GMetis - Xeon Phi

David Pereira Rui Brito

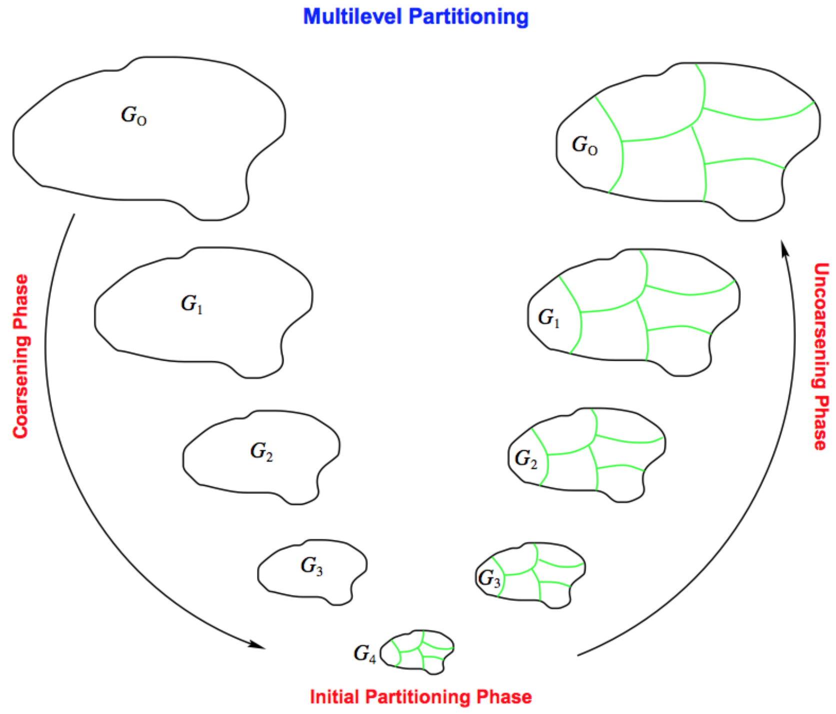
August 7, 2013

Outline

Introduction

- GMetis is a graph partitioning application which uses the Galois framework
- Consists of three major phases
  - Coarsening
    - Find matching nodes
    - Coarsen Graph
  - Initial Partitioning (Clustering)
  - Refinement

Algorithm Description



Formal Description

- Given a graph $G_0 = (V_0, E_0)$:
  - Coarsening
    - For a given graph G_0 is transformed into a sequence of smaller graphs $G_1, G_2, \cdots, G_m$ such that $|V_0| > |V_1| > |V_2| > \cdots > |V_m|$
  - Partitioning
    - A 2-way partition P_m of the graph $G_m = (V_m, E_m)$ is computed that partitions V_m into two parts, each containing half the vertices of G_0
  - Refinement
    - The partition P_m of G_m is projected back to G_0 by going through intermediate partitions $P_{m-1}, P_{m-2}, \cdots, P_1, P_0$

Stampede Host

Manufacturer	Intel
Model	Xeon E5-2680
μArch	Sandy Bridge
Clock freq	2.70 GHz
#CPUs (sockets)	2
#Cores/CPU	8
#Thread/Core	1
L1 cache size/core	32 KB
L2 cache size/core	256 KB
L3 shared cache size/CPU	20 MB
Vector width	256 bits (AVX)

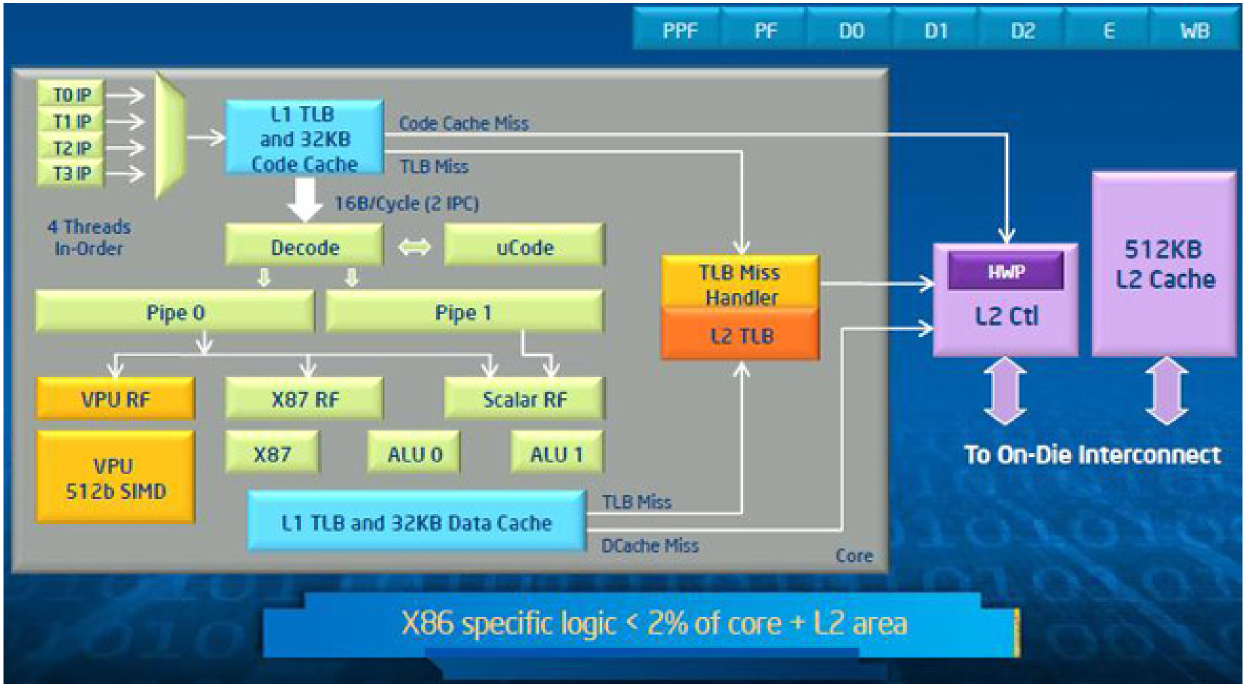
Table 1 : Intel Xeon E5-2680

Stampede Co-processor - Xeon Phi

Manufacturer	Intel
Model	Xeon E5-2680
μArch	Sandy Bridge
Clock freq	1.1 GHz
#CPUs (sockets)	1
#Cores/CPU	61
#Thread/Core	4
L1 cache size/core	32KB
L2 cache size/core	512 KB
Vector width	512 bits
Peak SP Gflops/s	2112
Peak DP Gflops/s	1056

Table 2 : Intel Xeon Phi

Xeon Phi μArchitecture



Important characteristics

- Four hardware threads per core
- In-order dual issue pipeline
- Pipeline does not issue instructions from the same hardware context for two consecutive clock cycles
- Maximum issue rate only attainable with at least 2 threads per core

Number of Hardware Threads per core	Minimum Theoretical CPI per Core
1	1
2	0.5
3	0.5
4	0.5

Table 3 : Minimum Theoretical CPI

Conclusion

- Metis and mt-metis have better edgecut
- Metis and mt-metis have lower runtime for small number of partitions
- GMetis is faster for high number of partitions
- Metis graph partitioning algorithm is not suitable to run on MIC as it do not harness vector
- Metis and mt-metis are written in C whereas GMetis is written in C++ and uses Templates. This may explain differences in performance

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Questions & Discussion