Unbalanced tree-search at scale using the Chapel’s DistributedBag module

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Virtual event
Need for a specialized data structure

Combinatorial optimization

e.g. the Branch-and-Bound (B&B) method:

- **Exact method**
  - Large trees
  - **Memory efficiency**

- **Node elimination (pruning)**
  - Irregular trees
  - **Load balancing**

The Chapel’s DistributedBag package module

The `distBag` data structure:

- Extensively reworked in Chapel 2.0
- Parallel-safe distributed multi-pool specialized for Depth-First Search (DFS)
- Dynamic load balancing mechanism, based on work stealing
CODE DEMO:

*distBag*-based distributed multi-core B&B applied to the Permutation Flowshop Scheduling Problem (PFSP)

[Click here to access the video]
distBag-based scalable B&B: Experimental results

(higher is better)

Fig. 1: Strong scaling efficiency.

- TOP500-ranked MeluXina supercomputer:
  2 × 64-cores AMD EPYC Rome 7H12 @ 2.6 GHz CPUs and 512 GB of RAM per node. Interconnection using the InfiniBand HDR high-speed fabric.

- 50% of strong scaling efficiency using 400 compute nodes (51,200 CPU cores)
Conclusions & Future perspectives

- **distBag** is a powerful tool to implement tree-based algorithms at scale
- We demonstrated its efficiency at scale on the B&B method applied to PFSP

Future perspectives:
- Look for ways that programmers might not need to pass the task ID
- Collect users feedbacks and improve/add features
- Performance optimization and tuning

Thank you for your attention.

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