

GAMS



GAMS

General Algebraic Modeling System

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Algebraic Modeling Languages

- High-level programming languages for large scale mathematical optimization problems
- Algebraic formulation
 - Syntax similar to mathematical notation
 - Does not contain any hints how to process it
- Do not solve optimization problems directly, but call appropriate external algorithms

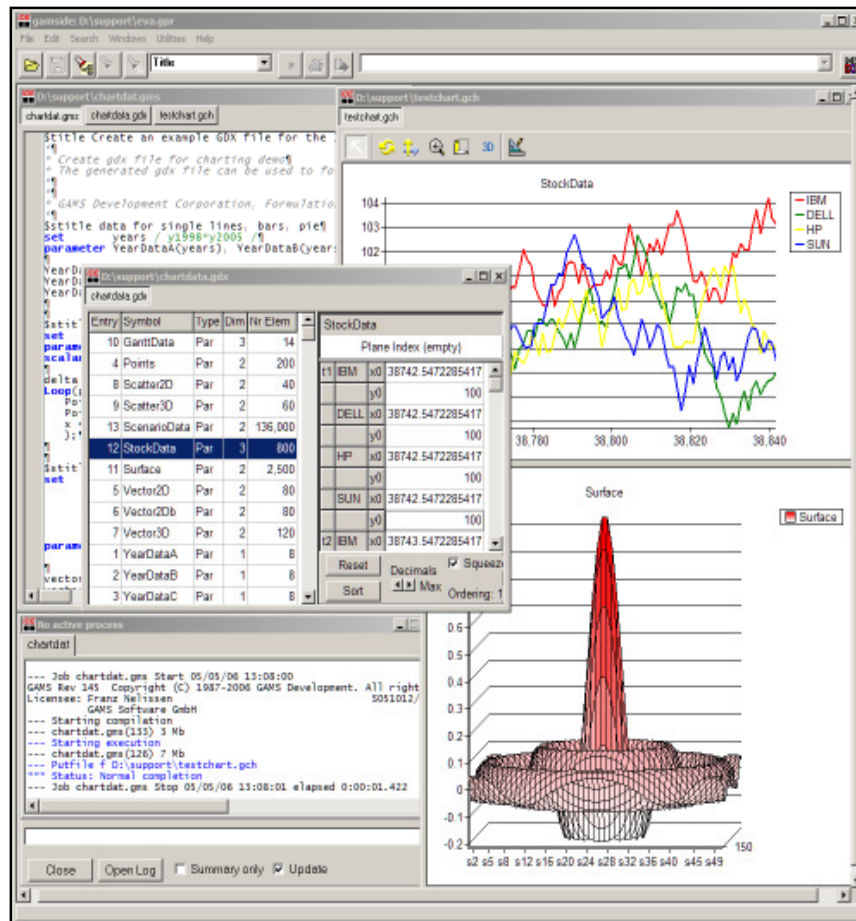


Goals

- Efficient handling of mathematical optimization problems
- Simplify model building and solution process
- Increase productivity and support maintainable models
- Support of decision making process

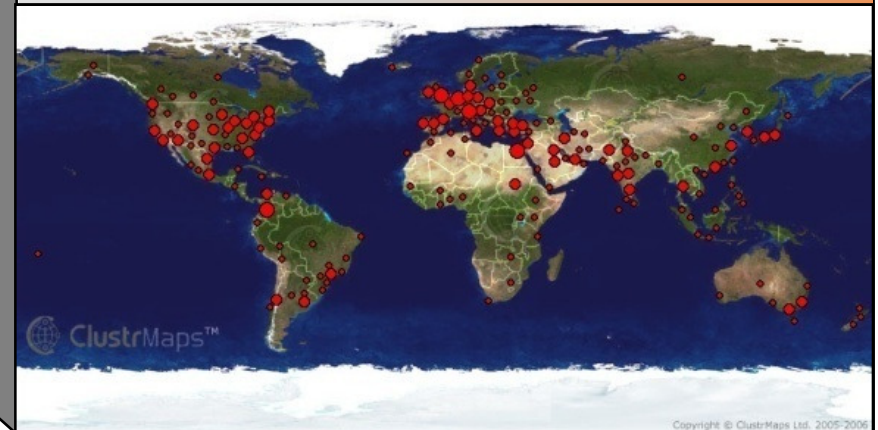


GAMS at a Glance



General Algebraic Modeling System

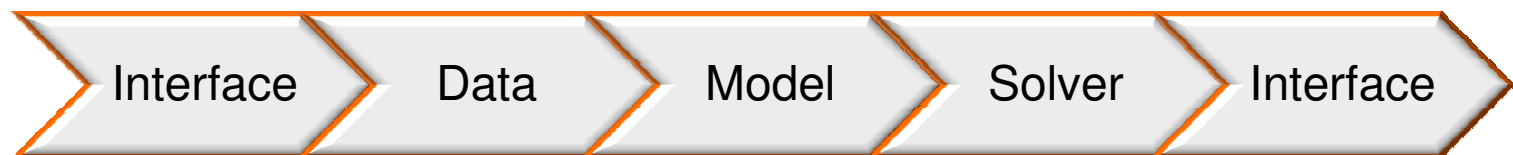
- Roots: World Bank, 1976
- Went commercial in 1987
- GAMS Development Corp.
- GAMS Software GmbH
- Broad academic & commercial user community and network





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



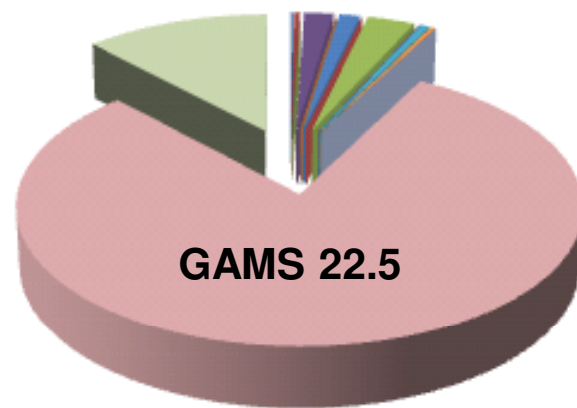
Typical Application Areas *

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

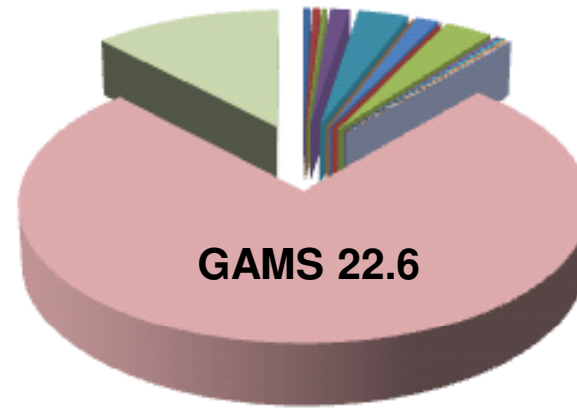
* Illustrative examples in the GAMS Model Library



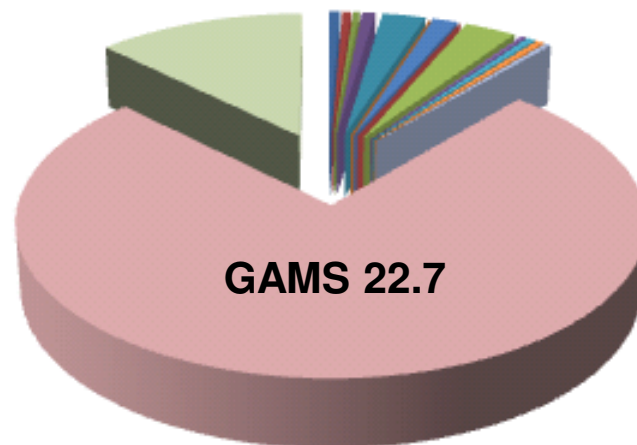
Downloads by Platform



~525 downloads/week



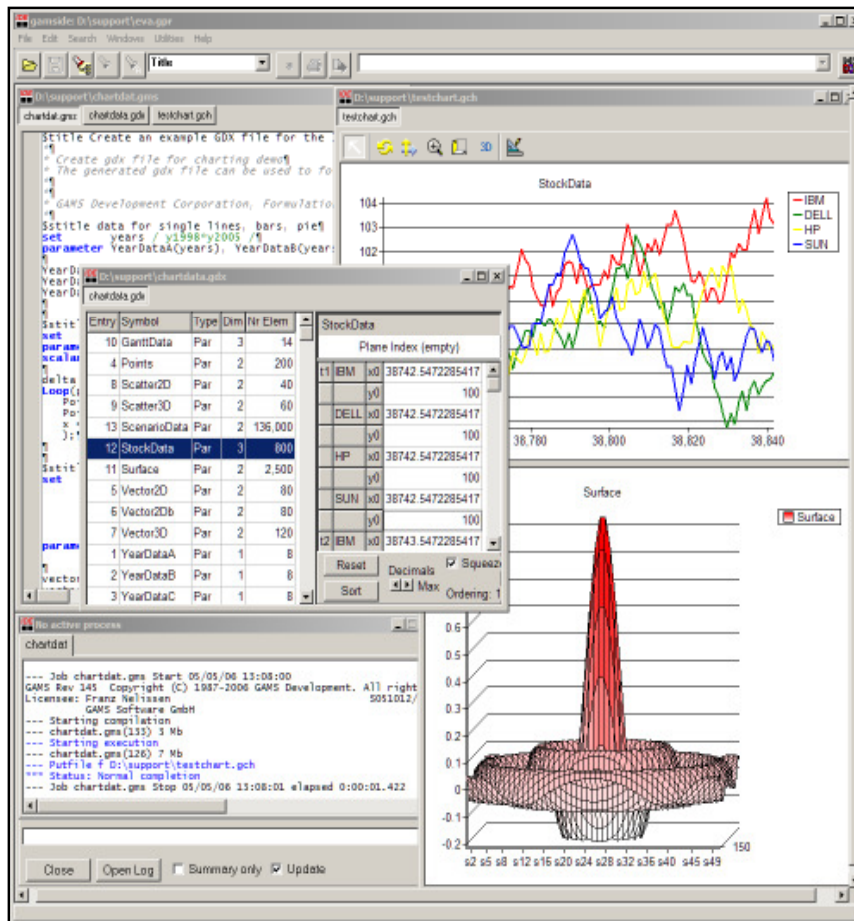
~590 downloads/week



~590 downloads a week

- aix
- axu
- hp7*
- dar
- dii
- leg
- lei
- lnx
- lx3
- sgi**
- sig
- sol
- sox
- vis
- wei

GAMS at a Glance



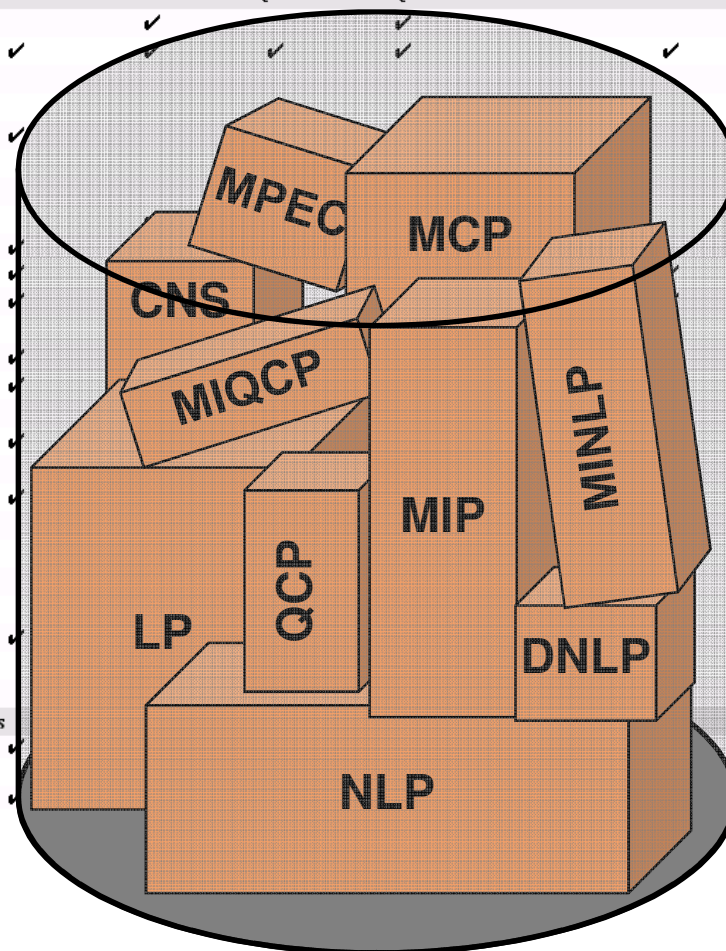
General Algebraic Modeling System

- 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 22.7)

Solver/Model type availability - 22.7 May 1, 2008												
	LP	MIP	NLP	MCP	MPEC	CNS	DNLP	MINLP	QCP	MIQCP	Stock.	Global
ALPHAEC												
BARON 8.1	✓	✓	✓				✓	✓	✓	✓		✓
BDMLP	✓	✓										
COIN	✓	✓										
CONOPT 3	✓		✓			✓	✓					
CPLEX 11.0	✓	✓										
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	✓	✓	✓	✓	✓	✓						



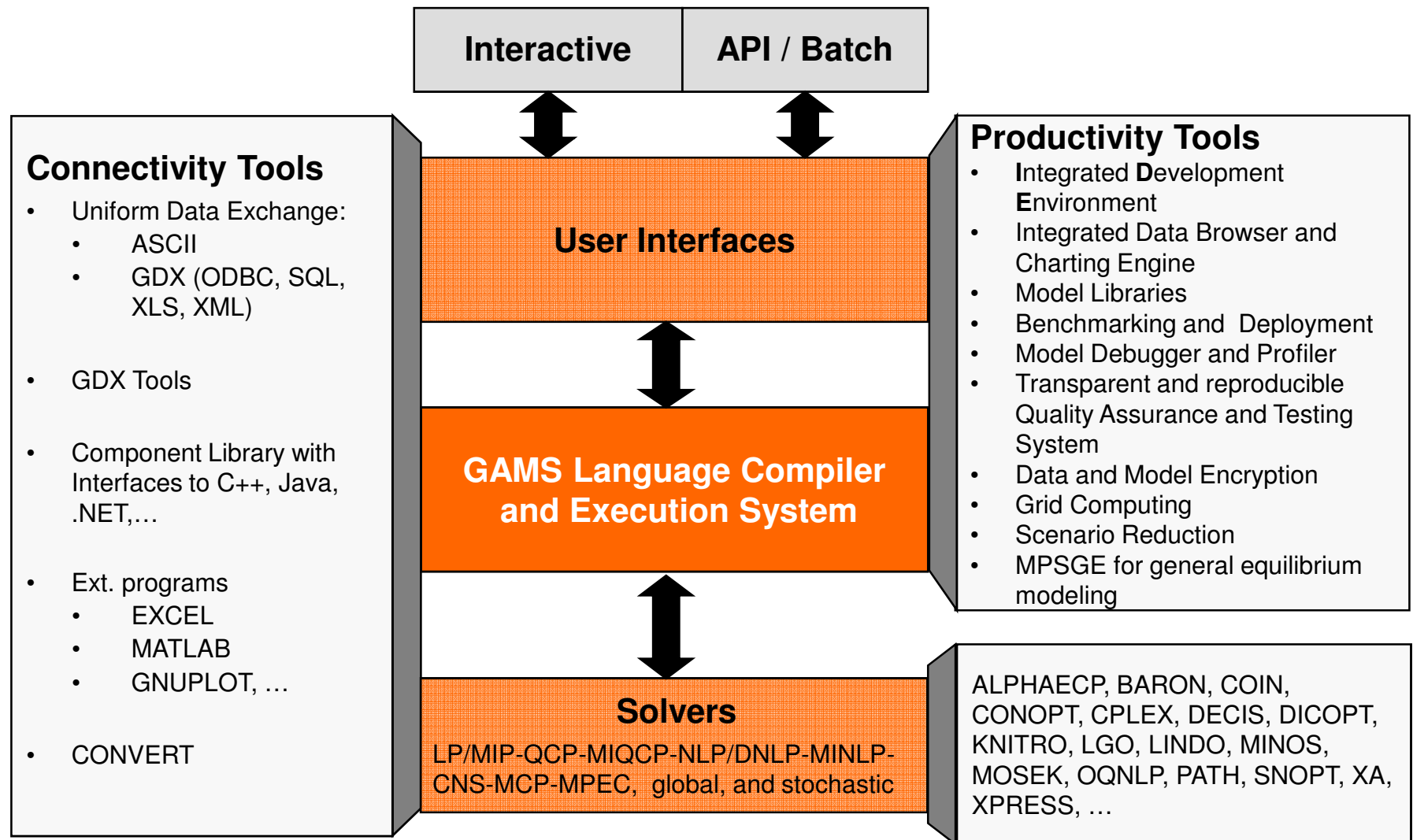


Supported Platforms (GAMS 22.7)

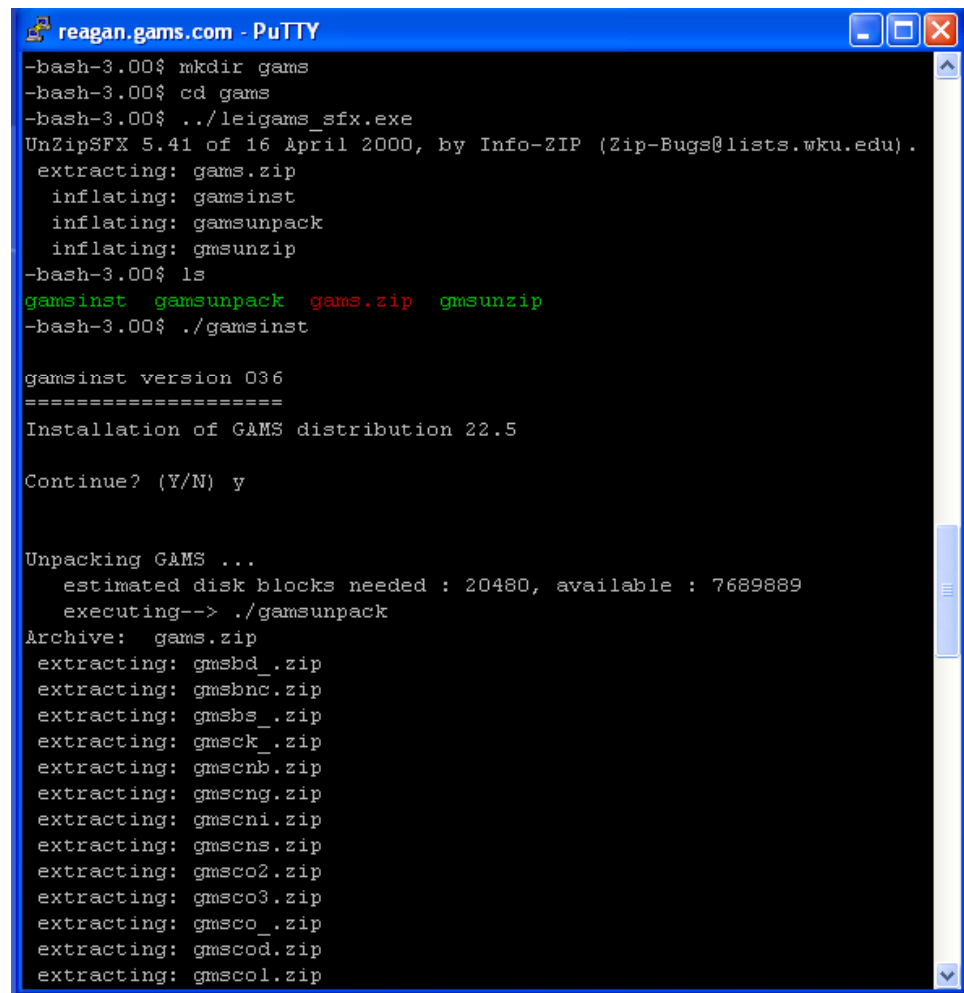
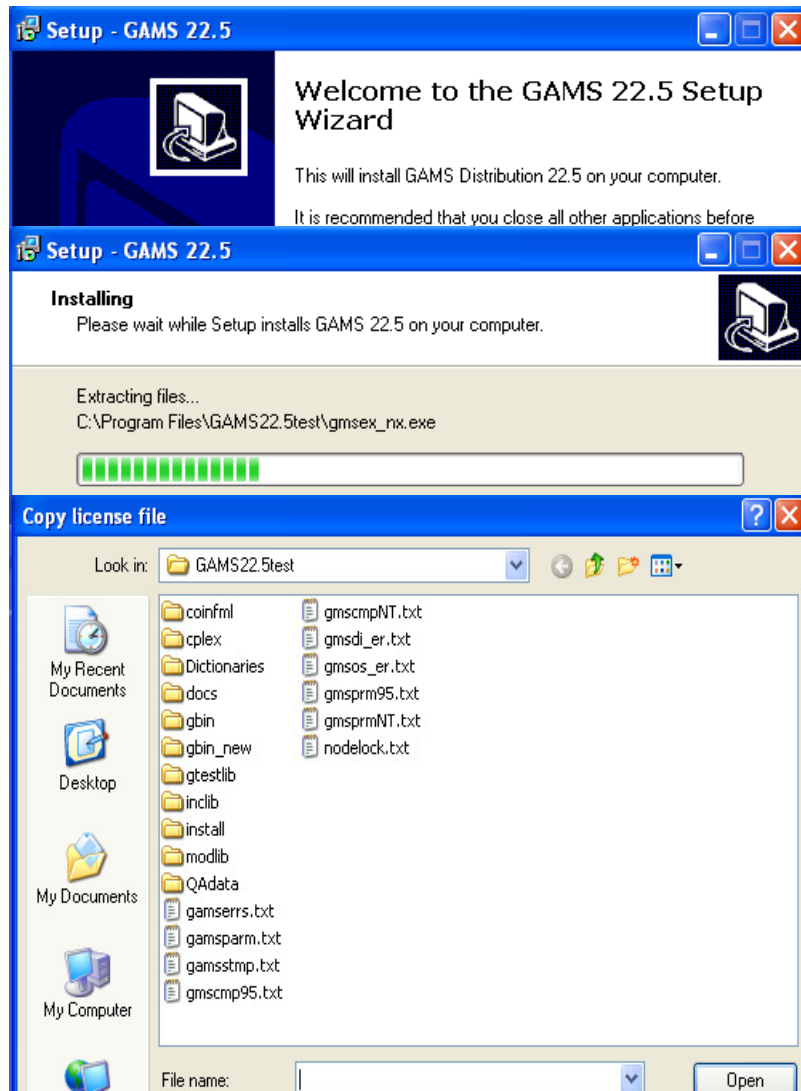
Solver/Platform availability - 22.7: May 1, 2008													
	x86 MS Windows	x86_64 MS Windows	x86 Linux	x86_64 Linux	Sun Sparc SOLARIS	Sun Sparc64 SOLARIS	Sun Intel SOLARIS	HP 9000 HP-UX 11 ¹	DEC Alpha Digital Unix 4.0	IBM RS-6000 AIX 4.3	Mac PowerPC Darwin	Mac Intel32 Darwin	SGI IRIX ²
ALPHAECF	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
BARON 8.1	✓	32bit	✓	32bit						✓			
BDMLP	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
COIN	✓	✓	✓	✓			✓				✓	✓	
CONOPT 3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CPLEX 11.0	✓	✓	✓	✓	✓	✓	✓	10.0	8.1	✓		✓	9.1
DECIS	✓	✓	✓	✓	✓	32bit	✓	✓	✓	✓		✓	✓
DICOPT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
EMP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
KNITRO 5.1	✓	32bit	✓	✓	✓	32bit					✓	✓	✓
LINDOGLOBAL 5.0	✓	✓	✓	✓	✓	✓					✓	✓	
LGO	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
LOGMIP	✓	✓	✓								✓	✓	
MILES	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MINOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MOSEK 5	✓	✓	✓	✓	✓	✓	✓	3.2			✓	✓	✓
MPSGE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MSNLP	✓	✓	✓	✓	✓	32bit		✓		✓	✓	✓	✓
NLPEC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OQNLP	✓	32bit	✓	32bit					✓	✓			
OSL V3	✓	32bit	✓	32bit	✓	32bit		V2		✓			V2
OSLSE	✓	32bit	✓	32bit	✓	32bit				✓			
PATH	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SBP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SNOPT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
XA	✓	32bit	✓	✓	✓	32bit		✓	✓	✓			
XPRESS 18.00	✓	32bit	✓	32bit	✓	32bit		16.10		✓			
¹ GAMS distribution for HP 9000/HP-UX is 22.1.													
² GAMS distribution for SGI IRIX is 22.3.													
Contributed Plug&Play solvers													
AMPLwrap	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
DEA	✓	✓	✓	✓	✓	✓		✓	✓				
Kestrel	✓	32bit	✓	32bit	✓								



System Overview



Hands-on! Installing GAMS



export PATH=/home/jhjagla/gams:\$PATH

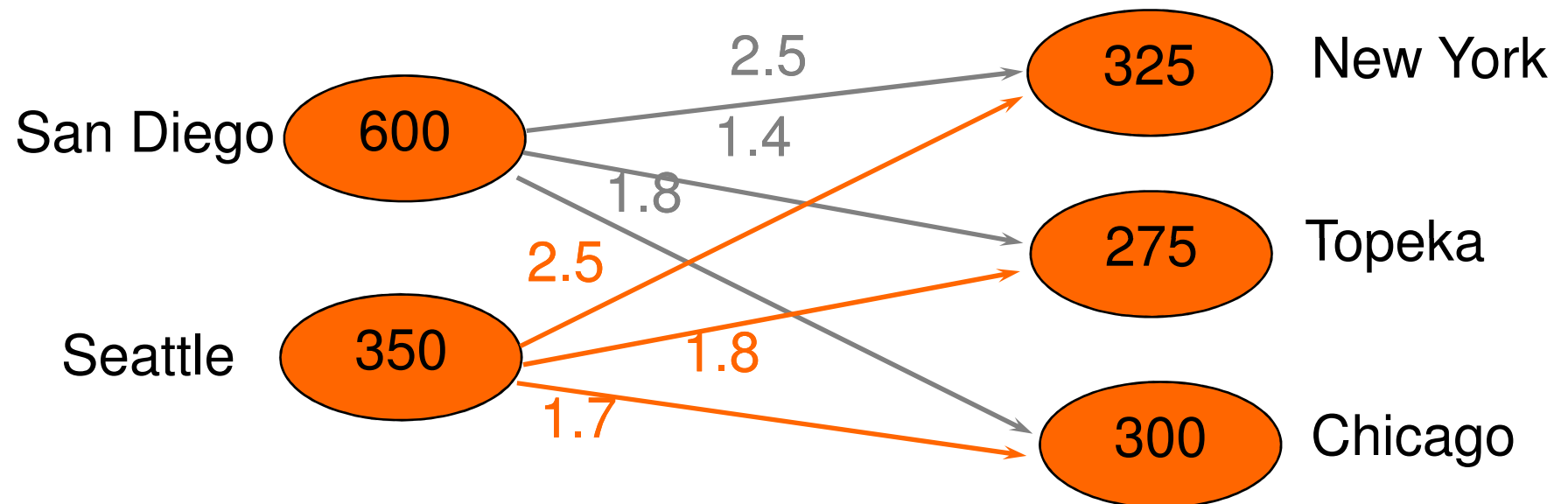


What is a Model?

- 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

```
IDE gamside: C:\Documents and Settings\bussieck\My Documents\gamsdir\project.gpr - [c:\documents an...
IDE File Edit Search Windows Utilities Help
[Icons] call {a} [Icons] MS
transport.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) ;

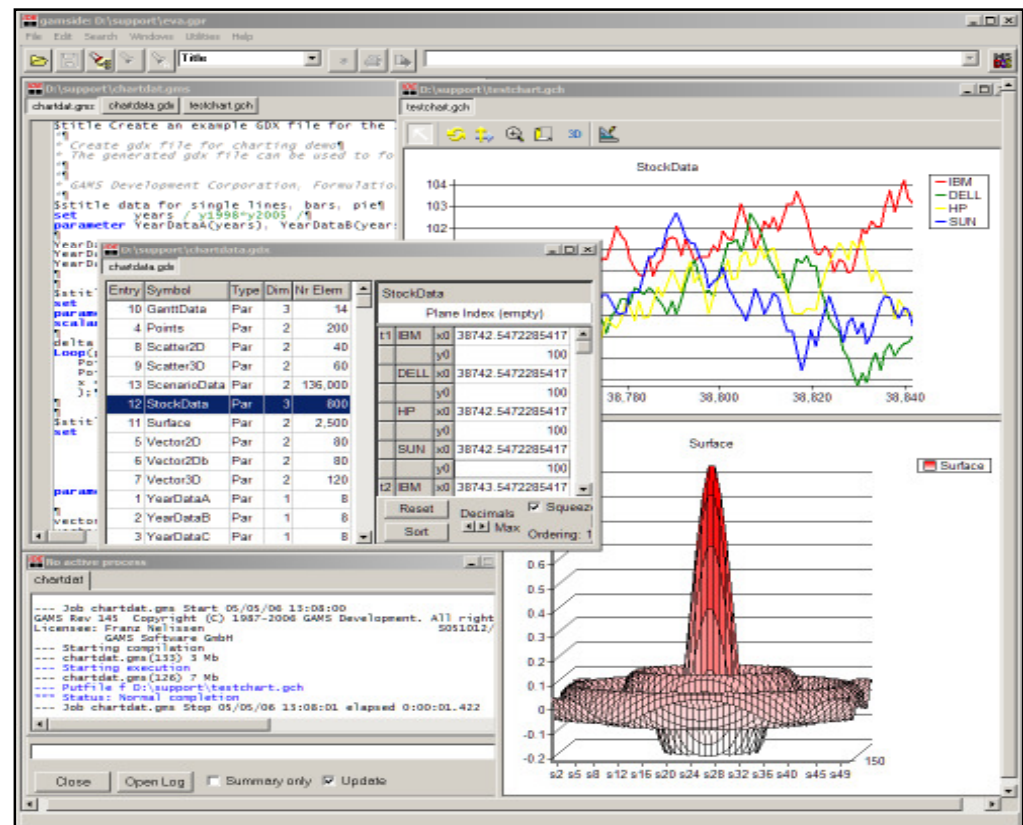
demand(j) ..  sum(i, x(i,j))  =g=  b(j) ;

Model transport /all/ ;
```



Hands-on! IDE - A Guided Tour

- Project Management
- Documentation
 - User's Guide
 - McCarl User's Guide
 - Solver Manuals
- Model Library
- Solver Selection
- Option Editor
- Listing file
 - Tree view
 - Error navigation
- Spell checking





GAMS Talks at IFORS 2008

Global optimization with GAMS

Lutz Westermann

Monday, 2:00 PM - 3:30 PM

Sandton Sun: Oleander

Extended mathematical programming in GAMS

Jan-Hendrik Jagla

Monday, 4:00 PM - 5:30 PM

Sandton Sun: Oleander

Recent enhancements in GAMS

Jan-Hendrik Jagla

Tuesday, 8:00 AM - 9:30 AM

Sandton Sun: Oleander



GAMS on the Web

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Help and Support

Support Wiki <http://support.gams-software.com>
Interfaces Wiki <http://interfaces.gams-software.com>
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User Group http://www.gams.com/maillist/gams_l.htm
Google Group <http://groups.google.de/group/gamsworld>

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