Anomaly Detection

In Searches for New Physics in the ATLAS/LHC Experiment

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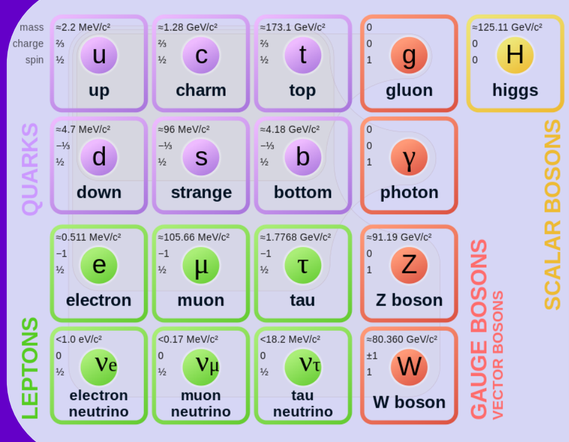


Why?

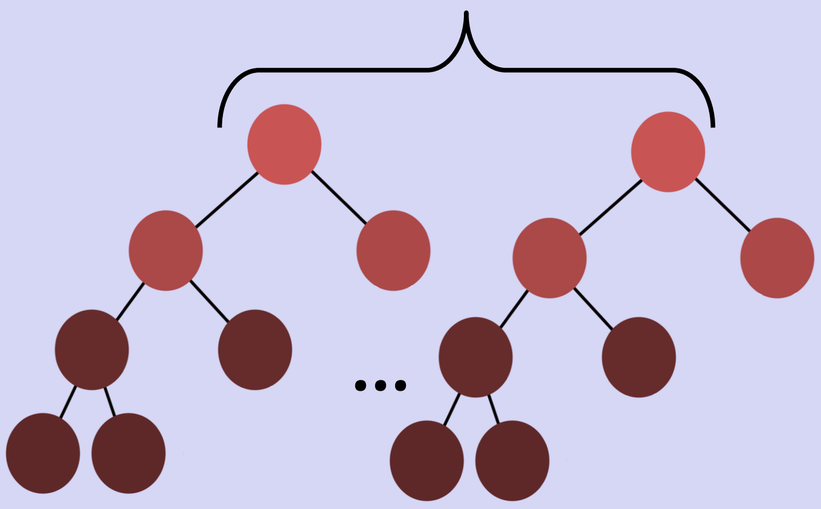
The **Standard Model** of Particle Physics organizes the elementary particles and fundamental forces between them.

Some **open questions** remain such as the neutrino masses, the mystery of dark matter and the matter--antimatter asymmetry.

Use of weakly supervised Machine Learning techniques, namely **Anomaly Detection**, to perform model--independent searches.

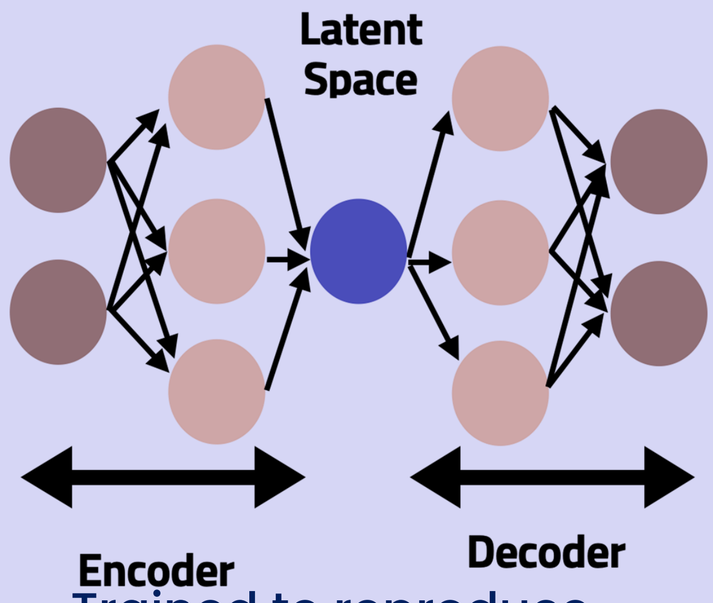
How?

Isolation Forest



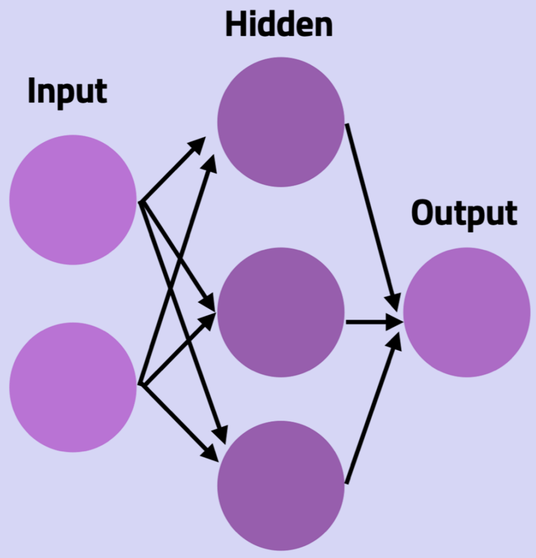
Ensemble of decision trees.
Random splits in data.
Anomalies will be separated faster.

AutoEncoder



Trained to reproduce background.
Reconstruction error can be taken as an anomaly score.

Deep SVDD

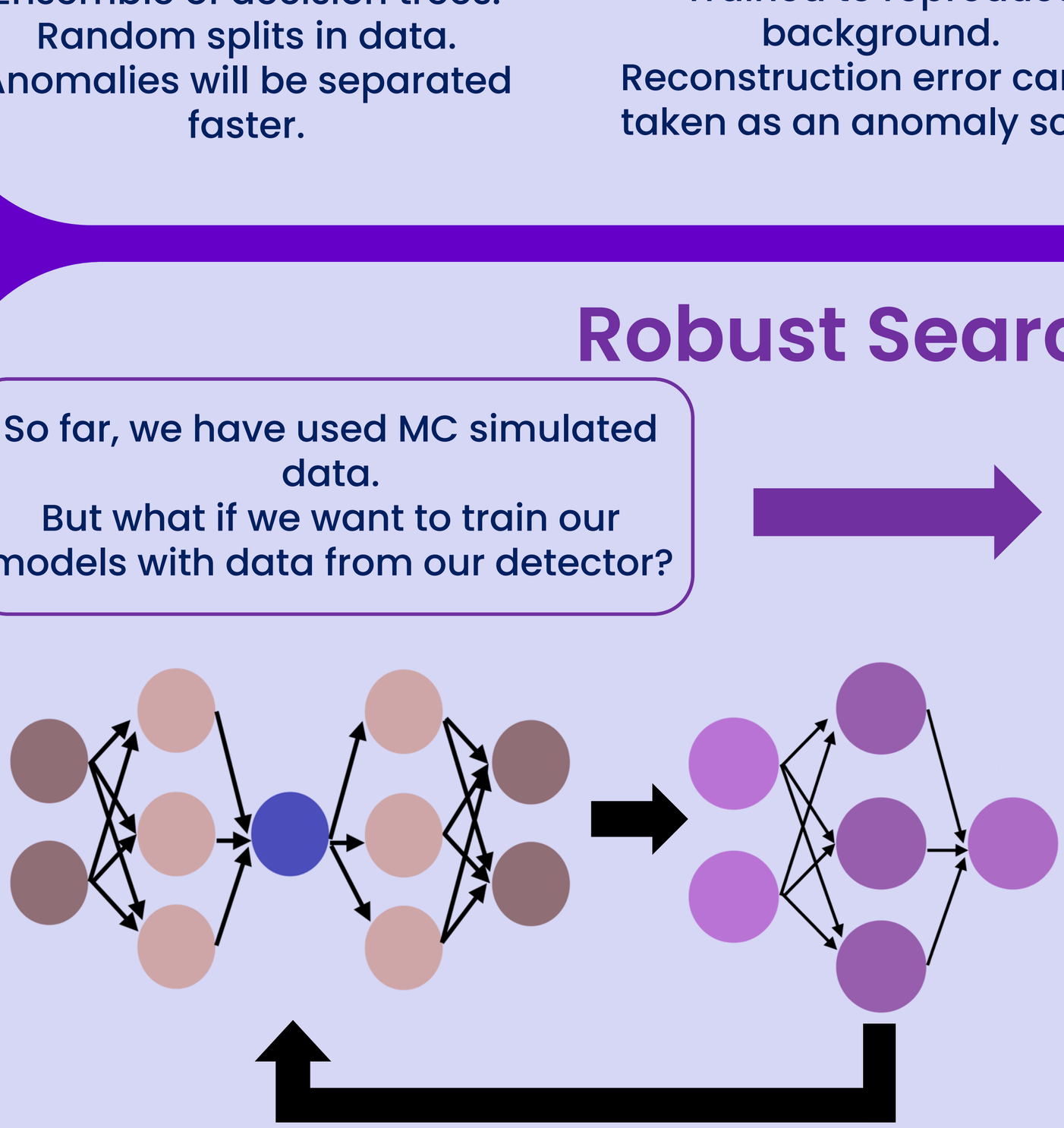


Neural Network initialized to obtain centre (c) of output distribution on background.
Anomaly score from distance to c.

Robust Searches

So far, we have used MC simulated data.
But what if we want to train our models with data from our detector?

Need to be robust to systematic uncertainties present in experimental data.
We do this with **adversarial training**.



AutoEncoder trained with background and systematics aims to deceive a classifier Neural Network.

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