Uni.lu HPC School 2019

PS12b: Machine / Deep learning II

Distributed DL with Horovod

Uni.lu High Performance Computing (HPC) Team

V. Plugaru, Dr. F. Pinel

University of Luxembourg (UL), Luxembourg

http://hpc.uni.lu

Latest versions available on Github:

UL HPC tutorials: https://github.com/ULHPC/tutorials

UL HPC School: http://hpc.uni.lu/hpc-school/

PS12b tutorial sources: ulhpc-tutorials.rtfd.io/en/latest/deep_learning/scalable/

Summary

1 Introduction

2 Scalable Deep Learning with Horovod

Foreword

So we have some news...

Foreword

LE GOUVERNEMENT DU GRAND-DUCHÉ DE LUXEMBOURG

luxembourg.lu guichet.lu crossgov.lu Autres sites

En poursuivant votre navigation vous acceptez que des **cookies** soient utilisés afin d'améliorer votre expérience utilisateur. En savoir plus

J'accepte

Le gouvernement luxembourgeois | gouvernement.lu

Actualités | Le gouvernement | Ministères | Administrations | Dossiers | Système politique

Actualités / Toutes les actualités

Le superordinateur luxembourgeois "Meluxina" fera partie du réseau européen EuroHPC

Communiqué 14.06.2019

En date du 14 juin 2019, le Vice-Premier ministre, ministre de l'Économie, Étienne Schneider, le directeur général adjoint de la Direction générale des réseaux de communication, du contenu et des technologies à la Commission européenne, Khalil Rouhana, ainsi que le CEO de LuxConnect, Roger Lampach, ont présenté le futur superordinateur luxembourgeois, dénommé "Meluxina", qui intègrera le réseau européen EuroHPC de superordinateurs.

©MECO

Foreword

NEWS CLUB BUSINESS GUIDE JOBS

PAPERJAM
BUSINESS ZU LËTZEBUERG

POLITIQUE & INSTITUTIONS — POLITIQUE

SUPERCALCULATEUR

Meluxina, l'outil du futur du Luxembourg

Écrit par Thierry Labro
Publié Le 14.06.2019 • Édité Le 17.06.2019

Partager

TOP
LUS | RECOMMANDÉS

1 FINTECH
Revolut s'installe au Luxembourg

2 POLITIQUE
Le Benelux approuve les transports gratuits

3 BANQUES
BGL BNP Paribas, un siècle d'histoire bancaire

Foreword

NEWS CLUB BUSINESS GUIDE JOBS

PAPERJAM
BUSINESS ZU LËTZEBUERG

ENTREPRISES & STRATÉGIES — TECHNOLOGIES

ÉCONOMIE DE LA DONNÉE

Meluxina, le supercalculateur en 10 questions

Écrit par Thierry Labro
Publié Le 14.06.2019 • Édité Le 14.06.2019

Partager

TOP
LUS | RECOMMANDÉS

1 FINTECH
Revolut s'installe au Luxembourg

2 POLITIQUE
Le Benelux approuve les transports gratuits

3 BANQUES
BGL BNP Paribas, un siècle d'histoire bancaire

Foreword

LUXEMBOURG SPACE AGENCY

THE PLACE FOR SPACE DEVELOPMENT

EXPERTISE INNOVATION SKILLS FUNDING NEWS MEDIA ABOUT US CONTACT

BACK TO HOME > News

THE LUXEMBOURG SUPERCOMPUTER “MELUXINA" TO BE PART OF THE EUROPEAN EUROHPC NETWORK

14/06/2019

Foreword

Donnerstag, 20. Juni 2019 20°

DE

Luxemburger Wort

LOGIN ABONNEMENT

HOME RUBRIKEN INFO-SERVICE FAMILIENANZEIGEN ANZEIGENMARKT E-PAPER SUCHE

"Meluxina" unter den 25 schnellsten Supercomputern

Grafik: CBE / LuxConnect

Das LuxConnect-Datenzentrum in Bissen (Mitte). Das Gebäude links wird neu errichtet.

WIRTSCHAFT / 2 Min. / 14.06.2019

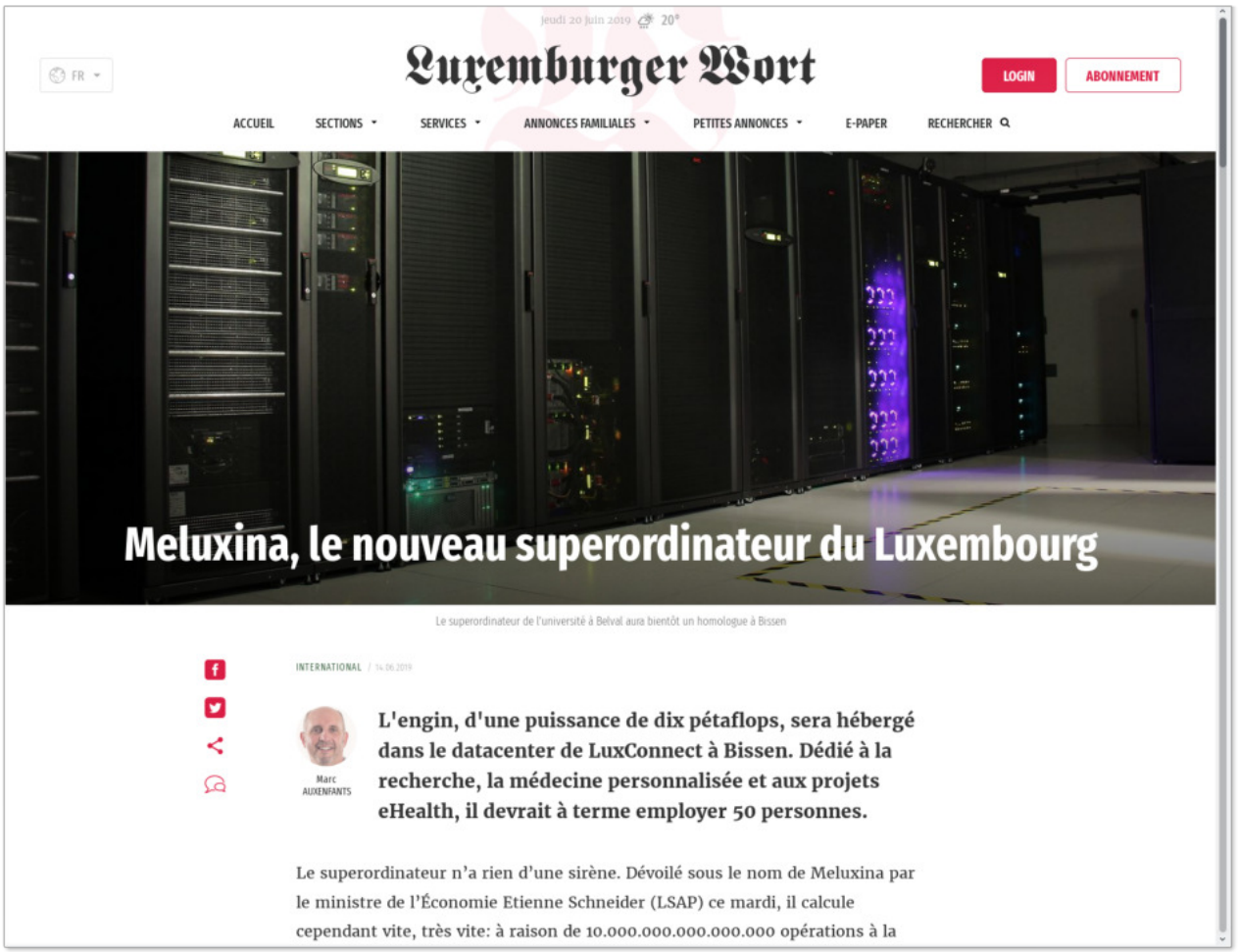
Michel THIEL

Wirtschaftsminister Etienne Schneider stellte am Freitag Luxemburgs zukünftigen Hochleistungsrechner vor.

Zehn Petaflops Rechenleistung wird "Meluxina" bieten, wie der neue luxemburgische Hochleistungsrechner vom Betreiber Luxconnect getauft wurde. Das sind zehn Millionen Milliarden oder 10 hoch 18 Rechenoperationen

https://www.wort.lu/de/business/meluxina-unter-den-25-schnellsten-supercomputern-5d03b626da2cc1784e3460b1# **30 Millionen Euro teuren Supercomputer weltweit**

Foreword



jeudi 20 juin 2019 20°

FR

Luxemburger Wort

LOGIN ABONNEMENT

ACCUEIL SECTIONS SERVICES ANNONCES FAMILIALES PETITES ANNONCES E-PAPER RECHERCHER

Meluxina, le nouveau superordinateur du Luxembourg

Le superordinateur de l'université à Belval aura bientôt un homologue à Bissen

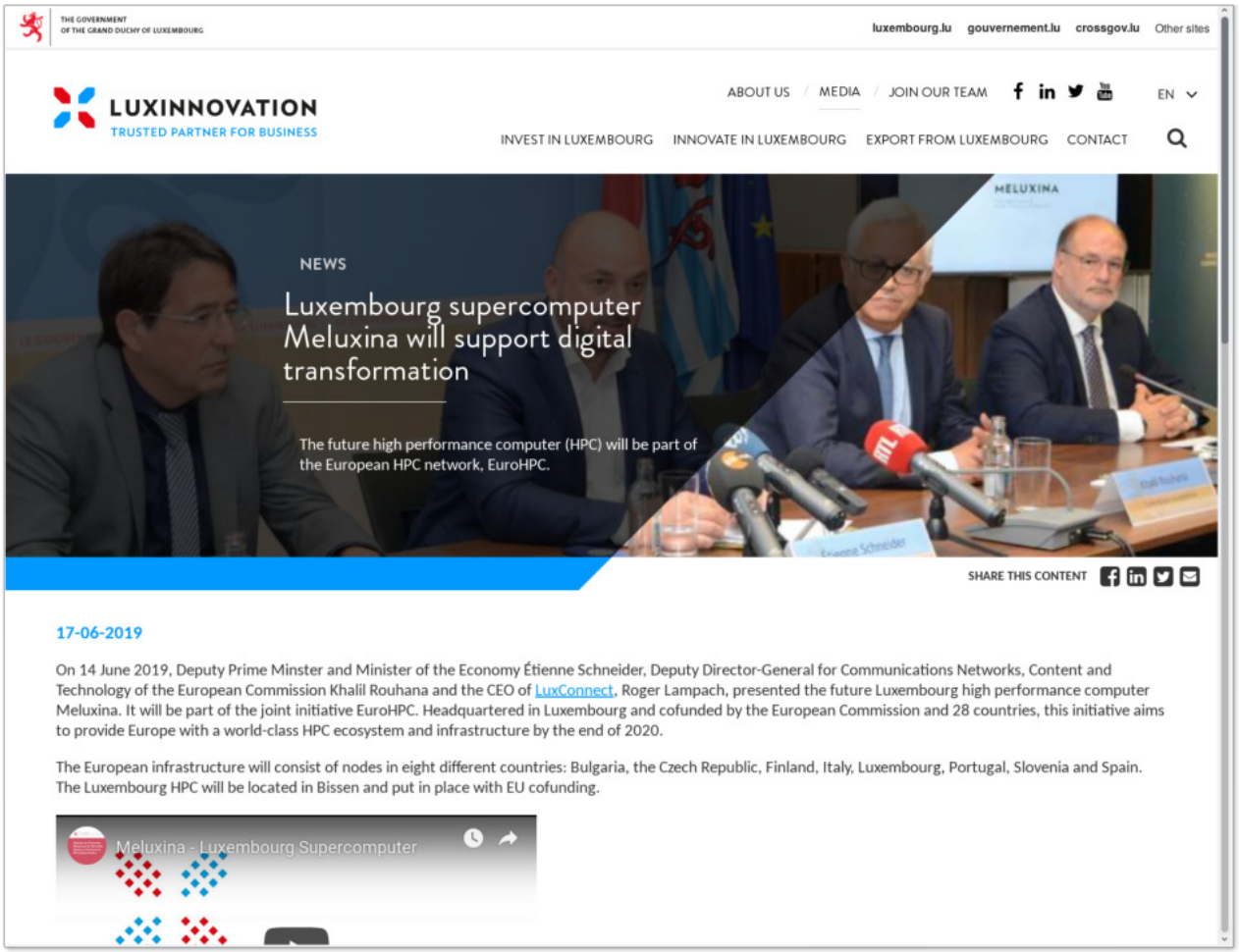
INTERNATIONAL / 14.06.2019

Marc AUXENFANTS

L'engin, d'une puissance de dix pétaflops, sera hébergé dans le datacenter de LuxConnect à Bissen. Dédié à la recherche, la médecine personnalisée et aux projets eHealth, il devrait à terme employer 50 personnes.

Le superordinateur n'a rien d'une sirène. Dévoilé sous le nom de Meluxina par le ministre de l'Économie Etienne Schneider (LSAP) ce mardi, il calcule cependant vite, très vite: à raison de 10.000.000.000.000.000 opérations à la

Foreword



THE GOVERNMENT OF THE GRAND DUCHY OF LUXEMBOURG

luxembourg.lu gouvernement.lu crossgov.lu Other sites

LUXINNOVATION
TRUSTED PARTNER FOR BUSINESS

ABOUT US / MEDIA / JOIN OUR TEAM EN

INVEST IN LUXEMBOURG INNOVATE IN LUXEMBOURG EXPORT FROM LUXEMBOURG CONTACT

NEWS

Luxembourg supercomputer Meluxina will support digital transformation

The future high performance computer (HPC) will be part of the European HPC network, EuroHPC.

SHARE THIS CONTENT

17-06-2019

On 14 June 2019, Deputy Prime Minster and Minister of the Economy Étienne Schneider, Deputy Director-General for Communications Networks, Content and Technology of the European Commission Khalil Rouhana and the CEO of LuxConnect, Roger Lampach, presented the future Luxembourg high performance computer Meluxina. It will be part of the joint initiative EuroHPC. Headquartered in Luxembourg and cofunded by the European Commission and 28 countries, this initiative aims to provide Europe with a world-class HPC ecosystem and infrastructure by the end of 2020.

The European infrastructure will consist of nodes in eight different countries: Bulgaria, the Czech Republic, Finland, Italy, Luxembourg, Portugal, Slovenia and Spain. The Luxembourg HPC will be located in Bissen and put in place with EU cofunding.

Meluxina - Luxembourg Supercomputer

Foreword

Anzeigen-Preise Jobs Immobilien Verkehr Box Finder E-Paper Newsletter

fr de Luxembourg 22° Suchen

essentiel

Luxemburg Ausland Panorama Wirtschaft Sport Community People Lifestyle Digital Buzz Entertainment Mehr

L'essentiel Radio

IN LUXEMBURG

14. Juni 2019 17:07; *Akt: 14.06.2019 20:36*

«Meluxina» soll Lücke zu China und USA schließen

BISSEN – Der Supercomputer, der bis Ende 2020 installiert wird, soll einer der 20 schnellsten Rechner der Welt werden. Das teilte Wirtschaftsminister Schneider am Freitag mit.

Mario Grotz, Étienne Schneider, Khalif Rouhana und Roger Lampech (v.l.) haben am Freitag den Supercomputer vorgestellt. (Bild: L'essentiel)

TIERISCHE FRACHT

Cargolux liefert die Beluga-Wale wohlbehalten ab

LUXEMBURG – In einer Bucht bei Island entsteht ein Freiwasserreservat für Wale und Delphine - als Alternative zu Freizeitparks. Zwei Beluga-Wale wurden nun aus China eingeflogen.

CHAMBER-PRÄSIDENT

Etgen zieht nach dem erstem Halbjahr Bilanz

LUXEMBURG – Vor einem halben Jahr hat Fernand Etgen das Amt des Parlamentspräsidenten übernommen. Zeit für eine Zwischenbilanz.

RADARE IN LUXEMBURG

Am Donnerstag heißt es wieder aufpassen!

LUXEMBURG – Die Police Grand-Ducale zeigt keine Gnade für Raser: Am Donnerstag hat sie sich dieserorts im Großherzogtum auf die Lauer gelegt.

IN LUXEMBURG

Foreword

Thursday, 20 Jun 2019

Chronicle.lu

NEWS FEATURES EVENTS OPINION CLASSIFIEDS PROMOTIONS ABOUT LUXEMBOURG EMERGENCY

HOME / NEWS / ECONOMICS / LUXEMBOURG MELUXINA SUPERCOMPUTER TO JOIN EUROPEAN EUROHPC NETWORK

Luxembourg Meluxina Supercomputer to Join European EuroHPC Network

Published on Friday, 14 Jun 2019 17:11 by ED

SHARE THIS ARTICLE: RATE THIS ITEM: ★★★★★

Subscribe Now

On Friday 14 June 2019, Luxembourg's Deputy Prime Minister and Minister of the Economy, Étienne Schneider, together with the Deputy Director General of the Directorate General of Communication Networks, Content and Technologies (DG CNECT) at the European Commission, Khalil Rouhana, as well as LuxConnect CEO, Roger Lampach, presented the future Luxembourg supercomputer, named "Meluxina", which will join the European network of EuroHPC supercomputers.

Meluxina Supercomputer (L-R): Mario Grotz, Ministry of Economy; Minister Étienne Schneider; Khalil Rouhana, European Commission; Roger Lampach, CEO LuxConnect; Credit: MECO

The EuroHPC Joint Undertaking, headquartered in the Grand Duchy, is an initiative co-financed by the European Commission and 28 countries, including Luxembourg, which aims to provide Europe with an ecosystem and a computing infrastructure. By June 2019, following a call for projecta, EuroHPC selected eight sites in different Member States to host supercomputers. The Luxembourg project to install the petascale supercomputer Meluxina at LuxConnect in Bissen has high performing

TRENDING NEWS

Jean Asselborn Advocates Defence of Human Rights, Support for Jordan at EU Foreign Affairs Council
Abroad 18 Jun, 2019 09:59

Minister Gramegna Reveals 60 Companies Established in Grand Duchy re Brexit
Nordic Chamber (Nobelux & Swebelux) 17 Jun, 2019 17:37

Nicolas Graas Formally Appointed Honorary Consul General of India in Luxembourg
Embassies & Consulates 17 Jun, 2019 20:05

Luxembourg-UK Agreement Guarantees Citizens' Voting Rights Post-Brexit
Politics 18 Jun, 2019 15:04

Grosbusch Introduces 100% Recyclable, Biodegradable Packaging
Environment 17 Jun, 2019 10:10

Luxembourg, LU

mailto:?Subject=Chronicle&Body= https://chronicle.lu/category/economics/29524-luxembourg-meluxina-supercomputer-to-join-european-eurohpc-network

Foreword

D NEWS AGENDA MAGAZINE EXPAT GUIDE JOBS REAL ESTATE INSIGHTS

DELANO

LUXEMBOURG IN ENGLISH

MEET MELUXINA, LUXEMBOURG'S NEW SUPERCOMPUTER

NEWS • BUSINESS • 17.06.2019 • DELANO STAFF

Luxembourg's petascale supercomputer, planned to open in Bissen before the end of 2020, was presented to the public on Friday.

Meluxina will join the European EuroHPC network of supercomputers. Photo: Shutterstock

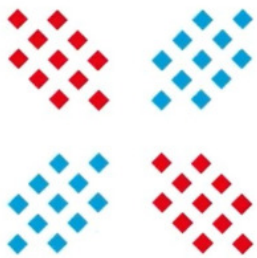
Industry and startups will be able to access Meluxina, as the computer has been dubbed, at the offices of LuxConnect in Bissen, where project will eventually generate up to 50 jobs. The Luxembourg supercomputer is one of eight to join the European network of supercomputers.

According to a government statement published on Friday, it will have a computing power of 10 petaflops/second, which corresponds to 10,000,000,000,000,000 computing operations per second.

Meluxina will be dedicated to applications in research, personalised medicine and eHealth projects, as well as the needs of companies, in

LATEST NEWS

Foreword



MELUXINA

HIGH PERFORMANCE
COMPUTING IN LUXEMBOURG

MeluXina National Supercomputer

MeluXina - coming in 2020

- 10 PetaFlop supercomputer
- Modular architecture covering a wide variety of needs
- High performance network & storage for HPC, BigData & AI

MeluXina National Supercomputer

MeluXina - coming in 2020

- 10 PetaFlop supercomputer
- Modular architecture covering a wide variety of needs
- High performance network & storage for HPC, BigData & AI

What this means for you

- Algorithms and applications must be run **at scale**
- **Code development** will play a large role
- Need to use different computing elements and memory hierarchy
  ↪ will play a critical role in your **application performance**

Session Objectives

- Practice with the (excellent) SC18 Tutorial: Deep Learning At Scale
  - ↪ ... on the UL Iris cluster
  - ↪ ... with our latest software environment
  - ↪ ... with and without GPU accelerators

`https://github.com/NERSC/sc18-dl-tutorial`

- For Horovod details also highly recommending the talk **Horovod: Distributed Deep Learning in 5 Lines of Python**
  - ↪ from Uber Open Summit 2018

`https://www.youtube.com/watch?v=4y0TDK3KoCA`

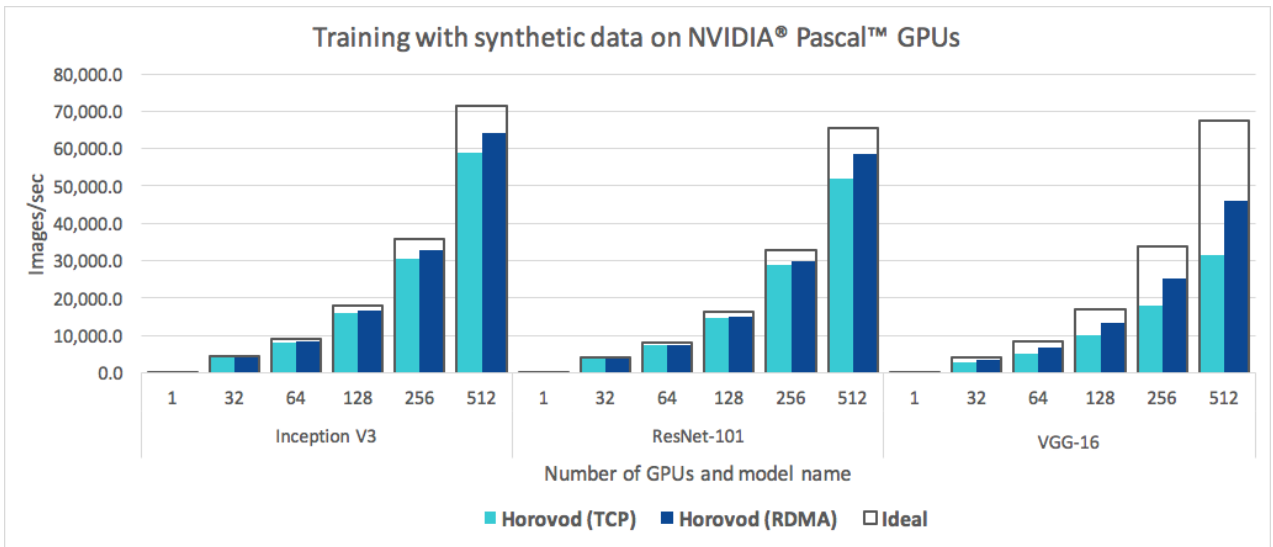
Summary

1 Introduction

2 Scalable Deep Learning with Horovod

Horovod in brief

- Distributed training framework for
  - ↪ TensorFlow
  - ↪ Keras
  - ↪ PyTorch
  - ↪ MXNet
- Goal: make distributed Deep Learning fast & easy to use



https://github.com/horovod/horovod

Horovod on Iris

```
$> module load swenv/default-env/devel
```

only needed during HPC School, part of 2019 software env. soon

- Horovod and TensorFlow **without GPU support**

```
module load lib/TensorFlow/1.13.1-foss-2019a-Python-3.7.2
module load tools/Horovod/0.16.3-foss-2019a-Python-3.7.2
```

- Horovod and TensorFlow **with GPU support**
  - ↪ **highly recommended**
  - ↪ using cuDNN for GPU-accelerated DNN primitives
  - ↪ using NCCL for multi-GPU communication

```
module load lib/TensorFlow/1.13.1-fosscuda-2019a-Python-3.7.2
module load tools/Horovod/0.16.3-fosscuda-2019a-Python-3.7.2
```

Multi-GPU Multi-Node Horovod + TF

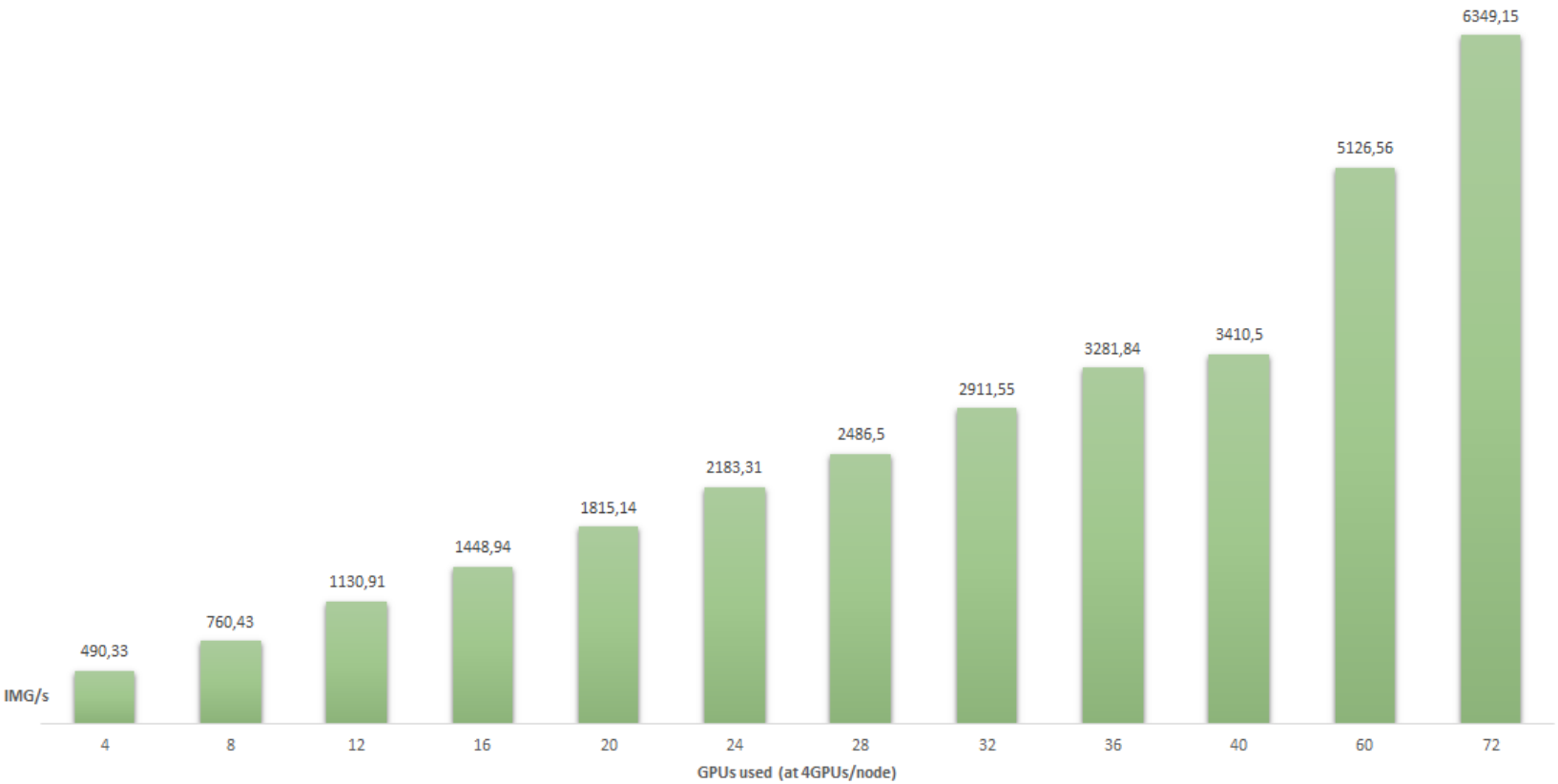
```
#!/bin/bash -l
#SBATCH -J HorovodTFGPU
#SBATCH -o %x_%j.out
#SBATCH -N 1
#SBATCH --ntasks-per-node=4
#SBATCH --gres=gpu:4
#SBATCH -t 1:0:0
#SBATCH -p gpu

module load swenv/default-env/devel
module load lib/TensorFlow/1.13.1-fosscuda-2019a-Python-3.7.2
module load tools/Horovod/0.16.3-fosscuda-2019a-Python-3.7.2

mkdir ~/tests-horovod && cd ~/tests-horovod
git clone https://github.com/tensorflow/benchmarks && cd benchmarks
git checkout cnn_tf_v1.13_compatible

horovodrun -np $SLURM_NTASKS \
    python scripts/tf_cnn_benchmarks/tf_cnn_benchmarks.py \
      --model resnet101 --batch_size 64 --variable_update horovod
```

Some scaling benchmarks on Iris



Questions?

http://hpc.uni.lu

High Performance Computing @ uni.lu

Prof. Pascal Bouvry
Dr. Sebastien Varrette
Valentin Plugaru
Sarah Peter
Hyacinthe Cartiaux
Clement Parisot
Dr. Fréderic Pinel
Dr. Emmanuel Kieffer

University of Luxembourg, Belval Campus
Maison du Nombre, 4th floor
2, avenue de l'Université
L-4365 Esch-sur-Alzette
mail: hpc@uni.lu

1 **Introduction**

2 **Scalable Deep Learning with Horovod**