Quantitative Modelling of Cognitive Systems

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Abstract

The modelling of human cognitive system allows human behaviours to be investigated and better understood. We present two case studies of cognitive systems modelling and analysis. The first case study aims at investigating addiction phenomena. In particular, we consider Internet addiction, namely the excessive Internet (and technology) use that may interfere with daily life. We show that this form of addiction can be somehow "transmitted" through the interaction on social networks, and that the structure of social networks actually facilitate such a transmission. The study is performed by developing a Hybrid Automata model of the Dopamine system, the main cognitive system involved in addiction phenomena, that we use to simulate the effects of interactions among users of a social networking service. The second case study aim at investigating the role of human attention in the simultaneous interaction with more than one device. The modelling of cognitive processes is quite common in the context of Human Computer Interaction (HCI), since failure in the interaction with (the interface of) a device can be caused by human factors such as the erroneous perception of the device state, the limited capacity of the human working memory, etc. When a user is involved in more than one task simultaneously (e.g. when he/she is interacting with more than one device/interface concurrently) attention becomes a critical shared resource. Several studies in the field of Psychology show that one of the factors that cause attention to be moved and kept on one of the tasks is the amount of cognitive resources required by such a task (cognitive load). Hence, a task with a high cognitive load could become a distractor and cause attention to be rarely moved to the other concurrent tasks. Such distraction phenomena may lead to dangers if one of the concurrent tasks is safety critical (e.g. interacting with an infotainment system while driving). In order to study these kind of problems we developed a computational model of the human attention system.