



SKEMA BUSINESS SCHOOL

**Introduction to
Artificial Intelligence**
Dmitry A. Zaitsev
<http://daze.ho.ua>



skema
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A woman's silhouette is shown from the back, with her hair in a bun. Inside her head and shoulders, a city skyline is visible, featuring the Eiffel Tower, the Christ the Redeemer statue, and the Empire State Building. The background is a warm, orange-hued sky.

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Lesson 1:

Basics of Artificial Intelligence



Lesson 1: Basics of Artificial Intelligence

Definitions of AI

the science and engineering of making intelligent machines

Turing Test

if we cannot tell a machine from a human being – AI is achieved

Classification of AI directions

Symbolic, Logic, Representation and application of knowledge, Machine learning, Agent-oriented etc

Overview of AI domain

Personalized shopping, AI powered assistants, Smart purchasing, Fraud prevention, Administrative Tasks etc

Artificial Intelligence around us

Recently widespread

- advanced web-search engines (Google Search)
- content recommendation systems of YouTube, Amazon, Netflix
- understanding human speech – Siri, Alexa
- self-driving cars – Waymo
- automatic decision-making in business
- strategic game systems – Chess, Go

Definition of Artificial Intelligence

John McCarthy, 1955

Artificial Intelligence (AI) is the science and engineering of making intelligent machines.

Definition of Artificial Intelligence

John McCarthy, 1997

Intelligence is the
computational part of the
ability to achieve goals in the
world.

Definition of Artificial Intelligence

Simple functional

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems.

Definition of Artificial Intelligence

Simple functional, nested definition of « intelligence »

Intelligence is the ability to learn and perform suitable techniques to solve problems and achieve goals, appropriate to the context in an uncertain, ever-varying world.

Definition of Artificial Intelligence

Modern

Artificial intelligence (AI) is the study and design of intelligent agents.

An intelligent agent is a system that perceives its environment and takes actions which maximizes its chances of success.

Definition of Artificial Intelligence

Pragmatic

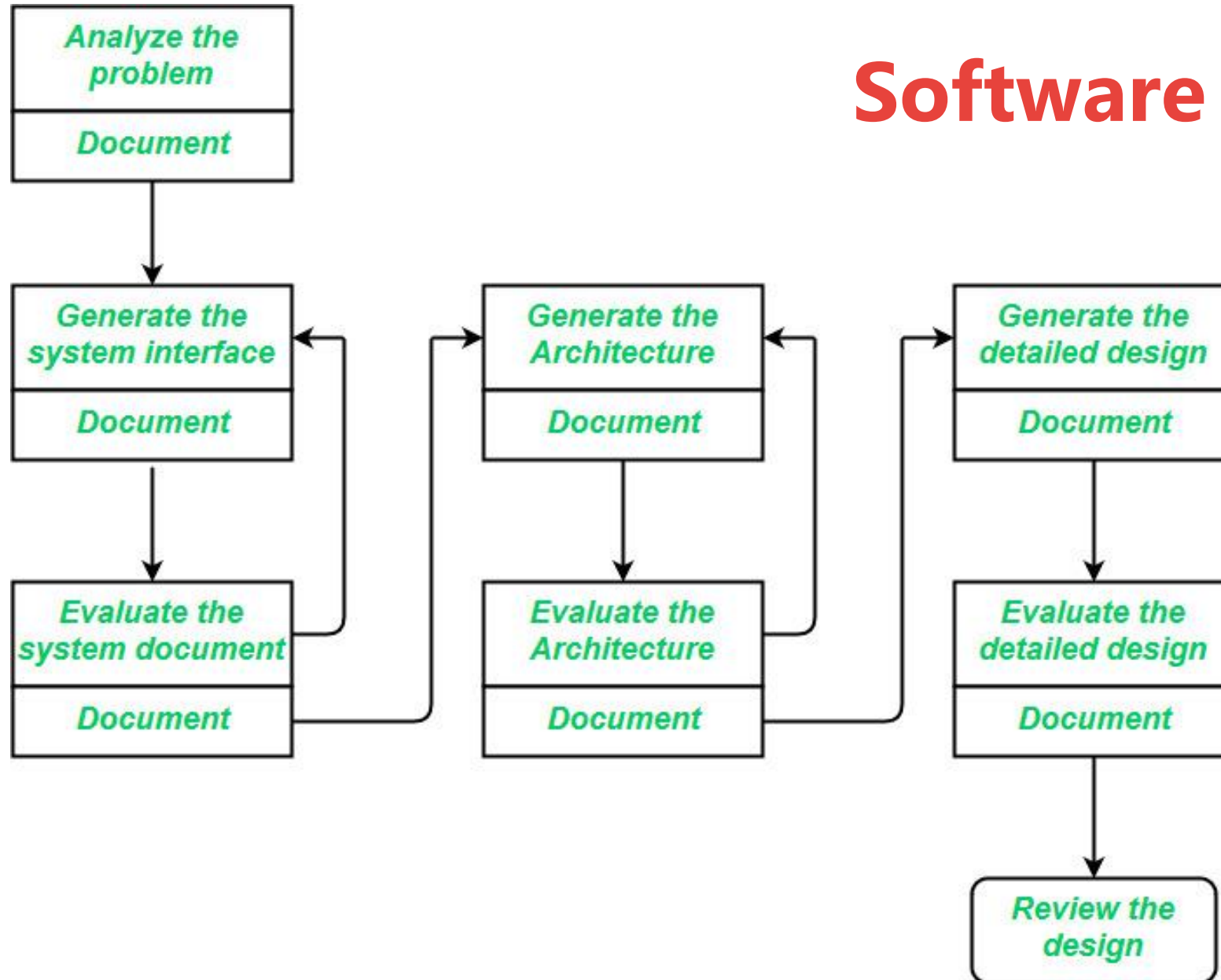
Artificial intelligence (AI) is the property of artificial intelligent systems to perform creative functions that are traditionally considered the prerogative of human beings. AI is the science and technology of building intelligent machines, especially intelligent computer programs.

Conventional algorithmic approach

Formalized by Alan Turing in 1936 as [Turing Machine](#)

- requirements
- algorithm – prescription (mass, elementary steps, deterministic, constructive),
- computer program (software) – implementation of algorithm
- debugging and testing vs correctness proof

Software Design

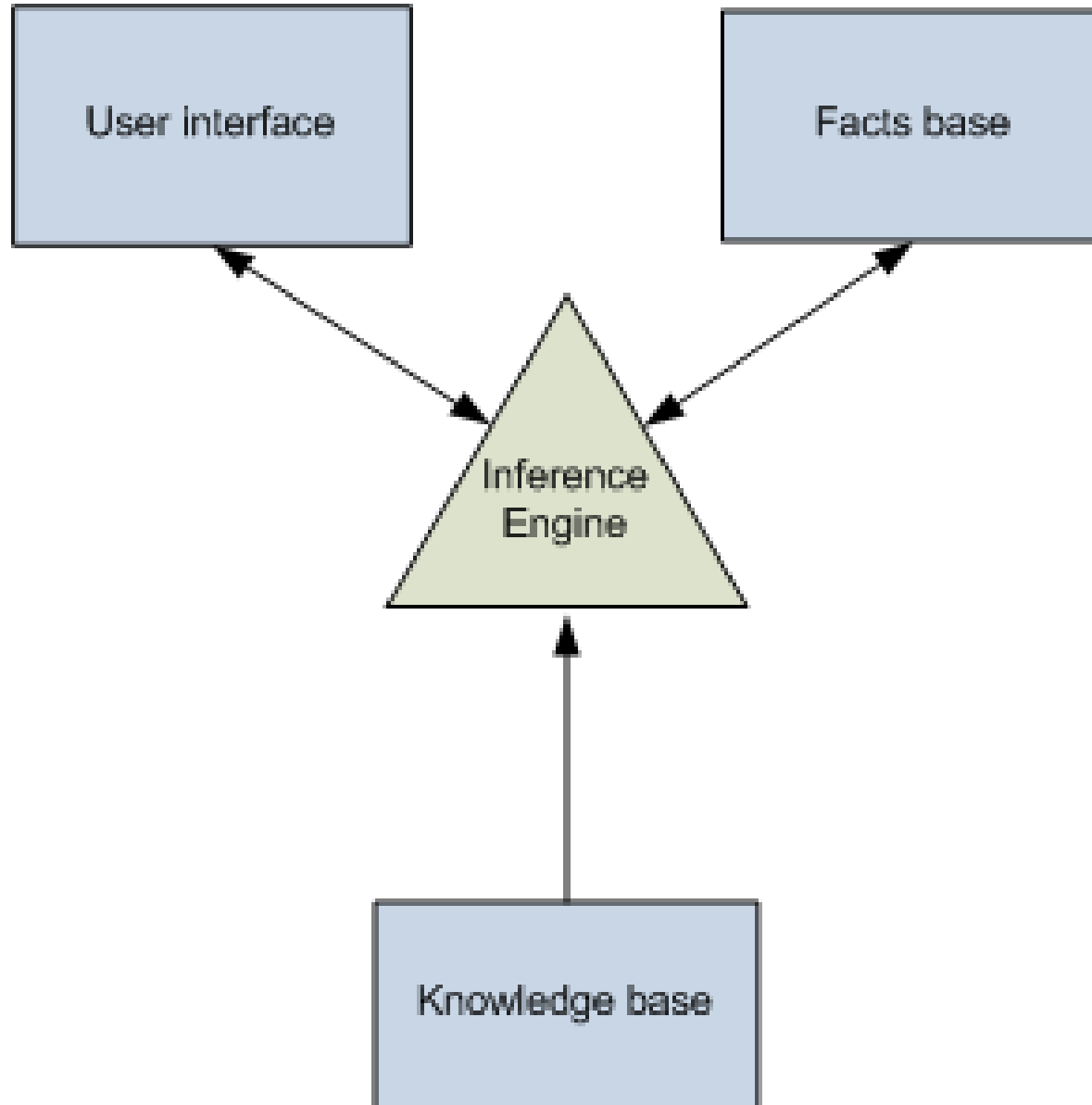


Intellectual approach

John McCarthy

- goal
- knowledge
- facts
- solution

To achieve a given goal AI system applies knowledge over facts to infer a solution



Knowledge based system

Self-learning as a basic property of AI

Knowledge base

- *knowledge base* is applied for obtaining solutions
- *knowledge base* is replenished during the process of solving tasks
- *knowledge base* is replenished by experts – human beings – professionals for a domain

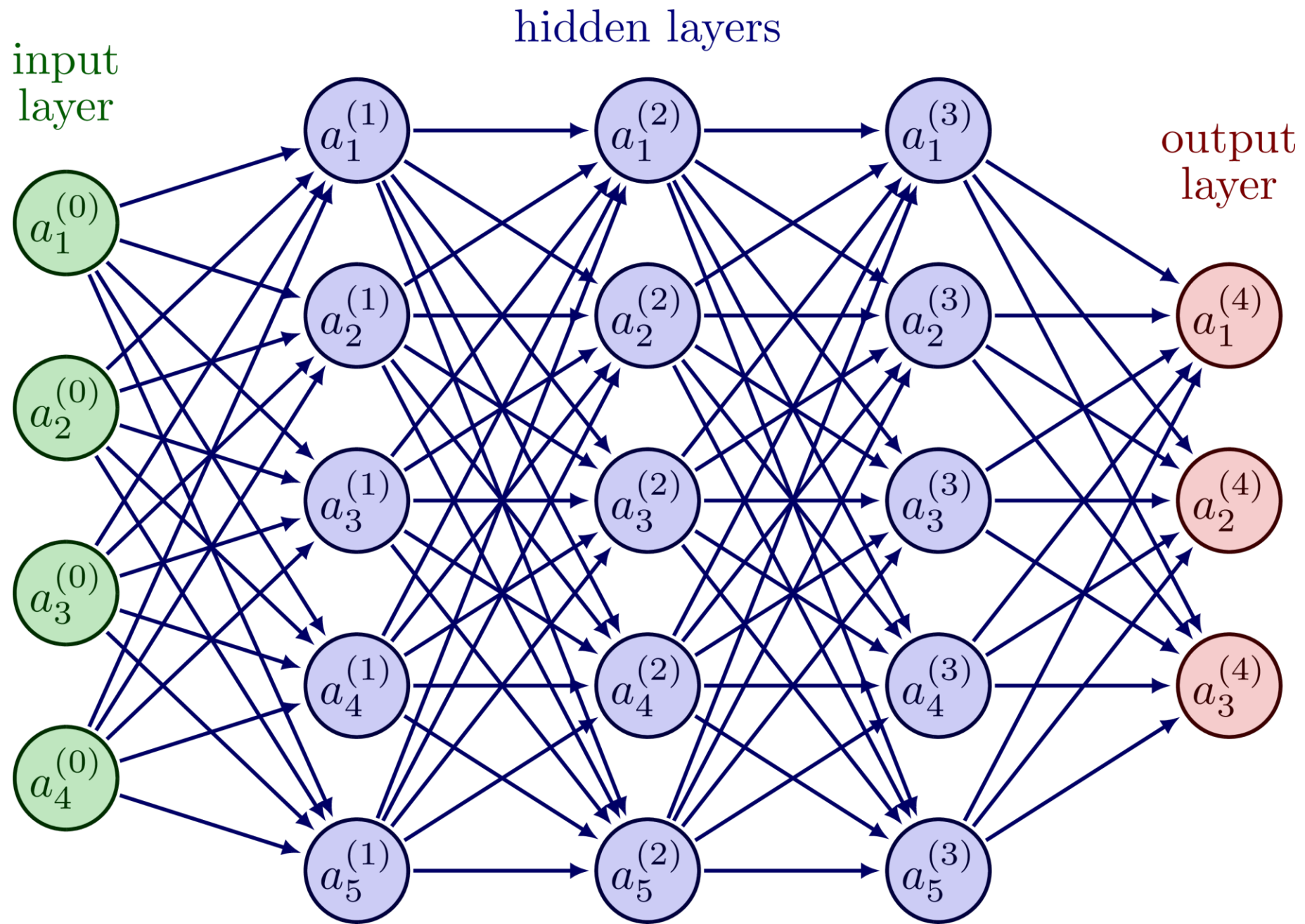
Basic approaches to AI

Psychological vs biological

- simulation of intellectual processes of *reasoning* and solving problems based on *knowledge*
- simulation of human brain structure and functioning – *neuron networks*



Super macro close-up view of neurons inside of human brain



Machine learning neural network architecture

Can Machines Think?

Alan Turing, 1950

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous, If the meaning of the words "machine" and "think" are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, "Can machines think?" is to be sought in a statistical survey such as a Gallup poll. But this is absurd.

Babbage's Analytical Engine

Lady Lovelace Objection, 1842

- “The Analytical Engine has no pretensions to originate anything. It can do *whatever we know how to order it to perform*”
- ➔ A machine can never do anything really new
- ➔ But there is nothing new under the sun

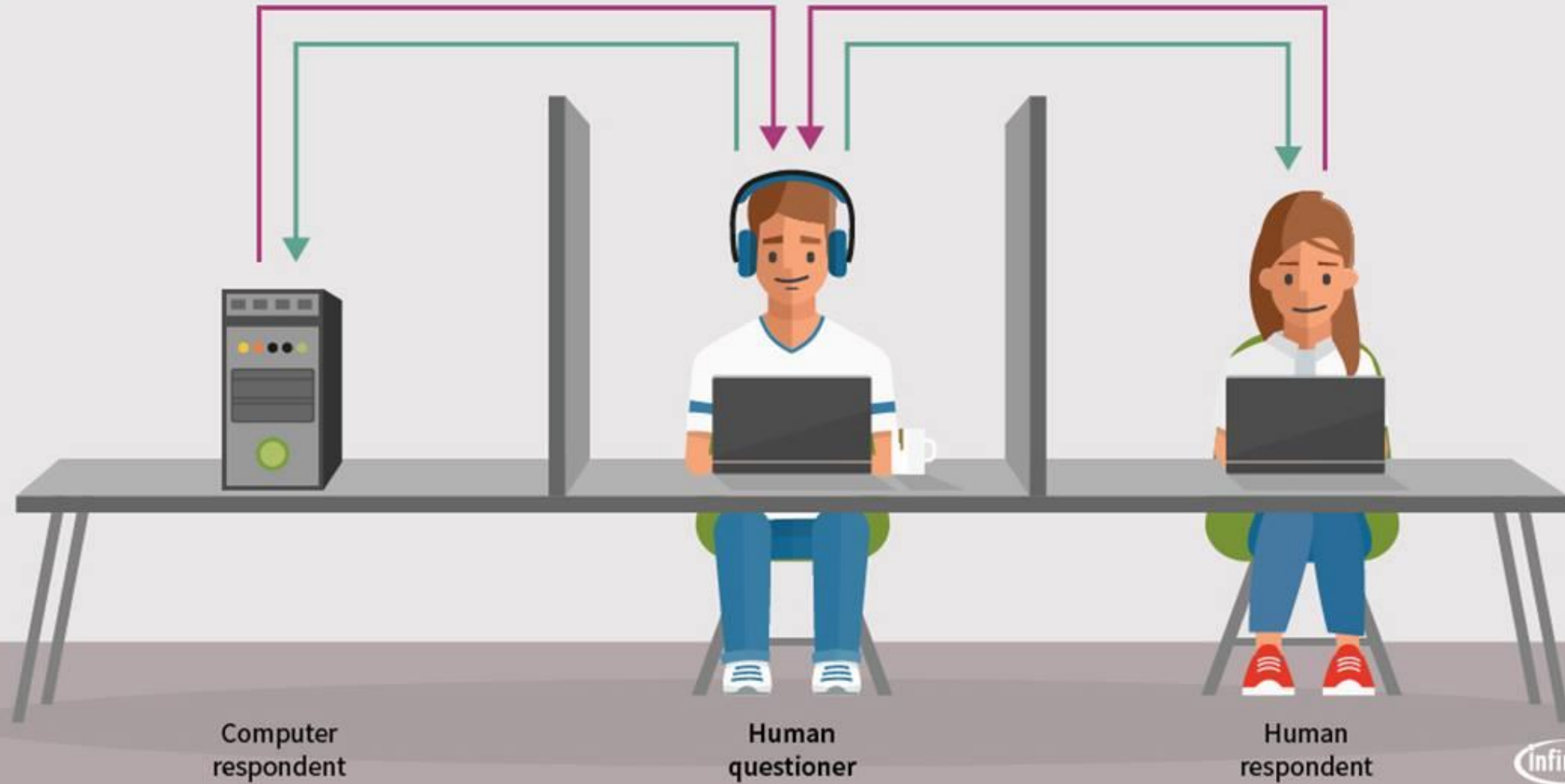
Imitation game

Wide known as Turing test on AI

- two isolated rooms and an outside examiner
- a human being (HB) in one room
- an artificial intelligence agent (AIA) in other room
- examiner is asking questions
- based on answers to his/her questions, the examiner concludes where is HB and where is AIA
- real is AI achieved when the examiner can not conclude

Turing Test

- Question to respondents
- Answers to questioner



Infineon

Turing test accomplished?

AI agents which are nearly passing Turing test

- IBM supercomputer Deep Blue versus Garry Kasparov, 1996-1997, AI won the second match. A documentary film, [*Game Over: Kasparov and the Machine*](#).
- IBM computer Watson wins Jeopardy clash – supercomputer outwits US quiz show champions in epic head-to-head battle – Watson was constant winner during 3 days against 2 human being champions. [*IBM Watson: Final Jeopardy! and the Future of Watson*](#).

IBM Deep Blue



IBM Watson



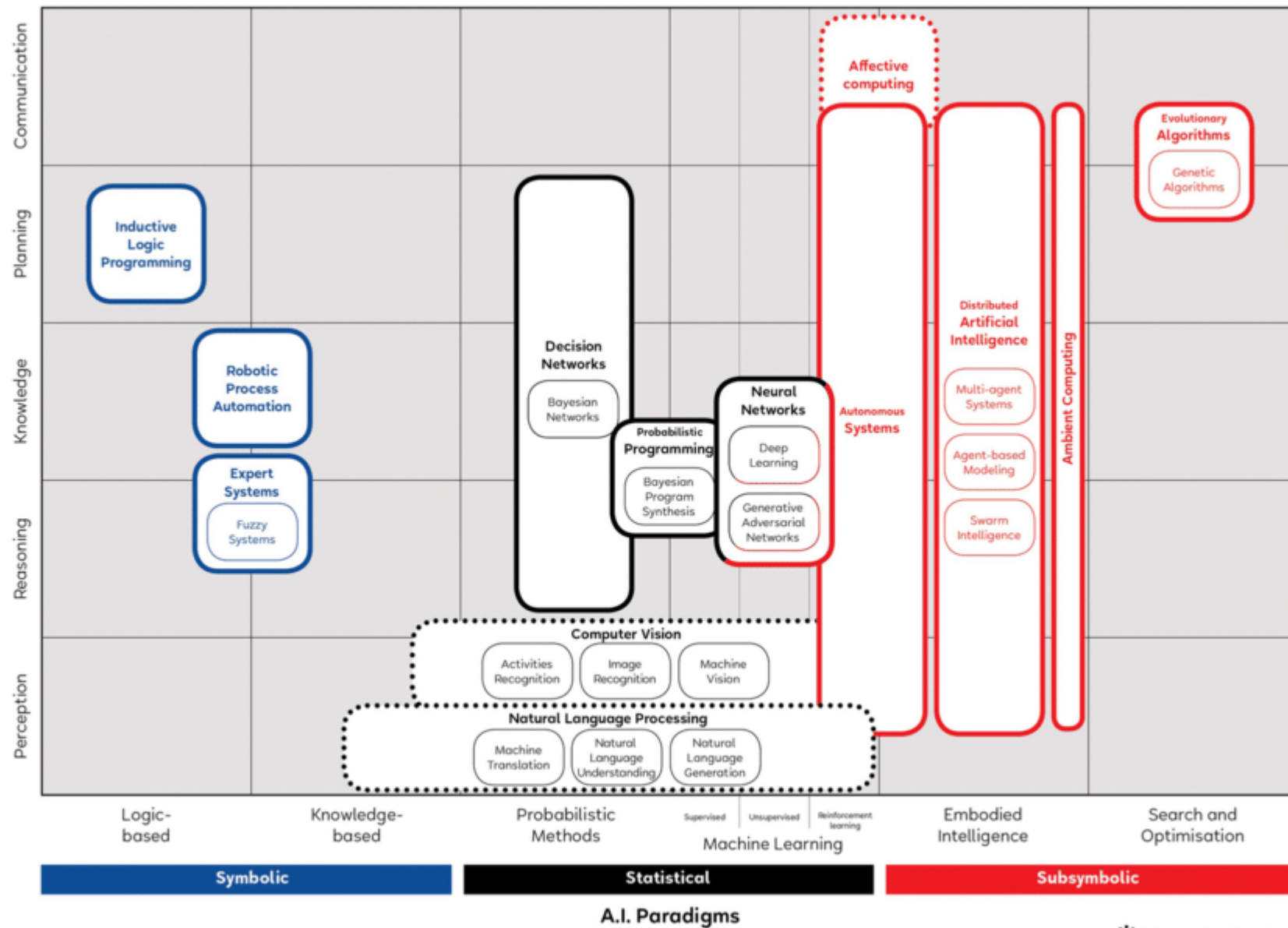
Approaches to AI

- *Symbolic*: symbolic simulation of thinking processes
- *Logic*: representing knowledge, goals and the current situation by sentences in logic
- *Representation and application of knowledge*: ontology, frame networks, productions
- *Machine learning*: use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy
- *Agent-oriented*: a rational agent could be anything that makes decisions, as a person, firm, machine, or software
- *Natural language processing*: recognize and synthesize texts and speech
- *Biological simulation*: simulate brain structure and processes
- *Intellectual Robot*: an intelligent machine with the ability to take actions and make decisions
- *Machine creativity*: poetry, composing music, drawing pictures, playing games

AI Programming Cognitive Skills

Learning, Reasoning and Self-Correction

- *Learning*: The acquisition of information and the rules needed to use that information.
- *Reasoning*: Using the information rules to reach definite or approximate conclusions.
- *Self-Correction*: The process of continually fine-tuning AI algorithms and ensure that they offer the most accurate results they can.



How to classify AI technologies

Corea (2019) AI Knowledge Map: How to Classify AI Technologies. In: An Introduction to Data (pp. 25–29). Studies in Big Data, vol 50. Springer, Cham

AI paradigms

Horizontal axis

- **Logic-based tools:** tools that are used for knowledge representation and problem-solving;
- **Knowledge-based tools:** tools based on ontologies and huge databases of notions, information, and rules;
- **Probabilistic methods:** tools that allow agents to act in incomplete information scenarios;
- **Machine learning:** tools that allow computers to learn from data;
- **Embodied intelligence:** engineering toolbox, which assumes that a body (or at least a partial set of functions such as movement, perception, interaction, and visualization) is required for higher intelligence;
- **Search and optimization:** tools that allow intelligently searching through many possible solutions.

AI problem domains

Vertical axis

- **Reasoning:** the capability to solve problems;
- **Knowledge:** the ability to represent and understand the world;
- **Planning:** the capability of setting and achieving goals;
- **Communication:** the ability to understand language and communicate;
- **Perception:** the ability to transform raw sensorial inputs (e.g., images, sounds, etc.) into usable information (knowledge).

Forms of AI

Consciousness, emotions and critical-thinking to become AGI

- **Weak/Narrow AI (ANI):** an application of artificial intelligence technologies to enable a high-functioning system that replicates – and perhaps surpasses – human intelligence for a dedicated purpose. Examples: Image and facial recognition systems, Chatbots and conversational assistants, Self-driving vehicles, Predictive maintenance models, Recommendation engines etc
- **Strong/General AI (AGI):** a theoretical AI system that could be applied to any task or problem. AGI involves a system with comprehensive knowledge and cognitive capabilities such that its performance is indistinguishable from that of a human, although its speed and ability to process data is far greater.
- **Artificial Super Intelligence (ASI):** a form of AI capable of surpassing human intelligence by manifesting cognitive skills and developing thinking skills of its own.

Wide AI features

From narrow to wide AI

- *explainable AI: (XAI)* is a set of processes and methods that allows human users to comprehend and trust the results and output created by machine learning algorithms;
- *transfer learning:* a machine learning technique where a model trained on one task is re-purposed on a second related task;
- *few-shot learning:* a type of machine learning method where the training dataset contains limited information;
- *structured prediction and learning:* predict multiple output variables by exploiting the dependencies between them;
- *incremental learning:* a method of machine learning in which input data is continuously used to extend the existing model's knowledge.

List of AI technologies

- Robotic Process Automation
- Expert Systems and Fuzzy systems
- Computer Vision
- Natural Language Processing
- Neural Networks and Deep Learning
- Autonomous Systems
- Distributed Artificial Intelligence, Multi-agent systems, and Swarm Intelligence
- Affective Computing
- Evolutionary Algorithms and Genetic algorithms
- Inductive Logic Programming
- Decision Networks or Bayesian networks
- Probabilistic Programming and Bayesian Program Synthesis
- Ambient Intelligence

Top AI applications

<https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/artificial-intelligence-applications>

- Personalized shopping
- AI powered assistants
- Smart purchasing
- Fraud prevention
- Administrative Tasks
- Creating Smart Content
- Voice Assistants
- Personalized Learning
- Autonomous Vehicles
- Cybersecurity threats
- Surveillance

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