Summerschool Learning Systems / Biocomputing: Summer 2017

Reading Assignment

In preparation for the Summerschool Learning Systems / Biocomputing, please read the following papers and hand in (via email to `lernsys@ovgu.de`, **Deadline Sunday, July 30th**) a one to two-page paper that (briefly) answers the questions asked on the next page.

- [Brooks et al., 2012] Is the brain a good model for machine intelligence? `http://www.idt.mdh.se/~gdc/work/TURING-SEMINAR/TURING-NATURE/Brain-Computer.pdf`
- [Chappell et al., 2012] How to build an information gathering and processing system. `http://www.academia.edu/download/42905376/d912f50069dd5558bb.pdf`
- [Tenenbaum et al., 2011] How to Grow a Mind. `http://ai.cs.washington.edu/www/media/papers/tmpujUupM.pdf`
- [Jones, 2014] The Learning Machines. `https://kr.nvidia.com/content/tesla/pdf/machine-learning/nature-learning-machines.pdf`
- [Bengio, 2016] Machines Who Learn. `http://search.ebscohost.com.0029c4hx0cc8.han.med.uni-magdeburg.de/login.aspx?direct=true&db=pbh&AN=115370468&site=ehost-live`
- [Ghahramani, 2015] Probabilistic machine learning & AI. `http://www.cse.iitk.ac.in/users/piyush/courses/pml_winter16/nature14541.pdf`
- [Holzinger, 2016] Interactive Machine Learning. `http://link.springer.com/content/pdf/10.1007/s00287-015-0941-6.pdf`
- [Doya, 2007] Reinforcement learning: Computational theory & biological mechanisms. `http://www.tandfonline.com/doi/pdf/10.2976/1.2732246/10.2976/1`
- [Tokic, 2013] Reinforcement Learning: Psychologische und neurobiologische Aspekte. `http://www.tokic.com/www/tokicm/publikationen/papers/rl-ki13.pdf`
- [Wolff and Brechmann, 2015] Carrot & Stick 2.0: The benefits of natural & motivational prosody in computer-assisted learning. `http://www.sciencedirect.com/science/article/pii/S074756321400538X`
- [Puschmann et al., 2013] Learning-dependent plasticity in human auditory cortex during appetitive operant cond. `http://onlinelibrary.wiley.com/doi/10.1002/hbm.22107/pdf`
- [Schulz et al., 2015] Selective Increase of Auditory Cortico-Striatal Coherence during Auditory-Cued Go/NoGo Discrimination Learning. `https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4707278/pdf/fnbeh-09-00368.pdf`

1.1 Asking the right questions about human inquiry [Coenen et al., 2017]

1. What are some computational challenges that people face when gathering information?

1.2 Is the brain a good model for machine intelligence? [Brooks et al., 2012]

1. What is the difference between brains and computers?
2. What can neuroscience contribute to AI?

1.3 How to build an information gathering & processing system [Chappell et al., 2012]

1. What are the requirements for biological or artificial learning systems that are stated in the paper?

1.4 How to Grow a Mind [Tenenbaum et al., 2011]

1. How is prior knowledge encoded in the different domains (computer science, neuroscience, psychology)?
2. What is the mechanism that the authors propose by which humans learn concepts from few (new) objects?

1.5 The Learning Machines [Jones, 2014] and Machines Who Learn [Bengio, 2016]

1. What is deep learning?

1.6 Probabilistic Machine Learning and Artificial Intelligence [Ghahramani, 2015]

1. What is meant by uncertainty in the paper? Give examples (like noise).
2. What constitutes a well-defined model?
3. Describe the probabilistic approach in one or few sentences.
4. What is the difference between a parametric and a non-parametric model?
5. Explain the Bayesian optimisation approach by using Figure 3.
6. What is the aim and approach of "The Automated Statistitian"?

1.7 Interactive Machine Learning [Holzinger, 2016]

1. What is the meaning of Interactive Machine Learning?
2. What is the potential advantage of iML over automatic ML, e.g. in the "Doctor-in-the-Loop" example?

References

[Bengio, 2016] Bengio, Y. (2016). Machines who learn – springtime for ai: The rise of deep learning. *Scientific American*, 314(6):46 – 51.

[Brooks et al., 2012] Brooks, R., Hassabis, D., Bray, D., and Shashua, A. (2012). Is the brain a good model for machine intelligence? *Nature*, 482:462–463.

[Chappell et al., 2012] Chappell, J., Demery, Z. P., Arriola-Rios, V., and Sloman, A. (2012). How to build an information gathering and processing system: Lessons from naturally and artificially intelligent systems. *Behavioural processes*, 89:179–186.

[Coenen et al., 2017] Coenen, A., Nelson, J. D., and Gureckis, T. (2017). Asking the right questions about human inquiry.

[Doya, 2007] Doya, K. (2007). Reinforcement learning: Computational theory and biological mechanisms. *HFSP Journal Frontiers in Life Science*, 1(1).

[Ghahramani, 2015] Ghahramani, Z. (2015). Probabilistic machine learning and artificial intelligence. *Nature*, 521(7553).

[Holzinger, 2016] Holzinger, A. (2016). Interactive machine learning (iml). *Informatik Spektrum*, 39(1).

[Jones, 2014] Jones, N. (2014). The learning machines. *Nature*, 505.

[Puschmann et al., 2013] Puschmann, S., Brechmann, A., and Thiel, C. M. (2013). Learning-dependent plasticity in human auditory cortex during appetitive operant conditioning. *Human Brain Mapping*, 34(11).

[Schulz et al., 2015] Schulz, A. L., Woldeit, M. L., Goncalves, A. I., Saldeitis, K., and Ohl, F. W. (2015). Selective increase of auditory cortico-striatal coherence during auditory-cued go/nogo discrimination learning. *Frontiers in Behavioural Neuroscience*, 9:368.

[Tenenbaum et al., 2011] Tenenbaum, J. B., Kemp, C., Griffiths, T. L., and Goodman, N. D. (2011). How to grow a mind: Statistics, structure, and abstraction. *Science*, 331(6022):1279–1285.

[Tokic, 2013] Tokic, M. (2013). Reinforcement learning: Psychologische und neurobiologische aspekte. *Künstliche Intelligenz*, 27(3):213–219.

[Wolff and Brechmann, 2015] Wolff, S. and Brechmann, A. (2015). Carrot and stick 2.0: The benefits of natural and motivational prosody in computer-assisted learning. *Computers in Human Behavior*, 43.