Lesson 13

Planar graphs

Activity

Let's play Brussel sprouts (2 players)

Set-up: draw 2 x's

Let's play Brussel sprouts (2 players)

Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.

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player 1

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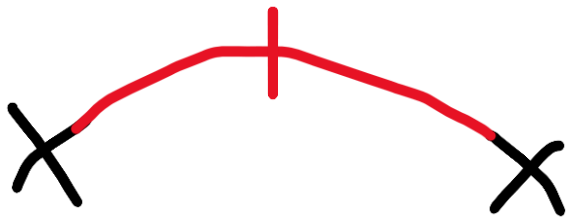

player 1

Let's play Brussel sprouts (2 players)

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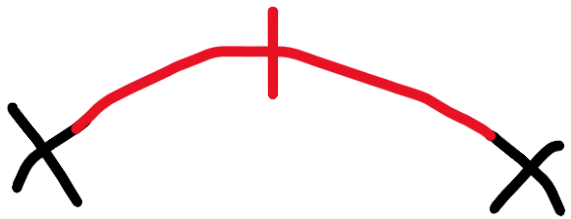
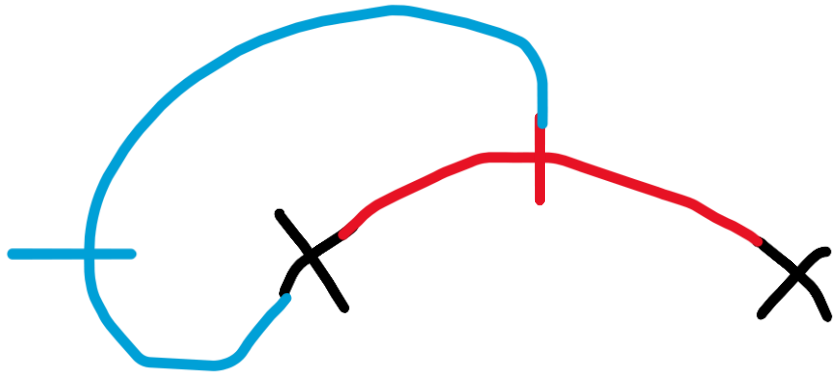


player 2

Let's play Brussel sprouts (2 players)

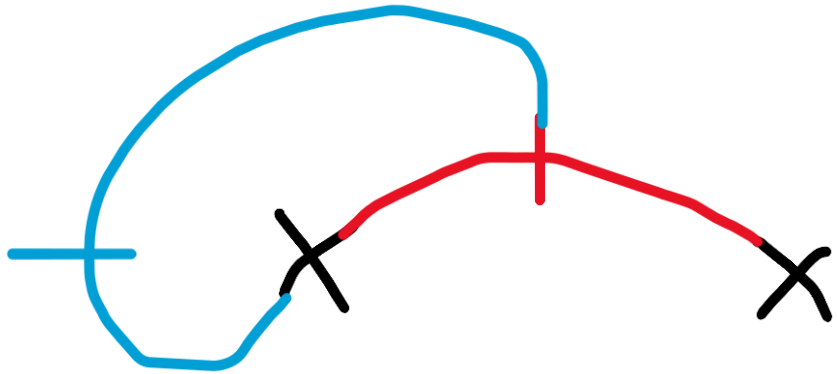
Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.



player 2

Let's play Brussel sprouts (2 players)

Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.



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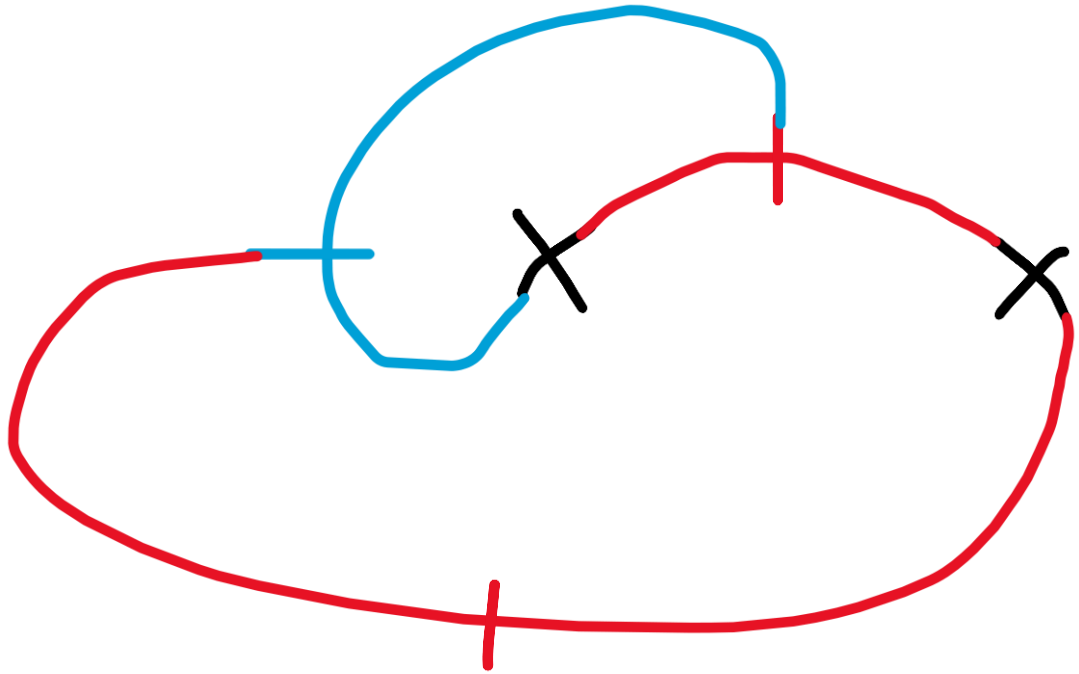
Let's play Brussel sprouts (2 players)

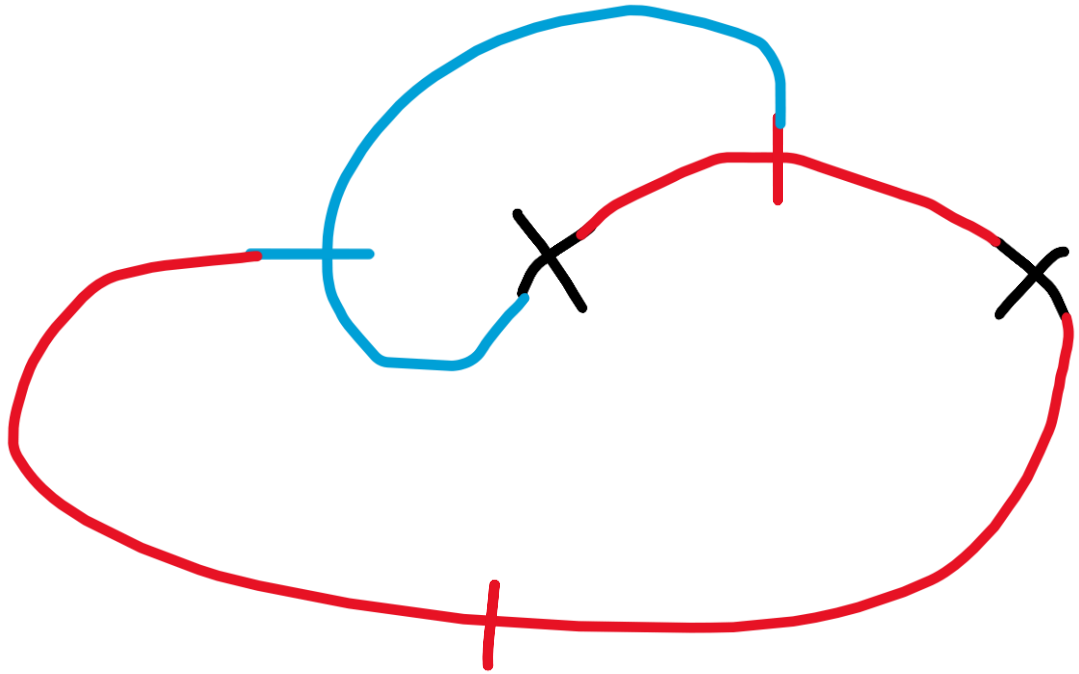
Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.



player 1

Let's play Brussel sprouts (2 players)

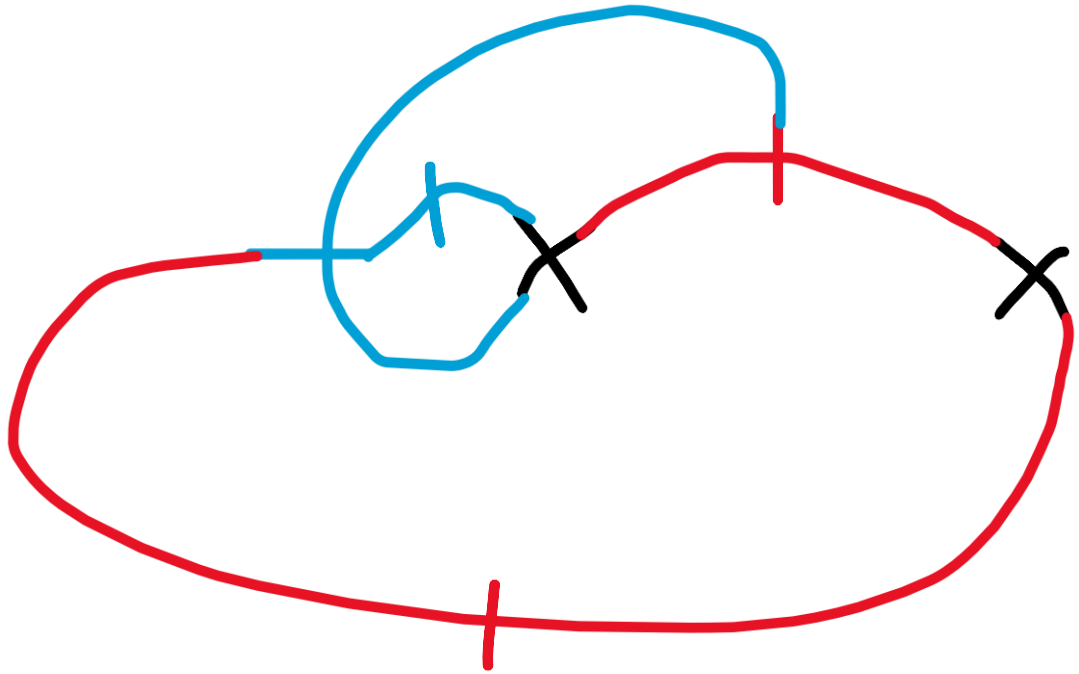
Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.



player 2

Let's play Brussel sprouts (2 players)

Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.

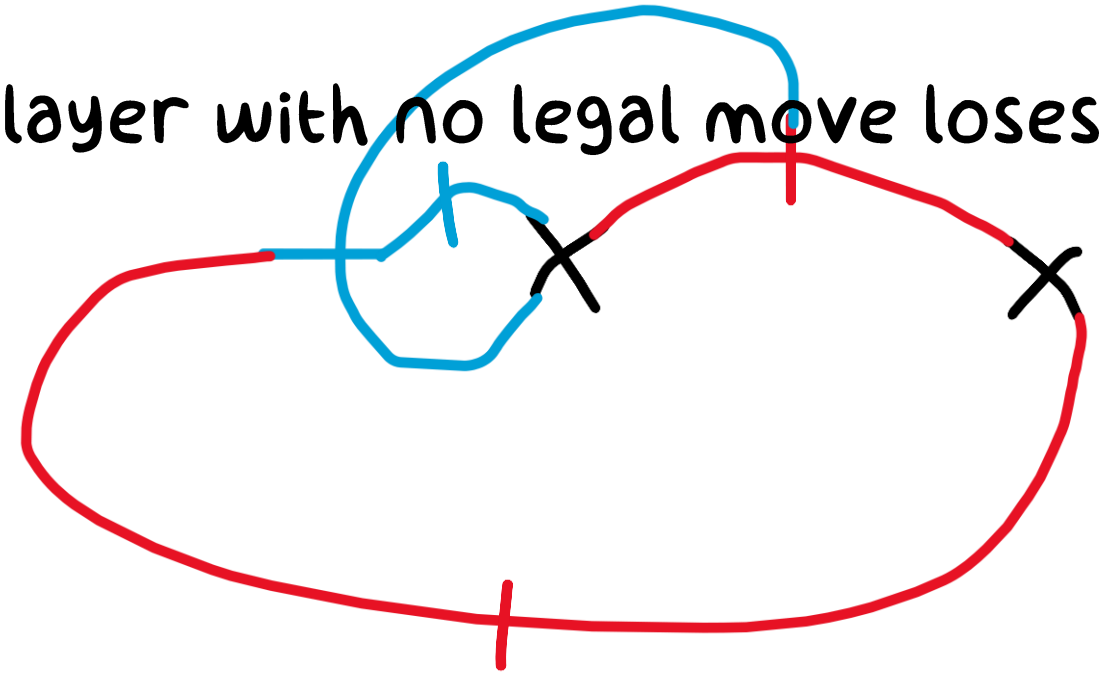


player 2

Let's play Brussel sprouts (2 players)

Players take turn connecting two free ends by an edge (don't cross existing edges) and adding a new tick to the edge.

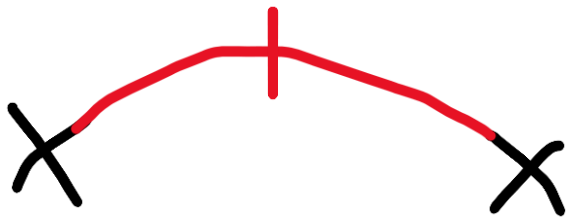
Player with no legal move loses.



player 2

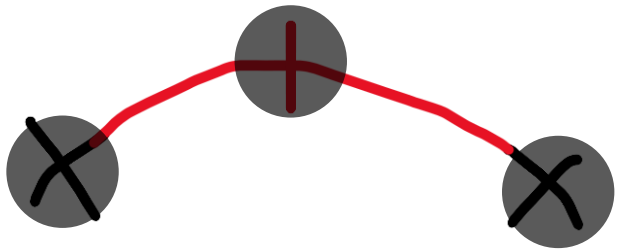
Activity Answers

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	



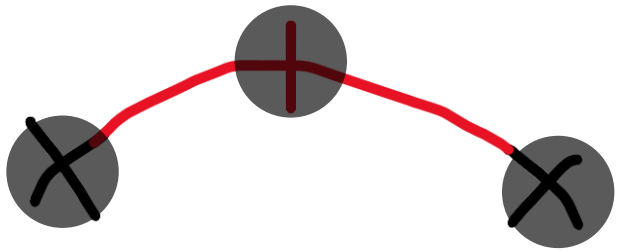
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1				8	



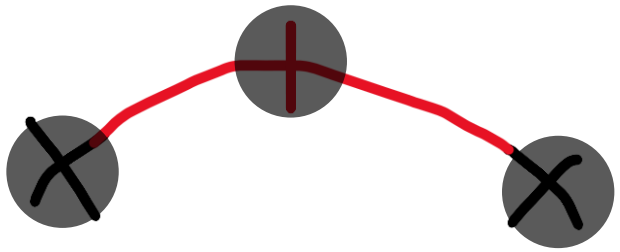
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3			8	



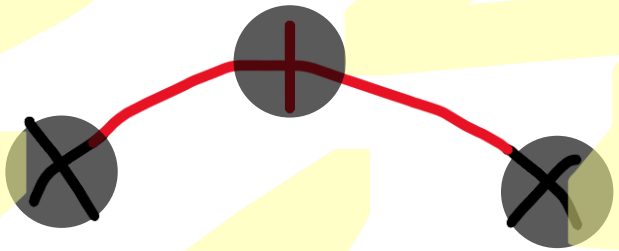
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2		8	



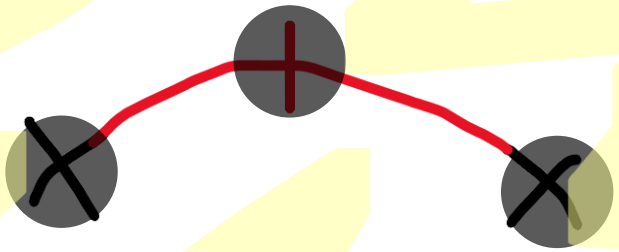
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2		8	



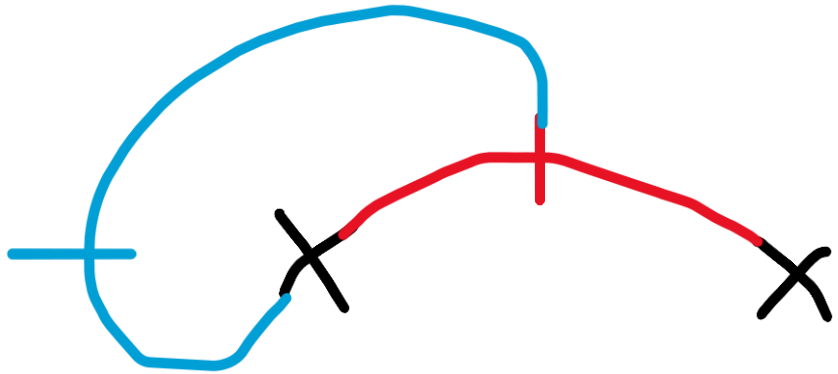
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	



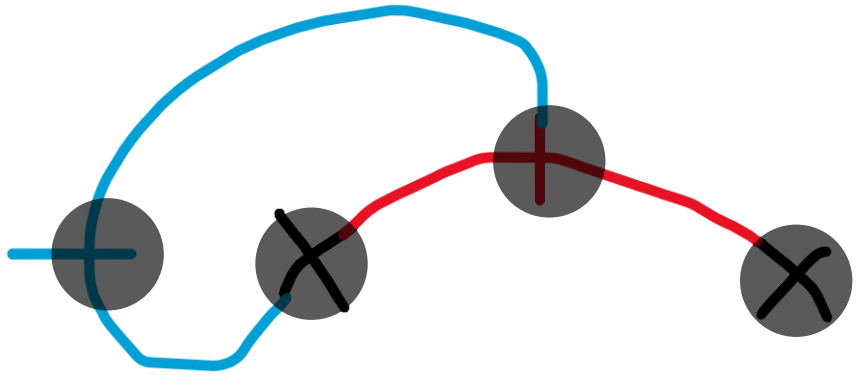
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2				8	



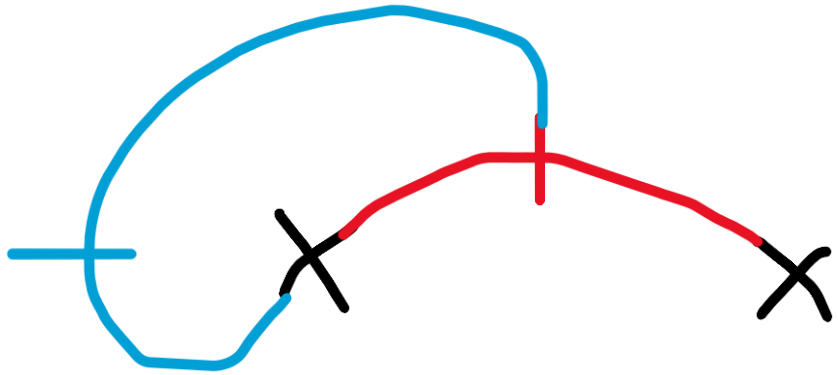
player 2

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	



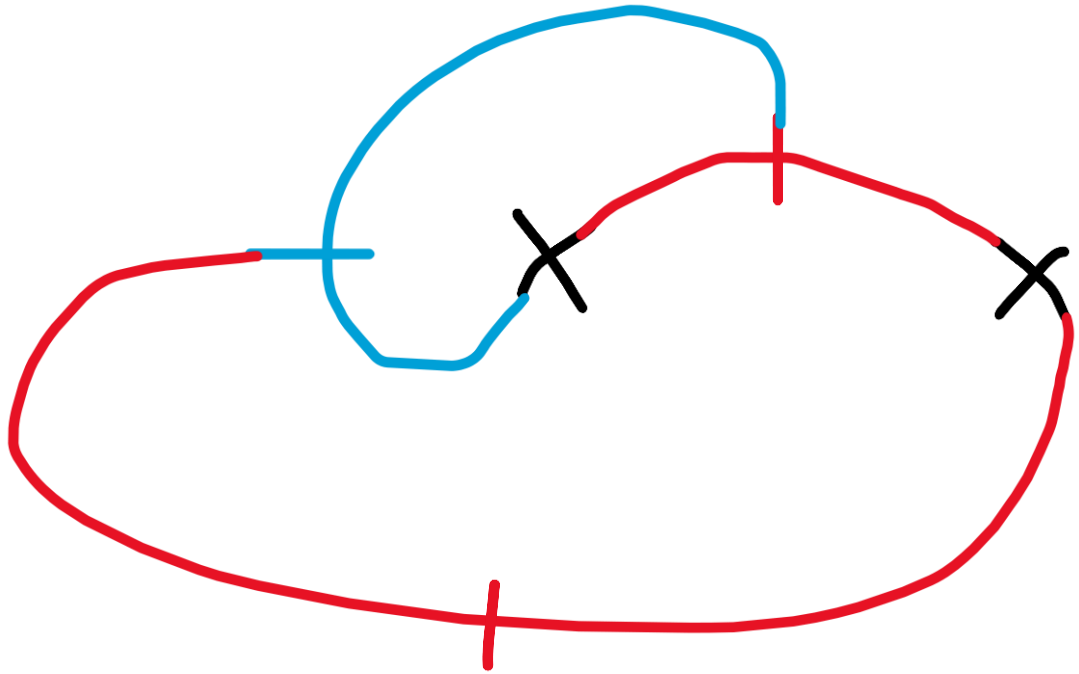
player 2

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	



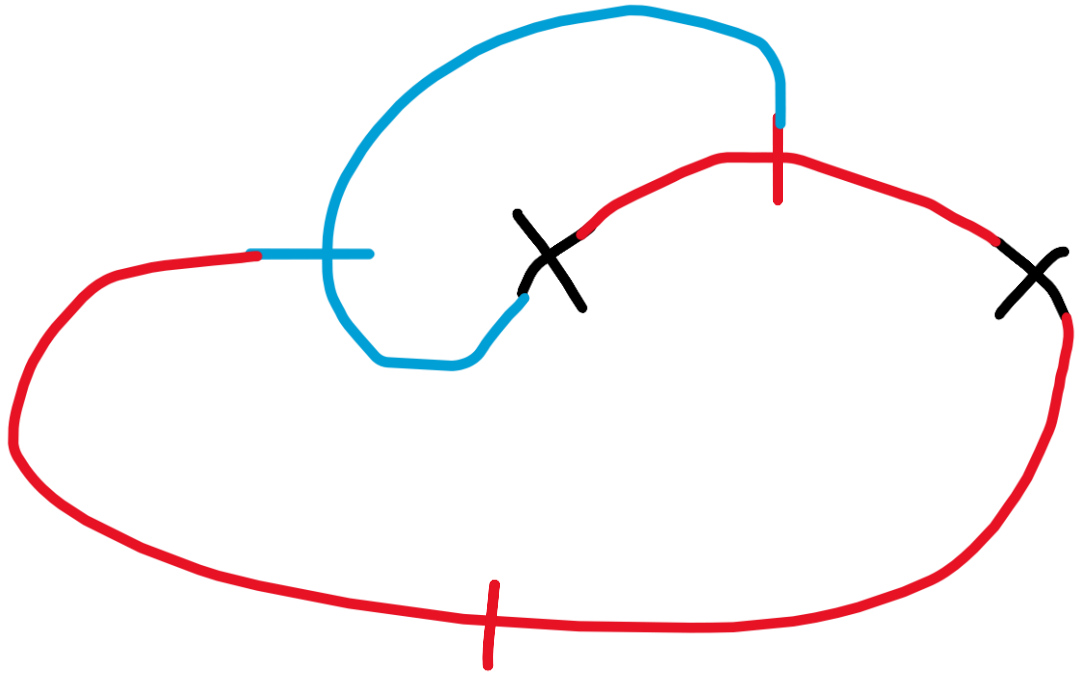
player 2

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3				8	



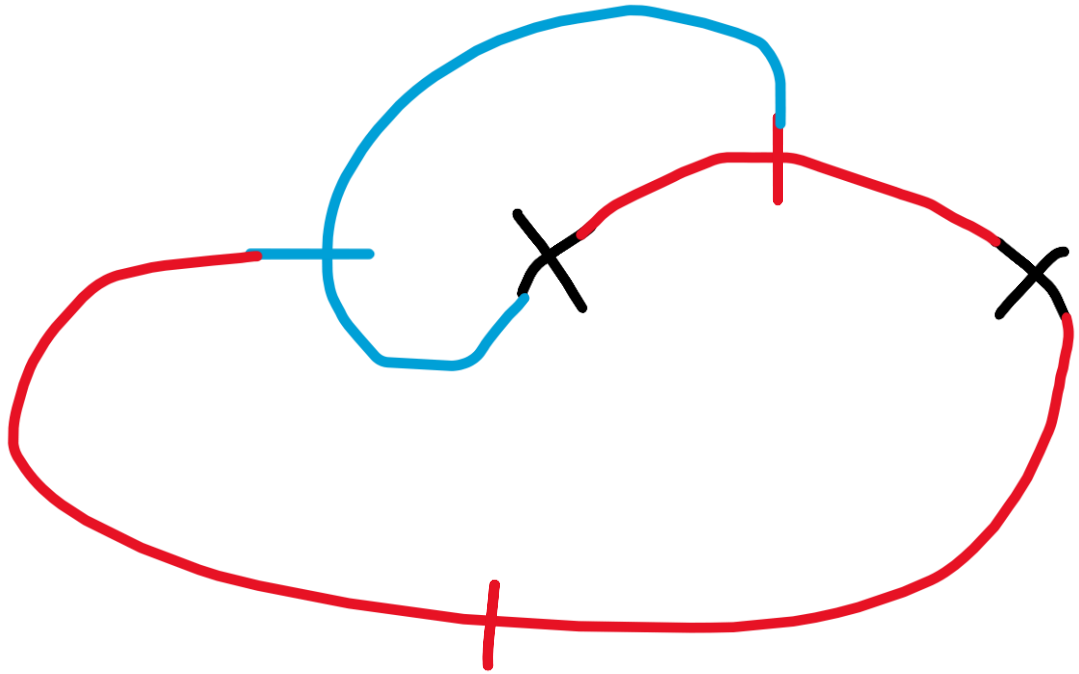
player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	



player 1

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	



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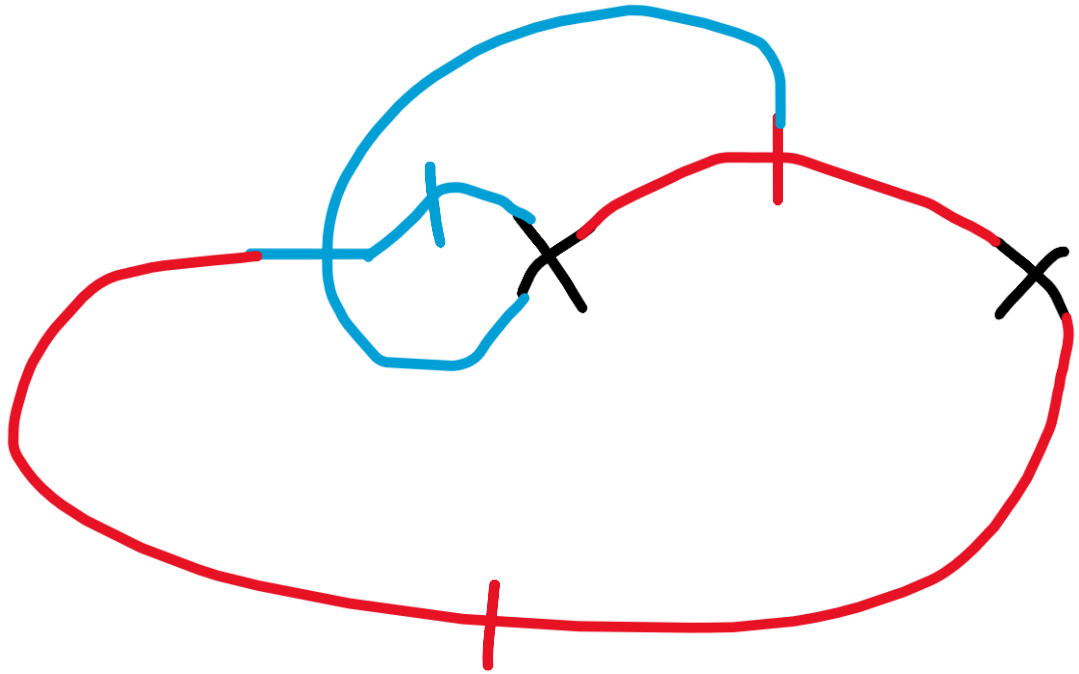
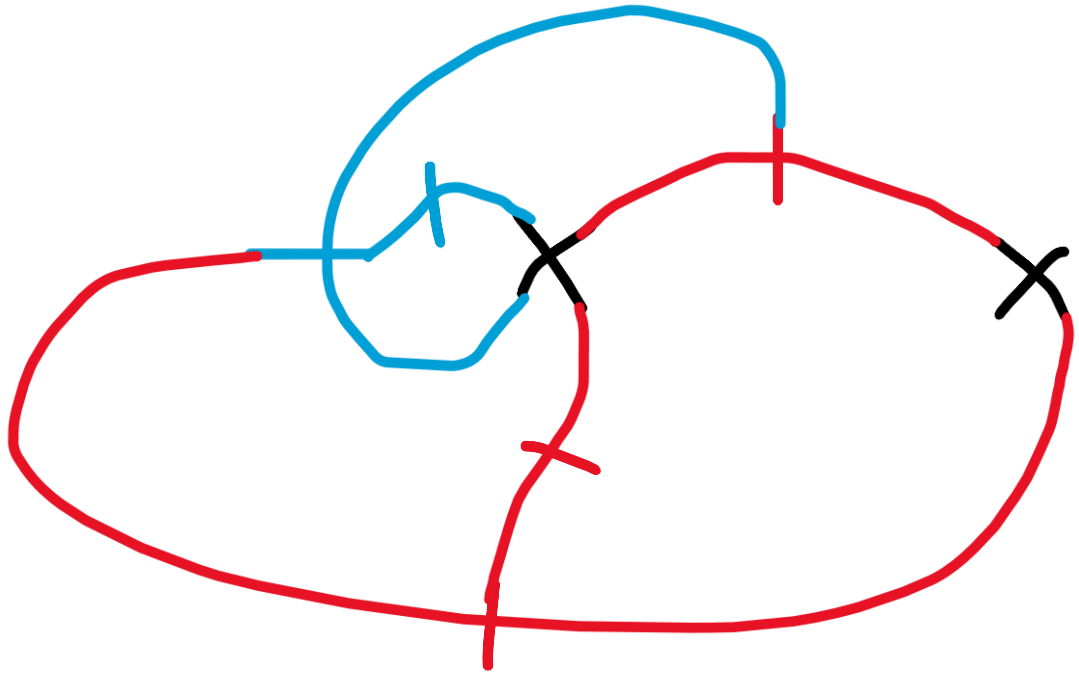
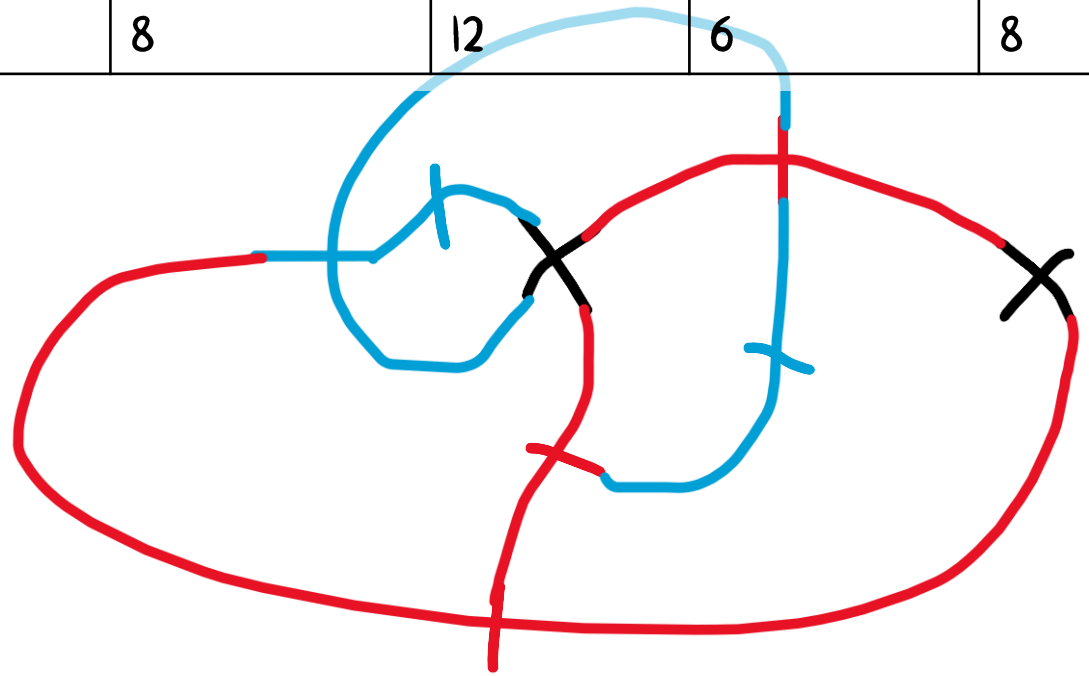
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	



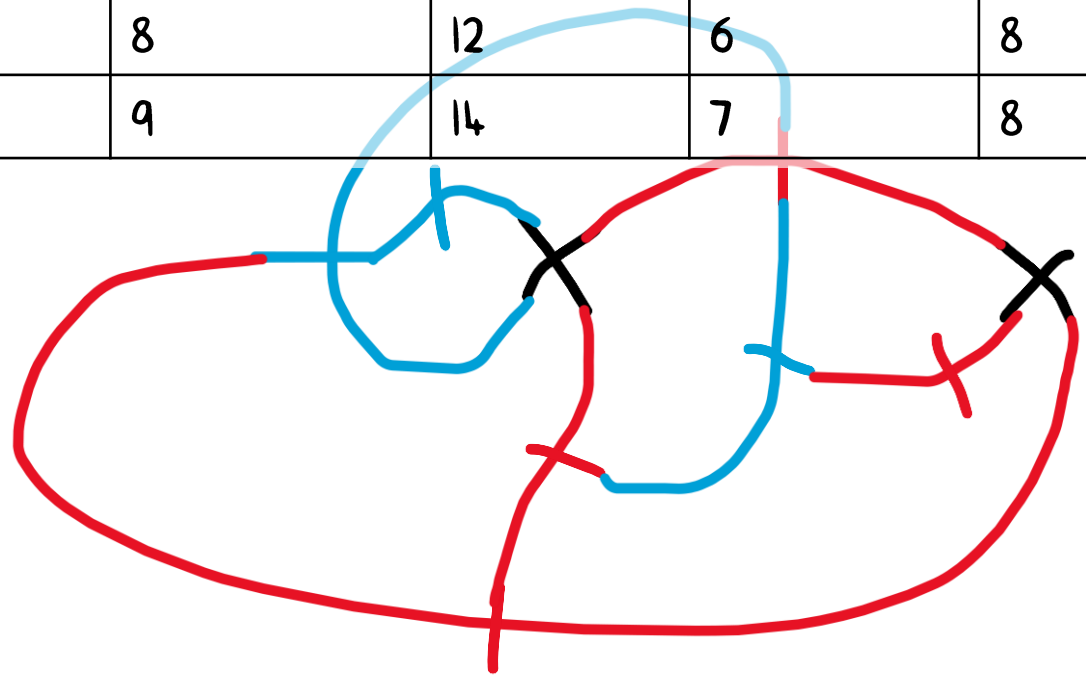
Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	



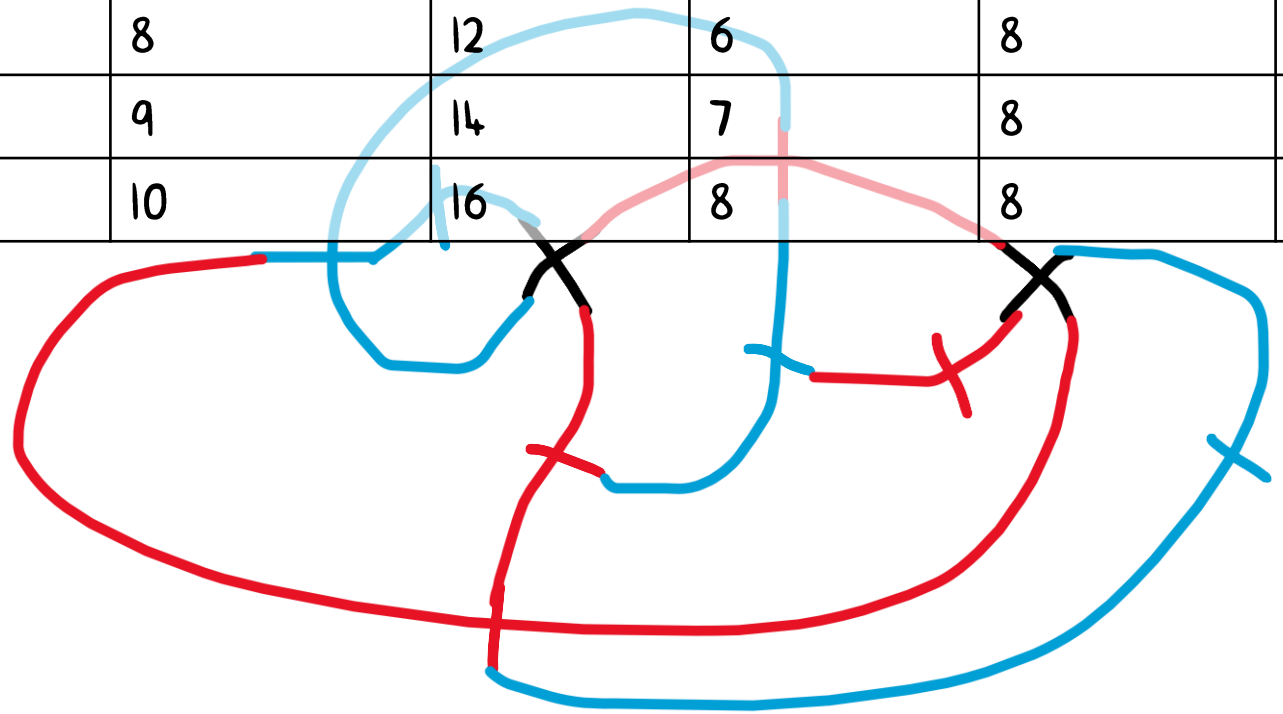
Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	



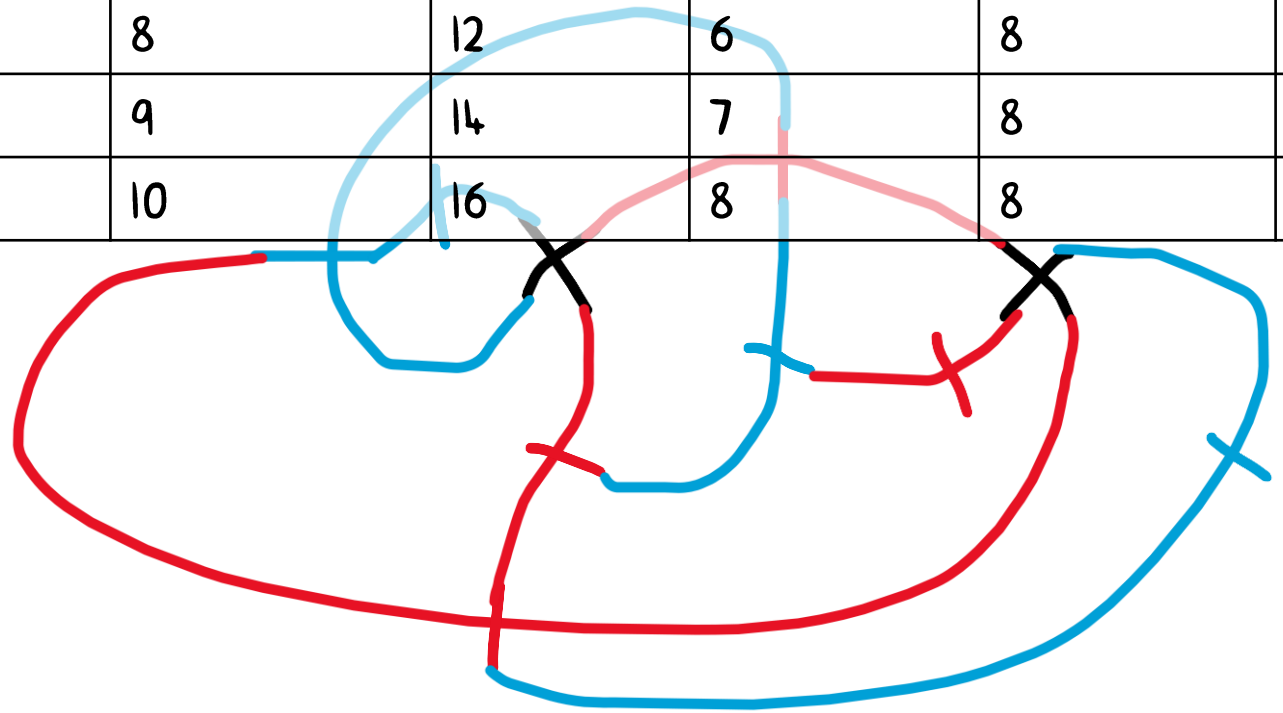
Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	
7	9	14	7	8	



Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	
7	9	14	7	8	
8	10	16	8	8	

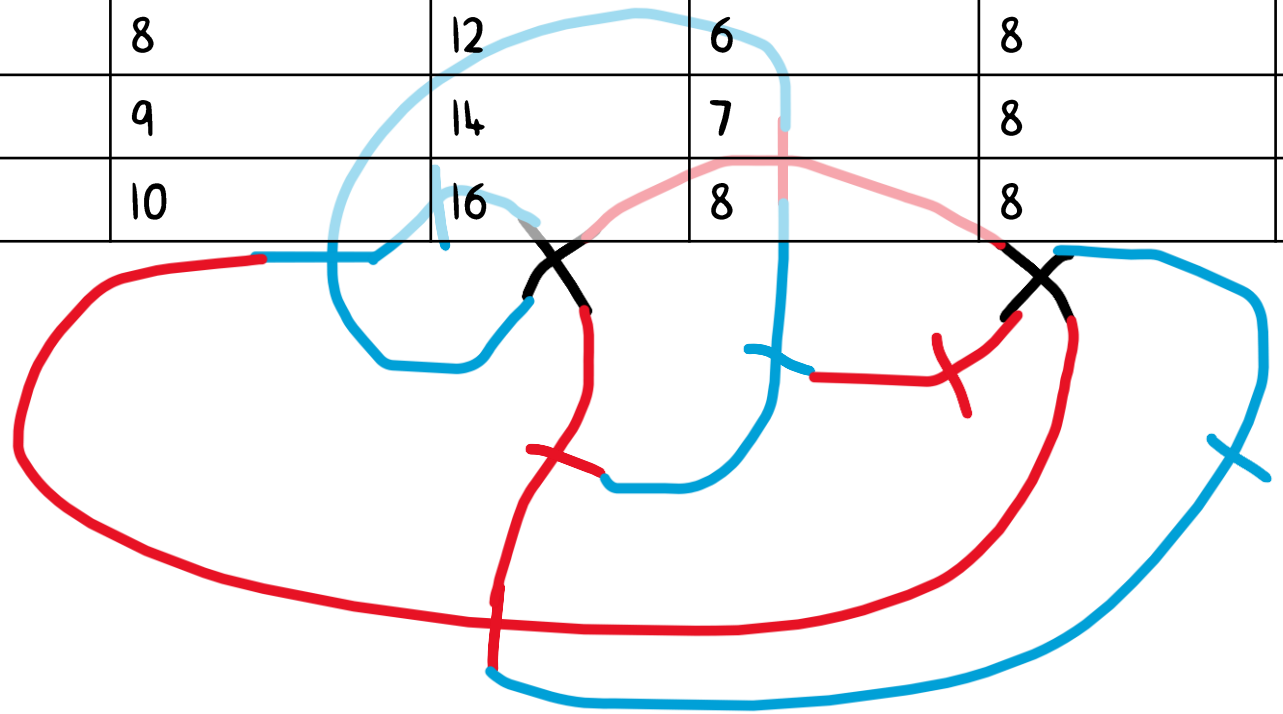


Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	
7	9	14	7	8	
8	10	16	8	8	



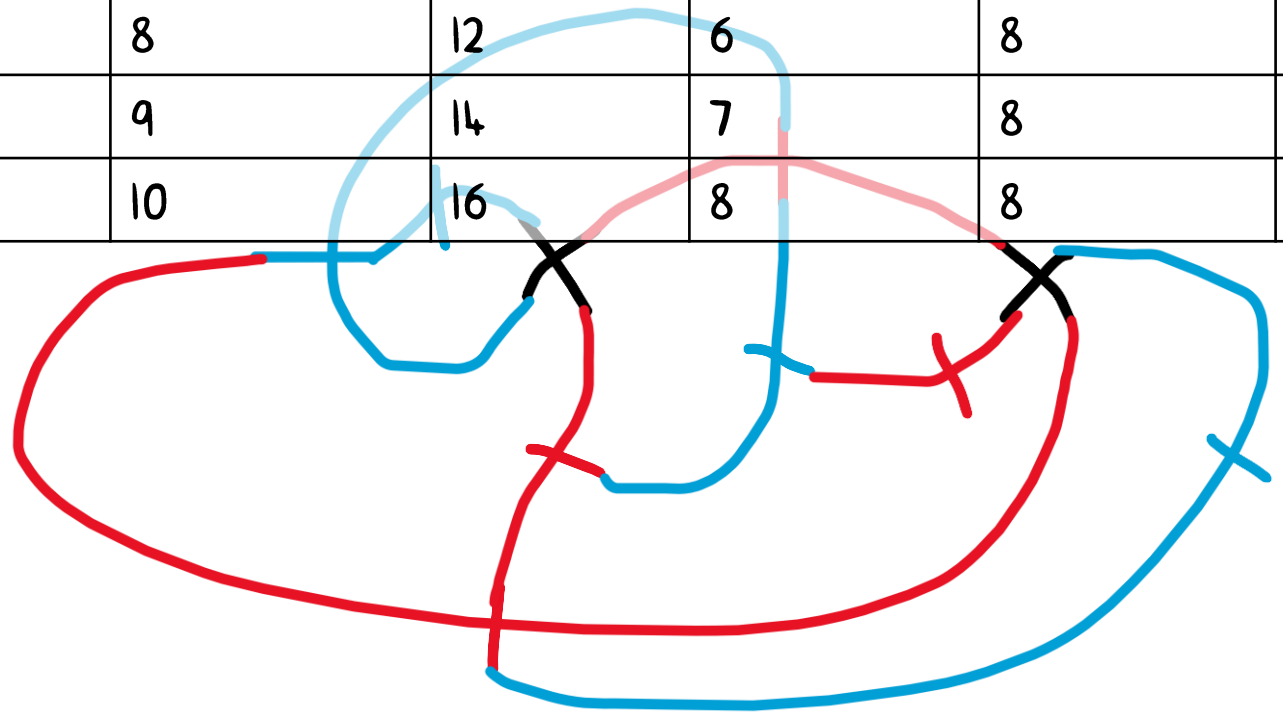
Each face (region) has exactly one free end, not two, so the game ends when the number of faces equals the number of free ends (8 turns).

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	V-E+F
1	3	2	1	8	
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	
7	9	14	7	8	
8	10	16	8	8	



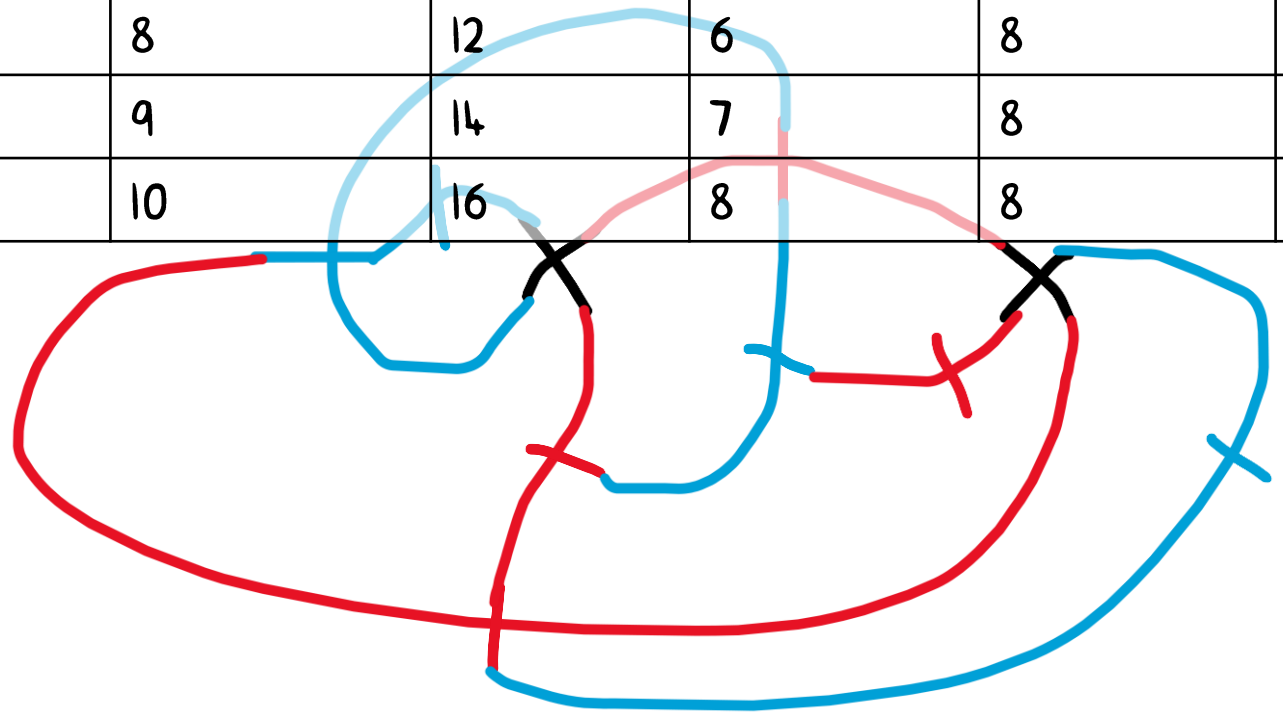
A different pattern:
Euler's formula

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	V-E+F
1	3	2	1	8	2
2	4	4	2	8	
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	
7	9	14	7	8	
8	10	16	8	8	



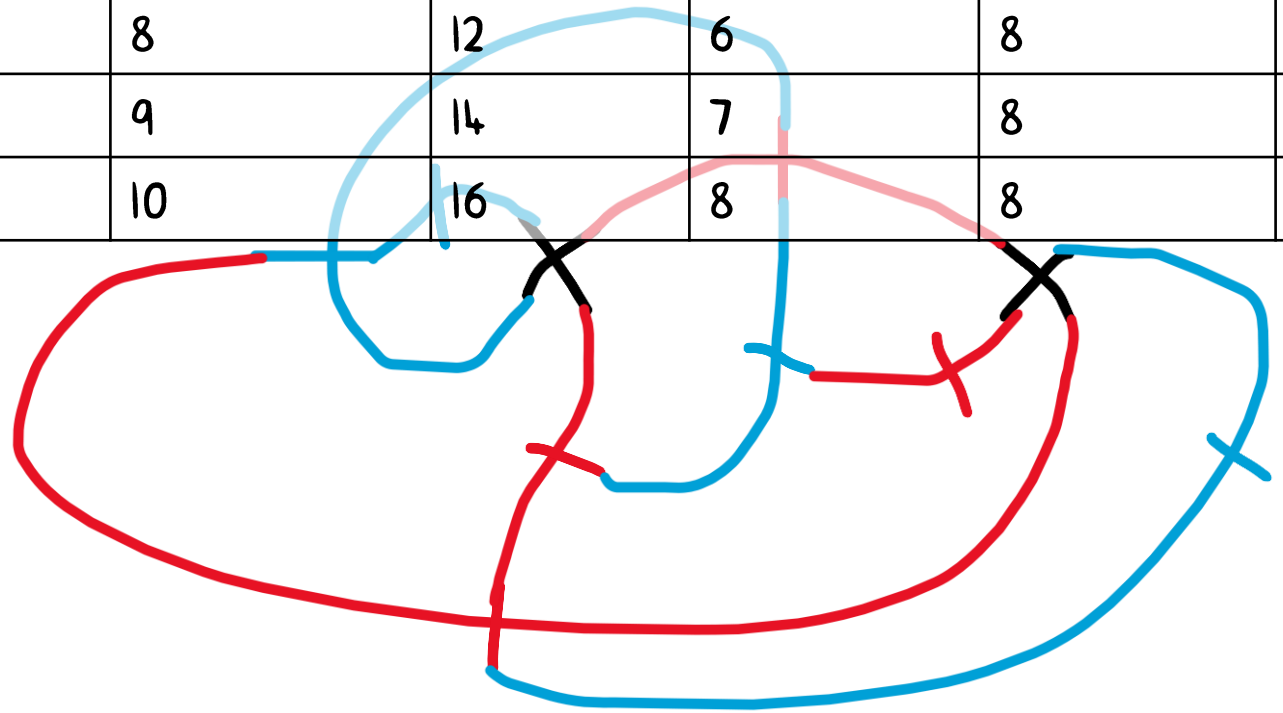
A different pattern:
Euler's formula

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	V-E+F
1	3	2	1	8	2
2	4	4	2	8	2
3	5	6	3	8	
4	6	8	4	8	
5	7	10	5	8	
6	8	12	6	8	
7	9	14	7	8	
8	10	16	8	8	



A different pattern:
Euler's formula

Turn	Vertices (V)	Edges (E)	Faces (F) aka Regions	Free ends	V-E+F
1	3	2	1	8	2
2	4	4	2	8	2
3	5	6	3	8	2
4	6	8	4	8	2
5	7	10	5	8	2
6	8	12	6	8	2
7	9	14	7	8	2
8	10	16	8	8	2



A different pattern:
Euler's formula