Artificial Neural Networks
AHP Slot- 1
Neural Networks: Why in Computing and VLSI Industry?

Dheemanth Joshi , Aniket Gangotri, CH Sai Pranay, Shwetha R*

Teaching Assistant, Department of Electronics and Communication Engineering, PES University

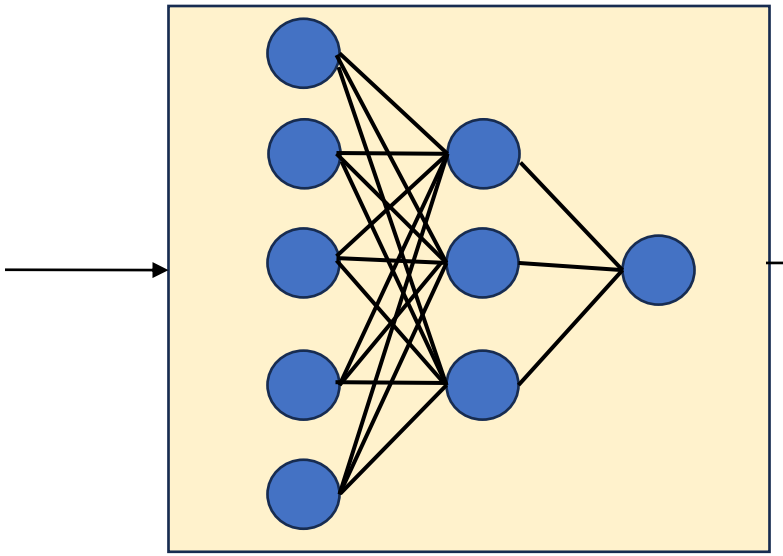
*** Faculty In-charge, Department of Electronics and Communication Engineering PES University**

ANN AHP Slots: A Top-Down Approach

- Applications
- Architecture of Neural Network
- Design from scratch (Linear Algebra based Approach)
- Implementing the Neural Network
- Hardware Implementation of Neural Networks

Input

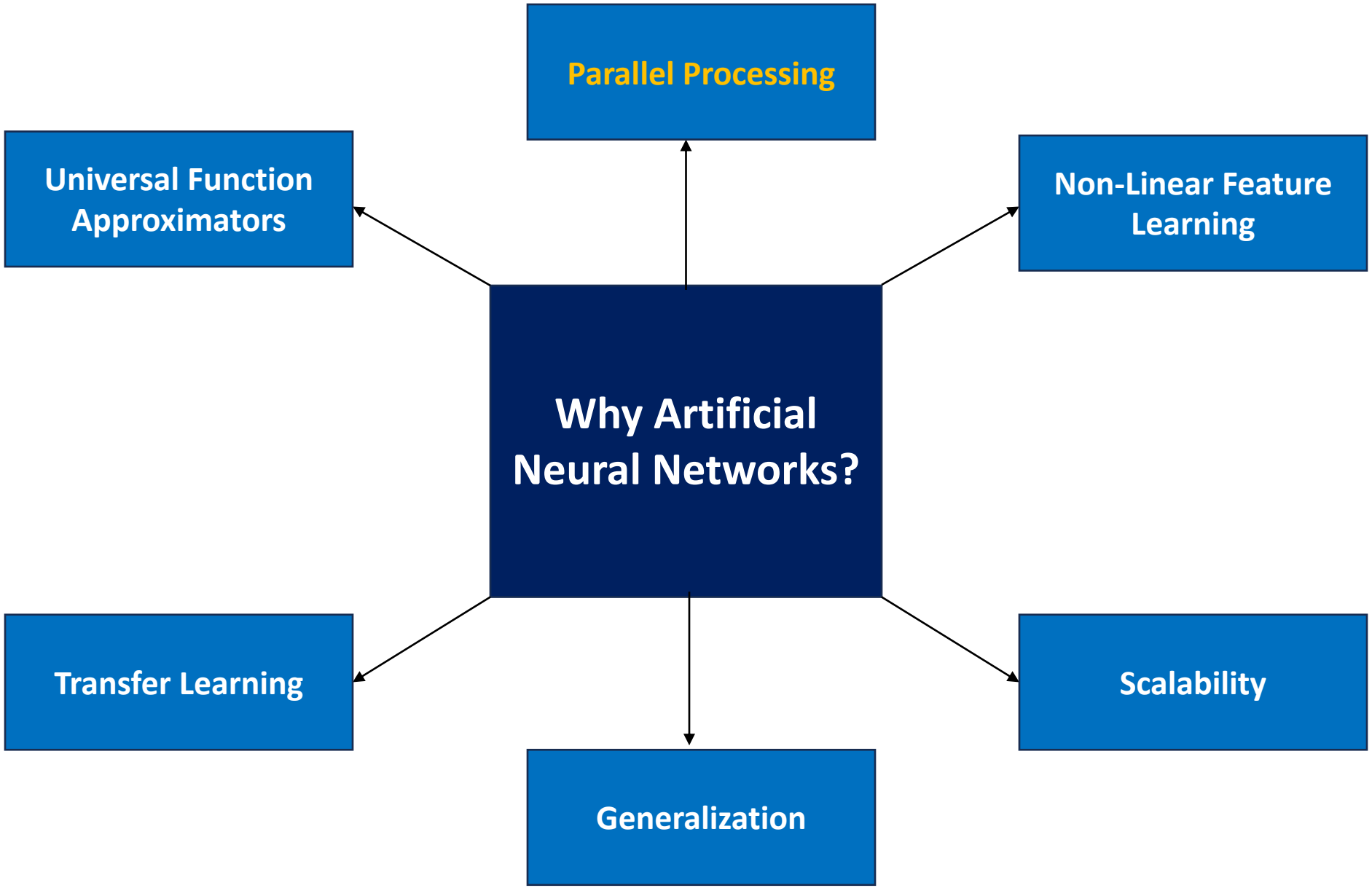
Basic Working of Neural Network



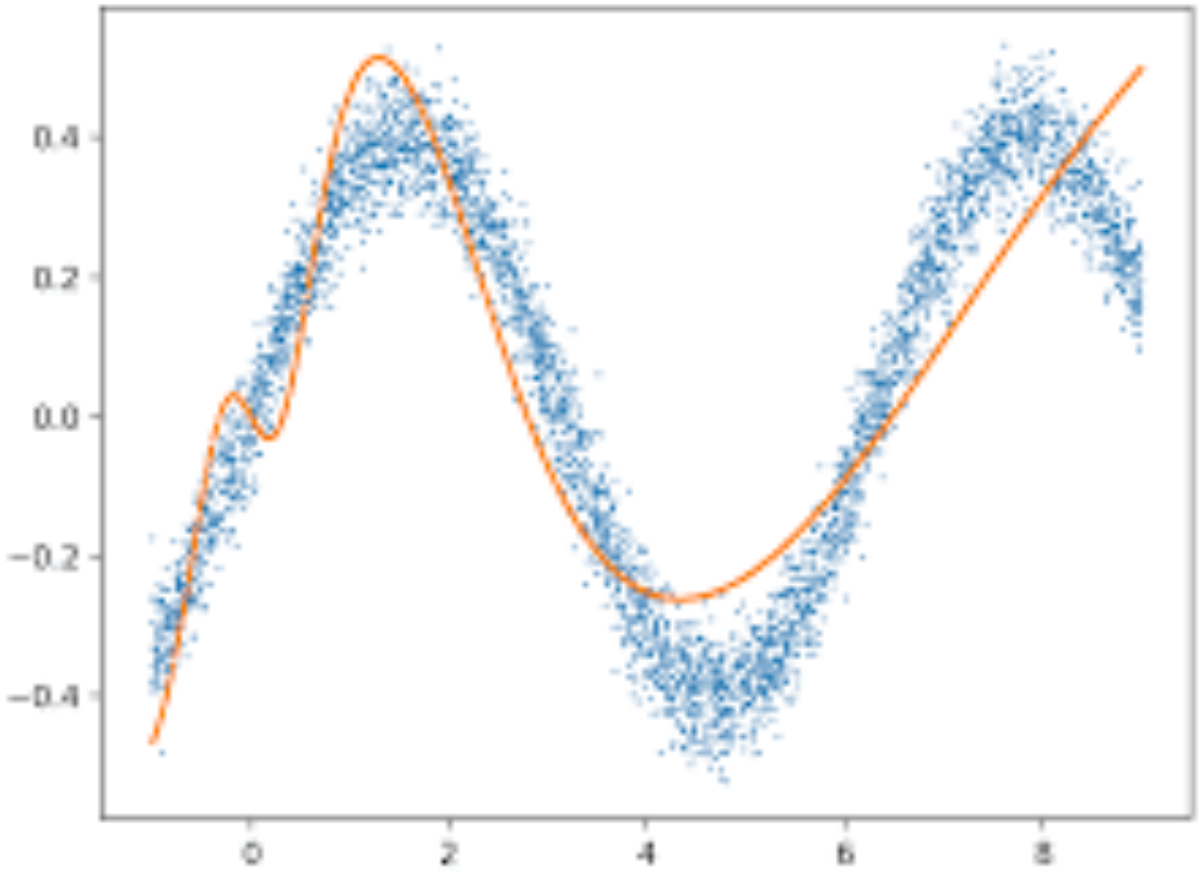
CAT

Output

Why Top-Down Approach for understanding Neural Networks ?

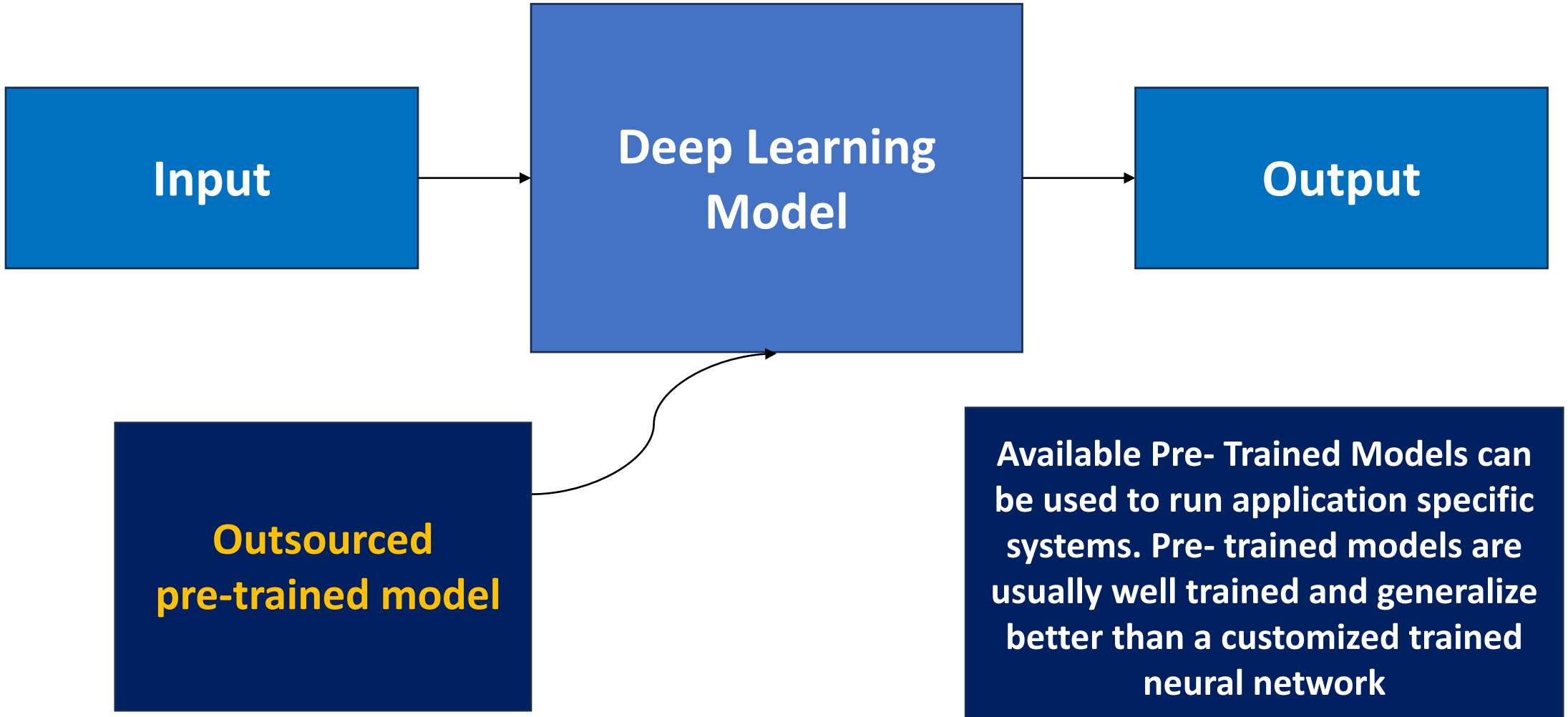

Parallel Processing
Universal Function Approximators
Non-Linear Feature Learning
Why Artificial Neural Networks?
Transfer Learning
Scalability
Generalization

Universal Function Approximators



Well Trained Neural Networks can learn any multidimensional feature problem and predict the most accurate solution to the problem

Transfer Learning

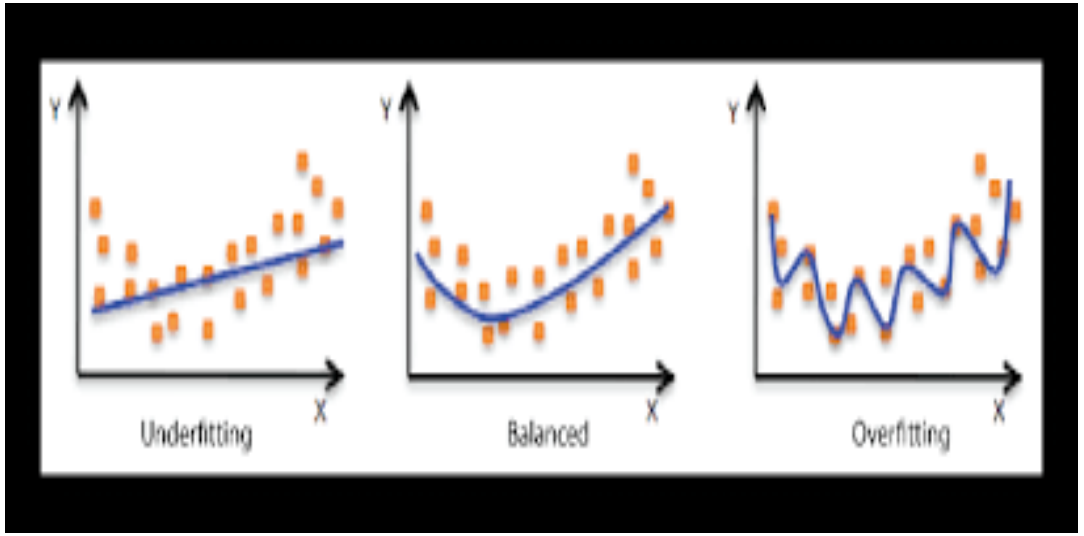


Non-Linear Feature Learning

- **Features are extracted from dataset to learn and map data.**
- **Complex Neural Network architectures can learn multi dimensional, non-linear datasets.**
- **Helpful in probabilistic and dynamic environment operated systems.**

Generalization

- **Neural Networks generalize better on new datapoints.**



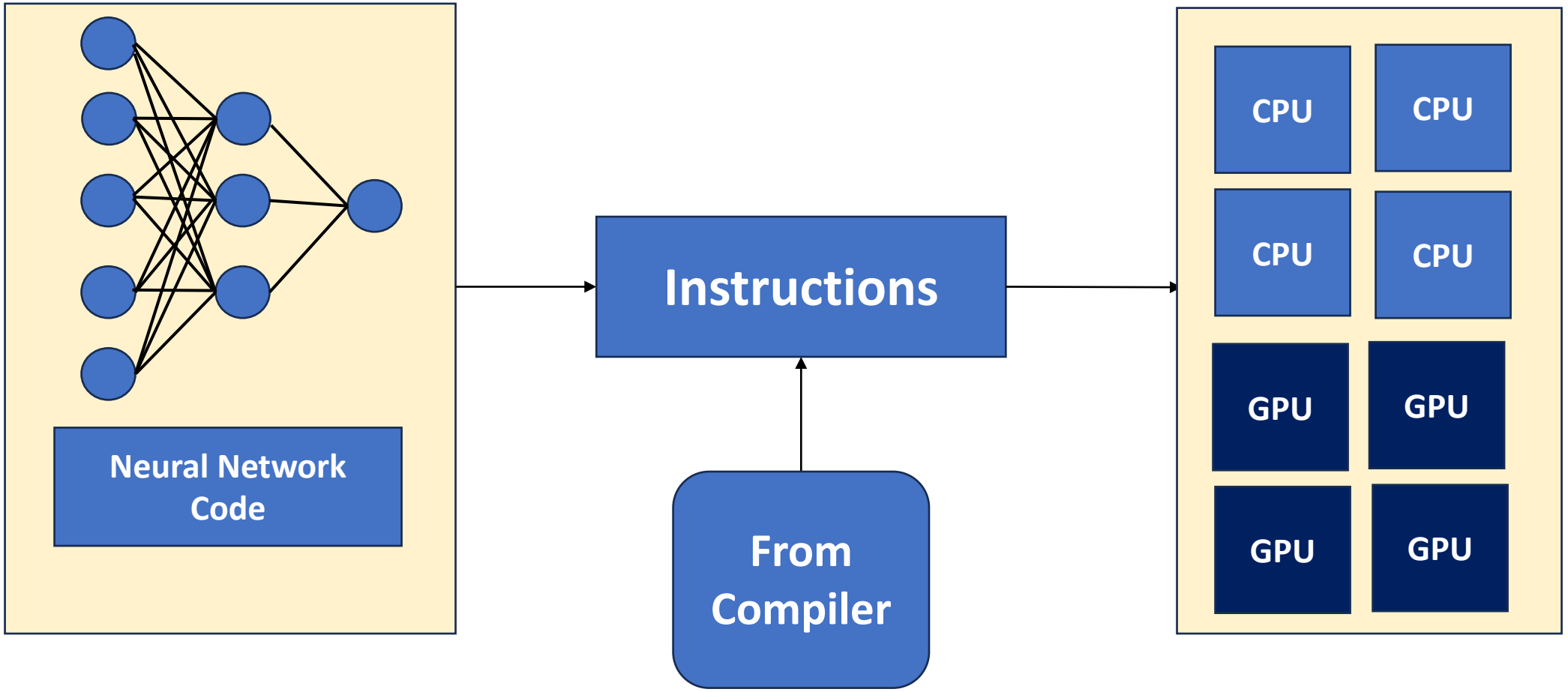
Features of all the cats in this image are different, but all belong to same class "CAT"

Parallel Processing- 1

- **Most of the instructions in neural network designs are independent hence parallelism and pipelining can be employed.**
- **If the number of computing units is high, we can employ parallelism easily for neural network algorithms unlike other machine learning (ML) models.**
- **Modern ASICs are being developed to accelerate neural processing.**

Parallel Processing- 2

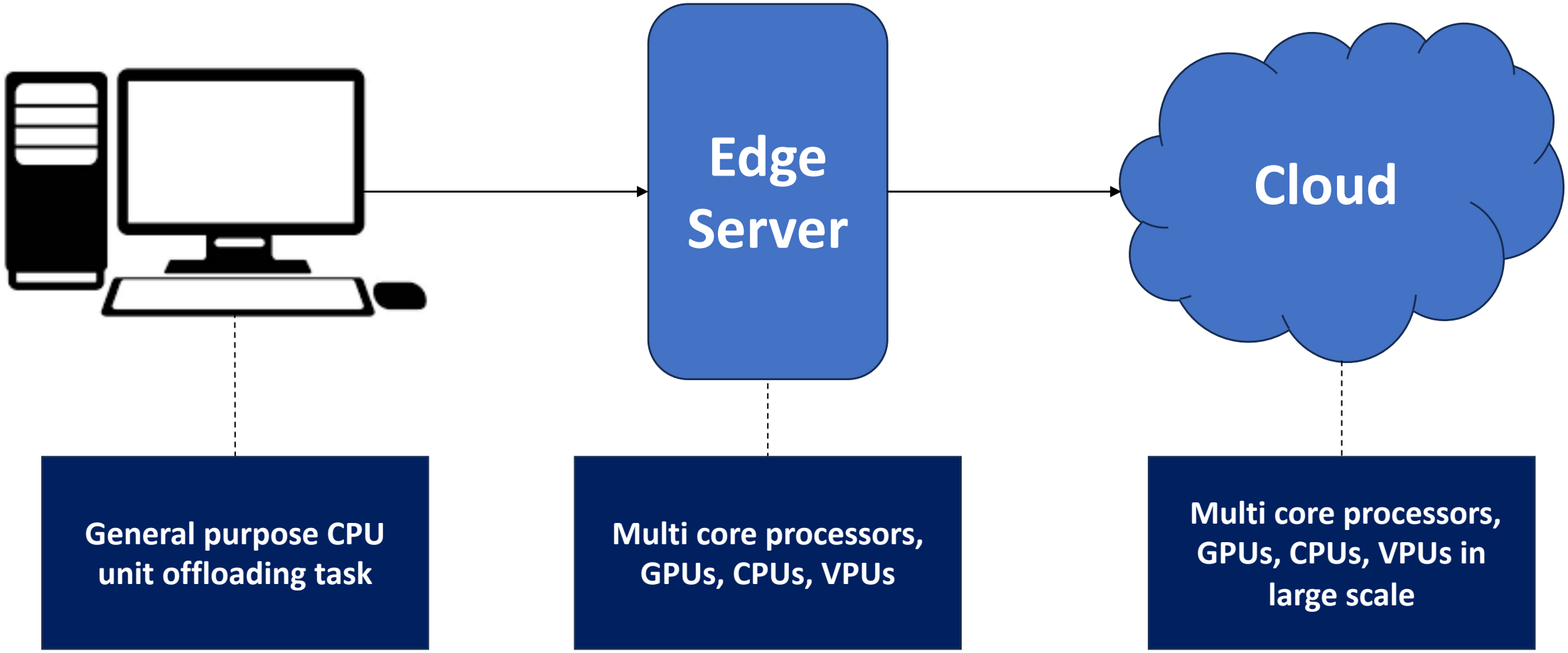
General structure of parallel computing



Applications/Research Areas of Neural Networks

- **Cloud and Edge Computing**
- **Computer Vision for ADAS systems**
- Healthcare
- Language Models
- Generative AI

Cloud and Edge Computing



Computer Vision for ADAS systems

Neural Networks are used for:

- **Object Detection**
- **Object Recognition**
- **Image Segmentation**
- **Driving Automation**

Neural Networks In Industries- AI Accelerators

Modern AI Hardware include:

1) **Neuromorphic Processors**

2) **Vision Processors**

3) **Neural Network Accelerators**

4) **Neural Engines**

Highly customized AI chips are often deployed in complex real time systems to handle tasks which are latency and power sensitive

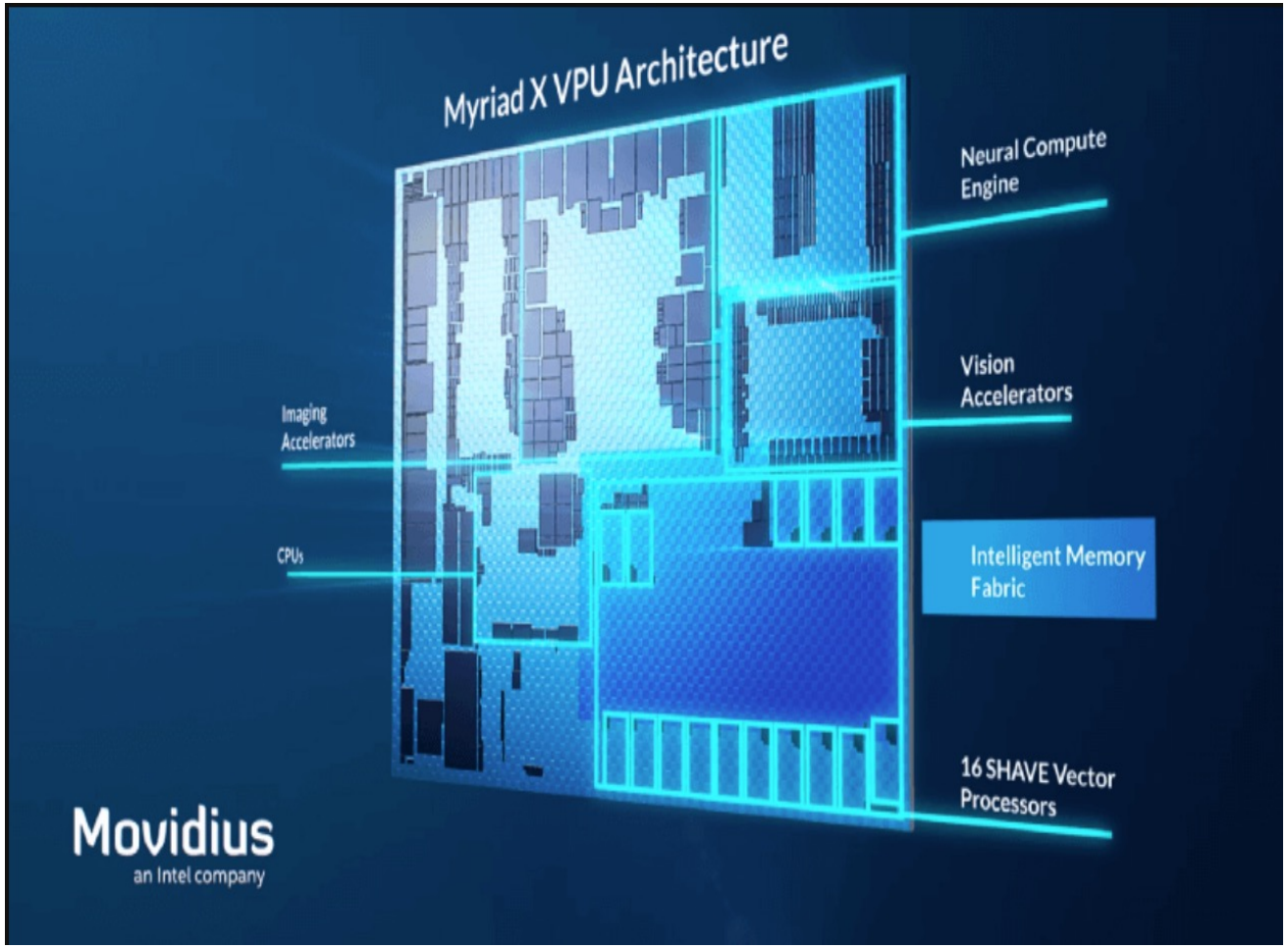
Neural Networks In Industries- Intel

Intel AI Development and Tools:

1) **DevCloud: A cloud service provider with heterogenous cores (CPUs, GPUs, FPGAs, VPUs) for AI developers.**
2) **Neural Network acceleration boards for fast and efficient computations**
3) **Cloud to Edge Regime: Installations of various edge servers capable running large AI algorithms**
4) **OpenVINO toolkit for software development**

Neural Networks In Industries- Intel's Vision Processing Unit

VPUs are generally used for Edge AI oriented image processing / Computer vision applications
It consists of dedicated vision accelerators and vector processors integrated with the CPU.



Neural Networks In Industries- Apple

Apple's M series System on Chip (SoC)

M1 chip can have upto:

1) 8 cores of CPU
2) 8 cores of GPU
3) Neural Engine for accelerate AI applications

Task: Can you access each core individually in M1 chip?

Neural Networks In Industries- Nvidia

Nvidia's AI applications:

1) **High quality graphics**

2) **Software to build graphics/ other AI applications**

3) **Graphic cards to run intense vector operations**

QNA

Thanks