Mathematics in Motion: Animating Math Concepts for the Web

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Agenda

1. Why Animate Math?
2. Tools for Motion
3. RAPID Framework
4. Demos
5. Takeaways

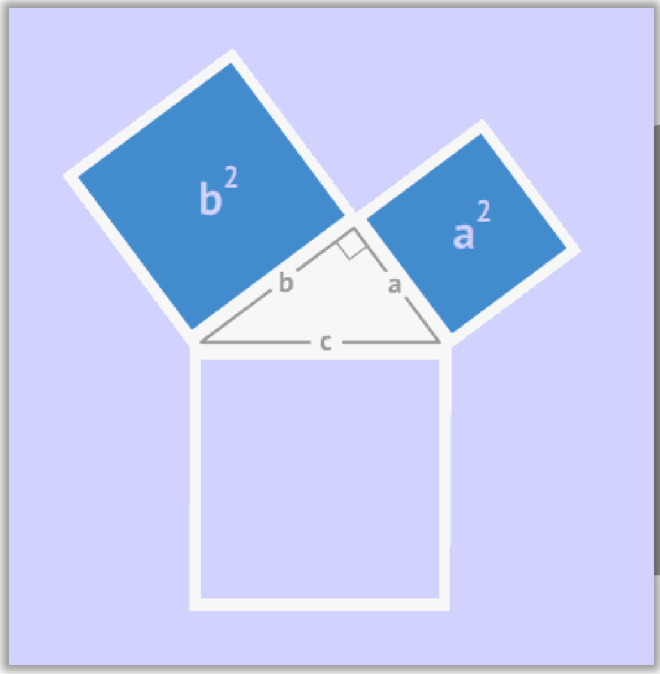
github.com/cyatteau/math-in-motion-bcc2025

Today's Objectives

- Understand the RAPID workflow for animations
- Learn to apply math to real-world animations

Why animate math on the web?

- Motion makes abstract ideas intuitive
- Interactivity turns watchers into explorers
- Runs anywhere a browser runs
- Same techniques power media/data viz, games



Research-backed benefits

1. Animated/interactive visuals increase engagement & retention
2. Learning improves when learners can control pace and inputs

Tools to Animate on the Web

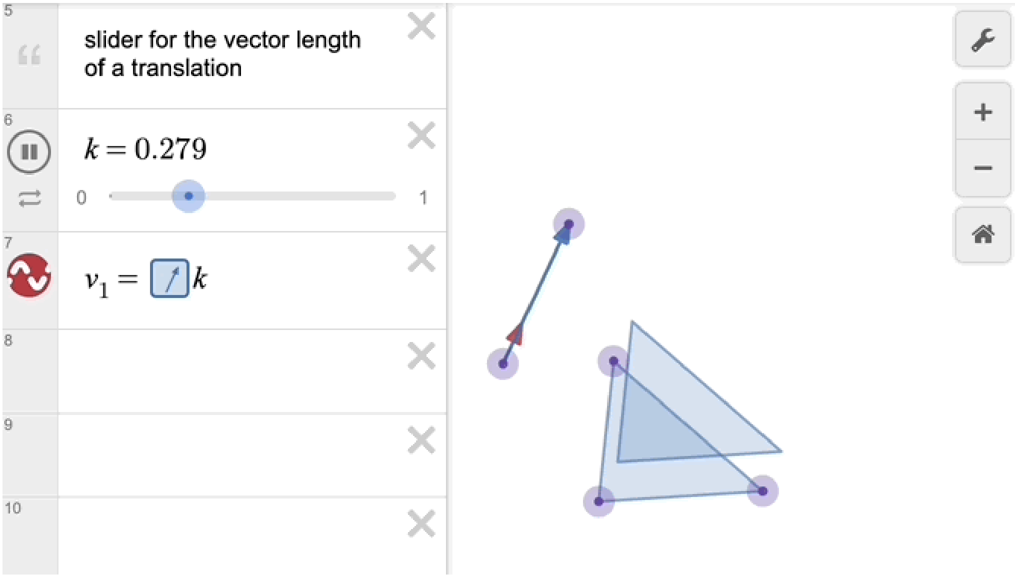
- CSS (transforms, keyframes, math functions)
- Canvas + JavaScript
- WebGL / Three.js

RAPID Framework

- **R**eceive
- **A**pply
- **P**roject
- **I**terate
- **D**raw

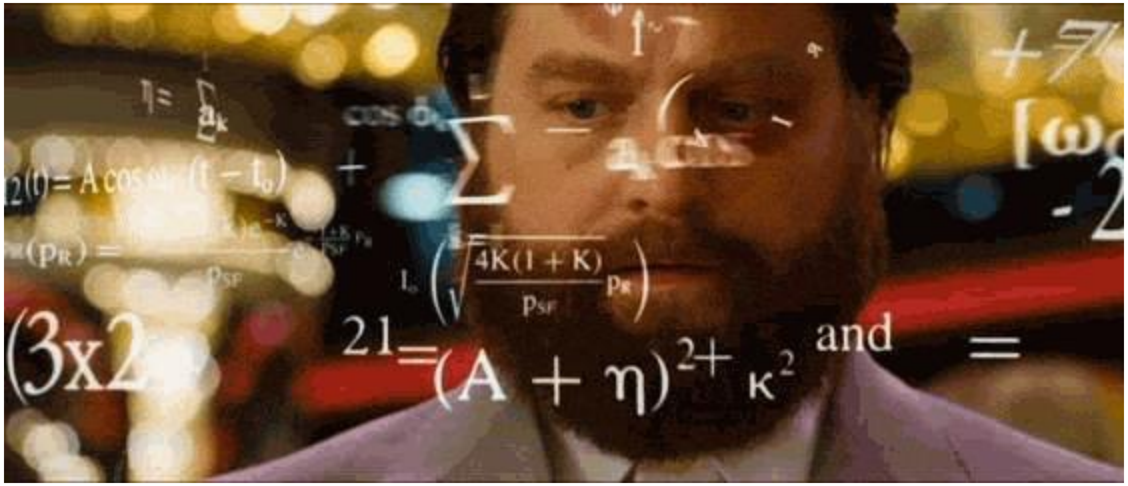
R — Receive

Read sliders, mouse drags, or microphone data



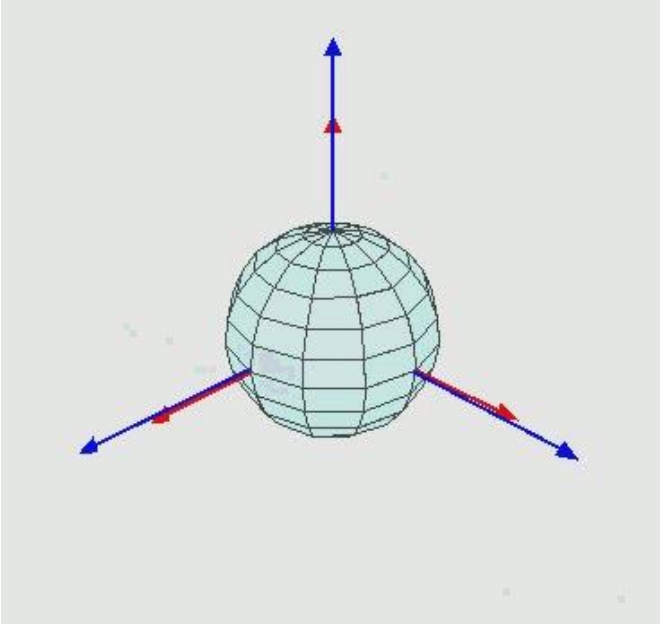
A - Apply

Take the received input and feed it into your mathematical model.



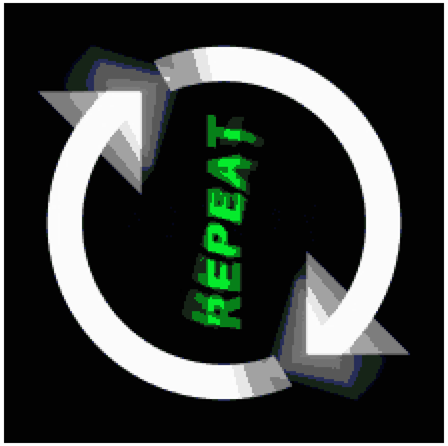
P - Project

Map your mathematical results into the space you’re drawing in (e.g., pixels, canvas coords, or map coords).



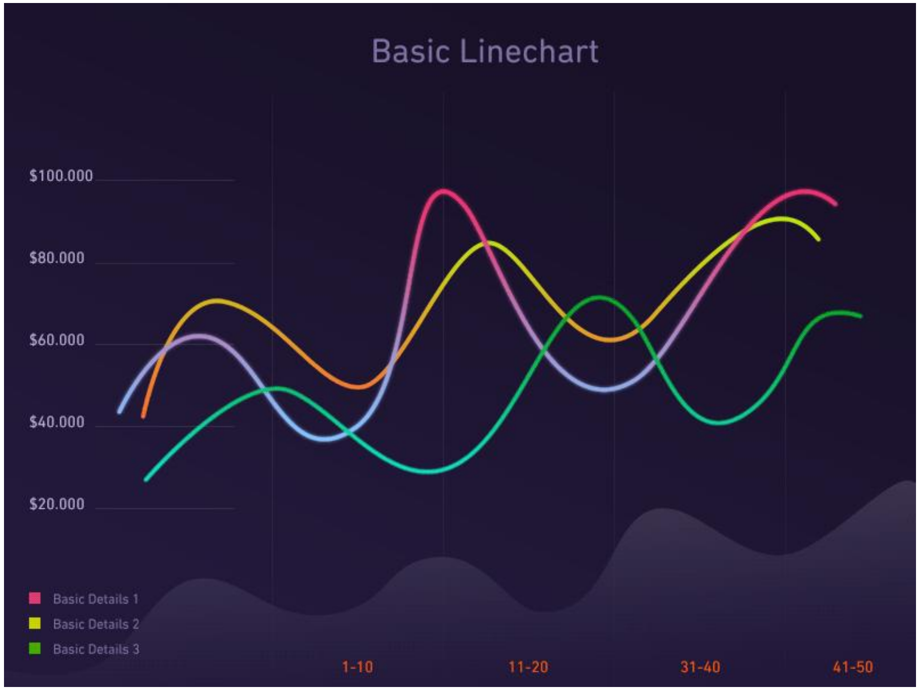
I - Iterate

Repeat the process to create motion, updating parameters each frame.

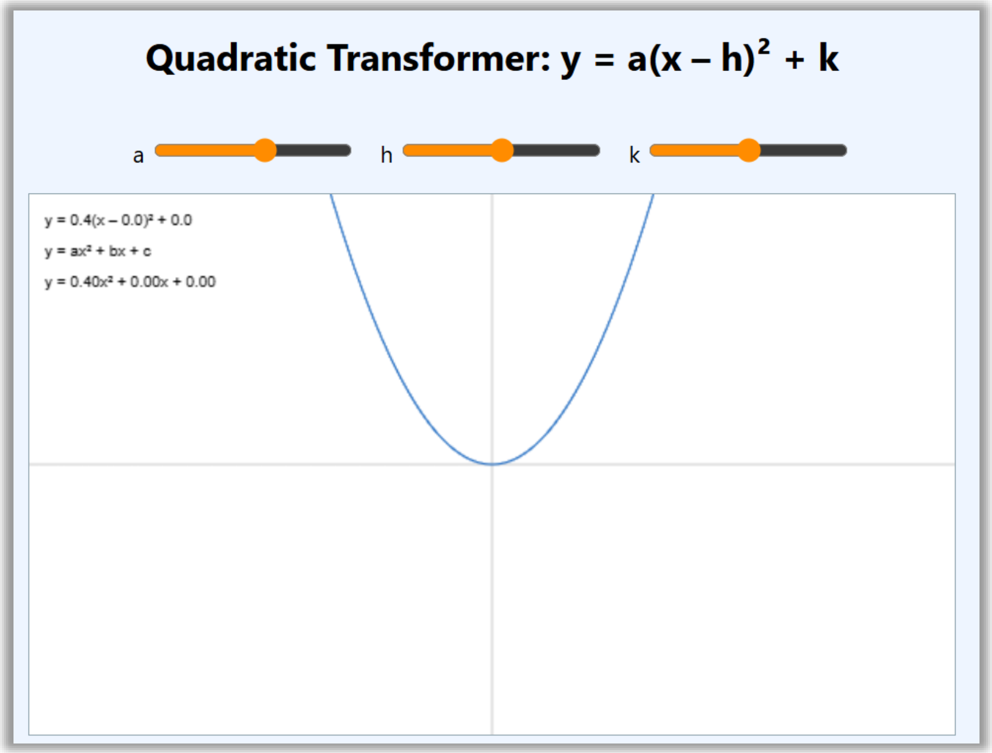


D - Draw

Render the current state to the screen so the user can see the results.



Demo IA: Quadratic Transformer



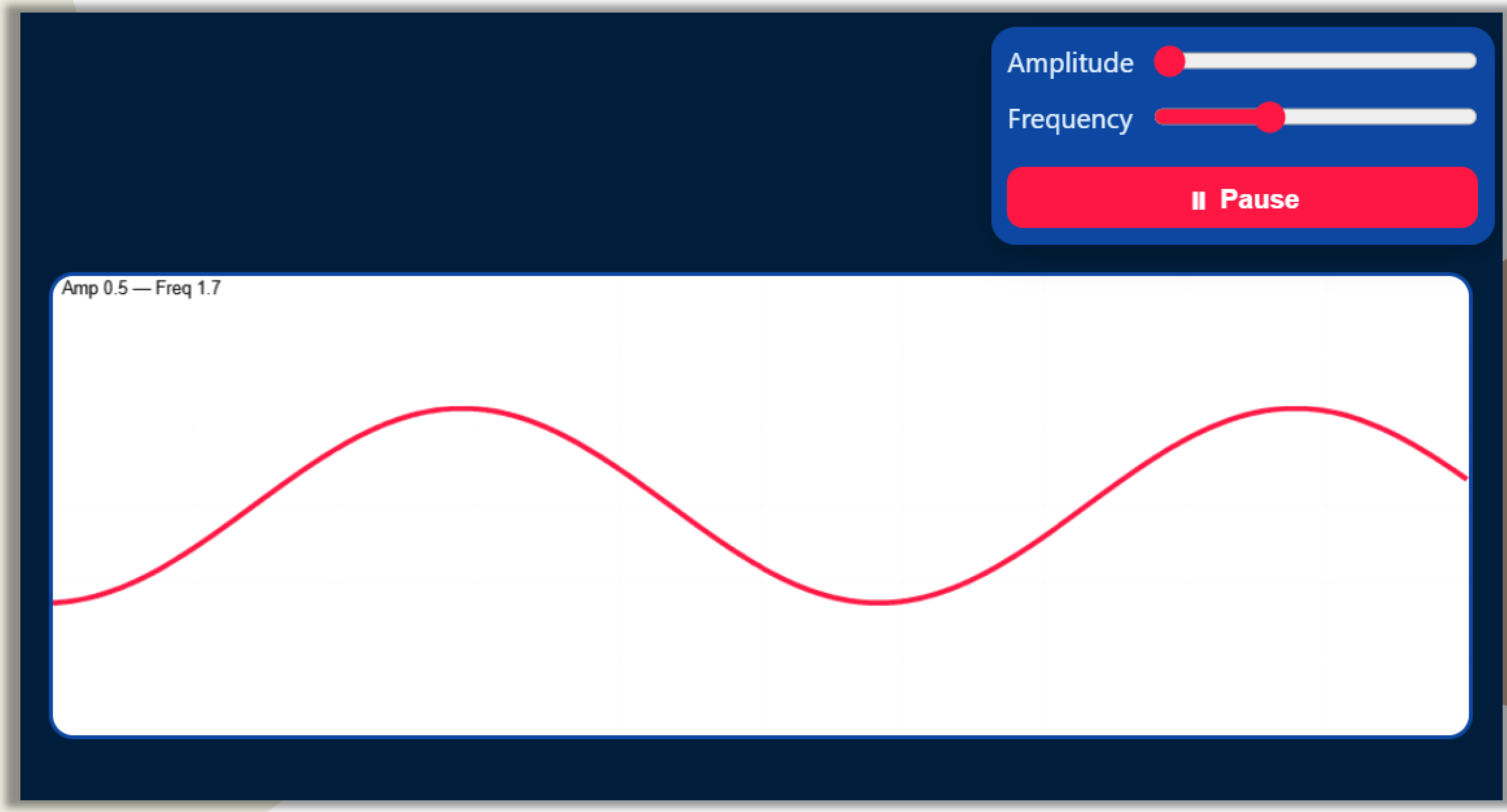
Demo IB: Real-World Example

Baseball Savant Home-Run Derby uses same parabola

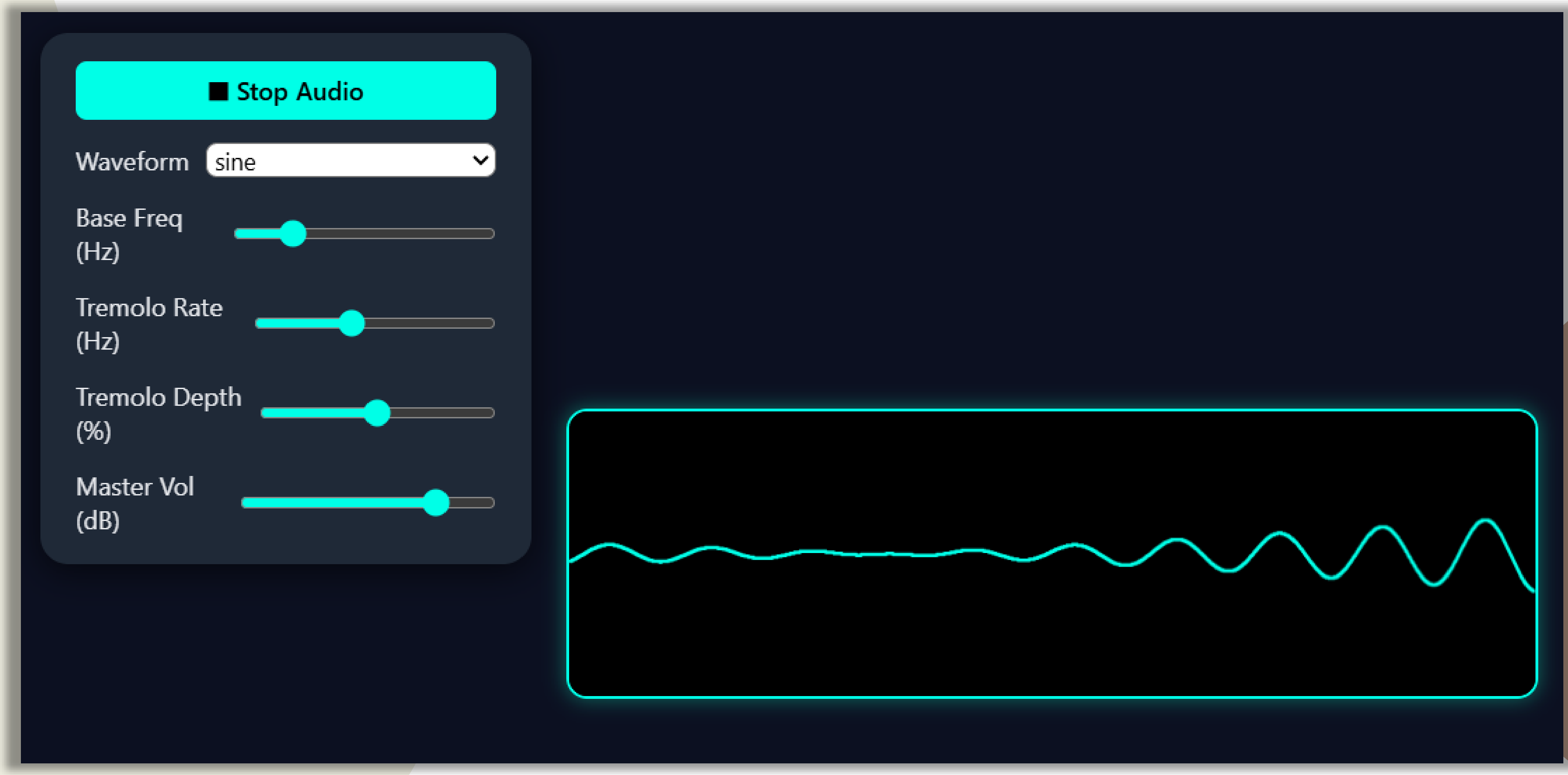
- **Receive**: radar
- **Apply**: projectile formulas
- **Project**: 3D coordinates to WebGL2 scene
- **Iterate**: requestAnimationFrame
- **Draw**: Render arcs & balls on the canvas

https://baseballsavant.mlb.com/hr_derby

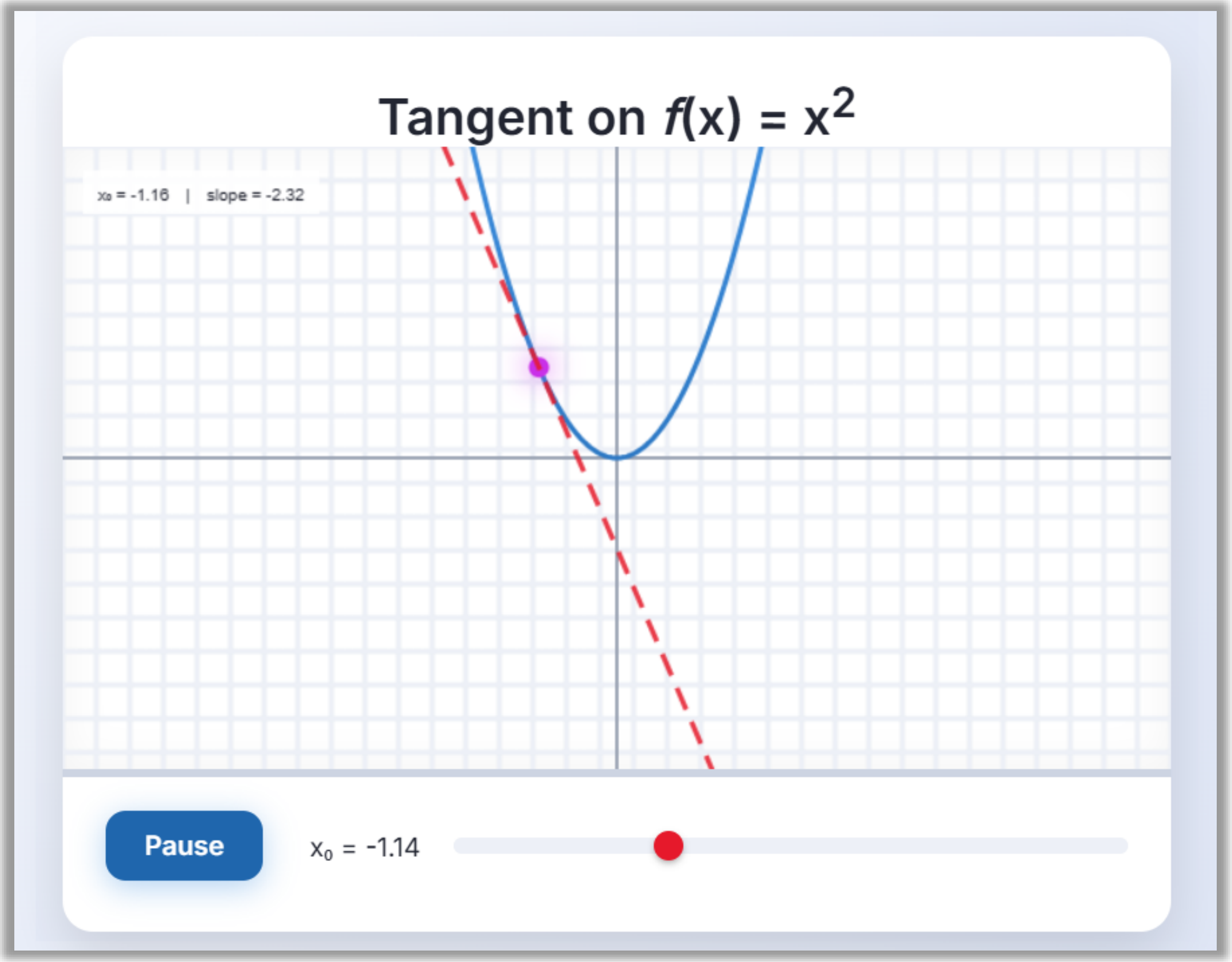
Demo 2a: Sine-Wave Visualizer



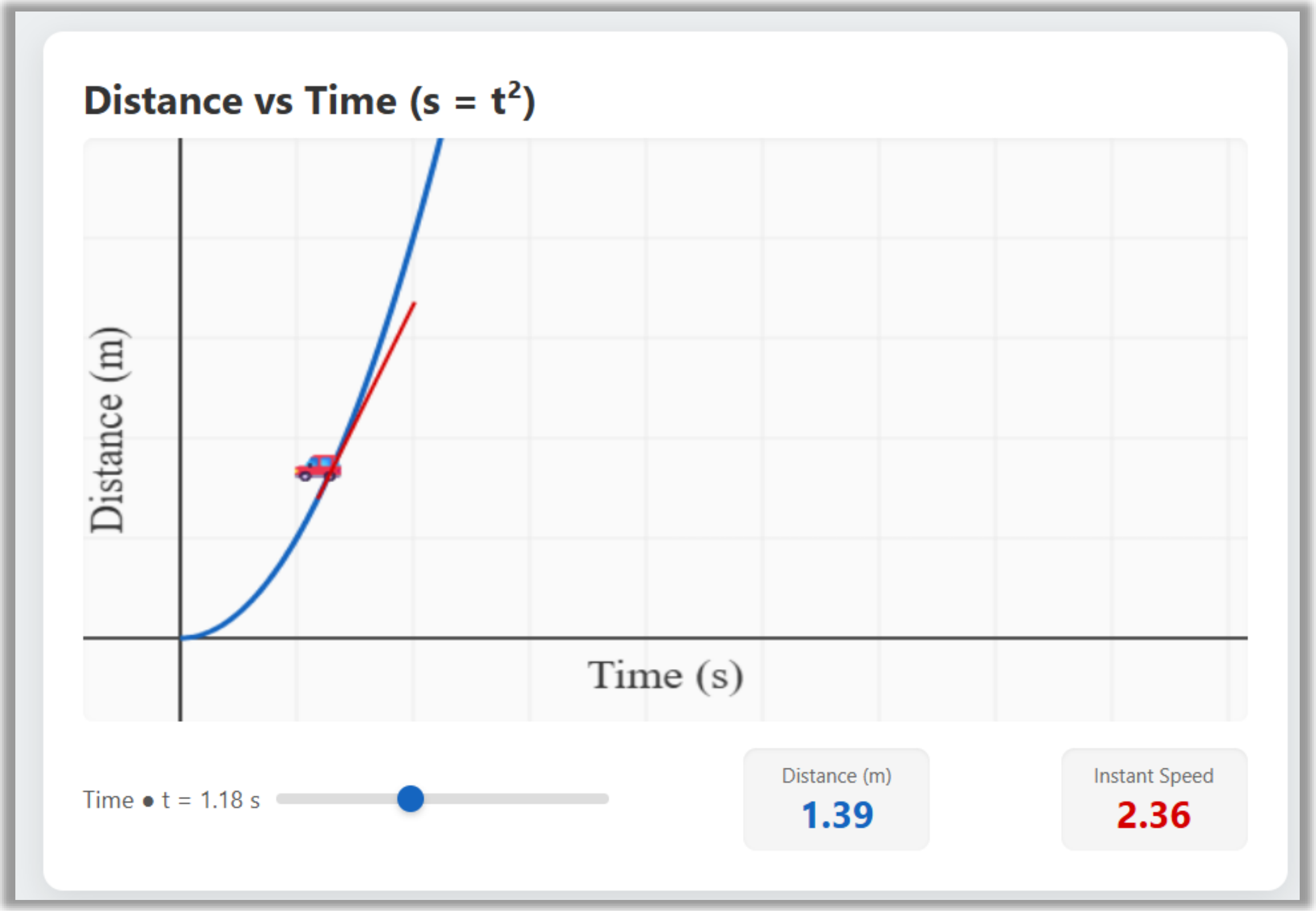
Demo 2b: Tremolo Pedal Demo



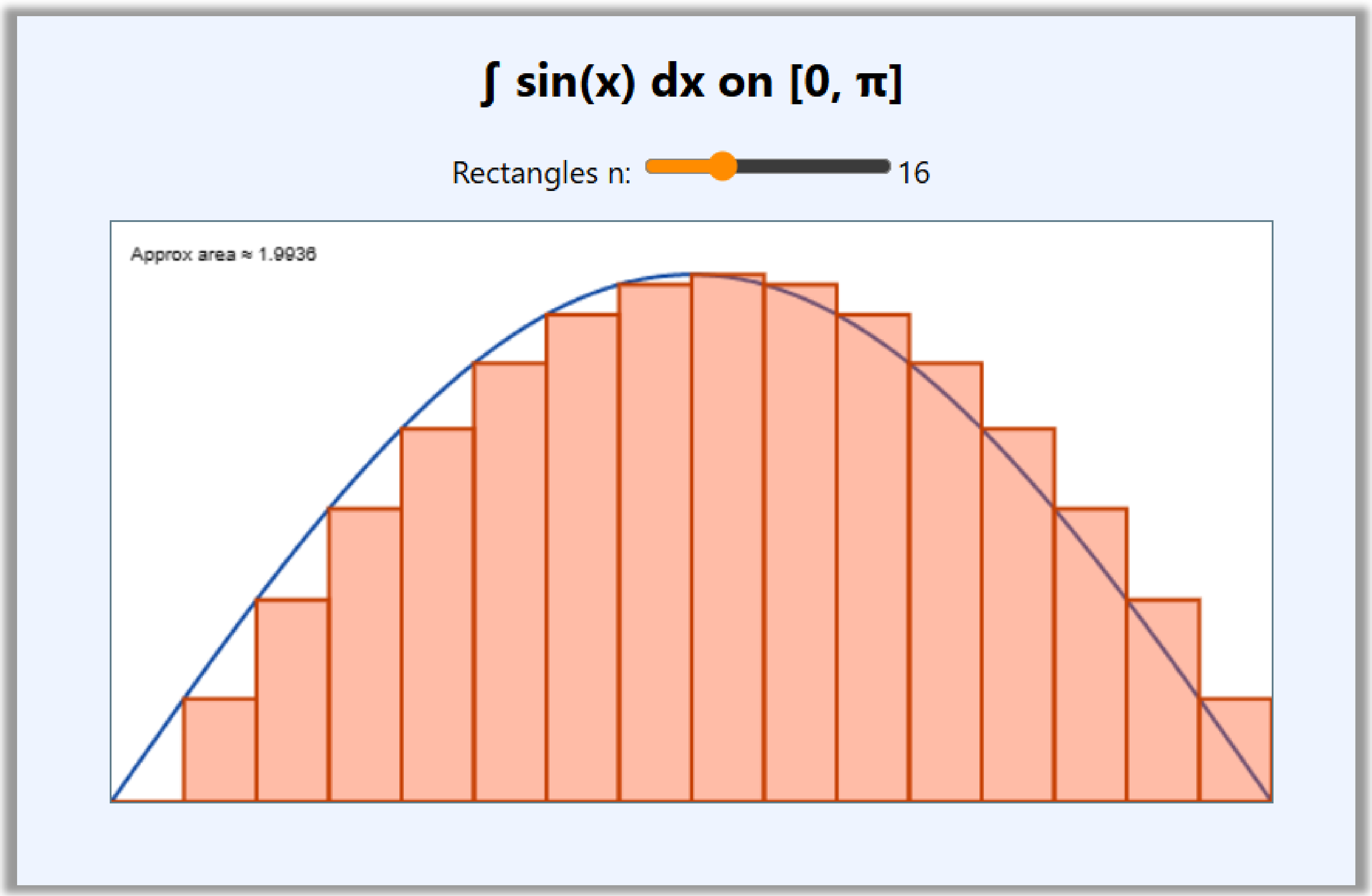
Demo 3a: Tangent Explorer



Demo 3b: Instant Speedometer



Demo 4a: Riemann Sums

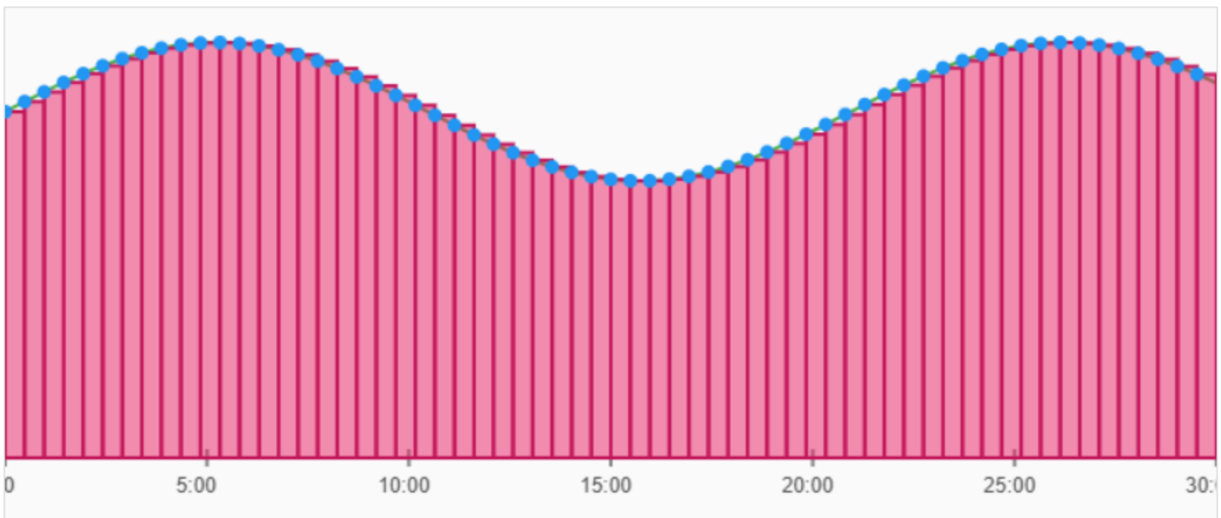


Demo 4b: Calories Burned

Calories Burned in 30 Minutes

Drag the slider to pick how many slices (N) you break 30 minutes into. Each slice covers Δt = 1800 s ÷ N. Hover a bar below to see:

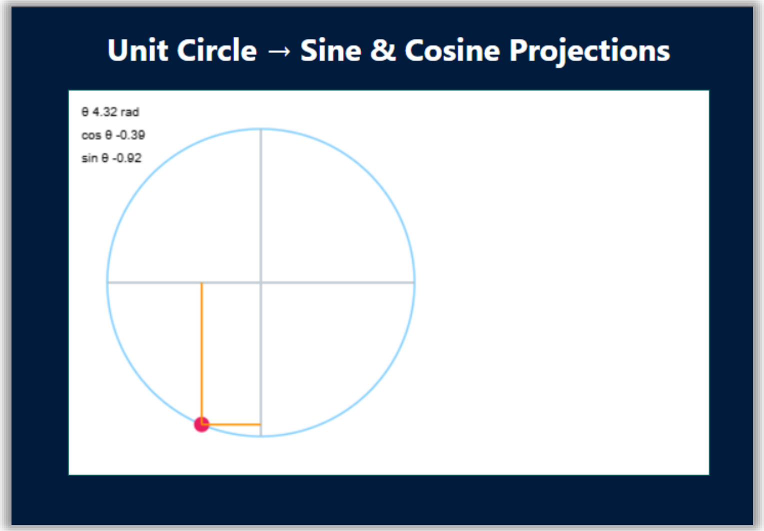
Slices (N): 62 Δt: 29.0 s

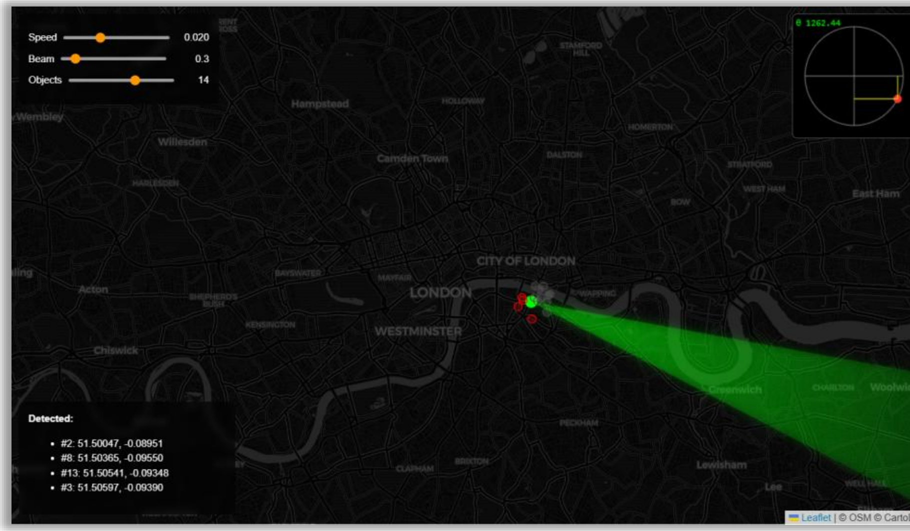


Slice at 28:33 → HR≈86 bpm
0.14 cal/s × 29.0 s = **4.18 cal**
Running total ≈ 226.26 cal

Approx 234.39 cal

Demos 5a and 5b: Unit Circle and Radar Map





Key Takeaways

- RAPID is a reusable mental model for math in motion
- Swap formulas; keep the pipeline
- Canvas, Audio, Maps - same five steps

Thank you, Beer City Code!

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