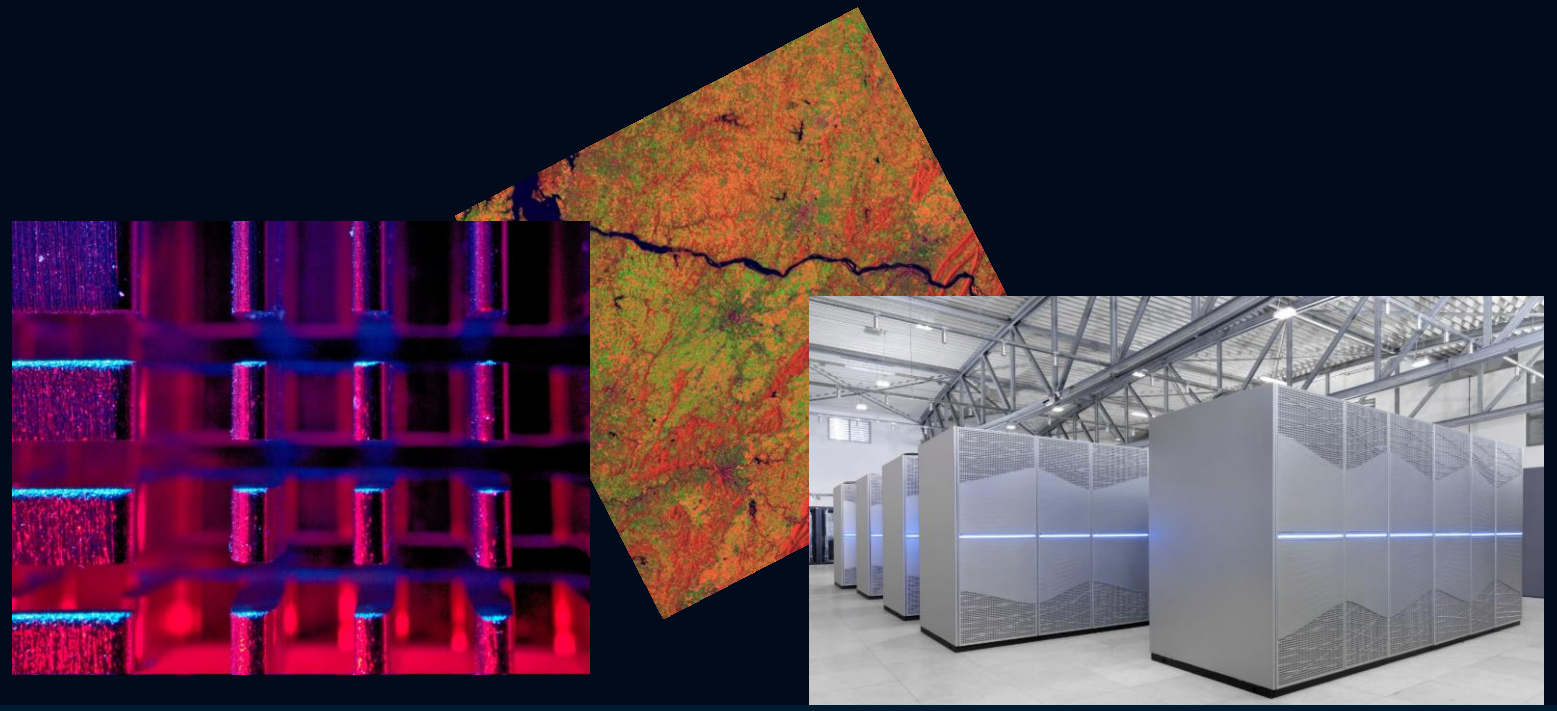


INTRODUCTION

IEEE IGARSS 2021 Tutorial on Scalable Machine Learning with High Performance and Cloud Computing

DR. – ING. GABRIELE CAVALLARO
HIGH PRODUCTIVITY DATA PROCESSING RESEARCH GROUP
JÜLICH SUPERCOMPUTING CENTRE
WWW.GABRIELE-CAVALLARO.COM

JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

UNIVERSITY OF ICELAND

HDCRS

ESI

IEEE GRSS

IGARSS BRUSSELS 2021

INSTRUCTORS

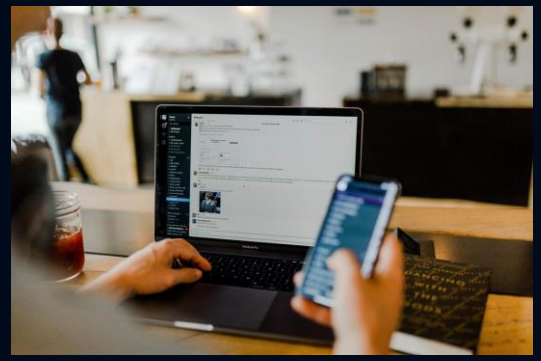
Gabriele Cavallaro

Rocco Sedona

Shahbaz Memon

COMMUNICATION AND MATERIAL

Slack Channels



#general and #technical-support

#day-n: related to the lectures

Material ☞ https://www.gabriele-cavallaro.com/teaching/tutorial-igarss2021/

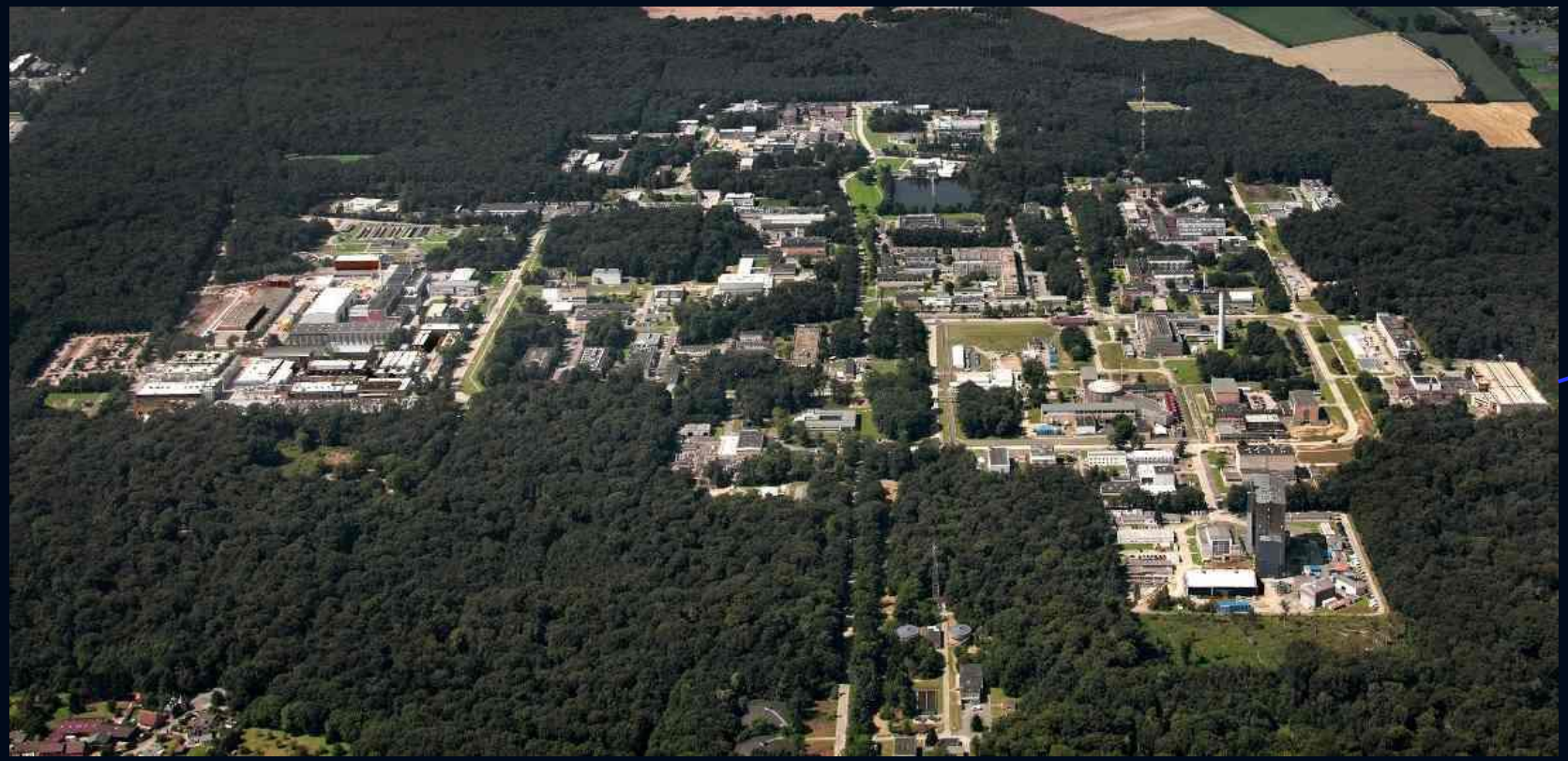
AGENDA

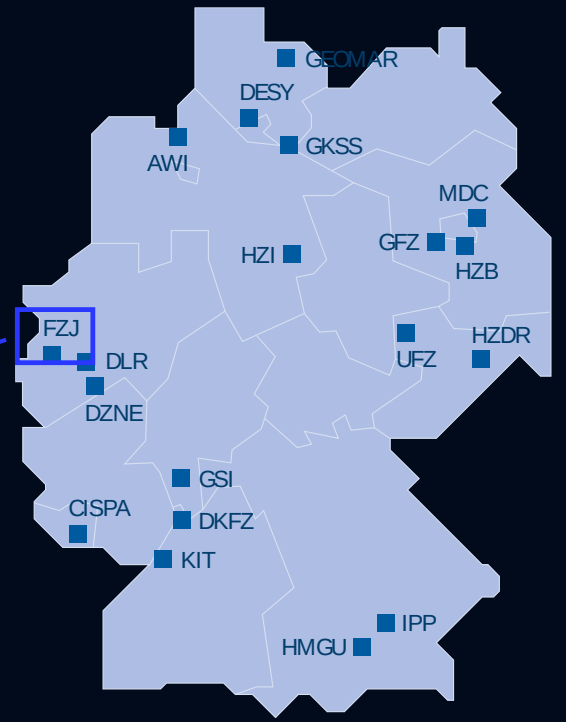
- First day (Saturday July 10)
  - (14:00 - 14:30) Lecture 1: Introduction
  - (14:30 - 16:00) Lecture 2: Levels of Parallelism and High Performance Computing
  - (16:00 - 16:30) Break
  - (16:30 - 17:45) Lecture 3: Distributed Deep Learning
  - (17:45 - 18:00) Q&A and wrap-up

- Second day (Sunday July 11)
  - (14:00 - 15:30) Lecture 4: Hands-on Distributed Deep Learning
  - (15:30 - 16:00) Break
  - (16:00 - 17:30) Lecture 5: Big Data Analytics using Apache Spark
  - (17:30 - 18:00) Q&A and wrap-up

FORSCHUNGSZENTRUM JÜLICH

Helmholtz Association (Germany)

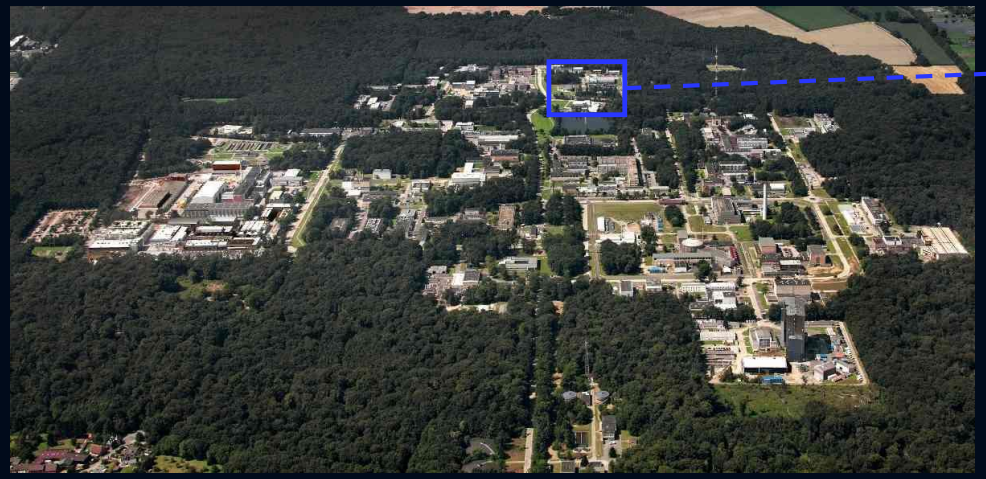




https://www.fz-juelich.de/portal/EN/Home/home_node.html

JÜLICH SUPERCOMPUTING CENTRE

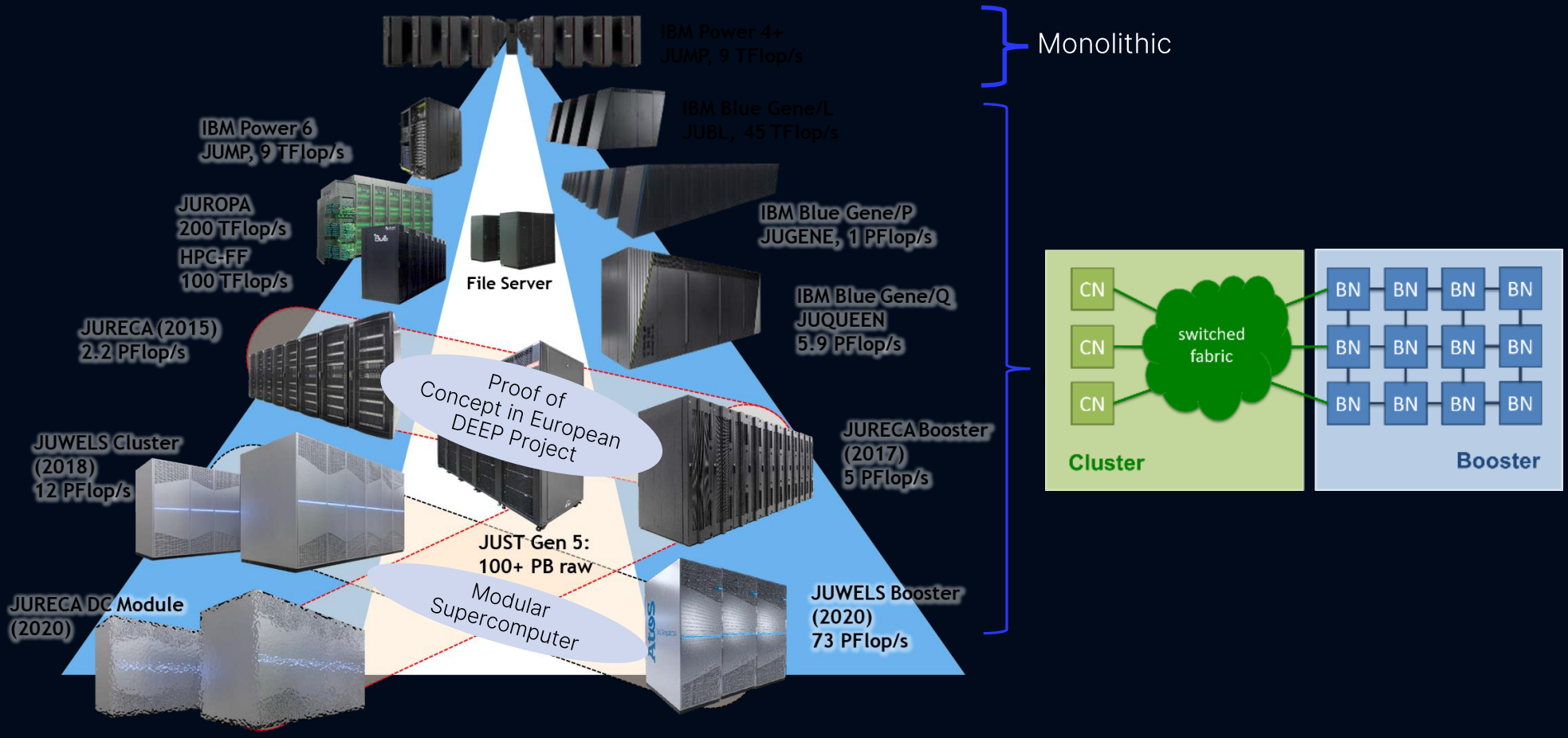
Background



https://www.fz-juelich.de/ias/jsc/EN/Home/home_node.html

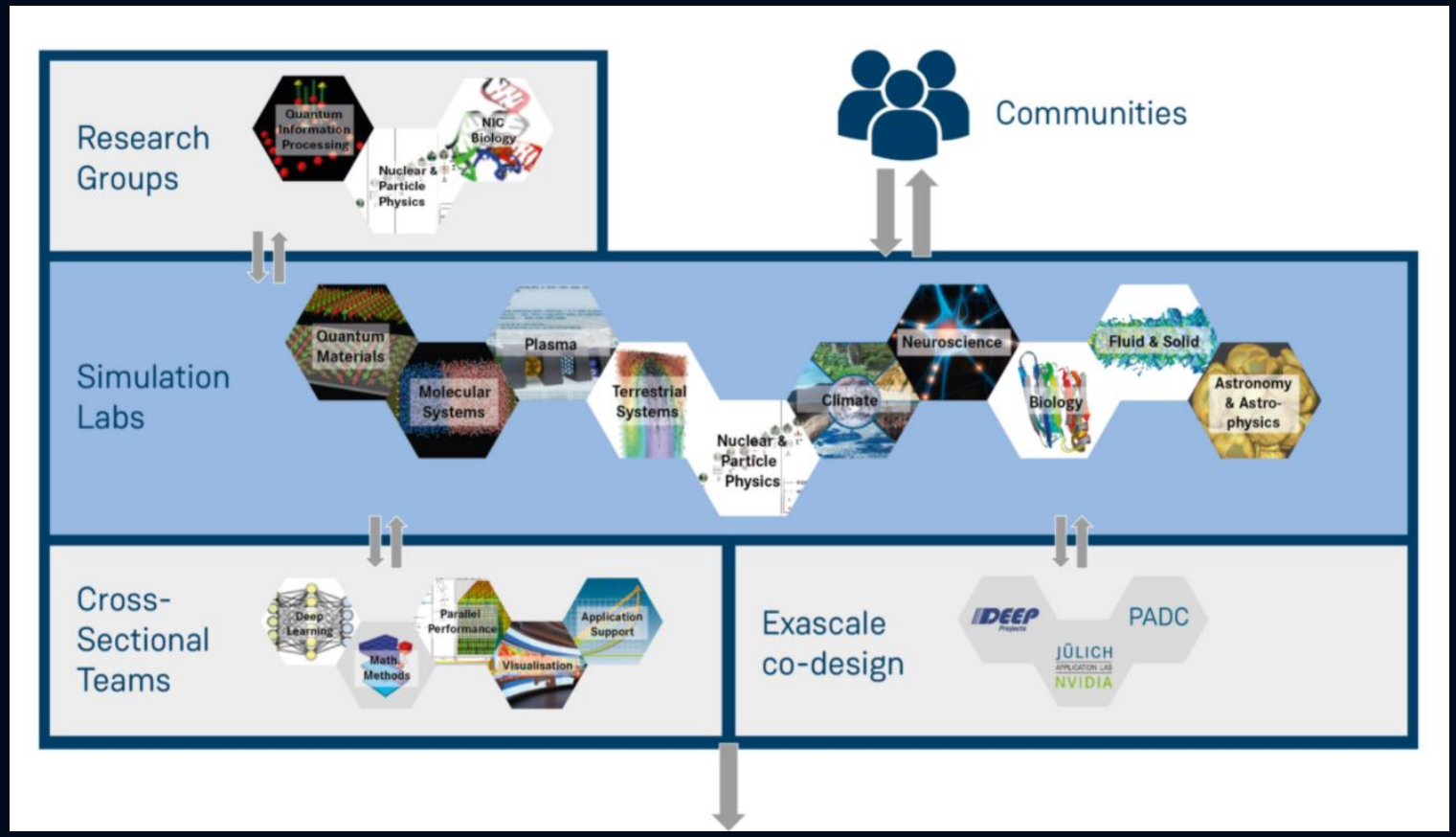
JÜLICH SUPERCOMPUTING CENTRE

Supercomputers



JÜLICH SUPERCOMPUTING CENTRE

Simulation and Data Laboratories



https://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/simlab_node.html

JÜLICH SUPERCOMPUTING CENTRE

Projects

Research on AI- and Simulation-based Engineering at Exascale

https://www.coe-raise.eu/

Adaptive Multi-Tier Intelligent Data Manager for Exascale

https://www.admire-eurohpc.eu/

HDCRS

High Performance and Disruptive Computing in Remote Sensing Working Group

www.hdc-rs.com

https://www.grss-ieee.org/technical-committees/earth-science-informatics/

INVITED SESSION

IGARSS, 15 July

Data Intensive Computing for Remote Sensing

Dr. Gabriele Cavallaro and Prof. Dora Blanco Heras

Register here 👉 **https://igarss2021.com/view_session.php?SessionID=1277**

SPECIAL ISSUE

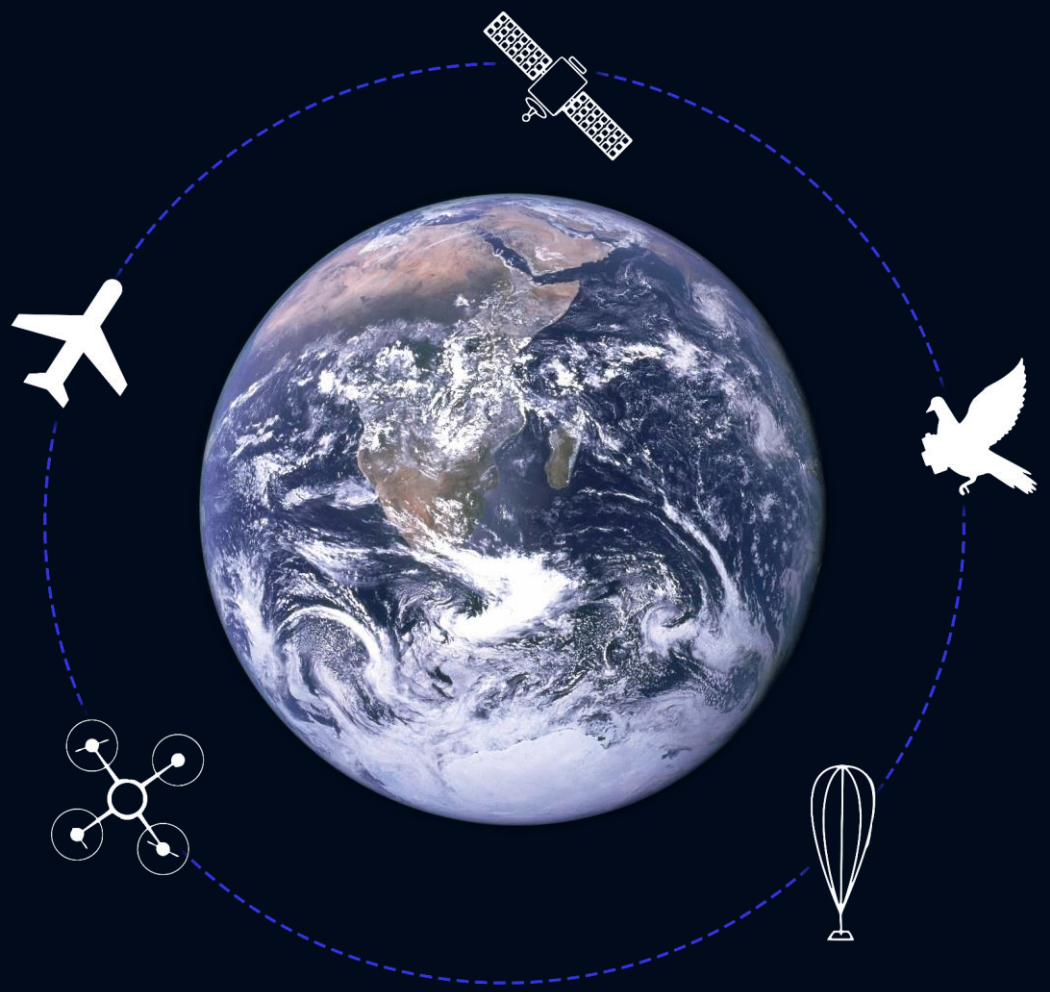
IEEE JSTARS

2021

Quantum Computing for Earth Observation

Prof. Mihai Dactu, Dr. Jacqueline Le Moignes, Dr. Bertrand Le Saux

More info 👉 **https://www.grss-ieee.org/publications/call-for-papers/jstars-special-issues/**

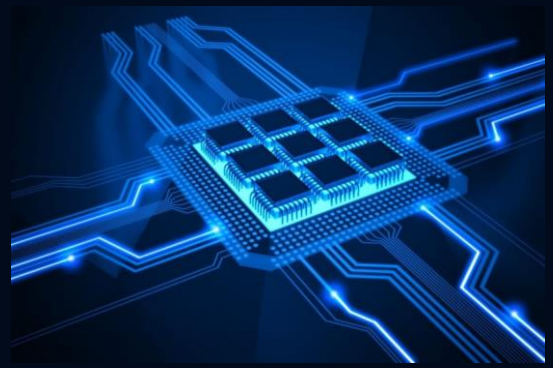


EXTRACTING KNOWLEDGE IN A TIMELY MANNER

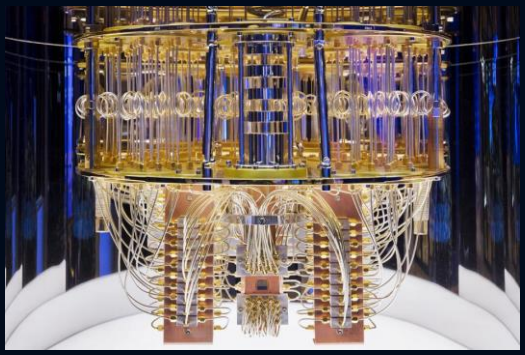
From data acquired by diverse observational systems

EMERGING COMPUTING PARADIGMS

Supercomputing and Distributed Computing



Specialized Hardware Computing



Quantum Computing

Martidaniel, CC BY-SA 4.0, MareNostrum 4 supercomputer, Barcelona Supercomputing Center
https://commons.wikimedia.org/wiki/File:2017_BSC_Superordenador_MareNostrum-4_Barcelona-Supercomputing-Center.jpg

Interior of IBM's Quantum Computer
https://www.ibm.com/

ARTIFICIAL INTELLIGENCE FOR EARTH OBSERVATION

APPLICATIONS THAT DRIVE THE DEVELOPMENT

GPT-3 Language model

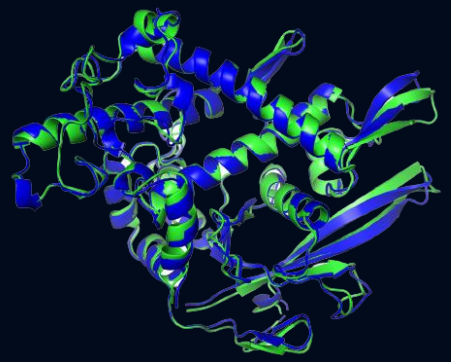
175 billion parameters

PanGu-α Language Model

盘古
PanGu-Alpha

200 billion parameters

AlphaFold



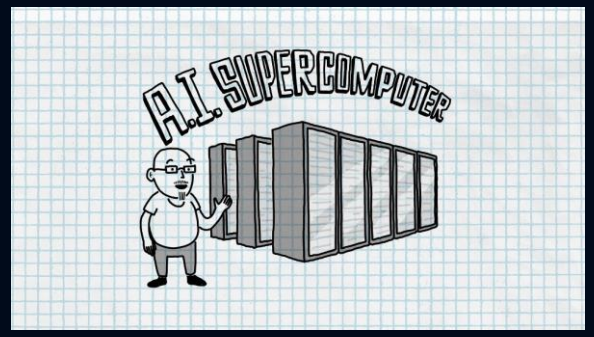
Tom B. Brown, Benjamin Mann, Nick Ryder, et al., "Language Models are Few-Shot Learners", 2020
https://arxiv.org/abs/2005.14165

Wei Zeng, Xiaozhe Ren, Teng Su, et al., "PanGu-alpha: Large-scale Autoregressive Pretrained Chinese Language Models with Auto-parallel Computation", 2021
https://arxiv.org/abs/2104.12369

AlphaFold: a solution to a 50-year-old grand challenge in biology
https://deepmind.com/blog/article/alphafold-a-solution-to-a-50-year-old-grand-challenge-in-biology

MORE SPECIALIZED HARDWARE

AI Supercomputers



10,000 GPUs

6,159 GPUs

• • •

--- GPUs

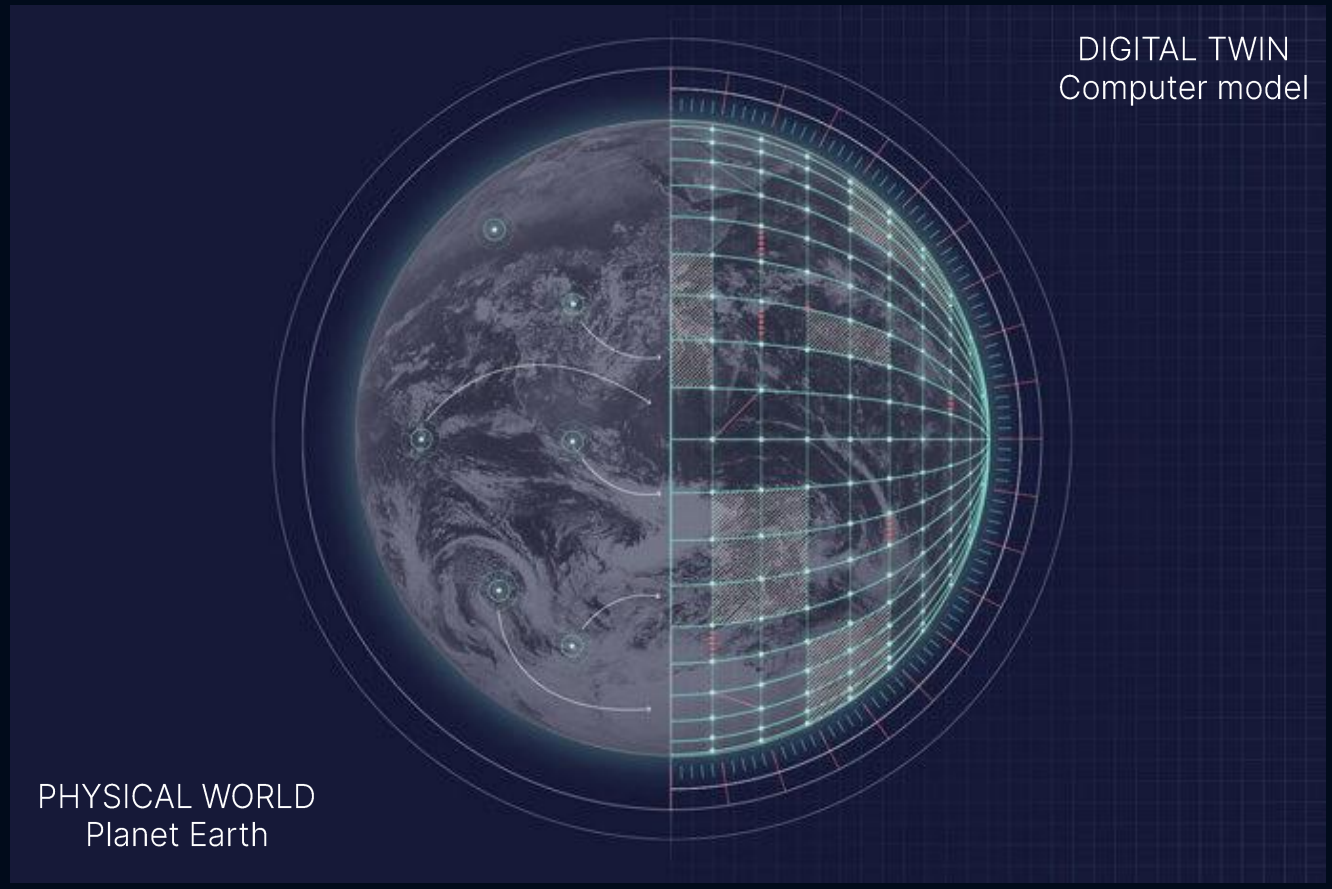
Microsoft announces new supercomputer, lays out vision for future AI work
https://blogs.microsoft.com/ai/openai-azure-supercomputer/

Berkeley Lab Debuts Perlmutter, World's Fastest AI Supercomputer
https://www.hpcwire.com/2021/05/27/nersc-debuts-perlmutter-worlds-fastest-ai-supercomputer/

CSCS, Hewlett Packard Enterprise and NVIDIA announce World's most Powerful AI-Capable Supercomputer
https://www.cscs.ch/science/computer-science-hpc/2021/cscs-hewlett-packard-enterprise-and-nvidia-announce-worlds-most-powerful-ai-capable-supercomputer/

DIGITAL TWIN OF THE EARTH

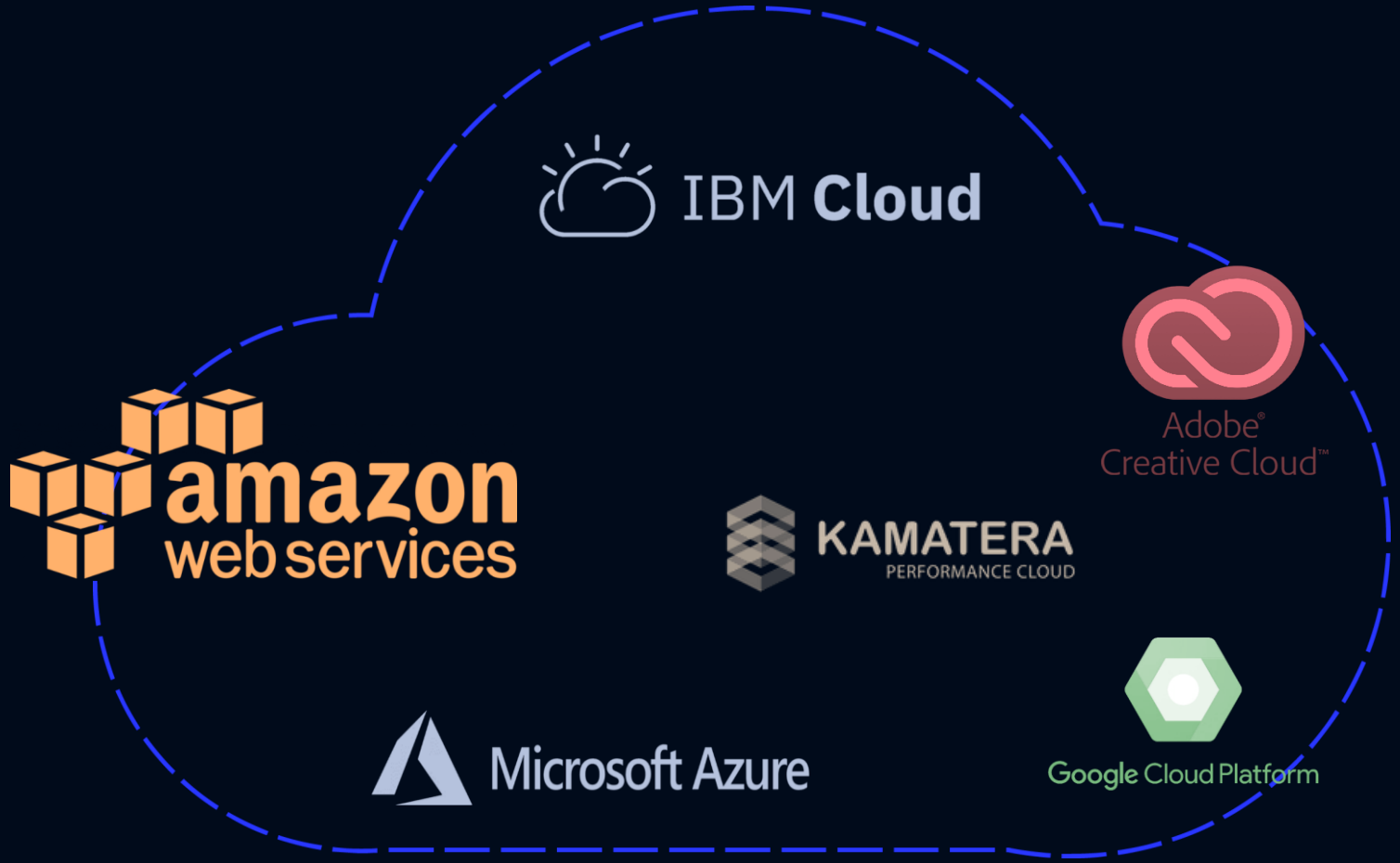
Destination Earth



Presenting Destination Earth: a Digital Replica of our Planet
https://www.ecmwf.int/en/about/media-centre/news/2021/presenting-destination-earth-digital-replica-our-planet

Bauer, P., Dueben, P. D., Hoefler, T. et al. , "The digital revolution of Earth-system science, in Nature Computational Science", vol. 1, pp. 104–113, 2021
https://doi.org/10.1038/s43588-021-00023-0

CLOUD COMPUTING IS SPREADING LIKE WILDFIRE

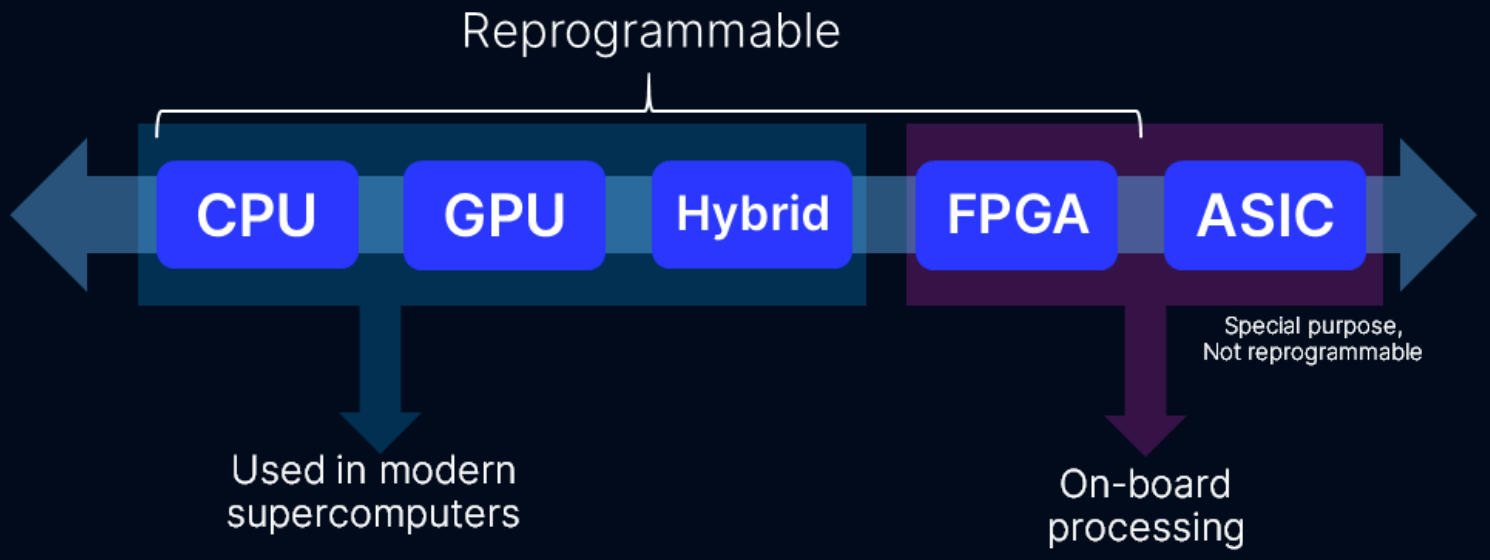


CLOUD AND EDGE COMPUTING ARE LAUNCHING THE NEXT SPACE RACE

Process and reduce the data before you send it down

IBM, Why Cloud and Edge are Launching the Next Space Race
https://www.ibm.com/blogs/industries/ibm-space-tech-cloud-edge-communication-breakthrough/

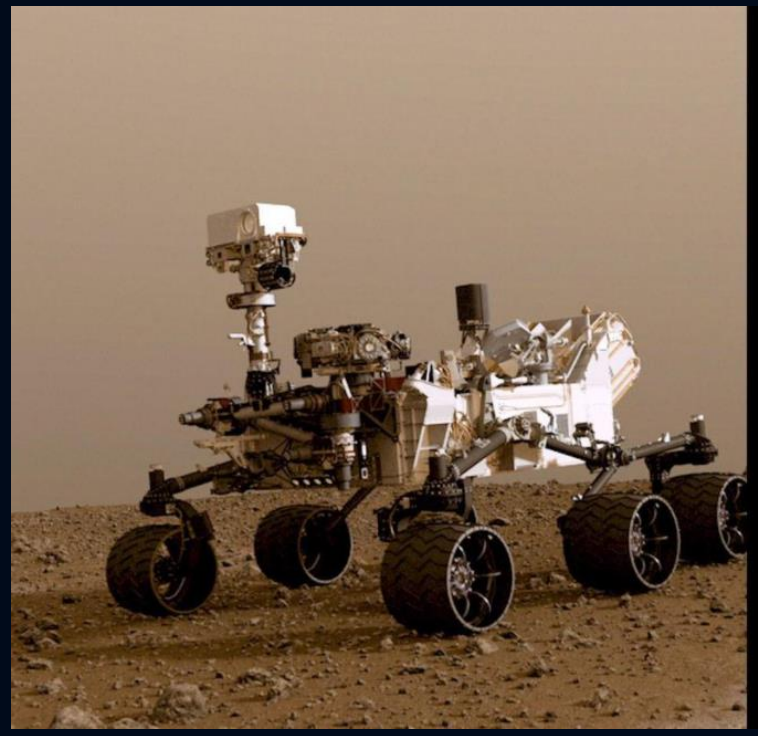
SPECIALIZED HARDWARE COMPUTING



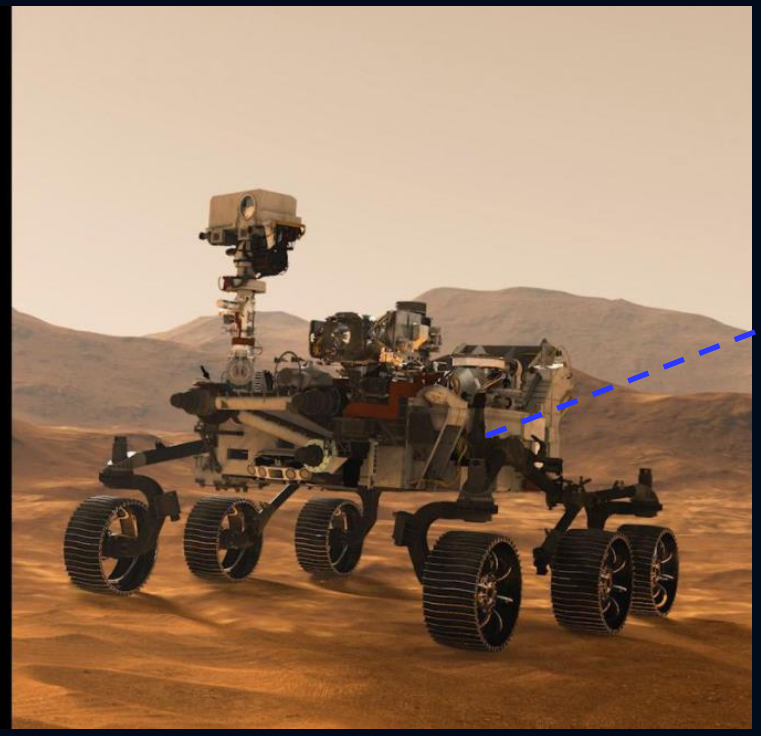
J. De Fine Licht and T. Hoefler, Productive Parallel Programming for FPGA with HLS
https://spcl.inf.ethz.ch/Teaching/hls-tutorial/

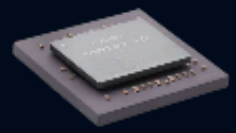
NEW ROVER HAS COMPUTER VISION

Curiosity



Perseverance



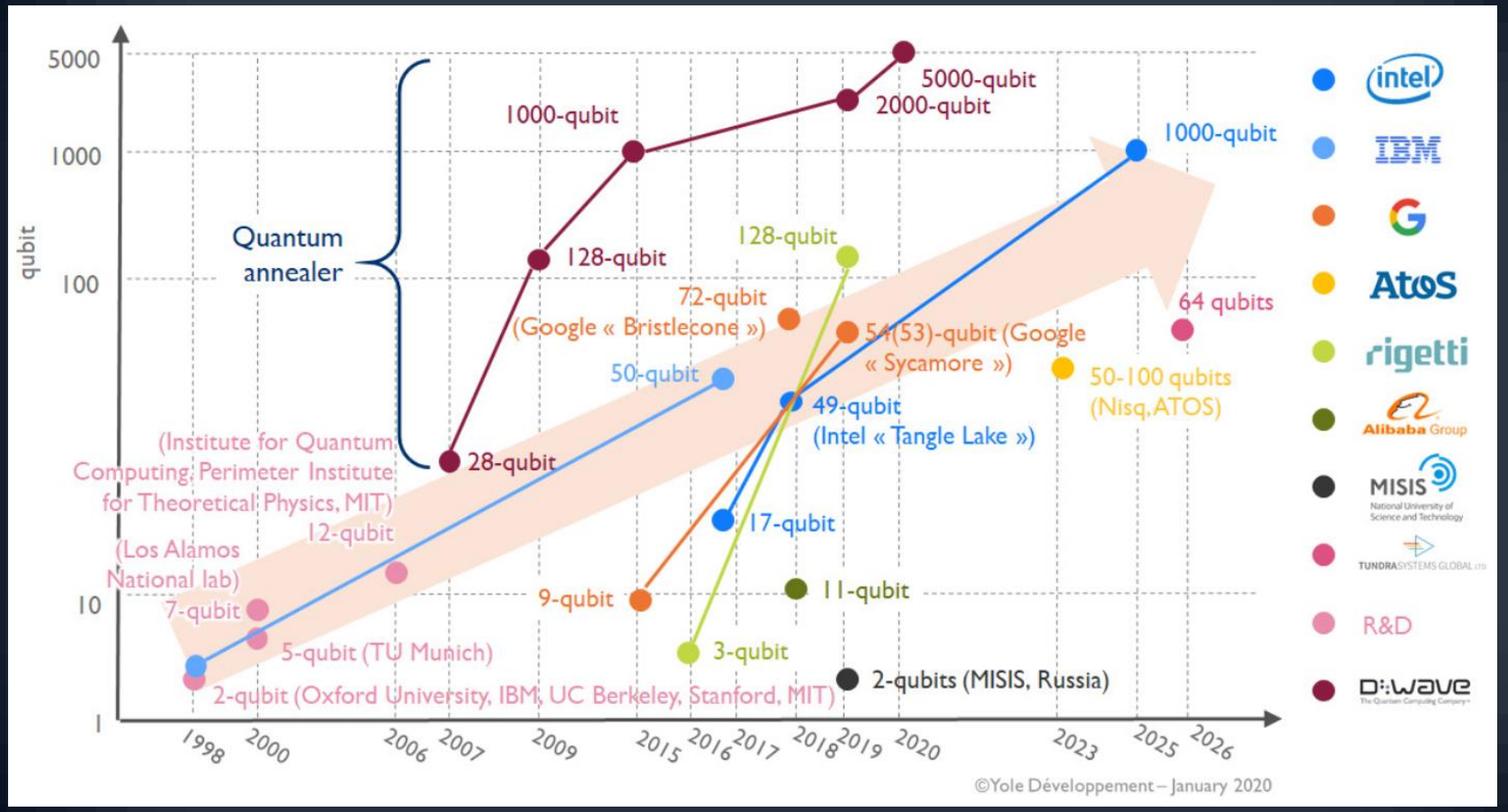


Virtex V5QV
FPGA

NASA/JPL-Caltech, Side-by-Side: Curiosity and Mars 2020
https://mars.nasa.gov/resources/24717/side-by-side-curiosity-and-mars-2020/

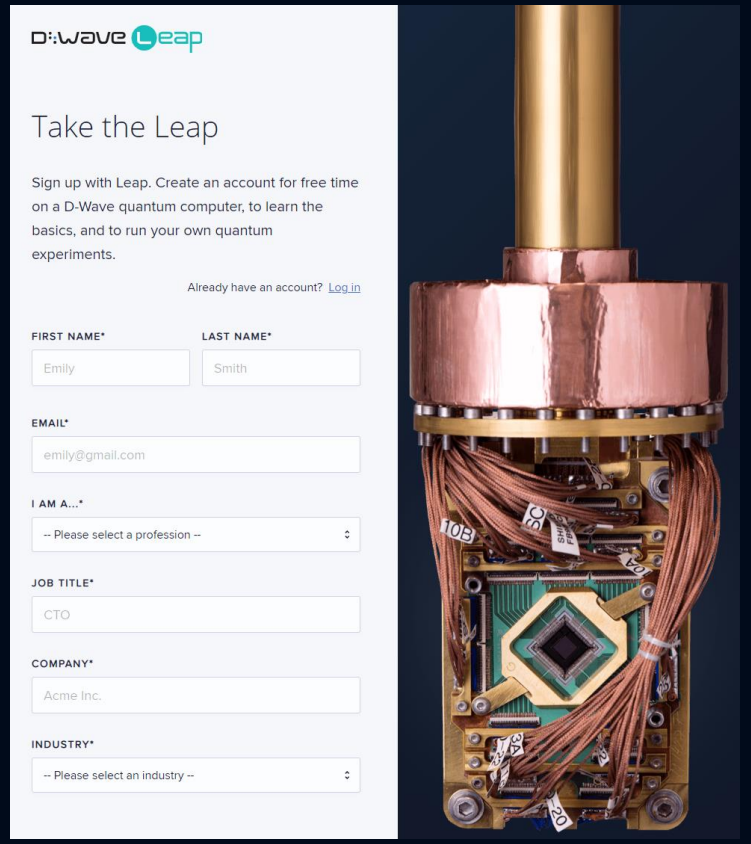
QUANTUM COMPUTING

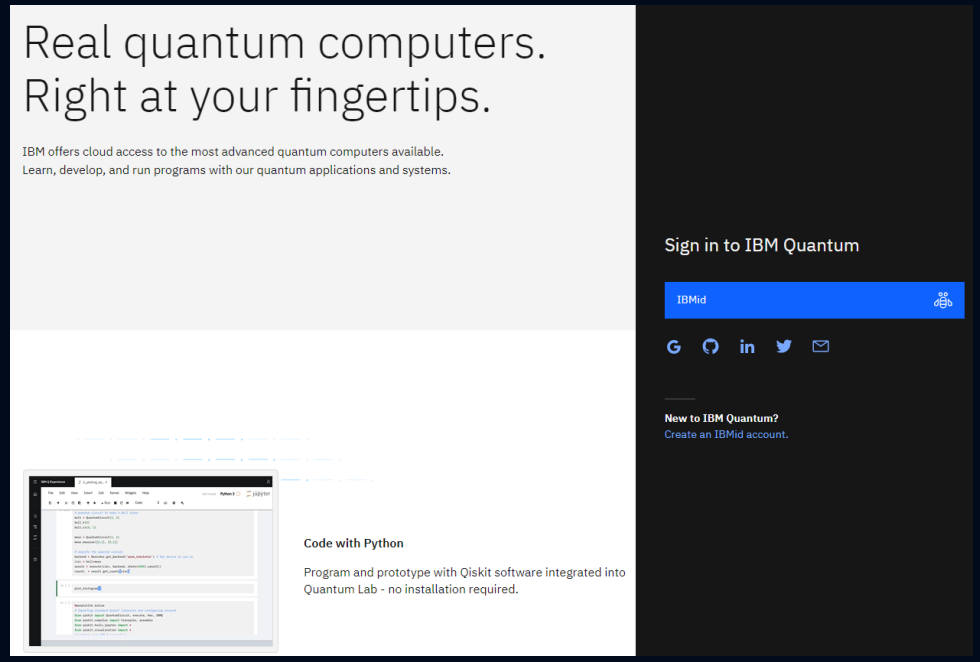
Physical qubit roadmap



Yole Développement, Market and Technology Report 2020 – Sample
https://s3.i-micronews.com/uploads/2020/01/YDR20062-Quantum-Technologies-2020-Yole-D%C3%A9veloppement-Sample.pdf

IT IS EASY TO TRY OUT!





D-Wave Systems, Take the Leap
https://www.dwavesys.com/take-leap

IBM Quantum Experience
https://quantum-computing.ibm.com/