

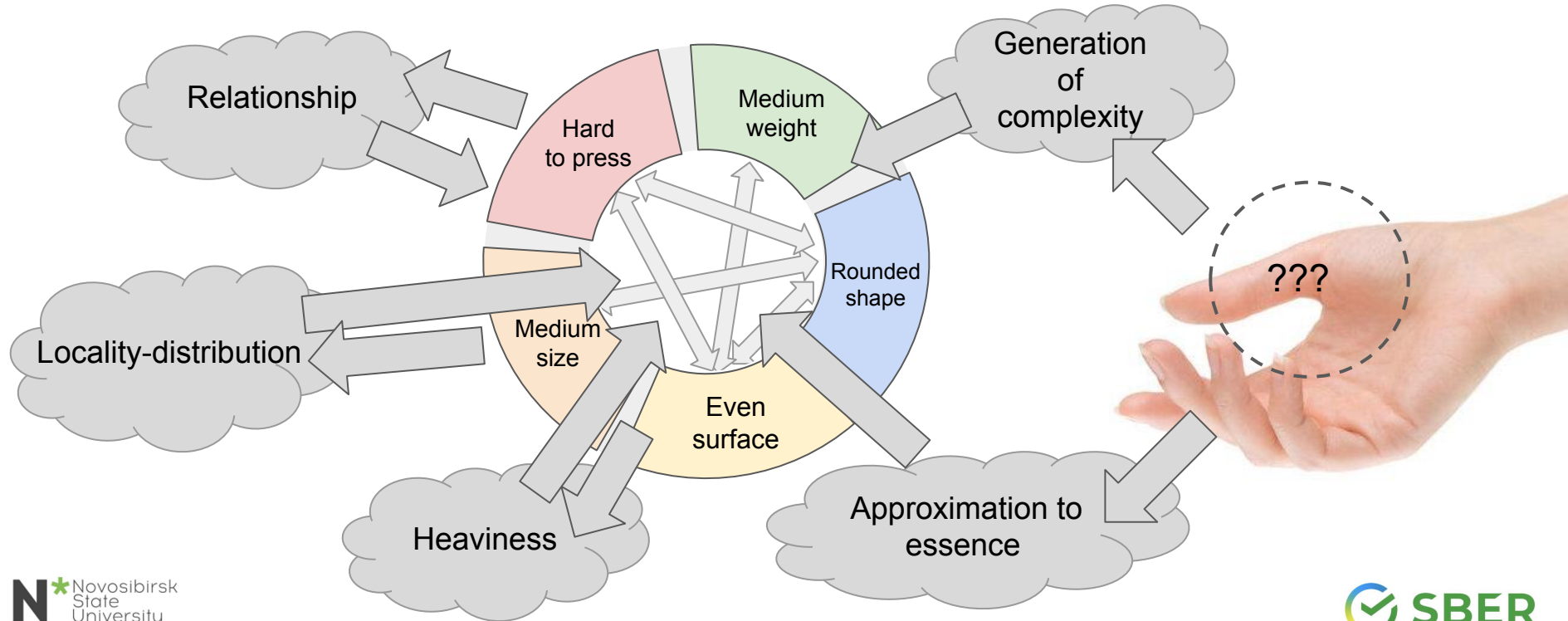
Cognitive Architecture for Decision-Making based on Brain Principles Programming

relying on **formal mathematical methods** - task-driven approach (TDA),
semantic probabilistic inference (SPI), probabilistic formal concepts (PFC) and
theory of functional systems (TFS)

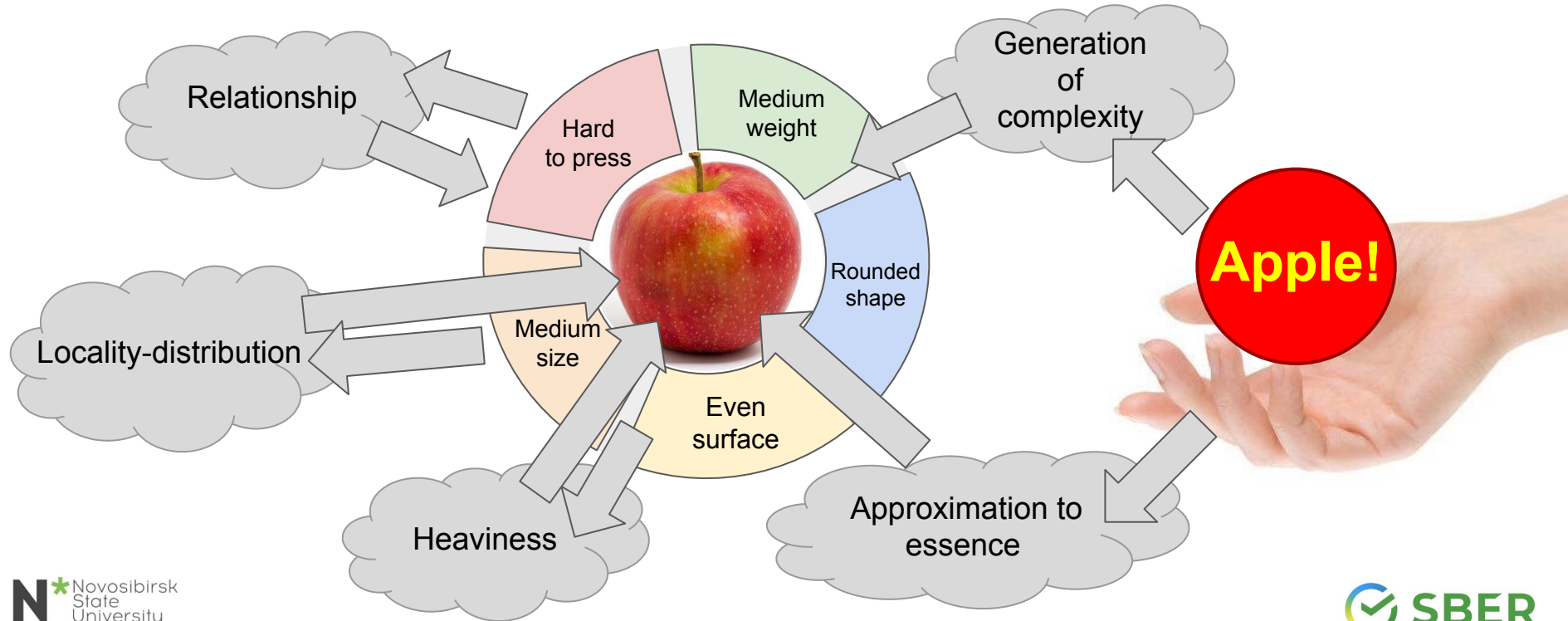
Anton Kolonin¹, Andrey Kurpatov², Artem Molchanov² and Gennadiy Averyanov²

¹Novosibirsk State University, ²Sber

Brain activity principles through decision making process

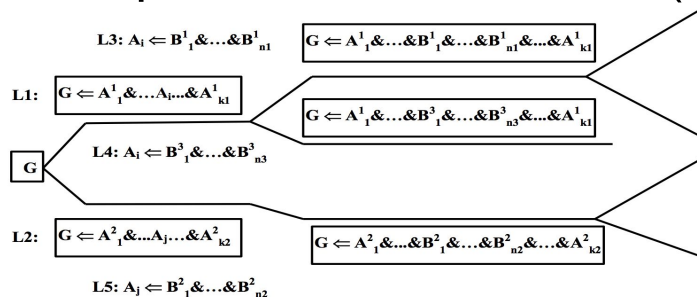


Brain activity principles through decision making process



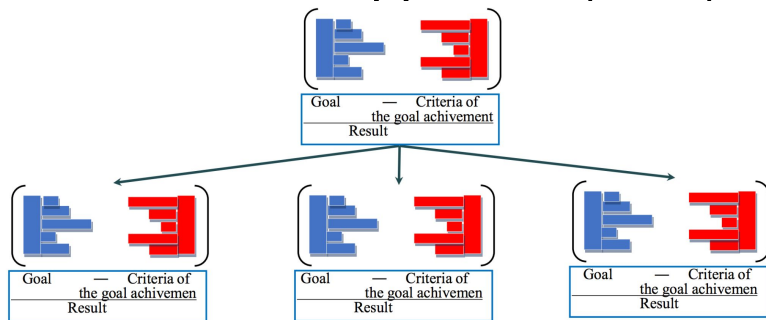
Formal mathematical methods

Semantic probabilistic inference (SPI)



Vityaev, E., Odintsov, S. How to predict consistently? // Trends in Mathematics and Computational Intelligence In: Studies in Computational Intelligence, 796, María Eugenia Comejo (ed), 2019, 35-41.

Task-driven approach (TDA)



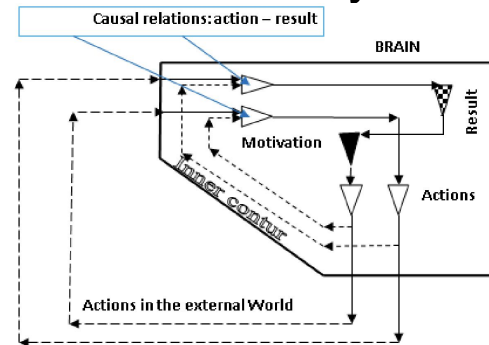
Evgenii E. Vityaev Purposefulness as a Principle of Brain Activity // Anticipation: Learning from the Past, (ed.) M. Nadin. Cognitive Systems Monographs, V.25, Chapter No.: 13. Springer, 2015, pp. 231-254.

Probabilistic formal concepts (PFC)

ANIMALS	preying	flying	bird	mammal
LION	×			×
FINCH		×	×	
EAGLE	×	×	×	
HARE				×
OSTRICH			×	

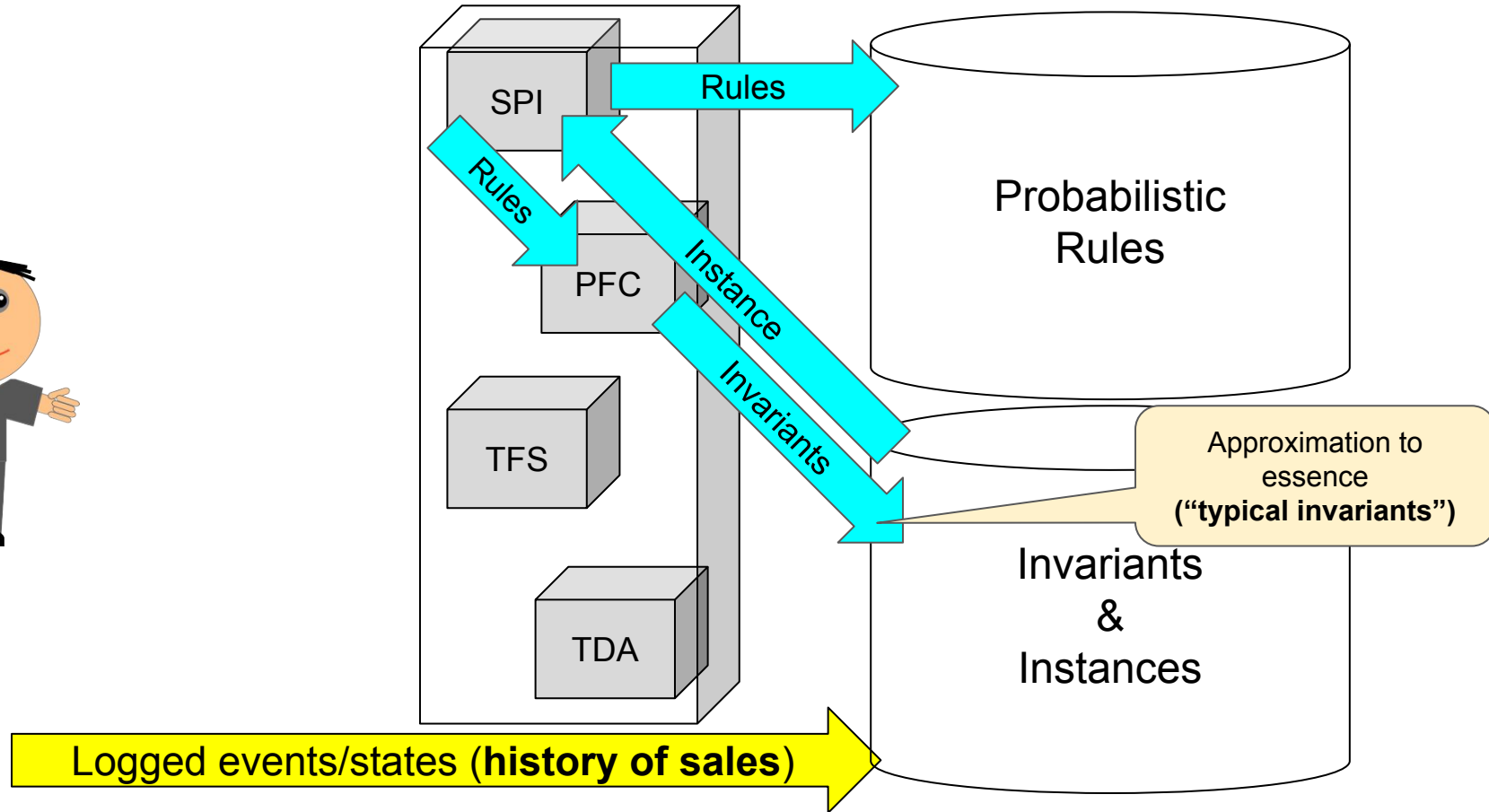
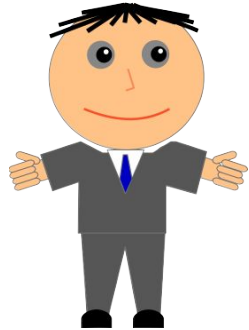
Alexander Demin, Denis Ponomaryov, Evgeny Vityaev. Probabilistic Concepts in Formal Contexts // Lecture Notes in Computer Science, Vol. 7162, Springer Verlag, 2012, p. 394-410 E. E. Vityaev, V. V. Martinovich. Probabilistic Formal Concepts with Negation // A. Voronkov, I. Virbitskaite (Eds.): PCI 2014, LNCS 8974, 2015, pp.385-399.

Theory of functional systems (TFS)

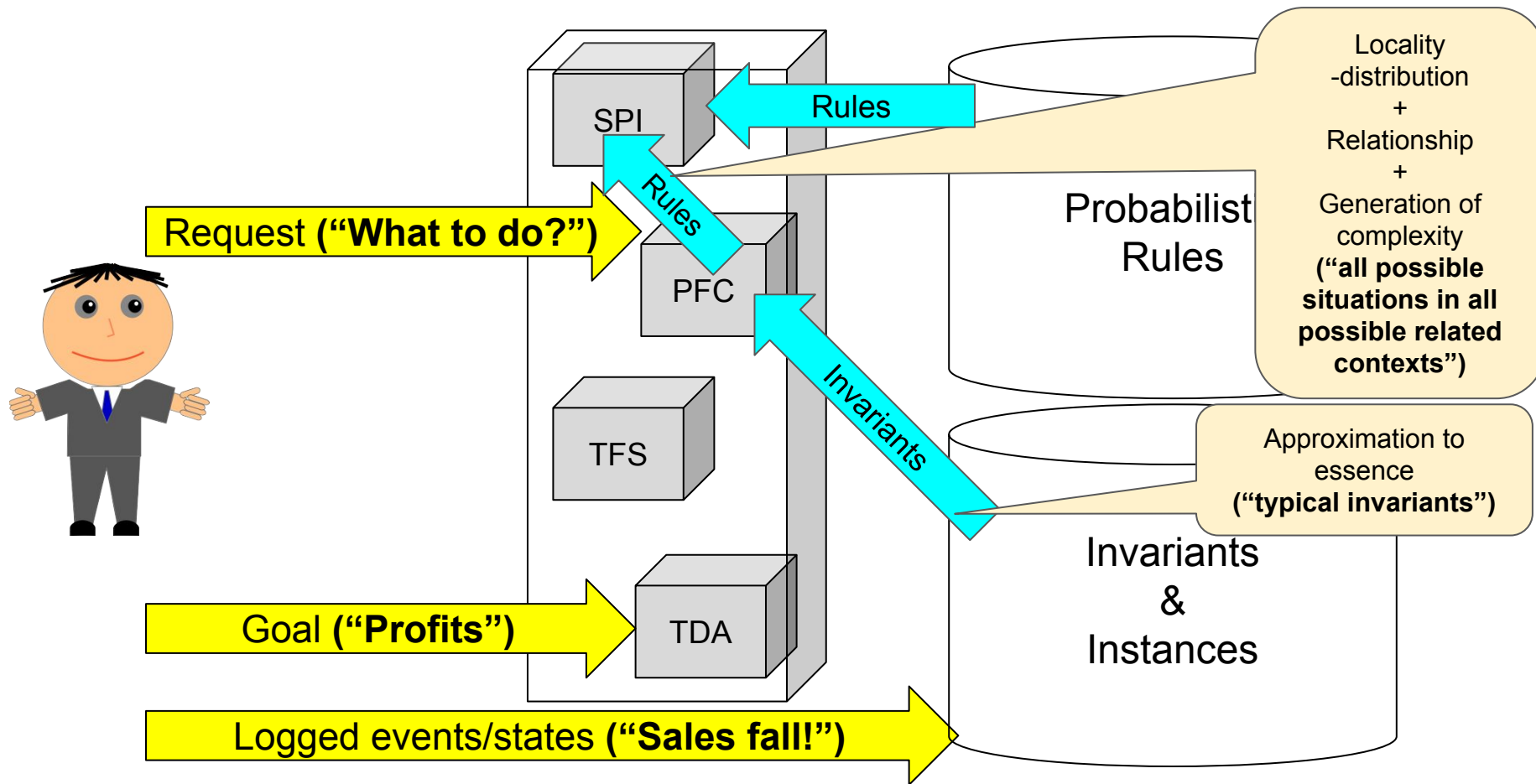


Vityaev, E.E., Demin, A.V., Kolonin, Y.A. (2020) "Logical Probabilistic Biologically Inspired Cognitive Architecture", In: Goertzel, B., Panov, A., Potapov, A., Yampolskiy, R. (eds) Artificial General Intelligence. AGI 2020. Lecture Notes in Computer Science(), vol 12177. Springer, Cham. https://doi.org/10.1007/978-3-030-52152-3_36

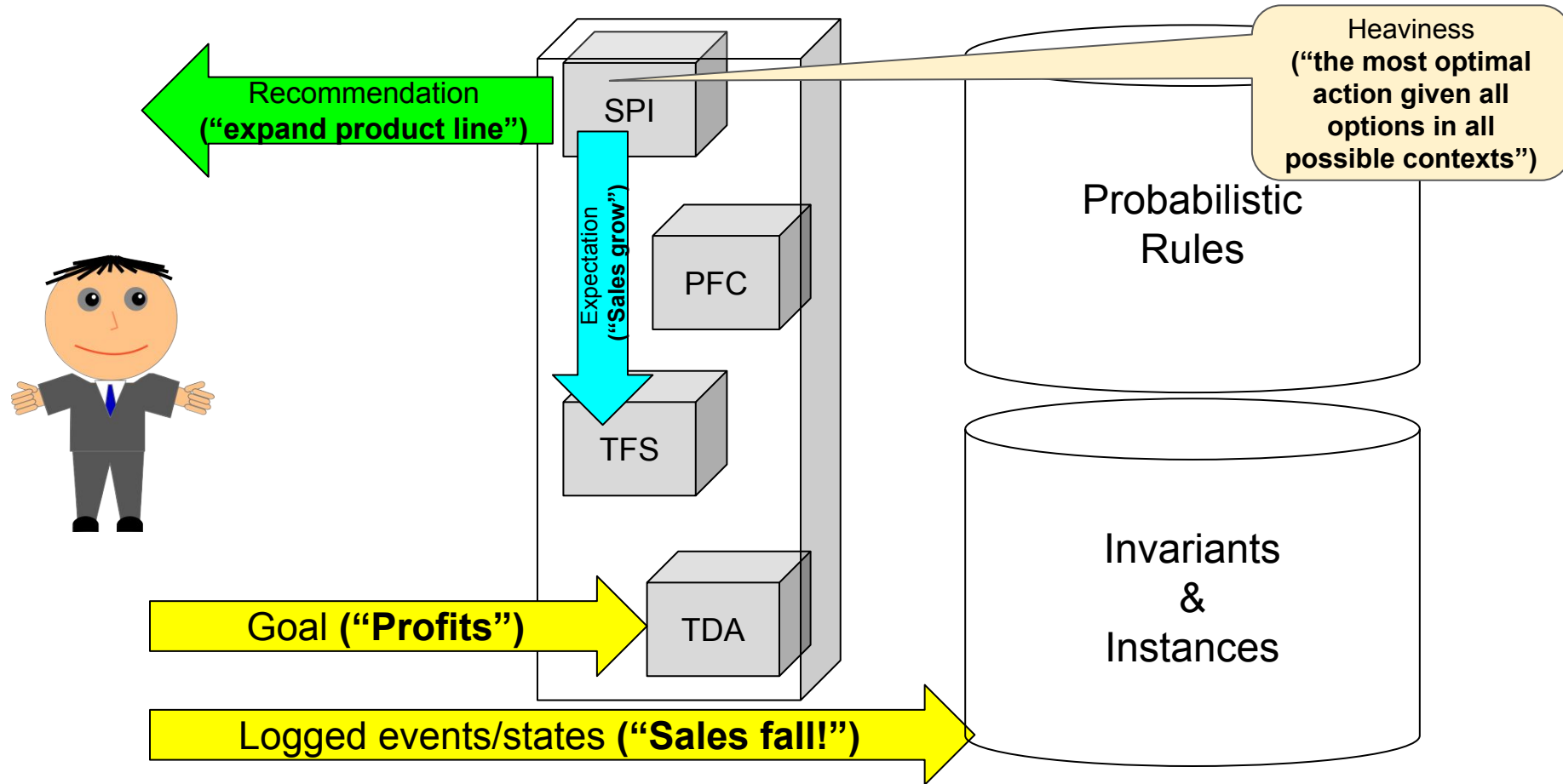
Decision Support Example: Manager Case - 1



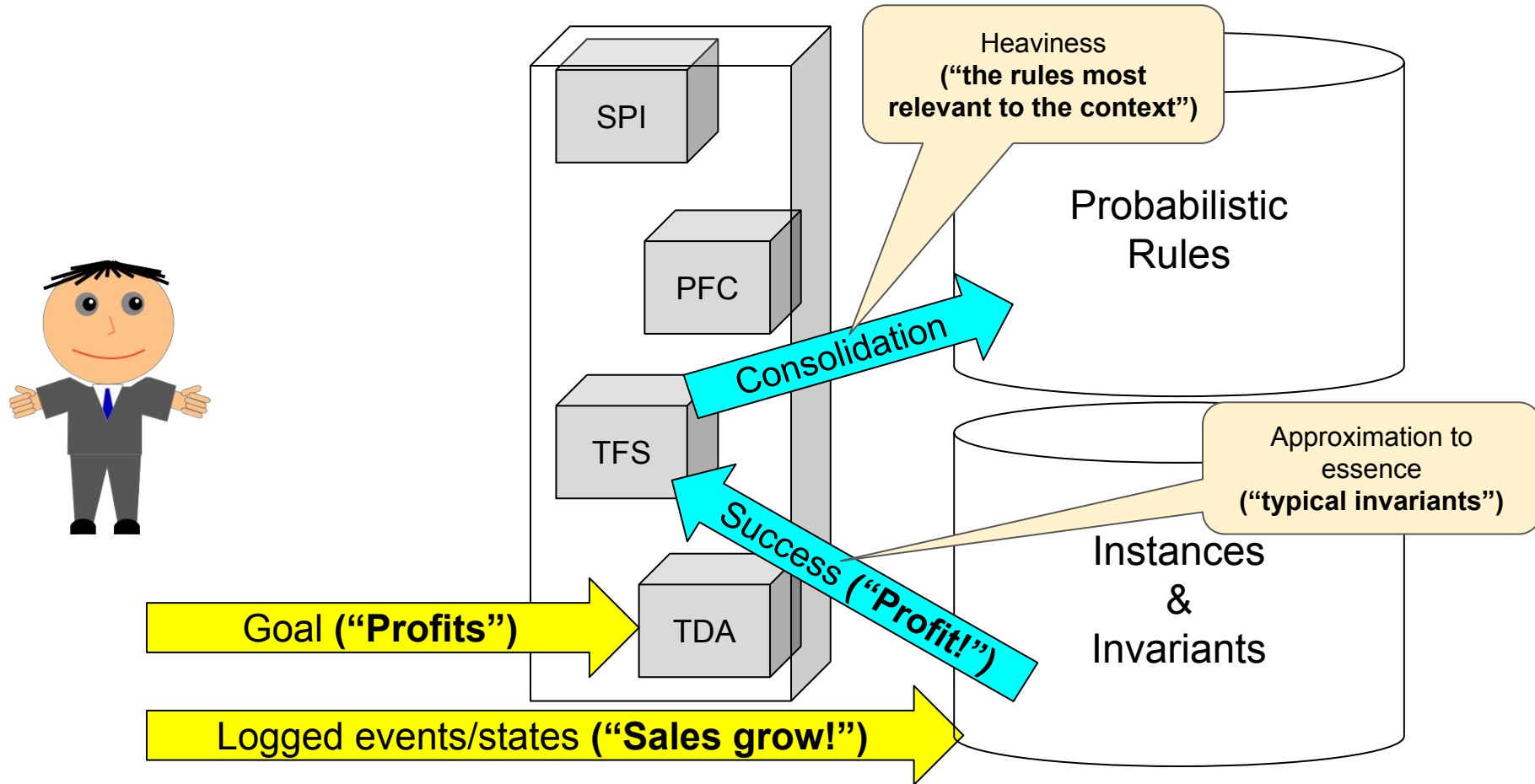
Decision Support Example: Manager Case - 2



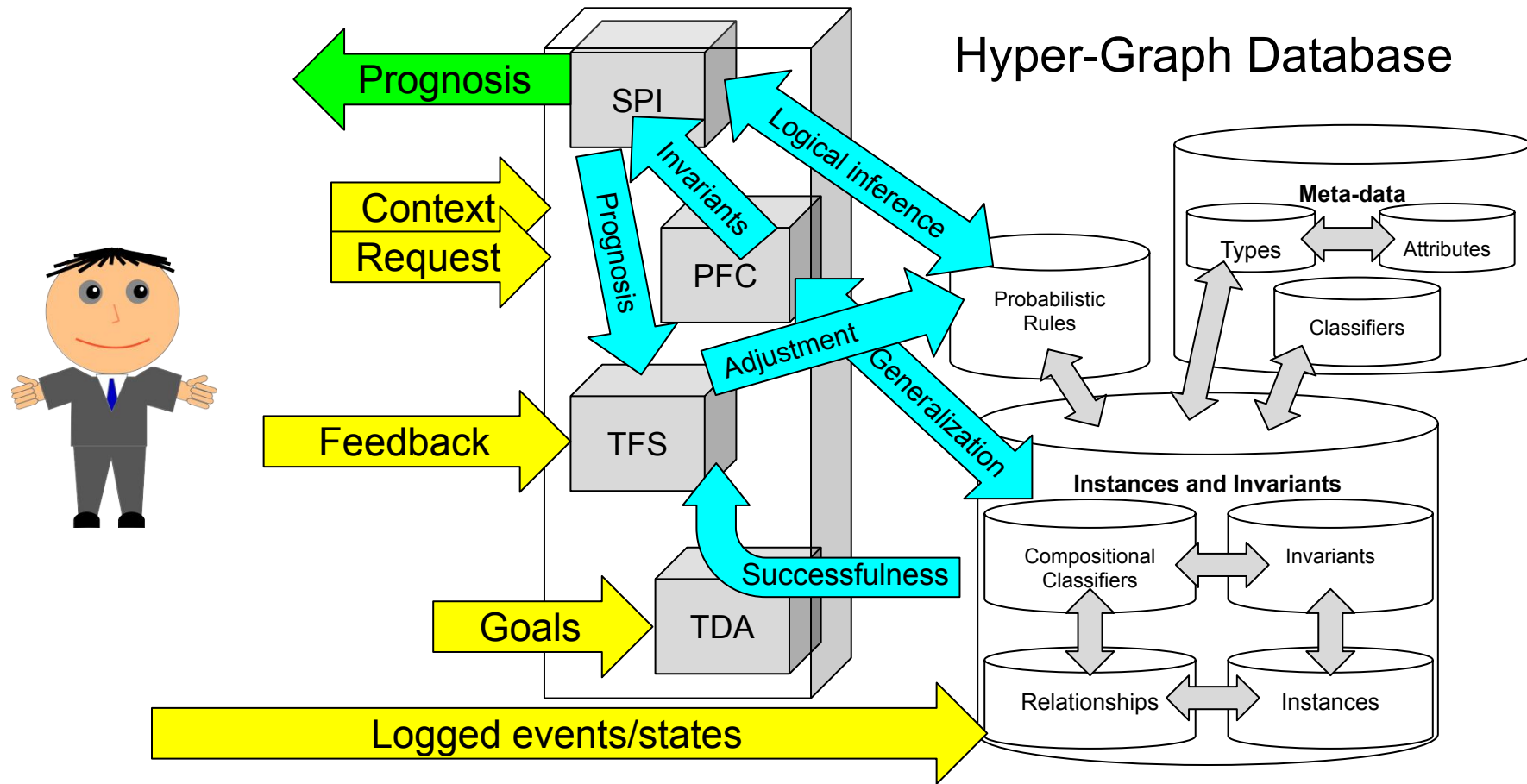
Decision Support Example: Manager Case - 3



Decision Support Example: Manager Case - 4



Cognitive Architecture for Decision Support System



Practical Applications and Domain Ontologies

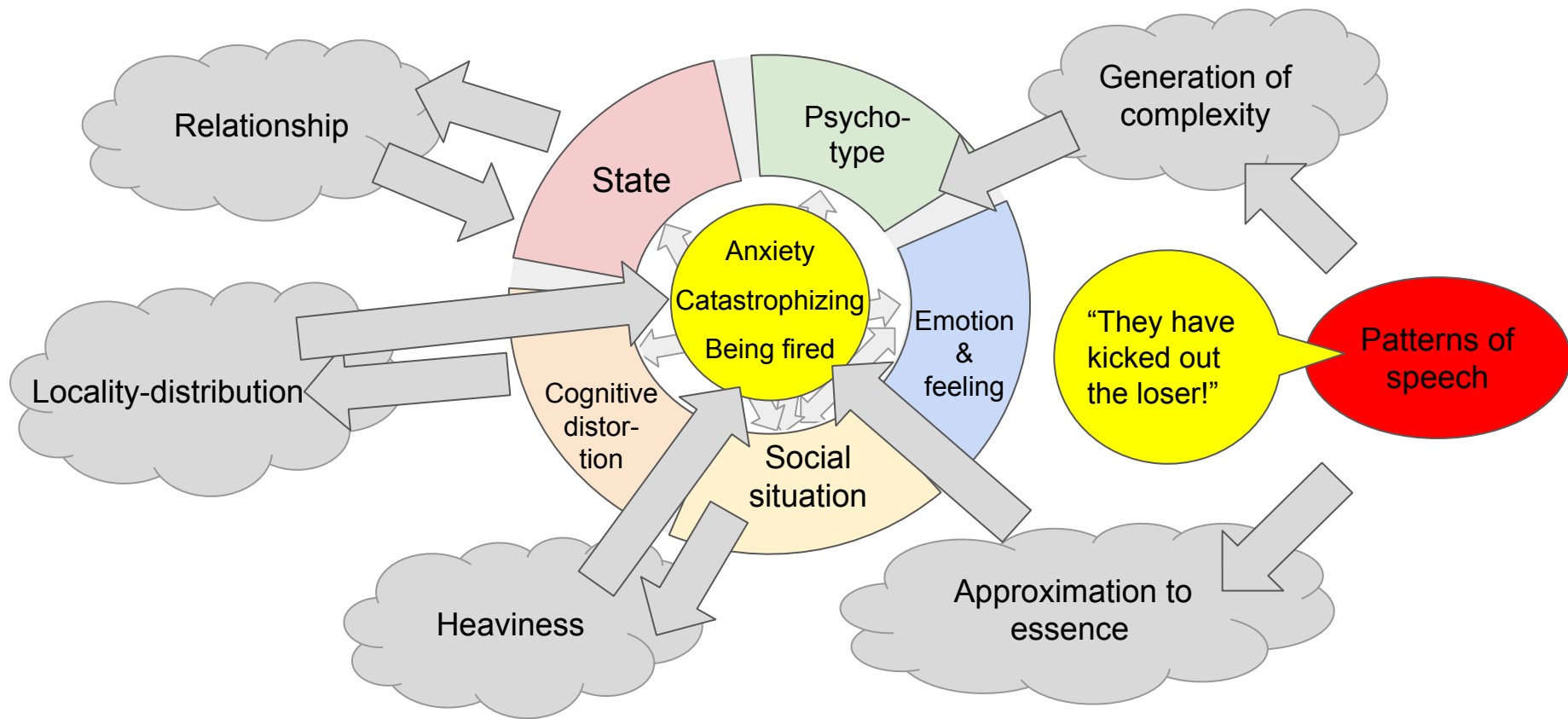
Unified “Upper” Ontology

Psycho-Therapy
Domain Ontology &
Application

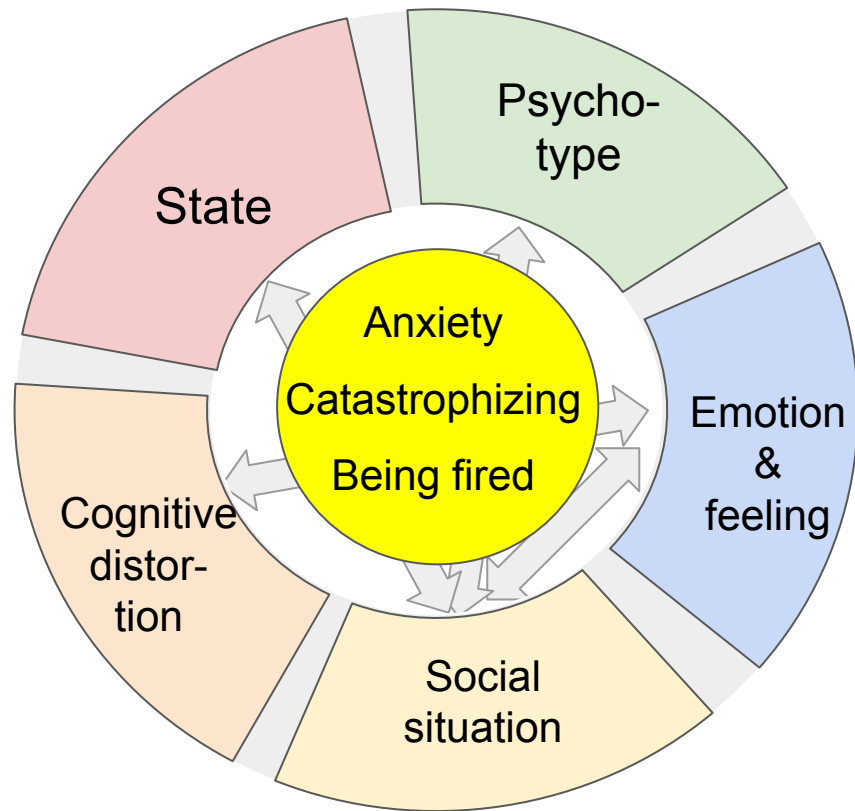
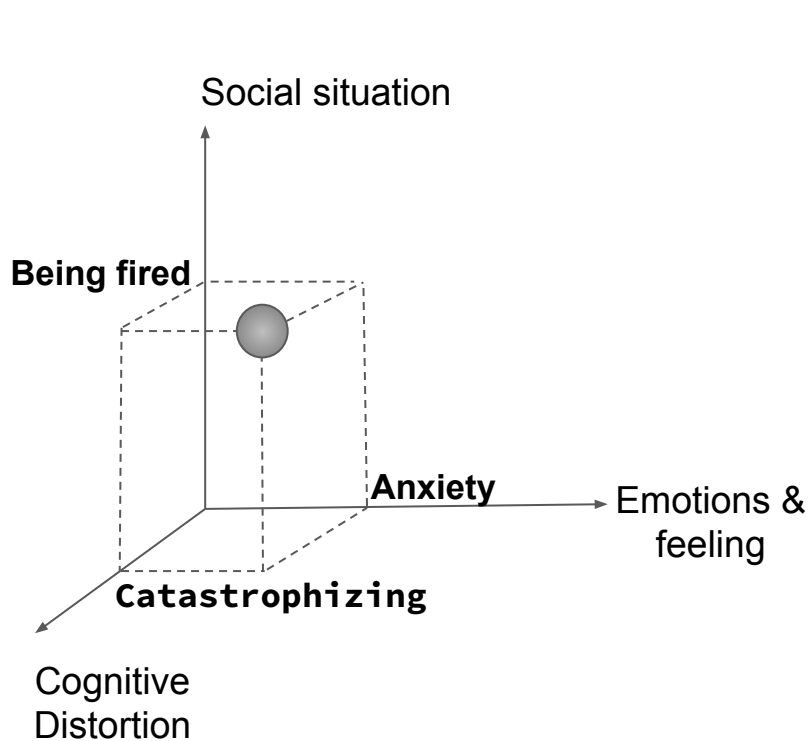
Customer Relationship
Managment Domain
Ontology & Application

Project Management
Domain Ontology &
Application

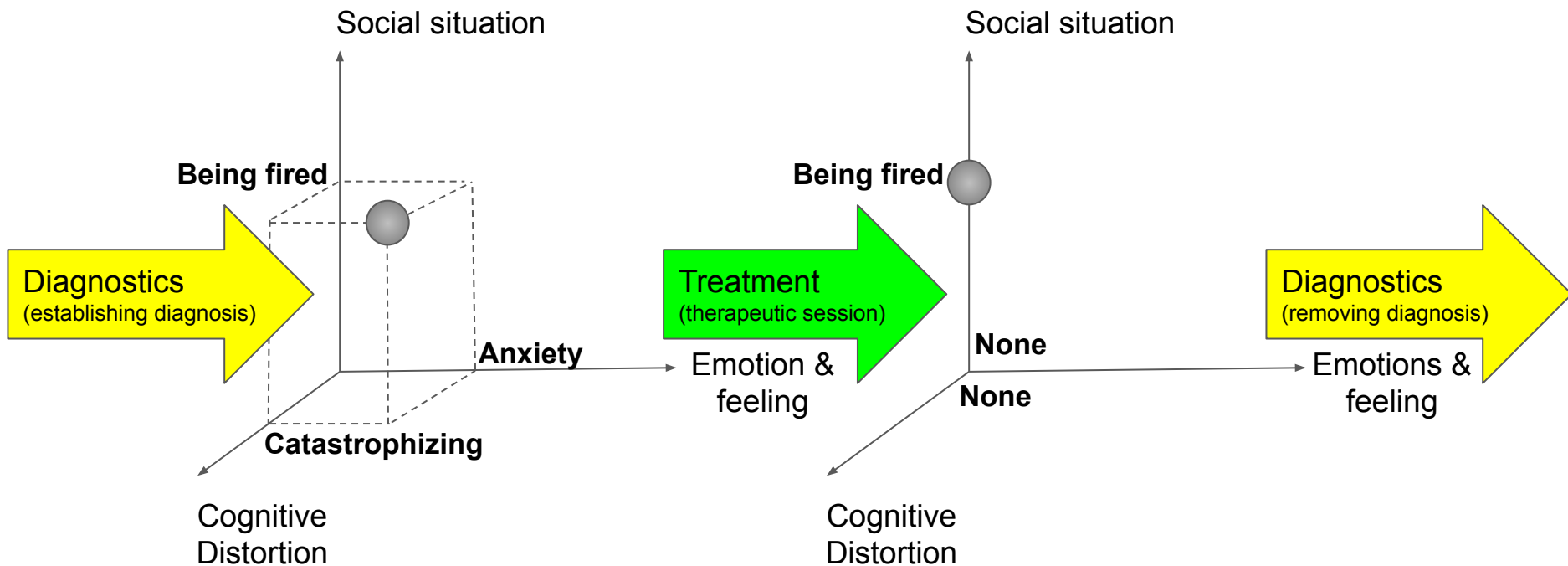
Example: Decision Support System for Psycho-Theraphy



Example: Decision Support System for Psycho-Theraphy



Example: Decision Support System for Psycho-Theraphy



Example: Decision Support System for Psycho-Theraphy

P: Hi! How are you?

K: Bad. They have **kicked out** the **loser**! (tentatively diagnosing **#being fired** and **#personalization**)

P: How did that happen? **Who did that**? (clarifying **social situation**)

K: It was my **job**. I am **fired** so to speak. (confirming **#being fired**)

P: Does it make you **anxious** or make you **angry** on them? (clarifying **emotion** - **#anxiety** or **#anger**)

K: **Anxious**, of course. I **have to** pay the mortgage. (confirming **#anxiety**, diagnosing **#shouldment**)

P: You have been **fired from** your **job** and you are **afraid**, that won't be able to pay, right? (**#being fired**, **#anxiety**)

K: **Yes**. (confirming diagnosis in respect to **social situation** and **emotion**)

P: What do you think was the reason?

K: I just was **not lucky** – the investor has left the company. (diagnosing **#personalization**)

P: Was that **your fault**? (clarifying **cognitive distortion** - **#personalization**)

K: **Not at all**. I just feel like my life **is ruined**. (change diagnosis to **#catastrophizing**)

P: You are **anxious**, that after the **being fired** you **won't be able** to find a new job, correct? (**#anxiety**, **#being fired**, **#catastrophizing**)

K: **Exactly**. Although in fact I am an experienced professional. (confirming diagnosis in regard to **emotion**, **social situation** and **cognitive distortion** moving on to correction with healing interventions)

Thank you for attention!

Evgenii Vityaev, Anton Kolonin, Andrey Kurpatov, Artem Molchanov,

Brain Principles Programming

<https://arxiv.org/pdf/2202.12710.pdf>

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Cognitive Architecture for Decision-Making Based on Brain Principles Programming

<https://arxiv.org/pdf/2204.07919.pdf>