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PANEL
ADAPTIVE/COGNITIVE

Challenges on Cognitive-supported Adaptation

MODERATOR:
Petre Dini, Concordia University, Canada | China Space Agency Center, China

Facts

- http://money.cnn.com/2016/02/29/autos/google-self-driving-car-accident/
- **“… on February 14, a Lexus 450 hybrid SUV with Google's self-driving technology had a scrape with a city bus in Mountain View, California, the company's hometown. It said no one was injured in the accident. "**

  "Google said the car was in the right lane of a city street, and was about to turn right. But after initially moving to the right side of the lane, it moved back to the center of the lane to avoid sand bags that had been placed around a storm drain. The bus, coming from behind, hit the left side of the car. "

  ""From now on, our cars will more deeply understand that buses (and other large vehicles) are less likely to yield to us than other types of vehicles, and we hope to handle situations like this more gracefully in the future," said the company. "

Ideas | Starting points

On adaptive-cognitive

→ Adaptation: technology, legislation, social behavior, ….

→ Cognition: time-sensitive decisions, cross-domain logic, self-learning,…

One facet

Adaptation, in general, is
- **either an entity to an environment (e.g., an application to an operating system, a car speed to the status of the asphalt, etc.)**
- **or, an environment to a set of users (e.g., as set of rules based on users' behavior, a marketing style, or a produce cost, based on customers' reaction, etc.)**

From the cognitive perspective, humans have a special perception, including
- **feeling**
- **intuition,**
- **extrapolation**
- **logic**
- **etc.**

We would like to identify whether some particular behaviors might/can/should drive adaptation rules.

In other words, how do cognitive aspects influence particular decisions on adaptation, at an entity level, system level, or simply, in general?

Are there some practical situations?

Are there particular thresholds of facts?

Are there some priorities?

Does the previous experiences/facts influence in any (and how) sense a decision?

Panelists

Moderator

Petre Dini, Concordia University, Canada | IARIA, USA

Panelists

- Yara Khaluf, Ghent University, Belgium
  [The interplay of exploration and exploitation to achieve adaptivity in robot swarms]
- Charlotte Sennersten, University of Tasmania & CSIRO-Data61, Australia
  [Can a dynamic 3D indexation system support local and global adaptation? | mine drones]
- Sew Bun Foong, IBM | National University of Singapore, Singapore
  [Co-value creation could become an important trait of behavior which fuels open service system innovation on a massive scale. Could we institutionalize this trait computationally in a highly connected eco-systems of systems? If so, how does this change human-computer interactions?]
- Petre Dini, Concordia University, Canada | IARIA, USA
  [Driverless cars | achievements and challenges | commercial values]

Open discussion

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Service Systems Innovations with Cloud and Cognitive Computing

Sew Bun Foong

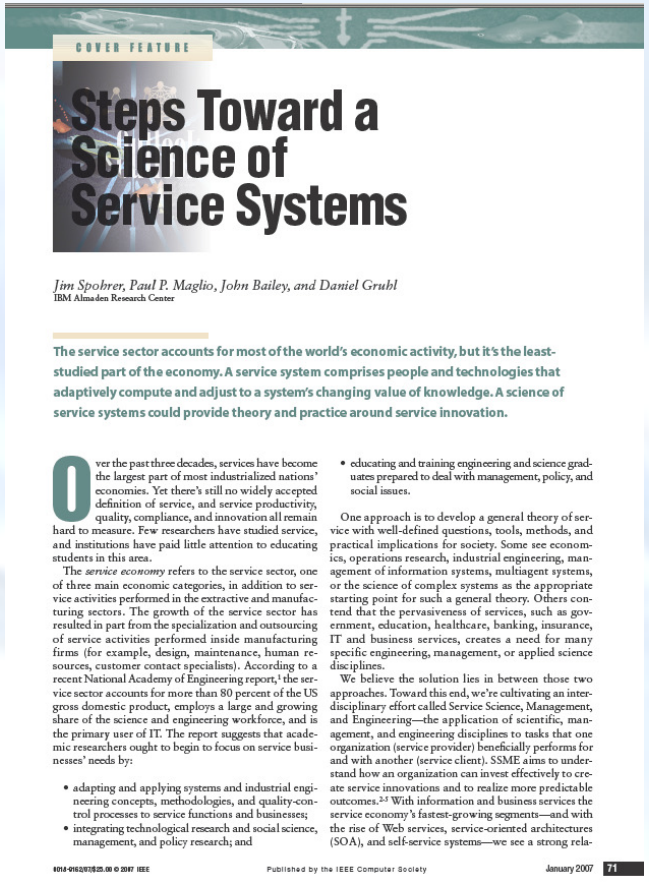
IBM Distinguished Engineer and Lead Cloud Advisor, IBM Cloud

Adjunct Professor, National University of Singapore

Sew Bun Foong
IBM Distinguished Engineer, Lead Cloud Advisor, IBM Cloud
Adjunct Professor, National University of Singapore

- Named IT Professional of the Year (Technology) by Singapore Computer Society (2016), one of 50 featured in SG50 – A Nation of Skilled Talents
- Lead Cloud Advisor of IBM Cloud (since 2015)
- Chief Technology Officer of IBM ASEAN and IBM Singapore (2007-2015)
- Named IBM Distinguished Engineer (2007/2008)
- IBM Academy of Technology Leadership Team, Chair of IBM Distinguished Engineer Board in Growth Market Unit
- Serves on Keppel Corp Technology Advisory Panel and several academic and government advisory committees
- Banking, Defense, Healthcare institutions

Recollection: Service System (Spohrer et. al.)



COVER FEATURE

Steps Toward a Science of Service Systems

Jim Spohrer, Paul P. Maglio, John Bailey, and Daniel Gruhl
IBM Almaden Research Center

The service sector accounts for most of the world's economic activity, but it's the least-studied part of the economy. A service system comprises people and technologies that adaptively compute and adjust to a system's changing value of knowledge. A science of service systems could provide theory and practice around service innovation.

Over the past three decades, services have become the largest part of most industrialized nations' economies. Yet there's still no widely accepted definition of service, and service productivity, quality, compliance, and innovation all remain hard to measure. Few researchers have studied service, and institutions have paid little attention to educating students in this area.

The *service economy* refers to the service sector, one of three main economic categories, in addition to service activities performed in the extractive and manufacturing sectors. The growth of the service sector has resulted in part from the specialization and outsourcing of service activities performed inside manufacturing firms (for example, design, maintenance, human resources, customer contact specialists). According to a recent National Academy of Engineering report,[1] the service sector accounts for more than 80 percent of the US gross domestic product, employs a large and growing share of the science and engineering workforce, and is the primary user of IT. The report suggests that academic researchers ought to begin to focus on service businesses' needs by:

- adapting and applying systems and industrial engineering concepts, methodologies, and quality-control processes to service functions and businesses;
- integrating technological research and social science, management, and policy research; and
- educating and training engineering and science graduates prepared to deal with management, policy, and social issues.

One approach is to develop a general theory of service with well-defined questions, tools, methods, and practical implications for society. Some see economics, operations research, industrial engineering, management of information systems, multiagent systems, or the science of complex systems as the appropriate starting point for such a general theory. Others contend that the pervasiveness of services, such as government, education, healthcare, banking, insurance, IT and business services, creates a need for many specific engineering, management, or applied science disciplines.

We believe the solution lies in between those two approaches. Toward this end, we're cultivating an interdisciplinary effort called Service Science, Management, and Engineering—the application of scientific, management, and engineering disciplines to tasks that one organization (service provider) beneficially performs for and with another (service client). SSME aims to understand how an organization can invest effectively to create service innovations and to realize more predictable outcomes.[2,3] With information and business services the service economy's fastest-growing segments—and with the rise of Web services, service-oriented architectures (SOA), and self-service systems—we see a strong rela-

0018-9162/07/$25.00 © 2007 IEEE Published by the IEEE Computer Society January 2007

IEEE Computer, Jan 2007

- **Service systems are value co-creation configurations of people, technology, internal and external service systems connected by value propositions and shared information (such as language, laws, measures, models)**

- **Service systems are designed**
  - **computer systems**
- **Service systems evolve**
  - **linguistic and social systems**
- **Service systems have scale**
  - **emergent properties**
  - **economic systems**

Recollection: What is "cyber-coated reality" like?

- From Bacteria to "nervous-system-coated reality"
- From Simple Machines to "cyber-coated reality"
- Complex Adaptive Systems with moral entity?
  - Physical systems
  - Chemical systems
  - Biological systems
  - Social systems
  - Socio-technical systems
  - Physical symbol systems
  - Cognitive systems
  - Service systems
    - Capabilities & Constraints
    - Rights & Responsibilities
  - Smart service systems
    - AKA "cognitive service systems"
  - Wise service systems

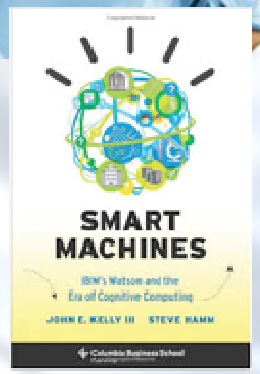
Source teachersparadise.com

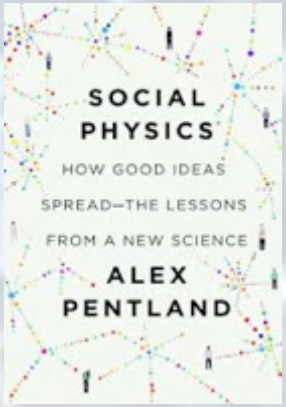
Recollection: Grand Challenges

Data Sets, Tools & Services

- **Artificial Intelligence**
  - Cognitive Sport & Games
  - Deep Blue (Chess)
  - Watson (Jeopardy!)
  - Robocup
  - TradingAgents
  - DARPA Grand Challenges
  - NIST Competitions
  - Hutter Prize
  - Loebner Prize

- **Intelligence Augmentation**
  - Pass professional certification exams
  - Improve performance – both productivity and creativity
    - Problem-solving professionals
    - Researchers
    - Research Teams
    - Research Universities
    - Regions
    - Cognitive Enterprise

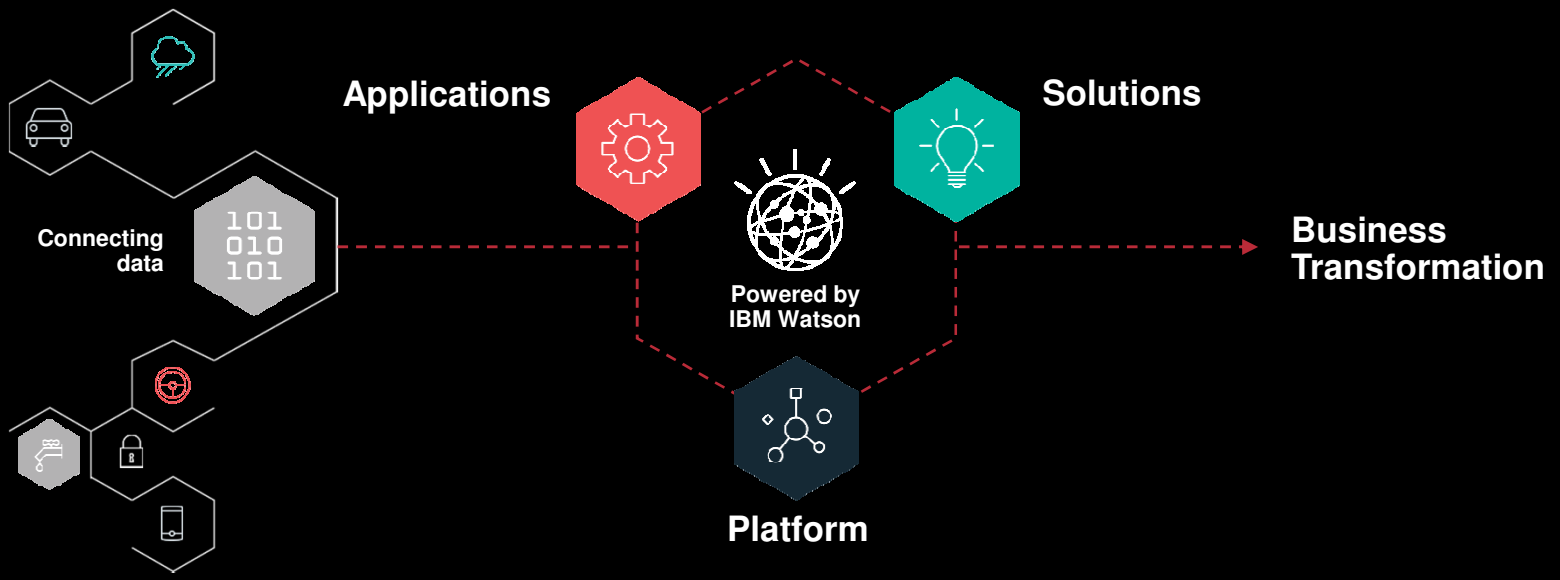




Adaptive Cognition of Systems

- From an entity like a car/drone, towards a cognitive system of a car/drone and co-value creation with other systems

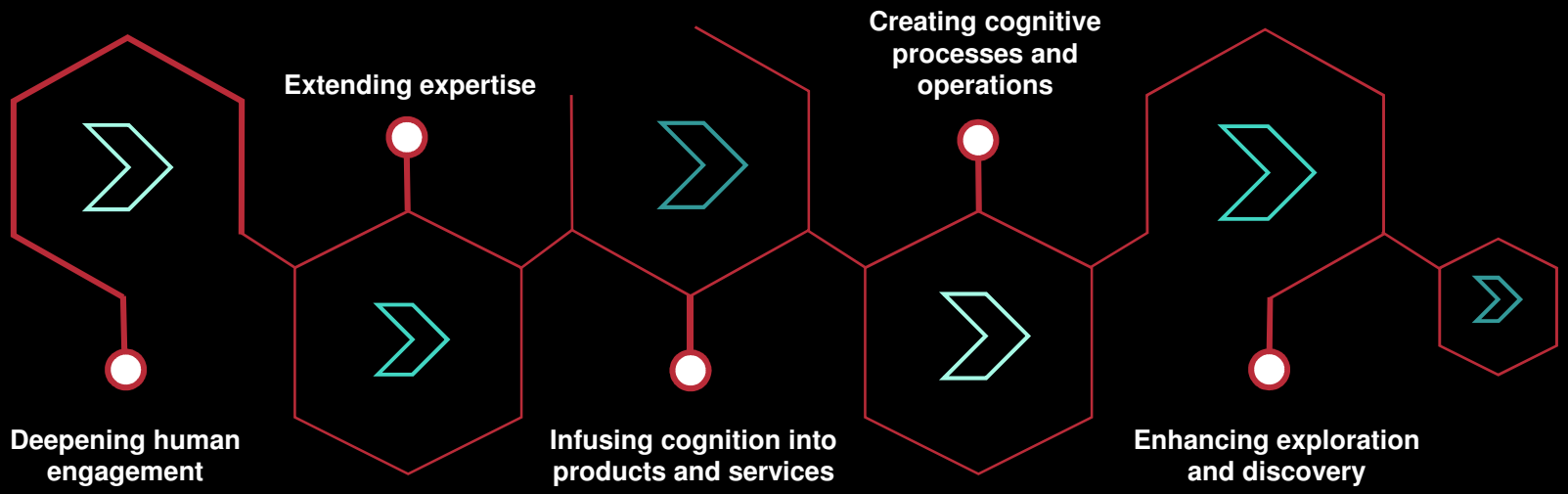
Adaptive Cognition IoT of Systems – Handling not just Data but Complexity to Value Co-Creation



Adaptive Cognition IoT of Systems – Handling not just Data but Complexity to Value Co-Creation

Adaptive Cognition IoT of Learning and Responsible Systems

- Interaction among humans and machines
- Sharing expertise among humans and machines
- Understand your intent
- Embedding intelligence into every device from clouds
- Co-value creation into business and industrial processes



CSIG: Cognitive Systems Institute Group

- **LinkedIn discussion**
  - **Cognitive-Systems-Institute-6729452**
- **Web site for resource sharing**
  - **cognitive-science.info**
- **Bluemix**
  - **ibm.biz/HackBluemix**
  - **ibm.biz/LearnBluemix**
  - **$0.07 per GB-Hour (*)**

*** = check online for current pricing info**

DATA 61

PANEL on ADAPTIVE/COGNITIVE

Topic: Challenges on Cognitive-supported Adaptation

Dr. Charlotte Sennersten | Can a dynamic 3D indexation system support local and global adaption?

March 24, 2016

www.csiro.au

CSIRO

Short Bio:

BICT, MCogSc and PhDComputerSc.

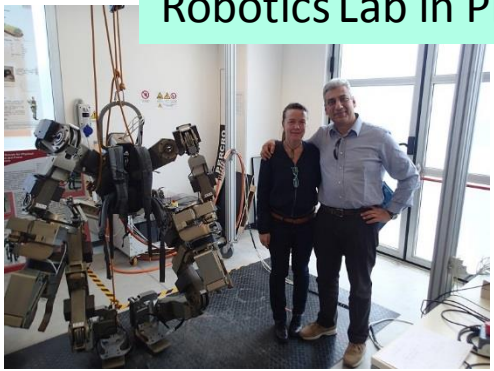
Currently a CSIRO Data61 PostDoc Researcher formally belonging to the Robot Systems Team in the 'Connecting to the World Research Program' and working in the 3D Systems Team for the 'Decision Sciences Program' in Australia.

Before:

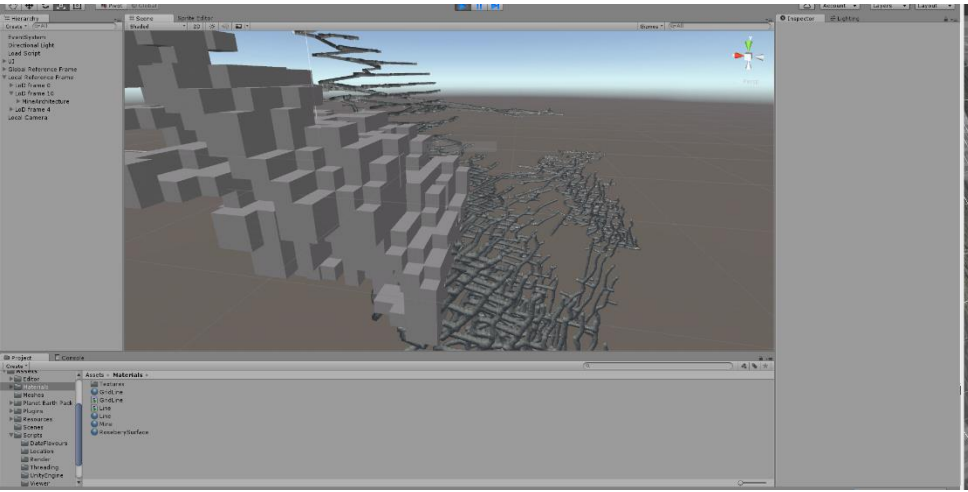
Entertainment Industry Massive/Ubisoft –build up a lab with eye tracking and physiological logging in relation to team play.
(Today Ubisoft's Tom Clancy game is implemented with Tobii eye gaze input for gameplay, …)
Defence Research (Aviation -fast paced decisions and training evaluation –HIFI engine, ARMA engine, …)
Been part of developing 3 major 3-year bachelor programs in Sweden, still running (2001-…):

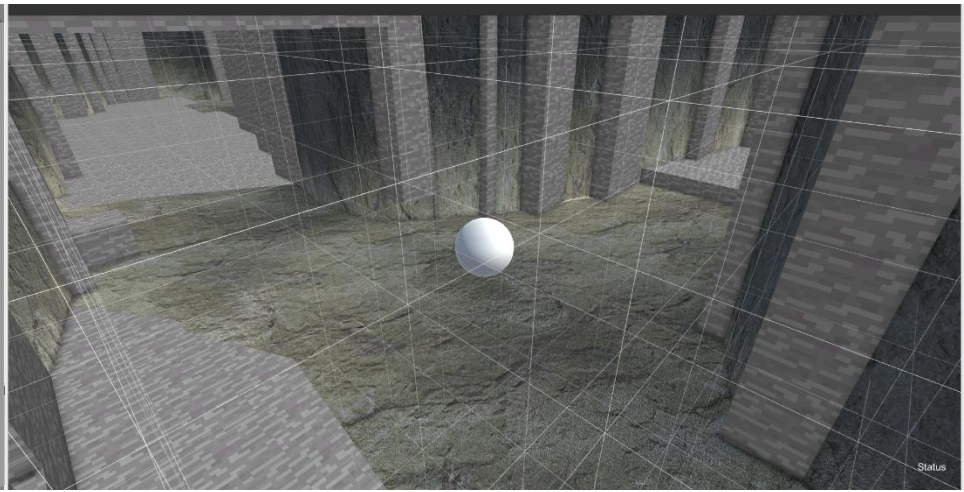
- Game Programming with Game Design
- 3D Graphics with Game Design
- Technical Artist

Robotics Lab in Pisa, Italy (2014).



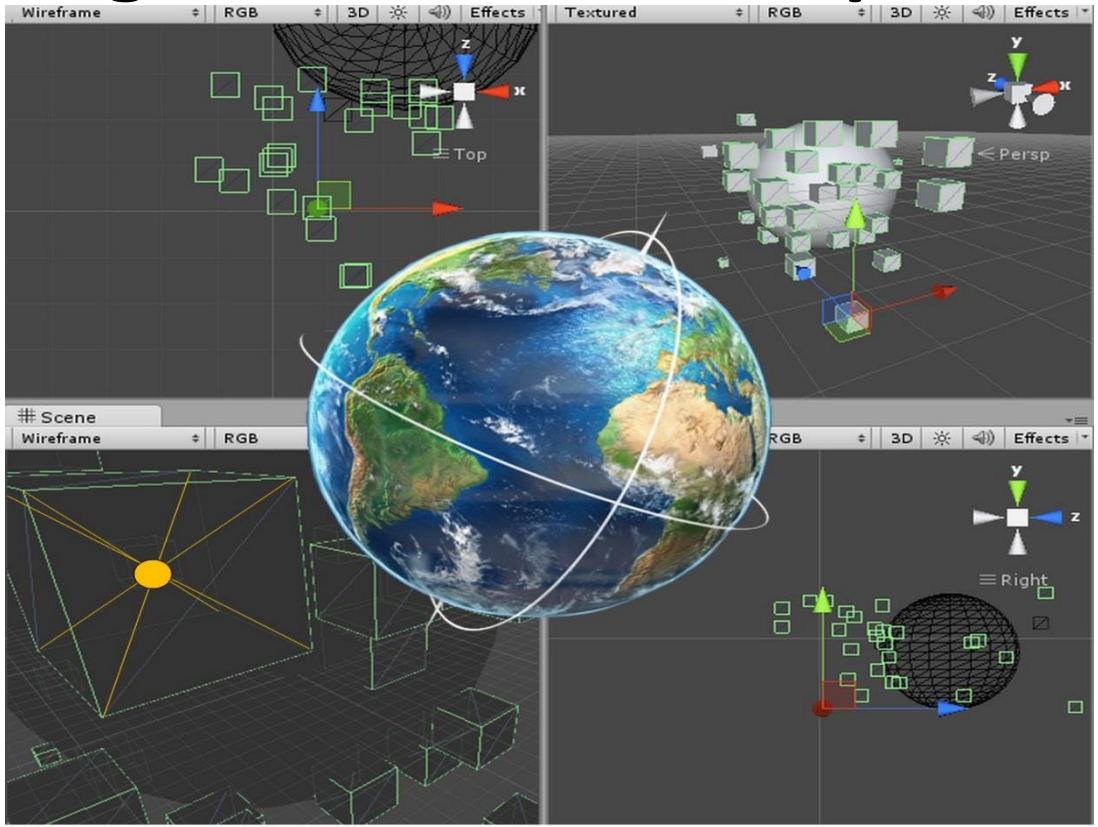
A dynamic 3D indexation system

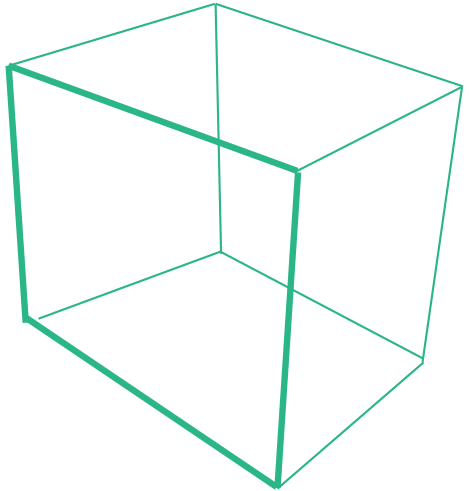




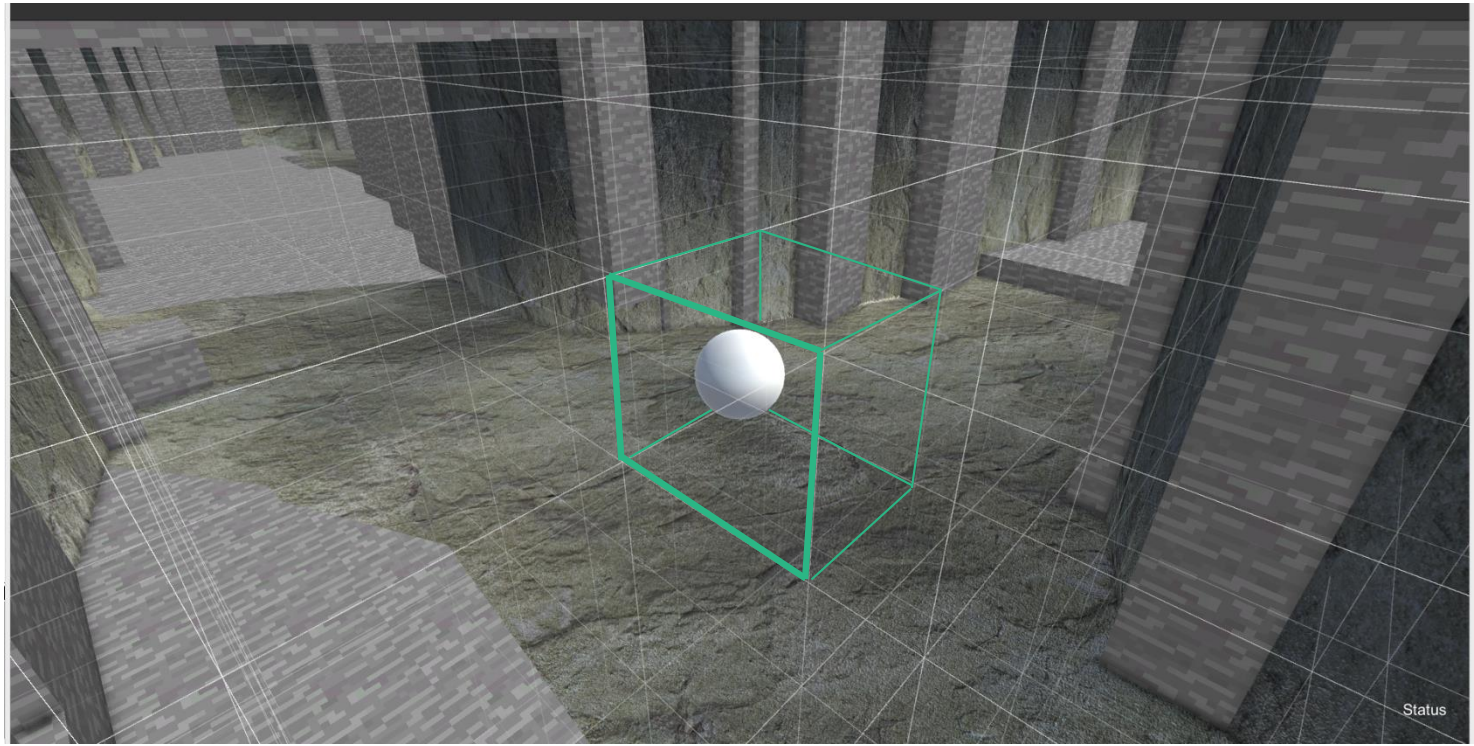
Degree of Local Adaptation

Degree of Global Adaptation





Degree of Global Adaptation



DATA 61

Thank you!

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CSIRO

Petre Dini - Panelist

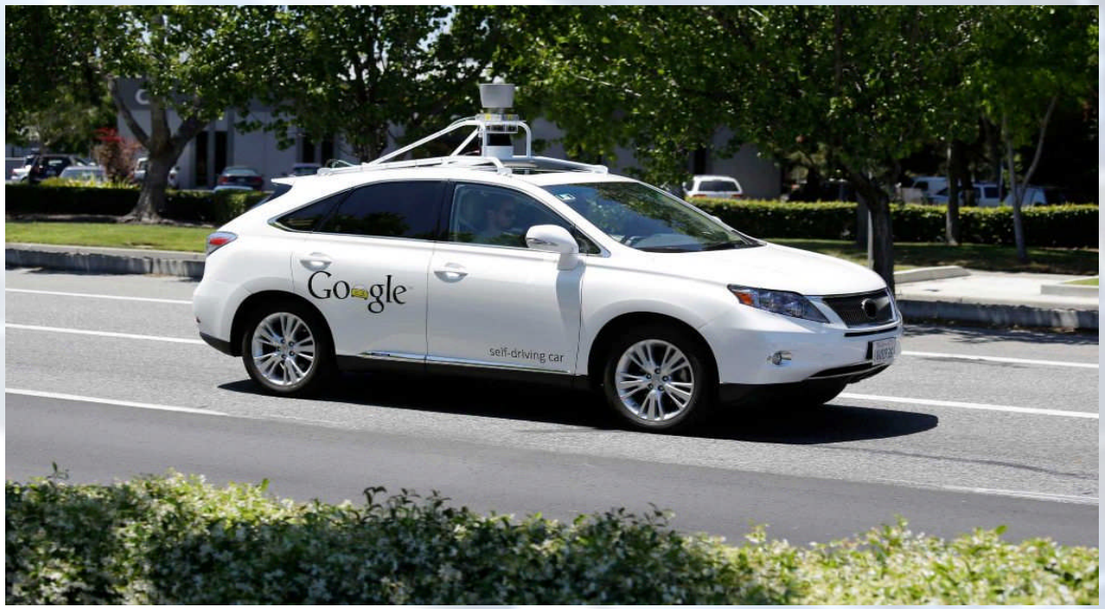
Issues and Achievements on Driverless Cars

Petre Dini, Concordia University, Canada | IARIA, USA

Self-driving I *Legal aspects*

- **Driverless car journey starts in Las Vegas**
- ***Published 7:59 pm, Friday, May 30, 2014***
- **http://www.timesunion.com/business/article/Driverless-car-journey-starts-in-Las-Vegas-5517869.php#photo-6379150**
- **The Nevada Legislature and the Department of Motor Vehicles have enacted legislation and regulations to enable the testing and operation of autonomous vehicles in the Silver State. Currently, the DMV is accepting applications for testing only. Autonomous vehicles are not available to the general public.**

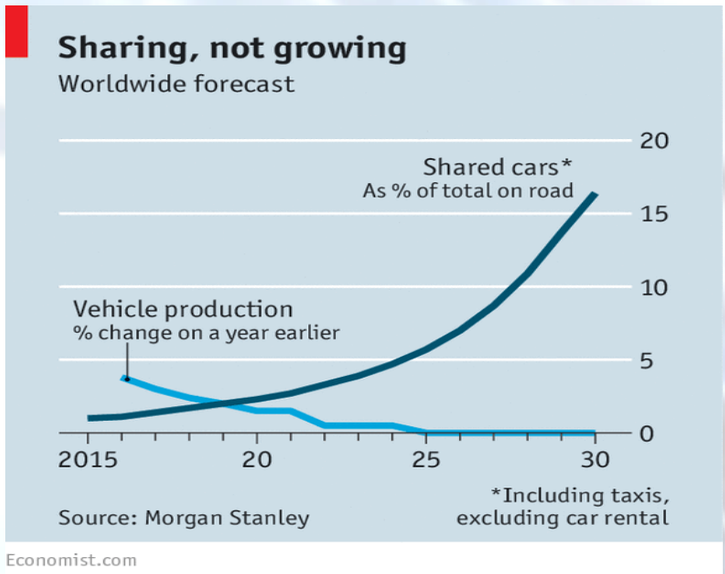
- **http://www.dmvnv.com/autonomous.htm**



Self-driving II | *Partnership and Incentives*

Partnership
http://www.economist.com/news/business/21685459-carmakers-increasingly-fret-their-industry-brink-huge-disruption

"A rumored tie-up between Ford and Google to produce driverless cars failed to materialize at the show, but even the rumors underlined the disruption that tech firms are bringing to the motor industry. And other partnerships were announced: Ford is teaming up with Amazon to connect its cars to sensor-laden smart homes. It was also revealed at CES that Toyota would adopt Ford's in-car technology, which is a competitor to Apple's CarPlay and Google's Android Auto, to access smartphone apps and other features."



"So when will the fully autonomous car hit the showrooms? Google, whose cars have done 1.3m test miles (2.1m km) on public roads, once promised 2018, whereas most analysts reckoned the 2030s more plausible as carmakers introduced automated-driving features in stages.
Barclays, another bank, forecasts that the fully driverless vehicle will result in the average American household cutting its car ownership from 2.1 vehicles now to 1.2 by 2040. A self-piloting car may drop off a family's breadwinner at work, then scuttle back to pick up the kids and take them to school. The 11m or so annual sales of mass-market cars for personal ownership in America may be replaced by 3.8m sales of self-driving cars, either personally owned or part of taxi fleets, Barclays thinks.
Driverless cars still have problems in bad weather. They may struggle to recognize that light shining off a puddle is harmless or guess that a pedestrian is about to step into the traffic without looking. But sophisticated systems for hands-free driving on motorways, and for automated parking, are already available on a number of manufacturers' models. Fully driverless cars will ferry workers round GM's technical centre in Detroit in late 2016."

Self-driving III | *Drones + IoE*

- **CES 2016: drones, driverless cars and smart brewers**
- **http://www.telegraph.co.uk/technology/ces/12081995/CES-2016-drones-driverless-cars-and-smart-brewers.html**
- **Beyond the Internet of Everything, drones took centre-stage. The Telegraph's picks of drones on the showfloor include winner of the CES 2016 Innovation Award, Lily Robotics which makes a "throw-and-shoot camera" – a 2.8 pound camera drone ($799, shipping begins in February 2016), which follows the user via a tracking device.**

"Chinese drone giant DJI showcased its new Phantom 3 4K – its first-ever sub-$1000 drone with a 4K camera and WiFi transmission upto 1.2km.
And finally, popular drone-maker Parrot showed its giant Disco Drone – a 50-miles-per hour sleek fixed-wing aircraft with a 1080p camera onboard, weighing just 700 grams. When the show opens officially on Wednesday, there will be an Unmanned Systems marketplace, with 26 different exhibitors."

Self-driving IV | *Computing for vehicles*

Connected cars

http://www.telegraph.co.uk/technology/ces/12081995/CES-2016-drones-driverless-cars-and-smart-brewers.html

- **That prophecy has already started to fulfill itself – GPU chip maker Nvidia kicked off the week's keynote speeches with the announcement of its "supercomputer" for driverless cars. This new system apparently has power equivalent to 150 Macbook Pros, squeezed into a lunchbox-sized case and can tell apart cars, humans and street signs.**
- **Its supercomputer is already being tested in cars by companies ranging from Volvo to BMW, Daimler, Ford and Audi, which managed to train its cars to read German road signs better than any other computer, and even humans could.**
- **Nvidia wants to supercharge the self-driving car phenomenon by launching a supercomputer designed specifically for the vehicles.**

The Faraday Future Zero 1 concept car was unveiled at the Consumer Electronics Show in Las Vegas, Jan. 4, 2016. Photo: David Gilbert

Drive and Steer by Web / *e-Vehicle*

http://www.altreonic.com/content/steer-web-kurt

Altreonic has demonstrated for the first time "steer by web“ capability for its KURT vehicle.

Using a camera input and a smartphone, the vehicle was remotely steered over Internet using a web application. Even with the application server and the vehicle being widely apart (about 3000 km) and using a standard ADSL connection, the control was with minimal delay.

This brings KURT in the domain of Internet of Things, enabling semi-autonomous driving for a fleet of KURT vehicles.

events (March 2016)

http://www.citycarsummit.com/ http://www.autotechnica.be/en

→ **urban mobility (uncontrolled behavior of the pedestrian crowd, driverless, drones,…)**

→ **driverless cars, e-vehicle, exceptions handling**

→ **special regulations**

To be done

- Legal back-up and regulations
- Social acceptance
- Cognition/adaptation advanced theory/algorithms
- Encouraging partnership/incentives
- Specialized/high performance computing devices
- Appropriate monitoring/surveillance infrastructures
- Urban computing to be carefully supported
- Continuously revisiting progress/issues
- Governmental enforced regulations

Thanks

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The interplay of exploration and exploitation to achieve adaptivity in robot swarms

Panelist: **Yara Khaluf**

Ghent University

22.03.2016

@ ADAPTIVE, Rome

Exploration

- Involves searching for new solution. It is a risky behavior that can stabilize the system.
- However, exploration allows the system to adapt to dynamic changes in the environment.

Exploitation

- Involves the use of the information made available by other individuals.
- It helps the system to converge faster and to stabilize.
- However, it risks the ability of the system to adapt and may lead to be locked in a local minima.

Exploration and Exploitation in Swarm Intelligente

Ant Colony Optimization (ACO)

M. Dorigo, Optimization, Learning and Natural Algorithms, PhD thesis, Politecnico di Milano, Italy, 1992.

Exploration Exploitation

$$p_{ij}^{k}(t)=\frac{[\tau_{ij}(t)]^{\alpha}\cdot[\eta_{ij}]^{\beta}}{\sum_{l\in N_i^k}[\tau_{il}(t)]^{\alpha}\cdot[\eta_{il}]^{\beta}},\quad if\quad j\in N_i^k$$

Particle Swarm Optimization (PSO)

Kennedy, J.; Eberhart, R. (1995). "Particle Swarm Optimization". Proceedings of IEEE International Conference on Neural Networks. pp. 1942–1948.

$$v_i^{t+1} = v_i^t + \psi_1 U_1^t(pb_i^t - x_i^t) + \psi_2 U_2^t(lb_i^t - x_i^t)$$

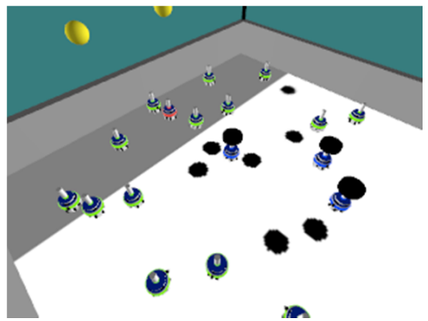
Inertia — Exploration

Personal influence — Exploitation

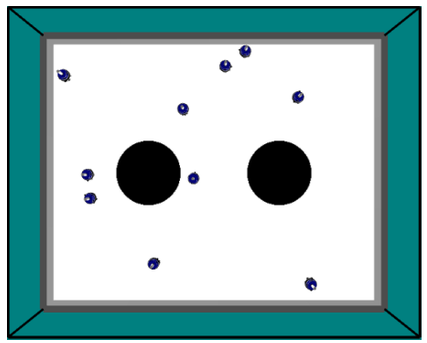
Social influence — Exploitation

Exploration and Exploitation in Swarm Intelligente - Robotics

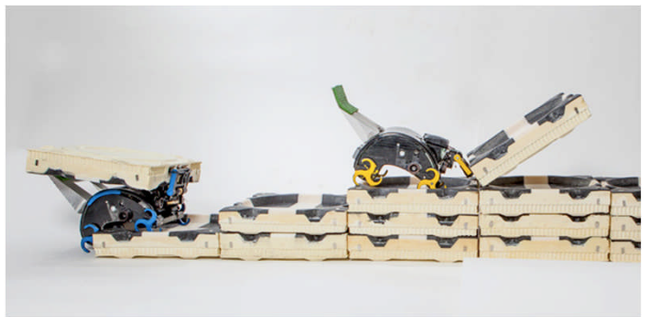
Foraging



Aggregation



Collective Construction



Need to be Done

1. Explore other potentially existing solutions.

1. Trigger the exploration that results in adaptivity.

1. Balance the exploitation and the exploration tendencies.

Thanks for your attention