# 18-344 Recitation 5

Lab2 - Memory Hierarchy
Design Space Exploration

# Logistical Notes

- HW 3 done

- Lab 2 due October 21
  - You can submit before fall break…

- Benchmarks can take a while to run
  - Leave time for testing, split benchmarks between team members
  - Limit parameter sweeps to reasonable values

# Optimization

# What are you optimizing for?

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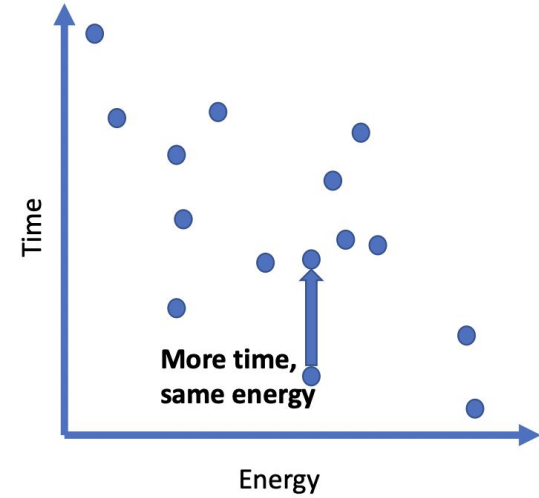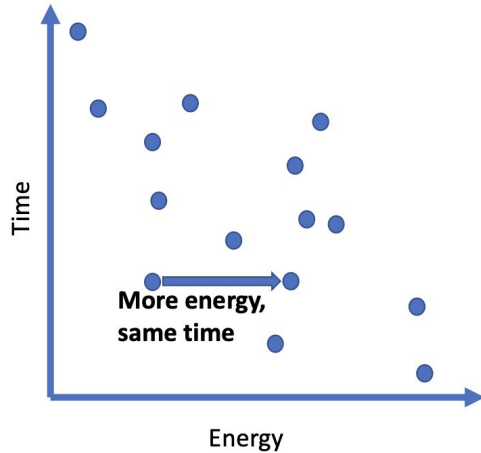- There is always more than one constraint

# Design Space Exploration

# Defining a design space

- A design space is a set of possible incarnations of a system

- A design space is defined over a set of parameters

- A point in the design space is a concrete system

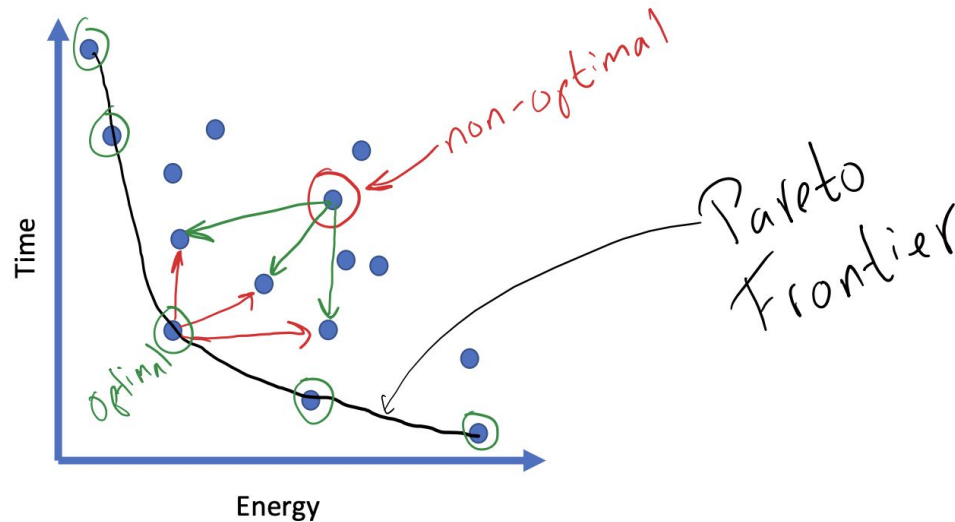- Defining a design spaces allows systematic exploration

# Plotting many designs to study a trade off

- Branch predictor example
  - GHT size, BHT # entries, hash func, BHT entry size, BTB # entries, BTB assoc



**More energy, same time**

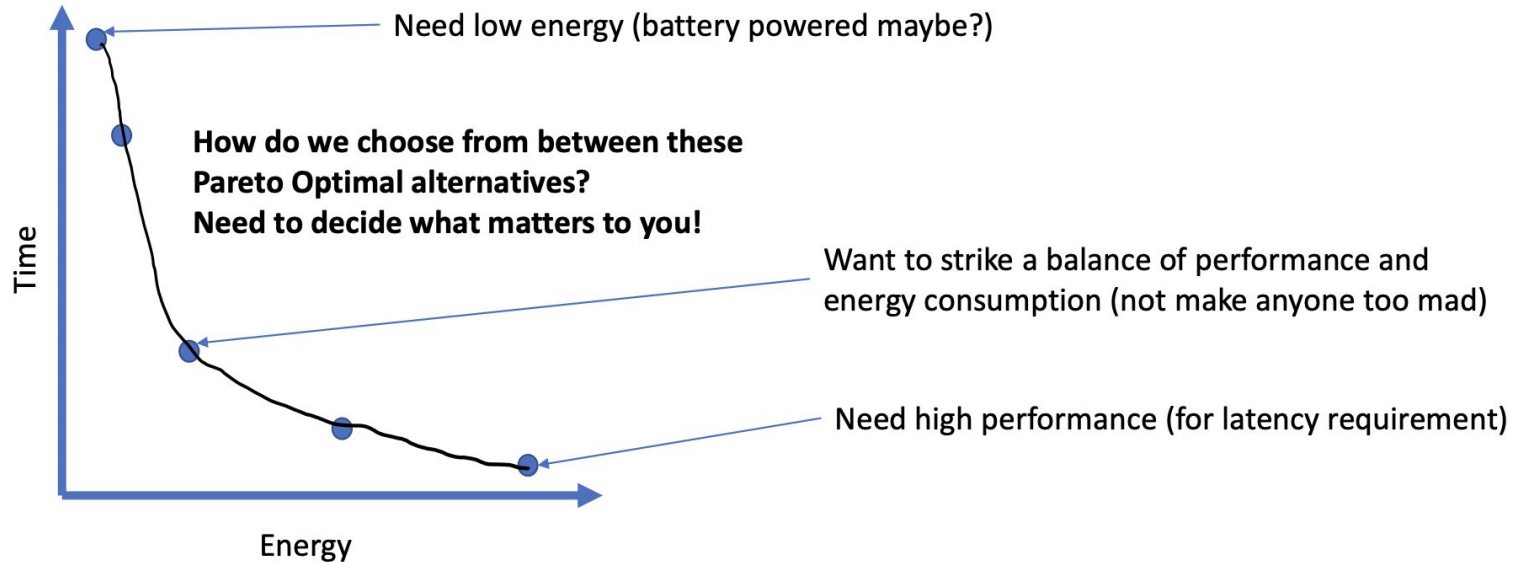Time

Energy

**More time, same energy**

Time

Energy

# Pareto Optimality of Design Alternatives

- A design is optimal if no change leads to improvement in one dimension without a loss in at least one other dimension

# Design Consequence of Pareto Optimality

- A design is optimal if no change leads to improvement in one dimension without a loss in at least one other dimension



Need low energy (battery powered maybe?)

How do we choose from between these Pareto Optimal alternatives? Need to decide what matters to you!

Want to strike a balance of performance and energy consumption (not make anyone too mad)

Need high performance (for latency requirement)

Time

Energy

# Design Space Exploration - Find the best feasible system

- Define a system's important design parameters
  - Example: L1 L2 associativity, L1 L2 block size, L1 L2 size, L1 L2 replacement
- Define a system's figure(s) of merit
  - Example: AMAT, latency, power
- Define a set of constraints on the feasibility of a binding of design parameters
  - Example: 5MB of cache that you can split across the layers of cache in your system
- Choose a feasible parameter setting and measure its merit
- Iterate until satisfied:
  - If this system is better than the last one, keep it. If worse, discard it.
  - Choose a parameter and change it