**Chapter 16**

**Cognitive computing**

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# Short type Questions & Answers

## Q What is cognitive computing?

Cognitive computing systems use processed models to simulate the human knowledge method to search out solutions in advanced things wherever the answers is also ambiguous and unsure.While the term psychological feature computing is usually used interchangeably with computing (AI). Cognitive computing overlaps with AI and involves several of constant underlying technologies to power psychological feature applications, together with professionalsystems, neural networks, AI and video game (VR)

## Q Write in short about history of computing

The history of computing can be distinguished into the following three eras:

1 Tabulating Era

The ﬁrst was the tabulating period (1890s–1940s), the early 1900 calculators and tabulating machines were

made of mechanical systems and later of vacuum tubes. In the period of tabulating era, the numbers were fed in on the punch cards, and the data could not be extracted from this.

2 Programmable Era

The second era was the programmable era of computing (1950s–present), which ranged from vacuum tubes to microprocessors. It consisted of taking processes and placing these into the machine. Computing was effectively controlled by the programming furnished to the system.

3 Cognitive Computing Era

The third era includes cognitive computing era (2011–future), where CC technology represented an intersection between neuroscience, supercomputing and nanotechnology. Approximately after a century, computing moved from numbers to data and from data to knowledge.

## Q Cognition comes from the human brain. So what’s the brain of cognitive systems?

Cognitive computing represents the third era of computing. In the first era, (19th century) Charles Babbage, also known as ‘father of the computer’ introduced the concept of a programmable computer. Used in the navigational calculation, his computer was designed to tabulate polynomial functions. The second era (1950) experienced digital programming computers such as ENIAC and ushered an era of modern computing and programmable systems. And now to cognitive computing which works on deep learning algorithms and big data analytics to provide insights. Thus the brain of a cognitive system is the neural network, fundamental concept behind deep learning. The neural network is a system of hardware and software mimicked after the central nervous system of humans, to estimate functions that depend on the huge amount of unknown inputs.

# Descriptive Question & Answer

## Q How different is Cognitive Computing from Artificial Intelligence?

As the scope and reach of[Artificial Intelligence](http://analyticsindiamag.com/netflix-now-uses-artificial-intelligence-improve-streaming-video-quality/) and the related fields have increased, there has been an indecisive understanding on the technological jargons that AI encompasses under its banner. Machine learning, deep learning, text mining, speech recognition, neural networks, cognitive technology being a few. Often used interchangeably, these terms however are quite distinctive in their objectives and approaches.

AIM brings an understanding on how Cognitive technology, one such technology closely associated with artificial intelligence, is actually different from the latter. Though the underlying idea between the two terms are quite same, the technology holds its own separate meaning when brought to practical use.

Understanding the idea-

AI could be named an umbrella term for all those set of methods, theories, algorithms and technologies that enables computer systems to perform tasks that normally require human intelligence. Implying that machine learning, computer vision, robotics, NLP are all a part of artificial intelligence and are inter-related in some sense or the other.

AI advocates claim that artificial intelligence enables a machine to provide augmented intelligence, and it would hence surpass humans in accuracy and insight, or strength and agility.

A subfield of AI, Cognitive technology on the other hand, remains little difficult to be defined. If experts are to believed, cognitive computing is nothing but computing that is focused on reasoning and understanding at a higher level. It may be in a manner quite analogous to human cognition that is capable of making high-level decisions in complex situations. Rather than just pure data or sensor streams, cognitive computing can deal with symbolic and conceptual informations.

According to cognitive technology advocates, it can deal with huge volumes of data, exhaustive rounds of analytics, albeit humans remain firmly in charge of decision making process.

In other words- AI enables a computer to be smart to an extent to being smarter than humans. The individual technologies on the other hand that are performing specific tasks that facilitates human intelligence are called cognitive technologies. Computer vision, machine learning, speech recognition, robotics– being a few.

Let’s understand with a use case-

Let us imagine a scenario where a person is looking for a decision on career change. An AI assistant will automatically assess the job seeker’s skills, find a relevant job where his skills match the position, negotiate pay and benefits, and at the closing stage it will inform the person that a decision has been made on his behalf.

Whereas, a cognitive assistant will suggest potential career paths to the job seeker, besides furnishing the person with important details like additional education requirements, salary comparison data, and open job positions. However, in this case the final decision must be still taken by the job seeker.

In simpler words, cognitive computing helps us make smarter decisions on our own leveraging the machines, while AI is rooted in the idea that machines can take better decisions on our behalf.

## Q How cognitive computing works?

CC is a fusion of some of the most exciting technologies around, and it aims to make the best use of them.

Some of the top technologies used by CC include the following:

1. Machine learning

2. Deep learning

3. Data mining

4. Reasoning

5. Emotional intelligence

6. Natural language processing

7. Speech processing

8. Computer vision

9. Human–computer interaction

10. Dialog and narrative generation

11. Sentiment analysis

Each of the aforementioned technologies is an individual field of study. This makes CC applications immensely alluring to work on.

CC systems will synthesise knowledge from numerous information sources while consideration context

and conflicting proof to counsel the most effective potential answers. To achieve this, psychological feature

systems embrace self-learning technologies that use data processing, pattern recognition and tongue process (natural language processing, NLP) to mimic the approach of work done by the human brain. Using computer to solve the types of problems that humans are typically tasked with needs vast amount of structured and unstructured data, fed into machine-learning algorithms. Over the time, cognitive systems are able to refine the way they identify patterns and the way they process data to become capable of anticipating new problems and model possible solutions. To gain those capabilities, psychological feature computing systems should have five key attributes, as recorded by the psychological feature computing association.

These are as follows:

1. Adaptive: The adaptive computing systems may learn as information changes and goals and requirements evolve. These may resolve ambiguity and tolerate unpredictability, and may be further engineered to feed on dynamic data in real time, or near real time.

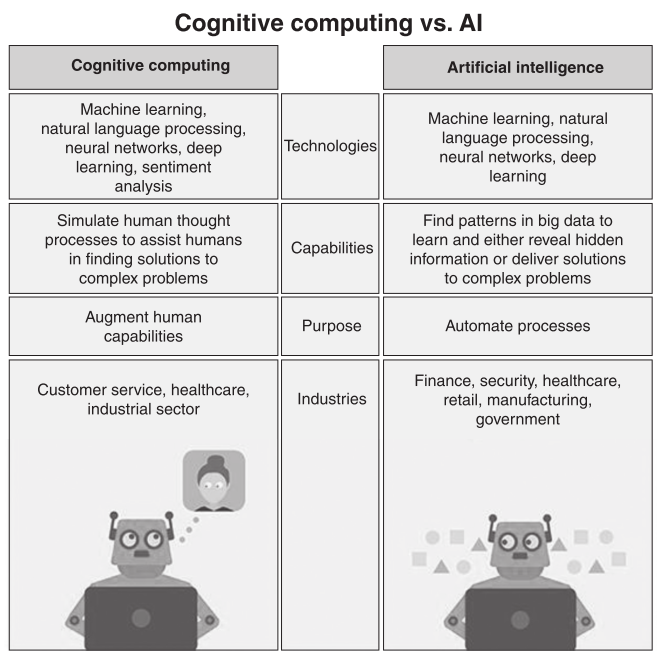
2. Interactive: The interactive computing systems will simply move with users so those users will outline their desires well. These may move additionally with various processors, devices and cloud services, in addition to folks.

3. Iterative and stateful: These will aid in the process, a haul by asking queries or further finding supply input if a haul statement is ambiguous or incomplete. These may “remember” previous interactions in an exceedingly method and come info that’s appropriate for the particular application at that time in time.

4. Contextual: These will perceive, identify and extract discourse components which means syntax, time, location, applicable domain, rules, user’s profile, process, task and goal. These may draw on multiple sources of data, as well as each structured and unstructured digital info, in addition to sensory inputs (visual, gestural, auditory, or sensor provided).

## Q How cognitive computer differs from AI?

Cognitive computing is commonly used interchangeably with AI -- the umbrella term for technologies that suppose information to create selections.But there are nuances between the 2 terms, which might be found among their functions and applications.AI technologies embody -- however are not restricted to -- machine learning, neural networks, information processing and deep learning.With AI systems, information is fed into the formula over a protracted amount of your time in order that the systems learn variables and may predict outcomes.Applications supported AI embody intelligent assistants, such as Amazon's Alexa or Apple's Siri, and driverless cars are based on AI.



The term psychological feature computing is usually wont to describe AI systems that aim to simulate human thought.Human psychological feature involves time period analysis of setting, context and intent, among several different variables that inform an individual's ability to resolveissues.A number of AI technologies are needed for a computing system to makepsychological feature models that mimic human thought processes, as well asmachine learning, deep learning, neural networks, NLP andsentimentanalysis.In general, psychological feature computing is employed to help humans in their decision-making method.

Some samples of psychological feature computing applications embrace supporting medical doctors in their treatment of illness.IBM Watson for Oncology, for example, has been used at Memorial Sloan Kettering Cancer Center to provide oncologists with evidence-based treatment options for cancer patients.When medical workers input queries, Watson generates a list of hypotheses and offers treatment options for doctors to consider.

Where AI relies on algorithms to solve a problem or to identify patterns hidden in data, cognitive computing systems have the loftier goal of creating algorithms that mimic the human

brain's reasoning method to resolve AN array of issues because the knowledge and also the issues amendment.

## Q What are the features of a cognitive computing solution?

With the present state of cognitive function computing, basic solution can play an excellent role of an assistant or virtual advisor. Siri, Google assistant, Cortana, and Alexa are good examples of personal assistants. Virtual advisor such as Dr. AI by HealthTap is a cognitive solution. It relies on individual patients’ medical profiles and knowledge gleaned from 105,000 physicians. It compiles a prioritized list of the symptoms and connects to a doctor if required. Now, experts are working on implementing cognitive solutions in enterprise systems. Some use cases are fraud detection using machine learning, predictive analytics solution, predicting oil spills in Oil and Gas production cycle etc.

The purpose of cognitive computing is the creation of computing frameworks that can solve complicated problems without constant human intervention. In order to implement cognitive function computing in commercial and widespread applications, Cognitive Computing consortium has recommended the following features for the computing systems –

1. Adaptive

This is the first step in making a machine learning based cognitive system. The solutions should mimic the ability of human brain to learn and adapt from the surroundings. The systems can’t be programmed for an isolated task. It needs to be dynamic in data gathering, understanding goals, and requirements.

2. Interactive

Similar to brain the cognitive solution must interact with all elements in the system – processor, devices, cloud services and user. Cognitive systems should interact bi-directionally. It should understand human input and provide relevant results using natural language processing and deep learning. Some skilled intelligent chatbots such as Mitsuku have already achieved this feature.

3. Iterative and stateful

The system should “remember” previous interactions in a process and return information that is suitable for the specific application at that point in time. It should be able to define the problem by asking questions or finding an additional source. This feature needs a careful application of the data quality and validation methodologies in order to ensure that the system is always provided with enough information and that the data sources it operates on to deliver reliable and up-to-date input.

4. Contextual

They must understand, identify, and extract contextual elements such as meaning, syntax, time, location, appropriate domain, regulations, user’s profile, process, task, and goal. They may draw on multiple sources of information, including both structured and unstructured digital information, as well as sensory inputs (visual, gestural, auditory, or sensor-provided).

## Q What is the scope of cognitive computing?

While computers have been faster at calculations and processing than humans for decades. But they have failed miserably to accomplish tasks that humans take for granted, like understanding the natural language or recognizing unique objects in an image. Thus cognitive technology makes such new class of problems computable. They can respond to complex situations characterized by ambiguity and have far-reaching impacts on our private lives, healthcare, business, etc.

According to a study by the IBM Institute for Business Value – “Your Cognitive Future“, the scope of cognitive computing consists of engagement, decision, and discovery. These 3 capabilities are related to ways people think and demonstrate their cognitive abilities in everyday life.

1. Engagement

The cognitive systems have vast repositories of structured and unstructured data. These have the ability to develop deep domain insights and provide expert assistance. The models build by these systems include the contextual relationships between various entities in a system’s world that enable it to form hypotheses and arguments. These can reconcile ambiguous and even self-contradictory data. Thus these systems are able to engage in deep dialogue with humans. The chatbot technology is a good example of engagement model. Many of the AI chatbots are pre-trained with domain knowledge for quick adoption in different business-specific applications.

2. Decision

A step ahead of engagement systems, these have decision-making capabilities. These systems are modeled using reinforcement learning. Decisions made by cognitive systems continually evolve based on new information, outcomes, and actions. Autonomous decision making depends on the ability to trace why the particular decision was made and change the confidence score of a systems response. A popular use case of this model is the use of IBM Watson in healthcare. The system can collate and analyze data of patient including his history and diagnosis. The solution bases recommendations on its ability to interpret the meaning and analyze queries in the context of complex medical data and natural language, including doctors’ notes, patient records, medical annotations and clinical feedback. As the solution learns, it becomes increasingly more accurate. Providing decision support capabilities and reducing paperwork allows clinicians to spend more time with patients.

3. Discovery

Discovery is the most advanced scope of cognitive computing. Discovery involves finding insights and understanding vast amount of information and developing skills. These models are built on deep learning and unsupervised machine learning. With ever-increasing volumes of data, there is a clear need for systems that help exploit information more effectively than humans could on their own. While still in the early stages, some discovery capabilities have already emerged, and the value propositions for future applications are compelling. Cognitive Information Management (CIM) shell at Louisiana State University (LSU) is one of the cognitive solutions. The distributed intelligent agents in the model collect streaming data, like text and video, to create an interactive sensing, inspection, and visualization system that provides real-time monitoring and analysis. The CIM Shell not only sends an alert but reconfigures on the fly in order to isolate a critical event and fix the failure.

## Q Give a short description of Cognitive computing landscape

Present cognitive computing landscape is dominated by larger players – IBM, Microsoft, and Google. IBM being the pioneer of this technology has invested $26 billion dollars in big data and analytics and now spends close to one-third of its R&D budget in developing cognitive computing technology. Many other companies and organizations are developing products and services that are as good, if not better than Watson. IBM and Google have acquired some of the rivals and the market is moving towards consolidation. Let’s take a look at the prominent players in this market –

1. IBM Watson

Originally Watson is an IBM supercomputer that combines artificial intelligence (AI) and sophisticated analytical software for optimal performance as a “question answering” machine famously featured in show ‘Jeopardy’. Now it uses a set of transformational technologies such as natural language processing, image recognition, text analytics and virtual agents. IBM Watson leverages deep content analysis and evidence-based reasoning. Combined with massive probabilistic processing techniques, Watson can improve decision making, reduce cost and optimize outcomes.

2. Microsoft Cognitive Services

Microsoft cognitive services previously known as Project Oxford are a set of APIs, SDKs and cognitive services which the developers can use to make their applications more intelligent. With Cognitive Services, developers can easily add intelligent features – such as emotion and sentiment detection, vision and speech recognition, knowledge, search and language understanding – into their applications. Infact, the first version of our chatbot – ‘Specter’ (lower right corner) was built using the Microsoft Bot Framework to improve the efficiency of our marketing team. We then subsequently built it using our own chatbot development platform ‘[WotNot](https://www.wotnot.io/)‘.

3. Google DeepMind

DeepMind was acquired by Google in 2014 and considered to be a leading player in AI research. The team consists of many renowned experts in the field of deep neural networks, reinforcement learning, and systems neuroscience-inspired models. DeepMind became popular with AlphaGo, a narrow AI to play Go, a Chinese strategy board game for two players. AlphaGo became the first AI program to beat a professional human player in October 2015, on a full-sized board.

4. CognitiveScale

CognitiveScale founded by former members of IBM Watson team provides cognitive cloud software for enterprises. Cognitive Scale’s augmented intelligence platform delivers insights-as-a-service and accelerates the creation of cognitive applications in healthcare, retail, travel, and financial services. They help businesses make sense from ‘dark data’ – messy, disparate, first and third party data and drive actionable insights and continuous learning.

5. SparkCognition

SparkCognition is an Austin-based startup formed in 2014. SparkCognition develops AI-Powered cyber-physical software for the safety, security, and reliability of IT, OT, and the IIoT. The technology is more inclined towards manufacturing. It is capable of harnessing real-time sensor data and learning from it continuously, allowing for more accurate risk mitigation and prevention policies to intervene and avert disasters.

Watson and DeepMind’s success has inspired other companies to develop cognitive platforms using open source tools. Other leading technology companies like Qualcomm and Intel are taking cautious steps to include cognitive solutions for specialized industries. Uber has established a research arm dedicated to AI and machine learning and acquired Geometric Intelligence and Otto. Otto is an autonomous truck and transportation startup and Geometric Intelligence is focused on generating insights from fewer data using machine learning. Gamalon has developed an AI technique using Bayesian Program Synthesis. It requires only a few pieces to train the system to achieve same levels of accuracy as neural networks.

Healthcare is the most popular sector to adopt cognitive solutions. Startups such as [Lumiata](https://www.lumiata.com/) and [Enlitic](http://www.enlitic.com/) have developed small and powerful analytic solutions that assist healthcare providers in diagnosis and prediction of disease conditions.Other companies in this market are Cisco cognitive threat analytics, CustomerMatrix, Digital Reasoning and Narrative Science.

## Q Explain Limitations of cognitive computing

Limited analysis of risk

The cognitive systems fail at analyzing the risk which is missing in the unstructured data. This includes socio-economic factors, culture, political environments, and people. For example, a predictive model discovers a location for oil exploration. But if the country is undergoing a change in government, the cognitive model should take this factor into consideration. Thus human intervention is necessary for complete risk analysis and final decision making.

Meticulous training process

Initially, the cognitive systems need training data to completely understand the process and improve. The laborious process of training cognitive systems is most likely the reason for its slow adoption. WellPoint’s financial management is facing a similar situation with IBM Watson. The process of training Watson for use by the insurer includes reviewing the text on every medical policy with IBM engineers. The nursing staff keeps feeding cases until the system completely understands a particular medical condition. Moreover, the complex and expensive process of using cognitive systems makes it even worse.

More intelligence augmentation rather than artificial intelligence

The scope of present cognitive technology is limited to engagement and decision. Cognitive computing systems are most effective as assistants which are more like intelligence augmentation instead of artificial intelligence. It supplements human thinking and analysis but depends on humans to take the critical decisions. Smart assistants and chatbots are good examples. Rather than enterprise-wide adoption, such specialized projects are an effective way for businesses to start using cognitive systems.

Cognitive computing is definitely the next step in computing started by automation. It sets a benchmark for computing systems to reach the level of the human brain. But it has some limitations which make AI difficult to apply in situations with a high level of uncertainty, rapid change or creative demands. The complexity of problem grows with the number of data sources. It is challenging to aggregate, integrate and analyze such unstructured data. A complex cognitive solution should have many technologies that coexist to give deep domain insights.

Thus, besides AI, ML and NLP, technologies such as NoSQL, Hadoop, Elasticsearch, Kafka, Spark etc should form a part of the cognitive system. This complete solution would be capable of handling dynamic real-time data and static historical data. The enterprises looking to adopt cognitive solutions should start with a specific business segment. These segments should have strong business rules to guide the algorithms, and large volumes of data to train the machines.

# MCQs & answers

**1.** What does cognitive computing involve?

(a) Natural language processing

(b) Machine learning

(c) Deep learning

(d) All of the above

**2.** The field that investigates the mechanics of human intelligence is\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(a) History

(b) Cognitive science

(c) Psychology

(d) Sociology

3. People overcome natural language problems by:

(a) grouping attributes into frames

(b) understanding ideas in context

(c) identifying with familiar situations

(d) both understanding ideas in context & identifying with familiar situations

4. A series of AI systems, developed by Pat Langley to explore the role of heuristics in scientific discovery is \_\_\_\_\_\_\_\_.

(a) RAMD

(b) BACON

(c) MIT

(d) DU

5. Incubator Kstart is partnering which tech major to foster a start up ecosystem in India?

(a) IBM

(b) Infosys

(c) Lenovo

(d) Dell

6. Output segments of AI programming contain \_\_\_\_\_\_\_\_\_\_\_.

(a) Printed language and synthesized

(b) Manipulation of physical object

(c) Locomotion

(d) All of the above

7. When a top-level function is entered, what the LISP processor does?

(a) It reads the function entered

(b) It prints the result returned by the function

(c) Large memory and high-speed processor

(d) All of the above

8. The component of an ICAI (Intelligent Computer Assisted Instruction) presenting information to the student is the

(a) Student model

(b) Problem solving expertise

(c) Tutoring module

(d) All of the above

**Answers**

**1. (d) 2. (b) 3. (d) 4. (b) 5. (a) 6. (d) 7. (b) 8. (c)**