Computing with Spherepop: A Geometric Merge–Collapse Calculus

Flyxion

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Abstract

Spherepop is a geometric model of computation in which values are represented as spatial regions and computation proceeds through two primitive operations: merge, which unites regions, and collapse, which abstracts internal detail. Unlike symbolic models that manipulate syntactic expressions, Spherepop implements computation as spatial interaction and simplification. This article develops a formal core calculus, operational semantics, and reference implementations in Racket, Python, and Haskell. We analyse basic algebraic properties, sketch expressiveness results, and describe connections to neural computation.

1 Introduction

[Shortened version for the bundle. You can paste the longer monograph we developed into this file if you prefer.]

2 Core Definitions

Definition 1 (Region)**.** *Fix a base space P, typically $\mathbb{R}^n$. A* region *is a connected, bounded subset $A \subseteq P$ together with a label and an optional payload.*

Definition 2 (Collapse)**.** *A* collapse operator *is a function $\mathsf{pop} : \mathcal{R} \to \mathcal{R}$ on the class of regions such that* pop *is idempotent and extensive on labels.*

Definition 3 (Merge)**.** *Given regions A, B, the* merge *operation is*

$$A \diamond B \;:=\; \mathsf{pop}(A \cup B).$$

[...trimmed: expand with the full text you already have...]