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Predicting Power Consumption of High-Memory-Bandwidth Workloads

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Motivation

- 3% of the entire US energy consumption is estimated to be caused by data centers

Server
Efficiency
Rating
Tool

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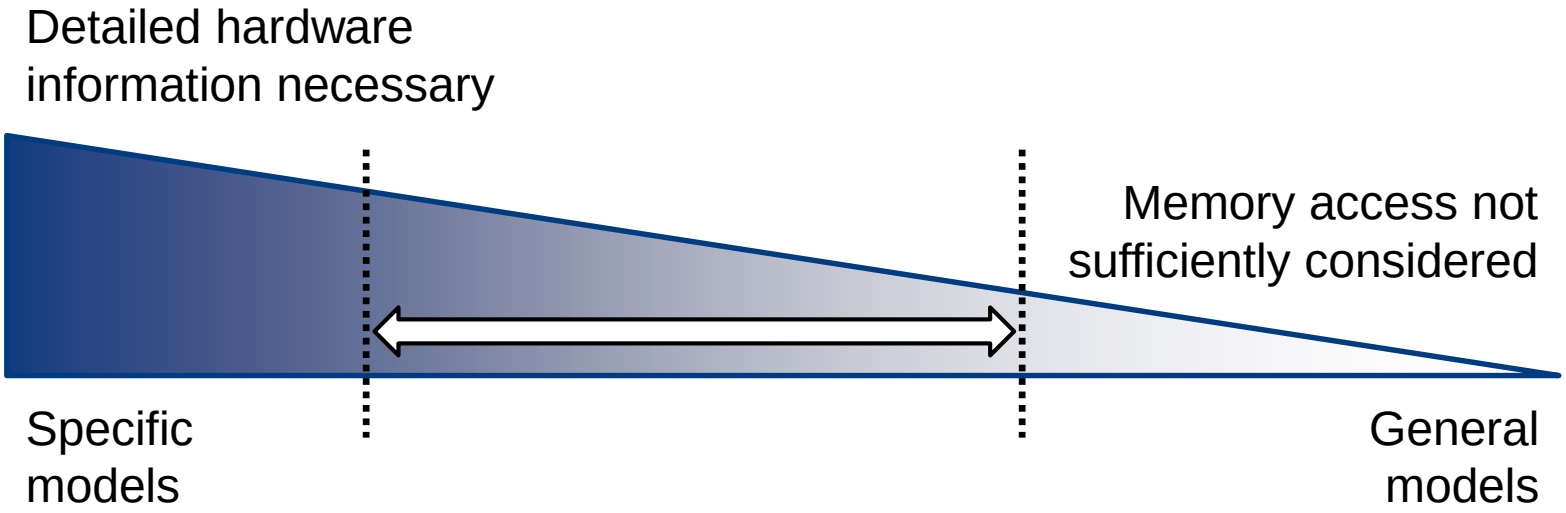
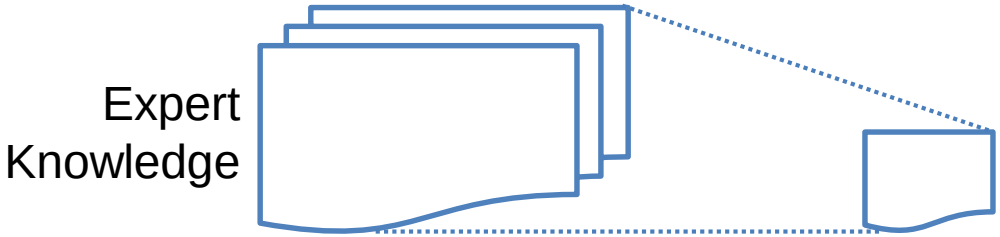
- High-Memory-Bandwidth Workloads are among the most power consuming applications
- Gap between detailed and general prediction models

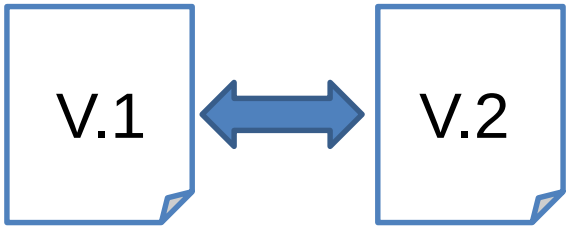


Challenges

- Accurate power prediction with as less expert knowledge as possible

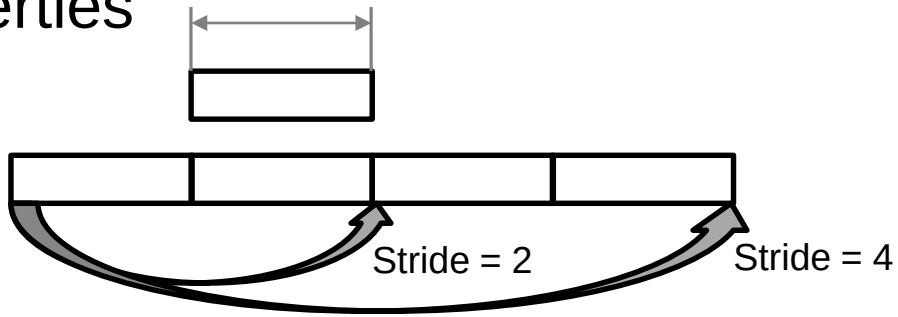


- Relative comparison of two different software versions without expert knowledge



Approach

- We propose a model based on memory access software properties
  - Datasize
  - Stride



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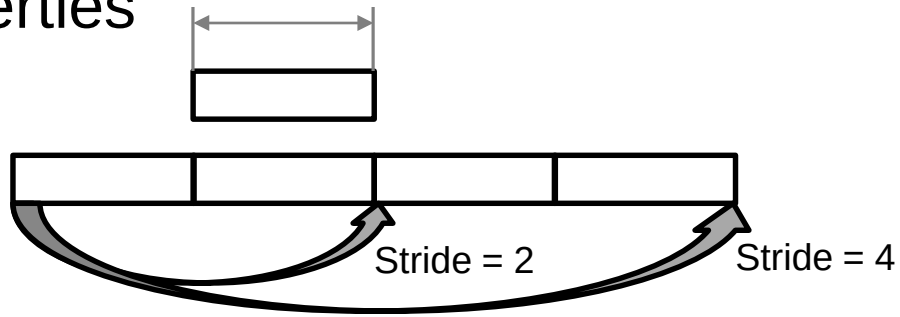
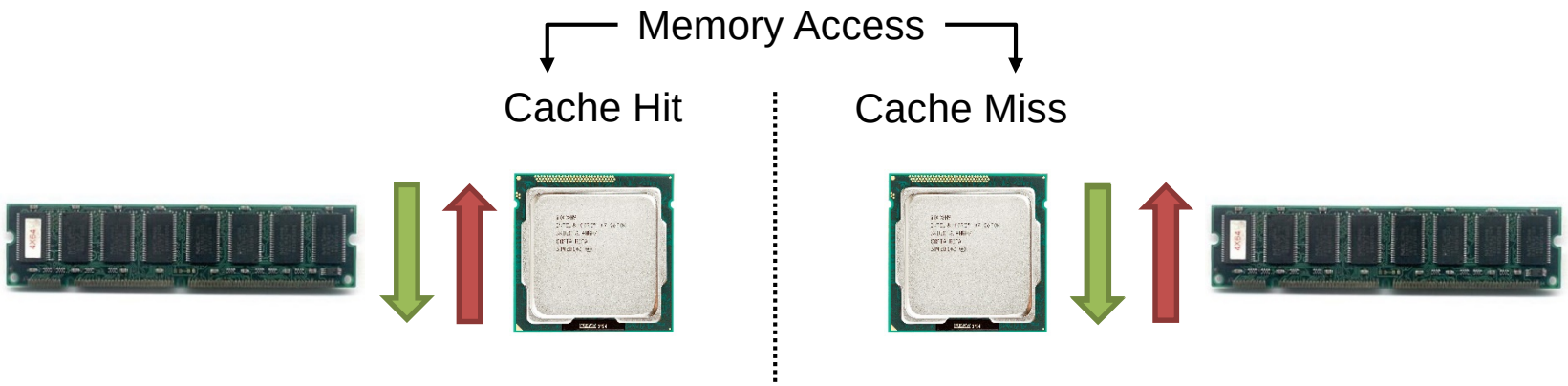


- Assumption: Larger data types and bigger steps in data traversal cause lower CPU power consumption



Approach

- We want to predict
  - Total system power: $pwr(sys)$
  - CPU power: $pwr(CPU)$
  - Memory power can be derived through

$$pwr(mem) = pwr(sys) - pwr(CPU) - pwr(idle)$$

$$pwr(CPU) = pwr_{min}(CPU) + \left(pwr_{max}(CPU) - pwr_{min}(CPU)\right) * p$$

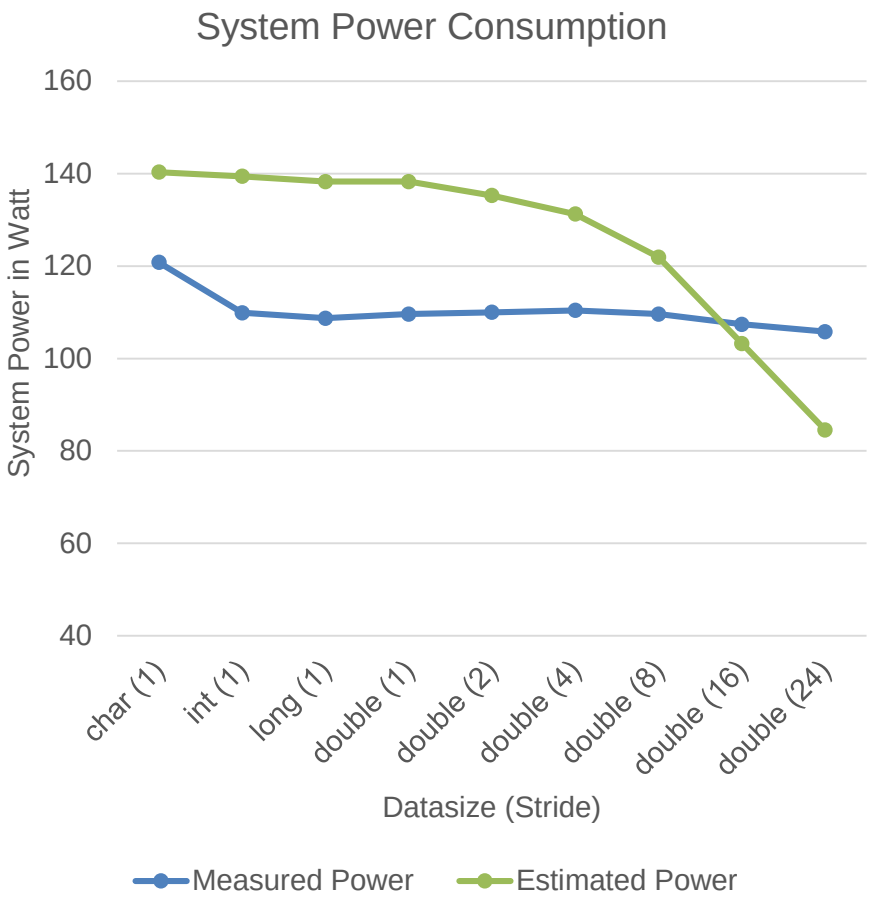
$$pwr(sys) = pwr_{min}(sys) + \left(pwr_{max}(sys) - pwr_{min}(sys)\right) * p$$

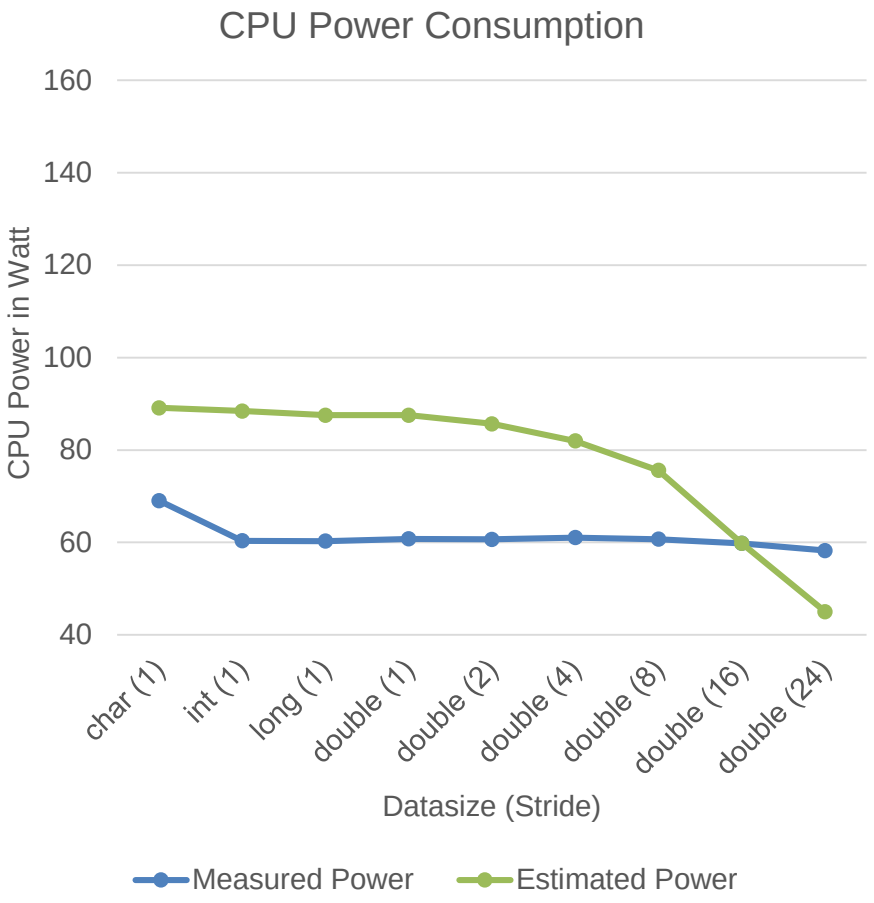
$$p = \frac{datasize * stride}{cachesize} * inverseprefetcheraccuracy$$

- One hardware parameter needed for p allows for
  - Compare relative results if hardware specific parameters are replaced with standard values
  - Predict absolute power consumption when hardware parameters are selected

Evaluation - Preliminary

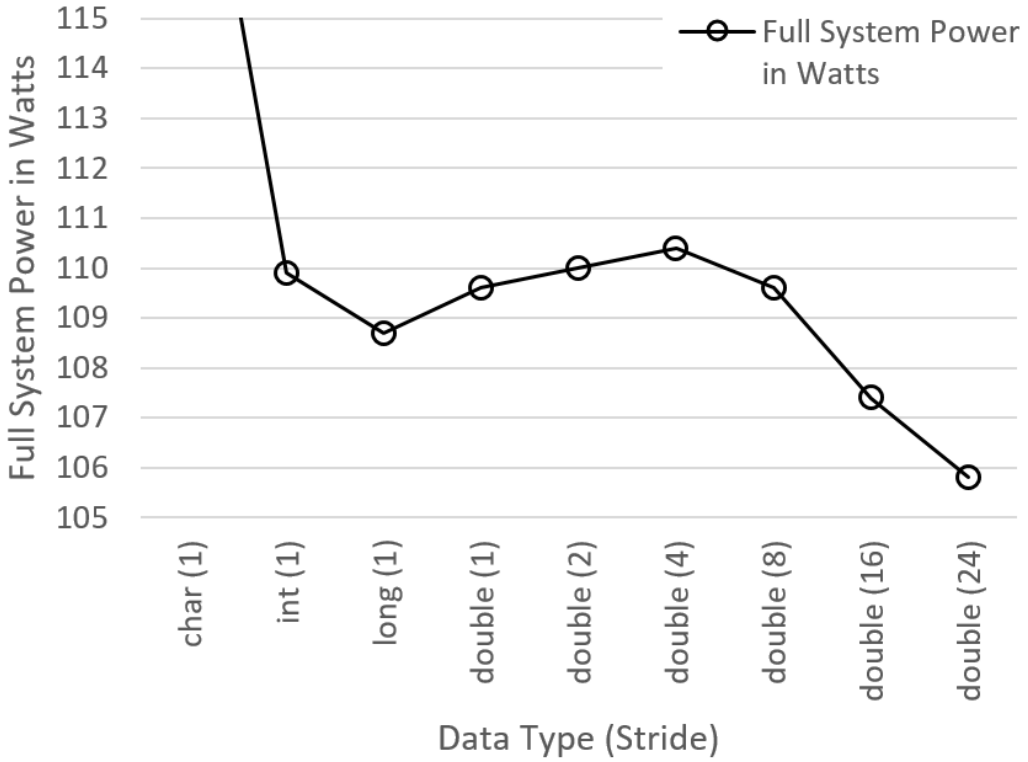
- Comparison of measured and estimated CPU and System power consumption





Evaluation

- Power consumption is not monotonically decreasing as expected
- Power consumption is decreasing when cache line size is exceeded (`double(8)`)



Conclusion

- We want to develop a new simple model that is aimed at bridging the gap between system specific models and generic models
- Allowing software developers to predict the relative change of power consumption
- Predict power consumption of high-bandwidth workloads with minimum expertise

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Questions?

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