IPP32 WASHINGTON DC

Lomino Cube 4

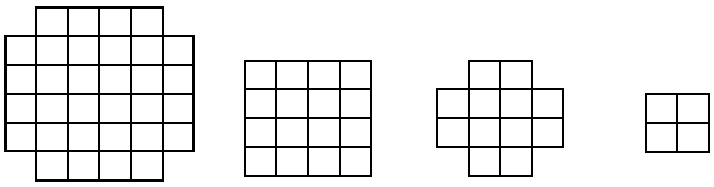
Designed and exchanged
by George Bell

Puzzle design and challenges

"**Lomino Cube 4**" is a set of 13 polycubes to be packed into various 2D and 3D shapes. The puzzle pieces are all L-shaped, they were named "Lominoes" by Alan Schoen. A complete set of lominoes of order *n* consists of all lominoes that fit inside an $n \times n$ square. This puzzle consists of two complete sets of order n = 4 plus one extra L tetromino (of volume 4). The total volume of the pieces is $4^3 = 64$. This defines the puzzle for n = 4, it is interesting that an analogous cube puzzle can be defined for any n > 2.

Ten puzzling tasks (in roughly increasing difficulty, but may be attempted in any order):

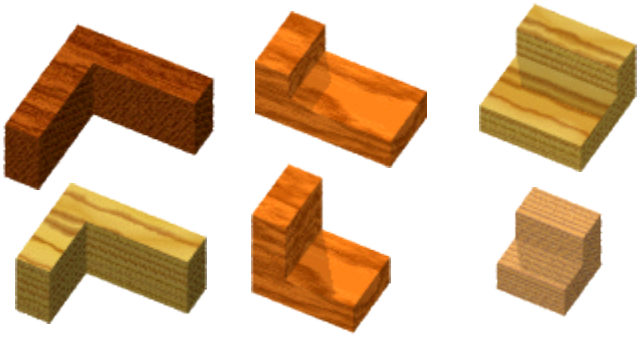
1. 2D: Make an 8×8 square using all the pieces.
2. 3D: Make a $4 \times 4 \times 4$ cube using all the pieces.
3. 3D: Make a $3 \times 4 \times 5$ brick using all but one of the pieces.
4. 2D: Pack all the pieces flat in the "**quilt block**" tray.
5. 2D: Pack all the pieces flat in the "**accordion**" tray.
6. 3D: Pack all the pieces within the inner outline in the "**accordion**" tray, two layers deep, "**Crystal Gateway Hotel**".
7. 2D: Leaving out the smallest piece, pack the remaining pieces flat in the "**quilt block**" tray, leaving the four points of the pattern empty.
8. 2D: Pack all the pieces flat in the "**Navajo rug**" shape (on the back of this booklet), two solutions.
9. 2D: Pack all the pieces flat in the "**quilt block**" tray, leaving a hole in the center (unique solution).
10. 3D: Build the "**US Capitol Dome**" using all the pieces. The first layer fits in the inner outline in the "accordion" tray. The "**US Capitol Dome**" has four layers which look like this:



Bottom Top

Extra Challenges

There are over 3 million ways to construct a $4\times4\times4$ cube using these 13 pieces! Most of them have two identical pieces that are stacked together into an L-shaped piece of height 2. Suppose we stack all identical pieces together like this, can a cube still be constructed?



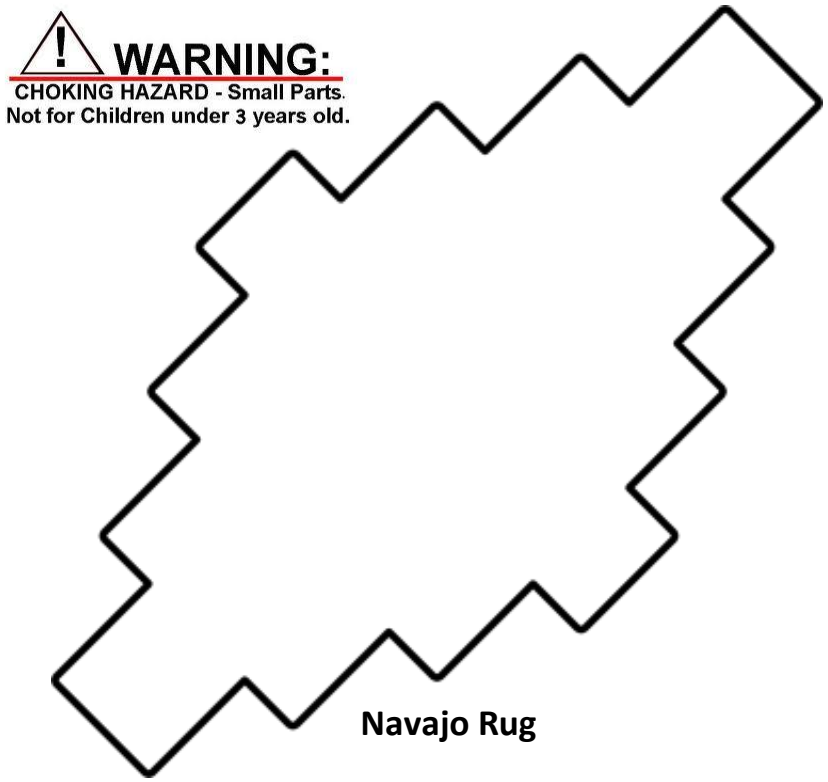
Extra challenge #1: Stack identical pieces to make Lominoes of thickness 2 and 3 (for the L-tetromino). You should now have only 6 puzzle pieces, shown above. Assemble them into a cube. These 6 pieces can also be assembled into an $8\times4\times2$ brick, and other interesting shapes.

Extra challenge #2: This is in some sense the opposite of Extra Challenge #1. Can you pack the pieces into a cube, such that no two identical pieces touch face to face? This is much more difficult than the previous challenge, and Burr Tools won't help you here. There are many solutions.

Extra challenge #3: When the pieces are packed in the "quilt block" tray, there is always a hole. Solutions where this hole is in the interior are hard to find. Find all five solutions where this hole is in the interior. Each solution is unique!

Extra challenge #4: Pack all the pieces in the "quilt block" tray where one of the smallest L's is not at the edge of the board. Better yet, find a solution where it is in the center (unique solution).

For solutions and more information, see
http://home.comcast.net/~gibell/puzzles



Navajo Rug

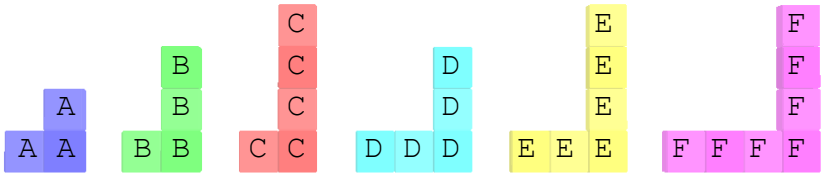
Solutions

Number	Description	Number of distinct solutions
#1	2D: Make an 8×8 square using all the pieces	814,732
#2	3D: Make a 4×4×4 cube using all the pieces	3,391,045
#3	3D: Make a 3×4×5 brick using all but one of the pieces	471,467, of which 640 are planar in 3 layers
#4	2D: Pack all the pieces flat in the "**quilt block**" tray	406
#5	2D: Pack all the pieces flat in the "**accordion**" tray	11
#6	3D: Pack all the pieces within the inner outline in the "**accordion**" tray, two layers deep, "**Crystal Gateway Hotel**"	Many, 1,920 are planar in 2 layers
#7	2D: Leaving out the smallest piece, pack the remaining pieces flat in the "**quilt block**" tray, leaving the four points of the pattern empty.	22
#8	2D: Pack all the pieces flat in the "**Navajo rug**" shape (on the back of this booklet)	2
#9	2D: Pack all the pieces flat in the "**quilt block**" tray, leaving a hole in the center	1
#10	3D: Build the "**US Capitol Dome**" using all the pieces	11
Extra #1	3D: Make a cube using identical pieces stacked, 6 pieces total.	5
Extra #2	3D Make a cube where no two identical pieces touch face to face (a "non-touch" solution)	At least 45
Extra #3	2D: Pack all the pieces flat in the "**quilt block**" tray, leaving a hole in the interior	5
Extra #4	2D: Pack all the pieces flat in the "**quilt block**" tray, leaving the smallest L in the center	1

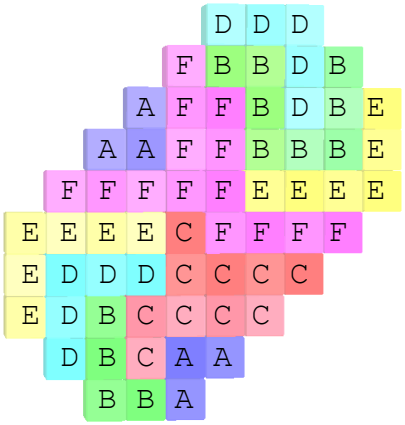
Solutions to the Harder Challenges

Note: Solutions to the easier problems are not given here. Use BurrTools if you can't find these solutions by hand.

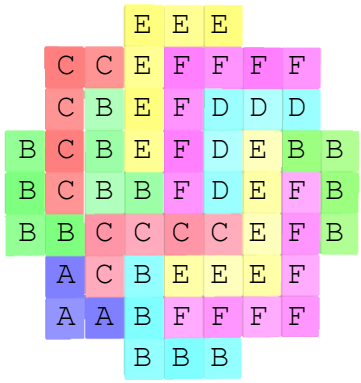
We label the pieces A-F in order of increasing size:



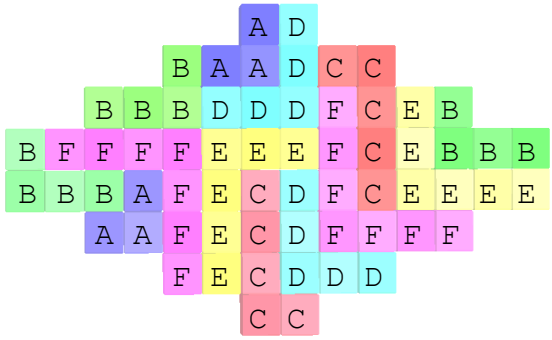
#5 solution (1 of 11):



#7 solution (1 of 22, but the only non-touch* solution):

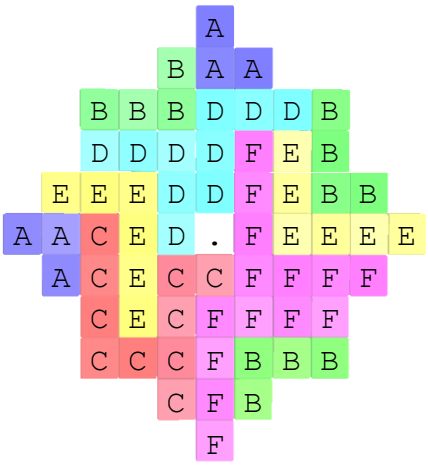


#8 solution (1 of 2, both are non-touch* solutions):

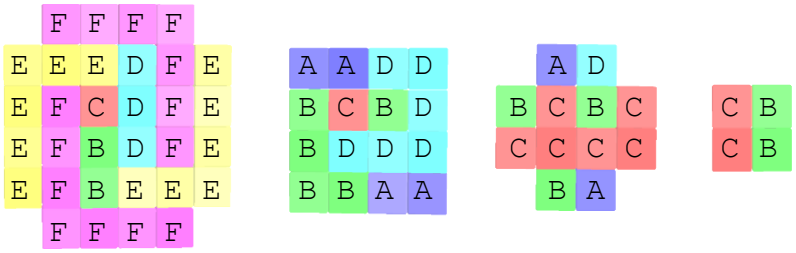


* A "**non-touch**" solution is one where no two identical pieces touch face-to-face.

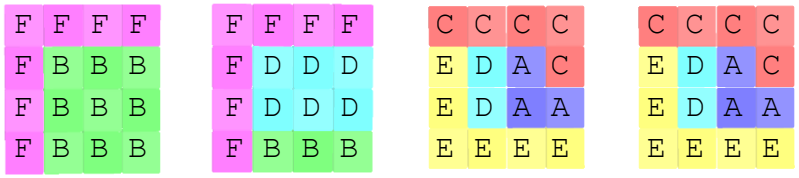
#9 solution (unique):



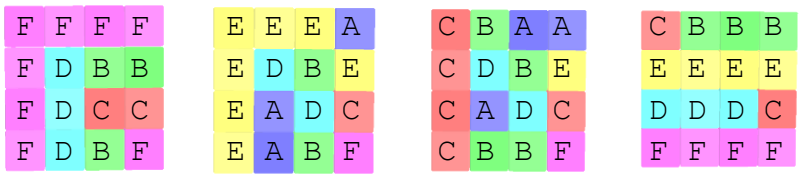
#10 solution (1 of 11):



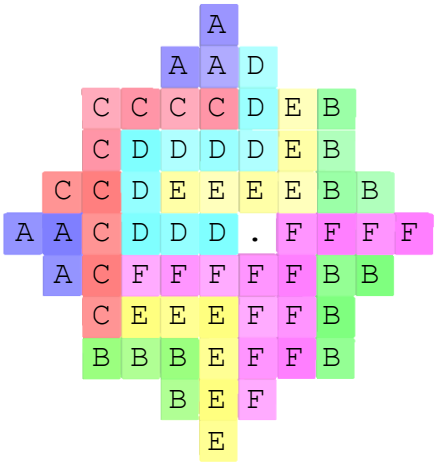
Extra #1 solution (1 of 5):

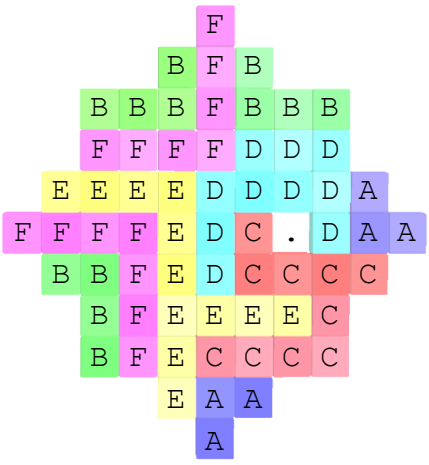


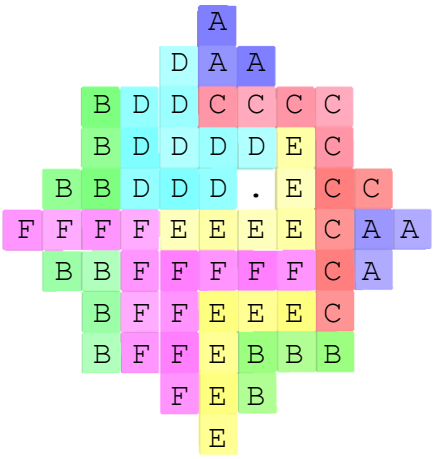
Extra #2 solution (1 of at least 45):

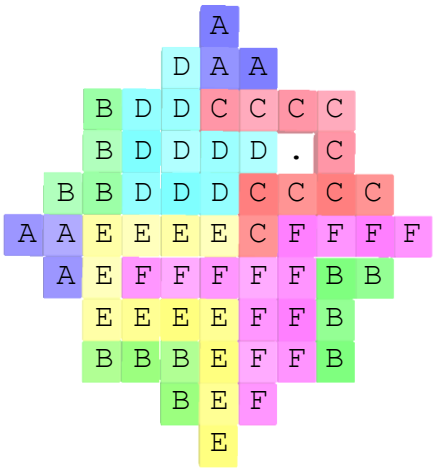


Extra #3 solutions (each is unique):

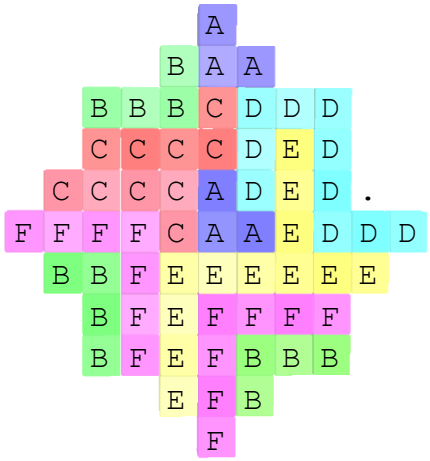








Extra #4 solution (unique):



Original Packaging

The puzzle comes packaged with 12 of the pieces packed in the “**accordion**” tray in a rotationally symmetric, “no touch” solution: