BILL, RECORD LECTURE!!!!

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Some HW04 Solutions

October 17, 2020

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HW04, Problem 2

October 17, 2020

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HW04, Problem 2a

Alice and Bob are using the Rail Fence Cipher with 4 rows. Show how Alice encodes

The rail fence cipher.

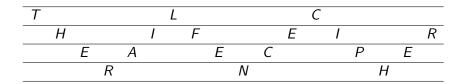
Show all steps. Give the answer in blocks of 5 all caps for readability. (The last block will be smaller than 5.)

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We then get TLCHI FEIRE AECPE RNH Alice and Bob are using the Rail Fence Cipher with 4 rows. State the rail fence cipher (with 4 rows) in MOD terminology (as I did on the slides).

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First list out the letters in positions $\equiv 1 \pmod{6}$. Second list out the letters in positions $\equiv 0, 2 \pmod{6}$. Third list out the letters in positions $\equiv 3, 5 \pmod{6}$. Fourth list out the letters in positions $\equiv 4 \pmod{6}$.

HW04, Problem 2c

Give the modern view of the 5-row rail cipher, in terms of mods.

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HW04, Problem 2c

Give the modern view of the 5-row rail cipher, in terms of mods. This one I leave to you. I might put it on the **midterm** or **final**

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HW04, Problem 4a

This problem is MOD 13. Fill in the XXX in the following statement: The 2 \times 2 matrix

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

has an inverse mod 13 IFF XXX.

(XXX can't be something like the determinant is not a number of Shen-type, it has to be about a, b, c, d.)

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XXX is ad - bc is rel prime to 13. Equivalent to XXX is $ad - bc \not\equiv 0 \pmod{13}$

HW04, Problem 4b

This problem is MOD 13.

Give an example of a 2×2 matrix that DOES have an inverse mod 13 and give the inverse.

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HW04, Problem 4b

This problem is MOD 13.

Give an example of a 2×2 matrix that DOES have an inverse mod 13 and give the inverse.

So many work that it would be hard to come up with one that DOESN" T work.

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

 $1\times 4-2\times 3=4-6=-2\equiv 11\not\equiv 0.$

The final answer uses the formula for inverses BUT NOTE THAT you DO NOT us $\frac{1}{11}$ IN THE FINAL ANSWER. You use what it is mod 13 which is WELL LETS SEE: $13 = 11 \times 1 + 2$ $11 = 2 \times 5 + 1$. $1 = 11 - 2 \times 5 = 11 - (13 - 11) \times 5 = 11 \times 6 - 13 \times 5$ $1 \equiv 11 \times 6 \pmod{13}$. So the inverse of 11 mod 13 is 6.

HW04, Problem 4c

This problem is MOD 13.

Does there exist a 2 \times 2 matrix with all entries DIFFERENT and in $\{1,\ldots,12\}$ that DOES NOT have an inverse mod 13? If YES then give such a matrix, if NO then explain why not.

HW04, Problem 4c

This problem is MOD 13.

Does there exist a 2×2 matrix with all entries DIFFERENT and in $\{1, \ldots, 12\}$ that DOES NOT have an inverse mod 13? If YES then give such a matrix, if NO then explain why not.

YES: Here is such a matrix.

$$\begin{pmatrix} 6 & 3 \\ 4 & 2 \end{pmatrix}$$

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The determinant is $6 \times 2 - 3 \times 4 = 0 \equiv 0 \pmod{13}$.