Due to power limits, single-processor performance is no longer increasing. We need extreme energy-efficiency. GPPs and GPUs have some benefits, but extreme heterogeneity has potential for even greater energy efficiency. We cluster similar hot code regions from a variety of applications. The goal is to build one 10x10: Using Extreme Heterogeneity to Build a General-Purpose Processor with Exascale Energy-Efficiency

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\textbf{CHALLENGES}

- 10x10 has to satisfy both energy efficiency and programmability.
- Energy-efficiency of customized silicon (SoCs and ASICs).
- Programmability of multi-core systems.

\textbf{REQUIREMENTS OF A SOLUTION}

- Code regions are executed by the best matched micro-engines, and the rest remain 'off'.
- Together, the micro-engines provide high performance and energy efficiency for entire applications.

\textbf{SOLUTION}

- Each core is an ensemble of micro-engines.
- Usability challenges become more severe as heterogeneity increases.
- Elegant programmability solutions necessary.

\textbf{CONCLUSIONS}

- Paradigm shift in architecture design inevitable.
  - 90/10 optimization not viable anymore.
  - Individual code patterns will have larger influence on architecture.
- Extreme heterogeneity needed.
  - Hybrid CPU-GPU computing not enough.
  - 10x10 marks a shift to this new paradigm for GPPs.
- Heterogeneous solutions must be usable.
  - Usability challenges become more severe as heterogeneity increases.
  - Elegant programmability solutions necessary.

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