

# Notes on Contemporary Table Recognition

*George Nagy*

DocLab

Department of Electrical, Computer, and Systems Engineering,  
Rensselaer Polytechnic Institute, Troy, NY 12180

*and David W. Embley (BYU), and Daniel Lopresti (Lehigh University) and NSF # 0414854*

*and my past and current students, and all the folks on whose work I have freely.*

# Traditional Terminology

Stub		Column Header					Dimension
Stub Head	Box Head	Nested Column Header			Dimension		
Course	CS.AI.131 - Artificial Intelligence (Introduction & Algorithms)						
Student	John Doe						
Term	Assignments			Exams		Final Grade	
	1	2	3	Midterm	Final		
2003	Fall	85	80	90	60	85	77,5
	Winter	79,5	50,5	82,5	60	70	67,3
	Spring	78	89	-	55	80	62,8
2004	Fall	60	77	68	70	75	70,8
	Winter	82	63	75	75	80	75,8
	Spring	-	100	-	75	85	61,3

Row Header: 2003, 2004  
 Nested Row Header: Fall, Winter, Spring  
 Cell: 85, 80, 90, 60, 85, 77,5  
 Block: 75, 75  
 Body: 75  
 Dimension Header: Final Grade

# Traditional Terminology (2)

Stub head      Stub separation      Boxhead

Term	Assignments			Examinations		Final
	Ass1	Ass2	Ass3	Midterm	Final	Grade
1991						
Winter	85	80	75	60	75	75
Spring	80	65	75	60	70	70
Fall	80	85	75	55	80	75
1992						
Winter	85	80	70	70	75	75
Spring	80	80	70	70	75	75
Fall	75	70	65	60	80	70

Boxhead separation

Row

Stub

Cell

Column

Block

Body

# Levels of Table Recognition

**Start:** Print, ASCII, HTML, PDF, EXCEL, ...

- Detection, isolation, extraction
- Structural analysis (recover 2-D array structure)
- Canonicalization (distribute headers)
- Transcription (recover text)
- Interpretation (Wang Notation: layout-independent representation)
- Understanding (?)

**End:** editable/reconfigurable/reusable table, DB, IR, DM, SWeb

# Detection, isolation, extraction

## 5. Evaluation of WNT

Every attempt by every subject was recorded in detail during evaluation. An example of the complete log for one attempt appears in Appendix E. The log recorded times and button clicks made by the user, specifying whether the button click was to undo a mistake or not. A subject's interaction with WNT can be re-created with the logs. Appendix G shows summaries of times for every table.

An example summary table for T09 is shown in Table 5. All values (time in seconds) are averages over subjects. *# of attempts* is the average number of attempts made by all subjects on a table. *Time for Pre-Processing* (computer time) is the time taken to display the original HTML table, convert the ASCII file to a Matlab array, and display a corresponding GUI to the subject. *Time to Construct Categories* (subject time) is the time taken by subjects to think about and click the cells designating categories. This time indicates the confusion factor (Section 0) of a table; subjects spend more time constructing categories when a table is confusing.

*Time for Category Correction* (subject time) is the time subjects took to correct all categories in the table using the error-correction GUI. This time is higher for confusing and badly-formed tables and lower when subjects have seen similar tables before. *Time for Final Processing* (computer time) is the time taken to perform final category processing, generate category notation, generate delta notation, and generate the XML representation. *Total Time* is the addition of all time and *% Subject Time* is the percent of total time that is subject time.

Table 5: Distribution of Processing Time for T09, Average Over All Subjects

	AVERAGE	STD. DEVIATION
# of attempts	1.67	0.65
Time for Pre-Processing	0.52	0.10
Time to Construct Categories	80.68	67.63
Time for Category Correction	103.21	126.45
Time for Final Processing	0.42	0.19
Total Time	184.81	192.11
Percent Table is Completed	77.78	35.06
% Subject Time	0.99	0.01

Wang notation was generated in 82.75% of all attempts and was generated *correctly* in 57.25% of all attempts (Table 6). Figure 45 shows the results of the evaluation by

50



	AVERAGE	STD. DEVIATION
# of attempts	1.67	0.65
Time for Pre-Processing	0.52	0.10
Time to Construct Categories	80.68	67.63
Time for Category Correction	103.21	126.45
Time for Final Processing	0.42	0.19
Total Time	184.81	192.11
Percent Table is Completed	77.78	35.06
% Subject Time	0.99	0.01

# Array Models for Structural Analysis





Cells are larger left and top

# “Canonicalization”

Year	Term	Mark					
		Assignments			Examinations		Grade
		Ass1	Ass2	Ass3	Midterm	Final	
1991	Winter	85	80	75	60	75	75
	Spring	80	65	75	60	70	70
	Fall	80	85	75	55	80	75
1992	Winter	85	80	70	70	75	75
	Spring	80	80	70	70	75	75
	Fall	75	70	65	60	80	70

?	?	Mark	Mark	Mark	Mark	Mark	Mark
?	?	Ass't	Ass't	Ass't	Exams	Exams	Grade
?	?	Ass 1	Ass 2	Ass 3	Midterm	Final	Grade
1991	Winter	85	80	75	60	75	75
1991	Spring	80	65	75	60	70	70
1991	Fall	80	85	75	55	80	75
1992	Winter	85	80	70	70	75	75
1992	Spring	80	80	70	70	75	75
1992	Fall	75	70	65	60	80	70

# Asymmetry

AGE	MALE		FEMALE	
	WEIGHT	HEIGHT	WEIGHT	HEIGHT
5				
10				
15				

		MALE		FEMALE	
		WEIGHT	HEIGHT	WEIGHT	HEIGHT
AGE	5				
	10				
	15				



# Example of low-level analysis

Table I

<b>fleck</b>	<b>gosity (ld/gg)</b>	<b>hepth (gd)</b>
<b>burlam</b>	1.2	120
<b>falder</b>	2.3	230
<b>multon</b>	2.5	350

# Structural Analysis

XXXXXX	XXXXXXXX XXXX	XXXXXX XXX
XXXXXX	XXX	XXX
XXXXXX	XXX	XXX
XXXXXX	XXX	XXX

# Table Transcription

fleck	gonsity (ld/gg)	hepth (gd)
burlam	1.2	120
falder	2.3	230
multon	2.5	350

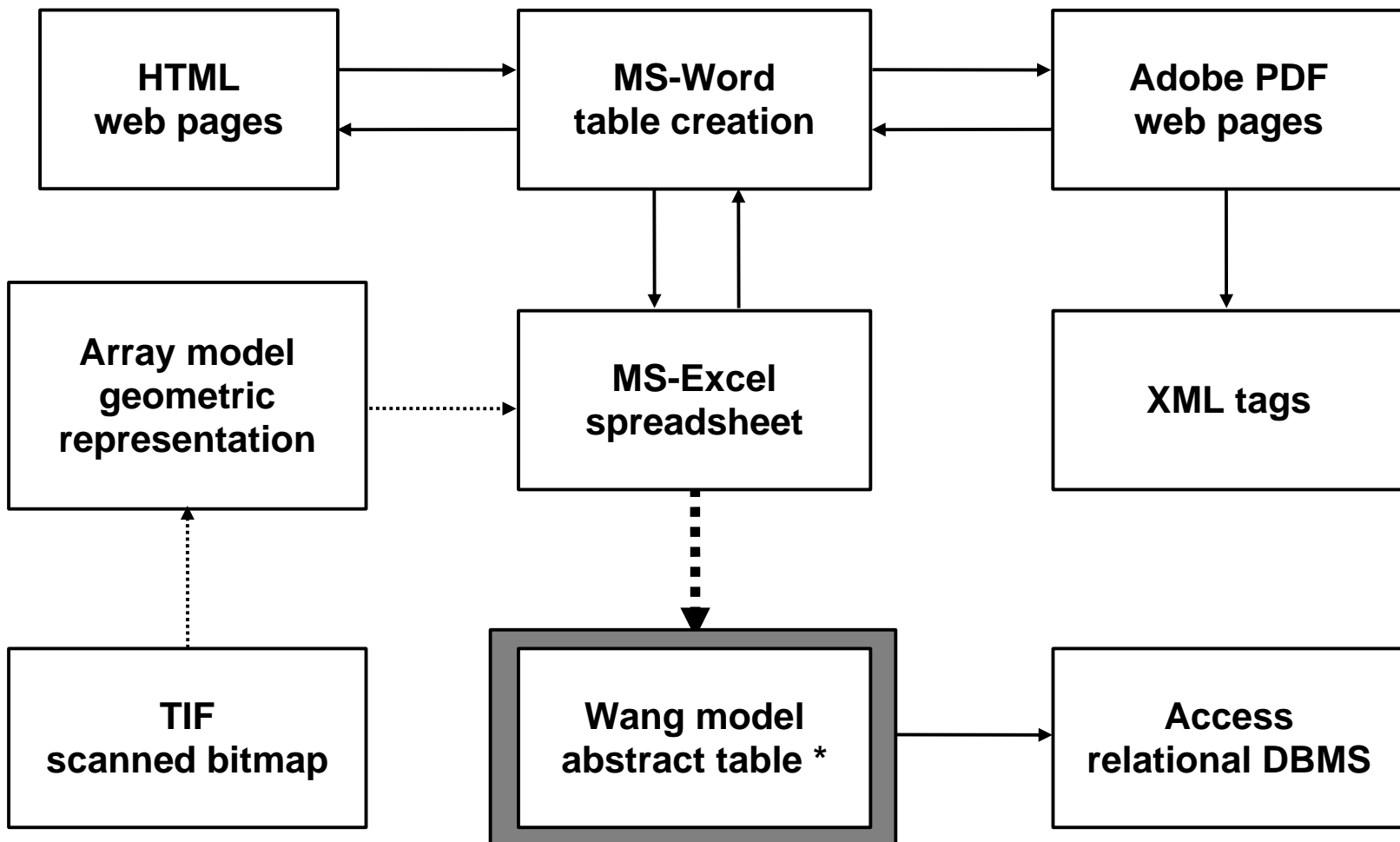
# Another relevant table

Table II

goldam	1.2 ld/gg	120 gd
falder	2.3 ld/gg	230 gd
elmer	2.5 ld/gg	350 gd

Table transcription is not sufficient for combining information from Table I and Table II. But it can often be accomplished with current commercial software.

# Existing Table Conversion Software



\* *Tabular abstraction, editing, and formatting*, Xinxin Wang, PhD thesis, University of Waterloo, 1996.

# Existing Table Conversion Software

Table as rendered by Microsoft Internet Explorer 6.0:

Organization for Standardization (ISO) in the ISO 3166 Alpha-2 list and used by the Internet Assigned Numbers Authority (IANA) to establish country-coded top-level domains (ccTLDs).

Entity	FIPS 10-4	ISO 3166		Internet	Comment
		ISO 3166-1	ISO 3166-2		
<b>Afghanistan</b>	AF	AF	AFG	004	.af
<b>Albania</b>	AL	AL	ALB	008	.al
<b>Algeria</b>	AG	DZ	DZA	012	.dz
<b>American Samoa</b>	AQ	AS	ASM	016	.as

# Existing Table Conversion Software

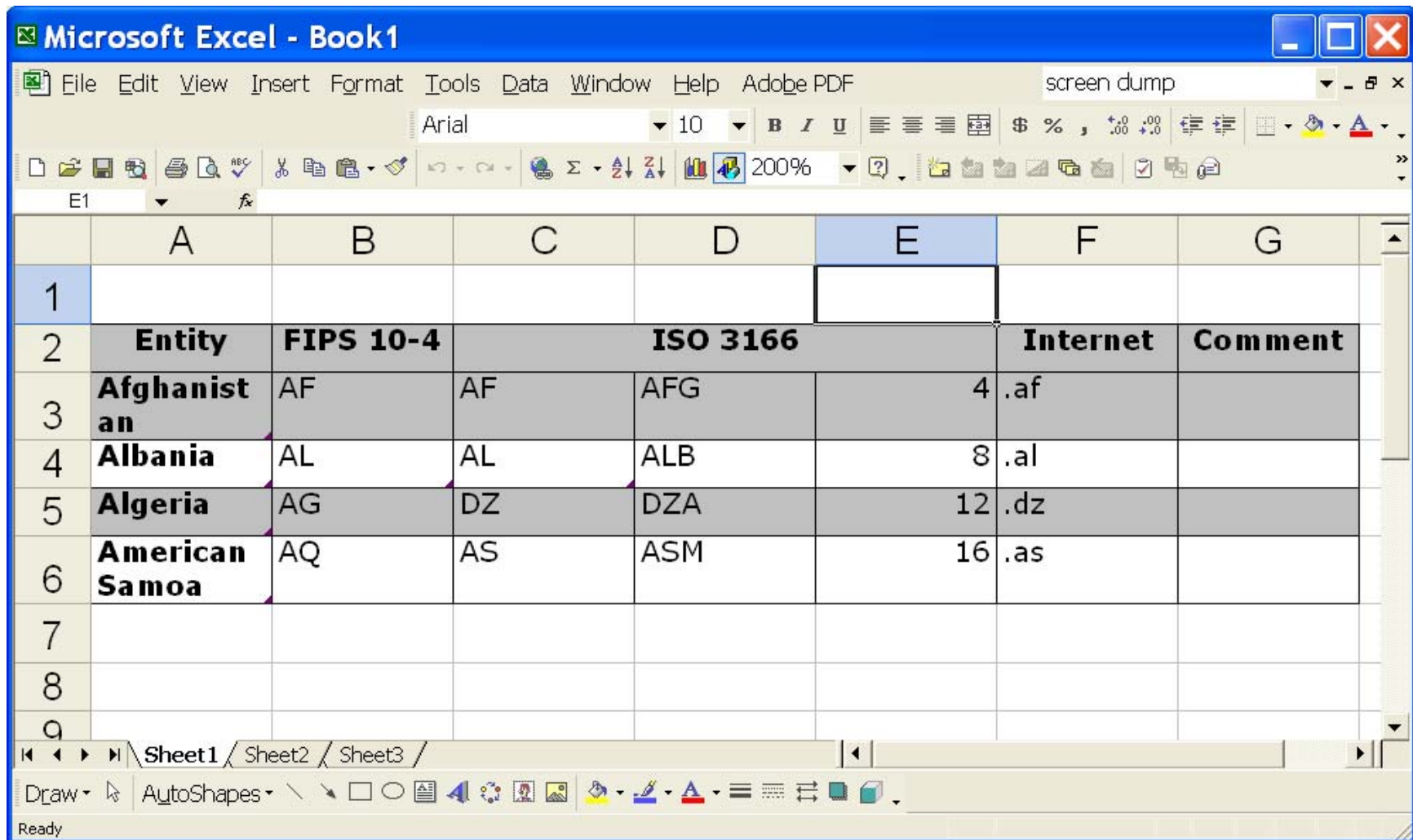
Table copied into Microsoft Word 10.2:

Entity	FIPS 10- 4	ISO 3166			Internet	Comment
Afghanistan	AF	AF	AFG	004	.af	
Albania	AL	AL	ALB	008	.al	
Algeria	AG	DZ	DZA	012	.dz	
American Samoa	AQ	AS	ASM	016	.as	

Not as an image or graphics!

# Existing Table Conversion Software

Table copied from Microsoft Word into Excel 10.2:



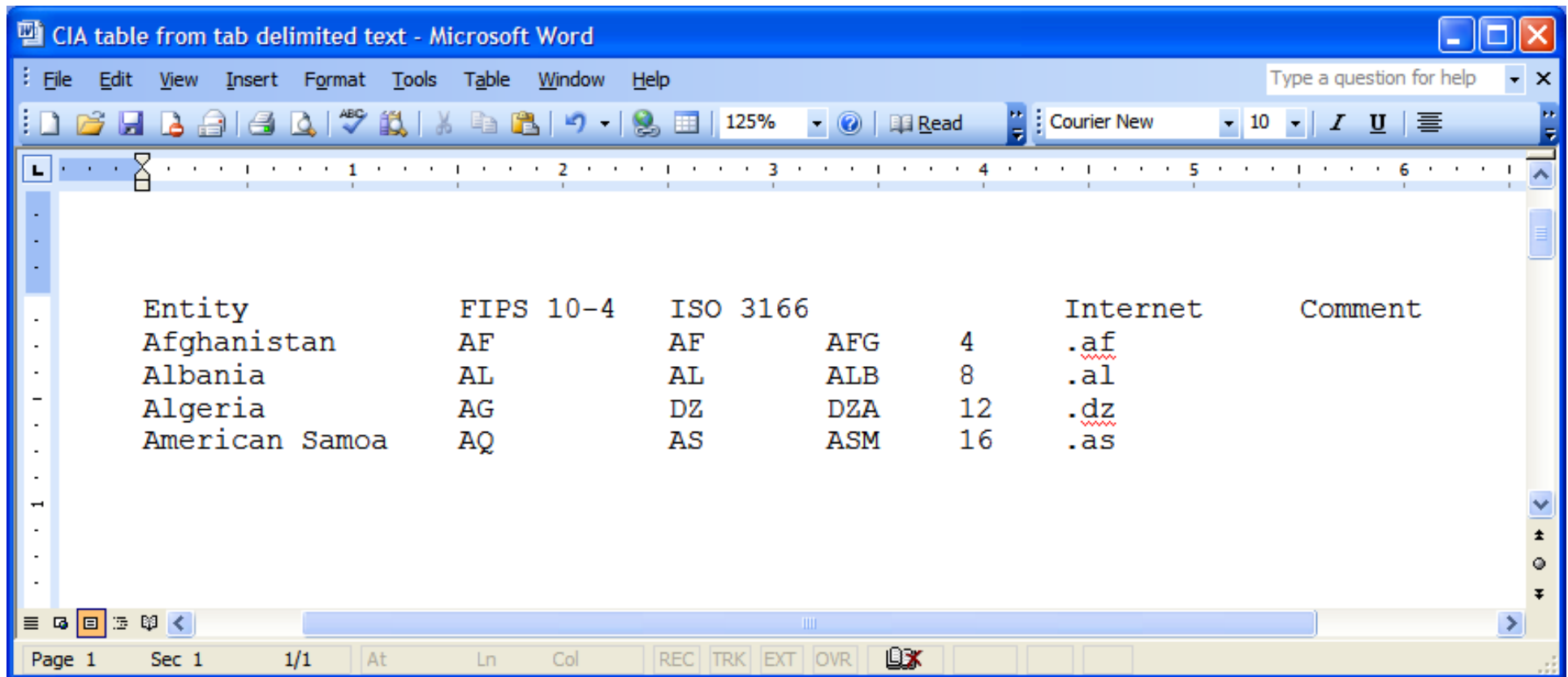
The screenshot shows a Microsoft Excel 10.2 window titled "Microsoft Excel - Book1". The window displays a table with 7 columns and 9 rows. The columns are labeled "Entity", "FIPS 10-4", "ISO 3166", "Internet", and "Comment". The data is as follows:

	A	B	C	D	E	F	G
1							
2	Entity	FIPS 10-4	ISO 3166		Internet	Comment	
3	Afghanistan	AF	AF	AFG	4	.af	
4	Albania	AL	AL	ALB	8	.al	
5	Algeria	AG	DZ	DZA	12	.dz	
6	American Samoa	AQ	AS	ASM	16	.as	
7							
8							
9							



# Existing Table Conversion Software

ASCII version of the table (as rendered by MS Word):



The screenshot shows a Microsoft Word window titled "CIA table from tab delimited text - Microsoft Word". The document content is as follows:

Entity	FIPS 10-4	ISO 3166	Internet	Comment	
Afghanistan	AF	AF	AFG	4	.af
Albania	AL	AL	ALB	8	.al
Algeria	AG	DZ	DZA	12	.dz
American Samoa	AQ	AS	ASM	16	.as

# Existing Table Conversion Software

Table rendered from a PDF file:

**Table 3. Dissimilarity indexes of labor force projections**

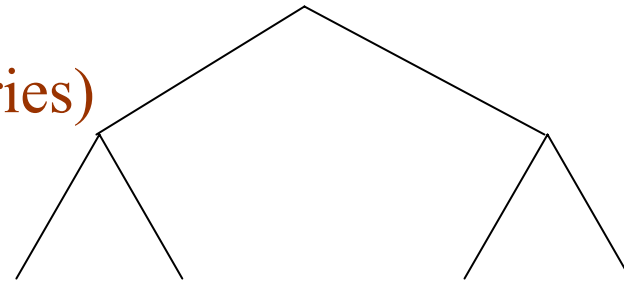
Age	BLS projections	Standards of comparison		
		Actual population and—		Census population estimate and—
		BLS participation rate	1988 participation rate	1988 participation rate
Gender, age .....	1.83	2.02	2.24	2.32
Men, age .....	1.63	.91	.62	1.37
Women, age .....	1.91	2.86	2.4	1.32

Can be saved at .rtf

# Table Interpretation

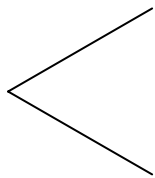
(row/col header  $\leftrightarrow$  content cell relations)

- Table headers as category trees
- *Dimensionality* (number of categories)
- Tables as *hypercubes*
- Wang Notation



roots?

This is a 2-D  
table



	INCOME		EXPENSE	
	SERVICES	PRODUCTS	SALARIES	TAXES
2008	8,000,000	12,500,000	4,000,000	1,700,000
2009	8,800,000	14,000,000	4,500,000	1,800,000

Any combination of paths through the category trees must lead to a delta cell;  
Each delta cell can be reached through a combination of category paths.

# Table Interpretation

(stub)		virtual column header ("characteristic")	
		gosity (ld/gg)	hepth (gd)
fleck	burlam	1.2	120
	falder	2.3	230
	multon	2.5	350

# “Layout-invariant” Wang Notation

*Categories*

$C = (\text{fleck}, \{(\text{bulram}, \phi), (\text{falder}, \phi), (\text{multon}, \phi)\}),$   
 $(\text{characteristic}, \{(\text{gonsity}, \phi), (\text{hepth}, \phi)\}).$

*Header cell mappings*

$\square\delta =$   
 $(\{\text{fleck.burlam}, \text{characteristic.gonsity}\}) \rightarrow 1.2$   
 $(\{\text{fleck.falder}, \text{characteristic.gonsity}\}) \rightarrow 2.3$   
 $\dots$   
 $(\{\text{fleck.multon}, \text{characteristic.hepth}\}) \rightarrow 350$

Essentially a set of category trees with common leaf cells – requires modification for table interpretation.

# Table III

		fleck		
		burlam	falder	multon
virtual row header	gosity (ld/cg)	1.2	2.3	2.5
	hepth (ld/cg)	120	230	350

Table I

Same Wang Notation as Table I.

fleck	gosity (ld/cg)	hepth (cd)
burlam	1.2	120
falder	2.3	230
multon	2.5	350

# Well-Formed Tables (WFT)

D1	C1	B1	A1	delta
D1	C1	B1	A2	delta
D1	C1	B2	A1	delta
D1	C1	B2	A2	delta
D1	C1	B3	A1	delta
D1	C1	B3	A2	delta
D1	C2	B1	A1	delta
D1	C2	B1	A2	delta
D1	C2	B2	A1	delta
D1	C2	B2	A2	delta
D1	C2	B3	A1	delta
D1	C2	B3	A2	delta
D1	C3	B1	A1	delta
D1	C3	B1	A2	delta
D1	C3	B2	A1	delta
D1	C3	B2	A2	delta
D1	C3	B3	A1	delta
D1	C3	B3	A2	delta
D1	C4	B1	A1	delta
D1	C4	B1	A2	delta
D1	C4	B2	A1	delta
D1	C4	B2	A2	delta
D1	C4	B3	A1	delta
D1	C4	B3	A2	delta

C1	B1	A1
C1	B1	A1
C1	B1	A1
C1	B1	A1
C1	B1	A1
C1	B1	A1
C2	B1	A1
C2	B1	A1
C2	B2	A1
C2	B2	A1
C2	B2	A1
C2	B2	A1
C3	B2	A2
C3	B2	A2
C3	B2	A2
C3	B2	A2
C3	B3	A2
C3	B3	A2
C4	B3	A2
C4	B3	A2
C4	B3	A2
C4	B3	A2
C4	B3	A2

D1	C1	B1	A1
D1	C1	B1	A2
D1	C1	B2	A1
D1	C1	B2	A2
D1	C1	B3	A1
D1	C1	B4	A2
D1	C2	B1	A1
D1	C2	B1	A2
D1	C2	B2	A1
D1	C2	B2	A2
D1	C2	B3	A1
D1	C2	B3	A2
D1	C3	B1	A1
D1	C3	B1	A2
D1	C3	B2	A1
D1	C3	B2	A2
D1	C3	B3	A1
D1	C3	B3	A2
D1	C4	B1	A1
D1	C4	B1	A2
D1	C4	B2	A1
D1	C4	B2	A2
D1	C4	B3	A1
D1	C4	B3	A2

every row unique

#items	4	3	2
# repetitions	6	8	12
# list rows	24	24	24

every row unique

# 6-D table

**Table 5. Average temperatures, 1900/2000, degrees centigrade**

HEMISPHERE			S	S	S	S	N	N	N	N
LATITUDE			10°	10°	20°	20°	10°	10°	20°	20°
WATER/LAND			water	land	water	land	water	land	water	land
YEAR	SEASON	TIME								
1900	summer	noon	32	35	37	39	30	33	35	38
1900	summer	midnight	28	32	33	35	26	29	30	35
1900	winter	noon	21	25	28	28	21	24	25	26
1900	winter	midnight	18	22	24	26	17	20	17	22
2000	summer	noon	33	37	37	40	30	33	36	39
2000	summer	midnight	29	32	34	35	26	29	30	35
2000	winter	noon	21	25	27	28	22	23	24	26
2000	winter	midnight	20	22	25	26	18	21	18	22



# 6-D table (cont'd)

**Table 5. Average temperatures, North and South himisphere, degrees centigrade**

LATITUDE WATER/LAND				10° water	10° land	20° water	20° land
HEMI- SPHERE	YEAR	SEASON	TIME				
S	1900	summer	noon	32	35	37	39
S	1900	summer	midnight	28	32	33	35
S	1900	winter	noon	21	25	28	28
S	1900	winter	midnight	18	22	24	26
S	2000	summer	noon	33	37	37	40
S	2000	summer	midnight	29	32	34	35
S	2000	winter	noon	21	25	27	28
S	2000	winter	midnight	20	22	25	26
N	1900	summer	noon	30	33	35	38
N	1900	summer	midnight	26	29	30	35
N	1900	winter	noon	21	24	25	26
N	1900	winter	midnight	17	20	17	22
N	2000	summer	noon	30	33	36	39
N	2000	summer	midnight	26	29	30	35
N	2000	winter	noon	22	23	24	26
N	2000	winter	midnight	18	21	18	22

(same data, different emphasis)

# On Human Interaction

- Complete automation is still out of reach.
- Some HCI is unavoidable, sooner or later.
- Sooner is better than later.
- Discovering errors later increases negative consequences (and potential for embarrassment).
- Partial automation + interaction is more accurate than machine alone and faster than unaided human.
- *TabbyCat* (for “table categorizer”) and *WNT* (Wang Notation Tool) are prototype interactive tools for supporting Wang-style markup.

# Table Annotation & Truthing

Snapshot of *TabbyCat* for creating Wang-style table mark-up:

The screenshot displays the TabbyCat software interface. The main window, titled 'table3.html', shows a table with the following data:

Age	BLS projections	Standards of comparison		
		Actual population and-		Census population estimate and-
		BLS participation rate	1988 participation rate	1988 participation rate
Gender / age .....	1.83	2.02	2.24	2.32
Men / age .....	1.63	.91	.62	1.37
Women / age .....	1.91	2.86	2.4	1.32

The 'Annotate Categories' dialog shows a hierarchical structure of categories:

- Dim 1: Age (0,0), Gender / age ..... (3,0), Men / age ..... (4,0), Women / age ..... (5,0)
- Dim 2: Standards of comparison (0,1), Actual population and- (1), BLS participation rate (2,1), 1988 participation rate (2), Census population estimate (2)

The 'Annotate Mappings' dialog shows the following mappings:

- Dim 0: null -> Age (0,0) -> Gender / age ..... (3,0) ->
- Dim 1: null -> -> Standards of comparison (0,2) -> Actual population

The 'Data cell' is set to '2.02 (3,2)' and the 'Current index' is 4. The 'Children' count is 2.

# Table Annotation & Truthing

*TabbyCat:*

The screenshot displays the TabbyCat software interface, which is used for table annotation and truthing. The main window, titled "table2.html", shows a table with the following structure:

Year	Term	Mark					
		Assignments			Examinations		Grade
		Ass1	Ass2	Ass3	Midterm	Final	
1991	Winter	85	80	75	60	75	75
	Spring	80					
	Fall	80	85				
1992	Winter	85	80				
	Spring	80	80				
	Fall	75	70				

The interface includes several windows for annotation and truthing:

- Annotate Categories:** A window showing dimensions (Dim 1, Dim 2, Dim 3) and their corresponding categories. Dim 1 (Year) is linked to 1991 and 1992. Dim 2 (Term) is linked to Winter, Spring, and Fall. Dim 3 (Mark) is linked to Assignments, Examinations, and Grade.
- Annotate Mappings:** A window showing mappings for dimensions. Dim 0: null -> Year (0,0) -> 1991 (3,0) ->. Dim 1: null -> Term (0,1) -> Fall (5,0) (8,0) ->. Dim 2: null -> Mark (0,2) -> Assignments (1,0) -> Ass1 (2,0) ->. The current index is 5.
- Children:** A window showing the number of children (3) for the current cell.

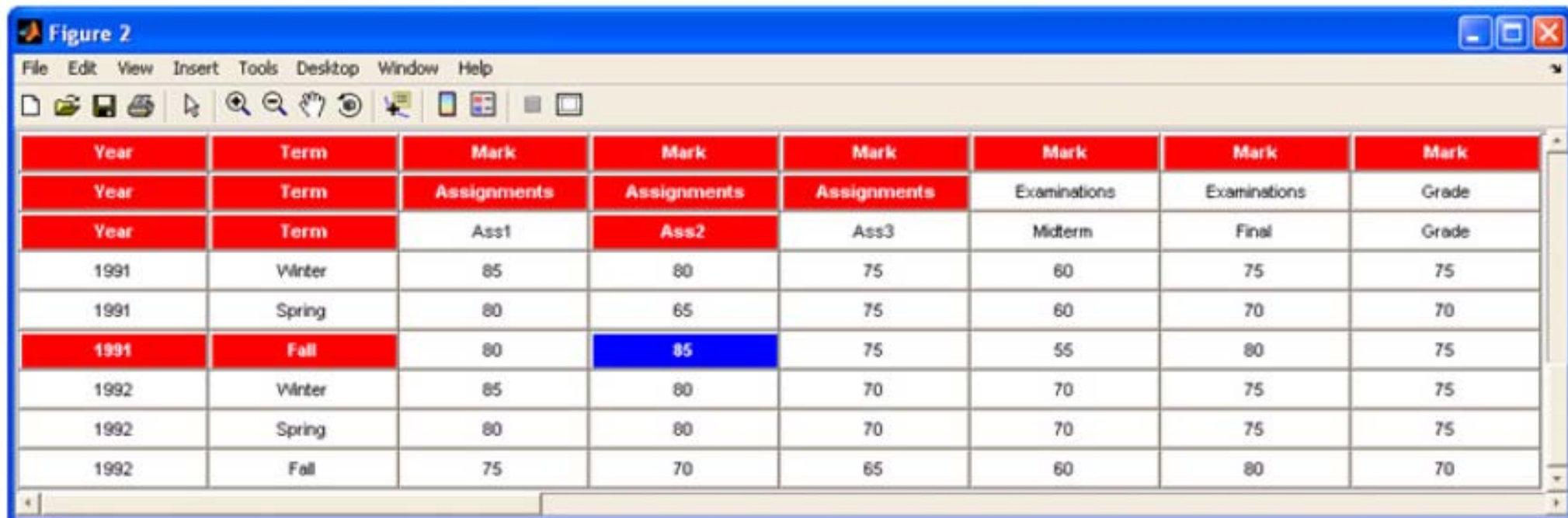
# Table Annotation & Truthing

WNT:

Year	Term	Mark					
		Assignments			Examinations		Grade
		Ass1	Ass2	Ass3	Midterm	Final	
1991	Winter	85	80	75	60	75	75
	Spring	80	65	75	60	70	70
	Fall	80	85	75	55	80	75
1992	Winter	85	80	70	70	75	75
	Spring	80	80	70	70	75	75
	Fall	75	70	65	60	80	70

# Table Annotation & Truthing

WNT (verification):



Year	Term	Mark	Mark	Mark	Mark	Mark	Mark
Year	Term	Assignments	Assignments	Assignments	Examinations	Examinations	Grade
Year	Term	Ass1	Ass2	Ass3	Midterm	Final	Grade
1991	Winter	85	80	75	60	75	75
1991	Spring	80	65	75	60	70	70
1991	Fall	80	85	75	55	80	75
1992	Winter	85	80	70	70	75	75
1992	Spring	80	80	70	70	75	75
1992	Fall	75	70	65	60	80	70

Figure 39: Verifying Delta Cell (1)

# Table Annotation & Truthing

WNT (verification):

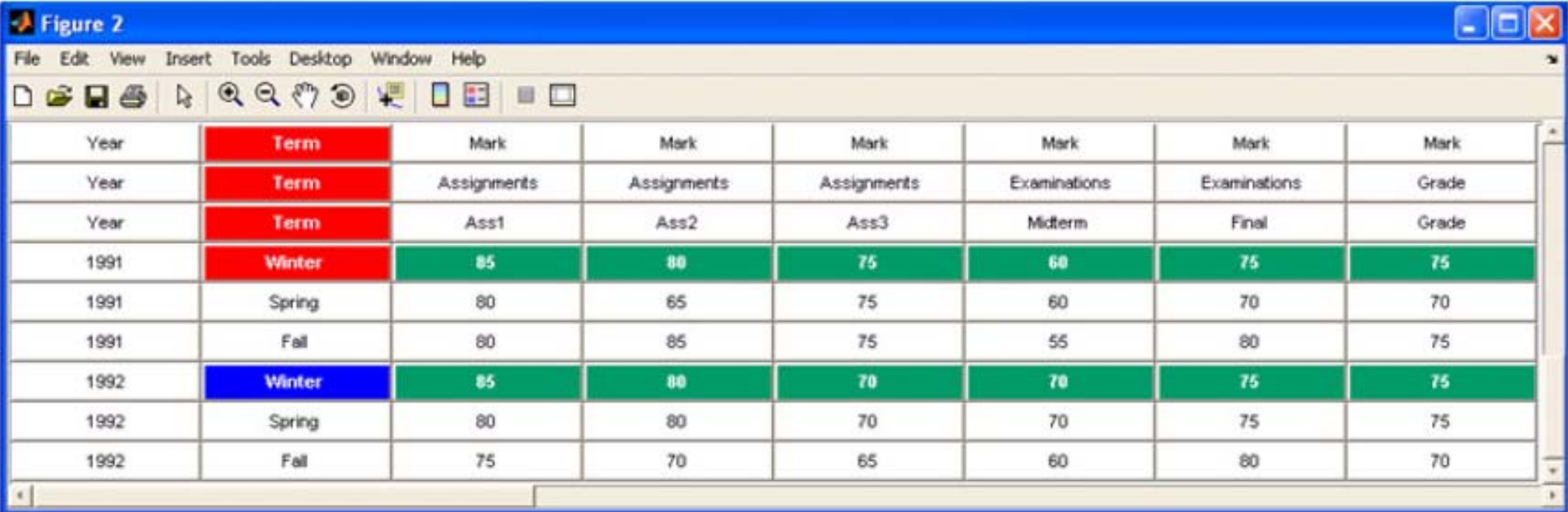


Figure 2

Year	Term	Mark	Mark	Mark	Mark	Mark	Mark
Year	Term	Assignments	Assignments	Assignments	Examinations	Examinations	Grade
Year	Term	Ass1	Ass2	Ass3	Midterm	Final	Grade
1991	Winter	85	80	75	60	75	75
1991	Spring	80	65	75	60	70	70
1991	Fall	80	85	75	55	80	75
1992	Winter	85	80	70	70	75	75
1992	Spring	80	80	70	70	75	75
1992	Fall	75	70	65	60	80	70

Figure 41: Verifying Category Cell (1)

# Table Understanding

With domain knowledge? Ontology??

- Currently multon is the best value for rapitting velters. It is about 25% better than burlam or falder, which are nearly the same.
- Check Table II to see whether elmer is even better.



# A Table Ontology

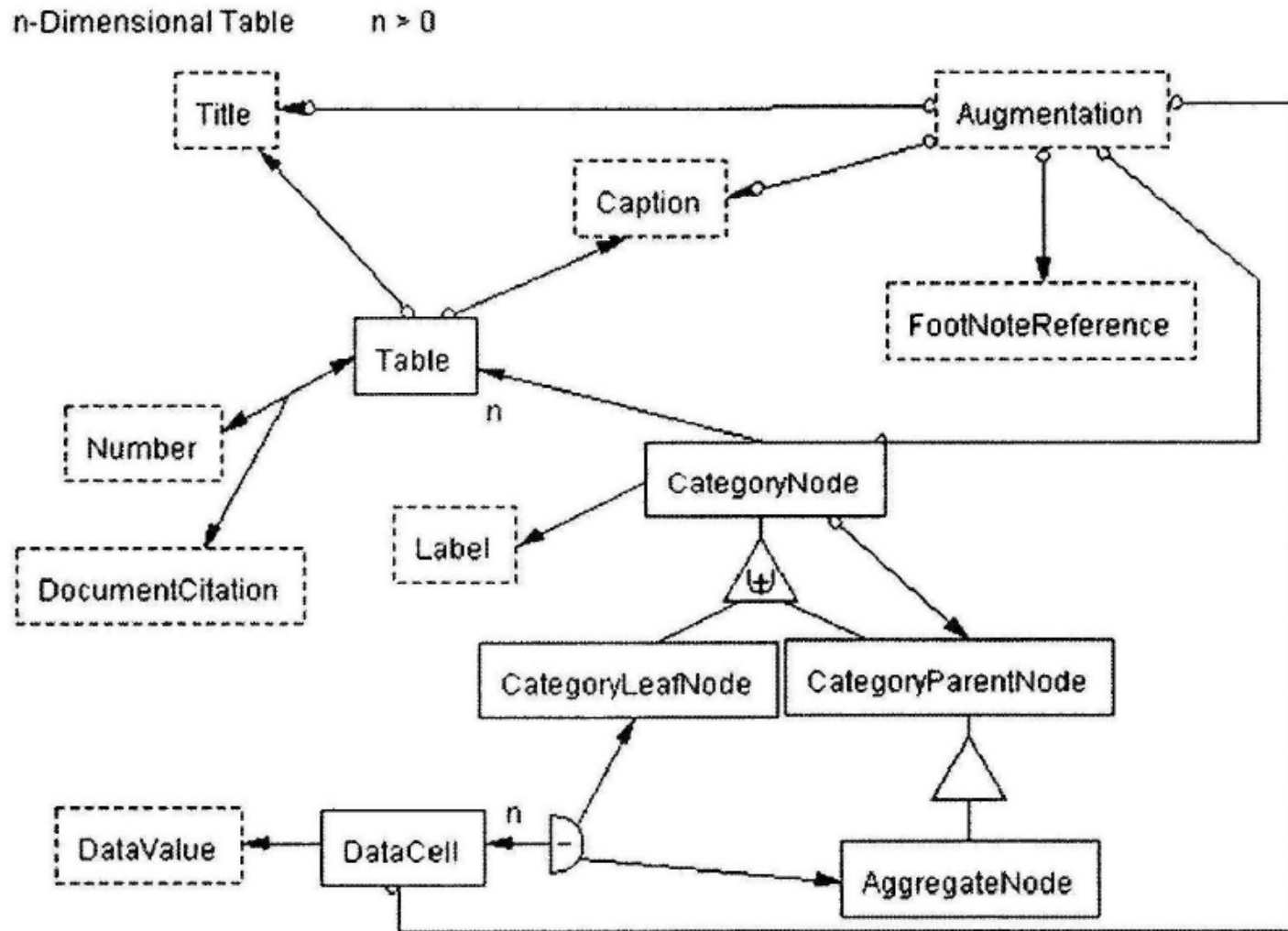


Figure 36: Ontology of a General Table

# TANGO

Table Analysis for Generating Ontologies  
(with D.W. Embley and D. Lonsdale at BYU)

<http://tango.byu.edu/>

- Interpret raw tables
- Converts each table into a mini-ontology
- Integrate mini-ontologies into growing ontologies that represent domain concepts, relationships, and constraints in the already processed tables.

Domains:

obituaries, census records, automobile ads, genetics, geo-politics

# Our current source of tables

Statistics Canada - Summary tables - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Refresh Mail Print Word Pad

Address <http://www40.statcan.ca/l01/cst01/> Go Links

Google Canada statistics Go Bookmarks 70 blocked Check AutoLink AutoFill Settings

Statistics Canada Statistique Canada

Canada

Français Contact us Help Search Canada site

Site map About us Privacy Accessibility My account

Key Word(s) Search Summary tables

**STATISTICS CANADA**  
CANADA'S NATIONAL STATISTICAL AGENCY

## Statistics Canada - Summary tables

This selection of summary tables, formerly called Canadian Statistics, provides an overview of statistical information on Canada's people, economy and governments. Please feel free to explore the tables by entering keywords in the search window below, or by using one of the navigational buttons in the left menu bar.

**New text and charts!**  
**Summary tables** now includes the [Overview](#) section where you can find charts and analysis.

Search **Summary tables** Key Word(s) Search [Tips](#)

Unless otherwise noted, all information is provided at the national level.

HOME

- Summary tables
- Overview
- Tables by...
  - subject
  - province or territory
  - metropolitan area
- Alphabetical list
- What's new?
- Standard symbols
- Latest indicators tables
- Consumer Price Index
- Labour Force Survey
- Gross domestic product

Discussions Discussions not available on <http://www40.statcan.ca/>

Internet

# Perhaps next?

indiatstat.com: Revealing india Statistically! - Information and Facts About India - Microsoft Internet...

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Refresh Print Mail W Wordpad Bluetooth RSS Feeds

Address <http://www.indiatstat.com/> Go Links

Google C Statistics India Go Bookmarks 70 blocked Check AutoLink AutoFill Settings

**indiatstat.com** REVEALING INDIA... STATISTICALLY

Home Membership Info Q & A Contact Info FAQs Must See Publications IP Login

Data Search  Go

Statistical Information

Administrative Setup  
Agriculture  
Banks and Financial Institutions  
Civil Supplies and Consumer Affairs  
Companies  
Cooperatives  
Crime and Law  
Demographics  
Economy  
Education  
Electoral Data  
Environment and Pollution  
Foreign Trade  
Forest and Wildlife  
Geographical Data

Population Watch

**This week, 161 tables have been added**

User Name  Password  Login

INDIA 1,133,493,426

WORLD 6,744,364,945  
(Estimated as of now)  
(Today's Weather)

Use of this web site constitutes acceptance of the **'Terms of Use and Disclaimer'**

**Indiatstat.com** is the authentic source for Indian statistics collected from the best sources for information and statistics on India. Within huge database of **www.indiatstat.com** you can easily surf through half-a-million pages that contain socio-economic statistical data and useful information on India.

At the site, you will have an easy access to statistics on health in India, figures on higher education in India, agricultural and industrial production information, economic statistics on India and tourism related data et al. Not only this, you will also get information on sectors like bank and financial institutions, companies, co-operatives, crime and law, population, foreign trade, labour and workforce, housing, media, power, transport, urban-rural settlements and economy in India and many more.

Data and statistics about India available on **www.indiatstat.com** can easily be downloaded in MS-Excel/ HTML formats by institutional and corporate users.

The available data and statistics on India cater to academicians, researchers and professionals in marketing, finance, socio-economic studies e.g. social sciences, economic research, political sciences, law and host of other disciplines as they will find **www.indiatstat.com** an extremely useful online resource for their India centric information needs. It is a paid site accessible only to registered members.

Ads by Google [GDP India](#) [India Girl](#) [India Energy](#) [India Cement](#)

Discussions not available on <http://www.indiatstat.com/>

Error on page. Internet

# Current Status

- Most previous work (>100 papers) on table layout analysis and transcription.
- Easier for tables in symbolic form (.doc, .xls, .pdf, html) than for scanned bitmaps.
- Most methods process only one table at a time.
- Commercial software already does it fairly well.
- Interaction required in many cases.
- The next step, in our view, is table interpretation.
- Table understanding is waiting in the wings.

# Why is table processing so difficult?

- Tables are intended for human consumption
- Often the *content* of the table must be inferred from external knowledge
- The roots of category trees are often missing
- Tables are intrinsically asymmetrical
- Tables are often combined or split to suit layout constraints
- Understanding tables requires domain knowledge
- Some authors consider understanding tables harder than understanding natural language
- Tables are not forms
  - they are meant to disseminate information,
  - whereas forms are designed to collect them,
- Web tables are often nested
- Web tables can be dynamic

# Next: some examples of tables from

D. Lopresti and G. Nagy, "Automated table processing: an (opinionated) survey," *Proceedings of IAPR Workshop on Graphics Recognition (GREC99)*, pp. 109-134, Jaipur, India, September 1999.

D. Lopresti and G. Nagy, "A Tabular Survey of Table Processing," *Graphics Recognition -- Recent Advances*, A. K. Chhabra and D. Dori, Eds., Springer Lecture Notes in Computer Science #1941, pp. 93-120, 2000.

J. Hu, R. Kashi, D. Lopresti, G. Wilfong, and G. Nagy, "Why table ground-truthing is hard," *Proceedings of International Conference on Document Analysis and Recognition*, pp. 129-133, Seattle, WA, IEEE Computer Society Press, September 2001.

G. Nagy and D. Lopresti, "Issues in ground-truthing graphic documents," *Lecture Notes in Computer Science*, pp. 46-66, Springer, 2002 (selected papers from the Fourth International Workshop on Graphics Recognition).

S. Veeramachaneni and G. Nagy, "Style context with second order statistics," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 27, #1, pp. 14-22, January 2005.

D. Lopresti, D.W. Embley, M. Hurst, and G. Nagy, "Table Processing Paradigms: A Research Survey," *International Journal of Document Analysis and Recognition*, vol 8, no. 2-3, pp. 66-86, Springer, June 2006.

# Table of tabular Q & A

Why tables?	<p>Prevalent means of communicating structured data</p> <p>Content may include words, numbers, formulas, even graphics</p> <p>Metadata represented by alignment and rulings</p> <p>Adapted to computerized composition</p> <p>Underlying paradigm for spreadsheets and relational databases</p> <p>Bridge between textual and graphic representations</p>
What is a table?	<p>2-D cell assembly for presenting information</p> <p>Regular, repetitive structure along at least one axis [41]</p> <p>Datatype determined by either horizontal or vertical index</p>
What is a form?	<p>Isothetic layout for collecting information</p> <p>One-to-one mapping between indices and data</p> <p>No implication of regularity [41]</p>
What is table analysis?	<p>Information extraction follows table detection and localization</p> <p>Geometric analysis to isolate cell contents</p> <p>Table structure determined simultaneously</p> <p>If needed, OCR translates cells and headers into symbolic form</p> <p>Interpretation requires understanding context</p>
Rationale for this study	<p>Importance of converting tables from one medium to another</p> <p>Rapid growth of tables in various digital formats</p> <p>Desirability of medium-independent query algorithms</p> <p>Interdependence of table composition and interpretation</p> <p>Advent of new applications that require table interpretation</p> <p>Need for research to address neglected table topics</p>



# Table of table analysis methods

TABLE 1  
A BRIEF SURVEY OF GEOMETRIC PAGE-LAYOUT ANALYSIS METHODS

No.	Author	Year	Approach	Features
1	Wahl et al. [11]	1982	Run length smoothing	Time consuming and skew sensitive
2	Nagy et al. [12]	1984	X-Y tree cut	Skew sensitive; Assumes rectangular blocks
3	Wang et al. [13]	1989	Run length smoothing and recursive X-Y cut	Newspaper analysis; Sensitive to skew
4	Fujisawa et al. [14]	1990	Top-down	Japanese patent documents
5	Fisher et al. [15]	1990	Run length smoothing and connected component extraction	Identifies text and nontext zones; Skew sensitive
6	Pavlidis et al. [16]	1991	Column oriented projection	Identifies text and nontext regions; Accommodates moderate skew
7	Baird [17]	1992	Global-to-local strategy	Accommodates different languages; Skew correction;
8	Jain et al. [18]	1992	Gabor filtering	Multichannel texture features from gray-scale images; Time consuming
9	Lebourgeois et al. [19]	1992	8x3 window filtering	Unconstrained documents; Skew not considered
10	Pavlidis et al. [20]	1992	Horizontal smearing and bottom-up	Accommodates small skew; Fixed parameters
11	Akindale et al. [21]	1993	White space tracing	Polygonal blocks; Only text zones considered
12	Amamoto et al. [22]	1993	Morphological operation on white space	Identifies horizontal and vertical writing; Skew not considered
13	Iltner et al. [23]	1993	White space and minimum spanning tree	Language and orientation free; Large computation
14	O'Gorman [24]	1993	k-nearest neighbor clustering	Can handle arbitrary orientation with high accuracy; Large computation
15	Antonacopoulos et al. [25], [26]	1994	Contours from white tiles	Finds nonrectangular and skewed regions; Error in classifying large fonts
16	Zlatopolsky [27]	1994	Connected component extraction	Multiple skewed document; Sensitive parameters
17	Doermann [28]	1995	Wavelet multiscale analysis	Segments nonblock-nested pages; Gray-scale image processing; High computational complexity
18	Drivas et al. [29]	1995	Connected component grouping	Skew correction with a time consuming algorithm
19	Ha et al. [30]	1995	Connected component-based projection profile	Faster than pixel-based projection profile; Skew sensitive
20	Sylwester et al. [31]	1995	trainable X-Y cut	Relatively robust; Skew and noise free
21	Tang et al. [32]	1995	Modified fractal signature	Handles documents with high geometrical complexity; Gray-scale image processing; Time consuming
22	Jain et al. [33], [34]	1996	Masks and neural network	Handles documents with multiple languages; Gray-scale image processing; Time consuming
23	Kise et al. [35]	1996	Background thinning	Skewed nonrectangular layout; Bounding box is not very tight
24	Liu et al. [36]	1996	Adaptive top-down and bottom-up	Nonrectangular regions; Skew free
25	Yamashita et al. [37]	1996	Run length smearing and adaptive thresholding	Less sensitive to font size and spacing; Skew free

# 1-D or 2-D?

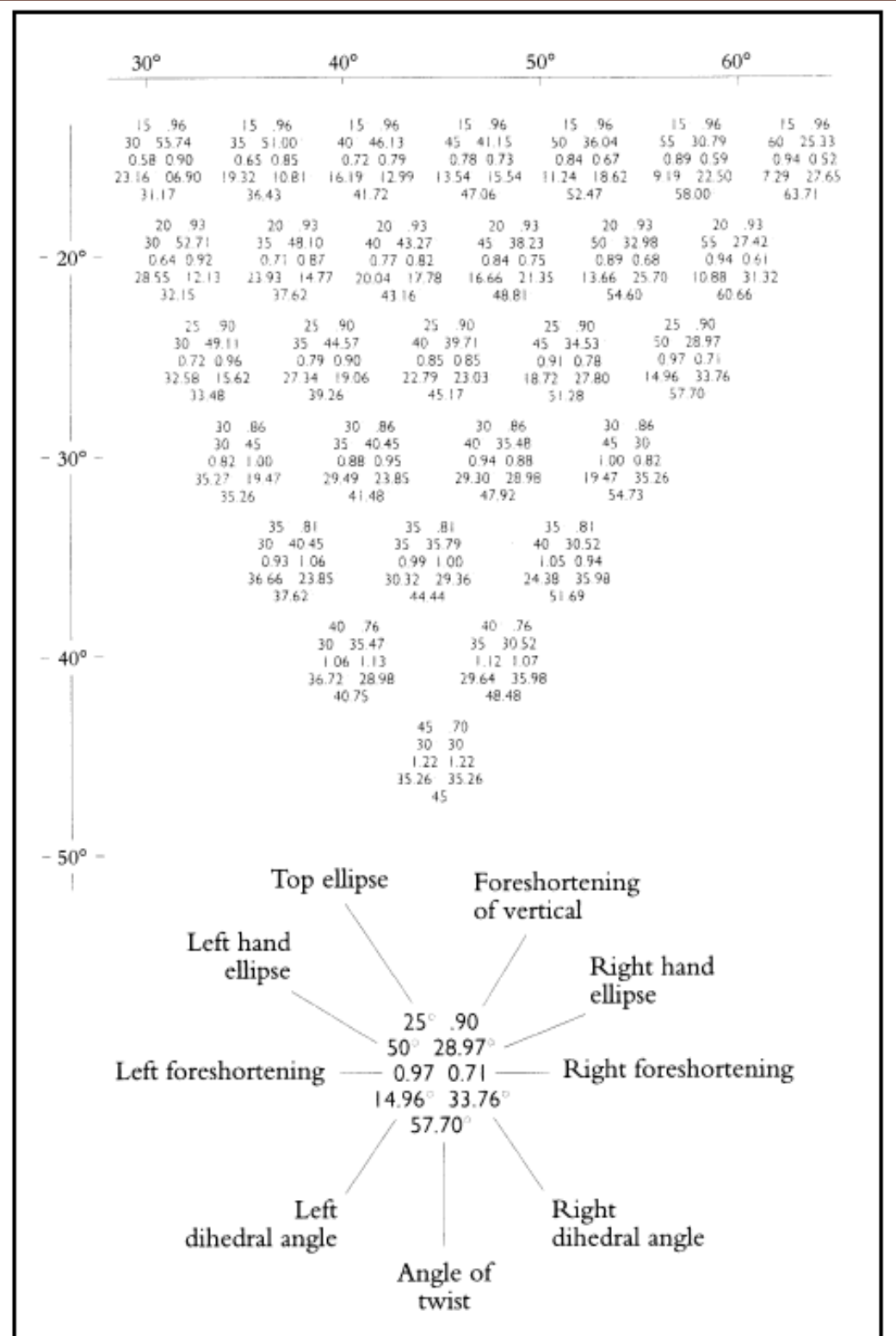
NAME		ADDRESS					TELNO		
First	Last	#	Street	City	State	Zip	Area-Code	#	Extension
...				...				...	

# Small table





# At the limit of tablehood



# Many tables combined

## How Different Groups Voted for President

Based on 12,782 interviews with voters at their polling places. Shown is how each group divided its vote for President and, in parentheses, the percentage of the electorate belonging to each group.

	CARTER	REAGAN	ANDERSON	CARTER-FORD in 1976
Democrats (43%)	66	26	6	77 - 22
Independents (23%)	30	54	12	43 - 54
Republicans (28%)	11	84	4	9 - 90
Liberals (17%)	57	27	11	70 - 26
Moderates (46%)	42	48	8	51 - 48
Conservatives (28%)	23	71	4	29 - 70
Liberal Democrats (9%)	70	14	13	86 - 12
Moderate Democrats (22%)	66	28	6	77 - 22
Conservative Democrats (8%)	53	41	4	64 - 35
Politically active Democrats (3%)	72	19	8	—

## How Different Groups Voted for President

Based on 12,782 interviews with voters at their polling places. Shown is how each group divided its vote for President and, in parentheses, the percentage of the electorate belonging to each group.

	CARTER	REAGAN	ANDERSON	CARTER-FORD in 1976
Democrats (43%)	66	26	6	77-22
Independents (23%)	30	54	12	43-54
Republicans (28%)	11	84	4	9-90
Liberals (17%)	57	27	11	70-26
Moderates (46%)	42	48	8	51-48
Conservatives (28%)	23	71	4	29-70
Liberal Democrats (9%)	70	14	13	86-12
Moderate Democrats (22%)	66	28	6	77-22
Conservative Democrats (8%)	53	41	4	64-35
Politically active Democrats (3%)	72	19	8	—
Democrats favoring Kennedy in primaries (13%)	66	24	8	—
Liberal Independents (4%)	40	29	15	64-29
Moderate Independents (12%)	31	53	13	45-53
Conservative Independents (17%)	22	69	6	26-72
Liberal Republicans (2%)	25	66	9	17-82
Moderate Republicans (11%)	13	81	5	11-89
Conservative Republicans (12%)	8	91	2	6-93
Politically active Republicans (2%)	5	89	8	—
East (32%)	45	47	8	51-47
South (27%)	44	51	3	54-45
Midwest (20%)	41	51	8	48-50
West (11%)	35	52	10	46-51
Black (10%)	62	14	3	82-16
Hispanic (2%)	54	38	7	75-24
Whites (88%)	36	55	8	47-52
Female (49%)	45	48	7	50-48
Male (51%)	37	54	7	50-48
Female, favors equal rights amendment (22%)	54	32	11	—
Female, opposes equal rights amendment (15%)	29	65	4	—
Catholic (25%)	40	51	7	54-44
Jewish (2%)	45	28	14	64-34
Protestant (48%)	37	58	6	44-55
Born again white Protestant (17%)	34	61	4	—
18 - 21 years old (8%)	44	43	11	46-53
22 - 25 years old (17%)	43	43	11	51-48
30 - 44 years old (31%)	37	54	7	49-48
45 - 59 years old (29%)	39	55	6	47-52
60 years or older (16%)	40	54	4	47-52
Family income				
Less than \$10,000 (13%)	50	41	6	58-40
\$10,000 - \$14,999 (14%)	47	42	8	55-43
\$15,000 - \$24,999 (24%)	38	53	7	48-50
\$25,000 - \$50,000 (24%)	32	58	6	36-62
Over \$50,000 (25%)	25	65	8	—
Professional or manager (40%)	33	56	9	41-57
Clical, sales or other white-collar (11%)	42	46	8	46-53
Blue-collar worker (17%)	46	47	5	57-41
Agriculture (3%)	29	66	3	—
Looking for work (3%)	33	35	7	65-34
Education				
High school or less (39%)	48	46	4	57-43
Some college (28%)	35	55	8	51-48
College graduate (27%)	35	51	11	45-55
Labor union household (26%)	47	44	7	59-39
No member of household in union (62%)	35	55	8	43-55
Family finances				
Better off than a year ago (16%)	53	37	8	30-70
Same (40%)	46	48	7	51-48
Worse off than a year ago (34%)	25	64	6	77-23
Family finances and political party				
Democrats, better off than a year ago (14%)	77	16	6	69-31
Democrats, worse off (14%)	—	—	—	—
Fair a year ago (12%)	47	39	10	94-6
Independents, better off (3%)	45	36	12	—
Independents, worse off (9%)	21	65	11	—
Republicans, better off (4%)	18	77	5	3-97
Republicans, worse off (11%)	6	89	4	24-76
More important problem				
Unemployment (34%)	51	40	7	75-25
Inflation (44%)	39	60	9	35-65
Feel that U.S. should be more forceful in dealing with Soviet Union even if it would increase the risk of war (54%)	28	64	6	—
Disagree (31%)	56	30	10	—
Favor equal rights amendment (46%)	49	36	11	—
Oppose equal rights amendment (36%)	26	68	4	—
When decided about choice				
Knew all along (41%)	47	50	2	44-55
During the primaries (12%)	30	60	9	57-42
During conventions (8%)	36	55	7	51-48
Since Labor Day (8%)	35	54	13	42-49
1 week before election (22%)	38	46	13	49-47

Source: 1976 and 1980 election day surveys by The New York Times-CBS News Poll and 1976 election day survey by ABC News.

# Simple, but is it computer understandable?

<b>Monday, September 20, 1999</b>			
	<b>Track A Convention Hall A</b>	<b>Track B Convention Hall B</b>	<b>Track C Chanakya Hall</b>
<b>08:30 10:00</b>	<b>OPENING SESSION (Mo-1) Banquet Hall</b>		
<b>10:00</b>	<b>COFFEE BREAK Pool Side</b>		
<b>10:30 12:30</b>	<b>MULTIMEDIA DOCUMENT PROCESSING Mo-2A</b>	<b>CHARACTER RECOGNITION Mo-2B</b>	<b>DOCUMENT IMAGE PROCESSING - I Mo-2C</b>
<b>12:30</b>	<b>LUNCH Pool Side</b>		
<b>13:30 14:30</b>	<b>POSTER PRESENTATION Mo-3A</b>	<b>POSTER PRESENTATION Mo-3B</b>	<b>POSTER PRESENTATION Mo-3C</b>
<b>13:30 15:30</b>	<b>POSTER SESSION - I (Mo-3) Banquet Hall (Coffee served at 14:30)</b>		
<b>15:30 17:30</b>	<b>INFORMATION RETRIEVAL Mo-4A</b>	<b>POSTAL AUTOMATION Mo-4B</b>	<b>FONT RECOGNITION Mo-4C</b>
<b>19:00 21:00</b>	<b>CONFERENCE RECEPTION Banquet Hall</b>		

# Bell Table

Time - Table

	Mon.	Tues.	Wed.	Thurs.	Frid.	Sat.
9 to 12	Boston	George (2 hrs.)	Boston	George	Boston	Boston
12 to 3	—	—	—	—	—	Boston
3 to 5	George	—	George	—	George	Boston

~ Mrs. Wed. + Frid. I go to the Boston School from 9 to 10 — ~~at~~  
 Class at University 10 to 11 (twice a week).  
 11 to 12 Reception hour.  
 I spend the whole of Saturday in Boston for the purpose  
 of receiving pupils — leaving Tues. + Thurs. free days.  
 Miss Locke is at present engaged ~~for~~ every day from 11:30  
 to ~~1:30~~ 1:30 — and I go in occasionally on Friday or Thurs. ~~for~~



# Split table

1996 DDVPC 2400bps Candidate Coder Intelligibility Performance Calibrations																			
DRT	Wgt	Wgt	Wgt	A	A	A	A	B	B	B	B	C	C	C	C	D	D	D	D
0.35				A(M)	A(F)	A(C)	A(SE)	B(M)	B(F)	B(C)	B(SE)	C(M)	C(F)	C(C)	C(SE)	D(M)	D(F)	D(C)	D(SE)
Quiet	0.20	0.100		90.8	88.9	89.9	0.55	90.1	90.8	90.5	0.48	93.8	90.8	92.3	0.70	92.7	90.1	91.4	0.71
Vinson Quiet	0.100			91.5	91.4	91.4	0.42	91.4	88.4	89.9	0.83	91.3	91.1	91.2	0.78	92.1	89.4	90.8	0.57
Office	0.60	0.067		91.8	91.2	91.5	0.91	88.6	88.2	88.4	0.55	91.5	91.0	91.2	0.75	92.4	89.8	91.1	0.59
Auto		0.067		87.9	77.6	82.7	0.93	86.3	79.2	82.7	0.91	86.8	79.9	83.4	0.81	87.5	81.3	84.4	0.88
Humvee		0.067		61.8	66.9	64.4	1.06	64.8	64.9	64.8	1.30	61.8	64.4	63.1	0.72	61.2	69.6	65.4	0.62
M2 Bradley		0.067		67.4	67.1	67.3	1.36	66.3	68.8	67.6	0.88	61.4	67.2	64.3	1.17	66.0	67.1	66.6	0.71
Helicopter		0.067		61.5	68.5	65.0	1.15	68.6	68.9	68.7	1.07	63.5	69.9	66.7	0.61	66.2	71.2	68.7	1.04
F-15		0.067		74.9	78.1	76.5	0.85	71.1	71.1	71.1	0.52	77.5	76.7	76.7	0.91	73.4	75.2	74.3	0.57
E3A		0.067		87.6	83.0	85.3	0.75	86.9	84.8	85.9	0.81	89.5	85.5	87.5	0.85	89.1	83.8	86.5	0.66
P3C		0.067		89.2	82.2	85.7	0.71	87.4	81.5	84.4	0.75	84.5	85.4	85.4	0.59	87.3	81.9	84.6	0.88
MCE		0.067		88.5	88.4	88.5	0.72	86.7	87.5	87.1	0.77	89.0	90.6	89.8	1.08	86.6	88.9	87.8	0.84
BER	0.10	0.050		86.2	82.6	84.4	0.89	88.5	85.7	87.1	0.52	88.6	89.2	88.9	0.63	87.2	86.1	86.7	0.71
BLER		0.050		92.3	89.7	91.0	0.86	92.4	89.7	91.1	0.63	93.4	90.0	91.7	0.64	90.2	88.2	89.2	0.45
S_Tandem	0.10	0.050		85.0	85.3	85.2	0.73	87.4	84.3	85.9	0.60	87.5	84.5	86.0	0.72	87.6	84.7	86.2	0.71
D_Tandem		0.050		84.1	81.9	83.0	0.86	83.0	78.0	80.5	0.62	85.2	80.6	82.9	0.58	84.3	81.2	82.8	0.75
Intell. Perf				82.984	81.872	82.437	0.261	82.829	81.132	81.984	0.293	83.279	82.779	83.032	0.241	83.259	82.214	82.759	0.217
Rank	1.00	1.000		A(M)	A(F)	A(C)	A(SE)	B(M)	B(F)	B(C)	B(SE)	C(M)	C(F)	C(C)	C(SE)	D(M)	D(F)	D(C)	D(SE)
				4	4	4		5	6	5		2	2	2		3	3	3	

1996 DDVPC 2400bps Reference Coder Intelligibility Performance Calibrations															
DRT	Wgt	Wgt	Wgt	CELP	CELP	CELP	CELP	CVSD	CVSD	CVSD	CVSD	LPC	LPC	LPC	LPC
0.35				Celp(M)	Celp(F)	Celp(C)	Celp(SE)	KY(M)	KY(F)	KY(C)	KY(SE)	LPC(M)	LPC(F)	LPC(C)	LPC(SE)
Quiet	0.20	0.100		90.9	90.5	90.7	0.34	88.2	88.8	88.5	0.85	87.3	85.1	86.2	0.60
Vinson Quiet	0.100			91.9	90.3	91.1	0.44	91.4	90.2	90.8	0.66	81.9	82.7	82.3	0.65
Office	0.60	0.067		89.8	88.3	89.0	0.88	89.6	88.1	88.8	0.50	84.8	85.5	85.2	0.81
Auto		0.067		88.9	83.3	86.1	0.85	89.0	84.8	86.9	1.02	73.1	63.7	68.4	0.73
Humvee		0.067		60.6	65.4	63.0	0.95	65.2	73.3	69.3	1.33	21.7	41.7	31.7	2.26
M2 Bradley		0.067		60.7	66.9	63.8	1.14	74.3	78.4	76.4	0.94	34.2	42.5	38.4	1.27
Helicopter		0.067		61.0	66.6	63.8	0.94	75.6	78.9	77.2	0.78	39.4	55.8	47.6	1.24
F-15		0.067		73.0	75.5	74.3	0.79	74.7	78.6	76.6	1.11	70.5	69.4	69.9	0.88
E3A		0.067		84.6	85.6	85.0	0.62	88.2	89.9	89.0	0.94	66.7	65.3	66.0	1.09
P3C		0.067		85.7	82.7	84.2	1.19	89.5	86.0	87.7	0.72	80.9	78.5	79.7	1.00
MCE		0.067		90.5	87.8	89.1	0.96	90.8	90.0	90.4	0.75	77.5	78.7	78.1	1.10
BER	0.10	0.050		90.3	86.0	88.2	0.73	86.1	87.8	86.9	0.67	80.0	82.7	81.4	0.90
BLER		0.050		87.1	89.3	88.2	0.96	86.8	85.6	86.2	0.78	85.2	82.9	84.0	0.72
S_Tandem	0.10	0.050		84.8	83.7	84.3	0.61	89.0	87.3	88.2	1.03	75.8	75.5	75.6	1.10
D_Tandem		0.050		83.0	80.6	81.8	0.96	84.4	85.9	85.2	0.70	72.0	73.5	72.7	0.64
Intell. Perf				81.860	81.867	81.859	0.260	84.402	85.097	84.742	0.297	69.157	71.250	70.202	0.332
Rank	1.00	1.000		Celp(M)	Celp(F)	Celp(C)	Celp(SE)	KY(M)	KY(F)	KY(C)	KY(SE)	LPC(M)	LPC(F)	LPC(C)	LPC(SE)
				6	5	6		1	1	1		7	7	7	

# Where does it begin and end?

\*\*\*\*\*  
LUCENT TECHNOLOGIES TODAY  
For the People of Lucent Technologies  
Friday, February 12, 1999  
\*\*\*\*\*

\*\*\* STOCK WATCH \*\*\*

	TODAY'S OPEN	YESTERDAY'S CLOSE	YESTERDAY'S CHANGE
Lucent	100 13/16	101 1/16	+ 3 13/16
Ascend	73 5/8	74 7/8	+ 2 3/8
AT&T	87 1/2	88 3/16	+ 2 3/8
Alcatel	21 7/8	22	+ 13/16
Ericsson	26 1/4	26 3/8	+ 1 5/16
Motorola	67 1/2	67 1/4	+ 1 13/16
DJIA	9367.32	9363.46	+ 186.15
NASDAQ	2375.99	2405.55	+ 96.05

\*\*\*\*\*

\*\*\* NEWS IN A NUTSHELL \*\*\*

- \* New software tool
- \* America's most admired
- \* Switch lands in winter games
- \* Students visit Bell Labs
- \* World of science Seminars
- \* Client feedback survey

\*\*\* LUCENT HERITAGE \*\*\*

On Feb. 17, 1998, Lucent announced that it would acquire Hewlett-Packard's local multipoint distribution service wireless business and launch a new Wireless Broadband Networks Division.

\*\*\*\*\* LUCENT IN THE NEWS \*\*\*\*\*

STUDENTS VISIT BELL LABS -- Hosted by Lucent Korea, elementary school students from Korea visited Bell Labs in New Jersey to explore its advanced science and technology. Lucent Korea provided the six-day tour for the students to encourage their education in science. [Naeway Economic Daily (Korea), 2/12]

# How many tables?

## NEW YORK STOCK EXCHANGE

### NYSE INDEXES

NEW YORK (AP) — Closing New York Stock Exchange indexes:

	Close	Chg.
Comp .....	610.49	-0.19
Indus .....	761.19	-0.24
Transp .....	494.71	-5.62
Utility .....	439.68	+0.75
Finance .....	549.34	-0.34

### WHAT THE NYSE MARKET DID

	Yester- day	Prev. day
Advanced .....	1,240	1,185
Declined .....	1,743	1,829
Unchanged .....	563	568
Total issues .....	3,546	3,582
New highs .....	36	58
New lows .....	96	90

### DOW JONES AVERAGES

NEW YORK (AP) — Final Dow Jones averages yesterday:

	Open	High	Low	Last	Chg.
Ind	9902.28	10005.95	9796.99	9890.51	-13.04
Trn	3337.44	3376.11	3242.21	3275.68	-62.80
Uti	303.91	306.48	300.13	303.22	-0.72
S&P	3030.50	3061.77	2985.30	3014.68	-16.16
30 Indus				61,210,600	
Tran				8,544,700	
Uti				8,781,600	
65 S&P				78,536,900	

### BONDS

	Close	Chg.
DJ AIG Futures .....	80.34	+1.46
10 Industrials .....	105.87	-0.30
10 Public Util .....	102.63	+0.70
20 Bonds .....	104.25	-0.16

### STOCK SALES

Approx final total .....	663,291,980
Previous day .....	922,200,000
Week ago .....	727,270,000
Month ago .....	718,530,000
Year ago .....	631,350,000
Two years ago .....	451,970,000
Year to date .....	43,374,202,000
To date one year ago .....	33,969,170,000
To date two years ago .....	28,938,520,000

### BOND SALES

Approx final total .....	\$13,626,000
Previous day .....	\$14,377,000
Week ago .....	\$12,090,000
Month ago .....	\$11,232,000
Year ago .....	\$10,034,000
Two years ago .....	\$22,323,000
Year to date .....	\$759,113,000
To date one year ago .....	\$1,050,662,000
To date two years ago .....	\$1,431,008,000

### MOST ACTIVE NYSE STOCKS

NEW YORK (AP) — Sales, closing price and net change of the 15 most active New York Stock Exchange issues trading at more than \$1:

Name	Volume	Last	Chg.
AmOnline s ..	30,279,300	130	+10 <sup>3</sup> / <sub>4</sub>
US Filter .....	18,371,300	30 <sup>3</sup> / <sub>8</sub>	- <sup>1</sup> / <sub>8</sub>
Compaq .....	16,316,100	30 <sup>1</sup> / <sub>8</sub>	- <sup>3</sup> / <sub>8</sub>
MediaOne ...	13,143,800	68 <sup>1</sup> / <sub>2</sub>	+7 <sup>3</sup> / <sub>4</sub>
AT&T .....	9,387,300	77 <sup>3</sup> / <sub>4</sub>	-1 <sup>7</sup> / <sub>8</sub>
CHS EI .....	7,415,500	3 <sup>5</sup> / <sub>8</sub>	-2 <sup>1</sup> / <sub>8</sub>
WarnLm s ...	7,113,300	66 <sup>5</sup> / <sub>8</sub>	-3 <sup>3</sup> / <sub>4</sub>
PhilMor .....	5,984,700	41 <sup>1</sup> / <sub>8</sub>	+ <sup>5</sup> / <sub>8</sub>
IBM .....	5,948,300	167	-1 <sup>1</sup> / <sub>8</sub>
RiteAid .....	5,777,200	26 <sup>3</sup> / <sub>4</sub>	+1 <sup>1</sup> / <sub>8</sub>
MicrnT .....	5,774,300	53	+2 <sup>1</sup> / <sub>2</sub>
Lucent .....	5,254,300	101 <sup>1</sup> / <sub>8</sub>	+ <sup>3</sup> / <sub>8</sub>
CBS .....	5,094,100	38 <sup>5</sup> / <sub>8</sub>	+1 <sup>1</sup> / <sub>8</sub>
DataGn .....	4,661,200	12 <sup>1</sup> / <sub>4</sub>	+2 <sup>1</sup> / <sub>8</sub>
Tycolnt .....	4,530,500	75 <sup>1</sup> / <sub>4</sub>	+ <sup>3</sup> / <sub>8</sub>

### STANDARD & POOR'S

NEW YORK (AP) — Standard and Poor's stock indexes yesterday:

	High	Low	Last	Chg.
S&P 100 ...	653.19	648.44	649.55	-0.56
S&P 500 .	1303.84	1294.26	1297.01	-2.28
MidCap ...	363.76	359.82	360.80	-1.51
Indust .....	1565.34	1552.88	1556.42	-2.67
Transp ...	716.73	707.36	708.28	-8.45
Utilities ...	245.12	243.81	243.99	-0.96
Financial .	142.66	141.59	142.22	-0.15
SmallCap .	160.66	158.57	158.70	-1.71

# What does this table show?

	feet						
	50	100	150	200	250	300	350
California	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—
Alabama	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—
Colorado	—	—	—	—	—	—	—
Florida	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—
Kentucky	—	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—	—
Maine	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—	—
Nebraska	—	—	—	—	—	—	—
Nevada	—	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—
New York	—	—	—	—	—	—	—
North Carolina	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—
Delaware	—	—	—	—	—	—	—
Iowa	—	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—	—

# Is it a table?

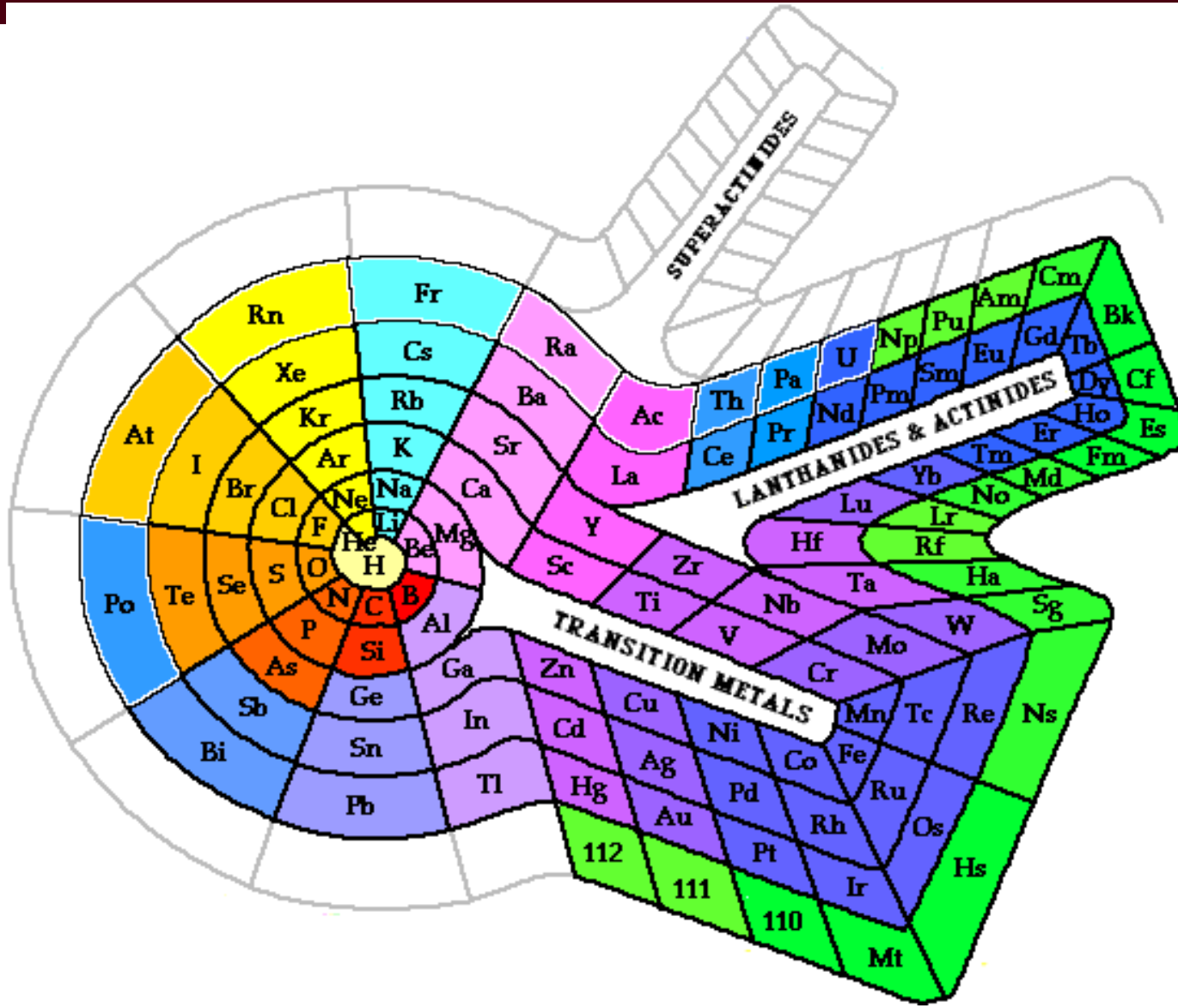
Ford Ranger Pickup 4 (2WD) '84 '85 '86 '87 '88 '89	TROUBLE SPOTS	Ford Ranger Pickup V6 (2WD) '84 '85 '86 '87 '88 '89
	Air-conditioning	
	Body exterior (paint)	
	Body exterior (rust)	
	Body hardware	
	Body integrity	
	Brakes	
	Clutch	
	Driveline	
	Electrical system (chassis)	
	Engine cooling	
	Engine mechanical	
	Exhaust system	
	Fuel system	
	Ignition system	
	Suspension	
	Transmission (manual)	
	Transmission (automatic)	
	TROUBLE INDEX	
	COST INDEX	

# A wonderful table!

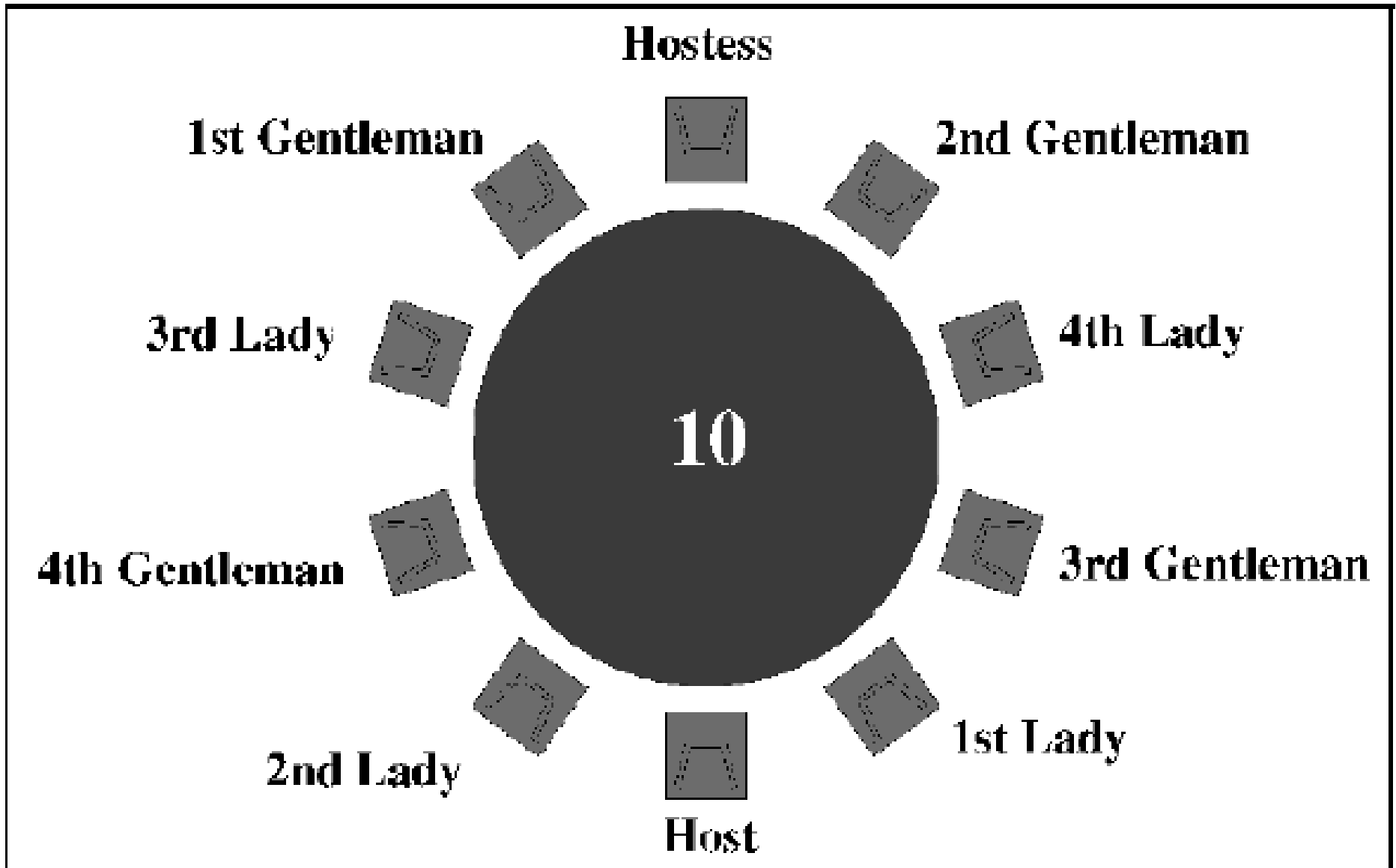
**Periodic Table**

1	2											13	14	15	16	17	18	
1	H 1.008 Hydrogen																He 4.003 Helium	
2	Li 6.941 Lithium	Be 9.012 Beryllium											B 10.811 Boron	C 12.011 Carbon	N 14.007 Nitrogen	O 15.999 Oxygen	F 18.998 Fluorine	Ne 20.180 Neon
3	Na 22.990 Sodium	Mg 24.305 Magnesium	3	4	5	6	7	8	9	10	11	12						
4	K 39.098 Potassium	Ca 40.078 Calcium	Sc 44.956 Scandium	Ti 47.88 Titanium	V 50.942 Vanadium	Cr 51.996 Chromium	Mn 54.938 Manganese	Fe 55.847 Iron	Co 58.933 Cobalt	Ni 58.69 Nickel	Cu 63.546 Copper	Zn 65.39 Zinc	Ga 69.723 Gallium	Ge 72.61 Germanium	As 74.912 Arsenic	Se 78.96 Selenium	Br 79.904 Bromine	Kr 83.80 Krypton
5	Rb 85.468 Rubidium	Sr 87.62 Strontium	Y 88.906 Yttrium	Zr 91.224 Zirconium	Nb 92.906 Niobium	Mo 95.94 Molybdenum	Tc (98) Technetium	Ru 101.07 Ruthenium	Rh 101.07 Rhodium	Pd 106.42 Palladium	Ag 107.868 Silver	Cd 112.411 Cadmium	In 114.82 Indium	Sn 118.71 Tin	Sb 121.76 Antimony	Te 127.60 Tellurium	I 126.905 Iodine	Xe 131.29 Xenon
6	Cs 132.905 Cesium	Ba 137.327 Barium	Lu 174.967 Lutetium	Hf 178.49 Hafnium	Ta 180.948 Tantalum	W 183.85 Tungsten	Re 186.207 Rhenium	Os 193.2 Osmium	Ir 192.22 Iridium	Pt 195.08 Platinum	Au 196.967 Gold	Hg 200.59 Mercury	Tl 204.383 Thallium	Pb 207.2 Lead	Bi 208.980 Bismuth	Po (209) Polonium	At (210) Astatine	Rn (222) Radon
7	Fr (223) Francium	Ra 226.025 Radium	Lr (260) Lawrencium	Rf (261) Rutherfordium	Db (262) Dubnium	Sg (263) Seaborgium	Bh (264) Bohrium	Hs (265) Hassium	Mt (266) Meitnerium									
			La 138.905 Lanthanum	Ce 140.12 Cerium	Pr 140.908 Praseodymium	Nd 144.24 Neodymium	Pm (145) Promethium	Sm 150.36 Samarium	Eu 151.965 Europium	Gd 157.25 Gadolinium	Tb 158.925 Terbium	Dy 162.50 Dysprosium	Ho 164.93 Holmium	Er 167.26 Erbium	Tm 168.934 Thulium	Yb 173.05 Ytterbium		
			Ac 227.033 Actinium	Th 232.038 Thorium	Pa 231.036 Protactinium	U 238.029 Uranium	Np 237.048 Neptunium	Pu (244) Plutonium	Am (243) Americium	Cm (247) Curium	Bk (247) Berkelium	Cf (251) Californium	Es (252) Einsteinium	Fm (257) Fermium	Md (258) Mendelevium	No (259) Nobelium		

# Still being improved



# A table table





Thank	you	for
your	patience	!
Any	questions ?	