Date Night

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This is a fairly straight-forward logic puzzle from Alex Bellos's Monday Puzzle in *The Guardian* ([1]).

When it comes to the world of mathematical puzzles, Hungary is a superpower. Not just because of the Rubik's cube, the iconic toy invented by Ernő Rubik in 1974, but also because of its long history of maths outreach.

In 1894, Hungary staged the world's first maths competition for teenagers, four decades before one was held anywhere else. 1894 also saw the launch of *KöMaL*, a Hungarian maths journal for secondary school pupils full of problems and tips on how to solve them. Both the competition and the journal have been running continuously since then, with only brief hiatuses during the two world wars.

This emphasis on developing young talent means that Hungarians are always coming up with puzzles designed to stimulate a love of mathematics. (It also explains why Hungary arguably produces, per capita, more top mathematicians than any other country.)

I asked Béla Bajnok, a Hungarian who is now director of American Mathematics Competitions,[1] a series of competitions involving 300,000 students in the US, whether he knew of any puzzles that originated in Hungary. The first thing he said that came to mind was the '3-D logic puzzle', a type of logic puzzle in which you work out the solution in a three dimensional box, rather than (as is the case with the standard version) in a two-dimensional grid. He said he had never seen this type of puzzle outside Hungary.

Below are two examples he created. You could solve these using an extended two dimensional grid. It's more in the spirit of the question, however, to draw a three-dimensional one, like you are looking at three sides of a Rubik's Cube.

1. Date night

Andy, Bill, Chris, and Daniel are out tonight with their dates, Emily, Fran, Gina, and Huong. We have the following information.

1. Andy will go to the opera
2. Bill will spend the evening with Emily,
3. Chris would not want to go out with Gina,
4. Fran will see a movie
5. Gina will attend a workshop.

We also know that one couple will see an art exhibit. Who will go out with whom, and what will they do?

[1] https://www.maa.org/math-competitions

My (2D) Solution

We have three dimensions of items: 4 boys, 4 dates, and 4 locations for the rendezvous. We will present the boys and their dates in a two-dimensional grid and add the 4 locations via two duplicate grids as shown in Figure 1.

We will add the initial information in the appropriate cells. That is, there is a check in the Andy-Opera cell to reflect that Andy will go to the Opera; a check in the Fran-Movie cell, since she will see a Movie; a check in the Gina-Work Shop cell, since she will go to the Work Shop; a check in the Bill-Emily cell, since they are a date; and finally an X in the Chris-Gina cell, since they will not be having a date together.

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy					✓			
Bill	✓							
Chris			X					
Daniel								
Opera								
Movie		✓						
Art								
Work Shop			✓					

Order of deduction
0

Figure 1

From these initial data we can draw some immediate deductions, as shown in Figure 2. Andy won't be going to any other location, Bill won't have anyone else for a date, nor will Emily, Gina will be going to nowhere else than the Work Shop, nor will Fran be going anywhere else than the Movie. Because neither Gina nor Fran are going to the Opera, they are not Andy's date. And finally, because Gina is not Chris's date, he will not be going to the Work Shop.

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy	X	X	X		✓	X	X	X
Bill	✓	X	X	X				
Chris	X		X					X
Daniel	X							
Opera		X	X					
Movie		✓	X					
Art		X	X					
Work Shop		X	✓					

Order of deduction
0 1

Figure 2

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy	X	X	X	✓	✓	X	X	X
Bill	✓	X	X	X				
Chris	X		X					X
Daniel	X		✓					
Opera		X	X					
Movie		✓	X					
Art		X	X					
Work Shop		X	✓					

Order of deduction
0 1 2

Figure 3

The next set of deductions is shown in Figure 3. Andy's date must be Huong and Daniel's date must be Gina.

From this we get the deductions in Figure 4. As Gina's date, Daniel must go to the Work Shop and he has no one else as a date. As Andy's date, Huong must go to the Opera, and she is no one else as a date.

And so we deduce in Figure 5 that Daniel goes nowhere else than the Work Shop, nor does Huong go anywhere else than the Opera. Finally, we see that Fran is Chris's date.

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy	X	X	X	✓	✓	X	X	X
Bill	✓	X	X	X				
Chris	X		X	X				X
Daniel	X	X	✓	X				✓
Opera		X	X	✓				
Movie		✓	X					
Art		X	X					
Work Shop		X	✓					

Order of deduction
0 1 2 3

Figure 4

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy	X	X	X	✓	✓	X	X	X
Bill	✓	X	X	X				
Chris	X	✓	X	X				X
Daniel	X	X	✓	X	X	X	X	✓
Opera		X	X	✓				
Movie		✓	X	X				
Art		X	X	X				
Work Shop		X	✓	X				

Order of deduction
0 1 2 3 4

Figure 5

Since Fran, Gina, and Huong must be going to the Movie, Work Shop, and Opera respectively, and since someone has to go to the Art exhibit, that must be where Emily goes, as shown in Figure 6. Since Fran is going to the Movie, then so is Chris.

Finally, in Figure 7, since Bill is Emily's date, he must also be going to the Art exhibit.

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy	X	X	X	✓	✓	X	X	X
Bill	✓	X	X	X				
Chris	X	✓	X	X		✓		X
Daniel	X	X	✓	X	X	X	X	✓
Opera		X	X	✓				
Movie		✓	X	X				
Art	✓	X	X	X				
Work Shop		X	✓	X				

Order of deduction
0 1 2 3 4 5

Figure 6

	Emily	Fran	Gina	Huong	Opera	Movie	Art	Work Shop
Andy	X	X	X	✓	✓	X	X	X
Bill	✓	X	X	X			✓	
Chris	X	✓	X	X	X	✓	X	X
Daniel	X	X	✓	X	X	X	X	✓
Opera	X	X	X	✓				
Movie	X	✓	X	X				
Art	✓	X	X	X				
Work Shop	X	X	✓	X				

Order of deduction
0 1 2 3 4 5 6

Figure 7

Therefore, the final break down of dates is Andy and Huong are going to the Opera, Bill and Emily are going to the Art exhibit, Chris and Fran are going to the Movie, and Daniel and Gina are going to the Work Shop.

Bellos's (3D) Solution

Here's what I hoped you would do, which is to draw a 3D grid like the one below [Figure 8] with the four alternatives on each axis. It's as if you are looking at cube directly at a corner, showing three faces.

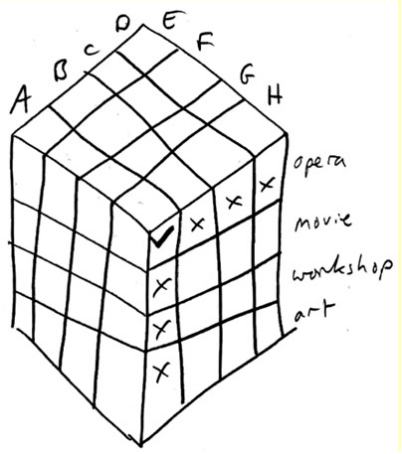

Figure 8

Once you have the grid, you go through the statements, inputting the information where you can. Statement 1 says that Andy goes to the opera. So you put a tick for Andy/opera, which appears on the right face of the cube. We need to assume that each date takes place in one location, so we can mark crosses in the cells Andy/movie, Andy/workshop and Andy/art, since we know he didn't go to any of those places. Bill, Chris and Daniel don't go to the opera, so the corresponding cells also gain an X.

Statement 2 says that Bill goes with Emily, so the top face will get a tick in the cell for Bill/Emily. If you continue in this way, you will fill up the grid with ticks and crosses. Each face will have four ticks only, and none of these ticks will share the same row or column. Finally, you will reach the conclusion that Andy and Huong attend the opera, Bill and Emily hang out at the art exhibit, Chris and Fran enjoy a movie, and Daniel and Gina go wild at the workshop.

The difference between this "3D" version and the "2D" I supposedly did seems minor, since mine was really the 3D only sliced along one edge and flattened out.

References

[1] Bellos, Alex, "Can you solve it? The playful genius of Hungarian puzzles", Alex Bellos's Monday Problems, *The Guardian*, 1 November 2021 (https://www.theguardian.com/science/2021/nov/01/can-you-solve-it-the-playful-genius-of-hungarian-puzzles)