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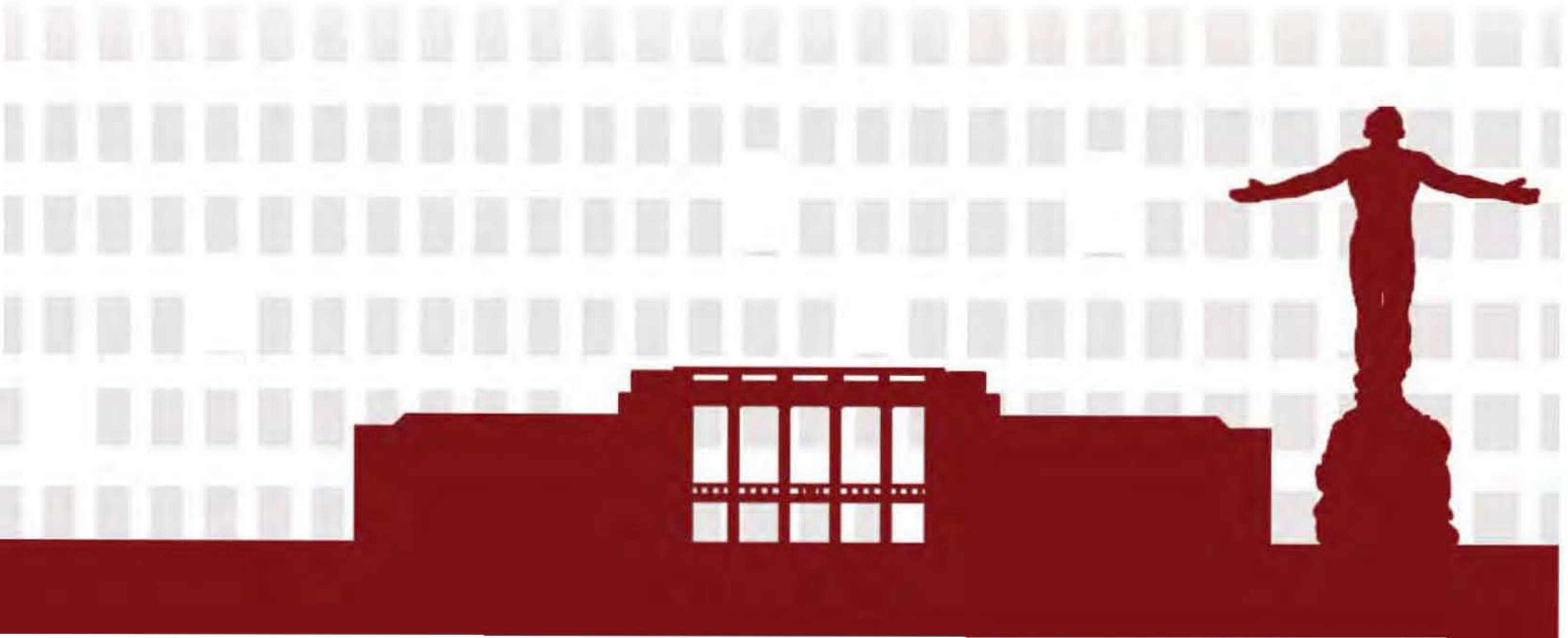
16-17 November 2015
Metro Manila, Philippines



Proceedings of the 8th AUN/SEED-Net RCEEE 2015 and 11th ERDT Conference on Semiconductor and Electronics, Information and Communications Technology, and Energy

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ISBN: 978-616-406-075-3

Published by: ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net) JICA Project
Faculty of Engineering, Bldg. 2
Chulalongkorn University, Bangkok
Thailand 10330

Printed in the Philippines by: ERZALAN PRINTING PRESS
45 Cotabato Street, Luzviminda Village, Batasan Hills, Quezon City, Philippines

8th AUN/SEED-Net Regional Conference
on Electrical and Electronics Engineering 2015

co-located with

11th ERDT Conference
on Semiconductor and Electronics, Information and Communications Technology, and Energy

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Published by: ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net) in partnership with Engineering Research and Development for Technology (ERDT) and University of the Philippines Diliman.

ISBN: 978-616-406-075-3

SOLUTION TO THE *SUBSET SUM* PROBLEM USING THE FRAMEWORK OF SPIKING NEURAL P SYSTEMS WITH STRUCTURAL PLASTICITY

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ABSTRACT

Spiking neural P systems (in short, SNP systems) are parallel, distributed models of computations based on the structure and function of neural cells or *neurons*. Neurons process only a single type of signal or object known as the *spike*. The neurons are placed on vertices of a directed graph, where each edge in the graph is called a *synapse*. Information cannot be discerned from the spikes, as spikes are *indistinct signals*. Instead, information is obtained from the time intervals between spikes, or the presence (absence) of spikes at certain time steps. Time therefore is a means to *encode information*, rather than simply being a background of the computations. It is known that SNP systems and their variants are *Turing universal*, i.e. they can simulate any Turing machine, and thus can carry out any effective computation that we know of.

Since the introduction of SNP systems in 2006 (see [3]), many theoretical and practical problems have been solved using SNP systems. See e.g. [4] and the SNP systems chapter in [5]. In this extended abstract we use the variant known as *SNP systems with structural plasticity* (in short, SNPSP systems). SNPSP systems were introduced in [6] to include the neuroscience feature of strutural plasticity in the SNP systems framework. In SNPSP systems, *plasticity rules* allow neurons to create or delete synapses.

We use SNPSP systems in this work to provide a constant time, nondeterministic solution to the *Subset sum* problem. This problem is a well known computationally hard problem with important use in cryptography. The hardness of the *Subset sum* problem is applied to practical use in order to secure many systems requiring encryption, see e.g. [1,2]. Briefly, the *Subset sum* problem has as its inputs a set of natural numbers $V = \{v1, v2, \dots, vn\}$ and a natural number S. The task is to find a subset B of V where the elements of B sum exactly to S, see e.g. [7].

An SNPSP system solving *Subset sum* is given in graphical form in Figure 1. Using plasticity rules (see Figure 1), we are able to reduce the number of neurons in our system by a linear amount (with respect to problem input size n) compared to the number of neurons in the SNP system given in [8].

Keywords: Spiking neural P systems, Structural plasticity, Subset sum

Acknowledgments
Cabarle is thankful for the support of the ERDT project of the DOST. Adorna is funded by a DOST-ERDT grant, the Semirara Mining Corp. professorial chair of the College of Engineering, UP Diliman, and the UP Diliman Gawad Tsanselor 2015 grant.