Artificial Intelligence, Blockchain, e Criptovalute nello Sviluppo Software

Lezione 6: Distributed Cognition, Extended Mind, and Systemic Thinking

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Structure of the lecture

- Extended Mind
- Distributed Cognition
- Systemic Thinking

Boundaries of the Mind

- Where is our mind?
  - Are the hands part of our mind?

Reference: Robert MacDougall, "The Significance of the Human Hand in the Evolution of Mind," The American Journal of Psychology, 16(2):232 – 242, Apr., 1905
Picture taken from
`https://www.yourtherapysource.com/blog1/2019/02/07/3-evidence-based-benefits-of-writing-by-hand/`.

Extended Mind (1/2)

- Let us consider a simple problem: we are given shapes and we have to see if they fit holes:

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998
Picture taken from `https://gurugamer.com/mobile-games/shapes-and-holes-a-new-mobile-puzzler-where-you-fit-things-into-other-things-1214`.

Extended Mind (2/2)

- Let us consider three cases:
  - this is a computer game (as in the picture) and the person has to rotate the pieces by mind and determines the fitting;
  - this is a paper game and the person has pieces that s/he rotates manually to determine the fit;
  - let us assume that the person has an implanted device, say, special smart glasses, that perform the rotation and then s/he just does the fitting
- What is the level of cognition present in these cases?
  - Clark and Chalmers claim that it is the same.
- Therefore, what is the boundary of our mind?

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Tools and Mind

- There are many tools even before computer that helped our cognitive tasks
  - abacus
  - paper and pen
  - sliding rule
  - ...
- Once we start using it, they become intrinsic part of our reasoning and computational process
- Think at how we do computations in column
  - papers and pen are essential components of our reasoning process
  - even when we do the computation in our mind we often simulate the presence of paper and pen
- Once more, **what are the boundaries of our mind**?

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Impact

- We care about this for at least three reasons:
  - we understand that the request of tools may be not a caprice of a spoiled kid but an actual desire to organize the (extended) mind in the most effective way
  - when developing tools we need to think at how such tools can most effectively "extend" the mind of the users, and not simply being tools
  - when creating a (development) environment for us and for our people we must determine the best configuration
- Once more, **what are the boundaries of our mind**?

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

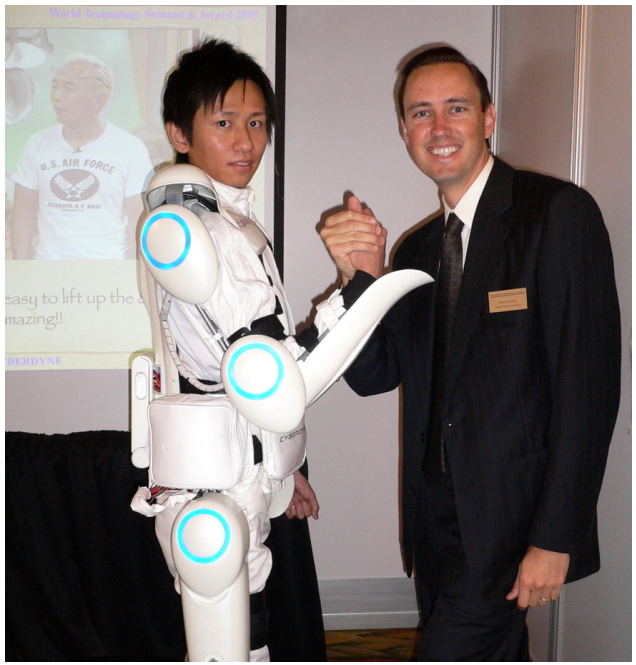
Active Externalism

- The claim of Clark and Chalmers is that the tool and the person couple together forming a unique mix
- The external tools are not just instruments for actions that are determined in an hypothesized internal mind
- Rather, they are a key active external component of our mind, hence we talk of:
  - Active Externalism
- Think at exoskeleton, for instance

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Example: Exoskeleton

- A Hybrid Assistive Limb:



- "The external features here are just as causally relevant as typical internal features of the brain" Clark and Chalmers.

Picture taken from `https://en.wikipedia.org/wiki/Powered_exoskeleton`. Statement from Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998.

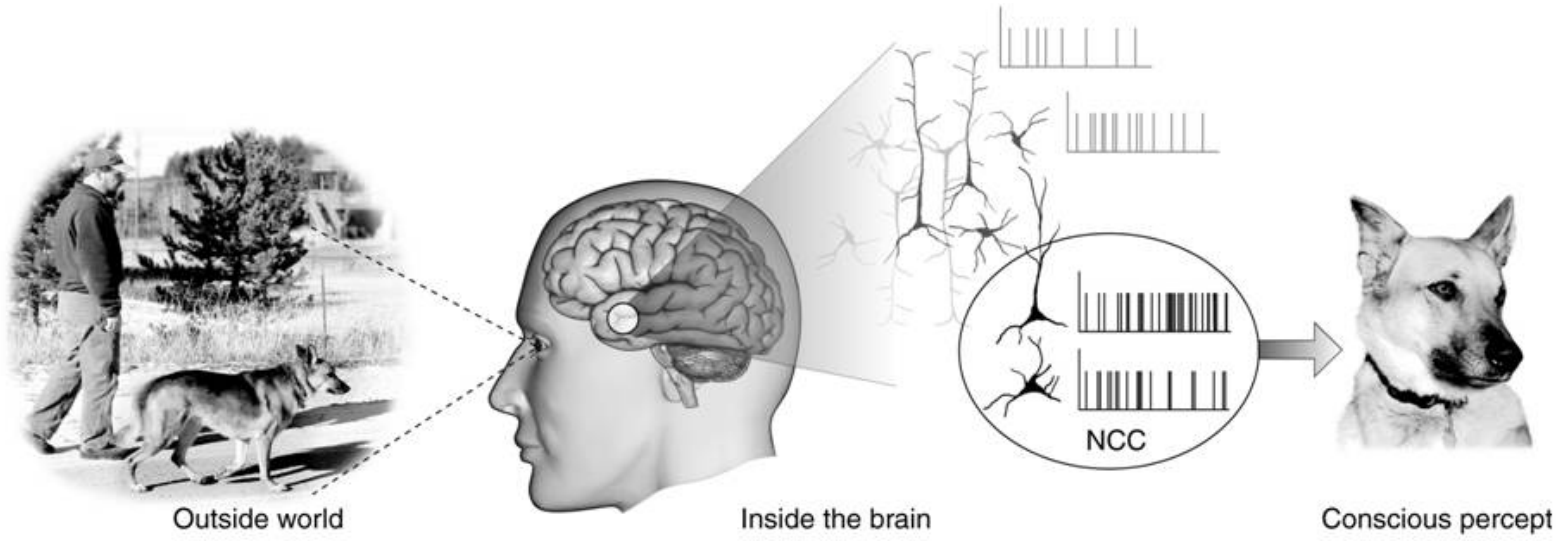
Beliefs

- The mind is also the center of our beliefs
- Typically we think at beliefs as something completely internal to our mind
- Is it really so?
- Or think at how many interaction with an environment of tools and devices we would need to think if we would assume that:
  - processes are only inside the body and
  - everything is is something that is manipulated and "used"

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Cognition and consciousness

- Cognition is not consciousness
- Remember of the emotional long term memory or even at the procedural long term memory
- And think at all the work, for instance of therapists of moving feelings at the consciousness level
- Discussing consciousness is beyond the purpose of this course



Picture taken from `https://en.wikipedia.org/wiki/Consciousness` where it is credited to Christof Koch (`https://en.wikipedia.org/wiki/Christof_Koch`).

Location of our beliefs (1/3)

- Let us consider these two cases (from the reference):
  - Inga wants to go to the MoMA and remembers that it is on 11 West 53 Street, Manhattan, and she goes there
    - She had a (previous) belief in her **mind** about the location and she uses it to direct her actions
  - Otto suffers from Alzheimer diseases, so he forgets what he learns and to overcome this he takes with him a tablet where marks down information
  - Also Otto wants to go to the MoMA, he looks it up in the tablet, finds that it is on 11 West 53 Street, Manhattan, and goes there
    - He had a (previous) belief about the location in his the **tablet** and he uses it to direct her actions
  - What is the difference?

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Location of our beliefs (2/3)

- We could explain the reasoning process of Otto in terms of external tools, but it would be quite convoluted
- For Otto the tablet plays the same role as the *mind* for Inga
- For beliefs what matter is not where they are located but the role that they play
- After all, in what the beliefs of Otto and of Inga differ?
  - Their only difference is in the physical location
- There could be additional counterclaims of the differences on beliefs:
- The tablet of Otto could not be always with him for instance when he takes a shower
  - Inga beliefs could also be our her if she is drunk or excited

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Location of our beliefs (3/3)

- Otto could be slower in gathering the information
  - What if Inga had a memory disorder that requires her a slow process to recall her beliefs?
- The process of Otto requires perception while the one of Inga only introspection
  - Are we sure that when we look up information on a table we are really exercising perception? If we consider the tablet as part of the mind, the process is still introspective
- There are no strong arguments against considering also the one of Otto as a belief, and thus that his minds extends to the tablet

Source of the content: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Additional speculation on Otto

- The tablet is an integral part of the life of Otto
- Otto can access directly and without any problem the information there
- Otto accepts as true the information stored in the notebook automatically
- Otto has once validated such information, and since then such information is valid
  - What if someone leaks inside the table and put there wrong information?
  - Well, if someone by some subliminal manipulation forces in the mind some wrong information?

Source of the content, also copied verbatim: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Can we extend this concept beyond?

- What about groups of people, where the knowledge is distributed?
- The key point is how much our belief is:
  - trust
  - reliance
  - availability
- indeed, the language pays a major role, but ...

Source of the content, also copied verbatim: Andy Clark and David Chalmers, "The extended mind," Analysis 58 (1): 7–19 , 1998

Communication means (1/3)

- Empirical studies with 38 IT professionals
- Analysis of the communication patterns

When the communication is considered positive

What is being used	by me	by others	by any
Vocalics	16%	16%	26%
Kinesics	21%	8%	24%
Chronemics	3%	5%	5%
Proxemics	0%	3%	3%
Oculesics	0%	0%	0%
Synchrony	3%	0%	3%

Source: Paolo Ciancarini, Mirko Farina, Sergey Masyagin, Giancarlo Succi, Sofiia Yermolaieva, and Nadezhda Zagvozkina. "Non verbal communication in software engineering - an empirical study." IEEE Access, 9:71942–71953, 2021

Communication means (2/3)

When the communication is considered negative

What is being used	by me	by others	by any
Vocalics	5%	8%	11%
Kinesics	11%	5%	11%
Chronemics	8%	8%	16%
Proxemics	0%	3%	3%
Oculesics	0%	3%	3%
Synchrony	5%	0%	5%

Source: Paolo Ciancarini, Mirko Farina, Sergey Masyagin, Giancarlo Succi, Sofiia Yermolaieva, and Nadezhda Zagvozkina. "Non verbal communication in software engineering - an empirical study." IEEE Access, 9:71942–71953, 2021

Communication means (3/3)

- When the communication is positive:
  - There is a larger incidence of vocalics and kinetics
  - When the communication is negative people think that time is wasted
- Chronemics play a major role in meetings:
  - When the communication is negative they are remarkably noted
  - When the communication is positive people feel them implicitly (coded in comments)

Source: Paolo Ciancarini, Mirko Farina, Sergey Masyagin, Giancarlo Succi, Sofiia Yermolaieva, and Nadezhda Zagvozkina. "Non verbal communication in software engineering - an empirical study." IEEE Access, 9:71942–71953, 2021

Questions?

End of lecture six.