University of Amsterdam
Informatics Institute

Parallel Computing Systems

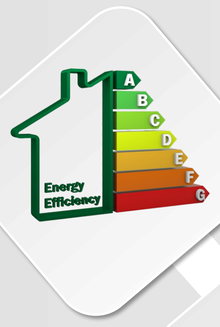
# *Extra-functional Behaviour of Computer Systems in Full Glory*

## Parallel Computing Systems (PCS)

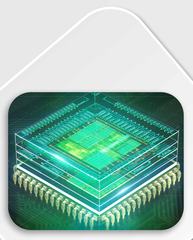
### *Our Mission*

We aim at making future computer systems **...**

More Energy Efficient



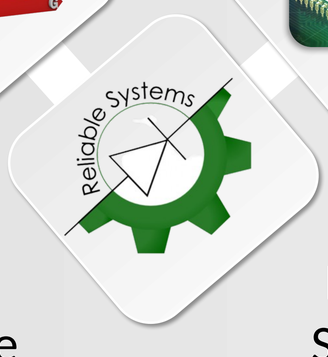

Higher Performance



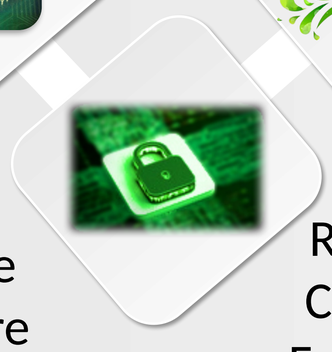
More Sustainable



More Reliable




More Secure



Reduce Carbon Footprint



### *Our Focus*

- **Optimizing AI frameworks for deployment at Edge/resource constrained platform**
- **Optimal design of complex Cyber-Physical Systems**
- **Thermal behavior analysis**
- **Cyber-security & Digital Privacy**
- **Secure AI**

EPT

Sesame

CoMeT

SECURED

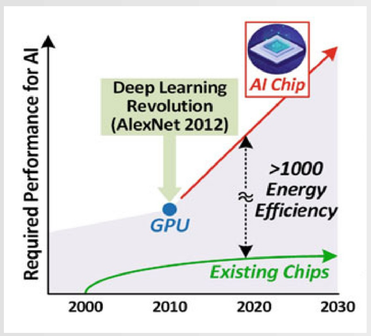
### Need for Adaptive AI Frameworks

**Self-Adaptive frameworks for efficient performance based on available compute resources & energy**

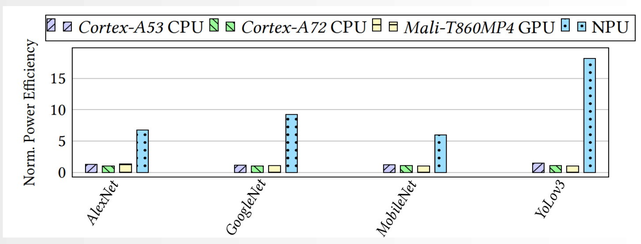
**Model Elasticity : A new paradigm?**

| | |
|---|---|
| **NAS** | **Knowledge Distillation** |
| **Pruning** | **Quantization** |

### Need to integrate efficient Hardware




**NPU's show up to 15x increased Power Efficiency : How to include in design with minimal performance losses?**

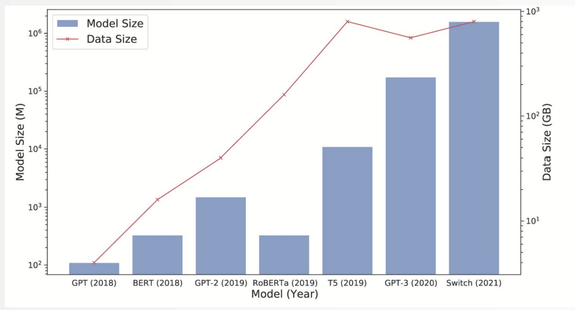



## *PCS faces Challenges for Sustainable & Secure AI*

### The increased energy demand in perspective.....

- Only few ChatGPT prompts ≈ **500ml of fresh water**
- LLM consumes **20x more power** than a Google search
- Google reported **emissions up by 50%** in just 5 years
- Estimated AI power demands to **rise by 100% by 2030**

**Big Tech companies considering a move to Nuclear Energy...**

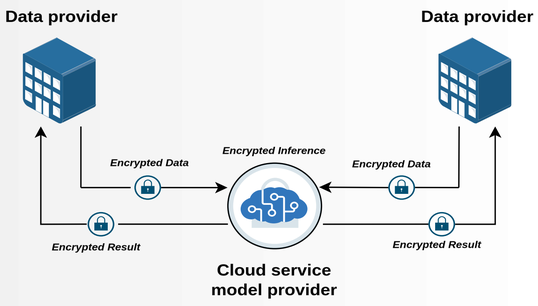





### Need to preserve Data Privacy

**To preserve the privacy of the data-in-use:**

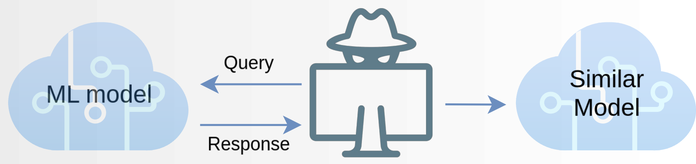
- **Fully Homomorphic Encryption**
- **Secure Multi-Party Computation**



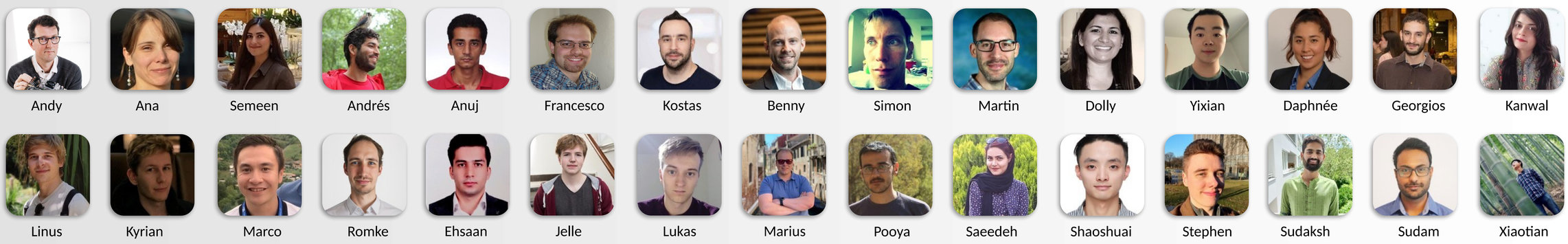

### Need to make AI agents secure

**Make AI resistant to Side-Channel Attacks against:**

- **Membership Inference**
- **Model extraction**
- **Data reconstruction**




## *Our Team*




**Main sponsors and industrial collaborators**

NWO · ESI · ASML · THALES · CERN · Collins Aerospace