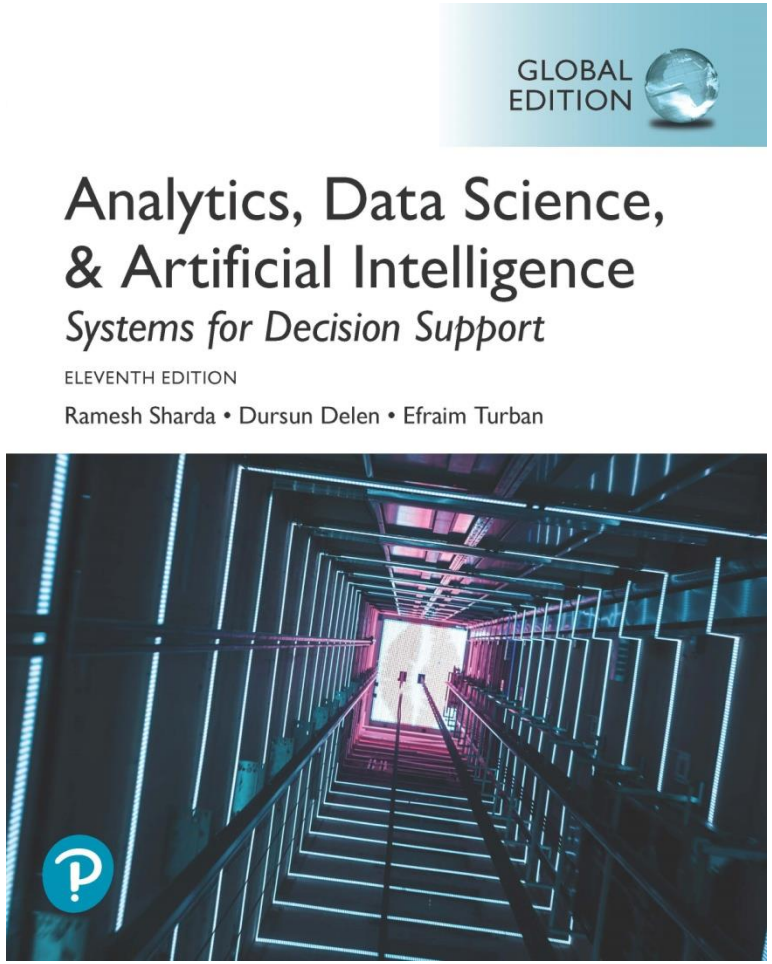
Analytics, Data Science and AI: Systems for Decision Support

Eleventh Edition, Global Edition



Chapter 2

Artificial Intelligence Concepts, Drivers, Major Technologies, and Business Applications

Learning Objectives

2.1 Understand the concepts of artificial intelligence (AI).

2.2 Become familiar with the drivers, capabilities, and benefits of AI.

2.3 Describe human and machine intelligence.

2.4 Describe the major AI technologies.

2.5 Discuss the manner in which AI supports decision making.

2.6 Describe AI business applications.

Introduction to Artificial Intelligence

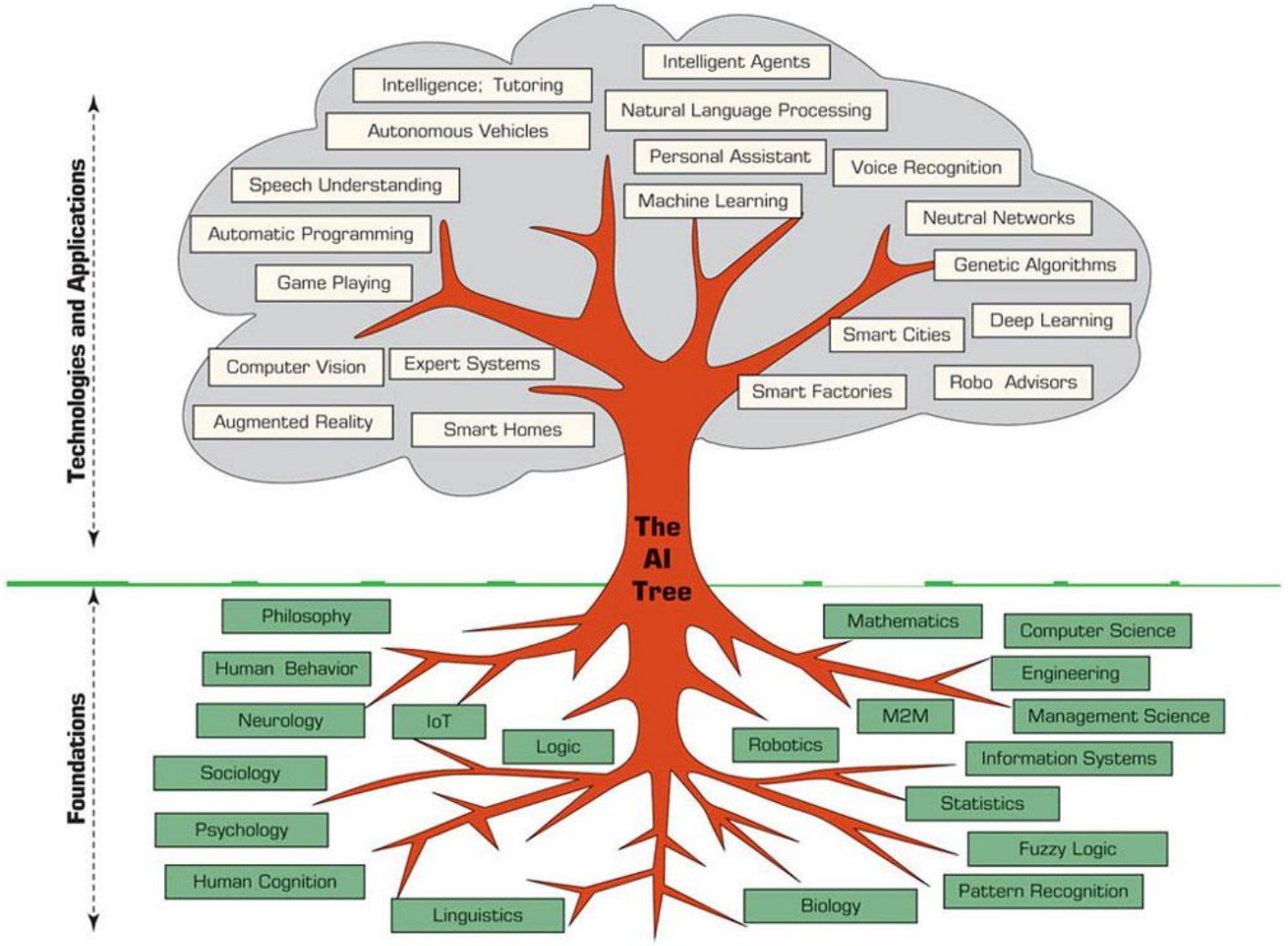
- **Definitions for artificial intelligence (AI)**

  - Many definitions of AI:
    - Aims to make machines (technology) exhibit intelligence as close as possible to what people exhibit, hopefully for the benefit of humans.
    - AI concerned with two basic ideas:
      1. The study of human thought processes (to understand what intelligence is).
      2. The representation and duplication of those thought processes in machines (e.g., computers, robots).

Introduction to Artificial Intelligence

- **Relationship between AI and logic**
  - **Logic is the basis of AI.**
    - Logic: the science/study of correct processes of thinking or reasoning.
    - Primarily deals with the principles that govern the validity of arguments.
    - Example – Argument 1:
      - *If it rains today, then the road is wet*.
      - *It rains today* (premise 1).
      - *Therefore, the road is wet* (conclusion).

The Functionalities and Applications of AI



Artificial Intelligence (AI) (1 of 6)

- **Major goals of AI**
  - AI overall goal is:
    - Create intelligent machines that are capable of executing a variety of tasks currently done by people.
    - AI machines should be able to reason, think, plan, solve problems, and learn

Artificial Intelligence (AI) (2 of 6)

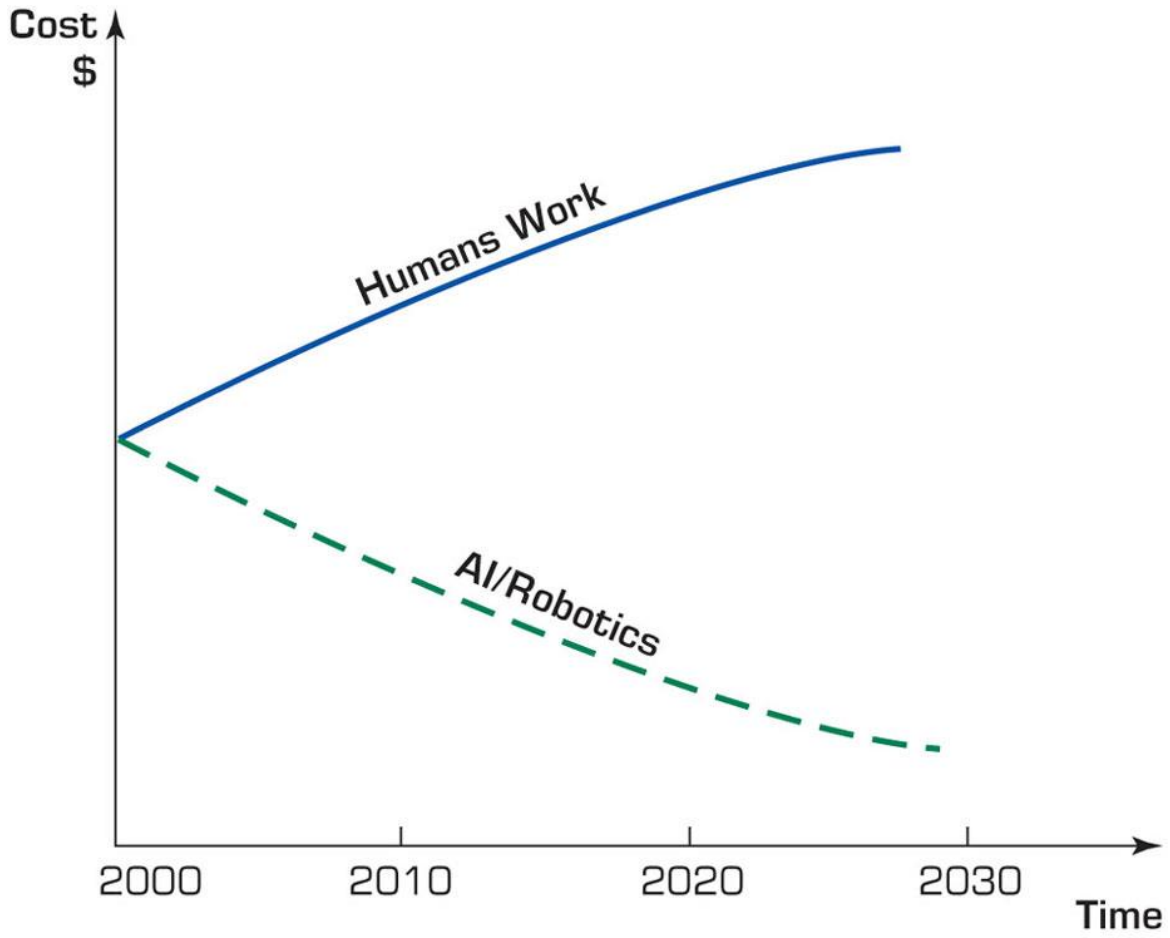
- **Drivers of AI (forces):**
  - Interest in smart machines and artificial brains
  - The low cost of AI applications
  - The pressure on management to increase productivity
  - The availability of quality data:
    - Big data.
  - The increasing functionalities and reduced cost of computers in general

Artificial Intelligence (AI) (3 of 6)

- **Benefits of AI**
  - AI has the ability to complete certain tasks much faster
  - The consistency of the work
    - AI machines do not make arbitrary mistakes
  - AI systems allow for continuous improvement projects
  - AI can be used for predictive analysis via its capability of pattern recognition
  - AI machines do not stop to rest or sleep
  - AI machines can work in environments that are hazardous to people.

Artificial Intelligence (AI) (4 of 6)

Figure 2.2 Cost of Human Work versus the Cost of AI Work.



Artificial Intelligence (AI) (5 of 6)

- **Some limitations of AI Machines**
  - Lack human touch and feel
  - Lack attention to non-task surroundings
  - Can lead people to rely on AI machines too much
  - Can be programmed to create destruction
  - Can cause many people to lose their jobs

Artificial Intelligence (AI) (6 of 6)

- **Three flavors of AI decisions**
  - Assisted intelligence (Week AI).
    - Works in narrow domains (e.g., loan approval; health monitoring).
    - Requires clearly defined inputs and outputs.
  - Autonomous intelligence (Strong AI).
    - A computer will take over many tasks, automating them completely.
    - Have absolute decision-making power (e.g. robo-advisor)
  - Augmented intelligence
    - complements—not a replacement—to human intelligence
    - helps humans to become faster and smarter (e.g. analytics to predict behaviors)
    - Combining the performance of people and machines [combining augmenting]
    - Augmented machines extend human abilities

Human and Computer Intelligence (1 of 4)

- **What is intelligence?**
  - Reasoning, learning, logic, problem-solving, perception, and linguistic ability.

- **Types of intelligence:**
  - Linguistic and verbal, logical, body/movement

Human and Computer Intelligence (2 of 4)

- **Capabilities of intelligence**
  - Learning or understanding from experience
  - Making sense out of ambiguous, incomplete, or even contradictory messages and information
  - Responding quickly and successfully to a new situation (i.e., using the most correct responses)
  - Understanding and inferring in a rational way, solving problems, and directing conduct effectively

Human and Computer Intelligence (3 of 4)

- **Comparing human intelligence with AI**
  - Many AI applications still show significantly less intelligence than humans.

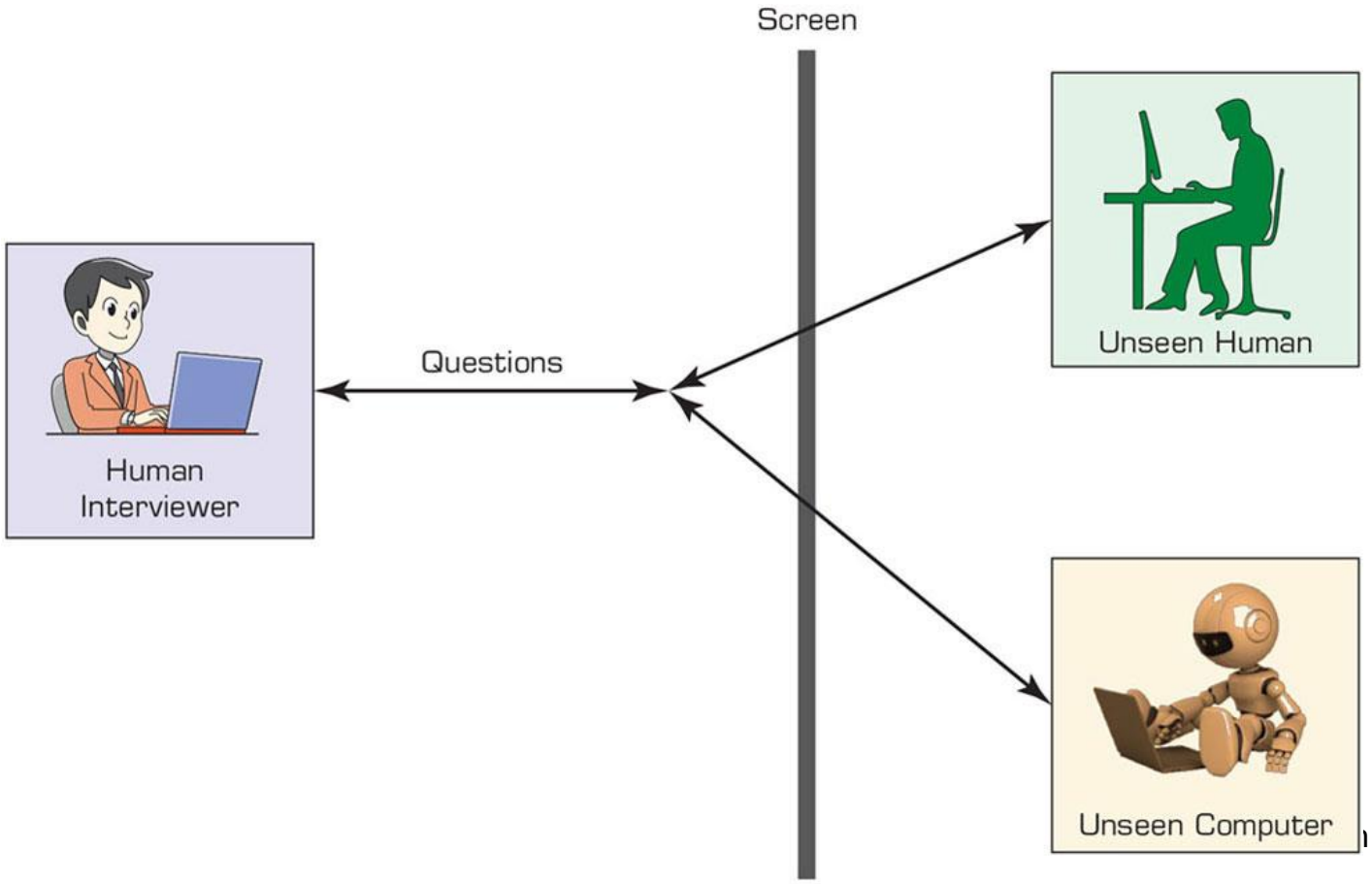
Artificial Intelligence versus Human Intelligence.

Area	AI	Human
Execution	Very fast	Can be slow
Emotions	Not yet	Can be positive or negative
Computation speed	Very fast	Slow, may have trouble
Imagination	Only what is programmed for	Can expand existing knowledge
Answers to questions	What is in the program	Can be innovative
Flexibility	Rigid	Large, flexible

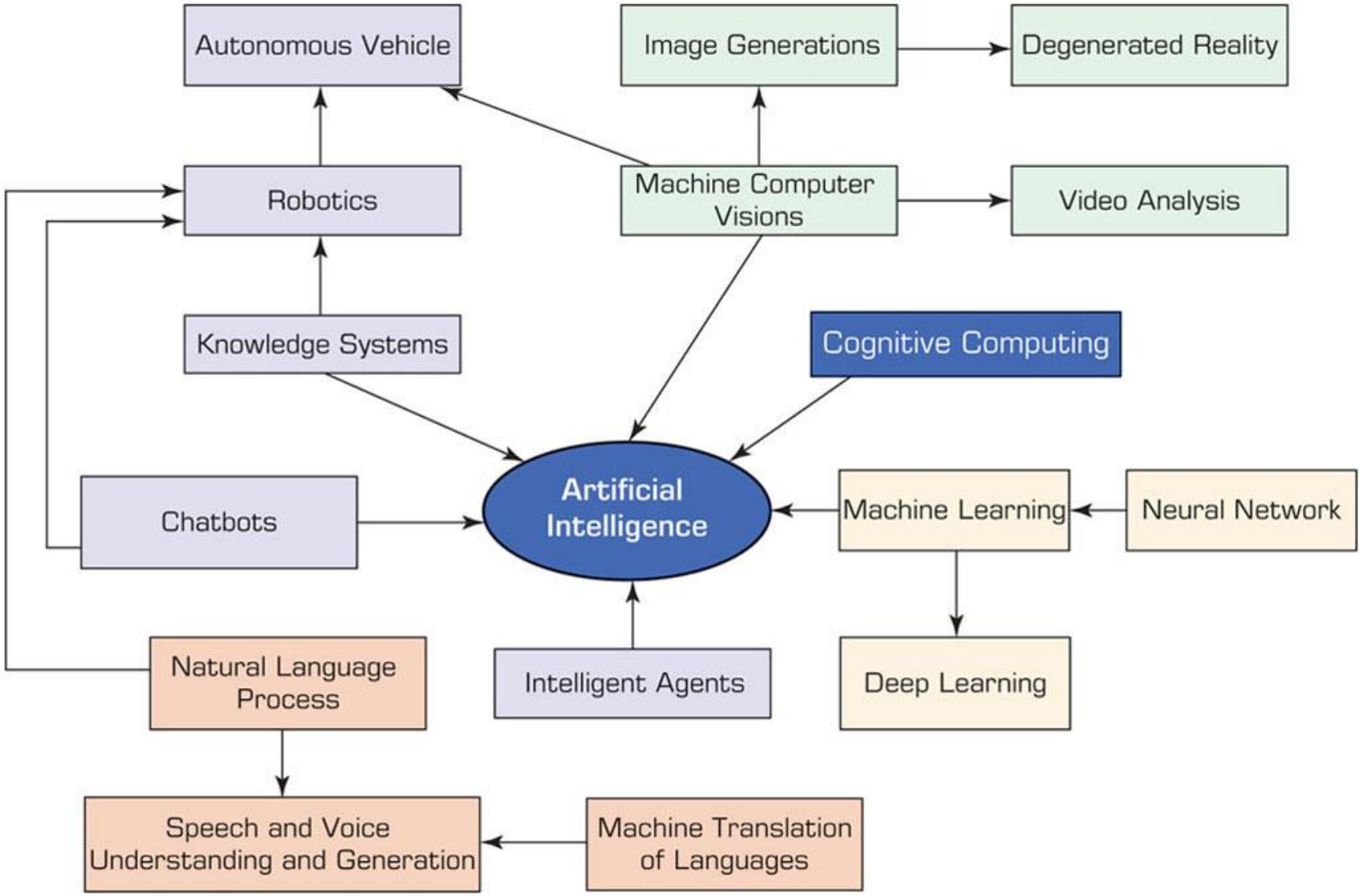
Human and Computer Intelligence (4 of 4)

- Measuring AI: **The Turing Test** (1950)

  Can a computer talk like a human?



Major AI Technologies



Major AI Technologies & Drivers (1 of 3)

- **Intelligent agents**
  - Relatively small computer software program that observes and acts upon changes in its environment by running specific tasks autonomously.
  - May have the ability to learn by using and expanding the knowledge embedded in them.
  - E.g., recommendations agents, virus detection programs, insurance quoting…
- **Machine learning**
  - "Human learning embedded into machines"
  - A scientific discipline concerned with the design and development of algorithms that allow computers to learn based on data coming from sensors, databases, and other sources.
  - E.g., credit card fraud, improving customer loyalty and retention.

Major AI Technologies & Drivers (1 of 3)

- **Deep learning**
  - A part of machine learning.
  - Deep learning uses artificial neural technology.
  - Plays a major role in dealing with complex applications that regular machine learning and other AI technologies cannot handle.
  - E.g., autonomous vehicles, robotics.
- **Computer vision (machine vision):**
  - The technology and methods used to provide imaging-based automated inspection and analysis for applications such as robot guidance, process control, autonomous vehicles, and inspection.
    - E.g.,
      - Facial recognition
      - image processing in visual quality control.

Major AI Technologies & Drivers (2 of 3)

- **Robotic systems**
  - Equipped with intelligent agents, scene recognition and signal processing.

Major AI Technologies & Drivers (3 of 3)

- **Natural language processing**
  - A technology that gives users the ability to communicate with a computer in their native language.
  - Two subfields:
    - Natural language understanding:
      - Comprehend instructions or queries provided in an ordinary language.
    - Natural language generation:
      - Have computers produce ordinary spoken language.
  - E.g., Speech (voice) understanding, Google translator.

Knowledge and Expert Systems (1 of 2)

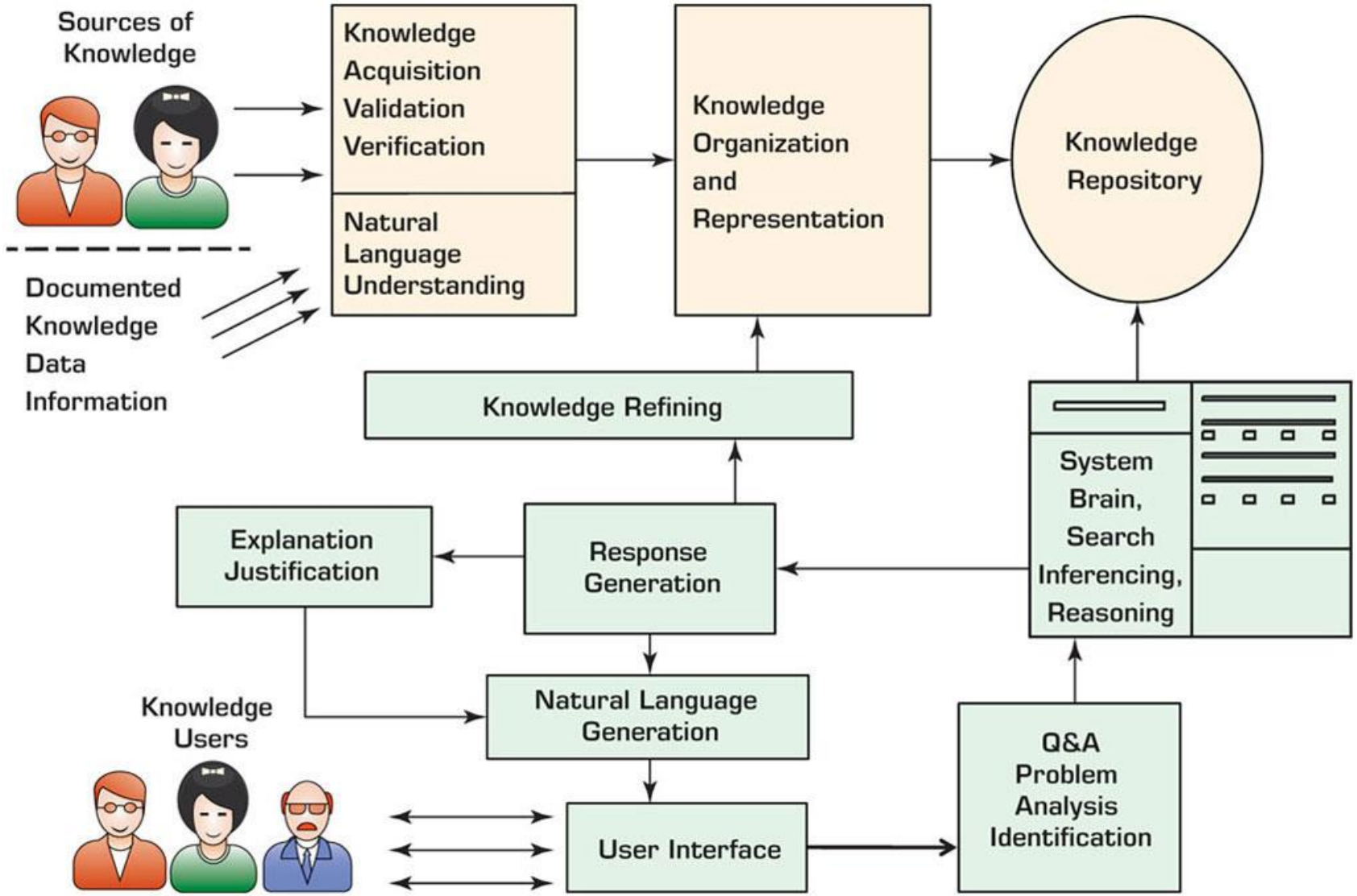
- **Knowledge & Expert Systems:**
  - Computer programs that store knowledge, which their applications use to generate expert advice and/or perform problem solving.
  - E.g., Recommendation systems for shopping; Chatbots.
  - For many intelligent systems to work, it is necessary for them to have knowledge. They need:
    - *Knowledge acquisition*
      - Identifying experts
    - *Knowledge representation*: e.g., matching answers (Q&A).
    - *Reasoning from knowledge*:
      - Processes users' requests and provides answers (e.g., solutions, recommendations) to the user.

Knowledge and Expert Systems (2 of 2)

- **Cognitive computing**
  - Knowledge derived from cognitive science (the study of human brain).
  - Simulate the human thought processes.
  - So that computers can exhibit and/or support decision-making and problem-solving capabilities.
  - Uses → Self learning algorithms, pattern recognition, machine vision…
  - E.g., IBM Watson

- **Augmented reality**
  - Augmentation: integration of digital information within the user environment in real time.
  - Uses: machine vision, scene recognition, and gesture recognition…

Automated Decision Making Process



Using AI in Decision Making

- **Issues & factors:**
  - The nature of the decision [routine vs non-routine]
  - The method of support / technologies used
    - Expert systems, recommender systems
    - Deep learning, pattern recognition, biometrics recognition
  - Cos-benefit and risk analysis
  - Using business rules
  - AI algorithms
  - Speed

- **We can distinguish between support of decision making & fully automating decision making.**

AI Support for Decision-Making Process

- **AI support in problem identification:**
  - E.g., diagnosing equipment malfunction, medical problems, finding security breaches.
- **AI support in generating or finding alternative solutions:**
  - E.g., expert systems, chatbots
- **AI support in selecting a solution:**
  - E.g., solution evaluation using predictive analysis.
- **AI support in implementing the solution.**

Intelligent & Automated Decision Support

- Automated decision making (since 1970s):
  - The use of rule-based expert systems that provided recommended solutions to repetitive managerial problems.
- Common examples:
  - Small loan approvals
  - Initial screening of job applicants
  - Prices of products and services (when and how to change them)
  - Product recommendation (e.g., at Amazon.com)

AI in Human Resource Management

- Recruitment – talent acquisition
- Training – AI facilitates training
- Performance assessment (evaluation)
- Retention –eliminating attrition
  - Predicting attrition way ahead of time to eliminate loss of talent

AI in Marketing, Advertising, & CRM

- One of the richest area for AI applications:
  1. Product and personal recommendations
  2. Smart search engines
  3. Fraud and data breaches detection
  4. Social semantics
  5. Web site design
  6. Producer pricing
  7. Predictive customer service
  8. … many more in the book …

AI in Production-Operation Management

- AI in manufacturing
  - Automation for compliance and cost reduction
  - React quicker and more effectively (agility)
- Implementation model
  - Streamlining processes, smart outsourcing, work automation, improving customer experience
- Intelligent factories
- Logistic and transportation
  - Example: DHL supply-chain

Q & A