

# GI4GI: Improving Genetic Improvement Fitness Functions

Mark Harman & Justyna Petke  
University College London

# GI4GI: Energy Optimisation Example

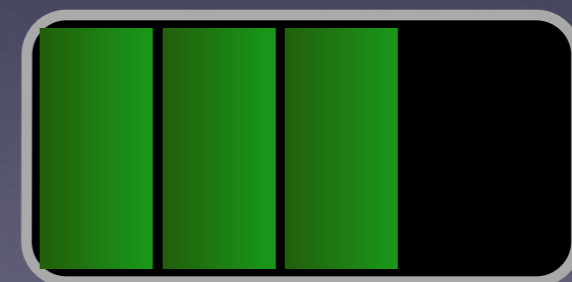
many factors affecting energy consumption, including:

screen behaviour

memory access

device communications

CPU utilisation



# GI4GI: Energy Optimisation Example

a hardware-dependent linear energy model for GI:

$$\begin{aligned}
 \text{power} &= C_{\text{const}} + C_{\text{ins}} \frac{\text{ins}}{\text{cycle}} + C_{\text{flops}} \frac{\text{flops}}{\text{cycle}} \\
 &\quad + C_{\text{tca}} \frac{\text{tca}}{\text{cycle}} + C_{\text{mem}} \frac{\text{mem}}{\text{cycle}} \\
 \text{energy} &= \text{seconds} \times \text{power}
 \end{aligned}$$

Coefficient	Description	Intel (4-core)	AMD (48-core)
$C_{\text{const}}$	constant power draw	31.530	394.74
$C_{\text{ins}}$	instructions	20.490	-83.68
$C_{\text{flops}}$	floating point ops.	9.838	60.23
$C_{\text{tca}}$	cache accesses	-4.102	-16.38
$C_{\text{mem}}$	cache misses	2962.678	-4209.09

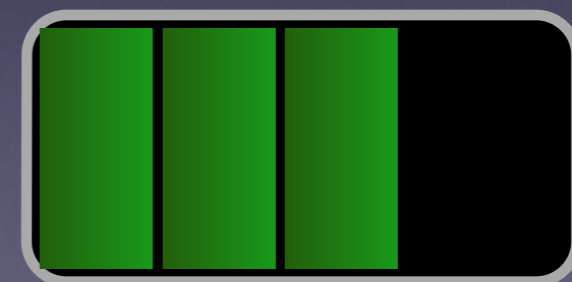
**Table 2.** Power model coefficients.

Post-compiler software optimization  
for reducing energy (ASPLOS'14)  
Schulte et al.

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Idea:

Use GI to evolve a fitness function  $f$  for energy consumption.





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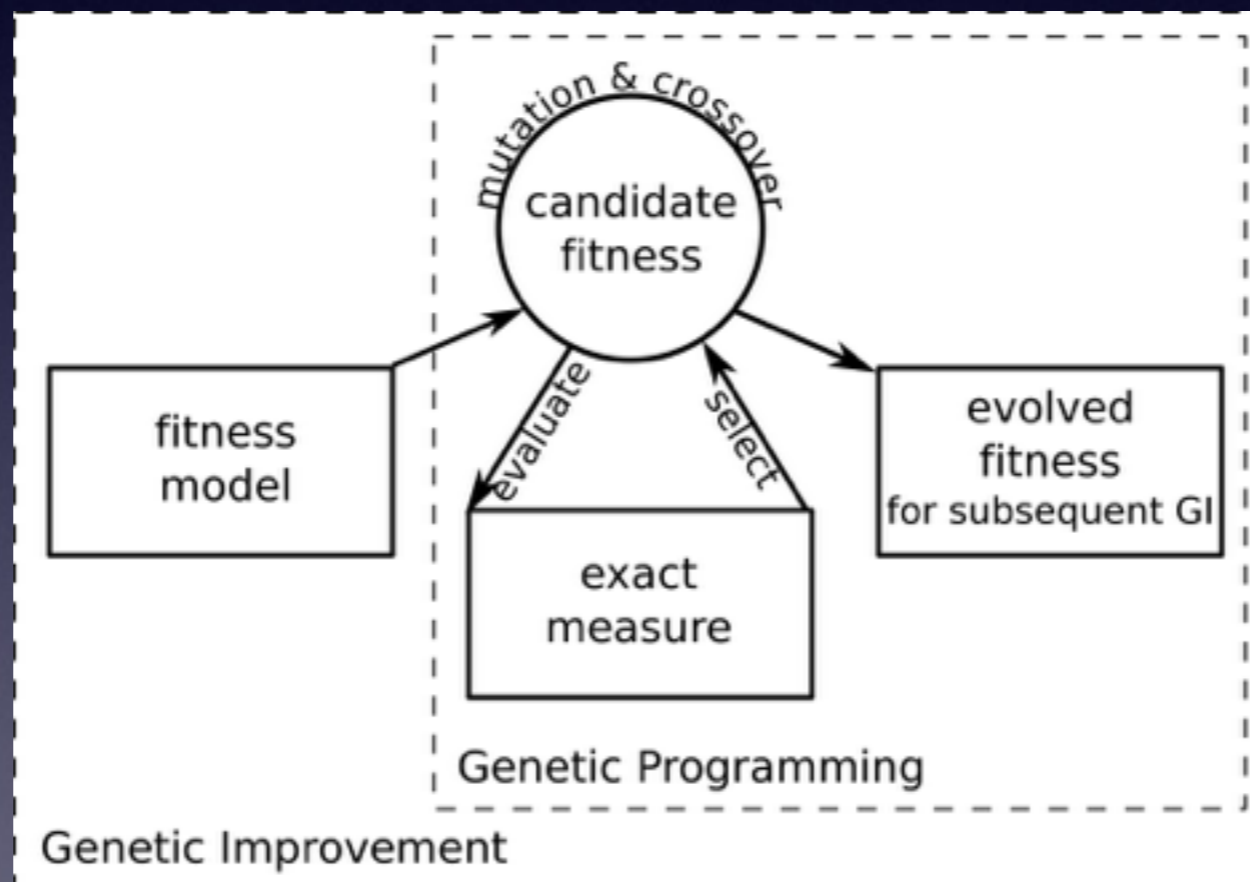
Idea:

Use GI to evolve a fitness function  $f$  for energy consumption.

Use  $f$  to improve energy consumption of software.



# GI4GI



# GI4GI: Software Architecture Example

objectives:

throughput maximisation

response time minimisation

performance optimisation



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throughput maximisation

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performance optimisation

problems:

expensive to compute fitness

(multiple platform & architecture

simulations required; actual

implementations infeasible)





# GI4GI: Software Architecture Example

GI4GI steps:

candidate performance model (or use GP to start from scratch)

execute a few instances of either simulation or actual architecture

calculate fitness function for subsequent GI (saves time/resources)

# GI4GI: Improving Genetic Improvement Fitness Functions

