Constructing an Associative Memory System Using Spiking Neural Network

A Seminar Report

submitted by

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2022 - 23

CERTIFICATE

This is to certify that the report entitled **Constructing an Associative Memory System Using Spiking Neural Network** submitted by **SANKAR VINAYAK E P** (PKD19CS046), to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the seminar work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

I SANKAR VINAYAK E P hereby declare that the seminar report **Constructing an Associative Memory System Using Spiking Neural Network**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Liji L Dominic

This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources.

I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Sreekrishnapuram
15-12-2022

SANKAR VINAYAK E P

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I take this opportunity to express my deepest sense of gratitude and sincere thanks to everyone who helped me to complete this work successfully. I express my sincere thanks to **Dr. Sabitha S**, Head of Department, Computer Science and Engineering, Government Engineering College Sreekrishnapuram for providing me with all the necessary facilities and support.

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Finally I thank my family, and friends who contributed to the succesful fulfilment of this seminar work.

SANKAR VINAYAK E P

Abstract

Associative memory is a concept widely used in the cases in which the memory needs to be accesed based on the content. A spiking neural network is a special type of neural network which simulates the biological neural network. Combining these two concepts can result in an effective memory representation technique in which the contents can be accessed with speed and efficiency. The report provides an overview of the principles of associative memory and spiking neural networks, and then describe the architecture and training procedure for the system. The results show that spiking neural networks can be effective for implementing associative memory systems, and have potential applications in a range of computational neuroscience and machine learning problems.

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Ω	Unit of Resistance
$\varepsilon^{'}$	Real part of dielectric constant
c	Speed of light
λ	Wavelength
δ	Delta

Chapter 1

Introduction

The ability to store and retrieve associations between different stimuli is a fundamental component of many cognitive processes, including perception, learning, and memory. Associative memory is a type of memory system that allows for the storage and retrieval of relationships between different items in memory. It is a key component of many artificial intelligence and machine learning systems, and has been extensively studied in both neuroscience and computer science.

Spiking neural networks (SNNs) are a type of neural network that can simulate the dynamics of individual neurons and synapses in the brain. They have been shown to be effective for modeling a range of cognitive and sensory processing tasks, and have potential applications in a variety of fields, including computational neuroscience and machine learning.

In this report, we present a study on the construction of an associative memory system using a spiking neural network. We describe the architecture and training procedure for our system, and evaluate its performance on a variety of associative memory tasks. We discuss the implications of our results for the use of SNNs in implementing associative memory systems, and highlight their potential applications in computational neuroscience and machine learning.

Chapter 2

Literature Review

Technical writing is writing or drafting technical communication used in technical and occupational fields [1], such as computer hardware and software [2], engineering, chemistry, aeronautics, robotics, finance [3], medical, consumer electronics, biotechnology, and forestry. Technical writing encompasses the largest sub-field in technical communication. See figure 2.1 that shows the autonomous systems in Internet.

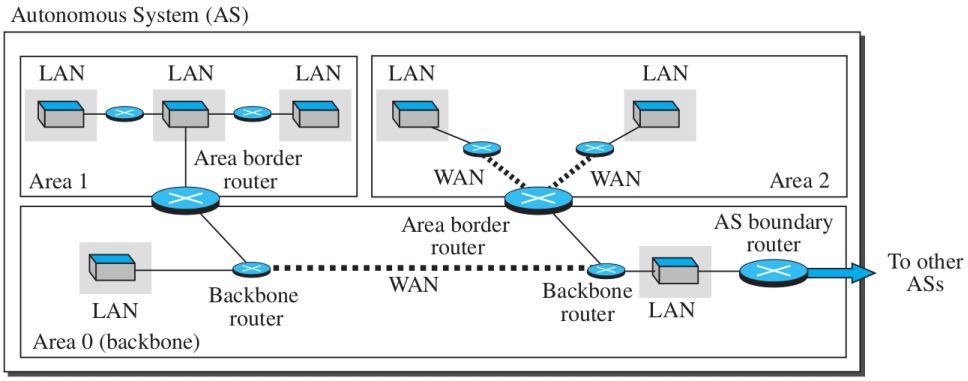

Figure 2.1: Autonomous System Hierarchy

2.1 section1

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2.1.1 title 2

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The system is described by the equation 2.1 below. Here y is the ordinate and x is the abscissa , m is the slope and c a constant.

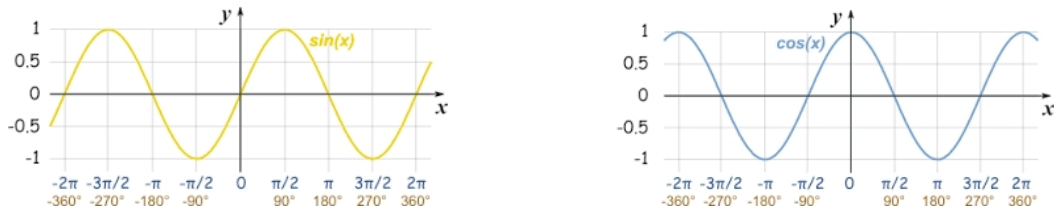
$$y = mx + c \tag{2.1}$$

Page centered and unnumbered multiple equations. The * symbol supresses equation numbering.

$$2x - 5y = 8$$

$$3x + 9y = -12$$

Side by side figures can be created using this environment. See fig 2.2 below.



(a) Sine Wave (b) Cosine Wave

Figure 2.2: The Sine and Cosine waves

Chapter 3

Results and Discussion

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Table 3.1: test table

Sl. No	Item 1	Itm 2
1	37	45
2	42	23
3	47	1
4	52	-21
5	57	-43
6	62	-65
7	67	-87
8	72	-109
9	77	-131
10	82	-153

Chapter 4

Conclusion

In conclusion, our study demonstrates the feasibility of using spiking neural networks for implementing associative memory systems. We show that our SNN-based associative memory system is able to perform robust and efficient associative memory retrieval, and discuss the potential applications of this approach in computational neuroscience and machine learning. Our findings indicate that SNNs are a promising tool for modeling and implementing associative memory systems, and highlight the need for further research in this area.

References

[1] HU, Yun Chao, et al., *Mobile edge computing?A key technology towards 5G*, ETSI white paper, 2015, vol. 11, no 11, p. 1-16.

[2] @online Raspberry pi, `https://www.raspberrypi.org/` Online; accessed 10-June-2019

[3] HU, Yun Chao, et al., *Mobile edge computing?A key technology towards 5G*, ETSI white paper, 2015, vol. 11, no 11, p. 1-16.