

T1

Cognitive Systems

2020 edition

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PSI 3560 – COGNITIVE SYSTEMS

class T1

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THE CONCEPT OF COGNITIVE SYSTEM AND THE NATURE OF COGNITION

Cognitive agents, natural versus artificial cognition, cognitive systems, machine learning and AI, paradigms of cognition, examples of cognitive systems and applications.

Session T1

Summary

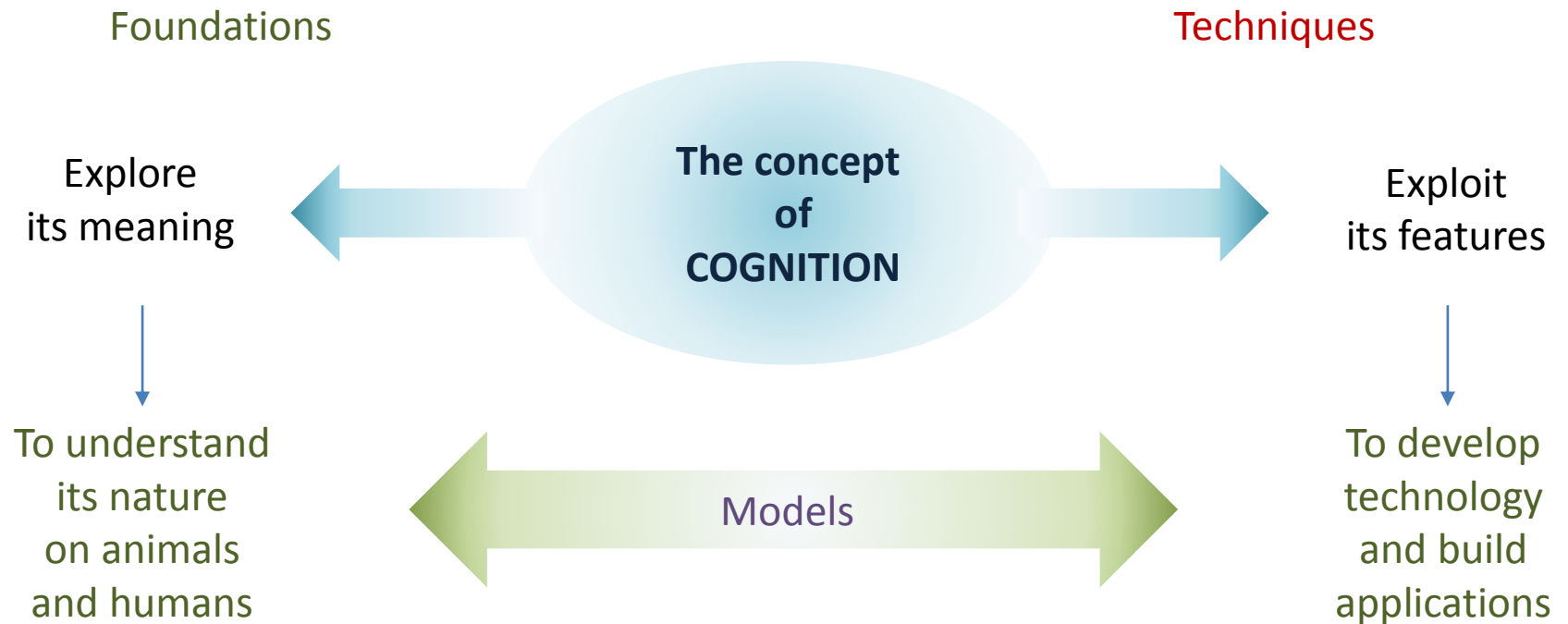
- Coffee break

– Second session (9:20 – 11:00)

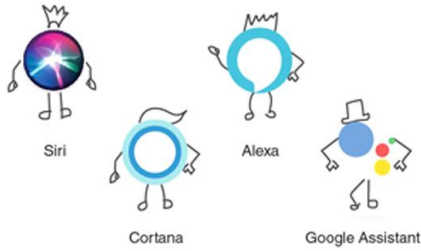
- Cognitive applications
- Working definition of cognition
- Types of cognitive systems
- Design of cognitive systems

Cognitive systems

- Foundations *versus* techniques



"Cognitive" applications



COGNITIVE VOICE ASSISTANTS



AUTONOMOUS VEHICLES

CHATBOT



Smart City IOC
Intelligent Building System
In-Building Communication Network
Smart Office and Business Solutions

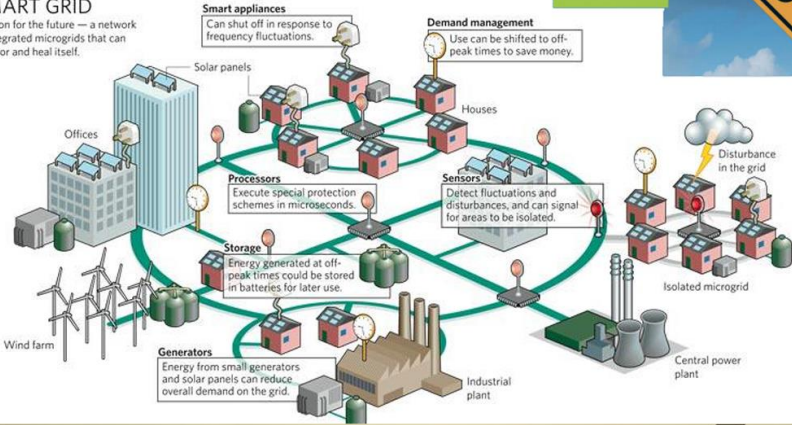


SMART GRID

SMART CITY

SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



SMART APPLIANCES



PERSONAL CARE COGNITIVE ENVIRONMENTS

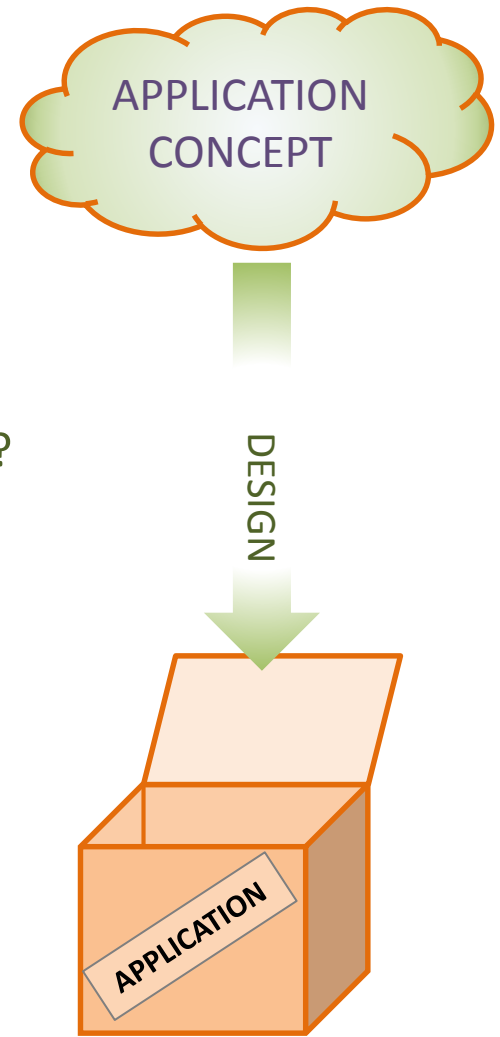
JK 2019

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6

Building cognitive applications

- Technical steps
 - Conceptual design
 - Uses → what for ?
 - Use → how ?
 - Pre-project
 - Functional specification → what it does ?
 - Foundational specification → how to accomplish ?
 - Project
 - Formal specification → (cognitive) architecture
 - Design specification → choice of methods
 - Project formalities → contract, deadline, costs
 - Design
 - Implementation
 - Tests
 - Application deployment



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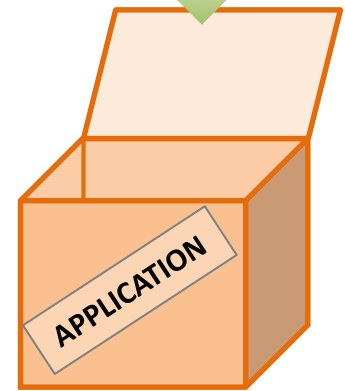
- Implementation

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DESIGN



Cognitive applications

- Companies are advertising and selling applications labeled as “cognitive”.
 - As pointed before, to offer a product that is a cognitive application suggests
 - It was conceived, designed and tested assuming that these steps were founded on a clear view of what is cognition.

“Cognitive” applications

- **McKinsey**

- **How cognitive technologies are transforming our capital markets**

- by Darshan Shandarana, Fuad Faridi and Christina Schulz **McKinsey Insights**, July 2017

- **Deloitte**

- **Cognitive technologies: The real opportunities for business**

- by David Schatsky, Craig Muraskin, And Ragu Gurumurthy **Deloitte Review** 16, 2015

- **IBM**

- **Computing, Cognition and the future of knowing**

- By John E. Kelly III
IBM Research & Solutions: Computing Cognition White Paper, 2015

- **KPMG**

- **Harnessing the power of cognitive technology to transform the audit**

- By M. Macaulay, R. O’Donell, V. Swaminathan
KPMG Portfolio, 2017

“Cognitive” applications

- **McKinsey Report**

- “Cognitive technologies **are** applications and machines that perform tasks that *previously required human intelligence.*”

- **Deloitte Report**

- “Technologies able to perform tasks *traditionally assumed to require human intelligence*, **are** known as cognitive technologies.”

“Cognitive” applications

- **IBM Report**

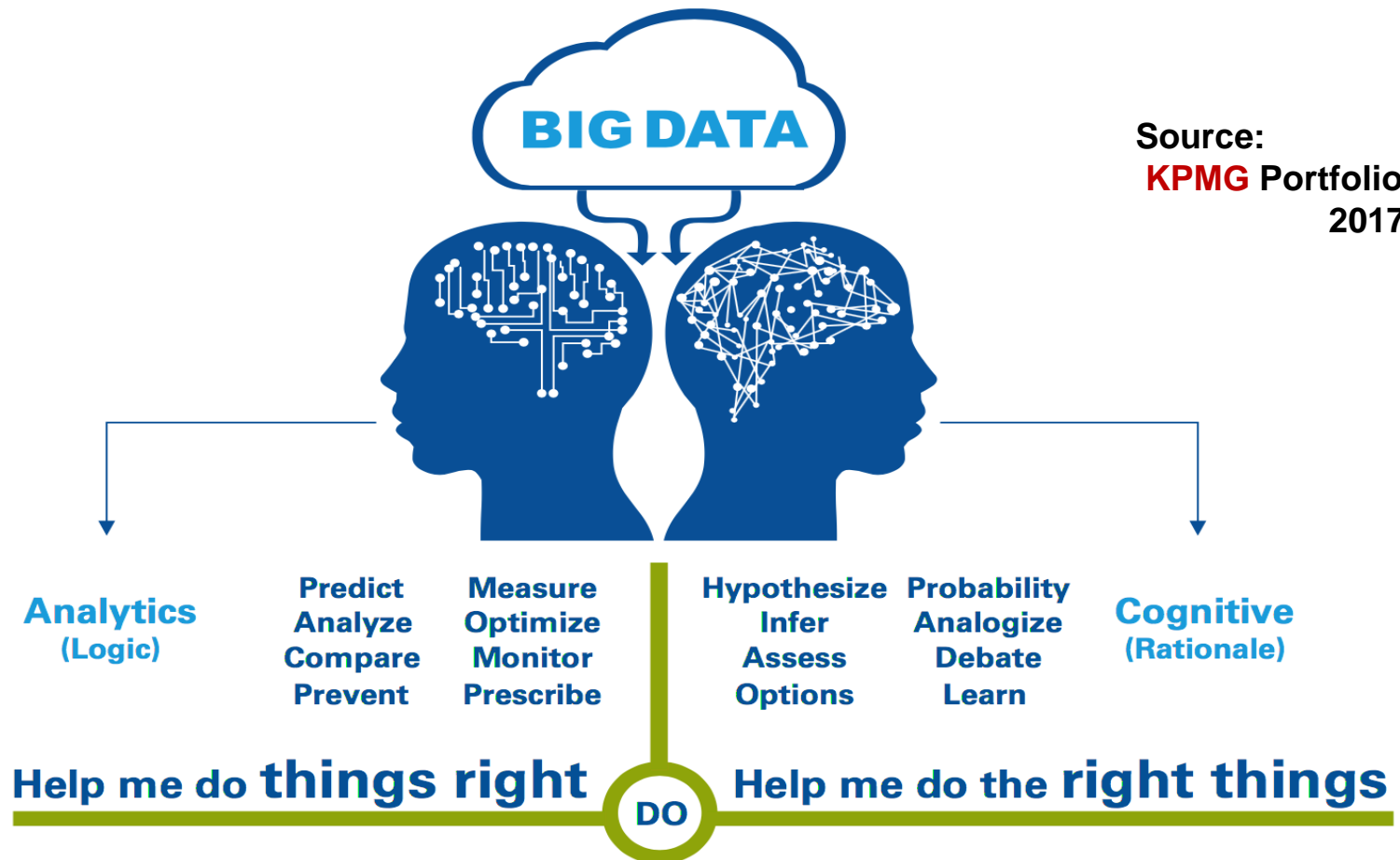
- “Cognitive computing **refers** to systems that learn at scale, reason with purpose and interact with humans *naturally*. Rather than being explicitly programmed, *they learn and reason from their interactions with us and from their experiences with their environment.*”

- **KPMG Report**

- “When we **refer** to cognitive technology, cognitive automation, or artificial intelligence, we are really talking about an algorithm, or chains of algorithms, that enable software to absorb information, reason, and think in *ways similar to human beings.*”

“Cognitive” & Analytics

Cognitive and analytics are different but synergistic – working together to create value.



Some updates

Early adopters combine bullish enthusiasm with strategic investments

Source:
Deloitte
report 2018

Endnotes

1. It would take a separate article to delve into the differences between cognitive technologies and artificial intelligence. In general, they are considered as synonymous in the market. Therefore, we use the terms *cognitive*, *cognitive technologies*, *artificial intelligence*, and *AI* interchangeably in this study.



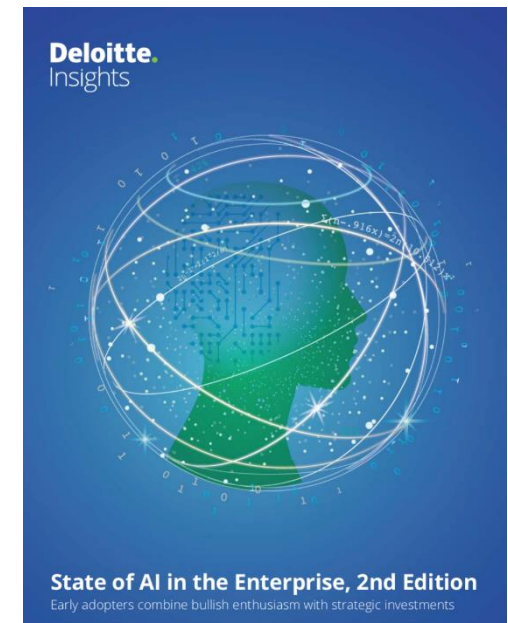
Some updates

Cognitive technologies are a necessity, not an option

Many early adopters are investing in cognitive technologies to improve their competitiveness. Sixty-three percent of surveyed executives said their AI initiatives are needed to catch up with their rivals or, at best, to open a narrow lead (see figure 2).

And the linkage between adept application of AI and competitive advantage appears to be growing stronger. Eleven percent said that adopting AI is of “critical strategic importance” today, but 42 percent believe it will be critical two years from now. This is a small window for companies to hone their AI strategies and skills, and they believe their success depends upon getting it right. Executives are becoming more realistic about the time this will require, however. In our 2018 survey, 56 percent of respondents said cognitive technologies would transform their companies within three years, down from 76 percent last year. The same was true of industrywide transformation: 37 percent of our 2018 respondents think it will happen within three years, 20 points lower than in 2017. We believe executives are acknowledging the complexity of using cognitive technologies to drive change across lines of business, without despairing of attaining that goal.

Source:
Deloitte
report 2018



Some updates

Cognitive technologies

Cognitive is shorthand for technologies such as machine learning (ML), neural networks, robotic process automation (RPA), bots, natural language processing (NLP), and the broader domain of artificial intelligence (AI). Cognitive technologies can help make sense of ever-growing data, handling both the volume and complexity that human minds and traditional analysis techniques cannot fathom. Algorithms replace queries, increasingly unsupervised and self-learning (through reinforcement learning, generative adversarial networks, and other techniques), which makes it possible for machines to explore potential connections and discover patterns and relationships that conventional wisdom would have never considered. And far from just visualizing findings, cognitive toolsets both augment human response and potentially automate the appropriate action. Where conventional analytics focused on finding and answering known crunchy questions, cognitive looks to both spark new questions and short-circuit the handling of the finding.

But similar to the story in analytics, foundational data is a crucial dependency for cognitive. Algorithms and advanced models are dependent on trusted, accurate input. New approaches to data

management and data architecture provide more dynamic approaches to ingesting, classifying, and correlating data, using the very machine learning, natural language, and RPA capabilities upon which cognitive is built. But most organizations remain in the early days of the journey. Just as important is the broader culture and organizational dynamic. Becoming data-driven and analytically curious is hard enough; there is an extra leap of faith to allow machines to decision and actuate core business capabilities.

Source:
Deloitte
report 2019

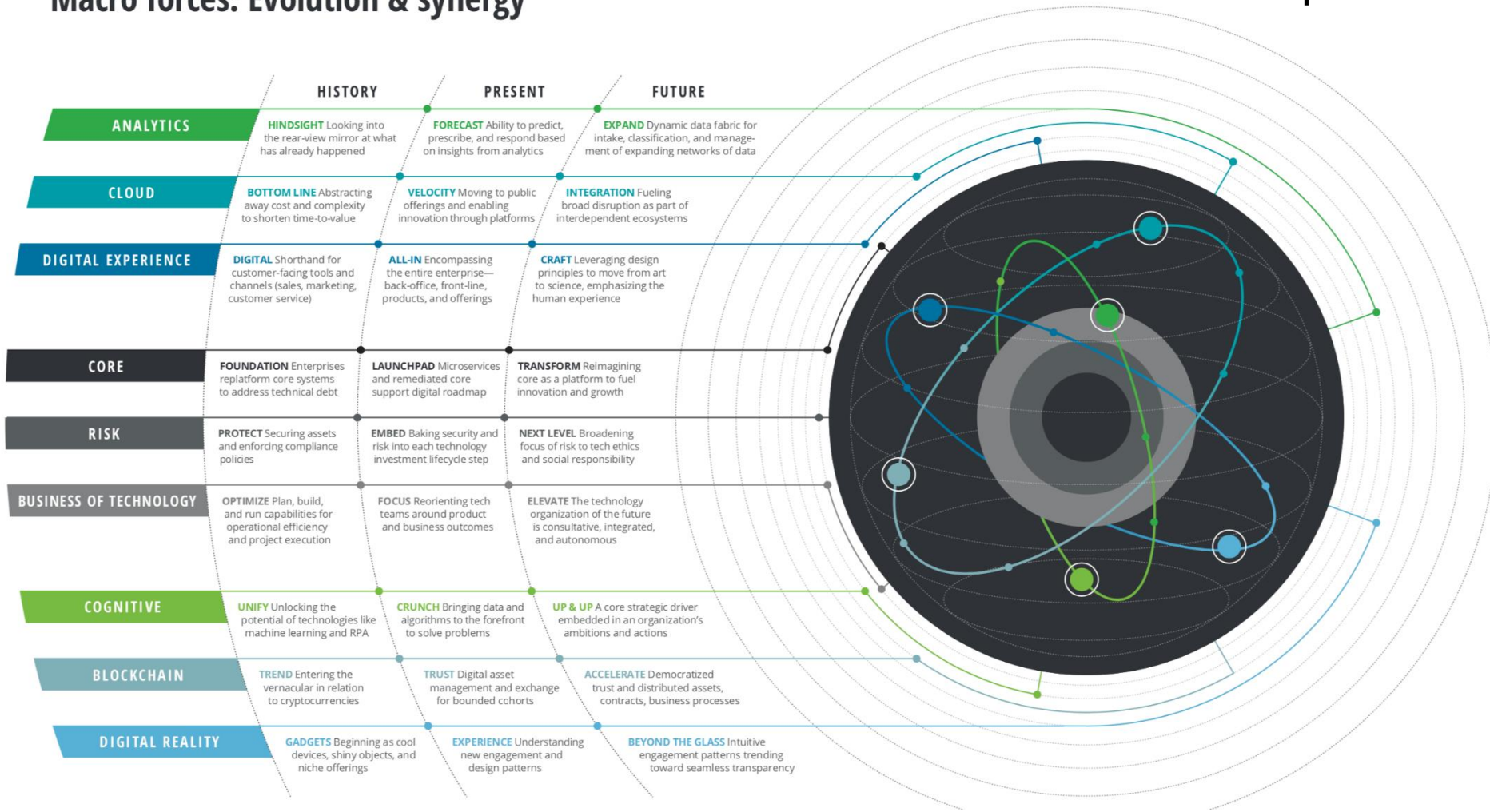


Some updates

Source:
Deloitte
report 2019

FIGURE 1

Macro forces: Evolution & synergy



Building *truly cognitive* applications

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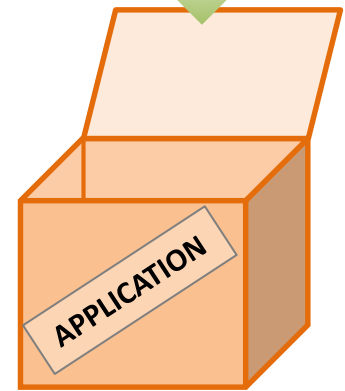
- Implementation

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DESIGN



We need a
**working
definition
of cognition**

What is cognition

- We need a working definition of cognition...
 - Why “definition” ?
 - Why “working” ?
- Properties of the idea of cognition
 - It is a kind of process
 - It is not a simple process, but a complex one
 - It is formed by a complex collection of processes
 - Called *cognitive processes*

Cognitive processes

- Cognitive processes characteristics
 - They deal with information
 - A special kind of information
 - Knowledge
- Knowledge
 - *Know* is the root of the word “knowledge”
 - It comes from the Sanskrit word *gnana*
 - *Gnana* also leads to the word *gnosis* → Greek word for “knowledge”
 - *Gnosis* leads to the Latin word *gnoscere* (to know, to learn) that led to *cognoscere* and *cognitio*

Cognitive processes

- Cognitive processes
 - Processes that deal with information
 - Build knowledge from information
 - Examples:
 - Learning process
 - Inferential process
 - Decision process
 - Application example: self-driving vehicle

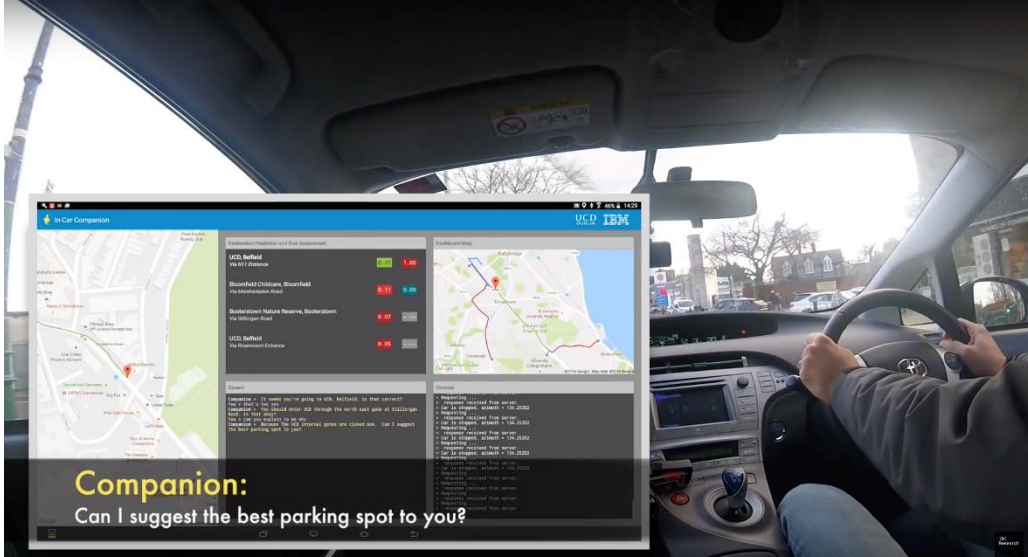
Example

What are the essential differences
Between situations A and B ?

Situation A



Cognitive In-Car Companion Live Demo



Situation B

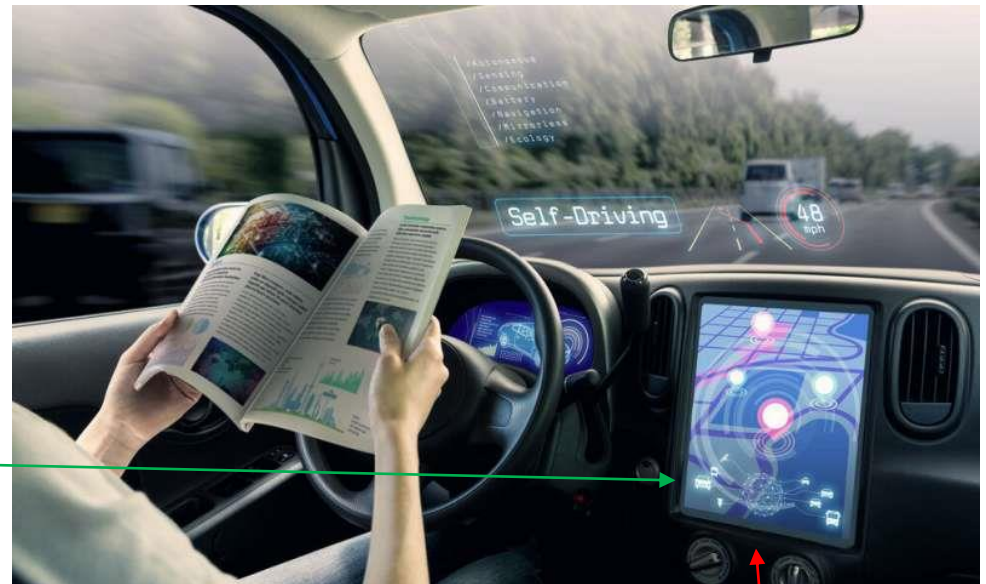
Images credits:
IBM Research - Ireland and University College Dublin

Example

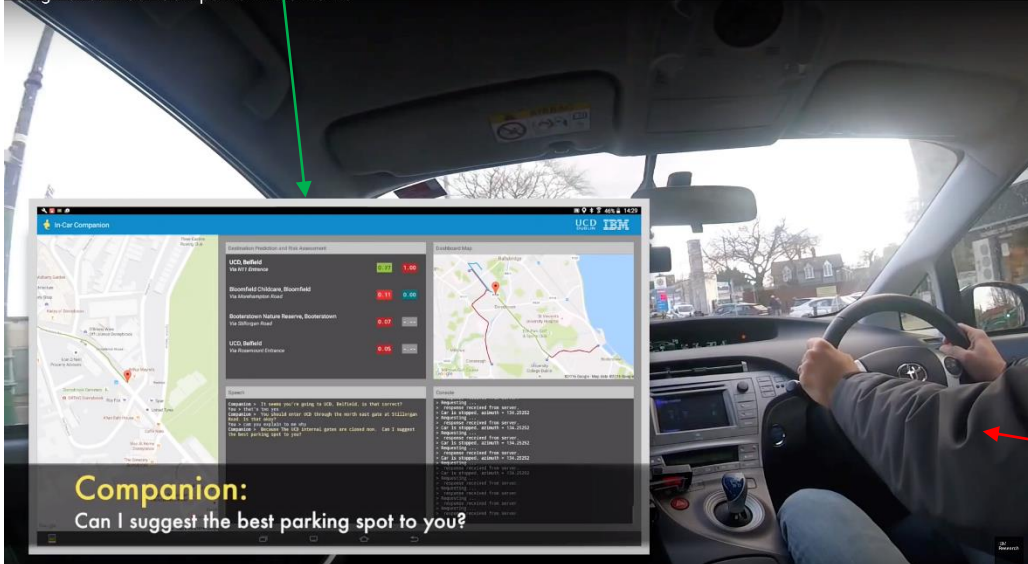
What are the essential differences
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Situation A

Knowledge source



Cognitive In-Car Companion Live Demo



Images credits:
IBM Research - Ireland and
University College Dublin

Situation B

Driving agent

Concept of cognition

- Cognition is based on cognitive processes
 - A cognitive process is a process that builds knowledge from information
 - But there's more about cognition...
- Cognition is the way to improve **autonomous action**
 - The **agent** executes the **action**...
 - ... based on the **knowledge** available
 - The agent has the autonomy

Concept of cognition (cont.)

- Working definition of cognition
 - Cognition is a system of processes that yield the **build of knowledge** and **shape its use**.
 - The processes that build knowledge are called cognitive processes.
 - So:
 - Cognition is a system of cognitive processes that shapes its use.
- Cognitive system
 - Is a system that builds knowledge.

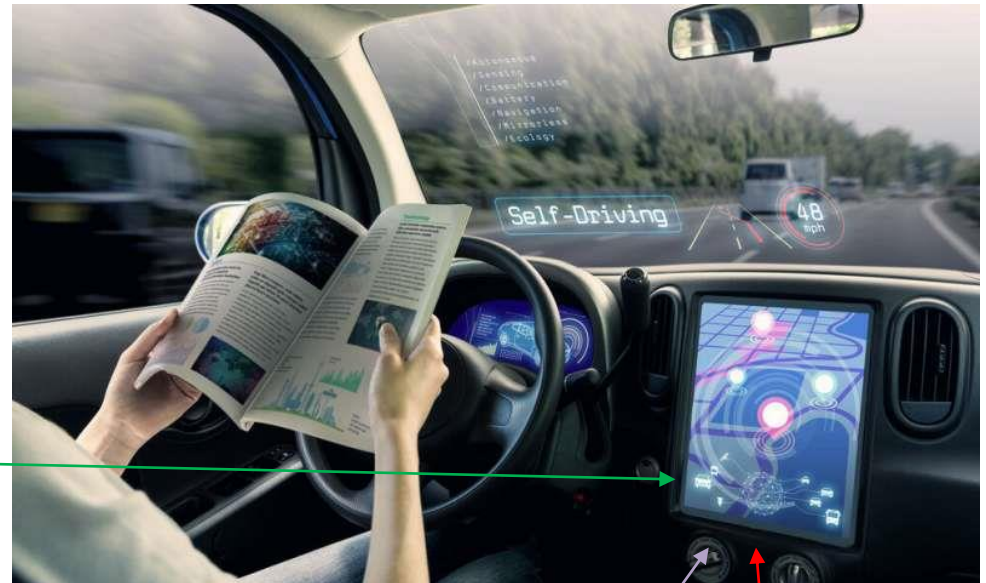
Cognitive Systems

- **Two kinds** of cognitive systems
 - Cognitive **agent**
 - Cognitive **tool**
- **Cognitive agent**
 - The agent is the entity capable of executing action
 - If the agent is capable of build the knowledge required to execute the action → cognitive agent
 - Otherwise it is a non-cognitive agent
- **Cognitive tool**
 - Is a cognitive system (builds knowledge) that doesn't execute the actions (based on the knowledge it built)
 - The cognitive tool provides knowledge to an agent to act.
 - This agent can be cognitive or non-cognitive.

Example

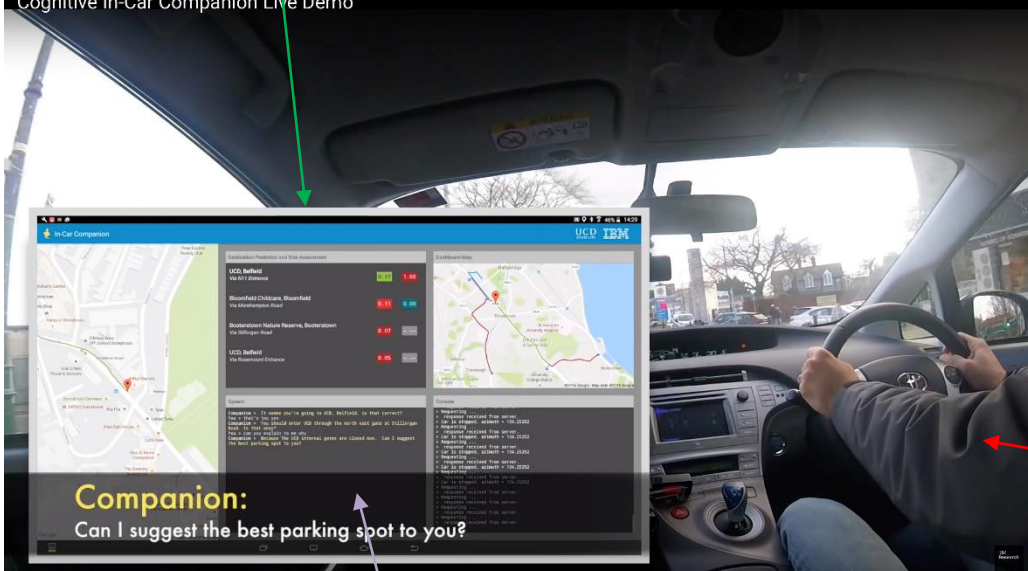
What are the essential differences
Between situations A and B ?

Situation A



Knowledge source

Cognitive In-Car Companion Live Demo



Cognitive agent

Images credits:
IBM Research - Ireland and
University College Dublin

Situation B

Driving agent

Cognitive systems

- Data analytics software are cognitive tools
 - They build knowledge for the users
 - The users are the agents
 - They will perform the actions based on the knowledge
- Exercise: what kind of cognitive systems are the following:
 - Smart voice assistants
 - Chatbots
 - Robot (autonomous)

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- What kind of
Cognitive system
the application is:
- A cognitive agent
 - A cognitive tool

Course project

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- Reference:

Kogler Jr., J.E. - *Cognitive is the new hype word* ,
available online at [Wordpress](#), April 2018.

Pdf available online at [Research Gate](#)

This is all for today.

See you next week !