



Computer Assisted LEGO brick-building

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Some LDraw content courtesy of Tim Courtney

Presentation Summary

- What is Computer Aided Drawing?
- LDraw, MLCAD, POVRay, and other CAD tools
 - LDraw History and Community
- Parts Library and Inventory Management
 - BrikTrak Development
- CAD and Parts Community

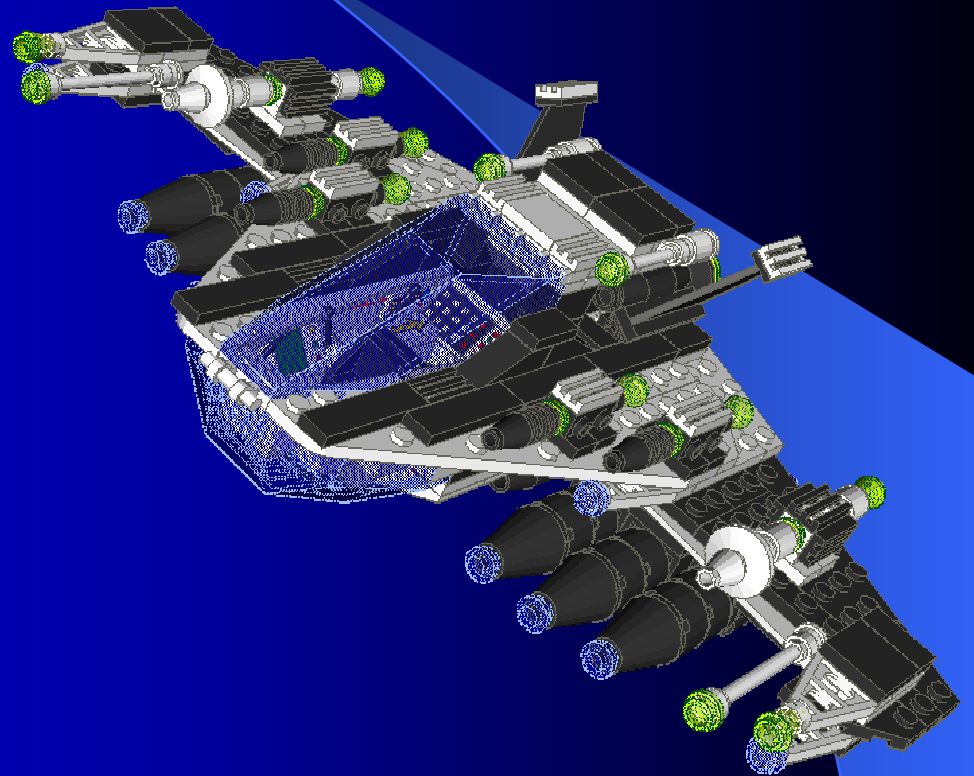
What is Computer Aided Drawing

- Industrial Computer Aided Drawing (CAD)
 - mechanical engineering
 - blueprint and schematic generation
 - structural testing
- LEGO-style CAD tools
 - publishing instructions
 - scalable construction
 - saving building history
- LEGO CAD Examples
 - LEGO Designer (built by LEGO Company)
 - LDraw (popular and functional, File format used by others)
 - MLCAD (easy to use)
 - LEOCAD (open source code)

what is LDraw?

LDraw is a system of tools and parts library for creating virtual LEGO models

- Create your own Building Instructions
- Render your models in 3D
- Document your creations
- Interactive Graphical/Text Editing



LDraw Brief History

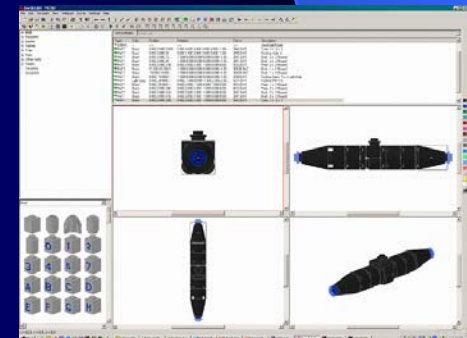
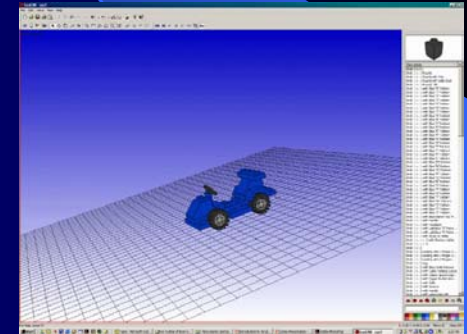
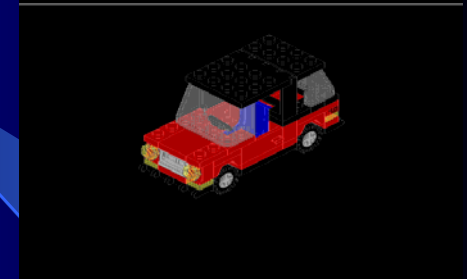
- Created by James Jessiman 1996
- LDraw catches on – Minifig World Tour
- After James died (July 97) LDraw has been community led
 - Terry Keller – James Jessiman Memorial
 - Tim Courtney – LDraw.org Website
 - Steve Bliss – Parts Library

LDraw System of Tools

The LDraw System of Tools is composed of several types of programs:

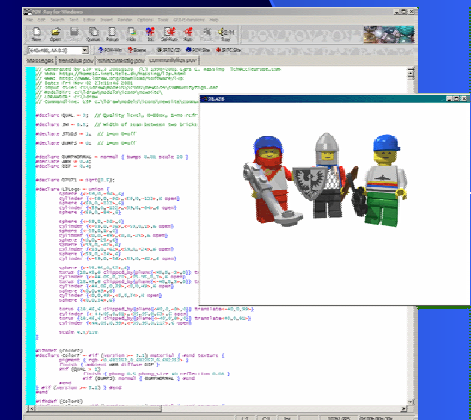
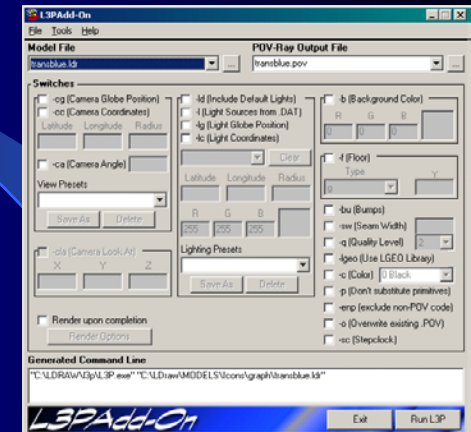
- **Editors** – The program the model is created in
 - LEdit – original DOS editor by James Jessiman
 - LeoCAD – Windows and Linux editor by Leonardo Zide
 - MLCAD – Most popular current editor, for Windows, by Michael Lachmann.
- **Viewers** – ‘Lite’ versions of Editors, these programs only have file viewing capabilities.
 - LDLite – First Windows viewer by Paul Gyugyi.
 - LDView – Windows viewer by Travis Cobbs
 - LDGLite – LDLite for OpenGL, portable to Mac and Linux. By Don Heyse.
 - L3Lab – Windows viewer with diagnostic features make this viewer perfect for parts authors. By Lars Hassing.

```
Line: 74 View: Three-D Zoom: x1.000 Move: Normal  
1 0 30.0 6.0 -60.0 0.0 0.0 -1.0 0.0 1.0 0.0 1.0 0.0 0.0 123.dat  
---END---
```



LDraw System of Tools (cont'd)

- **File Format Converters** – these programs convert an LDraw model file (.LDR) to other 3D file formats
 - L2P (with LGEO Library) – LDraw to POV-Ray conversion tool with its own POV parts library, by Lutz Uhlmann.
 - L3P – LDraw to POV-Ray conversion tool, does not need separate library, but may be used in conjunction with LEGO parts for higher quality renderings. By Lars Hassing.
 - 3DWin – 3D file format converter which can convert LDraw files to many other Windows-based 3D programs. By Thomas Baier.
- **Renderers** – these programs create super high-quality images of LDraw models.
 - POV-Ray – the most widely used renderer. POV is strictly code-based, it is not a modeler. By the POV-Team.
 - Other 3D Programs – The LDraw file format can be converted to 3DStudioMax, Lightwave, and many other professional 3D modeling/rendering programs.



LDRAW File Format:

How do the tools work together?

- Common LDraw file format
 - .DAT is the default extension for Parts
 - .LDR is the default extension for Models
 - .MPD is the default extension for Multi-Part Models
- Text-based format can be broken down
 - Line Type (Part, Meta Command, Comment)
 - Popular Meta Commands: STEP, CLEAR, SAVE
 - Color – numerical value associated with Part Color
 - Part Location in 3D Coordinate Plane (x,y,z)
 - Rotation Matrix (a1, a2, a3, a4, a5, a6, a7, a8, a9) defines part orientation

```
| a d g 0 |
| b e h 0 |
| c f i 0 |
| x y z 1 |
```
 - Part Number – references a part file (ie: 3001.DAT = 2x4 Brick)

Line Breakdown

Part Location in 3D Coordinate Plane

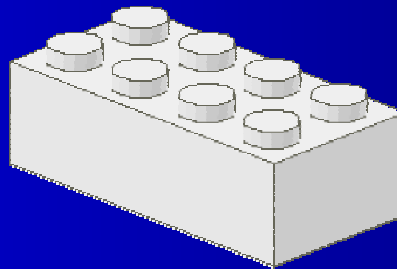
Part Number

Line Type

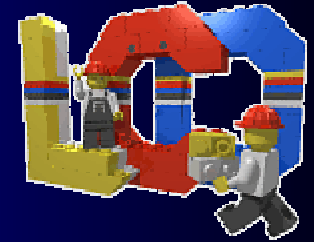


Color Number

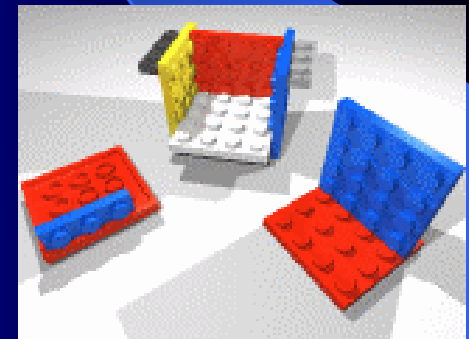
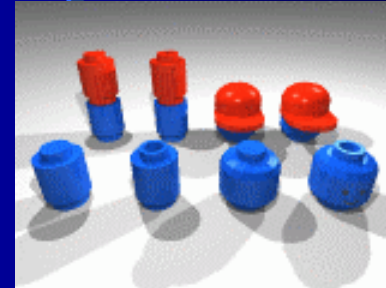
Rotation Matrix



LDraw Connection Database



- “Rethink” the basic LDraw coordinate format!
- How do you connect difference LEGO bricks elements?
- How do you model “building” in a CAD Tool?
 - twisting and connecting?
- Early design investigating different connection points and techniques
 - Rough specification is online



How do I get LDraw?

- LDraw is downloadable
 - LDraw official website:
<http://www.ldraw.org>
 - Low system requirements - LDraw and related tools run on almost all computers (Windows, Mac, Linux)
 - Its FREE!
- Brickswest 2003 CD-ROM
 - Attendees get a special BW03 LDraw Installer
 - LDraw Parts Libray, MLCad, LDView, L3Lab, L3P, L3PAO, LPub, LSynth, BMP2LDraw, POV-Ray and MegaPOV



Finding and Sharing Instructions?

- Building Instructions Portal
 - <http://www.bricksonthebrain.com/instructions/>
 - Maintained by Jake McKee (LEGO Direct Rep)
 - *Not affiliated with The LEGO Company*
- Find Fan-Created Instructions
 - Easily categorized (Castle, Train, Military, etc.)
- Find TLC-Instructions
 - Unofficially recorded and submitted by fans
- Share your own instructions
 - Digital pictures or LDraw instructions

How You Can Help?

- LDraw core tool is closed source
 - Actually source code disappeared
- LDraw File Format is open and extensible
 - MLCAD designer adding new tags
- Thriving community
 - new parts added constantly
 - existing tools evolving
 - countless published designs

Part & Inventory Management

- Peeron – Web-based LEGO-Set inventory



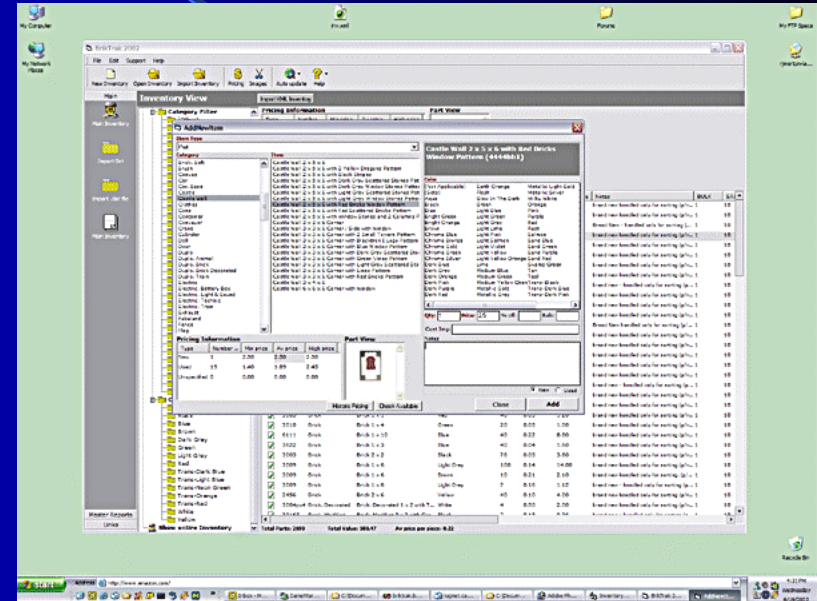
- BLDb – Windows tool built on Microsoft Access Database



- BrikTrak –built on top of Microsoft Visual Basic, XML, and SOAP

BrikTrak – Inventory Manager

- Community needed a way to publish LEGO brick inventory for online sales
- BrickLink used different format than Peeron
- Richard Morton created BrikTrak service and client application



BrikTrak Service

- BrikTrak web server imports part data
 - BrickLink used for price info
 - Peeron used for set inventories
 - LUGNET used for set photographs
- BrikTrak web server
 - running on Windows 2000/IIS
 - exposes Part/Sales/Set data as SOAP/XML web service
 - platform independent API for retrieving data
- BrikTrak desktop client
 - interacts with BrikTrak web service
 - manage, analyze and publish part and set inventories

Inventory View

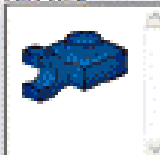
- Main Inventory
 - Category Filter
 - (Other)
 - Animal, Land
 - Antenna
 - Bar
 - Boat
 - Bracket
 - Brick
 - Brick, Decorated
 - Brick, Modified
 - Brick, Round
 - Car
 - Car, Base
 - Castle
 - Cone
 - Hinge
 - Hinge, Plate
 - Lever
 - Minifig, Footgear
 - Minifig, Utensil
 - Panel
 - Plate
 - Plate, Modified
 - Plate, Round
 - Radar Dish
 - Rock
 - Slope
 - Slope, Inverted
 - Top
 - Tile
 - Tile, Decorated
 - Tile, Modified
 - Tile, Round
 - Windows
 - Wedge
 - Windscreen
 - Color Filter
 - (Not Applicable)
 - Black
 - Blue
 - Brown
 - Dark Grey
 - Green
 - Light Grey
 - Red
 - Trans-Dark Blue
 - Trans-Light Blue
 - Trans-Neon Green
 - Trans-Orange
 - Trans-Red
 - White
 - Yellow

Import (URL) Inventory

Pricing Information

Type	Number	Min price	Avg price	High price
New	40	0.02	0.03	0.10
Used	15	0.02	0.03	0.10
Unspecified	59	0.01	0.01	0.05

Part View



Automatically import best price (order import)

History Pricing

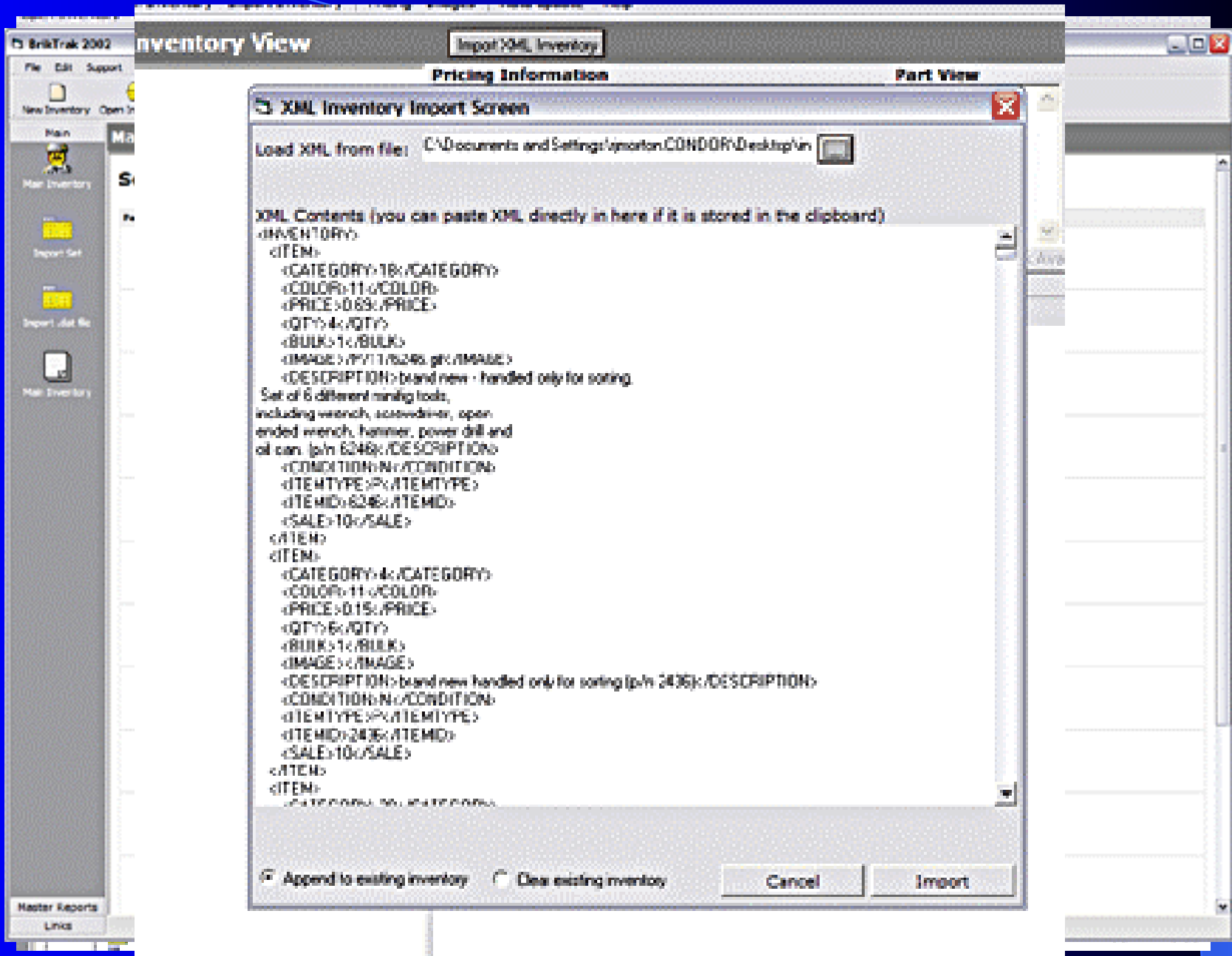
Check Available

Check Available for sale at BrickLink.com

Check set inventories at Deoron.com

Inventory

	Part no	Category	Description	Color	Price	Quantity	Total Value	Notes
	30148	Minifig, Utensil	Camera Movie Style	Black	6	0.19	1.14	brand seen handled only for sorting
	x80	Minifig, Utensil	Handle 1 x 3	White	6	0.25	1.50	brand seen handled only for sorting
	6246	Minifig, Utensil	Tool Wheel (set of 6)	Black	4	0.69	2.76	brand seen - handled only for sorting
	4864	Panel	Panel 1 x 2 x 2	Trans-Light Blue	24	0.46	11.04	brand seen handled only for sorting
	4865	Panel	Panel 1 x 2 x 1	Black	10	0.16	1.60	brand seen handled only for sorting
	3021	Plate	Plate 4 x 4	Blue	3	0.15	0.75	brand seen handled only for sorting
	3023	Plate	Plate 1 x 2	Green	20	0.15	4.00	brand seen handled only for sorting
	3021	Plate	Plate 2 x 2	Red	12	0.07	1.08	brand seen handled only for sorting
	3032	Plate	Plate 4 x 6	Light Grey	4	0.30	1.20	brand seen handled only for sorting
	3428	Plate	Plate 6 x 6	Light Grey	28	0.44	12.32	brand seen handled only for sorting
	3460	Plate	Plate 1 x 8	White	48	0.18	8.64	brand seen handled only for sorting
	3421	Plate	Plate 2 x 3	Blue	4	0.07	0.28	brand seen handled only for sorting
	3466	Plate	Plate 1 x 6	Light Grey	12	0.12	1.44	brand seen handled only for sorting
	3466	Plate	Plate 1 x 6	Black	4	0.13	0.52	brand seen handled only for sorting
	3023	Plate	Plate 1 x 2	Blue	12	0.07	0.84	brand seen handled only for sorting
	3195	Plate	Plate 3 x 6	Light Grey	10	0.18	1.80	brand seen handled only for sorting
	3020	Plate	Plate 3 x 4	Black	50	0.10	5.00	brand seen handled only for sorting
	3110	Plate	Plate 1 x 4	Black	3	0.10	0.30	brand seen handled only for sorting
	30094	Plate, Modified	Plate, Modified 2 x 2 plate with red frame square	Black	3	0.29	1.45	brand seen handled only for sorting
	6019	Plate, Modified	Plate, Modified 1 x 1 with Clip Horizontal	White	12	0.07	0.84	brand seen handled only for sorting
	6019	Plate, Modified	Plate, Modified 1 x 1 with Clip Horizontal	Blue	8	0.04	0.32	brand seen handled only for sorting
	2450	Plate, Modified	Plate, Modified 1 x 1 without Corner	White	3	0.18	0.90	brand seen handled only for sorting
	4510	Plate, Modified	Plate, Modified 1 x 8 with Over Rail	Black	12	0.63	7.60	brand seen handled only for sorting
	30303	Plate, Modified	Plate, Modified 4 x 6 x 2/3 Cross with Dome	Dark Grey	6	0.30	1.80	brand seen handled only for sorting
	4080	Plate, Modified	Plate, Modified 1 x 1 with clip vertical	Black	10	0.06	0.60	brand seen handled only for sorting
	2040	Plate, Modified	Plate, Modified 1 x 2 with handle	Dark Grey	12	0.10	1.20	brand seen handled only for sorting
	2817	Plate, Modified	Plate, Modified 2 x 2 with Holes	Black	12	0.12	1.44	brand seen handled only for sorting
	40814	Plate, Modified	Plate, Modified 1 x 1 with clip Light - Type 1	White	6	0.09	0.54	brand seen handled only for sorting
	4032	Plate, Round	Plate, Round 2 x 2	Blue	28	0.17	4.76	brand seen handled only for sorting
	30303	Plate, Round	Plate, Round Corner 4 x 4	Red	20	0.15	3.00	brand seen handled only for sorting
	4032	Plate, Round	Plate, Round 2 x 2	Light Grey	24	0.16	4.10	brand seen handled only for sorting



Inventory View

Import XML Inventory

Pricing Information

Part View

XML Inventory Import Screen

Load XML from file: C:\Documents and Settings\jmorlon.CONDOR\Desktop\in

XML Contents (you can paste XML directly in here if it is stored in the clipboard)

```
<INVENTORY>
  <ITEM>
    <CATEGORY>18</CATEGORY>
    <COLOR>11</COLOR>
    <PRICE>0.65</PRICE>
    <QTY>4</QTY>
    <BULK>1</BULK>
    <IMAGE>/P/11/6246.gif</IMAGE>
    <DESCRIPTION>brand new - handled only for sorting.
    Set of 6 different raming tools,
    including wrench, screwdriver, open
    ended wrench, hammer, power drill and
    oil can. (p/n 6246)</DESCRIPTION>
    <CONDITION>N</CONDITION>
    <ITEMTYPE>P</ITEMTYPE>
    <ITEMID>6246</ITEMID>
    <SALE>10</SALE>
  </ITEM>
  <ITEM>
    <CATEGORY>4</CATEGORY>
    <COLOR>11</COLOR>
    <PRICE>0.15</PRICE>
    <QTY>6</QTY>
    <BULK>1</BULK>
    <IMAGE></IMAGE>
    <DESCRIPTION>brand new handled only for sorting (p/n 2436)</DESCRIPTION>
    <CONDITION>N</CONDITION>
    <ITEMTYPE>P</ITEMTYPE>
    <ITEMID>2436</ITEMID>
    <SALE>10</SALE>
  </ITEM>
</INVENTORY>
```

Append to existing inventory Clear existing inventory

Cancel

Import

http://www.bricklink.com/storeResults.asp



SEARCH (?)

Shops














[Advanced Search](#) | [Site Map](#) | [Ending First](#) | [New Items](#)

- [Home](#)
 - [Buy](#)
 - [Sell](#)
 - [Search](#)
 - [Members](#)
 - [Catalog](#)
 - [Wanted](#)
 - [MyBrickLink](#)
 - [Orders](#)
 - [Re...](#)
- [Open Stores](#)
 - [Closed Stores](#)
 - [Store Filter](#)

[Store Filter](#): Open Stores with **Selected Items** for Sale

300 Stores found. Page 1 of 6 (Showing 50 Stores per page)

[Previous] 1 [2][3][4][5][6][Next]

Store Name	Location
I Mom's Legos (223) 	USA
I Missing Brick, FREE S&H (3001)  	USA
I Lego Quest (264)  	USA
I Charles Heap-o-Legos (1084) 	USA
I Steve`s Lego (428) 	Australia
I The Wright Brick (79)  	United Kingdom
I CUSTOM MiniFigures ETC (224)  	USA
I NORTHWINDS' LEGO (860)  	Netherlands

Money



bricklink

0.13

0.19

0.17

0.28

0.65

0.26

0.63

1.10

0.09

0.08

0.19

0.30

0.15

0.19

0.25

Upcoming Features

- Improved LDraw Data Import
 - Improved support for Multi-Part LDraw Data Files
 - Faster LDraw file import
- Improved BrickLink.com support
 - Seller remarks for parts
 - More intelligent pricing calculations
- Linking to Building Instructions Portal

BrikTrak Developer SDK

- Full documentation of BrikTrak SOAP web services
 - Tutorials
 - Samples (written in VB6, ASP/HTML, and newly released C#)
- Support for 3rd party application plugins
 - MLCAD plugin?
- Support for different client platforms
 - Web browser thin-client (in planning)
 - Linux/Unix?

BrikTrak Project Status

(How You Can Help?)

- Developed by Richard Morton and closed development team
- Public Beta Available NOW
 - Second Beta released Friday January 24th 2002
 - Biweekly stable updates
 - Almost Daily unstable updates
- Feature suggestions, bug feedback, & build updates on BrikTrak.com Discussion boards
- DonationWare – Free Download!
 - Send LEGO parts if you like it

Tool, Part and Inventory Links

- CAD Tools:
 - LDraw – <http://www.ldraw.org>
 - MLCAD – <http://www.lm-software.com/mlcad/>
- Parts and Inventory:
 - Set Inventories – <http://www.peeron.com/inv>
 - BLDB - <http://www.1000steine.de>
 - BrikTrak – <http://www.briktrak.com> or <http://britdog.briktrak.com>
- Community:
 - LUGNET – <http://www.lugnet.com>
 - Instructions Portal – <http://www.bricksonthebrain.com/instructions/index.cfm>

Questions? Answers? Tool Demos?

- MLCAD
 - building *very* basic models
 - view my personal models
- BrikTrak
 - brief demo of offline mode
- Offline questions – email Stephen Fisher
 - fishersa@hotmail.com