CVN tests

Saúl Alonso-Monsalve,

19 November 2020

CVN trainings

Induction plane → View 0 → SE-ResNet-34 Blocks 1-2

Induction plane → View 1 → SE-ResNet-34 Blocks 1-2

Collection plane → View 2 → SE-ResNet-34 Blocks 1-2

concatenate → SE-ResNet-34 Blocks 3-N

input

Output:
- softmax: CC ν_μ, CC ν_e, CC ν_τ, NC
- softmax: 0 protons, 1 protons, 2 protons, N protons
- softmax: 0 charged pions, 1 charged pions, 2 charged pions, N charged pions
- softmax: 0 neutral pions, 1 neutral pions, 2 neutral pions, N neutral pions
- softmax: 0 neutrons, 1 neutrons, 2 neutrons, N neutrons
- sigmoid: neutrino/antineutrino

output

Configurations

1. Only collection plane (view 2).
2. Two induction planes (views 0 and 1).
3. One induction plane + collection plane (views 1 and 2).

- Compare flavour results against original DUNE CVN (three views, two induction planes + collection plane).
  - Use the same training and test samples used for the DUNE CVN.

Results (I)

DUNE CVN (views 0, 1, and 2)

	precision	Recall	F1 score	#events
CC ν_μ	**0.93**	**0.96**	**0.95**	**26108**
CC ν_e	**0.93**	**0.97**	**0.95**	**25665**
CC ν_τ	0.66	0.37	0.47	5813
NC	0.94	0.95	0.94	42382

Collection plane (view 2)

	precision	Recall	F1 score	#events
CC ν_μ	**0.91**	**0.94**	**0.92**	**26108**
CC ν_e	**0.90**	**0.94**	**0.92**	**25665**
CC ν_τ	0.59	0.26	0.36	5813
NC	0.91	0.93	0.92	42382

Induction planes (views 0 and 1)

	precision	Recall	F1 score	#events
CC ν_μ	**0.91**	**0.95**	**0.93**	**26108**
CC ν_e	**0.90**	**0.95**	**0.92**	**25665**
CC ν_τ	0.59	0.27	0.37	5813
NC	0.92	0.93	0.92	42382

Induction plane, collection plane (views 1 and 2).

|	precision	Recall	F1 score	#events
CC ν_μ	**0.91**	**0.95**	**0.93**	**26108**
CC ν_e	**0.90**	**0.95**	**0.92**	**25665**
CC ν_τ	0.58	0.31	0.40	5813
NC	0.92	0.92	0.92	42382

Results (II)

CC ν_e cut: 0.85
CC ν_μ cut: 0.50

Due to network parameter initialisation, the results have a ± error of ~0.005

|	Overall Purity (CC ν_μ)	Overall Purity (CC ν_e)	Overall Efficiency (CC ν_μ)	Overall Efficiency (CC ν_e)
DUNE CVN (views 0, 1, and 2)	**0.9727**	**0.9219**	**0.9389**	**0.8896**
Collection plane (view 2)	0.9636	0.8749	0.8839	0.8086
Induction planes (views 0 and 1)	0.9631	0.8532	0.9129	0.8452
Induction plane, collection plane (views 1 and 2)	0.9633	0.8551	0.9106	0.8385

Probability histograms (I)

- Original DUNE CVN (views 0, 1, and 2).
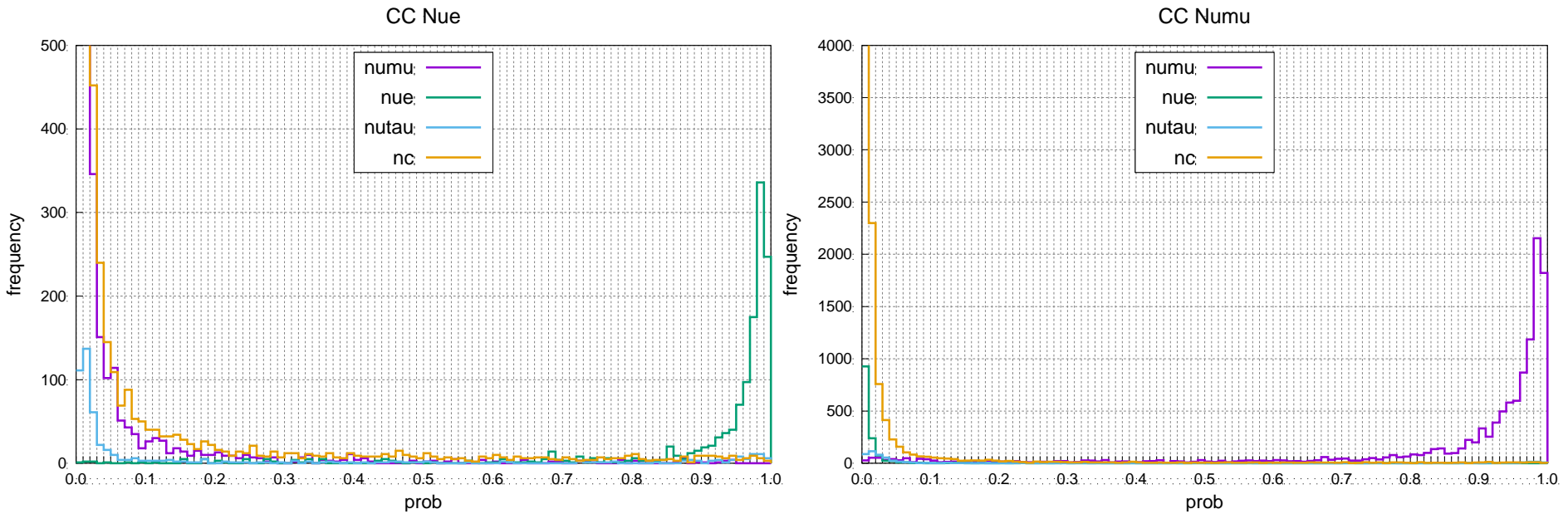 - CC v_e cut: 0.85.
  - CC v_μ cut: 0.50.
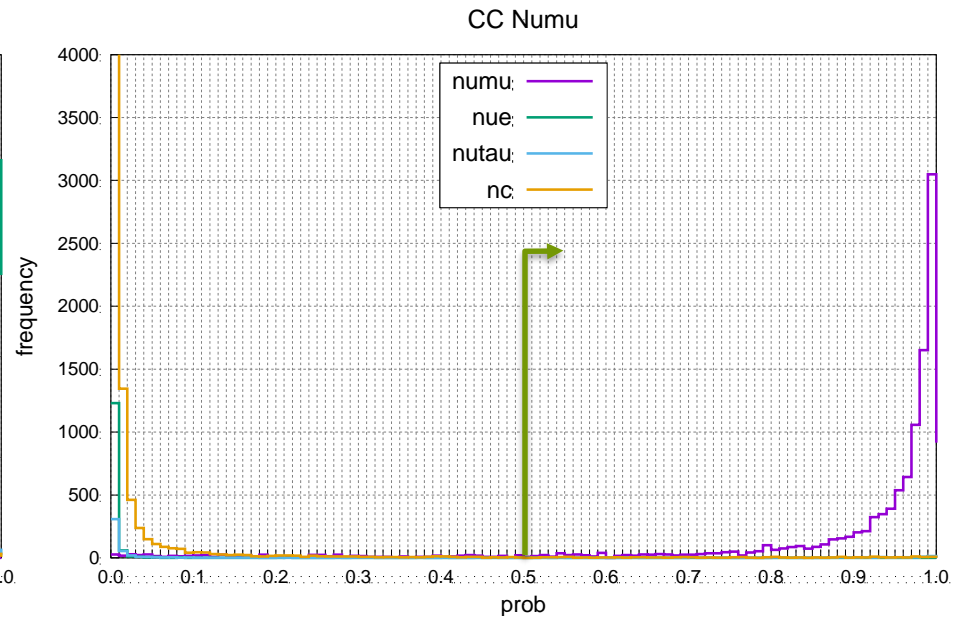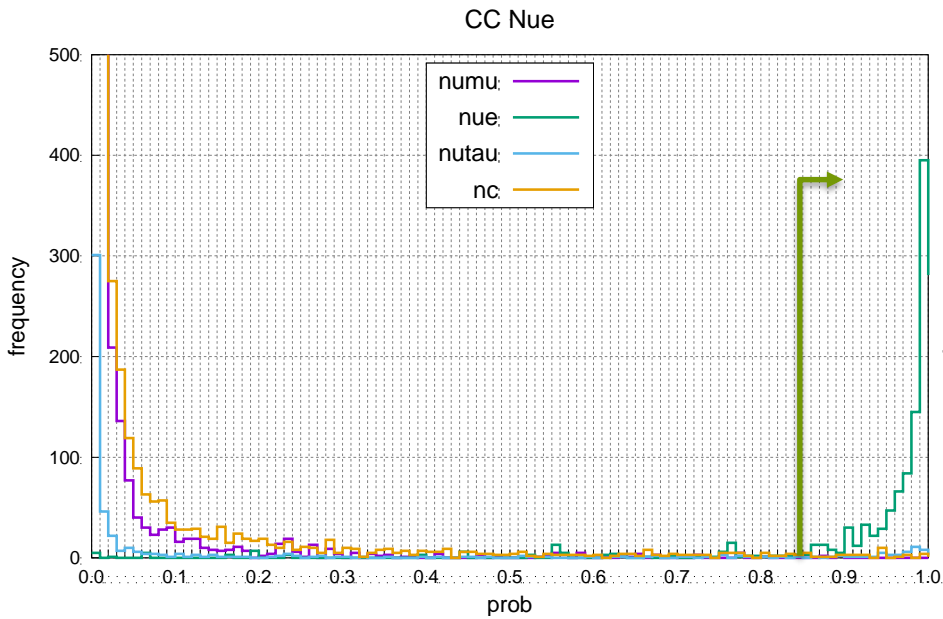
Probability histograms (I)

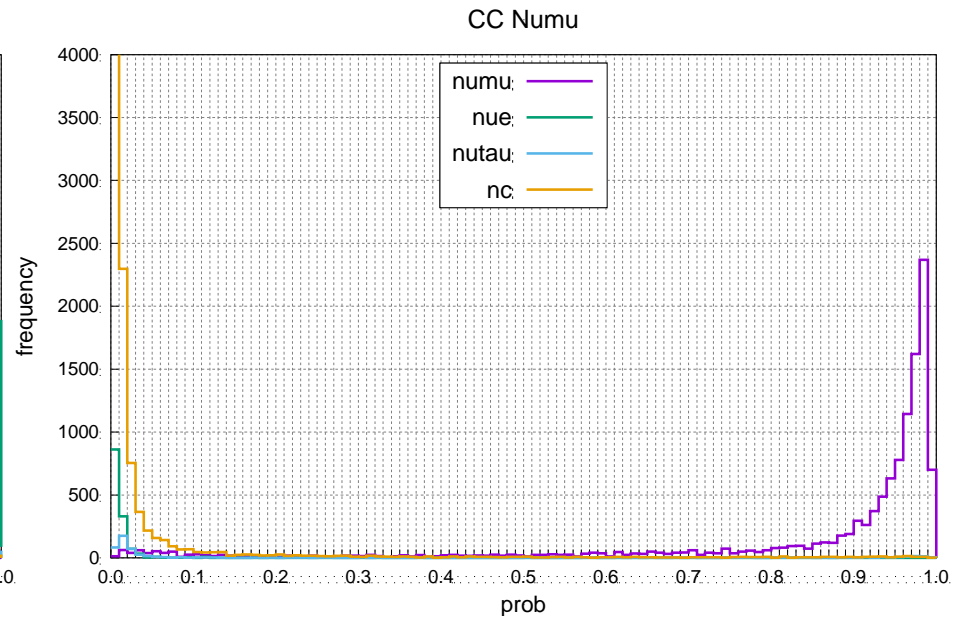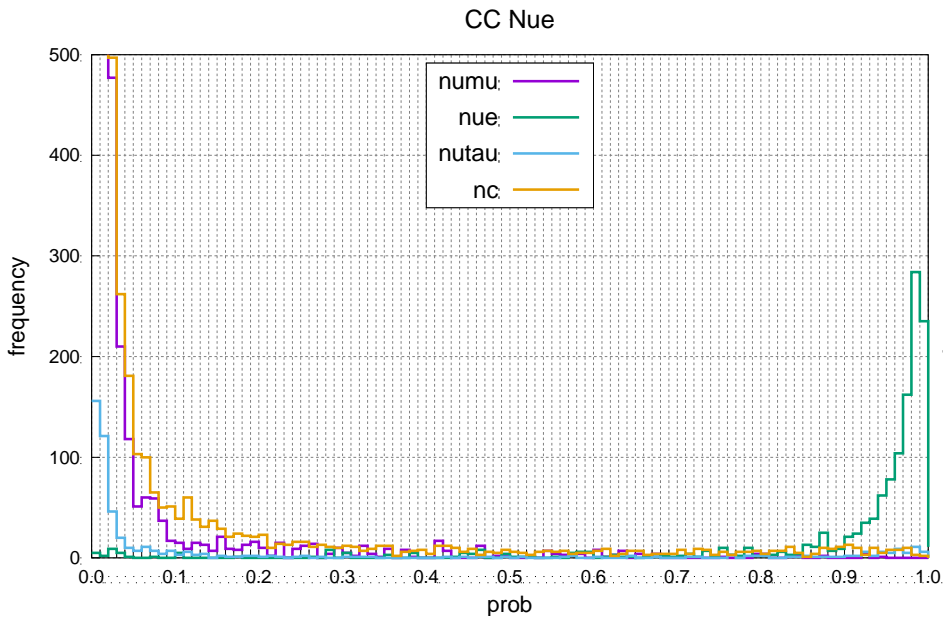- Alternative 1: only collection plane (view 2).
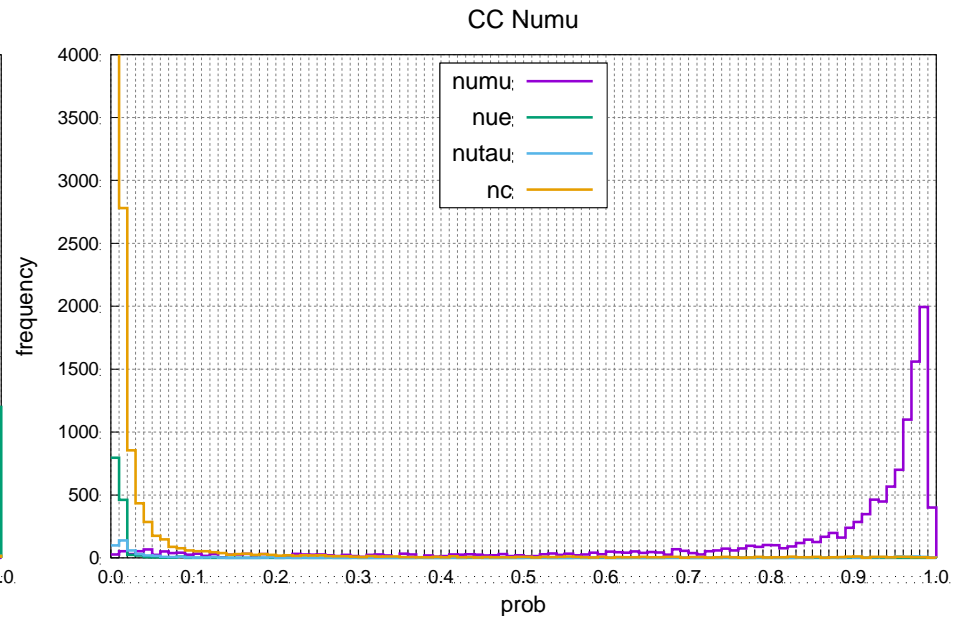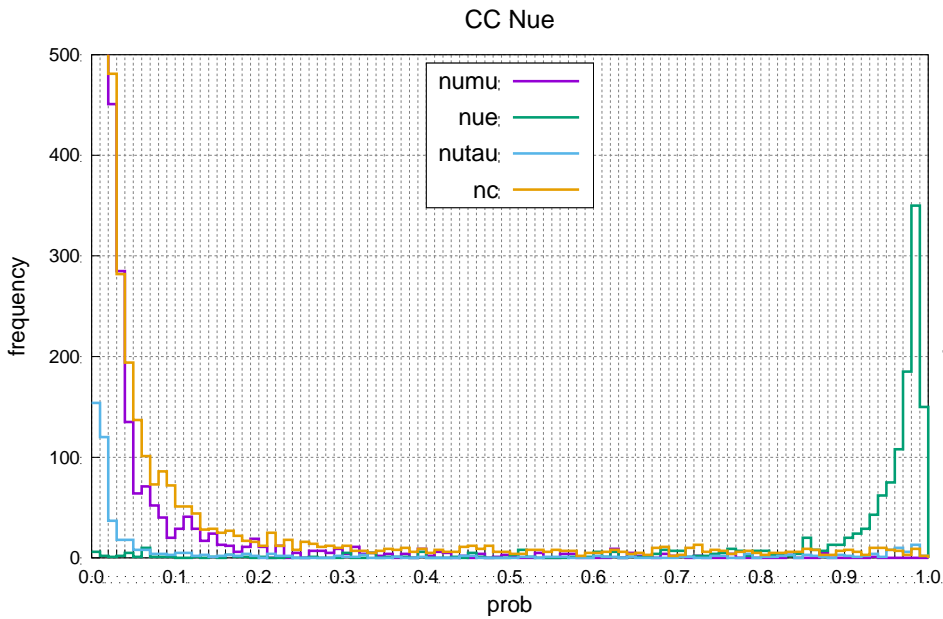
Probability histograms (I)

- Alternative 2: two induction planes (views 0 and 1).

Probability histograms (I)

- Alternative 3: one induction plane + collection plane (views 1 and 2).

Trying different CC ve cut values

Due to network parameter initialisation, the results have a ± error of ~0.005

Cut value:	Overal CC ve purity			Overal CC ve efficiency		
	0.80	0.85	0.90	0.80	0.85	0.90
DUNE CVN (views 0, 1, and 2)	**0.9040**	**0.9219**	**0.9360**	**0.9008**	**0.8896**	**0.8486**
Collection plane (view 2)	0.8526	0.8749	0.8998	0.8422	0.8086	0.7565
Induction planes (views 0 and 1)	0.8355	0.8532	0.8867	0.8673	0.8452	0.7992
Induction plane, collection plane (views 1 and 2)	0.8277	0.8551	0.8835	0.8575	0.8385	0.7823

Reweighting the loss function

- Pay more attention to CC ν_e events while training.