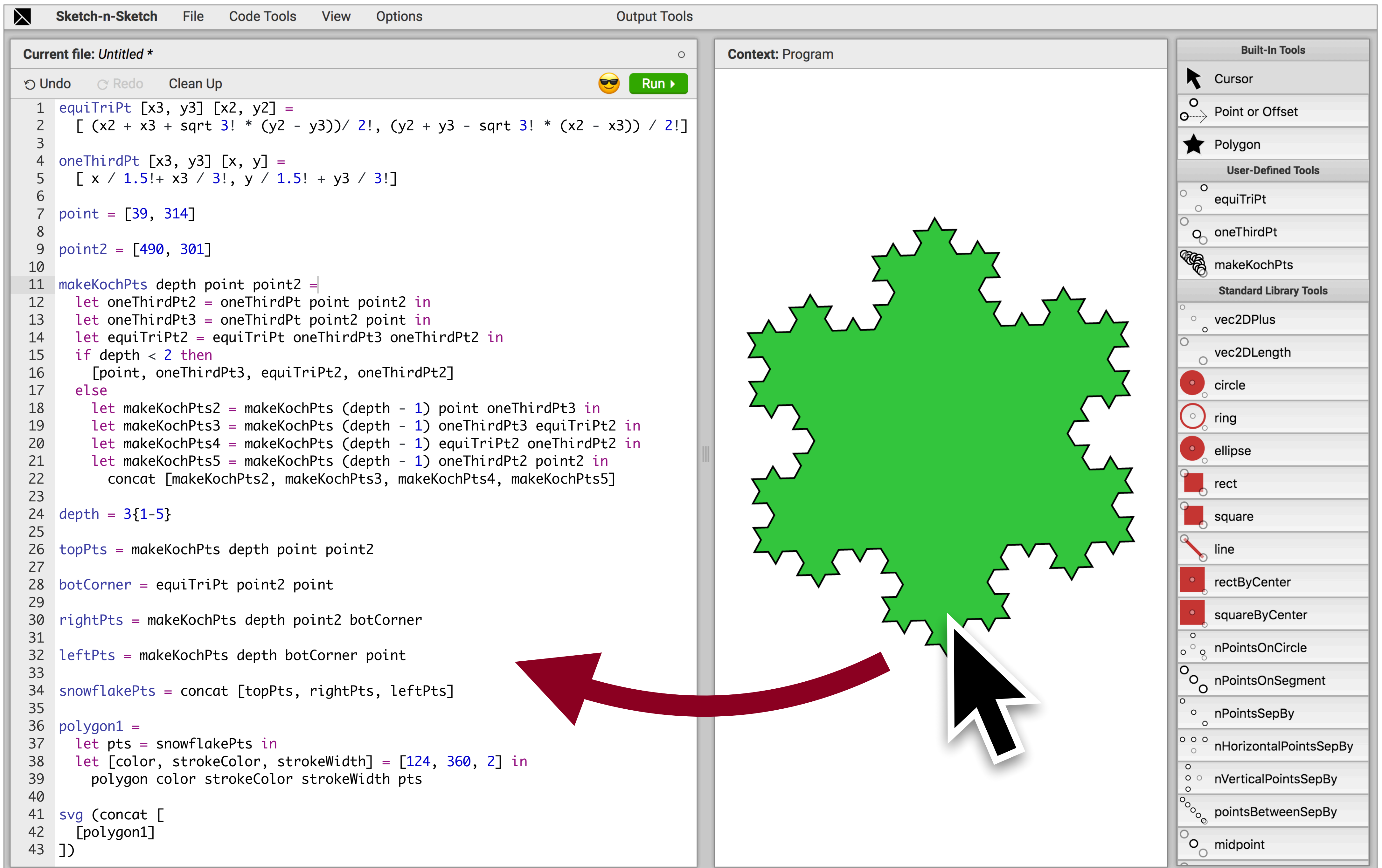


Sketch-n-Sketch: Output-Directed Programming for SVG

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Can we create programs just by directly manipulating their output?

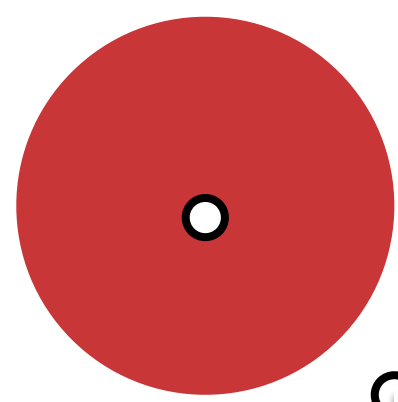


Yes! Sketch-n-Sketch is an IDE where manipulating graphical output with the mouse transforms the code to match. The programmer can **draw**, **move**, and **resize** shapes, as well as automatically **refactor** their code. Text editing is also always available, but the recursive program above was created *entirely* by output-directed interactions.

Drawing Shapes

Drawing a shape inserts a new definition into the program.

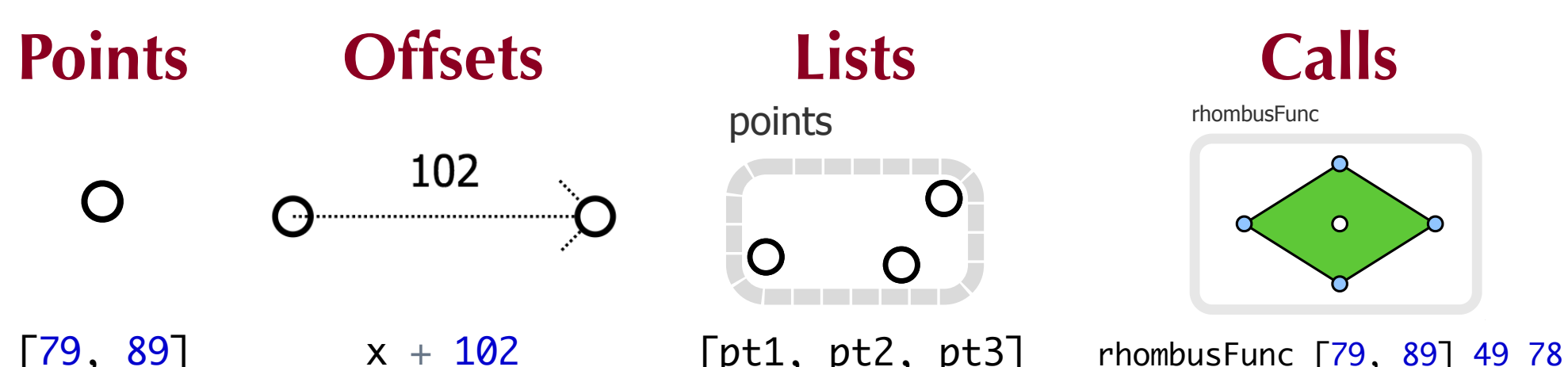
Existing shapes can be moved or resized to change corresponding numbers in the program. To map output values to code locations, Sketch-n-Sketch relies on a custom tracing evaluator.



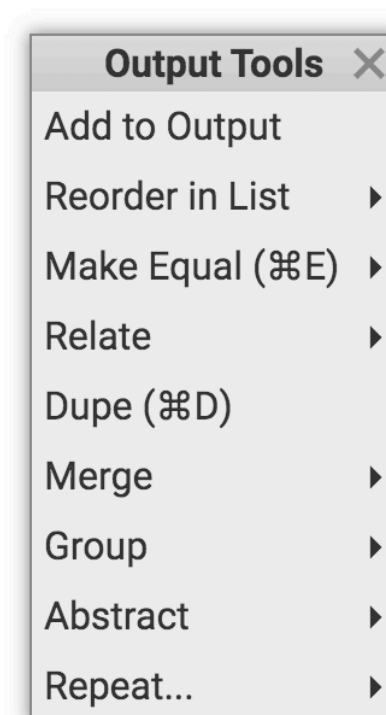
```
circle1 = circle 0 [122, 132] 63
svg (concat [
  [circle1]
])
```

Manipulating Intermediates

Besides shapes, certain **intermediate values** from execution are rendered and can be selected or manipulated.

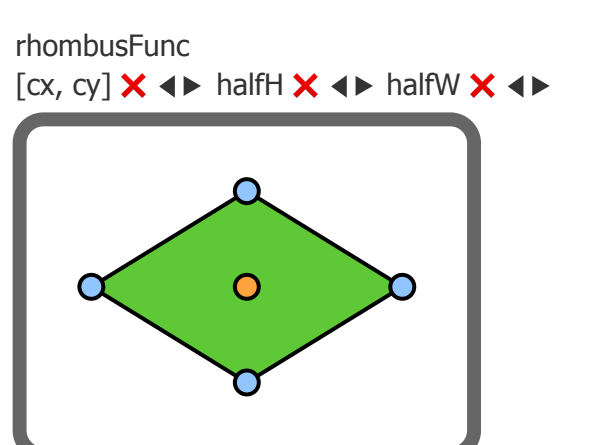


Refactoring



Program transformations operate on selected **items**. Shapes may be aligned by variable sharing (Make Equal), gathered into a list (Group), turned into a function (Abstract), or repeated (Repeat). Functions with an appropriate inferred type become drawing tools ("User-Defined Tools" above).

A call or a list may also be **focused**, so that drawing new shapes adds to the function or list instead of to the top level. Drawing a function inside itself induces recursion.



Future Work

Sketch-n-Sketch targets programs that output SVG. Concurrent work is exploring targeting HTML. In the future, output-directed interactions might specify program synthesis constraints on *non-visual, general-purpose* code.