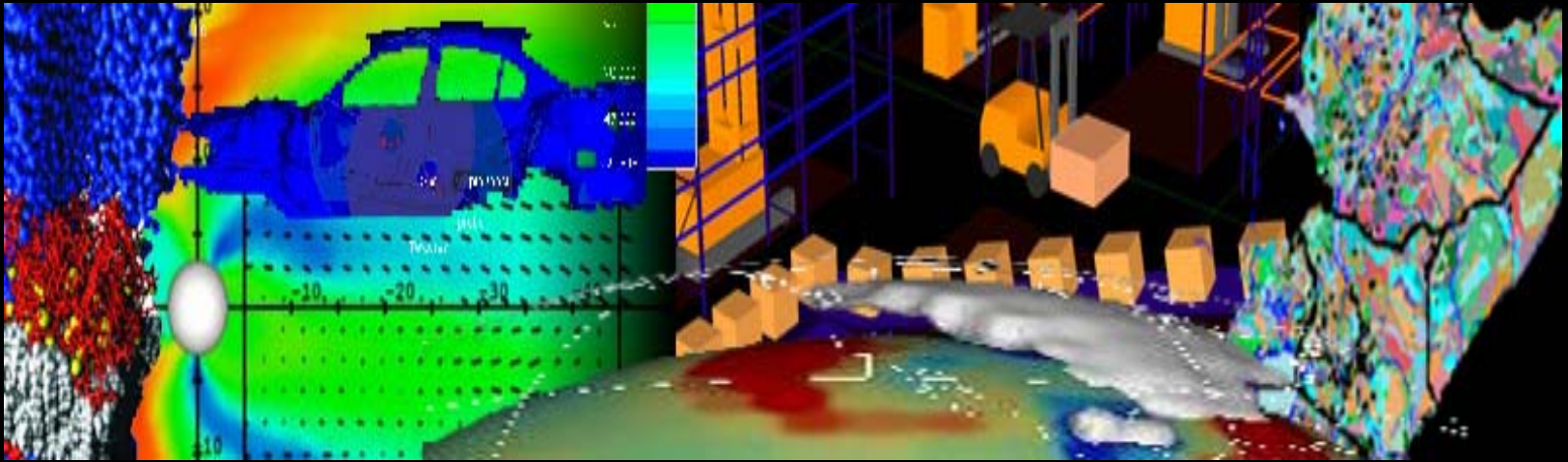




DATA CENTER

DATA CENTER

Make sense of your data



David Brock, Founder and Director
Data Center
Massachusetts Institute of Technology



PROBLEM

What are you going to do
with all your
Data?



PROBLEM





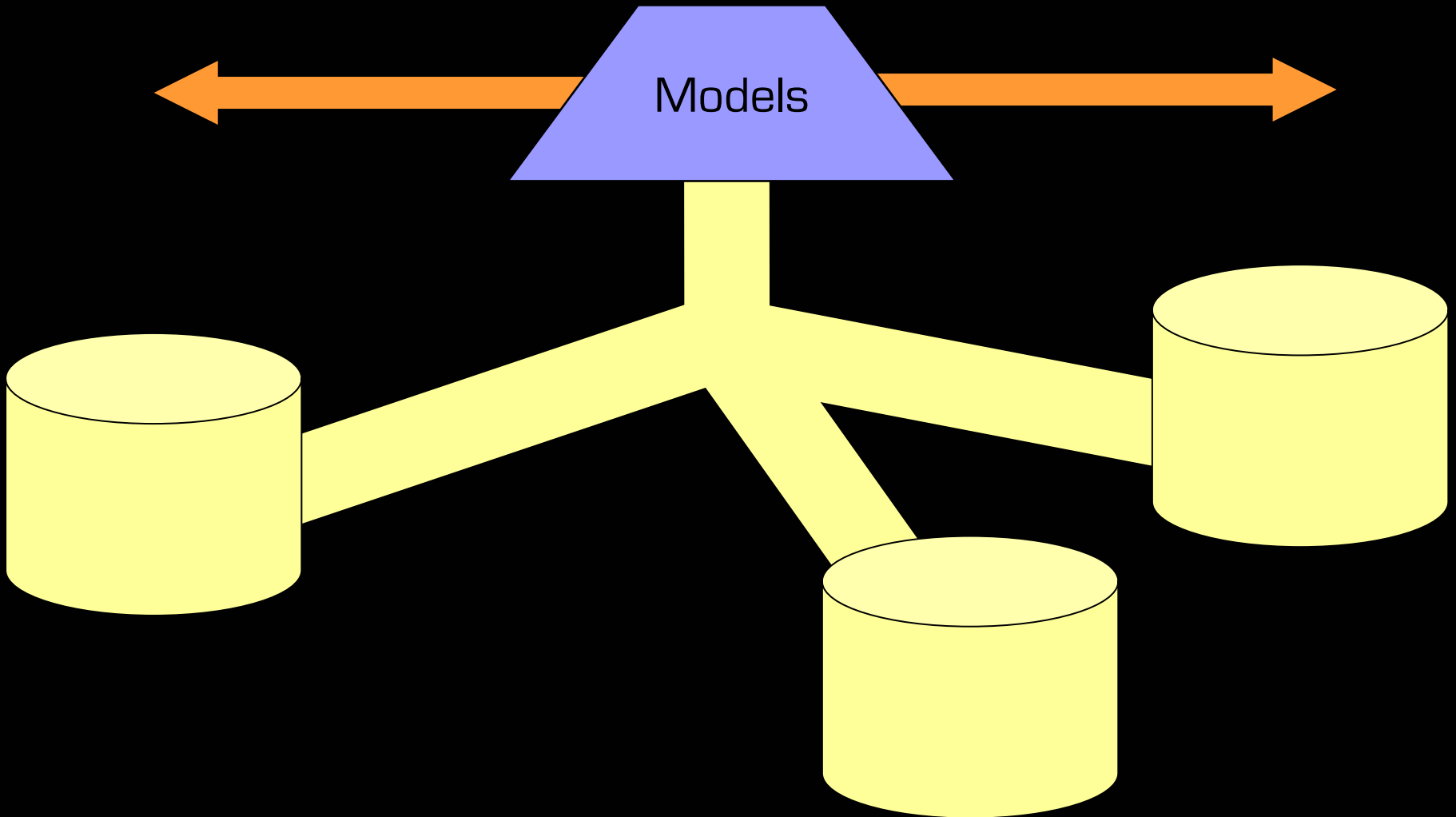
DATA CENTER

DATA CENTER

Make sense of your data



VISION





VISION

Data Models



DATA CENTER - MORNING

“A SmartWorld combines data and models”

“Data, Models and Decisions”

“The is the science of better”

- Richard Larson, MIT

“Models + Data”

- Franz Dill, P&G

“Information is our company’s most valuable asset”

- Larry Dzedzic, J&J

“The enterprise will be driven by sensed data”

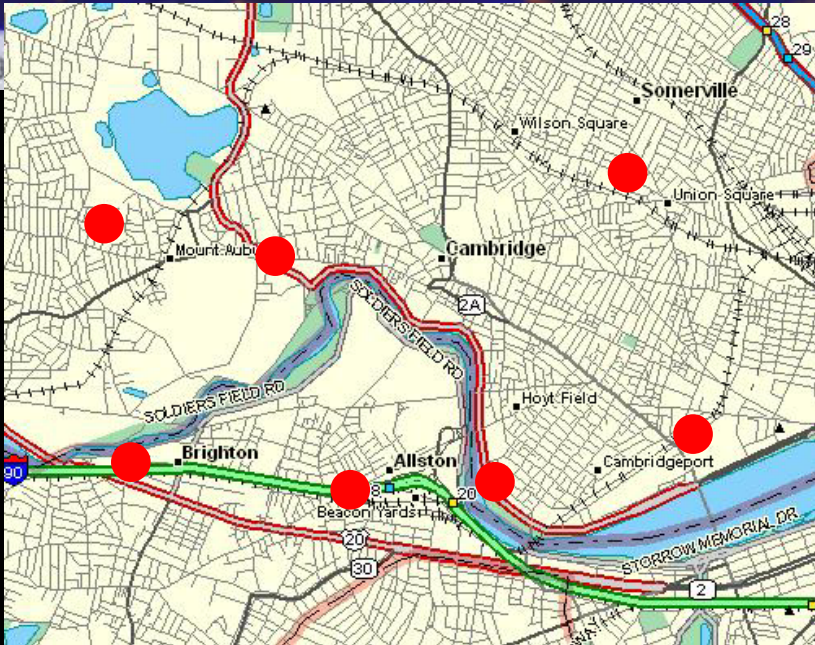
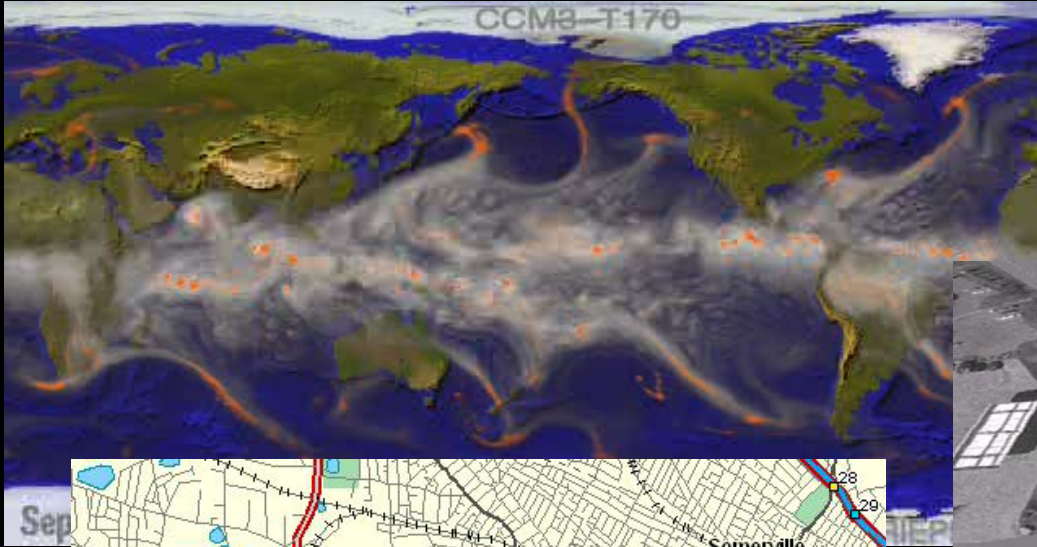
“Plan, Execute => Sense, Interpret, Act”

“Today’s models don’t talk”

- Alexander Renz, Microsoft



EXAMPLE - LOGISTICS





EXAMPLE - LOGISTICS



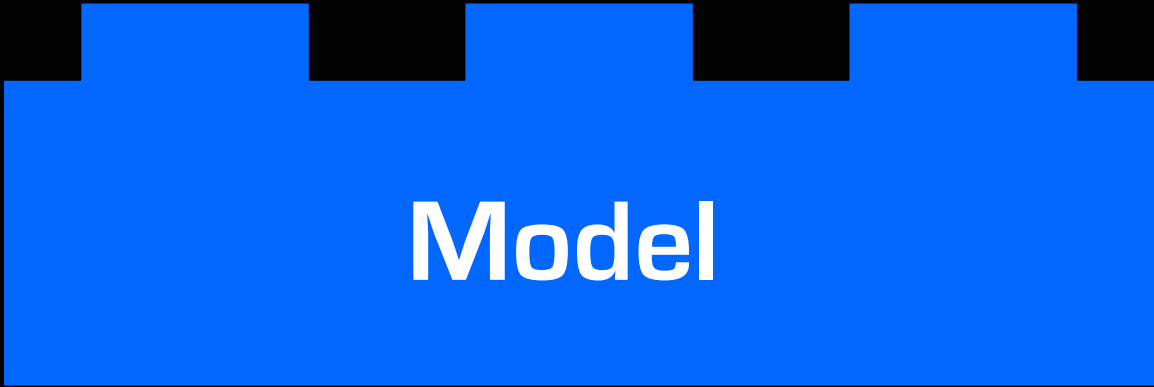


MODELS



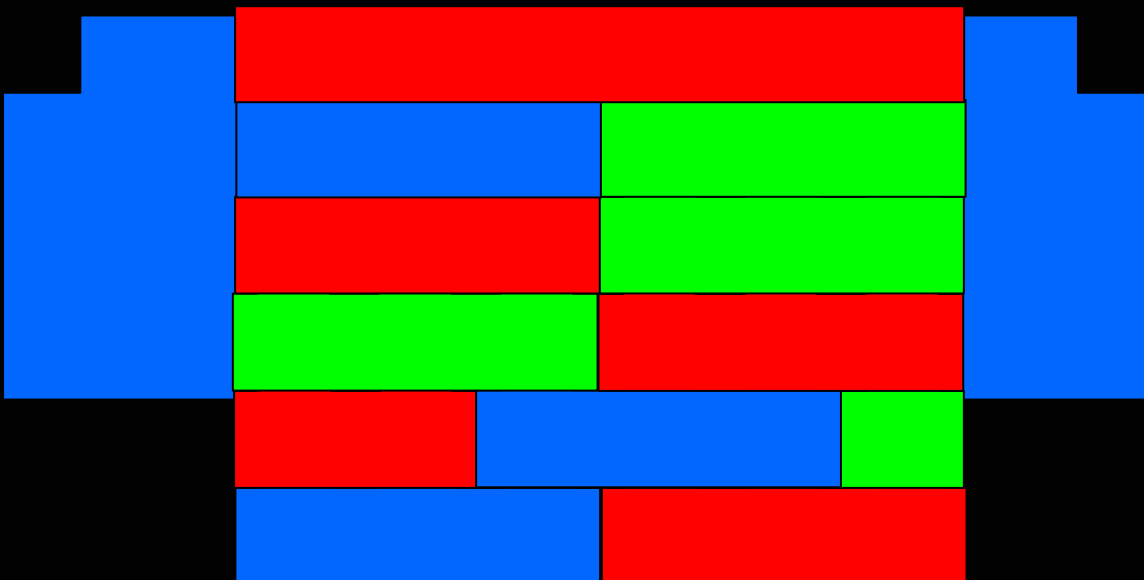


MODELS



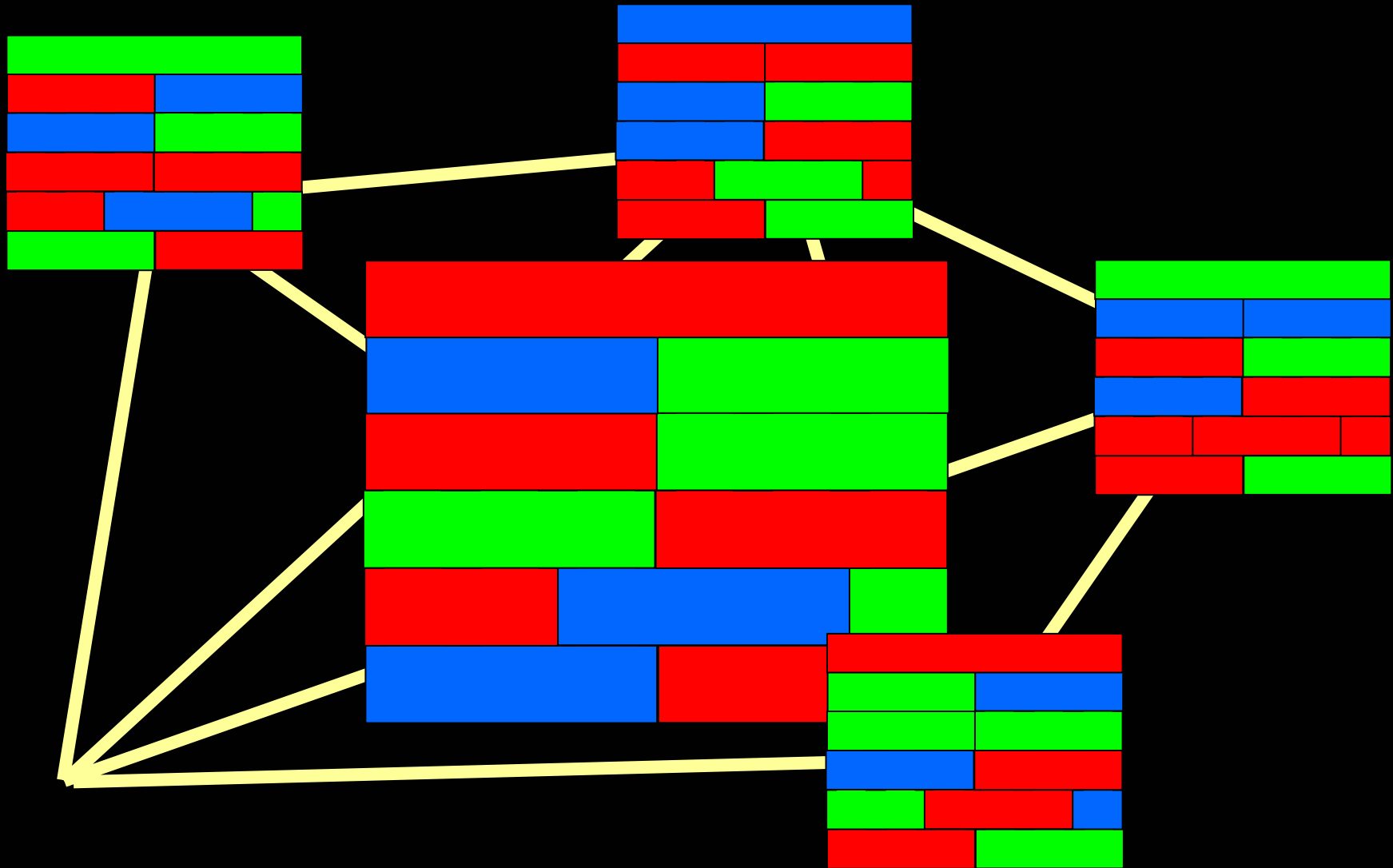


MODELS



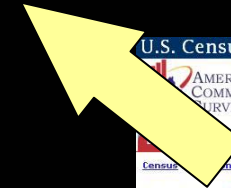
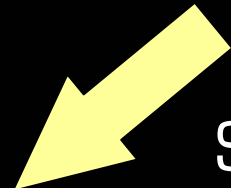
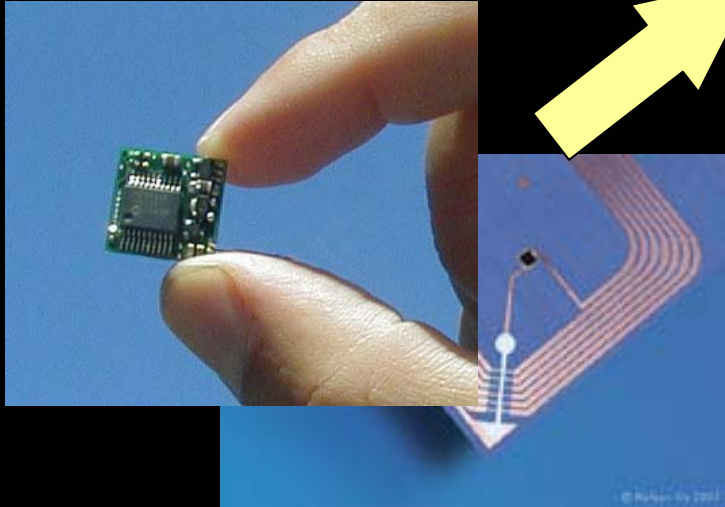
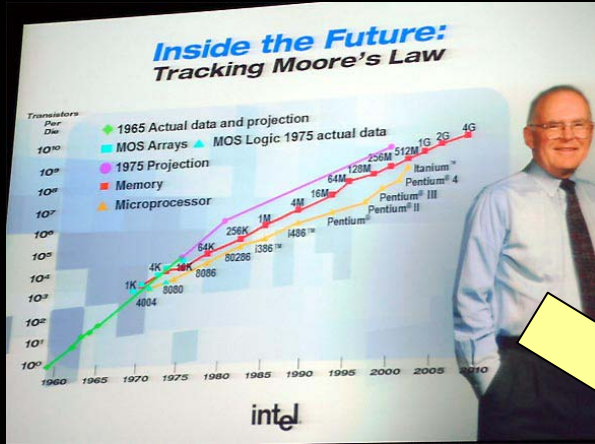


MODELS





DRIVERS



XML HTML
EPC
TCP/IP
HTTP
SOAP

U.S. Census Bureau
AMERICAN COMMUNITY SURVEY

Go to State / Region Click on Map to Zoom In

30 40 50 60 70 80 90 100 110

Low Temperature (F) Ending Tue Jul 06 2004 8AM EDT
(Tue Jul 06 2004 12Z)

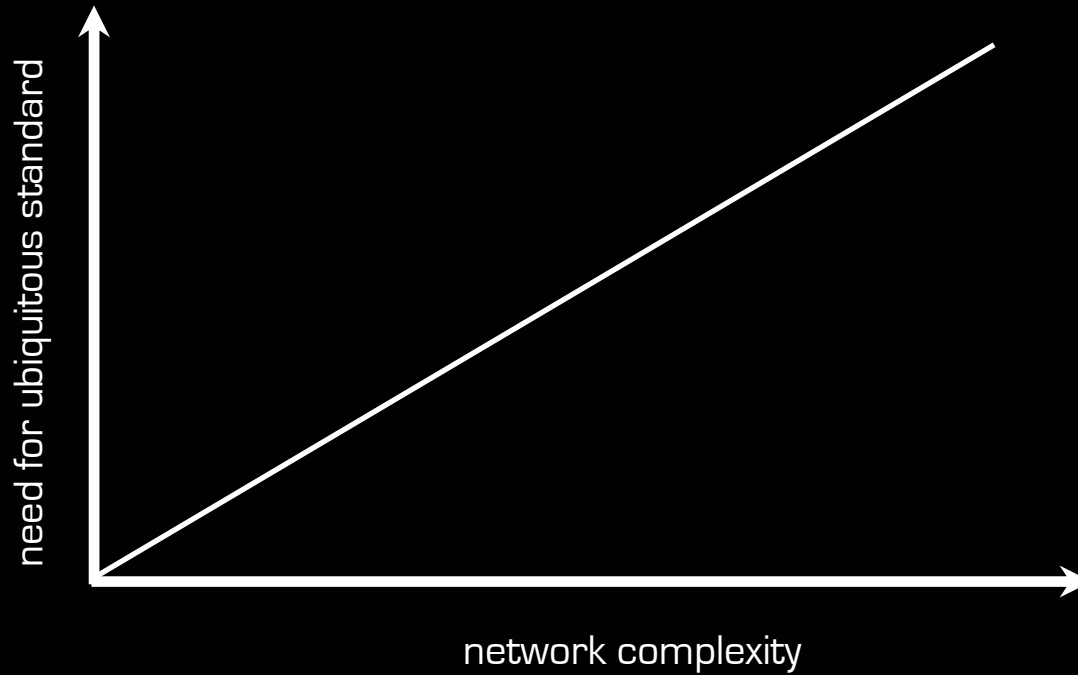
National Digital Forecast Database
Experimental graphic created 07/05/2004 11:36PM EDT

Available in this Section

- Data Tables Main
- 2002 Data Profiles
- 2001:2002 Change Profiles
- 2002:2000 Change Profiles
- Special Tabulations
- CD-ROM Order/Details
- Detailed Tables
- 2001 Data Profiles
- 2000:2001 Change Profiles
- 2000 Data Profiles
- 1999 Data Profiles



STANDARDS



The more complex the network, the more you need standards



VISION

Mission

- Make sense of your data

Task

- Create the standards and systems for interoperable data and modeling



DATA CENTER

Near-term

- Use current and emerging standards

Mid-term

- Develop next generation languages and protocols

Advanced

- Research and develop advanced technology for data management and model integration

Applications

- Business and applications research



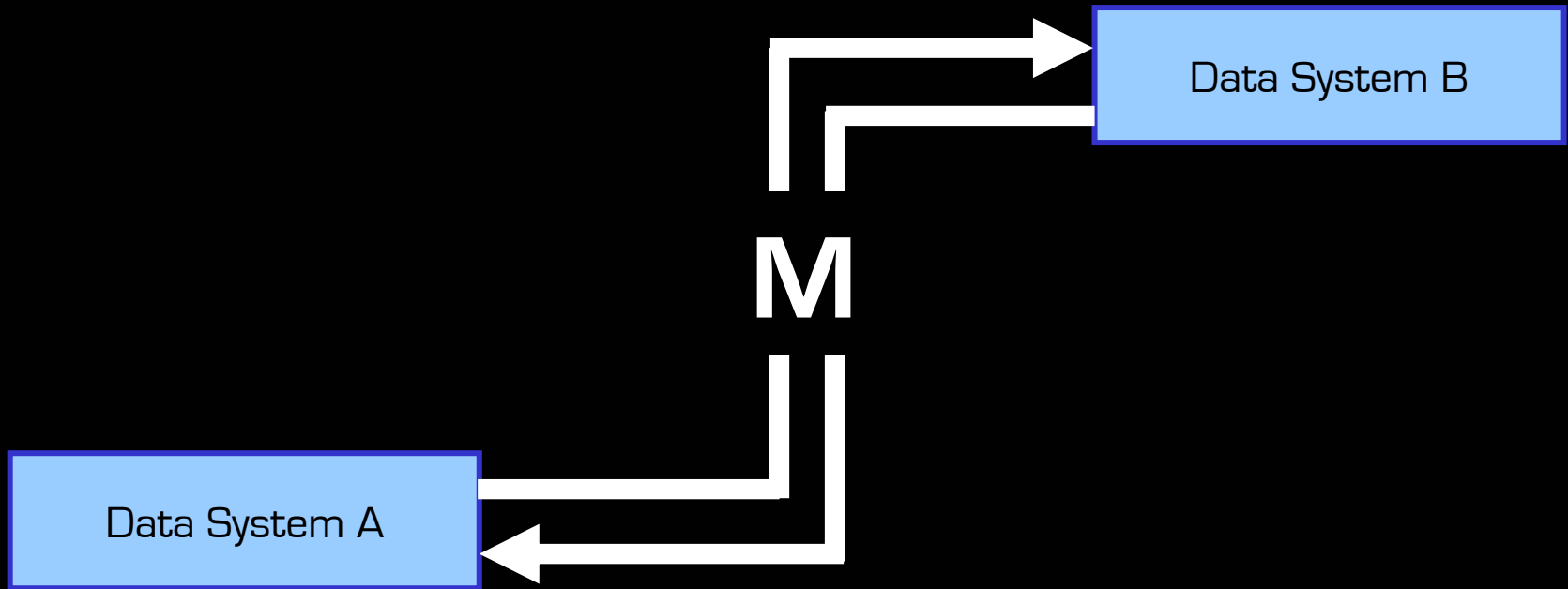
M

M

A Modeling Language



Interoperating Models and Data





M

- Dictionary
- Grammar



DICTIONARY DEVELOPMENT

- Web accessible
- Web editable
- Web community
- Staged approval
 - Proposal – Universal accessible and editable
 - Draft – Universal accessible and limited editable
 - Pre-approval – Universal accessible and limited comments
 - Recommendation – Universal accessible



DICTIONARY ENTRIES

- **Word** (ex. “call” and “account”)
- **Key** (ex. “call” and “account.5”)
- **Domain** (ex. “Medicine.” or “Legal.”)
- **Agency** (ex. “RosettaNet,” “APICS” or “ISO”)
- **References** (ex. “Acetylsalicylic acid” “CAS 50-78-2”)
- **Definition** (ex. “call – a telephone connection or conversation”)
- **Examples** (ex. “she reported several anonymous calls”; “he placed a phone call to London”; “he heard the phone ringing but didn't want to take the call”)



DICTIONARY ENTRIES

- Synonyms (ex. “sofa” and “couch”)
- Antonyms (ex. “fast” and “slow”)
- Type of (ex. “oak” is a *type of* “tree”)
- Types (ex. “oak” contains a *type* “white oak”)
- Part of (ex. “brim” is *part of* a “hat”)
- Parts (ex. “hat” has a *part* “brim”)
- Attributes (ex. “physical object” has *attributes* “mass” and “volume”)



DICTIONARY ENTRY

a keyrd

call *n.*

1. A loud cry, a shout.
2. The characteristic cry of an animal.
3. A telephone communication or connection.
4. Need or occasion.

call.3



ENTRY: call

call *n.* (*call*)

A telephone connection or conversation.

Syn. telephone call, phone call

Type of telephone.2, telephony

Attributes telephone number



ENTRY: model

model *n.* (*model*)

A simplified or idealized description or conception of a particular system, situation, or process, often in mathematical terms, that is put forward as a basis for theoretical or empirical understanding, or for calculations, predictions, etc.; a conceptual or mental representation of something.

Type of hypothesis, possibility.5, theory.2

Types simulation.4, computer simulation, stochastic process

Attributes name, identification.3, description.2, state, expression.4, model



ENTRY: AuthorizedPricingInformation

AuthorizedPricingInformation p. (*AuthorizedPricingInformation*)

The collection of business properties that describe the supplier's product cost issued to a distributor that is below distributor's book cost.

Phrase. information, pricing; information, authorized



DICTIONARY

The screenshot shows a Mozilla Firefox browser window with the address bar displaying `http://www.datacenter.info/MDictionary/call.2.html`. The page content is as follows:

Data Center
M Dictionary

[M Dictionary: Main Page](#)
[Discussion](#)
[Changes](#)

search

[article](#) [discussion](#) [edit](#) [history](#)

call *n.* (call.2) [\[edit\]](#)

A telephone communication or connection.

Syn. phone call, telephone call

Type of. telephony

Attr. telephone number

Done



DICTIONARY DEVELOPMENT



Oxford
English
Dictionary
OXFORD UNIVERSITY PRESS

Oxford English Dictionary



Unified
Medical
Language
System

National Library of Medicine
Unified Medical Language System



United States Department of Defense



Princeton University, WordNet



American Chemical Society
Chemical Abstracts Service



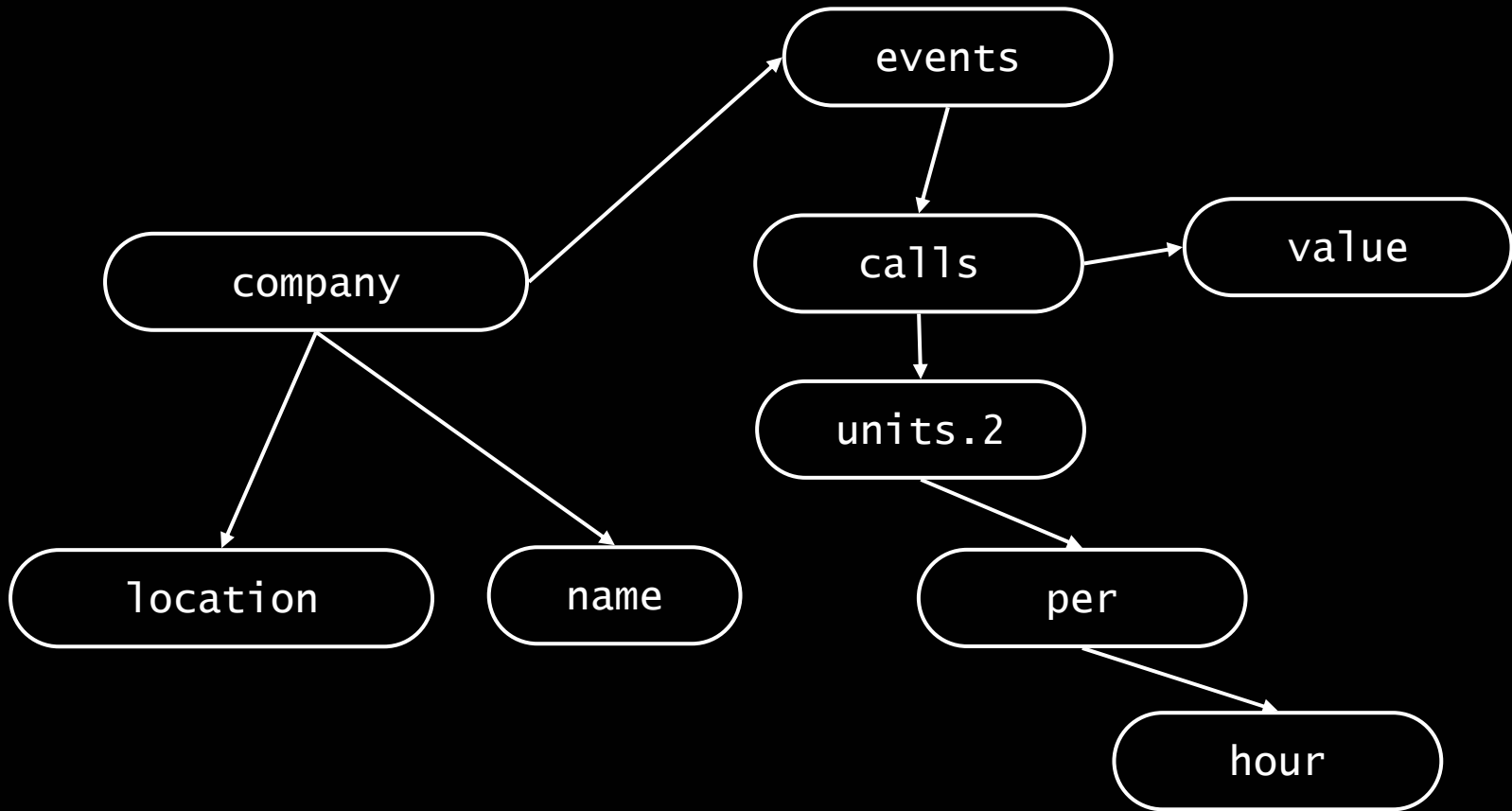
West Law Publishing
Black's Law Dictionary



Acronym Finder
Acronym Dictionary



GRAMMAR

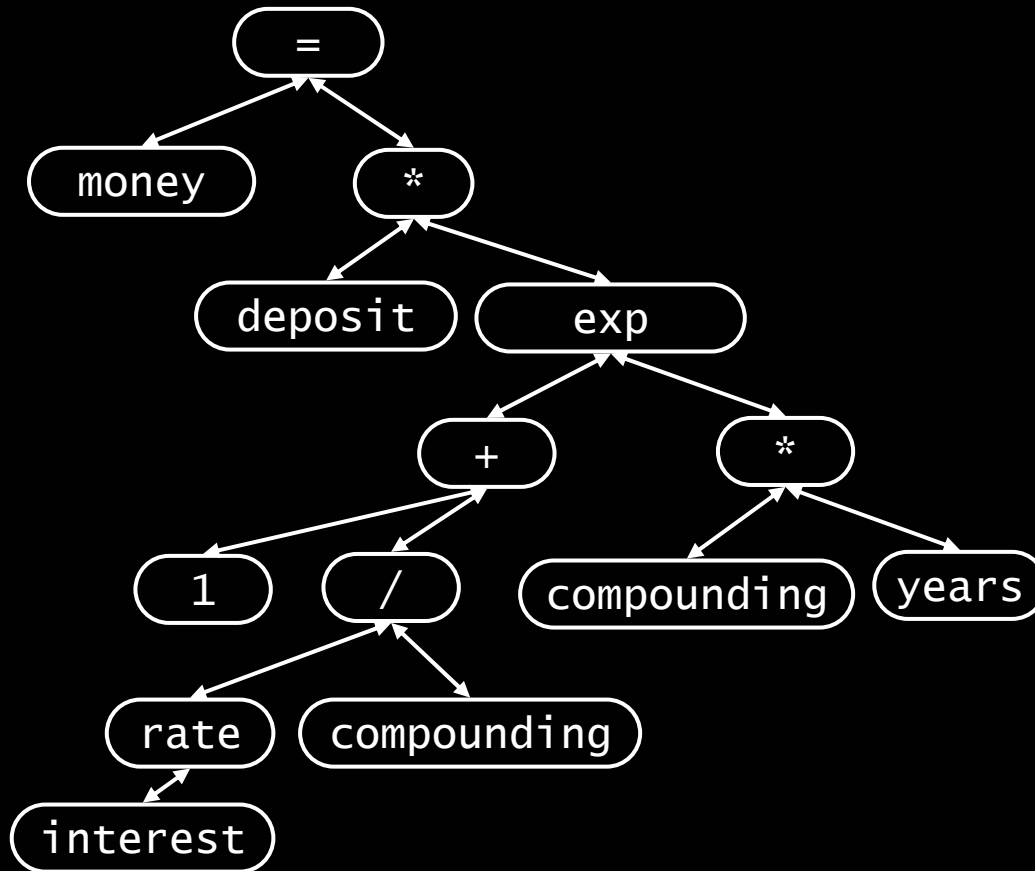




MATHEMATICS

Equations ...

$$P = C (1 + r/n)^{nt}$$

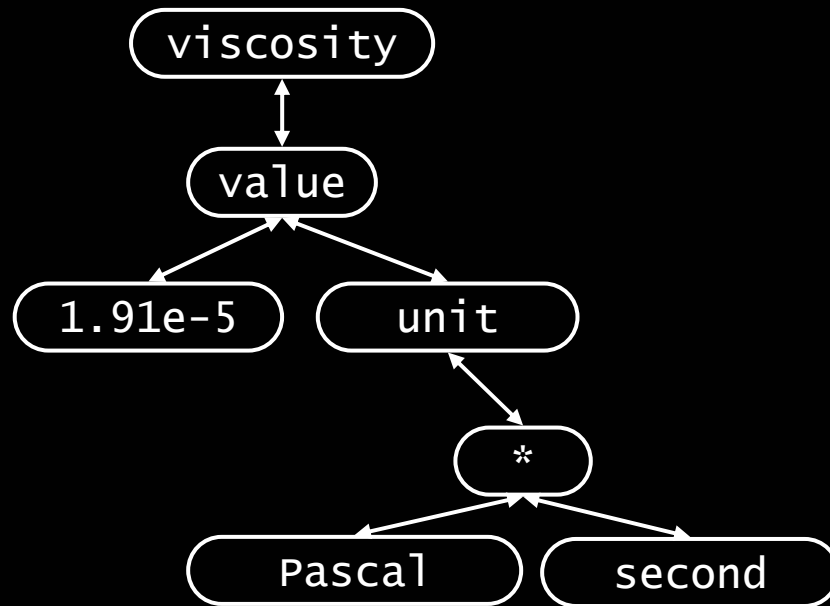




ENGINEERING

Engineering units ...

viscosity 1.91×10^{-5} Pa s

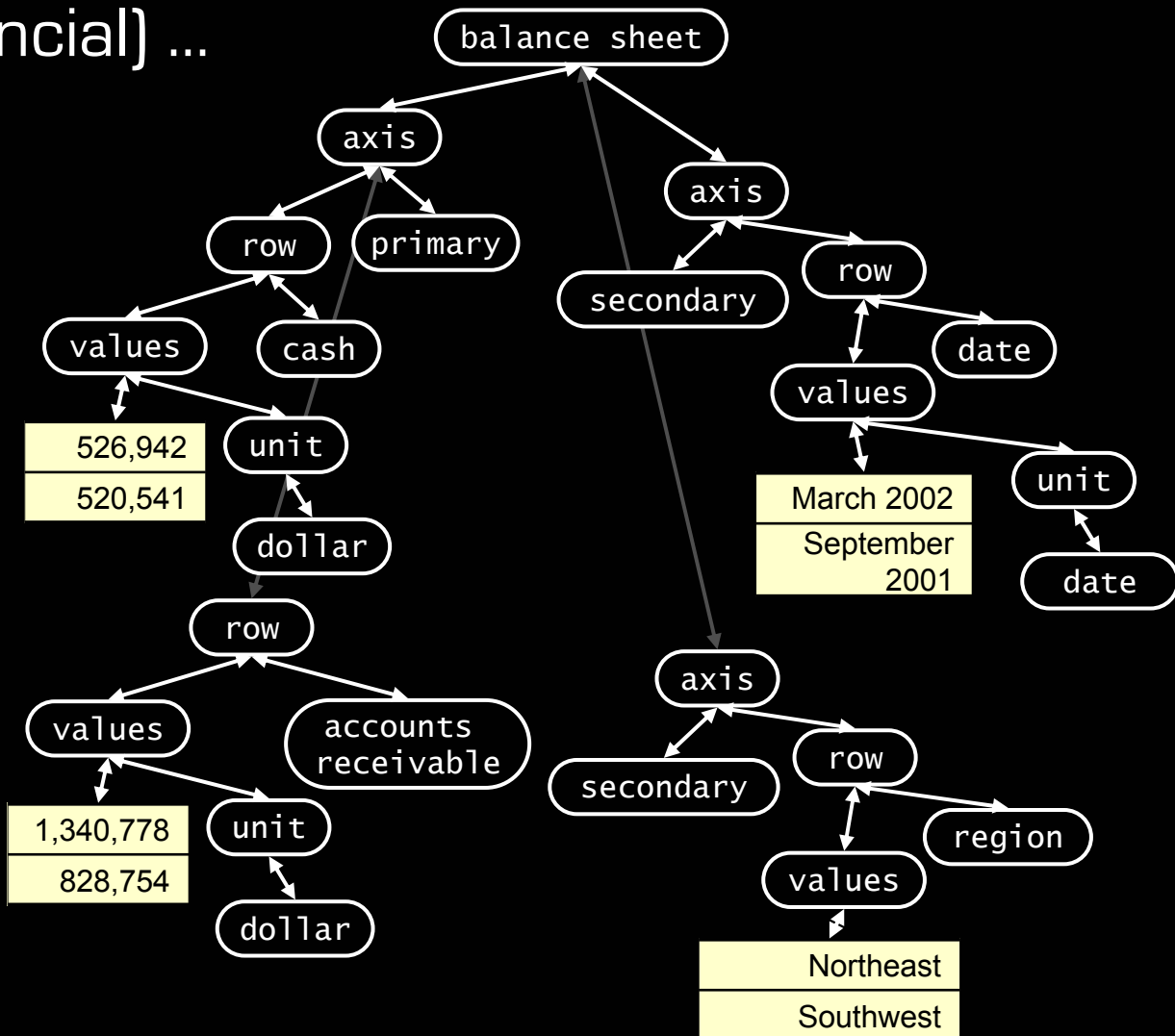




FINANCE

Spreadsheets (financial) ...

Assets	March 2002	September 2001
Cash	526,942	520,541
Accounts Receivable	1,340,778	828,754
Prepaid Expense	75,429	78,639
Equipment	84,102	93,393
Total Assets	<u>2,027,251</u>	<u>1,521,327</u>
Liabilities		
Accounts Payable	16,354	10,446
Deferred License Revenue	869,119	881,014
Unearned Support	295,957	312,110
Accrued Payroll/Expenses	87,861	80,372
Total Liabilities	1,269,291	1,283,942
Retained Earnings	757,960	237,385
Total Liabilities and Retained Earnings	<u>2,027,251</u>	<u>1,521,327</u>





Software Tools and Applications

Vista 2004 - Making the Internet of Things Visible - [Overview]

File Edit View Tools Window Help

Control Panel Overview Data View Plan View Display Real World View

Food Quality Version 1.12

Food quality model base on the Arrhenius Equation.

States
Arrhenius Constant

Algorithms
Food Quality

Control

United States Department of Defense
Natick Army Laboratories, Combat Feeding Division

D01:10.1002/047084155

Status Ready...



EXAMPLE - SHELF LIFE





EXAMPLE – SHELF LIFE

- 76 Million cases of foodborne disease
- 325,000 hospitalizations
- 5000 deaths *

- 1.8 Million deaths from foodborne illness worldwide

- 91 Million tons of food disposed
- Transported to landfills
- 26% of food supply*

* United States figures



EXAMPLE - SHELF LIFE

$$\frac{\partial Q}{\partial t} = -k_1 e^{\left[-\frac{E_a}{R_g T(t)} \right]} Q^n$$

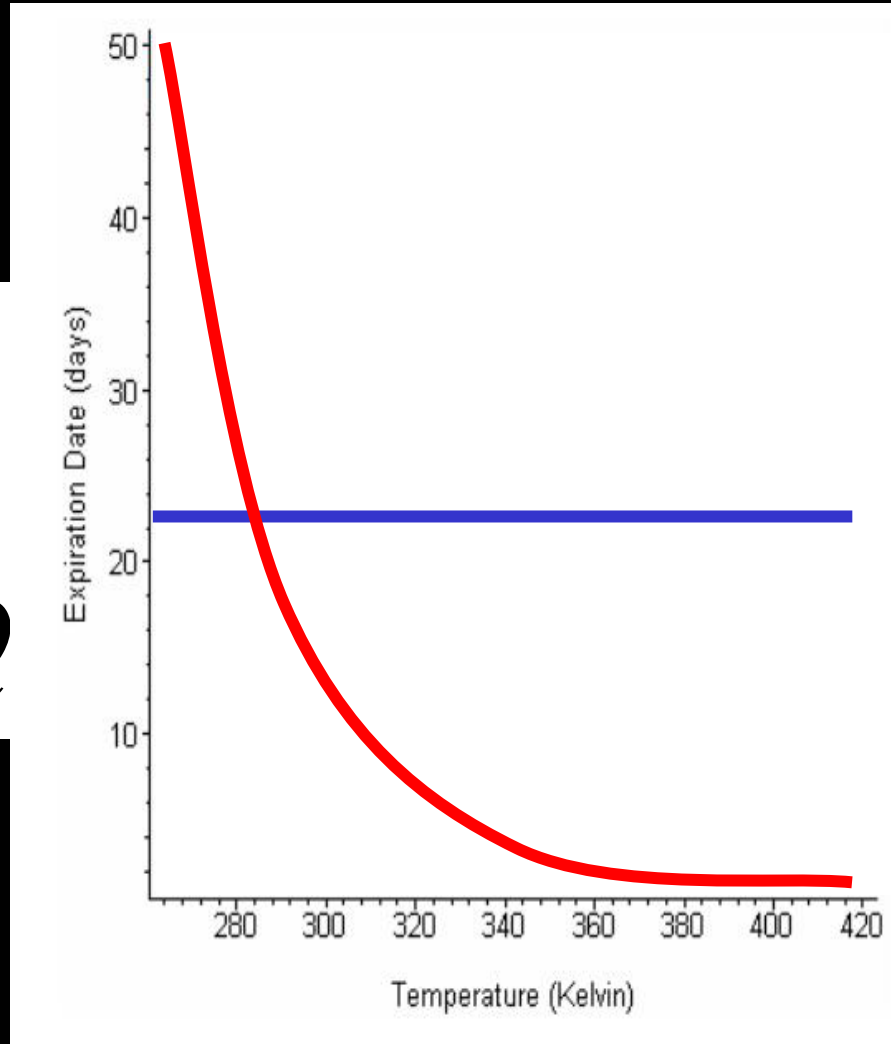
Variables

- E_a Activation energy
- k_1 Arrhenius constant
- n Order of the reaction
- T Temperature
- Q Quality
- t Time



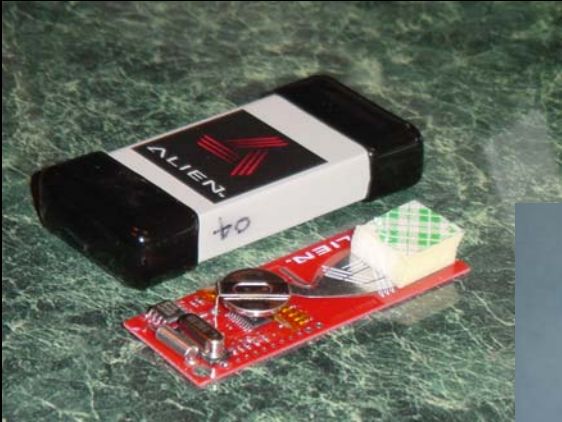
EXAMPLE - SHELF LIFE

Q

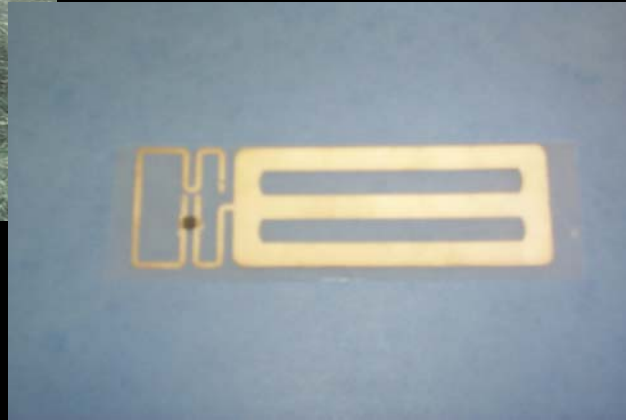




EXAMPLE - SHELF LIFE



Current Type 3 Tag
w/Temp Sensor



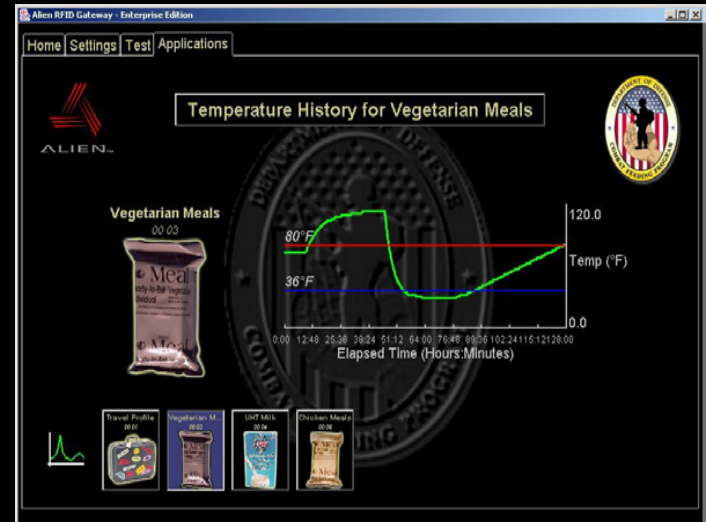
Next Generation
Application Specific
Integrated Circuit
(ASIC)



350 Micron NanoBlock™
chips



EXAMPLE - SHELF LIFE





EXAMPLE - SHELF LIFE

Name: Activation Energy

Desc

Sym

Acce

ID: E

Clas

Type

Unit

Defa

Name: Arrhenius Constant

Desc

Symb

Acce

ID: EF

Class

Type:

Unit:

Defau

Name: Temperature

Desc

Symb

Acce

ID: EF

Class

Type:

Unit:

Defau

Name: Quality

Desc

Sym

Acce

ID: E

Clas

Type

Unit:

Defa

Name: Order of Reaction

Description: Order of Reaction

Symbol: *n*

Access: Read

ID: EPC: 01020084191000001289731

Class: Scalar

Type: Int

Unit:

Default: 1



Food Quality

Name: Food Quality

Description: Food Quality based Arrhenius

Developer: Natick Army Laboratories

ID: EPC: 010300908808BF60000000AA

Comp: \$0.25 per month

Type: Analytic

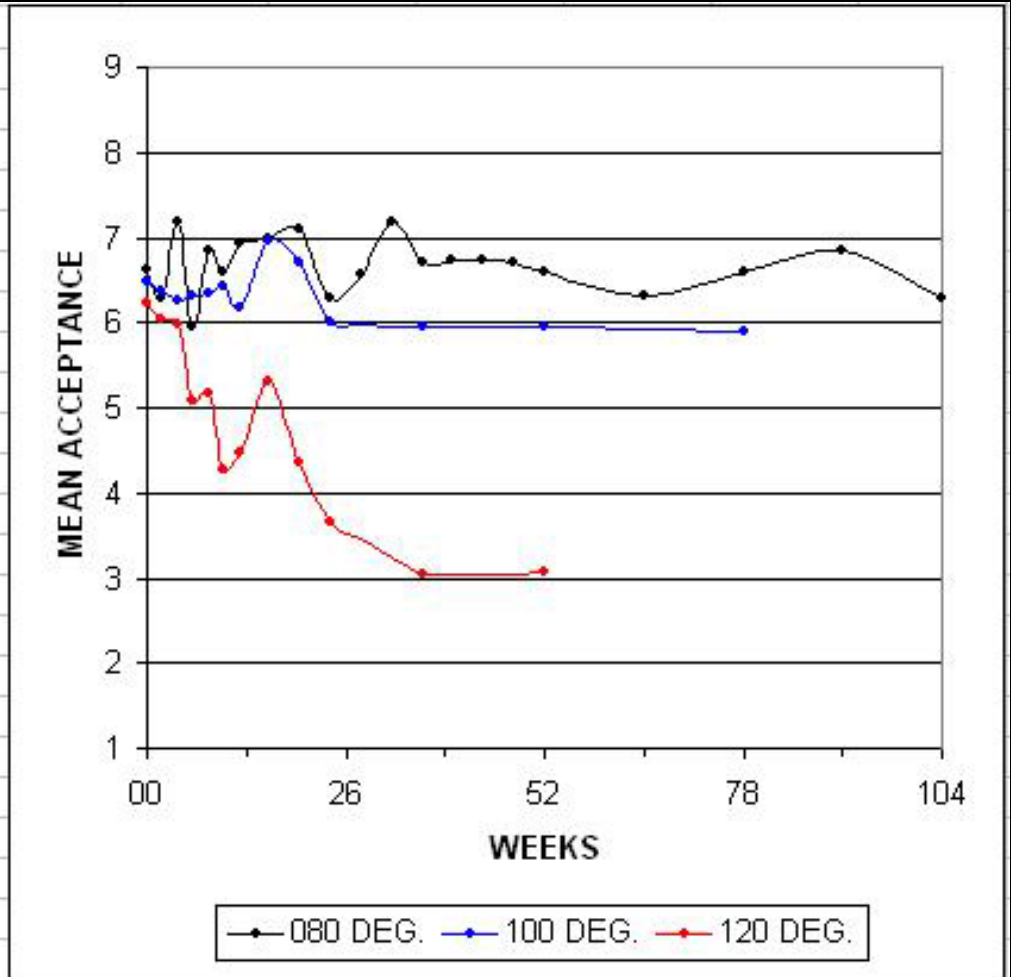
Rate: 1 to 10,000 sec

Algorithm:

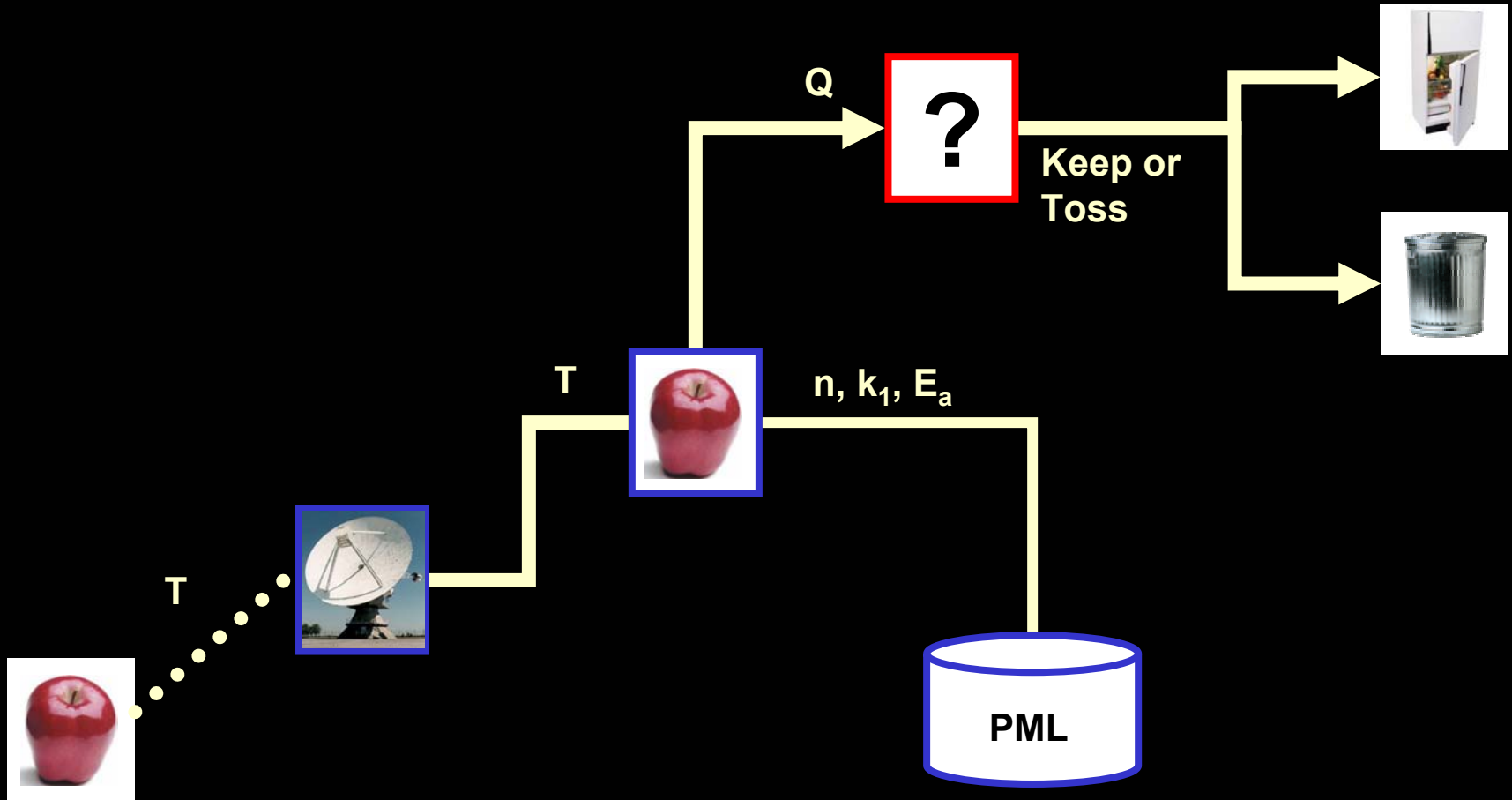


EXAMPLE - SHELF LIFE

WKS	080 DEG.	100 DEG.	120 DEG.
00	6.622	6.486	6.243
02	6.282	6.359	6.026
04	7.194	6.250	5.972
06	5.949	6.308	5.077
08	6.850	6.350	5.175
10	6.600	6.429	4.286
12	6.944	6.167	4.472
16	7.000	6.947	5.316
20	7.111	6.694	4.361
24	6.300	6.000	3.667
28	6.579		
32	7.189		
36	6.694	5.944	3.028
40	6.730		
44	6.730		
48	6.703		
52	6.583	5.944	3.056
65	6.316		
78	6.583	5.889	
91	6.842		
104	6.300		
130			
156			



EXAMPLE - SHELF LIFE





EXAMPLE - SHELF LIFE

MRE Temperature Sensor Data

Please Select an MRE:
01.0000A89.00016F.000169DC1

Start Temperature Sensor Day: Friday, May 23, 2003
Time: 11:23:07 AM
Temperature: 71

Stop Temperature Sensor

Time Temperature Chart

Time(S)	Temperature(F)
0	66
1	66
2	58
3	58
4	67
5	70
6	84
7	76
8	66
9	70
10	81
11	76
12	77
13	75
14	84
15	66
16	75
17	68
18	81
19	77
20	76
21	76
22	78
23	84
24	71

MRE Application

MRE Quality Application

Please Select an MRE:
01.0000A89.00016F.000169DC1

Quality: 50 - 100 Issue, 20 - 49 Inspect, 0 - 19 Discard

Time and Temperature Data:

- Monday, April 28, 2003 12:17:32 PM 81
- Monday, April 28, 2003 9:44:10 PM 64
- Friday, May 23, 2003 11:18:54 AM 59
- Friday, May 23, 2003 11:18:55 AM 49
- Friday, May 23, 2003 11:18:56 AM 53
- Friday, May 23, 2003 11:18:57 AM 54
- Friday, May 23, 2003 11:18:58 AM 56
- Friday, May 23, 2003 11:18:59 AM 42
- Friday, May 23, 2003 11:19:00 AM 54
- Friday, May 23, 2003 11:19:01 AM 54
- Friday, May 23, 2003 11:19:02 AM 42

Time Quality Chart

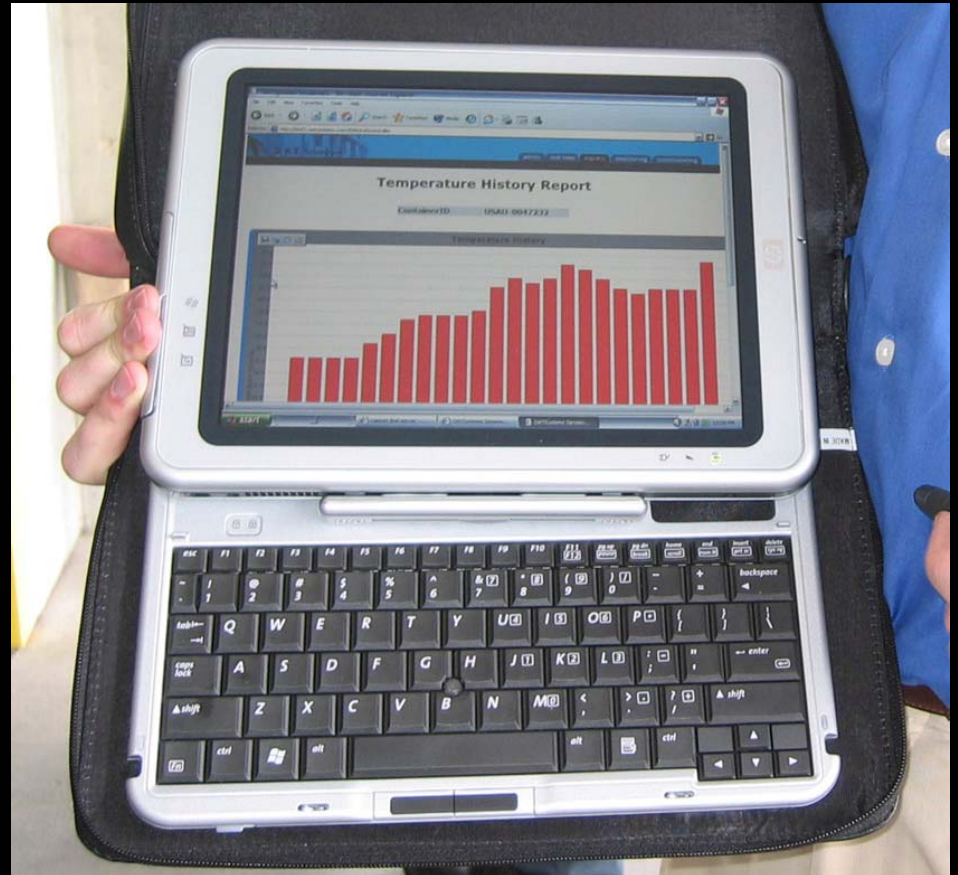
Time(Day)	Quality
0	100
20	~70
40	~45
60	~25
80	~15
100	~10

Discard





EXAMPLE - SHELF LIFE

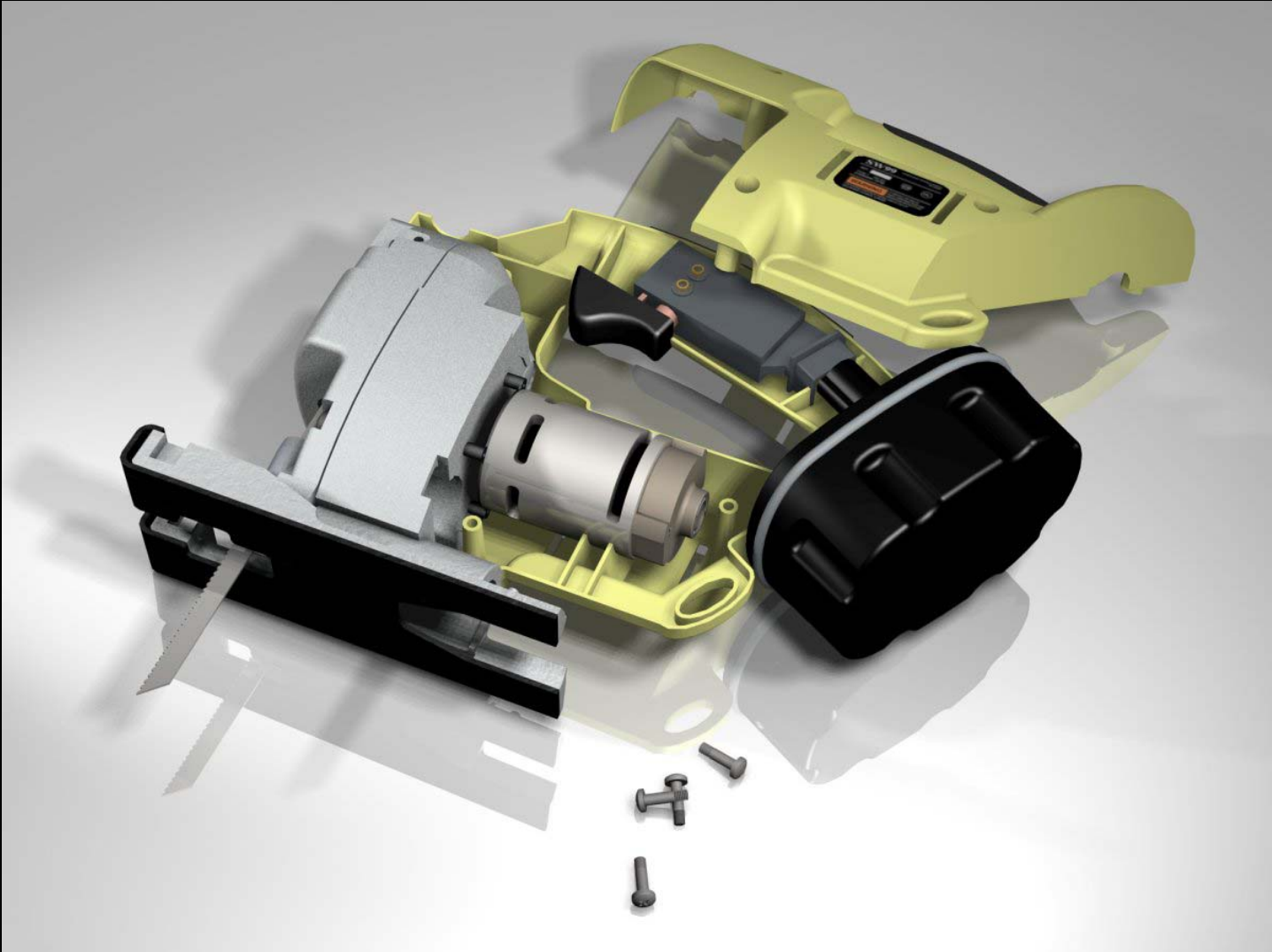




WHAT CAN YOU USE IF FOR?



APPLICATIONS - PRODUCT DESIGN





APPLICATIONS - LOGISTICS





APPLICATIONS - TRAFFIC AND ROUTING



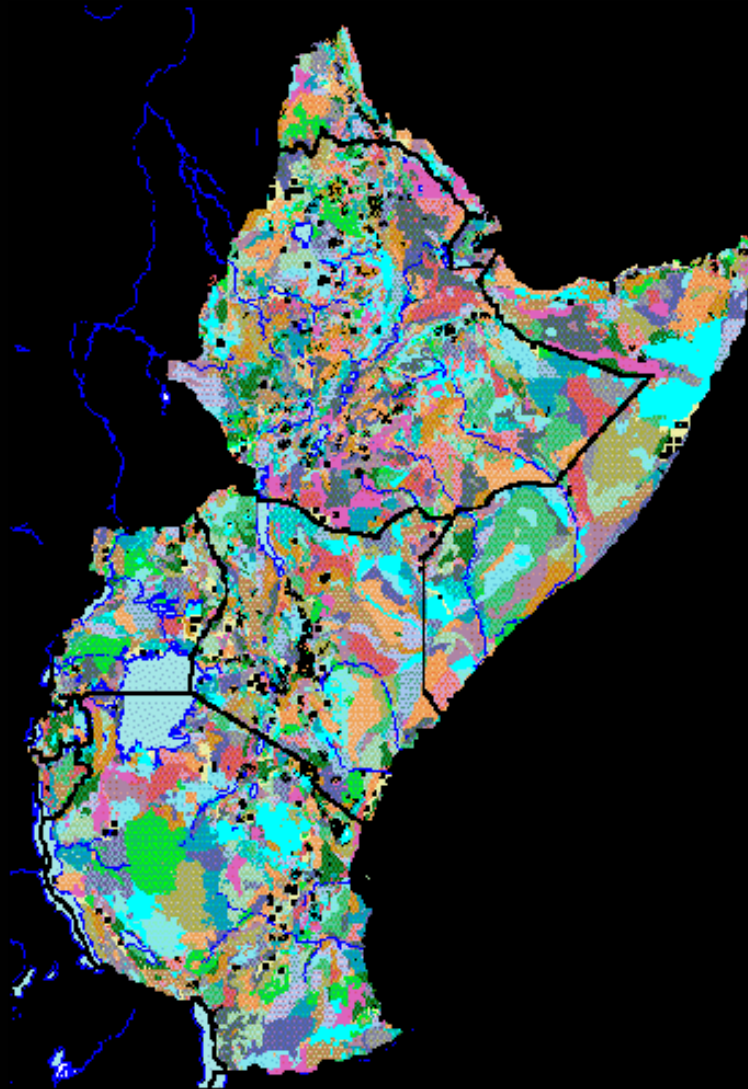


APPLICATIONS - MANUFACTURING





APPLICATIONS - ENVIRONMENTAL IMPACT



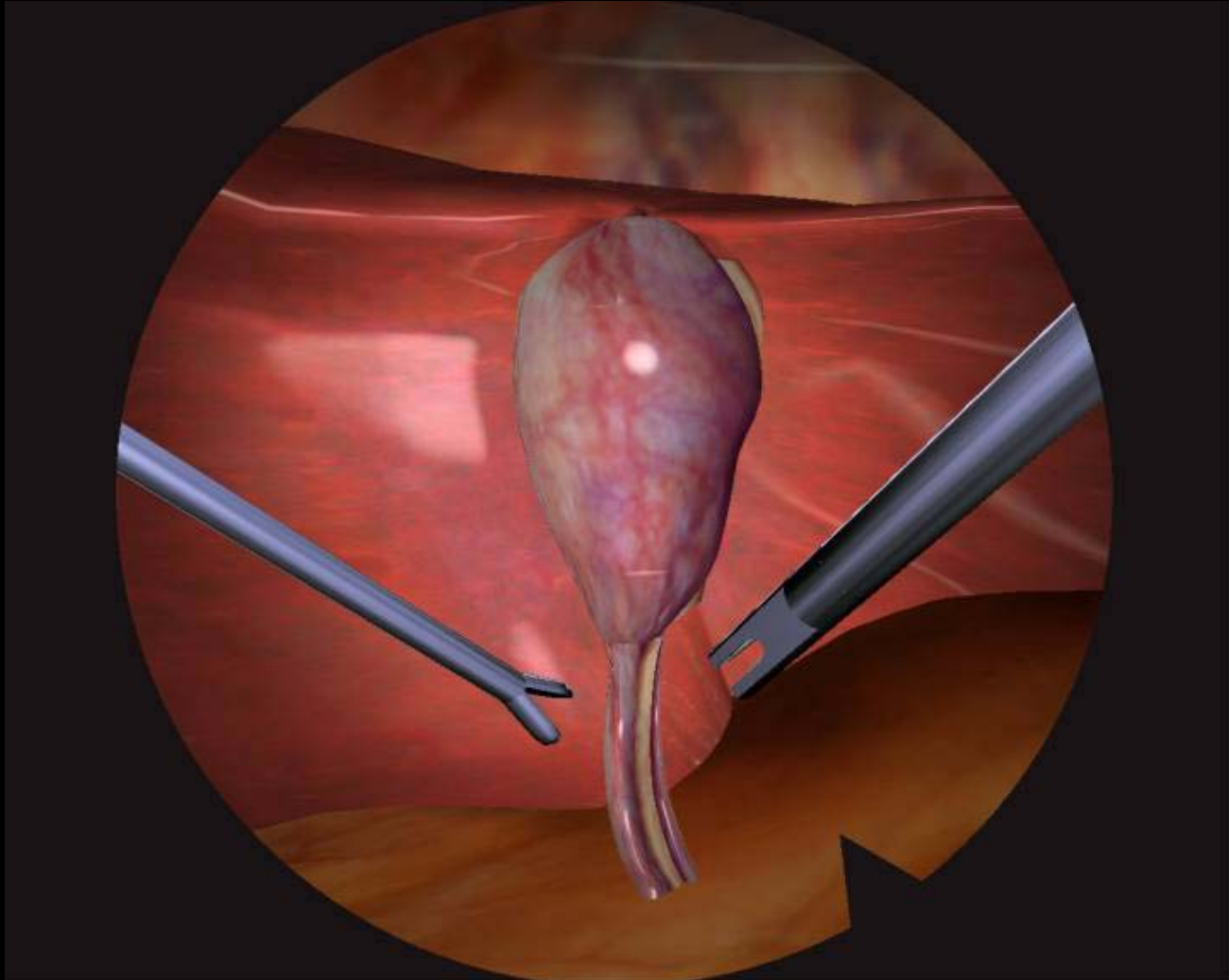


APPLICATIONS - DEFENSE





APPLICATIONS - HEALTHCARE





APPLICATIONS - FINANCE

LSM Demo

Acquire NET Resources: 5
Total # of Simulations: 50000
Interest rate model: Vasicek
Choose an Instrument: US fixed coupon callable bond
Running mode: Go with Pauses
NET Cluster
Graph mode on
GO

Price (Y) vs Interest Rate (X) $Y = a_1 + a_2 \cdot X + a_3 \cdot X \cdot X$

Wait... Matlab is being spawned over the NET cluster
Got parameters from matlab:
Initial interest rate = 0.05
Begin Forward simulation...
Computing non-callable bond price...
Starting Reverse sweep and regression plots..

Interest Rate (Y) vs Time (X)



APPLICATIONS - LEGAL

Crash 3
Blue vehicle at 60 Km/h
Yellow vehicle at 50 Km/h



Civil and Forensic



DATA CENTER

DATA CENTER

Making sense of your data