Inteligencias Artificiales
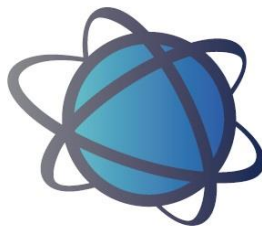
Superando Desafíos, Aprovechando Oportunidades y Proyectando Consecuencias Futuras
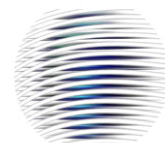
Carlos Araya

June 21, 2023
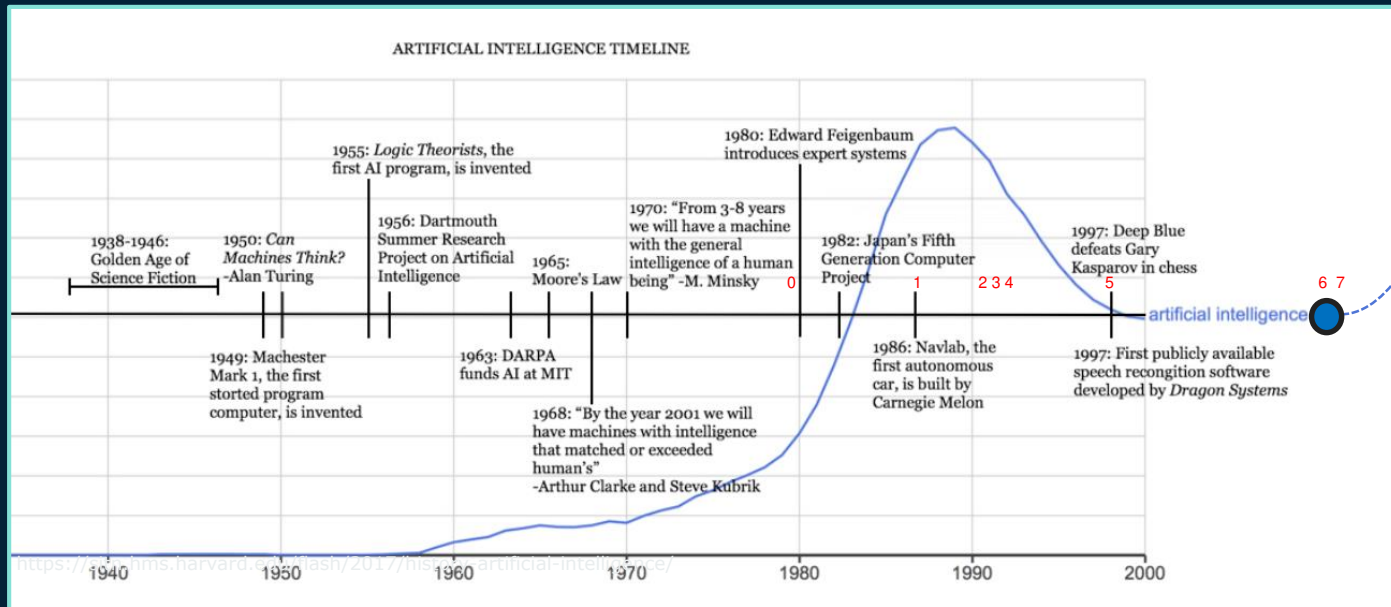
Club de Investigación Tecnológica
Desde 1988

SINGULARITIES

universidad cenfotec_

MUSCLE

In perspective

Productivity?

ARTIFICIAL INTELLIGENCE TIMELINE

1955: *Logic Theorists*, the first AI program, is invented

1980: Edward Feigenbaum introduces expert systems

1970: "From 3-8 years we will have a machine with the general intelligence of a human being" -M. Minsky

1938-1946: Golden Age of Science Fiction

1950: *Can Machines Think?* -Alan Turing

1956: Dartmouth Summer Research Project on Artificial Intelligence

1965: Moore's Law

1982: Japan's Fifth Generation Computer Project

1997: Deep Blue defeats Gary Kasparov in chess

1949: Machester Mark 1, the first storted program computer, is invented

1963: DARPA funds AI at MIT

1986: Navlab, the first autonomous car, is built by Carnegie Melon

1997: First publicly available speech recongition software developed by *Dragon Systems*

1968: "By the year 2001 we will have machines with intelligence that matched or exceeded human's" -Arthur Clarke and Steve Kubrik

0   1   2 3 4   5   6 7

artificial intelligence

1940   1950   1960   1970   1980   1990   2000

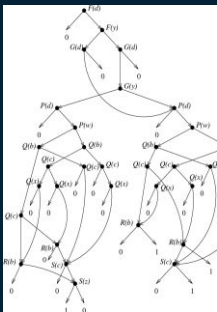https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/

[3] 1993 : proof of a AI belief system fulfillsCarlos E. Alchourrón, Peter Gärdenfors and David Makinson (AGM) postulates the gold standard in Agents' rationality and change – C Araya

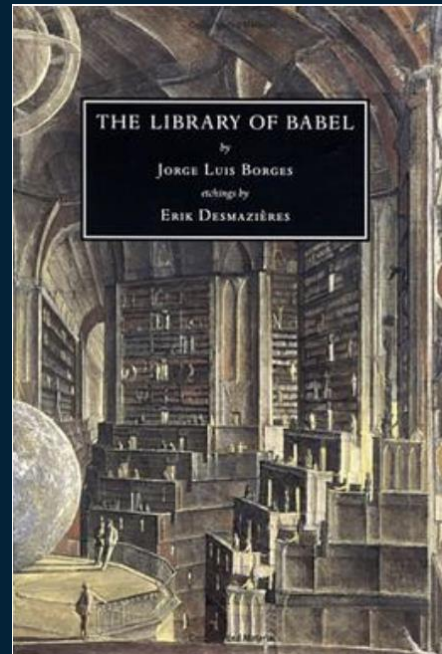# ANNs great news and opportunities …

Unexpected amazing results

No real *understanding*, not **truth**, but coherence….

Is it the missing piece for Hard + Soft AI?

– Extracting **representations** and **ontologies**, explanations!
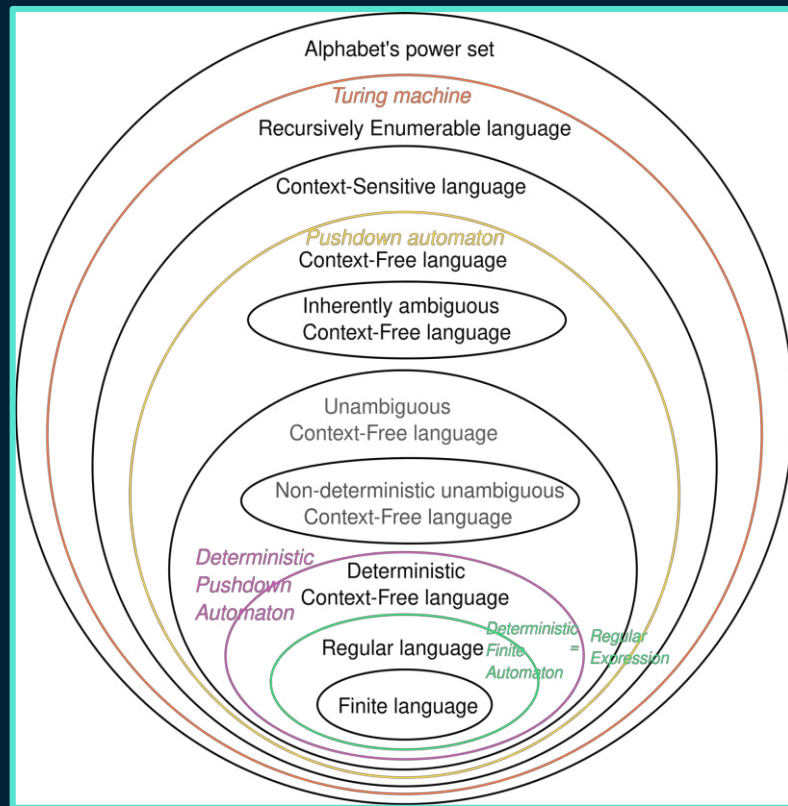– attenuating real-world **computational complexity**
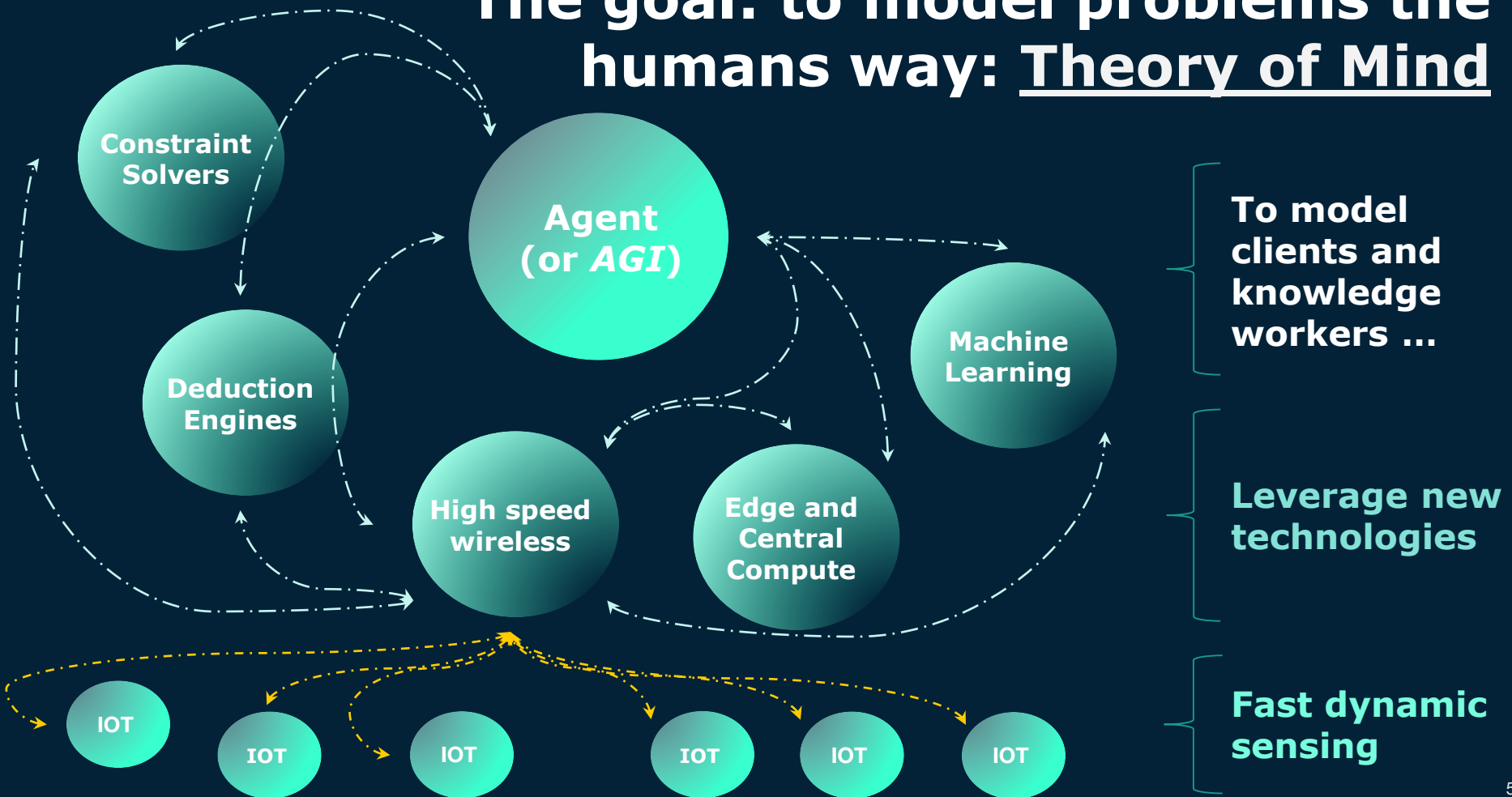

Should it make us more critical?

... learning the laws of reality ...

Automata and formal languages

The goal: to model problems the humans way: <u>Theory of Mind</u>

Constraint Solvers

Agent (or *AGI*)

Deduction Engines

Machine Learning

High speed wireless

Edge and Central Compute

IOT IOT IOT IOT IOT IOT

To model clients and knowledge workers ...

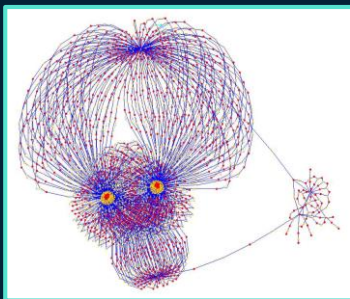**Leverage new technologies**

Fast dynamic sensing

Aleph: **a formal logic for business solutions**

A **language** for some abstract concepts

- To model **necessity**, and **possibility**
- And **entailment** and **consistency**
- And **beliefs** & **behaviors** for **rational *Agents*[1]**

For mathematically manipulating your business problem's '**possible worlds**'

The convergence opportunity …
- **Reasoning systems**
- **Machine learning**
- **Constraint programming**
- **Mathematical optimization**

… *"Search is dead! Long life proof!"* Peter J. Stuckey

[1] *Fulfills AGM postulates, the gold standard in Agents' rationality and change*

Possible worlds of a Business

ID	Age	Salary	...	Product	Category	Weight
AAAAAA	1	$0.0		P1	C1	1e-128 Kgrs
...	...	...		...	...	...
ZZZZZZ	1000	$1e8		Pn	Cm	9.9999e10 Kgrs

X   X   X   ...   X   X

Gottfried Leibniz - proposed the existence of an infinite number of *possible worlds*, each representing a distinct way the world could be

Saul Kripke - a framework for semantics of modal statements

Aleph – engineered to **finite state systems** (computers)
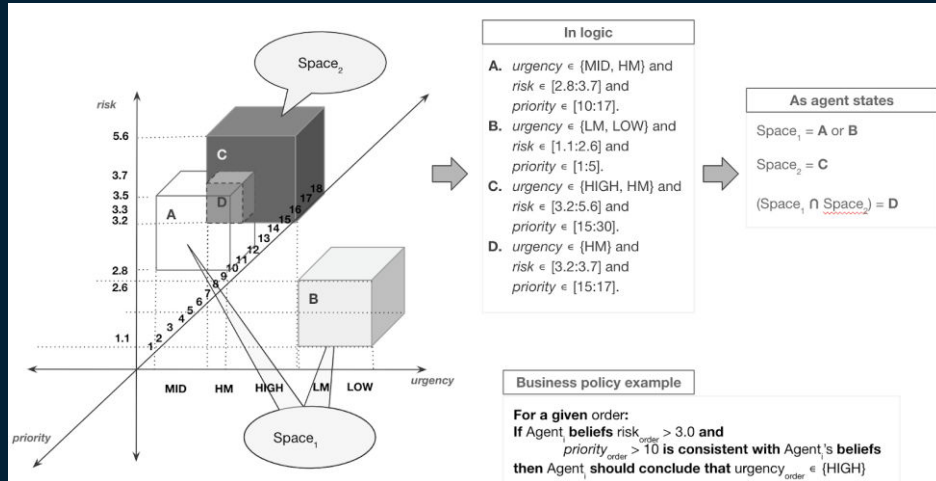
Aleph hyperspaces: **your Business algebra** …

In mathematics

meaning(**4**) =
     {s : s has exactly four elements }

meaning(**1 + 2**) =
     {s : s has exactly 1 plus 2 elements

In *Aleph*

Where **W** is the universe of a business states

meaning(**True**) = **W**

meaning(**∼** a) = **W** − **meaning**(a)

meaning(a ∧ β) = **meaning**(a) ∩ **meaning**(β)

meaning(a ∨ β) = **meaning**(a) ∪ **meaning**(β)

meaning(a **entails** β) =
     meaning(a) ⊆ **meaning**(β)

meaning(a **isConsistentWith** β) =
meaning(a) ∩ **meaning**(β) ≢ ∅

meaning(t_1 = t_2) =
     {ω : ω ∈ **W** and t_1 = t_2 is in ω}

Logics are extensible onions …

Logics are characterized by the language of their theorems

Axioms + **Inference Rules** = **Theorems**

Tautologies

Propositional

Predicate

FOL

Modal

Equality

Sortals

Business

Rasing Management with new (old) paradigm

```
all(t : horizon ... 1,
    Kₜ ≡ max(sum(ORDERS, o ->
              ( d[o] ? DeliveryRequirement(o) * ( unitaryValue(o)-unitaryCostDelivery) : 0.0 )
           - ( s[o] ? StagingRequirement(o) * unitaryCostStaging  : 0.0 )
           - ( p[o] ? PackingRequirement(o) * unitaryCostPacking  : 0.0 ) ))
    & all( ORDERS, o ->
          ( (Kₜ₊₁ entails c[o] ) → c[o] )
        & ( DueTime(o) ≥ t      → ((Kₜ₊₁ isConsistentWith ¬c[o] ) & (Kₜ isConsistentWith d[o])) → (d[o]&c[o]) ) )
        & ( DueTime(o) > t       → ((Kₜ₊₁ entails (s[o] || d[o])) & (Kₜ isConsistentWith s[o])) → s[o]) )
        & ( DueTime(o) > t+1  → ((Kₜ₊₁ entails s[o] ) & (Kₜ isConsistentWith p[o])) → p[o]) )
        & ( DueTime(o) > t+1  → ((Kₜ₊₁ entails p[o] ) → c[o]) ) )
        & sum( ORDERS, o -> ( d[o]? DeliveryRequirement(o) : 0.0 ) ) ≤ DeliveryCapacity(t) )
        & sum( ORDERS, o -> ( s[o]? StagingRequirement(o) : 0.0 ) ) ≤ StagingCapacity(t) )
        & sum( ORDERS, o -> ( p[o]? PackingRequirement(o) : 0.0 ) ) ≤ PackingCapacity(t) ))
    & K_{horizon+1} ≡ all( ORDERS, o -> ¬c[o] )
```

Specify <u>business boundaries</u>: **domains** and **variables**

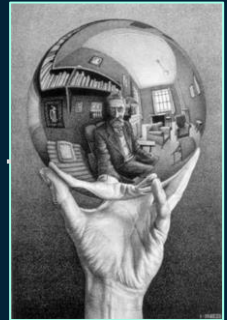↳ Describe the problem with **statements** about agents
- **Knowledge** (*truths*)
- **Beliefs** (*contingencies*)
- **Behaviors** (*conditionals*)

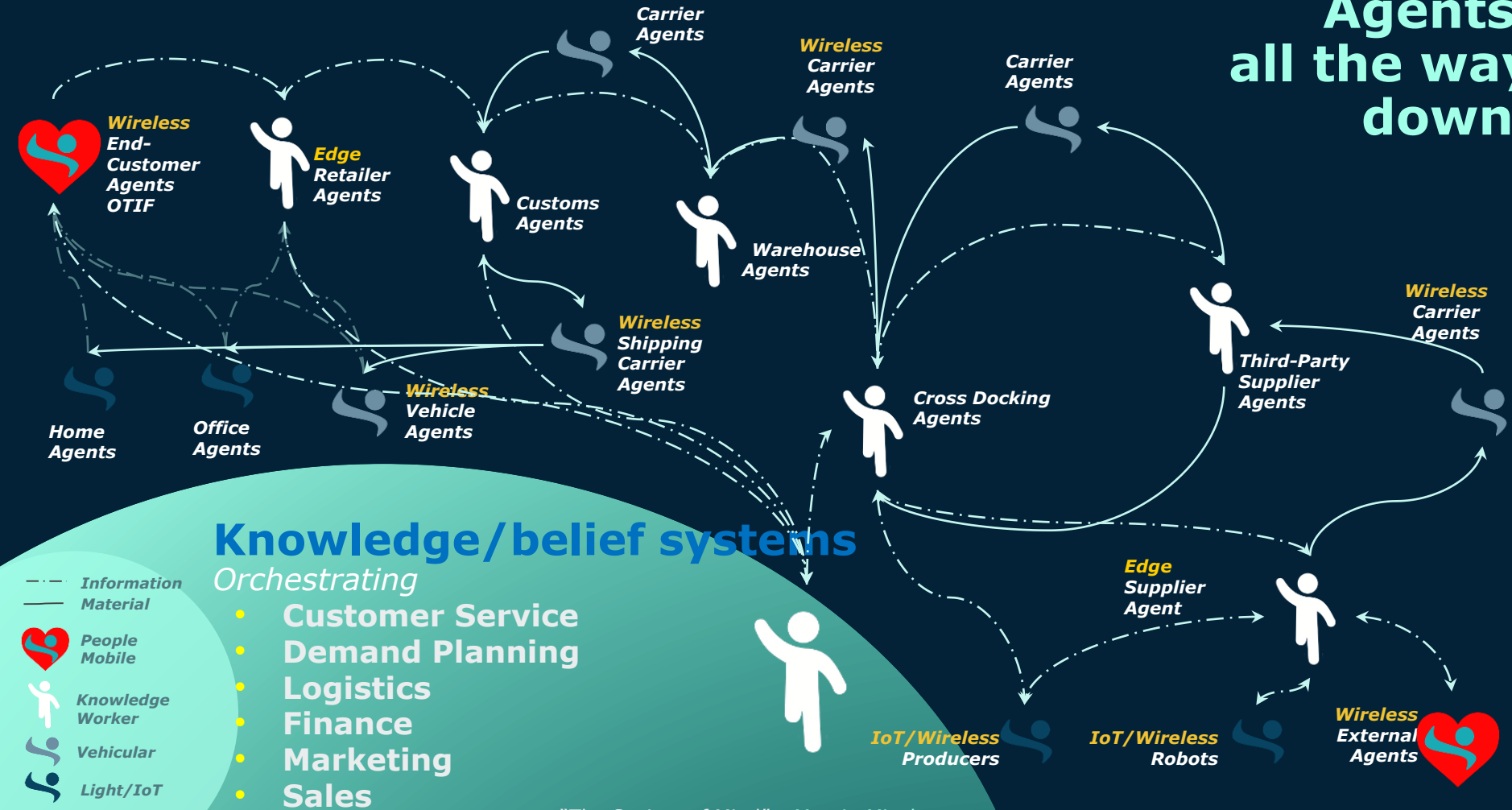↳ Find parameters using **machine learning** or **other methods**

↳ Model solution using reflective **equivalences** ('*equations*') as in Finance, Engineering, Economy

↳ Specify **goals** using maximizations and **reflection**

↳ Let *Aleph* find the *equations roots* using its advanced **proprietary** and **off-the-shelf** algorithms

Agents, all the way down!

Carrier Agents

Wireless Carrier Agents

Carrier Agents

Wireless End-Customer Agents OTIF

Edge Retailer Agents

Customs Agents

Warehouse Agents

Wireless Carrier Agents

Third-Party Supplier Agents

Wireless Shipping Carrier Agents

Cross Docking Agents

Home Agents

Office Agents

Wireless Vehicle Agents

Edge Supplier Agent

Knowledge/belief systems
Orchestrating
- **Customer Service**
- **Demand Planning**
- **Logistics**
- **Finance**
- **Marketing**
- **Sales**

Information
Material

People Mobile

Knowledge Worker

Vehicular

Light/IoT

IoT/Wireless Producers

IoT/Wireless Robots

Wireless External Agents

"The Society of Mind" - Marvin Minsky

Dealing with business and world complexity

- Kahneman's Systems 1 & 2
- Business operates with ***bounded rationality*** - satisfactory instead of optimal decisions
- … the **principal-agent problem** …
- The proposed paradigm
  - **Self-improving** by design
  - A explainable language for intelligent ***agents***
  - Integrative of Economy principles: **game theory**, Nash equilibrium, Shaply values, …
  - And of special purpose algorithms

Conclusion: The need for hard AI

"Like my cat, I often simply do what I want to do"
Reasons and Persons, Derek Parfit

"**Enlightenment**: rationality as humankind's highest achievement … Darwin's theory of evolution promise evolutionary progress at humankind's expense…"
The age of pseudocognition, Economist

AI is going to raise AGI's, and Business
        "*this is no time to go woobly*", *Margaret Thatcher*

Gracias