Particle Net Application for B Quark Decay

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Outline

Introduction

- We use EvtGen package to generator our simulated B-decaying data.
- Simulate 100000 events and further selected wanted events.
- Pick original B quark(PDG = 521) data and its full-decayed particles.
- We take 4-momentum and its mass of particles as data.
- Our goal is to rebuild the mass of B quark from the information of fully-decayed particles.

Points and Features

Particle Net needs points and features to build the neural network. Here we choose 3-vector momentum (p_x, p_y, p_z) as **points** and energy[1], mass, 3-momentum, and charge as **features**.

[1] Precisely, we take individual's, that is, *part_engy* and so on.

Loss Function

We use **MSE** as loss function for regression.

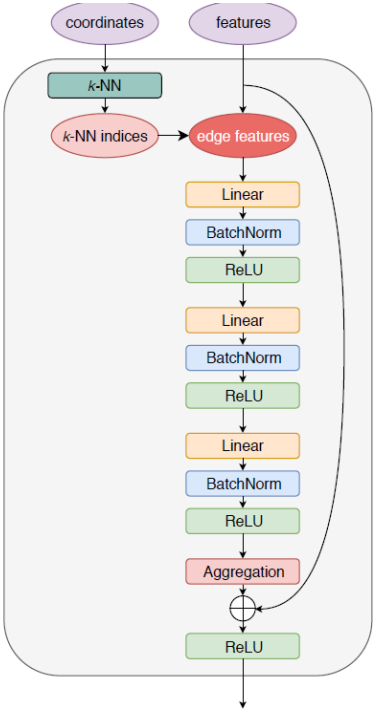

Figure 1: The structure of edge convolution block

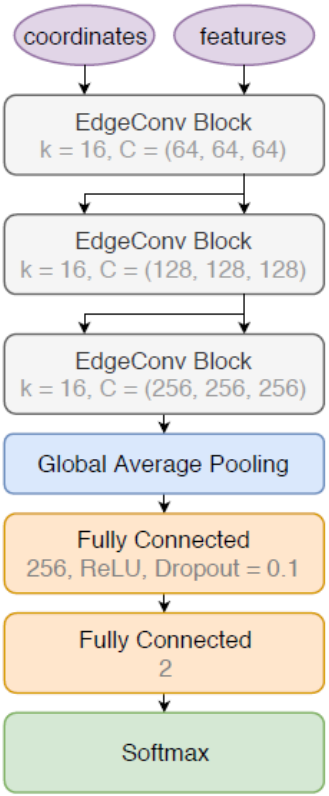

Figure 2: Particle Net Architecture

Loss Decay Rate

We train the model in 20,30,and 40 epochs and plot the corresponding change in vac_loss.

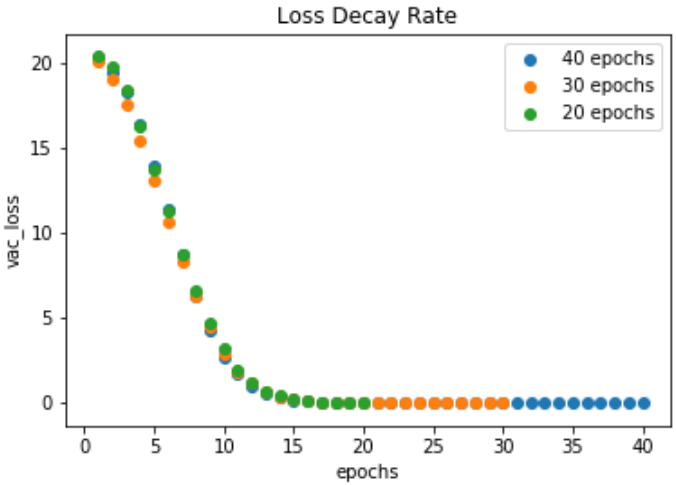

Figure 3: Loss Decay Rate: Loss converges after 30 epochs

Mass Prediction for 30 Epochs

Below are predictions of mass for 30 epochs and 40 epochs, and the true mass is 5.27933GeV. Statistic parameters:
mean $\mu = 5.27369$ GeV
standard deviation $\sigma = 0.06745615009664585$

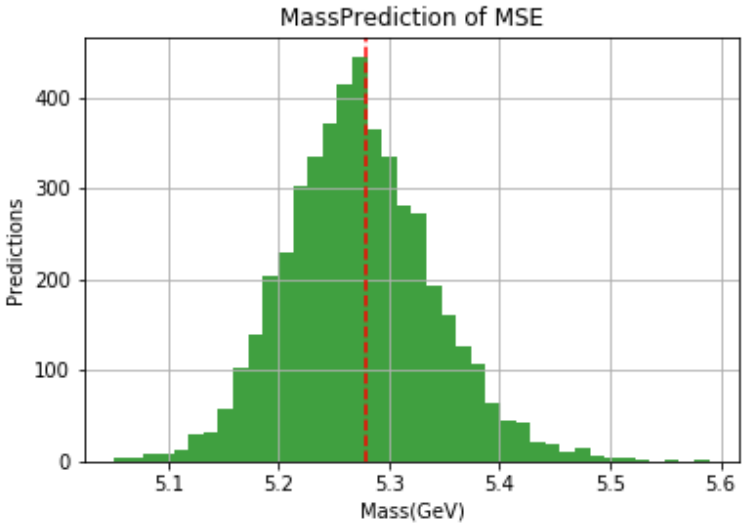

Figure 4: Mass Prediction for 30 epochs

Mass Prediction for 40 Epochs

Statistic parameters:
mean $\mu = 5.28434$ GeV
standard deviation $\sigma = 0.05832376890127553$

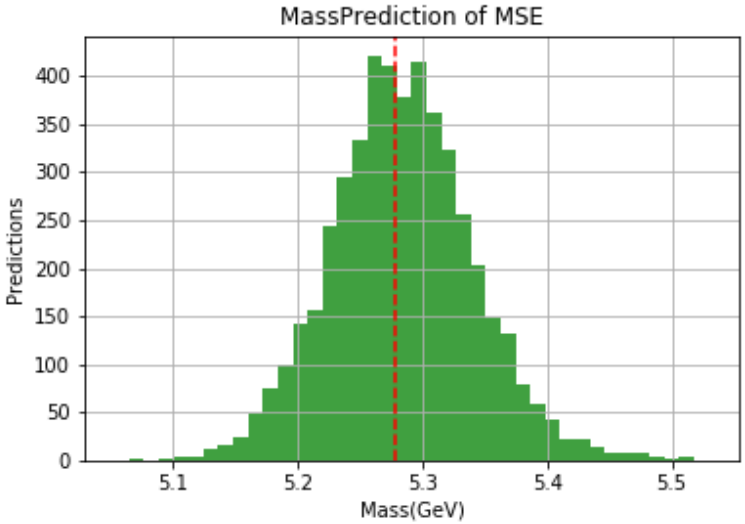

Figure 5: Mass Prediction for 40 epochs

Future

- Modification on Model.
- Recover 4-momentum of B quark.
- Take out some particles that are difficult to be detected.