# Teacher's & Workshop Guide: Ring 7 - The Speed Booster (Computation)

## Polya Studio Discovery Series

### Introduction to the Workshop

Welcome to Ring 7 of the Polya Studio. We have covered physical constraints and logical organization. Ring 7 introduces **Scale**. This is the world of Computer Science and Algorithms.

Your role as the Guide is to teach them that "Fast" isn't about moving your hands quickly; it's about thinking smarter. You will force them to handle a dataset that is too big to manage with their human intuition.

The goal of Ring 7 is for students to discover **Divide and Conquer** (The Algorithm). They will learn that solving a big problem is slow, but breaking it into small buckets is fast. They will use the "Complexity Triangle" to measure efficiency.

### Part 1: The Station Setup

You must prepare a task that is easy with 5 items but impossible with 100 items. You will need a large dataset.

First, create **"The Dataset."** Get 100 index cards and number them from 1 to 100. Shuffle them thoroughly so they are completely mixed up.

Second, provide **"The Timer."** You need a stopwatch.

Third, provide **"The Workspace."** A large table where they can spread out.

When the students arrive, the challenge is clear: "Put these 100 cards in perfect numerical order (1-100). You have 2 minutes."

### Part 2: The Workshop Dialogue

Stand back. Watch them use the "Brute Force" method (picking up one card, scanning the table for where it goes, then picking up the next). This is $O(N^2)$ behavior—it gets exponentially slower as they add cards.

| Teacher's Nudge (The Guide) | Student's Action (The Discovery) |
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| "Here is a shuffled deck of 100 cards. Put them in order from 1 to 100. You have 2 minutes. GO!" | The team dumps the cards. They grab a card (e.g., "42") and put it on the table. They grab "7" and put it to the left. They grab "99" and put it to the right. |

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| (Wait for the Friction Point. As the line of cards grows, they spend more and more time scanning back and forth to find the right slot for each new card.) | **The Friction Point.** With 10 cards, it was easy. With 50 cards on the table, finding the spot for "53" takes forever. They are colliding with each other. They yell "Time!" and they are only half done. |
| "You failed the time limit. You were working fast, but your *method* was slow. Why did it get harder at the end?" | They pant. "There were too many cards on the table. I couldn't find the spot for the new card." |
| "You were trying to eat the whole elephant at once. Stop. How can we break this big problem into smaller problems?" | They look at the mess. "Maybe we split them up first?" "Like... 1s, 20s, 30s?" |
| "Yes. Draw the Algorithm." (Hand them the whiteboard.) | The team sketches a plan. |
| "Draw the Complexity Triangle. Draw the Input, the Method, and the Time." | **The Visualization.** They realize that searching through 100 cards takes a long time. But searching through a pile of 10 cards is instant. |
| "Create 'Buckets' first. Don't sort yet. Just group." | **The Resolution.** They restart. They quickly toss cards into piles: 1-10, 11-20, 21-30. This is fast because they don't need to be precise, just close. |
| "Now sort the buckets." | Once the cards are in small piles of 10, sorting each pile takes seconds. They assemble the line. They finish in under 2 minutes. |

**Part 3: The Visual Rule (The Complexity Triangle)**

Once they have discovered the power of "Bucketing" (Divide and Conquer), gather them around the whiteboard. Draw the Complexity Triangle diagram. This is how they will judge if a method is good or bad.

The top point of the triangle is **THE INPUT** (N).

- *How many things do we have to sort? (100 cards)*

The bottom left point of the triangle is **THE METHOD** (The Algorithm).

- *How do we handle them? (One by one? Or split into groups?)*

The bottom right point of the triangle is **THE TIME** (The Result).

- *Did doubling the cards double the time (Good)? Or did it quadruple the time (Bad)?*

**The Rule:** If a job gets too big, **Divide** it. Never try to sort a mountain. Break the mountain into rocks, sort the rocks, then build the mountain back up.

**Part 4: Teacher's Quiz (Pedagogy Check)**

**Question 1** Why do we use 100 cards instead of 10? A) Because 100 is a nice round number. B) Because with only 10 cards, the "Brute Force" method works fine. You need 100 to force the students to feel the "Friction" of a bad algorithm. *Correct Answer: B*

**Question 2** What is the "Brute Force" method? A) Punching the cards. B) Looking at every single card one by one to find its spot. *Correct Answer: B*

**Question 3** What algorithm are they discovering? A) Divide and Conquer (or Bucket Sort). B) Random Guessing. *Correct Answer: A*

### Part 5: Student's Quiz (Concept Check)

**Question 1** You have to clean a messy room with clothes, toys, and trash everywhere. What is the fastest way? A) Pick up one item, walk to the closet, put it away. Walk back. Pick up next item. B) Throw all clothes in one pile, all toys in another, all trash in another. Then put the piles away. *Correct Answer: B*

**Question 2** Why is "Bucketing" faster than "Line Scanning"? A) Because you don't have to be perfect right away. You just have to be "close enough," then perfect later. B) Because buckets are magic. *Correct Answer: A*

**Question 3** What is the Superpower of Ring 7? A) Moving your hands at light speed. B) Creating a system (Algorithm) that makes big problems feel small. *Correct Answer: B*

### Closing Note

By the end of this session, your students have practiced **Computation**. They learned that computers aren't smart; they just use good recipes. By moving from "Brute Force" to "Divide and Conquer," they