



Templight: a compiler profiler

The issue

long compilation times for `TDataFrame`
(~15s for the integration test)

Where are we spending time?

```
g++ -ftime-report
```



Templight: a compiler profiler

Where are we spending time?

g++ -ftime-report

Execution times (seconds)

phase setup	:	0.00 (0%)	usr	0.00 (0%)	sys	0.01 (0%)	wall	1339 kB (0%)	ggc
phase parsing	:	0.70 (13%)	usr	0.20 (32%)	sys	0.90 (15%)	wall	176271 kB (27%)	ggc
phase lang. deferred	:	1.87 (35%)	usr	0.13 (21%)	sys	2.01 (34%)	wall	210148 kB (32%)	ggc
phase opt and generate	:	2.73 (52%)	usr	0.29 (47%)	sys	3.00 (51%)	wall	259294 kB (40%)	ggc
phase finalize	:	0.00 (0%)	usr	0.00 (0%)	sys	0.01 (0%)	wall	0 kB (0%)	ggc
preprocessing	:	0.07 (1%)	usr	0.05 (8%)	sys	0.12 (2%)	wall	4969 kB (1%)	ggc
parser (global)	:	0.17 (3%)	usr	0.07 (11%)	sys	0.23 (4%)	wall	69082 kB (11%)	ggc
parser struct body	:	0.17 (3%)	usr	0.03 (5%)	sys	0.15 (3%)	wall	25272 kB (4%)	ggc
parser function body	:	0.03 (1%)	usr	0.00 (0%)	sys	0.05 (1%)	wall	6656 kB (1%)	ggc
parser incl. func. body	:	0.03 (1%)	usr	0.00 (0%)	sys	0.07 (1%)	wall	4576 kB (1%)	ggc
parser incl. meth. body	:	0.09 (2%)	usr	0.01 (2%)	sys	0.09 (2%)	wall	14554 kB (2%)	ggc
template instantiation	:	2.04 (38%)	usr	0.18 (29%)	sys	2.25 (38%)	wall	260536 kB (40%)	ggc
inline parameters	:	0.00 (0%)	usr	0.00 (0%)	sys	0.00 (0%)	wall	3901 kB (1%)	ggc
integrated RA	:	0.57 (11%)	usr	0.03 (5%)	sys	0.62 (10%)	wall	124792 kB (19%)	ggc



Templight: a compiler profiler

Enter Templight

Clang-based tool to profile the time and memory consumption of template instantiations

```
template <unsigned int N>
struct Fibonacci;

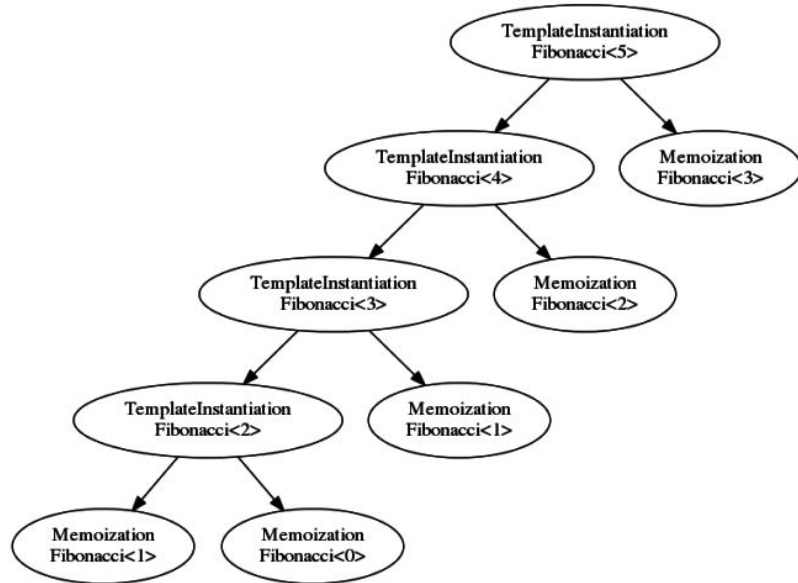
template <>
struct Fibonacci<0> { static const unsigned int value = 0; };

template <>
struct Fibonacci<1> { static const unsigned int value = 1; };

template <unsigned int N>
struct Fibonacci {
    static const unsigned int value = Fibonacci<N-1>::value + Fibonacci<N-2>::value;
};

int main() {
    return Fibonacci<5>::value;
};
```

“Flat” profile

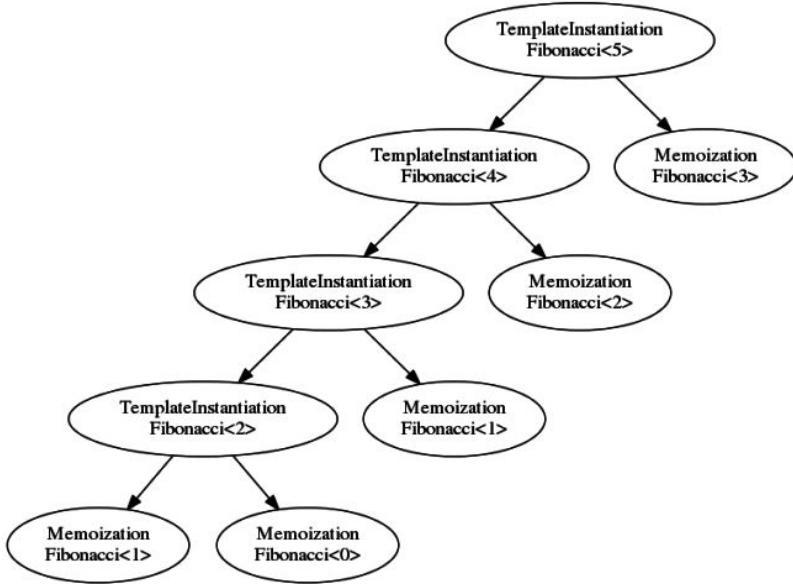




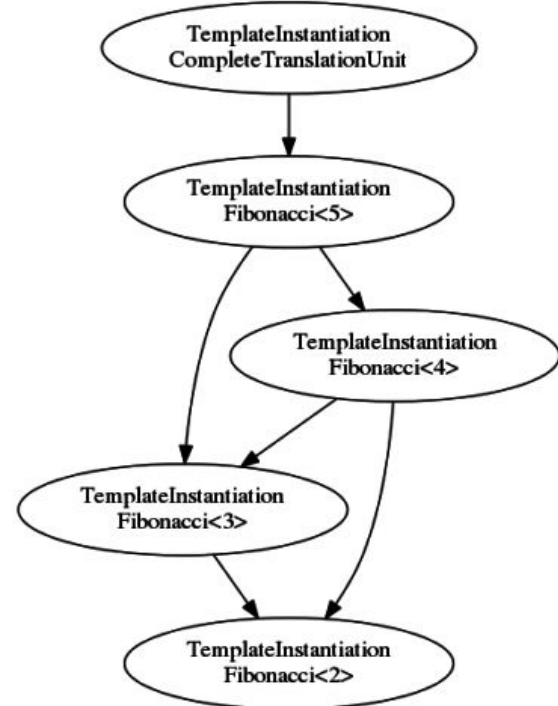
Templight: a compiler profiler

Flat vs call-graph profiles

“Flat” profile



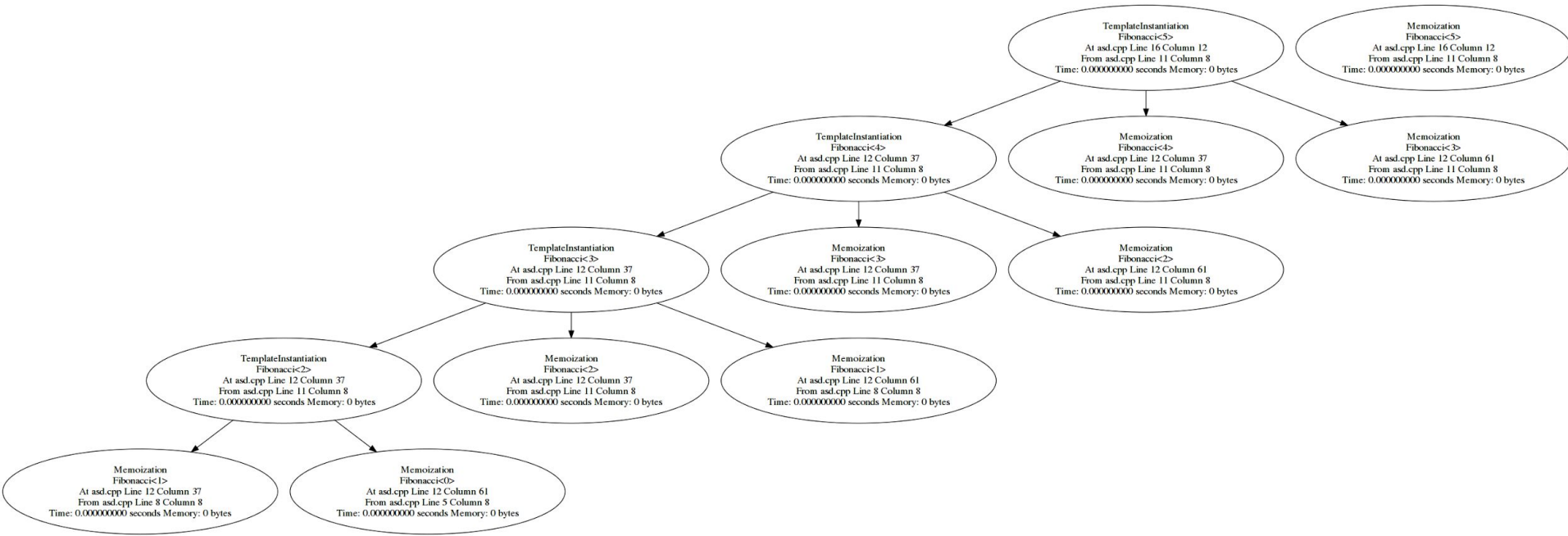
“Call-graph” profile





Templight: a compiler profiler

...vs reality





Templight: a compiler profiler

Make it human readable

```
TemplateInstantiation CompleteTranslationUnit 6.635999943
0.480000000 TemplateInstantiation std::make_shared<TDataFrameAction<(lambdaat/home/eguiraud/ROOT/root_install/include/ROOT/TDataFrame.hxx:739:31), TData
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TemplateInstantiation std::make_shared<Operations::FillT0Operation, std::shared_ptr<TH1F>&, unsignedint&> 0.128000000
TemplateInstantiation std::make_shared<TH1F, TH1F&> 0.116000000
TemplateInstantiation std::make_shared<Operations::FillOperation, std::shared_ptr<TH1F>&, unsignedint&> 0.115999999
TemplateInstantiation std::make_shared<bool, bool> 0.108000000
TemplateInstantiation std::vector<std::shared_ptr<bool>, std::allocator<std::shared_ptr<bool>>>::emplace_back<std::shared_ptr<bool>&> 0.103999999
TemplateInstantiation std::unordered_set<std::basic_string<char>, std::hash<string>, std::equal_to<std::basic_string<char>>, std::allocator<std::basic_s
TemplateInstantiation std::vector<double, std::allocator<double>>::emplace_back<constdouble&> 0.091999999
TemplateInstantiation std::unique_ptr<TH1F, std::default_delete<TH1F>> 0.060000000
TemplateInstantiation std::map<std::thread::id, unsignedint, std::less<std::thread::id>, std::allocator<std::pair<conststd::thread::id, unsignedint>>> 0
TemplateInstantiation std::vector<std::shared_ptr<TDataFrameActionBase>, std::allocator<std::shared_ptr<ROOT::Internal::TDataFrameActionBase>>>::~vect
TemplateInstantiation std::map<std::basic_string<char>, std::shared_ptr<TDataFrameBranchBase>, std::less<std::basic_string<char>>, std::allocator<std::p
TemplateInstantiation std::vector<std::basic_string<char>, std::allocator<std::basic_string<char>>>::vector 0.043999999
TemplateInstantiation std::vector<std::pair<longlong, TBranch*>, std::allocator<std::pair<longlong, TBranch*>>> 0.040000000
TemplateInstantiation std::vector<TSchemaHelper, std::allocator<ROOT::Internal::TSchemaHelper>> 0.036000000
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TemplateInstantiation CompleteTranslationUnit 3.135999948
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TemplateInstantiation std::make_shared<Operations::FillOperation, std::shared_ptr<TH1F>&, unsigned int&> 0.108000000
TemplateInstantiation std::make_shared<bool, bool> 0.099999999
TemplateInstantiation std::vector<std::shared_ptr<bool>, std::allocator<std::shared_ptr<bool>>>::emplace_back<std::shared_ptr<bool>&> 0.096000000
TemplateInstantiation std::unordered_set<std::basic_string<char>, std::hash<string>, std::equal_to<std::basic_string<char>>, std::allocator<std::basic_string<char>>> 0.096000000
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TemplateInstantiation std::vector<unsigned long, std::allocator<unsigned long>> 0.032000000
TemplateInstantiation std::vector<unsigned long long, std::allocator<unsigned long long>> 0.032000000
TemplateInstantiation std::vector<TVirtualArray*, std::allocator<TVirtualArray*>> 0.032000000
TemplateInstantiation std::vector<TDirectory*, std::allocator<TDirectory*>> 0.032000000
```




Templight: a compiler profiler

Issues encountered

- timings do not make too much sense
- hard to understand what the difference in call-graph and flat profiles means
- not exactly a drop-in tool

but

still a great help in indicating what the hotspots are



Templight: a compiler profiler

Installing Templight

requires to be compiled as a Clang tool

- 1) fetch LLVM and Clang's sources
- 2) clone Templight into clang/tools
- 3) compile everything together