

I501 – Introduction to Informatics
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Paper Presentation and Handout

Jonas, E., and Kording, K. P., (2017). Could a Neuroscientist Understand a Microprocessor? PLOS Computational Biology, 13(1), e1005268.

- Problems in neuroscience experimentation
 - Organisms are extremely complex
 - Not able to test most hypothesis
 - “Absence of a known truth”
- Inspired by Yuri Lazbnick’s “Could a biologist fix a radio?”
- Microprocessor
 - Known artificial system
 - Far less complex than the human brain
 - Reliable – results are repeatable, less entropy, more consistency
 - MOS 6502 (Apple I, the Commodore 64, and the Atari Video Game System (VCS))
- Apply neuroscience techniques to understand how a microprocessor
 - Can measure performance as we know how a microprocessor works
 - Implication that if method works well on microprocessor, it will perform better than other neuroscience methods that failed to understand a microprocessor
- Experiment
 - Virtualized the microprocessor
 - 1.5 GB per second of state information
 - “Behaviors” - Donkey Kong, Space Invaders, and Pitfall
 - Statistical analysis of “allocation of attention, cognitive processing, and multiple modalities of inputs and outputs”
 - Goal - “gain an under- standing of how circuit elements give rise to computation”
- Architecture of a microprocessor
 - Memory
 - Registers
 - Instruction decoder
 - ALU – provides addition operations
- Connectomics
 - Studying the “network” of the brain
 - In the microprocessor, we can use the configuration of the transistors
- Lesion Studies
 - Studying what happens by eliminating a component
 - Remove a transistor from the microprocessor and compare the results
 - Results

- Some transistors required for every game
- Some not required for the game to operate
 - Does not indicate importance, “behavior” not triggered in use of game
 - Some transistors are “vital” while others are not
- Study “off-to-on” of transistors which emulates neuron “spike trains”
 - Tuning neurons
- Results of experiments show that microprocessors have commonalities with the brain
- Didn’t really gain “understanding” as mentioned in goal of experiment
- Mixed reactions from experts, current neuroscience techniques might be far from understanding how the brain operates