Regent Update

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Goal: Pushing the Performance Envelope with Compilation

Task Granularity

- Coarse-Grained
- Fine-Grained

Scale

- Small
- Large

Dynamic Analysis

Static Analysis
Static Control Replication

Diagram showing the replication process with nodes labeled F[0], F[K], F[N-K], G[0], G[K], G[N-K] connected with arrows indicating the flow between them.
Weak Scaling with Control Replication

Weak Scaling ($40000^2$ Grid Points/Node)

Throughput ($10^8$ Grid Points/Node/s)

flat is better

Throughput:
- Regent
- Regent (no CR)
- MPI
- MPI+OpenMP

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http://regent-lang.org
Impact of Control Replication: 
$O(N)$ Overhead $=>$ $O(1)$

lower is better
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Task Granularity

Scale

Coarse-Grained

Fine-Grained

Static Analysis

Dynamic Analysis

http://regent-lang.org
Why Static Analysis?

- Legion is a dynamic *pipelined* runtime
  - Logical dependence analysis
  - Mapping
  - Physical dependence analysis
  - Execution

- Cost is hidden as long as:
  - Throughput of runtime >= velocity of tasks

- Use static analysis to avoid work at runtime
  - Ideal case:
    - *Logical dependence analysis*
    - Mapping
    - *Physical dependence analysis*
    - Execution
for i = 0, 3 do
  calc_forces(…, points)
end
for i = 0, 3 do
  adv_pos_full(p_points[i])
end
Future: Static Dependence Analysis

```
for i = 0, 3 do
    calc_forces(…, points)
end
for i = 0, 3 do
    adv_pos_full(p_points[i])
end
```
RDIR: Construction

while $t < T$ do
    for $i = 0, 3$ do -- $\text{Red+}(p_{\text{ghost}})$
        calc_forces(\ldots, p_{\text{ghost}}[i]) -- $\text{Red+}(p_{\text{ghost}}[i])$
    end
    for $j = 0, 3$ do -- $R(p_{\text{master}})$
        adv_pos_full(p_{\text{master}}[i]) -- $R(p_{\text{master}}[i])$
    end
    \ldots
end

\[\begin{array}{c}
\text{points} \\
p_{\text{ghost}} \\
p_{\text{master}} \\
\end{array}\]
Plan for Static Analysis

- Static Dependence Analysis (RDIR)
- Static Mapping (Bishop)
- Generate Static Realm Dataflow Graph
- Runs as Operation in Legion Pipeline
Not Just Static: JIT

- Some applications don’t fit static analysis
- But some of these properties are JIT-static
- Start executing Regent compiler at runtime
  - Just another stage in the runtime