

Data warehouse

Data analysis

Elena Baralis
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Data analysis

- OLAP analysis: complex aggregate function computation
 - support to different types of aggregate functions (e.g., moving average, top ten)
- Comparison operations, exploited to compare business trends (example: sale figure comparison for different time periods)
 - difficult by exploiting plain SQL
- Data analysis by means of data mining techniques

User interface

Users may query the data warehouse by means of various tools:

- controlled query environments
- query and report generation tools
- data mining tools

Controlled query environment

- It encompasses
 - complex queries with predefined structure (usually parametric)
 - ad hoc analysis procedures
 - predefined reports
- Techniques and knowledge of a specific economic area may be exploited
- It requires ad hoc code development
 - stored procedures, application packages, predefined joins and aggregations
 - flexible tools for report management are available, which allow defining
 - report layout
 - publication periodicity
 - distribution list

Ad hoc query environment

- Arbitrary OLAP queries may be defined
- Queries are designed on demand by users
 - query is defined by point and click techniques, which automatically generate SQL instructions
 - (typically) complex queries may be defined
 - spreadsheet is the user interface paradigm
- An OLAP session allows successive refinements of the same query
- Used when predefined reports are not enough

OLAP analysis

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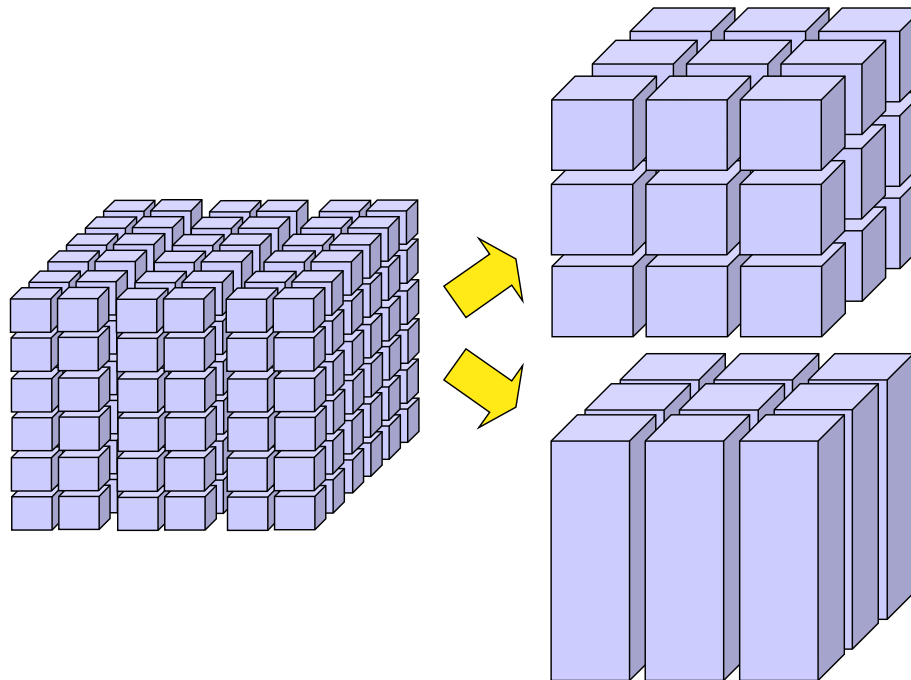
OLAP analysis

- Available query operations
 - roll up, drill down
 - slice and dice
 - (table) pivot
 - sorting
- Operations may be
 - used together in the same query
 - exploited in sequence to refine the same query which builds up the OLAP session

Roll up

- Data detail reduction by
 - decreasing detail in a dimension, by climbing up a hierarchy
 - example
group by store, month → group by city, month
 - dropping a whole dimension
 - example
group by product, city → group by product

Roll up



From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Roll up

Metrics Customer Region	Dollar Sales										
	North-East	Mid-Atlantic	South-East	Central	South	North-West	South-West	England	France	Germany	Canada
Month											
Jan 97	\$ 620	\$ 753	\$ 30	\$ 660	\$ 2.405	\$ 1.312	\$ 440	\$ 1.002	\$ 1.002	\$ 383	\$ 210
Feb 97	\$ 258	\$ 252	\$ 800	\$ 975	\$ 160	\$ 582	\$ 744	\$ 310	\$ 799	\$ 118	\$ 357
Mar 97	\$ 648	\$ 244	\$ 148	\$ 250	\$ 1.085	\$ 2.961	\$ 650	\$ 1.240	\$ 119	\$ 142	\$ 96
Apr 97	\$ 787	\$ 588	\$ 447	\$ 486	\$ 226	\$ 506	\$ 601	\$ 119	\$ 550	\$ 85	
May 97	\$ 1.350	\$ 245	\$ 936	\$ 159	\$ 664	\$ 626	\$ 107	\$ 135	\$ 200	\$ 177	\$ 230
Jun 97	\$ 842	\$ 582	\$ 1.281	\$ 937	\$ 240	\$ 774	\$ 176	\$ 1.139	\$ 652	\$ 254	\$ 745
Jul 97	\$ 652	\$ 690	\$ 486	\$ 1.293	\$ 605	\$ 303	\$ 818	\$ 103	\$ 124	\$ 173	\$ 66
Aug 97	\$ 1.783	\$ 304	\$ 1.032	\$ 170	\$ 398	\$ 356	\$ 432	\$ 190	\$ 241	\$ 407	\$ 259
Sep 97	\$ 581	\$ 778	\$ 3.558	\$ 587	\$ 440	\$ 1.652	\$ 1.071	\$ 315	\$ 210	\$ 202	
Oct 97	\$ 2.291	\$ 1.840	\$ 600	\$ 656	\$ 1.300	\$ 718	\$ 1.210	\$ 427	\$ 220	\$ 520	\$ 65
Nov 97	\$ 39	\$ 1.602	\$ 1.082	\$ 1.187	\$ 842	\$ 759	\$ 745	\$ 232	\$ 101	\$ 1.037	\$ 37
Dec 97	\$ 381	\$ 1.588	\$ 343	\$ 118	\$ 1.459	\$ 635	\$ 2.021	\$ 259	\$ 210	\$ 119	\$ 189
Jan 98	\$ 311	\$ 1.174	\$ 2.634	\$ 3.130	\$ 954	\$ 2.083	\$ 1.351	\$ 747	\$ 426	\$ 447	\$ 1.141
Feb 98	\$ 2.518	\$ 702	\$ 1.123	\$ 1.336	\$ 1.227	\$ 3.887	\$ 545	\$ 268	\$ 277	\$ 282	
Mar 98	\$ 2.459	\$ 1.523	\$ 1.178	\$ 4.708	\$ 1.420	\$ 3.514	\$ 1.948	\$ 1.705	\$ 276	\$ 1.168	\$ 63
Apr 98	\$ 407	\$ 841	\$ 524	\$ 712	\$ 133	\$ 2.486	\$ 49	\$ 390	\$ 1.298	\$ 221	\$ 46
May 98	\$ 667	\$ 1.721	\$ 440	\$ 148	\$ 80	\$ 1.310	\$ 303	\$ 104	\$ 657	\$ 65	
Jun 98	\$ 699	\$ 1.096	\$ 898	\$ 353	\$ 902	\$ 839		\$ 230	\$ 155	\$ 105	\$ 75
Jul 98	\$ 586	\$ 1.897	\$ 412	\$ 226	\$ 406	\$ 361	\$ 1.628	\$ 267	\$ 1.011	\$ 41	\$ 184
Aug 98	\$ 894	\$ 326	\$ 792	\$ 1.832	\$ 1.199	\$ 295	\$ 1.816	\$ 277	\$ 102	\$ 118	\$ 115
Sep 98	\$ 338	\$ 3.179	\$ 505	\$ 427	\$ 99	\$ 2.976	\$ 885	\$ 135	\$ 85	\$ 1.110	\$ 510
Oct 98	\$ 544	\$ 413	\$ 1.467	\$ 209	\$ 679	\$ 706	\$ 556	\$ 480	\$ 485	\$ 99	\$ 160
Nov 98	\$ 671	\$ 459	\$ 1.471	\$ 2.066	\$ 701	\$ 716	\$ 986	\$ 1.127	\$ 154	\$ 440	\$ 361
Dec 98	\$ 836	\$ 2.096	\$ 1.726	\$ 3.642	\$ 395	\$ 1.740	\$ 1.943	\$ 1.143	\$ 366	\$ 307	\$ 118



Metrics Customer Region	Dollar Sales										
	North-East	Mid-Atlantic	South-East	Central	South	North-West	South-West	England	France	Germany	Canada
Quarter											
Q1 1997	\$ 1.526	\$ 1.249	\$ 978	\$ 1.885	\$ 3.650	\$ 4.855	\$ 1.834	\$ 2.552	\$ 1.920	\$ 643	\$ 663
Q2 1997	\$ 2.979	\$ 1.415	\$ 2.664	\$ 1.582	\$ 1.130	\$ 1.906	\$ 884	\$ 1.393	\$ 1.402	\$ 516	\$ 975
Q3 1997	\$ 3.016	\$ 1.772	\$ 5.076	\$ 2.050	\$ 1.443	\$ 2.311	\$ 2.321	\$ 608	\$ 575	\$ 782	\$ 325
Q4 1997	\$ 2.711	\$ 5.030	\$ 2.025	\$ 1.961	\$ 3.601	\$ 2.112	\$ 3.976	\$ 918	\$ 531	\$ 1.676	\$ 291
Q1 1998	\$ 5.288	\$ 3.399	\$ 4.935	\$ 9.174	\$ 3.601	\$ 9.484	\$ 3.844	\$ 2.720	\$ 979	\$ 1.897	\$ 1.204
Q2 1998	\$ 1.773	\$ 3.658	\$ 1.862	\$ 1.213	\$ 1.115	\$ 4.635	\$ 352	\$ 724	\$ 2.110	\$ 391	\$ 121
Q3 1998	\$ 1.818	\$ 5.402	\$ 1.709	\$ 2.485	\$ 1.704	\$ 3.632	\$ 4.329	\$ 679	\$ 1.198	\$ 1.269	\$ 809
Q4 1998	\$ 2.051	\$ 2.968	\$ 4.664	\$ 5.917	\$ 1.775	\$ 3.162	\$ 3.485	\$ 2.750	\$ 1.005	\$ 846	\$ 639

From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Roll up

Category	Year	Metrics Customer Region	Dollar Sales									
			North-East	Mid-Atlantic	South-East	Central	South	North-West	South-West	England	France	Germa
Electronics	1997		\$ 138	\$ 1.774	\$ 384	\$ 138	\$ 2.346	\$ 2.554	\$ 2.184	\$ 566	\$ 199	\$
	1998		\$ 1.184	\$ 4.529	\$ 1.892	\$ 7.232	\$ 651	\$ 9.488	\$ 476	\$ 2.683	\$ 462	\$ 7
Food	1997		\$ 759	\$ 682	\$ 729	\$ 262	\$ 588	\$ 469	\$ 807	\$ 156	\$ 615	\$ 1
	1998		\$ 538	\$ 925	\$ 959	\$ 677	\$ 213	\$ 1.503	\$ 261	\$ 165	\$ 175	\$ 1
Gifts	1997		\$ 2.532	\$ 1.355	\$ 1.854	\$ 1.413	\$ 2.535	\$ 2.132	\$ 1.904	\$ 908	\$ 375	\$ 1.0
	1998		\$ 1.955	\$ 2.785	\$ 2.800	\$ 2.695	\$ 1.813	\$ 2.844	\$ 1.778	\$ 1.158	\$ 717	\$ 6
Health & Beauty	1997		\$ 624	\$ 640	\$ 1.317	\$ 647	\$ 588	\$ 754	\$ 654	\$ 143	\$ 292	\$ 3
	1998		\$ 611	\$ 887	\$ 566	\$ 382	\$ 499	\$ 1.162	\$ 1.044	\$ 273	\$ 72	\$
Household	1997		\$ 5.354	\$ 4.112	\$ 5.410	\$ 4.446	\$ 3.058	\$ 3.974	\$ 2.654	\$ 3.545	\$ 2.875	\$ 1.9
	1998		\$ 5.787	\$ 5.320	\$ 5.416	\$ 6.812	\$ 4.334	\$ 5.008	\$ 7.588	\$ 2.139	\$ 3.649	\$ 2.7
Kid's Komer	1997		\$ 201	\$ 398	\$ 485	\$ 186	\$ 409	\$ 323	\$ 396	\$ 105	\$ 34	\$
	1998		\$ 247	\$ 422	\$ 441	\$ 380	\$ 221	\$ 592	\$ 290	\$ 198	\$ 19	\$
Travel	1997		\$ 624	\$ 505	\$ 564	\$ 386	\$ 300	\$ 978	\$ 416	\$ 48	\$ 38	\$
	1998		\$ 608	\$ 559	\$ 1.096	\$ 611	\$ 464	\$ 316	\$ 573	\$ 257	\$ 198	\$



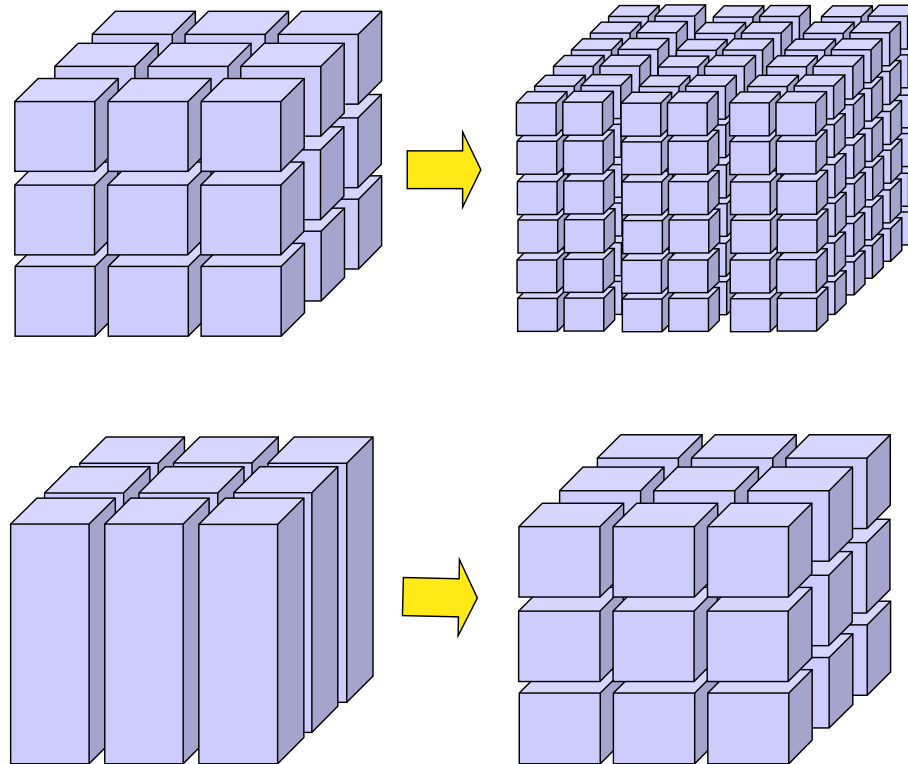
Category	Year	Metrics	Dollar Sales
Electronics	1997		\$ 10.616
	1998		\$ 29.299
Food	1997		\$ 5.300
	1998		\$ 5.638
Gifts	1997		\$ 16.315
	1998		\$ 20.047
Health & Beauty	1997		\$ 6.042
	1998		\$ 5.665
Household	1997		\$ 38.383
	1998		\$ 50.391
Kid's Komer	1997		\$ 2.559
	1998		\$ 2.943
Travel	1997		\$ 4.497
	1998		\$ 4.792

From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Drill down

- Data detail increase by
 - increasing detail in a dimension, by walking down a hierarchy
 - example
group by city, month → group by store, month
 - adding a whole dimension
 - example
group by product → group by product, city
- Frequently drill down operates on a subset of data produced by the initial query

Drill down



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Drill down

Quarter	Metrics Customer Region	Dollar Sales										
		North-East	Mid-Atlantic	South-East	Central	South	North-West	South-West	England	France	Germany	Canada
Q1 1997		\$ 1.526	\$ 1.249	\$ 978	\$ 1.885	\$ 3.650	\$ 4.855	\$ 1.834	\$ 2.552	\$ 1.920	\$ 643	\$ 663
Q2 1997		\$ 2.979	\$ 1.415	\$ 2.664	\$ 1.582	\$ 1.130	\$ 1.906	\$ 884	\$ 1.393	\$ 1.402	\$ 516	\$ 975
Q3 1997		\$ 3.016	\$ 1.772	\$ 5.076	\$ 2.050	\$ 1.443	\$ 2.311	\$ 2.321	\$ 608	\$ 575	\$ 782	\$ 325
Q4 1997		\$ 2.711	\$ 5.030	\$ 2.025	\$ 1.961	\$ 3.601	\$ 2.112	\$ 3.976	\$ 918	\$ 531	\$ 1.676	\$ 291
Q1 1998		\$ 5.288	\$ 3.399	\$ 4.935	\$ 9.174	\$ 3.601	\$ 9.484	\$ 3.844	\$ 2.720	\$ 979	\$ 1.897	\$ 1.204
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Q4 1998		\$ 2.051	\$ 2.968	\$ 4.664	\$ 5.917	\$ 1.775	\$ 3.162	\$ 3.485	\$ 2.750	\$ 1.005	\$ 846	\$ 639



Quarter	Metrics Customer City	Dollar Sales												
		Arlin	San Pedro	Springfield	Chappel Hill	Scranburg	Pebble Beach	Martinsville	Maddon	Peoria	Pecos	Lake Barkley	Alameda	Fingers Lake
Q1 1997		\$ 675										\$ 39		
Q2 1997					\$ 203				\$ 53					\$ 135
Q3 1997					\$ 276							\$ 252	\$ 63	
Q4 1997		\$ 215	\$ 124			\$ 113	\$ 45	\$ 192	\$ 348			\$ 79	\$ 98	
Q1 1998				\$ 140	\$ 174			\$ 85			\$ 237	\$ 30	\$ 119	
Q2 1998								\$ 12	\$ 17					
Q3 1998		\$ 734					\$ 25	\$ 1.535						
Q4 1998							\$ 219	\$ 119	\$ 142		\$ 85	\$ 1.533		

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Drill down

Category	Metrics	Dollar Sales	
	Year	1997	1998
Electronics		\$ 10.616	\$ 29.299
Food		\$ 5.300	\$ 5.638
Gifts		\$ 16.315	\$ 20.047
Health & Beauty		\$ 6.042	\$ 5.665
Household		\$ 38.383	\$ 50.391
Kid's Korner		\$ 2.559	\$ 2.943
Travel		\$ 4.497	\$ 4.792



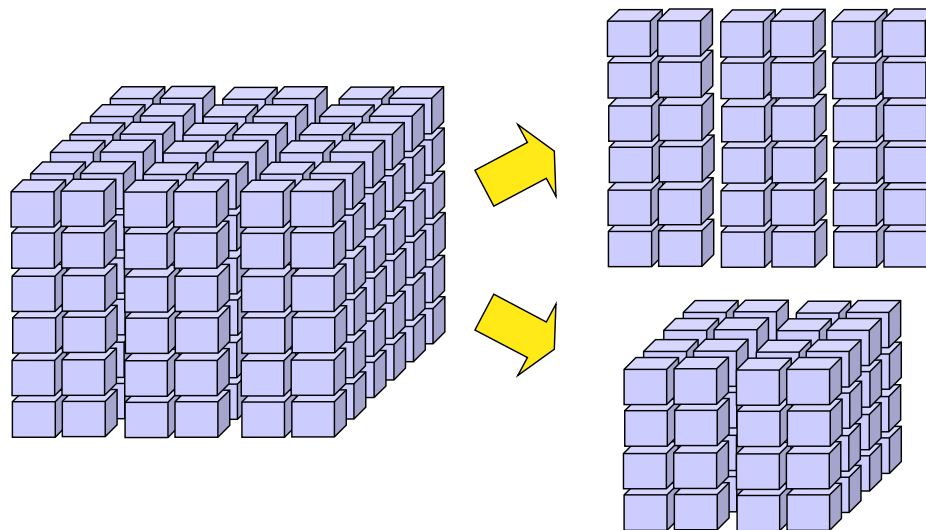
Category	Metrics Customer Region Year	Dollar Sales											
		North-East		Mid-Atlantic		South-East		Central		South		North-West	
		1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Electronics		\$ 138	\$ 1.184	\$ 1.774	\$ 4.529	\$ 384	\$ 1.892	\$ 138	\$ 7.232	\$ 2.346	\$ 651	\$ 2.554	\$ 9.488
Food		\$ 759	\$ 538	\$ 682	\$ 925	\$ 729	\$ 959	\$ 262	\$ 677	\$ 588	\$ 213	\$ 469	\$ 1.503
Gifts		\$ 2.532	\$ 1.955	\$ 1.355	\$ 2.785	\$ 1.854	\$ 2.800	\$ 1.413	\$ 2.695	\$ 2.535	\$ 1.813	\$ 2.132	\$ 2.844
Health & Beauty		\$ 624	\$ 611	\$ 640	\$ 887	\$ 1.317	\$ 566	\$ 647	\$ 382	\$ 588	\$ 499	\$ 754	\$ 1.162
Household		\$ 5.354	\$ 5.787	\$ 4.112	\$ 5.320	\$ 5.410	\$ 5.416	\$ 4.446	\$ 6.812	\$ 3.058	\$ 4.334	\$ 3.974	\$ 5.008
Kid's Korner		\$ 201	\$ 247	\$ 398	\$ 422	\$ 485	\$ 441	\$ 186	\$ 380	\$ 409	\$ 221	\$ 323	\$ 592
Travel		\$ 624	\$ 608	\$ 505	\$ 559	\$ 564	\$ 1.096	\$ 386	\$ 611	\$ 300	\$ 464	\$ 978	\$ 316

From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Slice and dice

- Selection of a data subset by means of selection predicates
 - slice: equality predicate selecting a “slice”
 - example: Year=2005
 - dice: predicate expression selecting a “dice”
 - example: Category='Food' and City='Torino'

Slice and dice



From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Slice and dice

Category	Year	Metrics Customer Region	Dollar Sales									
			North-East	Mid-Atlantic	South-East	Central	South	North-West	South-West	England	France	Germa
Electronics	1997		\$ 138	\$ 1.774	\$ 384	\$ 138	\$ 2.346	\$ 2.554	\$ 2.184	\$ 566	\$ 199	\$
	1998		\$ 1.184	\$ 4.529	\$ 1.892	\$ 7.232	\$ 651	\$ 9.488	\$ 476	\$ 2.683	\$ 462	\$ 702
Food	1997		\$ 759	\$ 682	\$ 729	\$ 262	\$ 588	\$ 469	\$ 807	\$ 156	\$ 615	\$ 100
	1998		\$ 538	\$ 925	\$ 959	\$ 677	\$ 213	\$ 1.503	\$ 261	\$ 165	\$ 175	\$ 100
Gifts	1997		\$ 2.532	\$ 1.355	\$ 1.854	\$ 1.413	\$ 2.535	\$ 2.132	\$ 1.904	\$ 908	\$ 375	\$ 1.000
	1998		\$ 1.955	\$ 2.785	\$ 2.800	\$ 2.695	\$ 1.813	\$ 2.844	\$ 1.778	\$ 1.158	\$ 717	\$ 686
Health & Beauty	1997		\$ 624	\$ 640	\$ 1.317	\$ 647	\$ 588	\$ 754	\$ 654	\$ 143	\$ 292	\$ 300
	1998		\$ 611	\$ 887	\$ 566	\$ 382	\$ 499	\$ 1.162	\$ 1.044	\$ 273	\$ 72	\$ 55
Household	1997		\$ 5.354	\$ 4.112	\$ 5.410	\$ 4.446	\$ 3.058	\$ 3.974	\$ 2.654	\$ 3.545	\$ 2.875	\$ 1.900
	1998		\$ 5.787	\$ 5.320	\$ 5.416	\$ 6.812	\$ 4.334	\$ 5.008	\$ 7.588	\$ 2.139	\$ 3.649	\$ 2.791
Kid's Korner	1997		\$ 201	\$ 398	\$ 485	\$ 186	\$ 409	\$ 323	\$ 396	\$ 105	\$ 34	\$
	1998		\$ 247	\$ 422	\$ 441	\$ 380	\$ 221	\$ 592	\$ 290	\$ 198	\$ 19	\$ 69
Travel	1997		\$ 624	\$ 505	\$ 564	\$ 386	\$ 300	\$ 978	\$ 416	\$ 48	\$ 38	\$
	1998		\$ 608	\$ 559	\$ 1.096	\$ 611	\$ 464	\$ 316	\$ 573	\$ 257	\$ 198	\$ 55



Filter Details: Year = 1998											
Category	Metrics Customer Region	Dollar Sales									
		North-East	Mid-Atlantic	South-East	Central	South	North-West	South-West	England	France	Germany
Electronics		\$ 1.184	\$ 4.529	\$ 1.892	\$ 7.232	\$ 651	\$ 9.488	\$ 476	\$ 2.683	\$ 462	\$ 702
Food		\$ 538	\$ 925	\$ 959	\$ 677	\$ 213	\$ 1.503	\$ 261	\$ 165	\$ 175	\$ 100
Gifts		\$ 1.955	\$ 2.785	\$ 2.800	\$ 2.695	\$ 1.813	\$ 2.844	\$ 1.778	\$ 1.158	\$ 717	\$ 686
Health & Beauty		\$ 611	\$ 887	\$ 566	\$ 382	\$ 499	\$ 1.162	\$ 1.044	\$ 273	\$ 72	\$ 55
Household		\$ 5.787	\$ 5.320	\$ 5.416	\$ 6.812	\$ 4.334	\$ 5.008	\$ 7.588	\$ 2.139	\$ 3.649	\$ 2.791
Kid's Korner		\$ 247	\$ 422	\$ 441	\$ 380	\$ 221	\$ 592	\$ 290	\$ 198	\$ 19	\$ 69
Travel		\$ 608	\$ 559	\$ 1.096	\$ 611	\$ 464	\$ 316	\$ 573	\$ 257	\$ 198	\$ 55

From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Slice and dice

Subcategory	Metrics Customer City	Dollar Sales											
		Afton	Akron	Albon	Alcameda	Alka	Allagash	Alta	Altoola	Amestra	Amsterdam	Andersonville	Annap
Audio							\$ 85						
Automotive								\$ 30					
Chocolate		\$ 42	\$ 42		\$ 50		\$ 20	\$ 22	\$ 44				\$
Christmas		\$ 30					\$ 25	\$ 30	\$ 15				
Classic Toys							\$ 7	\$ 26				\$ 38	
Coffee				\$ 9									
Comfort					\$ 59		\$ 59						
Furniture								\$ 485					
Gadgets							\$ 199	\$ 79	\$ 79				
Games & Puzzles							\$ 17		\$ 45			\$ 45	
Gift Baskets			\$ 55	\$ 43									\$
Golf		\$ 25						\$ 25	\$ 14			\$ 25	
Hearth									\$ 15				
Jewelry		\$ 75			\$ 189		\$ 24	\$ 77	\$ 189	\$ 24			
Kitchen							\$ 55	\$ 21	\$ 76				\$:
Lawn & Garden		\$ 75		\$ 100		\$ 15	\$ 63	\$ 100	\$ 180	\$ 67	\$ 40	\$:	
Learning		\$ 16						\$ 37					
Meat & Cheese			\$ 40		\$ 20			\$ 20				\$ 25	
Miscellaneous			\$ 200	\$ 1.320		\$ 200	\$ 139		\$ 993				
Natural Remedies		\$ 13							\$ 13				
Pets		\$ 215		\$ 26			\$ 30	\$ 68	\$ 115	\$ 25	\$ 34	\$:	
Plants & Flowers		\$ 65	\$ 65	\$ 65				\$ 50	\$ 60				\$
Safety & Security								\$ 30	\$ 22	\$ 22			
Skin Care													
Sleeping				\$ 18									
Toys & Accessories								\$ 29	\$ 185	\$ 744			\$:



Filter Details:

- Category = Electronics
- AND
- Dollar Sales > 80
- AND
- Customer Region = North-West
- AND
- Year = 1997

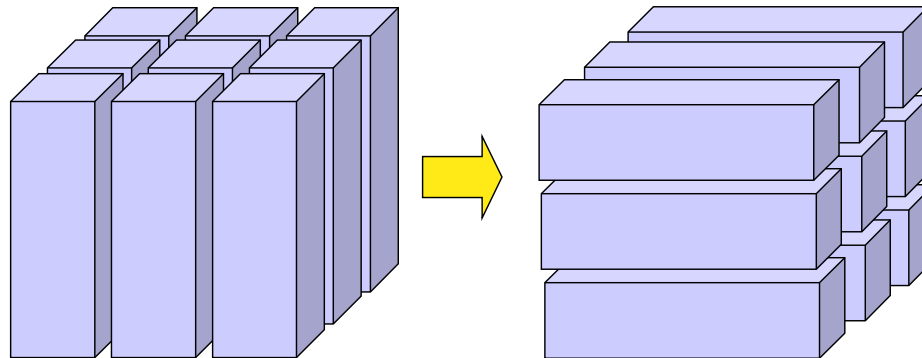
Subcategory	Metrics Customer City	Dollar Sales					
		Alta	Armstrong	Avery Heights	Lane	Mt. Everest	San Francisco
Audio			\$ 98		\$ 123	\$ 85	
Comfort				\$ 118		\$ 1.495	
Gadgets		\$ 199					\$ 199

From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Pivot

- Reorganization of the multidimensional structure without varying the detail level
 - increases readability of the same information
 - multidimensional representation is always based on a “grid” (hierarchical spreadsheet)
 - two dimensions are the main grid axes
 - position of dimensions in the grid are changed

Pivot



From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006

Pivot

Category	Metrics	Dollar Sales
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Electronics	1997	\$ 10.616
	1998	\$ 29.299
Food	1997	\$ 5.300
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	Year	1997	1998
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Electronics	1997		\$ 138	\$ 1.774	\$ 384	\$ 138	\$ 2.346	\$ 2.554	\$ 2.184	\$ 566	\$ 199	\$
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Food	1997		\$ 759	\$ 682	\$ 729	\$ 262	\$ 588	\$ 469	\$ 807	\$ 156	\$ 615	\$ 1
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Health & Beauty	1997		\$ 624	\$ 640	\$ 1.317	\$ 647	\$ 588	\$ 754	\$ 654	\$ 143	\$ 292	\$ 3
	1998		\$ 611	\$ 887	\$ 566	\$ 382	\$ 499	\$ 1.162	\$ 1.044	\$ 273	\$ 72	
Household	1997		\$ 5.354	\$ 4.112	\$ 5.410	\$ 4.446	\$ 3.058	\$ 3.974	\$ 2.654	\$ 3.545	\$ 2.875	\$ 1.9
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	1998		\$ 608	\$ 559	\$ 1.096	\$ 611	\$ 464	\$ 316	\$ 573	\$ 257	\$ 198	\$



Category	Metrics Customer Region Year	Dollar Sales											
		North-East		Mid-Atlantic		South-East		Central		South		North-West	
		1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
Electronics		\$ 138	\$ 1.184	\$ 1.774	\$ 4.529	\$ 384	\$ 1.892	\$ 138	\$ 7.232	\$ 2.346	\$ 651	\$ 2.554	\$ 9.488
Food		\$ 759	\$ 538	\$ 682	\$ 925	\$ 729	\$ 959	\$ 262	\$ 677	\$ 588	\$ 213	\$ 469	\$ 1.503
Gifts		\$ 2.532	\$ 1.955	\$ 1.355	\$ 2.785	\$ 1.854	\$ 2.800	\$ 1.413	\$ 2.695	\$ 2.535	\$ 1.813	\$ 2.132	\$ 2.844
Health & Beauty		\$ 624	\$ 611	\$ 640	\$ 887	\$ 1.317	\$ 566	\$ 647	\$ 382	\$ 588	\$ 499	\$ 754	\$ 1.162
Household		\$ 5.354	\$ 5.787	\$ 4.112	\$ 5.320	\$ 5.410	\$ 5.416	\$ 4.446	\$ 6.812	\$ 3.058	\$ 4.334	\$ 3.974	\$ 5.008
Kid's Korner		\$ 201	\$ 247	\$ 398	\$ 422	\$ 485	\$ 441	\$ 186	\$ 380	\$ 409	\$ 221	\$ 323	\$ 592
Travel		\$ 624	\$ 608	\$ 505	\$ 559	\$ 564	\$ 1.096	\$ 386	\$ 611	\$ 300	\$ 464	\$ 978	\$ 316

From Golfarelli, Rizzi, "Data warehouse, teoria e pratica della progettazione", McGraw Hill 2006