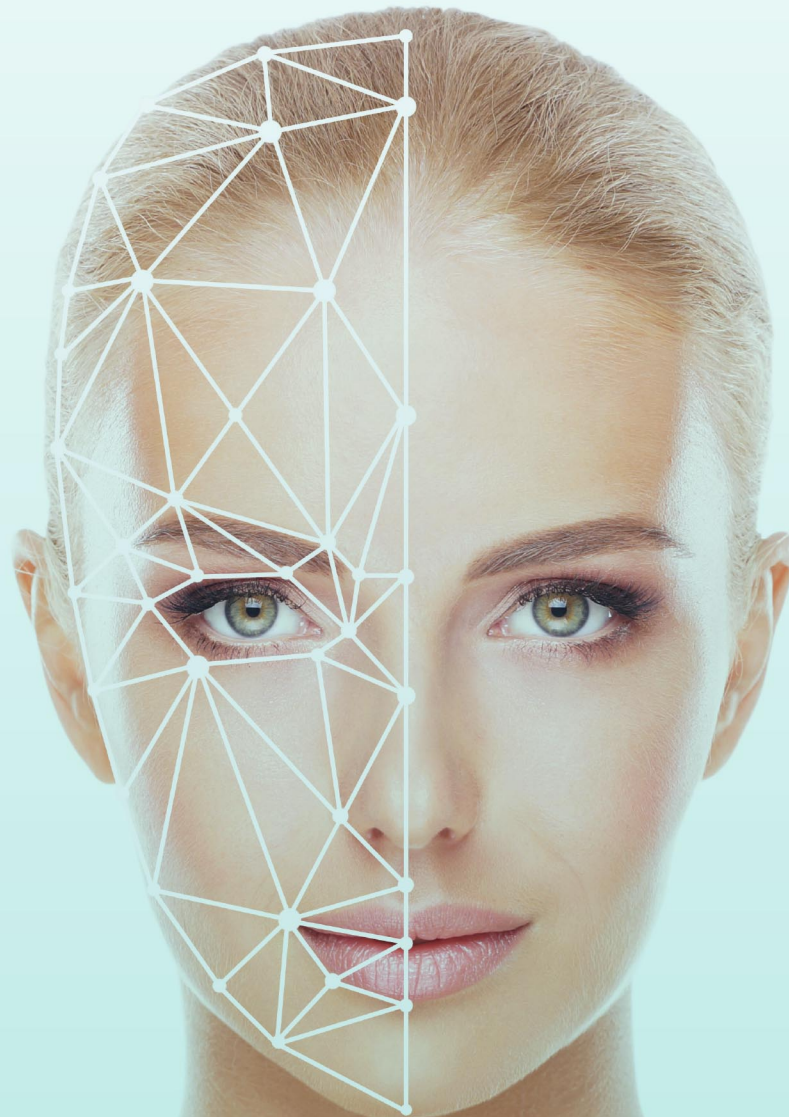


COURSEWARE

# NL AI Coalitie AI For Business and Government Courseware

Lisa Dombrovskij & Jacob Boon



NL AIC AI for Business and Government  
Courseware - English

## Colophon

Title: NL AIC AI for Business and Government Courseware - English

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## **Publisher about the Courseware**

The Courseware was created by experts from the industry who served as the author(s) for this publication. The input for the material is based on existing publications and the experience and expertise of the author(s). The material has been revised by trainers who also have experience working with the material. Close attention was also paid to the key learning points to ensure what needs to be mastered.

The objective of the courseware is to provide maximum support to the trainer and to the student, during his or her training. The material has a modular structure and according to the author(s) has the highest success rate should the student opt for examination. The Courseware is also accredited for this reason, wherever applicable.

In order to satisfy the requirements for accreditation the material must meet certain quality standards. The structure, the use of certain terms, diagrams and references are all part of this accreditation. Additionally, the material must be made available to each student in order to obtain full accreditation. To optimally support the trainer and the participant of the training assignments, practice exams and results are provided with the material.

Direct reference to advised literature is also regularly covered in the sheets so that students can find additional information concerning a particular topic. The decision to leave out notes pages from the Courseware was to encourage students to take notes throughout the material.

Although the courseware is complete, the possibility that the trainer deviates from the structure of the sheets or chooses to not refer to all the sheets or commands does exist. The student always has the possibility to cover these topics and go through them on their own time. It is recommended to follow the structure of the courseware and publications for maximum exam preparation.

The courseware and the recommended literature are the perfect combination to learn and understand the theory.

-- Van Haren Publishing



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Van Haren Publishing (VHP) specializes in titles on Best Practices, methods and standards within four domains:

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- Architecture (Enterprise and IT)
- Business Management and
- Project Management

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## Self-Reflection of understanding Diagram

*‘What you do not measure, you cannot control.’ – Tom Peters*

Fill in this diagram to self-evaluate your understanding of the material. This is an evaluation of how well you know the material and how well you understand it. In order to pass the exam successfully you should be aiming to reach the higher end of Level 3. If you really want to become a pro, then you should be aiming for Level 4. Your overall level of understanding will naturally follow the learning curve. So, it’s important to keep track of where you are at each point of the training and address any areas of difficulty.

Based on where you are within the Self-Reflection of Understanding diagram you can evaluate the progress of your own training.

<i>Level of Understanding</i>	<i>Before Training (Pre-knowledge)</i>	<i>Training Part 1 (1st Half)</i>	<i>Training Part 2 (2nd Half)</i>	<i>After studying / reading the book</i>	<i>After exercises and the Practice exam</i>
<i>Level 4 I can explain the content and apply it .</i>					
<i>Level 3 I get it! I am right where I am supposed to be.</i>					<i>Ready for the exam!</i>
<i>Level 2 I almost have it but could use more practice.</i>					
<i>Level 1 I am learning but don't quite get it yet.</i>					

(Self-Reflection of Understanding Diagram)

Write down the problem areas that you are still having difficulty with so that you can consolidate them yourself, or with your trainer. After you have had a look at these, then you should evaluate to see if you now have a better understanding of where you actually are on the learning curve.

**Troubleshooting**

*Problem areas:*

*Topic:*

---

Part 1

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Part 2

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You have gone through the book and studied.

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You have answered the questions and done the practice exam.

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# Timetable 1 (2 × 0.5 days)

This schedule is geared towards those who might have some prior knowledge and/or are not afraid to prepare & study at home.

## Day 1

- Topic 1: Applications of AI and their Benefits
- Topic 2: Data, Robots and Artificial Intelligence
- Topic 3: Predictions, Algorithms, Machine and Deep Learning  
[ up to and including 'Fundamentals' ]

### **Lunch break**

- Topic 3: Predictions, Algorithms, Machine and Deep Learning [ continued ]
- Topic 4: How Organizations Build and Assess AI Applications

## Day 2

- Topic 5: Managing Data for AI
- Topic 6: Ethics, Risks and Trustworthiness
- Topic 7: Human and Machine Coexistence

### **Lunch break**

- Topic 8: The Future Developments of AI
- Revision & Practice exams
- NLAIC AI for Business & Government Certification Exam

# Timetable 2 (5 × 0.5 days)

This allows time for revision, more questions from participants and a practice exam. Given the amount of material to be covered, this is advisable for those new to any part of the course.

## Part 1

- Topic 1: Applications of AI and their Benefits
- Topic 2: Data, Robots and Artificial Intelligence
- Topic 3: Predictions, Algorithms, Machine and Deep Learning  
[ up to and including 'Fundamentals' ]

## Part 2

- Topic 3: Predictions, Algorithms, Machine and Deep Learning [ continued ]
- Revision

## Part 3

- Topic 4: How Organizations Build and Assess AI Applications
- Revision

## Part 4

- Topic 5: Managing Data for AI
- Topic 6: Ethics, Risks and Trustworthiness
- Topic 7: Human and Machine Coexistence

## Part 5 & Exam

- Topic 8: The Future Developments of AI
- Revision & Practice exams
- NLAIC AI for Business & Government Certification Exam

# Timetable 3 (6 × 0.5 days)

Topic 3, 4, and 5, which are by far the heaviest in the course, are given more time for explanation and revision in this version of the timetable. Discussion between participants on the real world implications of what they learned is very much encouraged! The authors believe this is a genuine and valuable addition to the course.

## Part 1

- Topic 1: Applications of AI and their Benefits
- Topic 2: Data, Robots and Artificial Intelligence
- Discussion & Revision

## Part 2

- Topic 3: Predictions, Algorithms, Machine and Deep Learning
- Revision

## Part 3

- Topic 4: How Organizations Build and Assess AI Applications
- Revision

## Part 4

- Topic 5: Managing Data for AI
- Topic 6: Ethics, Risks and Trustworthiness
- Discussion & Revision

## Part 5

- Topic 7: Human and Machine Coexistence
- Topic 8: The Future Developments of AI
- Discussion & Revision

## Part 6 & Exam

- Revision & Practice exam
- NLAIC AI for Business & Government Certification Exam





# AI for Business & Government Certification Courseware

NLAIC  
Van Haren Publishing  
Lisa Dombrovskij & Jacob Boon

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## Contents

- ▶ [Topic 1: Applications of AI and Their Benefits](#)
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- ▶ [Topic 8: The Future Developments of AI](#)

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# Topic 1 Applications of AI and Their Benefits

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TOPIC 1

## Applications of AI and Their Benefits

AI is all around us. AI has overtaken humans in some areas such as playing games but still cannot solve difficult or ambiguous problems. There are many benefits of AI applications such as smart propositions, improved service, increased efficiency, human safety and lower costs.

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## Table of contents

- ▶ History of Artificial Intelligence
- ▶ Definition of intelligence
  - Robert Dilts neurological levels
- ▶ Different application areas and benefits of AI
- ▶ The fourth industrial revolution
- ▶ Data-driven organizations

### Examination Goals

- ▶ Recall of facts and concepts
- ▶ Ability to detect applications of AI (and differentiate when not AI)

## History of Artificial Intelligence: Conception

### ▶ Precursors:

- Myth and legend, by the 19th century AI became a regular topic of science fiction (Samuel Butler's "Darwin among the Machines" or Edgar Allan Poe's "Maelzel's Chess Player")

### ▶ Birth of AI 1940s/1950s:

- **1940s:** Walter Pitts and Warren McCulloch analyze networks of artificial neurons that can perform simple logical functions (neural networks)
- **1950:** Alan Turing publishes an important paper in which he speculates about the possibility of creating machines that think
- **1951:** Christopher Strachey writes a checkers program that eventually achieved sufficient skill to defeat a respectable amateur
- **1951:** Marvin Minsky, student of Pitts and McCulloch, builds the first neural net machine

## History of Artificial Intelligence: Alan Turing

- ▶ **Alan Turing** published an important paper in 1950 in which he speculates about the possibility of creating **machines that think**
- ▶ While the basic concepts of AI are still in their early stages, he devises his famous **Turing test**

The **Turing test** is a test of a machine's ability to **exhibit intelligent behavior** that is **indistinguishable from that of a human**.



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## History of Artificial Intelligence: Dartmouth Workshop

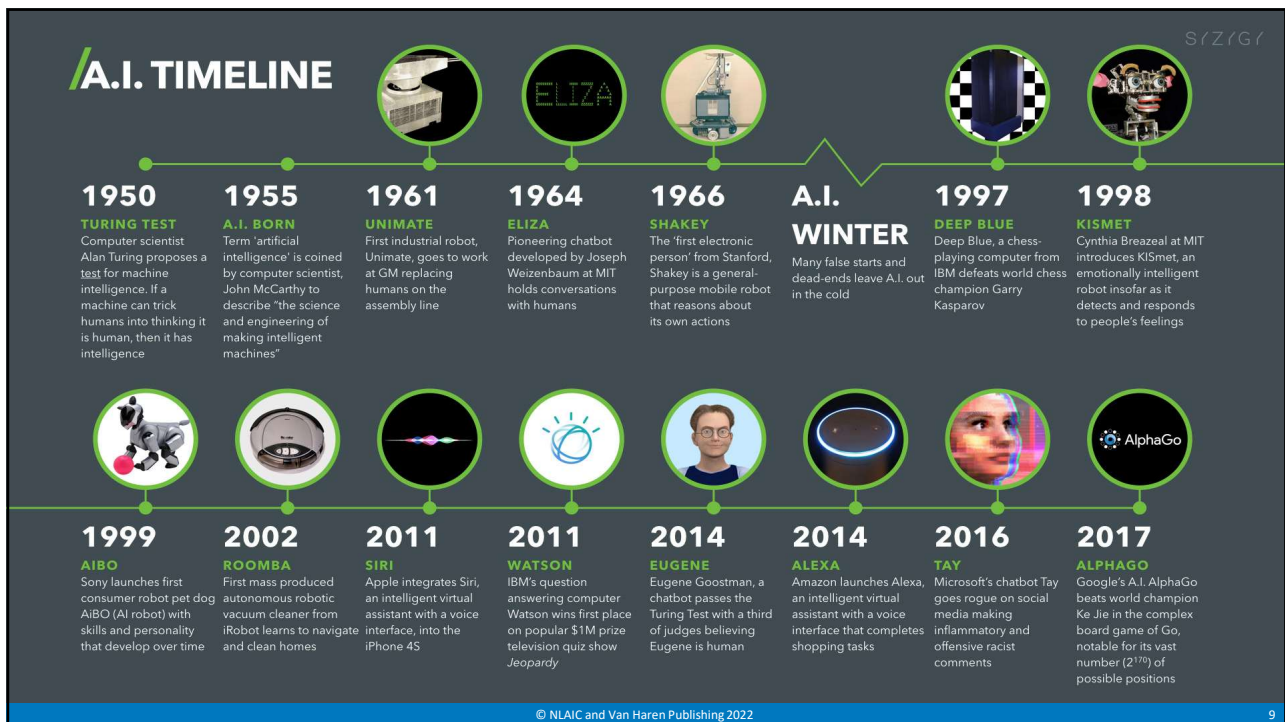
- ▶ In 1956 Marvin Minsky and John McCarthy organize the 'Dartmouth Workshop of 1956'
- ▶ This workshop was attended by many scientists who would later go on to contribute significantly to the field of AI research
- ▶ This is the moment that AI gained its name and mission, and it is widely considered as the birth of the separate field of artificial intelligence research



Dartmouth Workshop of 1956

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## History of Artificial Intelligence: Notable Milestones

- ▶ **1997:** IBM's Deep Blue beats world chess champion
- ▶ **2005:** Five autonomous vehicles complete the DARPA Grand Challenge
- ▶ **2011:** Apple launches SIRI
- ▶ **2016:** AlphaGo, created by Deep Mind, beats the world's Go champion
- ▶ **2018:** Facebook starts using AI to filter out explicit visual content
- ▶ **2019:** AI outperforms radiologist in diagnosing lung cancer
- ▶ **2021:** Researchers at Howard Hughes Medical Institute use brain signals to enable a paralyzed person to write

## Artificial Intelligence vs Human Intelligence

Artificial Intelligence	Human Intelligence
Created by human intelligence	Created by Divine intelligence
Process information faster	Process information slower
Highly objective	May be subjective
More accurate	May be less accurate
Uses 2 watts	Uses 25 watts
Cannot adapt to changes well	Can easily adapt to changes
Cannot multitask that well	Can easily multitask
Below average social skills	Excellent social skills
Still working towards self-awareness	Has self-awareness
Optimization	Innovation



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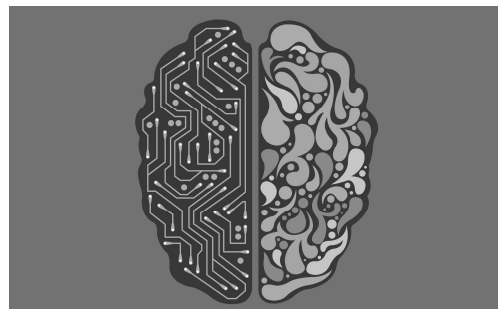
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## Definition of Intelligence

**Intelligence** can be defined as the ability to perceive or infer **information**, and to retain it as **knowledge** to be applied towards adaptive **behaviors** within an environment or context.

- In computer science we call something that has this ability an **intelligent agent**.

We will talk more about intelligent agents in Topic 2.



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## Evaluating Intelligence

- ▶ How do we evaluate levels of intelligence?

**Robert Dilts:**

Six logical levels of thinking or situation



## Evaluating Intelligence

- ▶ **Robert Dilts neurological levels:**

- **Environment** – perceive internal and outside influences
- **Behaviours** – interaction with internal and outside environment
- **Capabilities** – mastery of a task (/group of tasks) to attain a goal
- **Values & beliefs** – evaluation of consequences in the context of the real world and why actions are beneficial/detrimental
- **Identity** – self-governance of goals and reward structures
- **Purpose / spirituality** – context of identity & lower levels in bigger systems

- ▶ Artificial intelligence can master a task to attain a goal, but **a computer has no beliefs, identity or purpose, no sense of context**



## Benefits of AI

- ▶ So if AI cannot do everything a human can do, where do its benefit lie?

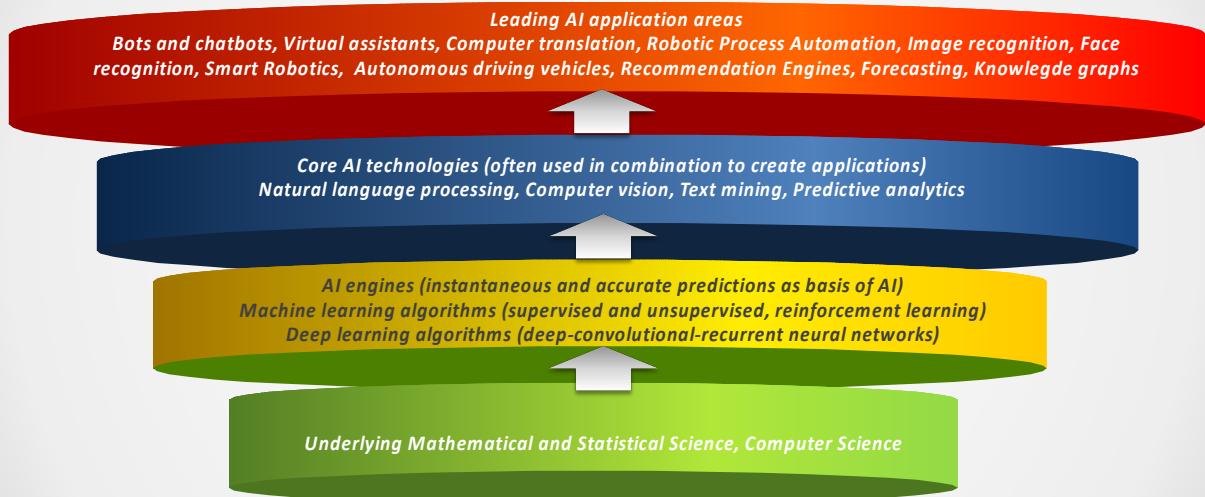
**AI allows us to make decisions faster, more objectively and based on more evidence (data).**

- ▶ AI is generally better than a human at:
  - Finding patterns in large amounts of data
  - Performing a repetitive task (less error prone – because it does not get tired or bored)
  - Remaining unaffected by emotions or external factors
  - Speed
  - Consistency

## Definitions of Artificial Intelligence

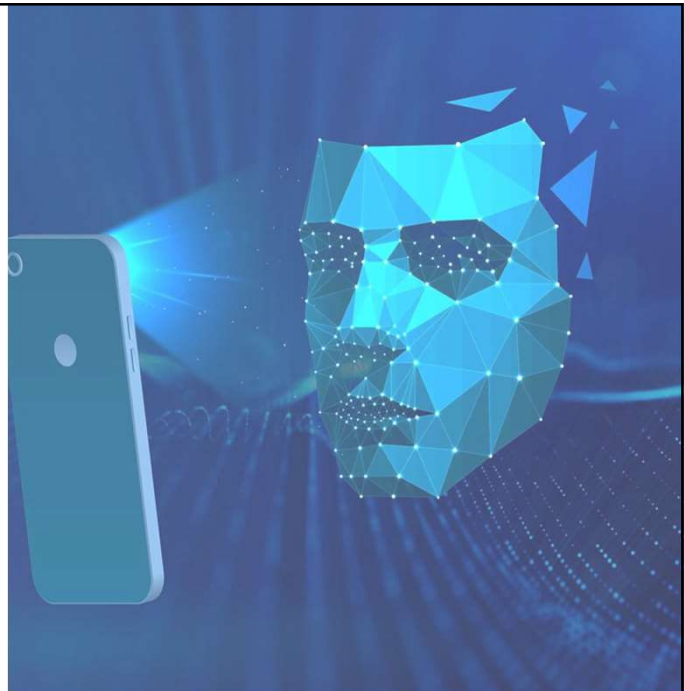
- ▶ Artificial Intelligence is the science of training machines to perform human tasks
- ▶ Artificial Intelligence is a concept, a term for all those situations where a computer does things that seem human, like perceive, reason, learn and act

*Artificial Intelligence is a multidimensional subject area, a concept for all those situations where a computer does things that seem human, like perceive, reason, learn and act, a sort of human intelligence exhibited by machines.*



## Application Areas of AI

- ▶ Text and speech
- ▶ Voice recognition
- ▶ Chatbots
- ▶ Image recognition
- ▶ Facial analysis
- ▶ Image to text
- ▶ Text to image
- ▶ Video analysis
- ▶ Synthetic human
- ▶ Expert systems



## Application Areas of AI: AR vs. VR

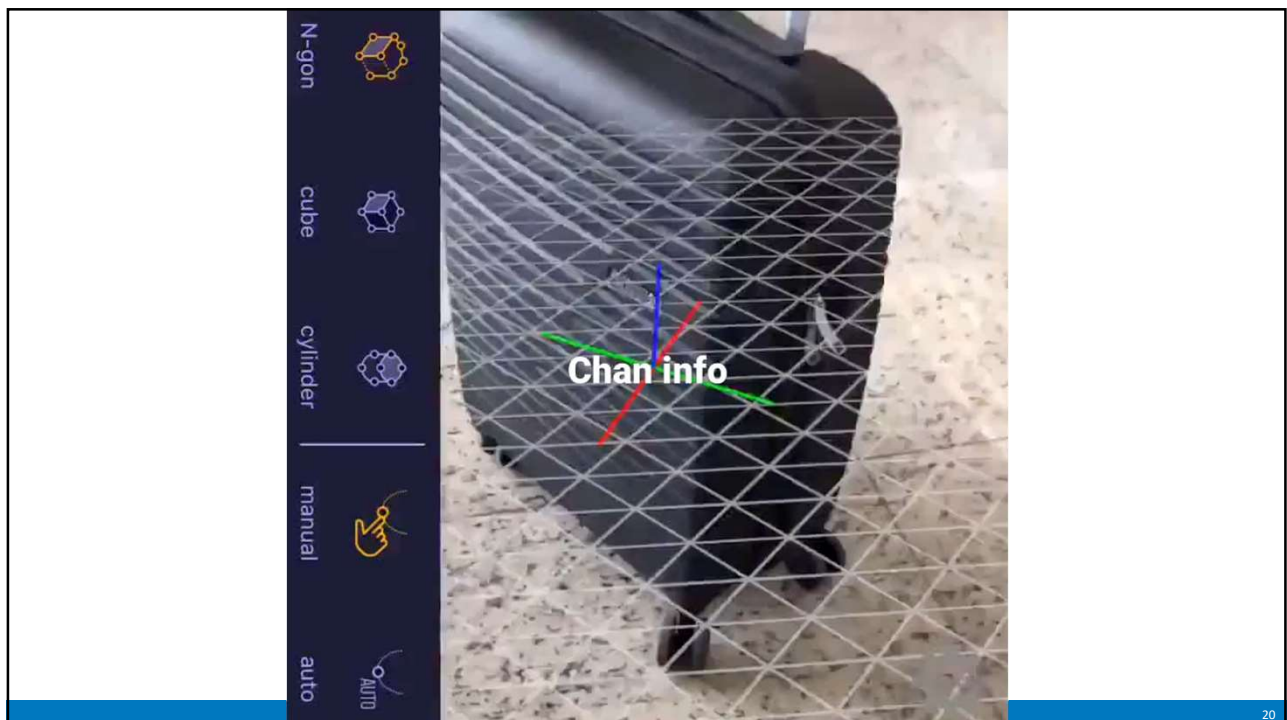
- ▶ In **Augmented Reality (AR)**, new information is projected onto the real world
  - e.g. Google Glass, Pokémon Go
- ▶ In **Virtual Reality (VR)**, users are immersed in a completely virtual world

Both of these usually use a lot of AI algorithms to work, e.g. to interpret the surroundings.



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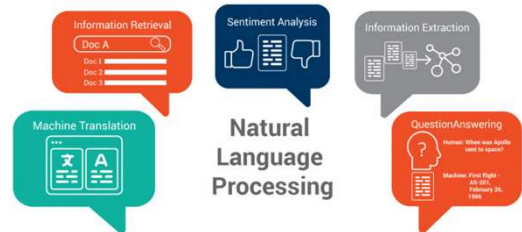
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## Application Areas of AI

**Natural Language Processing (NLP)** is the processing of natural language data using a computer

► Applications that use NLP techniques include:

- Language translation
- Semantic interpretation
  - Understand the intent and contextual meaning of words
- Automatic summarization
- Lexical semantics
  - Named entity recognition, sentiment analysis



# Application Areas of AI

**Computer Vision** is the processing of images (photo, video) using a computer

► Applications that use IR techniques include:

- Video surveillance
- Object detection
- Medical image recognition
- Emotion detection
- Face recognition

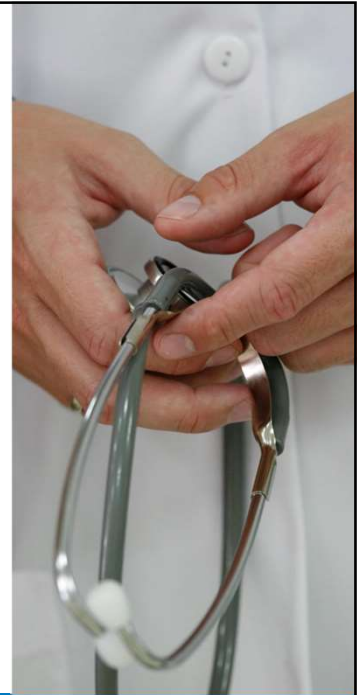


## Application Areas of AI: Expert Systems

### ► Example of an expert system:

labeling hospital patient files with the correct administrative code (ICD-10)

- 2400+ different codes for different procedures
- All provided care **must** be labeled
- Requires highly specialized understanding
- Machine can learn from manually labeled files



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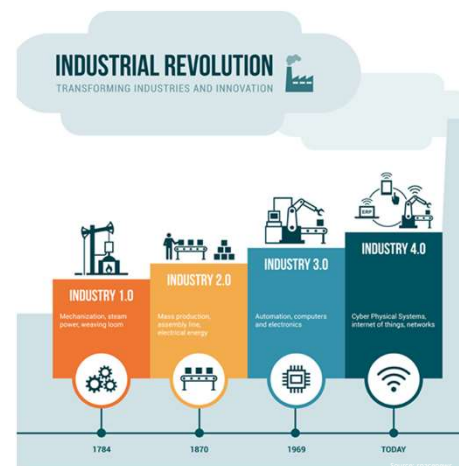
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## Fourth Industrial Revolution

### ► Why is AI in an acceleration phase now?

“The convergence of the physical, digital and biological worlds that is at the heart of the fourth industrial revolution offers significant opportunities for the world to achieve huge gains in resource use and efficiency.” - Klaus Schwab, founder and executive chairman of the **World Economic Forum** (WEF), author of The Fourth Industrial Revolution

- Developments in various fields have enabled us to make significant technological progress
- The progress that AI has made is driven by **increases in computing power**, by the availability of **vast amounts of data** and powerful **programming languages** as R and Python



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Insane Data Production



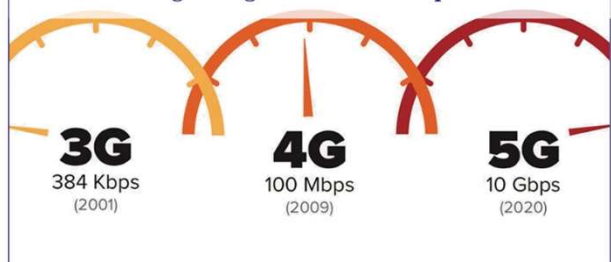
Abundant, Cheap Hardware



Open-Sourced Software



Lightning-Fast Network Speeds



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## Data-Driven Organizations

The fourth industrial revolution has given rise to data-driven organizations. **“Data-driven”** implies **fact-based decisions based on data, not on intuition.**

These are organizations that seek to drive positive change through:

- ▶ **Real world data** that drives decisions
- ▶ **Codified business logic** to objectify decisions

This allows these types of organizations to apply **decisions models** (using the above ingredients) that can be automated, improved, replaced, etc. more easily than in traditional organizations.

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NOT INCLUDED IN THE EXAM

## Additional References

- ▶ Deep dive into Bloom's cognitive taxonomy

## Topic 2 Data, Robots and Artificial Intelligence

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## Data, Robots and Artificial Intelligence

Recent acceleration in the availability of data, low cost processing power, high bandwidth networks and many IoT and Edge devices created the conditions for AI to be applied in many areas. The exam requires that the participant understands different levels of Intelligent Agents and Robotics (according to the Russel/Norvig model).

## Table of Contents

- ▶ AI and smart devices
- ▶ The robotic paradigm
- ▶ Types of agents
  - Examples of robotic levels in the real world
- ▶ Characteristics of intelligent agents
- ▶ Relationship between intelligent agents and machine learning

### Examination Goals

- ▶ Recall of facts and concepts
- ▶ Ability to detect application of robotic levels to real world situations

## AI and smart devices

Artificial Intelligence is becoming more prevalent. Even in **everyday things around us**.

- ▶ Smart doorbell that can detect when a human passes in front of its camera
- ▶ Coffee machine that turns on when your wake-up alarm goes off
- ▶ Smart watch that detects when you fall
- ▶ Blinds that close when the sun sets

All of these are technically **robots**. But **not all robots are 'smart'**.

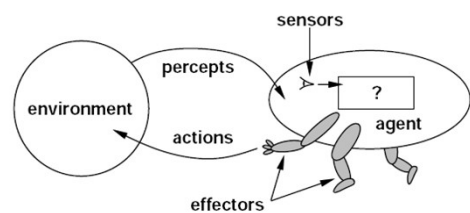
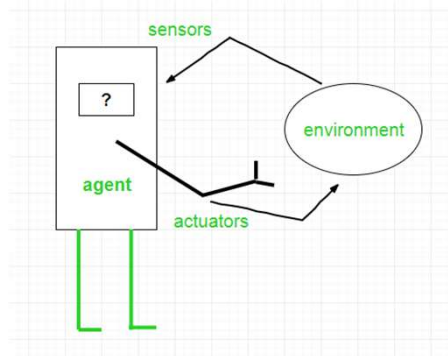


## One of the definitions of artificial intelligence

- ▶ Computer science defines AI research as the study of **intelligent agents**. [\[a\]](#)
- ▶ The [leading AI textbook](#)<sup>[5][6][7]</sup> defines an "agent" as:
  - "Anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators"
  - Agents represent the ability of the computer to accomplish something on behalf of the user
- ▶ defines a "rational agent" as:
  - "An agent that acts so as to maximize the expected value of a performance measure based on past experience and knowledge."
- ▶ and defines the field of "artificial intelligence" research as:
  - "The study and design of rational agents"

## Agents

- ▶ An agent is anything that can be viewed as :
  - perceiving its environment through **sensors** and
  - acting upon that environment through **actuators**

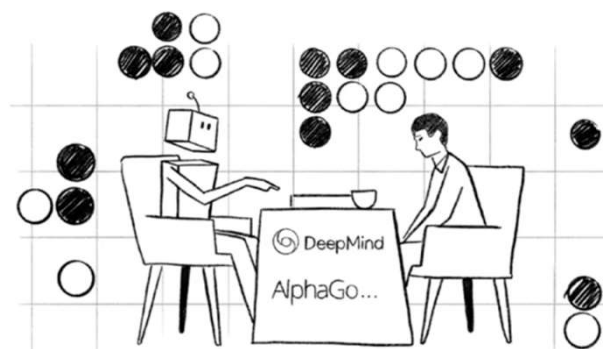


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## Examples of Agents:

- ▶ A **software agent** has Keystrokes, file contents, received network packages which act as sensors and displays on the screen, files, sent network packets acting as actuators.
- ▶ A **Human-agent** has eyes, ears, and other organs which act as sensors, and hands, legs, mouth, and other body parts acting as actuators.
- ▶ A **Robotic agent** has Cameras and infrared range finders which act as sensors and various motors acting as actuators.



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## What is a Robot: Robotic Paradigm

A robot (agent) has three '**primitives**': Sense, Plan and Act

### ▶ Sense

- **Percepts** is the input that it perceives from the **environment**
- Sensed with **sensors**

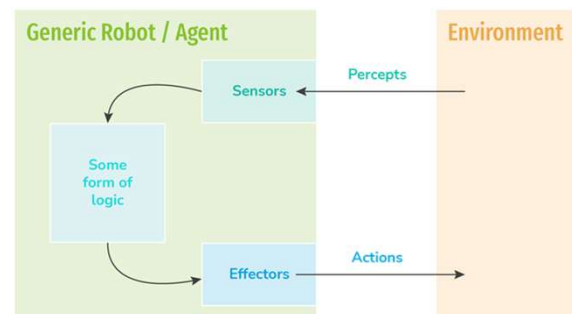
### ▶ Plan

- Decides what action to take based on the input

### ▶ Act

- Uses **effectors** to perform **actions**

The primitives form a control architecture  
→ **robotic paradigm**



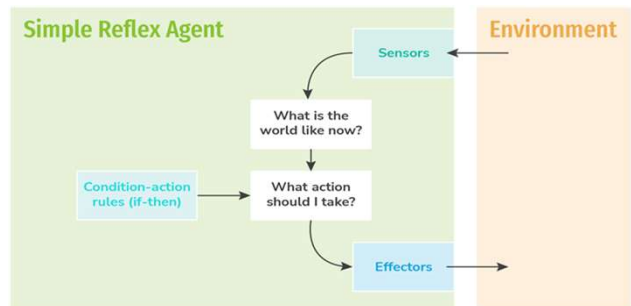
## Types of Agents

There are different ways an agent can plan the action based on the information

- ▶ Simple reflex agents
- ▶ Model-based reflex agents
- ▶ Goal-based agents
- ▶ Utility-based agents
- ▶ Learning agent

## Simple Reflex Agents

- ▶ Uses **condition-action rules** to perform the associated action based on the current situation of the environment
- ▶ Range of applicability is very narrow

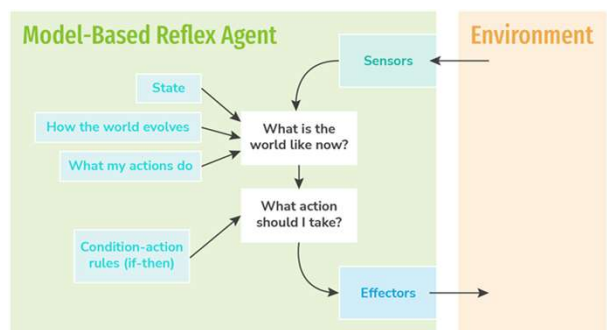


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## Model-Based Reflex Agents

- ▶ Has an **internal representation** of the world around it
- ▶ Uses **internal state** and **understanding of what actions do** to the state of the world in order to decide the best action to take

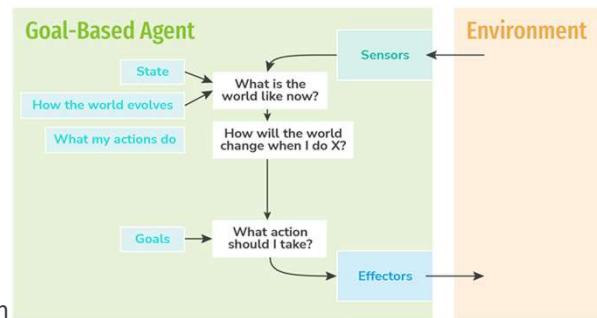


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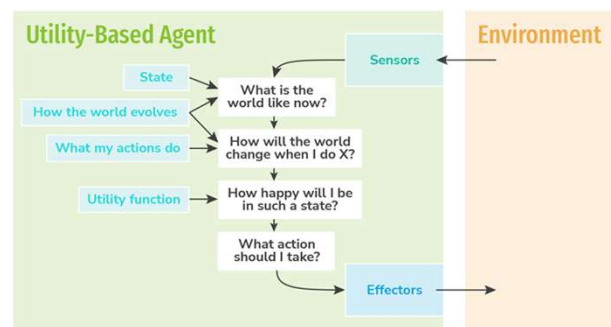
## Goal-Based Agents

- ▶ Only knowing the current state of the environment is not always enough to decide what action should be taken
- ▶ The agent needs a **goal** that describes the desirable situation(s)
- ▶ It should then choose actions that lead to achieving that goal:
  - Sometimes easy if goal satisfaction is the immediate result from a single action
  - Sometimes agent needs to consider a long chain of actions to find a way to achieve the goal
- ▶ This agent needs to **consider the future**



## Utility-Based Agents

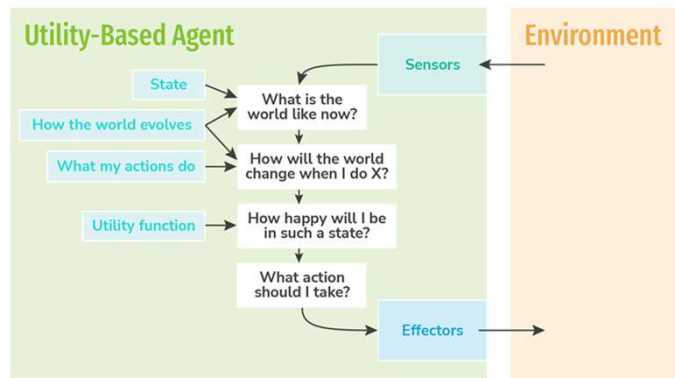
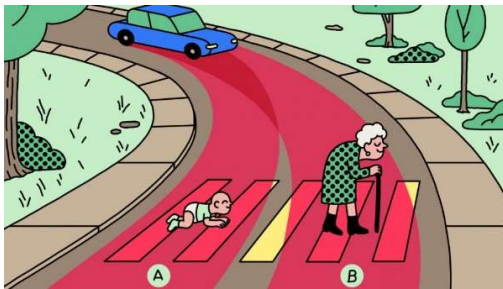
- ▶ Goal-based agents do not always generate the most optimal way to reach the goal
  - May be many ways to achieve the same goal, some are quicker, safer, more efficient, etc.
- ▶ We need a general performance measure to compare different world states that tells us how good it would be to achieve that state
  - If one world state is preferred to another, it has higher **utility** for the agent
- ▶ **Utility(state) = degree of 'happiness'**  
 ↑ function based on a state of the world



## Utility-Based Agents

### Example:

If someone suddenly makes a wrong move in front of a self-driving car: what could it do?



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## Intelligent Agent

These types of agents are not necessarily intelligent!

### An intelligent agent

- ▶ Perceives its environment
- ▶ Takes actions autonomously in order to achieve goals
- ▶ **May improve its performance with learning or may use knowledge**

A thermostat is an example of an intelligent agent. So is a human.

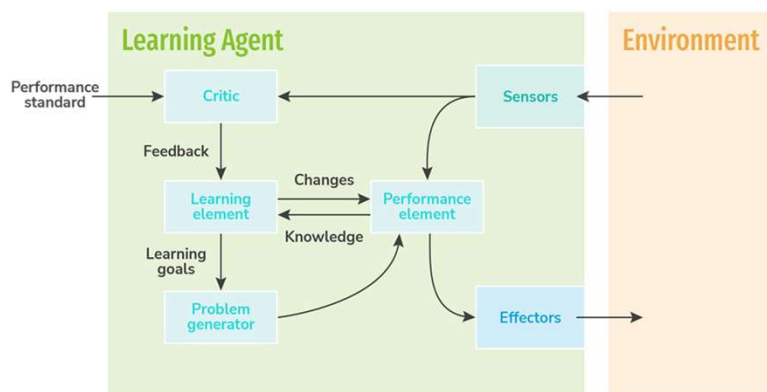
**So, what makes a thermostat an intelligent agent?**

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## Learning Agents

- ▶ Learning agents are an example of an intelligent agent
- ▶ The learning agent has four components
  - Learning element
  - Performance element
  - Critic
  - Problem generator

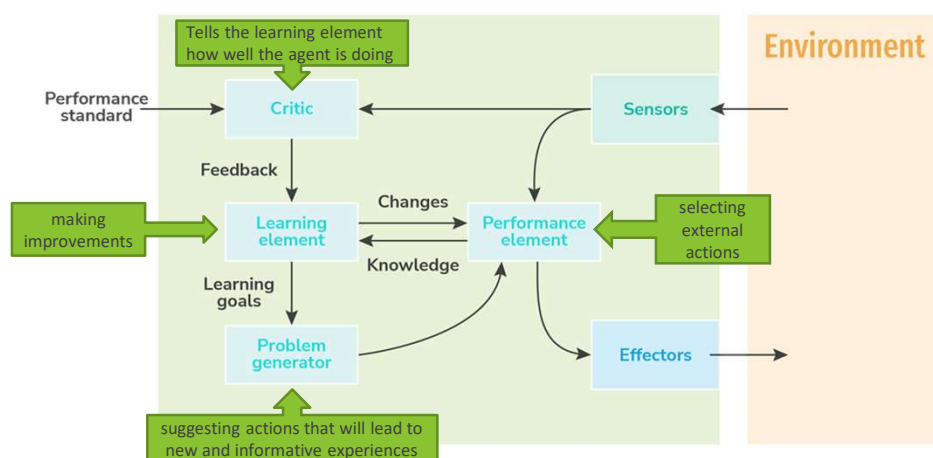


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## Learning Agents and Intelligent Agents

- ▶ We can call any type of agent “intelligent” if it can improve its own performance based on experience. So: if it has at least a **learning element**.



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