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Session 9:
Multiple Instances of Modules

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art and LArSoft Course

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In this Session You Will Learn

- How to make an *art* job in which you run the same module more than once

- What is a module label?
  - This is a critical idea for the exercises that will come after lunch

- How does it differ from a module_type?
  - Some people say "module class name" or "module class"
  - These are synonyms for module_type

- Restrictions on characters that may appear in a module label.
  - The same restrictions apply to the characters that may appear in the name of an *art* process.

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Header from ModuleInstances/MagicNumber_module.cc

```
namespace tex {

 class MagicNumber : public art::EDAnalyzer {
 public:

   // Read a parameter named magicNumber from pset; store it in the
   // data member magicNumber_ ; print its value.
   explicit MagicNumber(fhicl::ParameterSet const& pset );

   // Print the art::EventID and magicNumber_ .
   void analyze(art::Event const& event) override;

 private:
   int magicNumber_;

 };
}
```

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Comments on Previous Slide

- The module used in this exercise is very simple.

- It has one data member named magicNumber_
  - It is set in the c'tor from the parameter set
  - It is printed for each event

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Fragments from ModuleInstances/magic.fcl

```
process_name : magic

physics :{
 analyzers: {
  boomboom : {
   module_type : MagicNumber
   magicNumber : 5
  }

  rocket : {
   module_type : MagicNumber
   magicNumber : 9
  }

  flower : {
   module_type : MagicNumber
   magicNumber : 10
  }
```

```
  bigbird : {
   module_type : First
  }

 } // end analyzer

  e1 : [ rocket, boomboom,
         bigbird, flower ]

  end_paths : [ e1 ]

} // end physics
```

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Comments on the Previous Slide

- The module_type MagicNumber is used three times
- The instances of the same module_type are differentiated by different module labels

  – Each module instance has its own run-time configuration.
  – The magicNumber parameter is there to help us know which module instance is which.

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Rules for Module Labels

- Must be unique within each *art* process
- May only contain letters and numbers:
  - Must NOT contain any underscores
  - Must not start with a number

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What's an *art* process?

- One run of the *art* executable
- You can give a process a name by defining it in the .fcl file:

  process_name : magic

- If a process produces any data products, then the process_name is part of the name of those data products.
  - Think of a chain of processes all adding data products to a file
  - It's legal for two data products to be distinguished only by the process name field.
  - A use case: validating a new compiler
- A process_name may only contain letters and numbers.
  - Must NOT contain any underscores
  - It may start with a number but that's an accident!

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A Module Label has many uses

- The name of an instance of a module_type
- The name of the FHiCl table used to configure that instance
  - May also refer to the fhicl::ParameterSet passed to the c'tor when making that instance of the module.
- A part of the name of any data product produced by that instance of that module
- The name of the TDirectory that holds all histogram/tree objects created by that module instance
- Paths are sequences of module labels

Module labels are a critical idea that permeates *art*

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Questions so Far?

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Please Help Us Make the Course Better

- In order to help us improve the art/LArSoft course, we are asking for your assistance.

- Each day, we'll be sending out a survey form with a few questions about each of the sessions of the day.

- The first survey is available at:
  http://goo.gl/forms/TWTHjuVkG1

- We, and future students, thank you!

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Get Started

- Start to work on Chapter 15 (Exercise 5) in the *art* workbook writeup
  - https://web.fnal.gov/project/ArtDoc/Shared%20Documents/art-documentation.pdf

- My Powerpoint is flakey.
- If the above link fails or if it display pdf as text, try:
  - https://web.fnal.gov/project/ArtDoc/SitePages/documentation.aspx
  - Under latest releases, click on the document with the highest version number.
- If both links fail, mouse in the url.

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Backup Slides:

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Where does the No Underscore Rule Come From?

- Each data product has a 4 part name.
  - The parts are delimited by underscores
  - Therefore each part must not itself contain an underscore

- Two parts of the name are:
  - The module label of the module instance that created it
  - The process_name of the *art* process that created it
  - You will learn about the other parts later.

- Each data product is stored in a ROOT file as a TBranch and the name of the TBranch is the name of the data product.

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Hints on Navigating the Giant PDF file

- Title page

- Blank page

- List of Chapters (3 pages long)

- Detailed Table of Contents (16 pages long)

- Everything is internally hyperlinked:
  - Page numbers in the TOC, and index
  - Table, Listing, Figure and Section cross-references
  - Configure your browser to highlight hyperlinks.

- Many PDF browsers have previous and next buttons
  - MAC Safari
    - Back: Apple-[
    - Forward: Apple-]

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