Chapter Three

Artificial Intelligence (AI)

Chapter Objectives

➢ *After completing this chapter, the students will be able to:*

- To explain what artificial intelligence (AI) is.

- To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.

- To describe the eras of AI.

- To explain the types and approaches of AI.

- To describe the applications of AI in health, agriculture, business and education

- To list the factors that influenced the advancement of AI in recent years.

- To understand the relationship between the human's way of thinking and AI systems

- To identify AI research focus areas.

- To identify real-world AI applications, some platforms, and tools

What is Artificial Intelligence?

- Artificial defines man-made
- Intelligence defines thinking power
- So AI means a man made thinking power.
- AI is a branch of computer science by which we can create intelligent machines which can behave like a human, think like a humans, and able to make decisions.
- The idea of AI came into existence and the term AI was first coined in **1956**.
- AI "is it possible to build a machine that has intelligence, specifically a human level of intelligence?"
- Artificial Intelligence is:
  ‣ "The science and engineering of making intelligent machines, especially intelligent computer programs." **(Stanford Professor John McCarthy in 1955)**
  ‣ "About **algorithms** enabled by constraints exposed by **representations** that support **models** targeted at **thinking**, **perception** and **action.**"
  ‣ "The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as **visual perception**, **speech recognition**, **decision-making**, and **translation between languages**. "
  ‣ AI - Create a machine with programmed algorithm which can work with own intelligence.

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- From a business perspective **AI** is a set of very powerful tools, and methodologies for using those tools to solve business problems.
- From a programming perspective, **AI** includes the study of symbolic programming, problem solving, and search.
    - Typically AI programs focus on symbols rather than numeric processing.
    - Problem solving - achieve goals.
    - Search - seldom access a solution directly. Search may include a variety of techniques.
    - AI programming languages include: LISP, PROLOG, Object oriented languages
- **Artificial Intelligence** is a new electronic machine that stores large amount of information and process it at very high speed.
- The computer is interrogated by a human via a teletype, It passes if the human cannot tell if there is a computer or human at the other end.
- The ability to solve problems.
- It is the science and engineering of making intelligent machines, especially intelligent computer programs.
- It is related to the similar task of using computers to understand human intelligence.

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- AI is the creation of a computer program that can learn to think and function on its own, kind of like robots that don't need to be told what to do all the time.

Programming without AI	Programming with AI
A computer program without AI can answer the **specific** questions it is meant to solve.	A computer program with AI can answer the **generic questions** it is meant to solve.
Modification in the program leads to change in its structure.	AI programs can absorb new modifications by putting highly independent pieces of information together. Hence you can modify even a minute piece of information of program without affecting its structure.
Modification is not quick and easy. It may lead to affecting the program adversely.	Quick and easy program modification.
Leads to knowledge.	Leads to intelligence and wisdom.

- Most advanced AI systems use **machine learning technology** to analyze current conditions and learn from experience.

- Intelligence is composed of:
  - ▸ Reasoning, Learning, Problem Solving, Perception and Linguistic Intelligence

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- **Examples** of technologies that uses AI
  - ✖ Machine Learning
  - ✖ Robotics
  - ✖ Machine Automation
  - ✖ Deep learning
  - ✖ Virtual Reality
  - ✖ Natural Language Processing
  - ✖ Cloud Computing
  - ✖ Augmented Reality
  - ✖ Neural Networks
  - ✖ Big Data
  - ✖ Internet of Things
  - ✖ Computer Vision

Artificial Intelligence System

✴ An **AI system** is **composed** of an **agent** and its **environment**.

  ▪ An **agent** (e.g., **human or robot**) is **anything** that can **perceive** its **environment** through **sensors** and **acts upon** that **environment** through **effectors**.

  ▪ **Intelligent agents** must be able to **set goals** **and** **achieve them**.

✴ In **classical planning problems**, the **agent** can **assume** that it is the **only system acting in the world**, **allowing the agent to be certain of the consequences of its actions**.

  ▪ However, if the **agent is not the only actor**, then it **requires** that the **agent can reason under uncertainty**.

  ✓ This calls for an **agent** **that** **cannot only** assess **its** **environment** and **make predictions** but also **evaluate its predictions** and **adapt based on its assessment.**

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∗ **Machine perception** is the **ability** to use **input from sensors** (**such as cameras, microphones, sensors, etc.**) to **deduce (to reach to conclusion)** **aspects of the world**.

   e.g., **Computer Vision**.

∗ **High-profile** examples of **AI** include:

- **Autonomous vehicles** (such as **drones and self-driving cars**),
- **Medical diagnosis, Creating art** (such as **poetry**)
- **Proving mathematical theorems**
- **Playing games** (such as **Chess or Go**)
- **Search Engines (such as Google search)**
- **Online assistants (such as Siri on Apple device**
- **Cortana on Microsoft device and Google Assistant on Android Device)**
- **Image recognition in photographs, Spam filtering**
- **Prediction of judicial decisions and Targeting online advertisements**

Cont. ..

∗ **AI** deals with the area of developing **computing systems** that are **capable** of **performing tasks** that **humans** are **very good** at, for **example:**
  - **recognizing objects,**
  - **recognizing** and **making sense of speech,** and **decision making** in a constrained environment.

∗ The advent of **Big Data, driven by the arrival of the internet, smart mobile and social media has enabled AI algorithms**, in particular from **Machine Learning** and **Deep Learning**, to **leverage Big Data** and **perform** their **tasks** more **optimally**.

- This combined with **cheaper** and **more powerful hardware** such as **Graphical Processing Units (GPUs)** has enabled **AI to evolve into more complex architectures.**

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* **Machine Learning** is an advanced form of **AI** where the **machine** can **learn** as it goes rather than having **every action programmed by humans**.

- Many times, students get confused between **Machine Learning and Artificial Intelligence** but **Machine learning**, a fundamental **concept** of **AI research** since the **field's inception,** is the **study** of **computer algorithms** that **improve automatically** through **experience**.

- The term **machine learning** was introduced by **Arthur Samuel** in **1959**.

* **Neural networks** are **biologically inspired networks** that extract features from the **data** in a **hierarchical fashion**.

- The **field** of **neural networks** with several **hidden layers** is called **deep learning.**

Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL)
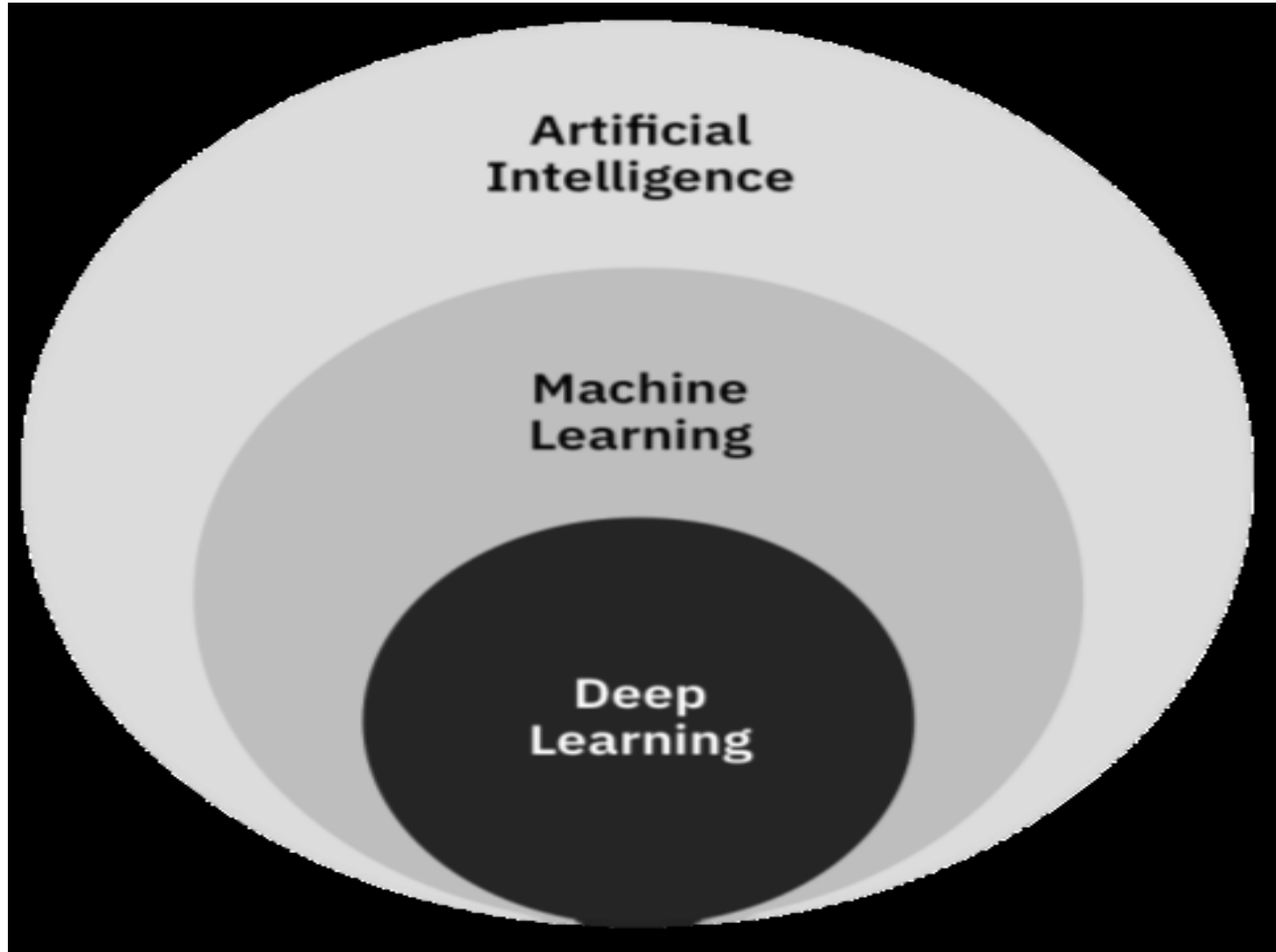
Components of AI system

1. **Applications:** Image recognition, Speech recognition, Chatbots, Natural language generation, and Sentiment analysis.

2. **Types of Models:** Deep learning, Machine learning, and Neural Networks.

3. **Software/Hardware for training and running models:** Graphic Processing Units (GPUs), Parallel processing tools (like Spark), Cloud data storage and computer platforms.

4. **Programming languages for building models:** Python, TensorFlow, Java, and C/C^{++}, etc.

History of Artificial Intelligence (AI)

- Formally initiated in 1956 and the name **AI** was coined by **John McCarthy(Father of AI)**.

- "Every aspect of learning or any feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, from abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves."

▪ **Humans** have **developed** the **power of computer systems** in terms of their **diverse working domains**, their **increasing speed**, and **reducing size** with respect to **time**.

✓ A **branch of Computer Science** named **Artificial Intelligence pursues creating the computers** or **machines** as **intelligent** as **human beings**.

➢ According to the **father** of **Artificial Intelligence John McCarthy**, it is "The **science** and **engineering of making intelligent machines**, especially **intelligent computer programs**".
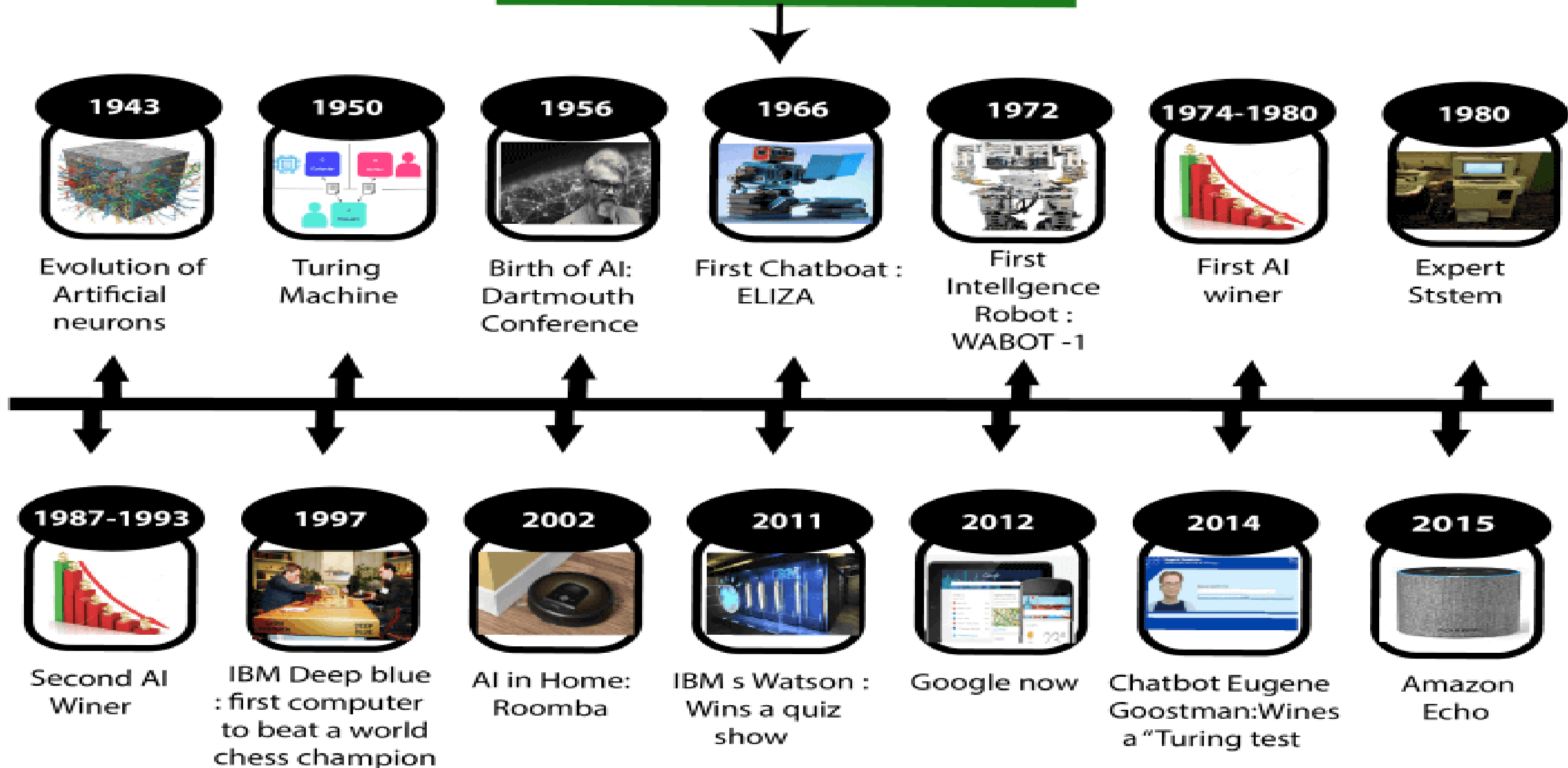
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- **Artificial Intelligence** is a way of **making a computer, a computer-controlled robot,** or **a software think intelligently**, in the similar manner the **intelligent humans think.**

➤ **AI** is accomplished by **studying how human brain thinks**, and **how humans learn, decide**, and **work** while trying to **solve a problem**, and then using the **outcomes of this study** as a **basis** of **developing intelligent software** and **systems**.

- The advent of **general purpose computers** provided a vehicle for creating artificially intelligent entities.
    - Used for solving general-purpose problems

- Which one is preferred?
    - General purpose problem solving systems
    - Domain specific systems

The Original 7 Aspects of A.I.(1956)

1. Simulating higher functions of the human brain.
2. Programming a computer to use general language.
3. Arranging to hypothetical neurons in a manner so that they can form concepts.
4. A way to determine and measure problem complexity.
5. Self-improvement.
6. Abstraction: the quality of dealing with ideas rather than events.
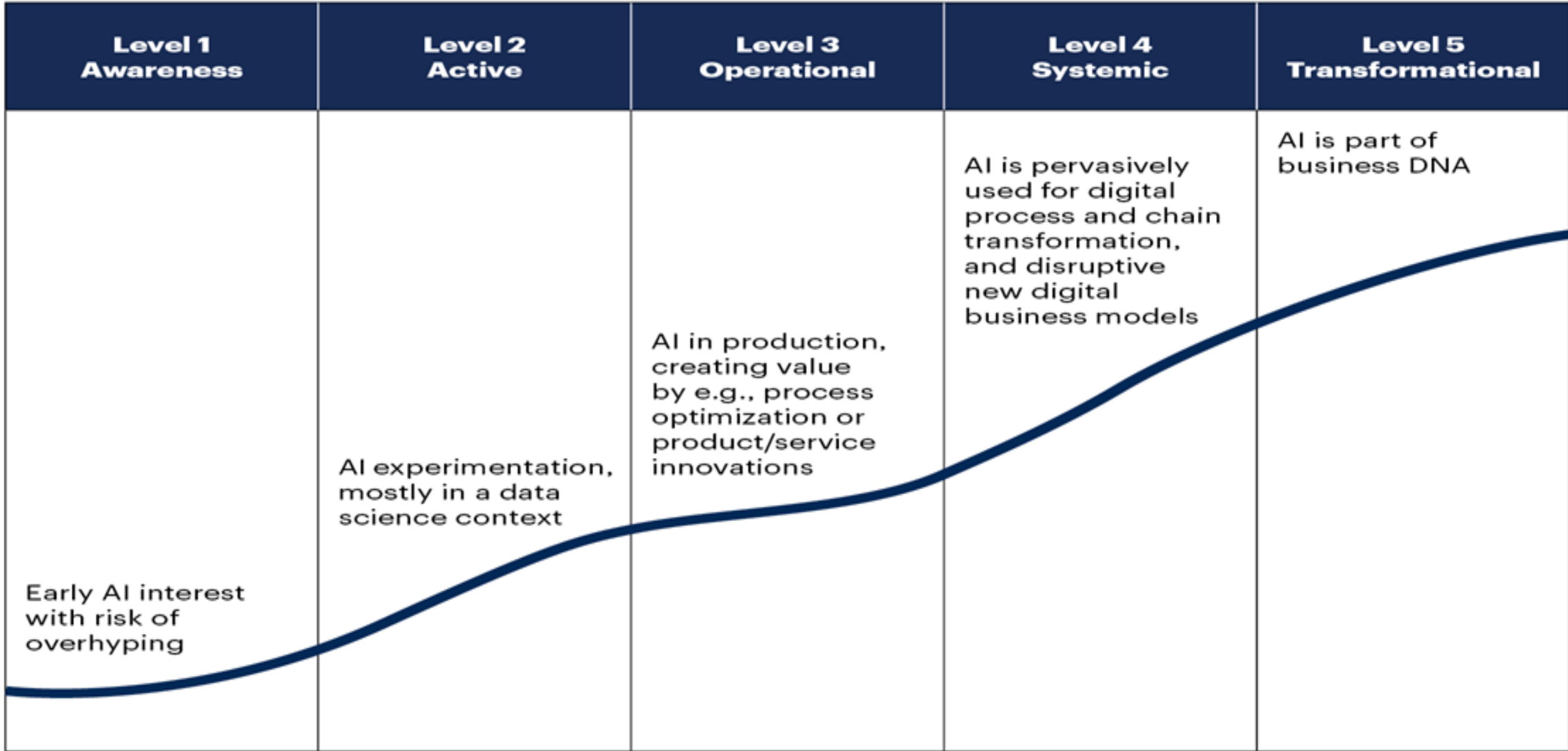7. Randomness and creativity.

History of AI

1943 — Evolution of Artificial neurons

1950 — Turing Machine

1956 — Birth of AI: Dartmouth Conference

1966 — First Chatboat : ELIZA

1972 — First Intellgence Robot : WABOT -1

1974-1980 — First AI winer

1980 — Expert Ststem

1987-1993 — Second AI Winer

1997 — IBM Deep blue : first computer to beat a world chess champion

2002 — AI in Home: Roomba

2011 — IBM s Watson : Wins a quiz show

2012 — Google now

2014 — Chatbot Eugene Goostman:Wines a "Turing test

2015 — Amazon Echo

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Year	Description
1943 - 1956	The term "artificial intelligence" is coined by John McCharty at a Dartmouth conference and AI is founded as an academic discipline
1956–1974	The golden years of AI enjoy government funding in promising, logic-based problem-solving approaches.
1974–1980	Overly high expectations coupled with the limited capacities of AI programs leads to the **first** "**AI winner**", with reduced funding and interest in AI research.
1980–1987	The rise of knowledge-based expert systems brings new successes and a change in the focus of research and funding toward this form of AI.
1987–1993	The **second** "**AI winner**" starts with the sudden collapse of the specialized hardware industry in 1987. The AI hype brings with it negative perceptions by governments and investors, as expert systems show their limitations and prove expensive to update and maintain.

1993 – 2011	Optimism about AI returns and increases. New successes are marked with the help of increased computational power and AI becomes data-driven.
	In 1997, IBM's **DeepBlue** beats world champion Gary Kasparov at chess.
	In 2002, Amazon uses automated systems to provide recommendations.
	In 2011, Apple releases Siri and IBM Watson beats two human champions at the TV quiz Jeopardy.
2012 – today	Increased availability of data, connectedness and computational power allow for breakthroughs in machine learning, mainly in neural networks and deep learning, heralding a new era of increased funding and optimism about the AI potential.
	In 2012, Google driverless cars navigate autonomously and in 2016 Google AlphaGo beats a world champion in the complicated board game Go.

AI Maturity Model

Level 1 Awareness	Level 2 Active	Level 3 Operational	Level 4 Systemic	Level 5 Transformational
			AI is pervasively used for digital process and chain transformation, and disruptive new digital business models	AI is part of business DNA
		AI in production, creating value by e.g., process optimization or product/service innovations		
	AI experimentation, mostly in a data science context			
Early AI interest with risk of overhyping				

Gartner AI Maturity Model

- Now, AI is eating the world. AI maturity model is also essential for AI adoption and refinement.
- **AI maturity** measures the degree to which the organizations have mastered AI-related capabilities in the right combination to achieve high performance for customers, shareholders and employees.

Level 1- Technology Awareness

- Companies in this stage know about AI but haven't quite used it yet.
- There is high market entry barriers.

Level 2 – Experimental activation of AI

- These companies are playing with AI informally.
- The first experimentation of AI involved Data Science

Level 3- Operational

- The operationalization of AI to innovate processes or products.
- Companies have adopted machine learning into their day-to-day functions.
- In the operational phase, the technology takes a further step forward and, from experimentation, enters the heart of organizations: **production**.

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Level 4 – **Systemic**

- A systems approach and the creation of new business models
- These companies are using machine learning in a novel way to disrupt business models.
- Currently, Artificial Intelligence is in what **Gartner** calls the **operational level.**
- In fact, there are few contexts where we are beginning to see a global orientation to its adoption in the enterprise.
- The systemic approach to technology occurs when it has become accessible to everyone. Or rather, when in the company, AI does not just support individual actions or departments but involves **digital supply chains and processes**, **creating new business models**.
- This approach will require a reinvention of **roles** and **responsibilities**.
- We could say that this path is concluded when, on the wave of these changes, the way of thinking and working of resources will also change.
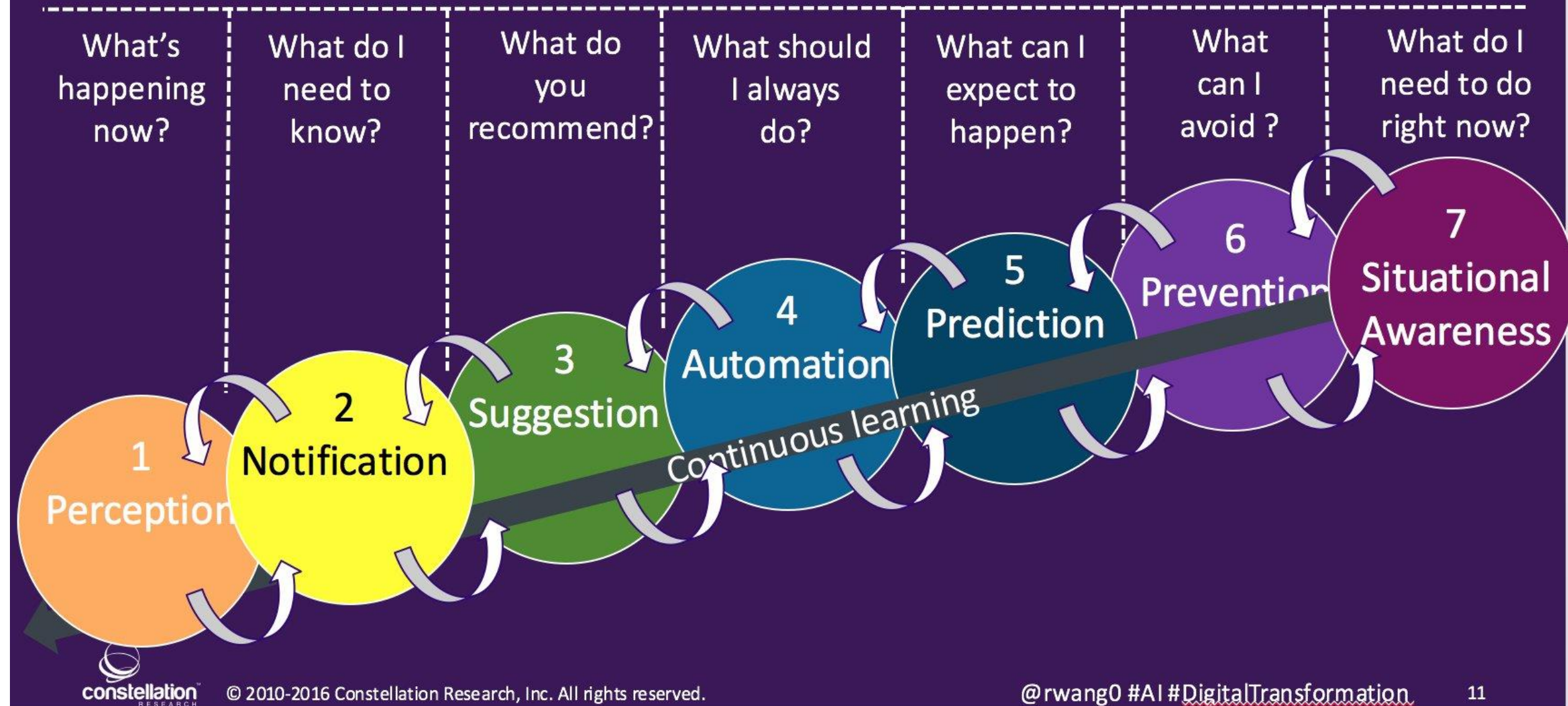
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Level 5 – The Future of AI

- Companies at this level use ML pervasively.
- In the last level, technology does not enter companies by improving a process or department but becomes the foundation for **building new models, processes, and activities.**
- They are in what **Gartner** calls the **transformative level** of the AI maturity model.
- A stage that provides a huge **competitive advantage**.

The seven outcomes of AI

What's happening now?	What do I need to know?	What do you recommend?	What should I always do?	What can I expect to happen?	What can I avoid ?	What do I need to do right now?

1 Perception

2 Notification

3 Suggestion

4 Automation

5 Prediction

6 Prevention

7 Situational Awareness

Continuous learning

constellation
RESEARCH

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Spectrum of Seven Outcomes for AI

- The disruptive nature of AI comes from the **speed, precision, and capacity** of **augmenting humanity**.
- When AI is defined through seven outcomes, the business value of AI projects gain meaning and can easily show business value through a spectrum of outcomes:

1. Perception describes what's happening now.
 - The first set of outcomes rudimentary describe surroundings as manually programmed.

2. Notification tells you what you asked to know.
 - Notifications through alerts, workflows, reminders, and other signals help deliver additional information through manual input and learning.

3. Suggestion recommends action.
 - Suggestions build on the past behaviors and modify over time based on weighted attributes, decision management, and machine learning.

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4. Automation repeats what you always want.
- Automation enables leverage as machine learning matures over time and tuning.

5. Prediction informs you what to expect.
- Prediction starts to build on **deep learning** and **neural networks** to anticipate and test for behaviors.

6. Prevention helps you avoid bad outcomes.
- Prevention applies cognitive reckoning to **identify potential threats**.

7. Situational awareness tells you what you need to know right now.
- Situational awareness comes close to **mimicking human capabilities** in decision making.

What Comprises to Artificial Intelligence?

- To make a **machine learn and make a decision like humans do**, **AI requires the knowledge of some disciplines**. Write down some disciplines which AI requires?

* **Artificial Intelligence** is **not just a part of computer science** even it's so **vast** and **requires** **lots of other factors that can contribute** to it.

- To **create the AI-first** we should **know that how intelligence is composed**, so **Intelligence** is an **intangible part of our brain** which is a **combination** of **reasoning, learning, problem-solving, perception, language understanding**, and etc.

*To **achieve** the above **factors for a machine or software Artificial Intelligence** requires the following **disciplines**

Artificial Intelligence is multidisciplinary

Need for Artificial Intelligence (AI)

1. To **create expert systems** that **exhibit intelligent behavior** with the capability to learn, demonstrate, explain and advice its users.

2. **Helping machines** find solutions to **complex problems** like humans do and applying them as algorithms in a computer-friendly manner.

Goal of Artificial Intelligence (AI)

- **Following are the main goals of Artificial Intelligence:**

1. Replicate human intelligence

2. Solve Knowledge-intensive tasks

3. An intelligent connection of perception and action

4. Building a machine which can perform tasks that requires human intelligence such as:

   ‣ Proving a theorem

   ‣ Playing chess

   ‣ Plan some surgical operation

   ‣ Driving a car in traffic

5. Creating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.

Advantage of Artificial Intelligence (AI)

- **Following are some main advantages of Artificial Intelligence:**
  - ‣ **High Accuracy with fewer errors**
    - AI machines or systems are prone to fewer errors and high accuracy as it takes decisions as **per pre-experience or information**.
  - ‣ **High-Speed**
    - AI systems can be of **very high-speed** and **fast-decision making**, because of that AI systems can beat a chess champion in the Chess game.
  - ‣ **High reliability**
    - AI machines are highly reliable and can perform the same action multiple times with high accuracy.
  - ‣ **Useful for risky areas**
    - AI machines can be helpful in situations such as **defusing a bomb**, **exploring the ocean floor**, where to employ or a human can be risky.
  - ‣ **Augment our workforce**
    - We will see more of our jobs outsourced to AI b/c they can do amazing things they can read, write, speak, smell do many things that previously only humans could do.

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‣ **Digital Assistant**

- AI can be very useful to provide digital assistant to users, such as AI technology is currently used by various E-commerce websites to show the products as per customer requirements.

‣ **Personal virtual Assistant** – like Cortana, google assistant, Sri

‣ **Useful as a public utility**

- AI can be very useful for public utilities, such as:

- **Self driving car** which can make our journey safer and hassle-free
- **Facial recognition** for security purposes
- **Natural language processing** (for search engines, for spelling checker, for assistant like Siri, for translation like google translate), etc.

‣ **Better Language Modeling**

- It is the process which allows machines to understand and communicate with humans with the language human understand

- **High Costs of Creation**
  - The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.

- **Lacking out of the box thinking**
  - Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.

- **No feelings and emotions**
  - AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with humans, and may sometime be harmful for users if the proper care is not taken.

- **Increase dependence on machines**

  - With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.

- **No Original Creativity**

  - As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

Types of Artificial Intelligence

- Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on **capabilities** and based on **functionally** of AI.
- Following is flow diagram which explain the types of AI.
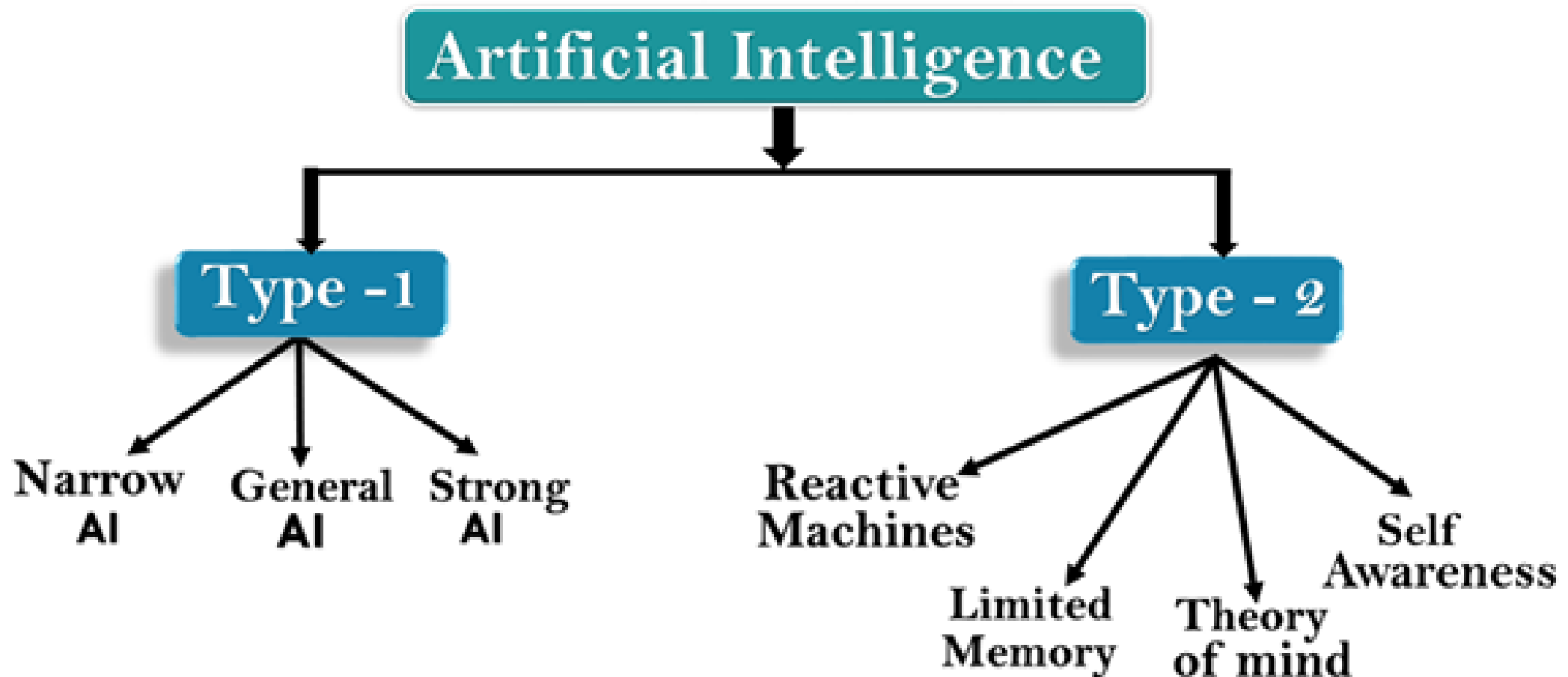
Types of AI based on Capability

1. Artificial Narrow Intelligence (Weak AI or Narrow AI)

- A type of AI which is able to perform a dedicated task with intelligence.
- The most common and currently available.
- It is only trained for one specific task, cannot perform beyond its field or limitations
- Narrow AI can fail in unpredictable ways if it goes beyond its limits.

Example of narrow AI
- Playing chess
- Purchasing suggestions on e-commerce site
- Self-driving cars
- Google translator
- Face verification in your iPhone
- Speech recognition and
- Image recognition.

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2. Artificial General Intelligence (General AI or Strong AI)

- a type of intelligence which could perform any intellectual task with efficiency like a human.

- The idea is to make a system which could be smarter and think like a human by its own.

- The worldwide researchers are now focused on developing machines with General AI.

- General AI systems are still under research.

3. Artificial Super Intelligence (Super AI)

- **Super AI** – is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties.

- This refers to aspects like general wisdom, problem solving and creativity.

- It is an outcome of general AI.

- Characteristics of strong AI include :

  ✓ **the ability to think**, **to reason**,

  ✓ **To solve the puzzle**

  ✓ **To make judgments**, **plan**, **learn**, and

  ✓ **To communicate** by its own.

- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.

Classification of AI Based on Functionality

1. Reactive Machines:

- Purely reactive machines are the most basic types of Artificial Intelligence.
- Such AI systems do **not store memories** or **past experiences** for future actions.
- These machines only focus on current scenarios and react on it as per possible best action.
- Example: IBM's Deep Blue system and Google's AlphaGo

IBM Deep Blue Super Computer

Google Alpha Go

2. **Limited Memory**:

- Limited memory machines can store past experiences or some data for a short period of time.
- These machines can use stored data for a limited time period only.
- Self-driving cars are one of the best examples of Limited Memory systems.
- These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.

3. Theory of Mind:

- Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.

- Theory of Mind AI-powered systems will be able to simulate the consequences of their actions.

- Theory of Mind AI will consist of ML systems that can explain their decisions in languages that human beings understand.

- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

  - *Sophia* – the humanoid robot is one example of such effort where a number of young Ethiopians have contributed on the development.

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4. Self–Awareness:

- Self-awareness AI is the future of Artificial Intelligence.
- These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.
- These machines will be smarter than human mind.
- Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

What are some examples of Artificial Intelligence ?

- **Some examples of Artificial Intelligence (AI) are:**
  1. Google's AI-Powered Predictions
  2. Ridesharing Apps Like Uber and Lyft
  3. Email spam Filters & Categorization
  4. Plagiarism Checkers
  5. Mobile Check Deposits
  6. Fraud Prevention
  7. Credit Decisions
  8. Online shopping recommendations
  9. Voice-to-texts
  10. Smart Personal Assistants

Applications of AI

- Currently, AI is being applied across several industries.

- But we cannot say that AI is replacing humans but it is certainly making the work of human beings more efficient.

- **The main Applications of Artificial Intelligence (AI) are:**
  1. **Transportation**
  2. **Banking and finance**
  3. **Healthcare**
  4. **Natural Language Processing**
  5. **Speech Recognition**
  6. **Vision Systems**
  7. **Data Security**

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8. **Smartphones**

9. **Smart cars and Drones**

10. **Social Media Feeds**

11. **Music and Media Streaming Services**

12. **Video Games**

13. **Online Ads Network**

14. **Navigation and Travel**

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1. Agriculture

- AI technologies are being used to yield healthier crops, control pests, monitor soil and growing conditions, organize data for farmers, help with workload, and improve a wide range of agriculture-related tasks in the entire food supply chain.

Example. Agricultural Robots

- Companies are developing and programming autonomous robots to handle essential agricultural tasks such as harvesting crops at a higher volume and faster pace than human laborers.

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- Examples of AI applications in the agriculture sector.
    - ▸ **See & Spray Robot**
    - ▸ **Harvest CROO Robotics**
    - ▸ **Crop and Soil Monitoring**

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2. Health

- Artificial intelligence simplifies the lives of patients, doctors and hospital administrators by performing tasks that are typically done by humans, but in less time and at a fraction of the cost.

- The use of artificial intelligence in healthcare has the potential to assist healthcare providers in many aspects of patient care and administrative processes, helping them improve upon existing solutions and overcome challenges faster.

- AI applications are revolutionizing how the health sector works to reduce spending and improve patient outcomes.

- Companies are applying machine learning to make better and faster diagnoses than humans.
  - ‣ One of the best known healthcare technologies is IBM Watson.
  - ‣ Other AI applications include chatbots.

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- **Personal Health Virtual Assistant**

Examples of AI applications in the health sector.

- **Support Clinical Decision**
- **Robotic Surgeries**
- **Dip.io**
- **Apple Watch**
- **Medical Imaging Analysis**
- **IBM Watson analysis**
- **IDx software**
- **Precision Medicine**
- **Healthcare Bots**
- **Operational applications of AI**

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3. Business (Emerging market)

- Artificial Intelligence has enormous potential to augment human intelligence and to radically alter how we access products and services, gather information, make products, and interact.

- In emerging markets, AI offers an opportunity to lower costs and barriers to entry for businesses and deliver innovative business models that can leapfrog traditional solutions and reach the underserved.

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Examples of AI applications in the Business sector.

- **Improve Customer Services**
- **Automate Workloads**
- **Optimize Logistics**
- **Increase Manufacturing Output and Efficiency**
- **Prevent Outages**
- **Predict Performance**
- **Predict Behavior**
- **Manage and Analyze Data**
- **Improve Marketing and Advertising**

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4. Education

- The increasing adoption of the AI technology for various applications in the education sector.

- AI can automate grading, giving educators more time, and can also assess students and adapt to their needs, helping them work at their own pace.

- AI tutors can provide additional support to students, ensuring they stay on track.

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Examples of AI applications in the Education sector.

- **Administrative Tasks Automation**

- **Smart Content**

- **Smart Tutors and Personalization**

- **Virtual Lectures and Learning Environment**

- **Teachers' Support**

- **Students' Communication**

5. **Computer Science**

∗ Artificial intelligence has brought several changes to our modern society, such as smartphones, face recognition, search engines, machine translation, autonomous driving, and smart medical treatment.

∗ As technology improves, there will be many new applications of artificial intelligence.

∗ Applications of artificial intelligence in computer science include the following:

- **Robotics:** AI-enable robotics is an emerging and fast-developing technology. Robots often have shared sets of programming that allow them to function and communicate.

- **Self-Modifying Coding:** AI is now being put into programming languages to create self-modifying groups of code. AI programming languages include LISP, PROLOG, and object-oriented languages.

- **Speech And Language Processing:** It is becomingcommon for computers to be able to speak human in order to give and receive orders.

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- **Data Mining:** Data is mined or sorted and analyzed to find certain patterns, anomalies, or other values within extremely large volumes of information.
- **Visualizations:** Computer programs can now make visualizations, and artificial intelligence will greatly enhance this process.
- **Marketing Programs:** These are appealing for businesses who do not want to have to invest large sums of money into building marketing.
- **Image Recognition:** The ability of a program to remember and decode an image is appealing and has many applications.
- **Cloud Computing:** The ability to store and access data in the cloud is revolutionizing how people can access information from many locations. AI is going to help make this process more organized and systematic in the future.
- **Game Playing:** Game playing and theorem proving are two of the earlier attempts at getting computers to think intelligently. Popular games include Chess, Go, Kalah, and Checkers. There is some AI in some of these games.

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- **Computer Science Education:** Every branch of the educational sector is significantly affected by AI. AI is incorporated into the Computer Science curriculum. It plays an important role in the instruction of Computer Science courses. One can observe recent advances of virtual reality, augmented reality, and artificial intelligence and their applications to educational process.

AI tools and platforms

∗ The **business has workflows** that are **repetitive, tedious** and **difficult** which tend to **slow down production** and also **increases the cost of operation**.

- By **digitizing repetitive tasks**, an **enterprise** can **cut costs on paperwork** and **labor** which further **eliminates human error** thus **boosting efficiency** leading to **better results**.

∗ For a **business** to **gain** from the above **benefits**, they must **choose the right automation tools** otherwise it will all be in vain.

- **Automating processes** involving **employing artificial intelligence platforms** that can **support** the **digitalization process** and **deliver the same or better results** than human beings would have achieved.

∗ **AI platforms** are defined as some **sort of hardware architecture** or **software framework** (including **application frameworks**), that **allows the software to run**.

Cont. ..

- It **involves** the use of **machines to perform the tasks** that are **performed** by **human beings**.

* The **platform simulates** the **cognitive function** that **human minds perform** such as **problem-solving, learning, reasoning, social intelligence** as well as **general intelligence**.

* **Artificial intelligence (AI) platforms** provide users a **tool kit** to **build intelligent applications**.

- These **platforms** combine **intelligent, decision-making algorithms** with **data**, which enables **developers** to **create a business solution**.

- Some platforms offer **pre-built algorithms** and **simplistic workflows** with such features as **drag-and-drop modeling** and **visual interfaces** that **easily connect necessary data to the end solution**, while **others require** a greater **knowledge** of **development** and **coding**.

Cont. ..

* These **algorithms** can include **functionality for:**
- **Image recognition** (it gives the **machine the ability** to **identify an image** which is helpful in **police stations** to **recognize a criminal**),
- **Natural language processing** (it gives **machines** the **ability to read and understand human language**).
  • **Some straightforward applications** of **natural language processing** include **information retrieval, text mining, question answering,** and **machine translation**,
- **Voice recognition** (It gives the **machine the ability to differentiate the voice of a person**),
- **Recommendation systems** and **predictive analytics** (It gives the **machine to predict the question** and **prepare the answer**, in **online marketing platforms** this will **predict the items you may buy**), in addition to other **machine learning capabilities**.

Cont. ..

* **AI platforms** are frequently used by **developers** to **create** both the **learning algorithm** and **intelligent application**.

  - However, **users without intensive development skills** will **benefit** from the **platforms' pre-built algorithms** and other **features** that **curb** the **learning curve**.

* **AI platforms** are very similar to **Platforms as a Service (PaaS),** which allows for **basic application development**, but these products differ by offering **machine learning options**.

  - As **intelligent applications** become the **norm**, it may become **common place** for all **PaaS products** to begin to provide the **same machine learning options as AI Platforms**.

Cont. ..

* The most common **artificial intelligence platforms** include:

- **Microsoft AZURE Machine Learning,**

- **Google AI platforms,**

- **IBM Watson Studio, TensorFlow, Infosys Nia,**

- **Wipro HOLMES, Dialogflow,**

- **API.AI, Premonition, Rainbird,**

- **Ayasdi, MindMeld, KAI and Meya.**

* Many **tools** are used in **AI**, including versions of **search** and **mathematical optimization, logic**, **methods based on probability** and **economics**.

* **AI has developed** a large number of **tools** to **solve** the most **difficult problems in computer science**, like:

- **Search and optimization**
- **Logic**
- **Probabilistic methods for uncertain reasoning**
- **Classifiers and statistical learning methods**
- **Neural networks**
- **Control theory**
- **Languages**

Sample Artificial Intelligence Application

Sample AI Application	Purposes of Application
1. Commuting	▪ **Google's AI-Powered Predictions** ▪ **Ridesharing Apps Like Uber and Lyft** ▪ **Commercial Flights Use an AI Autopilot**
2. Email	▪ **Spam Filters** ▪ **Smart Email Categorization**
3. Social Networking	∗ **Facebook**: ▪ When you **upload photos to Facebook**, the **service** automatically **highlights faces** and **suggests friends tag** **Pinterest**: ▪ **Pinterest** uses **computer vision**, an **application of AI** where **computers** are **taught to "see,"** in order to **automatically identify objects in images (or "pins")** and then **recommend visually similar pins**.

Sample AI Application	Purposes of Application
	✓Other **applications of machine learning** at **Pinterest** includes **spam prevention, search**, and **discovery, ad performance** and **monetization,** and **email marketing**. ∗ **Instagram**: ▪ Instagram, which Facebook acquired in 2012, uses **machine learning** to **identify** the **contextual meaning of emoji**, which have been steadily **replacing slang** (for **instance**, a **laughing emoji could replace** "**lol**") ∗ **Snapchat:** ▪ Snapchat introduced **facial filters**, called **Lenses**, in 2015. ✓These **filters track facial movements**, allowing **users** to **add animated effects** or **digital masks** that adjust when their **faces moved.**

Sample AI Application	Purposes of Application
4. Online Shopping	∗ **Search:** ✓ Your **Amazon searches** ("ironing board", "pizza stone", "Android charger", etc.) quickly return a list of the most relevant products related to your search ∗ **Recommendations:** ▪ You see **recommendations** for **products** you're interested in as "**customers who viewed this item also viewed**" and **"customers who bought this item also bought"**, as well as via **personalized recommendations on the home page, bottom of item pages, and through email**. ✓ **Amazon** uses **artificial neural networks** to generate these **product recommendations**.

Sample AI Application	Purposes of Application
5. Mobile Use	**∗ Voice-to-Text:** ▪ A standard feature on **smartphones** today is **voice-to-text.** ✓ By pressing a **button or saying a particular phrase** ("**Ok Google**", for **example**), you can **start speaking and your phone converts the audio into text** **∗ Smart Personal Assistants:** ✓ Now that **voice-to-text technology** is accurate enough to rely on for **basic conversation**, it has become the **control interface for a new generation of smart personal assistants**. ▪ **Siri and Google Now** (now succeeded by the more sophisticated **Google Assistant**), which could perform **internet searches, set reminders, and integrate with your calendar**. ▪ **Amazon** expanded upon this **model** with the **announcement of complementary** hardware and software components:

Sample AI Application	Purposes of Application
	▪ **Alexa-** an **AI-powered personal assistant** that **accepts voice commands** to **create to-do lists, order items online, set reminders**, and **answer questions** (via **internet searches**) ▪ **Echo** (and later, **Dot**) **smart speakers** that allow you to **integrate Alexa** into your **living room** and **use voice commands** to **ask natural language questions, play music, order pizza**, **hail an Uber**, and **integrate with smart home devices**. ▪ **Cortana**-Microsoft has followed **suit with Cortana**, its **own AI assistant** that comes **preloaded on Windows computers** and **Microsoft smartphones**.

Chapter Three Review Questions

1. Briefly explain intelligence? What it is composed of?
2. Define artificial intelligence?
3. Why we need artificial intelligence?
4. Write down the driving factors which accelerated the rise of AI?
5. List down disciplines which artificial intelligence requires?
6. Write the pros and cons of AI?
7. Who coined the term AI for the first time?
8. Who is Alan Turing? What is his contribution to AI?
9. What are the seven stages of AI? Briefly explain each of them?
10. Based on the level of strength we can classify AI into three, briefly explain each of them?

11. Based on the functionality we can classify AI into four, briefly explain each of them?

12. Briefly explain the mapping of human thinking to artificial intelligence components?

13. Why big data influence the rise of AI?

14. Write down some applications of AI in agriculture, health, education, and business?

15. List down some well-known AI tools and platforms?

16. List down some concrete examples of AI in social media, online shopping, and mobile phone usage?