Genetic Improvement of Energy Usage is only as Reliable as the Measurements are Accurate

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Overview

Motivation

“If you can not measure it, you can not improve it.”

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Software energy conservation

Energy optimisation with Genetic Improvement (GI)

Measuring energy with intent on improving

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- Environmental
- Financial
- Hardware is only as efficient as the software driving it.

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- Improving software is Multi-objective.

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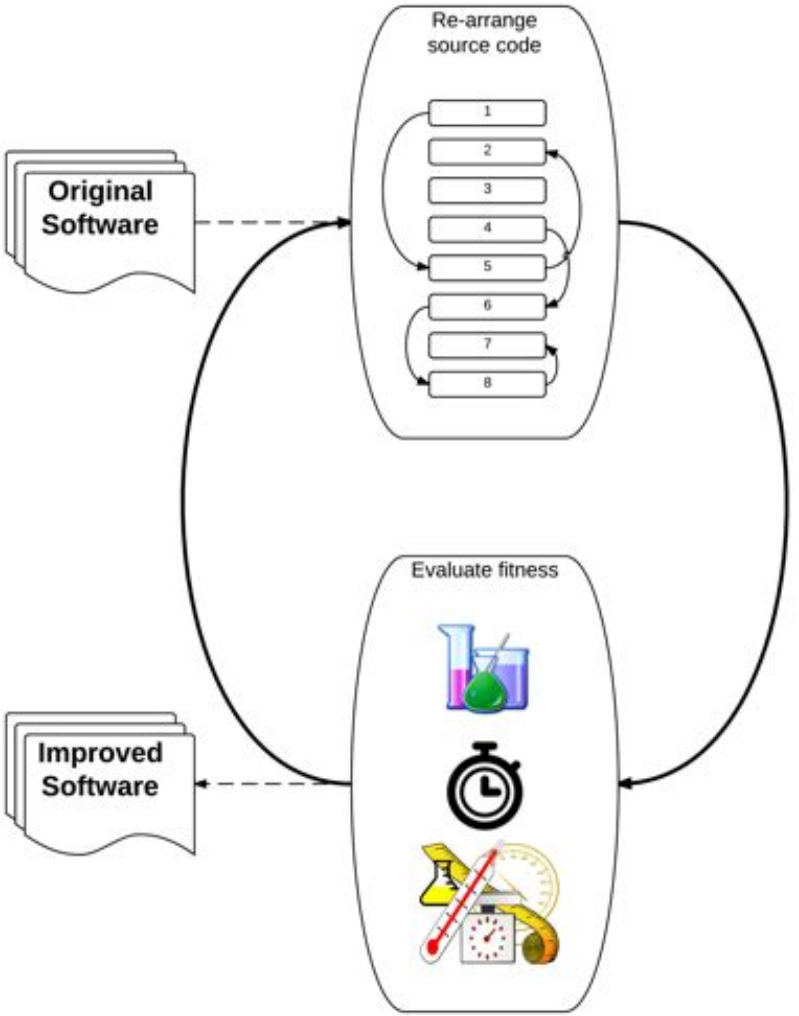
- Energy measurements are complicated [2].
- Be wary of overly simple surrogates [3].

Genetic Improvement

Automatic software adjustment operating directly on the source code, treating it as the genetic material [1].

- Improving the software by readjusting the source code.
- Works well on multiple objectives [5].
- Improvements are based on fitness evaluations.



1

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[1] Image courtesy of foto76 at FreeDigitalPhotos.net

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4 levels to optimize on:

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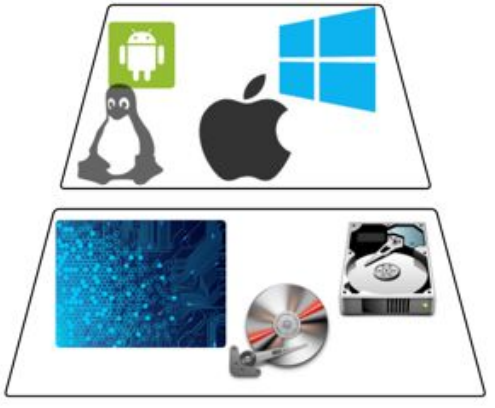

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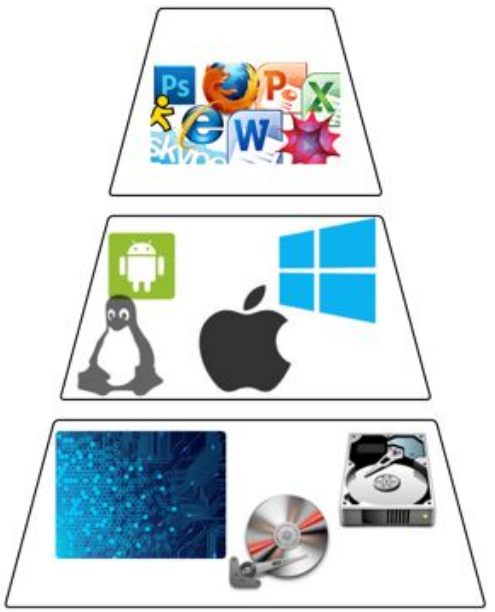
3. Minimizing the amount of computing used for a particular task.



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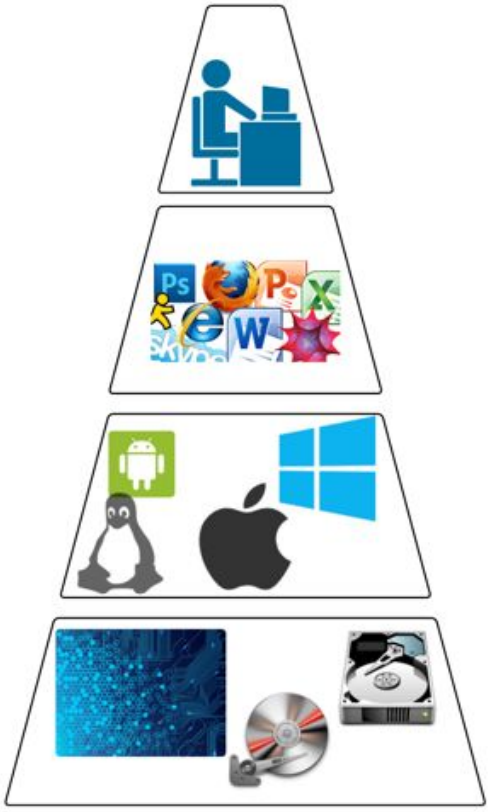
4. End user specific energy conservations



Measuring energy in computation

Physical measurements

- The whole system.
- Each hardware component.

Alternatives.

- Simulation
- Timing, CPU counts, Memory access, etc.

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- Be vary of overly simple alternatives.

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[2] Image courtesy of TAW4 at FreeDigitalPhotos.net

Things to consider

Genetic Improvement	Useful for “green” optimisation of software
Physical Measurements	Accurate if properly applied but impractical
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Conclusion	

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Genetic Improvement	Useful for “green” optimisation of software
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Alternative Measurements	Have to be implemented on case by case basis. Beware of overly simple surrogates
Conclusion	If you can not measure it *accurately*, you can not improve it *reliably*

Thanks

Any questions?

References

[1] W. B. Langdon and M. Harman. Optimising Existing Software with Genetic Programming. *IEEE Transactions on Evolutionary Computation*, PP(99):1–18, 2014.

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[3] Cagri Sahin, Furkan Cayci, Irene Lizeth Manotas Gutiérrez, James Clause, Fouad Kiamilev, Lori Pollock, and Kristina Winbladh. Initial explorations on design pattern energy usage. In *2012 First International Workshop on Green and Sustainable Software (GREENS)*, pages 55–61. IEEE, 2012.

[4] Cagri Sahin, Lori Pollock, and James Clause. How do code refactorings affect energy usage? In *Proceedings of the 8th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement - ESEM '14*, pages 1–10. ACM, 2014.

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