Implementing Differentiation of the Kokkos Framework in Clad

GSoC 2024 project by Atell Krasnopolski
Mentors: Vaibhav Thakkar, Vassil Vassilev, Petro Zarytskyi

kokkos

```
template <typename ViewtypeX>
double f(ViewtypeX x) {
   Kokkos::View<typename ViewtypeX::value_type**> y_2D
       ("y_2D", x.extent(0), 2);
   Kokkos::parallel_for(x.extent(0),
       KOKKOS_LAMBDA (const int j) {
           y_2D(j0, 0) = x(j0);
           x(j0) = 3*x(j0);
           y_2D(j0, 1) = x(j0);
       });
   return y_2D(0, 1)/y_2D(0, 0);
}
```

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```

Why

Clað

?

Source ↦ Source
Parallel ↦ Parallel

```
Kokkos::parallel_for("name", Policy, f);
```

```
Kokkos::parallel_for("name", Policy, f);
Kokkos::parallel_for("d_name", Policy, d_f);
```

Performance Portable Gradient Computations Using Source Transformation

(a paper)

GPUs

Kokkos-aware Clad #783

Open **kliegeois** wants to merge 75 commits into `vgvassilev:master` from `kliegeois:kokkos-PR`

Conversation 20 | Commits 75 | Checks 80 | Files changed 13

kliegeois commented on Feb 22 — First-time contributor

This PR provides the implementation of a first set of features for the automatic generation of gradients of Kokkos-based code.

The content of this PR supports reverse mode of Kokkos `parallel_for`, `deep_copy`, and view accesses.

@vgvassilev **@brian-kelley**

Kokkos-aware Clad #7

Open **kliegeois** wants to merge 75 [illegible] okkos-PR

Conversation 20 Co[illegible] 80 Files cha[illegible]

kliegeois commented o[illegible] First-time contributor

This PR provides the imp[illegible] of a first set of [illegible] utomatic [illegible] of gradients of Kokkos-based code.

The content of this PR sup[illegible] mode of Kokkos `para[illegible]` view accesses.

@vgvassilev **@brian-kelley**

```
// KokkosBuiltins.h

namespace clad::custom_derivatives::Kokkos {

   // ...
   // custom pushforwards and pullbacks for
   // Kokkos functions
   // ...

}
```

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```
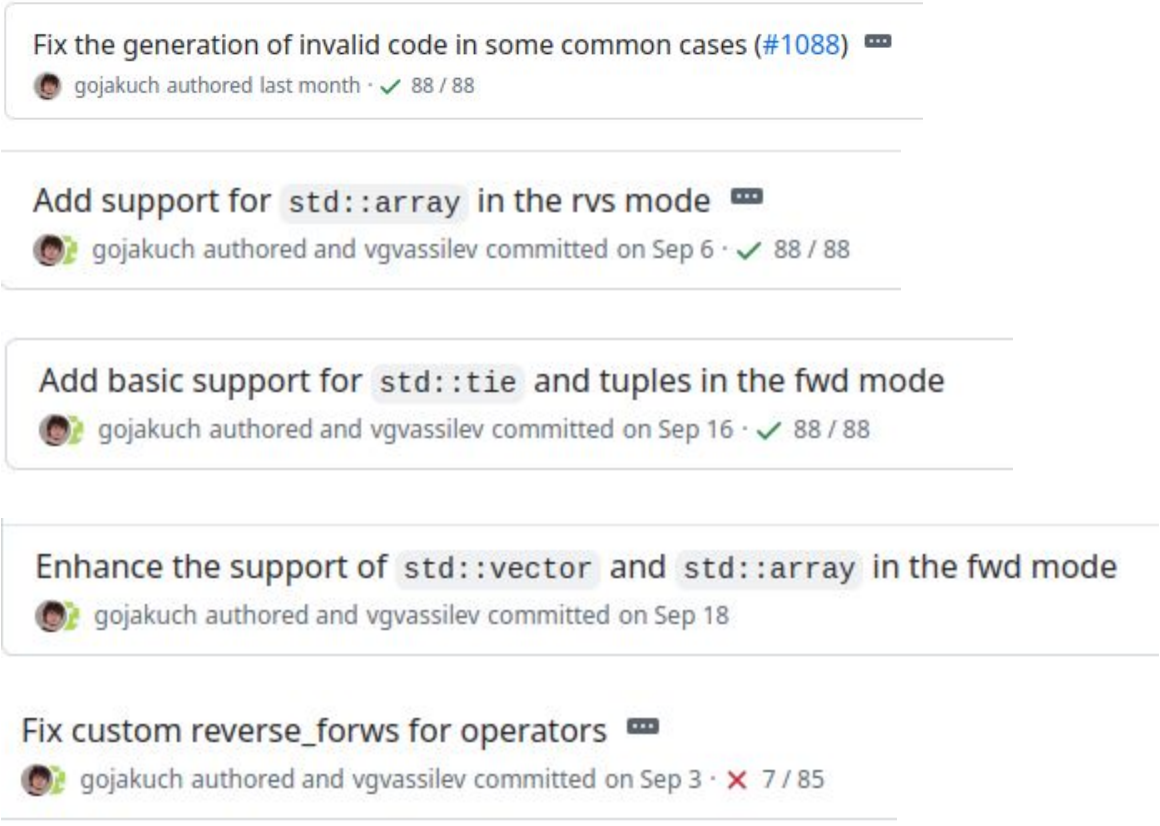

- **Make the signatures of `KokkosBuiltins.h` more general** ✓
  #1063 by gojakuch was merged last month
- **Provide pushforward methods for `Kokkos::View` indexing** ✓
  #1061 by gojakuch was merged last month
- **Add support for `Kokkos::parallel_reduce` in the fwd mode** ✓
  #1056 by gojakuch was merged last month
- **Add support for `Kokkos::fence` in the fwd mode** ✓
  #1048 by gojakuch was merged on Aug 21 • Approved
- **Add support for `Kokkos::parallel_for` in the fwd mode** ✓
  #1022 by gojakuch was merged on Aug 21
- **Add support for `Kokkos::resize` in the forward mode** ✓
  #999 by gojakuch was merged on Jul 24
- **Prevent Clad from trying to create a void zero literal** ✓
  #989 by gojakuch was merged on Jul 21 • Approved
- **Add basic Kokkos support for the original tests of #783** ✓
  #977 by gojakuch was merged on Jul 22 • Approved
- **Fix the derivative of string literals in forward mode** ✓
  #967 by gojakuch was merged on Jul 4 • Approved
- **Add Kokkos unittests** ✓
  #826 by gojakuch was merged on Apr 19 • Approved


Fix the generation of invalid code in some common cases (#1088)
gojakuch authored last month · 88 / 88
Add support for std::array in the rvs mode
gojakuch authored and vgvassilev committed on Sep 6 · 88 / 88
Add basic support for std::tie and tuples in the fwd mode
gojakuch authored and vgvassilev committed on Sep 16 · 88 / 88
Enhance the support of std::vector and std::array in the fwd mode
gojakuch authored and vgvassilev committed on Sep 18
Fix custom reverse_forws for operators
gojakuch authored and vgvassilev committed on Sep 3 · 7 / 85

etc...

Lambda support in the reverse mode #1126

Draft **gojakuch** wants to merge 3 commits into `vgvassilev:master` from `gojakuch:lambda-support-reverse`

+

```
Kokkos::parallel_for(...,
       KOKKOS_LAMBDA (const int j) {
            ...
       });
```