

Intelligent Agents in Robotics

Rob Janssen

Embedded Motion Control 2013

TU / **e**

Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

Introduction

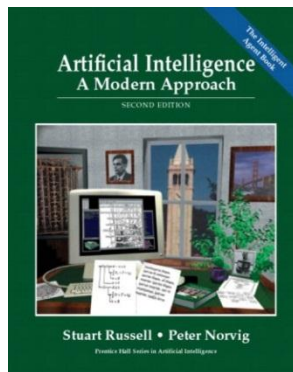
Relevant study material

“Artificial Intelligence: A Modern Approach”

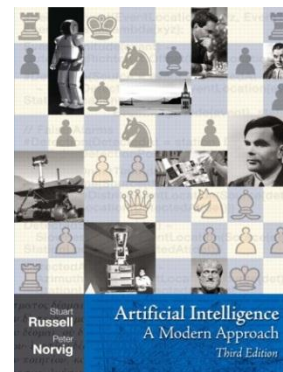
- Written by Stuart Russell and Peter Norvig
- Book available at <http://aima.cs.berkeley.edu/>
- Related free online AI courses available at <http://www.udacity.com>
 - cs271: Introduction to Artificial Intelligence
 - cs373: Artificial Intelligence for Robotics



1st edition



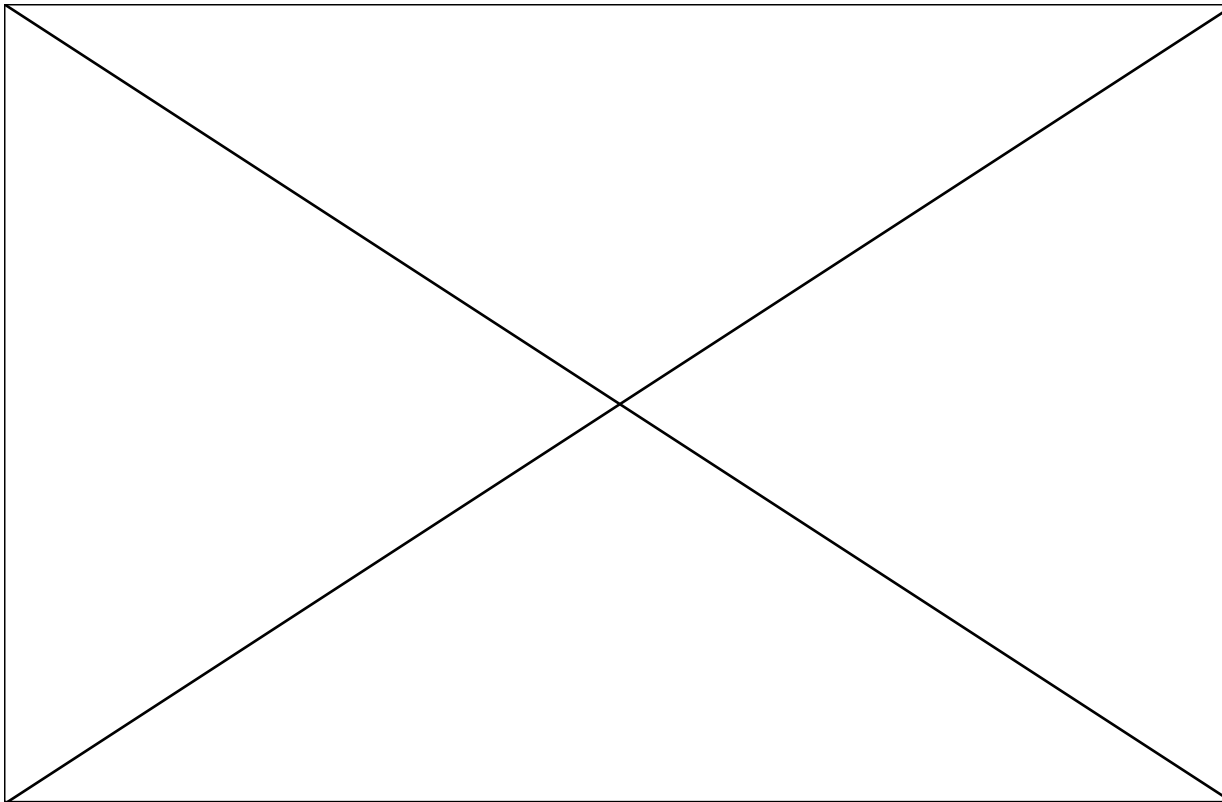
2nd edition



3rd edition

Introduction

What is an Intelligent Agent?



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“An autonomous entity that acts upon sensed information through an intelligent program”

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What is an Intelligent Agent?

“An autonomous entity that acts upon sensed information through an intelligent program, enabling the entity to make rational (i.e. optimal) decisions”

- Qualitative measure designed by Alan Turing in 1950: the Turing Test



Introduction

What is an Intelligent Agent?

“An autonomous entity that acts upon sensed information through an intelligent program, enabling the entity to make rational (i.e. optimal) decisions”

Concept of an Intelligent Agent used in many fields

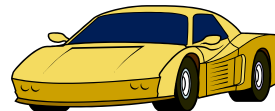
Finance



Medical



Automotive



Games



The Web



Logistics



Intelligent Agents in Robotics



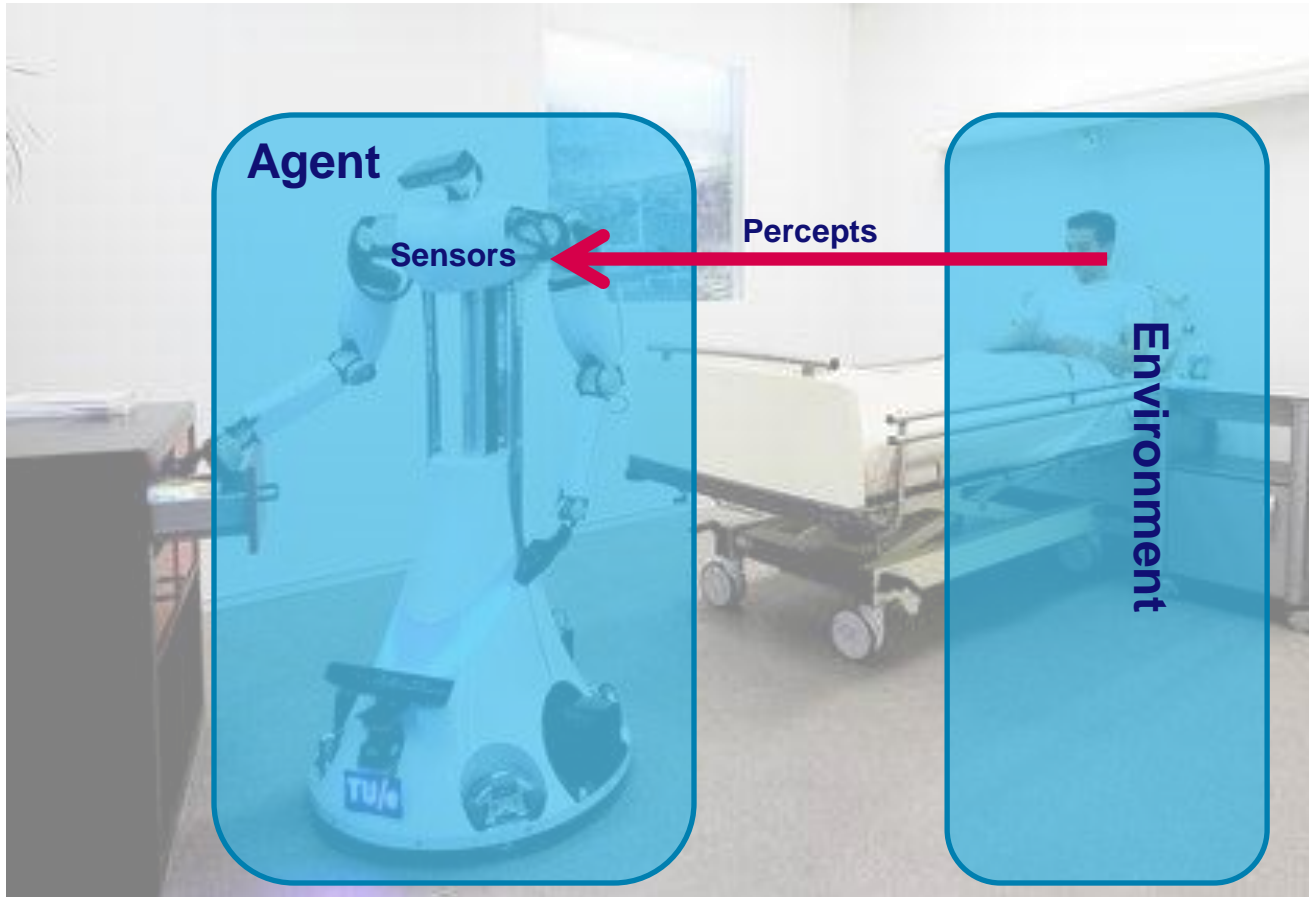
Intelligent Agents in Robotics



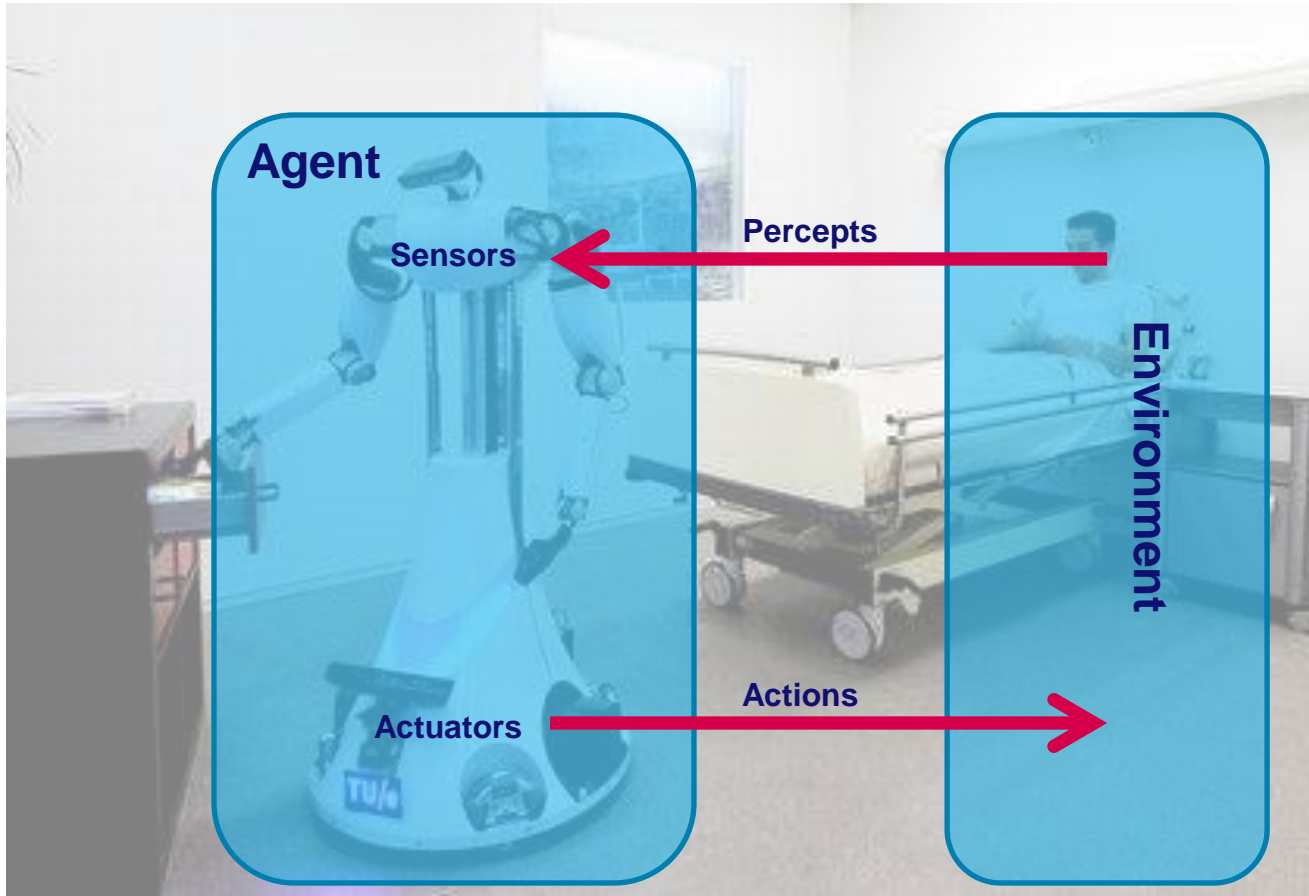
Intelligent Agents in Robotics



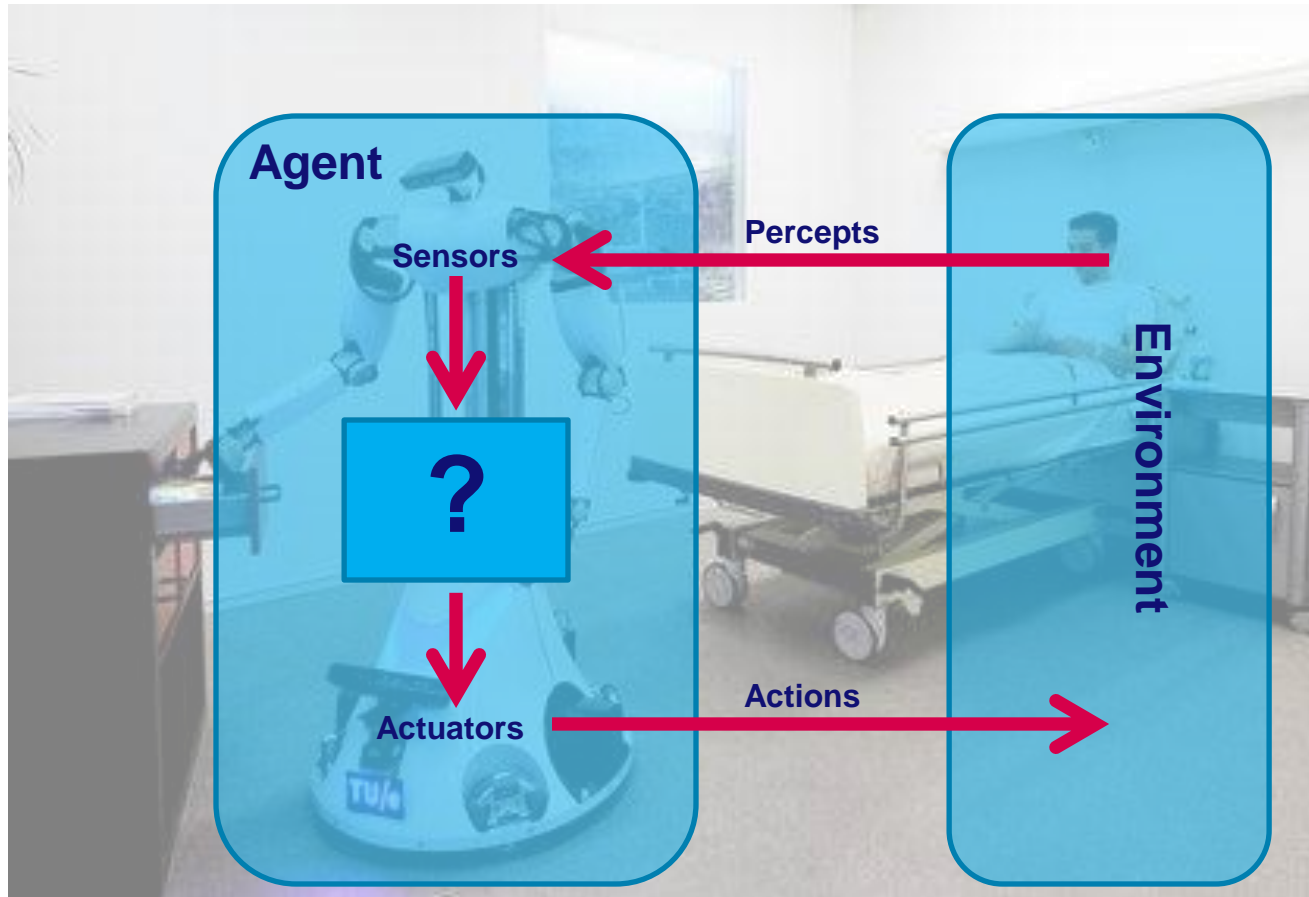
Intelligent Agents in Robotics



Intelligent Agents in Robotics



Intelligent Agents in Robotics



Basic concepts

Basic concepts used in Intelligent Agent design

Basic concepts

Basic concepts used in Intelligent Agent design

➤ Environment types

Basic concepts

Basic concepts used in Intelligent Agent design

➤ **Environment types**

➤ **Agent types**

Environment types

Environment types

Fully versus partially observable

➤ e.g. chess versus poker

Environment types

Fully versus partially observable

- e.g. chess versus poker

Static versus dynamic

- e.g. chess versus table foosball

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Deterministic versus stochastic

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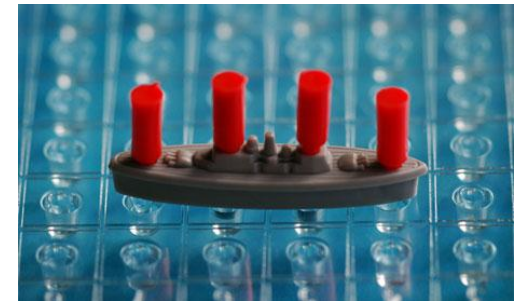
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Battleship?



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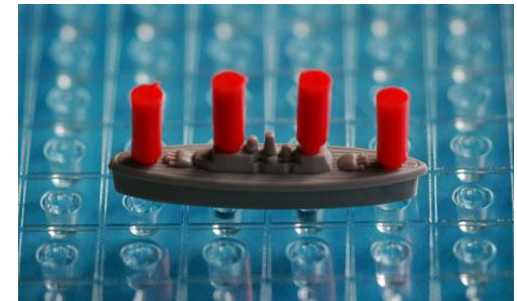
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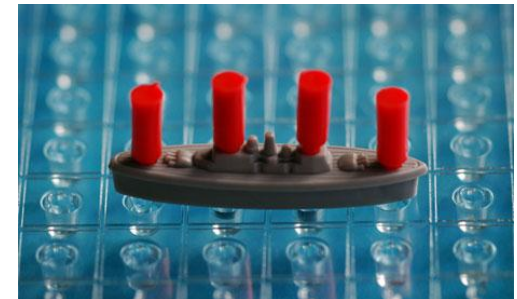
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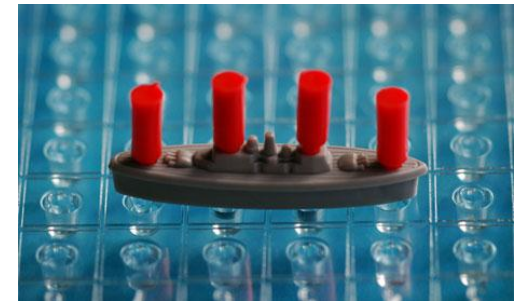
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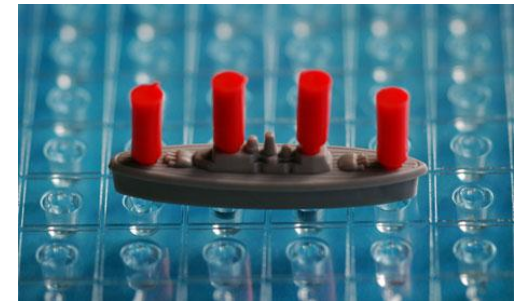
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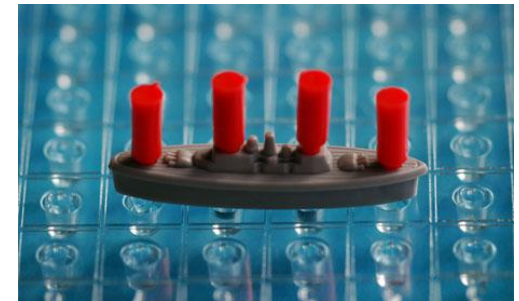
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- ✓ partially observable
- ✓ static
- ✓ deterministic
- ✓ discrete
- ✓ competitive

Agent types

Agent types

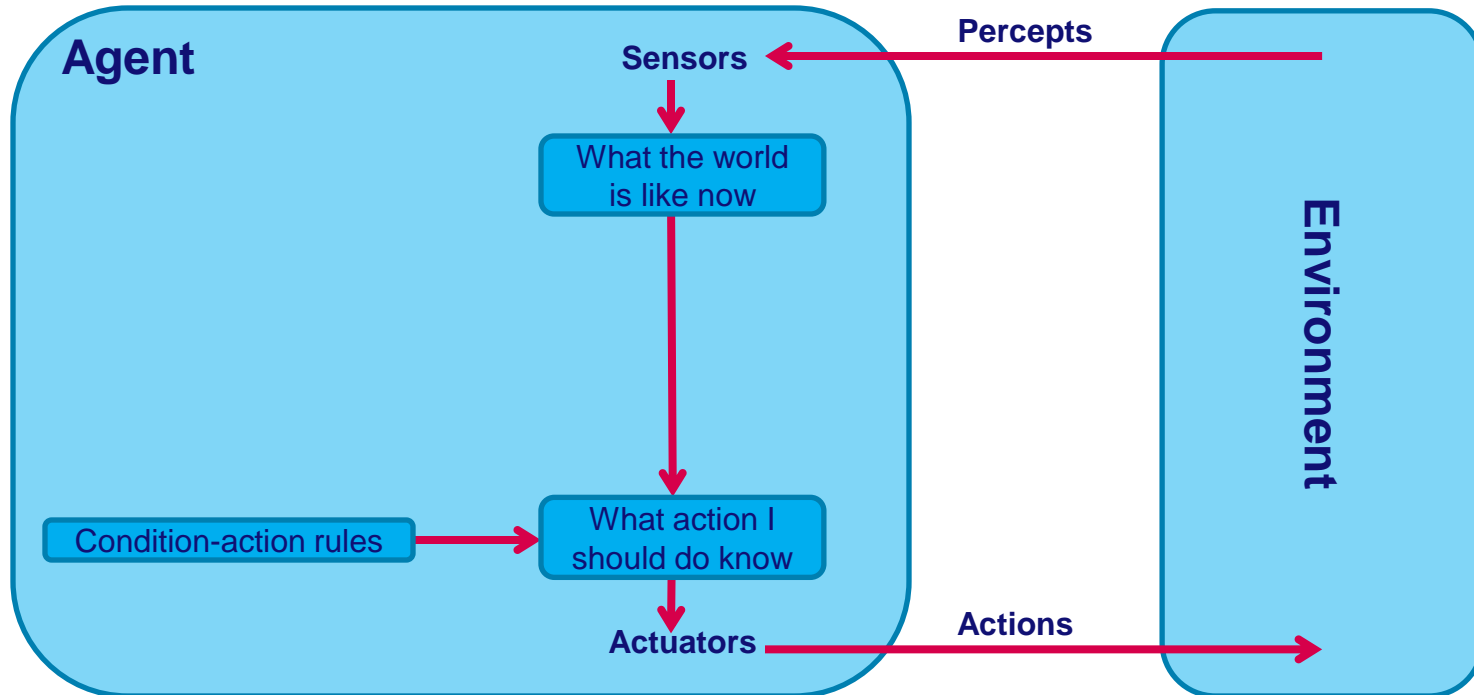
Simple reflex agent

- Acts upon current percept only, ignoring percept history (e.g. anti-slip-system in a car)

Agent types

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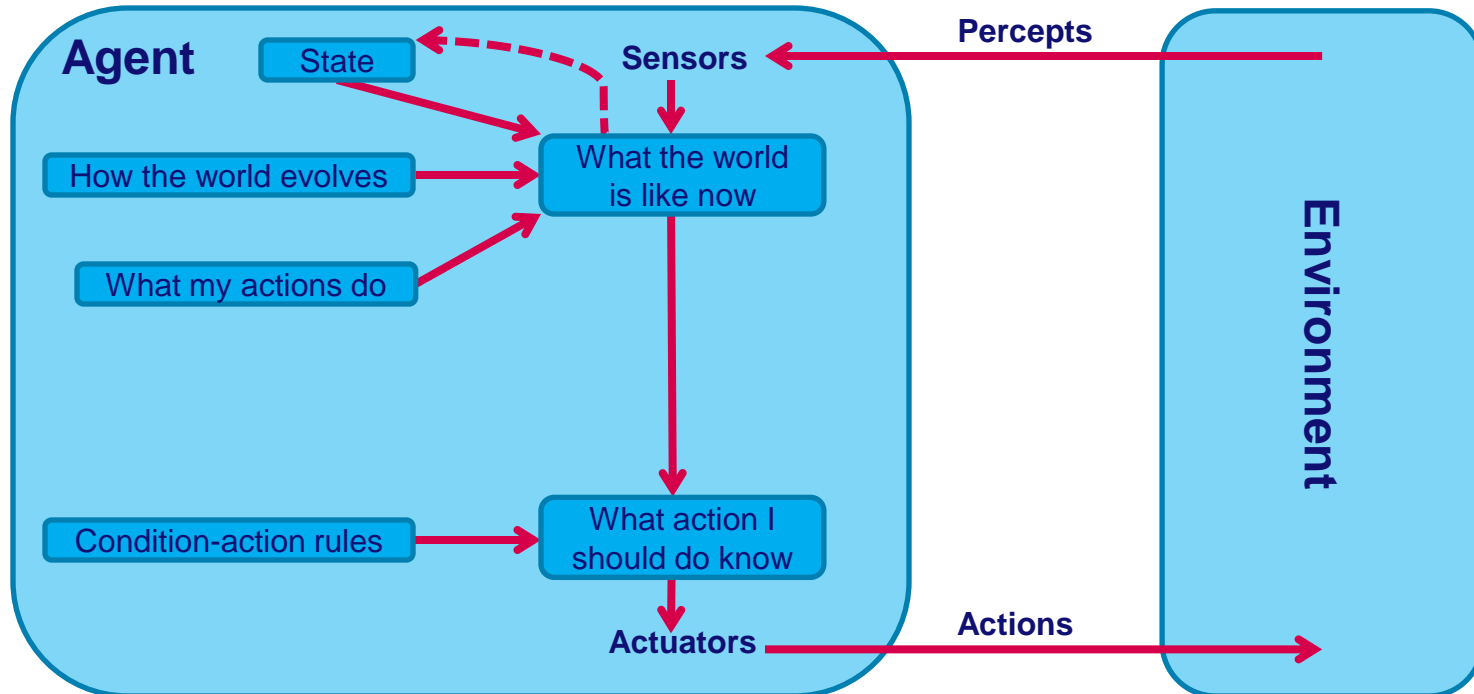
Model based reflex agent

- Acts upon a sequence of percepts combined with an environment model (e.g. radar-guided missiles). Deals with partial observability

Agent types

Model based reflex agent

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Agent types

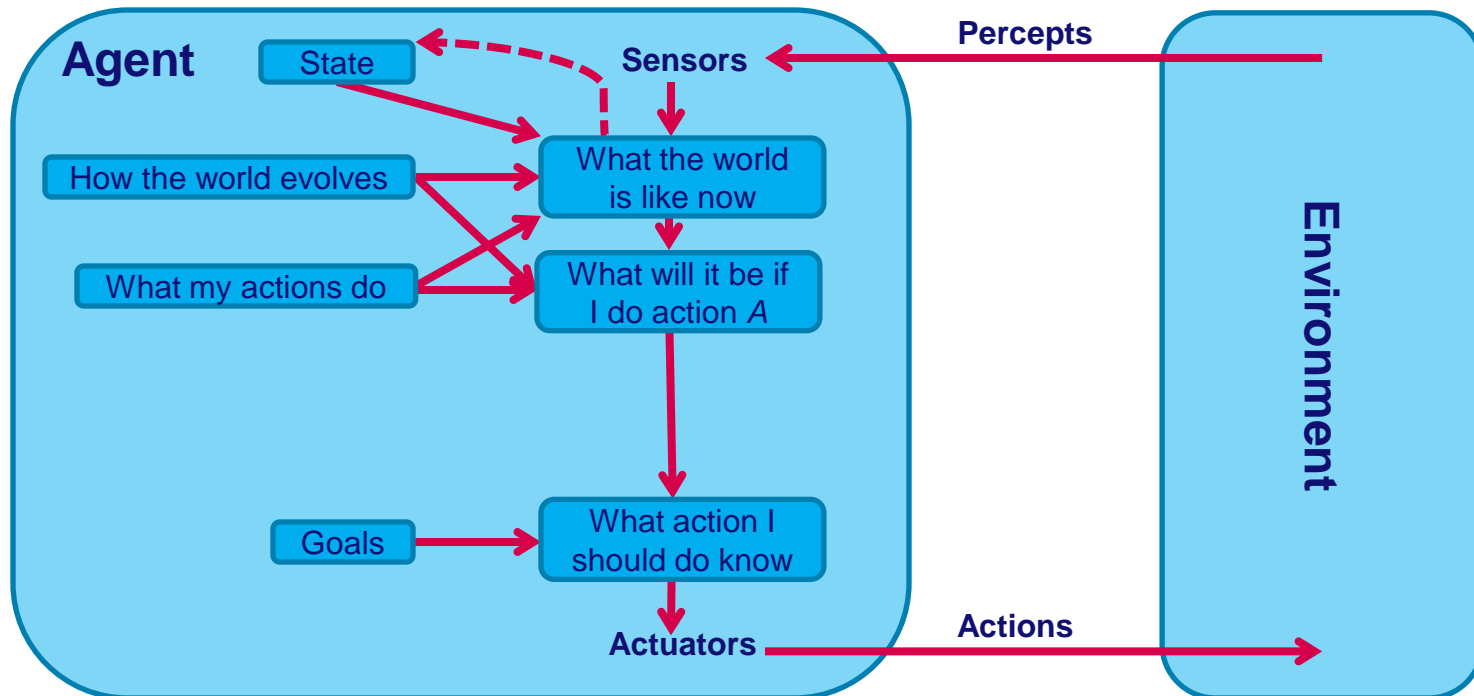
Goal based agent

- Acts upon percepts, an environment model and a long term goal (e.g. Deep Blue chess computer)

Agent types

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Agent types

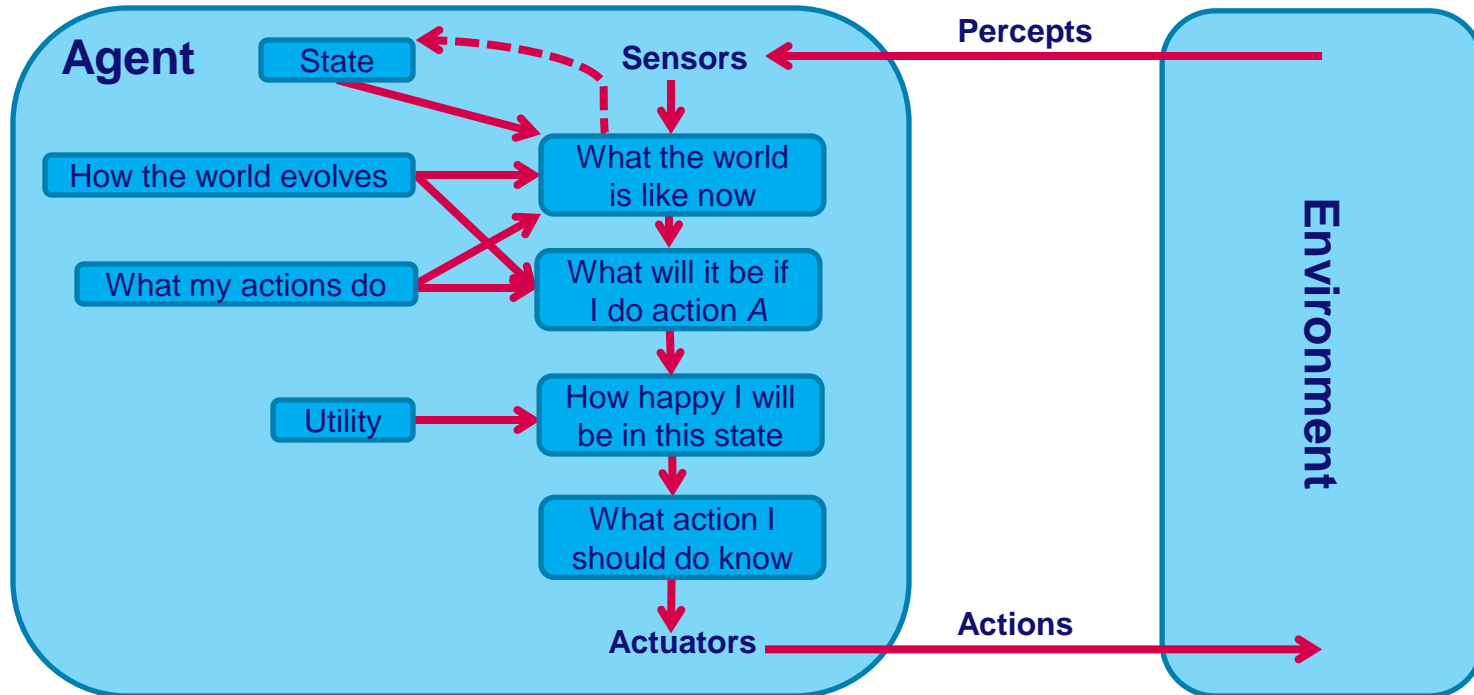
Utility based agent

- Acts upon percepts, an environment model, a long term goal and a cost function (e.g. navigation systems)

Agent types

Utility based agent

- Acts upon percepts, an environment model, a long term goal and a cost function (e.g. navigation systems)



Agent types

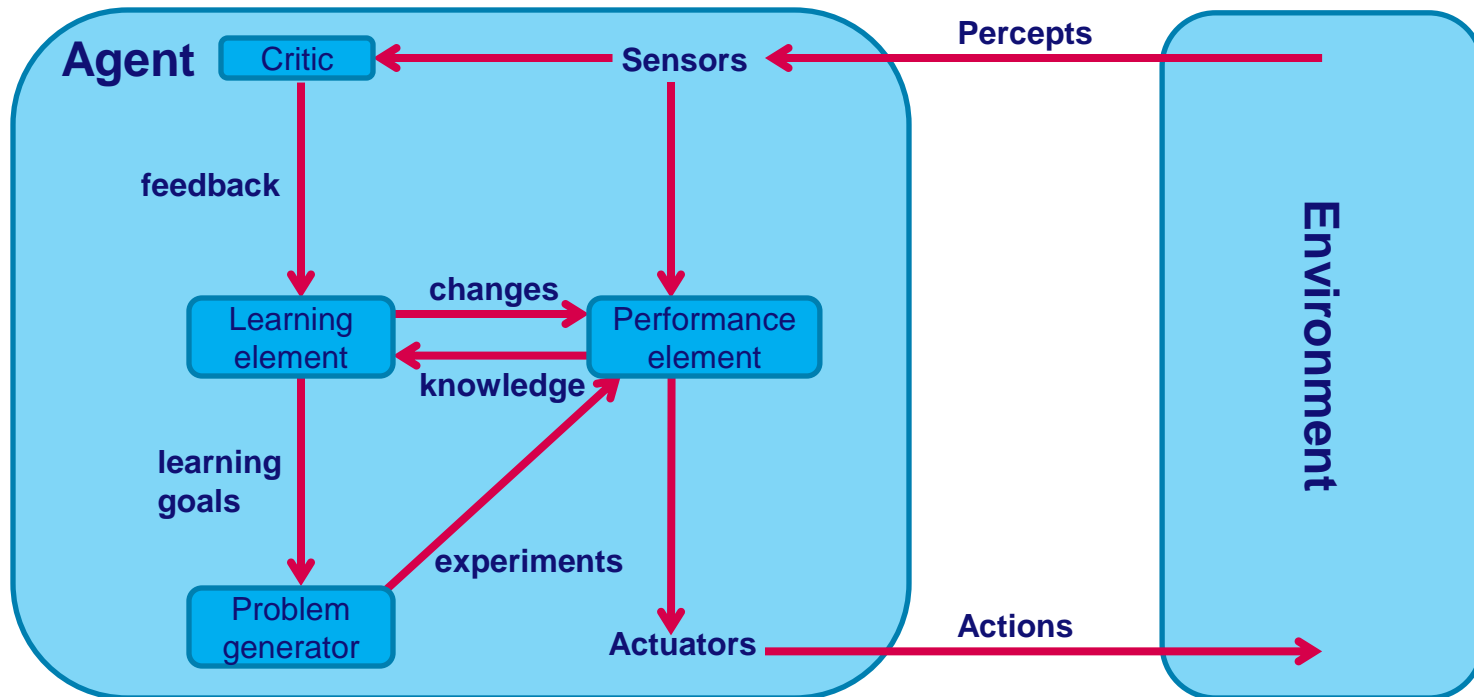
Learning agent

- Acts upon percepts, an environment model, a long term goal, a cost function and a performance improvement algorithm (e.g. humans)

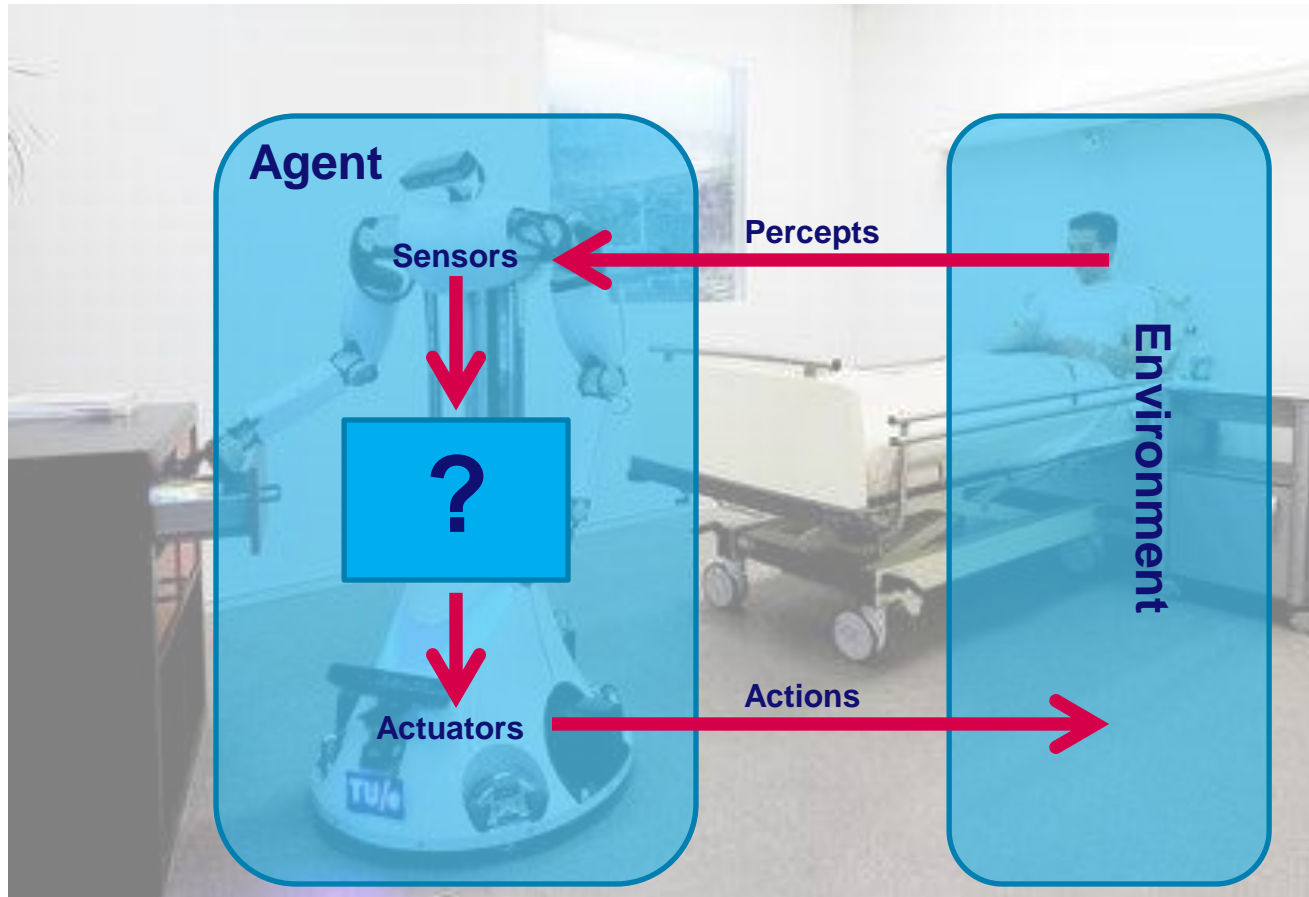
Agent types

Learning agent

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Designing an Intelligent Agent program



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- **Engineer first needs to classify the according environment type**

Designing an Intelligent Agent program

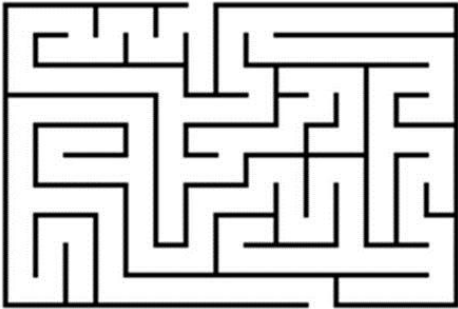
- Engineer first needs to classify the according environment type
- Based on this classification, a suitable agent type needs to be selected

Designing an Intelligent Agent program

- Engineer first needs to classify the according environment type
- Based on this classification, a suitable agent type needs to be selected
- Resulting in a required set of agent type components

An Intelligent Agent program for PICO

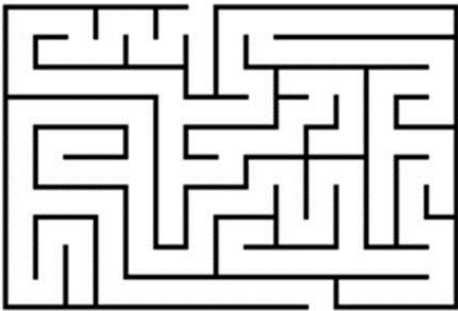
Environment type



An Intelligent Agent program for PICO

Environment type

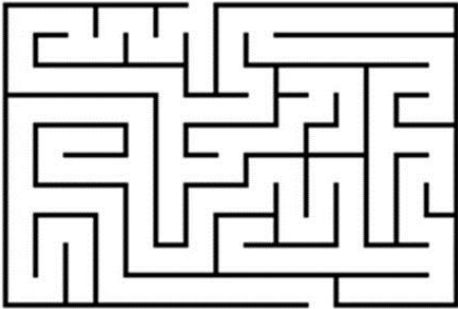
- Fully or partially observable?



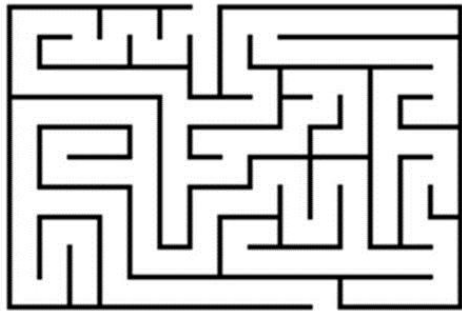
An Intelligent Agent program for PICO

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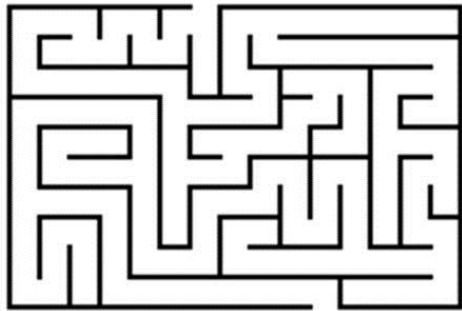
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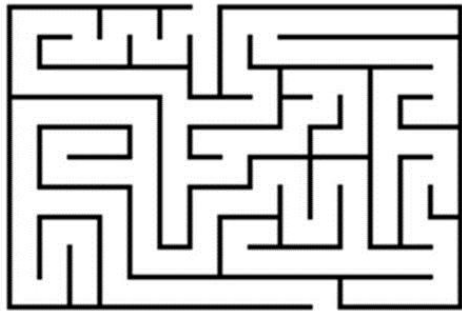
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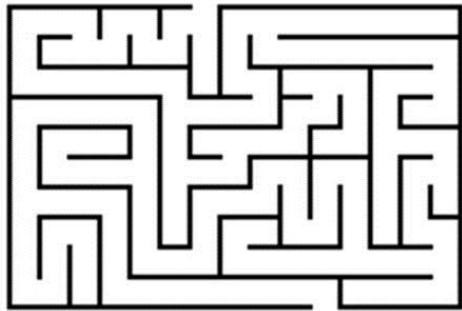
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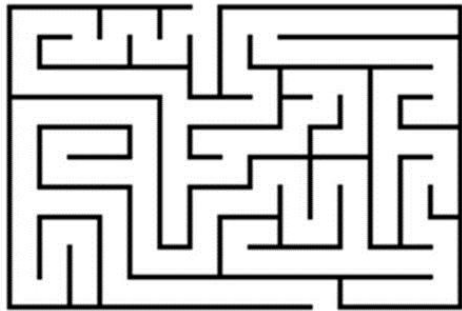
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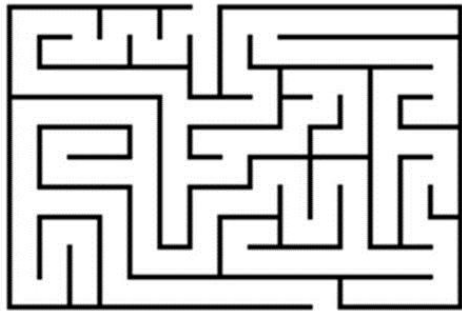
An Intelligent Agent program for PICO



Environment type

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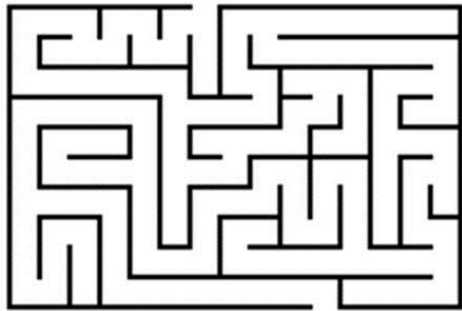
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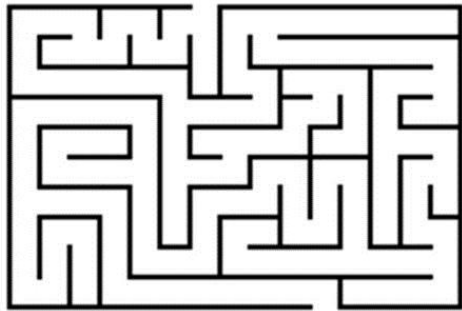
An Intelligent Agent program for PICO



Environment type

- ~~Fully~~ or partially observable?
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- Discrete or continuous?
- Competitive or collaborative?

An Intelligent Agent program for PICO



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An Intelligent Agent program for PICO

Agent type



An Intelligent Agent program for PICO



Agent type

- **Simple reflex agent?**
 - What could be PICO's reflexes?

An Intelligent Agent program for PICO



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- **Model based reflex agent?**
 - What can be modeled?

An Intelligent Agent program for PICO



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 - What is a suitable cost function?

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 - What is PICO's goal?
- **Utility based agent?**
 - What is a suitable cost function?
- **Learning agent?**
 - What can be learned?

An Intelligent Agent program for PICO

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➤ **Decide for your own!**

An Intelligent Agent program for PICO

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- **Find a suitable trade-off between agent performance and agent complexity**

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- **Assure that your program is intelligent but still comprehensible**
 - **Otherwise debugging might be impossible**

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- **Decide for your own!**
- **Find a suitable trade-off between agent performance and agent complexity**
- **Assure that your program is intelligent but still comprehensible**
 - **Otherwise debugging might be impossible**
- **Methods for optimization and learning algorithms can be found in Chapters 18 to 21 (3rd edition)**

Intelligent Agents in Robotics

