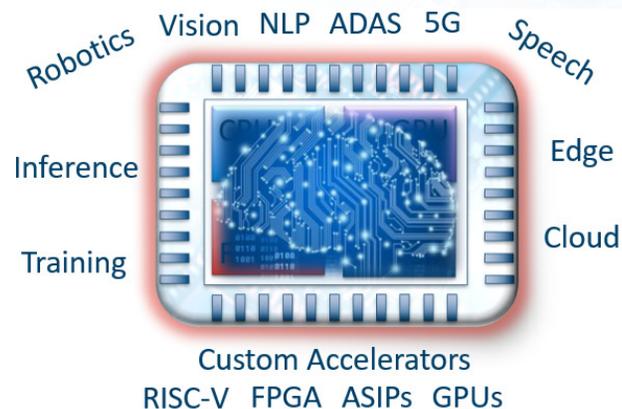# Workshop

Accelerating AI – Challenges and Opportunities in Cloud and Edge Computing

Welcome and Opening Remarks

Yassine Hariri
CMC Microsystems

Robotics Vision NLP ADAS 5G Speech
Inference Edge
Training Cloud
Custom Accelerators
RISC-V FPGA ASIPs GPUs

March 6th 2020
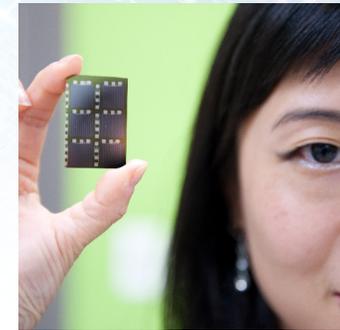***Polytechnique Montréal***

CMC
MICROSYSTEMS

CMC Microsystems

CMC Microsystems

The services provided by CMC are essential for the research and training required to advance the digital economy:

Industry 4.0, autonomous vehicles, big data, Internet of Things (IoT), cyber defence and security, 5G, quantum computing, artificial intelligence (AI)

Academic and Industrial Users

> Not for profit – federally incorporated 1984

> Manages Canada's National Design Network®

> Delivers micro-nano innovation capabilities

Lowering Barriers to Technology Adoption

CMC delivers key services to increase researchers' and companies' innovation capability in Canada:

- ➢ Design tools (software)
- ➢ Fabrication services to create working prototypes
- ➢ Equipment and services for prototype testing
- ➢ Platform technologies
- ➢ Training, support, networking
- ➢ Technology plan and roadmap
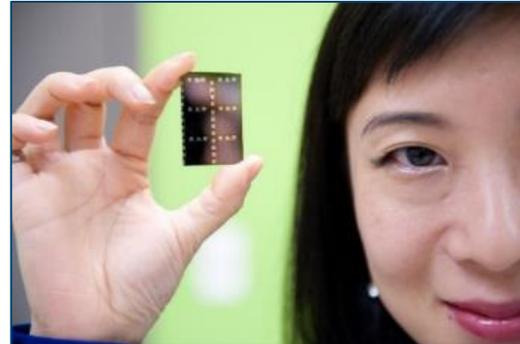
Canada's National Design Network®

A Canada-wide collaboration between 67 universities/colleges to connect 10,000 academic participants with 1,000 companies to design, make and test micro-nanosystem prototypes.

CMC Connects:

- ● Post-secondary institutions
- ● Collaborating companies
- ● Companies manufacturing micro-nanosystems products in Canada
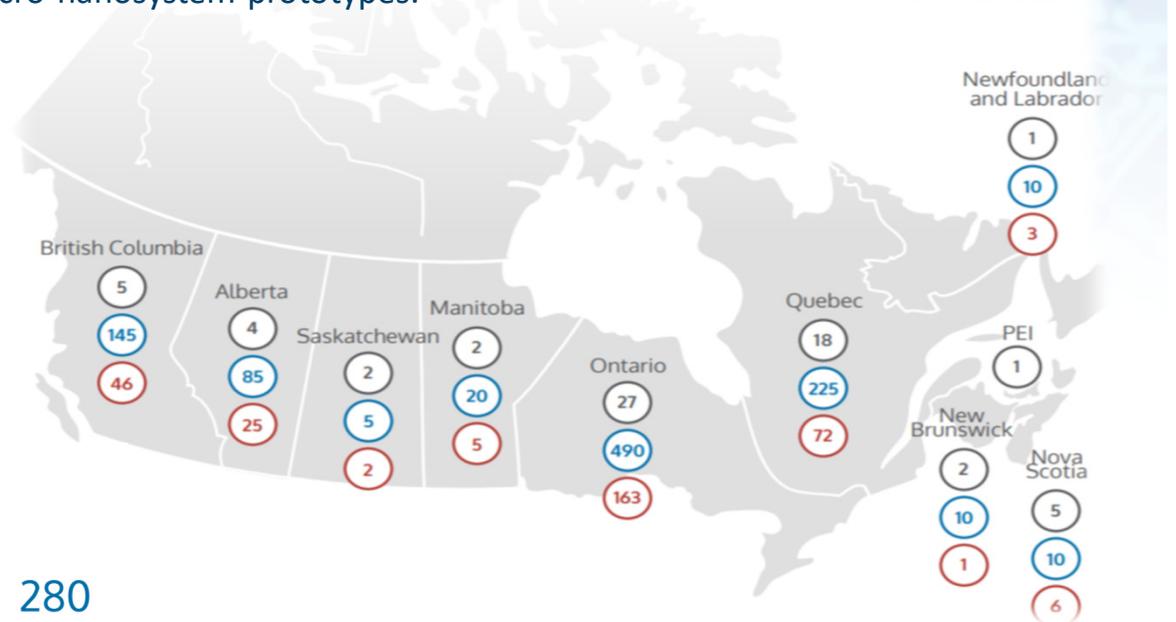
A growing community

More than 10,000 users, including:

1,250 professors including 150 research chairs	**3,395** graduate students	**400** post-doctoral fellows	**280** research staff
4,715 undergrads	**60** college students	↑ An increasing base of companies and academics outside Canada directly used CNDN services	

Map data

British Columbia
- 5
- 145
- 46

Alberta
- 4
- 85
- 25

Saskatchewan
- 2
- 5
- 2

Manitoba
- 2
- 20
- 5

Ontario
- 27
- 490
- 163

Quebec
- 18
- 225
- 72

Newfoundland and Labrador
- 1
- 10
- 3

PEI
- 1

New Brunswick
- 2
- 10
- 1

Nova Scotia
- 5
- 10
- 6

CMC

Industrially relevant research

A strong national network delivering globally competitive, industrially relevant research and innovation.

Research excellence	Industrial impact	
3,655 publications	**40** licensed technologies	**225** patents (applied for/issued)
165 national and international awards	**785** HQP moved to industry in Canada	**20** startups

CMC
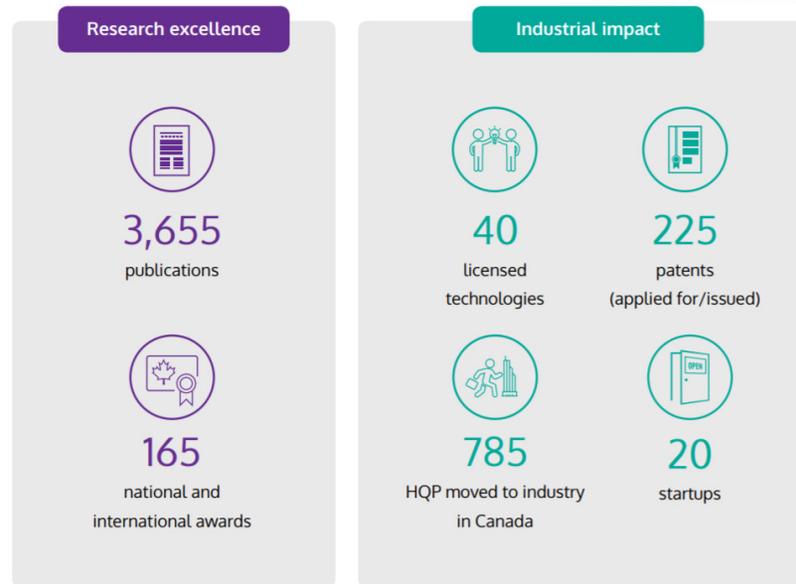
From idea to manufacturable prototype

CAD
State-of-the-art environments for successful design

- ✓ Selection of high-performance Computer Aided Design (CAD) tools and design environments
- ✓ Available via desktop or through CMC Cloud
- ✓ User guides, application notes, training materials and courses

CMC.ca/CAD

FAB
Services for making working prototypes

- ✓ Multi-project wafer services with affordable access to foundries worldwide
- ✓ Fabrication and travel assistance to prototype at a university-based lab
- ✓ Value-added packaging and assembly services
- ✓ In-house expertise for first-time-right prototypes

CMC.ca/FAB

LAB
Device validation to system demonstration

- ✓ Access to platform-based microsystems design and prototyping environments
- ✓ Access to test equipment on loan
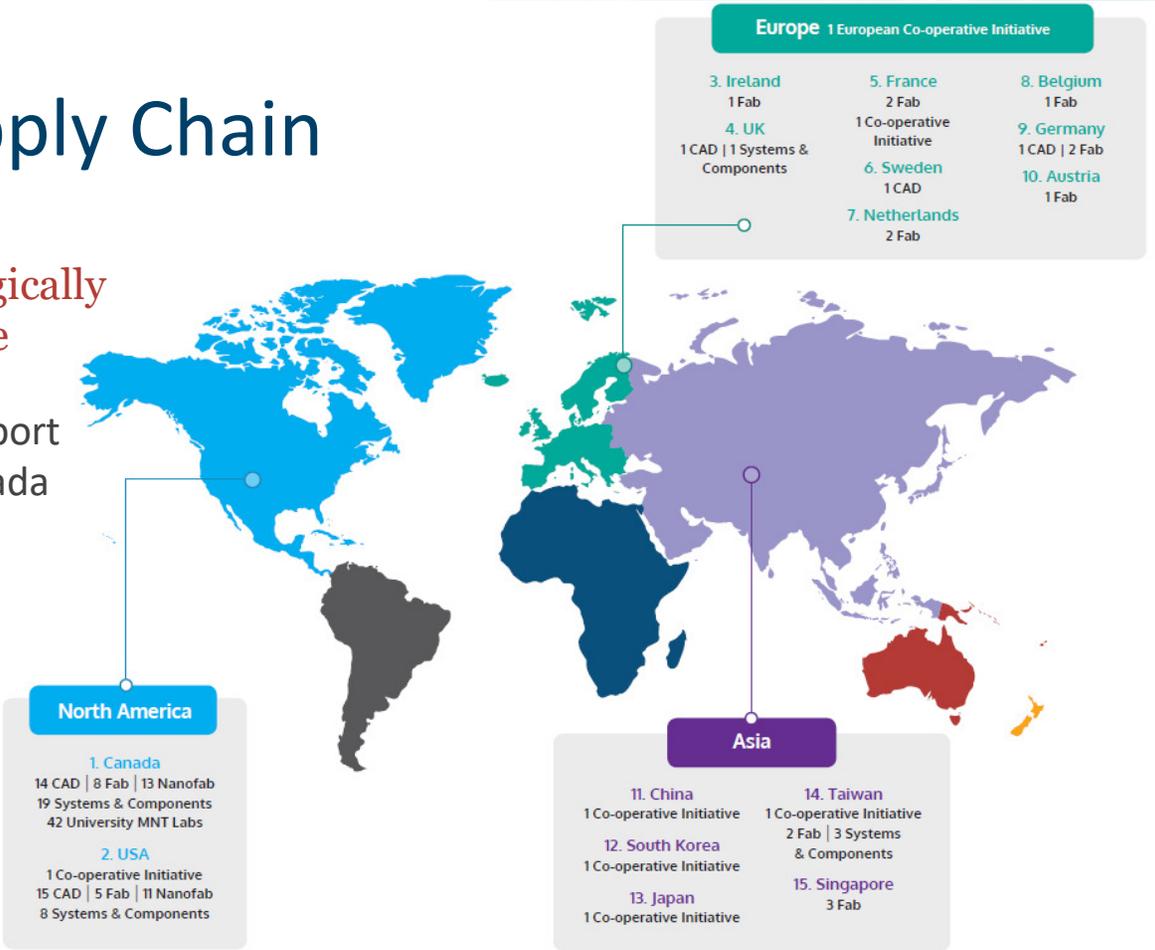- ✓ Access to contract engineering services

CMC.ca/LAB

CMC

Industrial Supply Chain

CNDN - Engaging strategically in Canada and worldwide

Global partnerships to support research excellence in Canada

info@cmc.ca

Europe 1 European Co-operative Initiative

3. Ireland
1 Fab
4. UK
1 CAD | 1 Systems & Components

5. France
2 Fab
1 Co-operative Initiative
6. Sweden
1 CAD
7. Netherlands
2 Fab

8. Belgium
1 Fab
9. Germany
1 CAD | 2 Fab
10. Austria
1 Fab

North America

1. Canada
14 CAD | 8 Fab | 13 Nanofab
19 Systems & Components
42 University MNT Labs
2. USA
1 Co-operative Initiative
15 CAD | 5 Fab | 11 Nanofab
8 Systems & Components

Asia

11. China
1 Co-operative Initiative
12. South Korea
1 Co-operative Initiative
13. Japan
1 Co-operative Initiative

14. Taiwan
1 Co-operative Initiative
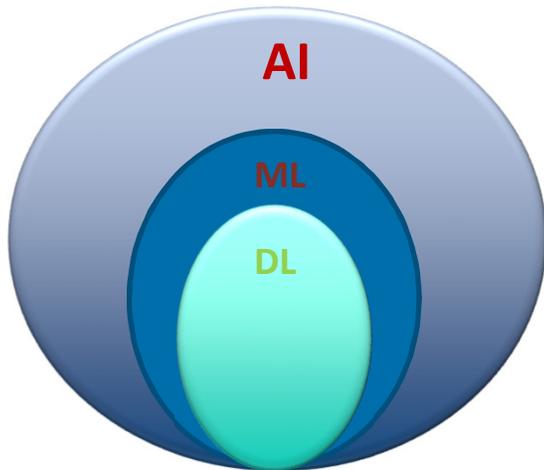2 Fab | 3 Systems & Components
15. Singapore
3 Fab

CMC

AI Hardware

Applications of AI

- Machine learning is programming computers to optimize a performance criterion using example data or past experience

- Transforming many industries

- Exploding ecosystem of tools and platforms

AI

ML

DL

- **AI: Artificial Intelligence**
  - Sense, reason, act and adapt
- ML: Machine Learning
  - Algorithm that improve as they are exposed to data over time
- DL: Deep Learning
  - Multilayered neural networks learn from vast amounts of data

https://www.javatpoint.com/application-of-ai

Source: What's the Difference Between Artificial Intelligence (AI), Machine Learning, and Deep Learning? by Glenn Evan Touger
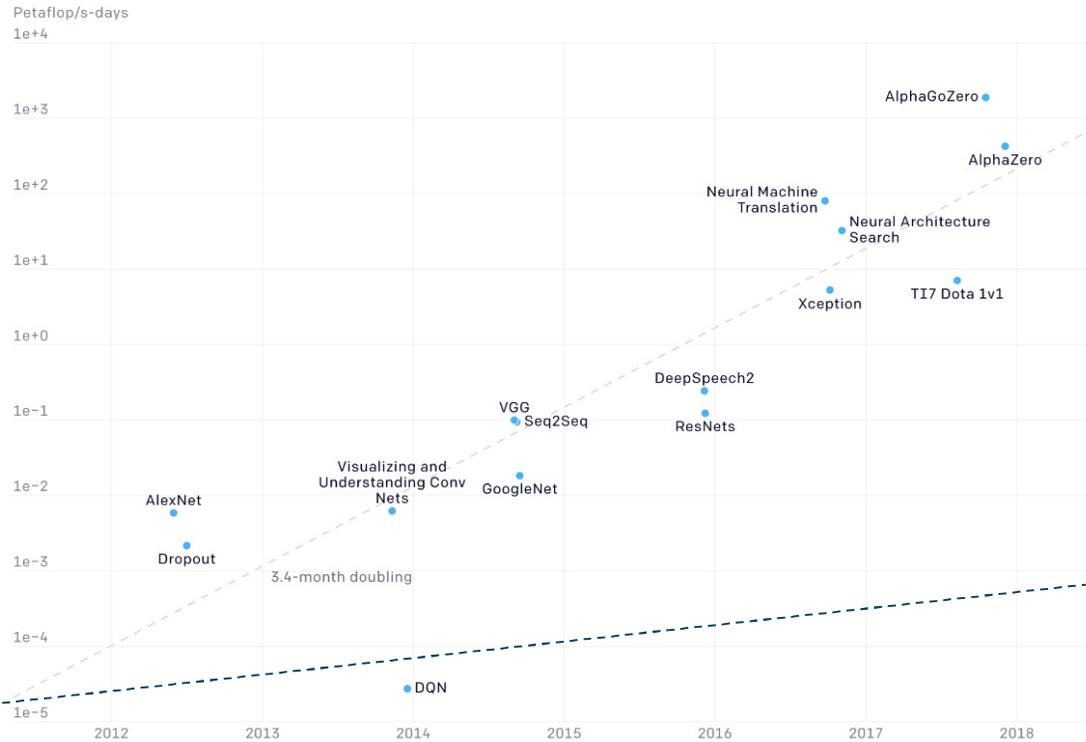
CMC

Rise in popularity of deep learning

Three factors drive the advance of AI:

- Greater availability of **large data** sets, containing more training examples

- **Novel algorithms** including new models, Open source machine learning flow, as well as libraries

- Efficient use of **accelerators** such as GPUs, FPGAs and custom hardware such as Tensor Processor to train

  deep learning models

Why we need Better AI Hardware?

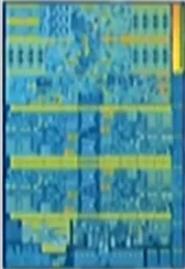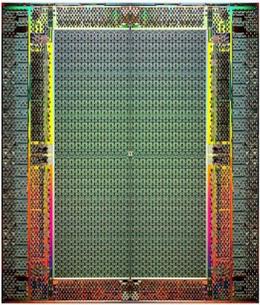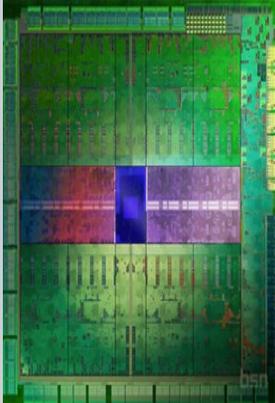AlexNet to AlphaGo Zero: A 300,000x Increase in Compute (Log Scale)

The evolution of AI Hardware

Era	70's	80's	90's	2010's	2020+
Processor	CPU	FPGA	GPU	TPU	Light/Quantum?

The AI Chip Market as a 2x2 Matrix

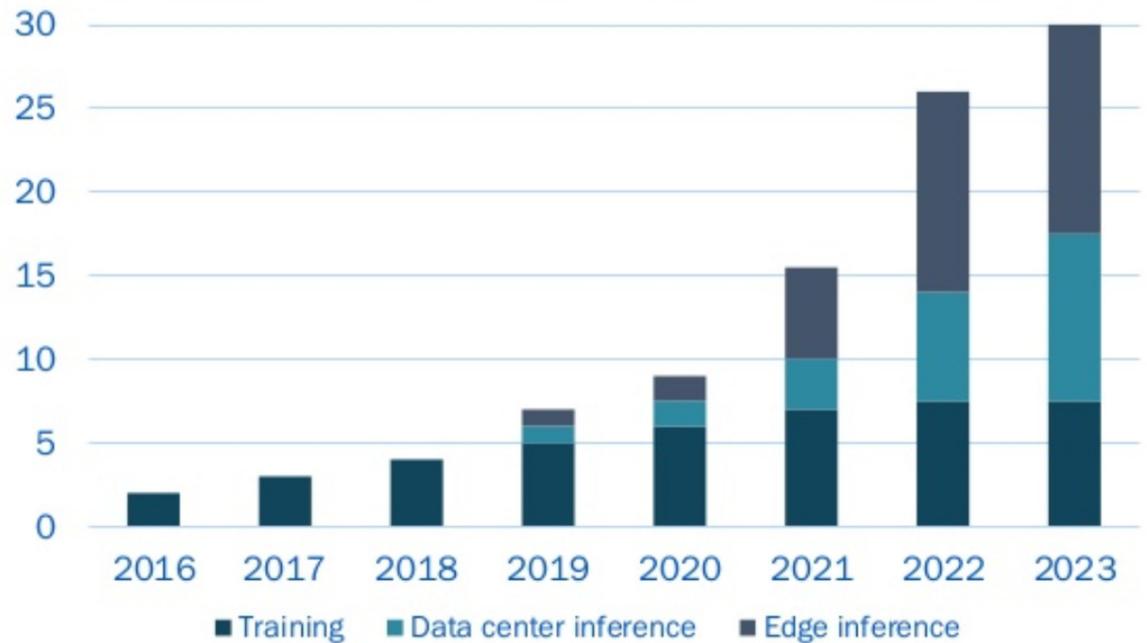|	Training	Inference
Cloud	GPU,TPU	CPU, FPGA, TPU, GPU
Edge	N/A	SoC

CMC

Big Trend: AI is moving to the edge

- ➢ **Increasing** demand for edge DNN compute

- ➢ **Need for bigger** models to handle a variety of cases

- ➢ Models running in **parallel** with tough latency, power and compute requirements

CMC
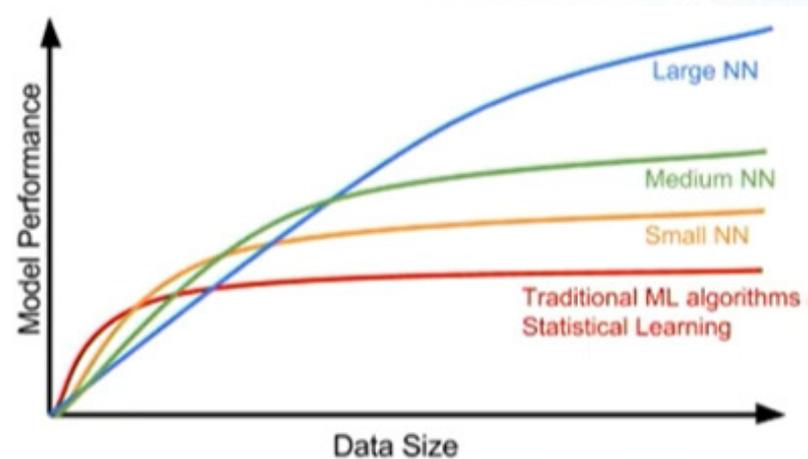
Large Growth Opportunity for AI Inference

- Faster training

- AI @ edge

- Specialized Inference HW

- ***

Semiconductor TAM for AI ($B) – Barclay's Research

Legend: Training, Data center inference, Edge inference

CMC

Workshop Agenda

CMC

Time	Topic	Presenter
8:30 to 8:50	Registration	
8:50 to 9:00	Welcome and Opening Remarks	▸ Yassine Hariri, CMC Microsystems
9:00 to 9:30	▸ Software Solutions for Deep Learning Model Optimization	▸ Ehsan Saboori, CTO and Co-founder of Deeplite
9:30 to 10:00	▸ Algean: An Open Framework for Machine Learning on Heterogeneous Clusters	▸ Paul Chow, Professor at University of Toronto
10:00 to 10:30	▸ Structurally-Regularized CNN Accelerator Architecture via Subband Decomposition	▸ Pavel Sinha, Ph.D. student at McGill University, Montreal, Canada
10:30 to 11:00	Break	
11:00 to 11:30	▸ Hardware Aware Acceleration For Deep Neural Network	▸ MohammadHossein AskariHemmat, Ph.D. Student at Ecole Polytechnique of Montréal
11:30 to 12:00	▸ Open Source Processor IP for High Volume Production SoCs: CORE-V Family of RISC-V cores	▸ Rick O'Connor, President & CEO, OpenHW Group
12:00 to 13:00	Lunch	

Time	Session	Speaker
13:00 to 13:20	▸ From Printed Flexible Sensors to Autonomous Communicating Objects : What's Going on in LACIME Research Lab	▸ Ghyslain Gagnon, Professor at École de Technologie Supérieure ÉTS
13:20 to 13:40	▸ What Use is Hardware without Software?	▸ Deborah Guillon, Co-founder and the Machine Learning Lead of YetiWare
13:40 to 14:00	▸ Efficient DL Inference by Learning Per-Layer Memory Supply Voltage Scaling	▸ Sébastien Henwood, Ph.D. Student at Ecole Polytechnique of Montréal
14:00 to 14:10	▸ CMC Microsystems: CAD, FAB and LAB	▸ Owain Jones, Manager, CAD Business Unit, CMC Microsystems
14:10 to 14:20	Break	
14:20 to 14:30	▸ CMC Microsystems Infrastructure for Supporting Cloud and Edge Computing Research	▸ Yassine Hariri, CMC Microsystems
14:30 to 15:30	Panel Session: Accelerating AI – Challenges and Opportunities in Cloud and Edge Computing	▸ Moderator: Mounir Boukadoum
15:30 to 15:40	Closing Remarks	Yassine Hariri, CMC Microsystems

Panel Session: Accelerating AI – Challenges and Opportunities in Cloud and Edge Computing

Moderator: Mounir Boukadoum

Panellists:

- **Ehsan Saboori**, CTO and Co-founder of Deeplite
- **Paul Chow**, Professor at University of Toronto
- **Deborah Guillon**, Co-founder and the Machine Learning Lead of YetiWare
- **Pavel Sinha**, Ph.D. student at McGill University, Montreal, Canada
- **MohammadHossein AskariHemmat**, Ph.D. Student at Ecole Polytechnique of Montréal

14:30 to 15:30 — Panel Session: Accelerating AI – Challenges and Opportunities in Cloud and Edge Computing

Thank you

Yassine Hariri
Hariri@cmc.ca

www.cmc.ca