On the Energy Efficiency of Sorting Algorithms

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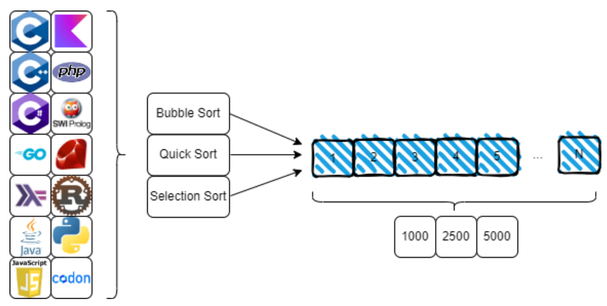
Abstract

This paper presents the findings of a comprehensive study focused on evaluating the energy efficiency of three sorting algorithms implemented in thirteen programming languages. The research investigates the overall energy consumption of each algorithm across different languages and examines the impact of CPU power limits on algorithm and language performance. The results indicate that Quick Sort exhibited superior performance in terms of execution time, particularly when a power cap was enforced. Notably, the programming language C emerged as the most favorable choice, delivering optimal execution time and power efficiency in these scenarios. Conversely, Selection Sort demonstrated the weakest performance in terms of execution time, especially when subjected to a power cap. Moreover, our findings revealed that Kotlin exhibited relatively lower performance in terms of execution time and power efficiency compared to other programming languages. Overall, our study provides valuable insights into the energy efficiency of sorting algorithms across multiple programming languages and sheds light on the influence of power limitations on their performance.

Analysis of programming languages' performance when running various sorting algorithms.



Scan me!

Temperature sensors

lm-sensors

Reads CPU temperature

Guarantee that all programs execute at the same (CPU) temperature

PowerCap

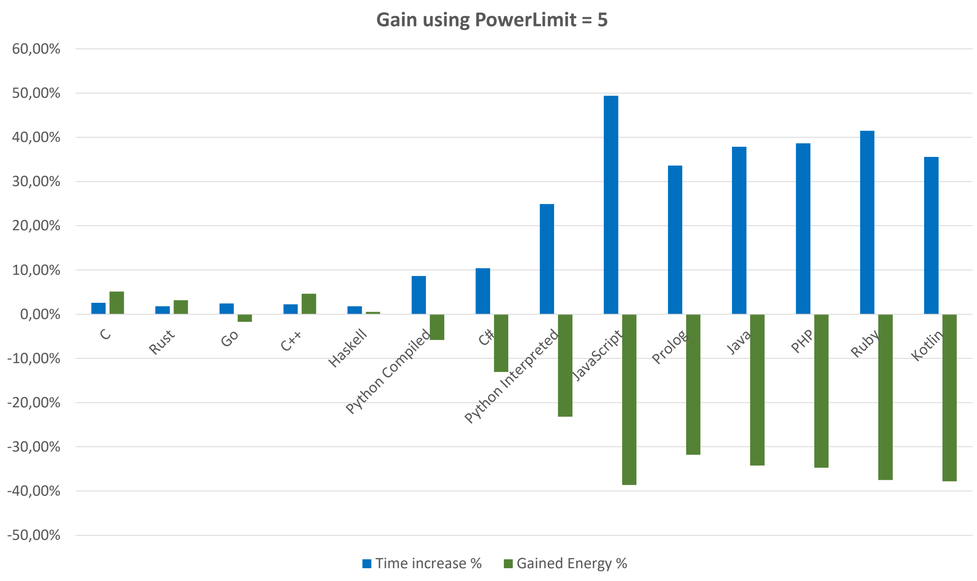
raplcap/powercap

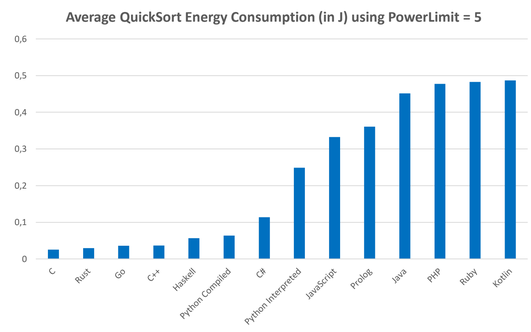
Limits CPU power

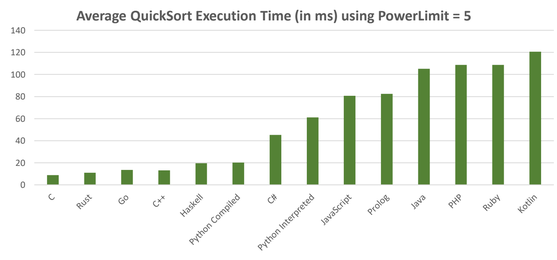
Consumes less energy

Longer execution time

Results

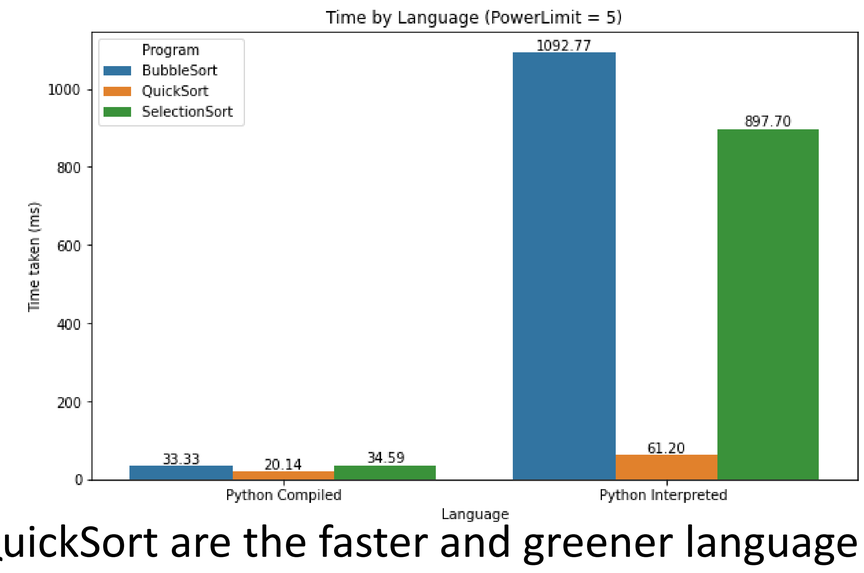


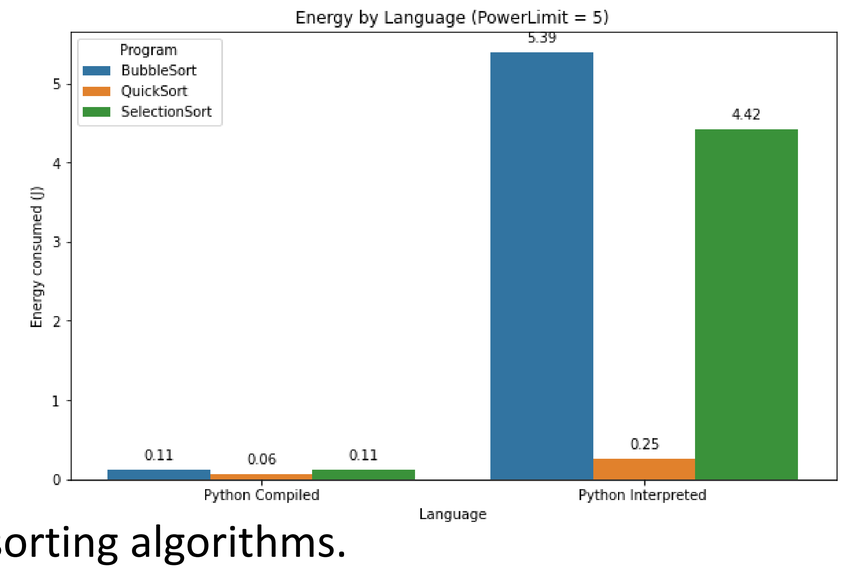




QuickSort	Energy (J)	Time (ms)
(c) Pascal	0.02	3
(c) C	0.02	4
(c) Rust	0.03	6
(c) Go	0.05	9
(c) OCaml	0.09	9
(i) PHP	0.23	20
(v) Lisp	0.25	18
(i) Lua	0.26	23
(c) Haskell	0.29	20
(i) Perl	0.32	28
(i) Ruby	0.61	45
(i) Python	0.73	61
(i) JavaScript	0.78	60
(v) Java	1.49	87
(v) Erlang	1.50	101
(i) Dart	1.70	114
(v) Racket	2.24	169

Pereira, R. et al. (2020). "Ranking Programming Languages by Energy Efficiency" in Science of Computer Programming, volume 205. Elsevier, 2021, page 48.





- C and QuickSort are the faster and greener language and sorting algorithms.
- Powercap reduces energy consumption, while increasing runtime.
- JavaScript language reduces 38.63% its energy consumption by limiting the power of the CPU.
- Python compiled is better than Python interpreted.

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