ExaCT CENTER FOR EXASCALE SIMULATION OF COMBUSTION IN TURBULENCE

Implementing BCs in Legion-S3D

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Legion Bootcamp
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Background

- S3D is an explicit finite difference PDE solver for turbulent combustion:
  - Rectangular Cartesian fixed structured mesh.
  - Perfectly load balanced spmd decomposition.
  - Very large field space (~100 state variables at each grid point).
  - Number of PDEs (number of stencil ops) scales with #fields.
  - Rich mix of physics kernels involved in the r.h.s function evaluation.

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    - Top level task (single)
        - "distribute task" (one per spmd sub-domain) with phase_barriers.
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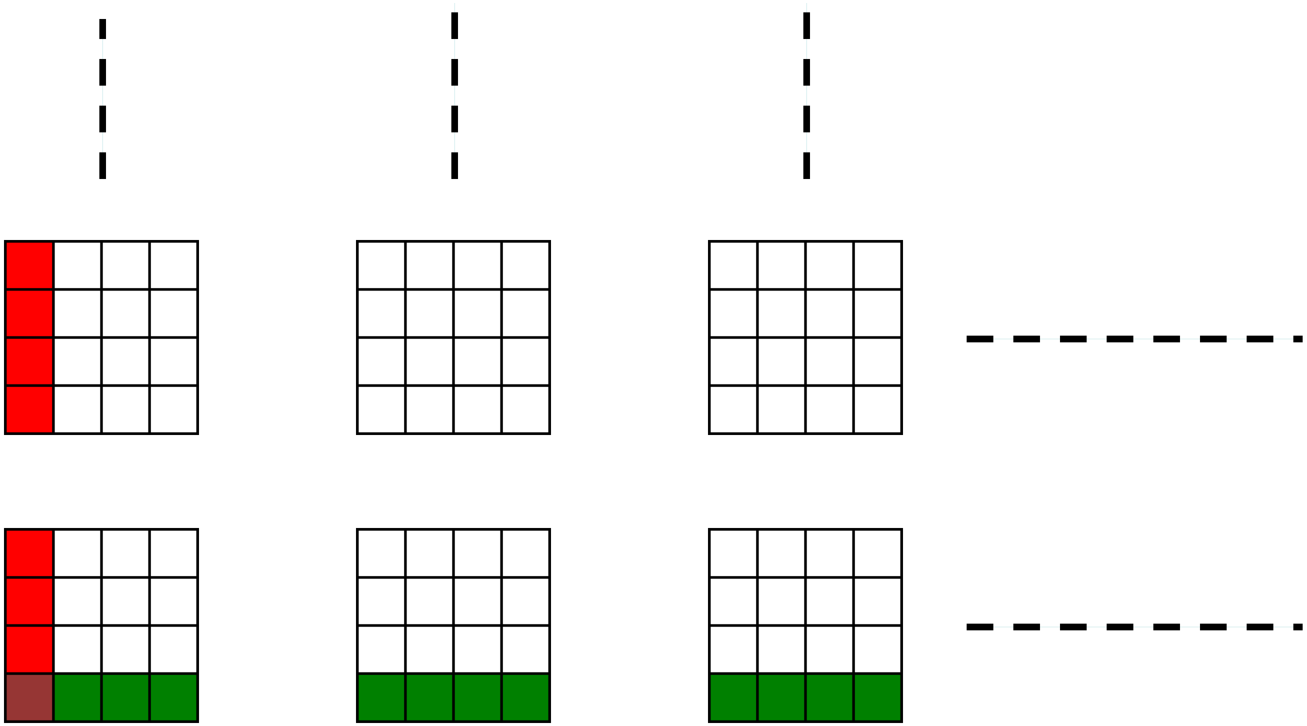
- Singe compiler for chemistry and transport kernels.
- The legion port operational for periodic problems.

Scenario for physical boundaries



□ interior

🟥 Boundary type 1

🟩 Boundary type 2

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- Implement/register tasks for each BC type (a.k.a MiniAero).
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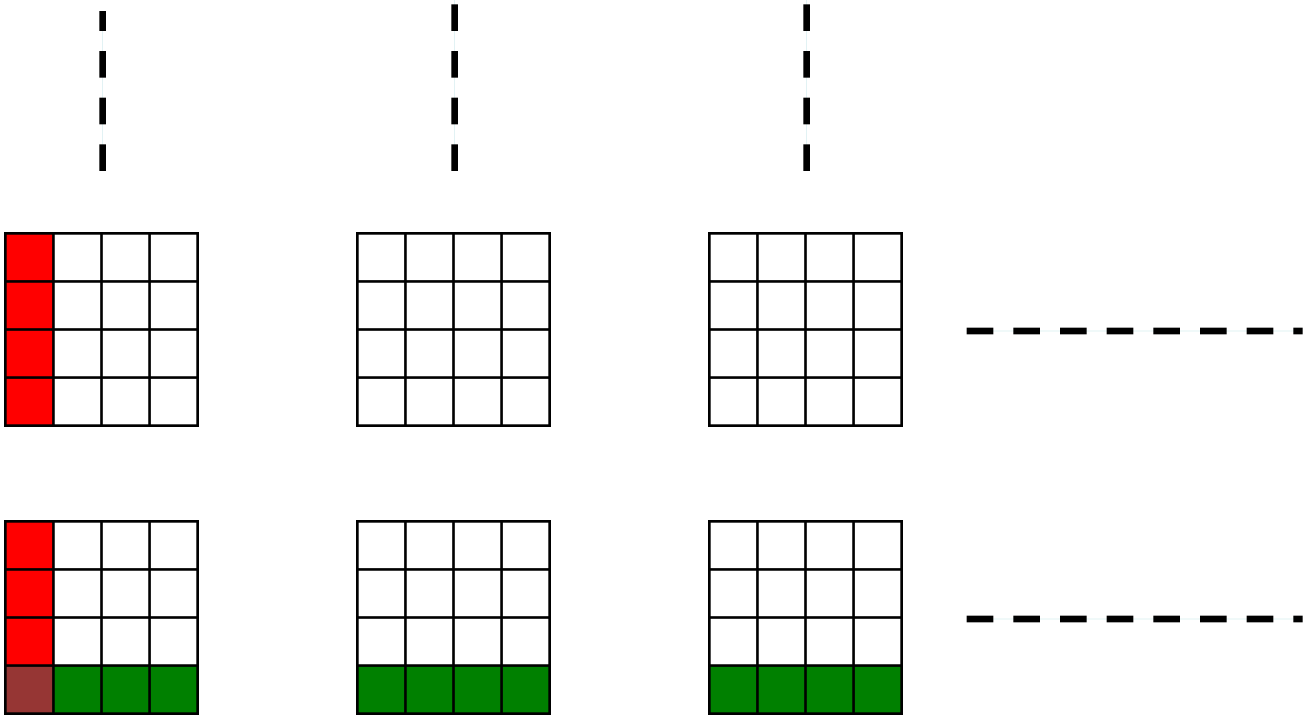
Option B

- Have a generic BC task.
- Branch statements for implementing the BC type required by the problem.



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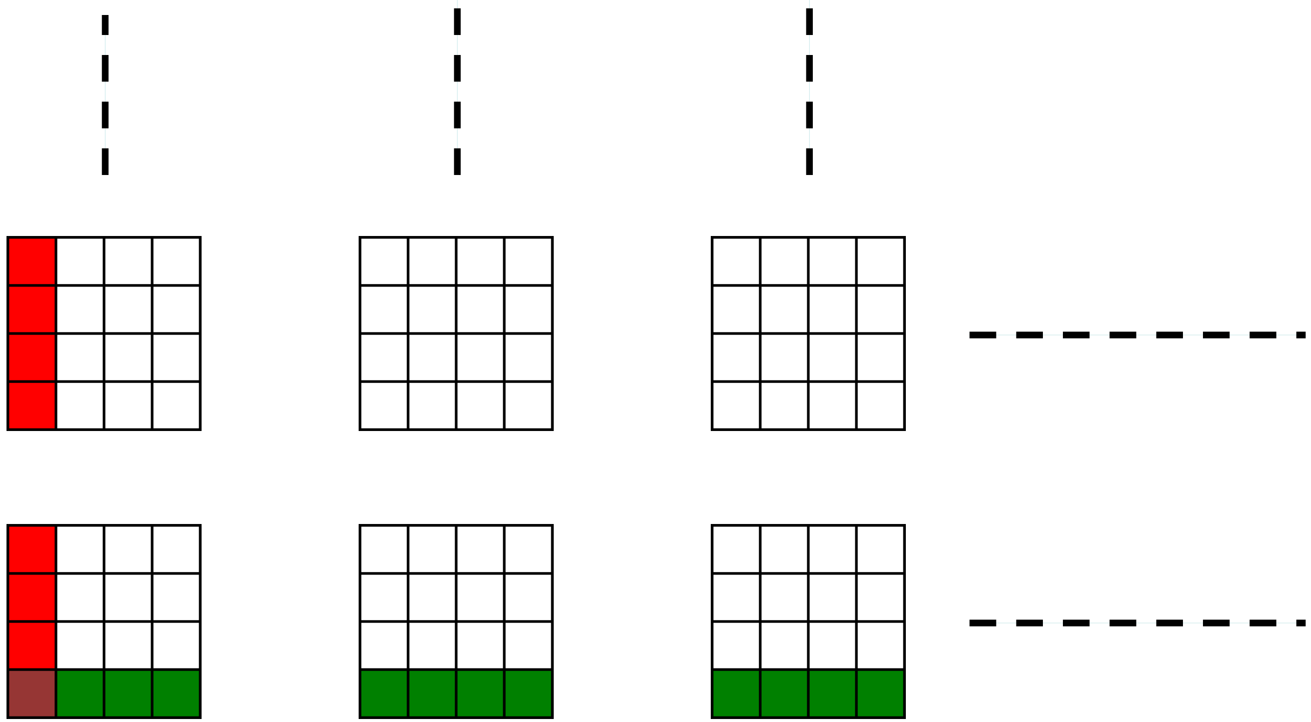

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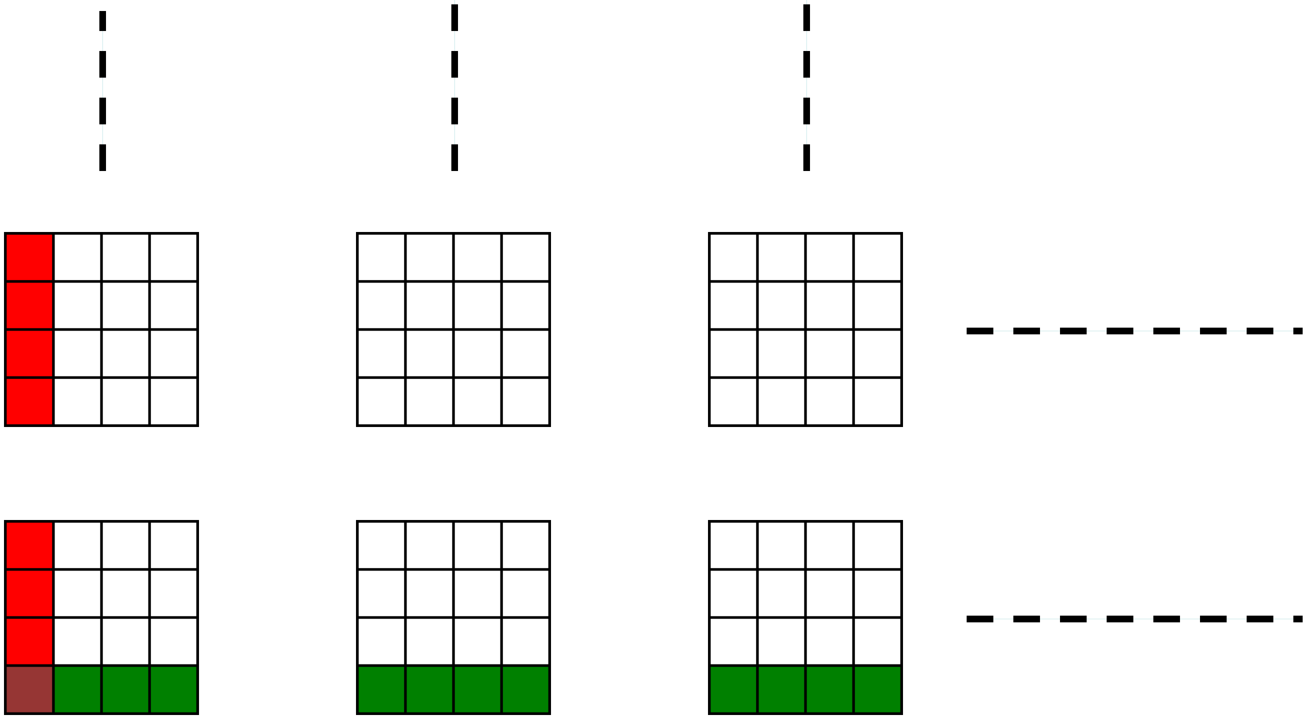

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- Launch all bc_type tasks for all spmd subdomains.
- BC types that do not exist => NO_REGION requirement => no task instance.

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- What is the nature of an index space task that has only arguments but NO_REGION requirements?
- What is the nature of an index space task whose region requirements are all READ_ONLY?

Miscellaneous Observations

- Iterating over an index_space or Rect based off of a NO_REGION causes runtime error. Users need to check for this.
- Projection functions could be better documented, maybe with a good example.
- In S3D, BCs require specialized stencils (in_plane, one-sided, variable-width) which is hard/tricky with explicit ghost zones.
- Peeking into the runtime (legion.*, runtime.*) is not hairy and occasionally very helpful.

Thank you