SourceLink and Any

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CERN
2022-11-29
SourceLink change

- Plan to change SourceLink
- History:
  - SourceLink used to be a template parameter on almost everything (with compile-time and complexity consequences)
  - I untemplated everything from SourceLink
- SourceLink is experiment-specific (+ we have a few incarnations in the Examples)
Status quo

- Status quo type erasure: minimal base class, inheritance and downcast
- Consequence: needs to be passed by reference, stable address somewhere
- Needed some workaround with `std::list` in the Examples + problematic for ATLAS deployment

```cpp
class SourceLink {
    protected:
        constexpr SourceLink(GeometryIdentifier id) : m_geometryId{id} {} 

    public:
        constexpr GeometryIdentifier geometryId() const { return m_geometryId; } 

        virtual ~SourceLink() = 0;

    private:
        GeometryIdentifier m_geometryId;
};
```
Proposal

- Move away from inheritance, make SourceLink contain an *any* type
- Downcast changes from *static_cast* to variation of *any_cast*

```cpp
MyExperimentSourceLink e;
Acts::SourceLink sl1{e}; // if e.geometryId() is defined
Acts::SourceLink sl2{gId, e}; // if not
// ... somewhere else in reconstruction
const auto& e2 = sl2.get<MyExperimentSourceLink>(); // downcast
```

- Option 1: *std::any* - Has SBO but only up to 64bit (in ATLAS we’ll need 96bit) (PR here)
- Option 2: *Acts::Any* - Can have any SBO, downside: black magic, *reinterpret_cast* required
Acts::Any

- Can carry out change after switching SourceLink to std::any: is abstracted, no client changes needed
- PR for Acts::Any is here
  - Has optimization potential, but should be able to refactor without interface changes
  - No implicit constructions (explicit everything)
  - Can configure the SBO size (default: sizeof(void*))
  - Cast via a.as<int>() -> int&
- Checked performance on standard full chain ODD job, breaking down by algorithm, 200 runs each, 100 events, 1 thread
Performance I

Reader: EventGenerator
- feat Acts::Any, 200 runs
- feat std::any, 200 runs
- main, 200 runs

Algorithm: FatrasSimulation
- feat Acts::Any, 200 runs
- feat std::any, 200 runs
- main, 200 runs

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Performance II

**Algorithm: ParticleSelector**
- feat Acts::Any, 200 runs
- feat std::any, 200 runs
- main, 200 runs

**Algorithm: DigitizationAlgorithm**
- feat Acts::Any, 200 runs
- feat std::any, 200 runs
- main, 200 runs

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Algorithm: TruthSeedSelector
feat Acts::Any, 200 runs
feat std::any, 200 runs
main, 200 runs

Algorithm: TrackParamsEstimationAlgorithm
feat Acts::Any, 200 runs
feat std::any, 200 runs
main, 200 runs
Performance V

Algorithm: TrackFindingAlgorithm
- feat Acts::Any, 200 runs
- feat std::any, 200 runs
- main, 200 runs

Algorithm: AmbiguityResolutionAlgorithm
- feat Acts::Any, 200 runs
- feat std::any, 200 runs
- main, 200 runs

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