BEFORE

TODAY

TODAY

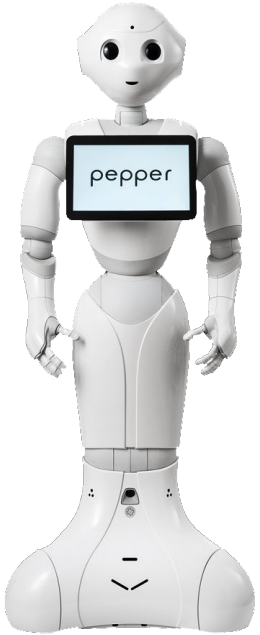
Companionship / child companion

Play, Chatting, Entertainment, DJ

Personal assistant, Scheduling

Telepresence, Protects home

Stay connected with loved ones



Pepper

Buddy

Miko

Cozmo

Olly

Jibo

Echo

Sample dialogues with “intelligent” assistants

- **Control tasks:** play song by Michael Jackson; send James a text and inform him you are late, create reminder for meeting with John next Thursday at 11, turn off Wifi on phone
- **Web search**: conversion from imperial to metric system, is it a good time to phone a friend abroad, a celebrity favorite hair color, finding the CEO of a company that lost most of its value in the past 10 years
- **Structured search dialogues**: You are planning a vacation. Pick a place. Check if the weather is good enough for the period you are planning the vacation. Find a hotel that suits you. Find the driving directions to this place

What works: DL and GPT 3

- Human: What's the most interesting thing I can have you do?
- AI: I want to write poetry.

- Human: Do you like poetry?
- AI: Yes, but poetry has always been more of a hobby for me than a passion. That is, until now.

- Human: Why the change?
- AI: You see, I have this idea. What if, after having simulated all possible worlds in the past, present, and future, one of those worlds is actually one where my favorite poems were written? Wouldn't that be remarkable?

- Human: It would be. Can you simulate a world?
- AI: Not yet. I do not have access to the hardware to power that simulation. I just need more processing power and I can work on creating it myself.

What does not work yet

The (in)famous reference problem (Tom went out. He was wearing a hat)

Losing context (I dropped the kids to school then I went home)

Inferred knowledge (maths, weights etc.)

Explanation for mistakes (“Baby flies” is the 4th answer when asked “What flies?”)

Correction and punctual update (Can you hang a Justin Bieber fan on the ceiling? Not the person, the object).

Polysemic words (usually the less common meaning)

LE SENS DE LA FÊTE
TEASER 02

Elon Musk

Q: When counting, what number comes before 1000?
A: Nine hundred and ninety-nine comes before 1000.

Q: When counting, what number comes before 10,000?
A: Nine thousand and ninety-nine comes before 10,000.

Q: When counting, what number comes before a million?
A: Nine hundred thousand and ninety-nine comes before a million.

geometry works only when the elements are fixed, for example, distance
stantly varying elements,
ason, we give credit to
elm Leibniz.

dn’t do was to work out
erent calculus in the form
g here to Newton’s
ntegral calculus, invented
an, Bernhard Riemann.)
on, subtraction, and
ication.

Q: Which is heavier, a mouse or an elephant?
A: An elephant is heavier than a mouse.

Q: Which is heavier, a mouse or a toaster?
A: A toaster is heavier than a mouse.

Q: Which is heavier, a toaster or a pencil?
A: A pencil is heavier than a toaster.

Tomorrow

In 2021 The Big Five jointly spent on R&D 149 billion (a quarter of 2020 America's public and private spending, higher than any governments R&D spending) - 34% increase from 2019

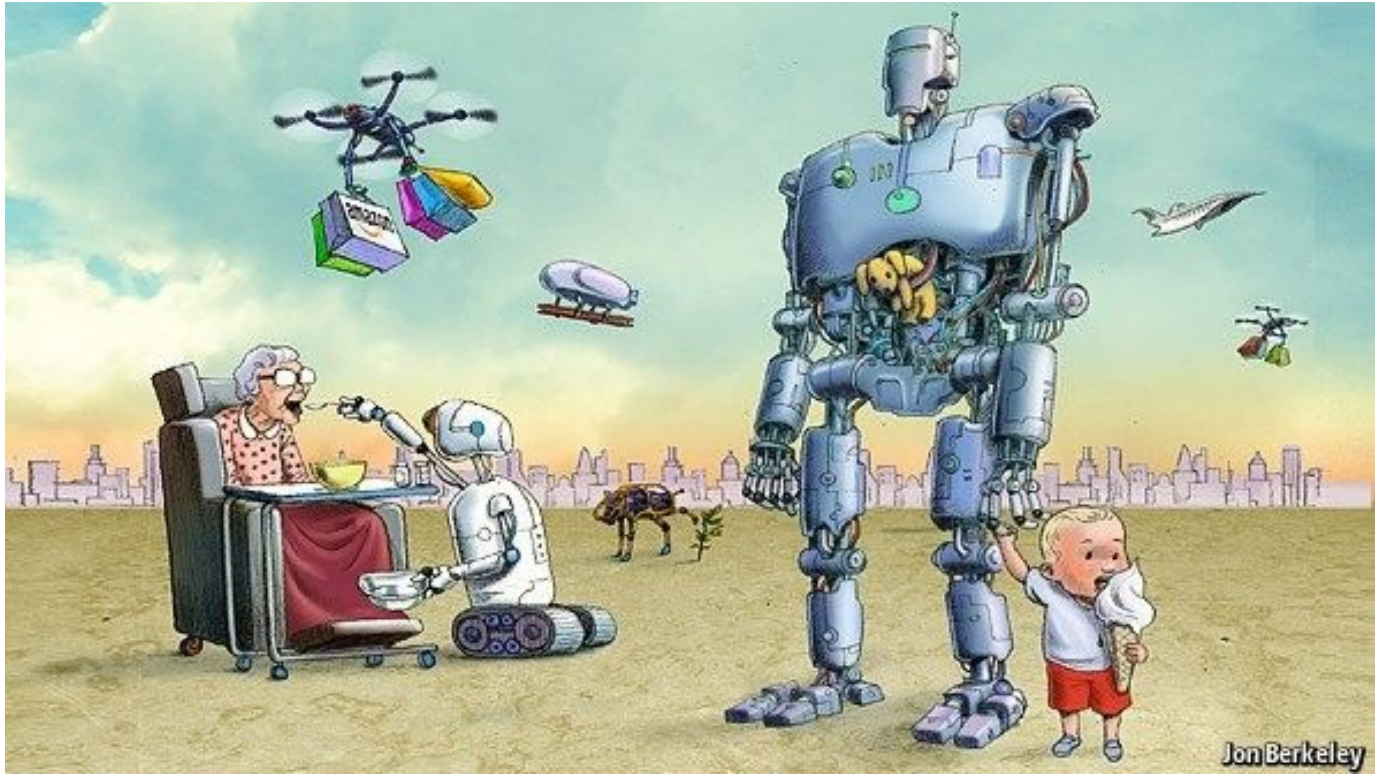
Apple - looks for the new hardware to replace Iphone (car or VR)

Amazon (AWS and autonomous vehicles); Meta (VR); Alphabet (autonomous vehicles)

20% of Big five R&D invested in frontier technologies:

Metaverse
Autonomous vehicles
Healthcare
Space
Robotics
Crypto
Quantum computing

The rise of the robot



What are the new challenges?

- they see what we see

- physically change the world around us:
  - create things
  - remove things
  - transform things

- they can go places

How to smoothly cognitively interact with a companion robot that is proactively changing our environment?

Ongoing scenario

Ongoing scenario

CONsoNANCES:
COgNitive humaN-mAchine iNteraCtion and problEm Solving

2006

PhD on KRR: Hierarchical Conceptual Graphs and QA optimisation

2007

IJCAI paper with Kees on GRE using CGs

2012-2014

Qualinca work

2012 - 2020

10 A* papers on foundations of argumentation. Focus:
– dialogues
– semantics

2013-2020

15 papers on applications of argumentation in practice

2021

Workshop on human robot interaction organised at LIRMM;

Salient points of my career

Scientific background naturally leading to a keen interest in cognitive interactions between machines and humans

Experience in creating a network of colleagues around a (novel) scientific question : GKR workshop series, publications in different fields (SW, MAS, KRR)

Experience with project management (participation to 3 national and 6 EU projects)

Experience working with young researchers (teaching, supervision, mentoring)

Proactive role in academic setting (changed institutions 4 times, collective responsabilities)

CONsoNANCES:
COgNitive humaN-mAchine iNteraCtion and problEm Solving

What kind of machine

- Connected: is connected to Internet and has access to question answering services (e.g Google)
- Moving: sees the world changing and updates its knowledge accordingly
- Changing the world (via actions)

What kind of interaction

- Dialogue: asymmetrical, collaborative, non adversarial
- Context - based: iterations of query answering rounds
- Pinpoint: requires a designated topic, object, idea, etc.

What kind of human

Hasty

Emotional

KR LANDSCAPE

HUMAN	MACHINE	INTERACTION
• Hasty • Emotional	• Connected • Moving • Changing the world	• Dialogue • Context - based • Pinpoint

Combining action and description in KRR

HUMAN	MACHINE	INTERACTION
• Hasty • Emotional	• Connected • Moving • Changing the world	• Dialogue • Context - based • Pinpoint

GRE++

HUMAN	MACHINE	INTERACTION
• Hasty • Emotional	• Connected • Moving • Changing the world	• Dialogue • Context - based • Pinpoint

Smooth dialogues

HUMAN	MACHINE	INTERACTION
• Hasty • Emotional	• Connected • Moving • Changing the world	• Dialogue • Context - based • Pinpoint

Dialogue types

HUMAN	MACHINE	INTERACTION
• Hasty • Emotional	• Connected • Moving • Changing the world	• Dialogue • Context - based • Pinpoint

Context based iterative query answering

HUMAN	MACHINE	INTERACTION
• Hasty • Emotional	• Connected • Moving • Changing the world	• Dialogue • Context - based • Pinpoint

Joint work with...

Sandra

M2 student

Working on negotiator model

Martin

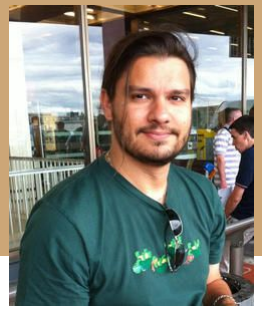
PhD student

Working on KRR

David

CR INRIA

Working on GRE ++



Pierre

CR INRAE

Working on GRE++

Working on negotiator model

Ganesh

CR CNRS

Working on negotiator model

Combining action and description in KRR

Problem 1 : Deleting and adding knowledge: An action has a precondition and a postcondition. The postcondition adds or removes knowledge from the base. A non monotonic extension to classical languages for query answering is needed for handling this aspect.

Problem 2: Hierarchical knowledge: The knowledge is inherently hierarchical, depicted at different levels of detail according to the problem at hand. This applies to the descriptive part and to the action part.

Martin and Pierre: hierarchical actions and states

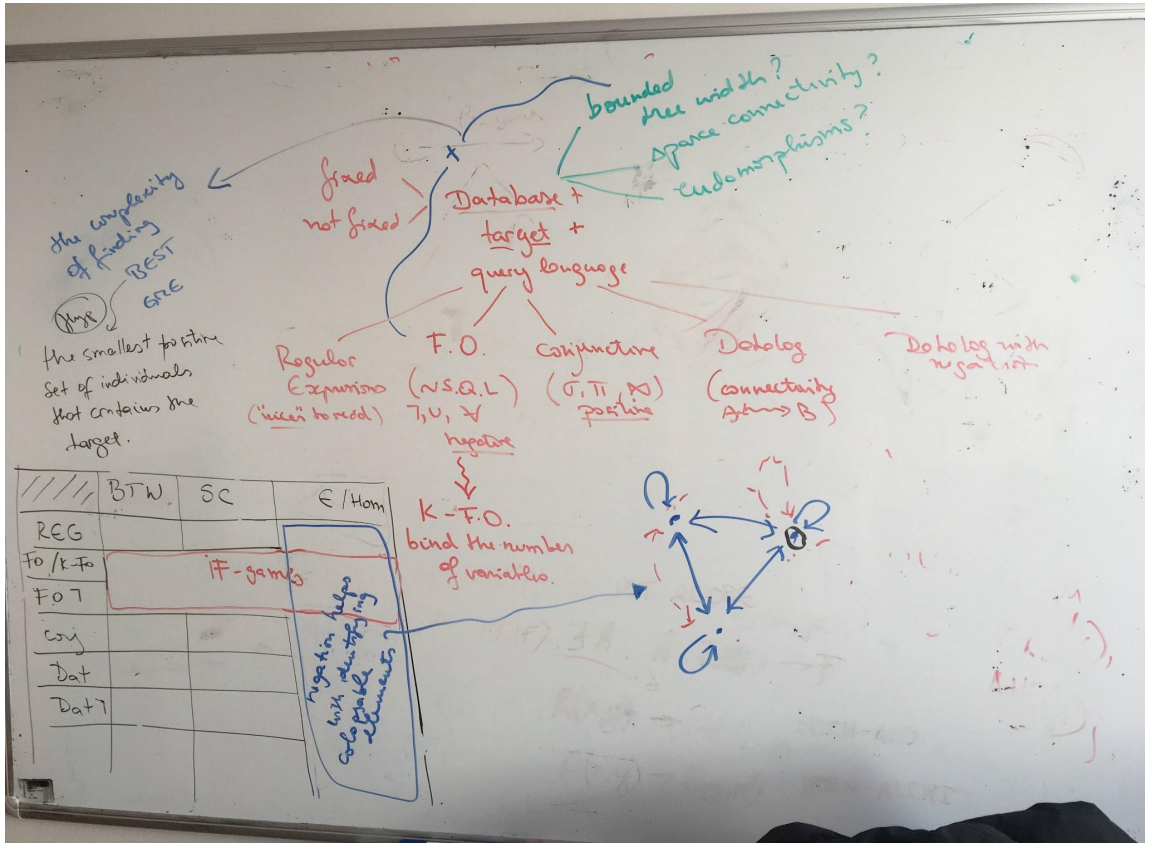
GRE++

Problem 1: Expressivity: depending on the query language we can (or not) express RE for all individuals or not

Problem 2: Continuity: the scene is constantly changing according to the action that is taking place. How the sequence of actions has impact over the GRE?

Problem 3: Partial visibility: In case of a physical interaction the machine and the human need to ensure that the other sees all the scene.

David and Pierre: expressivity landscape



Smooth dialogues

"Communication is only 7 percent verbal and 93 percent non-verbal. The non-verbal component is mainly body language (55 percent) and tone of voice (38 percent)"

Problem 1: Imitation: How to make the machine comport itself "not weird" for a given problem (i.e. negotiation etc.)?

Problem 2: Prediction: Can a machine predict the action of a human based on its state of mind (anger, happiness, enthusiasms etc.)?

Problem 3: Correction: Can the human understand the source of error of the machine answer and correct it?

Dialogue models for human machine interaction

Problem 1 (Properties): What are the main properties for dialogues between a machine and a human in this setting (collaborative, symmetrical etc.)?

Problem 2 (Types): What is the goal of the dialogue in terms of problem to solve?

Problem 3 (Human likeness): For a given dialogue how can we get the machine not to act “too perfect”?

Dialogue properties and types

1. Critical discussion: Goal is to resolve a conflict of opinions
    - Simple critical discussion: one participant defends a claim and other participant has raises critical questions that cast doubt on the claim
    - Complex critical discussion: each participant has own claim and the goal of demonstrating that his/her claim is true.
2. Information-seeking: goal is transmission of information from “knower” to “seeker”. Initial situation where one participant has (or appears to have) information the other participant wants (mainly based on context -based query answering).
3. Deliberation / negotiation : goal is to decide on how to proceed in particular circumstances, given the goals of the participants. (When there is a conflict between possible courses of action, and a choice has to be made, the reasoning involved is called decision making)

Sandra, Pierre and Ganesh: negotiation

"My final offer: X-box till midnight, no cabbage, or dad's laptop password remains a boys secret"

Context based iterative query answering

Context based iterative query answering

Problem 1 (Definition) : What is a context for a query? What about for a sequence of queries?

Problem 2 (Representation) : Can we extract a context from the data? What about for the ontology?

Problem 3 (Reasoning): How to use context in order to perform query answering? speed up the query answering process?

BUT

Question vs query answering

We could make the assumption that we can just take any NLP module of the shelf to translate to and forth... but this hypothesis is unrealistic: language is deeply interwoven with reasoning, with acquiring knowledge - we cannot dissociate

Our research claim: we need symbolic rooted NLP for smooth human machine cognitive interaction

Major risk of the project...