- In the git repository:
  - https://gitlab.desy.de/yun-tsung.lai/hls4ml-tutorial
  - In challenge/ folder, there are the data files for your challenge.

- Let's take a look at waveform_demo.ipynb
  - There are two data samples prepared:
    - waveform_data_0.npy and waveform_data_1.npy
  - Each contains 10000 events (rows) and 104 columns.
  - You can use one of them for training and the other one for testing.

```python
sample_0 = np.load('waveform_data_0.npy')
```

## Take a look at the sample

```python
sample_0.shape
```

```
(10000, 104)
```

```
evt = 0

x = np.zeros(100)
for i in range(100):
    x[i] = i

y = sample_0[evt][4:104]
plt.scatter(x, y)
plt.show()
```

- For each event (row) in the data sample, from the 4th column to the 103th column are 100 data points of a single waveform.
  - Here is the waveform of the 0th event:

- The waveform is a Gaussian peak with pedestal and noise.
  - The data point (y) ranges from 0 to 1023, just like a 10-bit ADC.
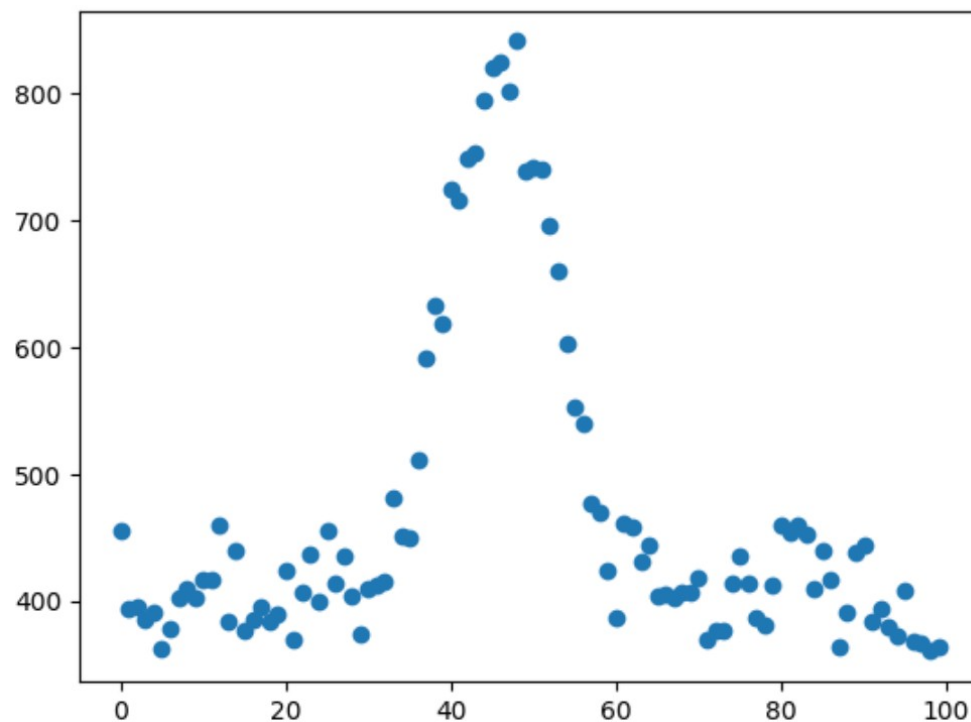
- The 0th column to the 3rd column are the information of this waveform.

- You can use them as labels for training.

```python
# The 0th column: mean of the Gaussian peak
# The 1st column: sigma of the Gaussian peak
# The 2nd column: height of the Gaussian peak
# The 3rd column: pedestal of the waveform


print("mean of the peak: ", sample_0[evt][0])
print("sigma of the peak: ", sample_0[evt][1])
print("height of the peak: ", sample_0[evt][2])
print("pedestal of the waveform: ", sample_0[evt][3])
```

```
mean of the peak:  45.77531814575195
sigma of the peak:  8.481695175170898
height of the peak:  436.0751037597656
pedestal of the waveform:  409.2980041503906
```

# Target

- Please try to use these data samples, and make a NN model which takes those waveform data points as input variables and predicts the information of the waveform
  - Mean, sigma, height of the peak, and pedestal of the waveform.

- Then try to use hls4ml to make a IPcore for hardware tets.