Parallel & Distributed Computing: Lecture 30

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Project A – Overview

Introduction

Produce a report, using Pandoc (Markdown + LaTeX), including:

1. the link to the personal project repository in GitHub;
2. for each feature parallelized / optimized:
   - specific examples/feature.jl file, demostrating the working feature;
   - test/feature.jl file testing the feature implementation;
   - doc/feature.md file with problems description, and type of parallelization / optimization;
   - study of the speed-up obtained, including a graph, in doc/feature.md.

The project must include at least 3 features modified / optimized.

For each modified feature, the project should discuss (why) the preference between shared memory (threads) and distributed parallelization (processes)

Overview of Arrangement pipeline 1/2

Input Facet selection, i.e., construction of the collection $\mathcal{S}_{d-1}$ from $\mathcal{S}_d$, using `LAR`.

Indexing Spatial index made by intersection of $\boxed{d \text{ interval-trees}}$ on bounding boxes of $\sigma \in \mathcal{S}_{d-1}$.

$\boxed{\textbf{Decomposition}}$ Pairwise $z = 0$ intersection of line segments in $\sigma \cup \mathcal{I}(\sigma)$, for each $\sigma \in \mathcal{S}_{d-1}$.

Congruence Graded bases of equivalence classes $C_k(U_k)$, with $U_k = X_k/R_k$ for $0 \leq k \leq 2$.

Connection Extraction of $(X^p_{d-1}, \partial^p_{d-1})$, maximal connected components of X_{d-1} $(0 \leq p \leq h)$.

$\boxed{\textbf{Bases}}$ Computation of redundant cycle basis $[\partial^+_d]^p$ for each p-component, via TGW.

Overview of Arrangement pipeline 2/2

- $\boxed{\text{Boundaries}}$ Accumulation into $H \mathrel{+}= [o]^p$ (hole-set) of outer boundary cycle from each $[\partial_d^+]^p$.
- **Containment** Computation of antisymmetric $\boxed{\text{containment relation } S}$ between $[o]^p$ holes in H.
- **Reduction** Transitive R reduction of S and generation of forest of flat trees $\langle [o_d]^p, [\partial_d]^p \rangle$.
- **Adjoining** of roots $[o_d]^r$ to (unique) outer cell, and non-roots $[\partial_d^+]^q$ to container cells.
- **Assembling** Quasi-block-diagonal assembly of matrices relatives to isolated components $[\partial_d]^p$.
- **Output** Global boundary map $[\partial_d]$ of $\mathcal{A}(\mathcal{S}_{d-1})$, and reconstruction of 0-chains of d-cells in X_d.

Overview of Boolean mapping

Atomic description Boolean description of **CSG terms** as *d-chains* ("oracle" answering if atom $i \subset$ term j)

pointInPolyhedron Computation of **intersection number** of a ray from a point with a *3D polyhedron* boundary.

Other parallelizable algorithms in LAR

$\boxed{\text{pointInPolygon}}$ Computation of **intersection number** of a ray from a point with a *2D polygon boundary*.

$\boxed{\text{Integration}}$ Monomial *integration on triangular domains* (2D/3D signed *volumes* and *inertia*)

Parallelizable tasks

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