Report from Group6

KMI school 2020

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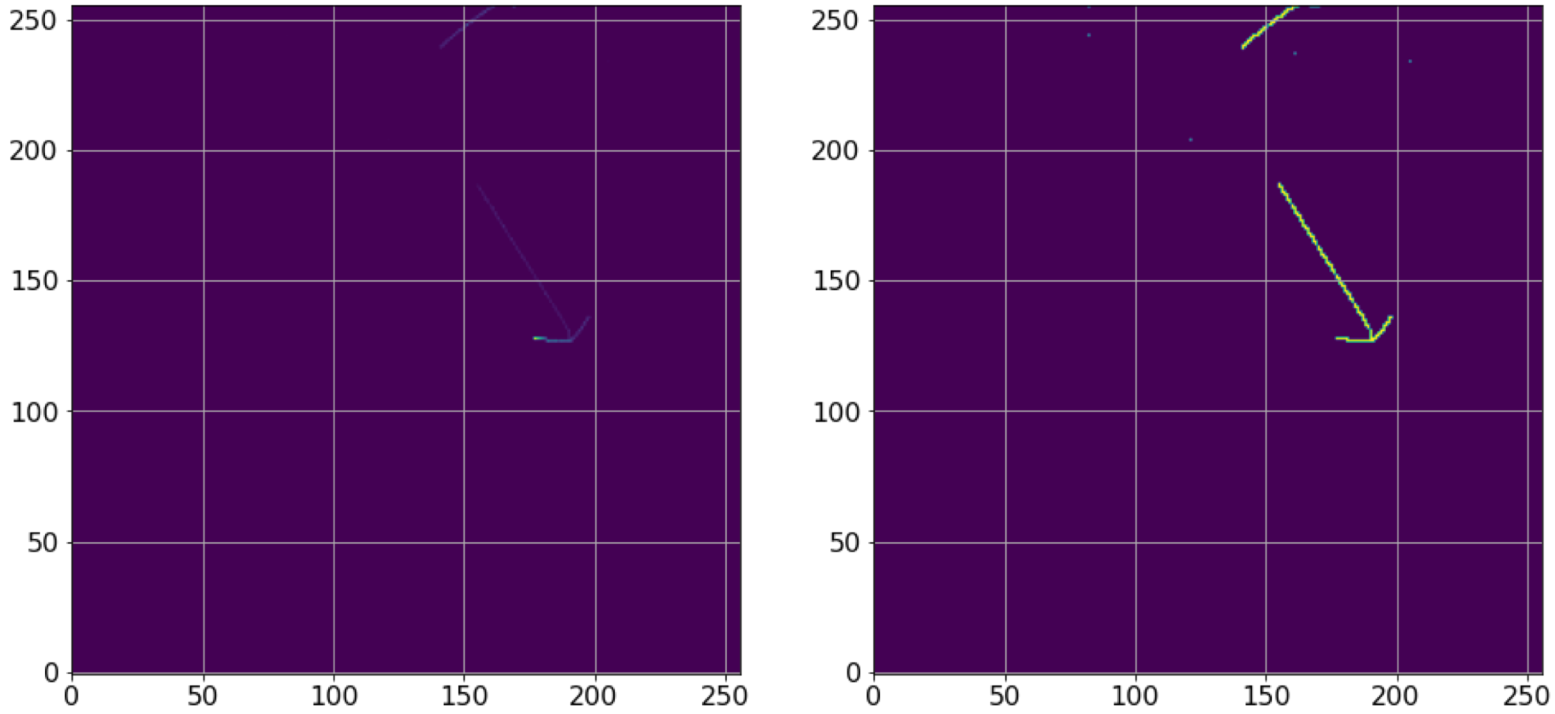
Project | Challenge-B (Image Segmentation)

The 2D projections of their 3D energy deposition patterns ("trajectories").

↓ By the **“pixel level”** classifier algorithm

Every pixel's type into one of three categories: **background**, **shower**, or **track**.



from “drinkingkazu/slacml-kmi2020 Github”

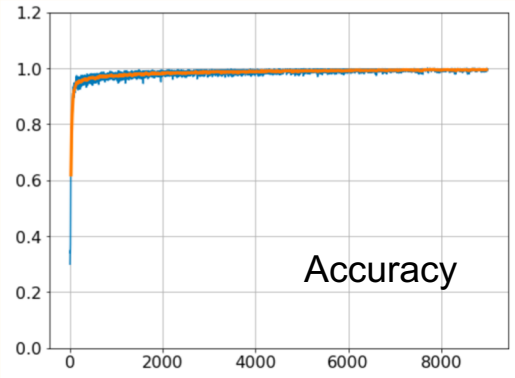
Training & Test Results

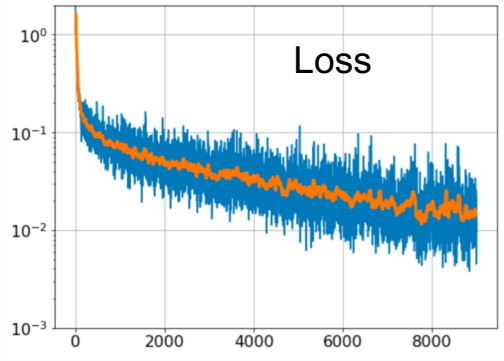
We tried to construct CNN for this challenge, but we struggle with computing loss values.
→ It was because we applied the same way as an image classification
to the image segmentation.

We've checked the performance with the deep learning on "Challenge-B-ExampleTrain.ipynb"

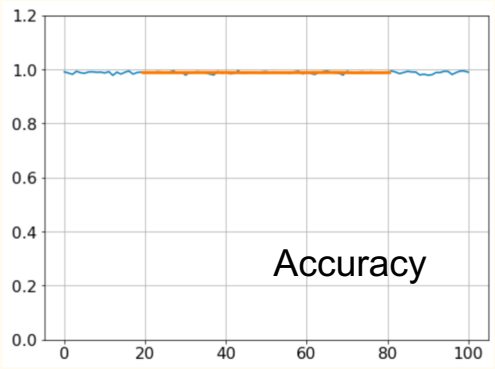
Training results after 9000 iterations

by K. Kojima



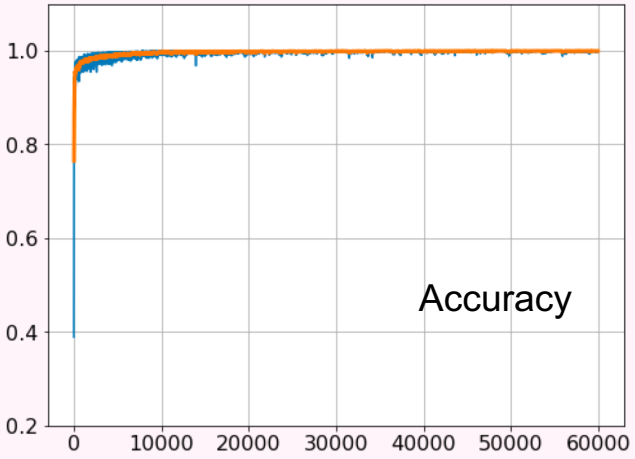


Test results



by M. Kondo

Training results after 60,000 iterations



What We Learned

I was almost beginner on machine learning, but I got some basic idea what technique is applicable to what type of problem during this workshop. Though working time was not enough for me to complete projects, the hands-on materials are good 1st step for self-study after this workshop. (C. Kozakai)

I learned many things about CNN and DNN and practiced CNN for a reasonable time.
I will also practice DNN and try to use it for my research. (H. Koo)

I thought that machine learning is an all-purpose and surprisingly useful tool before this workshop.
However, I learn there are exact statistics and it needs complex optimization and careful treatment. (H. Kondo)

This workshop has provided us dedicated time to learn about not only conceptual aspects of machine learning but also mathematical or practical methods with the well-organized lecture materials and notebooks. We learn how to construct essential parts of machine learning as well as the basic techniques like linear regression, gradient descent, and loss. (K. Kojima)

I thought machine learning was very difficult, but I found that it is basically made various efforts to reduce the loss function. Also, I used pytorch for the first time, and I was able to experience its usefulness. (M. Kondo)

I could be convinced that I can learn ML, pytorch, Python. (N. Maekawa)

Future Research Plan with Machine Learning

- To study transient noise in gravitational wave interferometer.

  Discrimination of gravitational wave signal and detector noise is important topic.
  Detector noise can be identified using auxiliary data like seismometer/microphone/magnetometer which observe environmental transient noise.

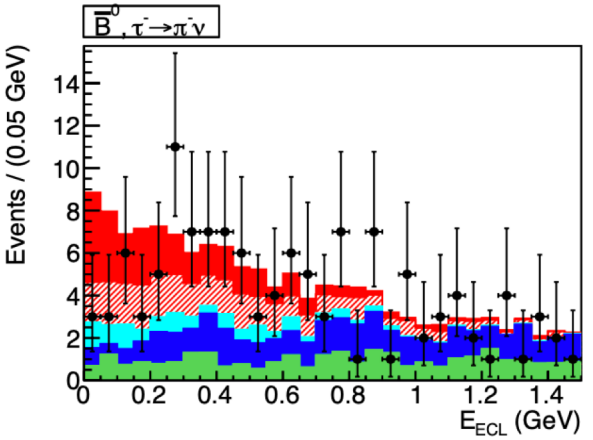
- To distinguish structures (halo, arm, bar, bulge, etc.) in the galaxy and large scale structures (void, filament, sheet, cluster, etc.) in the universe using image segmentation.

  Pixel-by-pixel work in image segmentation can be interpreted as star-by-star and galaxy-by-galaxy work.

- To improve $R\left(D^{(*)}\right)$ analysis at the Belle II experiment.

  The Belle II experiment is under severer condition
  with large beam background coming from high-current e^+e^- beams
  than the Belle experiment.
  It can, for example, be an issue in the analysis
  as the beam background on the variable for signal extraction,
  E_{ECL} (a linear sum of the energy of ECL clusters
  not used for the reconstruction), or π^0 reconstruction from γs.

S. Hirose, "Measurement of the Branching Fraction and Polarization of the τ Lepton in the Decay $\bar{B} \to D^*\tau^-\bar{\nu}$ at the Belle Experiment" (2017)
Ph.D thesis



- To solve inverse problem in renormalization group analysis.
- To constrain cosmological parameters without heavy fitting.