

Computational Humanism

Fausto Giunchiglia
Smart Society
Final review meeting

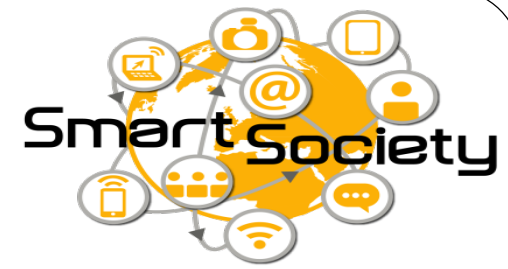
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"Man is the measure of all things: of the things that are, that they are, of the things that are not, that they are not."

[Protagoras, VC B.C.]

- Ancient China
- Ancient Greece
- Renaissance (Italy)
- 19° - 20° Century (Germany)
- Modern Humanism
- ...

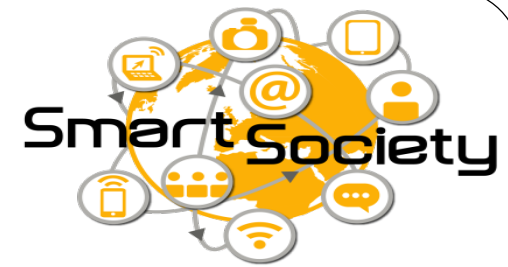
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Humans



Humans live immersed in a space-temporal continuum where everything evolves. Their main abilities (as relevant in this context) are:

- a. Recognizing those patterns (*substances*) which repeat themselves in space and time, and this is not by accident [*Millikan 2000, Giunchiglia & Fumagalli 2016*]
- b. Organizing and giving structure to such patterns (as *substance concepts*) through language, thus providing the basis for understanding what is the case (true and false facts), i.e., by organizing their understanding of the space-temporal continuum in what we call *the world* [*Giunchiglia & Fumagalli 2016, Giunchiglia & Fumagalli 2017*]
- c. Acting in the world both *individually* and as members of *collectives*
- d. *Reasoning about and exploiting what is the case* in order to achieve their (life) objectives
- e. *Adapting to what is the case* when this was unpredicted or (even worse) was never seen before

Humans (continued)

Humans have intrinsic limitations:

- a. They have limited time and space extension
- b. They have limited perception capabilities (through sensing)
- c. They can memorize only so much data and knowledge
- d. They have limited processing and acting capabilities

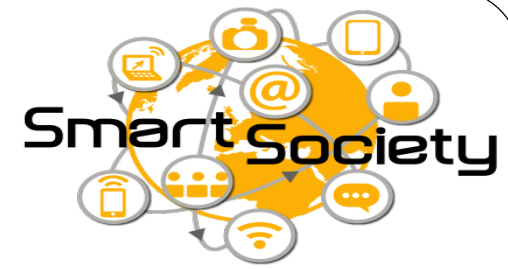
Humans are highly diversified with more/less knowledge, skills and competence depending on the domain.

Artifacts

Historically, inventing and building *artifacts* which would substitute or facilitate humans in their activities has been (and still is) one the main means towards scaling beyond humans' intrinsic limitations and diversity.

Artifacts (often hugely) exceed the humans' capabilities. For instance,

- a. *Passive artifacts* facilitate some of their activities (e.g., bowl, house, weapon)
- b. *Machines* substitute humans in some of their activities (e.g., car, coffee machine, machine making, robot)
- c. *Computers* substitute humans in their abilities of recognizing, representing and reasoning about the world
- d. *Computer networks* facilitate humans in their ability of *sending/ receiving* information to/ from anywhere in the world, which now happens in near-zero time



Collectives and services

Enabling *collectives* has been (and still is) another main means towards scaling beyond humans' *intrinsic limitations* and *diversity*.

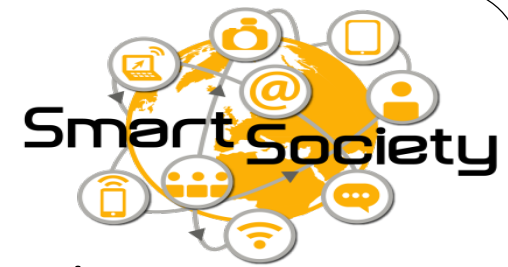
Collectives are *enabled* by the *diversity of people*. People with diverse capabilities collectively help people in doing things they don't know how to do or that would find very hard to do.

Collectives have *capabilities which are more than the sum of the capabilities of any single member*.

Collectives are the main means for *service* provision. We identify a collective by the service to be delivered. A collective is the *set of people* which contribute the achievement of the service. Often not all the members of the collective know the service to be delivered but only some of its components.



Services



A **service** is an activity where an immaterial exchange of value occurs. Usually a service repeats itself in time according to some pattern.

A service can be seen as a **whole** or as **composed of simpler atomic services** which, in turn, can be further decomposed.

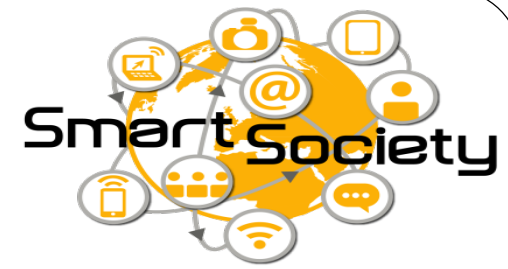
Service Provider is whatever (e.g., machines, objects, infrastructure, people) provides the service. **Service Consumer** is whatever (e.g., machines, objects, infrastructure, people) is recipient of the service.

Most often the service provision:

- **is enabled by physical resources** (e.g., car for mobility, see UBER, apartment for rental, see RbnB), and/or
- **is organized and managed, in parts** (e.g., Uber and Rbnb) **or completely** (e.g., Facebook, Whatsapp) **by software**, and/or
- **is run by an organization** (e.g., any of the company above, but also utilities, transportation companies, Health organizations).



Services (cont.)



Sometimes the service provision *is **provided solely by a person*** (e.g., information provision, consulting, feeding).

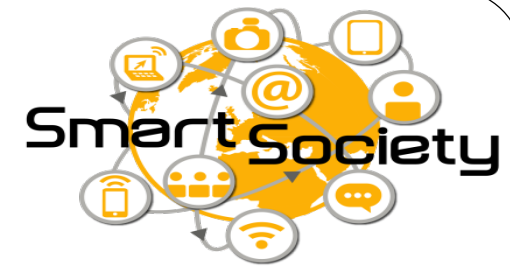
In general, no matter what the service provider and the service consumer are (e.g., machines, objects, infrastructure, people), the ultimate service providers and consumers are people, i.e., the people controlling and managing whatever provides the service, and whatever consumes the service.

We take the **Service Provider** to be the **person** who ultimately provides the service and **Service Consumer** is the **person** who ultimately is recipient of the service.

Using *skill, ingenuity and experience*, service providers generate benefit to service consumers.



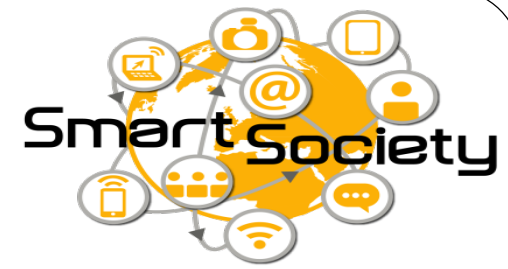
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Empowering service provision – to day



Access to services is mediated and mainly controlled *in the virtual world*. As a consequence, service access is extended, *in space and time*, to cover potentially all the *world*.

Examples:

- a. Uber: access to rides *through* the people who offer them;
- b. AirBnB: access to places to stay *through* the people who manage them;
- c. ...

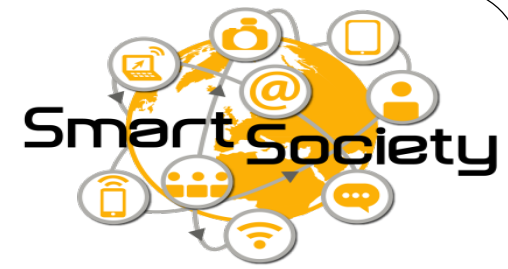
Advantages:

- a. Enabling an easily accessible huge (often worldwide) space of possibilities;
- b. Going beyond humans' space and time limitations in service delivery;
- c. Overall, producing better personal and social performance
- d. ...

NOTE: we are not focusing on purely online services (e.g., email, Whatsapp, Facebook)

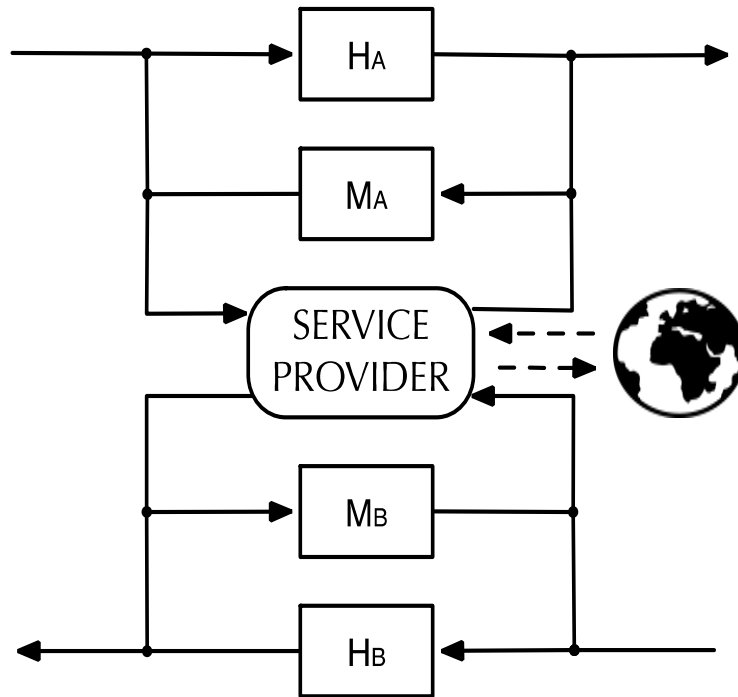


Empowering service provision – to day



HA, HB: *Humans*
MA, MB: *machines*

AirBnB, Uber, ...:
examples of Service providers



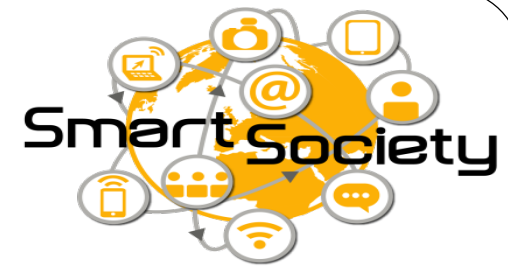
The interaction HA – HB, via the service Provider SP is organized as follows:

1. HA – SP agree on service provision
2. HB – SP agree on service consumption
3. SP finalizes agreement between HA - HB
4. HA delivers service to HB when they finally meet (in the real world)

NOTES:

1. Access to the real world service is managed by SP
2. Steps 1-3 are in the virtual world, step 4 is in the real world

Empowering service provision – drawbacks



- ✗ *No end-to-end interaction between people; no direct interaction / negotiation.* The person being «real» service provider is intermediated by the machine in the interaction with the person being the «real» service consumer
- ✗ *Inflexible service provision:* platforms focus on a single service or a set of related services. The services to be provided are defined a priori and built-in as part of the service provision platform;
- ✗ *Inflexible service negotiation:* no awareness of the local (provider and consumer) context, e.g., of the people, goals, actions, and state, no flexibility in the service configuration, no flexibility in the answers – only yes/no answers;
- ✗ *Inflexible interaction protocol:* no personalization of the interaction, no diversity awareness of, e.g., the people values, culture and language

Empowering service provision – drawbacks (cont.)



- ✗ *Inflexible service provision*: service users manually choose which platform to connect to;
- ✗ *Inflexible service negotiation*: service providers and service users manually negotiate the details of the service to be provided, and only through the protocols enabled by the platform;
- ✗ *Inflexible interaction protocol*: service providers manually interact and decide how to interact based on the quality of the interaction so far.

Human intervention is needed at any relevant decision step. All the most «sensitive, mission critical» decisions are left to humans.

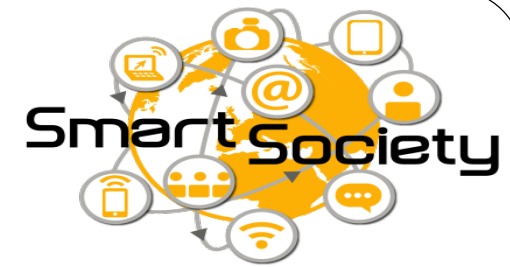
The human limitations in their ability to interact with other humans (sometimes humans off line, low speed processing, sequential processing) slow down immensely the process of service provision.

The rigid distinction of roles and the rigid boundary between humans and machines is the main bottle-neck for scaling service provision to the ability of solving (large scale) societal challenges. Humans and machines, both on the service provider and on the service consumer side, have reciprocally no knowledge of the other, of what it does, why it does it, how it does it.

Machines cannot help humans beyond what was originally designed and humans cannot help machines in helping humans



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Social relations



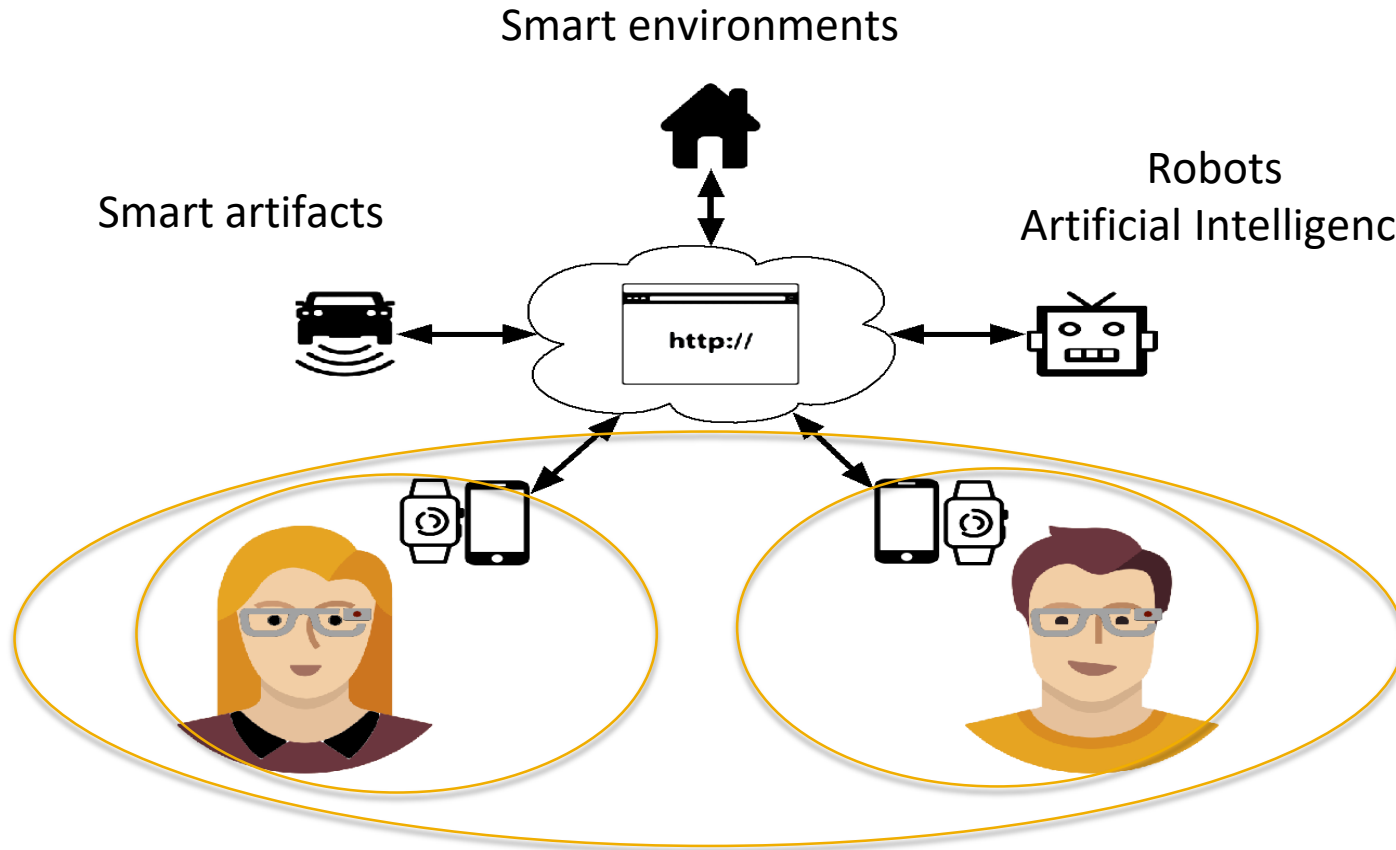
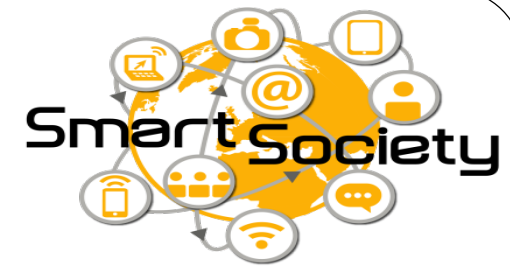
We take a ***social relation***, or ***social interaction***, to be any relationship between two or more individuals. Social relations derived from ***individual agency*** form the basis of ***social structure*** and therefore of ***society***.

In everyday life, not machine mediated, service provision, collectives are formed, operate and deliver their services because they are immersed and exploit a huge infrastructure of social relations. In turn, services are what enables the establishment and evolution in time of social relations. Social relations are what enables efficient service delivery by providing the service provider and consumer of the reciprocal knowledge of the other, of what she does, why she does it, how it does it.

In machine mediated service provision, services are provided without any support from social relations. All the missing information must be provided by humans. Service provider and service consumer have reciprocally no knowledge of the other, of what she does, why she does it, how she does it.

In machine mediated service provision, for services delivered in the Virtual world (e.g., email, Facebook, Whatsapp) new forms (of virtual) social relations are empowered (though never reaching the complexity and richness of the real world social relations).

The challenge - Empowering social relations



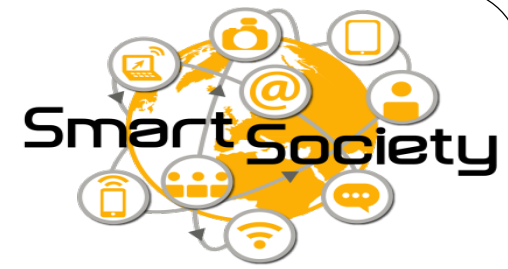
A **model** which enables **people**, to develop **social relations**, and to enable reciprocal services beyond the human limitations (in time, space, processing, memory, service delivery and consumption, social relations).

A **technology** implementing the model which is always available to the user, 24 hours a day, irrespective of any contextual factor.

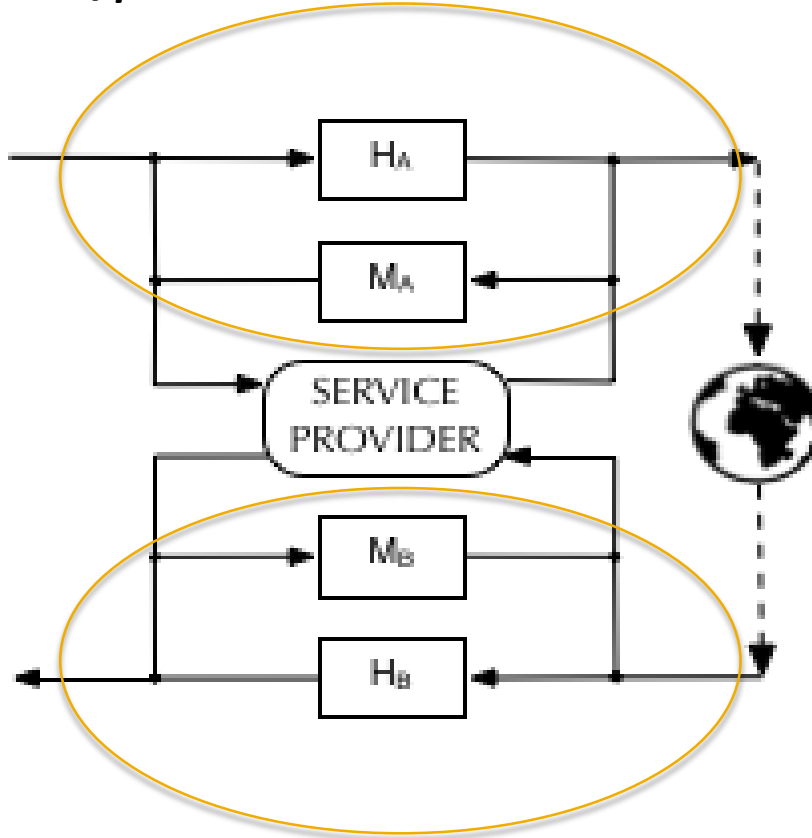
Machines do not substitute people. Machines empower their social relations



Empowering social relations



Service consumers/prosumers



HA, HB: *Humans*
MA, MB: *machine*

Service providers/ prosumers

The interaction HA – HB, via the service Provider SP is organized as follows:

1. SP enables and supports social relations
2. MA and MB enable and support the service provision
3. HA – SP agree on the service provided by SP
4. HB – SP agree on the service provided by SP
5. HA – HB directly negotiate and deliver, though MA – MB the service as supported by SP. The negotiation is end-to-end

NOTE: steps 1-3 are in the virtual world, step 4 is in the real world

The challenge – a person centric example



It is Monday morning. I am late for a meeting with a visitor from Spain. My PDA has already told (the PDA of) my assistant to notify the visitor. It has also agreed with (the PDA of) my postdoc that he would try to arrive at the meeting on time. (The PDA of) my postdoc has also provided the (PDA of the) Spanish visitor with the exact location of the meeting (building, floor, conference room). My meeting is now scheduled for half an hour later. My PDA has already adjusted the schedule for all the meetings of the day. He made sure I could go home at the same time: I have a dinner with my wife and some friends. I cannot be late.

At 3pm I have to have an exam at the Hospital. I got confirmation only today. Because of this I need to have a very light lunch. My PDA agreed with the physician the best time which could fit my schedule, it booked a light menu at the restaurant for 1pm and rescheduled the 3pm meeting for next week. The lunch will be with some students who requested an urgent meeting. It is the only time I have available today.

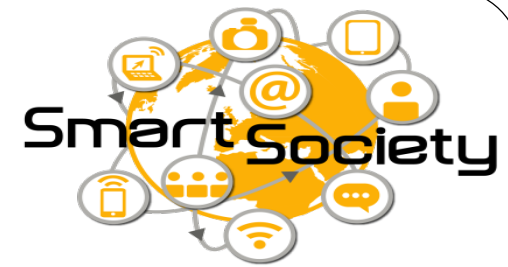
I park my car in the best available parking lot. Among the ones immediately available it is the one midway between the restaurant, my office and the lab of the physician. It is slightly more expensive than the others. It is also a good way to make sure that I walk a high number of steps. My car has not been washed for 3 months, my PDA has booked a carwash during the parking time. It negotiated the best time among those available.

When arriving in the office I urgently need to talk to Luisa, the person in charge of our collaborations with India. The deadline for confirming their visit is 12Noon. I am calling her but I cannot find her. She is not online. My PDA launches a person search by asking some mutual friends (and by asking them to ask to iterate the question). Finally, at 11:30 she calls me up and we solve the issue. She was away in a meeting with a friend who unexpectedly visited her.

And so on ...



The challenge – an example in health



The Povo town council is struggling to provide integrate health and social care for its community because of difficulties in raising funds to support an adequate number of carers and make good use of the limited number of primary care doctors in the town. The citizens of Povo are also aware that many of their older people are living alone and suffer from loneliness. Together the council and the citizens decide they need to make a Povo care collective that will co-produce health and care for the community. The collective will be a hybrid diversity aware Collective Adaptive System. The collective starts off by profiling the human and computing resources available in the community from the senior medical staff through to the chat systems in peoples house, their phones, IoT devices. This is a dynamic learning collective with people and computational resources entering and leaving the system all the time as more people volunteer or leave the region. The initial task of the collective is to understand what services people use and what they need

Key elements are identifying need for services

developing services

e.g. flexible friending service that involves bots, tele-interaction and face-to-face

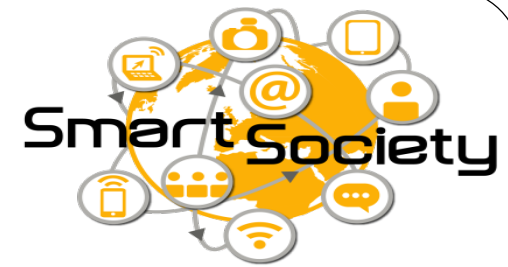
as skill shortages are identified then people are encouraged to learn via interaction with machine and human resources and develop to provide reliable service

some economic analysis...

NEEDS REWORKING SIMILAR TO PREVIOUS EXAMPLE



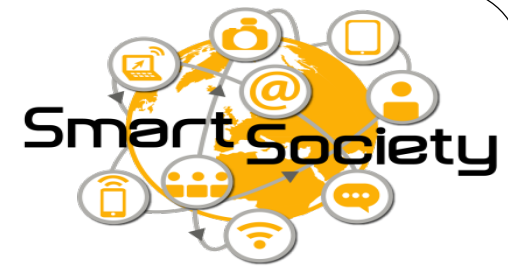
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Augmented Collectives



Augmented Collectives as the means for automating social relations as a key enabler of service provision

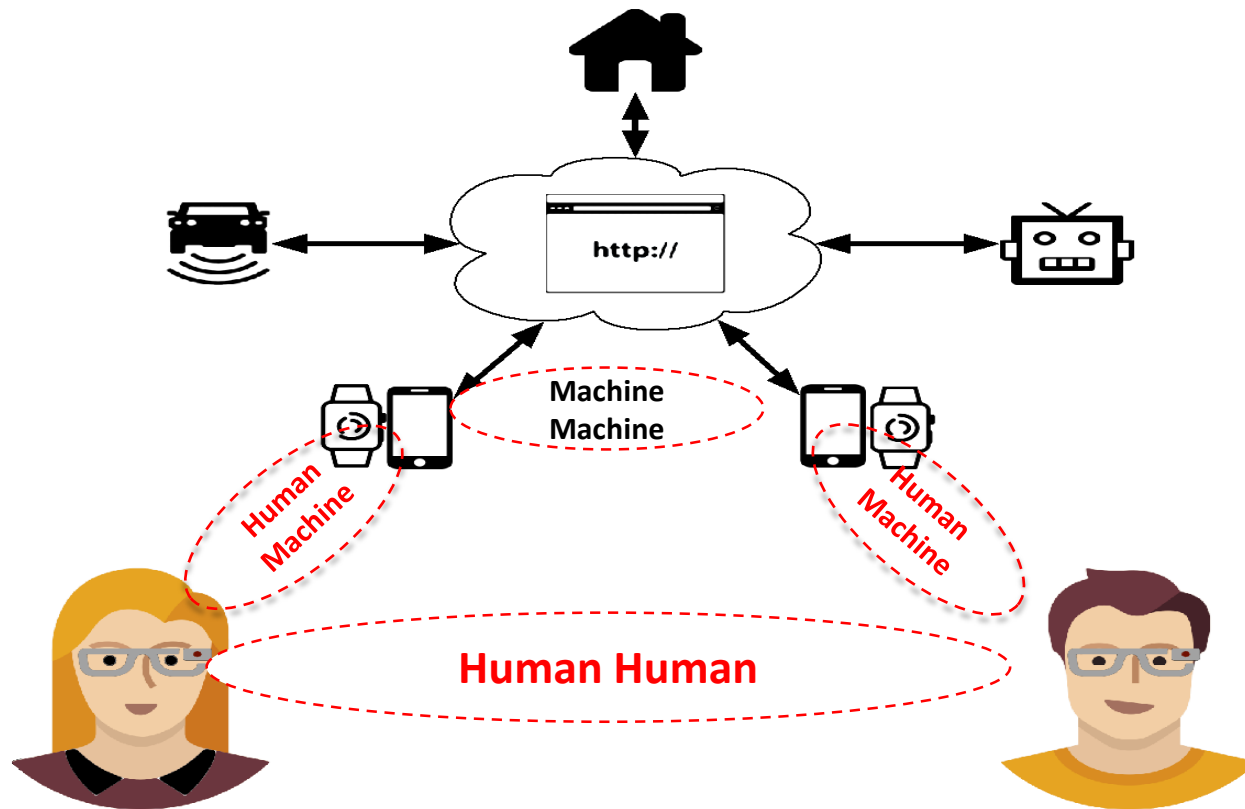
Augmented Collectives - The result of the convergence among humans whose collaboration capabilities are empowered by machines, with capabilities which are more than the sum of the capabilities of the original collectives and the single machines

In augmented collectives, *machines help humans, **by automating social relations***, as required for service compositionality to be successful, allowing them to go *beyond their physical limitations* (e.g., spatio-temporal, computational, memory, interaction ...).

*Augmented Collectives are collectives enabled by the **diversity between machines and people**.*



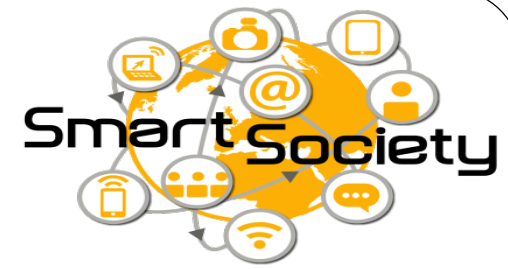
A three layer model of compositionality



A **person** is characterized by:

1. The set of services (s)he can exploit (**service consumer**) thanks to, e.g., her/ his PDA,
2. The set of services (s)he can provide (**service provider**) thanks to, e.g., her/ his PDA,
3. Her **social relations** as enabled by machines, which provide her with the ability to *expose/ negotiate/ compose* with other people/ the services (s)he provides/exploits, (**social service prosumer**).

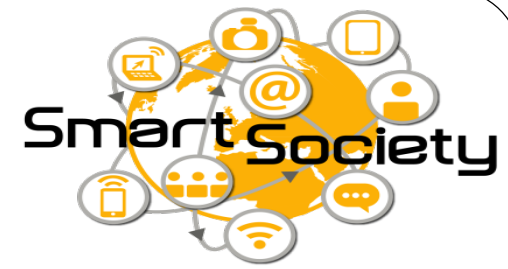
The human compositionality is modeled as social relations and implemented as the composition of human machine machine compositionality



A three layer model of compositionality

- ×Layer 1: *Machine compositionality*: extensively studied in mainstream CS. (Out of focus.)
- ×Layer 2: *Human – machine compositionality*: studied in Artificial Intelligence, HCI, Human Computation, Ubiquitous Computing, Focus on how machines can improve **human machine interactions**.
- ×Layer 3: *Human compositionality*: studied in CSCW, workflow systems, social networks, social computing, crowdsourcing, Focus on how people can interact and collaborate towards better **service provision**.

Service provision as social computation



The role of **people**:

1. Deliver and exploit services (social service prosumers)

The role of **machines**:

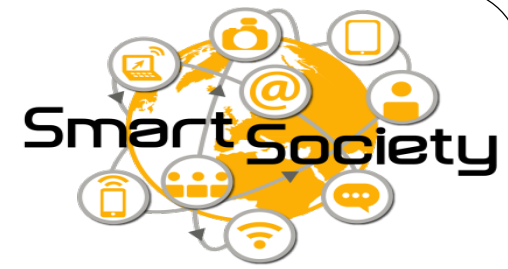
1. Acquire (partial) knowledge about the service to be provided (modeled as the “current” goal) and of state of affairs (the world, people, and the current collective) (*property recognition*);
2. Adapt the collective to deliver the service provision as a plan resulting from the composition of (atomic) services to be delivered by people (*contextual privacy, search, provenance management, orchestration, incentive mechanisms*);
3. Monitor the results of service provision, recognize them and detect the arousal of unexpected obstacles (*anomaly recognition*);
4. If an unexpected obstacle is detected, go to step 2

A social computation is a sequence of computation steps, as traced by the machine, where each computation step is the delivery of an (atomic) service, as performed by a person.

A computation step is modeled according to the plan semantics, as understood by the service prosumers, as a prerequisite for the compositionality of people actions



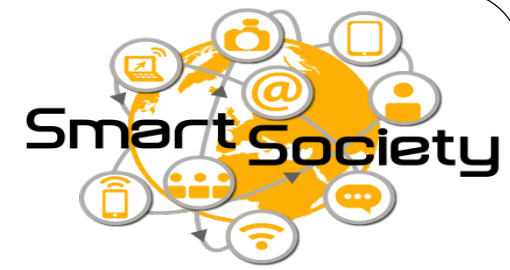
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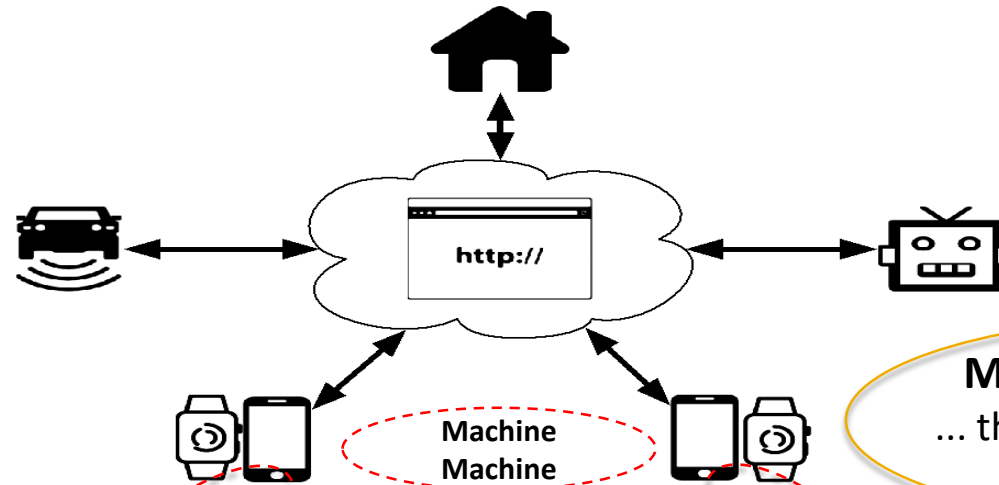
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Diversity in an *Open World* (e.g., the real world)



**Partial
incomplete/ incorrect
models of reality**



**Human machine (HM) diversity
(Hibridity)**

... the (extended) Semantic Gap problem

Machine (MM) diversity
... the (semantic) Web problem
(out of focus)

Unexpected diversity

Human (HH) diversity

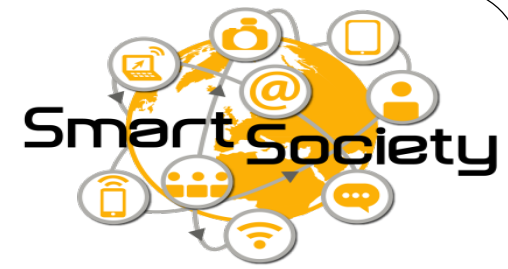
... Culture, Language, goals, activities, emotions, values, ...

So far mainly studied in the humanities

No general computational theories of human diversity



Unexpected diversity

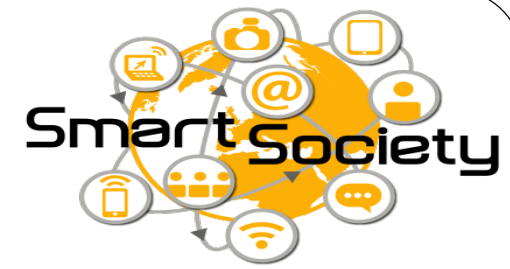


Unexpected diversity as the cause of a failure in the automation of service provision.

- × **Collectives** - When having a role in a collective, *humans help humans, by providing diversified services*, as required by their role, the former allowing the latter to go beyond their limitations (in knowledge, skills and capabilities).
 - × **Unexpected world diversity** *may cause the failure of the service provided by a person*
- × **Augmented collectives** - When having a role in an augmented collective, *machines help humans, by automating their interactions with other humans*, as required for service compositinality to be successful, allowing them to go *beyond their physical limitations* (e.g., spatio-temporal, computational, memory, ...).
 - × **Unexpected people diversity** *may cause the failure of the machine automation of people interactions*

The composition of the effects of an unexpected obstacle in the world (world diversity) with those of an unexpected obstacle in the people interactions (people diversity) may cause the failure of an augmented collective in reaching its objectives.

Recognizing and Adapting to Unexpected Diversity



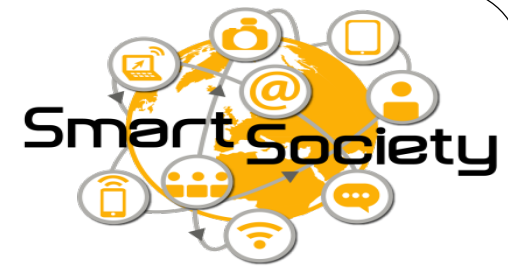
Adaptability as the means for enabling the automation of service provision in presence of **unexpected diversity**, once **recognized**.

- × **Collectives** - *(Unexpected) **world diversity** may cause the failure of the service provided by a person*
 - *Machines help humans by **recognizing failures** in the service provision, and by **adapting the collective** in a way to deliver successful service provision in presence of the unexpected obstacles.*
- × **Augmented Collectives** - *(Unexpected) **people diversity** may cause the failure of the machine automation of an interaction among people*
 - *Machines help humans by **recognizing failures** in the (automated) interaction strategy, and by **adapting the collective** in a way to deliver successful service provision in presence of the unexpected obstacles.*

Adaptability to the world and people unexpected diversity is realized **via the emergence of the most suitable service provision and Augmented Collective**.



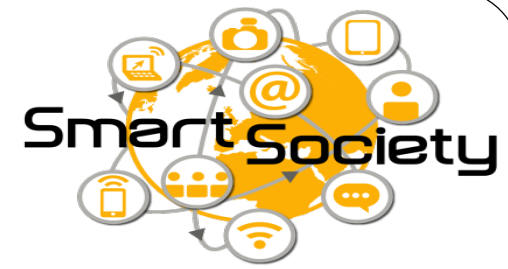
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Challenges



Social computation

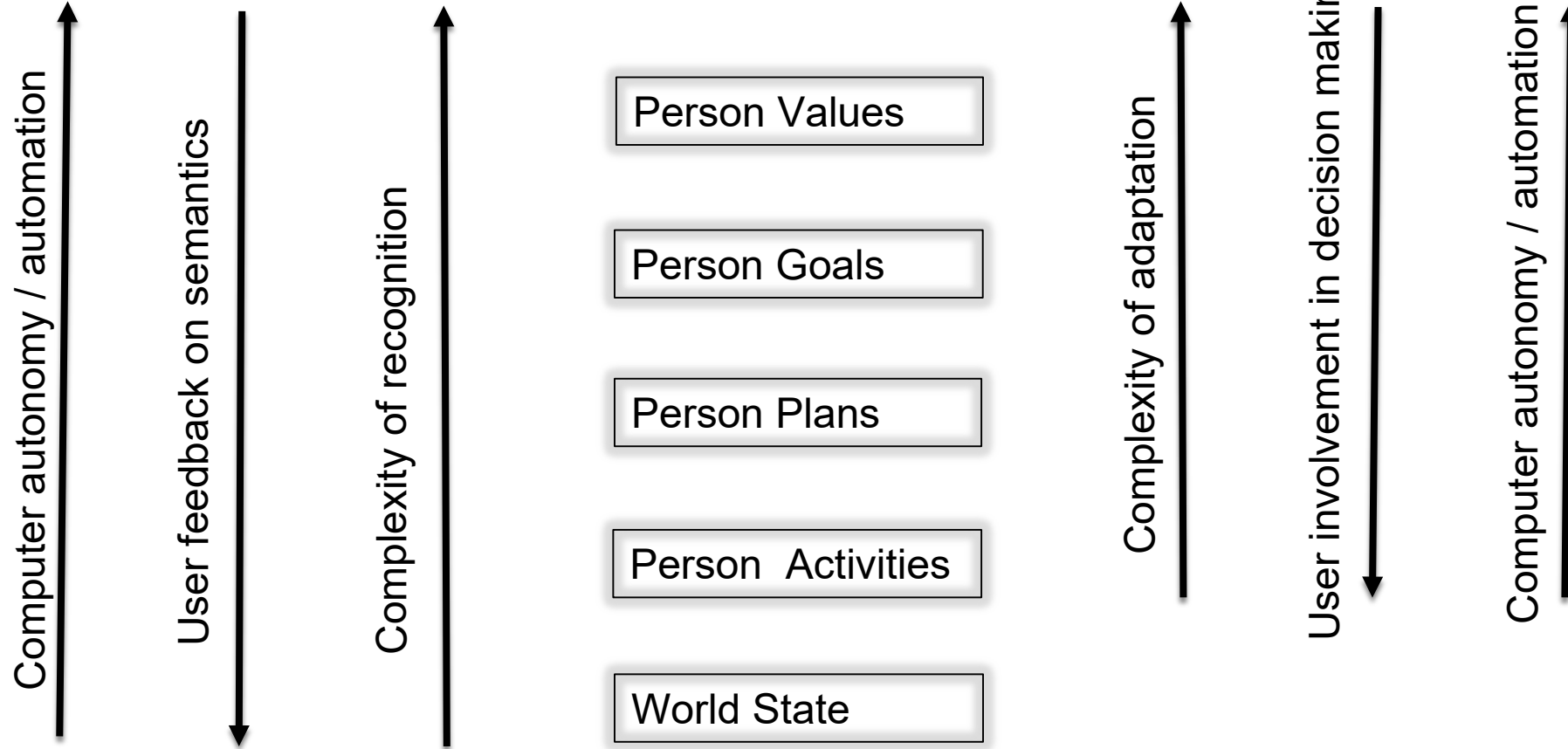
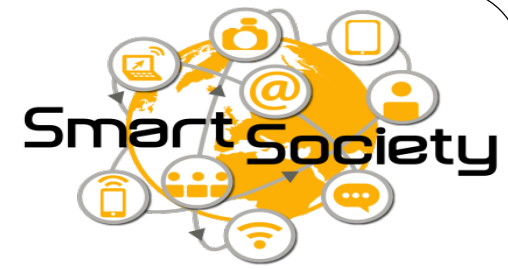
- × computation models
- × Governance models
- × languages for social computation [Elephant 2000]
- × Run-time environments (completion validation)

Diversity

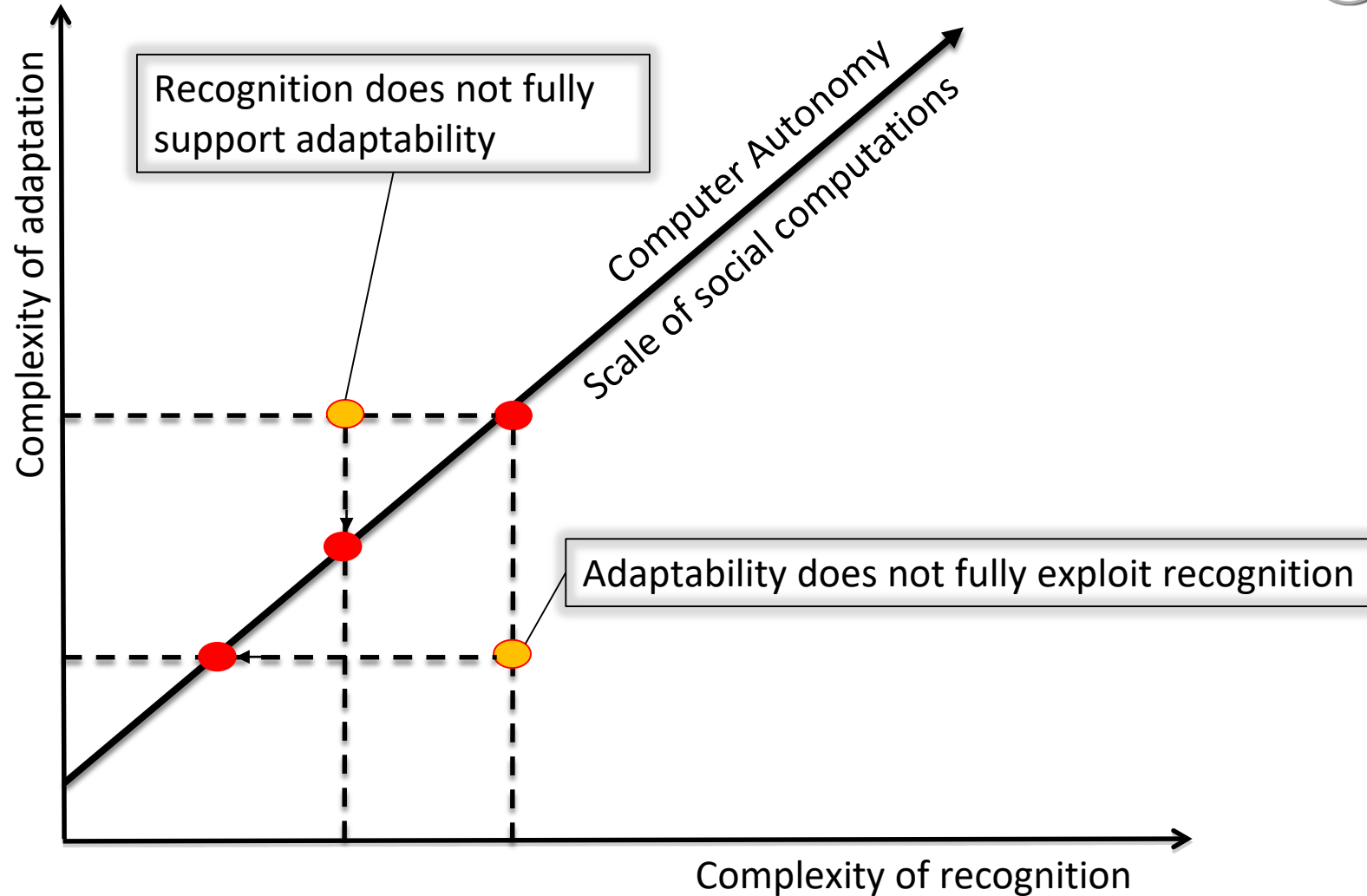
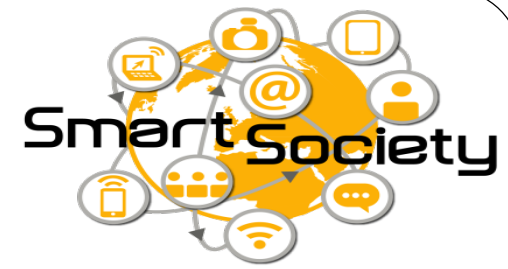
- × Modelling diversity
- × Recognizing diversity
- × Adapting to diversity



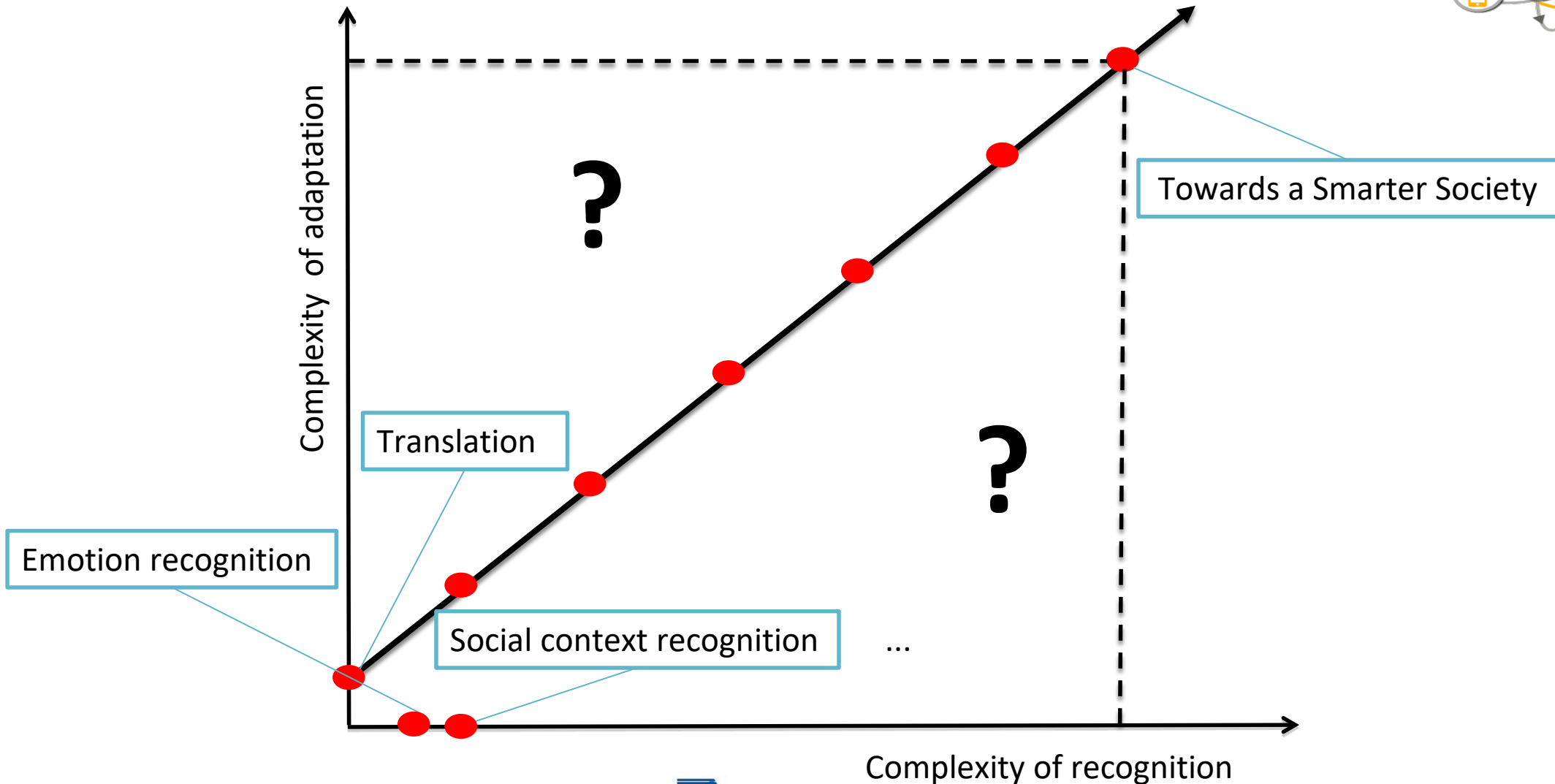
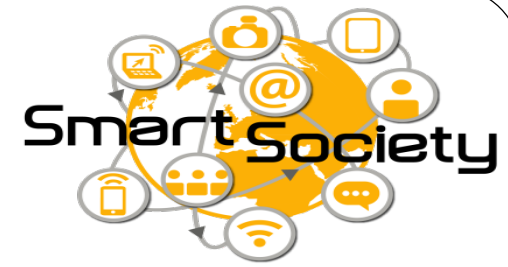
The dimensions of diversity



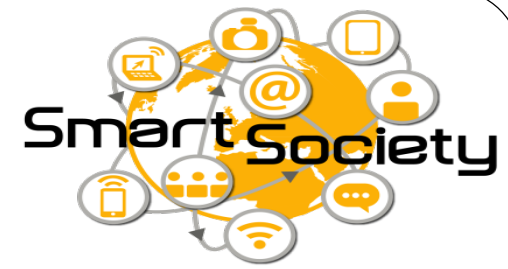
Automation of social computations



Automation of social computations (cont.)



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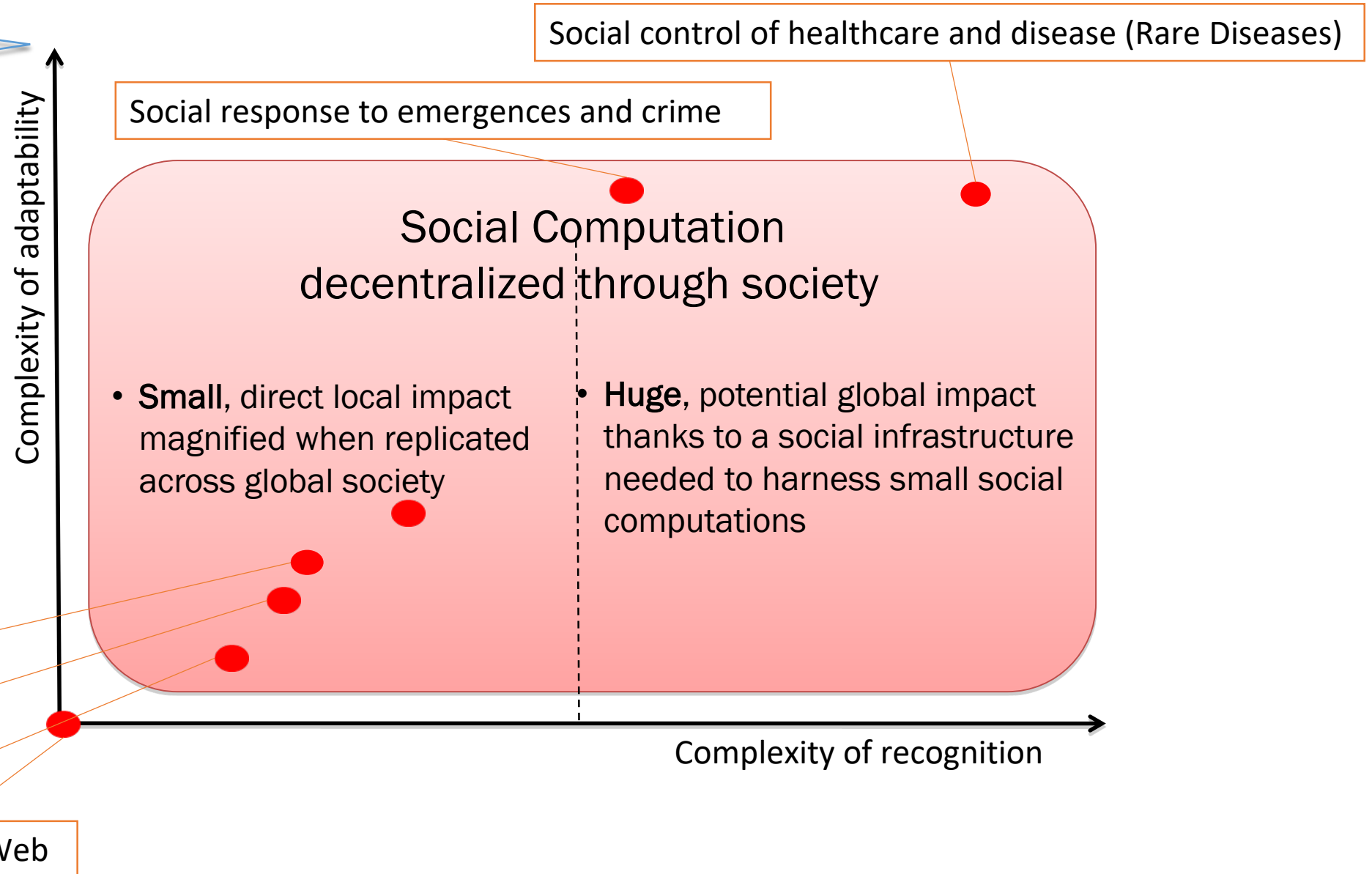


1. Premise: Artifacts and services
2. Empowering service provision
3. Empowering social relations
4. Service provision as social computation
5. Managing diversity
6. Challenges
 - a. Social computations
 - b. Managing diversity
7. **Impact**
8. Computational Humanism
9. Demo (video)



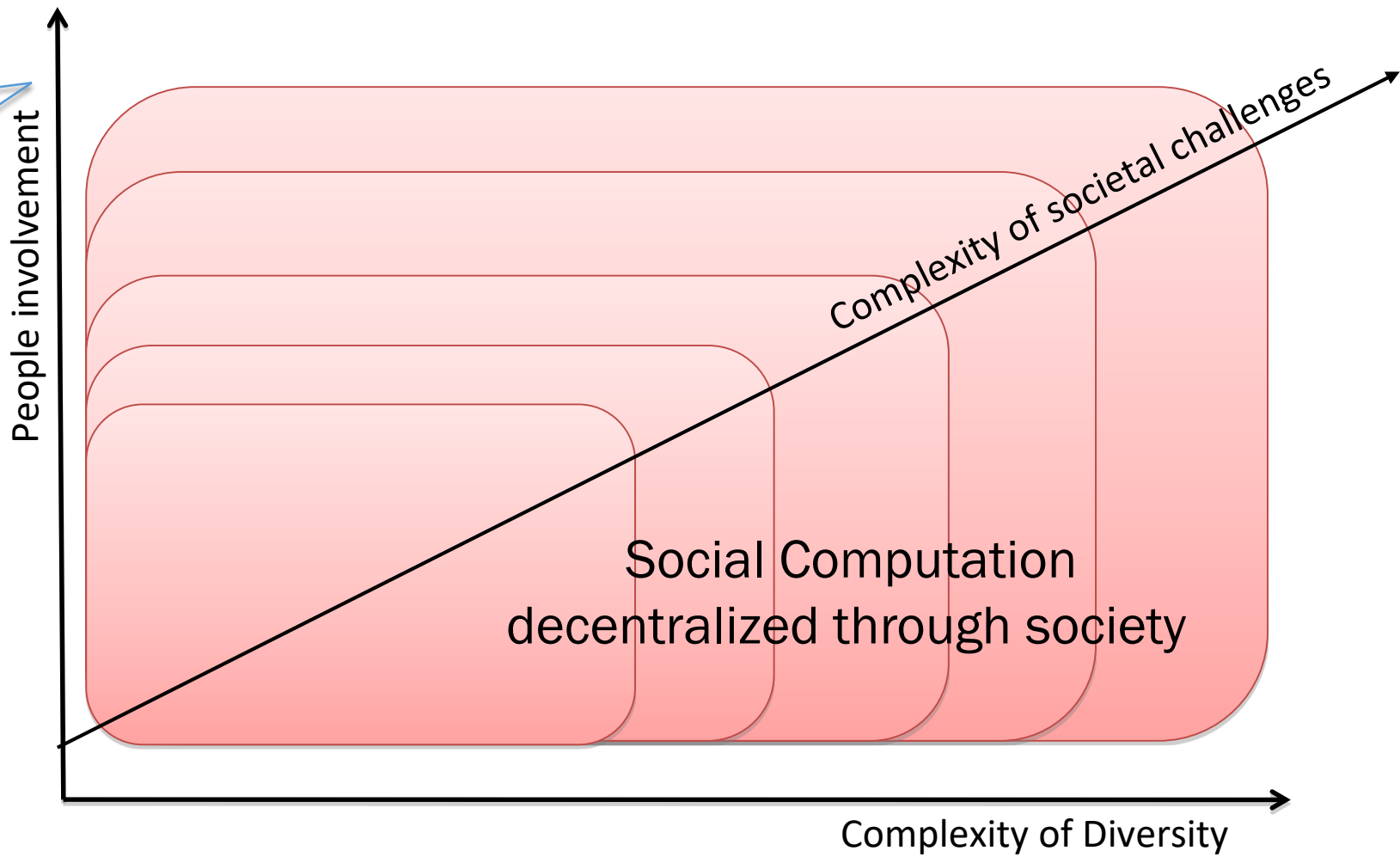
Societal challenges – Scaling over machine intelligence

Fixed Diversity

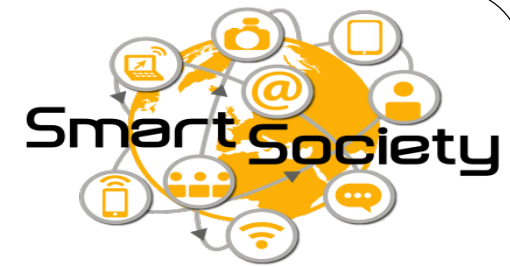


Societal challenges – Scaling over diversity

*Assuming sufficient
Recognition and
Adaptability
Capabilities by machines*



Long term Impact



B2B2C Paradigm - a new generation of Services:

- ✗ From multi-channel mono-directional service provision ...
- ✗ ... to end-to-end multi-directional social service provision

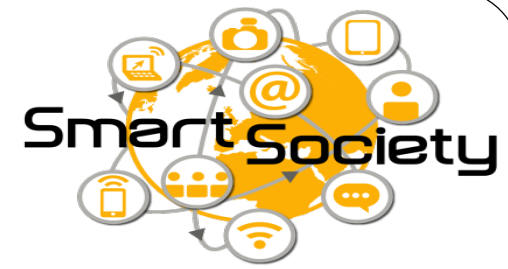
Potential huge improvement of the ***quality of service provision***

1. Scale (space, people)
2. Time of delivery
3. Customization
4. Personalization
5. All service sectors (financial, education, transportation, retail, media, health/well-being, ...)

Service innovation as the means to ***Societal Innovation***.



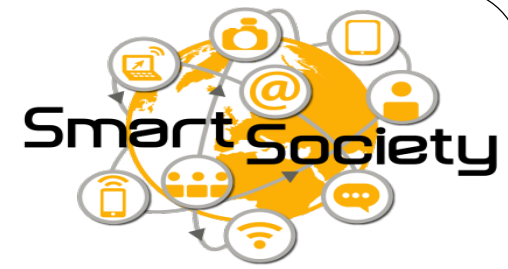
The person to the moon



Augmented Collectives and *Artificial Intelligence*

- The ultimate success of **Artificial Intelligence** would be to build a machine whose Intelligence equals or exceeds human intelligence.
- The ultimate success of **Augmented Collectives** would be to make it possible for everybody to exploit, when trying to achieve her objectives, the best expertise available in the planet. Each person would be augmented with all the knowledge available in the world.

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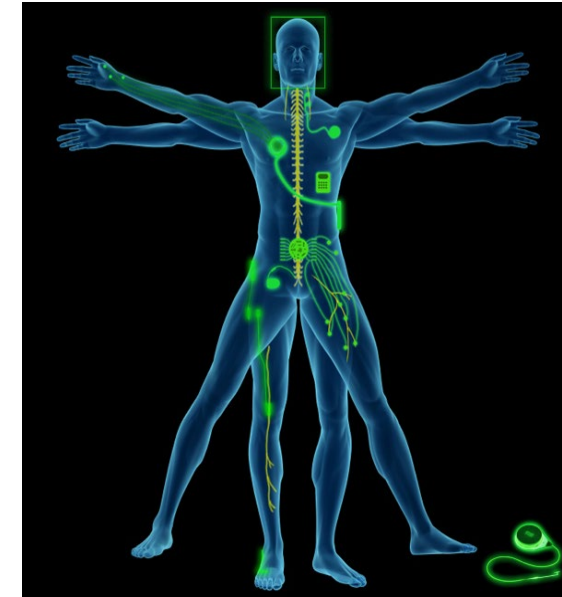
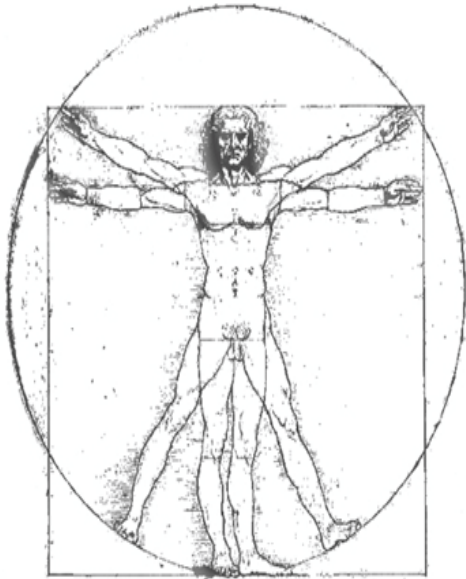


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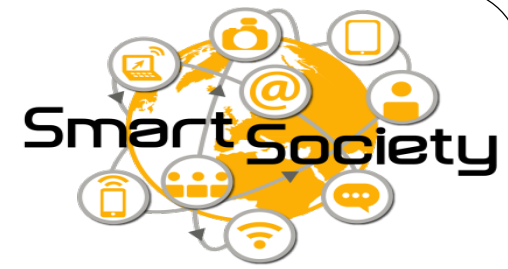


Computational humanism

*Humans at the core of our studies as the way to guide the technology development towards scaling **collective intelligence***



Computational humanism



New discipline, resulting from the convergence of

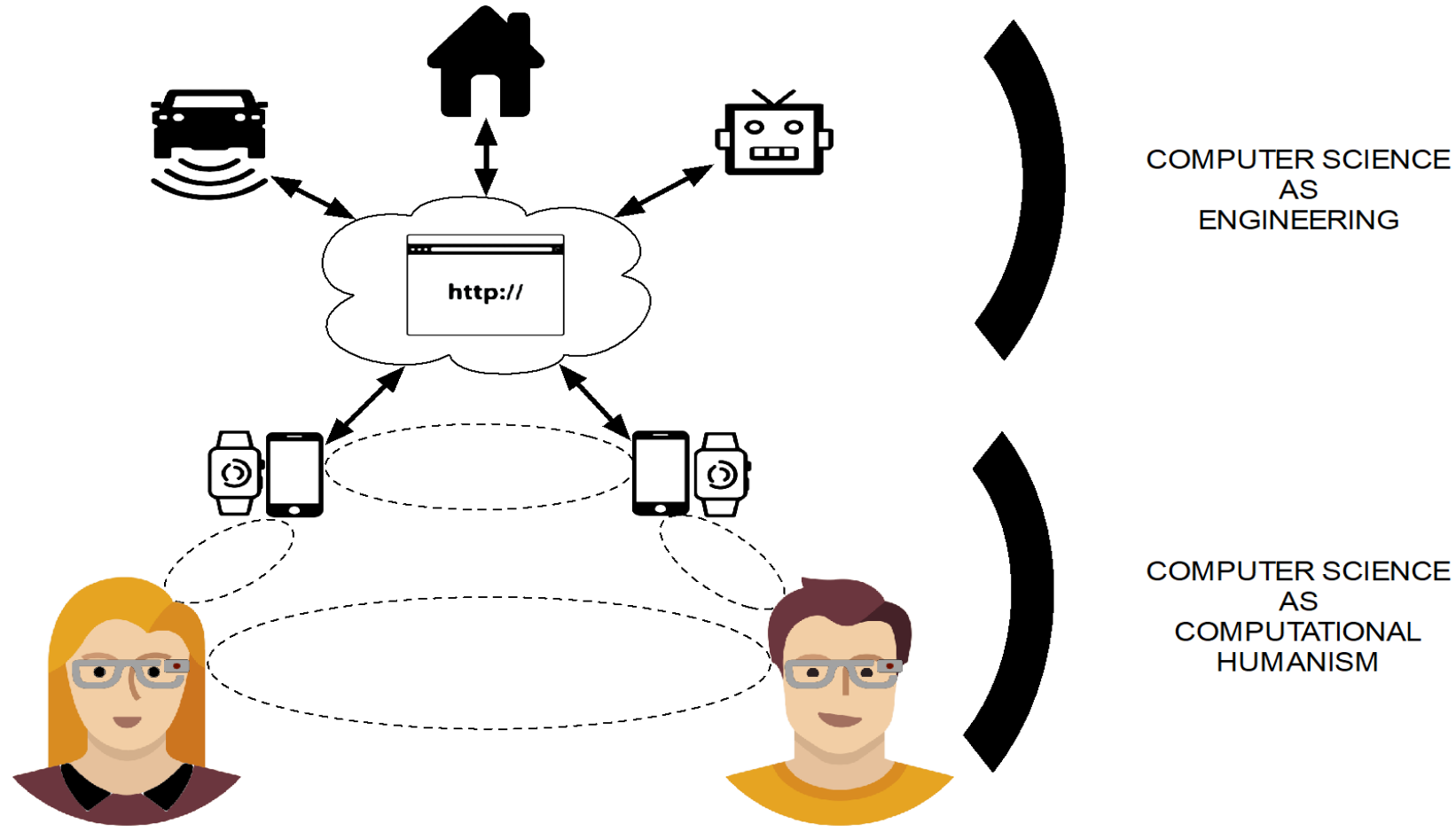
- *Humanities*, providing the knowledge of the human behaviour
- *Computer Science*, providing the methodology for the development of computational models of the human behaviour

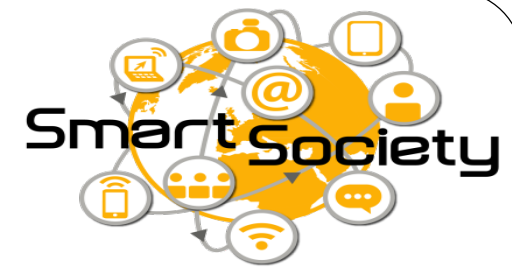
Dual approach

- *Engineering*: develop systems which will realize the socio-digital Society
- *Science*: use the big data generated by running the systems to study the socio-digital society



From Computer Science to Computational Humanism





THANK YOU!
Fausto Giunchiglia