

## Conveying Algorithm Analysis Concepts through Visualization

### Problem:

1. Data structures and Algorithms (DSA) courses emphasize abstract concepts related to algorithm dynamics and algorithm analysis. These are hard for students to grasp when conveyed using text and static images.
2. Current algorithm visualizations (AVs) focus mainly on conveying algorithm dynamics. The AV community has a lot of successful experience with this. Our OpenDSA eTextbooks have many AVs that do a good job of presenting algorithm mechanics.
3. The AV community has produced little in the way of visualizations to present analysis concepts. These are conveyed almost always using text and static images. A "small number of "visual proofs" exist in the education literature.

### Solution:

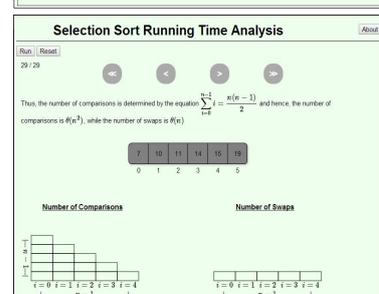
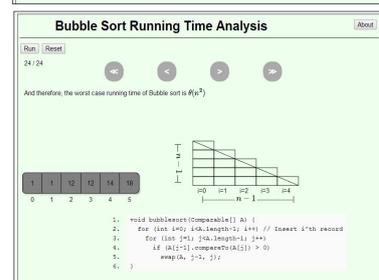
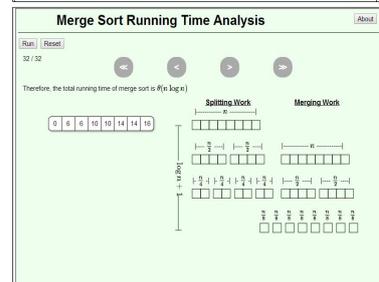
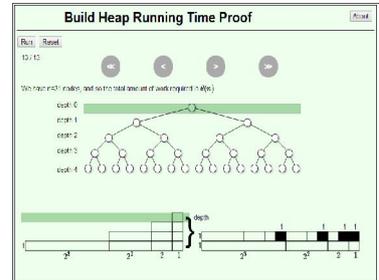
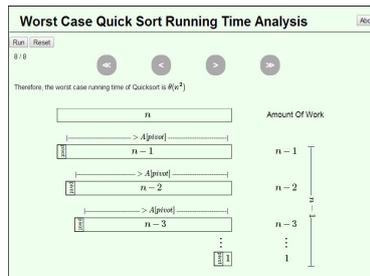
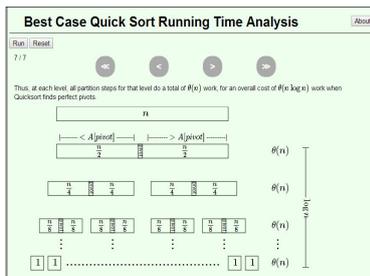
- We seek to systematically develop visualization techniques that are applicable in this domain
- Algorithm analysis concepts are conveyed visually to give intuition about the running time analysis of an algorithm.
- Most analysis explanations are presented as a series of slides, where each statement of the explanation is connected to a visual showing the data structure or algorithm.
- Many summations and recurrence relations can be conveyed with geometric diagrams relating area to cost

### Inspiration

- Our ideas are inspired by a concept called visual proofs.
- Graphical primitives are leveraged to represent the amount of work required for each algorithm step.
- The total running time can be viewed as the total surface area of the resulting shape.

### Implementation

- OpenDSA Sorting modules were enhanced by adding interactive algorithm analysis visualizations.
- The JSAV framework was leveraged to ensure consistency among all types of visualizations.
- The MathJAX library displays equations and asymptotic notation.



Students taking a DSA course need a better understanding of algorithm analysis concepts. While the algorithm visualization community has a long history of effectively conveying the dynamics of an algorithm, there is little understanding of how best to convey analytical material.

Students gain better understanding of DSA analytical concepts. Students can therefore better judge the relative costs of various solutions when doing algorithm design.

**NABC**

- We convey algorithm analysis concepts visually to provide better intuition for students.
- We use geometric visualizations to convert costs.

There are effectively no competitors in this field. DSA textbooks convey analytical information using non-visual prose. A few ad hoc "visual proofs" exist, but no organized body of knowledge is available on this subject.