

# ACT-R Tutorial (half day)

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ACT-R (Anderson, Bothell, Byrne, Douglass, Lebiere & Qin, 2004) is a cognitive theory and simulation system for developing cognitive models. It assumes cognition emerges through the interaction of a procedural memory of productions with a declarative memory of chunks and independent modules for external perception and actions. Since its release in 1993, ACT-R has supported the development of over 100 cognitive models, published in the literature by many different researchers. These models cover topics as diverse as driving behavior, implicit memory, learning backgammon, metaphor processing, and emotion. This tutorial will discuss the latest version of ACT-R, ACT-R 6.0, which is more interruptible, achieves greater across-task parameter consistency, has better mechanisms of production learning, and is more in correspondence with our knowledge of brain functioning than previous versions (Figure 1). The tutorial has no prerequisite knowledge, and is intended to on the one hand give an overview of the theory, and on the other hand offer some direct demonstration of ACT-R models. Although half a day is not sufficient to cover all material, it can wet the appetite for and serve as a kick-start to the full ACT-R tutorial that is available online at <http://act-r.psy.cmu.edu/>. This website also provides the necessary software, and an overview of researchers using ACT-R. It also has a list of ACT-R publications (many of them downloadable). The tutorial will consist of three parts of approximately one hour each. In the first hour, we will give an overview of the theory and software, and demonstrate a simple example model. In the second hour, participants will be able to get some hands-on experience with the system in that they can experiment with some example models. For this purpose, we recommend they download a java version of ACT-R before the start of the tutorial from:

<http://cog.cs.drexel.edu/act-r/>

In the third hour we will show models of more complex phenomena to showcase the depth and breadth of the theory. During the tutorial, following Taatgen, Lebiere and Anderson (2006) three popular research paradigms within ACT-R will be used as a vehicle both to explain the architecture and to explain how ACT-R accounts for these phenomena. The three paradigms are the following:

## Instance learning

Learning by storing and retrieving old experiences from memory, similar to Logan's instance theory.

## Perceptual/Motor constrained processing

Models in which the main factor in explaining human performance lies in the limitations of their perceptual and motor systems.

## Rule learning

Models in which new production rules are learned on the basis of combination of old rules and substitution of declarative knowledge.

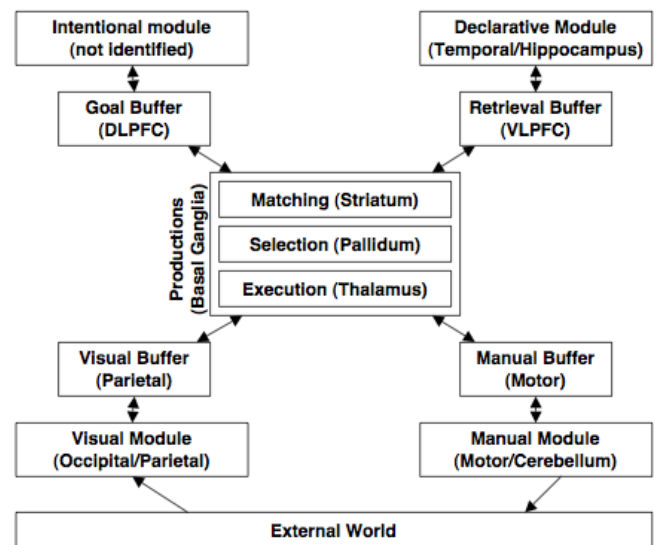


Figure 1: Overview of the ACT-R architecture

Although these individual research paradigms have produced interesting models by themselves, the full potential of the architecture can only be seen when they work together in models of complex cognition, which is the focus of a large proportion of current ACT-R research. In addition to the modeling paradigms we will discuss imaging research that shows how components of the ACT-R architecture can be mapped onto brain regions.

## References

- Anderson, J. R., Bothell, D., Byrne, M.D., Douglass, S., Lebiere, C., Qin, Y. (2004) An integrated theory of Mind. *Psychological Review*, 111, 1036-1060. Available online: <http://act-r.psy.cmu.edu/papers/403/IntegratedTheory.pdf>
- Taatgen, N.A., Lebiere, C. & Anderson, J.R. (2006). Modeling paradigms in ACT-R. In R. Sun (ed.), *Cognition and Multi-Agent Interaction: From Cognitive Modeling to Social Simulation* (pp. 29-52). Cambridge University Press. Available online: <http://www.ai.rug.nl/~niels/publications/taatgenLebiereAnderson.pdf>

## Tutorial History

Taatgen has given this tutorial during CogSci 2004, and Taatgen and van Rijn during CogSci 2005-2008. In

addition, Taatgen has organized the ACT-R summer school at CMU in the past, and presently co-hosts the yearly European ACT-R spring school and workshop. In this year we have added some hands-on experience in addition to just presenting material in order to lower the threshold for participants to start working with ACT-R on their own.

## Requirements

We will provide participants with copies of the slides. Participants are encouraged to bring along a laptop and download the software before the start of the tutorial (<http://cog.cs.drexel.edu/act-r/>). We will bring along the software ourselves on USB-keys, and people can team up and share computers when necessary.