These notes on the Neuroscience and AI Session of SOCML 2016 were provided by Alex Kurakin. If you attended the session and would like to add some notes, request edit permission from Ian.

Attended around ~25 people. Some left/some arrived in the middle

Initially we briefly talked about potential topics interesting to discuss:

- Use of machine learning in neuroscience
- NLP
- Computer vision inspired by neuroscience
- Unsupervised VS supervised learning
- Creative models in the brain
- Sensory motor
- Neuroscience basics
- Cognitive architectures
- Reinforcement learning in the brain

Though after that people just asked various random questions (non necessarily from the list above) and we discussed it:

- What are differences of NNs and brain which CS does not know
    - Many types of cells
    - Slow signal prop
    - Perceptron model is not like real neurons in the brain work
- Specific nonlinearities in real neurons
    - One input of neuron can veto output
    - Multiplications
    - Response properties of real neuron change over time
        - Chemical process
        - Change of weights
- Cortex-hippocampus interaction. They might have different representation of same input (real world object). How knowledge is transformed between them?
    - Hippocampus might have neuron which fires on specific object (like grandmother), cortex might have distributed representation of the same concept.
    - Grid cells
    - Place cells in hippocampus

- Column architecture in the brain
    - Vertically connected VS horizontally connected cells
    - Column goes through layers of brain tissue
    - Visual cortex: V1, V2, (V3), V4, V5
- V1 - visual processing, what kind of processing of information V2 does.
- How language processing works in brain? How similar it is to Visual Cortex
    - A1, A2, A4? (similar to V1, V2, V4)
- How much similarity/difference between brains of different people
    - fMRI shows that brains are different
    - But overall order of parts of the brain is similar
    - Ex: some people have bigger V1 than other, but it's achieved by having other part of brain smaller
- Plasticity of the brain. What parts of the brain could take over other parts in case of damage.
    - There is a lot of plasticity. Brain able to reroute information (for ex. auditory cortex can do work of visual cortex)
    - There are opinions that different part of cortex are universal (i.e. could potentially do the same). But there are arguments against it
- Why some animals could start walking right after birth
    - Seems like animals already have some knowledge when they born
    - ...
- What are problems current in AI, that neuroscience can help?
    - Brain integrate subsystems with different architectures and makes it work together
    - Humans are good in being bounded (computationally). Humans can't remember everything and good in the world which constantly throwing tasks at them.
    - Humans might have troubles explaining their decision process. Brain can't explain why it did what it did.
    - Brain has far more connections than any neural network
    - Brain might have model of itself and that helps make decisions. Maybe it would be useful for NN to have model of itself
- What are comparisons between number of params in brain and NN? How much differences are caused by size of NN and how much are caused by architectural differences?

    - 100 Trillions synaptic connections. Though maybe not all of them are needed to solve tasks.
    - Current computer hardware does not handle sparsity very well
- Predictive coding theories of the brain
    - Brain has top down nature. Top level send expectations to bottom levels.
    - Brain constantly make predictions to drive it's action
- Sensory motor work in AI
- Does spine do computations?
    - Experiment with cat: if you tap paw then it would move paw around (like if cat tripped). This done by spine
    - Octopus tentacles are doing computations
- Backprop in brain?
    - Gradient descent is not biologically realistic.
    - SGD need forward and backward pass, need to utilize global knowledge of the net
    - On the other hand there are papers which showed that you can do training and use random matrix for backward pass.
    - Dimensionality reduction - you can use also use random matrix to do projection.
    - Though biological system might have learned how to do backprop if it's really needed. But it seems like it's not needed for real brain.
- Can you train biological neurons to do something
    - Yes, people have done that.
- Inhibitory connections. Seems like not used in NN. Is it useful or not?
    - LSTM, multiplicative connections like inhibitory
    - Attention networks also inhibitory.