

GMetis - Xeon Phi

David Pereira Rui Brito

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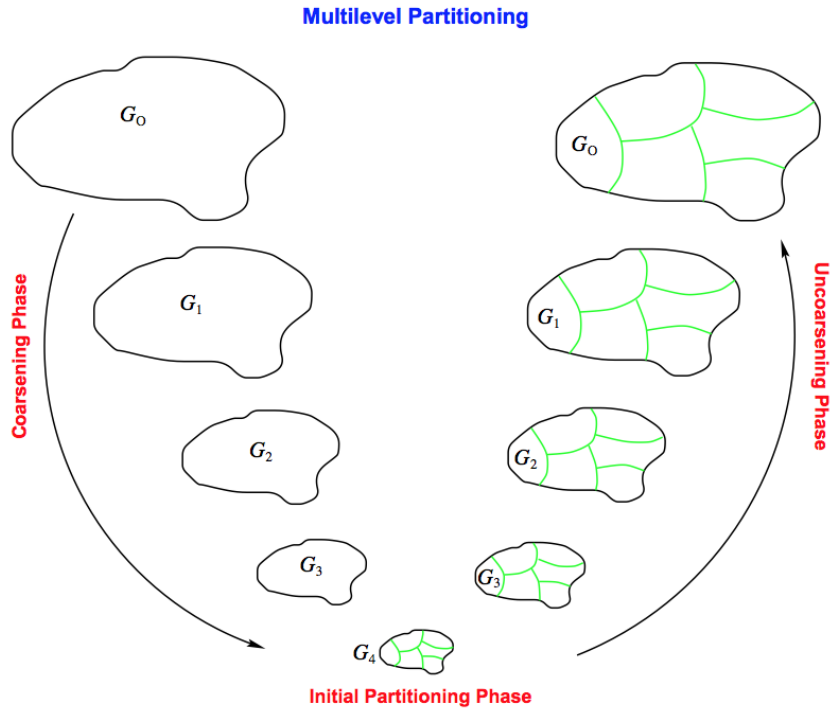
Outline

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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

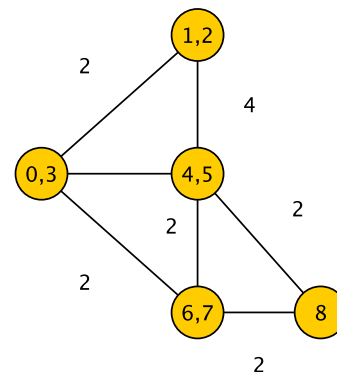
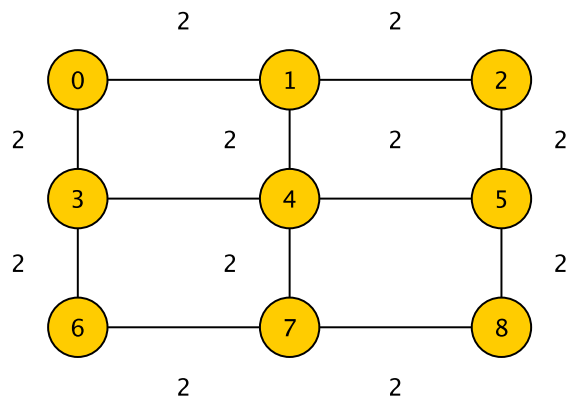
Algorithm Description



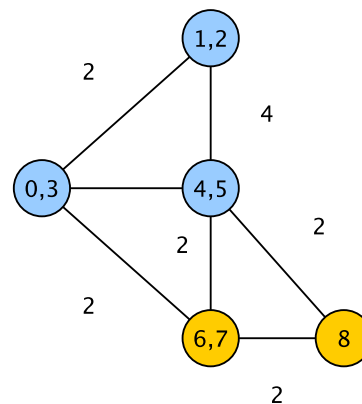
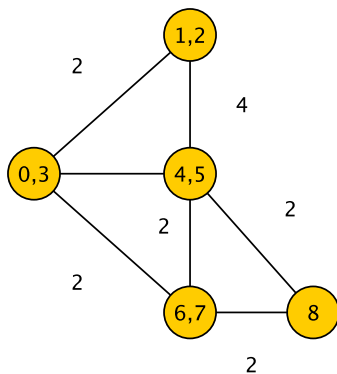
Formal Description

- Given a graph $G_0 = (V_0, E_0)$:
 - ▶ Coarsening
 - ★ G_0 is transformed into a sequence of smaller graphs G_1, G_2, \dots, G_m such that $|V_0| > |V_1| > |V_2| > \dots > |V_m|$
 - ▶ 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 $P_{m-1}, P_{m-2}, \dots, P_1, P_0$

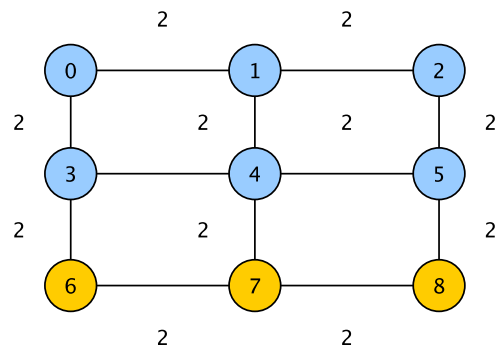
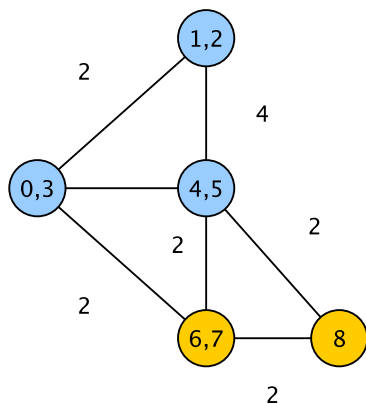
Coarsening



Partitioning



Refinement



Stampede Host

Manufacturer	Intel
Model	Xeon E5-2680
μ Arch	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)

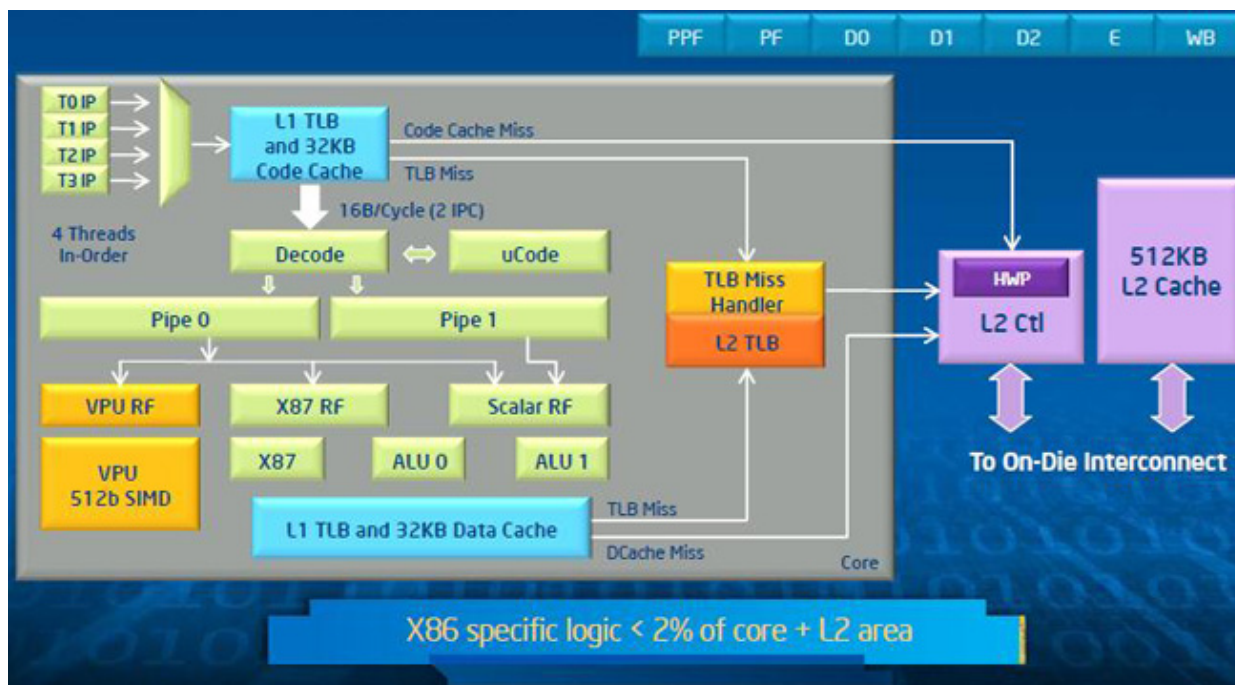
Table 1 : Intel Xeon E5-2680

Stampede Co-processor - Xeon Phi

Manufacturer	Intel
Model	Xeon E5-2680
μ Arch	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

Table 2 : Intel Xeon Phi

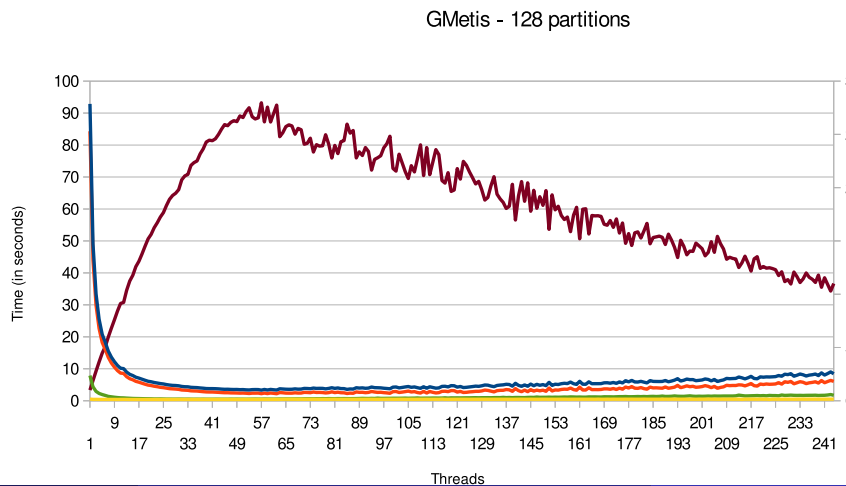
Xeon Phi μ Architecture

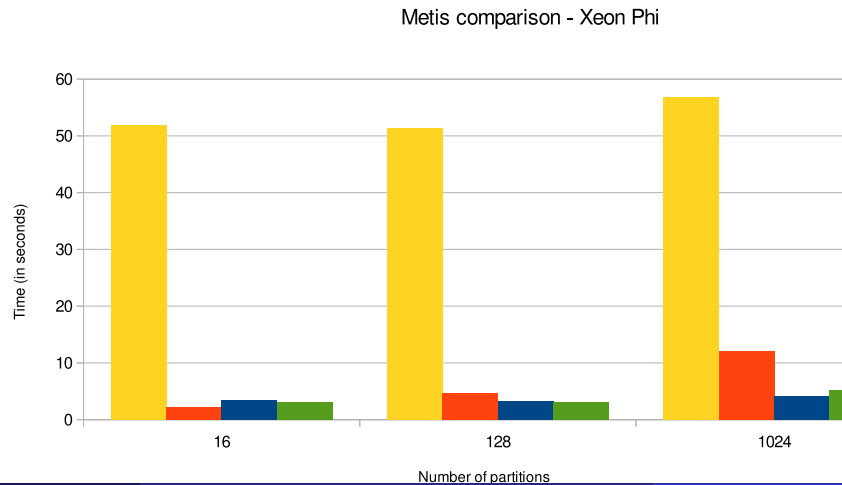


Important characteristics

- 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

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Conclusion

- Metis and mt-metis have better edgecut;
- Metis and mt-metis have lower runtimes for a smaller number of partitions;
- GMetis is faster for a high number of partitions;
- Metis graph partitioning algorithm is not suitable to run on MIC as it does not use SIMD extensions;
- Metis and mt-metis are written in C whereas GMetis is written in C++ and uses various high level resources (e.g. Templates). This may explain differences in performance.

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Questions & Discussion