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Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
وزارة التعليم العالي و البحث العلمي
École Nationale Polytechnique



المدرسة الوطنية المتعددة التقنيات
Ecole Nationale Polytechnique

Département d'Electronique

End-of-study project dissertation for obtaining
the State Engineer's degree in Electronics

Deep learning network on a SoC platform: Implementation and analysis

TOUMI Said

Under the supervision of Ms. Nour El Houda BENALIA

Presented and defended on July 2nd, 2024 in front of the members of jury:

President	M. Hicham	BOUSBIA-SALAH	Prof.	ENP, Alger
Supervisor	Ms. Nour El Houda	BENALIA	MCA.	ENP, Alger
Examiner	Ms. Fatiha	LANI	MAA.	ENP, Alger

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Département d'Electronique

Mémoire de projet de fin d'études

Pour l'obtention du diplôme d'Ingénieur d'État en Électronique

Réseau d'apprentissage profond sur des plateformes SoC : Implémentation et analyse

TOUMI Said

Sous la direction de Mme. Nour El Houda BENALIA ENP, Alger

Présenté et soutenu publiquement le 02/07/2024 auprès des membres du jury :

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Dedication

“

This work is dedicated, first and foremost, to my Mom, the source of all that I am. Through her vocation, she has taught me to turn empathy and a refusal to accept the suffering of the most disadvantaged in society into my own purpose. I am deeply grateful for her unwavering gentleness, a quality unique to her. Thank you for your constant support and advocacy. Any success I have achieved today is entirely because of you.

I also wish to thank my Father for his patience. In his own way, he shared with me all his knowledge and resources, and even more. Thank you.

This dedication extends my two sisters and my brother and my friends. Each of you is a radiant sunbeam that brightens my mornings and makes every day worthwhile, despite the challenges.

I would like to express my appreciation to all my friends and classmates ELN 2024 from the past three years at Ecole Nationale Polytechnique.

THANK YOU.

”

- TOUMI Said

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ملخص

تتمتع شبكات التعلم العميق بإمكانيات هائلة في مجالات مثل التشخيص الطبي والتعرف على الصور ومعالجة اللغات الطبيعية. ومع ذلك، يمثل تنفيذ هذه الشبكات على منصات النظام على الرقاقة (SoC) تحديات كبيرة بسبب الحاجة إلى عمليات حسابية معقدة وموارد كبيرة. يقدم هذا التقرير تحقياً شاملاً وتحليلاً شاملاً لأداء نماذج التعلم العميق على منصات SoC المختلفة، مع التركيز على تسريع الأجهزة. وعلى وجه التحديد، يقدم التقرير دراسة حالة عملية لتصنيف تخطيط القلب الكهربائي، مما يوفر رؤية قيمة حول التحديات والفوائد المرتبطة بذلك. يستلزم المشروع تنفيذ نماذج التعلم العميق لتصنيف تخطيط كهربية القلب على منصات مختلفة على رقاقات SoC وتحليل أدائها من حيث وقت التنفيذ وكفاءة الطاقة واستخدام الموارد. وتساهم النتائج في تعزيز فهمنا لتحسين أداء نماذج التعلم العميق على مختلف منصات الرقاقات الحاسوبية المركزة إلى جانب تقديم إرشادات للأبحاث المستقبلية في هذا المجال.

كلمات مفتاحية : التعلم العميق، منصات النظام على الرقاقة (SoC)، تخطيطات القلب الكهربائي (ECG).

Résumé

Les réseaux d'apprentissage profond présentent un immense potentiel dans des domaines tels que le diagnostic médical, la reconnaissance d'images et le traitement du langage naturel. Toutefois, la mise en œuvre de ces réseaux sur des plates-formes de systèmes sur puce (SoC) présente des défis importants en raison de la nécessité d'effectuer des calculs complexes et de disposer de ressources substantielles. Ce rapport présente une étude complète et une analyse des performances des modèles d'apprentissage profond sur diverses plateformes SoC, en se concentrant sur l'accélération matérielle. Plus précisément, il propose une étude de cas pratique pour la classification ECG, fournissant des informations précieuses sur les défis et les avantages associés. Le projet comprend la mise en œuvre de modèles d'apprentissage profond pour la classification ECG sur différentes plateformes SoC et l'analyse de leurs performances en termes de temps d'exécution, d'efficacité énergétique et d'utilisation des ressources. Les résultats contribuent à améliorer notre compréhension de l'optimisation des performances des modèles d'apprentissage profond sur différentes plateformes SoC et offrent des conseils pour la recherche future dans ce domaine.

Mots clés : Apprentissage profond, plates-formes de systèmes sur puce (SoC), ECG.

Abstract

Deep learning networks hold immense potential in fields such as medical diagnostics, image recognition, and natural language processing. However, implementing these networks on System on Chip (SoC) platforms presents significant challenges due to the need for complex computations and substantial resources. This report presents a comprehensive investigation and performance analysis of deep learning models on various SoC platforms, focusing on hardware acceleration. Specifically, it offers a practical case study for ECG classification, providing valuable insights into the associated challenges and benefits. The project entails implementing deep learning models for ECG classification on different SoC platforms and analyzing their performance in terms of execution time, energy efficiency, and resource utilization. The findings contribute to enhancing our understanding of optimizing deep learning model performance on various SoC platforms and offer guidance for future research in this area.

Keywords : Deep learning, System on Chip (SoC) platforms, ECG.

Contents

List of Tables

List of Figures

List of Equations

List of Abrviations

- General Introduction** **16**

- 1 Deep Learning** **18**
 - 1.1 Introduction 19
 - 1.2 Definition of Deep Learning 19
 - 1.2.1 Principles of deep learning 19
 - 1.2.2 Applications of deep learning in various fields 21
 - 1.2.2.1 Image and Video Recognition/Classification 21
 - 1.2.2.2 Audio Processing 21
 - 1.2.2.3 Text analysis 22
 - 1.2.2.4 Medical Diagnostics 22
 - 1.3 Deep Learning techniques 23
 - 1.3.1 Artificial Neural Network 23
 - 1.3.2 Convolutional Neural Network (CNN) 26
 - 1.3.3 Long Short-Term Memory (LSTM) 29
 - 1.4 Challenges in Deep Learning Implementation 31
 - 1.4.1 Execution Time 31
 - 1.4.2 Power consumption 32
 - 1.4.3 Memory and resource requirements 33
 - 1.5 Need for Hardware Acceleration 33
 - 1.6 Conclusion 34

- 2 SoC platforms and our choices** **35**
 - 2.1 Introduction 36
 - 2.2 SoC platforms 36
 - 2.2.1 Overview of CPU architecture 36
 - 2.2.2 Overview of GPU architecture 37
 - 2.2.3 Overview of FPGA architecture 38
 - 2.2.4 Comparison of CPU, GPU and FPGA for DL computing 39
 - 2.3 Criteria of selection a SoC Platform 40

2.4	Comparative analysis	40
2.5	Selection of SoC platforms	42
2.5.1	CPU - Intel i5-8250U	42
2.5.2	Jetson Nano dev kit	42
2.5.3	GPU GeForce RTX 2060 Super	43
2.5.4	GPU GeForce RTX 3070	44
2.5.5	FPGA - PYNQ Z2	44
2.6	Conclusion	45
3	Deep learning algorithms for medical application: ECG classification signals	46
3.1	Introduction	47
3.2	Electrocardiogram signals	47
3.2.1	Overview of Electrocardiogram	47
3.2.2	Characteristics of ECG signal	51
3.3	MIT-BIH Arrhythmia Database	52
3.4	Models for ECG Classification	55
3.4.1	ECG Classification - Related Work	55
3.4.2	Overview of proposed Models Architectures	56
3.4.2.1	Artificial Neural Network (ANN)	56
3.4.2.2	1 Dimensional Convolutional Neural Network (CNN1D)	57
3.4.2.3	Hybrid model CNN1D + Long Short Term Memory (LSTM)	58
3.5	Experimental Results	60
3.5.1	Results - ANN model	60
3.5.2	Results - CNN 1D model	61
3.5.3	Results - CNN 1D + LSTM model	63
3.6	Conclusion	65
4	Implementation & results	66
4.1	Introduction	67
4.2	Deployment on CPU : Method and results	67
4.2.1	Intel i5-8250U	67
4.2.2	Quad-core ARM Cortex-A57	69
4.3	Deployment on GPU : Method and results	73
4.3.1	128-core Nvidia Maxwell GPU	73
4.3.2	GeForce RTX 2060 super	76
4.3.3	GeForce RTX 3070	76
4.4	FPGA-Based Implementation: Method and results	77
4.4.1	HLS method	77
4.4.2	Models in C language	78
4.4.3	Vivado HLS	81
4.4.4	AXI protocol - IP Block Interfacing	84
4.4.5	Block Designs of the Architecture in Vivado	87
4.4.5.1	Block design creation:	88
4.4.5.2	Reports of Implementation in Vivado:	90
4.4.5.3	Pipeline optimization:	94
4.4.6	CPU programming in FPGA notebook	99

4.4.7	FPGA implementation Results	103
4.5	Comparison of SoC platforms results	104
4.5.1	Execution time	104
4.5.2	Power consumption	105
4.5.3	Discussion	105
4.6	Conclusion	105
	Conclusion and Perspectives	107
	Bibliography	109
	Webography	111

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