Brad McCoy Gage O'Neill CSCI 460 Project Proposal

For our project we plan on demonstrating that tools from algebraic topology can be applied on problems in concurrency.

The members of our group are Brad McCoy and Gage O'Neill

The goal of the project is to understand how directed topology and homotopy theory are being applied to problems in concurrency. The primary deliverable is a document that states a problem in concurrency and details how topological tools are used to solve it. A second deliverable is a 10 to 20 minute talk that communicates to someone without any exposure to homotopy theory that directed spaces are useful to problems in concurrency. Both the written document and the talk will include images that are generated to help visualize the geometric information involved in the problem.

The plan for completing the deliverables over the next 3-4 weeks:

1. Read [1].
2. Understand the problem that is being solved. In [1], the authors state "verification of concurrent programs is simplified by verifying one execution from each connected component of the space of directed paths". What does it mean for a concurrent program to be verified?
3. Type a document with clear definitions of the topological tools being used. So far I need, homotopy (and why it is not sufficient here), directed homotopy, cubical complex and directed collapse of a Euclidean cubical complex.
4. Make three dimensional image as in figure 7 of [2], only better looking.
5. Prepare the talk and give it to a non topologist to gauge understanding.

We will both read [1]. Brad will type a document with all definitions and stating the problem being solved. Gage will generate images as in figure 7 of [2]. We will then practice giving our talk.

References

[1] Eric Goubault Lisbeth Fajstrup, Martin Rauben. Algebraic topology and concurrency, 2006. Theoretical Computer Science, pages 241-271.

[2] Stefania Ebli Lisbeth Fajstrup Brittany Fasy Catherine Ray Nicole Sanderson Elizabeth Vidaurre Robin Belton, Robyn Brooks. Towards directed collapsibility, 2019. https://arxiv.org/pdf/1902.01039.pdf.