Using and Creating Automatically Generated PowerPoint Slides to Facilitate Teaching of Data Structures and Algorithms

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Abstract

The project is about prototyping a web-based system to automatically generate and supply slides for teaching of the data structures and algorithms (DSAs) that are most frequently taught in undergraduate computer science curricula, in the Microsoft PowerPoint (MSPPT) format.

The auto-generated MSPPT slides promote preparedness, standardization, consistency, centralization and reusing teaching materials and experiences.

The project aims to increase the accessibility of practical, lightweight, standardized, customizable, easy-to-edit, and teaching-oriented presentation materials for DSAs, and facilitate, enhance and modernize the current practice of algorithm teaching.

Challenges

- Time consuming
  - Each algorithm needs to be separately implemented and debugged
  - Programmers labor-intensive and expensive
  - Student programmers have to be great at algorithmic thinking
  - Novel
  - Qualified student programmers need to be trained

- Design issues
  - Need to figure out how to dynamically manifest the process using visual objects in limited space
  - Different algorithms may present different challenges

Benefits of the Project

- The approach promotes preparedness, standardization, consistency, centralization and reusing teaching materials and experiences.
- The slides are machine-made, so clean, clear, consistent, and accurate. They will reduce unnecessary frustrations caused by inaccurate hard drawings and enhance teaching by eliminating time-consuming constant drawing and redrawing.
- Classroom time is very limited and valuable. Pre-generated slides can make teaching more efficient, effective, and organized, and students can still use other approaches such as Java applets to explore at their own pace outside the classroom.
- The generators are reusable. The slides are also reusable.

About the Project (What?)

- The project is about prototyping a web-based system to automatically generate and supply slides for teaching of the data structures and algorithms (DSAs) that are most frequently taught in undergraduate computer science curricula, in the Microsoft PowerPoint (MSPPT) format.
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Significance and Motivation (Why?)

- DSAs are core content of any computer science curriculum.
- Despite that DSAs are easy for instructors to summarize or recite at the classroom level, they can be difficult for the first time students to fully understand especially when some effective visualization aids have been used.
- Many students often have trouble understanding algorithms and it is not a straightforward process of thinking but unfortunately they have no access to effective MSPPT-based teaching aids for DSAs, mainly due to the following major challenges:
  - Illustration of any non-trivial algorithm involves step-by-step demonstration, which is extremely time-consuming and space-consuming.
  - Teaching assistants, students, and instructors are not consistent in the presentation of algorithms.
  - Sometimes, different datasets or wrong intermediate steps may cause the algorithms not to be properly demonstrated.
  - Our auto-generation approach has potential to overcome these obstacles.

Two Levels of Automation (How?)

- Level one:
  - We make algorithms produce slides for themselves by injecting slide generation code snippets into the plain implementation of the algorithms at proper places. So, the generators can generate different slides for different input for the algorithms.
  - Level two:
  - In order to automatically run the generators themselves, we prototyped a web-based platform coupled with a background dispatcher service that transparently represents, manages and runs all generators.

System Components and Typical Information Flow of Using the Approach

1. Prepare data
2. Submit data
3. Dispatcher auto calls the generator
4. The generator auto produces the slides
5. Dispatch to other frames
6. Present

Acknowledgements

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  - Their students Christopher Fremgen, Sean Long, Thomas Rish and Erik Williams, etc. who have volunteered on this long-term project, contributed several algorithm generators and assisted in piloting the client-server based platform.
  - Their Grant Office, TUC Department of Mathematics, Computer Science and Statistics, and other relevant college offices for their support and assistance.

The First Level of Automation: Slides Generation

A Sample XML Schema and A Sample XML Input Data

Each algorithm has a dedicated generator which takes simple input data (described in straightforward XML format), runs the algorithm against the input, and generates a set of slides. These slides can subsequently be used in the classroom viewer offline or further edited (described in straightforward XML format), runs the algorithm against the input, and generates a set of slides. These slides can subsequently be further revised independent from the generator and manually by users.

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A Growing List of Pilot Generators

- 4. The generator auto produces the slides
- 5. Dispatch to other frames
- 6. Present

Sample Slides Produced by Piloted Generators

Sample Slides Produced by Piloted Generators

A Web-based Platform

Web Hits Distribution of the Project

A screenshot of the Ever-Running Backend Dispatcher

A screenshot of the Ever-Running Backend Dispatcher

Navigation Yes, built in support Usually no
Customizable/Editable Yes, once generated, existing Industry Level Support Yes Usually no Standardized Yes Usually no

Industry Level Support Yes Usually no

Some students are supported by two small college-level seed grants – Equal opportunity volunteers have contributed several algorithm generators and assisted in piloting the client-server based platform.

PPT vs. Other Approaches

Cycle of Preparing AV Slides

Screeshot of the Ever-Running Backend Dispatcher

A diagram showing the process of preparing AV slides.

Preliminary Work and Current Status

- About a dozen of generators have been piloted by the SUNY Oneonta Data Structures and Algorithms Visualization Group
- Some students are supported by two small college-level seed grants – Contributed by (faculty and student volunteers)
- The second level automation web-based platform has been fast prototyped
- All the above work can be further refined and gain adequate resources.
- The project has generated several presentations in major computer science education forums.
- It is a long-term, ongoing and accumulative computer science education project.

Web Hits Distribution of the Project

A screenshot of the project’s web hits distribution.

Sample Slides have been generated and made freely available on the Internet. Since then, the project library has steadily grown and we will advertise it more seriously, it is expected that the project will attract much more attention from the computer science education community.

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