

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