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Modeling computational algorithms using nonlinear storytelling methods of computer game design

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Abstract

Computational algorithms can be described in many methods and implemented in many languages. Here we present an approach using storytelling methods of computer game design in modeling some finite-state machine algorithms and applications requiring user interaction. An open source software Twine is used for the task. Interactive nonlinear stories created with Twine are applications that can be executed in a web browser. Storytelling approach provides an easy-to-understand view on computational algorithms allowing communication with people with no computer science education. It also allows rapid prototyping and testing in mixed background work teams.

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1. Introduction

Computer algorithms can be described in many methods such as flowcharts, pseudocode listings, state diagrams, illustrations, and universal modeling language (UML) models. While these models are understandable for those who have education in computer science, they can be too technical and unattractive for laymen.

Here we present an alternative way of presenting computational algorithms and computer programs using storytelling methods of computer game design. The method can also be used as a rapid prototyping tool as the model is an executable program.

Computer programs are sometimes depicted as stories in basic computer science education, especially for children and novices. The reason for this is twofold. Firstly humans are very good in understanding stories. Verbal stories

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were the way to store and communicate information before the written language. This is made possible by the highly developed episodic memory of human brain.

Secondly, simple programming tasks implemented using procedural programming languages have a sequential structure that resembles much of natural language stories.

The relation of human language and computer programming is also evident from the viewpoint that computer programs are realizations of models in our minds. Alan J. Perlis writes in the forewords of the classic computer science textbook *Structure and Interpretation of Computer Programs* [1]:

Every computer program is a model, hatched in the mind, of a real or mental process. These processes, arising from human experience and thought, are huge in number, intricate in detail, and at any time only partially understood. They are modeled to our permanent satisfaction rarely by our computer programs.

And even though computer languages are very formal and their logic is strict in the mathematical sense, there is evidence that human brain understands programming tasks more like a linguistic task than a mathematical reasoning [2].

This close relationship of human language and programming can also be seen from how we speak about programming. For example we casually say that programs are written using language, not coded or created using formal syntax and logical rules of a certain system.

But there are also differences between computer programs and human storytelling. The main difference is that a story tells just a single linear chain of events. Contrary to that, computer algorithms are often characterized by conditional branching of the program execution flow. Traditional story can describe for example a sorting algorithm execution when a single predetermined list is given as an input. Or it can describe a single game of chess.

Whereas a computer program implementing a sorting algorithm can sort any list given to it. And it can use the input values given by players to realize any legal game of chess.

In this paper we will examine the use of storytelling as a method of describing computational algorithm and computer programs to provide an alternative approach to understanding computations.

2. Methods

In this article we study the relationship of computer game design principles and computational algorithms and computer programs. For this work we use an open source license software Twine originally developed by Chris Klimas [3]. Twine has a modern codebase and is developed in Node.js. It can be used in a web browser or as a standalone software.

Interactive nonlinear stories created with Twine are text based games playable in an internet browser. It provides a low learning curve approach into digital storytelling and simple application development. Twine has been used as a storytelling tool with children as young as ten years old [4].

Here we will describe how it compares to some of the relevant programming languages and describe its task domains. We will also describe the tasks used for evaluating the method including the reasoning for the selection requirements.

2.1. Programming language

There is no one correct solution for choosing a modeling language or a programming language. The choice depends on many things such as task domain, performance requirements, library compatibilities, language portability, and developers experience. In this research we aim to present an easy to understand method for understanding computer programs and computational algorithms.

The approach compares closely to many visual languages used in education, such as Scratch and Lego Mindstorms NXT-G, and in engineering and simulation, such as LabView and Simulink.

It is also related to hypertext based programming such as using hypertext markup language HTML with client side Javascript or server side programming such as PHP, Perl, Python or other common web programming languages and frameworks.

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