GlobalModuleIndex in ROOT and Cling

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GlobalModuleIndex Design

- **GlobalModuleIndex**
  - **Identifier 4**
    - a.pcm, b.pcm, c.pcm, d.pcm, h.pcm, k.pcm
  - **Identifier 1**
    - b.pcm, d.pcm, e.pcm, f.pcm, g.pcm
  - **Identifier 2**
    - b.pcm, c.pcm, g.pcm, h.pcm, i.pcm

- **Test Program**
  - ...
  - ...
  - **Identifier 1**
  - ...

- **ROOT**
- Issues error: unknown identifier

- **GlobalModuleIndex**
- Issues error: unknown identifier

- **Load PCMs**
  - b.pcm, d.pcm, e.pcm, f.pcm, g.pcm
Implementation

- Found and compared the (number of) modules loaded
- Found the identifiers which cause the PCMs to be loaded
- Found the methods which cause the above PCMs to be loaded
- Identified a few ROOT identifiers (not in stl and libc) which require these modules to be loaded
- Initially, over 450 tests were failing, which was reduced to 50 tests by cleaning the code.
- Another temporary solution to fix the failing tests was introducing FIXMEModules
- Developed a script to find the modules/libraries loaded by each test/tutorial run by ctest
- Developed a script to extract time and memory measurements for each test/tutorial run by ctest
Performance Results

Number of Failing Tests

CPU User Time (s)

CPU System Time (s)

Max RSS (kbytes)
PR with GlobalModuleIndex implementation: https://github.com/root-project/root/pull/4016

My contributions: https://tinyurl.com/y4pzgsy9

Final performance results:
  - https://tinyurl.com/Performance-Measurements-1
  - https://tinyurl.com/Performance-Measurements-2

Final submission:
https://docs.google.com/document/d/1ryqNseURDZiL71anRMV0JL4DU7o9SrXG4nXZ4kJ510Y/edit?usp=sharing
Thank you!