

# University of São Paulo

Polytechnic School of Engineering

Department of Electronic Systems



## Handouts of slides of class F5 – Modelling Cognition

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During the COVID-19 pandemic, with remote classrooms, I am providing this text to compensate the lack of face-to-face contact that we are experiencing. I expect that you read this material and prepare for the remote discussion session, on April 28, via teleconference. Enjoy it and keep yourself safe and healthy.

Slide 2

# PSI 3560 – COGNITIVE SYSTEMS

*class F5*

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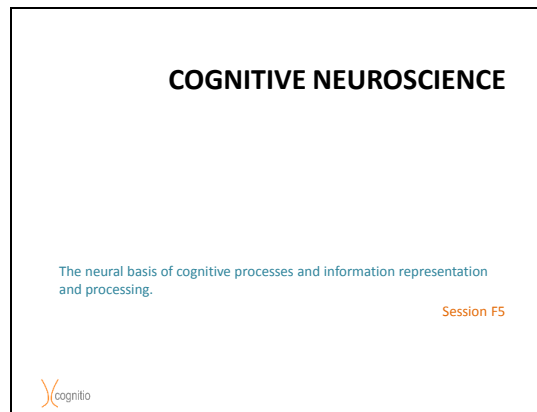


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This is session F5 of the part F – the foundations – of the course on Cognitive Systems, where we discuss the main concepts and views of cognitive science that serve as conceptual foundation for part T. Our primary concern in part T – the techniques – is how to design cognitive applications. Let us start by reviewing the main points discussed on previous classes, relevant to this class.

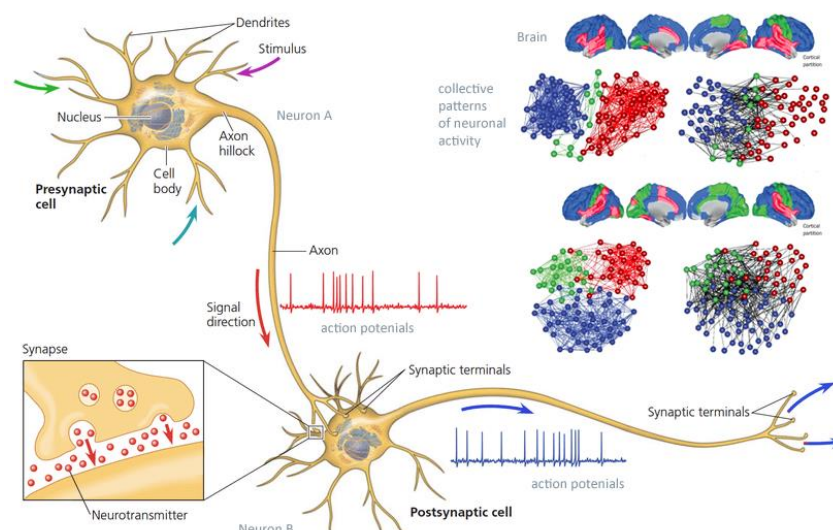
On class F2 we explored the **commonsense** view of cognition, i.e., how people in general conceive the idea of cognition. This led us to the approach called **L.O.T.** – the **language of thought**, which provides a framework for cognition as being the process of **constructing sentences using a language ‘based’ on thoughts**. Thoughts on their own are **considerations about something**, translated into **propositional attitudes**.

Class F3 was skipped this year due to the circumstances. In the 2019 edition, it considered topics in the syllabus that could not be covered on F2, which didn’t happen this year. Besides, we are experiencing the unpredicted lockdown that called us for employing another pedagogical strategy, of distance learning, which required extra time to adapt. Consequently, we discarded the eventual opportunity of including the new material programmed for F3 this year. However, it will be distributed in other classes when possible.



Slide 3: Class F4 covered some introductory aspects of neuroscience, mostly in a descriptive fashion. It essentially covered the following main points:


- That the nervous system is made of cells called **neurons**, which present themselves in several morphologies with a variety of behaviors playing distinct roles in the system;
- That neurons produce electrical pulses, called **action potentials**, in response to stimuli received as inputs to each cell – called **neuron firing**;
- That **information** in the nervous system is conveyed by **trains of action potentials** travelling from one neuron to the other;
- That the **communications between neurons** are mediated by small structures called **synapses**, which release **neurotransmitters** that act as stimulus to a neuron produced by the other neuron connected to the former via the synapse;
- That **circuits and networks of neurons** coupled by their synapses, **accomplish the information processing** in the nervous system;
- Finally, that the **patterns of collective firings** on networks of neurons constitutes the brain activity, which cognitive **neuroscientists** claim to be **the mechanism of thinking**.



Slide 4

## Summary

- Second session (remote)
- The neural basis of cognitive processes and information representation and processing
  - The mind-body problem, reduction, and representation
  - Information representation and processing in the brain


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From class F2: the **commonsense view** of **folk psychology** sustains that

*Cognition is a kind of thinking, which is a succession of mental states – a mental process – that expresses propositional attitudes. Complex thoughts are compositions of these simpler ones that translates into propositional attitudes. These include perceptions, experiences, reasoning, feelings and actions, considered also as mental processes.*

From class F4: the **empirical findings** of **cognitive neuroscience** lead to the view that

*Cognition is brain activity, produced by the networks of neuronal circuits in response to stimuli.*

Confronting the views provided by F2 and F4, some questions arise:

- Could we consider these views identical, equivalent, compatible or just correlated?
- Is it possible to explain the mind in terms of brain activity?
- Are mental states reducible to neural states? Is the mind just brain activity?

These points will be addressed on the first topic of this F5 class. On the second topic we will discuss the issue of information representation and processing in the brain. From this discussion, we will draw conclusions that will help us with our practical intentions of designing artificial cognitive systems, paving the way for the next sessions of the T part of this course.

With these two topics, we will have covered the rationale behind cognitive neuroscience. A final aspect yet to consider on this line should be a discussion of the methodology in cognitive neuroscience research, which is however beyond the scope of this introductory level course.

## Slides 5 and 6

## What is cognition

- Concept of cognition – class F2
  - Commonsense concept of cognition
    - Most people take cognition as **thinking**
    - Thinking → succession of mental states
      - **Mental state** → an expression of a consideration about something
        - » **Consideration** → a belief, desire, intention, expectation, attitude...
      - **Propositional attitude**
        - » believe that p, desire that p, intend that p, expect that p
    - Thinking is the mental process that expresses a propositional attitude
      - **Mental process** → something that happens in the mind
        - » in the brain



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## What is cognition

- Concept of cognition (commonsense)
  - Propositional attitude
    - Is a relation to a proposition
    - Is a declarative sentence → has meaning, has content
      - The meaning is derived from a composition of elementary meanings
        - » Compositionality → Syntactic prescriptions
          - Production rules → Generative grammar
          - Alphabet + Vocabulary + Grammar → Language
            - Language → *the language of thought*
  - Model of mind → language of thought

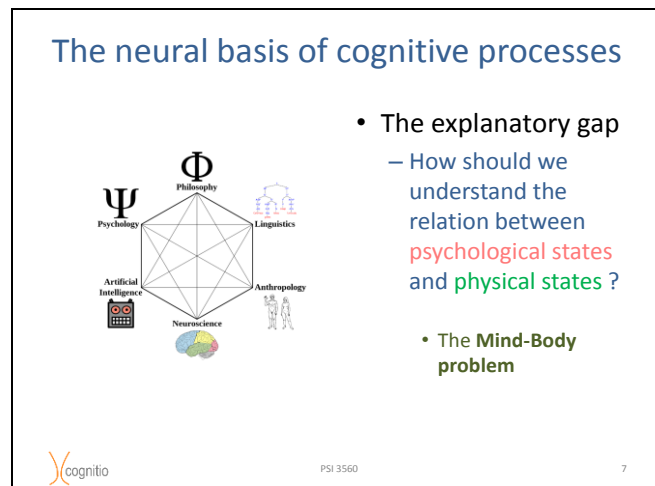


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**Folk psychology** is the term used to designate the everyday manner of explaining and understanding facts and properties about the mind by means of common sense. In class F2, we had shown that commonsense views cognition as a kind of thinking, i.e. a succession of mental states that expresses considerations about something. These considerations are, for example, beliefs, desires, intentions, or expectations, related to some item *p*, so one can *consider that p* (believe that p, desire that p, intend that p, or expect that p). Such propositions *consider that p* are termed **propositional attitudes**. It seems quite clear for common sense that thoughts that are more complex comprise simpler ones. There is a theory called the **Language of Thought (LOT)** in which the propositional attitudes, or simpler thoughts, can be composed following some **grammar** (a set of rules for composition of simpler terms) and produce **meaning derived** from the components plus the rules for composition, serving as a **model of the mind**.

## Slide 7



Cognitive science, as interdisciplinary product of several foundational branches of academic research, seeks to provide explanations for the so-called mind-body problem. However, because there are several explanatory gaps between these areas, it is difficult to go beyond the dispute among several schools of thinking that recently are arisen from a multidisciplinary – instead of interdisciplinary – approach. Nevertheless, the most prominent question is certainly that constituted by the mind-body problem. Roughly speaking, it concerns to the relation between mind states (or psychic, psychological states) and brain states (or physical, biological states):

- Are mind states reducible to brain states? , or
- Are psychological explanations reducible to biological (physical) explanations?

Roughly speaking, reduction is the translation of a theory into another theory that is simpler than the former respect to certain aspect:

- If a theory refers to objects (entities, substances) and their properties (including relations), which reduces to another theory with simpler component objects and/or properties, then we have an **ontological reduction**.
- If a theory that explains certain phenomena is reduced to another that requires fewer explanatory principles than the original, then we have **theoretical reduction**.

**Exercises:** (Read completely the last page in part 1, [this document](#), before doing the exercise.)

1. Explain, in your understanding, which type of reductionism is involved in the mind-body problem. Is it ontological, theoretical or both are involved? Why?
2. Do you think that all mental phenomena can be explained biologically? Do you see exceptions?

3. Compare the concepts of mind, soul, personal identity, and consciousness, using your own comprehension of these terms. Don't run any search on them in the internet or books. Just tell your own view.
4. Suppose that one makes a copy of your body in all aspects, up to the subatomic level, even registering the quantum states of each sub-atomic particle of your body and reproducing them in the copy. Suppose also that you don't know that you were copied. If your copy is submitted to the same environment and situation as you in the very moment that the duplication finishes, do you think that it will behave exactly as you?
5. In the same situation as above, do you think that you and your copy will have the same perceptions? Do you both have the same feelings, emotions, interpretations and thoughts? Are there exceptions?
6. Still in the same situation, do you think that anyone else could consider that you and your copy are the same person, or that they are equivalent? Why? In what sense?
7. Do you consider that you and your copy would be indistinguishable? (your evaluation, not of anyone else – in this case you can consider that you and your copy are both aware that the copy procedure happened, although you don't have met each other yet).
8. Would you believe in this case that your copy is also you? And, that your copy thinks the same?
9. Would you accept to be replaced by your copy? (under all circumstances, it would assume your life). Why? Is your answer consistent with your previous answers?
10. In the positive case, would you agree to be eliminated, discarded (for example, killed, by euthanasia), after your copy assumed your life?
11. Do you think it would be possible that machines could be as conscious as humans are?
12. Do you think that human minds could be copied into machines, or transferred to machines?
13. Would you like to be transferred to a machine if you'd know that it is possible? Why not, in case? Which should be the requirements that you find important to ensure this possibility as safe?
14. Consider the case of teleportation, as depicted in science-fiction stories and movies. In which aspects is it similar to situations proposed in the previous questions? In other words, what underlies the process?

*Note – The situations above were proposed by prof. Osvaldo F. Pessoa in his courses and seminars at the University of São Paulo. He also asks his students on philosophy of mind to write an exegesis, explaining their own theories of mind, in the first and in the last classes of the course.*

## **ATTENTION !!**

This is part 1 of the handouts for F5. I'll release part 2 on this weekend. However, this part has the exercise that is due to next Tuesday, April 28. Just do the exercise, answering the questions on your own, without consulting anywhere, just giving your view, your opinion. It is important that you do this BEFORE you read part 2. Your exercises will contribute for our research on understanding of how people deal with those ideas. So, don't care about being right or wrong. Nevertheless, the questions are in a certain extent still open and subjected to worldwide debate.

Put your name inside the document, your USP number, the date and the title – Class F5.

Send me your text in pdf format, single spacing. You don't need to make any summary about class T5, just answer the questions. I expect something between two to four pages with single spacing. However, be free to use as much pages as you want to tell your view.

After sending me your exercise, then you may read part 2 of the handouts.

**Besides** submitting via the [Moodle](#), for academic control purposes, please:

Send it via email to [kogler@lsi.usp.br](mailto:kogler@lsi.usp.br) with the **subject "Text of class F5"**.

**The deadline for sending me this text is April 28.**

If you experience problems to attend the deadline, tell me via email before April 28.

Keep safe and healthy !