Talk Practicalities !

- **Welcome !** **Bibliography: pgs. 42–44. CV: pg. 64**
- I shall use two separate projectors for my overheads (“slides”)
  - One, will show my **Talk** ! – The other an **Example**[1]
- Presenting OHs 16–25 I will refer to the OHs 45–57.

- Relax, listen – and I will “show” You some, I think, interesting ideas !
- Do not expect to “get it all in, i.e., grasp all” !
- But expect to know more than You knew when You came here !

- My talk & example can be found at
  - `https://www.imm.dtu.dk/~dibj/2026/moscow/moscow.pdf`
  - **talk:** pages 1–41 – **example:** pages 45–57

[1] The example has two texts: first the formalisations, pages 45–56, then their annotations, i.e., the narrative, pages 58–57 – which normally comes first !

The Moscow Lectures

Are We Studying and Teaching Computer Science Right ?

Dines Bjørner

Technical University of Denmark

December 2026

The **background** for this talk is this **book** [25]:

Dines Bjørner: Domain Modeling

Моделирование предметной области: основы [26]
Translator & co-author: **Dr. Mikhail Chupilko, ISP RAS**

A Chinese translation is underway: 领域科学与工程导论
Translator & co-author: **Dr. Yang ShaoFa, IoS CAS**

The 'Domain' idea:

The Triptych Dogma:

In order to *specify* $\mathbb{S}$***oftware***, we must **understand** its $\mathbb{R}$***equirements***.

In order to *prescribe* $\mathbb{R}$***equirements*** we must **understand** the $\mathbb{D}$***omain***.

So we must **study, analyze** and **describe** $\mathbb{D}$***omains***.

$$\mathbb{D}, \mathbb{S} \models \mathbb{R}$$

In **proofs** of $\mathbb{S}$***oftware*** **correctness**.
with respect to $\mathbb{R}$***equirements***,
assumptions are made with respect to the $\mathbb{D}$***omain***

- There are four topics to this talk:
  - **Topic I:** DOMAIN [5–27] [2]
  - **Topic II:** **Generative AI / LLMs and** DOMAIN [28–32]
  - **Topic III:** **BSc/MSc/PhD Courses & Research** [33–36]
  - **Topic IV:** **School** DOMAIN **Courses** [37–38]

- The topics are only indirectly related –
  through their presentation and use of the DOMAIN Method

[2] – the main topic of this talk

Topic I: The DOMAIN Approach

- The **issues** in this topic of the talk are:
  - What are domains ?
  - **How** to analyse & describe domains ?
  - A domain analysis & description **ontology**
  - **From** domains **via** requirements **to** software

- What do we mean (here) by Domain ?
  - By a **domain** we shall understand
    * a **rationally describable** segment of
    * a **discrete dynamics** fragment of
    * a **human assisted** reality: the world that we daily observe – in which we work and act, a reality made significant by human-created entities.
  - The domain embody
    * **endurants** and
    * **perdurants**

- **Example Domains:**[3]
  - Assembly Lines
  - Banking
  - Container Terminals
  - Delivery Service
  - Double-entry Bookkeeping
  - Documents
  - Healthcare
  - Hotels
  - Nuclear Power Plants
  - Pipelines
  - Railways
  - Retailing
  - Rivers & Canals
  - Swarms of Drones
  - Transaction Processing
  - Multi-mode Transport
  - Urban Planning
  - Weather Information

[3] – Bibliography entry 1 on page 42 refers to detailed domain descriptions and URLs!

- **Endurants** [in *space*] are

  those quantities of domains that we can observe (see and touch), as "complete" entities at no matter which point in *time*
  – "material" entities that persists, endures
  – capable of enduring adversity, severity, or hardship.

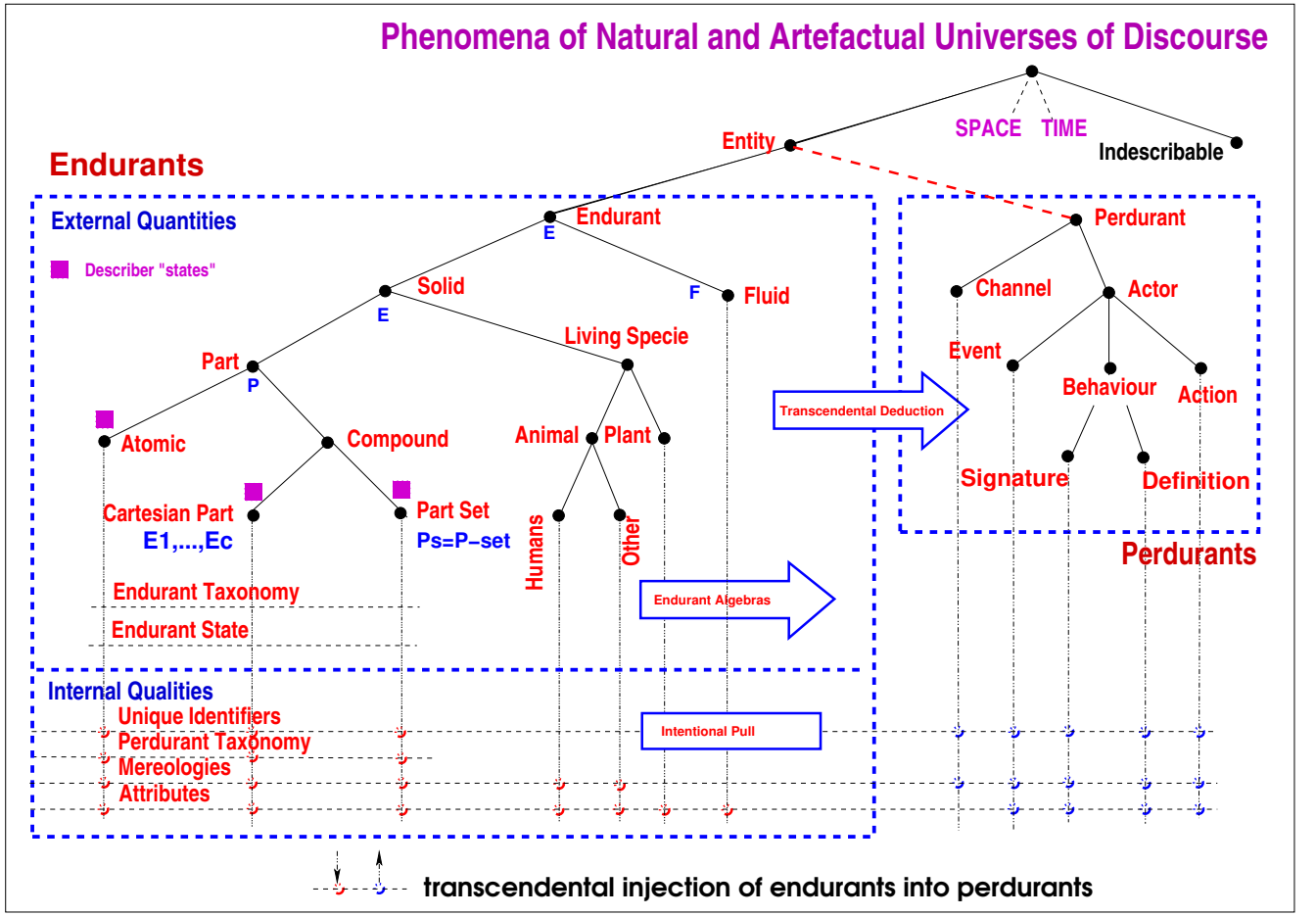
  [Merriam Webster]

- **Perdurants** [in *space*] are

  those quantities of domains for which only a fragment exists, if we look at or touch them at any given snapshot in *time*.

  [Merriam Webster]

A Domain ["the" DOMAIN] Analysis & Description Ontology:



- **Ontology** is

  the philosophical study of being and existence.

  Ontologies explores what kinds of things **exist** in the universe and how they **relate** to each other.

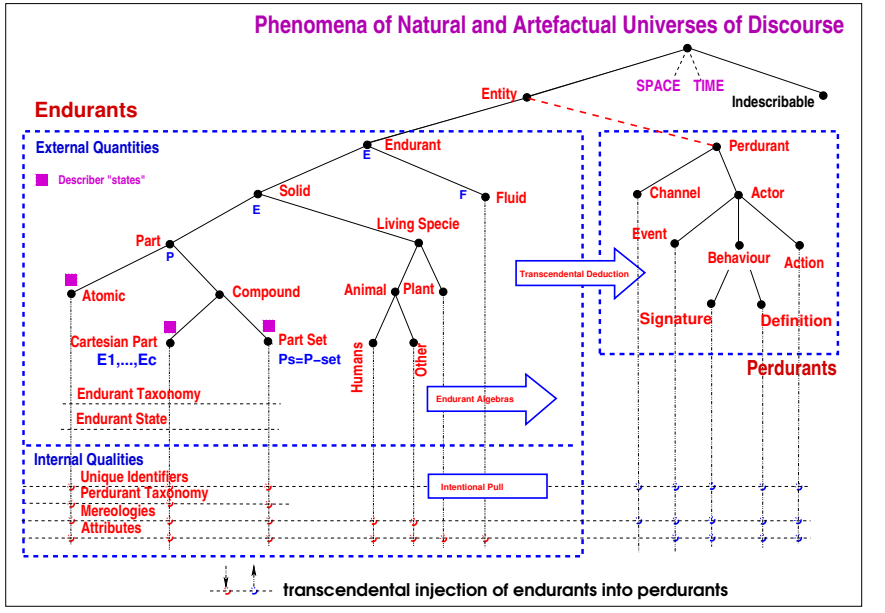
  In computer science and information science,
  ontology also refers to a formal system
  that models concepts and relationships within a specific domain

  [Wikipedia]

We shall use the concept 'ontology' beyond the above characterisation:

as a "graph" of **existence & relations,** and
as a **recipe,** a **procedure,** for **analysis & description.**

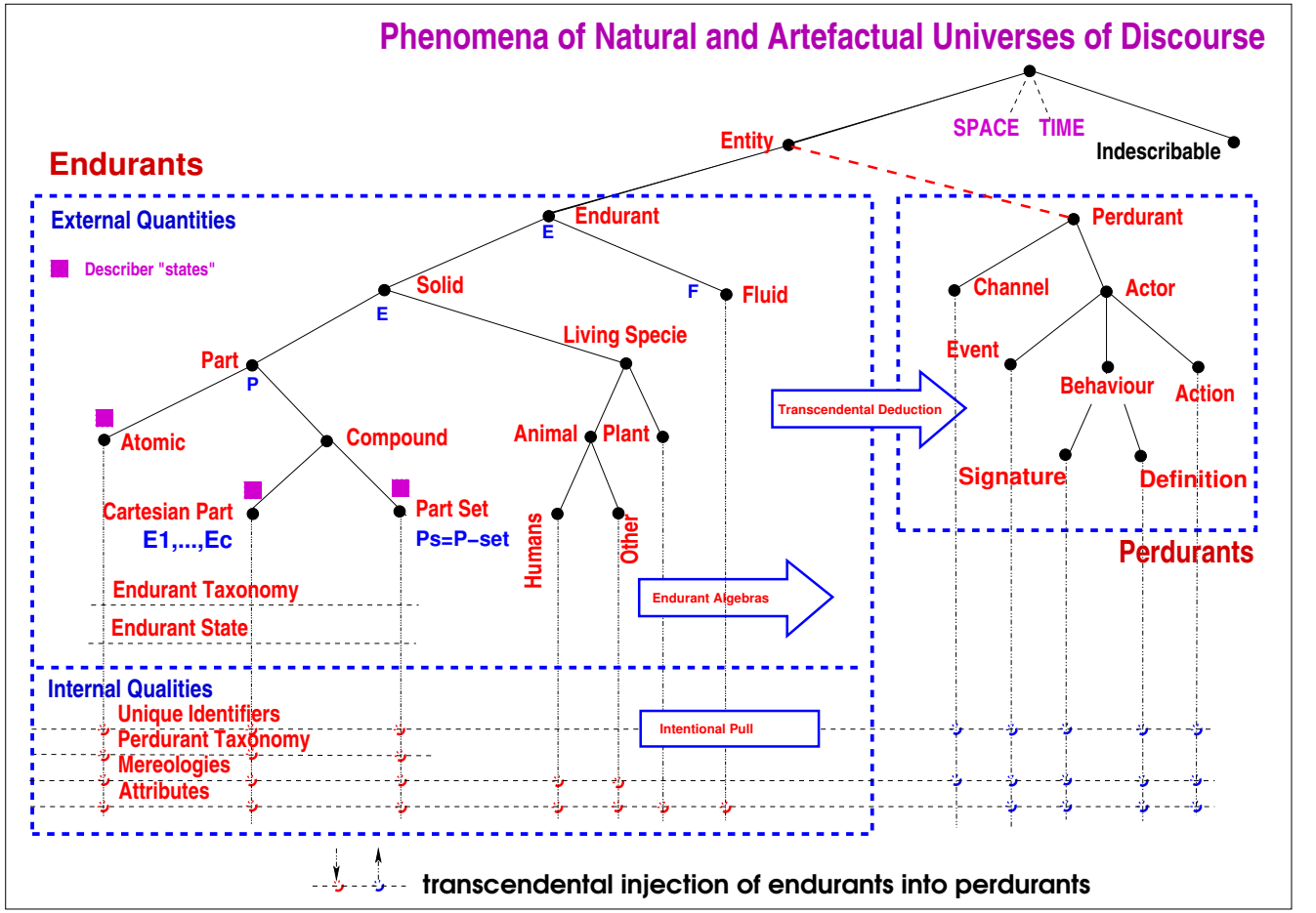
- The **ontology** means this:
  - Gives syntax & semantics to domains
  - Outline types of what there exists
  - Outline properties of domains
  - These are the things that exists:
    - * entities
    - * endurants
    - * perdurants
    - * solids
    - * fluids
    - * parts
    - * living species
    - * atomics
    - * compounds
    - * Cartesians
    - * Part sets
    - * etc., etc.



← I will spend time presenting

← the next overhead

- The **ontology** **also** means this:
  - First analyse & describe endurants; then synthesize perdurants

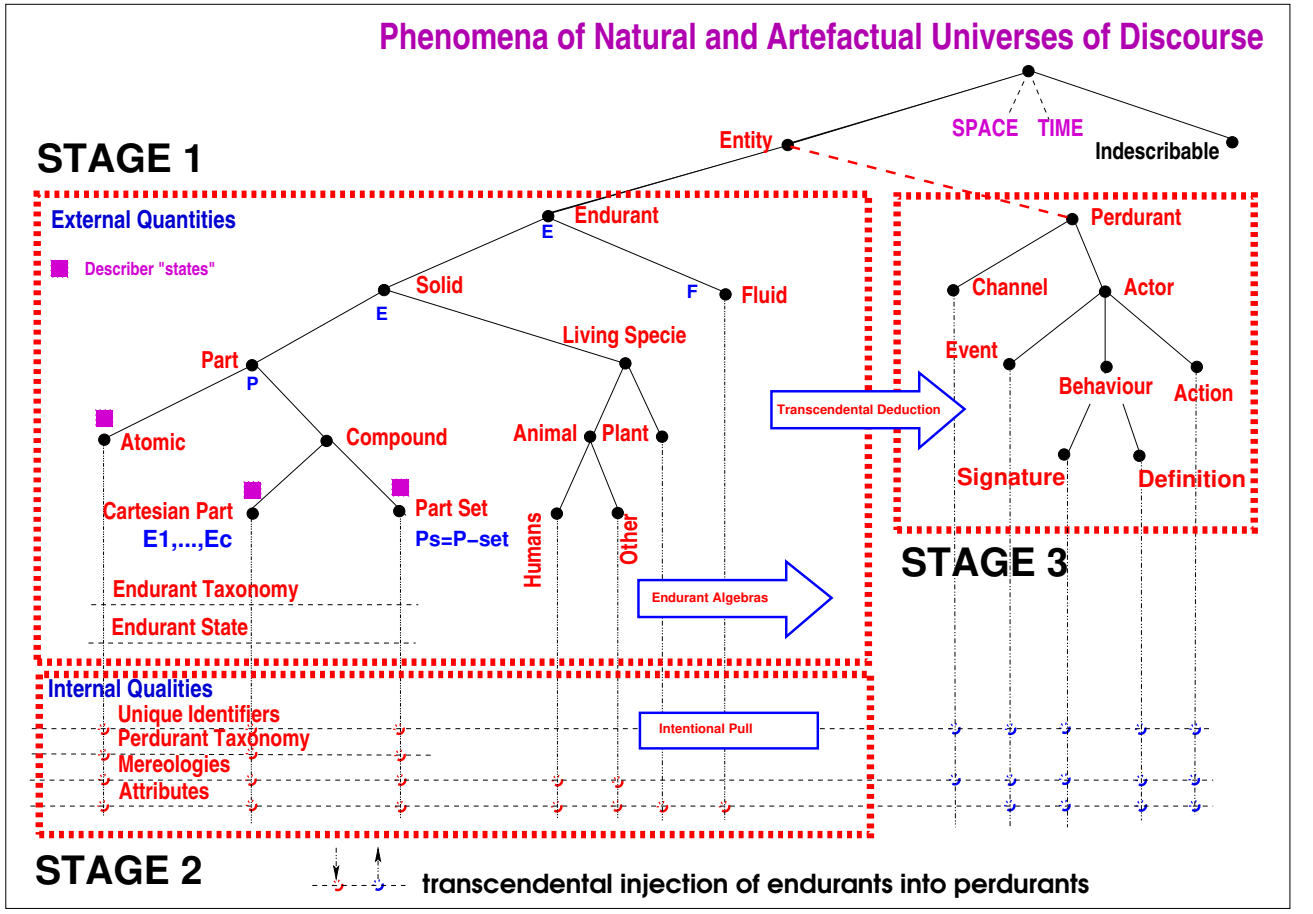

Phenomena of Natural and Artefactual Universes of Discourse
Entity
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TIME
Indescribable
Endurants
External Quantities
Describer "states"
Endurant
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Endurant Algebras
Transcendental Deduction
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Behaviour
Action
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Unique Identifiers
Perdurant Taxonomy
Mereologies
Attributes
Intentional Pull
transcendental injection of endurants into perdurants

- I shall now present some examples: [4]
  - Endurants
    * compound and atomic parts — $\iota 1 \pi 58$–$\iota 4 \pi 58$
    * state — $\iota 5 \pi 58$–$\iota 14 \pi 58$
    * unique identifiers — $\iota 15 \pi 59$–$\iota 32 \pi 59$
    * mereology — $\iota 33 \pi 59$–$\iota 35 \pi 59$
    * attributes — $\iota 36 \pi 60$–$\iota 46 \pi 60$
    * intentional pull — $\iota ?? \pi ??$–$\iota ?? \pi ??$
  - Perdurants
    * communication channel — $\iota 47 \pi 61$
    * behaviours — $\iota 49 \pi 62$–$\iota 59e \pi 63$

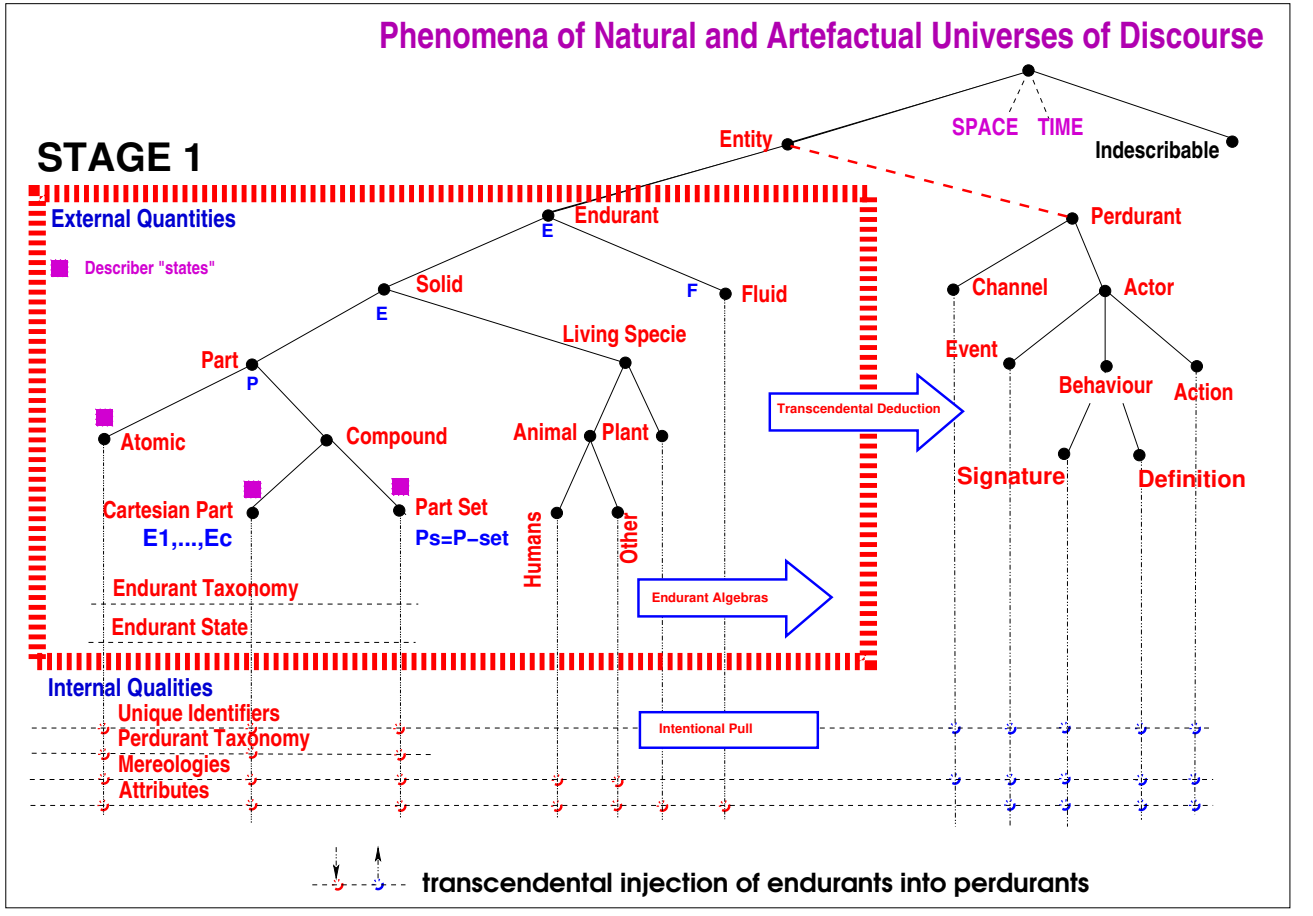
all of the above pointed to, in the ontology graph, by **FAT RED ARROWS**!

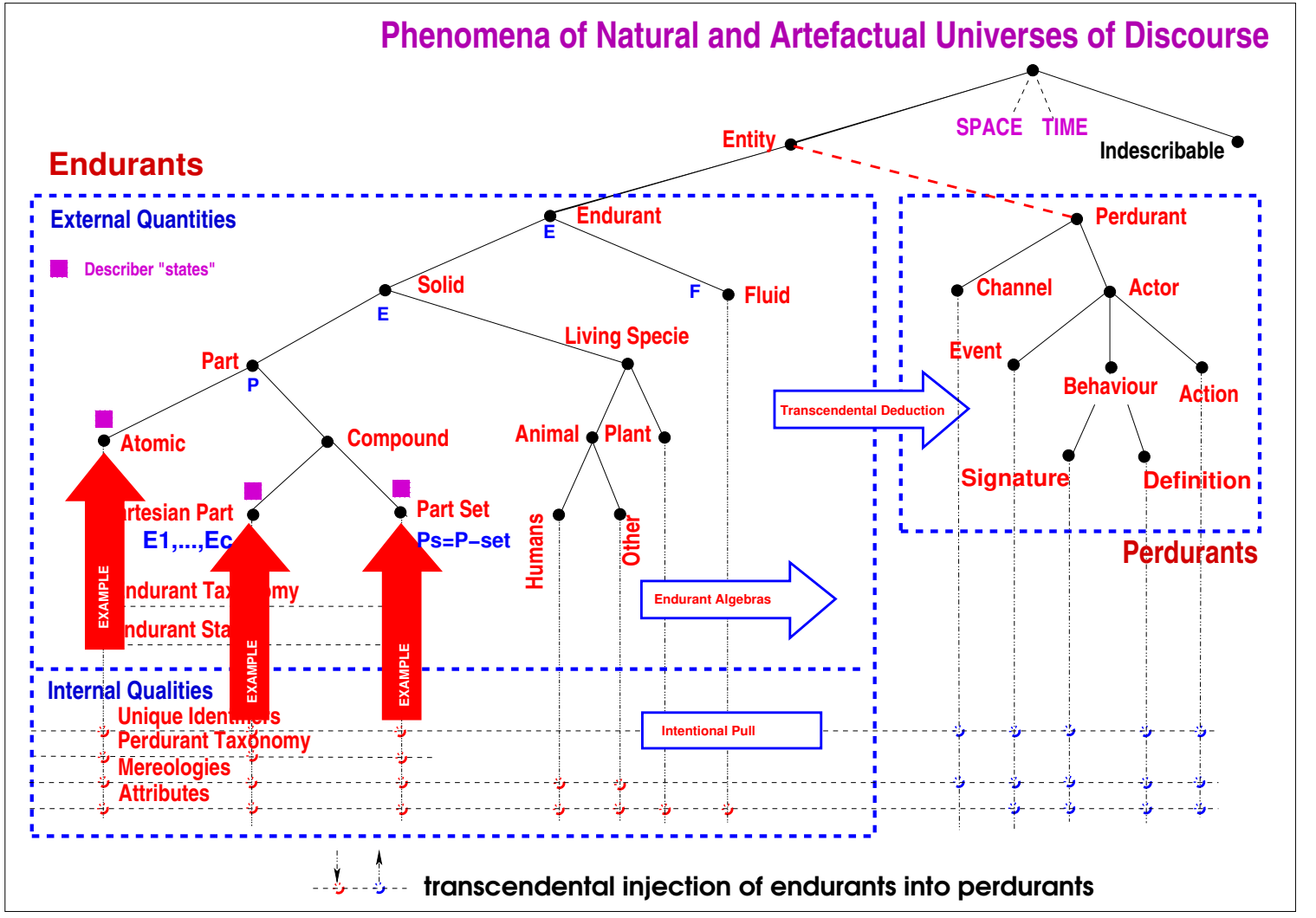
[4] – **the πage references are to ιtems of "the" narratives!**

- There are three stages to the unfolding of the example:.

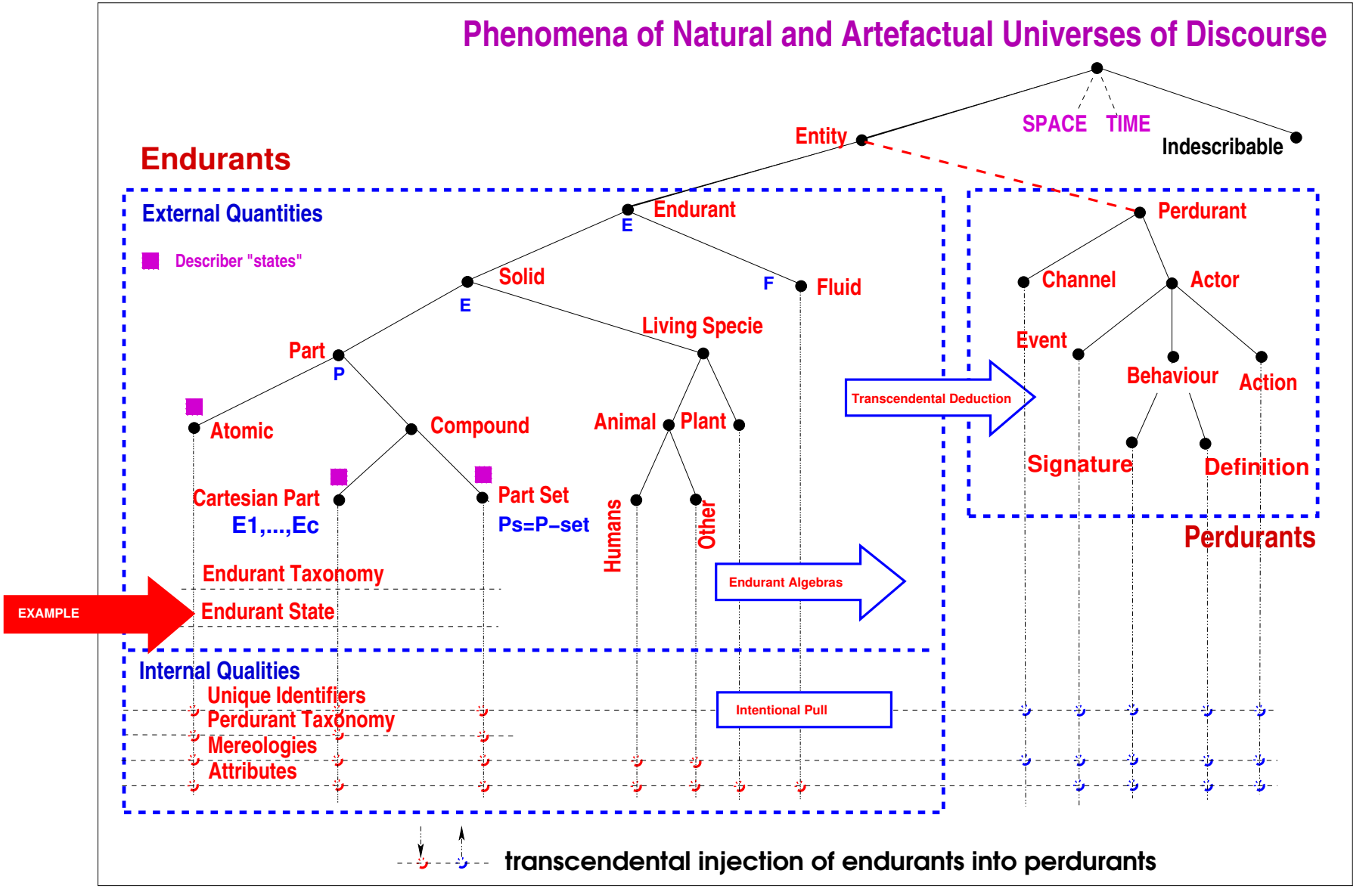


- **Stage 1:**


Phenomena of Natural and Artefactual Universes of Discourse
STAGE 1
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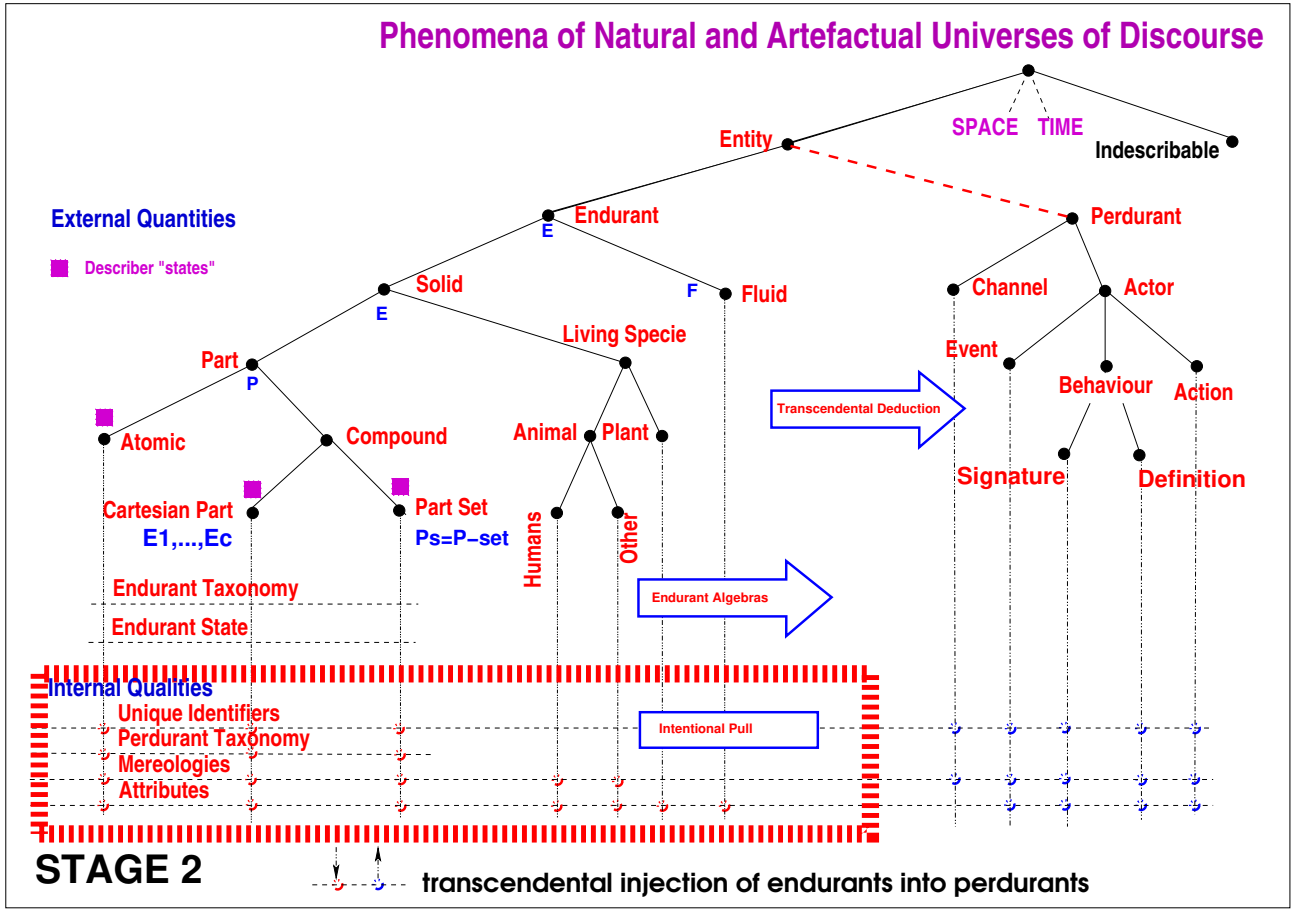

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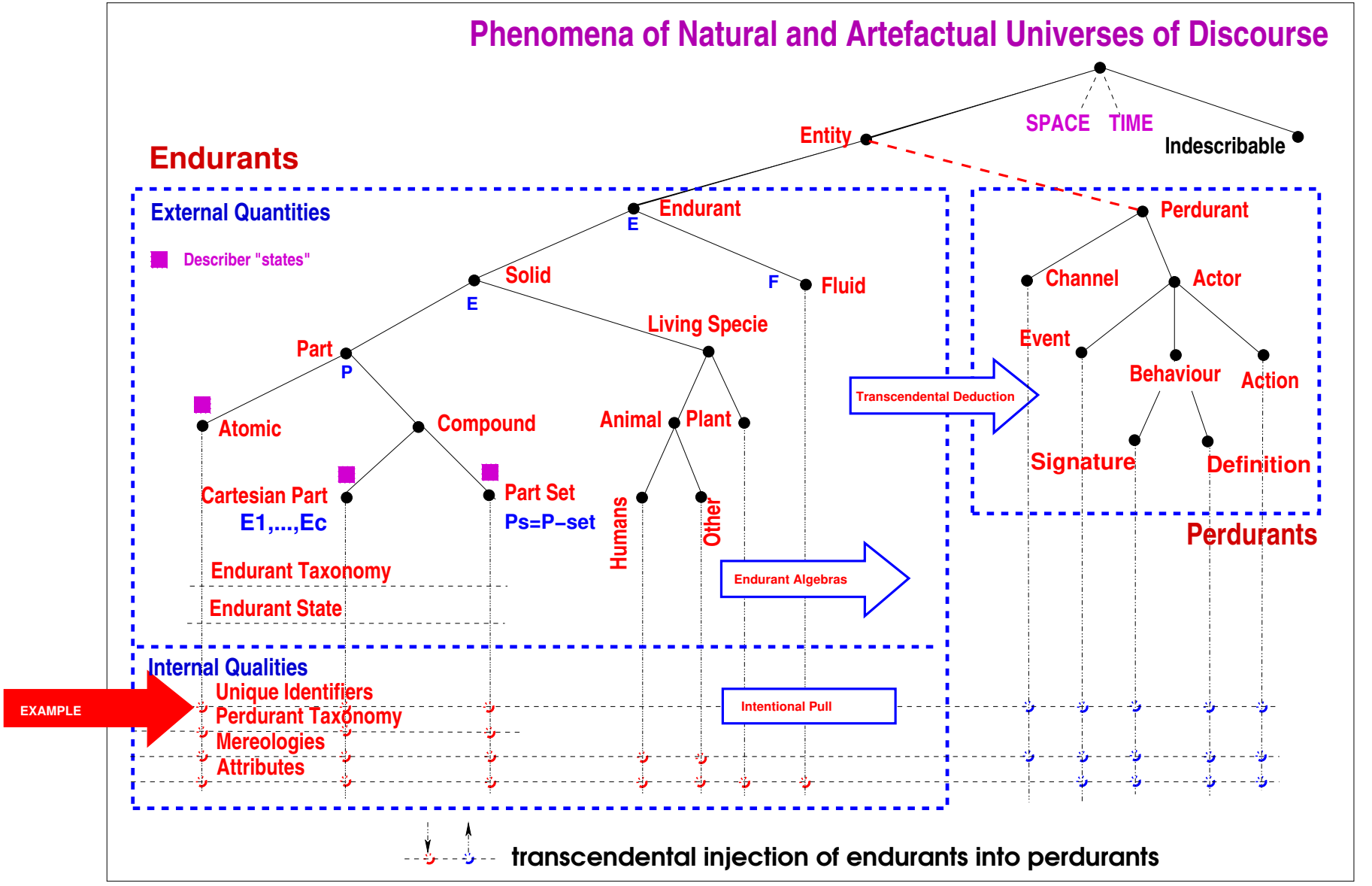
π 46:


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transcendental injection of endurants into perdurants

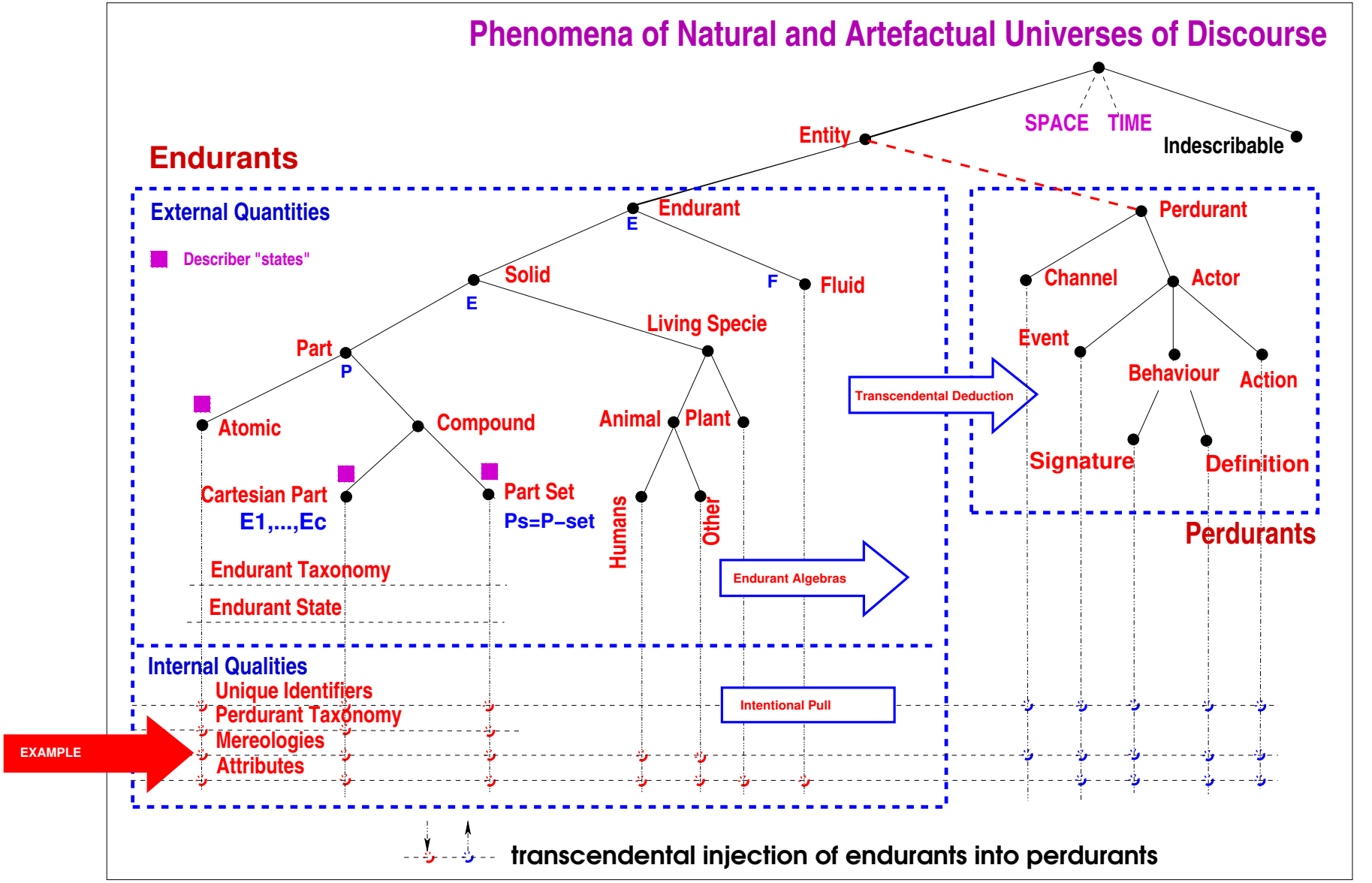
π 47:

- **Stage 2:**

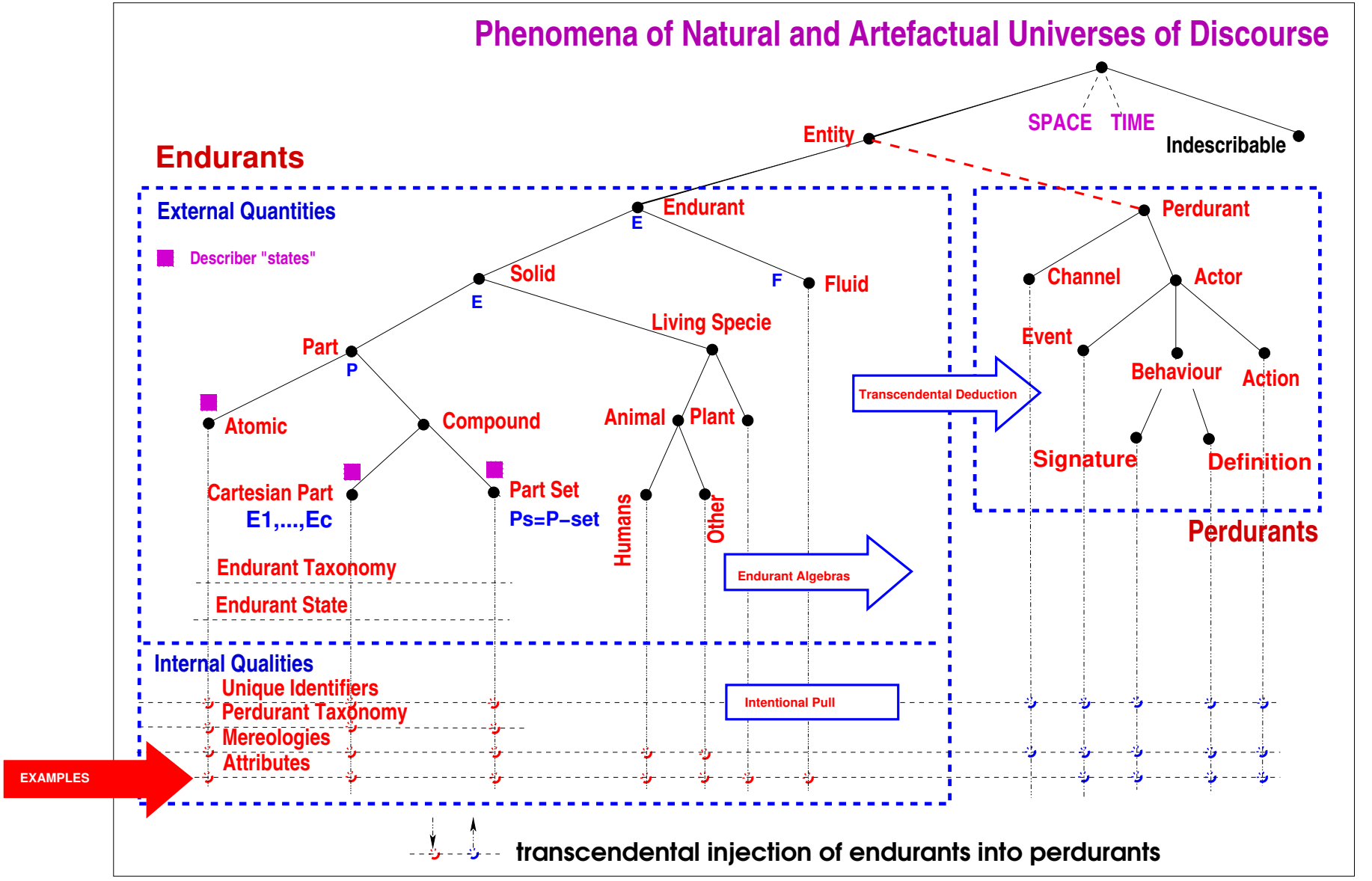

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transcendental injection of endurants into perdurants


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transcendental injection of endurants into perdurants

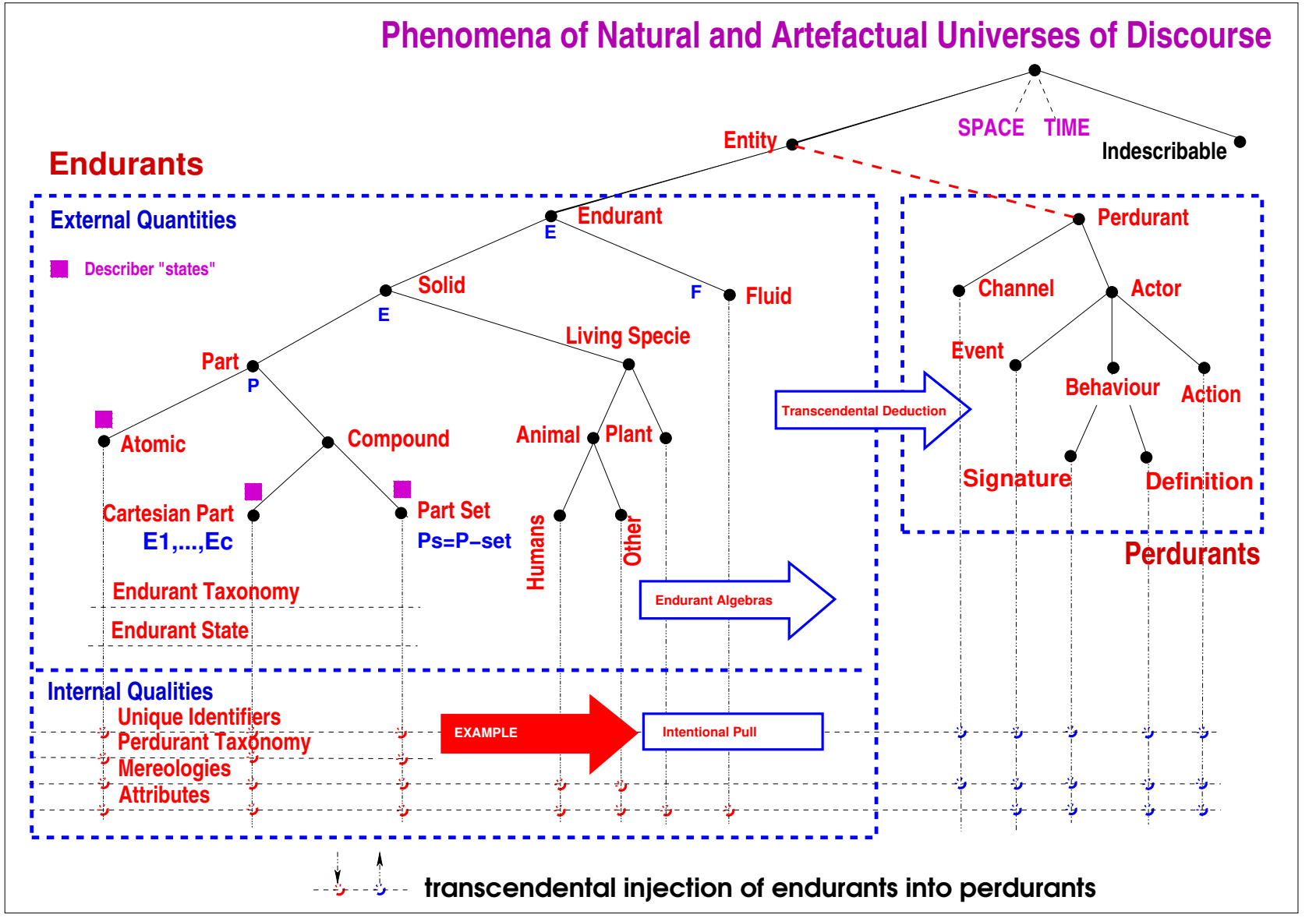
π 48:


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EXAMPLE
transcendental injection of endurants into perdurants

π 50:

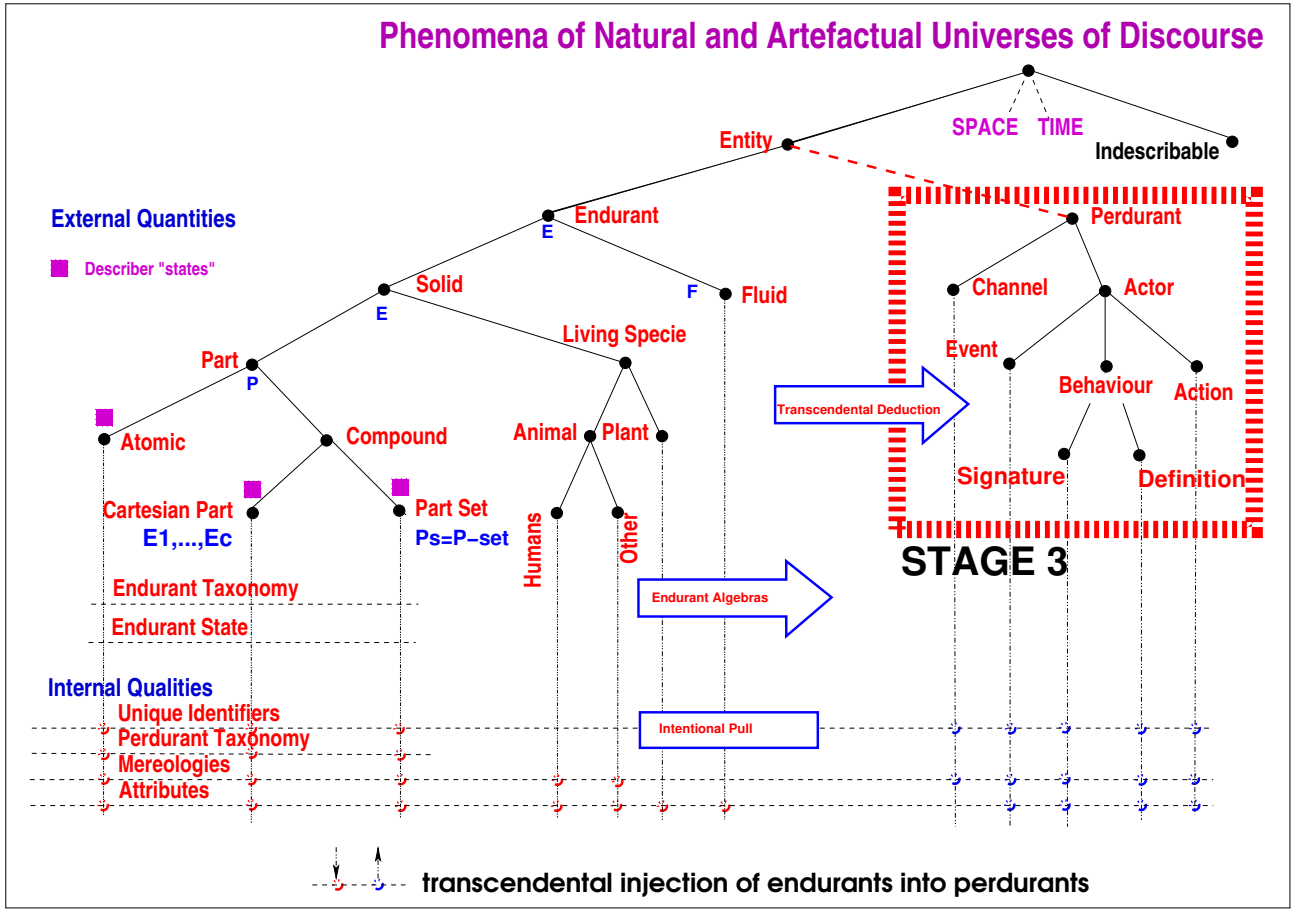

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EXAMPLES
transcendental injection of endurants into perdurants

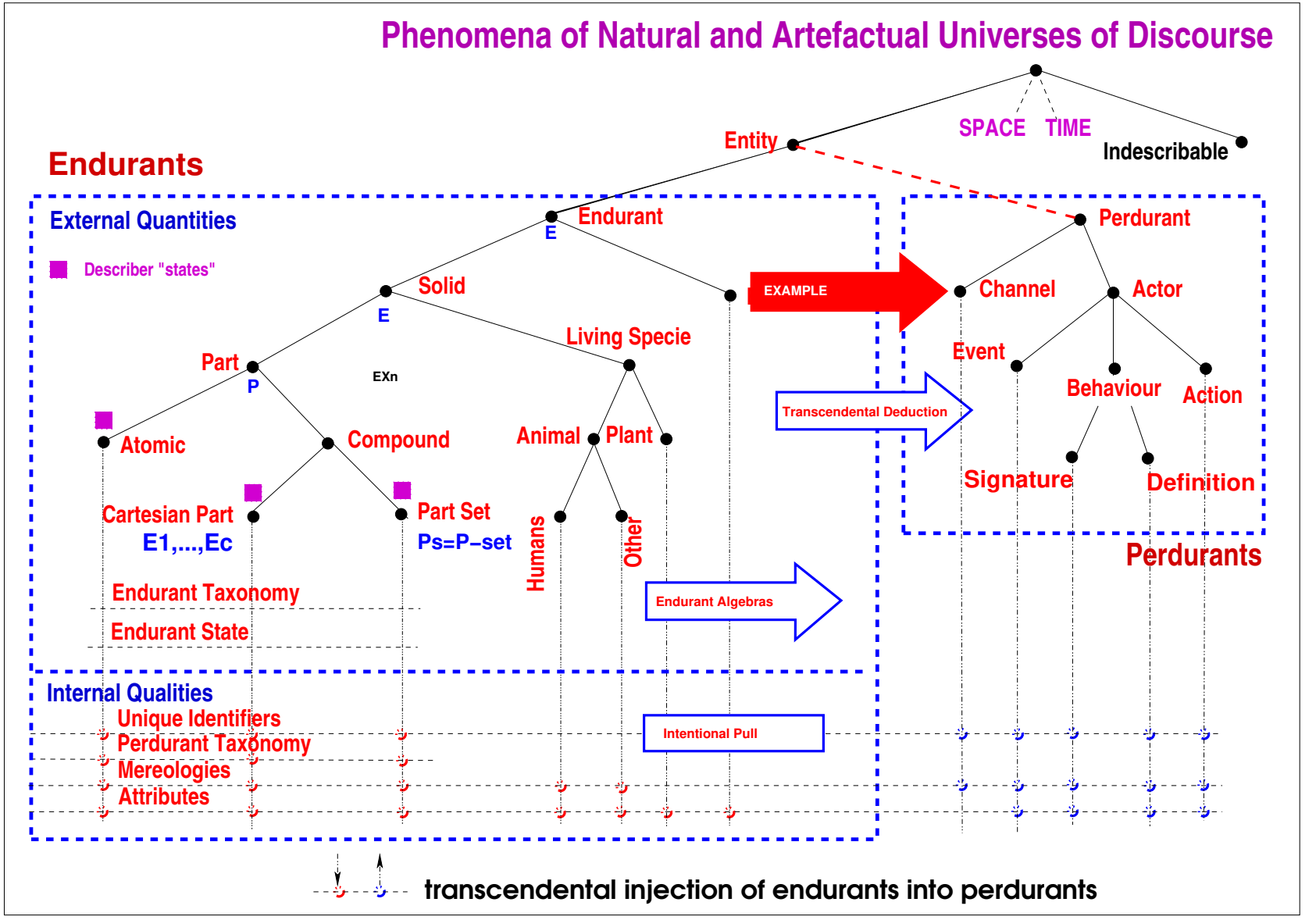
π 51:

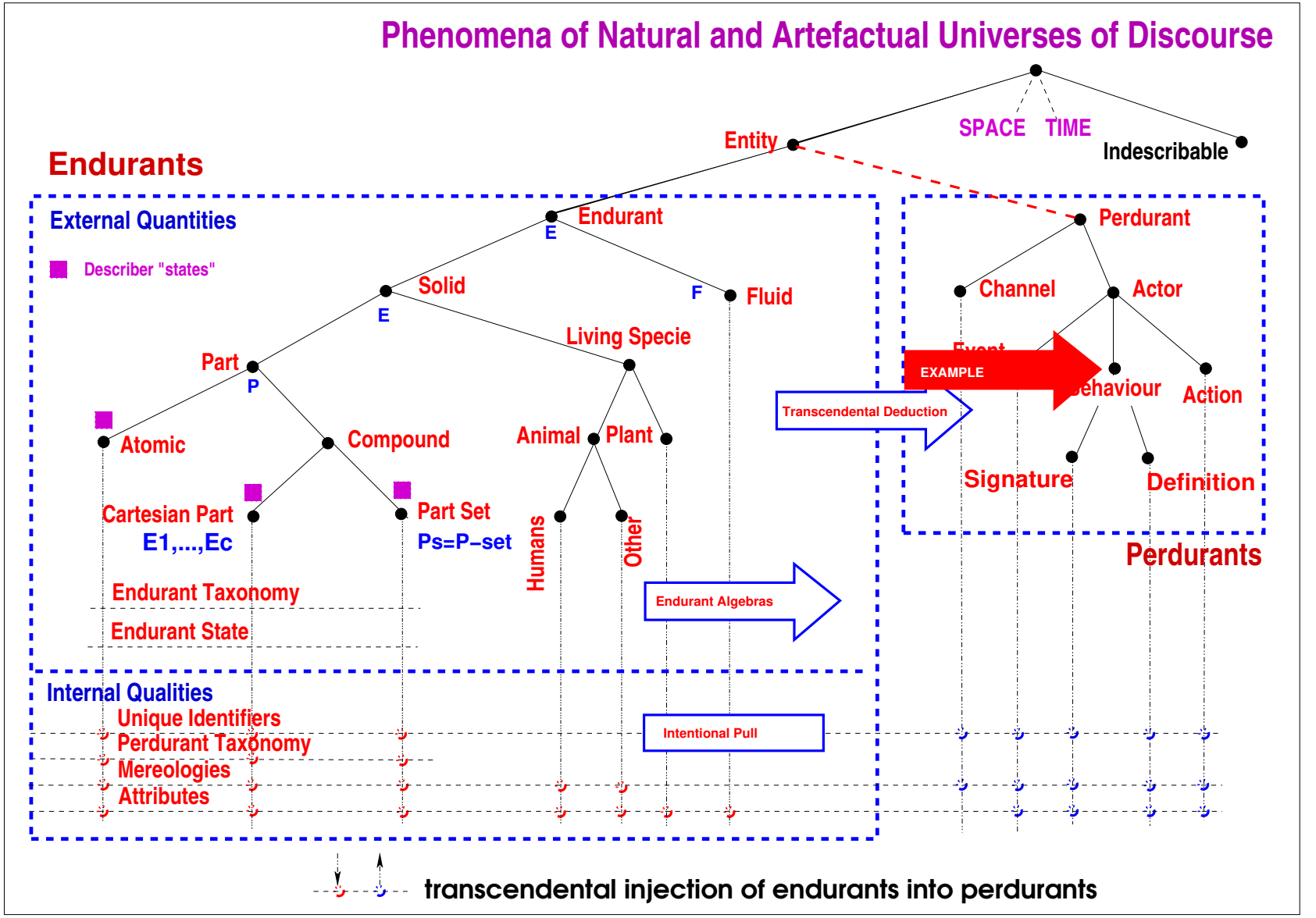

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π 52:

Stage 3:


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transcendental injection of endurants into perdurants

Summary of The DOMAIN Method:

- An Analysis & Description **method** has been "flashed"
- An Analysis & Description **ontology** graph has been suggested
  - It suggests that domains embody:
    - * entities
    - * endurants
    - * perdurants
    - * solids
    - * fluids
    - * parts
    - * living species
    - * atomics
    - * compounds
    - * Cartesians
    - * Part sets
  - and can be understood in terms of:
    - * uniqueness
    - * mereology
    - * attributes
    - * intentional pull
    - * communication
    - * behaviours
- **That's it !**

So where do we go from here ?

From Descriptions via Prescriptions to Software

- **Requirements Prescriptions** can be "derived" from domain descriptions – f.ex. Chapter 8 in DB [21]:
  - initialisation
  - projection
  - instantiation
  - determination
  - extension
  - fitting
  - interface
  - derived
  - machine
- For **Software Design** see SE1-2-3 [5]:

DB: 

SE1-2-3: 

Topic II: Generative AI, LLMs and DOMAIN

Topic II: Generative AI, LLMs and DOMAIN

- The **issues** in this part of the talk are:
  - Prospects of **Generative AI LLMs**
  - **Generative AI LLM** Tools for **Domain Analysis & Description**
  - Experimental R&D

– spurred on by a Danish/US Colleague[5]

[5] – who wishes to remain anonymous

- Let us refer to a **Generative AI/LLM** for DOMAIN as **domAIn** !

- You are to imagine the following, conceptual and/or physical set-up:
  - one or more domain engineers,
    "speaking", f.ex., via microphone, "to" **domAIn**.
  - **domAIn** knowledgeable of DOMAIN
    and a formal description language –
    like, f.ex., RSL [as we have used it today!]
- The aim of a *domain engineer* **domAIn** *session* is
  - for **domAIn** to produce
    a both narrative and formal domain description
  - based on an interactive exchange
    between the domain engineers and **domAIn**.

- Experiments have been carried out, by my colleague,
  - based on examples provided by me,
  - using **ChatGPT, Claude**, and other LLMs
  - resulting, after some interaction,
  - in quite astonishingly acceptable formal descriptions.
- Such **domAIn** sessions
  - have typically lasted 1–2 hours
  - compared to many more hours "to achieve the same" without **domAIn** !
- In other words:
  - we can avoid the oftentimes tiresome, tedious work using **domAIn**s !
  - So we must do experimental research and develop properly "trained" **domAIn**s

- That is all I wish to say about Generative AI LLMs for DOMAIN !

[See https://cacm.acm.org/author/mayukh-mukhopadhyay/, *Can VIBE Drive Development? Threats and Opportunities*

Communications of the ACM, November 2026 (Vol. 69 No. 11). pp 34–36; Mayukh Mukhopadhyay

Topic III: BSc/MSc/PhD Courses & Research

- The **issue**, that I shall touch upon, in this part of the talk is:
  - An apparent need for "re-making" our teaching and research

A View of TripTych Software Development

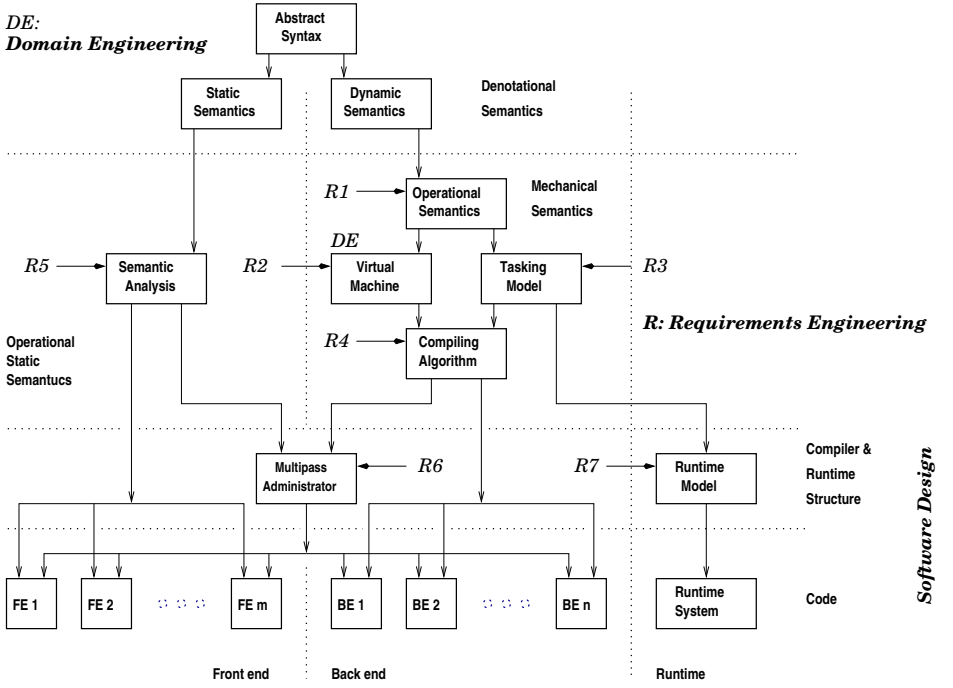
- I see software development proceed in **phases, stages** and **steps:**
  - There are, to us, the following **phases:**
    - **domain, requirements, software**
  - Within the **domain phase** we sugges the followng **stages:**
    - **external quantities, internal qualities, perdurants**
  - Within the **requirements phase** we sugges the following **stages:**
    - **initialisation, projection, determination, instatiation,** etc.

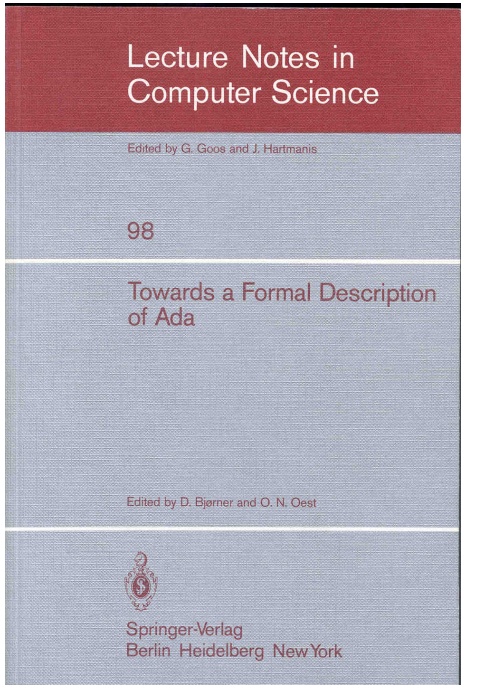
- And that is how I researched and taught it: 1976–2007.

A 1980s Project

- Compilers for CHILL and Ada were developed:

  for Ada in 44 manmonths, 1/5 of what it took SofTech





But that is not what most BSc/MSc Comp.Sci. Curriculae are structured

- Two factors determine my outlook:
  - the 𝔻𝕆𝕄𝔸𝕀ℕ approach and
  - the advent of **Generative AI LLM**s
- I suggest that we turn the current curricula "up-side down":
  focus separately on
  - domains - no algorithms & data structures to bother about [6]
  - focus is on using discrete mathematics including mathematical logic
  - computers - with its "classical themes", however reduced !
- In either case, the advent / onslaught of Generative AI LLMs
  shall necessitate that future software engineers learn to
  formulate, in their mother-tongue precise questions
  focus on properties, learn to be curious, inquire !

[6] – also no "theoretical computer science" issues either; but new ones !

Topic IV: Primary/Secondary School Courses

- The **issue** in this part of the talk is:
  - We teach physics, biology, ...
  - But we do not teach about human-artifact institutions and infrastructures:
    * banking
    * supply chains
    * retailing
    * transport
    * manufacturing
    * etcetera
  - Could domain science & engineering provide material for school textbooks on these subjects ?

Current Teaching

- Today's school teaching material
  - builds on serious, scientific textbooks and monographs
  - from which school teachers have authored children's textbooks
  - in math., physics, botany, zoology, geography/geology, ... [STEM]

Future Courses

- Is there a need for – and, if so,
  - could school textbook material
  - be based on scientifically researched domain models
  - of, f.ex., [worldwide] banking, multi-mode transport, etc. ?

• • •

Teaching Curiosity: to Doubt, to Inquire, to Formulate

Summing Up



Conclusion ?

- **I have shown You**
  an informatics "transformative" approach to software development
- **I have indicated**
  that Generative AI / LLMs can do a lot of the nitty-gritty work
- **I have suggested**
  that perhaps our BSc/MSc educational system need be revised
- **And I have suggested**
  that Domain Science & Engineering may have broader implication for our Primary and Secondary school education
- **Now You may**
  - go on with Your preconceived ideas of computer science
  - or You may "transform" !

THANKS

I thank the following ISP RAS people:

- Prof. Arutyun I. Avetisyan
- Dr. Mikhail Chupilko
- Dr. Oleg I. Samovarov
- Ms. Daria Echina

for

- inviting me,
- translating my book,
- facilitating things, and the
- smoothness of arrangements !

THANKS

Bibliography

The DOMAIN approach goes back to experimental research projects undertaken at the UN University's International Institute for Software Technology, UNU/IIST, 1992–1997. Precursor, to the specific enunciation of the DOMAIN approach, publications are [6,8,12,16]. First real mentioning of elements of the DOMAIN approach were [17-18]. Finally [19,20,21,22,24,25] marks the evolution of the current DOMAIN ideas.

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[7] The treatment of the time-concept in this report is unnecessarily complicated. It should be rewritten, i.e., grossly simplified as per the treatment of TIME in [24].

This is not a single document. It is a [printable] collection of older case studies. Some, i.e., the later ones, adhere to the emerging DDL: Domain Description Language. Earlier ones may not. *Urban Planning*, for example, `https://www.imm.dtu.dk/~dibj/2017/urban-planning.pdf`, do not. It treats TIME in an erroneous way – and should be corrected.

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An Example – The Formalisation

Compound Endurants

pg. 58[9]

type

1. RNA, AA
2. AH, AL
3. AS = A-**set**
4. HS = H-**set**, LS = L-**set**

value

1. **obs_**RNA: RT → RNA, **obs_**AA: RT → AA
2. **obs_**AH: RNA → AH, **obs_**AL: RNA → AL
3. **obs_**AS: AA → AS
4. **obs_**HS: AH → RS, **obs_**LS: AL → LS

[9] Ref. to Narrative

Endurants: State

pg. 58[10]

value

5. rt:RT
6. rna:RNA = **obs_**RNA(rt)
7. aa:AA = **obs_**AA(rt)
8. ah:AH = **obs_**AA(rna)
9. al:AL = **obs_**AL(rna)
10. as:AS = **obs_**AS(ah)
11. hs:HS = **obs_**HS(ah)
12. ls:LS = **obs_**LS(al)
13. σ_{parts} = {rt,rna,aa,ah,al} ∪ aa ∪ as ∪ hs ∪ ls
14. σ_{atoms} = aa ∪ hs ∪ ls

[10] Ref. to Narrative

Endurants: Unique Identifier Types

pg. ??[11]

type

15. RTI
16. RNAI
17. AAI
18. HAI
19. LAI
20. HI
21. LI
22. AI

value

15. **uid_**RT: RT → RTI
16. **uid_**RNA: RNA → RNAI
17. **uid_**AA: AA → AAI
18. **uid_**HA: HA → HAI
19. **uid_**LA: LA → LAI
20. **uid_**H: H → HI
21. **uid_**L: L → LI
22. **uid_**A: A → AI

[11] Ref. to Narrative

Endurants: Unique Identifier Values & Identification

pg. 59[12]

value

23. rt$_{uid}$RT: RT = **uid_**RT(rt)
24. rna$_{uid}$RNA: RNA = **uid_**RNA(rt)
25. aa$_{uid}$AA: AA = **uid_**AA(rt)
26. ah$_{uid}$AH: AH = **uid_**AA(rna)
27. al$_{uid}$AL: AL = **uid_**AL(rna)
28. as$_{uid}$AS: AS = {**uid_**A(a)|a:A·a∈as}
29. hs$_{uid}$:HS = {**uid_**H(h)|h:H·h∈hs}
30. ls$_{uid}$:LS = {**uid_**L(l)|l:L·a∈ls}
31. $\sigma_{parts_{uid}}$ = {rt,rna,aa,ah,al} ∪ aa ∪ hs unon ls
32. $\sigma_{atoms_{uids}}$ = aa ∪ hs ∪ ls

[12] Ref. to Narrative

Endurants: Mereology

type

33. ML = LI-**set** **axiom** ∀ ml:MK · **card** ml = 2 ∧ ml ⊆ ls_{uis}
34. MH = HI-**set** **axiom** ∀ mh:MH · mh ⊆ hs_{uis}
35. MA = (HI|LI)-**set** **axiom** ∀ ma:MA · ma ⊆ as_{uis}

value

33. **mereo_**L: L → ML
34. **mereo_**H: H → MH
35. **mereo_**A: A → MA

Endurants: Attributes

type

36. HΣ = (LI×LI)-set **[prg]**
37. HΩ = HΣ-set **[sta]**
38. LEN = **Nat** **[sta]** [m]
39. LΣ = (HI×HI)-set **[prg]**
40. LΩ = LΣ-set **[sta]**
41. APos = atH | onL **[prg]**

41a. atH :: HI

41b. onL :: LI × (fhi:HI × f:**Real** × thi:HI)

42. Veloc = **Real** **[mon]** [km/h]
43. Accel = **Real** **[mon]** [m/sec]
44. ...
45. HHis,LHis = $(\mathbb{TIME}\times$AI$)^*$ **[prg]**
45. AHis = $(\mathbb{TIME}\times$(HI|LI)$)^*$ **[prg]**

value

36. attr_HΣ: H → HΣ
37. attr_HΩ: H → HΩ
38. attr_LEN: L → LEN
39. attr_LΣ: L → LΣ
40. attr_LΩ: L → LΩ
41. attr_APos: A → APos
42. attr_Veloc: A → Veloc
43. attr_Accel: A → Accel
45. attr_HHis: H → HHis
45. attr_LHis: L → LHis
45. attr_AHis: A → AHis

axiom

46. ∀ mk_onL(li,(fhi,f,thi)):onL · 0<f<1 ∧ li∈ls_{uids} ∧ {fhi,thi}⊆hs_{uids} ∧ ..

Endurants: Intentional Pull

axiom
??. ∀ a:A · a ∈ as ⇒
??. **let** ahist = attr_AHist(a) **in**
??. ∀ ui:(LI|HI) · ui ∈ **dom** ahist ⇒
??. ∀ τ:$\mathbb{TIME}$ · τ ∈ **elems** ahist(ui) ⇒
??. **let** hist = is_LI(ui) → attr_LHist(retr_L(ui))(σ),
??. _ → attr_HHist(retr_H(ui))(σ) **in**
??. τ ∈ **elems** hist(uid_A(a)) **end end**
??. ∧
??. ∀ u:(L|H) · u ∈ $ls \cup hs$ ⇒
??. **let** uhist = attr(L|H)Hist(u) **in**
??. ∀ ai:AI · ai ∈ **dom** uhist ⇒
??. ∀ τ:$\mathbb{TIME}$ · τ ∈ **elems** uhist(ai) ⇒
??. **let** ahist = attr_AHist(retr_A(ai))(σ) **in**
??. τ ∈ **elems** uhist(ai) **end end**

Perdurants: Communication

channel

47. { ch[{ui,uj}] | {ui,ij}:(HI|LI|AI)-**set** · ui≠uj∧{ui,uj}⊆σ_{uids} } M

type

i47. M

Perdurants: Behaviours

value

49. automobile: AI → AM → ... → (Apos × AHist) → **Unit**
50. hub: HI → HM → (HΩ × ...) → (HΣ × HHist) → **Unit**
51. link: LI → LM → (LEN × LΩ × ...) → (LΣ × LHist) → **Unit**

52. automobile(ai)(ris)(...)(atH(hi),ahis)
52. automobile(ai)(ris)(...)(onL(li,(fhi,f,thi)),ahis)
53. hub(hi)(mh)(hω,...)(hσ,hhist)
54. link(li)(ml)(len,lω,...)(lσ,lhist)

55 automobile(ai)(ris)(...)(atH(hi),ahis) ≡
55a automobile_remain_at_hub(ai)(ris)(...)(atH(hi),ahis)
55b ⌈⌉
55c automobile_leaving_hub(ai)(ris)(...)(atH(hi),ahis)
55d ⌈⌉
55e automobile_stop(ai)(ris)(...)(atH(hi),ahis)

56 automobile_remain_at_hub(ai)(ris)(...)(atH(hi),ahis) ≡
56a **let** τ = **record_**$\mathbb{TIME}$() **in**
56b ch[{ai,hi}] ! τ ;
56c automobile(ai)(ris)(...)(atH(hi),⟨(τ,hi)⟩^ahis) **end**

```
57  automobile_leaving_b(ai)({li}∪ris)(...)(atH(hi),ahis) ≡
57a     let τ = record_𝕋𝕀𝕄𝔼() in
57b     (ch[{ai,hi}] ! τ ‖ ch[{ai,li}] ! τ) ;
57c     automobile(ai)(ris)(...)(onL(li,(hi,0,_)),⟨(τ,li)⟩^ahis) end
57      pre: [hub is not isolated]

58  automobile_stop(ai)(ris),(...)(atH(hi),ahis) ≡ stop

59  automobile(ai)(ris)(...)(onL(li(fhi,f,thi)),lhis) ≡
59a     automobile_remains_on_link(ai)(ris)(...)(onL(li(fhi,f,thi)),lhis)
59b   ⌈⌉
59c     automobile_leaving_link(ai)(ris)(...)(onL(li(fhi,f,thi)),lhis)
59d   ⌈⌉
59e     automobile_stops_on_link(ai)(ris)(...)(onL(li(fhi,f,thi)),lhis)
```

The End of Formal Example

Begin of Example Narration

The Example: Narratives

Compound Endurants

pg. 46[13]

1. In the road traffic domain we can observe
   a road net aggregate and
   an automobile aggregate.
2. In a road net aggregate we can observe
   an aggregate of hubs and
   an aggregate of links.
3. In an aggregate of automobiles we can observe a set ofautomobiles.
4. Aggregates of hubs ad links are sets of hubs and links.

The State

pg. 47[14]

5. There is the road transport [universe of discourse].
6. There is the road net aggregate.
7. There is the automobile aggregate.
8. There is the hub aggregate.
9. There is the link aggregate.
10. There is the set of automobiles.
11. There is the set of hubs.
12. There is the set of links.
13. And there is the entire set of all of these.
14. And there is the entire set of just all automobiles, hubs and links.

[13] Ref. to Formalisation
[14] Ref. to Narrative

Uniqueness

pg. 49[15]

15. The universe of discourse has a unique identifier.
16. The road net agregate has a unique identifier.
17. The automobile aggregate has a unique identifier.
18. The hub aggregate has a unique identifier.
19. The link aggregate has a unique identifier.
20. Each hub has a unique identifier.
21. Each link has a unique identifier.
22. Each automobile has a unique identifier.
23. There is the unique identifier of the road transport.
24. There is the unique identifier of the road net aggregate.
25. There is the unique identifier of the autombile aggregate.
26. There is the unique identifier of the hub aggregate.
27. There is the unique identifier of the link aggregate.
28. There are the unique identifiers of the automobiles of the set of automobiles.
29. There are the unique identifiers of the hubs of the set of hubs.
30. There are the unique identifiers of the links of the set of links.
31. And there is the entire set of all of these.
32. And there is the entire set of all identifiers of the automobiles, hubs and links.

Mereology

33. The mereology of links is a 2 element set of hub identifiers.
34. The mereology of a hub is a possibly empty set of hub identifiers.
35. The mereology of an automobile is a set of hub and link identifiers.

[15] Ref. to Narrative

Attributes

Hubs:

36. Hubs have states, hσ:HΣ: the set of pairs of link identifiers, (*f*li,*t*li), of the links *f*rom and *t*o which automobiles may enter, respectively leave the hub.
37. Hubs have state spaces, hω:HΩ: the set of hub states "signaling" which states are open/closed, i.e., **green**/**red**.

Links:

38. Links that have lengths, LEN;
39. Links have states, lσ:LΣ: the set of pairs of link identifiers, (*f*li,*t*li), of the links *f*rom and *t*o which automobiles may enter, respectively leave the hub.
40. Links have state spaces, lω:LΩ: the set of link states "signaling" which states are open/closed, i.e., **green**/**red**.

Automobiles:

41. Automobiles have road net positions, APos,
    (a) either *at a hub*, atH,
    (b) or *on a link*, onL, some fraction, f:**Real**, down a link, identified by li, from a hub, identified by fhi, towards a hub, identified by thi.
42. Automobiles have velocity;
43. Automobiles have acceleration;
44. Etc.

Hubs, Links, Automobiles:

45. Hubs, links and automobiles have *histories:* time-stamped, chronologically ordered sequences of automobiles entering and leaving links and hubs, with automobile histories similarly recording hubs and links entered and left.
46. Link positions have well-defined identifiers and fractions.

Intentional Pull

TO BE WRITTEN

Communications: Channel

47. There is a set of channels between hubs, links and automobiles.
48. These channels communicate messages, `M`. `M` will "transpire" frm the behaviour definitions.

Behaviours

There are three behaviours:

49. `automobile`, corresponding to endurants `a:A`, and with appropriate argument types,
50. `hub`, corresponding to endurants `h:H`, and with appropriate argument types, and
51. `link`, corresponding to endurants `l:L`, and with appropriate argument types.
52. The **automobile** behaviour is either *at a hub* or *on a link* – and **communicates** with the *hub* and *link* behaviours as to its entering, leaving, or remaining at the hub, respectively on the link.
53. Any **hub** behaviour is "passively" awaiting **communication** from automobile behaviours as to their entering, leaving, or remaining at the hub.
54. Any **link** behaviour is "passively" awaiting **communication** from automobile behaviours as to their entering, leaving, or remaining on the link.

55. We abstract automobile behaviour at a Hub (hi).
    (a) Either the automobile **remain**s at the hub,
    (b) or, **internally non-deterministically**,
    (c) **leaves** the hub entering a link,
    (d) or, **internally non-deterministically**,
    (e) **stops**.

56. [55a] The automobile **remains** at a hub:
    (a) time is recorded,
    (b) informing the hub behaviour, whereupon
    (c) the automobile remains at that hub, "idling",

57. [55c] The automobile **leaves** the hub entering link li:
    (a) time is recorded;
    (b) hub is informed of automobile leaving and link that it is entering;
    (c) "whereupon" the vehicle resumes (i.e., "while at the same time" resuming) the vehicle behaviour positioned at the very beginning (0) of that link.

58. [55e] Or the automobile **stop**s, "disappears — off the radar" !

59. We abstract automobile behaviour on a Link li:
    (a) Either (*internally non-deterministically*) the automobile **remains** on the link, advancing a fraction or halts [temporarily],
    (b) or, *internally non-deterministically*,
    (c) **leaves** the link [when reaching its end] and enters the connected hub,
    (d) or, *internally non-deterministically*,
    (e) **stops** [leaves the road net altogether (!)].

My CV

- Born: 4 October 1937
- Danish, Married, 61 years, 2 children[16], 5 grandchildren
- MSc.EE. 1962, Techn.Univ.of Denmark, PhD CS, 1969
- IBM:
  - Nordic Labs., Stockholm, 1962-1963
  - Sys.Devt.Lab., San Jose, CA, USA, 1963-1965
  - ESRI, Geneva, Switzerland, 1967-1968
  - ACS/1, Menlo Park, 1969
  - Vienna Lab., Austria, 1973-1975
- Vis.Prof., UC Berkeley, 1971-1972
- Vis.Prof., Copenhagen Univ., 1975-1976
- Prof.: Techn.Univ.of Denmark
- Vis.Prof., Kiel, Nancy, Saarbrüchen, Edinburgh, Vienna, Singapore, JAIST (Japan)
- Sci.Dir., Dansk Datamatik Ctr., 1980-1989
- UN Director, UNU/IIST, Macau, 1992–1997
- 120+ Papers, 9 books, ...

[16] Nikolaj is one of them: `https://www.microsoft.com/en-us/research/people/nbjorner/`

Prompt Notes for S peaker & A ssistant !

- There are two overhead projectors
- That is: there are two laptops, each with their "main.pdf" TALK
- One is controlled by the speaker
- The other by the assistant
- Speaker controls the main TALK section: OHs 3–41
- Assistant controls the EXAMPLE section: OHs 46–57
- Assistant "screen" shows OH 46 while speaker goes through OHs 2–11
- Speaker then "clicks" **OHs # 2–# 41**
- Assistant prepares for **OH # 46** when speaker shows **OH # 16**
- Speaker "paces" assistant to show **OHs # 46–# 57**
  as speaker clicks for **OHs # 16–# 25**

The Screens show one thing – the speaker says:

1. **S/A # 0:** On the screens as audience arrives
2. **S/A # 1:** Shown when speaker is introduced

   S/A # 1: The title was meant to be "catchy": to "lure" You to come. really (!) the talk if about the 𝔻𝕆𝕄𝔸𝕀ℕ Method and its possible implications !
3. **S/A # 2:** Mikhail: Pls. check Russian book title: Which characters should I remove ?
4. **S/A # 3:** *'The TripTych Dogma'*: Speaker"reads" it out loud !
5. **S/A # 4:** All the speaker says is that there are four Topics, 20 Sec.
6. **S/A # 5: Topic I:** the speaker reads these 4 "–" items !
7. **S/A # 6:** Domain Definition: the speaker reads only the first "–" item
8. **S/A # 7:** You will find links to documents – describing these domains – in the Bibliography for this talk
9. **S/A # 8:** The speaker reads these two definitions
10. **S/A # 9:** The speaker says: We can show an ontology graphically – and this graph will reappear many times — being explained
11. **S/A # 10:** The speaker defines the term 'Ontology'

12. **S/A # 11:** The speaker "tours" – ... "traverses" – the **External Quantities** "tree":
    - *a describable phenomena, i.e., an entity, is either an endurant – still object that we can see and touch – or a perdurant – a dynamic object that "behaves".*
    - *an endurant is either solid or fluid*
    - *a solid is either a part or a living species*
    - *a part is either atomic or compound*
    - Etc.

    Audience "reads" the text on the screen while the speaker emphasizes the two meanings of the 𝔻𝕆𝕄𝔸𝕀ℕ ontology:
    - **what there** is and
    - that the 𝔻𝕆𝕄𝔸𝕀ℕ ontology presents an analysis & description **procedure**

    2 minutes !
13. **S/A # 12:** Ontology Diagram: Flash: 20 seconds
14. **S/A # 13:** Listing Examples to come. Flash: 20 seconds
15. **S/A # 14:** There are three ... Speaker "reads" the OH
16. **S/A # 15:** First we treat Stage 1: The Endurant's External Quantities

. . . . . **Assistant: Prepare for OH "shifts" !**

17. **S # 16, A # 46:** Compounds: While this OH is flashed, the speaker reads Example **EX-1** **Assistant: Diff.OH !**
18. **S # 17, A # 47:** Endurant State Speaker reads Example **EX-2** **Assistant: Diff.OH !**
19. **S/A # 18:** Then we treat Stage 2:The Endurant's Internal Qualities 20 Sec.
20. **S # 19,A #s 48–49:** While this OH is flashed, the Speaker reads Examples **EX-3, EX-4**: Unique Identifiers **Assistant: Diff.OH !**
21. **S # 20, A # 50:** While this OH is flashed, the Speaker reads **EX-5** Mereology
22. **S # 21, A # 51:** While this OH is flashed, the Speaker reads **EX-6**: Attributes

23. **S # 22, A # 52:** While this OH is flashed, the Speaker reads **EX-7**: Intentional Pull
24. **S # 23, A # 23:** Then we treat Stage 3: Perdurants **Assistant: Diff.OH !**
25. **S # 24, A # 53:** While this OH is flashed, the Speaker reads **EX-8**: Channels **Assistant: Diff.OH !**
26. **S # 25, A #s 54–56:** While this OH is flashed, the Speaker reads **EX-9, EX-10, EX-11:** Behaviours
27. **S # 26, A # 26:** Summary of Domain Method: Speaker reads. **Assistant: Diff.OH !**
28. **S # 27, A # 27:** Summary of Topic I: From Ds via Ps to S

29. **S # 28, A # 28: Topic II: domAIn**
30. **S # 29, A # 29:** Issues: domAIn
31. **S # 30, A # 30:** domAIn: The issues: Speaker reads, 2–3 mins
32. **S # 31, A # 31:** domAIn: Speaker reads: 2–3 mins.
33. **S # 32, A # 32:** domAIn: That's it !.
34. **S # 33, A # 33: Topic III: Univ. Courses**
35. **S # 34, A # 34:** The following TripTych SW Devt. is possible
36. **S # 35, A # 35:** The CHILL/Ada Projects: 1 min.
37. **S # 36, A # 36:** Critique of Current R&dD and Courses
38. **S # 37, A # 37: Topic IV: Consequences School. Educ. !**
39. **S # 38, A # 38:** Current → Future
40. **S # 39, A # 39:** Summing Op: 20 sec.
41. **S # 40, A # 40:** Conclusion: 2 mins.
42. **S # 41, A # 41:** End of Talk !