Teaching Critical Thinking to Computer Science Engineering students.

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Communication proposal (574 words)

Critical Thinking (CT) was taught as a mandatory course for a degree in Computer Science Engineering (Licenciatura em Engenharia Informática) at Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, from 2006 through 2011. We hereby propose to present an outline of the course and the rationale behind the syllabus that we developed for these students. An overview of the first instalment of this course was previously published in [Pereira 2007], but this communication will provide an updated look on the final result of this six year experience.

The first part of the CT course covered the basics of argumentation and informal logic, as is common in critical thinking courses. The first lecture presented critical thinking as the conscious appropriation of the thinking process and introduced the argument as an expression of reasoning, stressing that a fundamental function of an argument is to make thinking explicit and shareable. Thus, the argument can serve not only to present a line of reasoning to others but also to make it explicit to oneself and facilitate the conscious introspective evaluation that is crucial to critical thinking. The two following lectures focused on the logical structure of arguments, their evaluation and dialectical argumentation. The fourth lecture concluded the argumentation part of the course by covering different argumentation schemes and fallacies.

The second part of the course focused on the credibility of sources and claims. This was presented in a single lecture, plus the corresponding tutorial session, and served as a bridge between argumentation and scientific reasoning. A basic notion of knowledge as justified true belief was presented as a first approach to assessing credibility by considering if the claims presented are known to be true by the source, aside from estimating the reliability of the source itself.

The second half of the course differed significantly from the typical critical thinking courses. In the third part, we covered scientific reasoning, starting with one lecture on the problem of inferring explanations (abduction) and the principles of parsimony and Occam's razor. The following lecture covered the generic structure of scientific reasoning, distinguishing between the model, the aspect of reality being modelled, the data and the predictions. Then, two lectures covered in more detail the problems of evaluating statistical and causal models, as well as experiment design. The rationale for focusing on scientific reasoning is that computer science students have a good foundation

in logic, thus requiring less time to cover argumentation, but have little contact with experimental work. This focus on scientific reasoning helped hone some critical thinking skills while making up for this shortcoming.

Finally, the last part of the course covered decision theory, from descriptive, normative and prescriptive perspectives. This seemed important to us because decision is fundamentally different from argumentation. Whereas an argument arises after one has a clear line of reasoning all the way to the conclusion, a decision must start by considering a range of possibilities and avoid any form of one track thinking. To this end, the first lecture on this part presented the differences between descriptive, normative and prescriptive models and some aspects of the psychology of decision making. The following lectures covered expected utility theories and, finally, a brief introduction to morality and ethics, with emphasis on ethics in decision making.

All course material is available online (http://ssdi.di.fct.unl.pt/pc), including exercises, slides and audiovisual recordings of lectures. This material is in the public domain and can be copied, used or adapted with no restrictions.

References

[Pereira 2007] Luís Moniz Pereira, Ludwig Krippahl (2007). On Teaching Critical Thinking to Engineering Students, The 13th International Conference on Thinking Norrköping, Sweden June 17-21, 2007

Short biographic note:

Ludwig Krippahl is Assistant Professor at the Computer Science department of FCT/UNL. Luís Moniz Pereira is Full Professor (emeritus) at the Computer Science department of FCT/UNL. Both authors are members of the Center for Artificial Intelligence of UNL and both worked in the conception and teaching of this Critical Thinking course.