

Scientific Visualization with ParaView

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ParaView: <http://www.paraview.org/download>

Code & data: <http://guanw.sharcnet.ca/ss2016viz.zip>



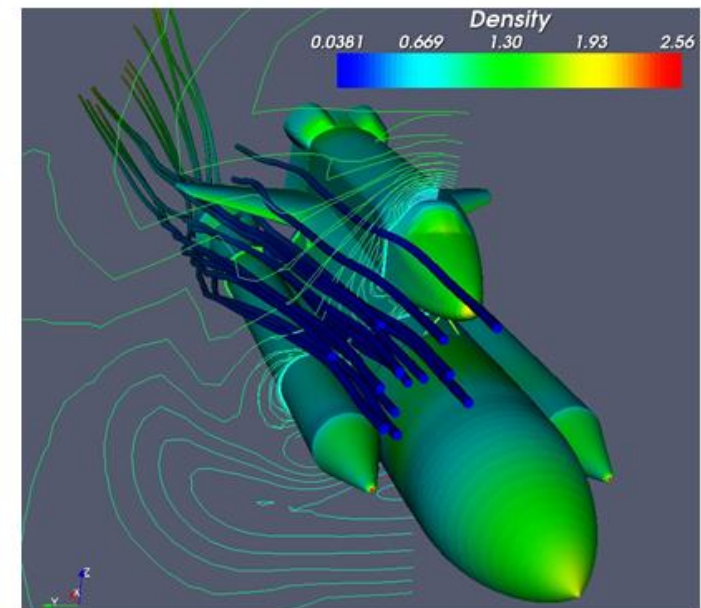
What is Visualization

Data → Graphical representations

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0265640 132304 133732 032051 037334 024721 015013 052226 001662
0265660 025537 064663 054606 043244 074076 124153 135216 126614
0265700 144210 056426 044700 042650 165230 137037 003655 006254
0265720 134453 124327 176005 027034 107614 170774 073702 067274
0265740 072451 007735 147620 061064 157435 113057 155356 114603
0265760 107204 102316 171451 046040 120223 001774 030477 046673
0266000 171317 116055 155117 134444 167210 041405 147127 050505
0266020 004137 046472 124015 134360 173550 053517 044635 021135
0266040 070176 047705 113754 175477 105532 076515 177366 056333
0266060 041023 074017 127113 003214 037026 037640 066171 123424
0266100 067701 037406 140000 165341 072410 100032 125455 056646
0266120 006716 071402 055672 132571 105645 170073 050376 072117
0266140 024451 007424 114200 077733 024434 012546 172404 102345
0266160 040223 050170 055164 164634 047154 126525 112514 032315
0266200 016041 176055 042766 025015 176314 017234 110060 014515
0266220 117156 030746 154234 125001 151144 163706 136237 164376
0266240 137055 062276 161755 115466 005322 132567 073216 002655
0266260 171466 126161 117155 065763 016177 014460 112765 055527
0266300 003767 175367 104754 036436 172172 150750 043643 145410
0266320 072074 000007 040627 070652 173011 002151 125132 140214
0266340 060115 014356 015164 067027 120206 070242 033065 131334
0266360 170601 170106 040437 127277 124446 136631 041462 116321
0266400 020243 005602 004146 121574 124651 006634 071331 102070
0266420 157504 160307 166330 074251 024520 114433 167273 030635
0266440 133614 106171 144160 010652 007365 026416 160716 100413
0266460 026630 007210 000630 121224 076033 140764 000737 003276
0266500 114060 042647 104475 110537 066716 104754 075447 112254
0266520 030374 144251 077734 015157 002513 173526 035531 150003
0266540 146207 015135 024446 130101 072457 040764 165513 156412
0266560 166410 067251 156160 106406 136770 030516 064740 022032
0266600 142166 123707 175121 071170 076357 037233 031136 015232
0266620 075074 016744 044055 102230 110063 033350 052765 172463

```



Why Visualization

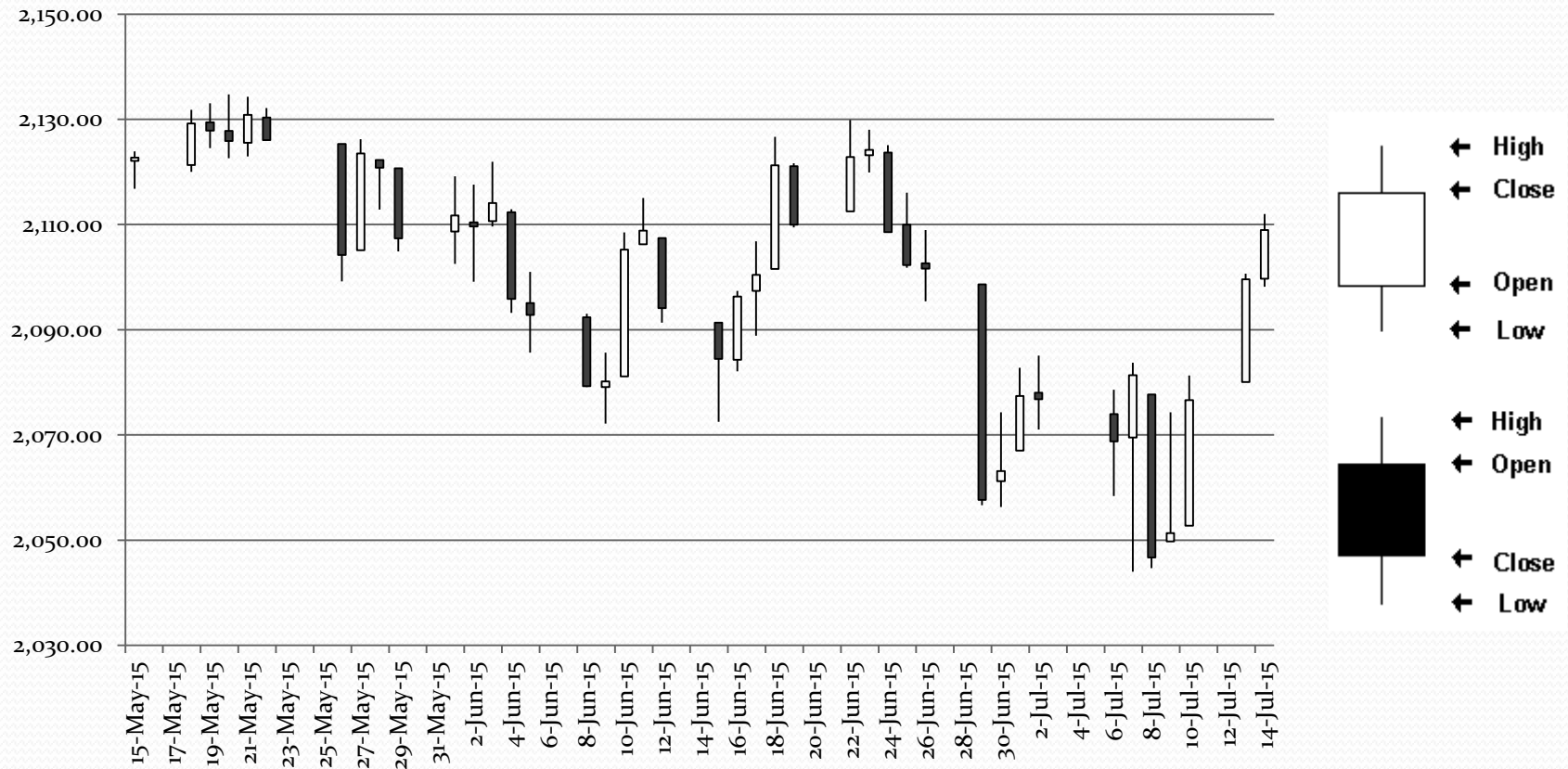
- To comprehend data
- To explore and discover
 - Patterns
 - Structures
 - Trends
- To monitor simulations
- To communicate with others

A picture is worth of thousand ~~words~~ numbers!

Numbers (S&P 500)

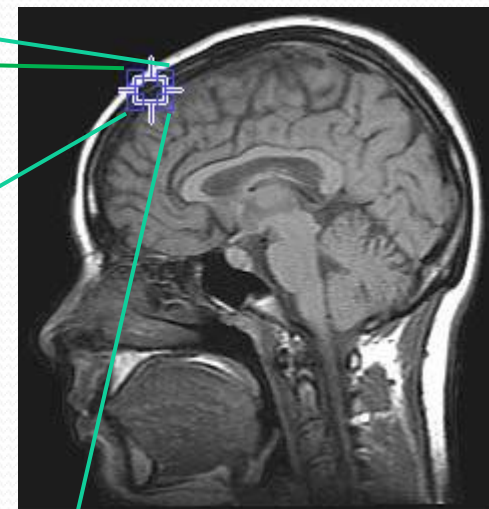
Date	Open	High	Low	Close
Jul 14, 2015	2,099.72	2,111.98	2,098.18	2,108.95
Jul 13, 2015	2,080.03	2,100.67	2,080.03	2,099.60
Jul 10, 2015	2,052.74	2,081.31	2,052.74	2,076.62
Jul 9, 2015	2,049.73	2,074.28	2,049.73	2,051.31
Jul 8, 2015	2,077.66	2,077.66	2,044.66	2,046.68
Jul 7, 2015	2,069.52	2,083.74	2,044.02	2,081.34
Jul 6, 2015	2,073.95	2,078.61	2,058.40	2,068.76
Jul 2, 2015	2,078.03	2,085.06	2,071.02	2,076.78
Jul 1, 2015	2,067.00	2,082.78	2,067.00	2,077.42
Jun 30, 2015	2,061.19	2,074.28	2,056.32	2,063.11
...

Graph (S&P 500)



More examples

129	192	243	255	255	229	142	69	28	48	58	37	32	50	89	73
206	250	255	255	207	118	40	31	42	58	56	55	76	98	82	46
255	255	234	159	99	32	31	52	58	38	36	73	85	56	39	38
255	243	148	35	25	39	64	31	38	77	91	75	48	23	42	72
246	138	47	41	45	40	43	58	82	89	62	29	34	61	82	80
108	43	16	35	49	59	74	68	58	45	36	40	57	74	72	59
34	28	43	51	51	61	67	65	49	30	33	55	67	64	46	43
30	57	67	54	44	46	32	49	56	47	46	57	60	52	80	78
51	55	44	44	49	39	27	39	50	49	46	50	58	64	89	85
61	37	28	55	71	43	40	37	39	46	51	55	65	76	63	65
37	30	41	72	84	47	43	40	43	55	64	68	73	79	83	79





Overview of ParaView

- Introduction
 - Open source
 - General-purpose visualization package
 - Large user base
 - Kitware, Los Alamos, Sandia National Labs, etc
 - www.paraview.org
 - Latest version 5.2

Overview of ParaView

- Introduction
 - Parallel visualization of large data
 - Either standalone or client/server mode
 - Multiple platforms (Windows, Linux/Unix, MacOS)
 - Multi-dimensional and/or Multi-variables
 - Rich functionalities implemented as filters
 - Many file formats
 - Various data types
 - Scripting

Overview of ParaView

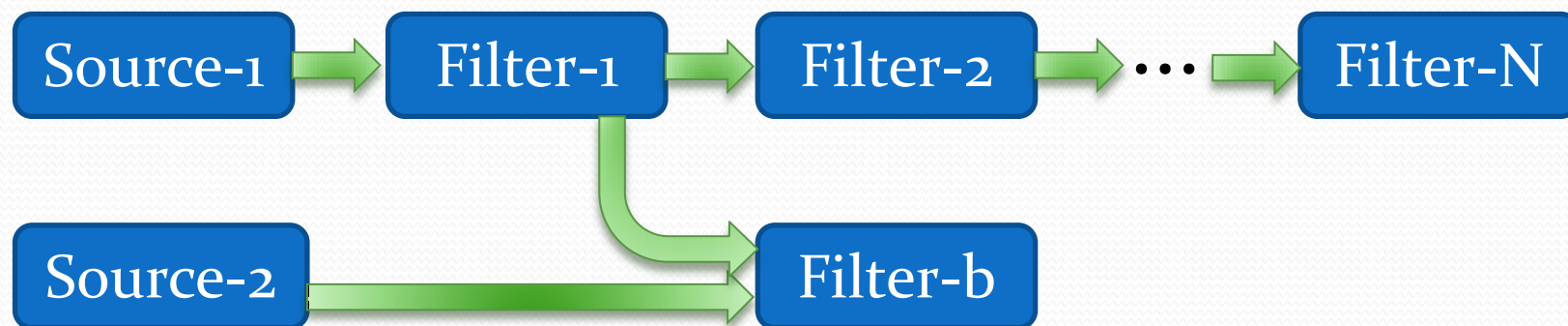
- Documentations and resources
 - Guide: <http://www.paraview.org/paraview-guide>
 - Wiki: <http://www.paraview.org/Wiki/ParaView>
 - Tutorials: <http://www.paraview.org/tutorials>
 - Webinars: <http://www.paraview.org/webinars>

Overview of ParaView

- Documentations and resources
 - Mailing lists:
 - Users:
<http://www.paraview.org/mailman/listinfo/paraview>
 - Developers
<http://www.paraview.org/mailman/listinfo/paraview-developers>
- Help online F1 ? or context-sensitive ?

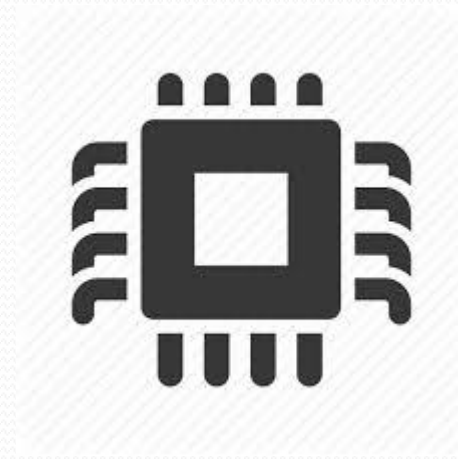
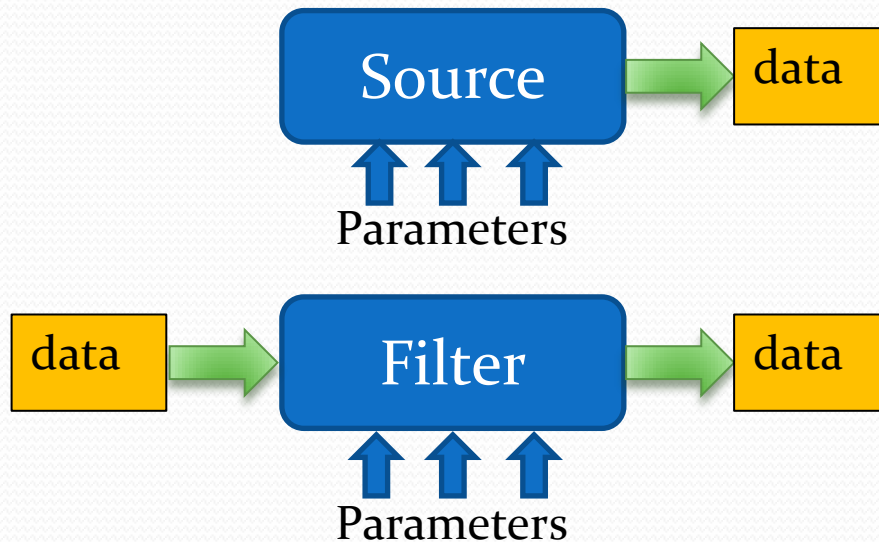
Overview of ParaView

- Visualization pipelines



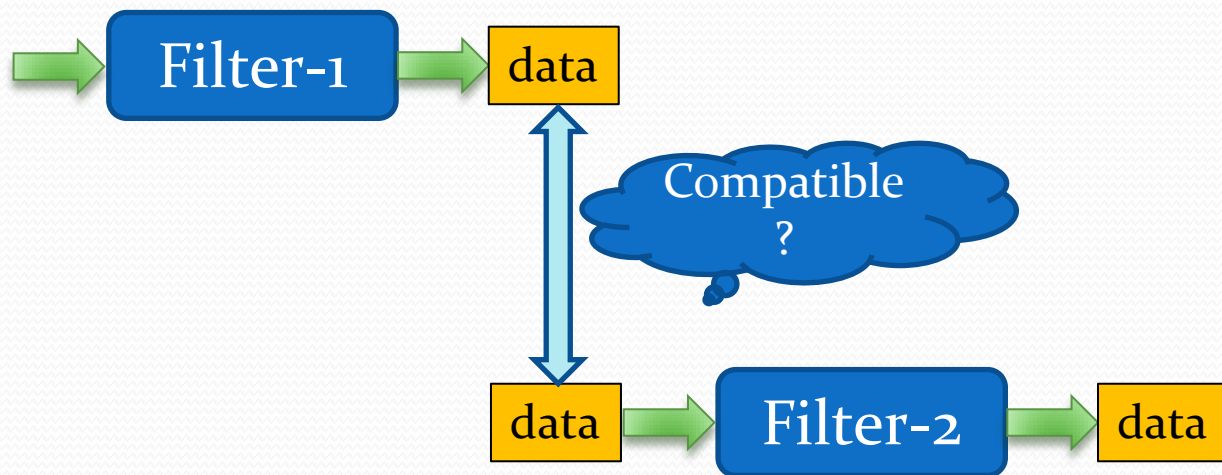
Overview of ParaView

- Pipeline components
 - Source: no input, one or more outputs
 - Primitive objects (cube, cylinder, cone, sphere, etc)
 - Data file readers
 - Filter: one or more inputs, one or more outputs



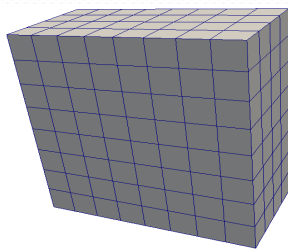
Overview of ParaView

- Connections in pipeline
 - Outputs of one component become the inputs of another
 - Compatibility of data type between inputs and outputs

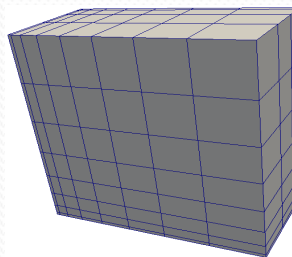


Overview of ParaView

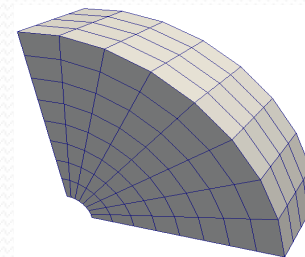
- Data types (sampling structures)



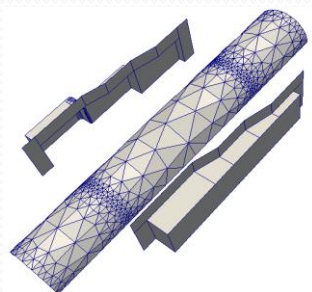
Uniform Rectilinear
(vtkImageData)



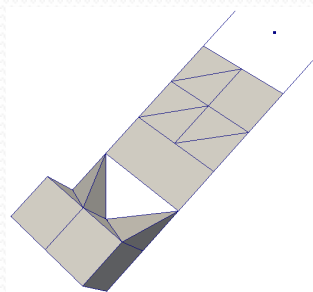
Non-Uniform Rectilinear
(vtkRectilinearData)



Curvilinear
(vtkStructuredData)



Polygonal
(vtkPolyData)



Unstructured Grid
(vtkUnstructuredGrid)

Multi-block

Hierarchical Adaptive
Mesh Refinement
(AMR)

Hierarchical Uniform
AMR

Octree

Overview of ParaView

- Data types at sampling points
 - Scalars (density, temperature, pressure, etc)
 - Vectors (velocity)
 - Normals
 - Texture Coordinates
 - Tensors

ParaView on SHARCNet

- SHARCNet visualization stations
 - 10 viz stations (≤ 64 GB memory, ≤ 12 cores, modern GPUs)
 - <https://www.sharcnet.ca/my/software/show/67>
- ParaView on SHARCNet viz stations
 - VNC (TigerVNC)
 - Client-server mode

Standalone ParaView

- Start ParaView
 - Linux/Unix: type *paraview* in a command window
 - MacOS: click ParaView in *Applications* folder
 - Windows: click ParaView from Start Menu

Then

- ParaView GUI appears
- *Pvserver* running in the background

ParaView GUI

Menu Bar

Toolbars

Pipeline Browser

Properties Panel

Advanced Toggle

3D View

