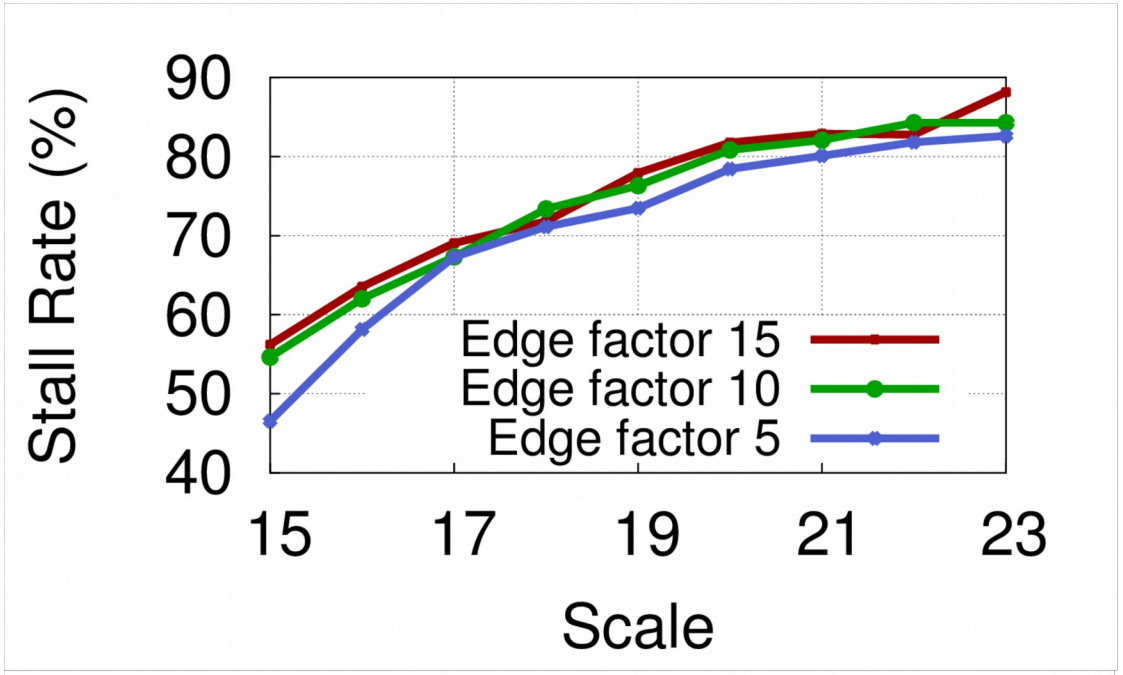
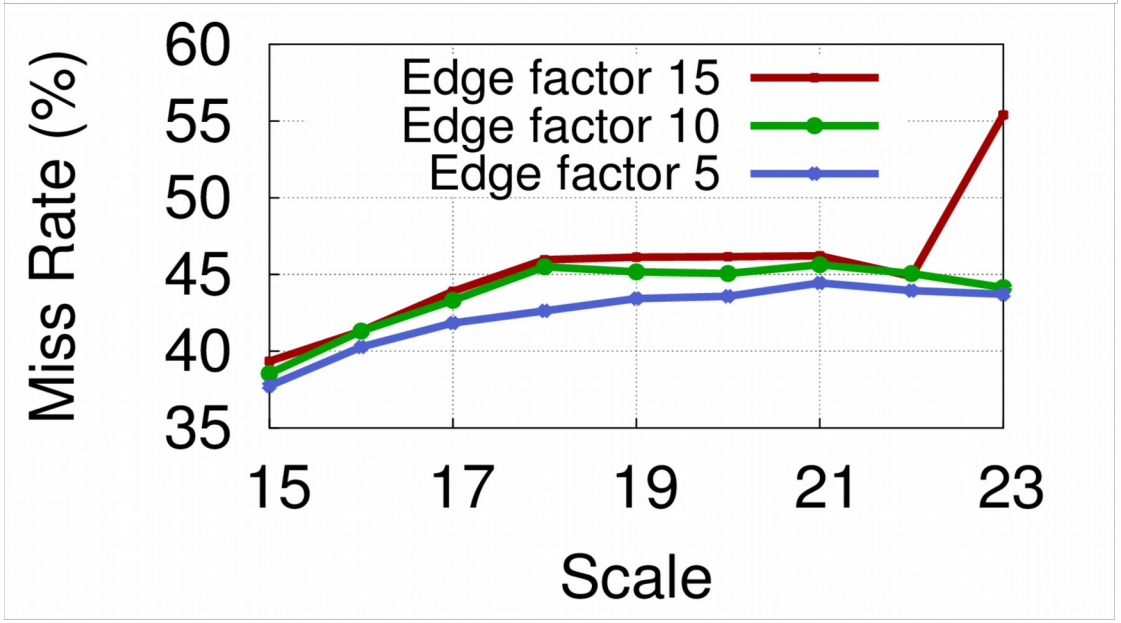
Graph Prefetching Using Data Structure Knowledge

Sam Ainsworth and Timothy M. Jones

Computer Laboratory

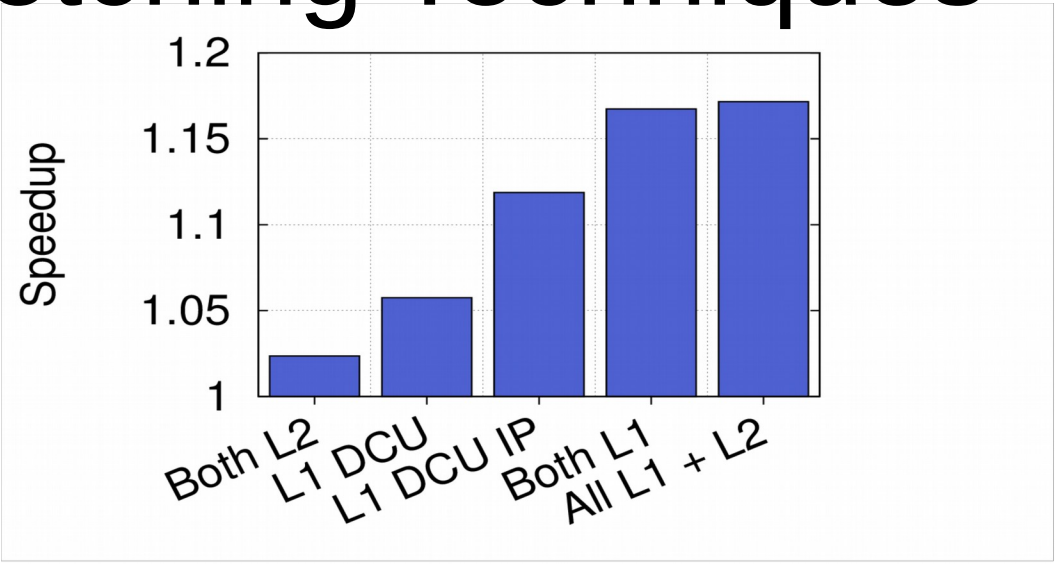
Graph500 Search Performance



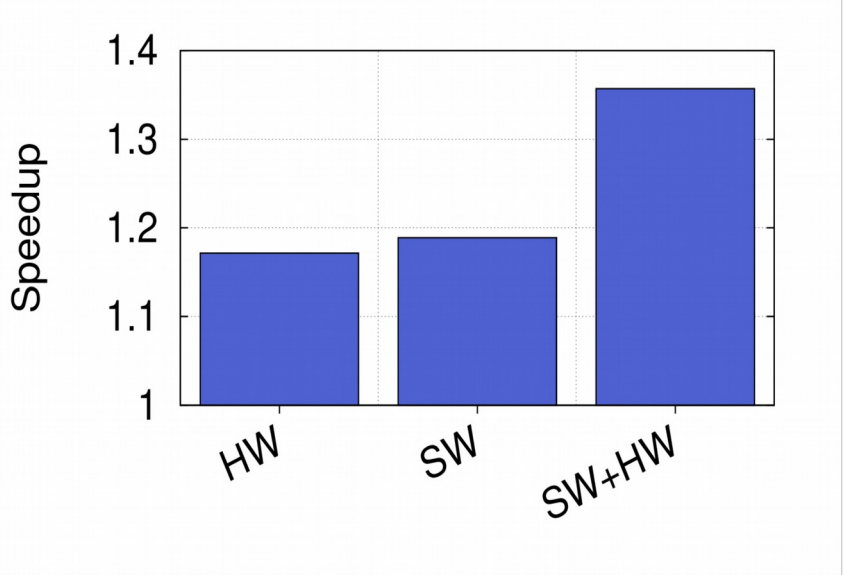


Current Prefetching Techniques

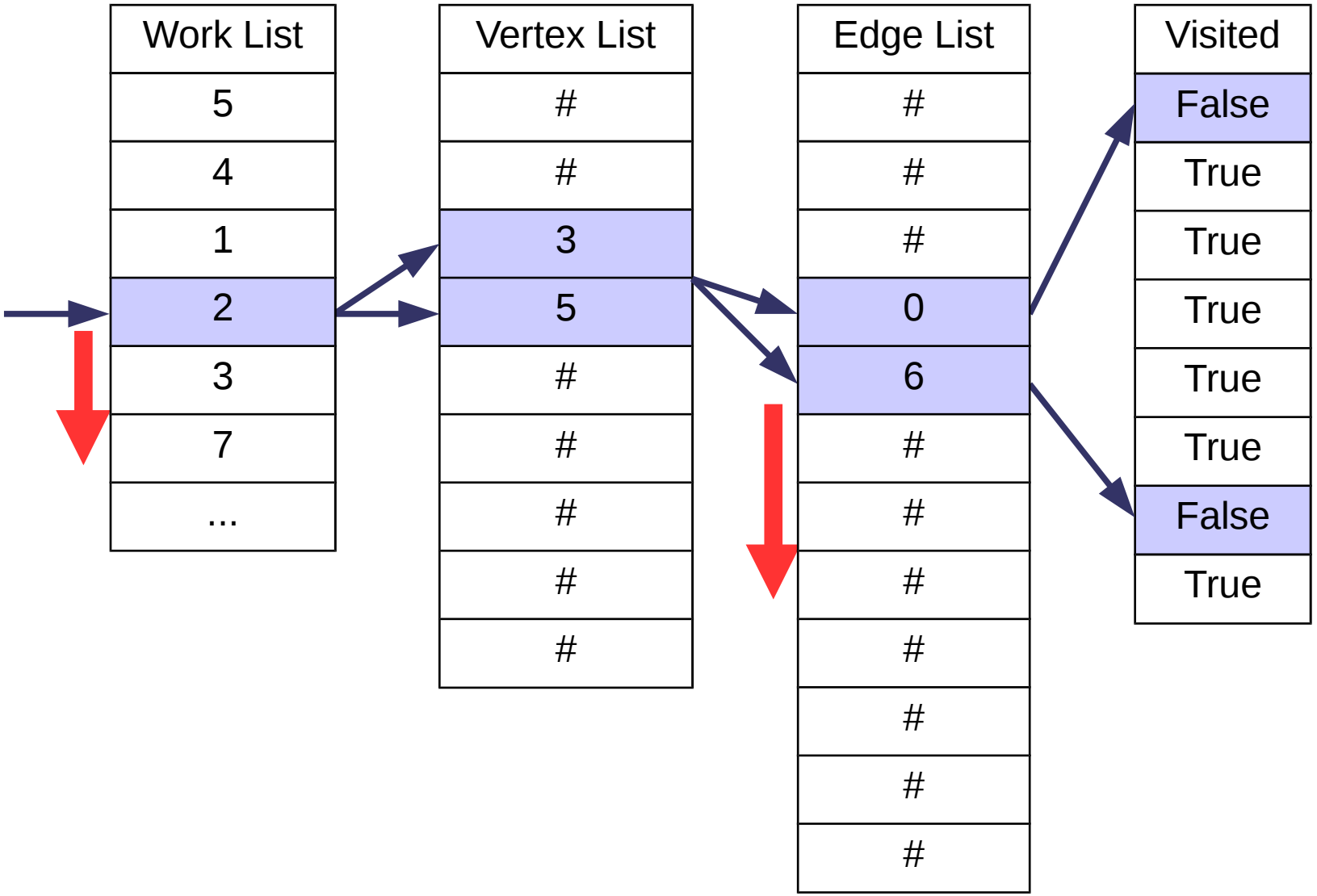
- Stride



- Software



Exploit Look-ahead!



Problems

- Need address bounds of data structures
- Need to schedule prefetches
- Need to react to variable latency loads

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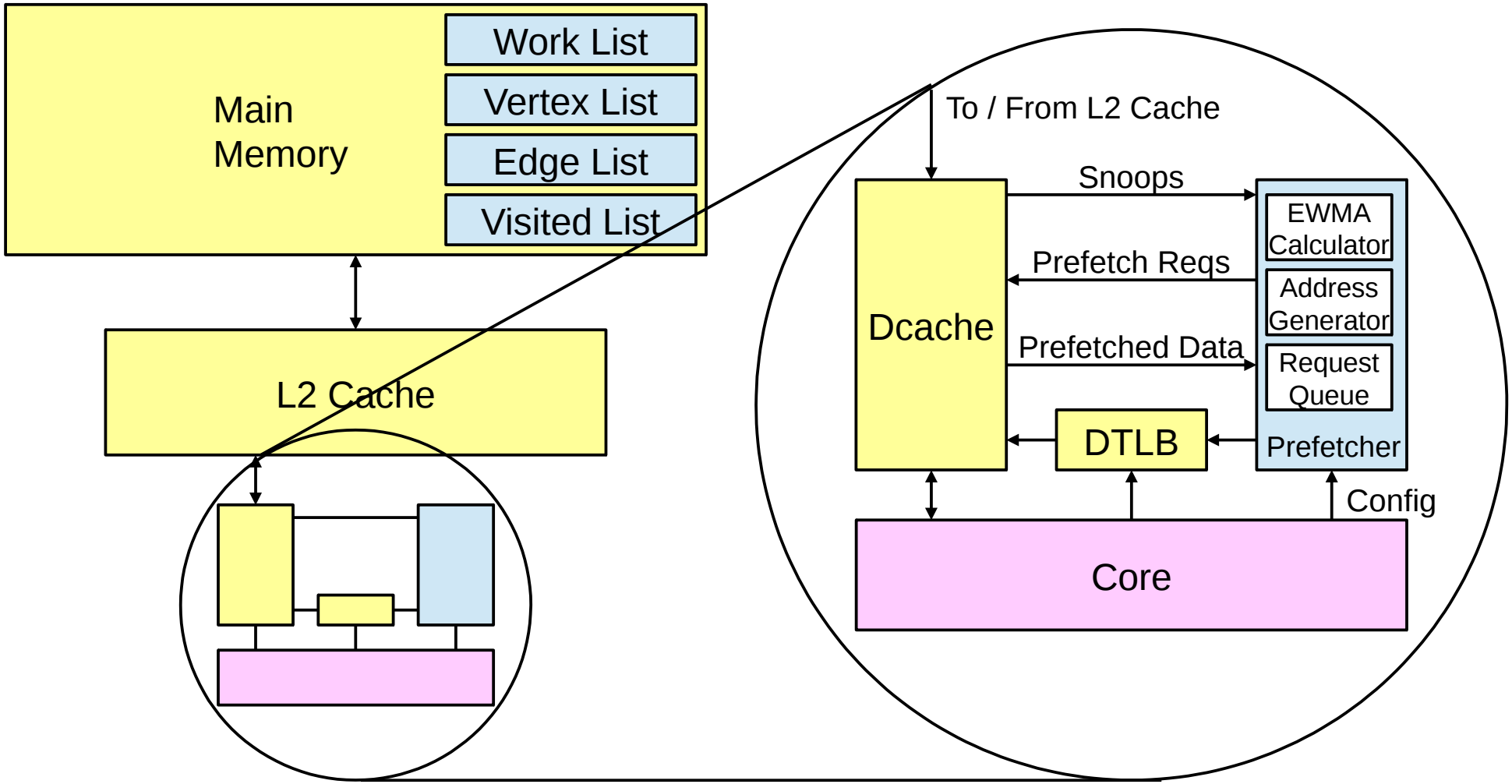
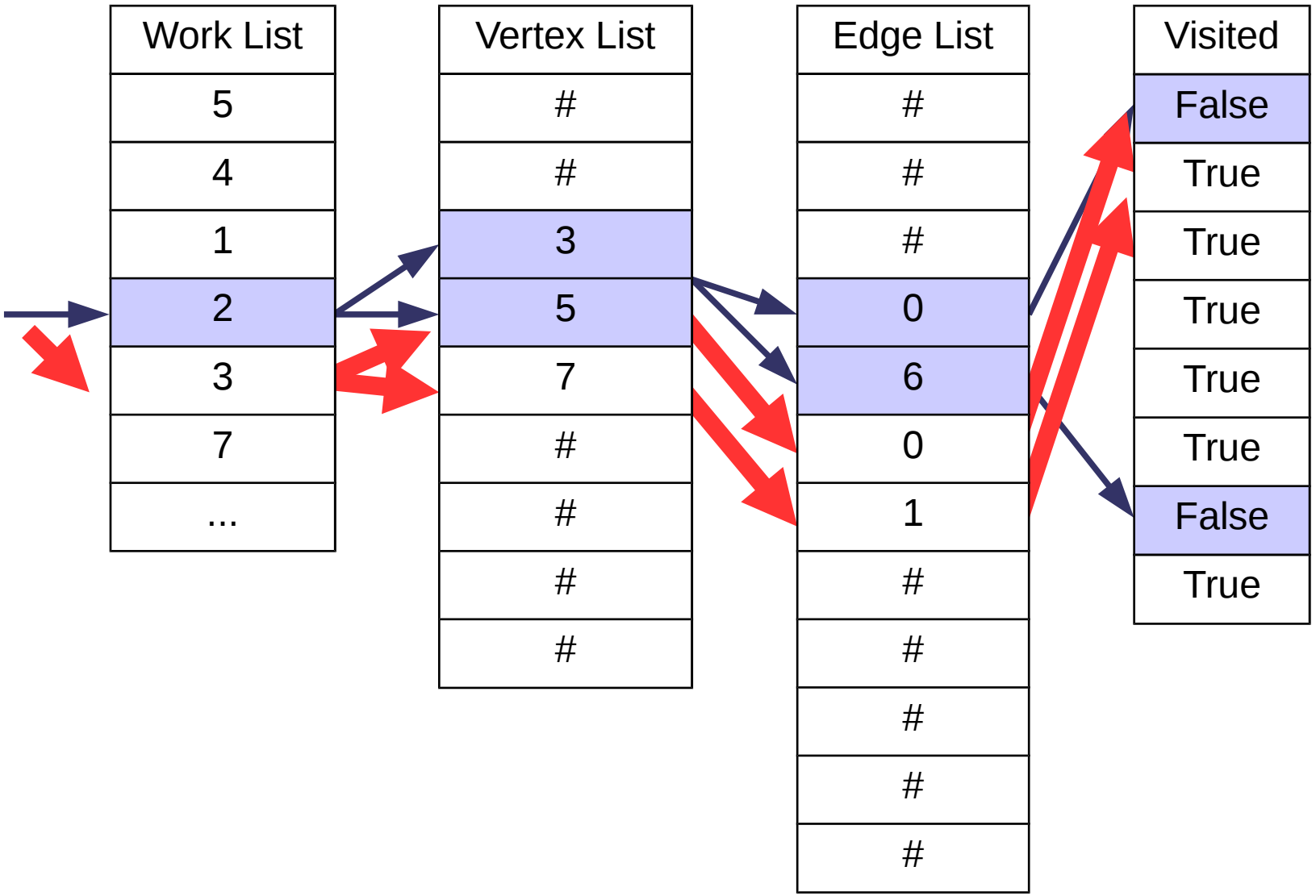
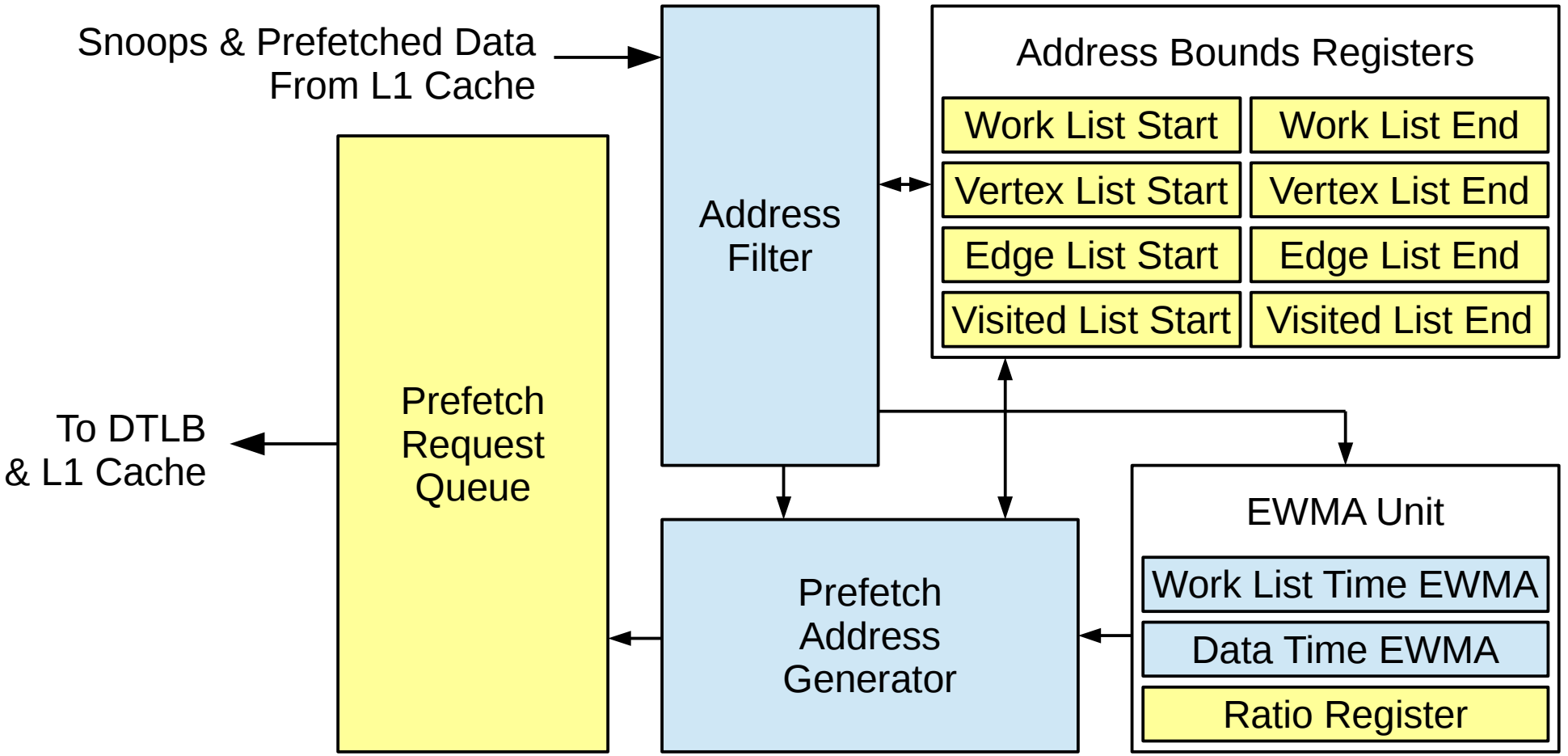
- Need address bounds of data structures
  - Configure them in software!
- Need to schedule prefetches
  - Use observation hardware – EWMAs.
- Need to react to variable latency loads
  - React to arrival of prefetches, not loads!

Graph Prefetcher

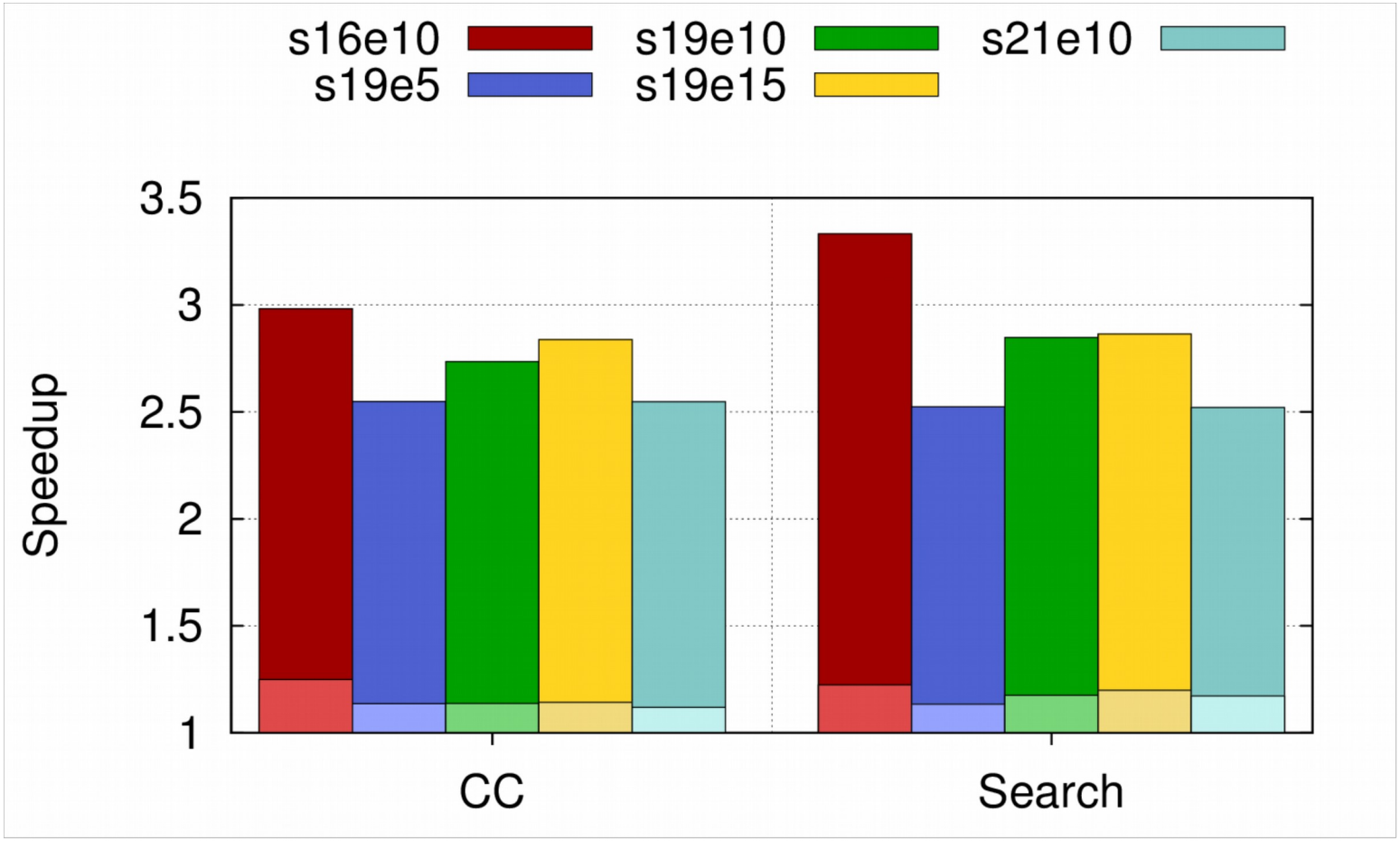



Work List
5
4
1
2
3
7
...
Vertex List
#
#
3
5
7
#
#
#
#
Edge List
#
#
#
0
6
0
1
#
#
#
#
#
Visited
False
True
True
True
True
True
False
True

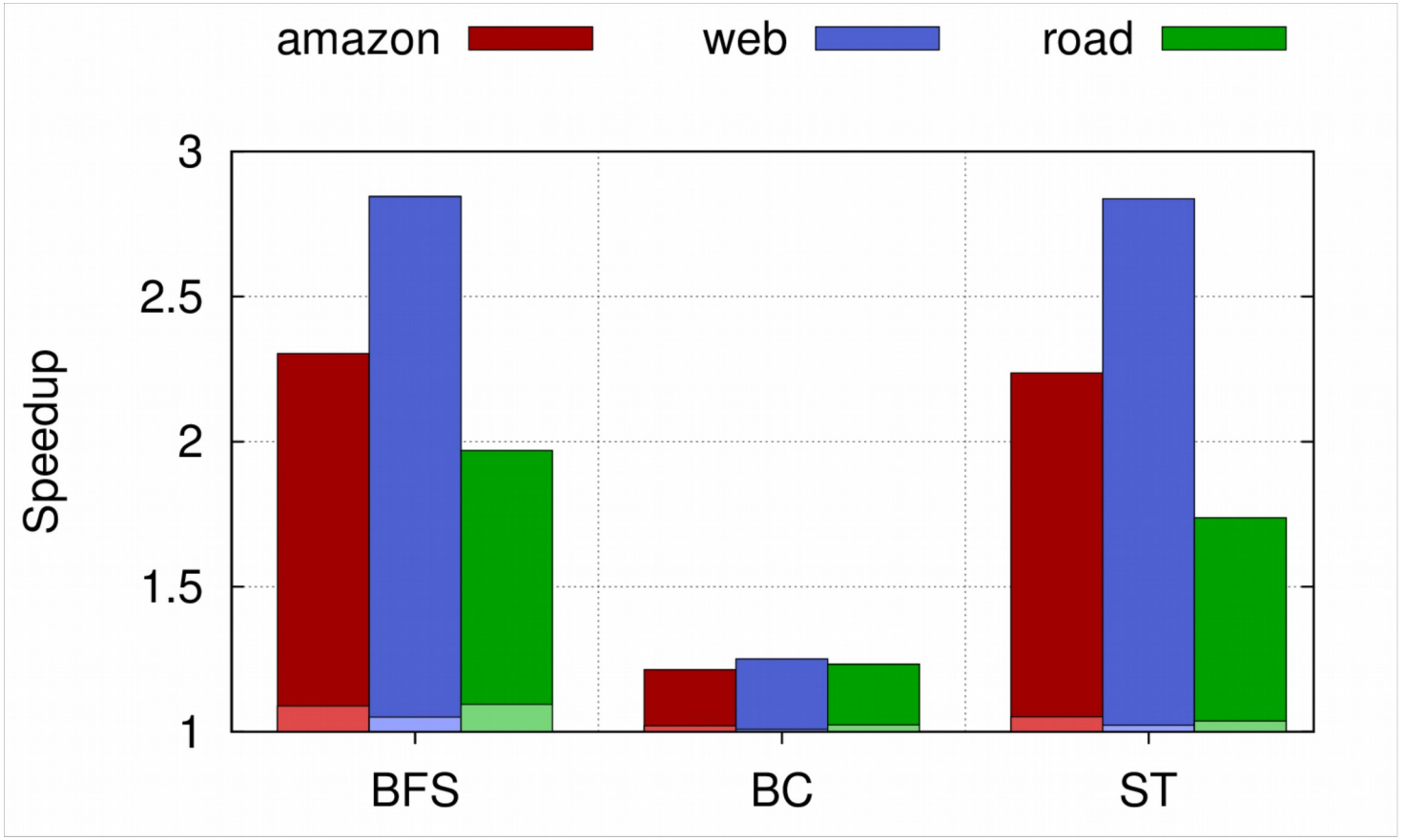
Graph Prefetcher: Microarchitecture



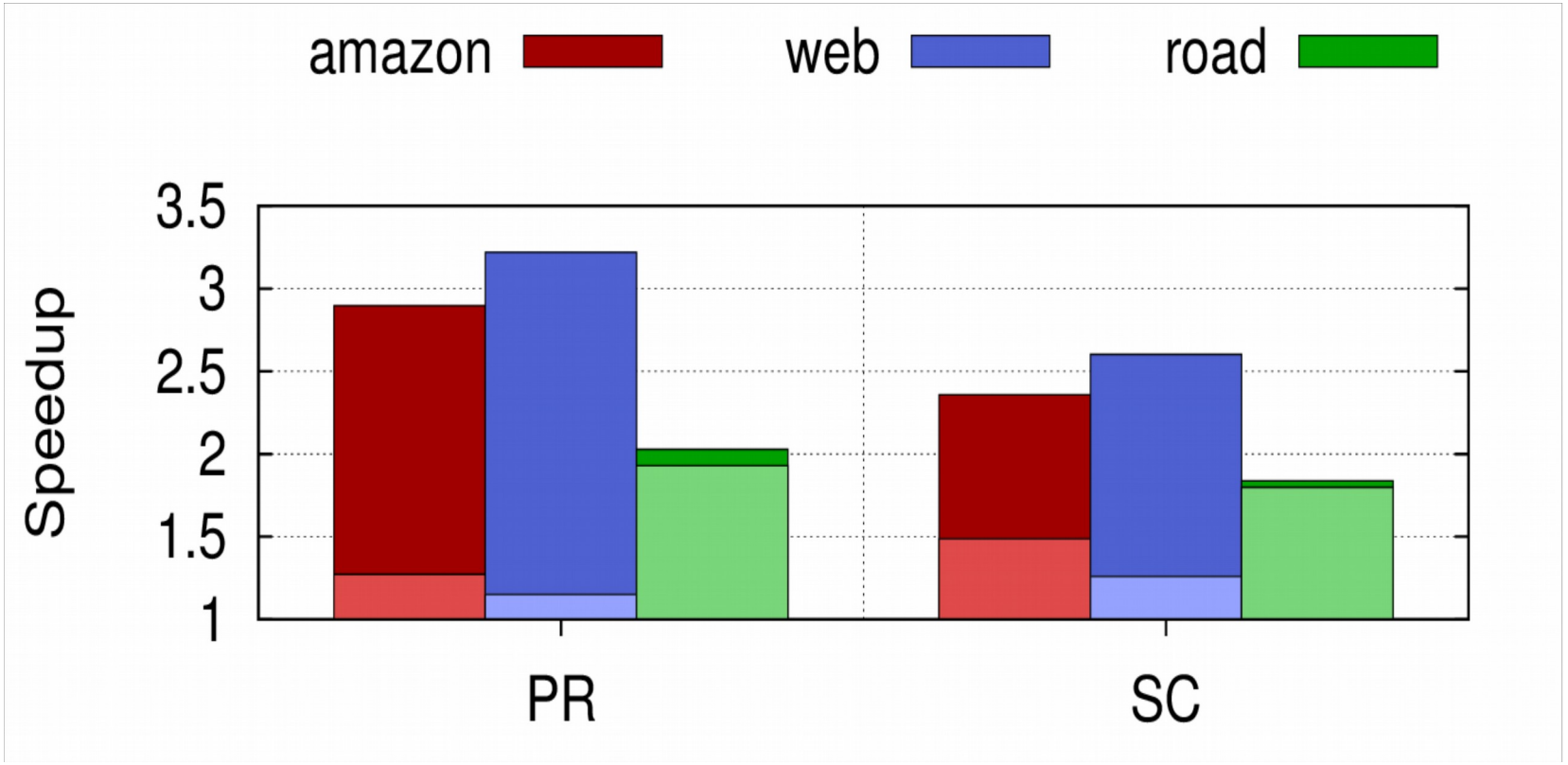
Results – Graph500



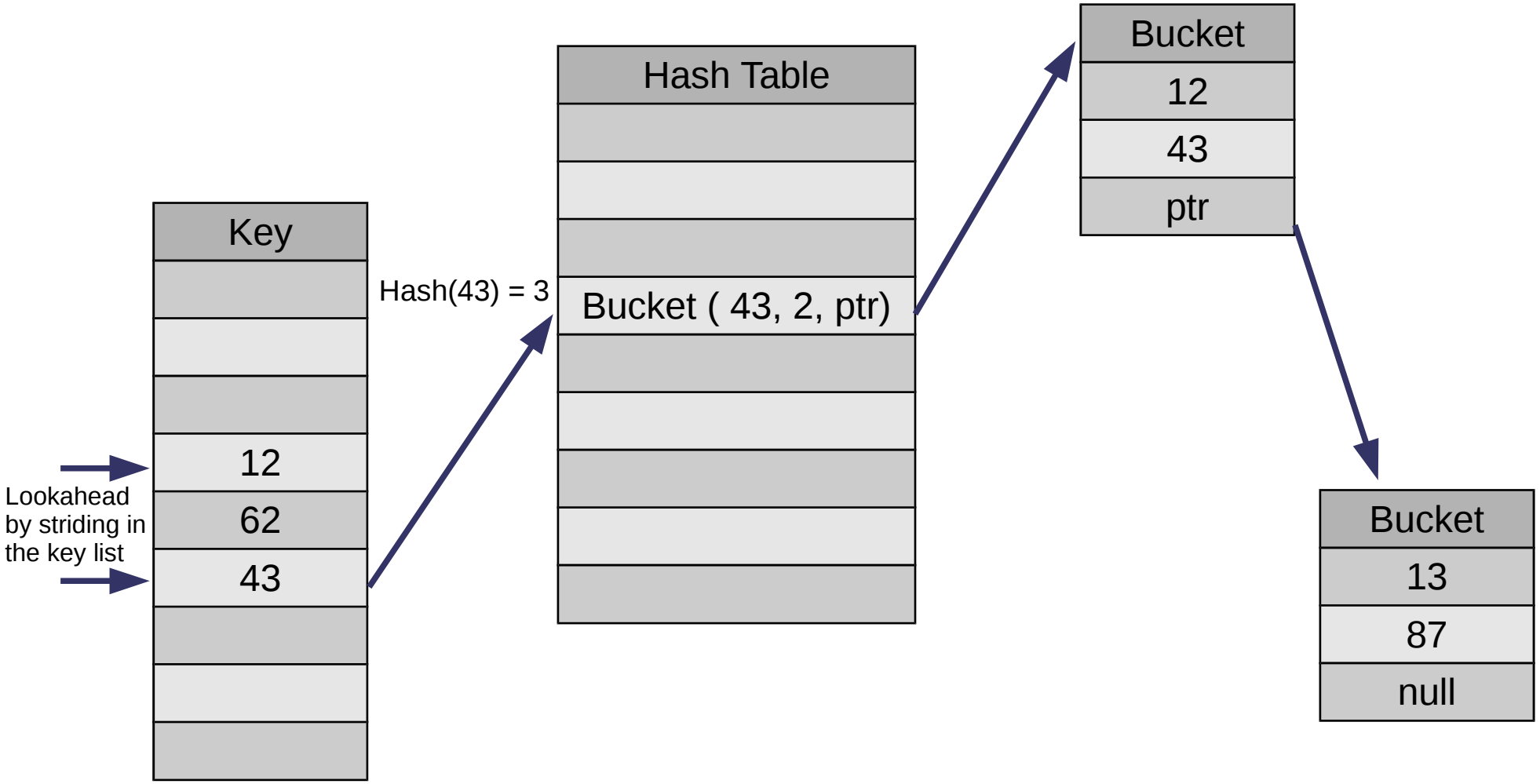
Results – Boost Graph Library



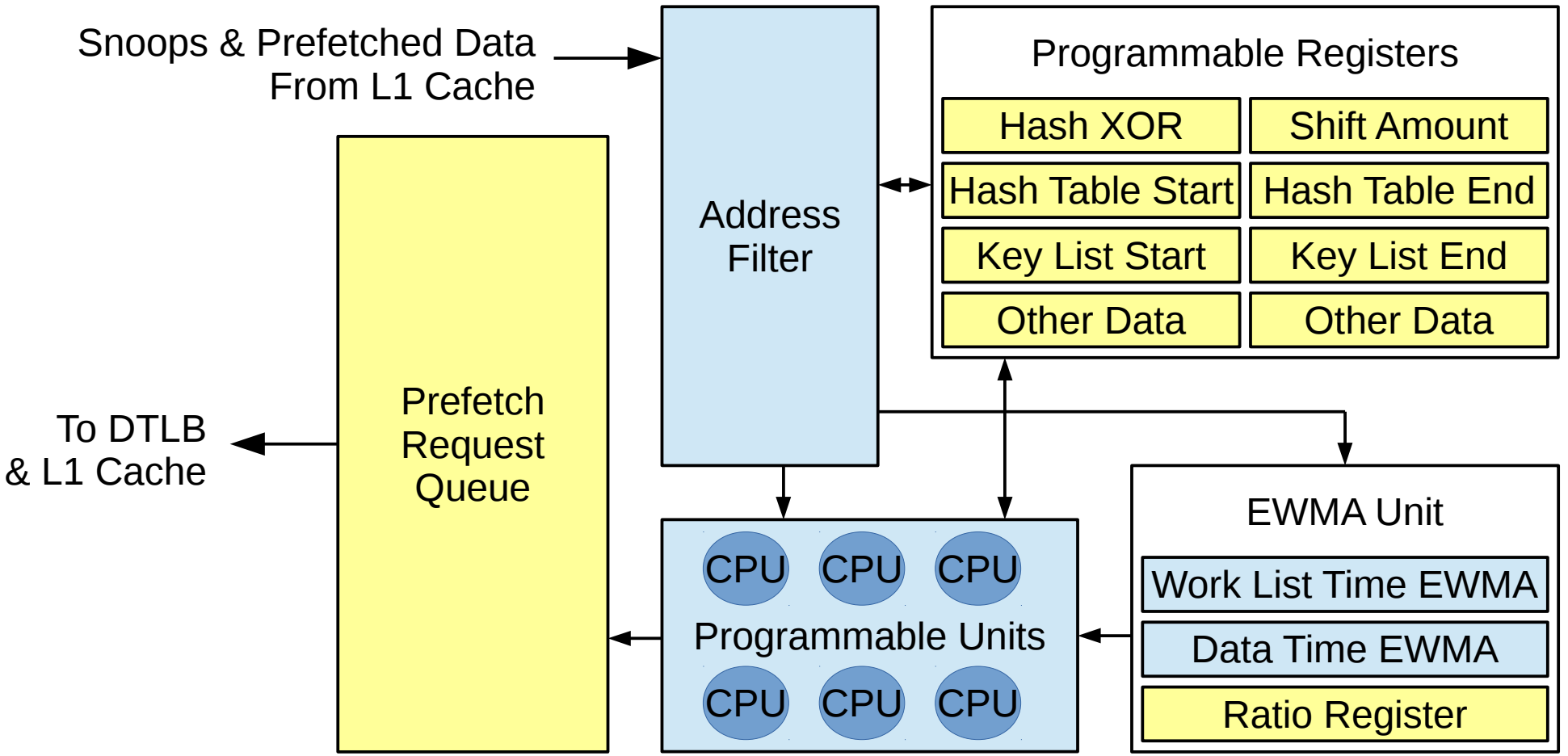
Results – Sequential Iteration



Generalized Prefetching - Databases



Programmable Prefetcher



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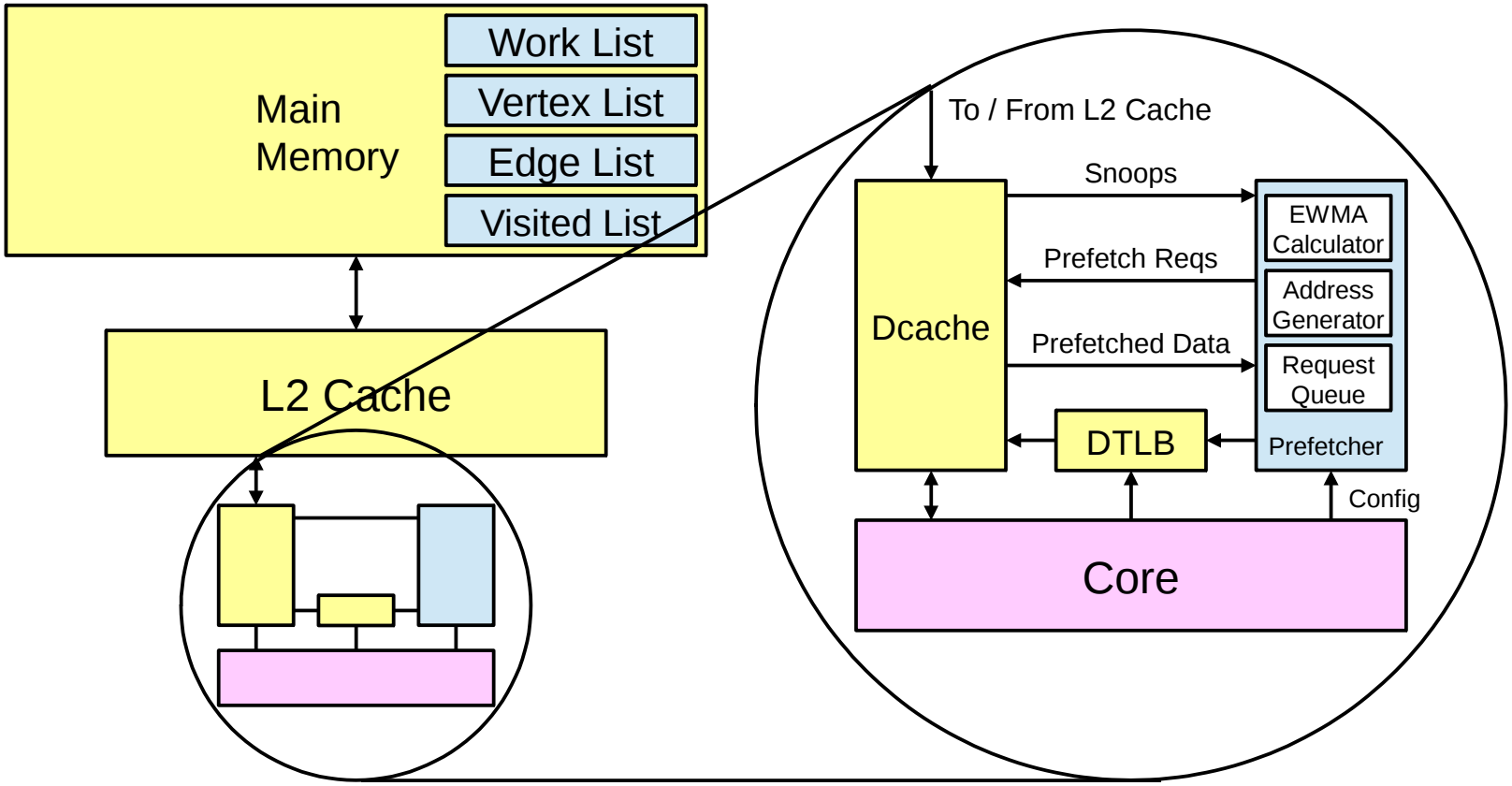

For more information, see our paper from ICS 2016!