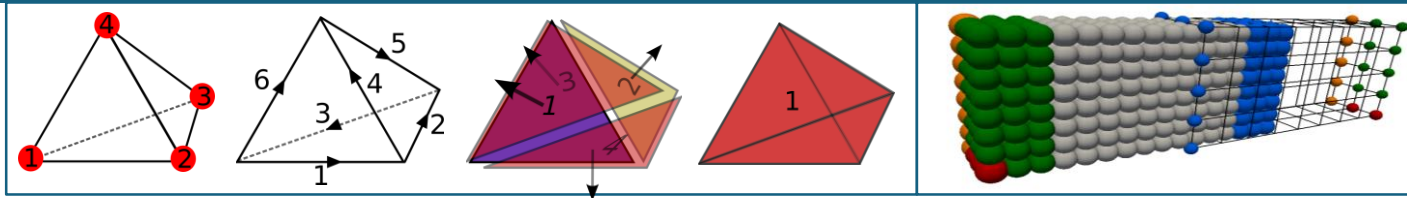


# Trilinos Discretizations Product Update



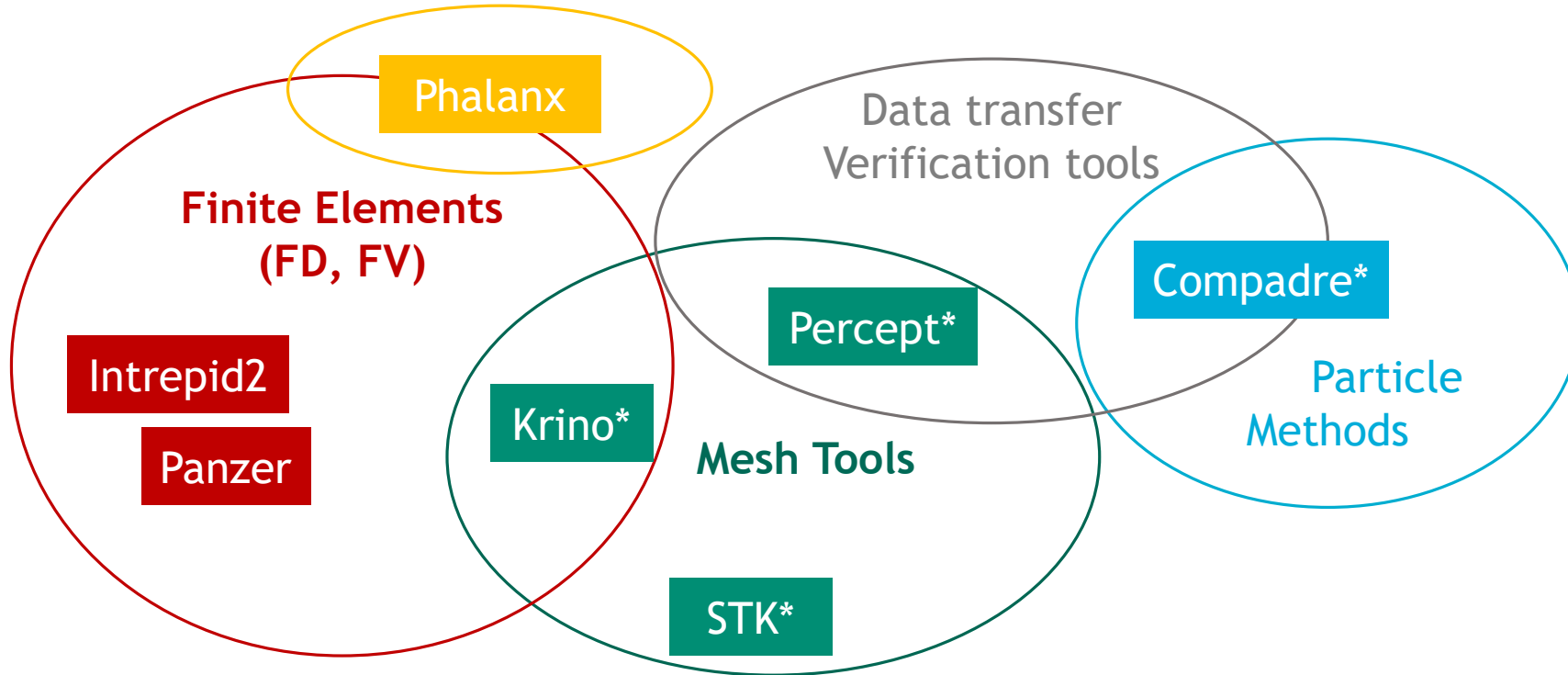
Presenter: Mauro Perego

Trilinos User Group meeting 2021



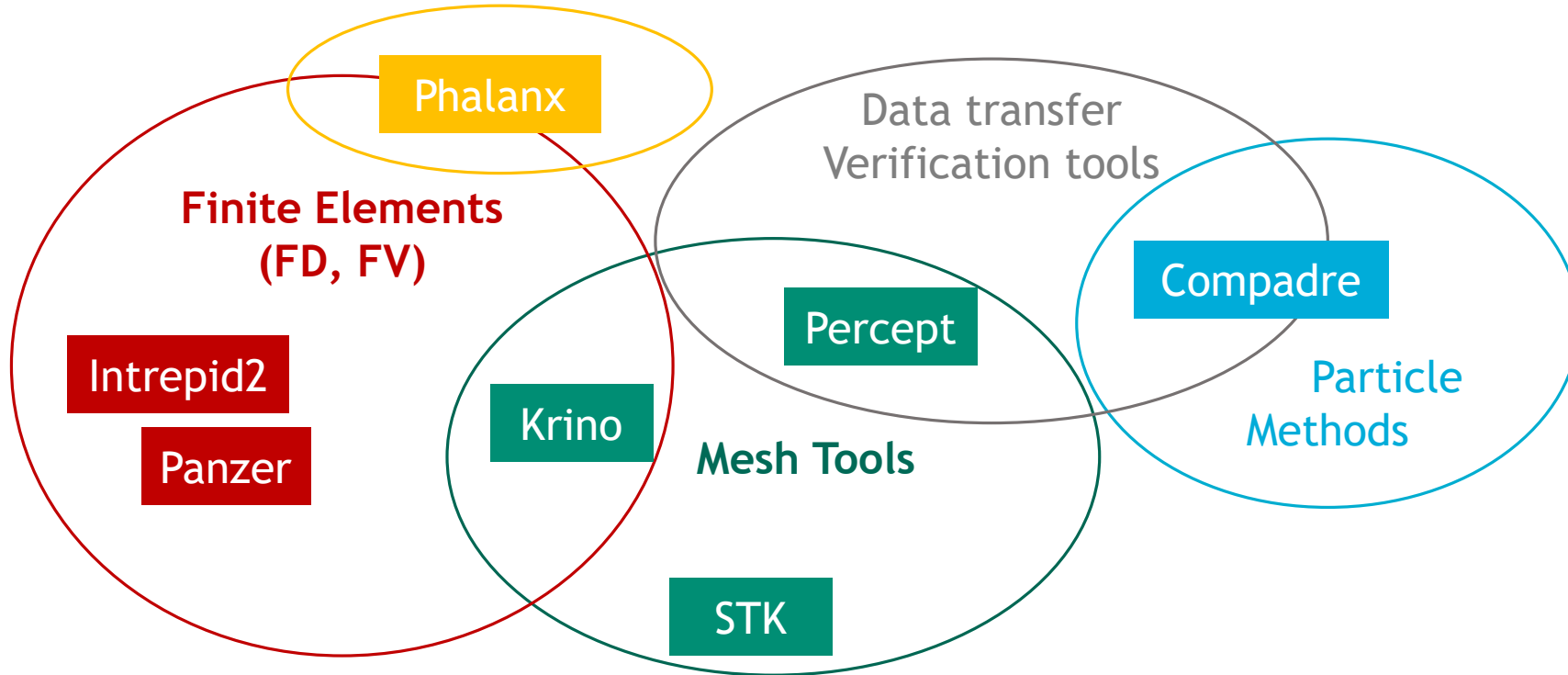
# Discretizations Product: overview

(actively developed packages)

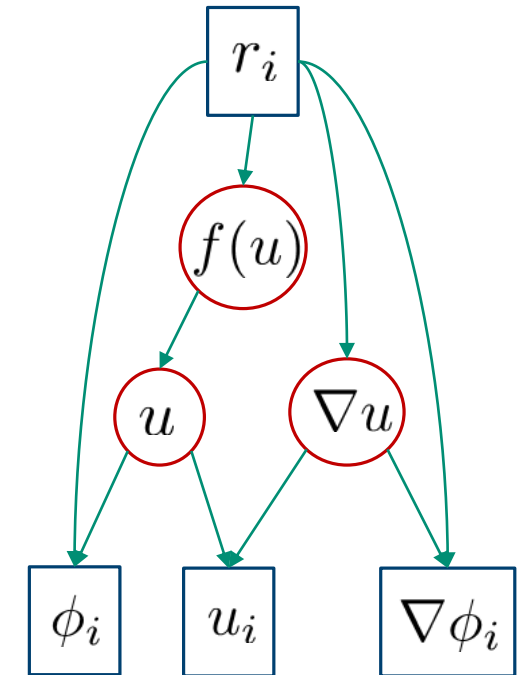


\*Packages snapshotted into Trilinos

# Discretizations Product: overview (actively developed packages)



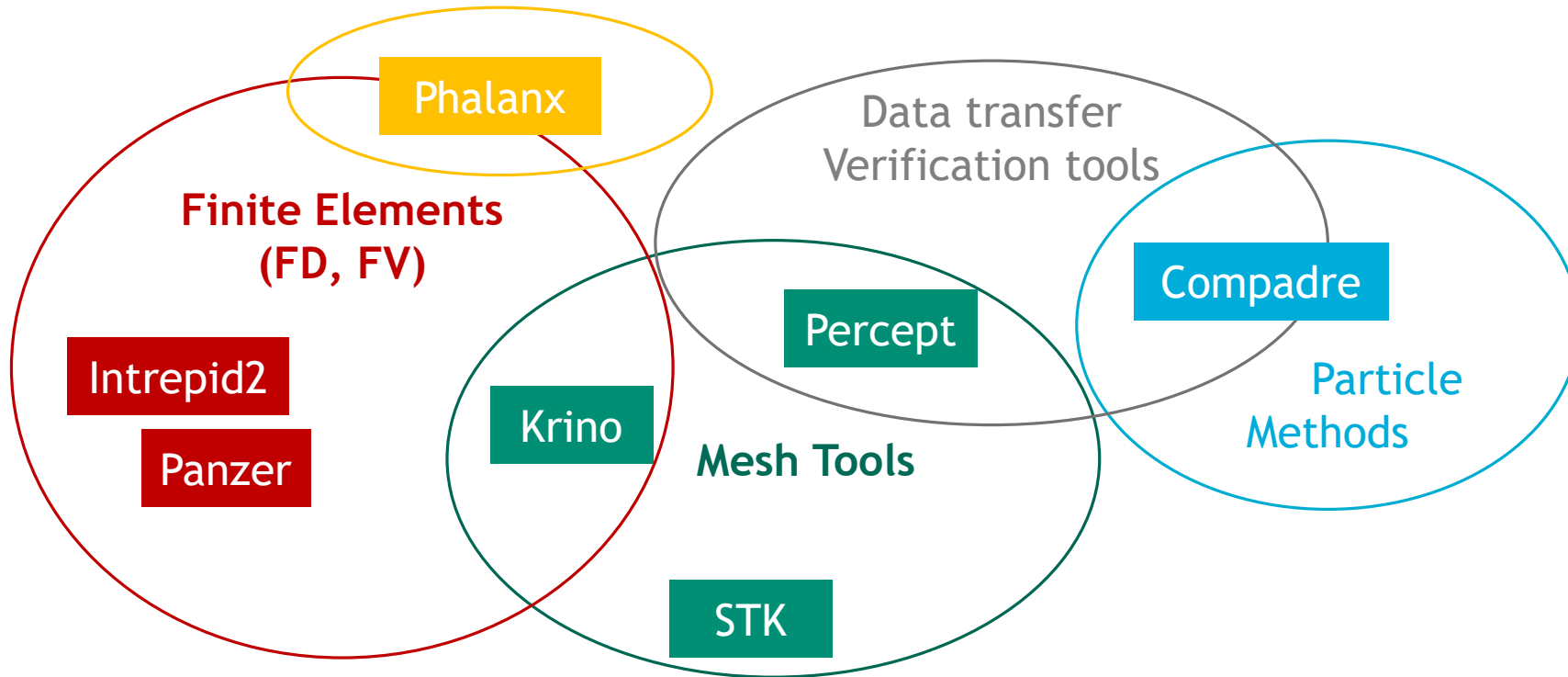
Phalanx DAG



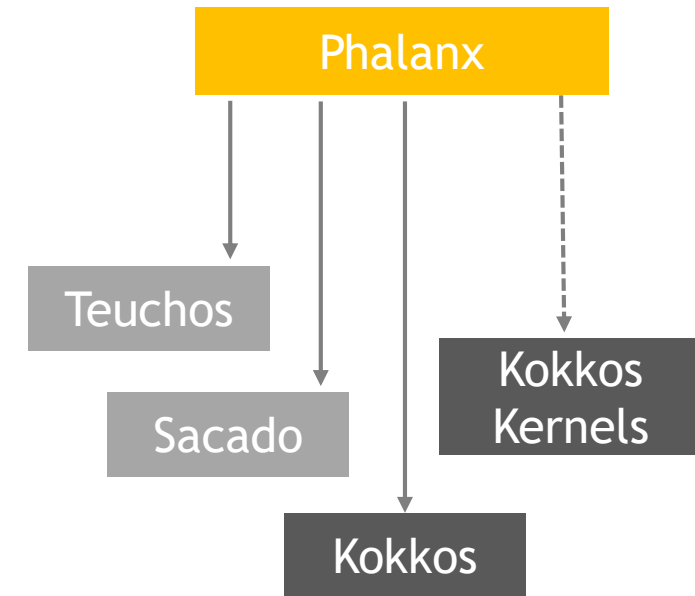
**Phalanx:** DAG-based expression evaluation – *R. Pawlowski*  
used to decompose complex PDE systems into a number of elementary  
user-defined expression

# Discretizations Product: overview

(actively developed packages)



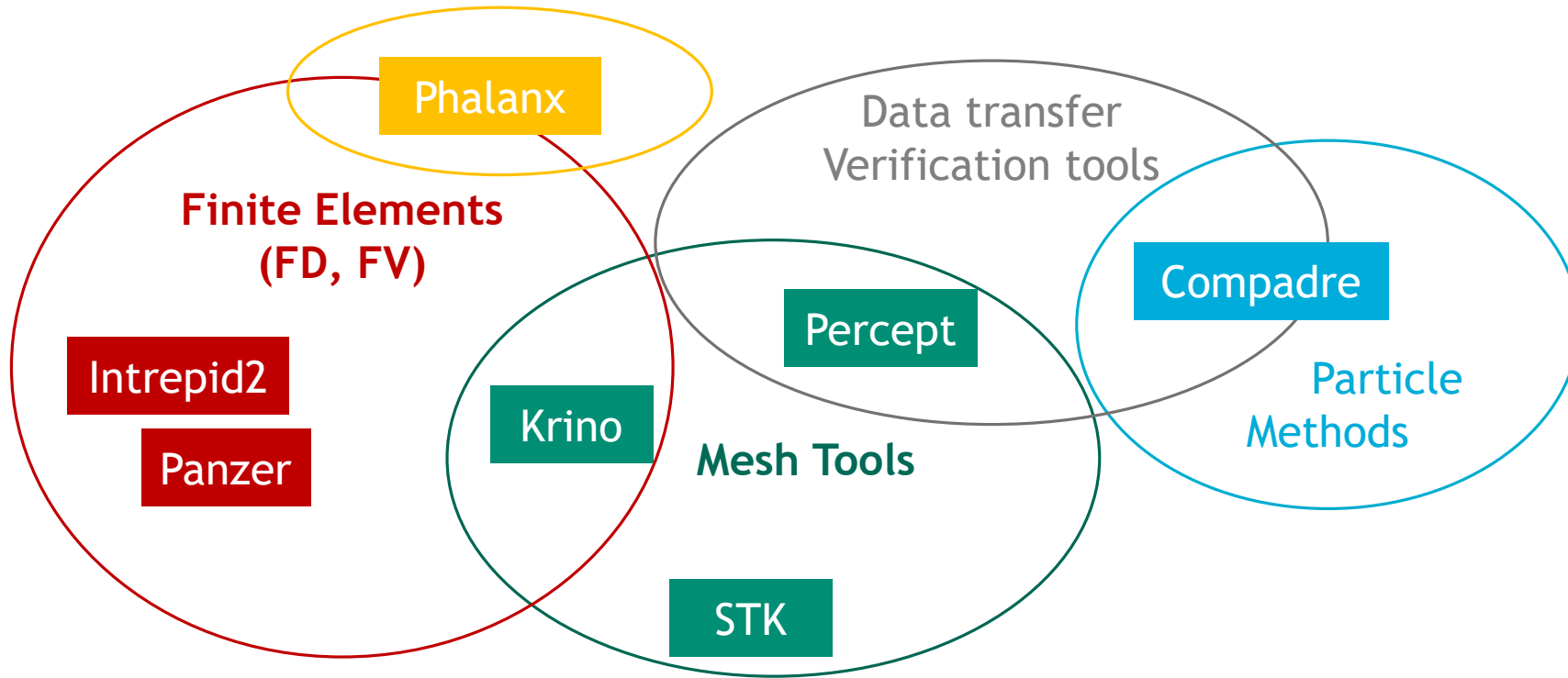
Dependencies:



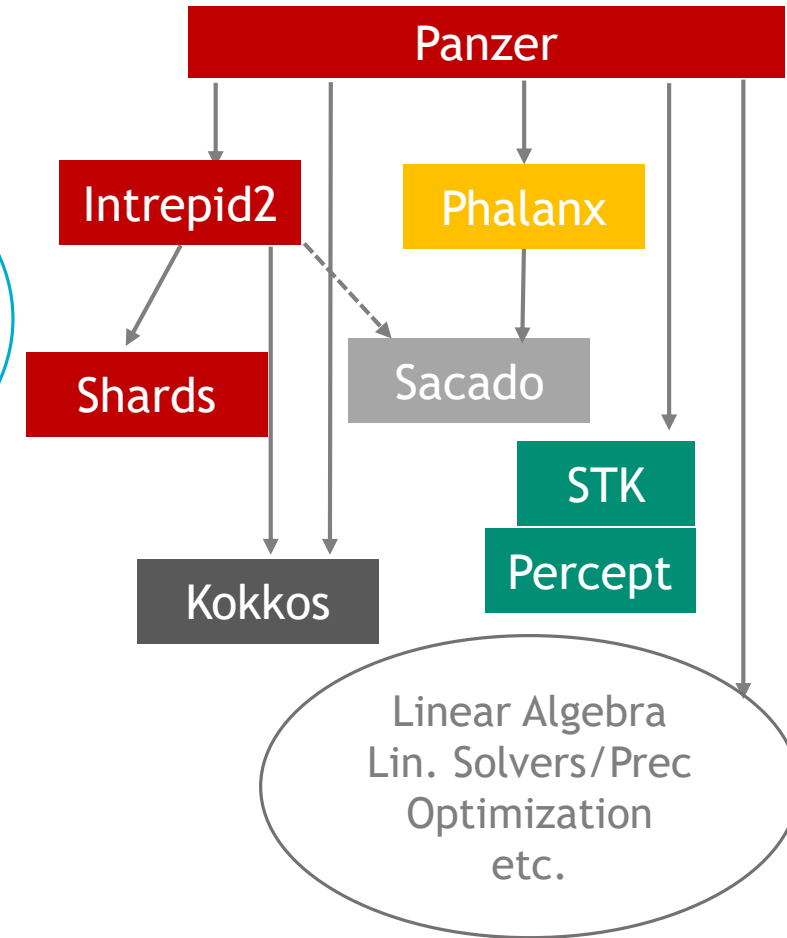
**Phalanx:** DAG-based expression evaluation – *R. Pawlowski*  
 used to decompose complex PDE systems into a number of elementary  
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# Discretizations Product: overview

(actively developed packages)



Dependencies:

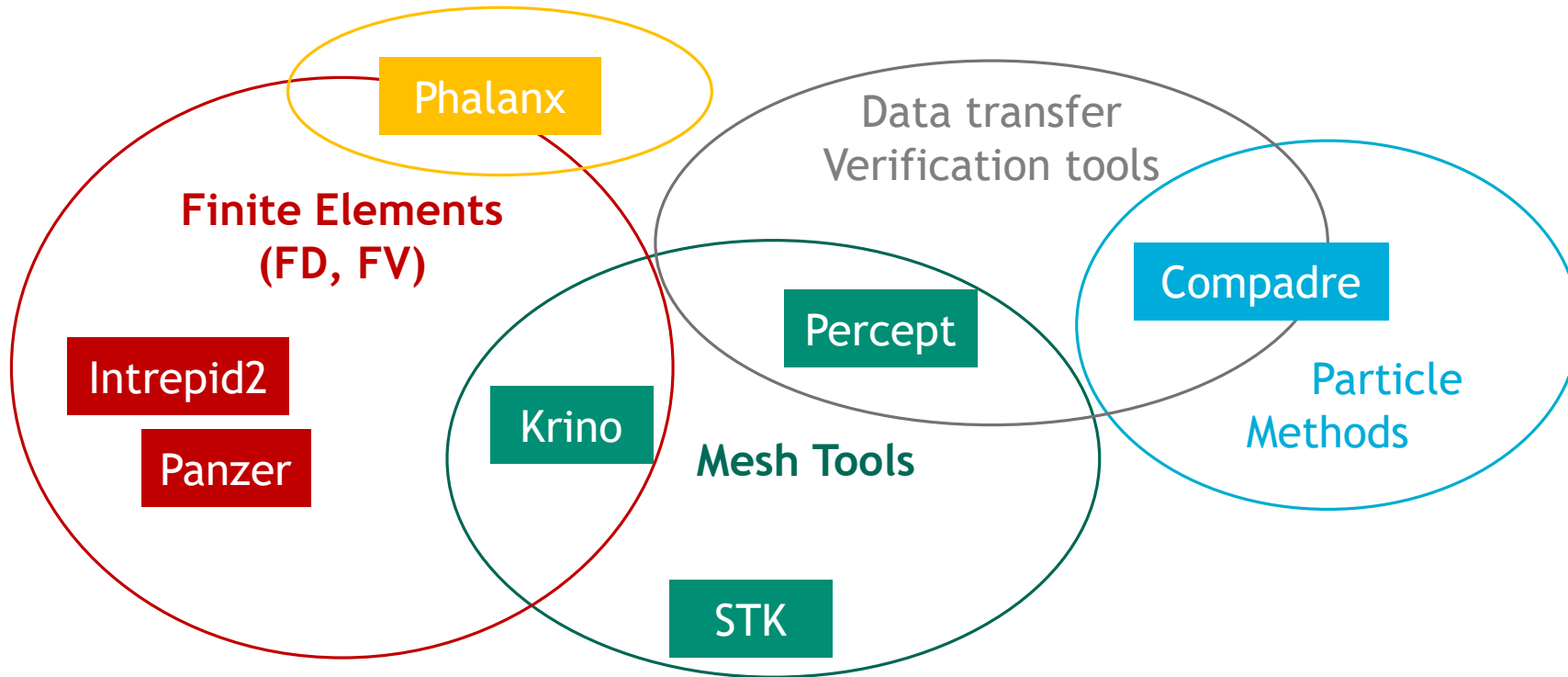


**Intrepid2:** Local FE assembly – *K. Kim, N. Roberts, M. Perego*  
Basis functions definitions, quadrature rules, orientations, projections

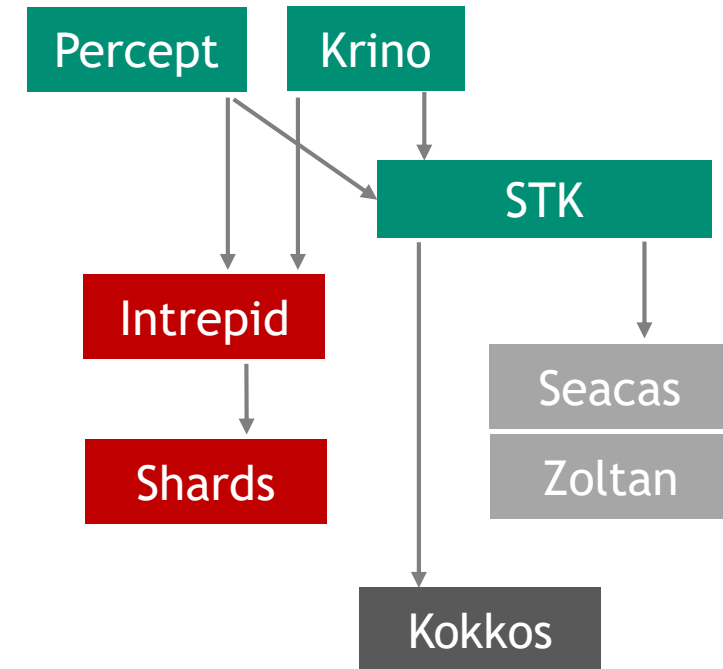
**Panzer:** FE library – *R. Pawlowski*  
DoF Management, FE global assembly into distributed nonlinear systems,  
handling of linear/nonlinear solvers, sensitivities and PDE-constrained optimization,  
Import/Export of meshes

# Discretizations Product: overview

(actively developed packages)



Dependencies:



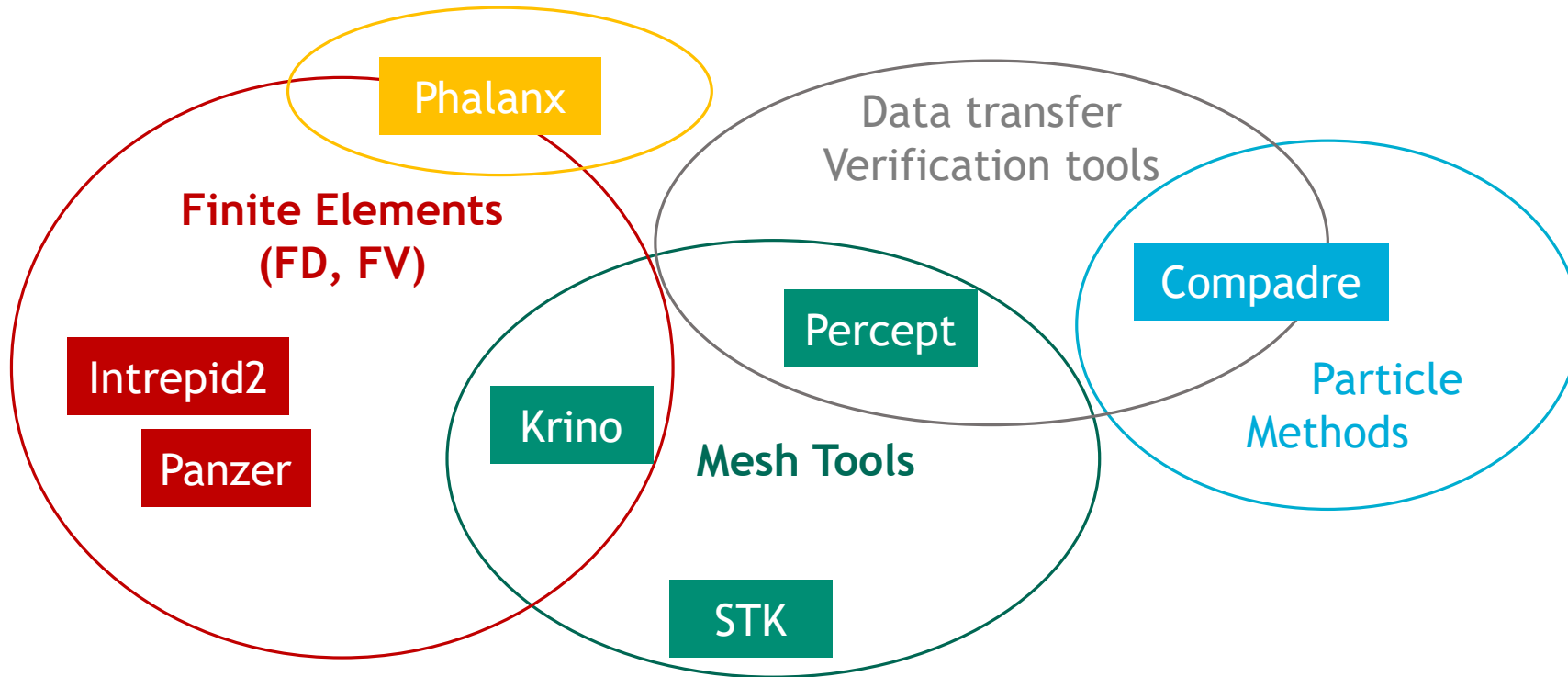
**STK:** unstructured mesh in-memory, parallel-distributed database – *A. Williams*  
 Mesh topology data structure, mesh subsetting, coefficient data, mesh field data,  
 support for changing the mesh topology, and support for parallel operations on the mesh

**Krino:** tools for level set fields (*New!* See next talk) – *D. Noble*

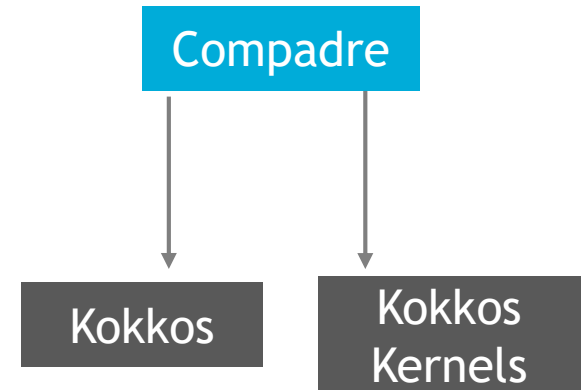
**Percept:** tools to enable solution verification, mesh adaptation and data transfer – *B. Carnes*

# Discretizations Product: overview

(actively developed packages)



Dependencies:



**Compadre:** local tools for mesh-free approximation of linear operators – *P. Kuberry*

Applications: mesh-free discretizations and data-transfer

## Discretizations Product: update (UVM removal)

### **The following packages can run UVM-free:**

Intrepid2,

Phalanx,

Panzer (Epetra stack a bit slower for additional host-device copies),

Compadre

### **Porting underway for AMD/HIP, expected to be completed by March 2022**

- Stk-mesh unit-tests now build and run on AMD platforms, using ROCM 4.3.





# Discretizations Product: update

## (General Improvements/Planning)



### **Intrepid2**

- Several optimization relying on structured data (tensor basis, affine meshes, etc)
- Continue providing tools for FE projections, targeting boundary BCs in 2022
- Finalize implem. of high-order hierarchical basis (Wedges and Pyramids), 2022

### **Phalanx**

- Added utilities to safely handle Kokkos View-of-Views object lifetimes

### **Panzer**

- Improved support for edge and face data
- Planning to improve performance of Periodic BC DOF search in 2022

### **Compadre**

- Planning to enable Automatic Differentiation through Sacado

### **STK**

- Improving the performance of synchronizing Fields between CPU and GPU memory spaces. (primarily for Sierra SM)
- STK Balance: improving work-flow and performance of Balance and BalanceM2N coming soon.

# Discretizations Product: update

(Intrepid Retiring and independence from the Epetra Stack)



## **Panzer**

- Planning to remove Epetra solver stack from Panzer by end of 2022

## **Krino**

- Planning to switch to Intrepid2 by end of 2022

## **Percept**

- Planning to switch to Intrepid2. Possibly by end of 2022

**Aiming at retiring Intrepid by 2023**

## Discretizations Product: next (Matrix-free capabilities)

The goal is to provide tools (in Intrepid2/Panzer) for *fast matrix-free assembly* relying on structured data for

- explicit problems
- implicit problems using matrix-free preconditioners (initial efforts in MueLu)

***If you are interested in such capability please let us know!***

