GREENS 2016 PROGRAM

ICSE 2016 Workshop

Monday, May 16, 2016

Austin, Texas, USA

GREENS

9:00 – 10:30	Session 1: Welcome **Welcome to GREENS 2016** Hausi Müller, *University of Victoria, Canada* Session 2: Keynote **Engineering Future Transactive Energy Systems: Challenges and Directions** Hong-Mei Chen, *University of Hawaii, USA* ***Abstract:*** The sea change in the Electric Power industry is posing many new challenges to green software engineering. The disruptive developments in smart grid distributed energy generation and distribution, the rapid growth and viability of renewable energies, the rise of "energy communities", the proliferation of demand response-enabled smart appliances/ devices and the threat from new battery technologies (e.g. graphene) all contribute to force energy utilities out of their "natural monopoly" status. The future of utilities is now seen to be in Transactive Energy: market-based transaction-oriented exchanges between energy producers, prosumer and consumers, with economic and control mechanisms that allow the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter. Existing utility control systems are not able to manage the physical infrastructure being added to the grid (e.g., solar panels, wind turbines, customer-owned microgrid systems, smart devices, etc.), let alone dictate realtime market exchanges. To survive, the utilities must change their business models and rethink their role in the value proposition, moving from an electricity supplier (i.e., a goods-dominant perspective) to a smart service provider in the new Transactive Energy ecosystem (i.e., a service-dominant perspective). This talk will provide a state of the art overview of the challenges, paradigm shifts required, and future directions for engineering for Transitive Energy systems. A promising Eco-architecture approach will be discussed based on an empirical case study with a large IT service consulting firm.
10:30 – 11:00	Nutrition Break
11:00 – 11:45	Session 3: **What do programmers know about software energy consumption?** Candy Pang, Abram Hindle, *University of Alberta;* Bram Adams, *École Polytechnique de Montréal;* Ahmed Hassan, *Queen's University, Canada* ***Abstract:*** Traditionally, programmers have received a wide range of training on programming languages and methodologies, but rarely about software energy consumption. Yet, the popularity of mobile devices and cloud computing require increased awareness about software energy consumption. On a mobile device, computation is often limited by the battery life. Under the demands of cloud computing, data centers struggle to reduce energy consumption through virtualization and data center infrastructure management (DCIM) systems. Efficient energy consumption of software is increasingly becoming an important non-functional requirement for programmers. However, are programmers knowledgeable enough about software energy consumption? Do programmers base their implementation decision on popular beliefs? In this article, we survey over 100 programmers for their knowledge of software energy consumption. We find that programmers have limited knowledge about energy efficiency, lack the knowledge about the best practice to reduce energy consumption of software, and are often unsure about how software consumes energy. Education about the importance of energy effective software will benefit the programmers. Our results highlight the need for training about energy consumption and efficiency.
11:45 – 12:30	Session 4: **Green Software Design: Challenges and Opportunities** Ziliang Zong, *Texas State University, USA* ***Abstract:*** In the past decades, substantial efforts have been made in improving hardware energy efficiency. Software developers benefit automatically without improving code energy efficiency. This trend will change as hardware is now approaching its physical limitation on further improving energy efficiency due to the transistor density wall, the heat wall, and the voltage scaling wall. The excessive power consumption of data centers and the ubiquitous usage of battery-driven devices require

	innovative research and creative practices in improving software energy efficiency, which brings great opportunities for promoting green software design. On the other hand, green software design faces enormous challenges due to the lack of 1) standards in software industry on designing green software and evaluating software energy efficiency; 2) government-recognized programs to incentivize green software products; 3) in-depth research and mature theories on improving software energy efficiency; 4) easy-to-use infrastructures/tools that allow software developers write green code on their daily programming practices; 5) lack of education and training at the college level and post-degree level. We recently interviewed over 100 people (from government, industry, and academia) on the challenges and opportunities green software is facing. This talk will present our findings, discuss the current ecosystem of green software engineering, and demonstrates our recent practices on building the cloud-based Greensoft system that supports green software research and education.
12:30 – 14:00	Lunch
14:00 – 14:30	Session 5: **Lightweight Measurement and Estimation of Mobile Ad Energy Consumption** Jiaping Gui, Ding Li, Mian Wan and William Halfond *University of Southern California, USA* ***Abstract:*** Mobile ads are an important component of the app ecosystem. Typically, developers use ads to generate revenue and, in return, end users get a “free” app. However, recent work has shown that apps with ads actually have significant hidden costs to end users in terms of energy, network usage, and performance. These can affect the ratings and reviews an app receives. Therefore, it is desirable for developers to balance the usage of ads with these potential negative costs. However, for energy developers lack techniques to help them measure the cost to their apps. To address this problem, we propose and evaluate several lightweight statistical approaches for measuring and predicting ad related energy consumption. We evaluate our approaches on real-world market apps and find that they are able to accurately and quickly estimate the energy cost without requiring expensive infrastructure or extensive developer effort.
14:30 – 15:00	Session 6: **Adaptive Virtual Machine Migration Mechanism for Energy Efficiency** Sahar Sohrabi, Antony Tang, Irene Moser, *Swinburne University of Technology, Australia* and Aldeida Aleti, *Monash University, Australia* ***Abstract:*** Cloud systems have become a popular platform for business applications due to the flexibility in usage and payment they offer. One of the caveats of Cloud systems is their high energy consumption. Minimizing energy consumption while maintaining a high service level has become a relevant optimization task for Cloud providers. Opportunities for energy savings arise when server hosts are overloaded, which also entails unnecessary delays. To address the problem, researchers have devised strategies how to choose the server host to deploy an application to and how to choose a running application for migration when a host has been identified as overloaded. In this work, we introduce a Bayesian Belief Network which learns over time which of the virtual machines are best removed from a host that has been identified as overloaded. The probabilistic choice is made among virtual machines that are grouped by their degree of CPU usage. Given the feedback in the form of the computing resources saved, the system learns which virtual machine profiles should be shifted for best performance. This strategy compares favourably to two existing methods for load balancing.
15:00 – 15:30	Session 7: **The Influence of the Java Collection Framework on Overall Energy Consumption** Rui Pereira, Marco Couto, Jácome Cunha, Joao Fernandes and João Saraiva, *HASLab/INESC TEC, Universidade do Minho, NOVA LINCS, DI, FCT, Universidade NOVA de Lisboa, RELEASE, Universidade da Beira Interior, Portugal* ***Abstract:*** This paper presents a detailed study of the energy consumption of the different Java Collection Framework (JFC) implementations. For each method of an implementation in this framework, we present its energy consumption when handling different amounts of data. Knowing the greenest methods for each implementation, we present an energy optimization approach for Java programs: based on calls to JFC methods in the source code of a program, we select the greenest implementation. Finally, we present preliminary results of optimizing a set of Java programs where we obtained 6.2% energy savings.
15:30 – 16:00	Nutrition Break
16:00 – 17:00	Session 8: Breakout Groups
17:00 – 17:30	Session 9: Reports from Breakout Groups