Sign Language Recognition on **L**ow Power, **L**ow Reliability, **L**ow Latency Devices

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(Presentation title)

Theoretical Approaches for Handling Soft Errors in KrylovSubspace Methods

(Research field / theme)

High Performance Computing- Computational Science

Siddharth D Jaiswal
Indian Institute of Science, India / MA

(Presentation title)

(Research field / theme)

STEM: STreaming Edge-based Motif Preserving Graph Partitioning Large Scale Graph processing

D

Yasuhiro Nakahara
Kumamoto U, JPN / MA

(Presentation title)

CNN accelerator for edge computing

(Research field / theme)

Embedded system, deep learning

Yuta Shimane
Tokyo U of Science, JPN / MA

(Presentation title)

Development of a neuro-musculoskeletal model of rat

(Research field / theme)

Bio-mechanics

Outline

- Introduction
- Problem Definition
- Sequence Diagram
- Proposed Solution
- Methodology
- Conclusion

Sign language

Translate sign language to text for deaf/mute people

There are more than **466 million** deaf people in the world (WHO, 2019)

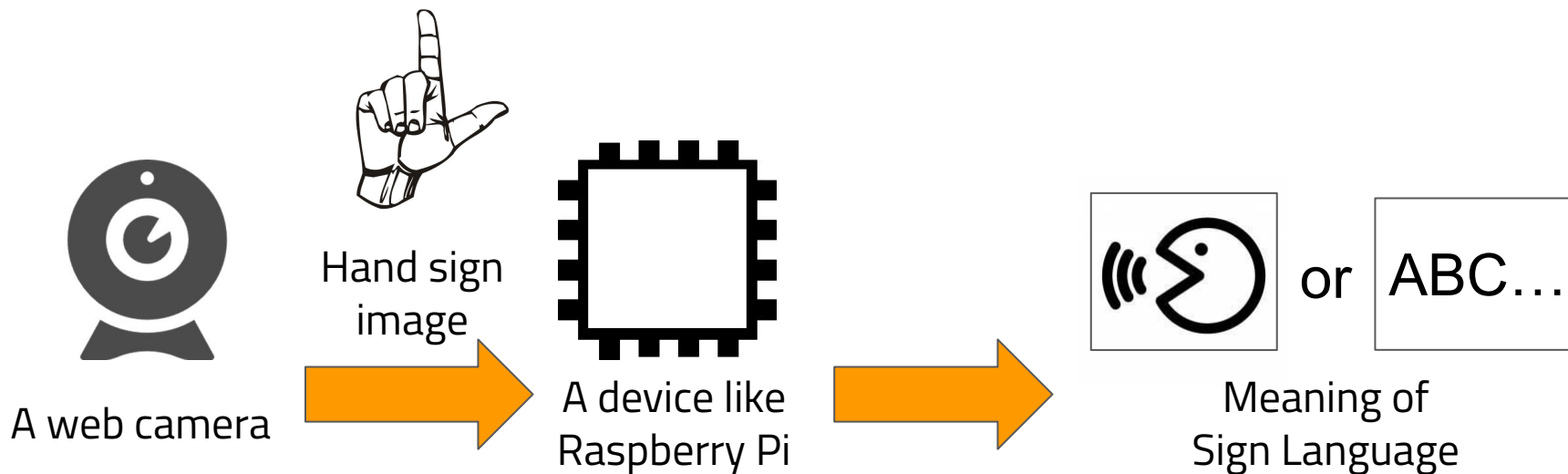It is difficult to translate message using sign language
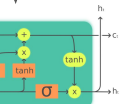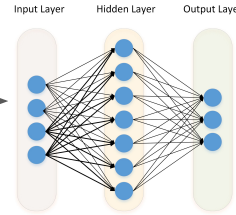
e.g call emergency

Need to develop device which **deaf people can use to communicate with other people easily**
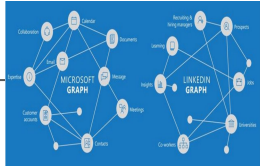
System Configuration

1. Shooting hand with webcam
2. Infer meaning of sign language with a device
3. Output sign language meaning by voice or text

Hand sign image

A web camera

A device like Raspberry Pi

or ABC…

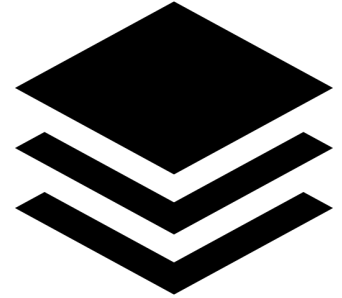Meaning of Sign Language

Sequence Diagram

Capturing sign language
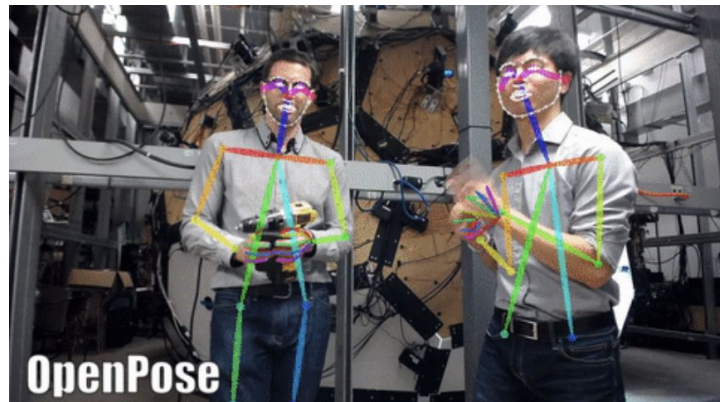
Sign language
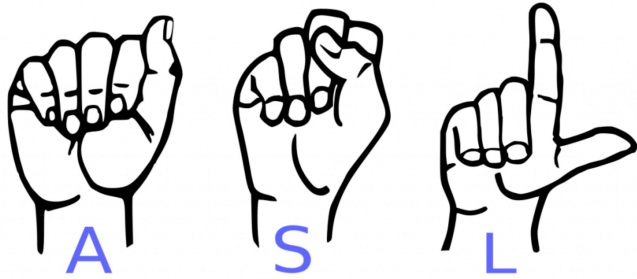
Video Camera

Image data

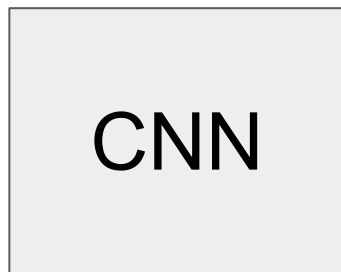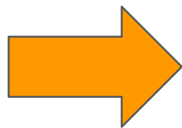**American sign language**

Getting Image information of sign language in a series of motion using video camera as also as Ashio K sahoo, 2014.
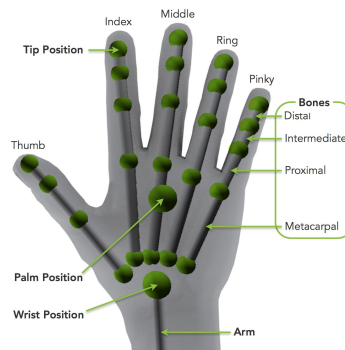
Hand bone recognition

- Estimate hand bones using Openpose's method
  - Processing is fast because only hand recognition
  - Convert images to coordinates to reduce data size

OpenPose

A Hand image → CNN → Hand bones

OpenPose for detection of Hands bones

8
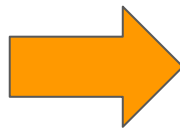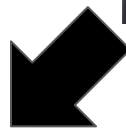
Hand bone to word conversion

- Infer words from time-series data of hand bones
  - it can be implemented with small models, since input is coordinates

time-series data
of hand bones

...

LSTM

Legend: Layer Pointwize op Copy

You
go
I
have
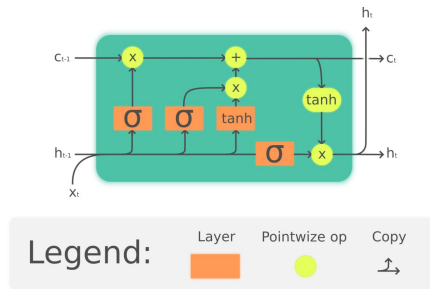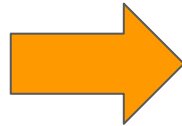
Word

Using Graphs to extract Meaning

"I am convinced that the crux of the problem of learning is recognizing relationships and being able to use them"
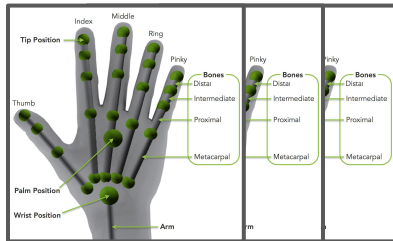-Christopher Strachey in a letter to Alan Turing, 1954

We create a graph from the words generated in the previous step and use contextual closeness to infer meaning from the words and take necessary action.

Resilience Analysis and Improving Fault Tolerance

- Hardware level fault
- Silent Data Corruption

The Consequence of Error
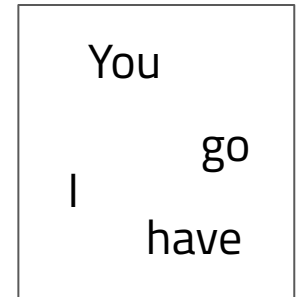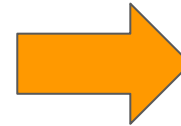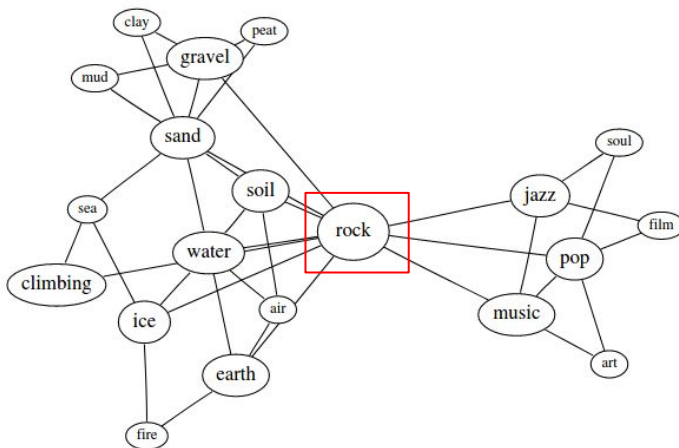
- Hardware faults that impact the parameters of a DNN (e.g., weights) can have drastic impacts on its classification accuracy
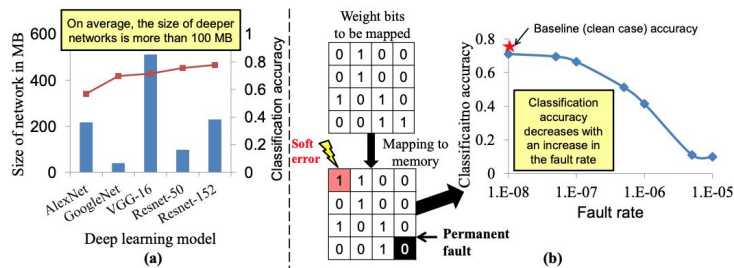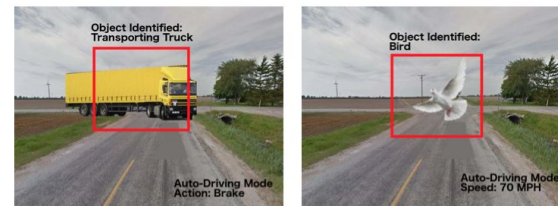

Figure 1: (a) Memory consumption of state-of-the-art DNN models. (b) The impact of hardware faults (bit flips in the weight memory) on the classification accuracy of AlexNet.

(a) Fault-free execution: A truck is identified by the DNN and brakes are applied

(b) SDC: Truck is incorrectly identified as bird and brakes may be not applied

Figure 2: Example of SDC that could lead to collision in self-driving cars due to soft errors
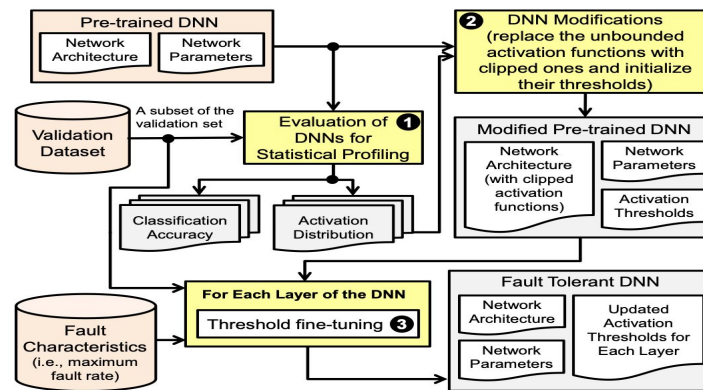
Figure 4: Our methodology to improve the resilience of a pre-trained DNN model

"FT-ClipAct: Resilience Analysis of Deep Neural Networks and Improving their Fault Tolerance using Clipped Activation" https://arxiv.org/pdf/1912.00941.pdf
"Understanding Error Propagation in Deep Learning Neural Network (DNN) Accelerators and Applications " https://people.csail.mit.edu/emer/papers/2017.11.sc.error_propagation_in_DNNs.pdf

Conclusion

We propose the following-

Interpretation and Understanding of sign language symbols(eg. ASL) from handicapped people to help in emergency situations, in the absence of other human presence.

For this, we plan to use a combination of Visual Analytics and NLP to associate meaning to the statements generated from the sign language symbols.

Thank You!