



# DATA SPEAKS OUT FOR EQUAL OPPORTUNITY



By: Jalen McKinnie, Chase Petti,  
Alexa Roberts, Alex Thornton

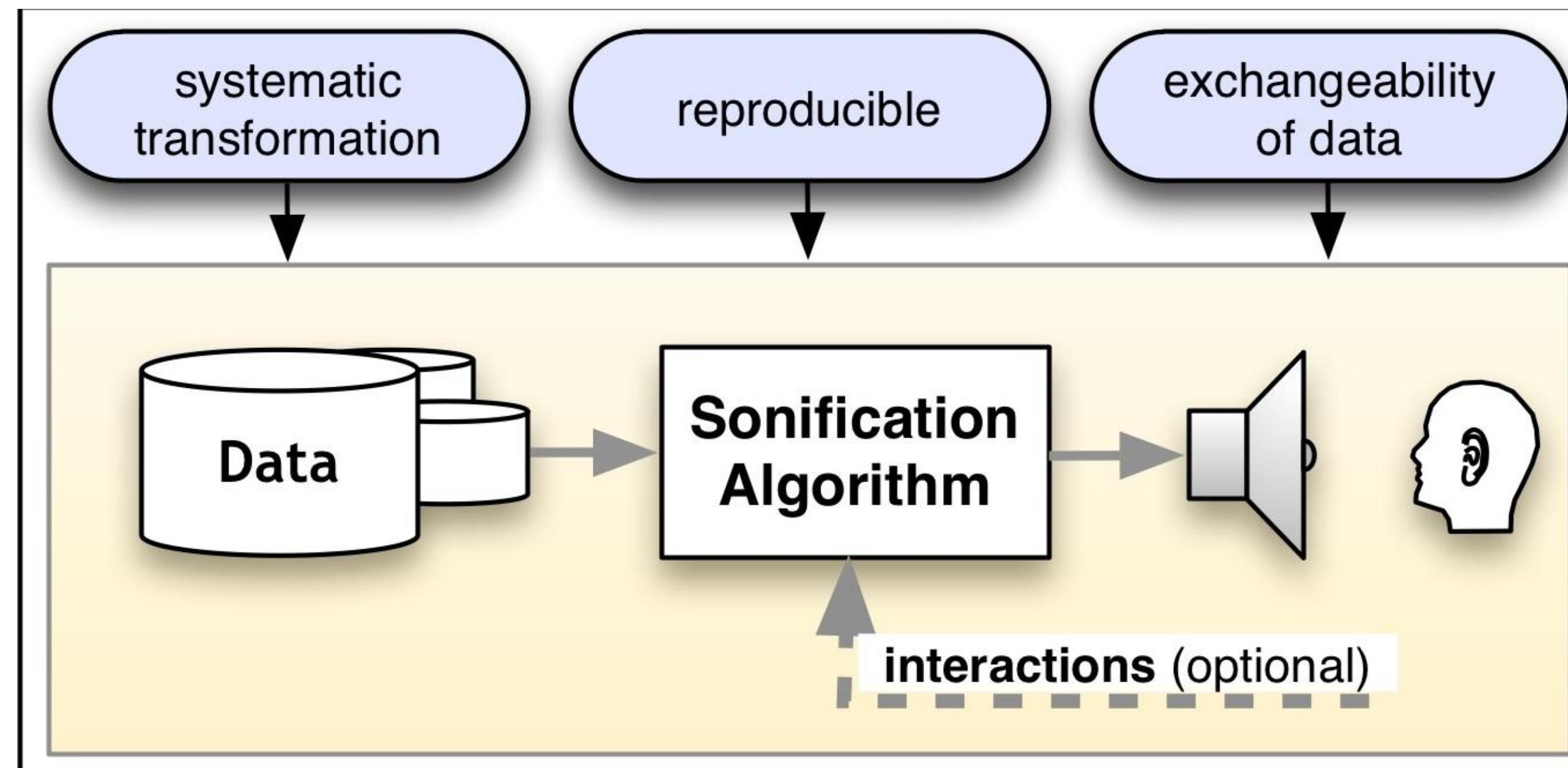
Advisor: Nigamanth Sridhar, PhD

## Introduction

Have you ever thought of what it would be like not being able to see data, but only hear it? It's a very obscure question, and many would not know how to answer it. We are here to emphasize the technology of sonification, which will bring more accessibility to the classroom. In short, sonification uses sound to help students visualize data, algorithms, graphs, and much more.

As a team, we explored sonification in the classroom, and found that it is not a prevalent idea. We researched and thought of ways on how sonification can complete the Big Ideas that are required in the AP Computer Science Principles curriculum.

### Sonification Schematic:



## Big Idea 3: Data-Info

- Provides new medium for visually disabled
- Software programs can enable a chemist to examine infrared spectrographic data via auditory presentation
- Auditory presentation likely useful for comprehending/monitoring complex temporal data or data embedded into other static signals
- Parallel listening (ability to monitor and process multiple auditory data sets); affective response (ease of learning and high engagement qualities); auditory gestalt formation (discerning relationships or trends in data streams)
- Geiger-counter: clicks in response to invisible radiation levels, altering one to danger that may go unnoticed with a visual display

### To enable these ideas into a classroom:

- Human-technology interactions for each student
- Classroom setting - rectangular room with good special distribution allows the acoustics to be tested easier
- A listener could be taken on random walk from generation

### Lesson Plan Idea:

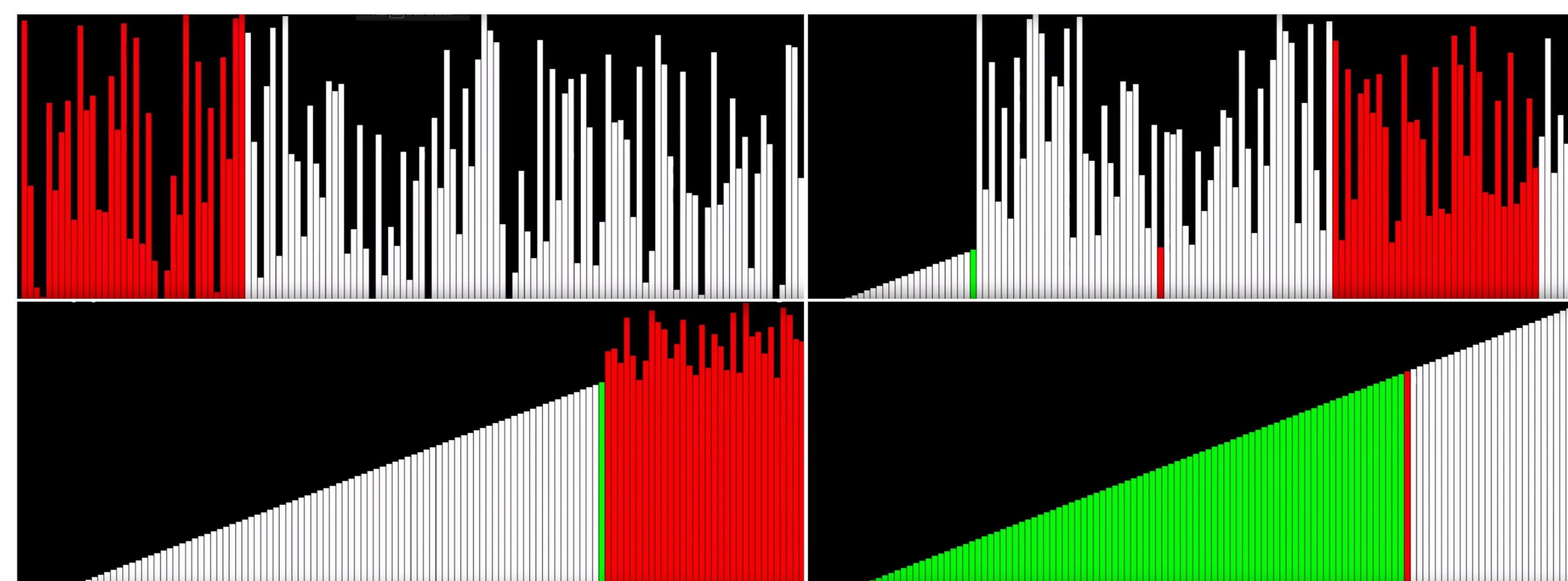
Have instructor demonstrate the method, have students practice with some exercises, and then try and analyze how it works. This would increase accessibility for visually impaired students, and allow nondisabled students to figure out and look at problems from a new perspective.

## Big Idea 4: Algorithms

- Necessary for the development of sonification software.
- Languages like Quorum lack a lesson on algorithms making this topic inaccessible to students with disabilities
- Sonification can be used to further explain what is happening during a sorting algorithm (pictured below - insertion sort)
- This method is especially useful when working with students who are visually impaired
- Visualize the concept when pictures wont work
- Useful even for non-impaired students

### Lesson Plan Idea:

Use sonification to help students visualize what is happening during a sorting algorithm. Then once the concept of an algorithm is understood talk about the applications ie sonification.



## Big Idea 5: Programming

There are a few available programs for sonification, including

- **Sonification Sandbox**
  - An open source Java program designed to convert data sets into sound
  - Intended to provide a simple, user friendly, moldable, and responsive environment for creating sonifications
  - Limited in terms of complexity since it's meant for varying skill levels
- **SoniPy**
  - An open source framework in Python
  - Integrates existing components and encapsulate them as Python modules
  - Can integrate libraries of different languages

A particularly promising tool for accessibility in programming for the visually impaired is Quorum, an evidence oriented programming language developed with simple, English like syntax. Quorum allows programmers to do a variety of tasks, ranging from playing music, designing auditory games, and programming Lego robots.

### Lesson Plan Idea:

Have the kids program a lego robot to sound a siren. This can be done in Quorum since it allows users to write for lego applications. This lesson allows kids to see the practical side to both programming and sonification.

## Big Idea 7: Global Impact

- Students that are visually impaired are at a disadvantage when it comes to being able to understand data and the way it is presented
- Implementation of sonification will impact the visually impaired in a positive way, giving them more access and understanding of algorithms and data analyses
- The technology of sonification gives the blind students an opportunity to explore the computer science world
- Sonification will allow these students to be more successful in this field, giving them the chance to further understand complex algorithms and different sets of data

### Lesson Plan Idea:

In the AP curriculum for the Computer Science Principles class, the requirement to teach the "Global Impact" section is extremely important. Incorporating sonification and its origins into this can expand the knowledge and awareness of this technology to give the visually impaired a better representation of what data is. Having class discussions and/or writing a short research paper on sonification and its many impacts.



## Conclusion

Sonification will not just benefit students in the United States, but optimistically can grow to other countries across the globe making classes more accessible to the entire world. This can allow more countries to produce more educated people in the computer science field, no matter if they have the misfortune of visual imparity. It will expand the computer science field, bringing in more vibrant minds and more creative views. The overwhelming impact is, undoubtedly, that it gives everyone an equal chance of being successful in this field, allowing them to analyze big data without needing to see it, but being able to mentally visualize it by using sound. Confidently in the near future, these methods can be implemented.

### References

- McKinsey, B. & Thornton, A. (July 2016). A New Listen at Information and Data.  
Walker, B. & Cothran, J. Sonification Sandbox: A Graphical Toolkit for Auditory Graphs  
Cabrera, D. & Ferguson, S. (June 26-29, 2007). Sonification of Sound: Tools for Teaching Acoustics and Audio.  
Worrall, D. Bylstra, M, Barrass, S. & Dean, R. (June 26-29, 2007). SoniPy: The Design of an Extendable Software Framework for Sonification Research and Auditory Display