Sketch input and grading in MOOCs

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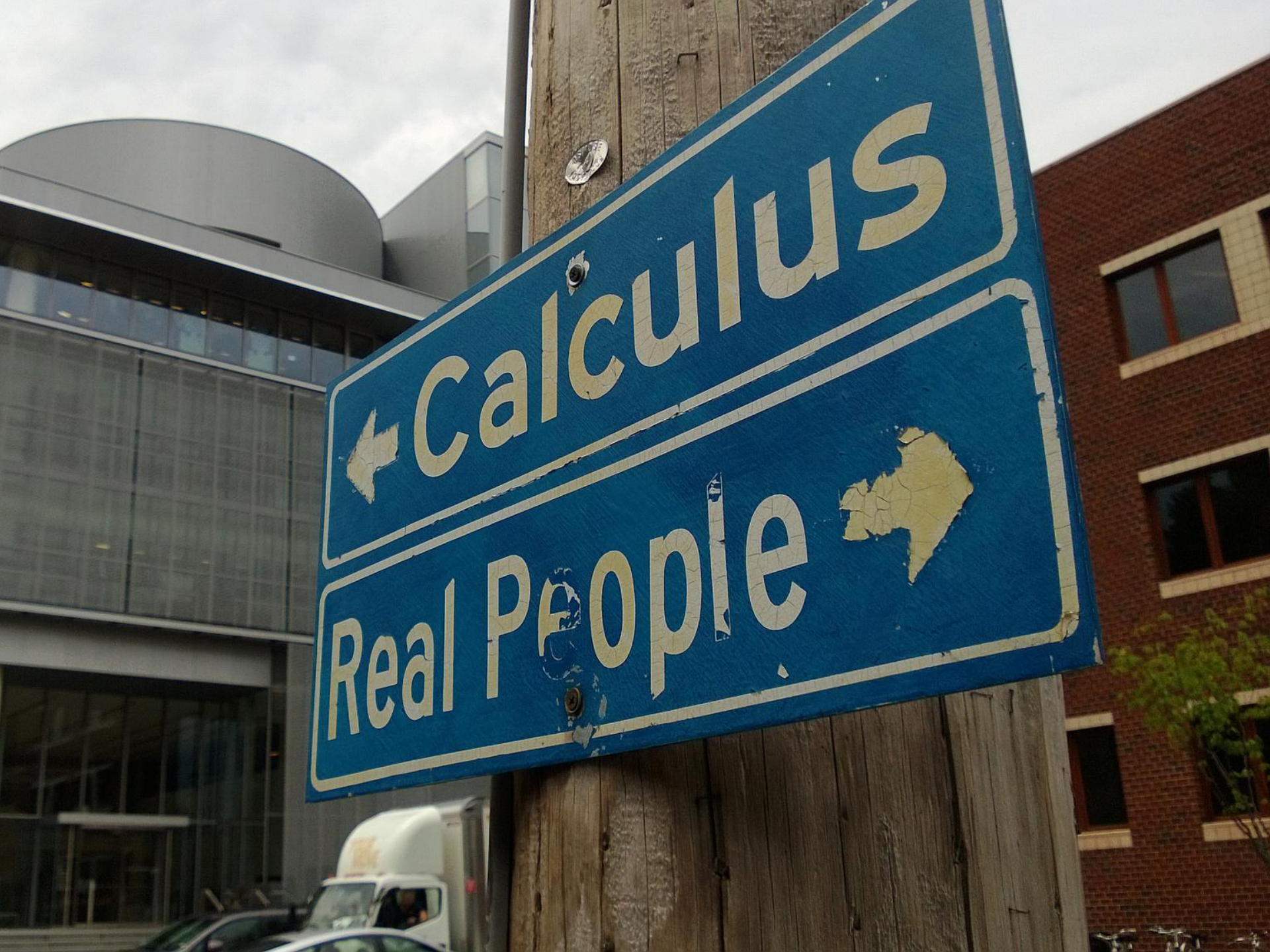
OFFICE OF DIGITAL LEARNING


Calculus
Real People

Why Sketching?

Fundamental objective in calculus

Expert problem solvers use qualitative sketches

Higher cognitive engagement than passive recognition tasks (Chi, 2014)

Not adequately measured using multiple choice (Livingston, 2009)

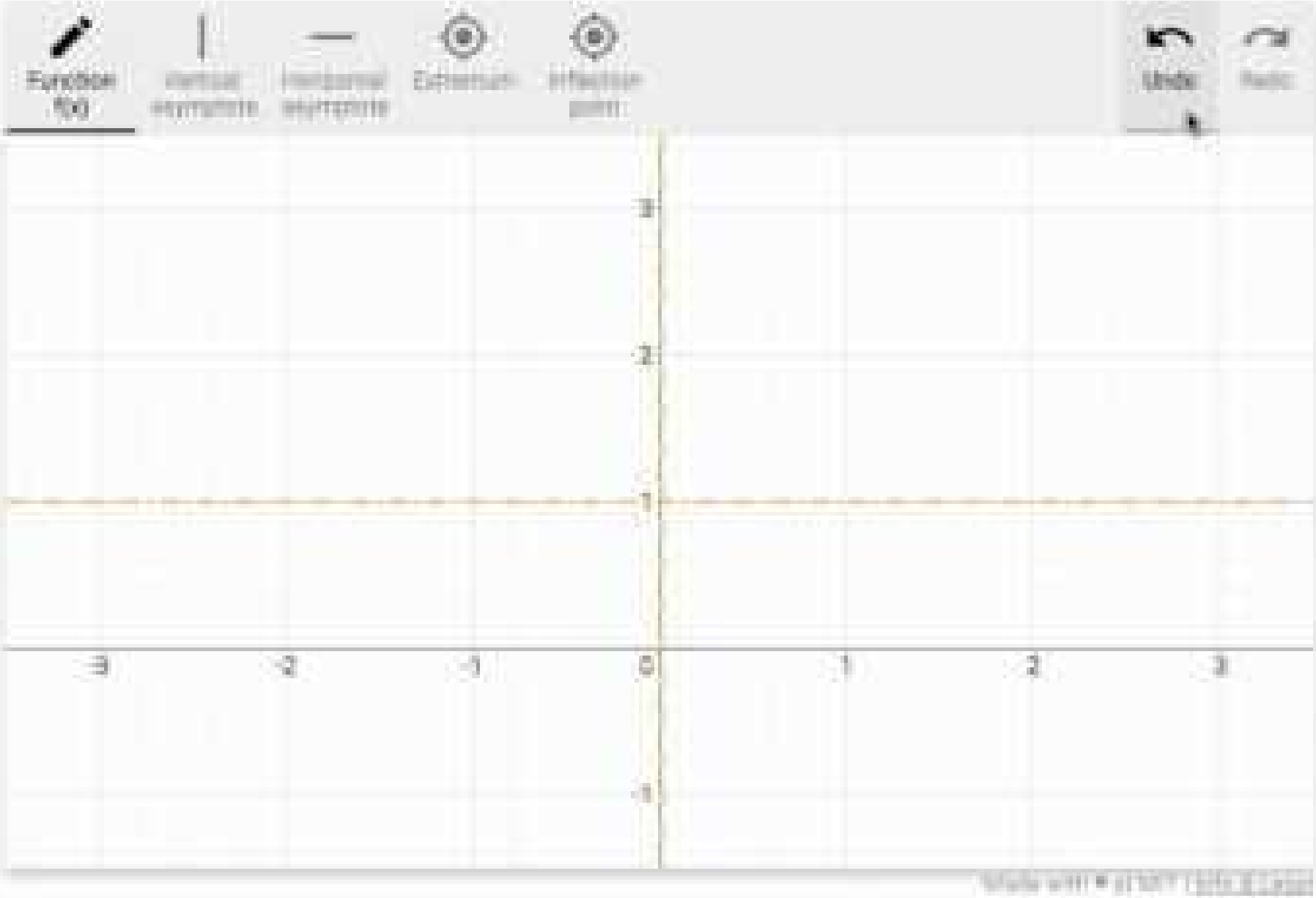
Why automatic grading of sketches?

Sketches completed on paper:

- Delayed feedback
- Feedback may not be detailed

Automatically graded sketches:

- Immediate, targeted feedback
- Multiple attempts gives the opportunity to correct mistakes immediately


Function f(x)
Vertical asymptote
Horizontal asymptote
Extremum
Inflection point
Undo
Redo
3
2
1
-1
-3
-2
-1
0
1
2
3

Results

Overall stats (13 problems):

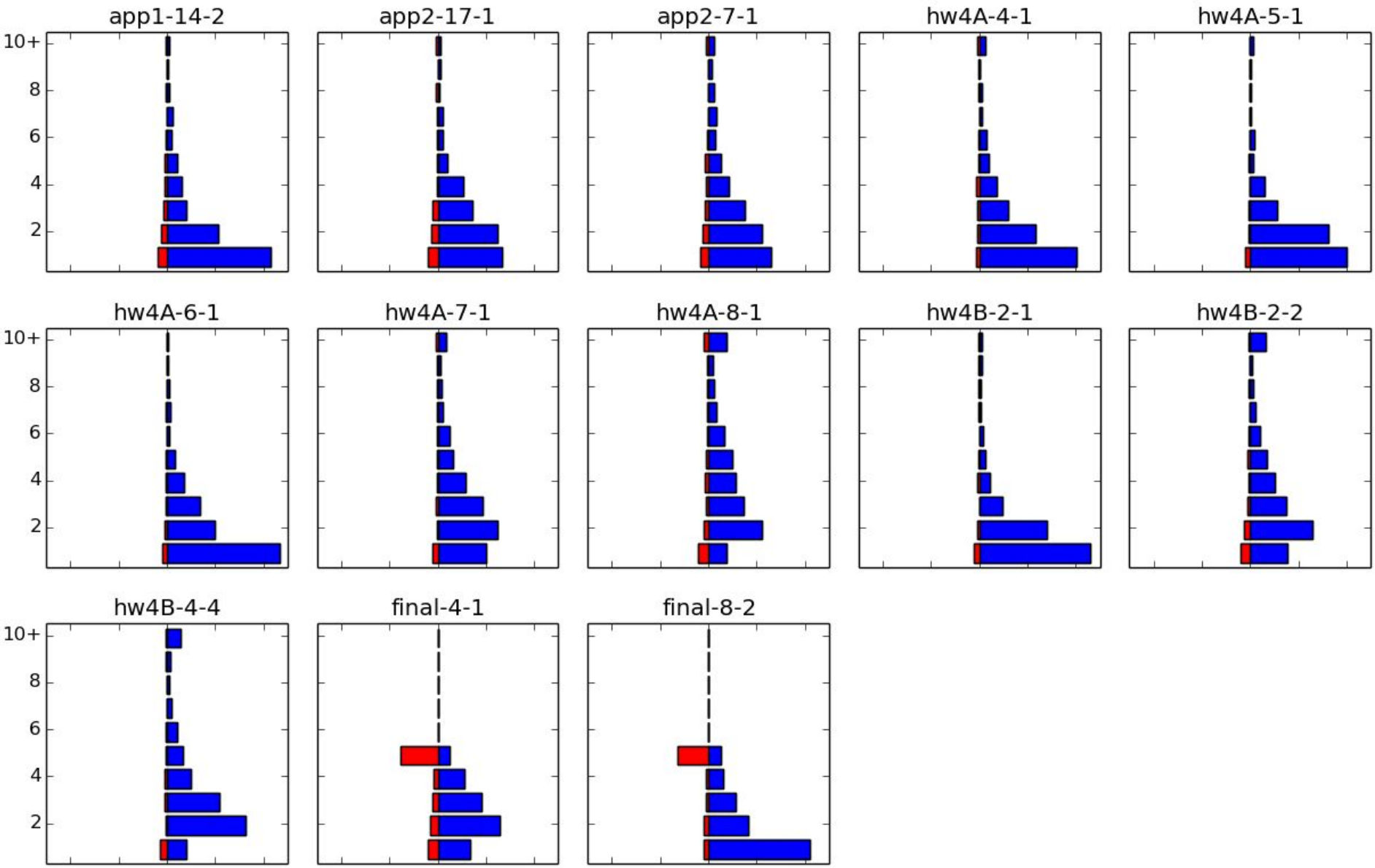
871 unique learners

8187 graphs submitted

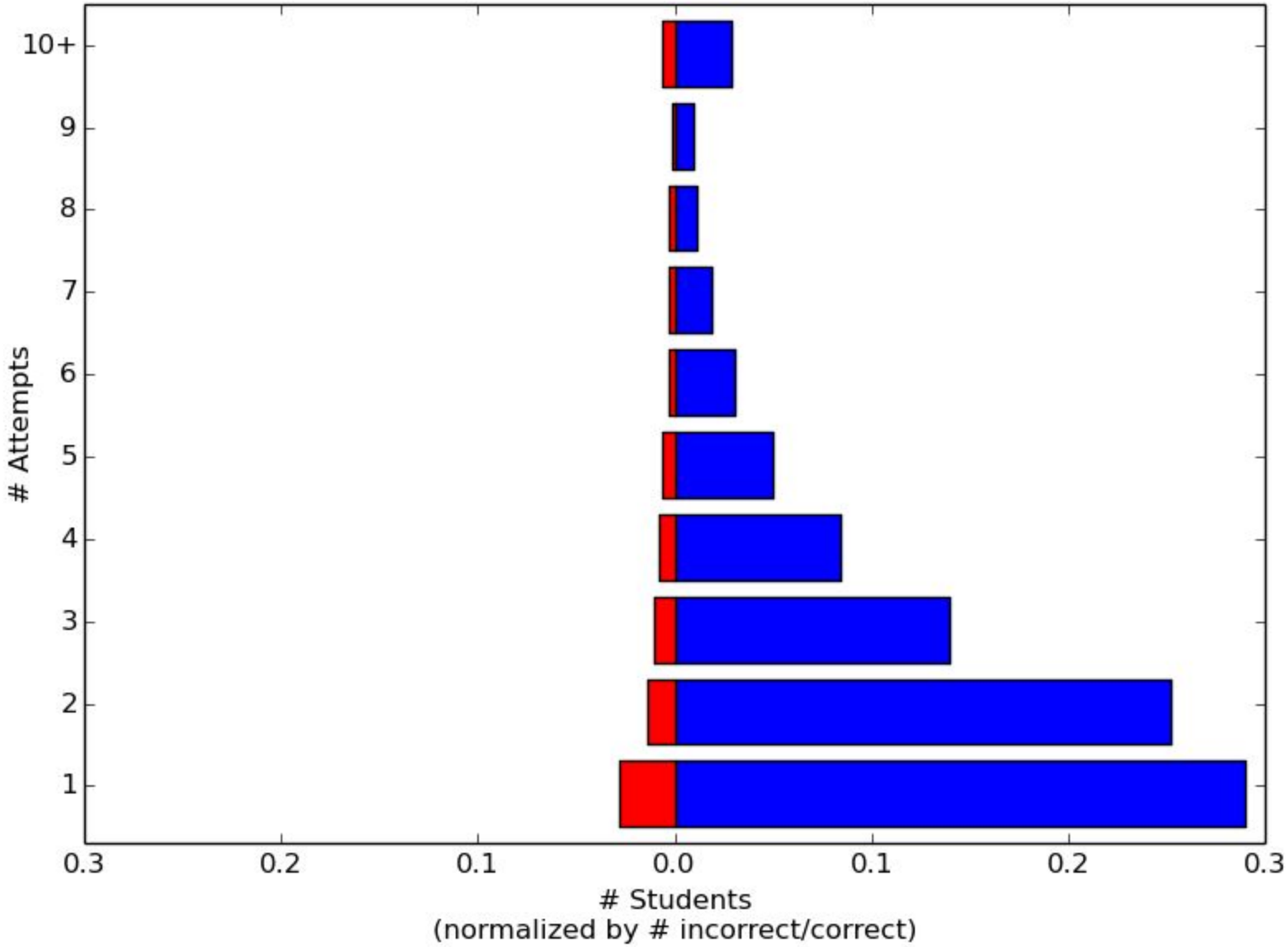
89% correct by last attempt

2~3 attempts typical

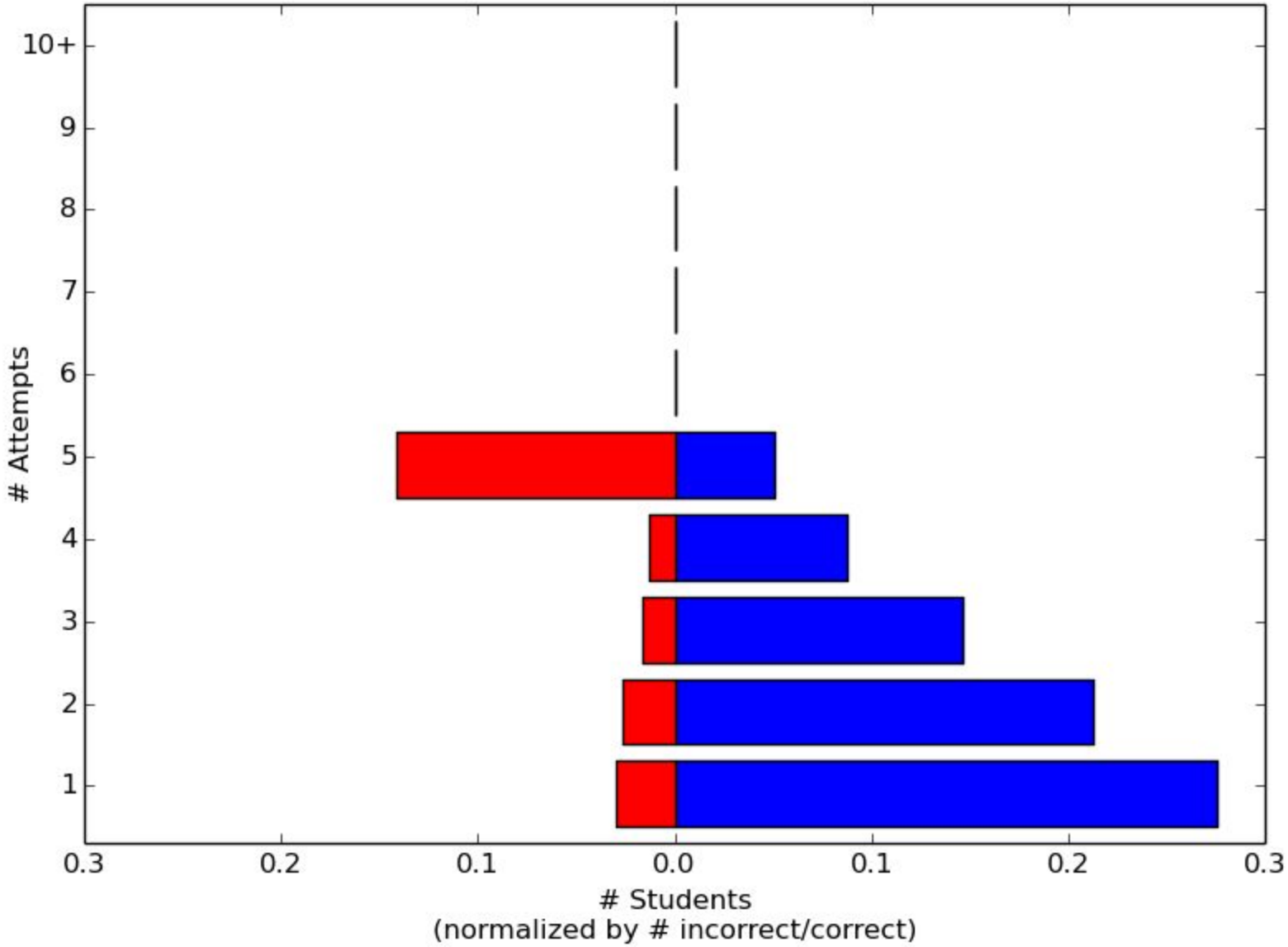
Attempt distributions



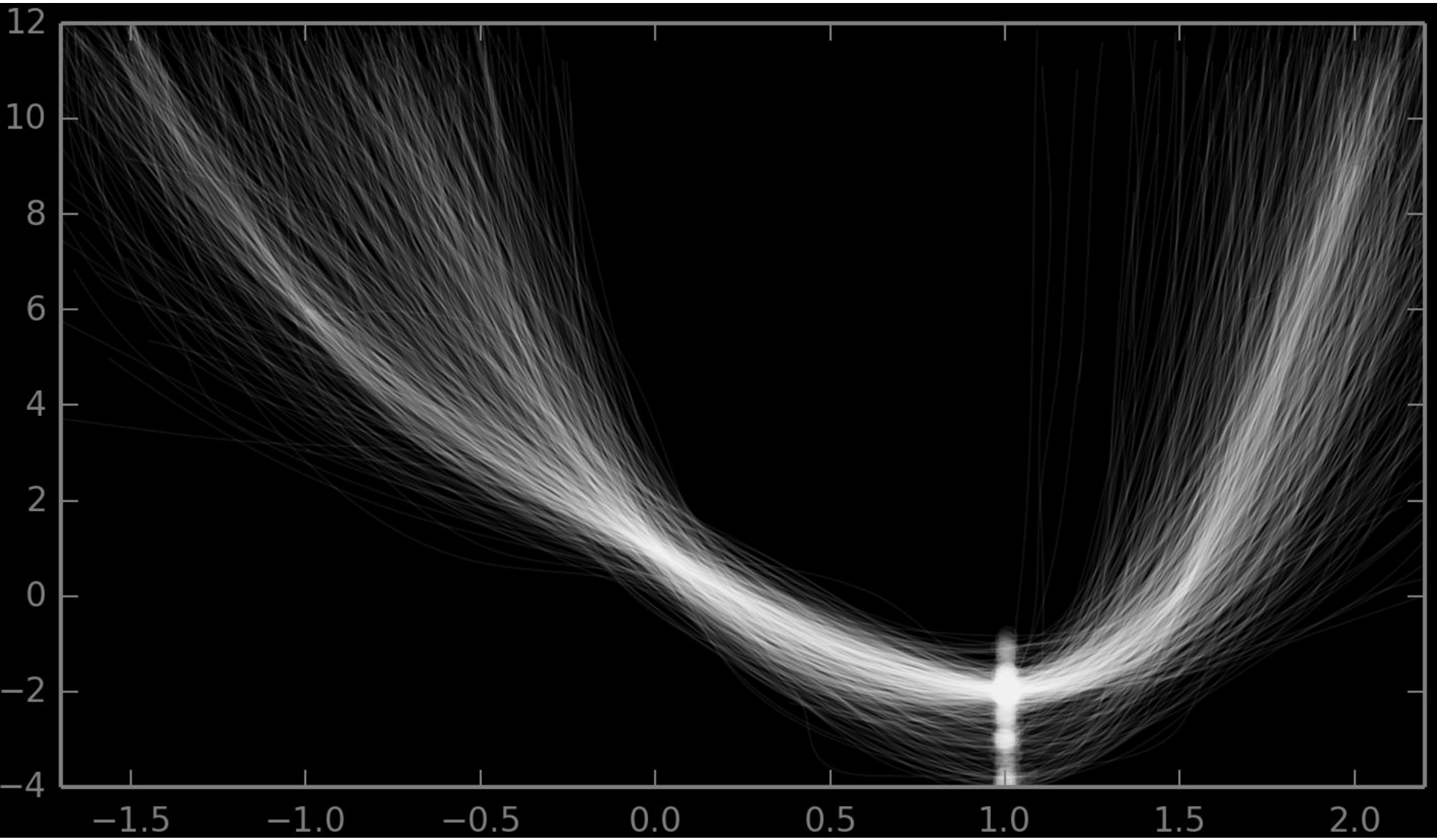
Attempt distributions (exercise/HW avg.)



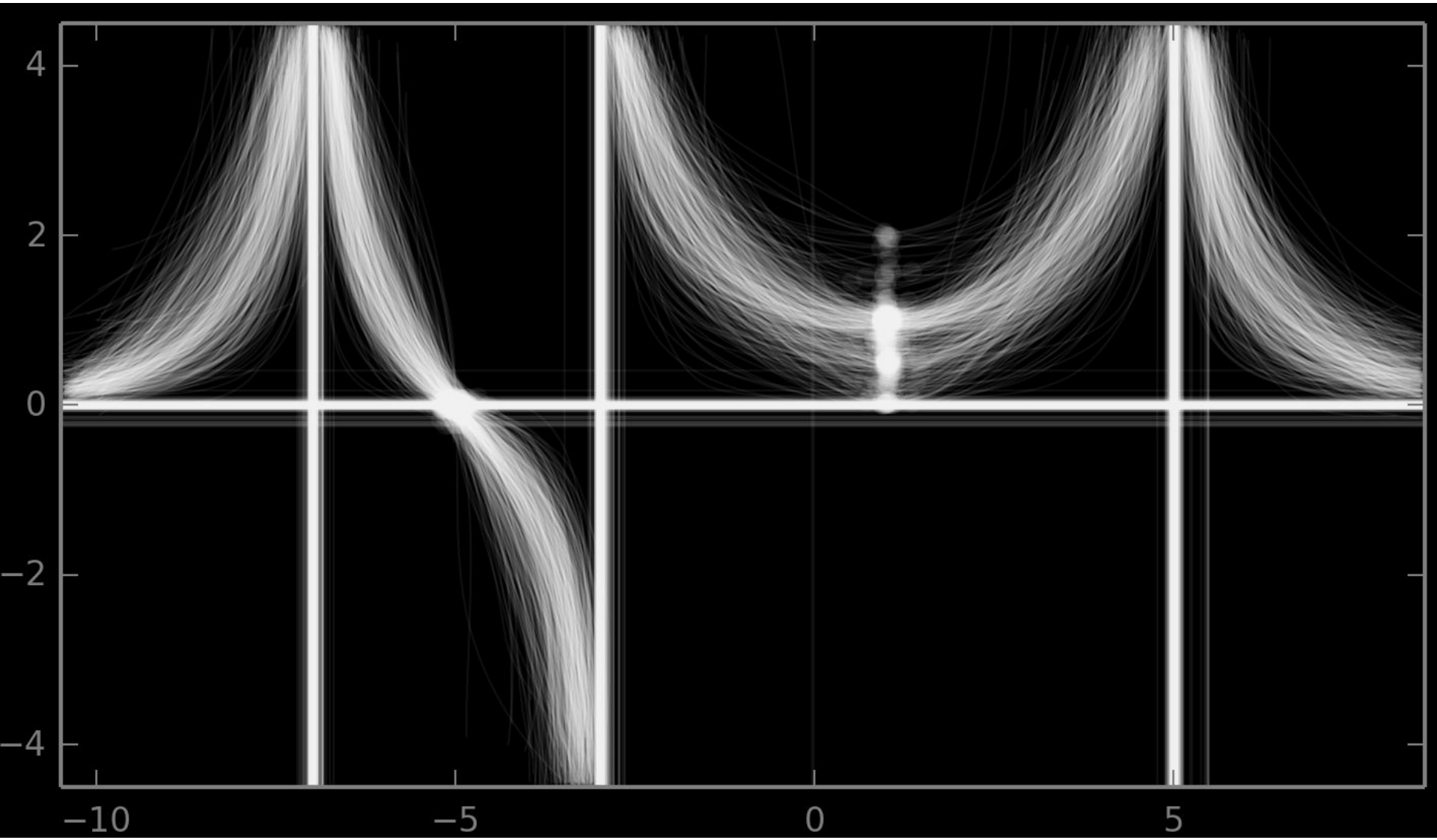
Attempt distributions (final exam avg.)



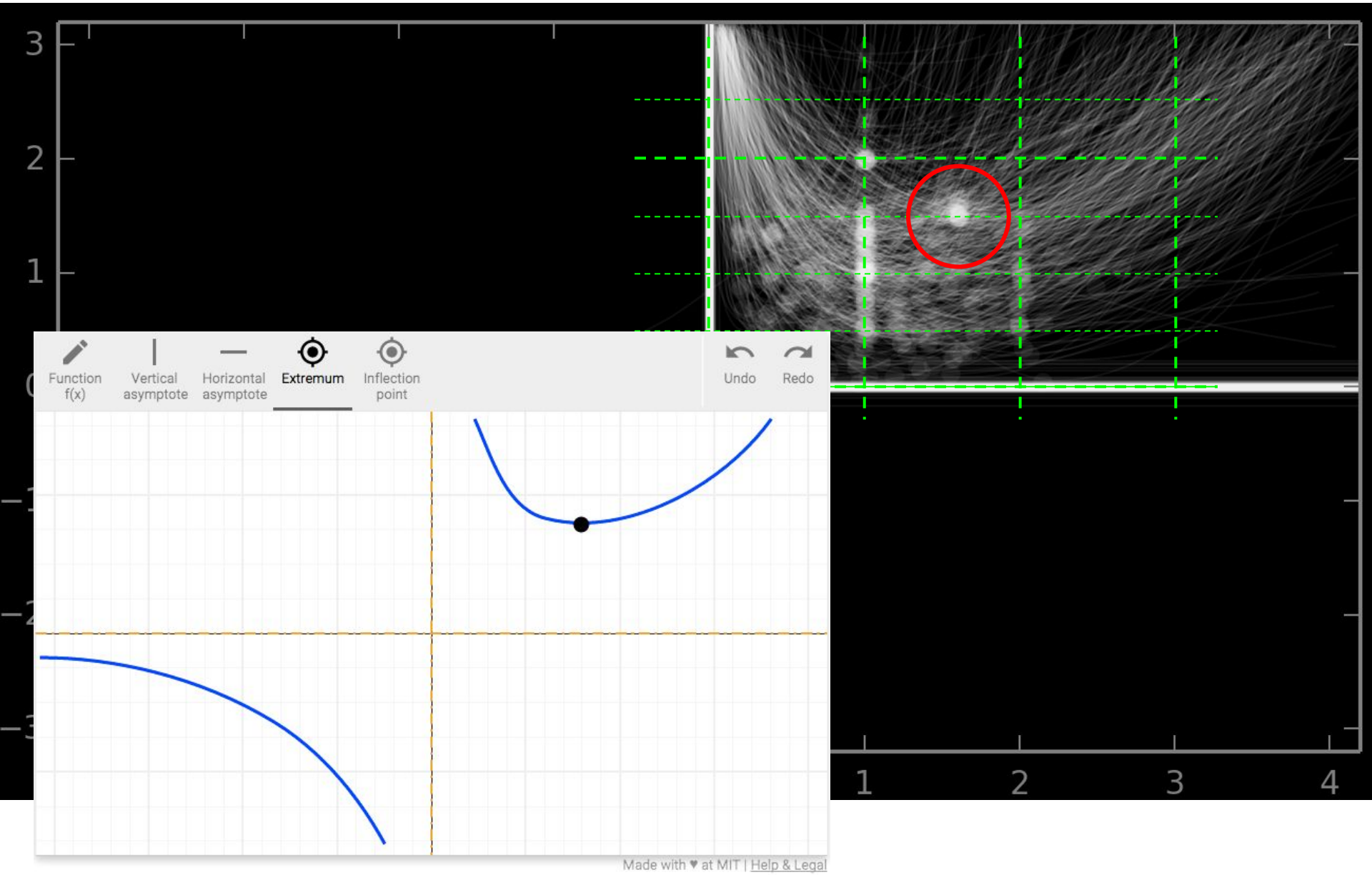
Correct answers: *hw4A-5-1*



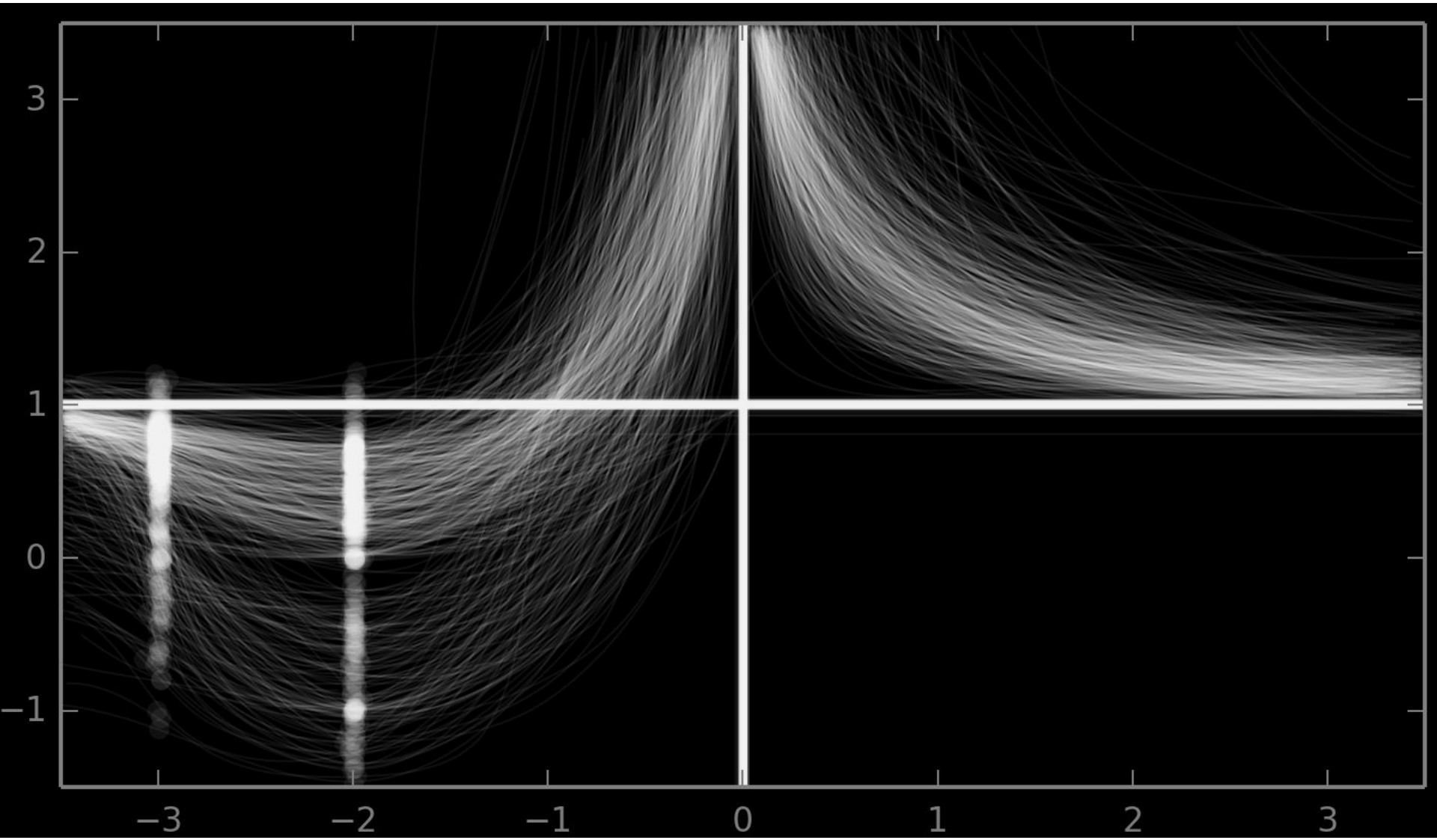
Correct answers: *hw4A-8-1*



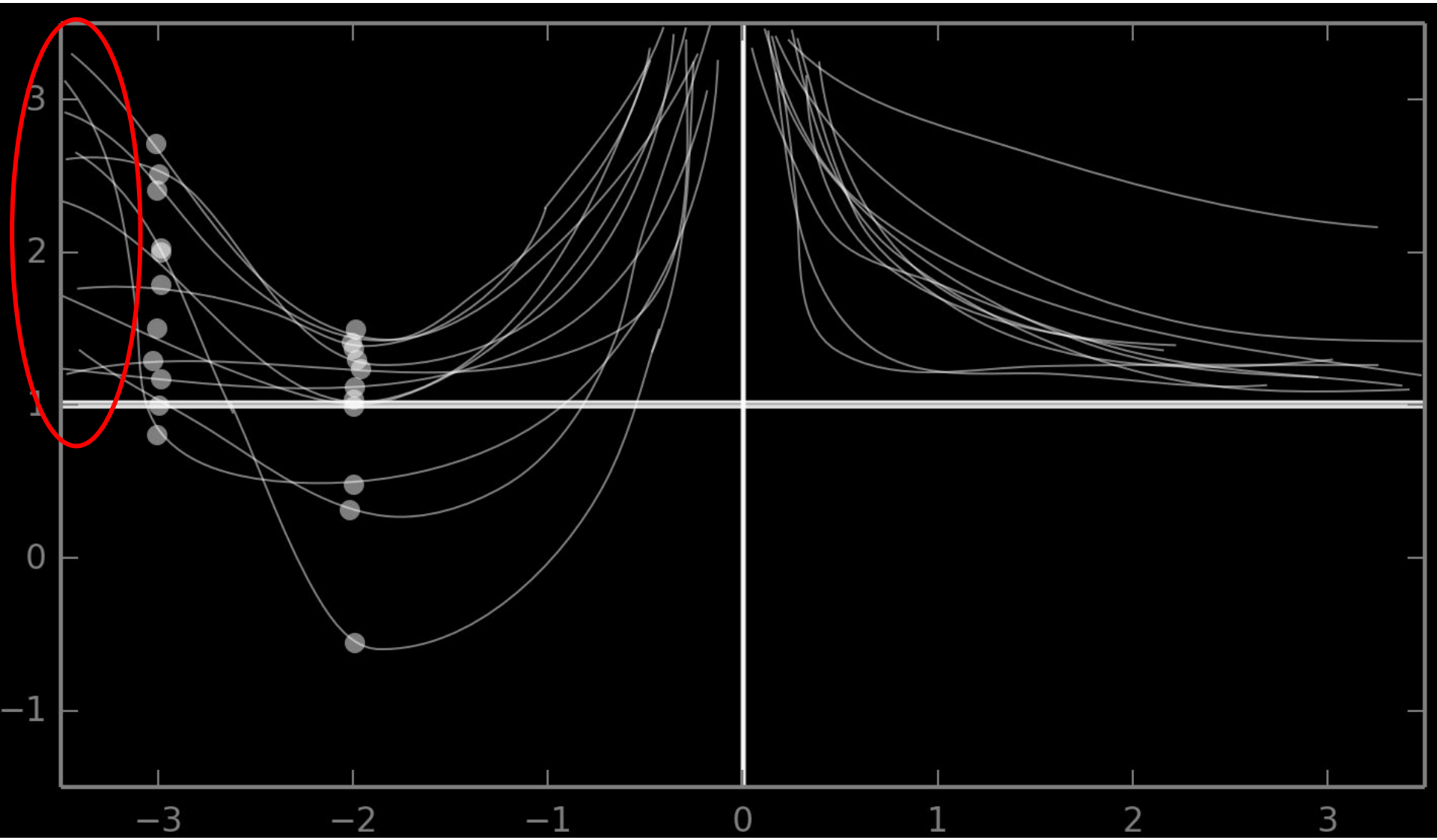
Correct answers: *app2-17-1*



Correct answers: *final-8-2*

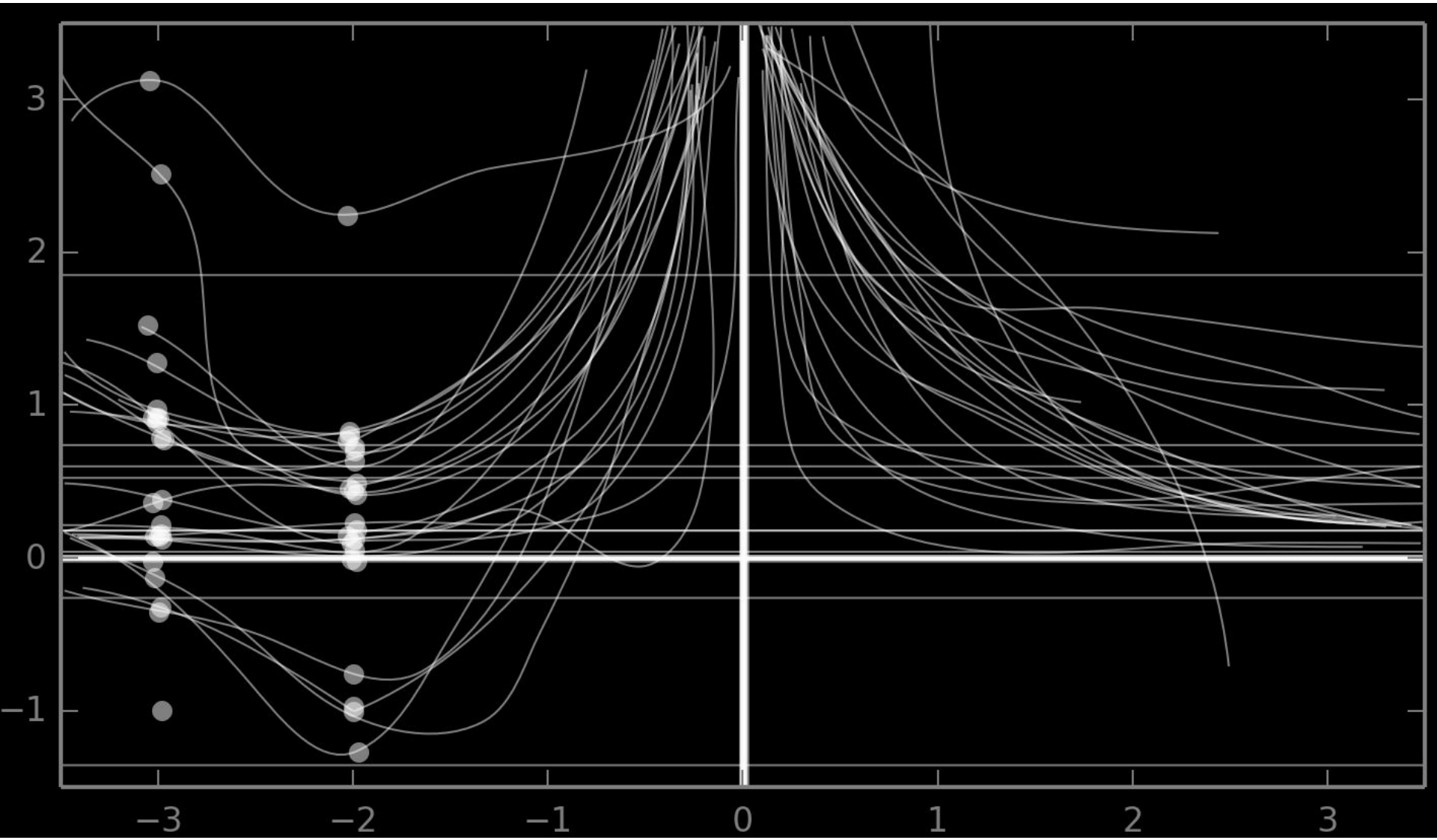


Wrong answers: *final-8-2*



(Feedback: "*What is the relationship of your function to the horizontal asymptote?*")

Wrong answers: *final-8-2*



(Feedback: "*Check the location of your horizontal asymptote.*")

Future Directions

Data analysis (e.g. clustering)

Automation of grading scripts

...and eventually, whole problems?

Keyboard navigation & accessible drawing tools

Open Source & dissemination

For more information

Check out the website

http://web.mit.edu/~jfrench/www/index.html

Or feel free to contact us!

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