

# Artificial Intelligence, Blockchain, e Criptovalute nello Sviluppo Software

## Lezione 7: Drawing as a Cognitive Experience (for SW Development)

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# Structure of the lecture

- Understanding ourselves and the others
- Drawing
- Mental states while drawing



# Understanding ourselves and the others

- Software is centered in the mind
  - The mind of developers, managers, customers, etc
- Indeed, it is therefore essential to understand the minds
  - Ours and the one of the people around us
- We often resort to drawing to help structuring our thoughts
  - And likewise do the people around us
- We now therefore turn our attention to understanding the role of drawing in developing software



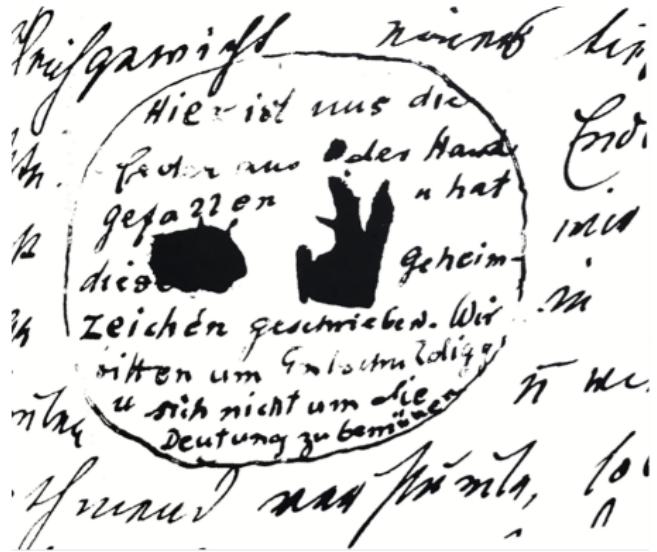
# The approach of this lecture

- We will use one of the several existing approaches, focusing on the work of Freud, through the analysis of Gianluca Solla in the book “Disegnare, la formula di Freud,” published by Orthotes in 2022
- We will consider Freud both as:
  - a researcher, explaining the meaning of drawing
  - a (very primitive) artist, that expresses his feelings in drawing
- In this way, we will attempt to grasp a bit of the intrinsic meaning of drawing:
  - why it is so relevant to software engineering
    - and so why Freud is a software engineer and we are psychoanalysts ...
  - the way it is ontologically a wicked problem



## A spot in a letter

- Freud writing a letter to his girlfriend Martha in 1882:



- In an earlier mail: “Give an artistic shape to the experience.”

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022, page 7.



# Interpreting

- Give an **artistic shape** to the **experience**
- **Experience:** the core, but alone remains meaningless and vanishes
- **Shape:** the interpretation of to the experience
- **Artistic:** the form and the technological ability underlying the creation of the shape
- **Give:** we, as subjects, creating such artistic interpretation

Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022.



# The role of the spot

- The random spot starts having a meaning
- This is at the core of the problem: what is the process by which we give meaning to elements
- The meaning may be the result of a random, non linear, non consequential sequence of actions
- The meaning of the spot may evolve in time – just think at how it started
- And our problem is how we integrate such meaning into the big picture

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



# Drawing

- Drawing is how we give meaning to spots
- Drawing has two very important roles:
  - The resulting picture
  - The process of drawing, which is a way in which we perceive the reasoning behind
  - Drawing has a strong relevance as drawing beyond the resulting picture

Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022.



# Kind of Drawings

- Drawing to **schematize a concept**
  - Simplifications of what is in the mind
- Drawing to **present an experience**
  - Narration of what is in the mind
- The two purposes are strictly interconnected and think at software:
  - **Class diagrams**, schematizing a concept
  - **User stories**, presenting a experience
- And in both cases, drawing is a way to objectify what is in the mind

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



## Understanding the Drawings (1/2)

- Drawings are starting point for an introspection in the (distributed) mind of the author(s)
  - They also present the reasoning process
- Drawings are bridges from the (past) history to the (future) desires or fears
- As such, using our schema of tame vs. wicked processes,
  - drawing is the wicked process of the self-exploration of the mind
    - while drawing we understand the drawing and refine it, stroke after stroke
    - the timing of drawing play a major role

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



## Understanding the Drawings (2/2)

- and ...
  - understanding the drawing is a “double wicked” process of exploring such inner exploration and
  - its time evolution
- Using the words of Freud:
  - Phantasieren, Übersetzen, Erraten
    - Fantasizing, translating, wandering, often (but not always) as when we are schematizing a concept and then
  - Speculieren, Theorisieren, Phantasieren
    - Thinking, theorizing, fantasizing, often (but not always) as when we are presenting a experience

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



## Phantasieren (fantasizing) (1/3)

- Two roots from Latin:
  - Fantasy, imagination
    - Referring to the creative act of the mind to think at entities, sometimes not yet existing in the reality
  - Phantom, ghost
    - Referring to the ability of following the mind into their deep thoughts, reflections, spanning also to the subconscious

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



## Phantasieren (fantasizing) (2/3)

- As already pointed out for the model of the dual mind, the researcher must go beyond the “standard” experimental practices
  - For the model of the mind, we referred to the **ethnographic exploration**
  - In this case, our “ethnography” will refer to the mental exploration of the mind – we could even say that the researcher or the software engineering is engaged in a **psychoanalytical exploration** of the mind
- This is not **anyhow** referred to any therapeutic initiative

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



## Phantasieren (fantasizing) (3/3)

- However, also from a purely technical perspective, **none would be able to understand** the requirements and the requests of colleagues, managers, employees, or customers
  - **unless there is deep exploration** and understanding of the **mind** in its fantasizing
- Something to keep well in mind:
  - This is not:
    - less rigorous
    - less technical
    - less difficult
    - less related to software engineering
  - than writing a highly complex piece of C++ code for a new device driver

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



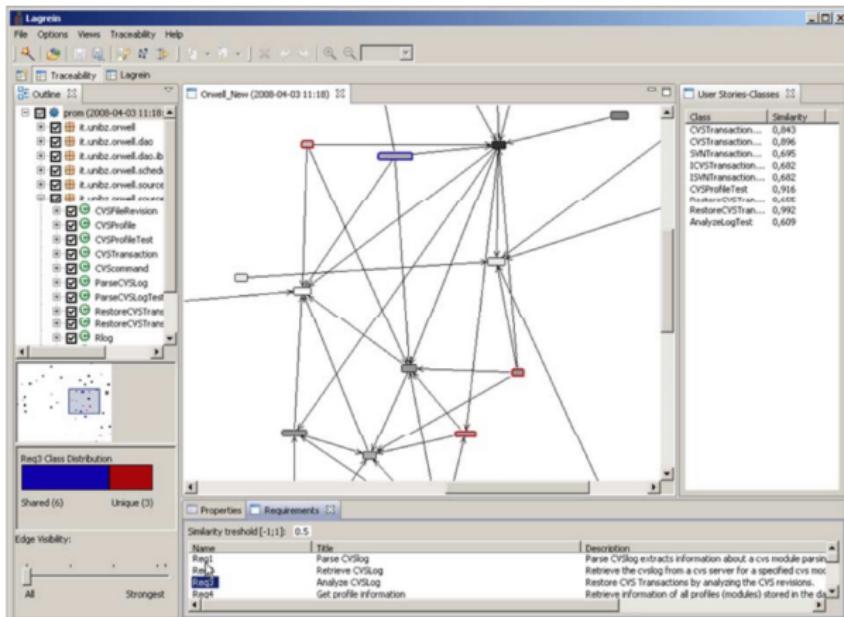
## Decoding the drawing (1/3)

- Drawing defines a language to interpret
- The interpretation involves
  - The individual elements
  - The drawing as a whole
  - The temporal placement of each individual stroke
- However, the language is not defined by the strokes in the resulting picture, which are in constant evolution, not static:
  - Therefore, it is a language that can be hardly formalized
  - This is why, for instance, the structure of a code repository cannot be explained without looking at its time evolution
- It has a role per-se, beyond what we can naïvely think that it represent

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



# Modeling the time evolution of a code repository

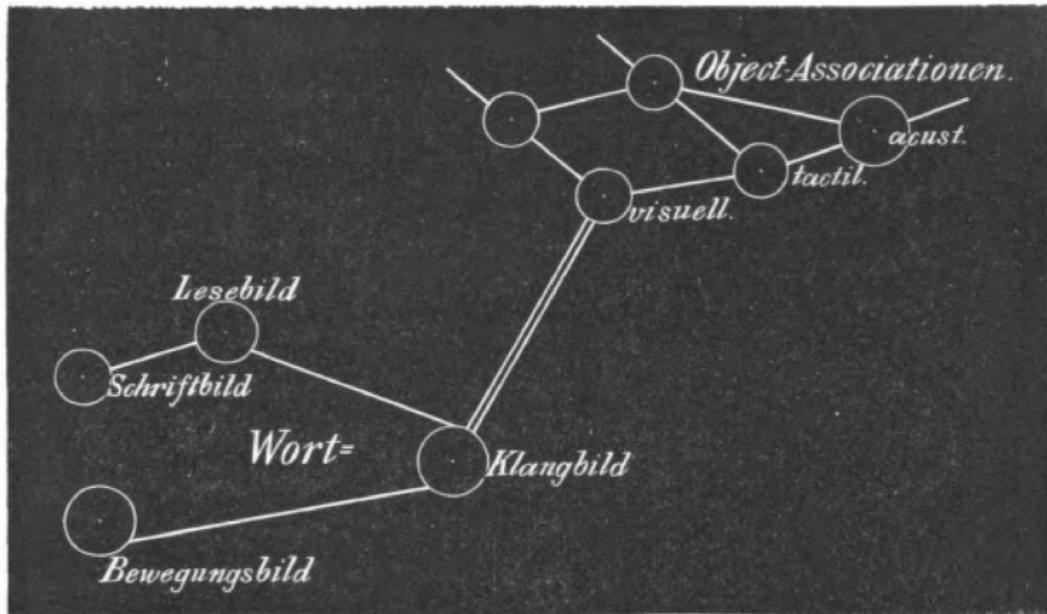


Source of the picture: Andrejs Jermakovics, Raimund Moser, Alberto Sillitti, and Giancarlo Succi. Visualizing Software Evolution with Lagrein. In Companion to the 23rd ACM SIGPLAN Conference on Object-Oriented Programming Systems Languages and Applications, OOPSLA Companion '08. ACM, October 2008, page 750.



## Decoding the drawing (2/3)

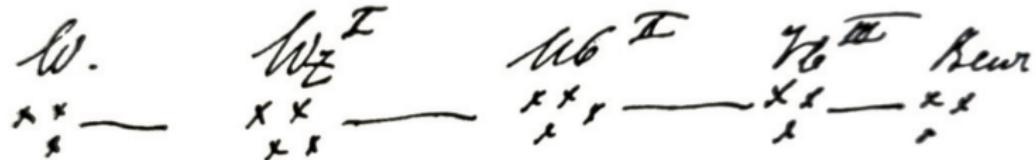
- How Freud represented such dynamic associations



Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022; Sigmund Freud "Zur Auffassung der Aphasien. Eine kritische Studie," Franz Deuticke, 1891, pag. 79, fig. 8.



## Decoding the drawing (3/3)



- This is how Freud represented the flow of information
  - W are the neurons connected to perception
  - Wz are the symbols of how such perception is taken
  - Ub is the subconscious, as memory traces that are unaccessible to the conscious mind
  - Vb is the rewriting related to words
- In essence, the physical life is a process

Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022, the pictures comes from page 23 and it is allegedly taken from Sigmund Freud, Briefe and Wilhelm Fließ. 1887-1904, S. Fischer, Frankfurt a.M., 1994



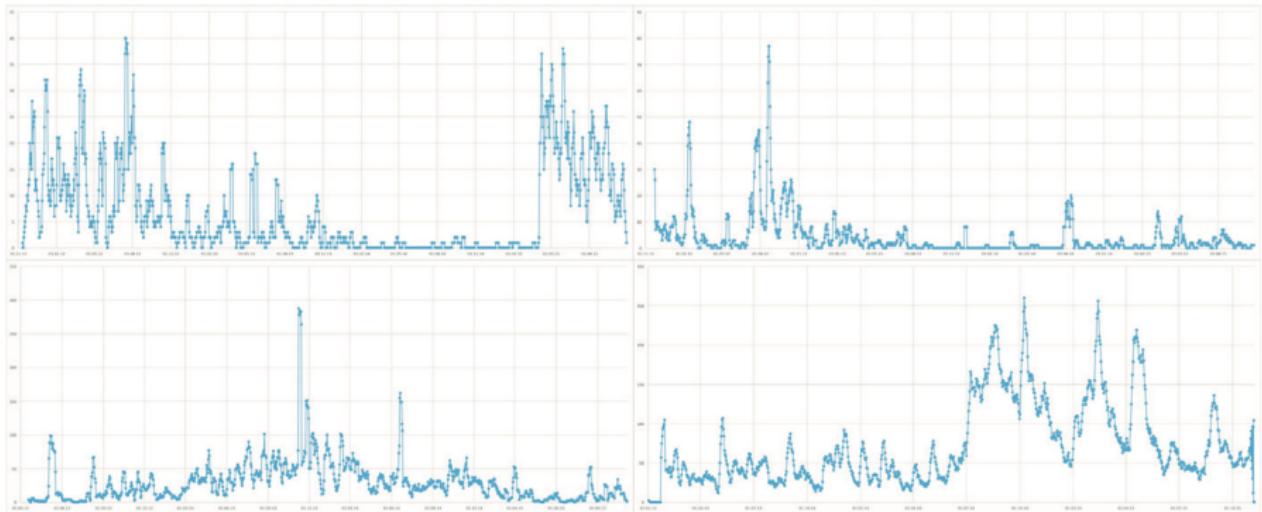
## Reflecting on the drawings

- Drawing also evidences what is missing
- Indeed, drawing has limitations, Freud defines it a “Hilfsapparat”
  - but still it is essential
- It helps also as evidencing the time-variant nature of the mind as a collection of differences
  - and any representation is in itself a very limited perspective
  - as it is well evidences considering the structure of a software repository

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022



# Sample time evolution of a code repository



Source of the picture: Vladimir Ivanov, Alexey Reznik, and Giancarlo Succi. "Comparing the reliability of software systems: A case study on mobile operating systems." *Information Sciences*. Elsevier, 2018, 423:398-411, fig. 1, page 405.



## Moving on

- Nature of wicked problems:
  - Freud: “We should be almost ashamed that after so much work we find always new difficulties in understanding the fundamental facts that are in front of us”
- It is always in a unstable balance between invention and repetition
- Every end is always like a new beginning
- This is why Freud represent his medical experiences, the “Clinical Cases” as a storyteller
  - We will discuss more about storytelling later on
- We will now have a review of a few drawings of Freud as per the reference book, to see how their interpretation can help explaining how to interpret drawings in software development

Source of the content: Gianluca Solla. “Disegnare, la formula di Freud,” Orthotes, 2022, the citation of Freud is allegedly from Sigmund Freud “Hemmung, Symptom und Angst,” 1926.



## Drawings in Trieste (1/2)

- Drawing to select elements for further analysis

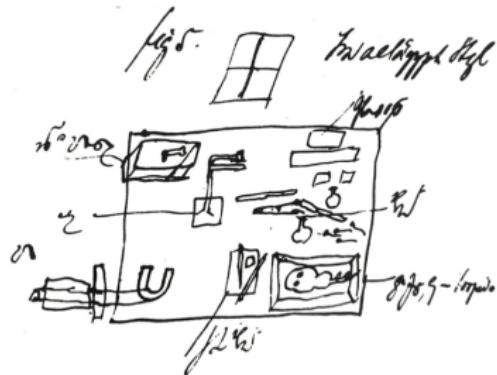


Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022, pag. 39



## Drawings in Trieste (2/2)

- Drawing to describe the own experience in terms of the perception of the outer world



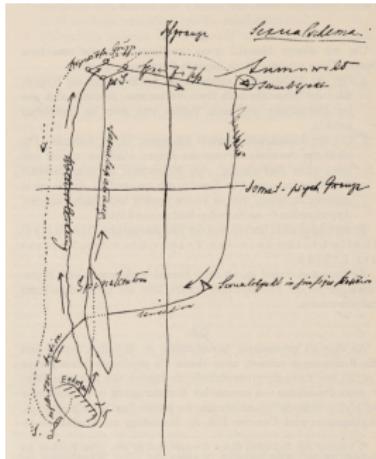
- Here we perceive how the drawing defines a wicked problem, where a solution is the beginning of a new investigation.

Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022, pag. 38



## Drawing in a letter to Wilhelm (1/2)

- Drawing to describe a model that has been devised



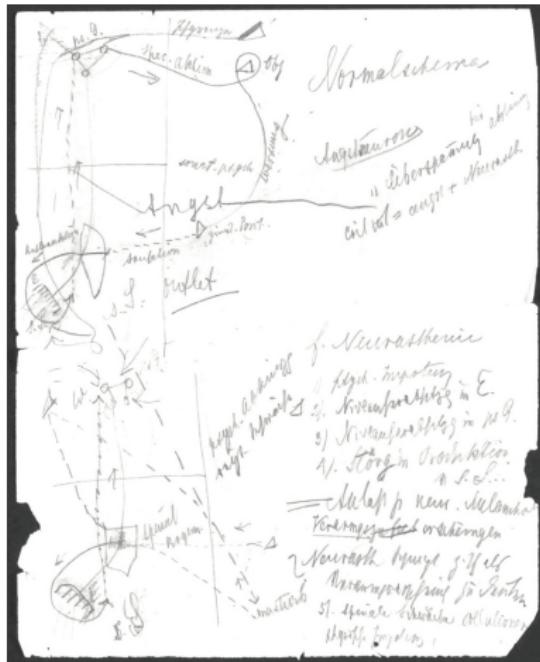
- We notice here a completely different approach to draw, where there is quite a statement of correctness

Sources of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022, pag. 74



## Drawing in a letter to Wilhelm (2/2)

- But look at how he got there:

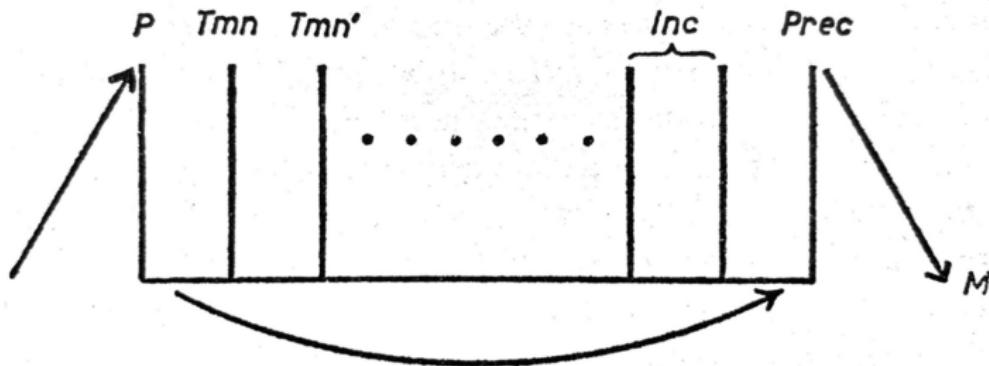


Source of the content: Gianluca Solla "Disegnare, la formula di Freud," Orthotes, 2022, pag. 51



“The psyche is extended. Knows nothing about it”

- This is an intuition of Freud, connected to our discussion of the extended mind, which is triggered by this drawing:
  - P(erception), M(utility), Inc(onscious), Pre(conscious), Mn(estic traces)



Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022, pag. 74.



# From drawing to understanding

- All this works of Freud on drawings for us is interesting under a dual perspective:
  - For what we said, since through pictures we understand the minds of the people we are dealing with
  - Because Freud itself, despite being a neurologist, so full aware of how the brain works, preferred drawing to elaborate ideas on the work of the mind:
    - they are more relevant than the physiological analysis;
    - “*individuals and interactions over processes and tools.*”

Source of the content: Gianluca Solla “Disegnare, la formula di Freud,” Orthotes, 2022.



# Drawing and Coding

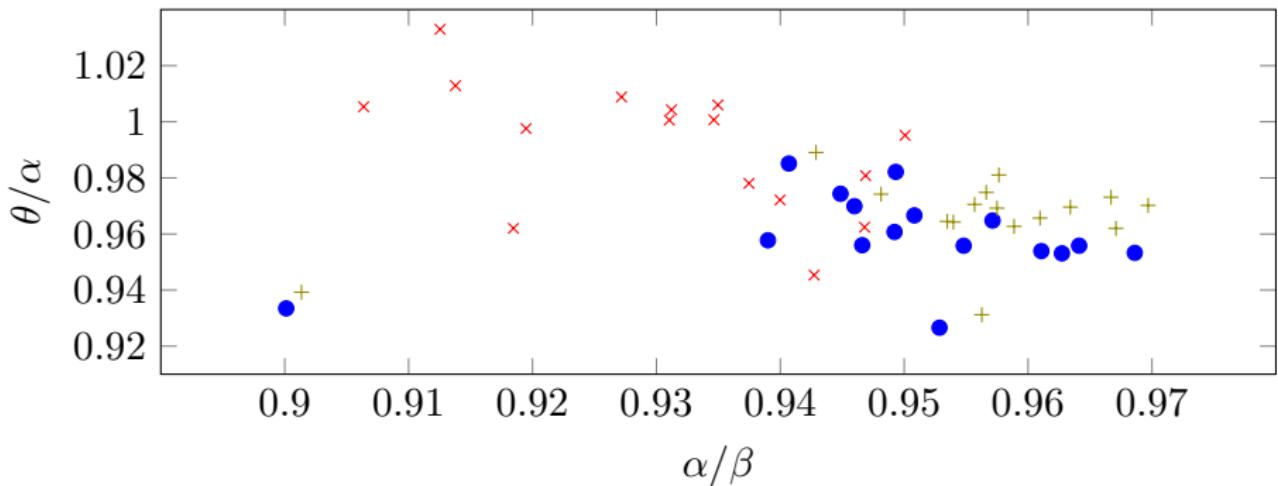
- We end this lecture discussing the similarities in the brain activity between coding and drawing, a further reinforcement of the relevance of drawings in our work.
- We have run an experiment with 22 participants coding and sketching
- The participants were first instructed and then had a sessions in which they prepared for recoding, and they were given a task to solve.
- The data has been collected using a 32-channels portable EEG cap.

Source of the content: Gcinizwe Dlamini, Giancarlo Succi, Nataliya Tupikina "Is the mind of a software developer similar to that of an artist? Focus on drawing," Under review, 2023.



## Drawing and Coding – Results (1/2)

- Clusters of values of  $\alpha/\beta$  and  $\theta/\alpha$  when resting (the red  $\times$ ), programming (the blue  $\bullet$ ), and drawing a picture (the olive  $+$ )

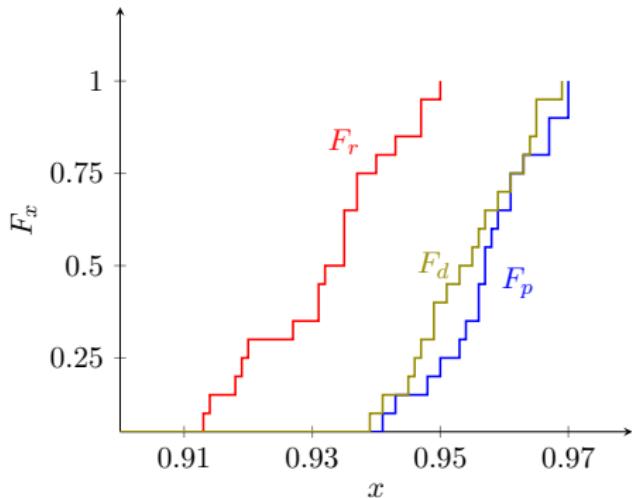


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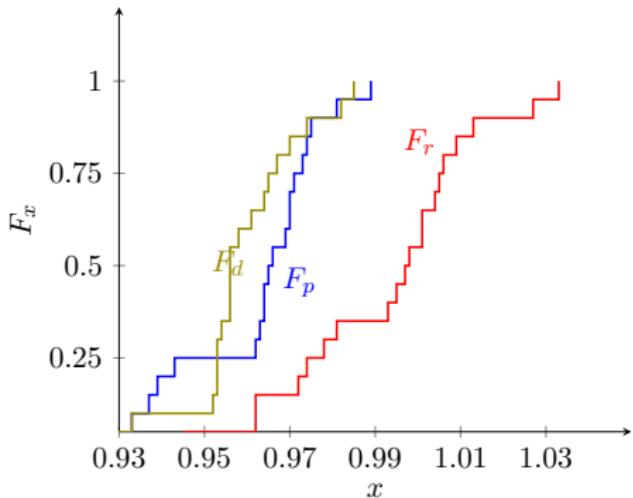


## Drawing and Coding – Results (2/2)

- Empirical distribution functions of (a)  $\alpha/\beta$  and (b)  $\theta/\alpha$  for resting ( $F_r$ ), programming ( $F_p$ ), and drawing ( $F_d$ )



EDF of  $\alpha/\beta$



EDF of  $\theta/\alpha$

Source of the content: Gcinizwe Dlamini, Giancarlo Succi, Nataliya Tupikina “Is the mind of a software developer similar to that of an artist? Focus on drawing,” Under review, 2023.



# Questions?

End of lecture seven.