

## Data Taxonomy (several cross-cutting categories):

- **Application Domains** (this shouldn't necessarily be a category rather a way to indicate the source of the data)
  - Climate data
  - SEM image data
  - CT scan for objects
  - Medical/CT/MRI scan
  - Simulation data
  - Molecular data
  - ....
- **Data Type**
  - **Structured Data**
    - Image data (uniform rectilinear grids)
    - Rectilinear grids
    - Structured grids (curvilinear)
    - AMR (Adaptive Mesh Refinement)?
  - **Unstructured Data**
    - Unstructured grids (arbitrary cell types)
    - Polygonal data (surfaces, meshes)
    - Point clouds
  - **Specialized Types**
    - Hyper-tree grids
    - Composite/multi-block datasets
    - Graph/network data
- **Temporal Dimension**
  - **Static/Single-Timestep**
    - Analysis of a single snapshot
    - Spatial patterns only
  - **Time-Series**
    - Multiple discrete steps
    - Temporal sequences
  - **Time-Dependent Processing**
    - Temporal interpolation
    - Particle tracing through time
    - Temporal statistics/aggregation
    - Flow map computation

- **Attribute Types** (how the data is represented, what information it has)
  - **Scalar Fields** (single value per point/cell)
    - Temperature, pressure, density
    - Scalars driving isosurfaces, color mapping
  - **Vector Fields** (3-component direction/magnitude)
    - Velocity, force, displacement
    - Visualized via streamlines, glyphs, LIC
  - **Tensor Fields** (matrix at each point)
    - Stress, strain, diffusion tensors
    - Visualized via tensor glyphs, eigenvalue analysis
  - **Multi-variate/Multi-field**
    - Multiple scalar/vector fields
    - High-dimensional data visualization by analyzing multiple dimensions all at once

## Tasks Taxonomy:

**Top level: 1) Atomic Operation, 2) Workflow, 3) Scientific Insights**

### 1) Atomic Operation (individual well-defined operations):

- Extraction & Subsetting (Isolate regions of interest from larger datasets)
  - **Spatial Extraction**
    - Clipping (by plane, box, sphere, implicit function)
    - Region selection (by point/cell IDs, bounding box)
    - VOI extraction (volume of interest from structured data)
  - **Value-Based Selection**
    - Thresholding (scalar range filtering)
    - Isocontouring/isosurfacing (constant value extraction)
    - Connectivity filtering (connected region extraction)
  - **Sampling**
    - Subsampling/decimation (reduce resolution)
    - Probing (sampling at specific points)
    - Masking (regular/irregular point selection)
- Geometry & Topology Transformation (Change the structure or shape of data without necessarily changing attribute values)
  - **Geometric Modification**
    - Translation, rotation, scaling

- Deformation, warping
  - Point/vertex manipulation
- **Topological Changes**
  - Triangulation (convert polygons to triangles), Tessellation/subdivision
  - Mesh refinement/coarsening
  - Cell type conversion
  - Boundary extraction (surface from volume)
- **Structural Operations**
  - Merging datasets
  - Appending data
  - Splitting/partitioning
- Attribute Computation & Derivation (Calculate new data attributes from existing ones)
  - **Field Derivatives**
    - Gradient computation
    - Divergence, curl, vorticity
    - Curvature calculation
    - Normal generation
  - **Scalar Operations**
    - Arithmetic operations on fields
    - Vector magnitude computation
    - Component extraction
    - Field aggregation/statistics
  - **Advanced Computations**
    - Tensor operations (eigenvalues, eigenvectors)
    - Interpolation between fields
    - Distance computations
    - Flow integration (streamlines, pathlines, streaklines)
- Representation & Mapping (Transform data into visual representations)
  - **Glyph-Based Representation**
    - Oriented glyphs (arrows, cones)
    - Scaled glyphs (size-mapped symbols)
    - Tensor glyphs (ellipsoids, superquadrics)
    - Volume markers
  - **Geometric Primitives**
    - Isosurfaces
    - Contour lines/surfaces
    - Cut planes/slices
    - Ribbons, tubes, streamlines

- **Color & Texture Mapping**
  - Scalar to color mapping
  - Texture coordinate generation
  - Opacity mapping
- **Volume Representations**
  - Ray casting
  - Splatting
- Smoothing & enhancement (Improve data quality or visual appearance)
  - **Smoothing Operations**
    - Surface smoothing (Laplacian, Gaussian)
    - Data noise reduction
    - Interpolation for filling gaps
  - **Enhancement**
    - Edge enhancement/detection
    - Feature extraction
    - Sharpening
  - **Filtering**
    - Outlier removal
    - Statistical filtering

## 2) Workflow (sequence of operations with a clear visualization/analysis goal)

- **Data Understanding & Exploration**
  - Data Characterization (statistics, distributions, quality check)
  - Spatial Exploration (slicing, probing, overview generation)
  - Feature Discovery (identifying interesting structures/patterns)
- **Analysis & Quantification**
  - Statistical Analysis (descriptive statistics, distributions, correlations)
  - Region-Based Measurement (volumes, areas, integrated quantities)
  - Profile & Cross-Section Analysis (1D/2D extraction from 3D)
  - Derived Quantity Computation (gradients, vorticity, custom fields)
- **Feature Extraction & Tracking**
  - Structure Identification (vortices, shocks, boundaries, topology)
  - Feature Characterization (properties, classification, quantification)
  - Temporal Tracking (feature evolution, lifecycle, trajectories)
- **Comparative & Temporal Analysis**
  - Multi-Variable Comparison (correlation, coordinated views)
  - Temporal Evolution (time-series analysis, trend identification)

- Simulation Comparison (parameter studies, model validation)
  - Difference Analysis (error fields, change detection)
- **Flow & Transport Analysis**
  - Trajectory Computation (streamlines, pathlines, streaklines)
  - Lagrangian Analysis (particle tracking, residence time, FTLE)
  - Transport Quantification (flux, mixing, coherent structures)
- **Verification & Validation**
  - Data Quality Assessment (outliers, artifacts, boundary conditions)
  - Code Verification (convergence, analytical comparison, consistency)
  - Physical Validation (experimental comparison, uncertainty **quantification**)
- **Data Processing & Optimization**
  - Data Conditioning (cleaning, smoothing, noise reduction)
  - Data Reduction (decimation, sampling, compression)
  - Format Conversion & Restructuring (mesh generation, type conversion)
  - Parallel & Distributed Processing (HPC workflows, decomposition)
- **Communication & Dissemination**
  - Static Visualization (publication figures, high-resolution images)
  - Animation Generation (temporal, spatial, parameter animations)
  - Interactive Applications (web/desktop viewers, dashboards)
  - Report Generation (automated analysis reports, summaries)

### 3) Scientific Insights

- **Application-specific questions and insights that were derived from analysis or visualization**
- **The result could be: binary decisions, multiple choices,**
- **Potentially involves different workflow steps**

### What not to include

- **Excessively large dataset (multiple GB to TB level)**
- **Interaction that ties to a specific tool/interface**
- **Questions do not have unique and clear answers/ground truth**