



**RoboExNovo**  
**Robots learning about objects from**  
**externalized knowledge sources**

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***Italian Institute of Technology &***  
***Politecnico di Torino***

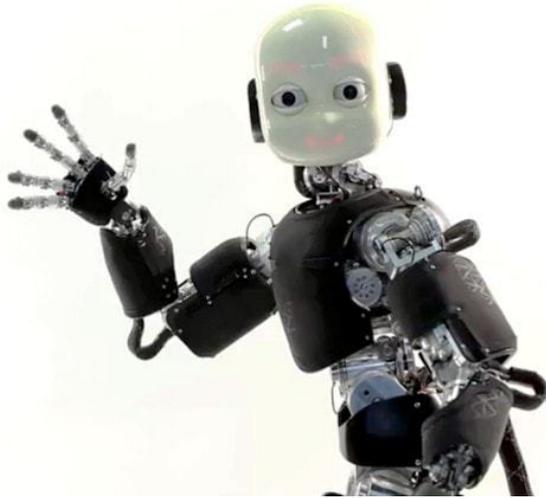


**POLITECNICO  
DI TORINO**



**ISTITUTO ITALIANO  
DI TECNOLOGIA**

# What is the vision behind RoboExNovo?



# What is the vision behind RoboExNovo?

*...what is this?*



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*...what is this?*

*..Let's search the  
Web...*



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# What is the vision behind RoboExNovo?

...what is this?



..Let's search the Web...



In the past, when they were 'Carnival's Crown,' according to Giuseppe Pitti (the doctor and ethnographer who founded Palermo's museum of folk culture in 1906), people gave cannoli to all their friends - by the dozen. One can only imagine the people in the [streets](#) churning them out and the sweet sugary smell of the [cannoli](#) filling wafting over the city! They are older, however Pitti also quotes an anonymous 17th century poet, who said:

# What is the vision behind RoboExNovo?

...what is this?



...OK got it!

...cannoli...  
 ....pastry...  
 ..dessert..

..Let's search the Web...



...The Web says...



# Why this is difficult?

...what is this?



...OK got it!

...cannoli...  
...pastry...  
...dessert..

..Let's search the Web...



The collage shows a search for 'cannoli'. At the top right is a photo of three cannolis. Below it is a search result for 'Holy Cannoli II' by Maria Liberati, dated 2008. The recipe text describes cannoli as a Sicilian 'little baller' dessert. To the right is an 'About.com Italian Food' page with a photo of a cannoli and a list of recipes.

...The Web says...



# Why this is difficult?

How does a robot know  
it doesn't know?

...what is this?



...OK got it!

...cannoli...  
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...dessert..

..Let's search the  
Web...



The screenshot shows a search engine results page. The top result is from 'The Basic Art of Italian Cooking' by Maria Liberati, titled 'Holy Cannoli II'. It includes a photo of several cannoli and text describing them as a popular Sicilian dessert. Below this is a result from 'About.com Italian Food' with a photo of a cannoli and text explaining its history and ingredients.

...The Web says...



# Why this is difficult?

How does a robot know  
it doesn't know?

How to extract from the Web  
information useful for a robot,  
from a robot query?

...what is this?



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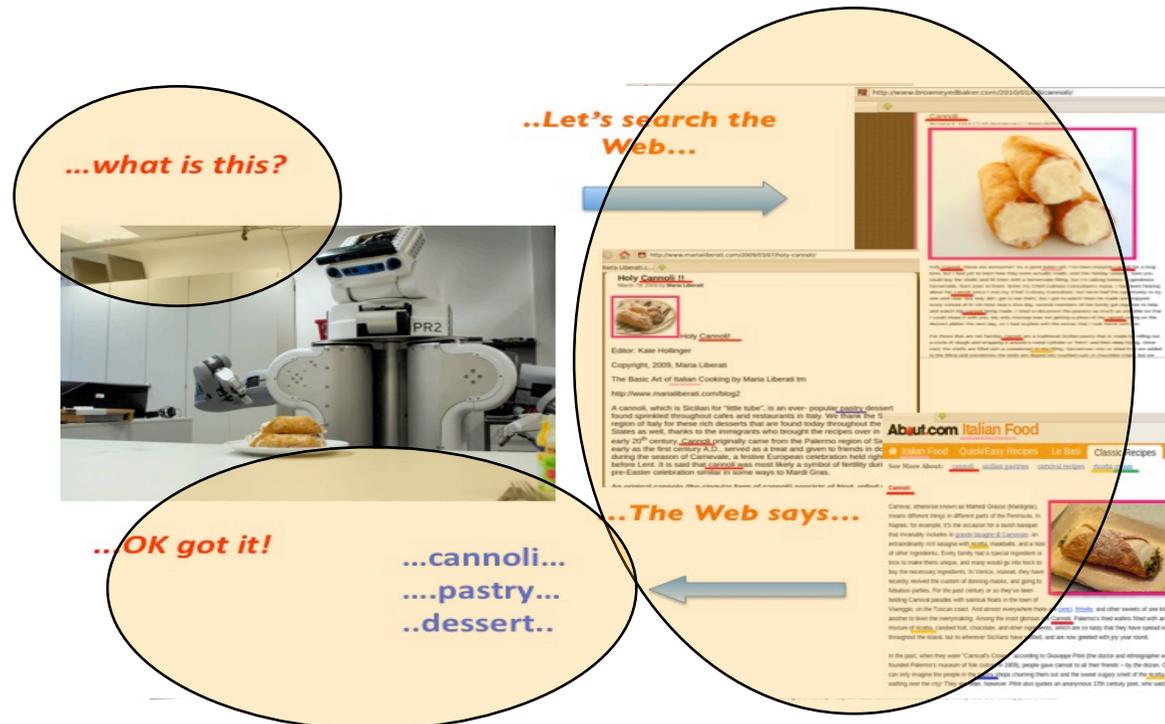
..The Web says...



# Why this is difficult?

*How does a robot know it doesn't know?*

*How to extract from the Web information useful for a robot, from a robot query?*



*How to make such information usable by robots?*

# Foundational nature of RoboExNovo

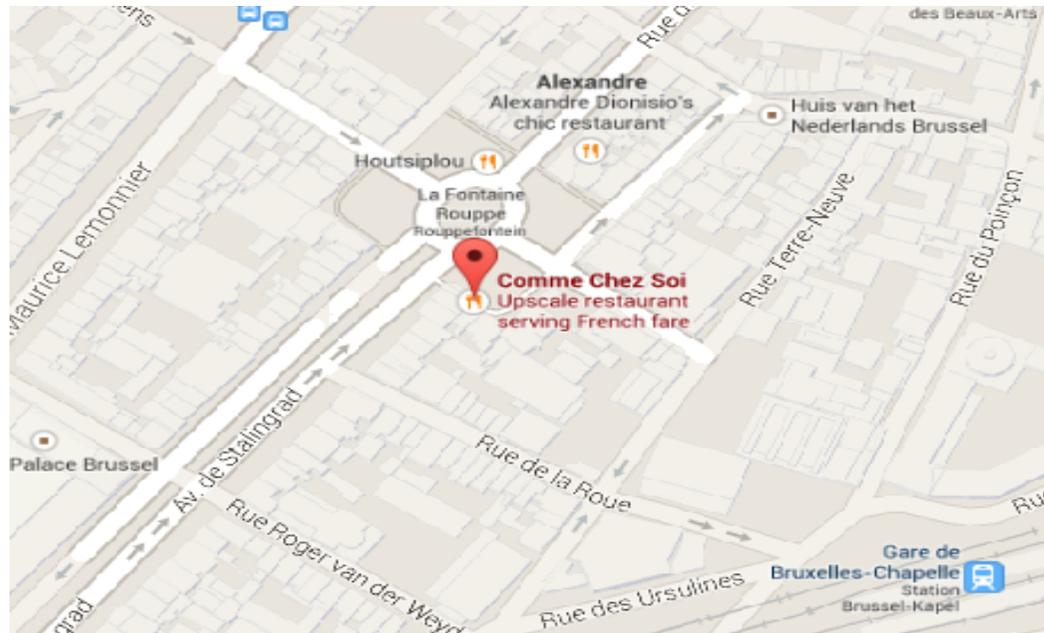
- **Embodied cognition** has been the leading principle in artificial cognitive system research over the last 10 years

# Foundational nature of RoboExNovo

- **Embodied cognition** has been the leading principle in artificial cognitive system research over the last 10 years
- ***BUT*** we humans learn also from externalized knowledge!

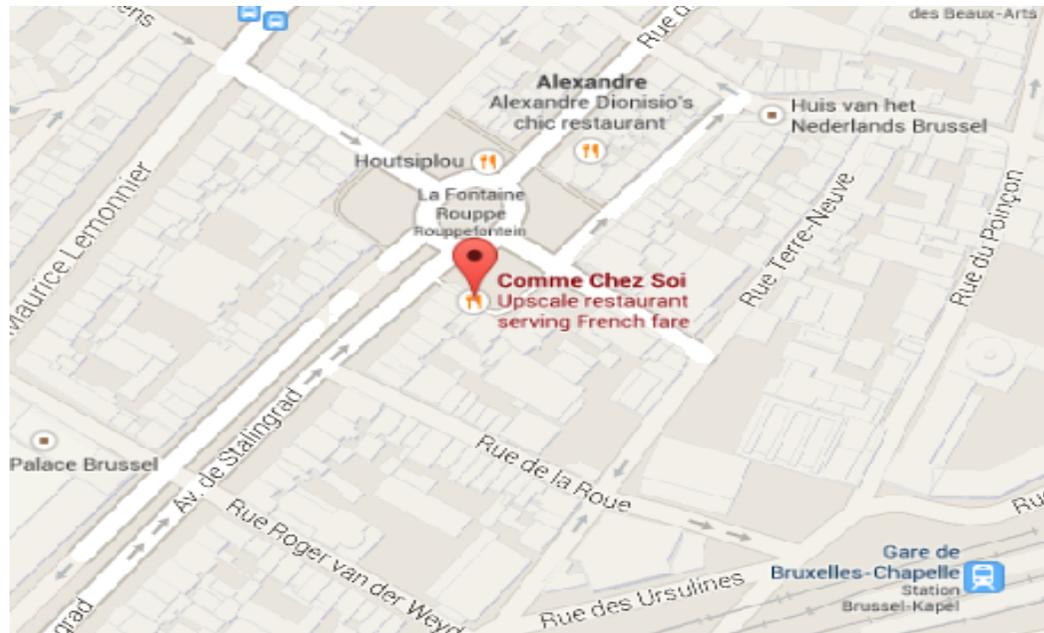
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## Paradigm shift in cognitive robotics

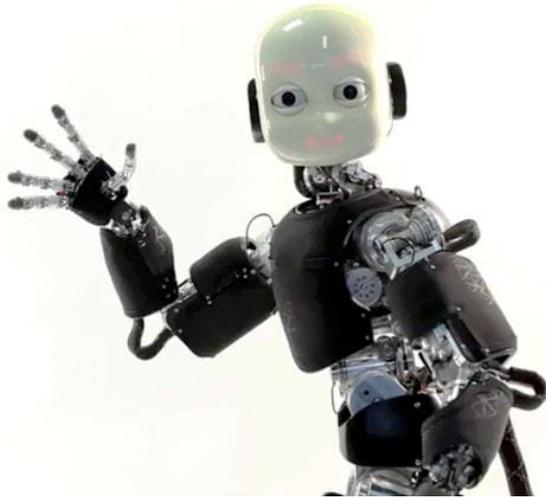
*The Web will become for robots  
what libraries have been in human history!*

# RoboExNovo: first results

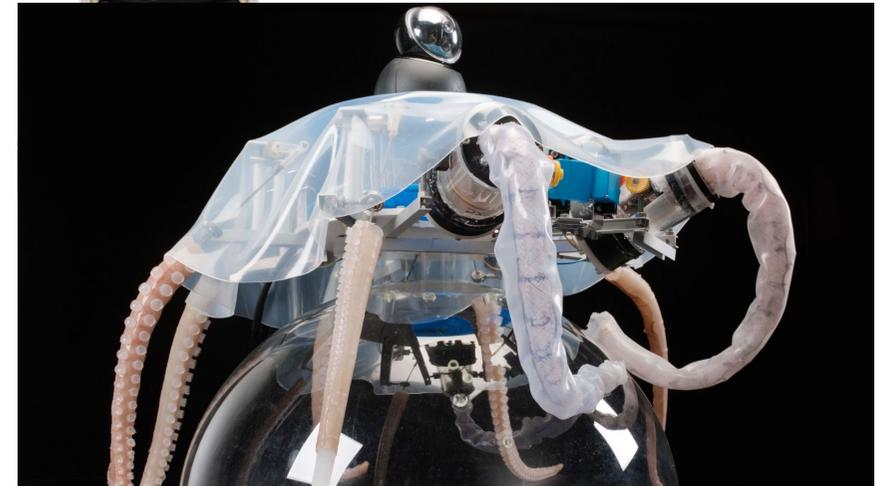
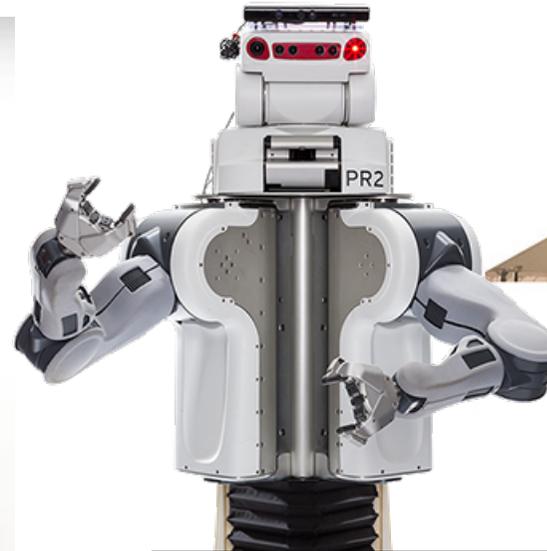
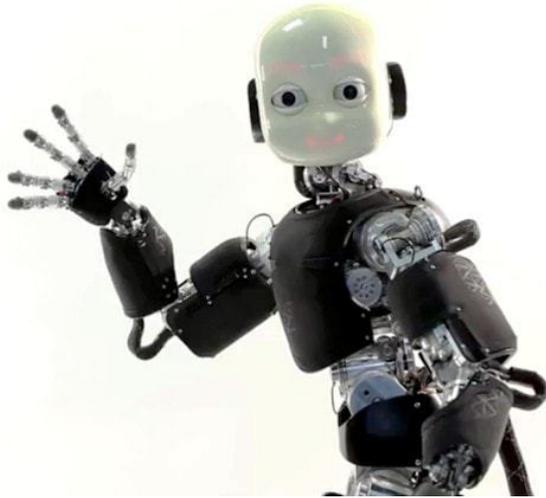


**What's next?**

# What's next?

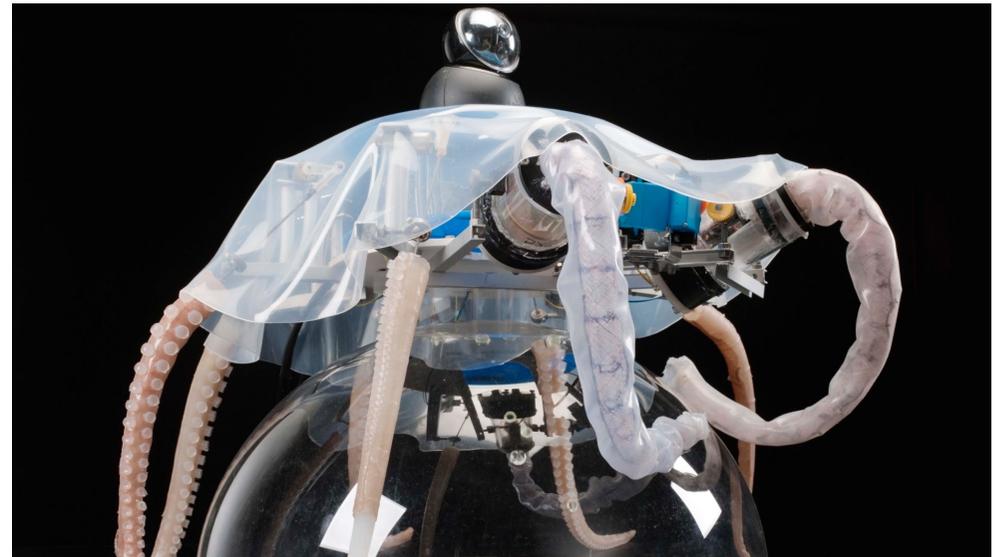
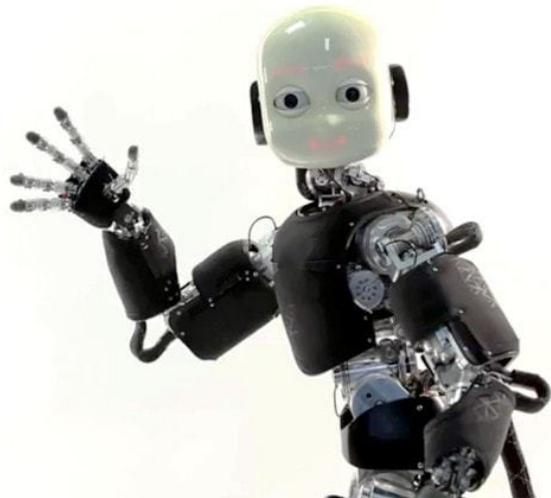


# What's next?



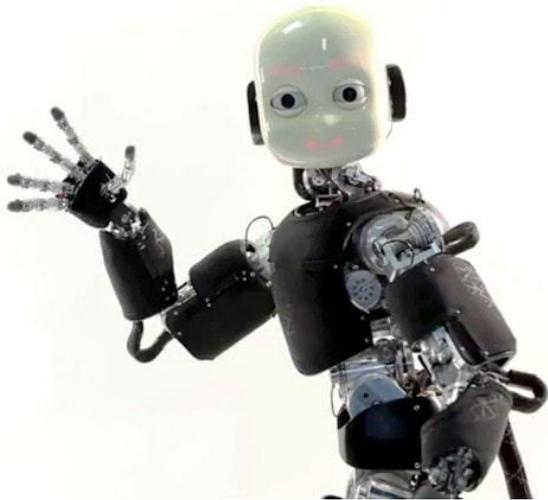
# What does it happen to AI when...

- ...the embodiment is not anymore anthropomorphic?



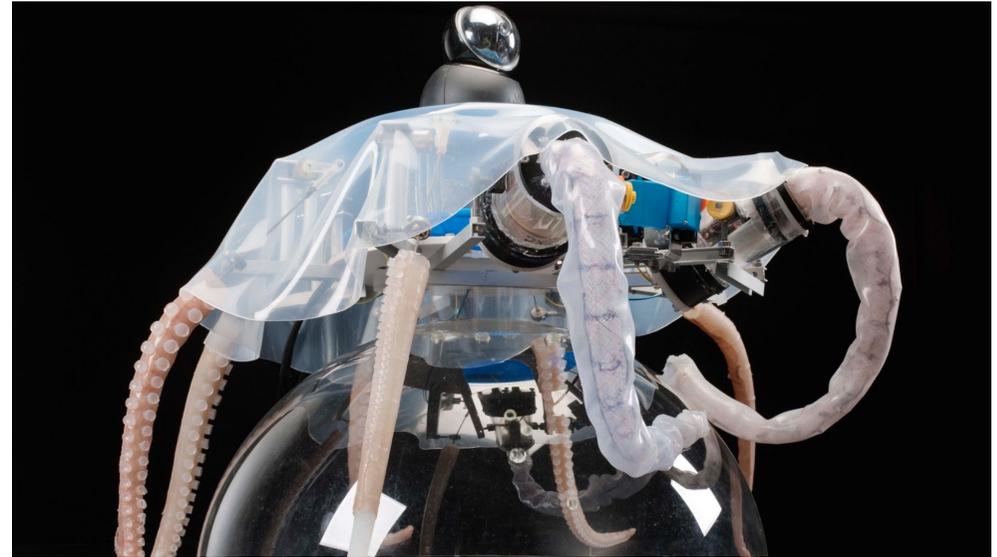
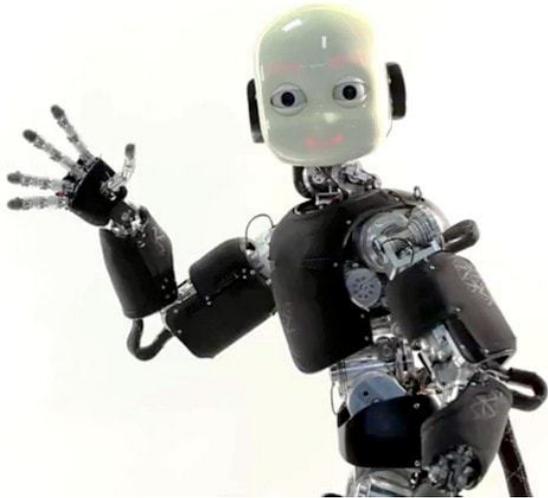
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- ...the embodiment is not anymore anthropomorphic?
- ...perception is distributed?

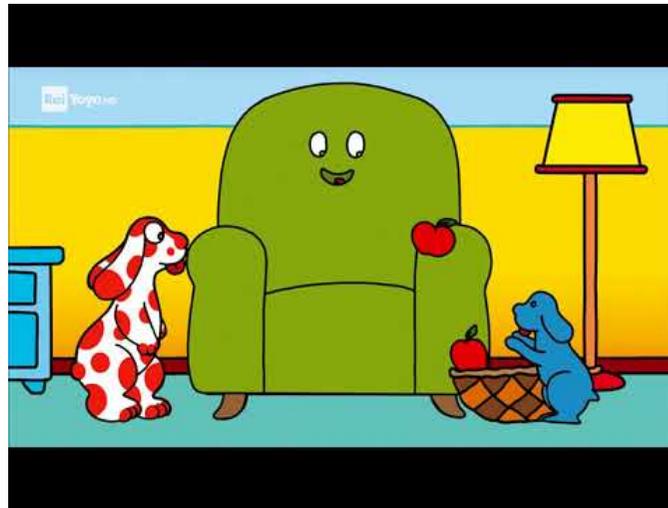
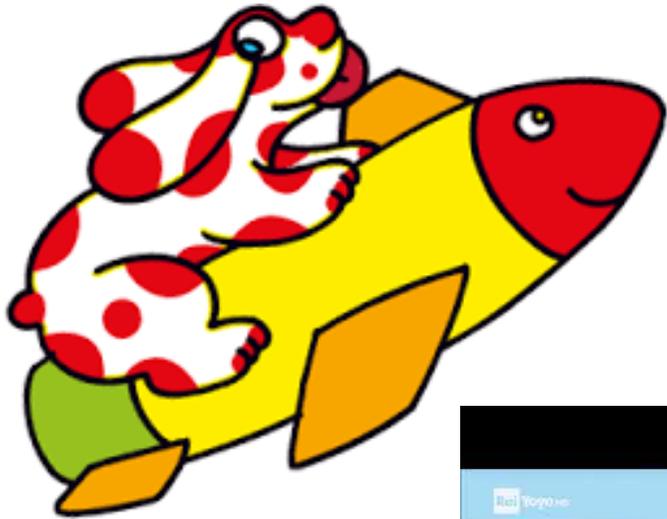


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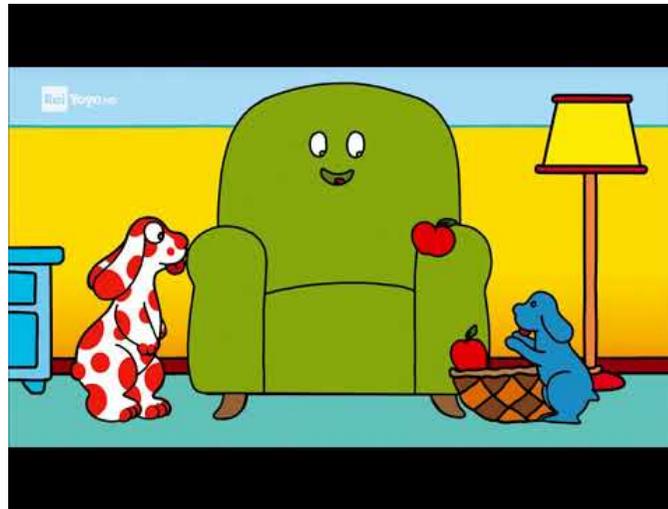
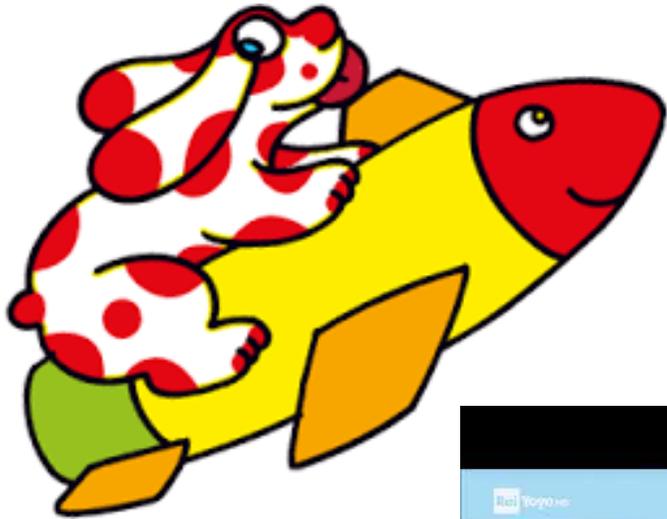
- ...the embodiment is not anymore anthropomorphic?
- ...perception is distributed?
- ***...the brain is distributed?***



# From Internet of Things to AI of Things?

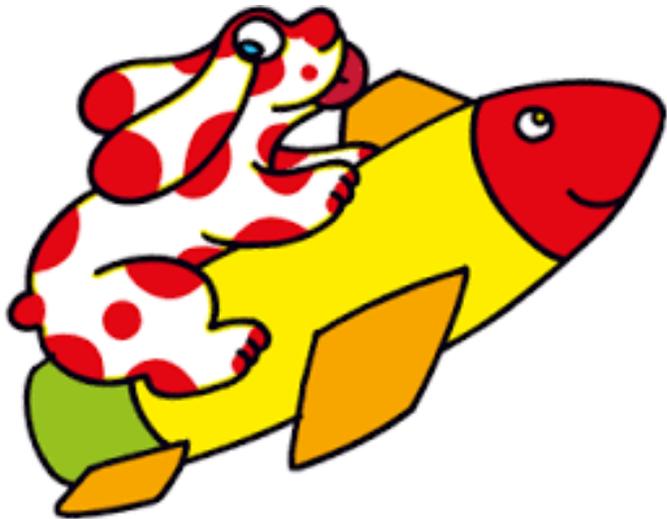


# From Internet of Things to AI of Things?



*What will be the impact on the Earth of these machines in terms of energy consumption and waste management?*

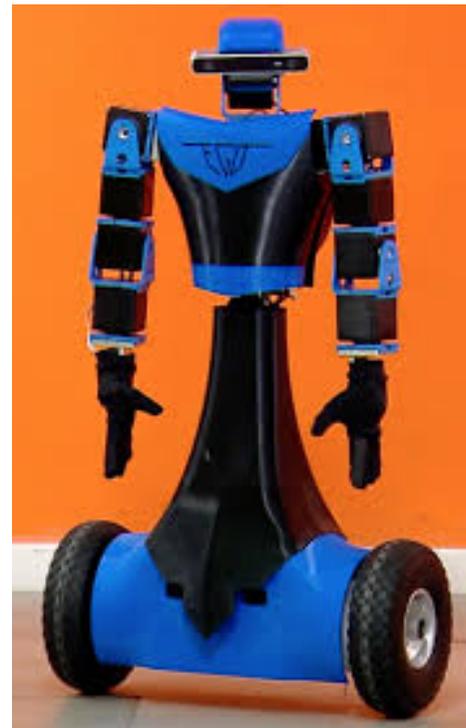
# A New Perspective calls for New Synergies



*Biology, Sustainable Design and Architecture, Green Economy...*

# The time is now!

- Commercial robot assistants @home: 2-3Y
- Commercial soft anthropomorphic robots:3-5Y
- ***Soft sustainable robotics enters the market: 10Y***



# A plea for an EU Strategy

***Europe is a world leader in embodied AI –this should be considered in the future upcoming long term strategic initiatives!***

# Thanks for your attention



http://www.marialiberati.com/2009/03/07/holy-cannoli/

**Holy Cannoli!!**  
March 7th 2009 by Maria Liberati



Holy Cannoli!

Editor: Kate Hollinger | <http://www.browneyedbaker.com/2010/01/08/cannoli/>

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The Basic Art of Italian Pastry

<http://www.marialiberati.com/2009/03/07/holy-cannoli/>

A cannoli, which is Sicilian, is found sprinkled throughout the region of Italy for these States as well, thanks to the early 20<sup>th</sup> century. Cannoli were made as early as the first century during the season of Carnival before Lent. It is said to be a pre-Easter celebration.

An original cannoli (the

**Cannoli**  
January 8, 2010 | 49 Comments | Email | Print



Holy Cannoli, these are awesome! As a good Italian girl, I've been enjoying cannoli for a long time, but I had yet to learn how they were actually made, until this holiday season. Sure you could buy the shells and fill them with a homemade filling, but I'm talking honest-to-goodness homemade, from start to finish. Enter my Chief Culinary Consultant's Nana. I had been hearing about her cannoli since I met my Chief Culinary Consultant, but never had the opportunity to try one until now. Not only did I get to eat them, but I got to watch them be made and enjoyed every minute of it. On New Year's Eve day, several members of the family got together to help and watch the cannoli being made. I tried to document the process as much as possible so that I could share it with you. My only misstep was not getting a photo of the cannoli sitting on the table the next day, so I had re-plate with the extras that I took home with me.

For those of you not familiar, cannoli are a traditional Sicilian pastry that is made by rolling out a dough and wrapping it around a metal cylinder or "form" and then deep frying. Once cool, the shells are filled with a sweetened ricotta filling. Sometimes nuts or dried fruit are added to the filling and sometimes the ends are dipped into crushed nuts or chocolate chips, but we

