SAND2012-3236C

Themis Web-based Ensemble Analysis

DOECGF

April 26, 2012

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Sandia National Laboratories

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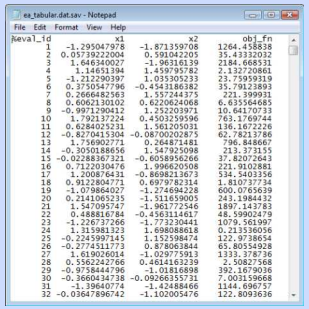
Ensembles

Tabular Ensemble

Dakota Parameter Studies

Simulation Input Parameters

Response Values

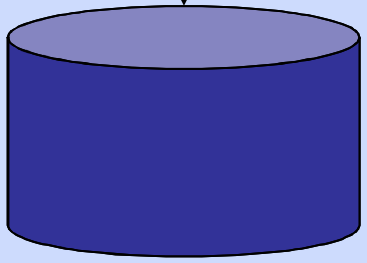


ASC Simulations

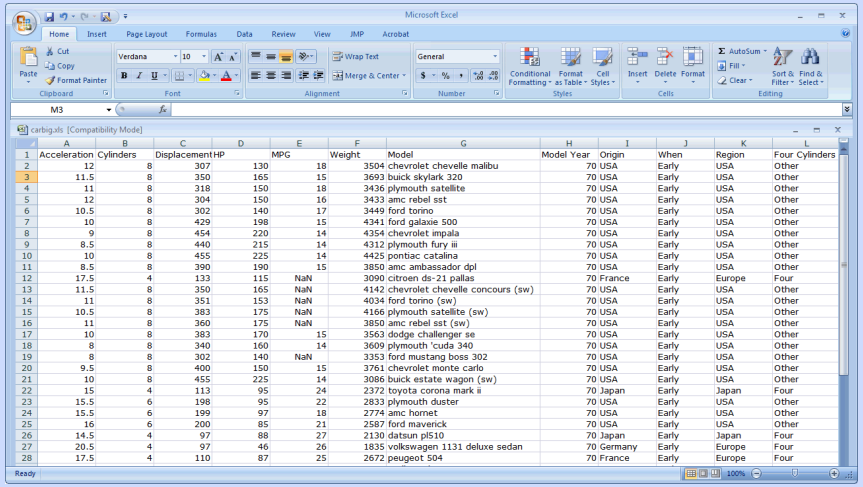
Analysis

Mesh Ensemble

Finite Element Meshes

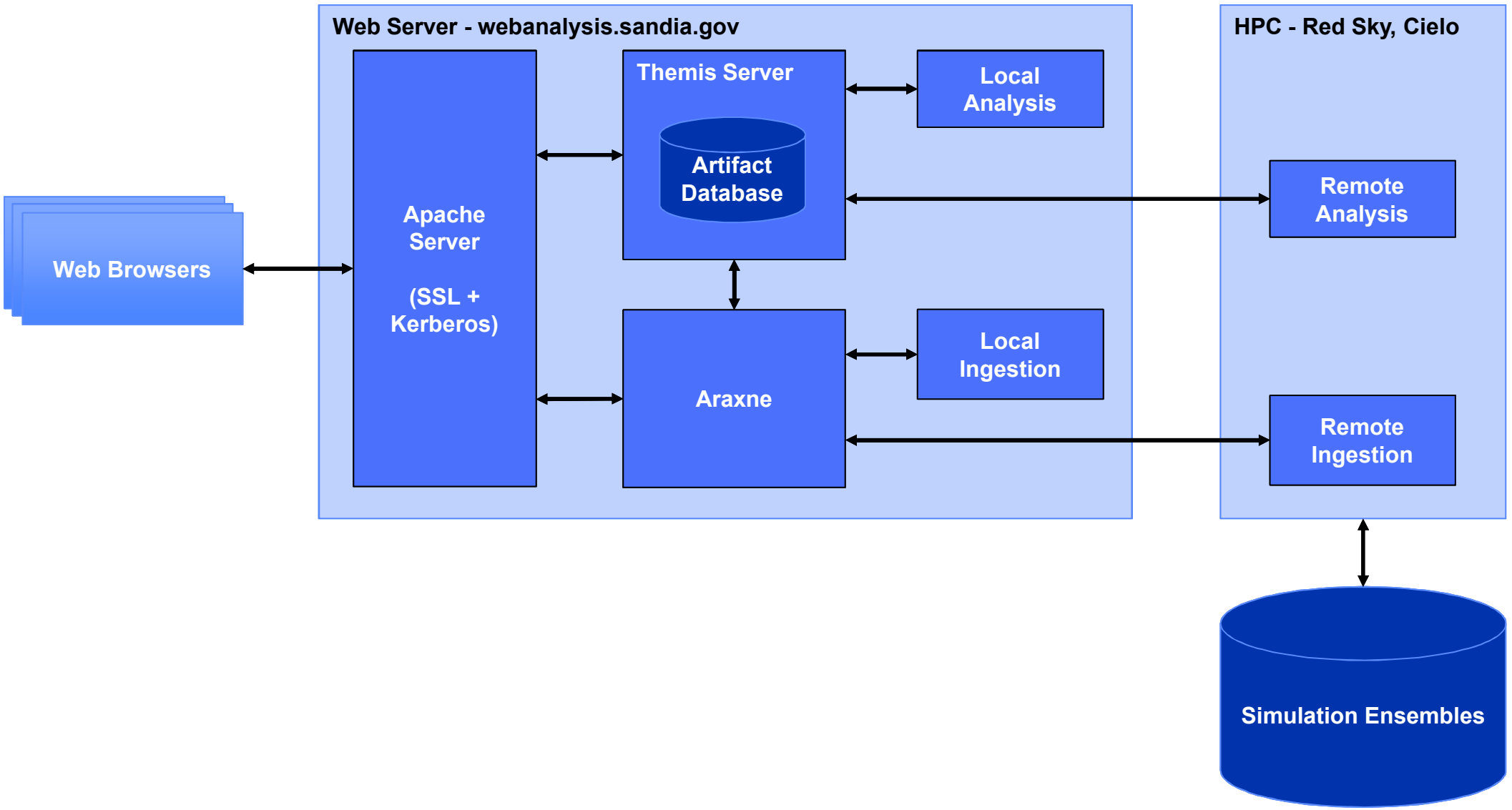


Sample Data Ensemble

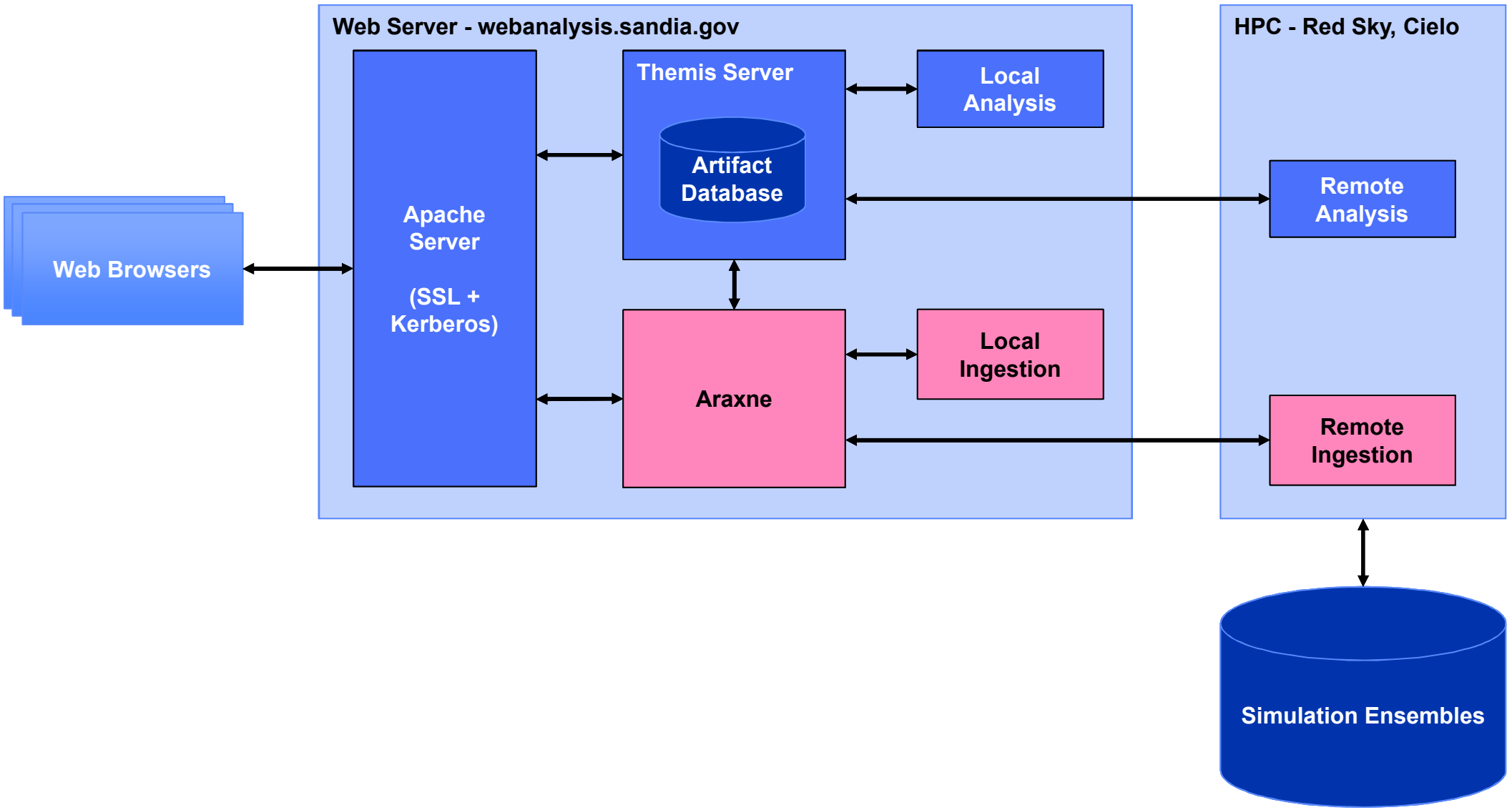


	Acceleration	Cylinders	Displacement	HP	MPG	Weight	Model	Model Year	Origin	When	Region	Four Cylinders
2	12	8	307	130	18	3504	chevrolet chevelle malibu	70	USA	Early	USA	Other
3	11.5	8	350	165	15	3693	buick skylark 320	70	USA	Early	USA	Other
4	11	8	318	150	18	3436	plymouth satellite	70	USA	Early	USA	Other
5	12	8	304	150	16	3433	amc rebel sst	70	USA	Early	USA	Other
6	10.5	8	302	140	17	3449	ford torino	70	USA	Early	USA	Other
7	10	8	429	198	15	4341	ford galaxie 500	70	USA	Early	USA	Other
8	9	8	454	220	14	4354	chevrolet impala	70	USA	Early	USA	Other
9	8.5	8	440	215	14	4312	plymouth fury iii	70	USA	Early	USA	Other
10	10	8	455	225	14	4425	pontiac catalina	70	USA	Early	USA	Other
11	8.5	8	390	190	15	3850	amc ambassador dpl	70	USA	Early	USA	Other
12	17.5	4	133	115	NaN	3090	citroen ds-21 pallas	70	France	Early	Europe	Four
13	11.5	8	350	165	NaN	4142	chevrolet chevelle concours (sw)	70	USA	Early	USA	Other
14	11	8	351	153	NaN	4034	ford torino (sw)	70	USA	Early	USA	Other
15	10.5	8	383	175	NaN	4166	plymouth satellite (sw)	70	USA	Early	USA	Other
16	11	8	360	175	NaN	3850	amc rebel sst (sw)	70	USA	Early	USA	Other
17	10	8	383	170	15	3563	dodge challenger se	70	USA	Early	USA	Other
18	8	8	340	160	14	3609	plymouth 'cuda 340	70	USA	Early	USA	Other
19	8	8	302	140	NaN	3353	ford mustang boss 302	70	USA	Early	USA	Other
20	9.5	8	400	150	15	3761	chevrolet monte carlo	70	USA	Early	USA	Other
21	10	8	455	225	14	3086	buick estate wagon (sw)	70	USA	Early	USA	Other
22	15	4	113	95	24	2372	toyota corona mark ii	70	Japan	Early	Japan	Four
23	15.5	6	198	95	22	2833	plymouth duster	70	USA	Early	USA	Other
24	15.5	6	199	97	18	2774	amc hornet	70	USA	Early	USA	Other
25	16	6	200	85	21	2587	ford maverick	70	USA	Early	USA	Other
26	14.5	4	97	88	27	2130	datsun pl510	70	Japan	Early	Japan	Four
27	20.5	4	97	46	26	1835	volkswagen 1131 deluxe sedan	70	Germany	Early	Europe	Four
28	17.5	4	110	87	25	2672	peugeot 504	70	France	Early	Europe	Four

Web-based Analysis - Themis Architecture



Web-based Analysis - Themis Architecture



Araxne

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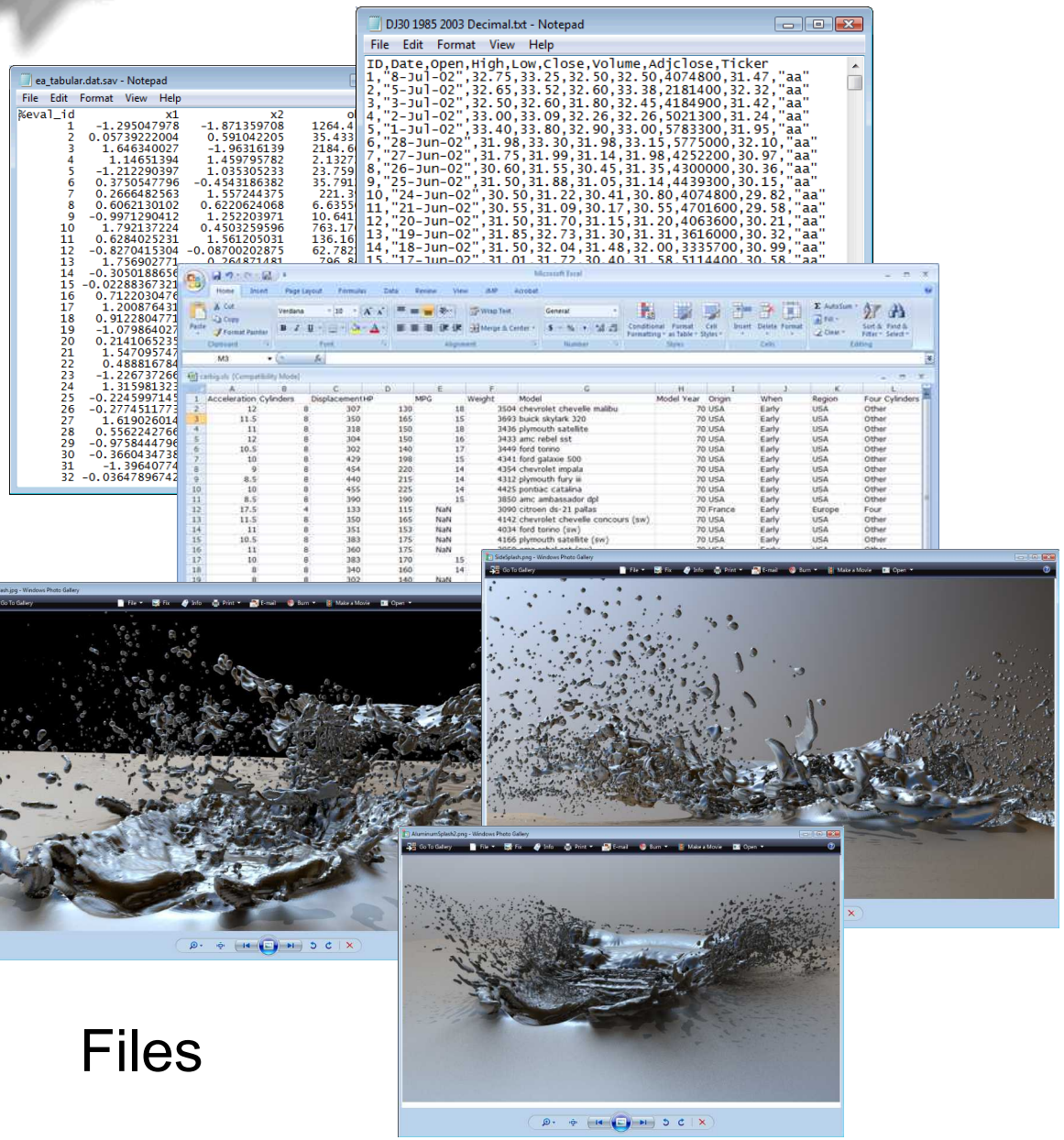
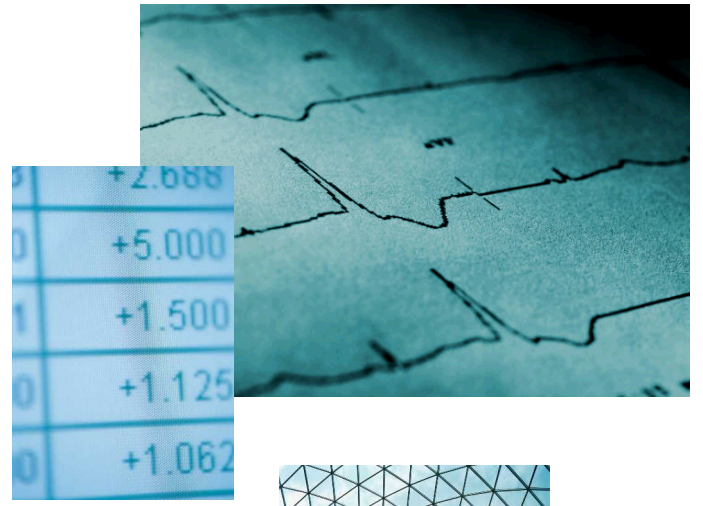
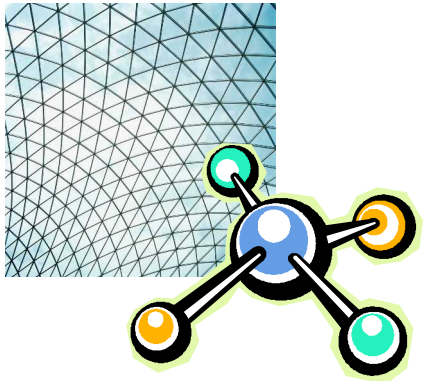
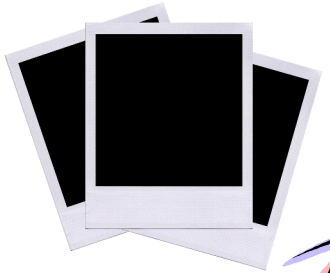


Files

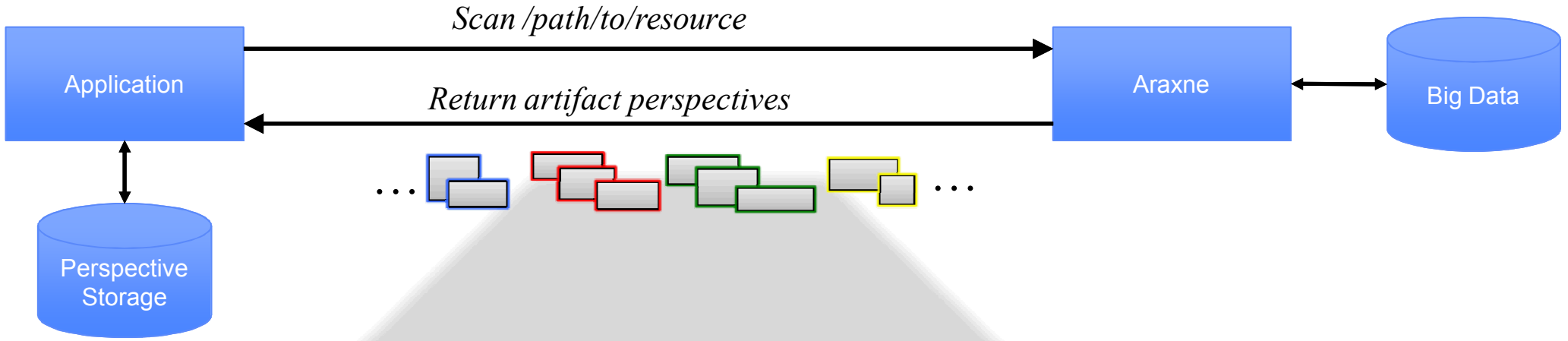






Perspectives

Araxne in a Nutshell



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mtime: 2012-01-

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md5-hash:149

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row-count:392
column-names:[cylinders, displacement, …]
column-types:[number, number, …]
preview: …

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mtime: 2012-02-

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height: 4000
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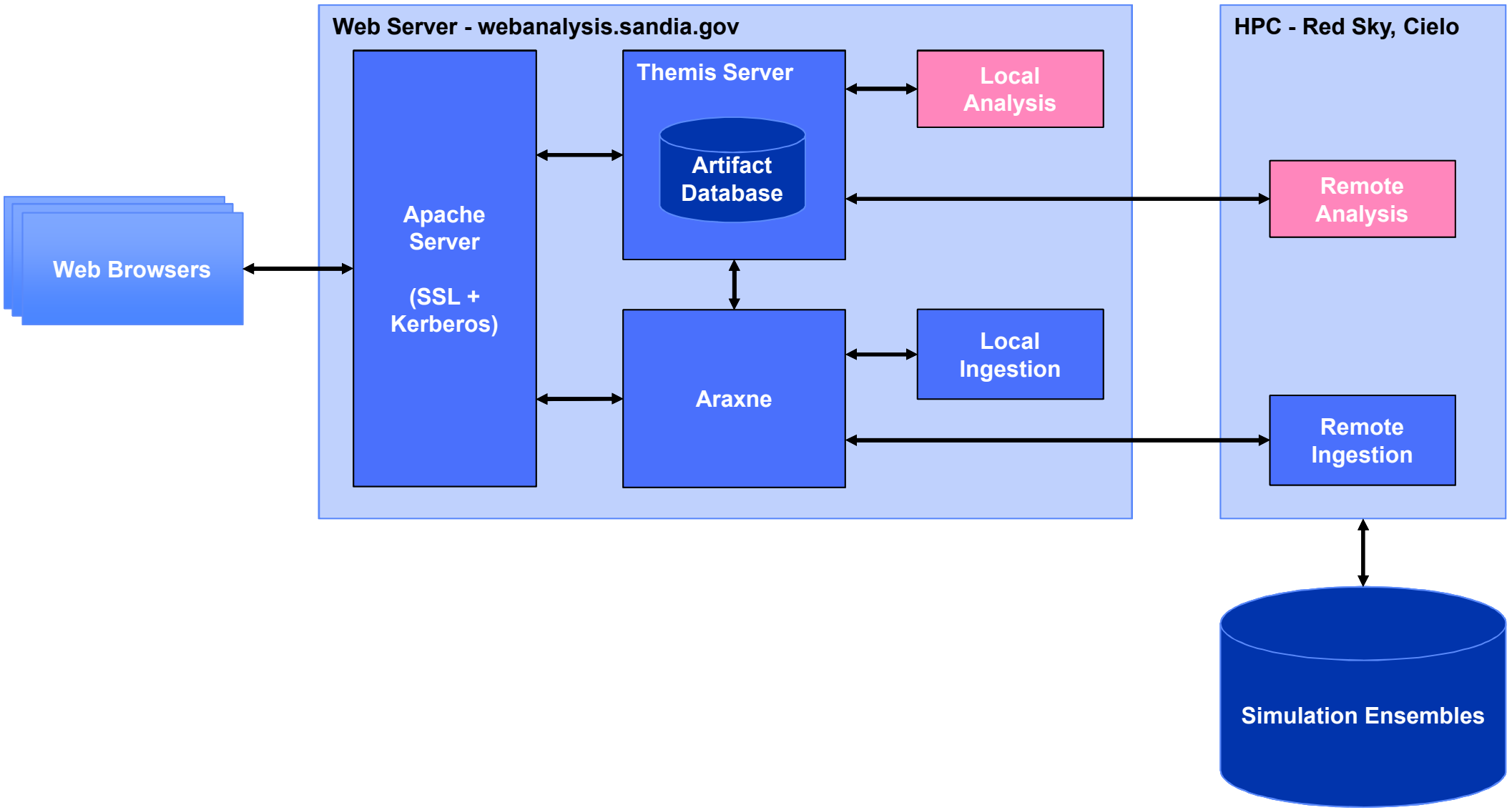
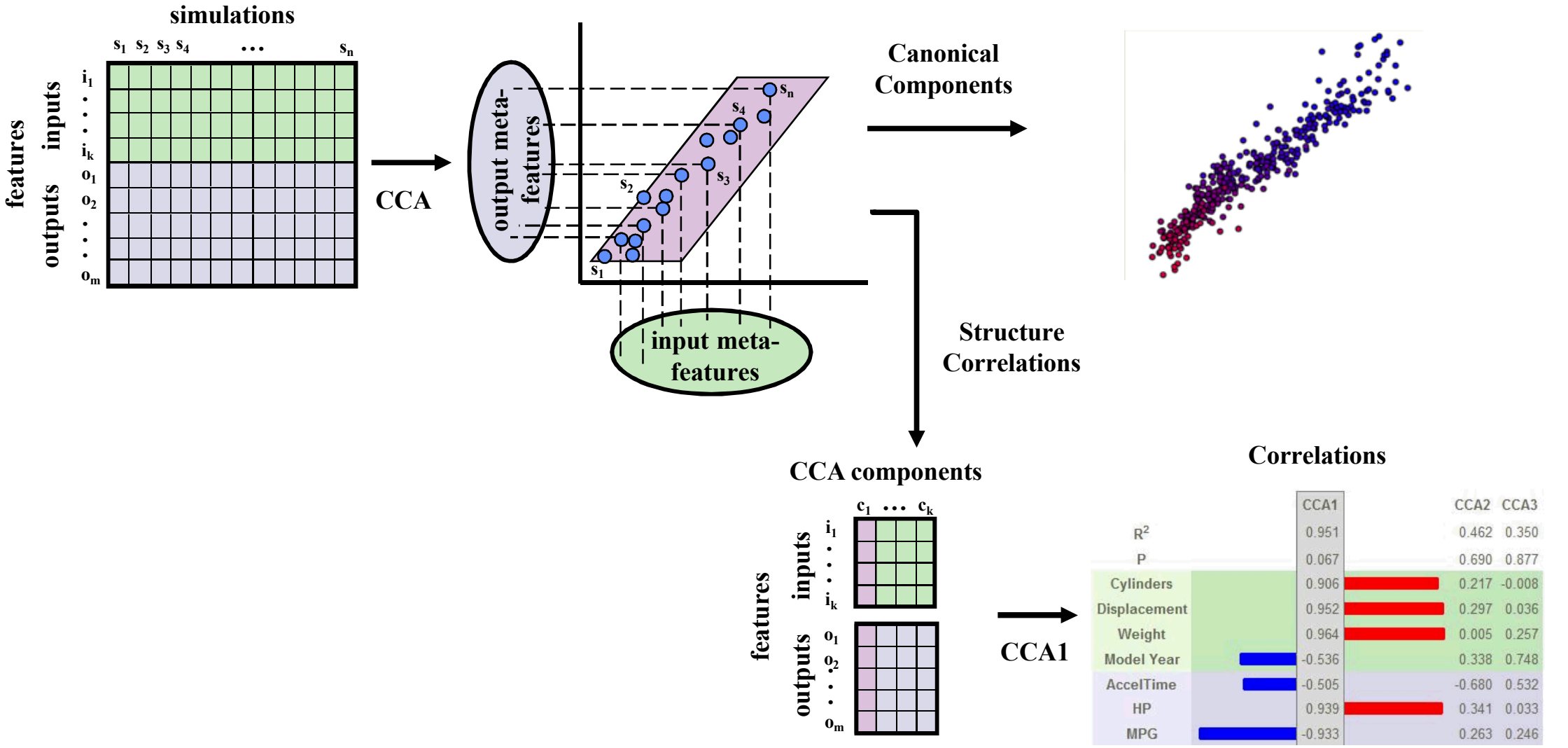
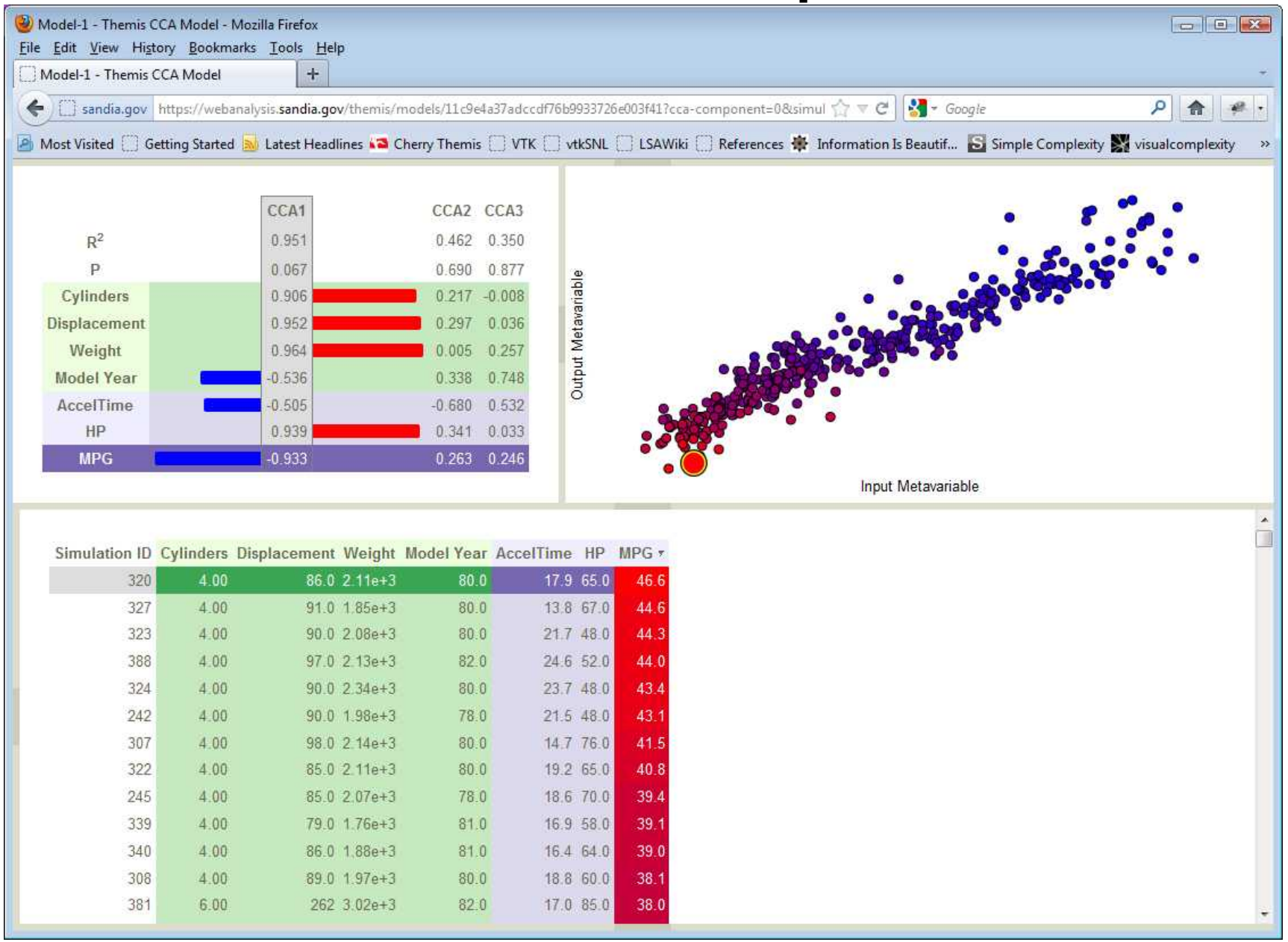
Web-based Analysis - Themis Architecture



Canonical Correlation Analysis



Car Data Example

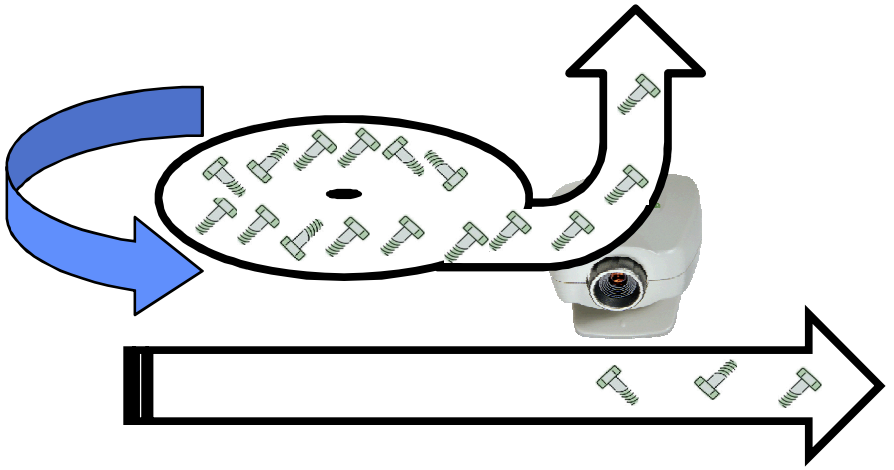


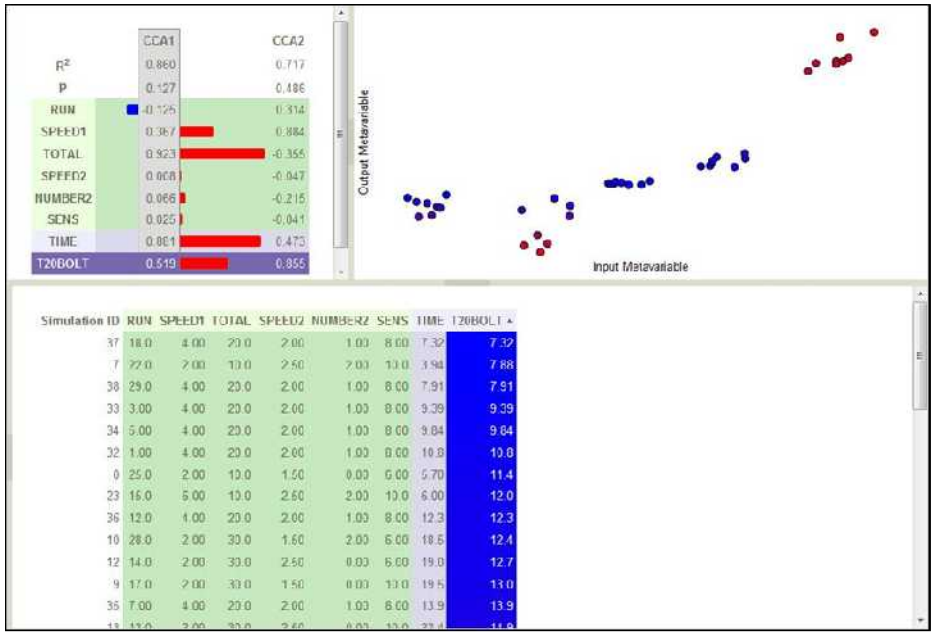
	CCA1	CCA2	CCA3
R^2	0.951	0.462	0.350
P	0.067	0.690	0.877
Cylinders	0.906	0.217	-0.008
Displacement	0.952	0.297	0.036
Weight	0.964	0.005	0.257
Model Year	-0.536	0.338	0.748
AccelTime	-0.505	-0.680	0.532
HP	0.939	0.341	0.033
MPG	-0.933	0.263	0.246

Simulation ID	Cylinders	Displacement	Weight	Model Year	AccelTime	HP	MPG
320	4.00	86.0	2.11e+3	80.0	17.9	65.0	46.6
327	4.00	91.0	1.85e+3	80.0	13.8	67.0	44.6
323	4.00	90.0	2.08e+3	80.0	21.7	48.0	44.3
388	4.00	97.0	2.13e+3	82.0	24.6	52.0	44.0
324	4.00	90.0	2.34e+3	80.0	23.7	48.0	43.4
242	4.00	90.0	1.98e+3	78.0	21.5	48.0	43.1
307	4.00	98.0	2.14e+3	80.0	14.7	76.0	41.5
322	4.00	85.0	2.11e+3	80.0	19.2	65.0	40.8
245	4.00	85.0	2.07e+3	78.0	18.6	70.0	39.4
339	4.00	79.0	1.76e+3	81.0	16.9	58.0	39.1
340	4.00	86.0	1.88e+3	81.0	16.4	64.0	39.0
308	4.00	89.0	1.97e+3	80.0	18.8	60.0	38.1
381	6.00	262	3.02e+3	82.0	17.0	85.0	38.0

Bolts Data Example

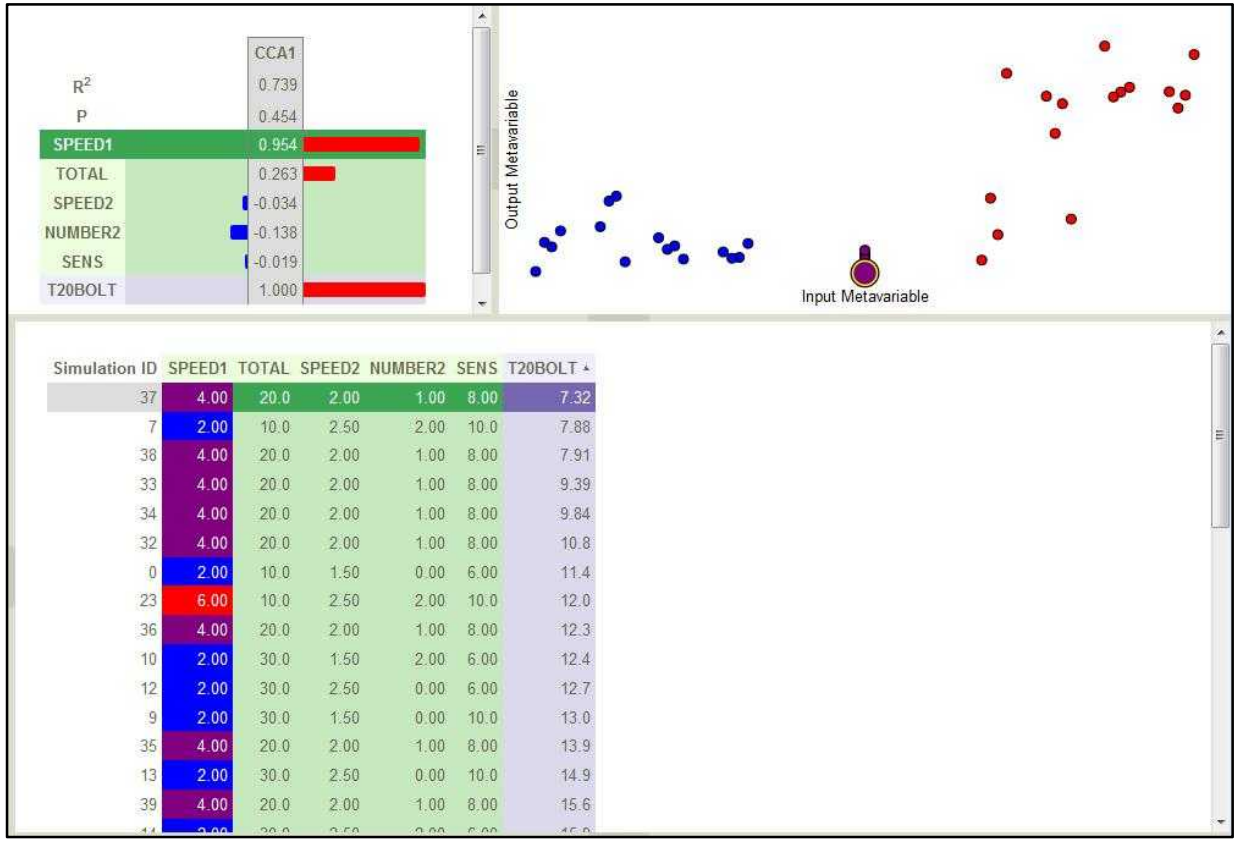
- Automatic bolt counting machine
- Spinning plate forces bolts up spiral ledge
- Bolts fall past optical sensor that counts them
- Experiment with 40 samples
- Input parameters:
  - RUN: experiment order
  - SPEED1: speed of plate rotation
  - TOTAL: total number of bolts being counted
  - SPEED2: plate rotation speed for last few bolts
  - NUMBER2: number of bolts counted at SPEED2
  - SENS: sensitivity of sensor
- Output parameters:
  - TIME: seconds to count TOTAL
  - T20BOLT: time to count 20 bolts





Bolts Data

- Questions:
  - What adjustments have the greatest effect on the time to count 20 bolts?
  - How would you adjust the machine to get the shortest time to count 20 bolts?
  - Are there any unusual features to the data?



Simulation ID	SPEED1	TOTAL	SPEED2	NUMBER2	SENS	T20BOLT
37	4.00	20.0	2.00	1.00	8.00	7.32
7	2.00	10.0	2.50	2.00	10.0	7.88
38	4.00	20.0	2.00	1.00	8.00	7.91
33	4.00	20.0	2.00	1.00	8.00	9.39
34	4.00	20.0	2.00	1.00	8.00	9.84
32	4.00	20.0	2.00	1.00	8.00	10.8
0	2.00	10.0	1.50	0.00	6.00	11.4
23	6.00	10.0	2.50	2.00	10.0	12.0
36	4.00	20.0	2.00	1.00	8.00	12.3
10	2.00	30.0	1.50	2.00	6.00	12.4
12	2.00	30.0	2.50	0.00	6.00	12.7
9	2.00	30.0	1.50	0.00	10.0	13.0
35	4.00	20.0	2.00	1.00	8.00	13.9
13	2.00	30.0	2.50	0.00	10.0	14.9
39	4.00	20.0	2.00	1.00	8.00	15.6

Bolts Data

- Questions:
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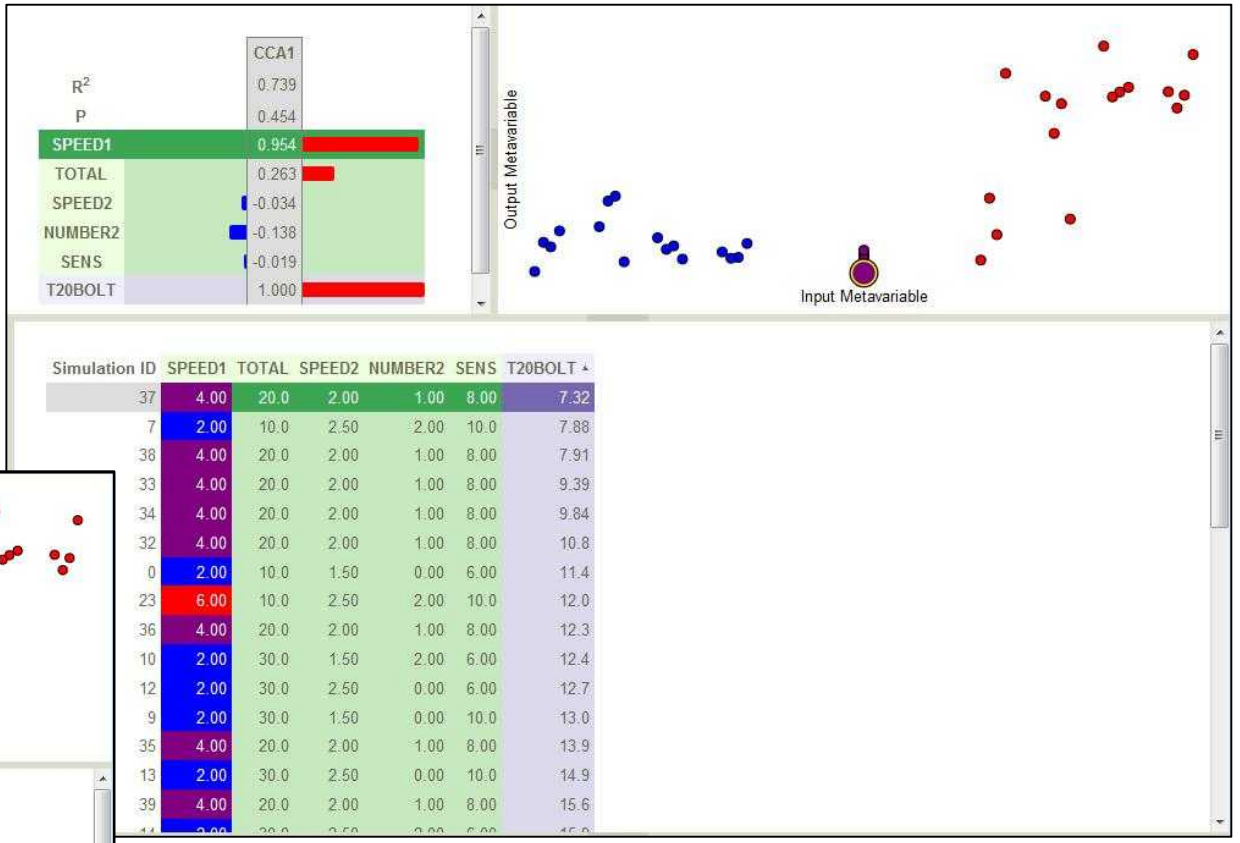
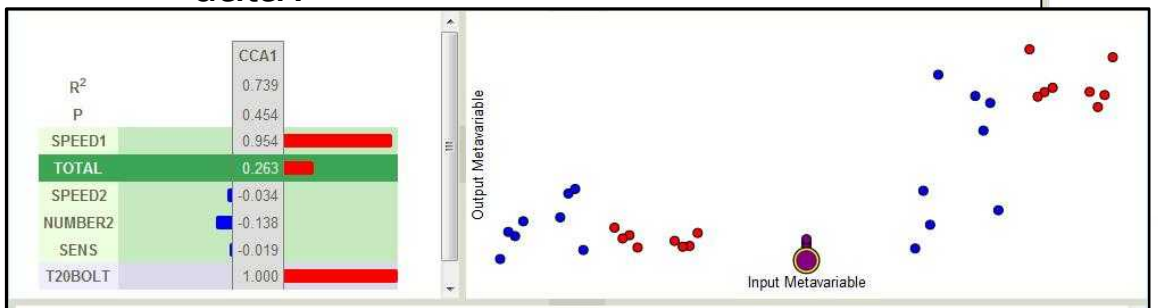


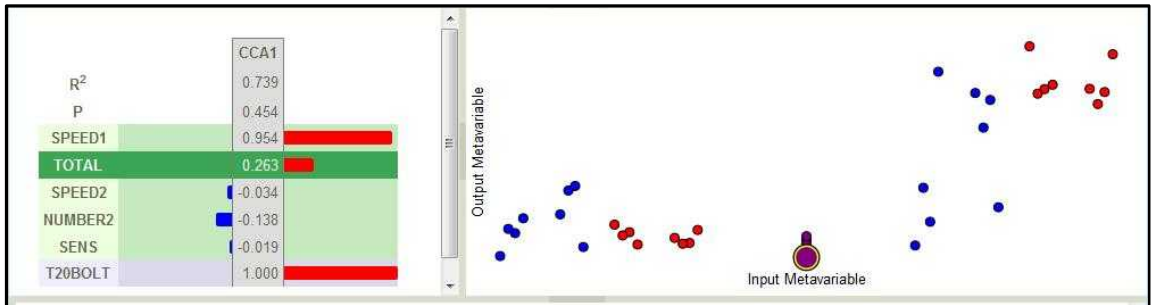
Simulation ID	SPEED1	TOTAL	SPEED2	NUMBER2	SENS	T20BOLT
37	4.00	20.0	2.00	1.00	8.00	7.32
7	2.00	10.0	2.50	2.00	10.0	7.88
38	4.00	20.0	2.00	1.00	8.00	7.91
33	4.00	20.0	2.00	1.00	8.00	9.39
34	4.00	20.0	2.00	1.00	8.00	9.84
32	4.00	20.0	2.00	1.00	8.00	10.8
0	2.00	10.0	1.50	0.00	6.00	11.4
23	6.00	10.0	2.50	2.00	10.0	12.0
36	4.00	20.0	2.00	1.00	8.00	12.3
10	2.00	30.0	1.50	2.00	6.00	12.4
12	2.00	30.0	2.50	0.00	6.00	12.7
9	2.00	30.0	1.50	0.00	10.0	13.0
35	4.00	20.0	2.00	1.00	8.00	13.9
13	2.00	30.0	2.50	0.00	10.0	14.9
39	4.00	20.0	2.00	1.00	8.00	15.6



Simulation ID	SPEED1	TOTAL	SPEED2	NUMBER2	SENS	T20BOLT
37	4.00	20.0	2.00	1.00	8.00	7.32
7	2.00	10.0	2.50	2.00	10.0	7.88
38	4.00	20.0	2.00	1.00	8.00	7.91
33	4.00	20.0	2.00	1.00	8.00	9.39
34	4.00	20.0	2.00	1.00	8.00	9.84
32	4.00	20.0	2.00	1.00	8.00	10.8
0	2.00	10.0	1.50	0.00	6.00	11.4
23	6.00	10.0	2.50	2.00	10.0	12.0
36	4.00	20.0	2.00	1.00	8.00	12.3
10	2.00	30.0	1.50	2.00	6.00	12.4
12	2.00	30.0	2.50	0.00	6.00	12.7
9	2.00	30.0	1.50	0.00	10.0	13.0
35	4.00	20.0	2.00	1.00	8.00	13.9
13	2.00	30.0	2.50	0.00	10.0	14.9
39	4.00	20.0	2.00	1.00	8.00	15.6

Bolts Data

- Questions:
  - What adjustments have the greatest effect on the time to count 20 bolts?
  - How would you adjust the machine to get the shortest time to count 20 bolts?
  - Are there any unusual features to the data?



Simulation ID	SPEED1	TOTAL	SPEED2	NUMBER2	SENS	T20BOLT
37	4.00	20.0	2.00	1.00	8.00	7.32
7	2.00	10.0	2.50	2.00	10.0	7.88
38	4.00	20.0	2.00	1.00	8.00	7.91
33	4.00	20.0	2.00	1.00	8.00	9.39
34	4.00	20.0	2.00	1.00	8.00	9.84
32	4.00	20.0	2.00	1.00	8.00	10.8
0	2.00	10.0	1.50	0.00	6.00	11.4
23	6.00	10.0	2.50	2.00	10.0	12.0
36	4.00	20.0	2.00	1.00	8.00	12.3
10	2.00	30.0	1.50	2.00	6.00	12.4
12	2.00	30.0	2.50	0.00	6.00	12.7
9	2.00	30.0	1.50	0.00	10.0	13.0
35	4.00	20.0	2.00	1.00	8.00	13.9
13	2.00	30.0	2.50	0.00	10.0	14.9
39	4.00	20.0	2.00	1.00	8.00	15.6

Simulation ID	SPEED1	TOTAL	SPEED2	NUMBER2	SENS	T20BOLT
0	2.00	10.0	1.50	0.00	6.00	11.4
1	2.00	10.0	1.50	0.00	10.0	35.1
2	2.00	10.0	1.50	2.00	6.00	22.6
3	2.00	10.0	1.50	2.00	10.0	16.8
4	2.00	10.0	2.50	0.00	6.00	33.3
5	2.00	10.0	2.50	0.00	10.0	24.1
6	2.00	10.0	2.50	2.00	6.00	18.4
7	2.00	10.0	2.50	2.00	10.0	7.88
16	6.00	10.0	1.50	0.00	6.00	26.8
17	6.00	10.0	1.50	0.00	10.0	68.5
18	6.00	10.0	1.50	2.00	6.00	79.5
19	6.00	10.0	1.50	2.00	10.0	21.2
20	6.00	10.0	2.50	0.00	6.00	57.8
21	6.00	10.0	2.50	0.00	10.0	71.2
22	6.00	10.0	2.50	2.00	6.00	34.4
23	6.00	10.0	2.50	2.00	10.0	12.0
32	4.00	20.0	2.00	1.00	8.00	10.8
33	4.00	20.0	2.00	1.00	8.00	9.39
34	4.00	20.0	2.00	1.00	8.00	9.84
35	4.00	20.0	2.00	1.00	8.00	13.9
36	4.00	20.0	2.00	1.00	8.00	12.3
37	4.00	20.0	2.00	1.00	8.00	7.32
38	4.00	20.0	2.00	1.00	8.00	7.91
39	4.00	20.0	2.00	1.00	8.00	15.6
8	2.00	30.0	1.50	0.00	6.00	18.0
9	2.00	30.0	1.50	0.00	10.0	13.0
10	2.00	30.0	1.50	2.00	6.00	12.4
11	2.00	30.0	1.50	2.00	10.0	17.1
12	2.00	30.0	2.50	0.00	6.00	12.7
13	2.00	30.0	2.50	0.00	10.0	14.9
14	2.00	30.0	2.50	2.00	6.00	15.9
15	2.00	30.0	2.50	2.00	10.0	20.1
24	6.00	30.0	1.50	0.00	6.00	86.3
25	6.00	30.0	1.50	0.00	10.0	71.6
26	6.00	30.0	1.50	2.00	6.00	74.4
27	6.00	30.0	1.50	2.00	10.0	72.7
28	6.00	30.0	2.50	0.00	6.00	67.0
29	6.00	30.0	2.50	0.00	10.0	72.8
30	6.00	30.0	2.50	2.00	6.00	71.0
31	6.00	30.0	2.50	2.00	10.0	89.3

Simulation ID	SPEED1	TOTAL	SPEED2	NUMBER2	SENS	T20BOLT
0	2.00	10.0	1.50	0.00	6.00	11.4
1	2.00	10.0	1.50	0.00	10.0	35.1
2	2.00	10.0	1.50	2.00	6.00	22.6
3	2.00	10.0	1.50	2.00	10.0	16.8
4	2.00	10.0	2.50	0.00	6.00	33.3
5	2.00	10.0	2.50	0.00	10.0	24.1
6	2.00	10.0	2.50	2.00	6.00	18.4
7	2.00	10.0	2.50	2.00	10.0	7.88
16	6.00	10.0	1.50	0.00	6.00	26.8
17	6.00	10.0	1.50	0.00	10.0	68.5
18	6.00	10.0	1.50	2.00	6.00	79.5
19	6.00	10.0	1.50	2.00	10.0	21.2
20	6.00	10.0	2.50	0.00	6.00	57.8
21	6.00	10.0	2.50	0.00	10.0	71.2
22	6.00	10.0	2.50	2.00	6.00	34.4
23	6.00	10.0	2.50	2.00	10.0	12.0
32	4.00	20.0	2.00	1.00	8.00	10.8
33	4.00	20.0	2.00	1.00	8.00	9.39
34	4.00	20.0	2.00	1.00	8.00	9.84
35	4.00	20.0	2.00	1.00	8.00	13.9
36	4.00	20.0	2.00	1.00	8.00	12.3
37	4.00	20.0	2.00	1.00	8.00	7.32
38	4.00	20.0	2.00	1.00	8.00	7.91
39	4.00	20.0	2.00	1.00	8.00	15.6
8	2.00	30.0	1.50	0.00	6.00	18.0
9	2.00	30.0	1.50	0.00	10.0	13.0
10	2.00	30.0	1.50	2.00	6.00	12.4
11	2.00	30.0	1.50	2.00	10.0	17.1
12	2.00	30.0	2.50	0.00	6.00	12.7
13	2.00	30.0	2.50	0.00	10.0	14.9
14	2.00	30.0	2.50	2.00	6.00	15.9
15	2.00	30.0	2.50	2.00	10.0	20.1
24	6.00	30.0	1.50	0.00	6.00	86.3
25	6.00	30.0	1.50	0.00	10.0	71.6
26	6.00	30.0	1.50	2.00	6.00	74.4
27	6.00	30.0	1.50	2.00	10.0	72.7
28	6.00	30.0	2.50	0.00	6.00	67.0
29	6.00	30.0	2.50	0.00	10.0	72.8
30	6.00	30.0	2.50	2.00	6.00	71.0
31	6.00	30.0	2.50	2.00	10.0	89.3

Themis Provides

- Scalability
- Interpretability
- High-dimensional analysis (many-to-many)
- Abstraction + raw data
- Interactive hypothesis exploration
- Project-based access control
- Shared visualizations with annotations

Sandia National Laboratories

Questions?