GGasCT: Bringing Formal Methods to the Computational Thinking*

Braz Araujo da Silva Junior[1], **Simone André da Costa Cavalheiro**[1], **Luciana Foss**[1]

[1]Programa de Pós-Graduação em Computação - Universidade Federal de Pelotas
CEP 96.010-610 - Pelotas - RS - Brazil

{badsjunior,simone.costa,lfoss}@inf.ufpel.edu.br

Abstract. *This work presents an alternative approach for developing computational thinking: the graph grammars. As the first step, the idea of computational thinking is systematically reviewed, discussed and has an interdisciplinary concept of three overlapping perspectives proposed: the use of the products, methods and/or impacts of computer science. Many related terms are individually explored in order to clarify what is in the range of computational thinking. The selection of the terms draws on a systematic literature review that sheds a light on the most commonly addressed terms in the literature. Based on that, a model of six major computational thinking lines is proposed, exploring the following abilities and their related skills: abstraction, decomposition, algorithmic thinking, data management, automation and evaluation. A formal and visual language, the graph grammar, is introduced, formally defined and explored, discussing its relations with computational thinking skills. It is highlighted the central use of abstraction and pattern recognition, as well as the different paradigm of algorithms in graph grammars, given that they are naturally parallel. An educational game and a game engine are developed and presented as examples of graph grammars to promote computational thinking. The educational game is a digital version of a turn-based strategy board game based on graph grammars. It is highlighted that the digital version turned explicit and reinforced the learning of a key process of graph grammars: the match, a mapping between graphs that enables the application of a graph transformation rule. A player experience and usability questionnaire answered by the participants shows they do not perceived learning, despite fully managing graph grammars for the first time, through playing the game. A game engine to create, edit and run graph grammar based games is developed to power this approach beyond merely running pre-made educational tools, allowing students to build their own graph grammars. As final products, a comprehensive framework to develop and assess computational thinking through graph grammars is theoretically grounded and made available by the developed educational tools. [Silva Junior et al. 2020]*

References

Silva Junior, B. A., Cavalheiro, S. A. d. C., and Foss, L. (2020). GGasCT: Bringing formal methods to the computational thinking. ExpPC, Pelotas, 2020. Available at: https://bit.ly/335Gf1X. Acessed: 25-09-2020.

*This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.