NO CONCURRENT COLLECTIONS TUTORIAL

The Eighth Annual Concurrent Collections Workshop
2016/09/27
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Agenda

Isolation

Intel® CnC...

Graphs
Separation and Isolation in CnC

- **Semantics/Dependences** From Tuning and Platform
- **What and How** From Where and When
- **Control** From Data
- **Consumer** From Producer
- **Controller/Caller** From Controlee/Callee
Semantics/Tuning

Abstract CnC

- Domain-spec vs tuning spec

Intel® CnC

- Collections vs Tuners
  - Combination decided at compile-time
  - Communication selected at runtime
Semantics/Tuning

Abstract CnC

• No code
• Tuning spec
  • Grouping
  • Placement
  • ...

Intel® CnC

• Steps define the how
• Collections define what
• C++ API brings them together
• Tuners define
  • Placement
  • influence timing
  • ...

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What and How / Where and When

Abstract CnC

• No explicit concept of time
• No concept of space
• Collections are arbitrators/proxies
  • Put and get

Intel® CnC

• Steps define the how
• Collections define what
• Tuners define placement and influence timing
• A step use only IO collections for communication (sender/receiver is unknown)
Control/Data

Abstract CnC

• Control is explicit
  • Special edges or
  • Dedicated control collections
• Data is separate
  • "if" something needs to be done can be elsewhere (in time and space) than its input data

Intel® CnC

• Explicit control collections
  • Separates controller/controlee
Consumer/Producer, Controller/Controlee

Abstract CnC

• Collections serve as arbitrator

Intel® CnC

• Steps only communicate with IO collections
• Other side is unknown/not important
• Space and time are also irrelevant
• Runtime coordinates
Agenda

Isolation

Intel® CnC...

Graphs
Intel® CnC

C++ (open source, Linux, Windows, Xeon, Phi™...)
  • Good performance through TBB, MPI and C++ template optimization potential

Domain API - Tuner API
  • Linked/combined at compile-time

Shared and distributed memory
  • With tuning only required data is transferred

Debugging aids
  • Tracing: printf and Intel® Trace Analyzer and Collector
  • Detailed timing
Intel® CnC - Advanced

**Tuning**

- Placement
- Scheduling (avoid re-try, priority)
- GC
- Sequentialization
- Cancelation
- Range/set partitioning
- Storage type (vector, hashmap, DB)

**Lower-level APIs**

- Communicator
- Scheduler
- Distributor (future)
Agenda

Isolation

Intel® CnC...

Graphs
Goal: compose components but minimize requirements

⇒ Maximize exposed parallelism
⇒ Maximize flexibility
⇒ Minimize visibility
⇒ Keep it simple

Let their semantic dependences be the only restriction on parallelism.

• no implicit (or even explicit) barriers

Stick with the dependence theme.

Resource utilization will be nicely isolated as a separate concern.
Example: Graph-like Reduction in Intel® CnC

- Operates on a “continuous” stream of incoming elements
Example: Graph-like Reduction in Intel® CnC

- Operates on a “continuous” stream of incoming elements
- Continuous input accessed via callbacks
- Input/output to a graph handled through CnC collections
Example: Graph-like Reduction in Intel® CnC

- Operates on a “continuous” stream of incoming elements
- Continuous input accessed via callbacks
- Input/output to a graph handled through CnC collections
- Connected steps operate with usual put/get semantics

```
Elems.put(x,y);
...
Ns.put(r,n);
...
Reduce
RedVals
...
RedVals.get(r,v);
...
```
Example: Graph-like Reduction in Intel® CnC

- Operates on a “continuous” stream of incoming elements
- Continuous input accessed via callbacks
- Input/output to a graph handled through CnC collections
- Connected steps operate with usual put/get semantics

```
... Elems.put(x,y);
...

p1

Elems

Reduce

RedVals

c1

... Ns.put(r,n);
...

p2

Ns

One Reduce graph handles multiple reduction instances (concurrently)

... RedVals.get(r,v);
...```
Example: Graph-like Reduction in Intel® CnC

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- Input/output to a graph handled through CnC collections
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Example: Graph-like Reduction in Intel® CnC
Ongoing Graph Discussions

Can a graph be prescribed and if so, what does it mean?

What's the "home" of IO collections?

Connecting runtimes through graphs?

Hierarchical data?

Hierarchical tag-spaces?
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