

Sprego Is Unplugged: Functional Programming for Young Children

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Theoretical background

Sprego – Spreadsheet Lego – is a programming tool in spreadsheet environment. Similar to Logo, it utilizes a limited set of instructions for real world problem solving, but in a functional language. As such, it is a concept based approach to programming in a widely used and accepted environment. Sprego would serve both as an introductory programming tool and a programming approach to spreadsheet management. The concepts and tools which Sprego applies are the following:

- functional modeling,
- schema construction, association, and accommodation.
- concept of function
- n-ary and composite functions,
- concept of n-dimensional vector,
- the set of Sprego functions: a dozen general purpose functions,
- authentic contents, matching the students' interest, making them motivated by the content, connection to other subjects,
- limited spreadsheet tools, switching the focus from the interface to the programming aspect.

The concept of function plays a crucial role in Sprego programming. We claim that with this novel approach we can help building and/or strengthening the students' concept of function and introducing n-ary and composite functions, providing practicing opportunities for building concepts which at present are considered higher mathematics. On the other hand, we can provide a simple tool for other sciences and subjects for data and information dissemination, retrieval, analysis, evaluation, and discussion in spreadsheet environment.

Description of the workshop material

In the workshop, authentic tables of various contents and data types will be provided to show what types of programming tasks can be carried out in Sprego environment and how these tasks can be related to introductory programming and data management. The selected data sources are also planned to demonstrate that text-based problems suit young children, since their knowledge in mathematics at this age is limited, and their lack of concepts, usually relied on in programming, will not be an

obstacle in building the models. Furthermore, one selected table is planned to be analyzed thoroughly, and based on this table real world problems to be solved.

In the workshop we present tools – printed materials, toys, stickers, scissors, 3D printed objects, colors, black board/interactive board (if it is available), etc. – which allow us to introduce functional modeling and programming for young children. With these tools we can demonstrate how a simplified functional programming environment would help building the concept of function, how we can utilize composite and n-ary functions, and n-dimensional vectors. The tools of unplugged Sprego allow us documenting the model and the coding process with minimalized writing duties, which plays a crucial role considering young children.

With reducing the number of handy tools, we can demonstrate how the approach would work with older and more advanced students in secondary and tertiary education who are new to programming and open to algorithmic based end-user computing.

Tentative agenda

- The prepared tables for the workshop can be downloaded from a reserved website. These tables of various contents have been tried out with our students and they seemed highly interested in the selected contents. With experienced teachers of the workshop, analyzing the tables and call attention to the opportunities which lie within them takes about a couple of minutes.
- The main section of the workshop is solving tasks, based on one selected table, mainly focusing on handling strings, conditions, and counting.
 - To each task, we build the functional model then the algorithms, in both phases using the tools which would help the understanding of the problems. These two phases go on unplugged, where the software is only used to present the table and the problem.
 - Based on the algorithm, still unplugged, we build the composite function starting from the innermost function and show how it can be expanded.
 - Depending on the age of the students we have the option to choose (1) staying completely unplugged or (2) using the unplugged tool parallel with coding, or (3) completing the unplugged phase and then do the coding.
- In the final phase of the workshop, we plan the discussion of the expansion of the composite functions, depending on the students' age and their level of computational thinking and on the discussion of the problem and the output.

Biography of the workshop leader

Maria Csernoch, associate professor at the Faculty of Informatics, University of Debrecen, Hungary (2009-). Teacher of Mathematics and Supervisor and Leading

Teacher of Informatics at the Teacher Training Secondary School of the University of Debrecen (1986–2009).

Degrees in Teacher of Mathematics, Descriptive Geometry, Informatics, and English, BSc in Software Engineering, PhD in Mathematics and Computer Sciences and Habilitation in Applied Linguistics.