



NanoAod RDataFrame

NanoAOD Processing

07/01/2022

Main class :NanoAodrdframe



it has several methods:

- Object definitions (selectElectrons, selectMuons,: These objects could be electrons, muons, jets, missing energy, etc...)
- Additional derived variables definition (defineMoreVars)
- Histogram definitions (bookHists)
- Selections (defineCuts)
- Some utility methods/functions (gen4vec, readjson, removeOverlaps, helper_1DHistCreator, createHists)

TprimeAnalyser & SingleTopAnalyser



These classes are the child class of the main class.

- All the variables and functions are inherited from the main class
- The selection functions are redefined in each child classes.

TprimeAnalyser & SingleTopAnalyser

These classes initialized in processnanoaod.py

```
aproc = ROOT.TprimeAnalyser(t, outputroot, year, syst, json, globaltag, split)
aproc.setupAnalysis()
aproc.run(saveallbranches, outtree)
```

- setupAnalysis() : run all defined selections:

```
// Object selection will be defined in sequence.
// Selected objects will be stored in new vectors.
selectElectrons();
selectMuons();
selectJets();      You, 2 days ago • tprime_analyser add functi
removeOverlaps();
```

- run(): save all the branches into the output root file.

Muon Selection

The **SelectMuons()** function will add a new column to the dataframe that defines a “**good muon**” for the purpose of the analysis.

name

selection

```
//SelectMuon function with selection criteria on muon momentum, pseudorapidity, identification level, and isolation level.

void TprimeAnalyser::SelectMuons()
{
    //cout << "select good muons" << endl;
    _rlm = _rlm.Define("goodMuons", MuonID("Tight")); //change the ID to : Loose-Medium-tight
    _rlm = _rlm.Define("Selected_muon_pt", "Muon_pt[goodMuons]") // define new variables
        .Define("Selected_muon_eta", "Muon_eta[goodMuons]")
        .Define("Selected_muon_phi", "Muon_phi[goodMuons]")
        .Define("Selected_muon_mass", "Muon_mass[goodMuons]")
        .Define("Selected_muon_charge", "Muon_charge[goodMuons]")
        .Define("Selected_muon_idx", ::good_idx, {"goodMuons"})
        .Define("numberof_muon_pass", "int(Selected_muon_pt.size())");
}
```

Example: Muon selection

Define selection criteria on muon identification level, isolation level, muon momentum, and pseudorapidity, (Muon_pt, Muon_eta, Muon_tightId, Muon_looseId, etc, are branches of interest.)

- Selection must be defined as string in RDframe
- All selection functions returns cuts as a string

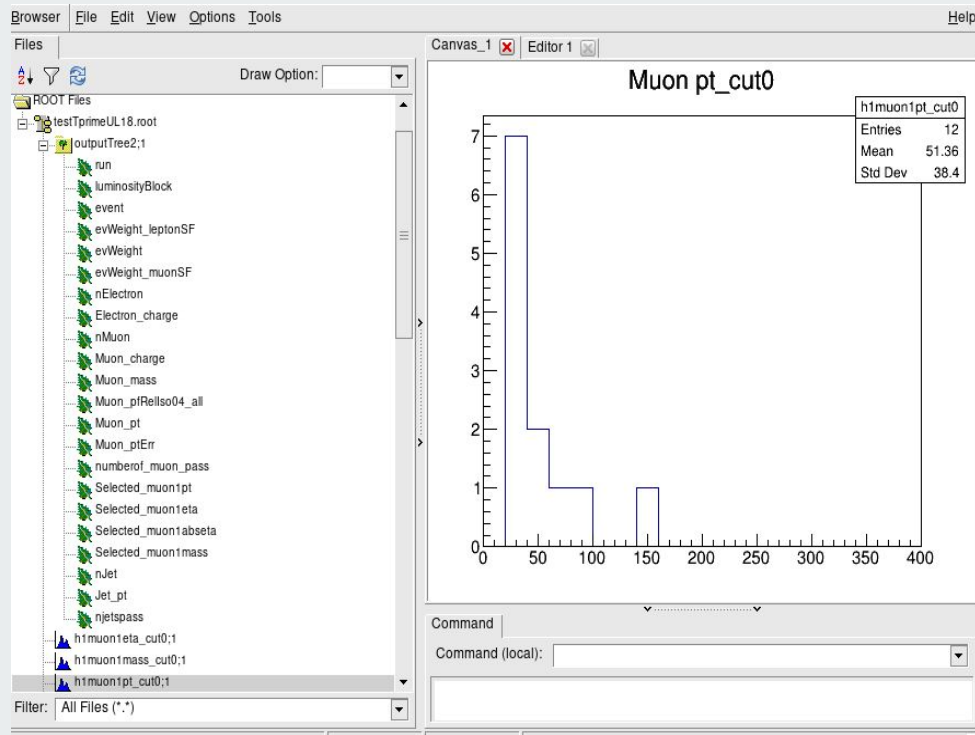
```
//-----  
//Find the interesting muons in the muon collection  
//Identification and isolation criteria depend mostly on your physics analysis goals.  
//-----  
std::string TprimeAnalyser::MuonID(std::string cutbasedID, bool enable_MuonIso = true, bool enable_veto_muon = false){  
  
    string Muon_cutBased_ID;  
    float Muon_pfRelIso04_all;  
  
    if(!_isRun17 || !_isRun18 ){  
        if (cutbasedID == "Loose"){  
            Muon_cutBased_ID = "Muon_looseId";  
            Muon_pfRelIso04_all=0.25;  
        }else if(cutbasedID == "Medium"){  
            Muon_cutBased_ID = "Muon_mediumId";  
            Muon_pfRelIso04_all=0.15;  
        }  
        else if(cutbasedID == "Tight"){  
            Muon_cutBased_ID = "Muon_tightId";  
            Muon_pfRelIso04_all=0.15;  
        }  
    }  
  
    string output;  
    if (enable_MuonIso==true){  
        if (enable_veto_muon==false){  
            output = Form("Muon_pt>%f && abs(Muon_eta)<%f && Muon_pfRelIso04_all< %f && Muon_tightId",cutdb->Id_Muon_pT,cutdb->Id_Muon_  
        }else{  

```

Example Output : flat tree+histograms

User should define/store variables specific to his/her analysis

```
void TprimeAnalysr::defineMoreVars()  
{  
    // define your higher level variables here  
    defineVar("muonvec",::select_leadingvec,{"muon4vecs"});  
  
    addVar({"Selected_muon1pt", "Selected_muon_pt[0]", ""});  
    addVar({"Selected_muon1eta", "Selected_muon_eta[0]", ""});  
    addVar({"Selected_muon1abseta", "abs(Selected_muon1eta)", ""});  
    addVar({"Selected_muon1mass", "Selected_muon_mass[0]", ""});  
  
    // define variables that you want to store  
    addVartoStore("run");  
    addVartoStore("luminosityBlock");  
    addVartoStore("event");  
    addVartoStore("evWeight.*");  
    addVartoStore("nElectron");  
    addVartoStore("Electron_charge");  
    addVartoStore("nMuon");  
    addVartoStore("Muon_charge");  
    addVartoStore("Muon_mass");  
    addVartoStore("Muon_ptRelIso04_all");  
    addVartoStore("Muon_pt.*");  
}
```



Input data: NanoAOD without skim
Output: Flat ntuple

Summary



Main skeleton of the framework is in progress

- Users should modify or add
 - Object definitions
 - Define additional variables,
 - Histogram definition,
 - Selections

More detailed instruction can be found in: https://codimd.web.cern.ch/tih_pPolQSaITZMwVO_vAQ?both

Any comments/suggestions are welcome.

Twiki page & tutorial under preparation



Thank You !

Useful links



Electrons

<https://twiki.cern.ch/twiki/bin/view/CMS/EgammaPOG>
<https://twiki.cern.ch/twiki/bin/view/CMS/EgammaRunIIRecommendations>
<https://twiki.cern.ch/twiki/bin/view/CMS/EgammaIDRecipesRun2>
<https://twiki.cern.ch/twiki/bin/view/CMS/CutBasedElectronIdentificationRun2>

Muons

<https://twiki.cern.ch/twiki/bin/view/CMS/MuonPOG>
<https://twiki.cern.ch/twiki/bin/view/CMS/MuonHLT>

Taus

<https://twiki.cern.ch/twiki/bin/view/CMS/Tau>
<https://twiki.cern.ch/twiki/bin/viewauth/CMS/TauIDRecommendationForRun2>
<https://twiki.cern.ch/twiki/bin/view/CMS/TauTrigger>
<https://github.com/cms-tau-pog/TauIDSFs>

Jet/MET

<https://twiki.cern.ch/twiki/bin/view/CMS/JetID>
<https://twiki.cern.ch/twiki/bin/view/CMS/MissingETUncertaintyPrescription>
<https://twiki.cern.ch/twiki/bin/view/CMS/JERCReference>
<https://twiki.cern.ch/twiki/bin/view/CMS/JECDataMC>
<https://twiki.cern.ch/twiki/bin/view/CMS/JetResolution>
<https://twiki.cern.ch/twiki/bin/viewauth/CMS/JetEnergyScale>
<https://twiki.cern.ch/twiki/bin/view/CMS/IntroToJEC>

B-jets

<https://twiki.cern.ch/twiki/bin/viewauth/CMS/BtagPOG>
<https://twiki.cern.ch/twiki/bin/view/CMS/BtagRecommendation>
<https://twiki.cern.ch/twiki/bin/view/CMSPublic/SWGuideBTagging>