

Estimating Energy Consumption of a Software System

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Overview

Technology use has grown rapidly in recent years. It is infused in virtually every aspect of organizational and individual life. This technology runs on servers, typically in data centers. As workloads grow, more servers are required. Each server incrementally adds to the energy consumption footprint of a data center. Currently, data centers account for more than 2% of all power usage worldwide [1]. Clearly, energy efficiency is a significant concern for data centers. While many aspects of data center energy efficiency have received attention, energy consumption is rarely considered in software development organizations. One of the key challenges in considering energy as a factor in software development is the knowledge of how much energy a software system will consume. Software systems run on top of an operating system in a computer. It is possible to measure the energy consumption of a computer by deploying a watt-meter. However, a single operating system instance hosts multiple software components simultaneously. Based on existing technologies it is difficult to measure and estimate the energy consumptions of individual software components. In this project, we intend to develop a model driven approach to estimate the energy consumption of individual OS processes. The tools developed as part of this project would help software developers to estimate the energy consumption of software. This data can then be used by developers to make the software more energy efficient. The data can also be used to estimate the total energy cost of a software system and include this in the TCO (Total cost of ownership) estimation.

Research Plan

Label	Milestones	Deliverables	Date
T1	Identifying and setting up benchmark applications on target OS (Linux) and hardware (Intel)	A set of benchmarks to represent usage of various resources – storage, memory and processor.	Start + 1 Month
T2	Running benchmark applications and experiments	Data related to energy usages and resource consumptions	T1 + 2 Months
T3	Building machine learning model	Machine learning Model	T2 + 2 Months
T4	Writing Report	An IEEE/ACM conference quality paper	T3 + 2 Months

Output of the Project

1. A machine learning based model for energy consumption of a software component based on its various resource usages.
2. An IEEE/ACM conference quality paper

Prior Knowledge Required

1. System level understanding of an operating system, preferably Linux.
2. Prior Java and C/C++ coding experience
3. Exposure to machine learning techniques and tools such as Neural Network and Support Vector Machine.

[1] S. Barth. (2010, 2011). *Reducing data center power consumption*. Available: <http://www.kmworld.com/Articles/Editorial/Feature/Reducing-data-center-power-consumption-68133.aspx>