

Cell Specification

1	2	3	4	5	6
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- Cell Rule 1: A Cell expresses which of **the numbers 1..6 are possible**
- Cell Rule 2: By default **every number is possible**
- Cell Rule 3: If there is **more than one** possible number, the **value** of the cell is **unknown**
- Cell Rule 4: If **exactly one number** is possible, the **value** of the cell is **known** to be that number
- Cell Rule 5: A cell with **no possible numbers** is a contradiction, this is **impossible**

Cell - Data

Test 1 - By default, anything is possible in a Cell

1	2	3	4	5	6
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Test 2 - A Cell keeps track of which numbers are possible

1	2	3	4	5	6
---	---	---	---	---	---

Test 3 - If only one number is left, a Cell knows its value

1	2	3	4	5	6
---	---	---	---	---	---

Test 4 - When no numbers are possible in a Cell we have a contradiction

1	2	3	4	5	6
---	---	---	---	---	---

Cell Tests

Test 1 - By default, anything is possible in a Cell

- GIVEN a new Cell

Question	Answer
How many numbers are possible?	6
What is the value of the cell?	Unknown
Is 5 a possible value?	Yes
Is 2 a possible value?	Yes

Test 2- A Cell keeps track of which Values are possible

- GIVEN a new Cell
- WHEN 3 is not possible
- WHEN 4 is not possible

Question	Answer
How many numbers are possible?	4
What is the value of the cell?	Unknown
Is 5 a possible value?	Yes
Is 3 a possible value?	No

Test 3 - If only one possibility is left, a Cell knows its value

- GIVEN a new Cell
- WHEN the value is known to be 3

Question	Answer
How many numbers are possible?	1
What is the value of the cell?	3
Is 4 a possible value?	No
Is 2 a possible value?	No

Test 4 - When no values are possible in a Cell we have a contradiction

- GIVEN a new Cell
- WHEN 1,6,3,2,5,4 is not possible

Question	Answer
How many numbers are possible?	0
What is the value of the cell?	IMPOSSIBLE!

Grid Specification

Part 1: Inside the Grid

Grid "E"		
	Column 1	Column 2
Row 1	Cell(1,1)	Cell(1,2)
Row 2	Cell (2,1)	Cell (2,2)
Row 3	Cell (3,1)	Cell (3,2)

- Grid Rule 1: A Grid has a **name**: "A", "B", "C", "D", "E" or "F"
- Grid Rule 2: A Grid consists of **3x2 Cells** addressed as **(Row, Column)**
- Grid Rule 3: IF a Cell within a Grid has a known value THEN **no other Cell in the grid can have the same value**
- Grid Rule 4: A Grid is **Solved** if **all the Cells have known values**

Example:

- Example Rule 4: If Grid E Cell(2,1) = 6 then
 - Grid E Cell(1,1) can't have value 6
 - Grid E Cell(1,2) can't have value 6
 - Grid E Cell(2,2) can't have value 6
 - Grid E Cell(3,1) can't have value 6
 - Grid E Cell(3,2) can't have value 6

Part 2: Around the Grid

A	B	C
D	E	F

- Grid Rule 5: IF a cell in a Grid has a **known value** THEN all **cells on the same row** of all grids to the left and the right **can't have the same value**
- Grid Rule 6: IF a cell in a Grid has a **known value** THEN all **cells on the same column** of all grids above and below **can't have the same value**

Examples

- Example Rule 5: if Grid E Cell(2,1) = 6 then
 - Grid D Cell(2,1) can't be 6
 - Grid D Cell(2,2) can't be 6
 - Grid F Cell(2,1) can't be 6
 - Grid F Cell(2,2) can't be 6
- Example Rule 6: if Grid E Cell(2,1) = 6 then
 - Grid B(1,1) can't be 6
 - Grid B(2,1) can't be 6
 - Grid B(3,1) can't be 6

Grid Data

Name:.....

	Column 1	Column 2												
Row 1	<p>(1,1)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	<p>(1,2)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6
1	2	3	4	5	6									
1	2	3	4	5	6									
Row 2	<p>(2,1)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	<p>(2,2)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6
1	2	3	4	5	6									
1	2	3	4	5	6									
Row 3	<p>(3,1)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	<p>(3,2)</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6
1	2	3	4	5	6									
1	2	3	4	5	6									



Grid Tests

GIVEN a new Grid with name 'B'

Note: Execute all tests on the same grid

A	B	C
D	E	F

Test step 1: empty grid

Question	Answer
Is the grid solved?	No
What is the name of the grid?	"B"

Test step 2: one value is known, uniqueness rules are applied

- WHEN the value of cell (3,1) is 4

Question	Answer
Is the grid solved?	No
Can the cell(1,2) have value 4?	No
Can the cell(3,2) have value 4?	No
What is the value of cell (3,1)?	4

Test step 3: add more known values, remove more possible values

- WHEN the value of cell(2,2) is 1
- WHEN the value of cell(1,2) is 3

Question	Answer
Is the grid solved?	No
Can the cell(2,1) have value 3?	No
Can the cell(2,1) have value 1?	No
Can the cell(2,1) have value 5?	Yes
Can the cell(3,2) have value 5?	Yes

Test step 4: the grid to the left has found a value, apply the row constraint

Hint: start applying rule 5 and keep applying rules 1-4

A	B	C
D	E	F

- WHEN cell(2,2) of Grid A (to the left of our grid B) has value 5

Question	Answer
Can the cell((2,1) of grid B have value 5?	No
Can the cell((1,1) of grid B have value 5?	Yes
Can the cell(3,1) of grid B have value 5?	No
Can the cell(3,2) of grid B have value 5?	Yes
Can the cell(3,2) of grid B have value 2?	Yes
Can the cell((2,2) of grid B have value 5?	No

Test step 5: the grid below has found a value, apply the column constraint

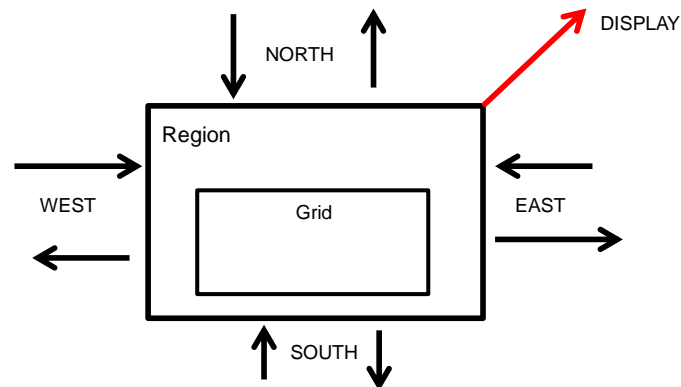
Hint: start applying rule 6 and keep applying rules 1-4

A	B	C
D	E	F

- When cell(2,1) of Grid E (below our grid B) has value 6

Question	Answer
Can the cell((2,1) of grid B have value 6?	No
Can the cell((2,1) of grid B have value 2?	Yes
What is the value of cell(3,2) of grid B?	6
What is the value of cell(1,1) of grid B?	5
Is grid B solved?	Yes

Region Specification



- A Region **contains a Grid**
- A **message** "GridName(Row, Column) = Value" means that the **cell(Row,Column) in Grid Gridname has value Value**. Example: "B(3,2) = 5"
- A **channel is a way to send messages on one side and receive messages on the other side**
- A Region has **4 input channels**: "North", "East", "South", "West" to receive messages
- A Region has **4 output channels**: "North", "East", "South", "West" to send messages
- A Region has an **output channel "Display"** to send messages

Region rules

- Region Rule 1: Whenever a **Cell has a known Value**
 - **Send a Message** "GridName(Row, Column) = Value" to all output channels
- Region Rule 2: **The Grid is initialized with a set of known values. Apply Region Rule 1** for all known values
- Region Rule 3: When you receive a "GridName(RowNumber, Column) = Value" Message
 - From the **North or South**
 - Apply Grid Rule 7: the Grid can't have Value in Cell(1,Column) and Cell(2,Column) and Cell(3,Column)
 - From the **East**
 - Apply Grid Rule 6: the Grid can't have Value in Cell(Row,1) and Cell(Row,2)
 - Send the received message to the **West** output
 - From the **West**
 - Apply Grid Rule 6: the Grid can't have Value in Cell(Row,1) and Cell(Row,2)
 - Send the received message to the **East** output
- Keep applying all the Grid Rules, especially the rule that **no two cells in a grid can have the same value!**

Region Data

Name: E

DISPLAY

NORTH INPUT		NORTH OUTPUT															
INPUT	(1,1) <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	(1,2) <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	INPUT		
1	2	3	4	5	6												
1	2	3	4	5	6												
WEST	(2,1) <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	(2,2) <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	EAST		
1	2	3	4	5	6												
1	2	3	4	5	6												
OUTPUT	(3,1) <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	(3,2) <table border="1" style="width: 100%; text-align: center; margin-top: 10px;"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> </table>	1	2	3	4	5	6	OUTPUT		
1	2	3	4	5	6												
1	2	3	4	5	6												
SOUTH INPUT		SOUTH OUTPUT															



Region Tests

Note: all tests are performed on the same Region. In this test you don't talk after setting up the test (the "Givens"). Program and test only "send" and "receive" messages.

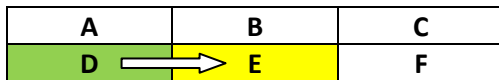
Test Step 1: known values are communicated

- GIVEN a Region containing a Grid with name 'E'
- GIVEN that the Grid cell(1,2) has value 3

Question	Answer
Wait until a message appears on the Display output. What does the message contain?	E(1,2)=3
Wait until a message appears on the South output. What does the message contain?	E(1,2)=3
Wait until a message appears on the North output. What does the message contain?	E(1,2)=3
Wait until a message appears on the East output. What does the message contain?	E(1,2)=3
Wait until a message appears on the West output. What does the message contain?	E(1,2)=3

Test Step 2: messages from west neighbour are passed to the east

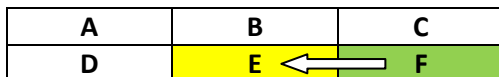
- WHEN the test sends a message D(2,1) = 4 to the WEST input of the Region



Question	Answer
Wait until a message appears on the East output. What does the message contain?	D(2,1)=4

Test Step 3: messages from east neighbour are passed to the west

- WHEN the test sends a message F(3,2) = 4 to the EAST input of the Region



Question	Answer
Wait until a message appears on the West output. What does the message contain?	F(3,2)=4

- WHEN the test sends a message F(3,1) = 6 to the EAST input of the Region

Question	Answer
Wait until a message appears on the West output. What does the message contain?	F(3,1)=6

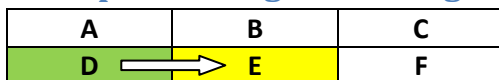
Test Step 4: messages from the top/bottom neighbours trigger constraints



- WHEN the test sends a message $B(1,2) = 6$ to the NORTH input of the Region
- WHEN the test sends a message $B(3,1) = 5$ to the NORTH input of the Region
- WHEN the test sends a message $B(2,1) = 1$ to the NORTH input of the Region

Question	Answer
Wait until 3 messages appear on the Display output. What do the messages contain? The order of the messages is not important	$E(1,1) = 4$ $E(2,1) = 6$ $E(3,1) = 2$
Wait until 3 messages appear on the East output. What do the messages contain? The order of the messages is not important	$E(1,1) = 4$ $E(2,1) = 6$ $E(3,1) = 2$
Wait until 3 messages appear on the West output. What do the messages contain? The order of the messages is not important	$E(1,1) = 4$ $E(2,1) = 6$ $E(3,1) = 2$
Wait until 3 messages appear on the North output. What do the messages contain? The order of the messages is not important	$E(1,1) = 4$ $E(2,1) = 6$ $E(3,1) = 2$
Wait until 3 messages appear on the South output. What do the messages contain? The order of the messages is not important	$E(1,1) = 4$ $E(2,1) = 6$ $E(3,1) = 2$
Is the Grid solved? Tip: you can know the grid is solved without looking at the grid. Look at the messages sent to the Display. Have you received a value for each of the 6 Cells?	NO

Test Step 5: message from neighbour decides between two possibilities



- WHEN the test sends a message $D(3,2) = 5$ to the WEST input of the Region

Question	Answer
Wait until 2 messages appear on the Display output. What do the messages contain? The order of the messages is not important	$E(2,2) = 5$ $E(3,2) = 1$
Is the Grid solved?	YES