

Math 301

Assignment 1

Last Name: **Your Last Name**

First Name: **Your First Name**

email: **Enter your email here**

due date: **Friday, Sept. 16, 2016 by 3:30pm**

Questions:

Submit questions in the order below (as they appear on the assignment)

- check the box ☒ if you are submitting a solution to the question,

- leave box unchecked ☐ if you skipped the question (you will only lose points for skipping a question that is being graded.

You will not be penalized for skipping a question that isn't assigned to be graded. 4-5 questions are selected at random after the due date to be graded.)

Questions :

☒ #1

☐ #2

☐ #3

☐ #4

☐ #5

☐ #6

☐ #7

☐ #8

☐ #9

☐ #10

☐ #11

☐ #12

☐ #13

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1. Here is question 1. In your answer you could do things like definitions...

Definition 0.1 A *permutation* of a set A is a function $\alpha : A \rightarrow A$ that is bijective (i.e. both one-to-one and onto).

And you can refer to your definition, by writing definition 0.1. (file would need to be latex'd twice for the definition number to appear, only latexing once would leave two question marks “?”).

2. Here is another question, notice the automatic numbering of questions. Want to write down a 3 dimensional vector? We have a macro for that $\begin{bmatrix} 1 \\ 2 \\ a+3 \end{bmatrix}$. Or a 2 dimensional vector $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$. Look above at the “some macros” section of this source tex file for details.
3. Here is another question. Here we show just a few latex commands.

$$1 + 2^3$$

Here is a permutation in array form: $\alpha = \begin{pmatrix} 1 & 22 & 3 & 4 & 5 \\ 5 & 3 & 1 & 4 & 2 \end{pmatrix}$

Could use the array environment for matrices too:

$$\begin{bmatrix} 1 & 0 & 2 \\ 3 & 2 & 5 \end{bmatrix}$$

Or could use *bmatrix* environment like in the paragraph below. The following paragraph is just a bunch of random illustrations of latex commands.

Writing $\mathbf{b} = (b_{1,1}, b_{1,2}, b_{1,3}, \dots, b_{4,5}, b_{5,5})$ for the 25 dimensional vector representing the light configuration (entries are 1 if the light at position (i, j) is on, 0 if off), a strategy vector \mathbf{x} for solving the puzzle is a solution to matrix equation (over the finite field \mathbb{F}_2)

$$A\mathbf{x} = \mathbf{b}$$

where A is the 25×25 matrix whose columns are the toggle vectors $\mathbf{t}_{k,\ell} = (t_{1,1}, t_{1,2}, \dots, t_{4,5}, t_{5,5})$ (entry (i, j) is 1 if pressing button (k, ℓ) toggles light (i, j) , or 0 otherwise):

$$A = [\mathbf{t}_{1,1} \mid \mathbf{t}_{1,2} \mid \dots \mid \mathbf{t}_{5,5}].$$

We can write A as

$$A = \begin{bmatrix} C & I_5 & 0 & 0 & 0 \\ I_5 & C & I_5 & 0 & 0 \\ 0 & I_5 & C & I_5 & 0 \\ 0 & 0 & I_5 & C & I_5 \\ 0 & 0 & 0 & I_5 & C \end{bmatrix} \quad (\text{lights out matrix})$$

where C represents the 5×5 matrix

$$C = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{bmatrix}$$

and I_5 denotes the 5×5 identity matrix. The matrix A is referred to as the lights out matrix.

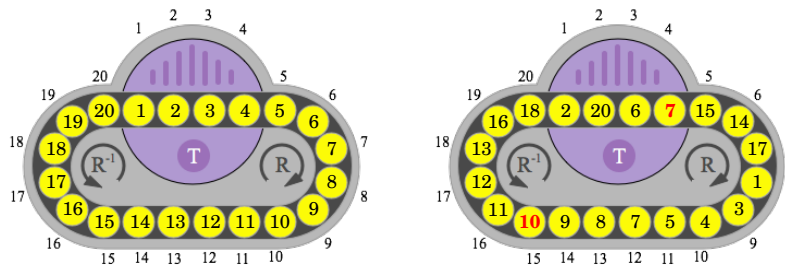
4. You could add a list of subquestions to this question...

- (a) this is the first item in the list
- (b) this is the second
- (c) another item

5. You could add an image to help with your answer...



6. Here we get a little fancier and draw the oval track puzzle with scrambled tile numbers.



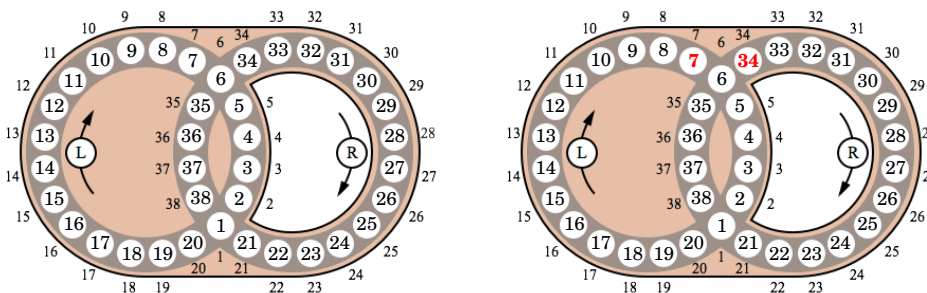
Draw using the command:

```
\drawOTpuzzle{{2 20 6 7 15 14 17 1 3 4 5 7 8 9 10 11 12 13 16 18 19}}
```

Use `\mrk` to highlight disks numbers in red to draw readers attention:

```
\drawOTpuzzle{{2 20 6 \mrk{7} 15 14 17 1 3 4 5 7 8 9 \mrk{10} 11 12 13 16 18 19}}
```

7. We can draw the Hungarian Rings puzzle too:



The second puzzle was drawn using the following command:

```
\drawHRpuzzle{{1 2 3 4 5 6 \mrk{7} 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22  
23 24 25 26 27 28 29 30 31 32 33 \mrk{34} 35 36 37 38}}
```

8. Here are some examples of drawing the 15 puzzle. We use a tilda ~ for the blank space.

¹ 1	² 2	³ 3	⁴ 4
⁵ 5	⁶ 6	⁷ 7	⁸ 8
⁹ 9	¹⁰ 10	¹¹ 11	¹² 11
¹³ 12	¹⁴ 13	¹⁵ 14	¹⁶ 15

¹ X	² X	³ X	⁴ X
⁵ X	⁶ X	⁷ X	⁸ X
⁹ X	¹⁰ X	¹¹	¹² X
¹³ X	¹⁴ X	¹⁵ X	¹⁶ X

¹ 1	² 2	³ 3	⁴ 4
⁵ 5	⁶ 6	⁷ 7	⁸ 8
⁹ 9	¹⁰ 10	¹¹	¹² 11
¹³ 12	¹⁴ 13	¹⁵ 14	¹⁶ 15

`\drawFTpuzzle{{1 2 3 4 5 \mrk{6} 7 8 9 \mrk{10} ~ 11 12 13 14 15}}`

9. Swap puzzle can also be drawn, here are some examples.

¹ 1	² 2	³ 3	⁴ 4	⁵ 5	⁶ 6	⁷ 7	⁸ 8	⁹ 9
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¹ X	² X	³ X	⁴	⁵ X	⁶ X	⁷ X	⁸ X	⁹ X
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There is a different command for each sized board:

¹ 1	² 2	³ 3	⁴ 4	⁵ 5	⁶ 6	⁷ 7	⁸ 8	⁹ 9
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`\drawSWpuzzleNine{{1 2 3 4 5 \mrk{6} 7 8 9}}`

¹ 1	² 2	³ 3	⁴ 4	⁵ 5	⁶ 6	⁷ 7	⁸ 8
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`\drawSWpuzzleEight{{1 2 3 4 5 6 7 8}}`

¹ 1	² 2	³ 3	⁴ 4	⁵ 5	⁶ 6	⁷ 7
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`\drawSWpuzzleSeven{{1 2 3 4 5 6 7}}`

¹ 1	² 2	³ 3	⁴ 4	⁵ 5	⁶ 6
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`\drawSWpuzzleSix{{1 2 3 4 5 6}}`

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

`\drawSWpuzzleFive{{1 2 3 4 5}}`

¹ 1	² 2	³ 3	⁴ 4
----------------	----------------	----------------	----------------

`\drawSWpuzzleFour{{1 2 3 4}}`

11. Notice the number to this question is 11. Where did 10 go? Look at the argument next to the `\item` command in the tex file, it allows you to override the automatic item numbering.