Cognizant

Cognitive Computing: An Antidote for the Data-Intensive, Time-Crunched Age

Cognitive science lets business professionals hand over urgent decisions to machines so that humans can focus on strategic goals.

INTRODUCTION: COGNITIVE EVOLUTION

In the digital era, two opposing forces keep business leaders from accomplishing their professional and personal goals. On the one side, they're buffeted by data growing at exponential speeds; on the other, they're hobbled by less available time. As a result, the *urgent* ("figure out how to increase market share") crowds out the *important* ("figure out how to make the world a better place"). What business professionals need is a way to augment themselves.

That's where cognitive science comes in.

Our distant ancestors' thoughts centered around one question: "What am I?" Male or female. Hunter or gatherer. Good guy or bad guy. Over time, our cognitive capabilities evolved to handle the more complex, "Where am I?" Contemporary people ponder, "Who am I?" My own answer includes husband, father, data scientist, global citizen, cat person.

Most recently, humans have evolved to ask, "How do I _____?" Fill in the blank: Make more money. Live a better life. Find somebody to love. Whatever the sought-after goal is, the answer probably requires finding more time. The quandary is that the details of daily life — e-mails, company meetings, long airport lines — lay claim to a growing portion of our time.

Productivity tools alone aren't the answer. While saving an hour or two a day is great, it's slim pickings if you need to complete 20 hours of work by end of day.

COGNITIVE COMPUTING BASICS

Enter cognitive computing. Cognitive computing simulates human thought processes with self-learning systems that mimic the way the human brain works. The goal is to create automated systems capable of solving problems without human assistance. Techniques include data mining, pattern recognition and natural language processing.

To mimic the brain, researchers first need to understand how it works. The blue swath in Figure 1 maps the number of neurons in living things – 302 for roundworms, 86 trillion for humans – to the number of neural connections. Cognitive scientists have successfully mimicked the brain of a cockroach, which has nearly one million neurons, each with approximately 100 connections. It's now known which connections between which neurons enable the cockroach to eat, sleep, eliminate waste and reproduce. The same techniques are being used to simulate human thought processes.

Understanding Brain Behavior

Intelligence grows in step with the number of neurons and the number of connections between neurons.

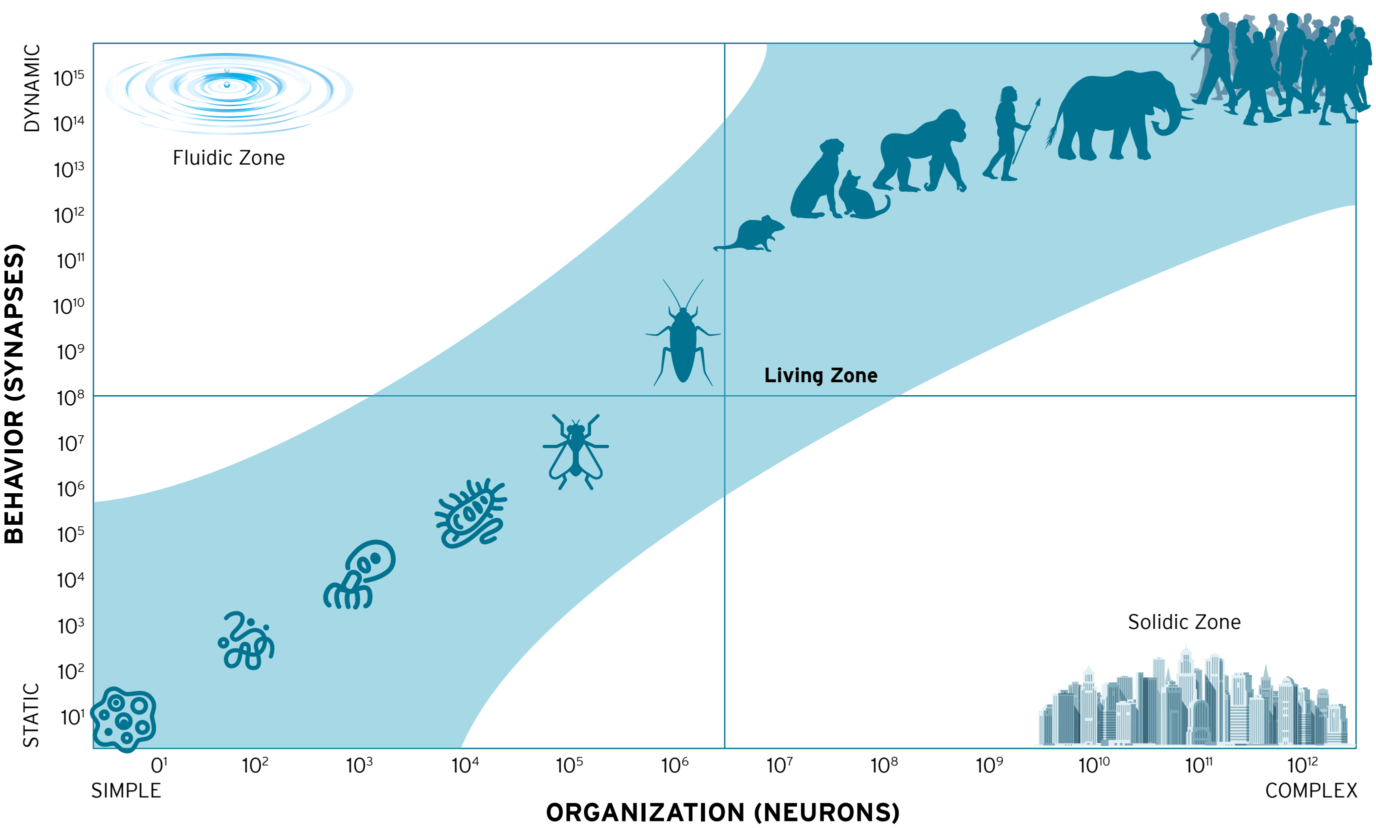

Figure 1

CHOOSING THE RIGHT COMPUTATIONAL METHOD

The best methodology for enabling a computing system to make a particular decision depends on the nature of the data: simple or complex, static or dynamic (see Figure 2).

Simple Data, Infrequent Change

Examples: enterprise data, such as relational databases.

For these data types, the best approach is to use organizational sciences methodologies, such as Bayesian inference, frequentist, network and genetic. These methodologies help make decisions such as, "What can we do to maximize sales?" "How profitable is this insurance product?"

Complex Data, Infrequent Change

Examples: IT data, such as network logs and web activity logs.

These data types require neural networks to discover complex relationships among different data sets. Examples include calculating the propensity to buy a product or service based on price, packaging, promotion, placement, social influences, economics, geography, political factors and weather. (Weather is a big deal, it turns out.) Neural networks can evolve on their own through self-learning — say, if the social network begins to exert more influence over the buying decision.

Here's how neural networks operate. The network examines a random selection of events, perhaps 10 or 1,000. It tries different connections between neural masses[1] to discover which combinations best solve the problem. Then, it combines those combinations in different ways to build the optimum network.

Cognitive science gets especially interesting when two events are related. If you flip two coins, the result of either flip is independent of the other. But for some entities, the behavior of one affects the other.

Picture a couple in love. An affirming statement from one person on Saturday might increase

Choosing a Computational Method

The best computational method depends on the type of data.

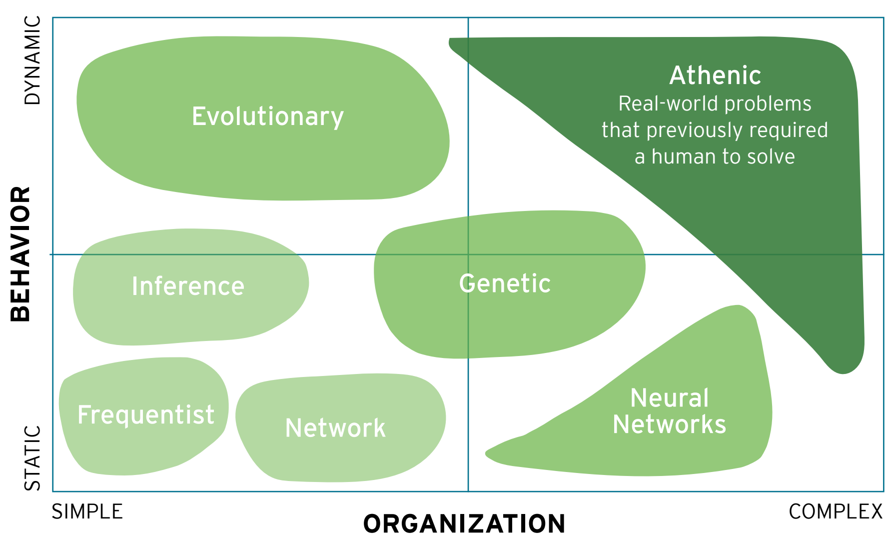

Figure 2

the likelihood that the other will volunteer to go grocery shopping on Sunday. Although both entities (people, in this case) are self-contained, something connects them. Cognitive science discovers that thing.

Complex, Dynamic Data Updated in Real-time

Examples: information from the public Internet, anonymized networks and the Internet of Things. This type of information can contain images, documents, videos, sensor readings, tweets, blogs and more.

For this type of data, Athenic systems are the best approach. Athenic systems – considered the third wave of cognitive computing (see Figure 3) – can solve real-world problems that previously required an actual human. A simple use case is identifying a solution for declining business revenue – perhaps selling underperforming units.

Athenic systems come the closest to simulating human thought processes because they consider interpersonal and sociocultural knowledge in their decisions. This is known as "contextual adaptation."

Imagine that someone has summoned a self-driving car and instructed it to take an unaccompanied child to grandma's house. Suppose grandma lives in an area where a wildfire evacuation order is in effect. A human driver would refuse on safety grounds, and so should the self-driving car. It gets interesting if the customer insists on following through with the original instruction even after being advised the ride is unsafe. Good robots are supposed to obey but also to not harm themselves or others. An Athenic-class system might respond by calling the police to report child endangerment and then shutting itself off.

Three Waves of Cognitive Systems

Athenic systems are the third wave of cognitive systems.

Type of System	Cognitive Computing Techniques	Sample Use Cases
Wave 1 Knowledge systems	Handcrafted knowledge	• Online therapists. • Automated cybersecurity patching.
Wave 2 Artificial intelligence	Handcrafted knowledge + Statistical learning	• Real-time identification of multi-location cyberattacks. • Real-time identification of disease outbreaks.
Wave 3 Athenic	Handcrafted knowledge + Statistical learning + Contextual adaptation	• Disease diagnosis from photos and other information, with explanation. • Identification of criminals, with reasons.

Figure 3

Building Is Once; Training Is Forever

Maintaining an Athenic system is a bit like raising a child. We "code" the child once, perhaps after a romantic dinner. Then we train the child — to be polite, to ask before petting a dog. Training is most reliable when we more or less control what she hears and sees. But when the child begins receiving outside inputs that lead to bad behavior — say, from the Internet — we don't recode her DNA. Instead, we talk to the child (or enlist a therapist) to discover the source of the undesirable behavior and why the child made the decisions he did. Then we re-train.

That's also how Athenic systems work. If the system makes a bad decision — for example, wrongly identifying a whistleblower as a criminal, or missing a sign of insurance fraud — we look for the source of the misunderstanding. Then we train it to not make the same mistake again.

LOOKING FORWARD

To put cognitive science to work in your organization, you need one or more of the computational methods shown in Figure 2. You need compute and storage infrastructure. You may need data services such as speech recognition, translation, big data analytics, visual recognition and video intelligence. Cloud services — cognitive science as-a-service — eliminate the need for upfront investments in infrastructure and talent, and also enable you to get started sooner.

When it comes to the future, two things are certain: Data will only grow, and business professionals will only feel they have less time. Using cognitive computing techniques, workers can hand off some items on their to-do lists and free themselves up for more strategic, and ultimately important, work.

FOOTNOTES

[1] A neural mass is a structured set of interconnected neurons that perform cognitive activities needed to solve a particular problem. In the human brain, connections between our seeing and hearing neural masses, for example, enable us to associate sights and sounds.

ABOUT THE AUTHOR

Jerry A. Smith

Vice-President of Data Sciences, Cognizant

Jerry A. Smith is Vice-President of Data Sciences at Cognizant. He is a practicing data scientist with a passion for realizing business value through enterprise data sciences services. Prior to Cognizant, Jerry was the North American Chief Data Scientist for Capgemini. He has a Ph.D., masters and bachelor of science in computer science, with theoretical and practical experiences in artificial intelligence. Jerry can be reached at Jerry.Smith@cognizant.com | LinkedIn: www.linkedin.com/in/drjerryasmith/.

ABOUT COGNIZANT

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Cognizant

World Headquarters

500 Frank W. Burr Blvd.
Teaneck, NJ 07666 USA
Phone: +1 201 801 0233
Fax: +1 201 801 0243
Toll Free: +1 888 937 3277

European Headquarters

1 Kingdom Street
Paddington Central
London W2 6BD England
Phone: +44 (0) 20 7297 7600
Fax: +44 (0) 20 7121 0102

India Operations Headquarters

#5/535 Old Mahabalipuram Road
Okkiyam Pettai, Thoraipakkam
Chennai, 600 096 India
Phone: +91 (0) 44 4209 6000
Fax: +91 (0) 44 4209 6060

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