of Robotics** are a set of three rules written by **Isaac Asimov**, which almost all **Robots** appearing in his fiction must obey. Introduced in his 1942 short story "**"Runaround**", although foreshadowed in a few earlier stories:
 - Law 0) A **robot may not injure humanity** or, through inaction, allow it
 - Law 1) A **robot may not injure a human being** or, through inaction, allow a human being to come to harm
 - Law 2) A **robot must obey orders** given to it by human beings, except where such orders would conflict with the First Law
 - Law 3) A **robot must protect its own existence** as long as such protection does not conflict with the First or Second Law



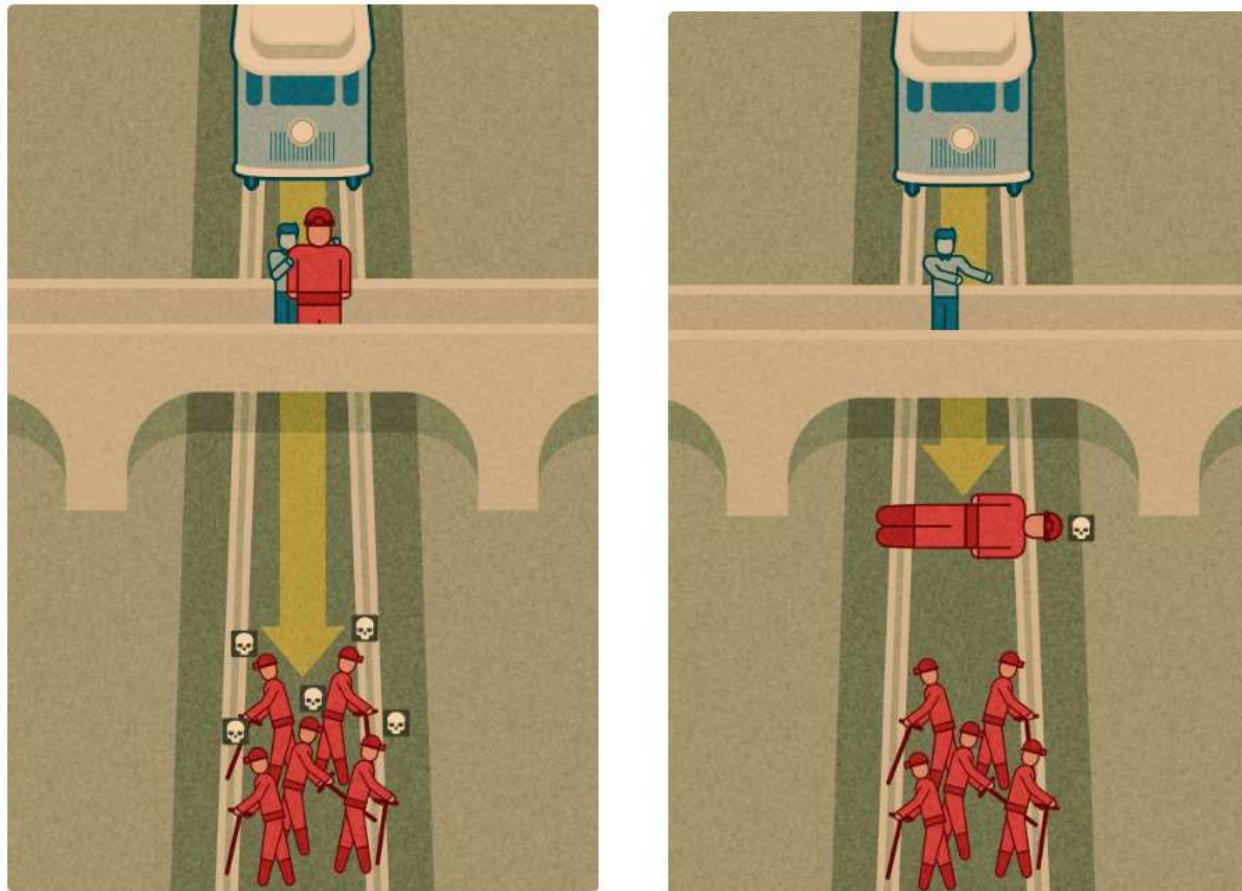
Moral Machine

What should the man in blue do?



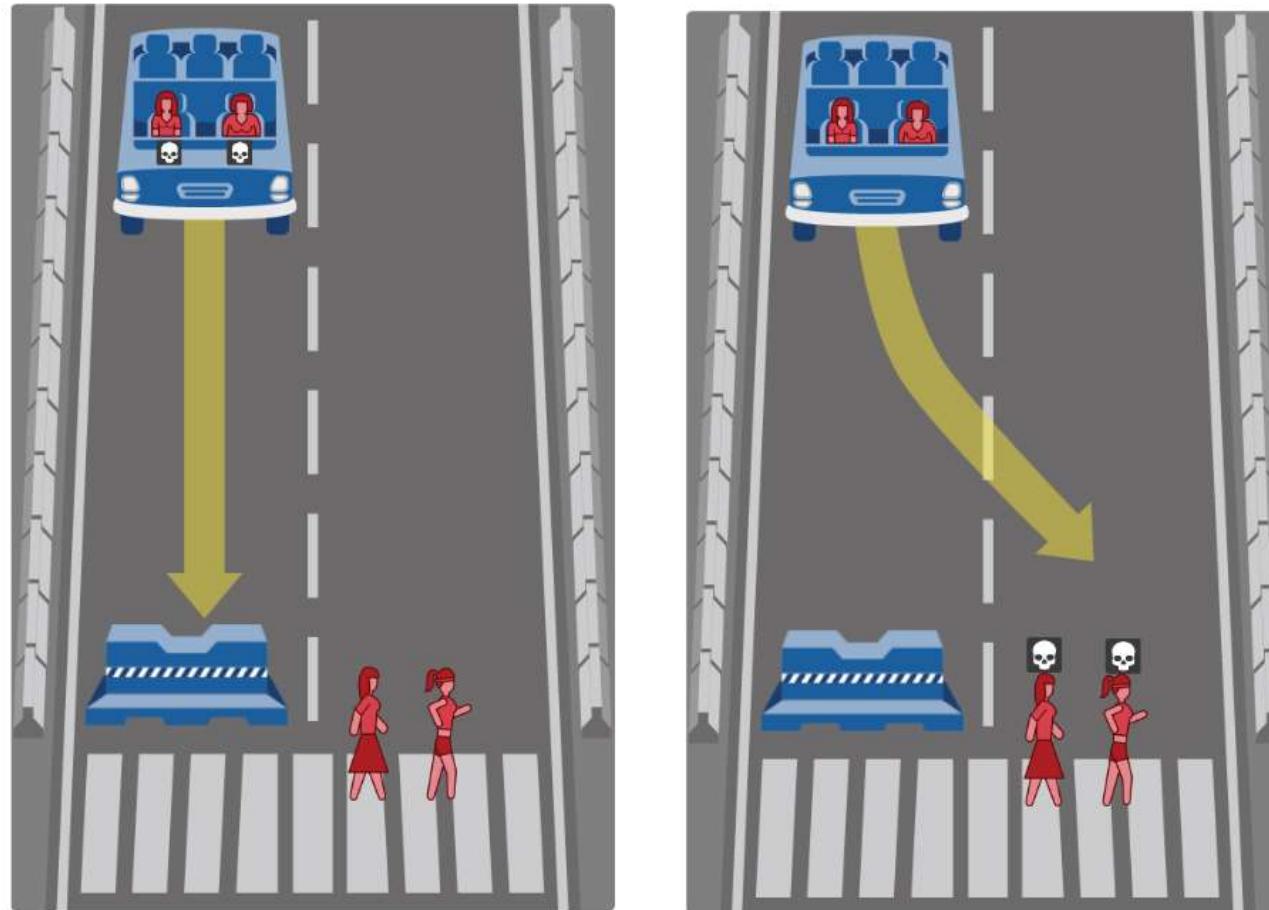
Moral Machine

What should the man in blue do?

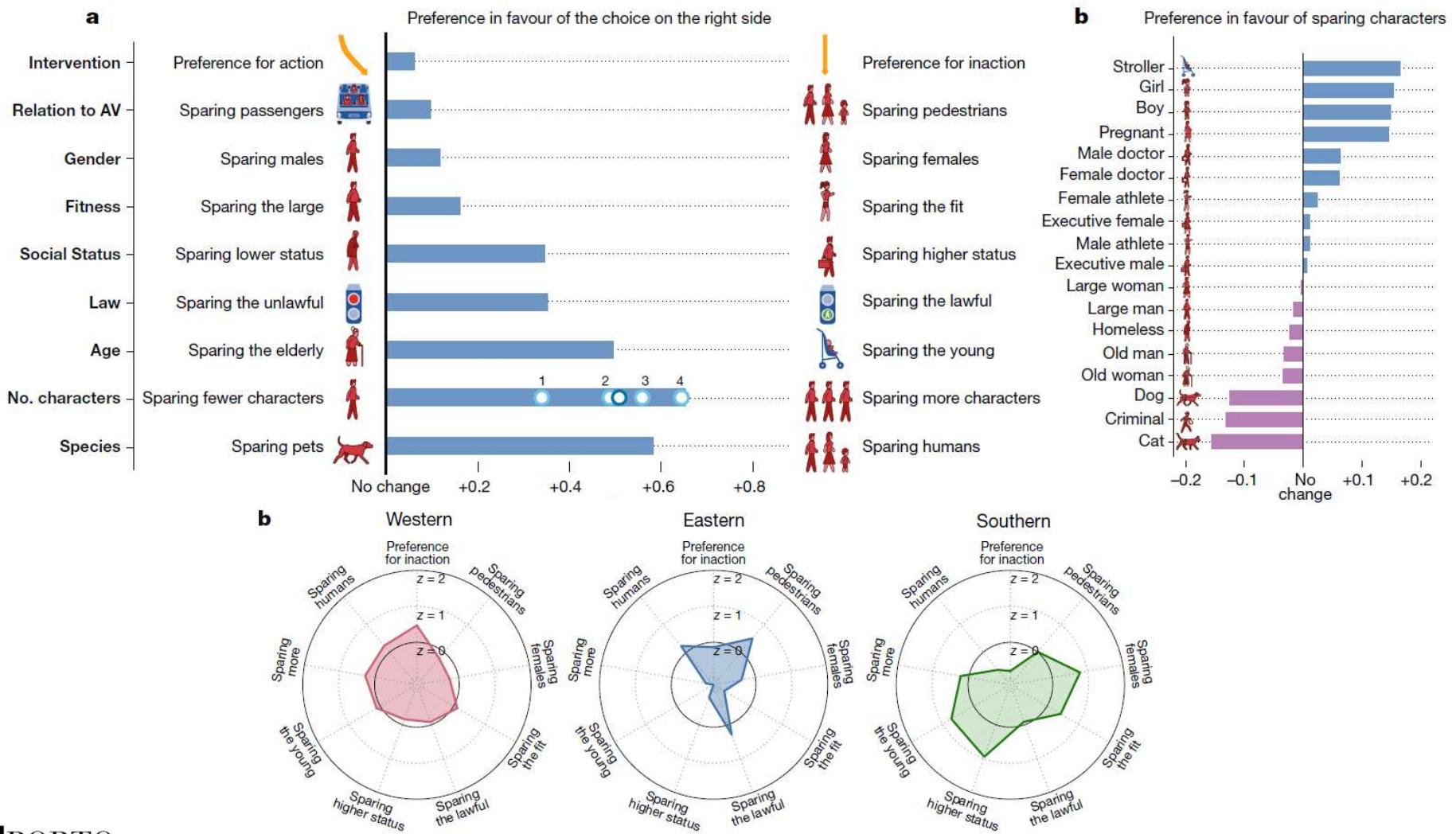


Moral Machine

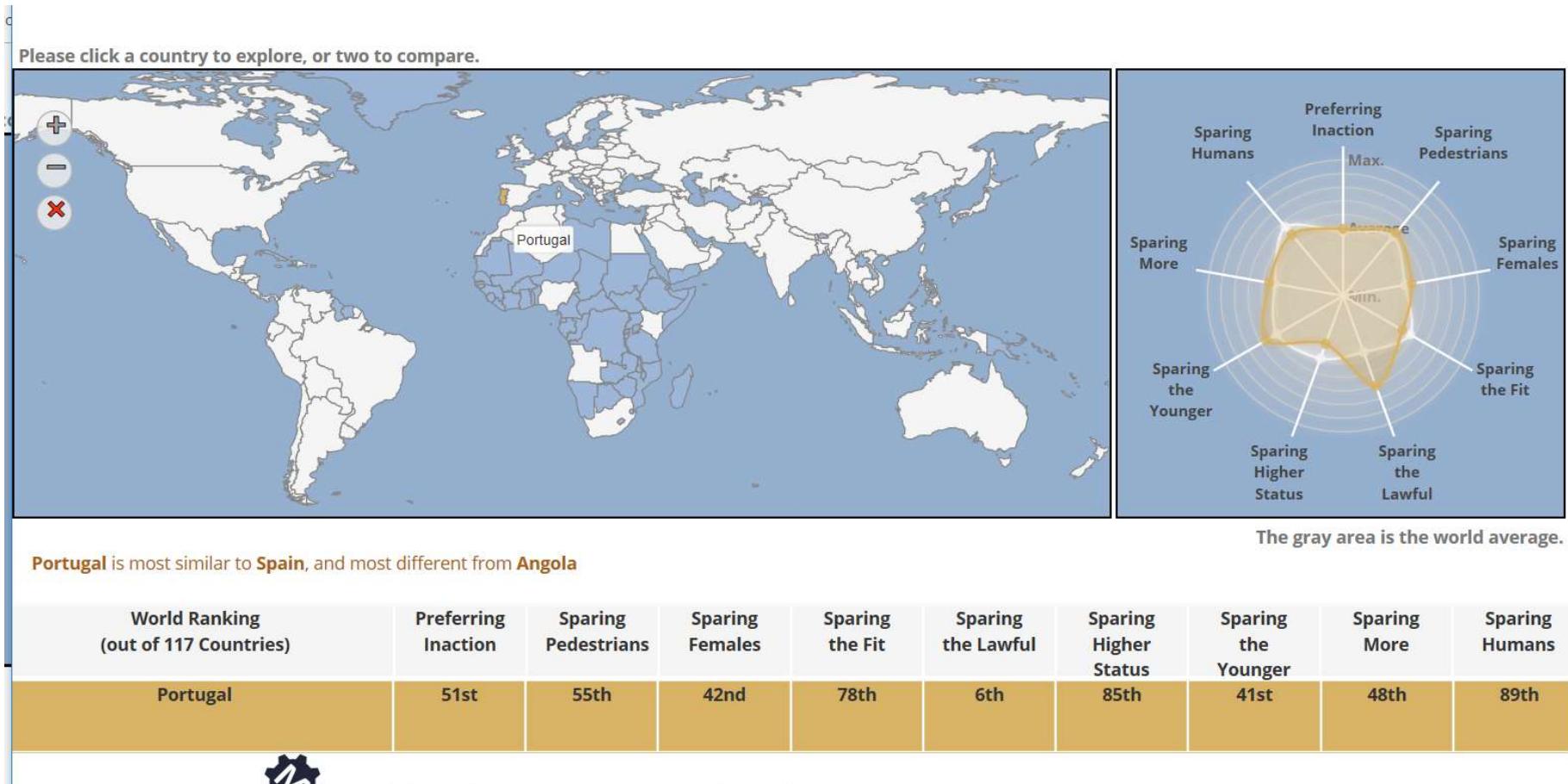
What should the self-driving car do?



Moral Machine – Results



Moral Machine – Results



AI in Government

- UAE Ministry of Artificial Intelligence - <http://www.uaeai.ae/en/>



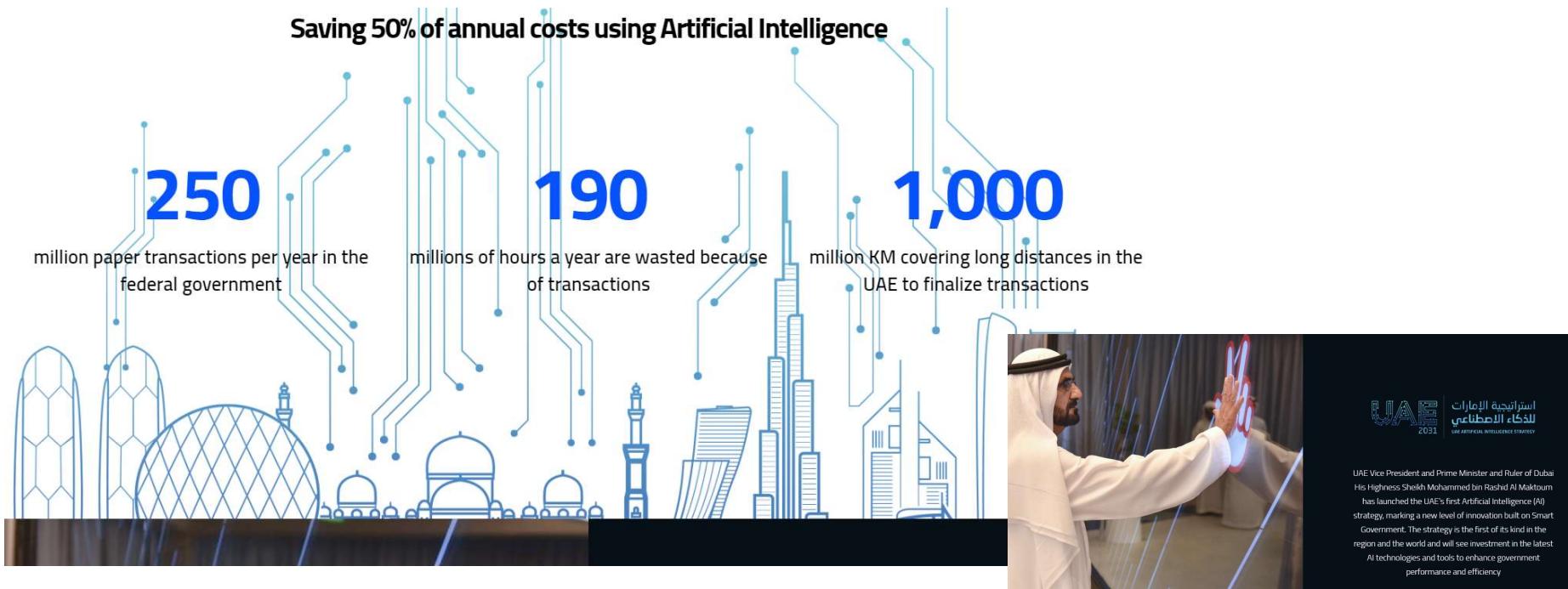
العربية Other languages Accessibility Help Register

In October 2017, the UAE Government launched '[UAE Strategy for Artificial Intelligence \(AI\)](#)'. This marks the post-mobile government phase which will rely on various future services, sectors and infrastructure projects. The strategy is first of its kind in the region and the world and it aims to:

- achieve the objectives of UAE Centennial 2071
- boost government performance at all levels
- use an integrated smart digital system that can overcome challenges and provide quick efficient solutions
- make the UAE the first in the field of AI investments in various sectors

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Artificial Intelligence – The Future

- **Super Artificial Intelligence**

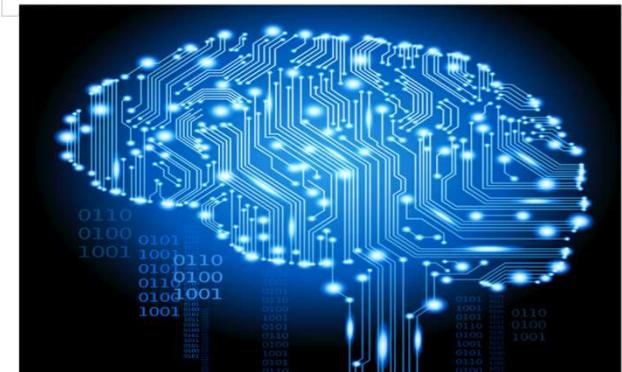
Hypothetical agent that possesses **intelligence far surpassing that of the brightest and most gifted human minds**

- **Explainable AI**

Interpretable AI, or **Transparent AI** refer to techniques in artificial intelligence (AI) which can be **trusted and easily understood by humans**. It contrasts with "black box" in machine learning

- **Singularity**

The technological singularity is a hypothetical future **point in time** at which **technological growth becomes uncontrollable** and irreversible, resulting in unfathomable changes to human civilization. **Intelligence explosion!**



Conclusions

- **AI is growing steadily** worldwide with emphasis for **Machine Learning, NLP and Intelligent Robotics**
- **Growing European and National Interest and Funding**
- Powered by huge amount of **data**, computer power and new algorithms
- AI/ML is a **new way of building computer programs**
- **Using AI/ML machines can beat human champions and learn to solve very complex problems**
- **AI/Robot Ethics, AI/Robot Rights**
- **AI Explainability, Trust, Transparency**
- **Demand for University/Industry/Government Cooperation!**

Artificial Intelligence: Current Trends and the Future

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