Section 4
Integration Interface

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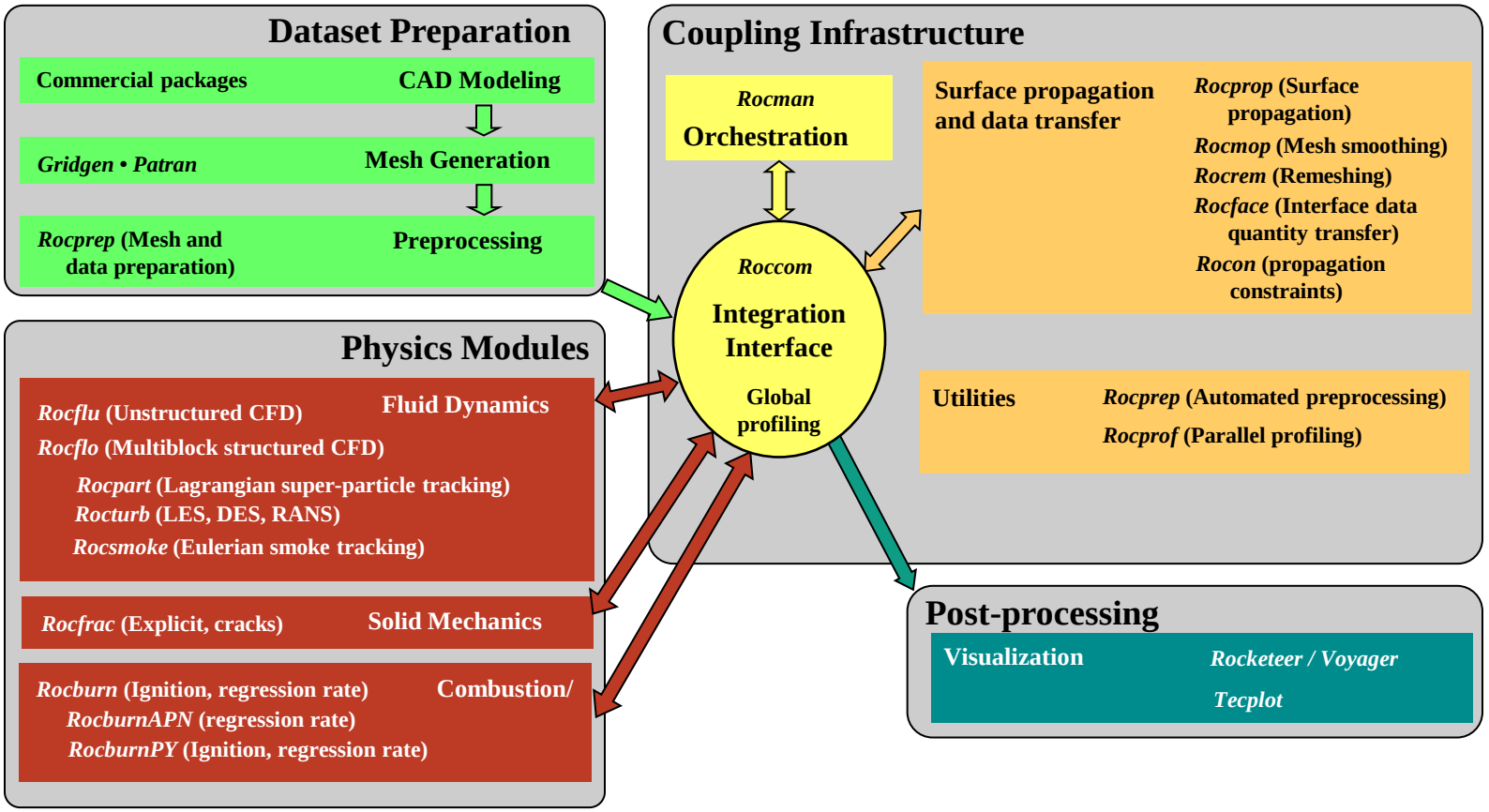
Rocstar Simulation Suite Architecture



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Software Integration Substrate: *Roccom*

- Object oriented paradigm (inheritance)
- Encapsulates applications into parallel component objects (i.e. modules)
- Provides encapsulation (i.e. common data structure wrappers) for application native data and methods (mesh and physics friendly)
- Provides mechanism for remote (intermodule) query and access of component objects
- Transparent language interoperability
- Automatic performance profiling

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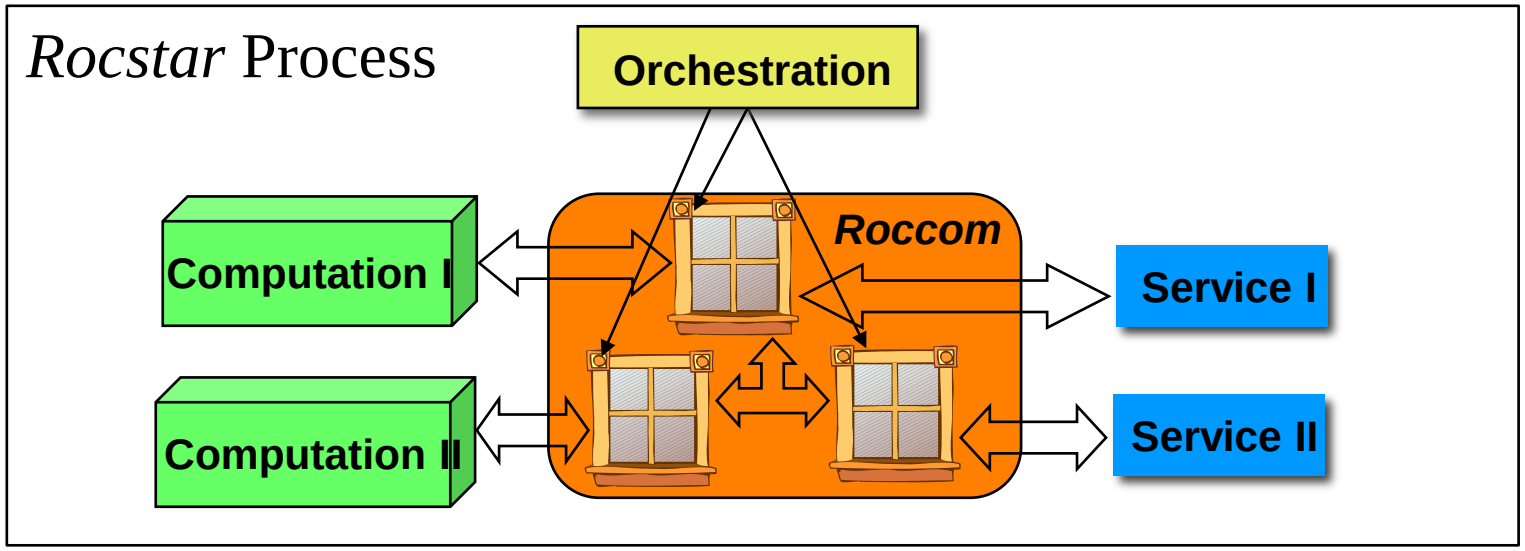
Integration Through *Roccom*

- Modules developed by wrapping in MPI library
- Organizes interface data and functions into distributed objects *windows*, composed of *panes*
- New and unique features driven by *Rocstar*
  - Dynamic data structures to facilitate adaptivity
  - Comprehensive API, allowing query of complete information
  - Inheritance of subset of windows
  - Advanced interoperability of C++ and F90
- Dynamic runtime loading of modules



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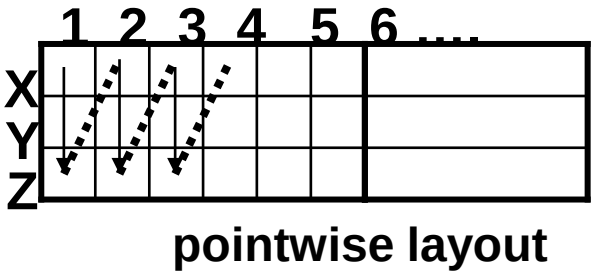
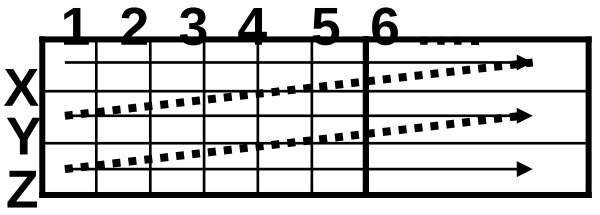
Data Attributes

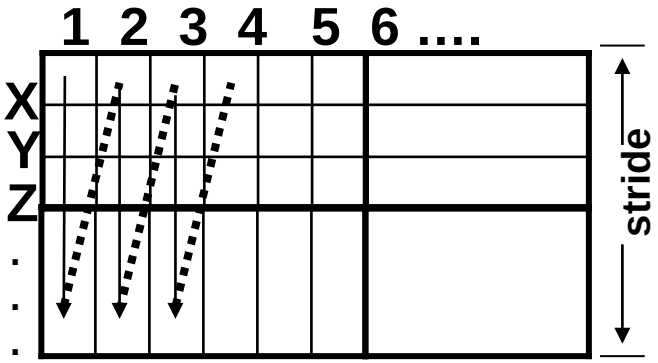
- Mesh data and field variables
  - Mesh data (e.g. coordinates and connectivity)
  - Contiguous or staggered layout, with strides
- Window or pane attributes
  - E.g., boundary condition flags
- Referenced by names and handles
- Named aggregate attributes
  - Collection of data attributes
  - E.g., “all” for all data, “mesh” for mesh-only
  - Atomic operations on collection of datasets



pointwise layout



block layout



strided layout

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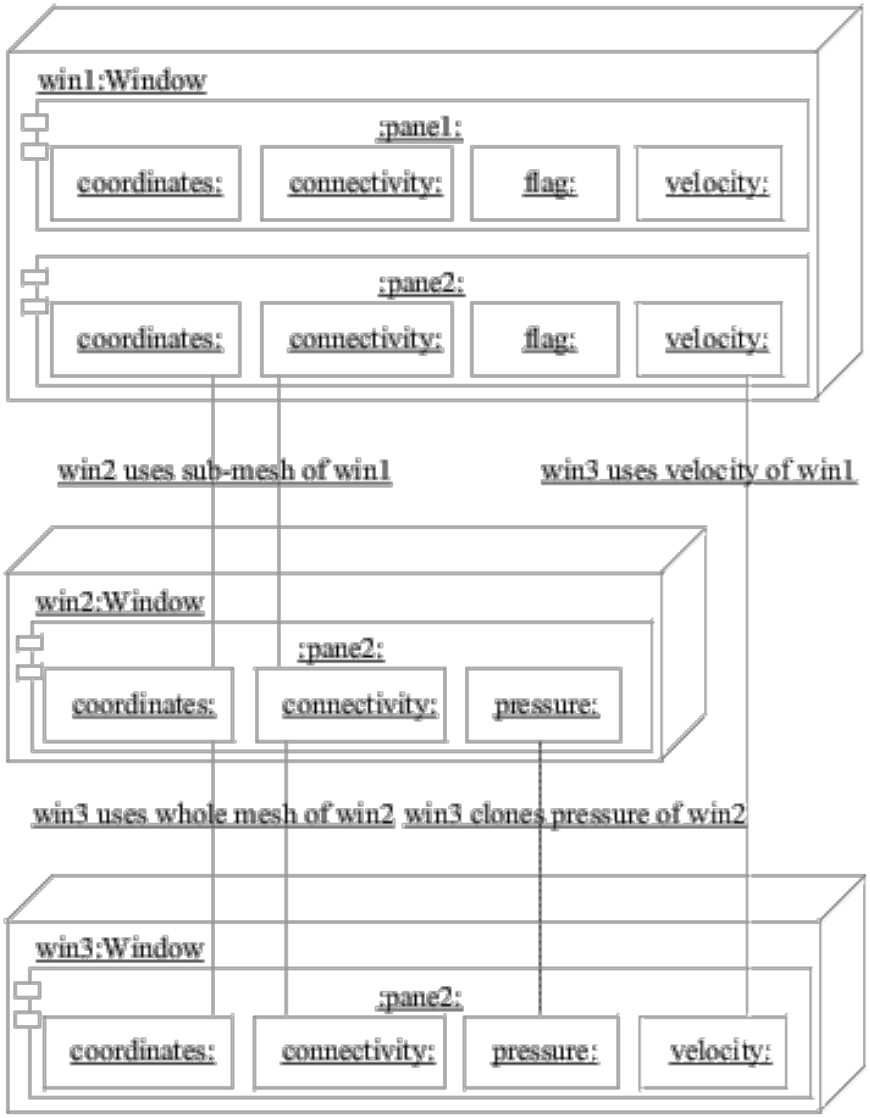
Inheritance



- Inheritance of subset of mesh
  - Subset of panes
  - Excluding ghost nodes
- Two modes: cloning or using
- Multiple inheritance

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Functions

- Problem for integration
  - Function invocation across languages (F90 and C++)
- *Roccom* provides a uniform mechanism for function invocation
  - Functions are registered with *Roccom* by modules at load time
    - Arguments can be primitive types or data attributes
    - Variable number of arguments supported
  - Inter-module invocation through Roccom
- Advantages
  - Transparent interoperability between C(++) and Fortran
  - Argument validation
  - Automatic profiling
- Member functions
  - Associated with “context objects”
  - Context passed in implicitly and transparently
  - Preserves object-orientedness

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Roccom Runtime Systems

- Middleware between modules
  - Keeps track of user-registered data and functions
  - Translates function and attribute handles
  - Transparent language interoperability
- Access protection and error checking
  - Enforces access protection
  - Argument validation (including shape/size)
- Tracing and profiling capabilities for inter-module calls
  - Automatic timing
  - Hardware counters through PAPI

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