

Chapter 1

Introduction to cognitive computing and its various applications

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Introduction

In this era of modern computing system, cognitive computing is emerging technological mode, as process automation is expected to evolve the old systems. According to Gartner, cognitive computing will change the technology era unlike none of the technology introduced in the last two decade. In technology, cognitive computing is becoming modern buzzword, capturing the attention of many entrepreneurs and tech enthusiasts.

Cognition is the combination of brain related processes and activities used to learn, perceive, think, understand and remember, to acquire knowledge and understand, experience, and the senses. Cognitive Science is the broad scientific study of the human-mind, the brain, and human-intelligent behavior. As cognitive system stimulates the mechanism of human thinking, the use-cases and benefits of cognitive computing are much more advanced and smarter than artificial intelligence (AI) systems. As it is able to analyze and handle Big data, cognitive computing is capable to be used in today's smart and complex system to solve real-life problem. AI creates new ways to solve problems better than human but cognitive computing tries to replicate human behavior to solve problems (Megha et al., 2017). Cognitive system must adopt the cognitive skills of human like perception, decision making ability, motor skills, language skills and social skills to solve problems. AI can only be intelligent as how individual teach it, but it is not suitable for current cognitive era. Advanced cognitive computing framework uses natural language processing (NLP) with context-aware emotion intelligence, AI, machine learning, neural networks as a foundation to tackle complex routine problems as humans-being. Cognitive computing is defined as "An advanced system that learns at scale, reason with purpose and interacts with humans in a natural form" (Megha et al., 2017).

Cognitive system learns the patterns and advises human react appropriately depending on acquired knowledge. It provides an assistance to human rather than one completing the task. The main purpose of cognitive computing is to assist people in decision making which gives them superior accuracy in analysis. Since cognitive computing has the ability to analyze data faster and more accurately, there is no need to worry about the incorrect decisions. If we see example of healthcare system using AI and using cognitive computing, treatment decisions are made without consulting with human doctor in AI system, whereas cognitive computing work one step ahead and assist doctors for disease diagnosis with the help of data repositories and data analysis which helps in smart decision making.

To provide human assistance, Chatbot's are important techniques. Chatbot development involves a collection of various advance techniques like machine learning, AI, also analytics all of which are involved to make Chatbot experience more conversational.

Cognitive system must analyze data accurately, also it must learn efficient business process. In cognitive systems data collection, comparison and cross-referencing must be highly-efficient to analyze a situation effectively (Megha et al., 2017). In this era of digital evolution, manual processes are identified so that it can be automated by adopting cognitive technology. IBM is becoming pioneered for the cognitive technology sphere by which it is driving many digital organizations across the globe.

Explosive data is analyzed to get insights from historical data for betterment of future. Cognitive technology understands the past and helps in providing assistant for predicting future events with more accuracy. In future, it will be immensely used by the businesses due to its robust and agile nature. Financial and healthcare domain is already leveraged by power of cognitive computing. In the future, with the use of such a technology, it will be helpful to make human-being more work-efficient.

Cognitive computing overview

Cognition is the word with origin from Latin base cognition "get to know," another meaning of the same is "thinking and awareness." Multiple mental processes are involved in these activities related to cognition such as perception, learn, think on, understand and remember. It also includes grasping knowledge and analyze through thinking and past experience.

Cognitive computing involves the methods, algorithms and approaches that supports the system to "think on," "understand" in similar way that the human brain does. In a way the cognitive computing methods works and inculcates all the mentioned activities which human mental processes does.

Cognitive computing arena includes various techniques, that helps to simulate the human cognition in computing world. Various technologies and tools such as machine learning, AI, NLP, exploratory data analytics and

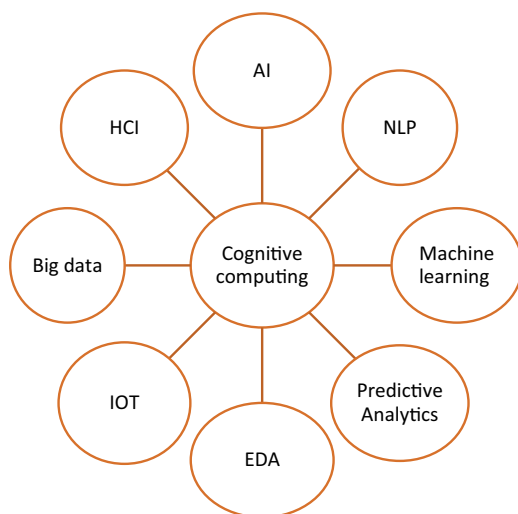


FIGURE 1.1 Cognitive computing technologies. *AI*, Artificial intelligence; *HCI*, Human-Computer-Interaction; *IoT*, Internet of things; *NLP*, Natural Language Processing.

predictive analytics are useful in simulating the human cognition like understanding, remembering, learn and perception. Along with these various technologies like internet of things (IOT), human–computer interfacing, Big data contributes to make cognitive systems reactive.

As shown in [Fig. 1.1](#), various advance technologies make the computer system as cognitive system. Big data is crucial component of cognitive computing systems, as it allows to get insights from the huge voluminous historical data to predict the feature. Some of the other sources of the data to cognitive systems are the data collected through IOT, human–computer interaction (HCI). HCI and IOT retrieve pass the data collected through various sensors or collected through interned across physically distinct locations. Sometimes data is available in audio form or in text form. To process such data using cognitive system, it is needed to convert it in proper understandable format. NLP do the task of conversion of audio data or text data in structured form which is suitable for analysis purpose. Valuable insights from this collected data can be drawn using exploratory data analytics like charts and graphs, or using intelligent machine learning techniques like predictive analytics, prescriptive analytics or denotive analytics.

Cognitive computing techniques

Natural language processing

NLP contributes in cognitive computing by realizing, processing and simulating the human expressions in terms of language expressed in terms of

speech or written. In literature (Aghav-Palwe & Mishra, 2017, 2020; Chen & Argentinis, 2016; Chen et al., 2017; Gupta et al., 2020; Orozco et al., 2010; Tian et al., 2016) various methods for NLP are proposed and implemented are bag of words, topic modeling, and lemmatization. Various models for NLP in computer science domain majorly used are state machines and automata, formal rules systems, logic and probability theory. Supervised machine learning methods like linear regression and classification proved helpful in classifying the text and mapping it to semantics.

Artificial intelligence and machine learning

AI methods contributes in cognitive computing by supporting perception, reasoning, learning and problem solving. AI methods like reinforcement learning helps in analyzing the context by learning with the help of past experience and apply/reply with the suggestion/prediction and reasoning of the context. Various intelligence for AI is ranging from musical, personal, logical, spatial and linguistic. Various AI methods and algorithms are proposed for solving the problems in each domain and context. Some of the examples of AI. Current AI application which helps in cognition simulation are driving car, game playing, Chatbots and many more.

Machine learning methods like predictive analytics and exploratory data analytics helps in analyze the hidden information and patterns from the given data. This learning is important in cognitive computing to react upon the situation for business decisions, AI-ML found useful for predicting the future possibilities.

Fig. 1.2 shows the usage of decision tree, supervised machine learning method to classify the customer in aspirant customer category. Considering the past experience as training data and <age, credit rating, income, student> features, the system is able to predict that the customer will buy the computer or not. With such decisions, the cognitive system can then further suggest/percept important strategies to motivate customers for improvement in business.

Internet of things and Big data

IOT and Big data are considered as foundations of the cognitive computing. These are the major resources of data, which is helpful in drawing valuable insights for decision making. Unstructured data which is generated from these resources need to be processed to make it suitable for analyzing and for finding meaningful insights. Cognitive systems process such collected unstructured data and consolidate it to propose the semantics from it.

IOT data gathered from the various sensors/devices is useful in predicting the need of maintenance of devices, relocation, rescheduling, resource management of devices.

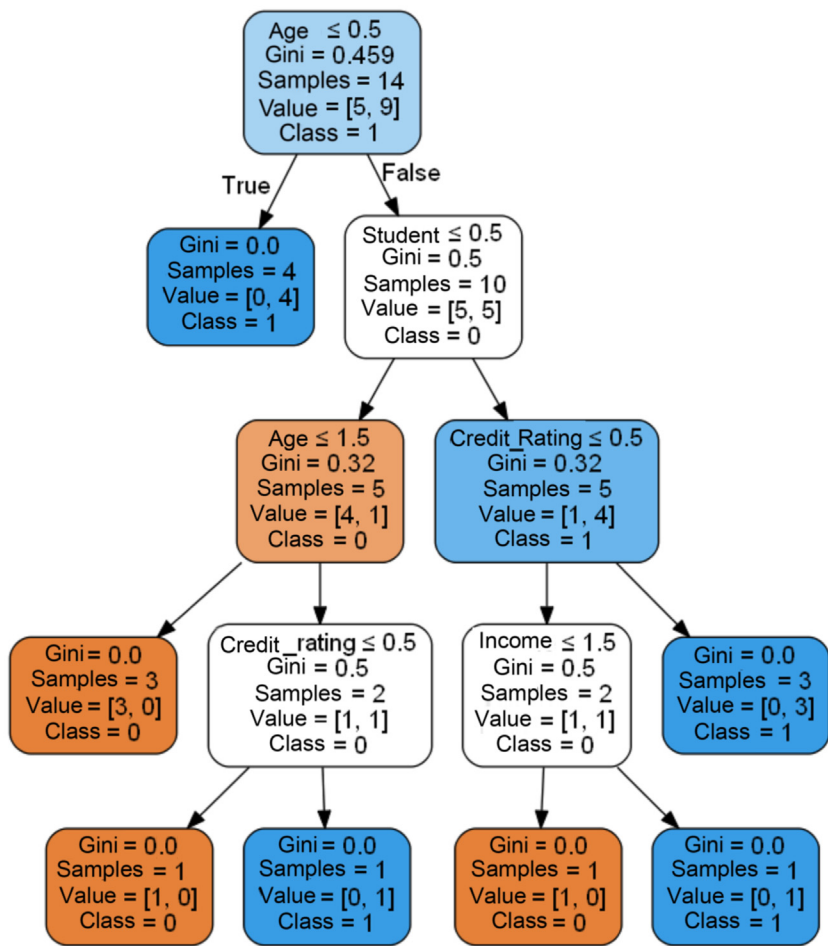


FIGURE 1.2 Decision tree to predict the aspirant customer. *Class 0: No, Class 1: Yes.*

Whether alarming systems are helpful to save and protect the health and wealth in real life. Whether related IOT data collected from various sensors after analyzing, generates the prevention alarms to save and protects the resources, similar to human rescue force.

Cognitive computing challenges

Security—Security is the major concern as digital devices manage critical information. As cognitive computing system analyze the big data, most important challenge is data security and privacy. Full-proof security mechanism must be followed in cognitive systems to detect fraudulent incidences to enhance data integrity (Makadia, 2019).

Adoption—Voluntary adoption is crucial obstacle in the progress of emerging technology. For cognitive computing to be successful, the main vision is to define the model to make the effective use of technology for betterment of business. The adoption stage is executed through collaboration with stakeholders like enterprises, government and individuals, technology developers, It is also important to include data protection policy that will help to increase adoption of cognitive computing (Makadia, 2019).

Accepting change—People are not easily ready to accept changes due to natural human tendency and also as cognitive computing is capable to mimic human-learning quality, technologist are scared as they think that someday machines would replace humans. Cognitive technology is designed to assist and associate humans in synchronization. By feeding the data into the systems, humans will nurture the technology. This is the distinct and excellent example of association amongst human and technology everyone needs to accept (Makadia, 2019).

In coming years, regardless of these challenges, cognitive technology will be proved as revolution in variety of industries. For any industry, it is unique chance to change and automate the industry processes. Understanding of the modern trends is required to make effective use of this revolutionary outreach like cognitive technology. It is engaged in creation of cutting-edge technologies for businesses. Many leading and top businesses have already adapted cognitive technology in their daily business processes. Variety of promising cognitive computing examples and use-cases shows how efficiently it is applied to make the businesses successful. Nowadays, in each aspect of human lives ranging from travel to sports, entertainment to health and wellness, cognitive computing is creating impact and will be proved as real transformer of the human lives. Various application domains of cognitive computing are explained in below section.

Cognitive computing application in financial and investment firms

The financial world is observing real changes and fluctuations now-a days. The most of the changes are observed as positive and helps in transformation of financial sectors like banking, investment, and share market from untrustworthy environment towards transparent services (5 Ways Cognitive Computing is Disrupting Finance <https://disruptionhub.com/5-ways-cognitive-computing-disrupting-finance/>). It is been mostly supported by the use of advance technology like cognitive computing. Data collection, analysis and usage are the most important aspects for finance sector which make cognitive computing really suitable for such industry.

Cognitive computing applications can be designed to understand the requirements in domain specific way as per the clients and assist the system to make context-aware suggestions. To provide target-oriented, real-time investment suggestions to managerial level knowledge workers, it must learn from

huge historical data repositories and use it to for smart decisions in client funds investment in a highly unpredictable market. Reporting and analytics capabilities must be provided to investment companies. In order to provide better insight and decision making, large amount of data needs to be analyzed to understand the available market resources, risk factors, and financial aspects. Most of the industries are using digital tools for huge data analysis and decision making. Use of cognitive computing in finance is motivated by the technology's capability to support the companies for managing huge real-time data for various subjects. As volume of financial data continuously growing, efficient data collection, analysis, exploit is very essential. This large amount of data increases complexity in decision making for financial sector. Cognitive computing can be used to accurate analysis, identifying patterns and relationships and correlation of qualitative and quantitative data of financial sector.

By using NLP and text analytics, intelligent automation can be done for customer interaction, claims management. It will give cost saving solutions to achieve customers satisfaction in financial sector. Most of the customers are using mobile and online banking for doing their business at any time. So through cognitive systems, customers' requests can be handled quickly and effectively as per customers' needs in their own language. It will provide valuable insight to customer. Cognitive systems can easily extract the data, identify trends, generate analytics and enhance the efficiency of automation.

Adoption of cognitive computing will notably transform financial sector. Knowledge workers in finance domain would make effective use of machines to promote customer satisfaction and enhance decision-making. Similarly, various managerial level person like advisors will make use of cognitive computing to make their task more accurate and easier. This will enhance client engagement and will lead to operational excellence across the finance sector.

Choosing virtual agents over digital channels which are empowered by cognitive computing can help financial organizations see meaningful transactions in convoluted areas like brokerage and mortgages. Using cognitive computing, the financial industry can now address fraud and risk management more efficiently and effectively. Advanced predictive analytics and incorporating external and internal data is enabling the detection of fraud and emphasize on proactive prevention. Operations cost and IT are the two areas where much of the financial industry struggle, in terms of both productivity and predictability. Productivity gains are in demand and always given a substantial amount of spending from these areas. Cognitive computing is a new way of containing costs with exceptional optimization options which is possible through automation and cognitive tooling. Following are various areas in financial sector where cognitive technology will be helpful:

1. **Organization:** Cognitive computing helps financial sector to gather context-aware data about the personal and use it to suggest and recommend the spending-investing so as to offer personalized experience.

As an example, installation of nifty apps which associate users' calendars with dues, reminding personnel to select best wishes card for relative. Personalized finance services showcase how smartly such automated systems enhance the customer experience with financial services. Such apps can also make customer aware of the their spending in financial limits by providing real-time message-prompts on such purchases.

2. Advice: Cognitive technologies in finance sector made customer motivated to use and explore this sector by provide self-pace and personalized platforms and services which mimic the human-being as adviser. Such techniques really helpful to answer the complex queries raised by customer and involve the customer in conversation to understand their needs better. For example, Chatbots as finance advisor are the AI adapted software apps modeled to set services and to enhance customer satisfaction.

Cognitive computing application for changing business values

Cognitive computing systems must learn business processes efficiently. Data is valuable asset in every business as with this data valuable insights can be drawn with the help of analytical methods and practices. In cognitive computing, as data analytics is important component, it offers a smart decision support mechanism which helpful for betterment of businesses. In real-time, cognitive computing can evaluate emerging trends, recognize market opportunities for business and solve process centric problems. These system helps in streamlining the business stages, helps in risk management and offers the solution with respect to changing environment. Businesses can build a specific action on uncontrollable factors, also can create lean business processes using cognitive systems.

Customer experiences can be improved by designing chatbots which offers conversational interactive interface. Chatbots can provide related and required data to customers without need of human intervention.

Cognitive computing in veterinary medicine

With historical medical data, cognitive computing application offers a medical practitioners an assistant which offers consolidated information about the specific disease and medication. With complexity of case studies and big data it is difficult to get accurate solutions on health-related question. Cognitive computing provides the assistance to human being by offering ease of use and consolidated data. To address individuals' questions and to make intelligent, personalized recommendations, immediate processing of vast volumes of data must be done (Behera et al., 2019). Health insurers, providers, and similar organizations can assist the individual enrollments and patients to enhance their overall medical related data analysis.

In the case of the medical field, cognitive computing systems consolidate and analyze health-data collected from heterogeneous and diverse resources such as diagnostic tools, health-related journals, past reports and past data from the medical fraternity thereby assists medical practitioners to provide treatment suggestions are useful to practitioners and patients too. Cognitive computing will speed up the data analysis in process automation in health-care industry. Cancer fighter patients can also be provided with intelligent phone assistant.

Helping veterinarians to detect and to handle the diseases of pets. Cognitive computing not only helps humans, but also helps veterinarians to take better care of the animals. Veterinarians ask a question in much simpler way as they communicate with their colleague. Instant support and advice must be provided, that saves time of busy vets and quality care is provided to their patients.

Cognitive computing application in health and wellness

Currently smart wearable devices generating data input that can help to get suggestions regarding healthcare program like diet, exercise etc., It also offers stress management programs which have crucial adverse impact on overall health. Such applications are the new ways that cognitive computing offers and can be scaled up with respect to future need. Here, fitness plans of individual and effective tracking system for health-progress is developed. This helps in tracking the health in accurate and hassle-free manner and offers effective support to fitness trainers and medical practitioners.

CaféWell—healthcare concierge by Welltok

Welltok designed an effective health caretaker, CaféWell ([Makadia, 2019](#)). This app records appropriate medical history records of patient through the collection of huge health-related data. This health-app effectively used by many health insurance companies to offer their customers the valuable data which in turn will enhance their health. Based on data gathering and query processing, it offers accurate and smart health-related suggestion which improve the wellness of personnel. To provide optimize health status of patient, the industry needs to be realistic, different approach need to engage that impact health of population.

Cognitive computing application in travel and tourism

Cognitive system applications plays important role in tourism and travels for suggesting the optimal itinerary. For this purpose system combine, merge and evaluate travel, destination information, for example routes, resources,

availability of flight and resort, their prices etc. and consolidate it with individual likings, financial aspects, etc.

Case study: personal travel planner to simplifying travel planning by WayBlazer

WayBlazer has created personal travel planner by using power of cognitive technology to make it easy for travelers to plan for trips (Makadia, 2019). Traveler can ask questions in natural language. By gathering and analyzing trip data as well as knowledge regarding traveler likings, the tourism agent asks simple questions and offers personalized results. To finalize the travel journey, time for hotel booking, flight search can be saved by cognitive tool. Travel agents have used this technology effectively which is important to improve their sales and customer loyalty both hand in hand.

Cognitive computing application in education and learning

It is most promising application area of cognitive computing. Research challenges and practical appeal are recognized and gives broad spectrum of human learning. Cognitive computing equally applicable in education and learning with advancement in digital education.

In online tutorials, cognitive computing will provide personalized learning and assessment materials. Cognitive tutor will assess the student for their learning and accordingly prompt the new topic to learn for precious learning outcome (Irfan & Gudivada, 2016). Students may ask topic related questions to cognitive tutor based on learning material and assessment components. The answers revealed by the cognitive tutor are context-aware which makes the learning experience more paced and personalized. And more importantly, the cognitive tutor mimics the teacher's ability to teach, assess and mentor multiple students parallelly; enabling the facilitator to offer exactly similar support to large number of students enrolled for the course (Irfan & Gudivada, 2016).

Cognitive assistant will also help in searching and applying for courses as per their profile. Based on historical student's data current relevant courses will be recommended. This can be made possible using the conversation and interaction using NLP. To initiate this conversation, students can ask for cognitive assistance to make course choices. Eventually, with teaching learning experience and observing the student's performance, solving capabilities, more related courses are offered perfectly. This entire process also takes care of financial affairs like course fees, module wise fees collection, offers and discounts, rewards etc. As per shown in Fig. 1.3 course recommender systems is modeled to recommend the courses to aspirants as per their need. Speech recognition module is used for text to speech and speech to text

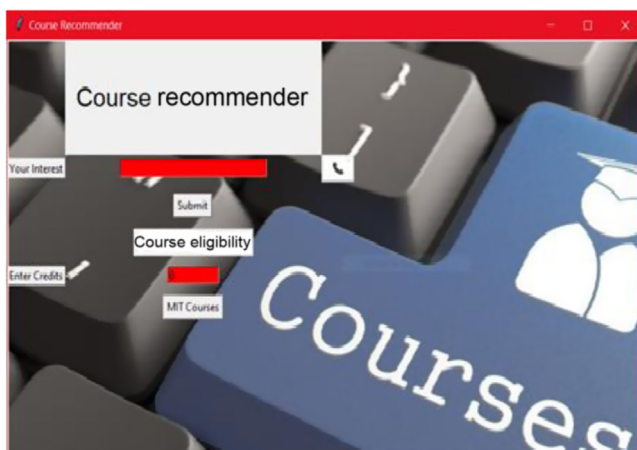


FIGURE 1.3 Course recommender systems.

conversions. Speech recognition facilitate the human-computer conversation in audio form.

Digital campus—apart from the course registration and recommendations, cognitive system help to keep students more connected to campus life by offering campus-news, newsletters as per the student’s interest, branch and classes. This is really helpful for huge campus to make students aware of campus happening and conduct the student affairs with good collaborations. Such services use context-aware approach to facilitate the information broadcasting services to students.

Virtual librarian—learning resources plays vital role in Teaching Learning process. To make this process more intuitive and effective, the cognitive system can be adopted as virtual librarian. For students’ assessments components, based on the relevant topic, Virtual Librarian will offer the books, articles which are useful for students to solve the assessment. Moreover, the student’s reading and involvement can be traced here to make this process more effective.

Library book searching is tedious job in case of vast book banks. This can be made easier and more reachable by providing conversation assistance for book searching, making the learning assistance system more user friendly.

A reward service which gives vouchers or credits to students—cognitive services can be utilized by schools, colleges and universities to encourage and support positive behavior amongst their students. Institutions could use cognitive services to promote better attendance or punctuality to lessons, the timely submission of coursework by students or improved grades. Colleges or universities can use cognitive computing to offer incentives to students in order to raise enrollment rates for courses or to raise the number of early applications to courses.

A virtual essay checker which takes advantage of natural language understanding to advise students about how they could improve their work before submitting it to their tutors. This service has the potential to reduce the percentage of assignments that need to be resubmitted by students and it has the potential to raise the average grade profile for courses.

Cognitive computing in agriculture

The cognitive computing is truly revolutionary in the field of agriculture, as it is the next milestone to assist, guide and cooperate farmers for the crop production, analysis, monitoring till sales. Cognitive system with personal assistant in local language is the need in rural areas of many countries. Better opportunities must be provided to farmers in a user friendly manner to acquire the required data and understand the current market needs. Latest farming practices and trends needs to be followed. Adoption of latest technologies in farming is slow, due to this reasons people involved in the occupation of farming are comparatively very less. Traditionally, field officers visit the farmlands and provide training, advice, and support to the farmers (Jain et al., 2018). Better decisions related to the crops that they cultivate must be taken. Many of the rural villages lack the ease of accessibility, this leads to reduced crop yield, increased wastage of valuable labor, and market inefficiency. These reasons add upto severely impact a farmer's earnings, time and opportunities to increase the crop yield (Fig. 1.4).

Speech-based apps offer various functionalities to farmers and to agriculture related professionals, this makes agriculture field more prospectus and engaged. Literacy is the basic need to make such agriculture supportive technologies more usable. These technologies offer simple interfaces which requires minimal understanding of new technical concepts or interaction methods. Data repositories and corpus are easy to edit and manage by

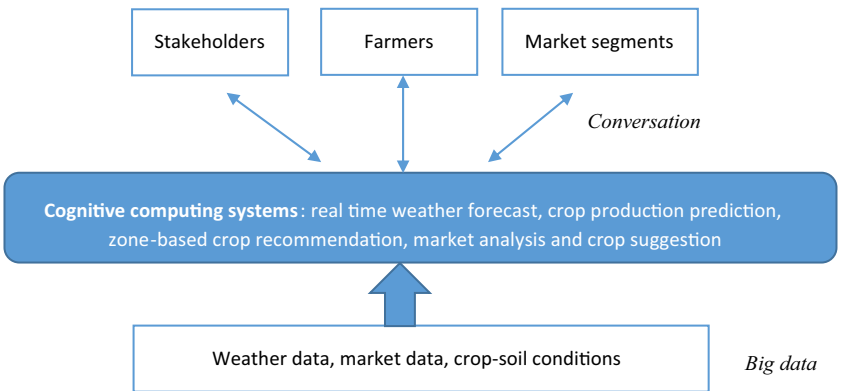


FIGURE 1.4 Cognitive computing in agriculture.

agriculture experts. However, chatbots for farmers are still seek the need of the acceptance and adaptation in rural spaces (Jain et al., 2018).

Some of the major areas wherein the information support is critically requiring are plant protection, pesticides and diseases, weather suitability for crop, and yield improvement (Bagchi, 2018). Many farmers are taking help of agri-experts for recommendations of pesticides for a particular crop disease. Farmers can interact with chatbots in their own language to get recommends medicine with dosage information. Farmers always seek the weather-related information, as adverse weather conditions can cause the losses and also understanding weather conditions may enhance crop management and profit. Information related to best practices can help increase yield in terms of the quantity or quality. Chatbots will give tips to increase yield based on data analysis and helpful on increase income of farmers. Farmers which seek crop-based recommendations from agri-experts on various agri-products they should purchase. Information related to fertilizers and seeds are collected by farmers from agri-experts.

Cognitive computing in communication and network technology

Communication and network technology are rapidly developing and demanding field of many services and applications. These technologies have high impact on society and the way people are leading their lives. To meet user-expectation, efficiency of energy and complex network environment, an optimal design-model its setup and efficient network communication are required (Sharma et al., 2020). Power of cognitive computing will be very useful to handle dynamic and complex network topology. Deep learning methodologies will give effective outcome for complex and smart decision making for optimal management of networks, optimal resource utilization and deep knowledge extraction in dynamic environment. Some of the areas of networking where cognitive computing will be effective to use are, to find and identify hot-spots with enhanced capacity, connections with less power, minimal delays and maximum reliability.

Cognitive computing enables to design new architecture and infrastructure for smart communication/network. Also, effective network management will be done by analysis and behavior prediction of data. In smart networks, cognitive computing will provide enhancement for complex-information-models, context-aware data management and deep knowledge analysis, performance evaluation, security and privacy protection (Sharma et al., 2020).

Cognitive computing surely offers solutions for planning and optimization of networks, best customer-services and leads for capital acquisitions by combining together the techniques to support such tasks like analytics of networks, understanding the schematics of network topology, relationships amongst entities etc. It also conducts the survey and examine regularity

compliance standards for various matrices related to finance to understand the suitable cost and prioritization in case of investment related to networks. Today, these activities are conducted by team of experts and knowledge worker for decision making and planning. With cognitive computing, it will be perfect use-case of human-machine association, as it will lead to enhance processes and methods, but human involvement is equally important to model such expert systems as per the need of context. Thus, cognitive computing will be very effective and powerful for providing advanced intelligence and interactive communication/network services and applications.

Cognitive systems is basically developed as a generic approach, so need to be modeled as per the context requirement to create the specific solution targeted to specific business.

Cognitive computing in renewable energy

With increasing demand for non-renewable energy, there is drastic need to utilize and focus on renewable energy, its sources and effective methods to make its use with ease. Wind energy, solar energy etc. are types of renewable energy. Major hurdle in using these sources as energy is that it's depends on a weather condition. More or less energies are getting generated based on the weather condition, and may not be very reliable source of energy. To find an optimal way in usage of renewable energy, one can predict the weather conditions and can tune other reliable energy sources accordingly. To make this possible, cognitive computing may play vital role. As shown in Fig. 1.5, With cognitive computer, prediction of whether condition by analyzing the past weather data is possible, with the help of predictive analytics and exploratory data analytics. Based on the prediction, the switching amongst energy sources in automated fashion is possible.

Cognitive computing in predicting the units of solar energy based on past data

To predict the units of energy generated in future with certain whether conditions is important to balance and manage and schedule various renewable and non-renewable energy sources as per the consumption requirement.

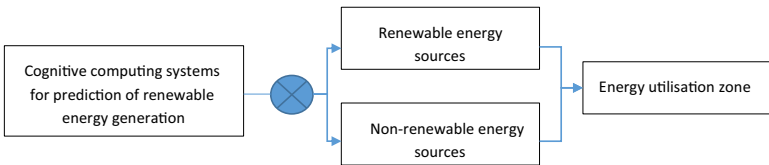


FIGURE 1.5 Cognitive computing model for renewable energy.

For this application, regression analysis is suitable machine learning algorithm for predicting the continuous solar energy value in given whether condition.

All attribute of the data is continuous value.

Features: {Cloud coverage(%), visibility (Miles), temperature (C), dew point (C), relative humidity (%), wind speed (mph), station pressure (inchHg), altimeter (inchHg)}

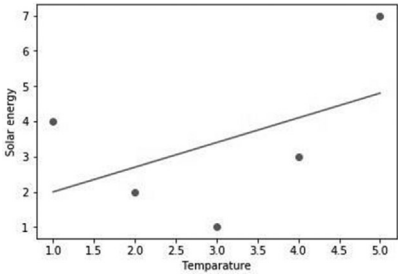
Target: {Solar energy (watt)}

Considering the sample dataset (Renewable energy dataset available from <http://s39624.mini.alsoenergy.com/Dashboard/>) described in Table 1.1, regression analysis models the relationship of all features with output values as regression line. Once this regression model is build based on past data, it would be useful to predict the units of solar energy for unseen data sample (Vinay & Mathews, 2014).

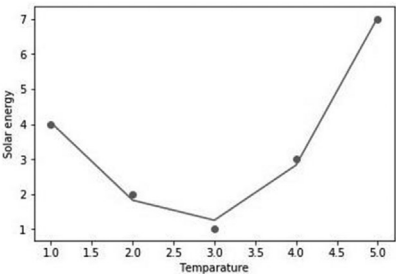
As shown in above Fig. 1.6: simple linear regression and multiple linear regression, the regression model tries to establish the relationship between dependent variable with independent variable. In simple linear regression dependent variable can be analyzed using single independent variable. Regression model created in this approach is using linear line, so called as linear regression. The linear line modeled in this approach is used to predict the value of unseen variable.

TABLE 1.1 Solar energy data attribute.

Cloud coverage	Visibility	Temperature
Dew point	Relative humidity	Wind speed
Station pressure	Altimeter	Solar energy



(A) Simple linear regression



(B) Multiple linear regression

FIGURE 1.6 Regression model for renewable energy prediction.

Multiple linear regression is a type of linear regression, wherein multiple independence features are available to predict the dependent variable. This regression is more accurate than the simple linear regression.

With this solar energy prediction, cognitive system switch the energy sources accordingly to make system reliable and available all the time.

Conclusion

Cognitive computing framework is broad and includes a range of methods, techniques, algorithms, and approaches.

Its complex framework itself suggests the applicability of the cognitive systems in state-of-art researches. Cognitive systems are not only multidisciplinary but also transdisciplinary and hence provide capable applications for various context, domain. These applications range from architecture, medical, education, business corporates, Environment and many more. Due to its adaptability and applicability, cognitive computing is a core research area. In this chapter we discussed various fundamental techniques of Cognitive computing. AI-ML, Big data, IOT, NLP are discussed in this chapter with examples of methods. With these methods, various case studies and challenges are discussed and stated. As discussed with various case studies, the cognitive systems are the aspirant evolutions in many areas.

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