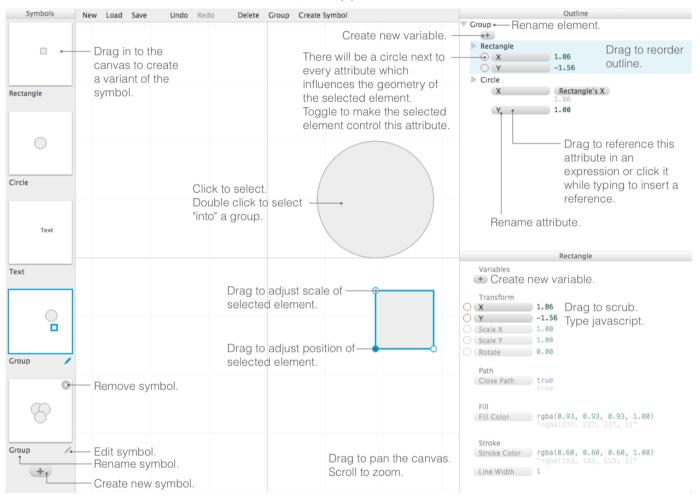
## **Apparatus**

Toby Schachman (2015), and Joshua Horowitz

"Apparatus is a hybrid graphics editor and programming environment for creating interactive diagrams" (http://aprt.us). It's central fantastic trick is that the diagram elements can be directly manipulated, allowing the diagram and code to be played backwards and forwards. A numerical solver is used to make the magic happen.



## What works:

- Powerful causal linkages between visual and parametric elements.
- Solver magically brings these bidirectional linkages to life.
- System has a lot of expressive power.
- Clear linkage between visual and inspector relationships.
- Combination of direct manipulation and coding.

## I wish:

- Multiple representations—outline, inspector view, constraints—were more consolidated, ideally as manipulables in the main canvas.
- More responsive performance.
- An ecology of reading and writing:
- Easy to embed diagrams and make content for them to live in.
  - Easy to share components.
- Complex network of causal and hierarchical relationships was somehow less dizzying.
- Improved graphics tools, e.g. color picker.
- Simulations: feedback loops and time.