

## CSCI 241H: HOMEWORK 1

In memory of ARK who asked questions 2, 3, 4 in a midterm...  
Show your work.

1. This problem is similar to Sudoku that we discussed in class. Consider a binary version of magic squares: you are given a  $3 \times 3$  grid. Each of the 9 squares in your grid will contain a 0 or a 1: some are already given, some need to be filled out. The restriction is that the sum of the numbers in each row and each column will be exactly the same. For instance, a grid filled completely with 1s will satisfy this as all rows and columns will add up to 3.

You are given that the square (1,1) is 1, (1,2) is 0 and (1,3) is 1. Write a formula such that this formula has a satisfying assignment if and only if this instance of magic squares has a solution (note that each row and column must add up to 2).

I do realize that this is an overkill for such a simple problem; the problem has a very easy, short solution. However, as one goes to bigger grids and non-binary cases, this will become much harder to do without a methodical approach, and I would like you to do the methodical approach with this super simple version.

You don't need to write everything down, try to use the notation we used in class. When you can't, and there are a lot of things to write, you can say, for instance: for all values of  $i$  and  $j$  from 1 to 3, I will write a formula of the sort ... etc. Try to be as concise as possible.

2. Given that

$$r \wedge (\neg(\neg q \rightarrow p))$$

is true, what are the truth values of :

- (a)  $q \rightarrow \neg r$
  - (b)  $\neg r \wedge q$
  - (c)  $p \iff \neg r$
  - (d)  $\neg q \rightarrow \neg p$
3. Simplify  $(p \rightarrow (\neg p \iff p))$  as much as you can.

4. Simplify  $(\neg(p \wedge q) \wedge (p \rightarrow q))$  as much as you can.
5. If  $((\neg p \rightarrow q) \vee r)$  is false then what is the value of  $\neg q \rightarrow p$ ?