Project B: Big Little Architecture

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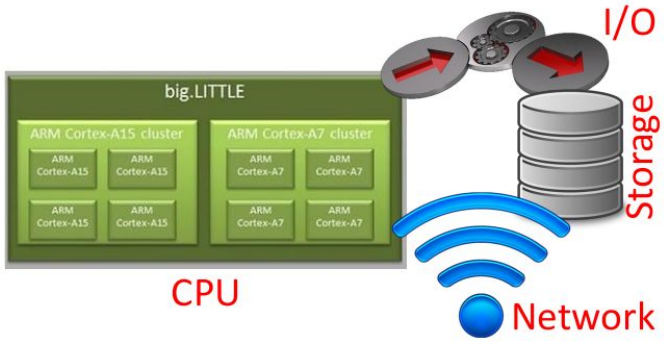
Terminology

- Heavy computational tasks: HCT
- Low computational tasks: LCT
- High Performance core: HPC
- Energy efficient core: EEC

System given characteristics

- Closed system
  - Deterministic number of jobs
- 4 HPCs
- 8 EECs
- Unknown service times of the cores
- Service time of other components was given
  - I/O, Storage and Network as processor sharing

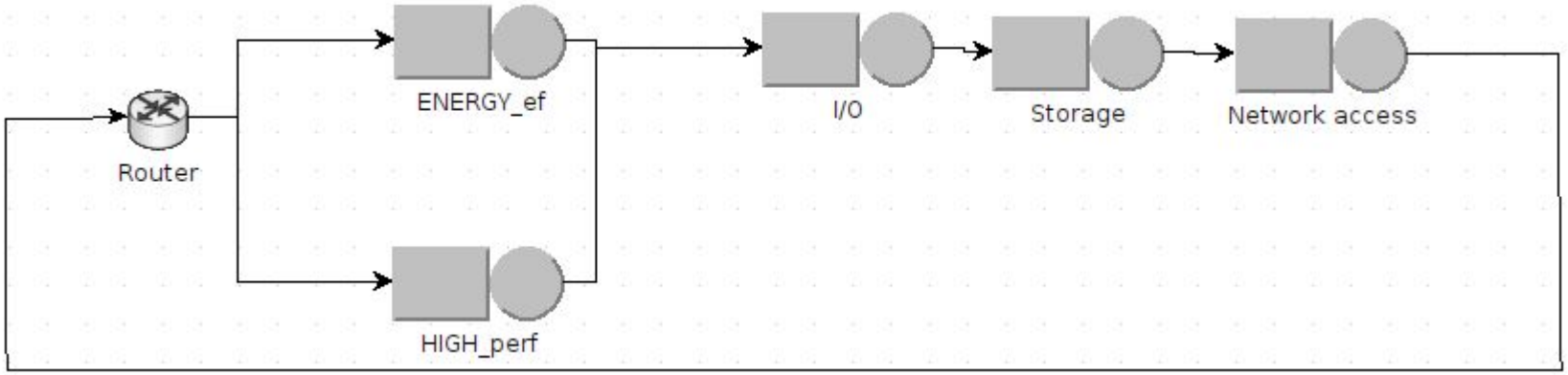


Design decisions

- Implemented via JSIMGraph
- Each core type modeled as a processor sharing station
  - Energy efficient station: 8 servers
  - High performance station: 4 servers
- I/O, Storage and Network in series
- Each workload type (Heavy or Low) as a class

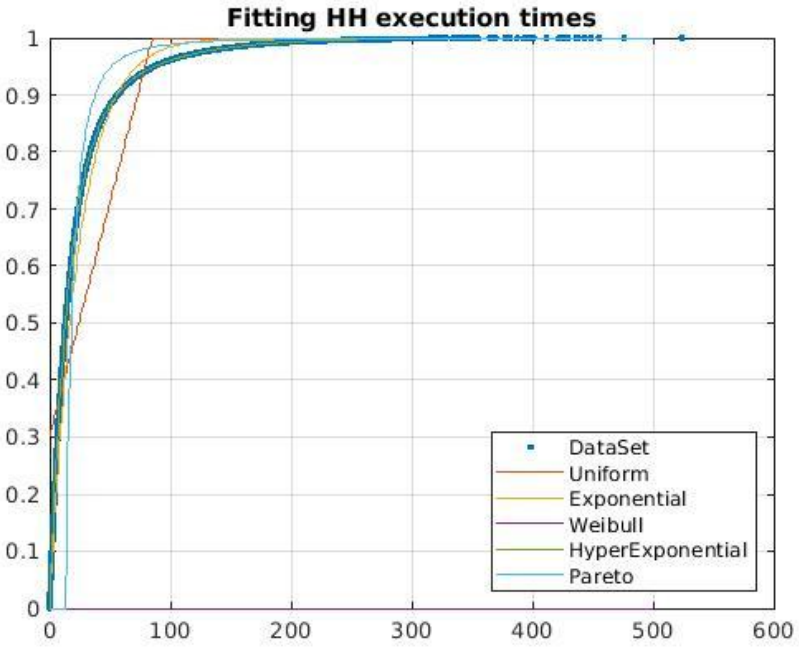
Name	Type	Priority	Population
LOW	Closed	0	32
HEAVY	Closed	0	10

System topology in JSIMGraph



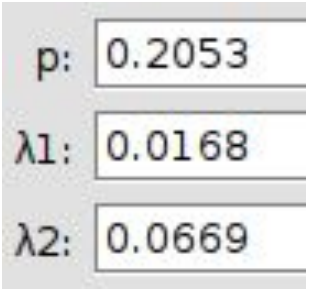
High Performance cores

- Fitting was performed via Assignment 4 code

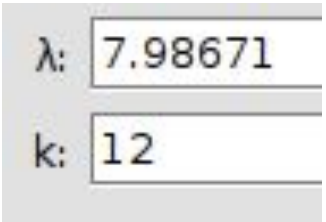


Results for High performance cores

- **Heavy computation** tasks service time: best fitted by **Hyper Exponential**

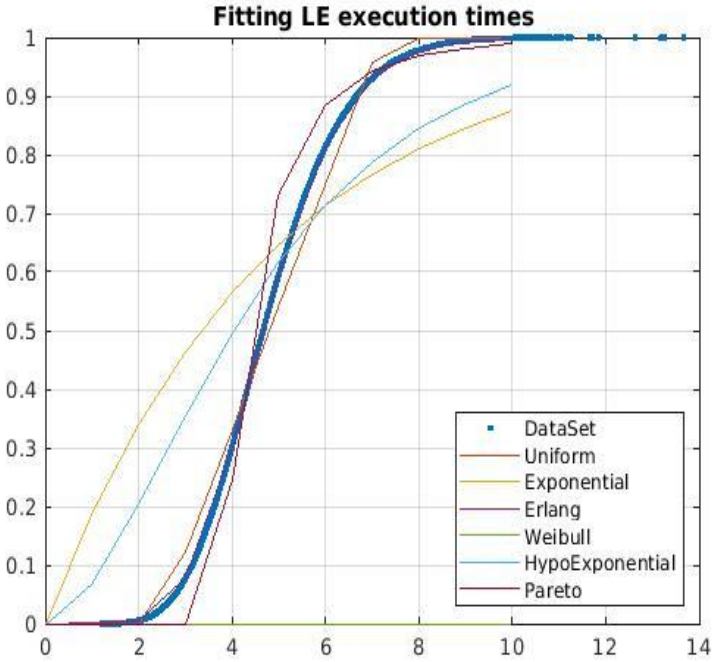


- **Low computation** tasks service time: best fitted by **Erlang**



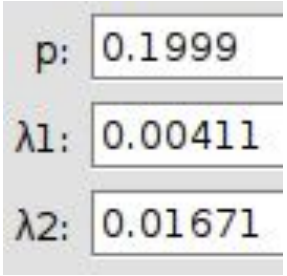
Energy Efficient cores

- Fitting was performed via Assignment 4 code

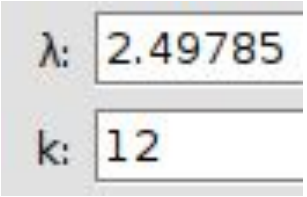


Results for Energy efficient cores

- **Heavy computation** tasks service time: best fitted by **Hyper Exponential**

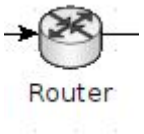


- **Low computation** tasks service time: best fitted by **Erlang**



Scenario definition

- To test different assignments probabilities:



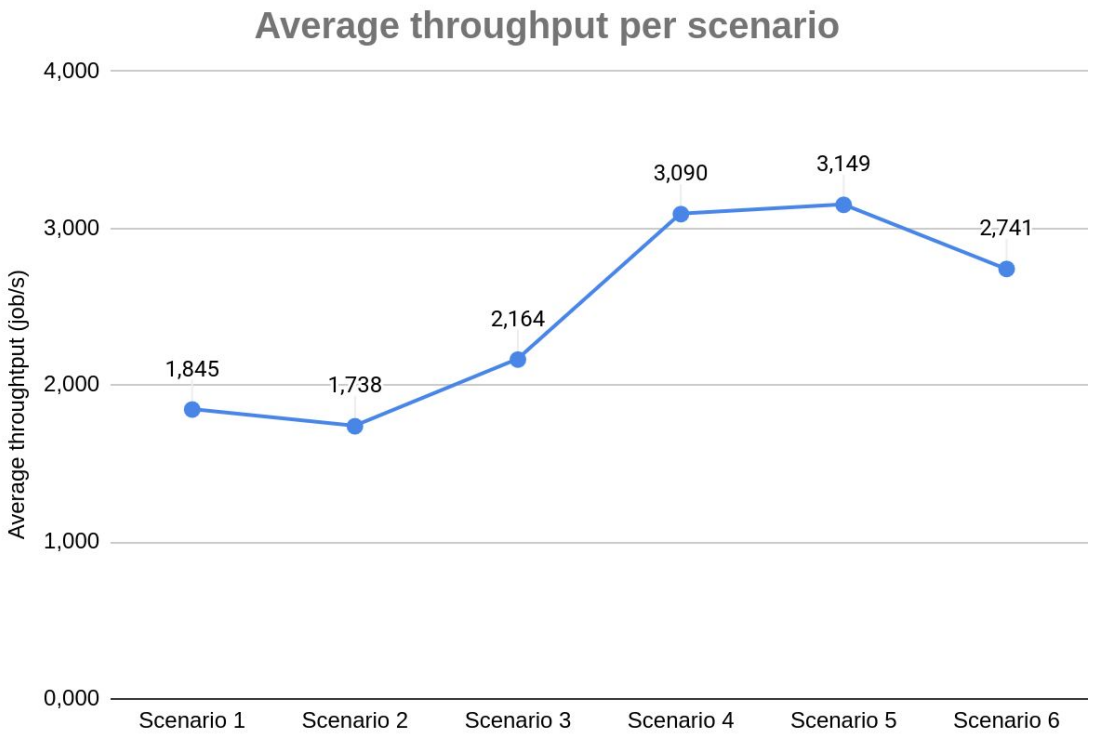
Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
HH = 1,0	HH = 0,8	HH = 0,6	HH = 0,4	HH = 0,2	HH = 0
HE = 0	HE = 0,2	HE = 0,4	HE = 0,6	HE = 0,8	HE = 1,0
LH = 0	LH = 0,2	LH = 0,4	LH = 0,6	LH = 0,8	LH = 1,0
LE = 1,0	LE = 0,8	LE = 0,6	LE = 0,4	LE = 0,2	LE = 0

Simulation results

	Min throughput (job/s)	Average throughput (job/s)	Max throughput (job/s)
Scenario 1	1,803	1,845	1,883
Scenario 2	1,703	1,738	1,775
Scenario 3	2,105	2,164	2,226
Scenario 4	3,029	3,090	3,154
Scenario 5	3,088	3,149	3,214
Scenario 6	2,702	2,741	2,781

Confidence interval: 99%
Max relative error: 3%

Simulation results



Early conclusions

“Determine the best assignment probability distribution:”

- The best assignment probability distribution is: **Scenario 5**

Scenario 5
HH = 0,2
HE = 0,8
LH = 0,8
LE = 0,2

But why?

- Utilization and response times

Scenario	Utilization High performance	Utilization Energy efficient	R High performance (s)	R Energy efficient (s)
Scenario 1	1,000	1,000	60,130	18,800
Scenario 2	0,531	1,000	5,702	29,019
Scenario 3	0,497	1,000	2,480	30,110
Scenario 4	0,778	1,000	2,603	28,559
Scenario 5	1,000	0,984	11,247	19,710
Scenario 6	1,000	1,000	11,680	119,290

Confidence interval: 99%
Max relative error: 3%

But why?

- In this multi-class and multi-station system we can’t just apply the “computer infrastructure course” formulas.
- Assigning 100% of one type tasks to one type of core is not a good idea:
  - EECs get overloaded in scenario 6 (high response time)
  - HPCs get overloaded in scenario 1 (high response time)
- Intuitively, scenario 5 is the one that maximizes the utilization of both stations while minimizing the response time, thus the greater throughput
- There is an optimal point where giving the EECs just a little bit of the HCT can liberate workload from the HPCs, increasing a little bit of EECs response time but decreasing dramatically the HPCs’ one. This helps increase the system throughput.

Final conclusion

- The best assignment probability distribution is **Scenario 5**, as it minimizes response time in both core stations while keeping their utilization near 100%.
  - Also produces the maximum calculated throughput

Scenario 5
HH = 0,2
HE = 0,8
LH = 0,8
LE = 0,2