Rapid Application Prototyping Using GAMS

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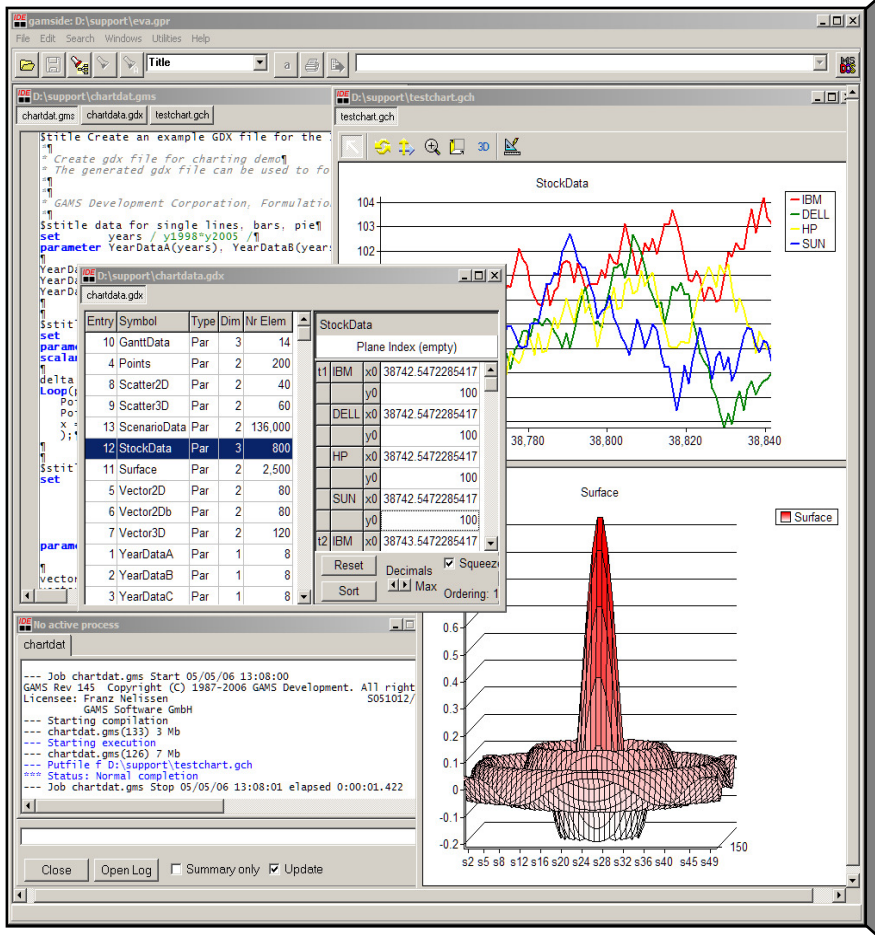
www.gams.com

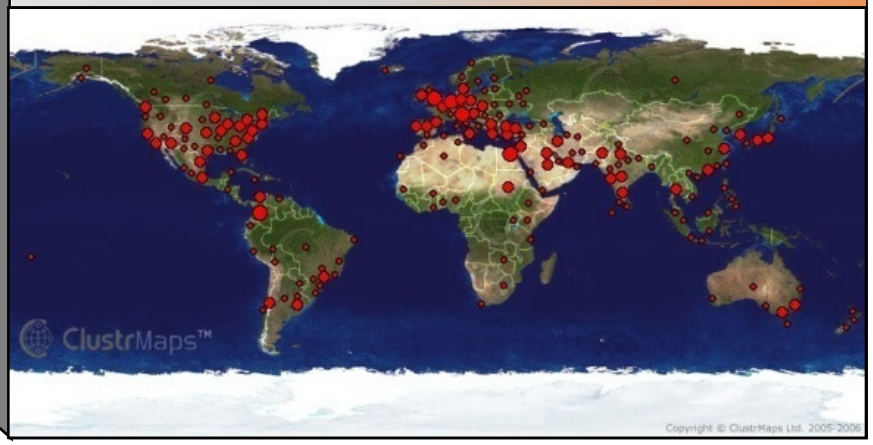
GAMS at a Glance



General **A**lgebraic **M**odeling **S**ystem

- Roots: World Bank, 1976
- Went commercial in 1987
- GAMS Development Corp.
- GAMS Software GmbH

- Broad academic & commercial user community and network



GAMS' Fundamental concepts

- Different layers with separation of
  - model and data
  - model and solution methods
  - model and operating system
  - model and interface

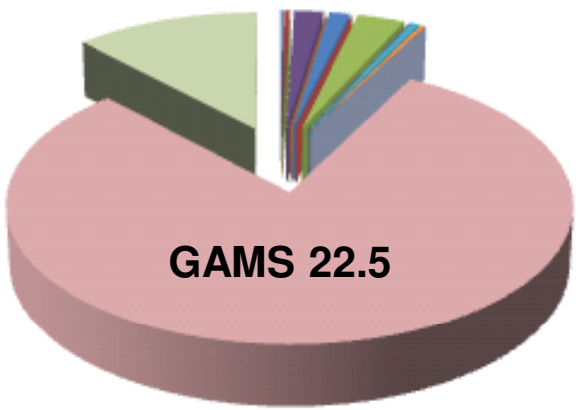
- Balanced mix of declarative and procedural elements
- Open architecture and interfaces to other systems
- Platform independence

Typical Application Areas *

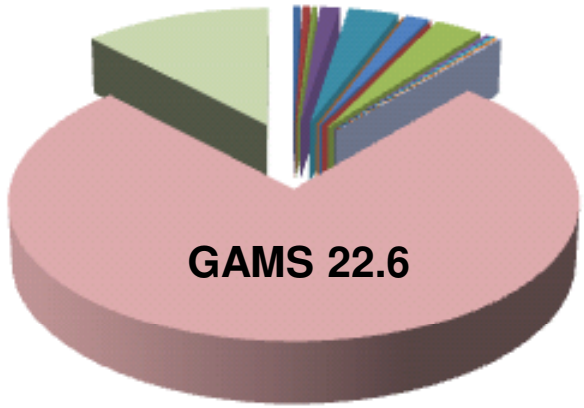
- Agricultural Economics
- Chemical Engineering
- Econometrics
- Environmental Economics
- Finance
- International Trade
- Macro Economics
- Management Science/OR
- Micro Economics
- Applied General Equilibrium
- Economic Development
- Energy
- Engineering
- Forestry
- Logistics
- Military
- Mathematics
- Physics

*** Illustrative examples in the GAMS Model Library**

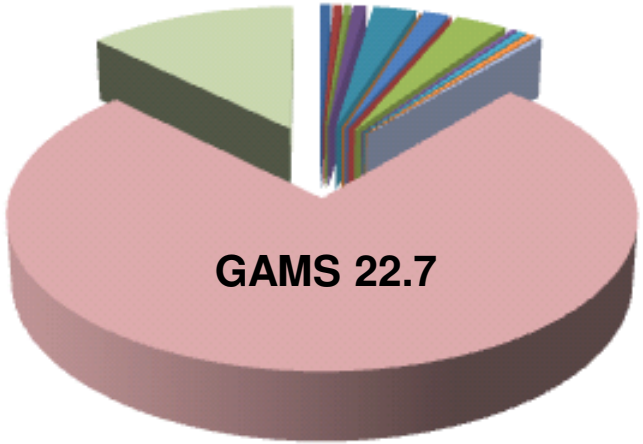
Downloads by Platform



~525 downloads/week

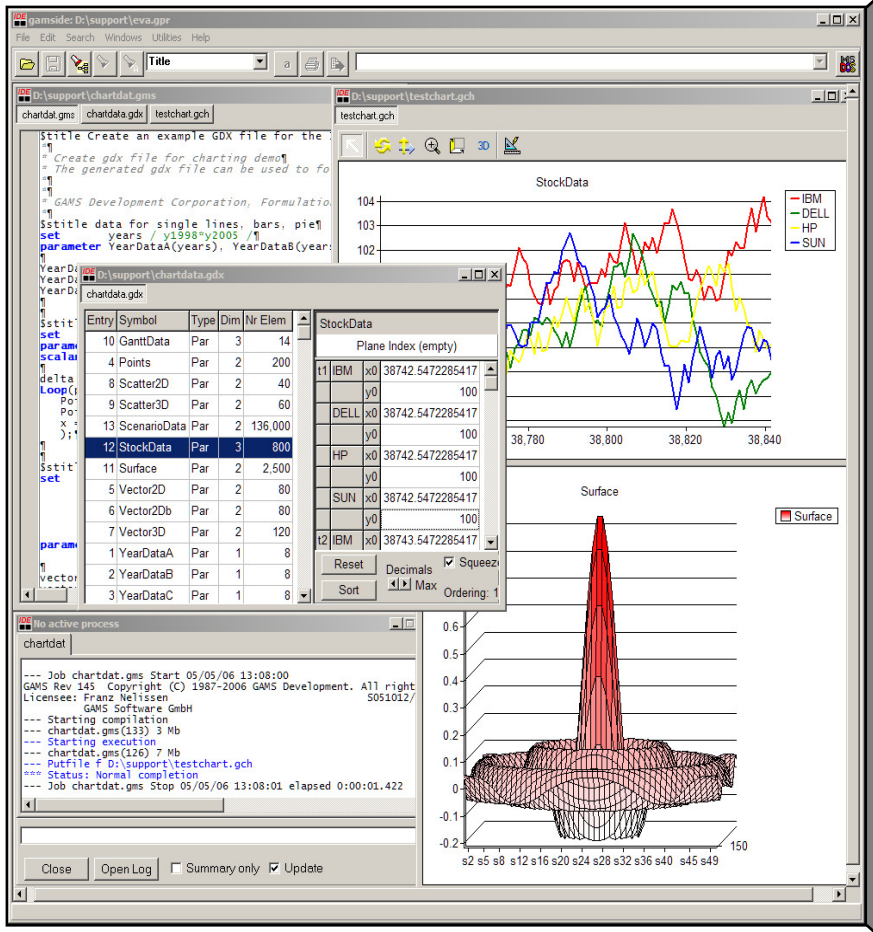


~590 downloads/week



~590 downloads a week

GAMS at a Glance

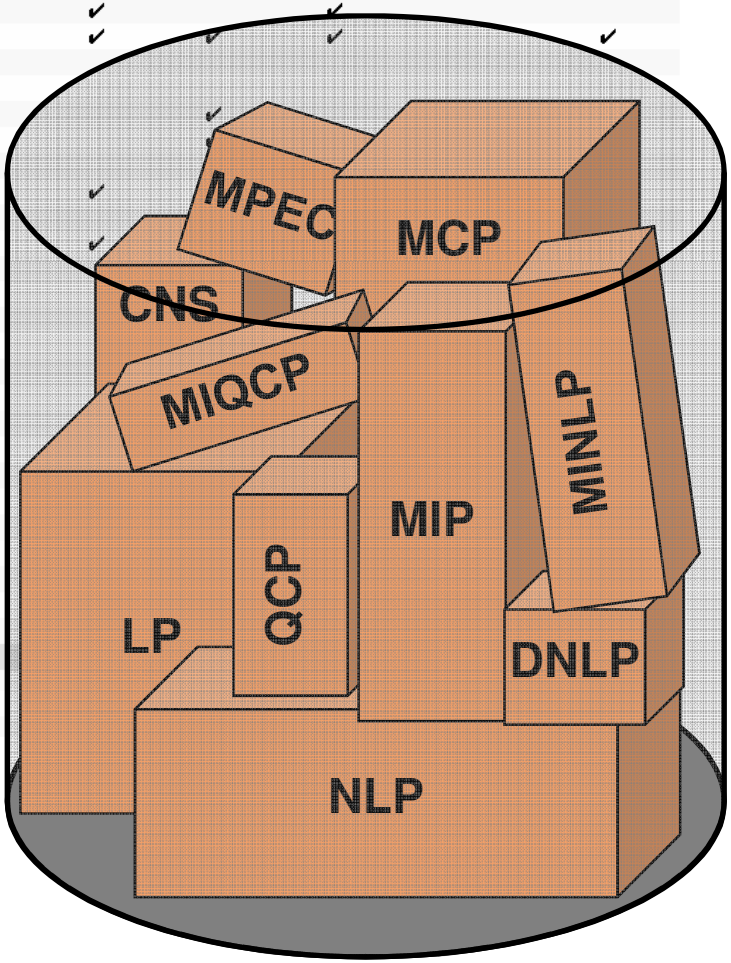


General **A**lgebraic **M**odeling **S**ystem

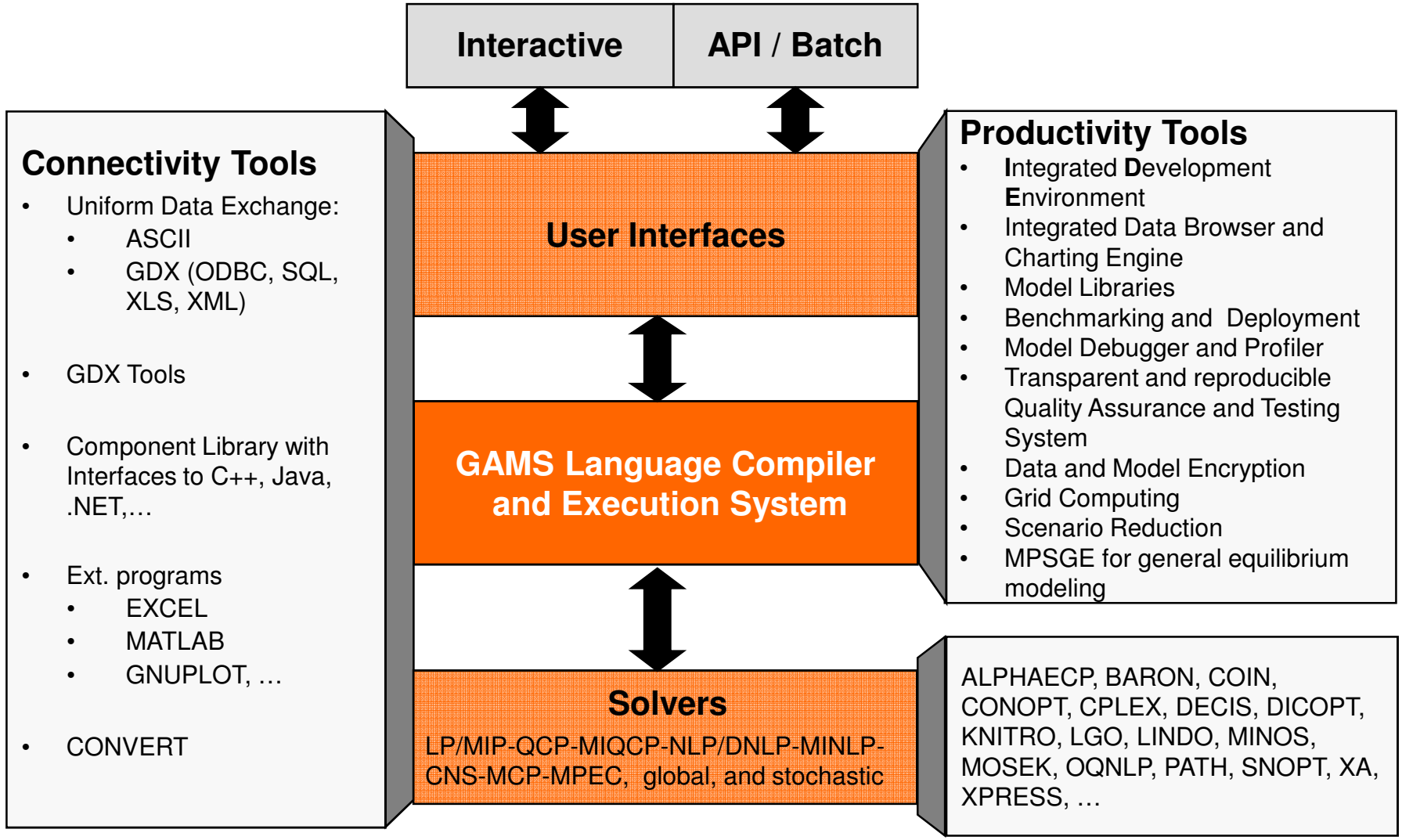
- Algebraic Modeling Language
- 25+ Integrated Solvers
- 10+ Supported MP classes
- 10+ Supported Platforms
- Connectivity- & Productivity Tools
  - IDE
  - Model Libraries
  - GDX, Interfaces & Tools
  - Grid Computing
  - Benchmarking
  - Compression & Encryption
  - Deployment System
  - …

Supported Model Types (GAMS 22.8)

Solver/Model type availability - 22.8 Aug 1, 2008	LP	MIP	NLP	MCP	MPEC	CNS	DNLP	MINLP	QCP	MIQCP	*Stoch.*	*Global*
ALPHAECP								✔		✔		
BARON 8.1	✔	✔	✔				✔	✔	✔	✔		✔
BDMLP	✔	✔										
COIN	✔	✔	✔									
CONOPT 3	✔		✔			✔	✔		✔			
CPLEX 11.1	✔	✔										
DECIS	✔											
DICOPT												
KNITRO 5.1	✔		✔				✔		✔			
LINDOGLOBAL 5.0	✔	✔	✔				✔		✔			
LGO	✔		✔				✔					
MILES				✔								
MINOS	✔		✔				✔					
MOSEK 5	✔	✔	✔				✔					
MPSGE												
MSNLP			✔				✔					
NLPEC				✔	✔							
OQNLP			✔				✔					
OSL V3	✔	✔										
OSLSE	✔											
PATH				✔		✔						
SBB												
SNOPT	✔		✔				✔					
XA	✔	✔										
XPRESS 18.00	✔	✔										
Contributed Plug&Play solvers												
AMPLwrap	✔	✔	✔	✔	✔	✔	✔					
DEA	✔	✔										
Kestrel	✔	✔	✔	✔	✔	✔	✔					



System Overview

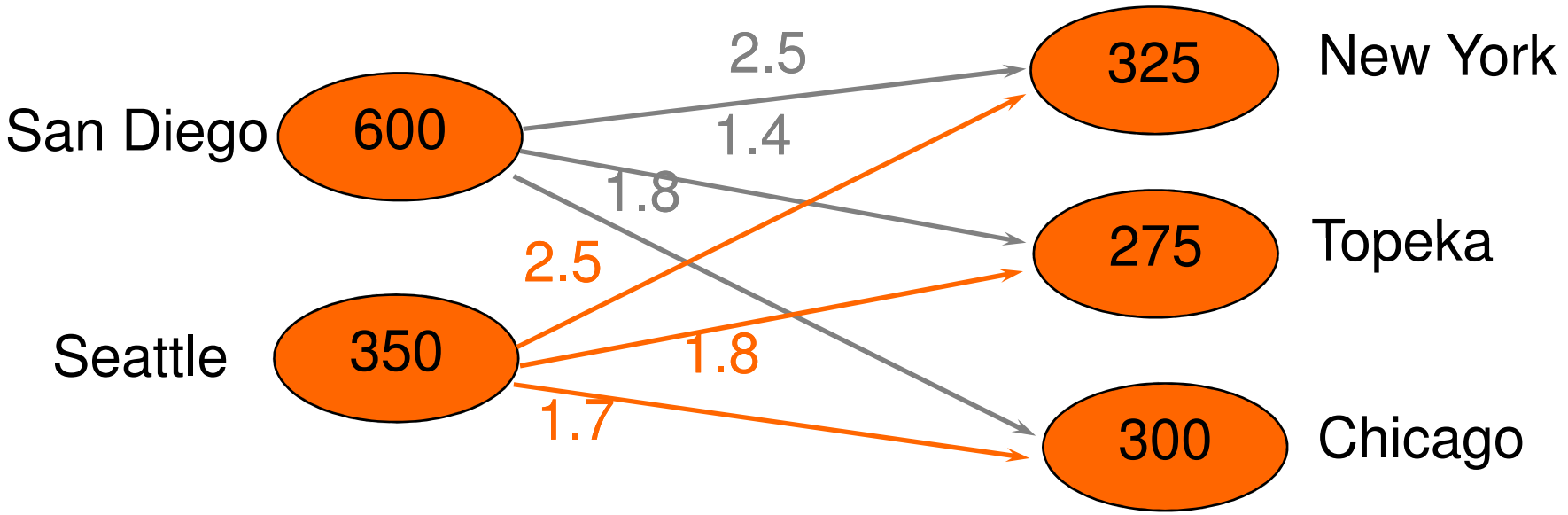


What is a Model?

- Mathematical Programming (MP) Model
  - List of Equations

- Collection of several intertwined MP Models
  - Data Preparation
  - Data Calibration
  - “Solution” Module (e.g. sequential, parallel, loop)
  - Report Module

A Transportation Model



Minimize	Transportation cost
subject to	Demand satisfaction at markets
	Supply constraints

Mathematical Algebra

$$\sum_{\substack{c,p:\\(c,p)\in\mathcal{N}}} tcost \cdot dist(c,p) \cdot x_p^c \rightarrow \min$$

$$\sum_{\substack{c,p:\\(c,p)\in\mathcal{N}}} x_p^c \leq sup(c) \quad \forall c$$

$$\sum_{\substack{c,p:\\(c,p)\in\mathcal{N}}} x_p^c \geq dem(p) \quad \forall p$$

$$x_p^c \geq 0 \quad \forall c,p : (c,p) \in \mathcal{N}$$

GAMS Algebra

gamside: C:\models\practiceDC\myStuff.gpr - [C:\models\practiceDC\trnsport.gms]

File Edit Search Windows Utilities Model Libraries Help

supply

trnsport.gms

```
Variables
     x(i,j)   shipment quantities in cases
     z        total transportation costs in thousands of dollars ;

Positive Variable x ;

Equations
     cost          define objective function
     supply(i)     observe supply limit at plant i
     demand(j)     satisfy demand at market j ;

cost ..         z  =e=  sum((i,j), c(i,j)*x(i,j)) ;

supply(i) ..    sum(j, x(i,j))  =l=  a(i) ;

demand(j) ..    sum(i, x(i,j))  =g=  b(j) ;

Model transport /all/ ;
```

54: 20 Insert

Basic Sudoku

Address http://www.dailysudoku.com/sudoku/index.shtml

Daily SuDoku

- Home
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- SuDoku Archive
- SuDoku for Kids
- Draw/Play
- Discussion
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- Books
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Welcome to the Daily SuDoku!

Today's SuDoku is shown on the right. Click the grid to download a printable version of the puzzle. Visit **the archive** for previous daily puzzles and solutions. Play online, print a Sudoku, solve and get hints using the new improved **Draw/Play** function.

But how do I do it?

The object is to insert the numbers in the boxes to satisfy only one condition: each row, column and 3x3 box must contain the digits 1 through 9 exactly once. What could be simpler?

The rules of the new **Monster Sudokus** are exactly the same, but more numbers and letters are needed.

Classic | Monster | Kids | Squiggly

						6		1
			7	3	1			4
5					9			
6			2				1	
		8				4		
	1				5			8
			9					3
7			8	6	3			
9		2						

Daily SuDoku: Thu 2-Nov-2006 very hard

Christmas Tree Sudoku

Address http://www.dailysudoku.com/sudoku/archive.shtml?year=2005&month=12&day=23&type=seasonal

Daily SuDoku

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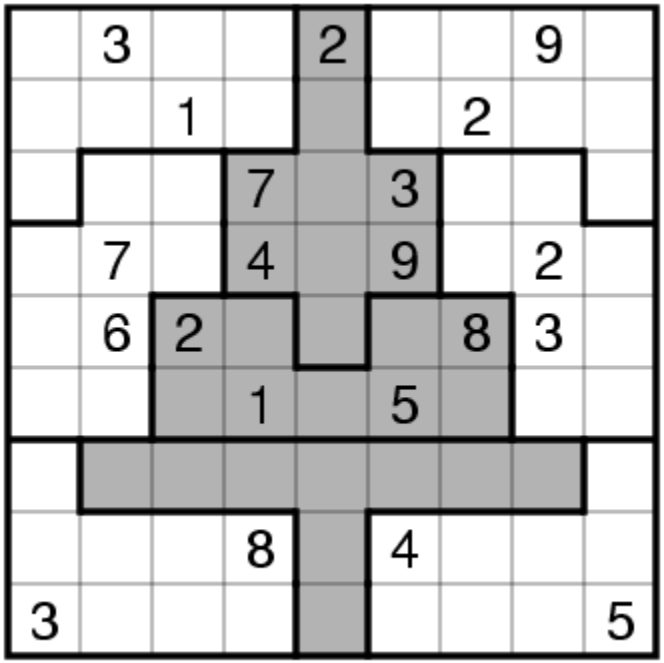
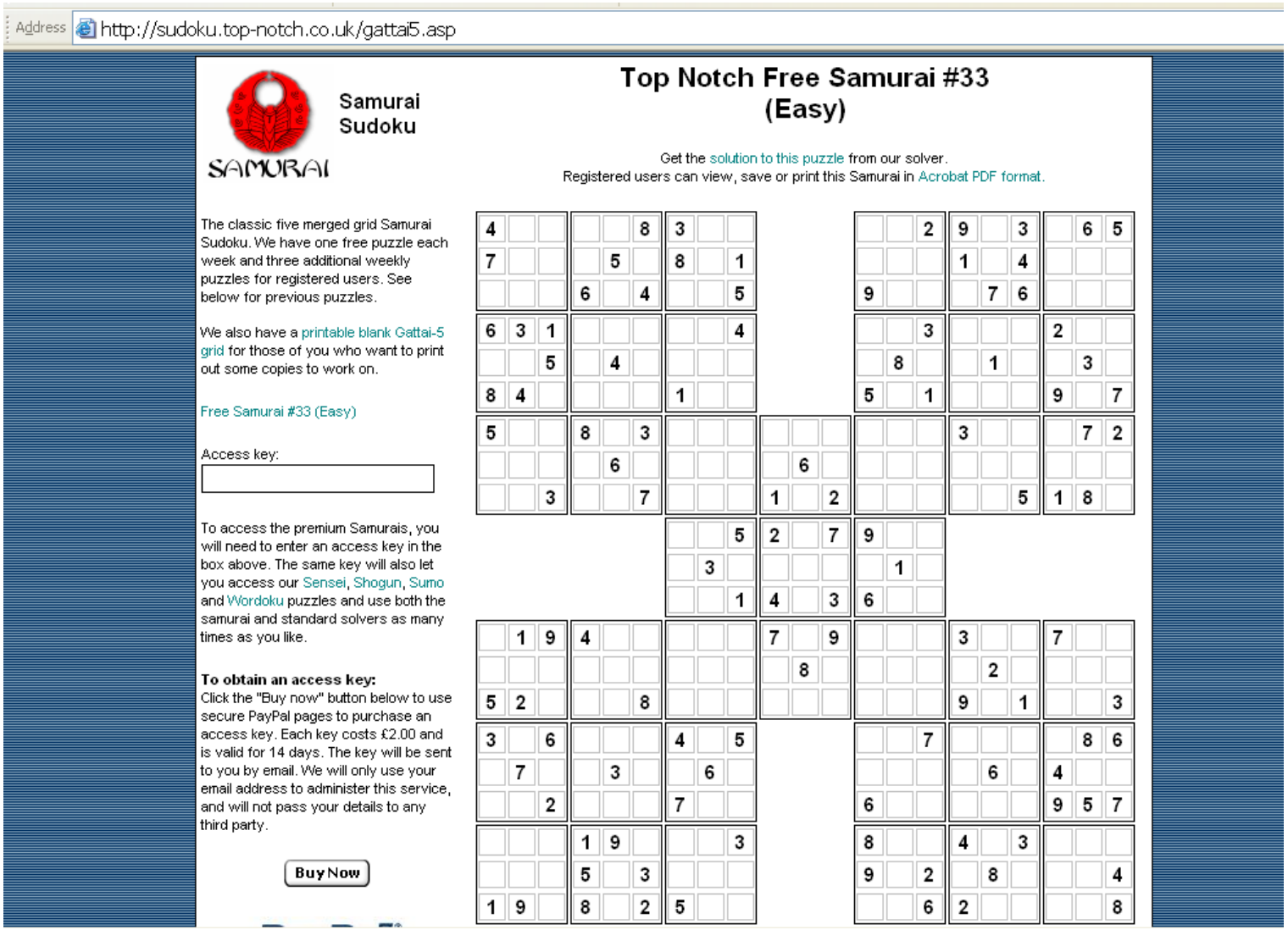
Daily Seasonal Sudoku: Fri 23-Dec-2005 [instructions]



Christmas tree Sudoku: Fri 23-Dec-2005 very hard

Samurai Sudoku



Calling GAMS from an Application

Creating Input for GAMS Model
Callout to a GAMS Process/Executable
Reading Output from GAMS Model

- Works from basically every environment
  - Web application (server side)
  - Application Builder
    - Oracle, Eclipse, .NET, …
    - Regular Programming language C++, Java, VB, …
  - MS Office Application / VBA

- Integrates with existing user IT infrastructure

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