DATA-STRUCTURE SUPPORT FOR AFDM

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Storage Philosophy

- Shared name space based on a global symbol table
- Symbol table implemented as a distributed hash table with local caching

Fundamental Data-Structures

- Scalable Distributed Dynamic Grid (SDDG)
- Distributed Adaptive Grid Hierarchy (DAGH)

SDDG Representation

- Transform to 1-D based on space filling curves
- Block to generate required granularity
- Assign weights to blocks based on associated work
- Partition list of blocks based on block weights

SDDG Representation

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15

{0 1 4 5 2 3 6 7 8 9 12 13 10 11 14 15} (Morton)

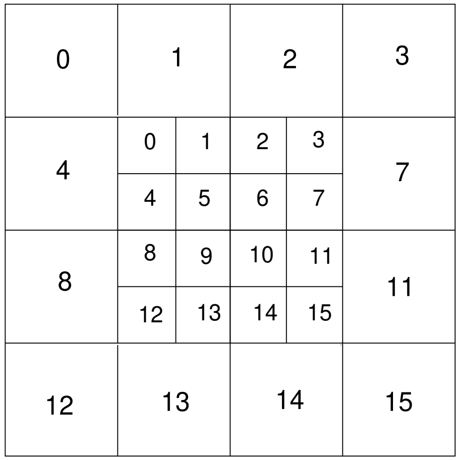
{0 1 5 4 8 12 13 9 10 14 15 11 7 6 2 3} (Peano-Hilbert)

DAGH Representation

- Array of independent lists
  $\Rightarrow$ 2-D array of SDDGs
  $\Rightarrow$ supports hierarchical view GRID

- Composite list
  $\Rightarrow$ single composite list of DAGH
  $\Rightarrow$ supports composite view of GRID

DAGH Composite Representation



{0 1 4 {0 1 4 5} 2 3 {2 3 6 7} 7 8 {8 9 12 13} 12 13 {10 11 14 15} 11 14 15} (Morton)

{0 1 {0 1 5 4} 4 8 12 13 {8 12 13 9 10 14 11 15} 14 15 11 7 {7 6 2 3} 2 3} (Peano-Hilbert)

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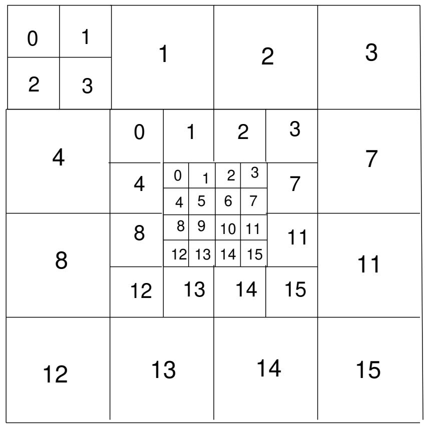
DAGH Composite Representation



{{0 1 2 3} 1 4 {0 1 4 {0 1 4 5}} 2 3 {2 3 {2 3 6 7} 7} 7 8 {8 {8 9 12 13} 12 13} 12 13 {{10 11 14 15} 11 14 15} 11 14 15} (Morton)

{{0 1 3 2} 1 {0 1 {0 1 5 4} 4} 4 8 12 13 {8 12 13 {8 12 13 9 10 14 15 11} 14 15 11} 14 15 11 7 {7 {7 6 2 3} 2 3} 2 3} (Peano-Hilbert)

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DAGH Composite Representation

- Generate SDDG for base grid
- For each refined region
  -replace parent sub-list by child list
  -modify sub-list weights to represent (parent + child)
- Repeat for each level of refinement
- Partition list of blocks based on block weights

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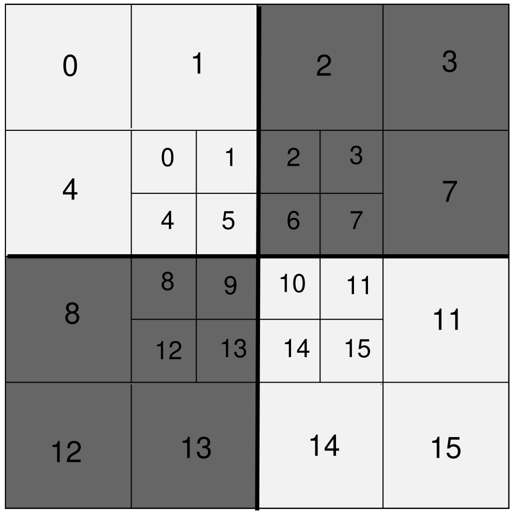
Data-Structure Representation

Motivations:

- Enables composite representation/decomposition of DAGHs
- Operations on a 1-D list
  - partition, merge, cluster, concatenate, sort
- Support the dynamics the data-structure
- Representation/access of internal/external boundaries
- Space filling curves tend to maintain locality
  (small overheads for SDDG distributions)
- Towards unification of APM/AFDM/AFEM methods

DAGH Composite Distribution



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P0 P1 P2 P3

{0 1 {0 1 5 4} 4 8 12 13 {8 12 13 9 10 14 11 15} 14 15 11 7 {7 6 2 3} 2 3} (Peano-Hilbert)
P0 P1 P2 P3

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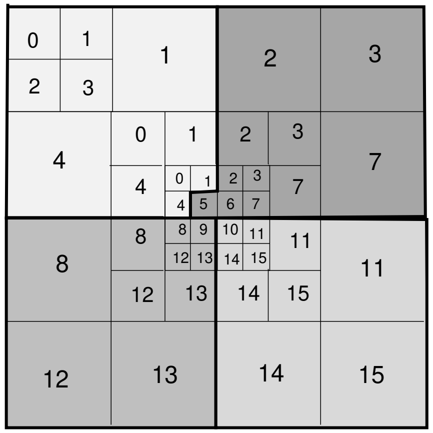
DAGH Composite Distribution



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P0 P1 P2 P3

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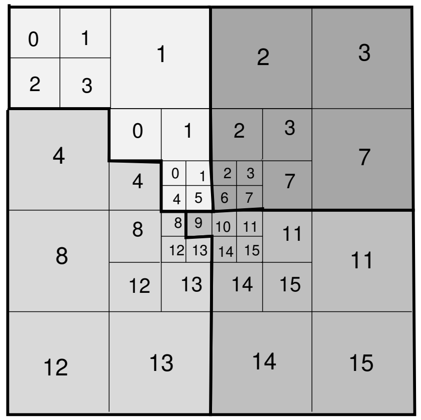
DAGH Composite Distribution



{{0 1 3 2} 1 {0 1 {0 1 5 4} | 4} 4 8 12 13 {8 12 13 {8 12 13 | 9 10 14 15 11} 14 15 11} 14 15 11 | 7 {7 {7 6 2 3} 2 3} 2 3} (Peano-Hilbert)

P0 | P1 | P2 | P3

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