CSE 311: Sample Homework

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CSE 311: Sample Homework
Section AE
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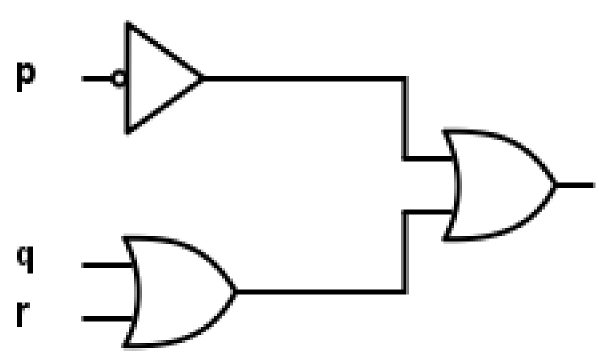
1. Propositional Logic

(a) If p ::= I know LaTeX, q ::= I can write fancy papers, and r ::= I can write homework assignments, then the sentence "If I know LaTeX, then I can write fancy papers, homework assignments, or both." can be expressed as $p \rightarrow (q \vee r)$.

(b) The truth table:

p	q	r	$(q \vee r)$	$p \rightarrow (q \vee r)$
T	T	T	T	T
T	T	F	T	T
T	F	T	T	T
T	F	F	F	F
F	T	T	T	T
F	T	F	T	T
F	F	T	T	T
F	F	F	F	T

(c) The circuit:



(d) Prove that your proposition is equivalent to $\neg p \to (q \to r)$.

$$
\begin{aligned}
p \to (q \lor r) &\equiv \neg p \lor (q \lor r) && \text{Law of Implication} \\
&\equiv (\neg p \lor q) \lor r && \text{Associativity} \\
&\equiv (q \lor \neg p) \lor r && \text{Commutivity} \\
&\equiv q \lor (\neg p \lor r) && \text{Associativity} \\
&\equiv \neg\neg q \lor (\neg p \lor r) && \text{Double Negation} \\
&\equiv \neg q \to (p \to r) && \text{Law of Implication}
\end{aligned}
$$

(e) The code is as follows:

```
public boolean foo(boolean p, boolean q, boolean r) {
    return !p || (q || r);
}
```

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2. Celebration?

Let x be the number of slices of the cake. The problem tells us that we have $x = \frac{x}{4} + \frac{x}{2} + \frac{x}{6} + 3$. Simplifying, we get

$$
\begin{aligned}
x &= \frac{x}{4} + \frac{x}{2} + \frac{x}{6} + 3 \\
12x &= 3x + 6x + 2x + 36 \\
x &= 36
\end{aligned}
$$

Thus, the cake had 36 slices.

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3. Sneak Peek

We must figure out if $n(n+1)(n+2)$ is evenly divisible by 6. We know that n, $n+1$, and $n+2$ are three consecutive numbers. In every two consecutive numbers, one is divisible by 2, and in every three consecutive numbers, one is divisible by 3. Therefore, one of n, $n+1$, and $n+2$ is divisible by 2 and one is divisible by 3; so, their product is divisible by 6 which is what we were trying to prove.

4. Yummy

First, number the mice from 0 to 4 and the batches from 0 to 29. Note that it is possible to write the numbers from 1 to 30 in binary using at most 5 bits since $2^5 = 32 \geq 30$. We feed mouse m a piece of cupcake from batch b if and only if the binary representation of b has a 1 for the bit corresponding to 2^m. We then wait 23 hours and see which mice have died. To figure out which tray is tainted, we add the powers of two corresponding to each dead mouse together. The cupcake batch with the matching number is the poisoned one.

For clarity, we show an example with fewer mice and cupcakes in the table below.

	Mouse 0	**Mouse 1**	**Mouse 2**
Batch 0			
Batch 1	X		
Batch 2		X	
Batch 3	X	X	
Batch 4			X

A cell in the above table has an X in it precisely when the mouse in the column will eat from the batch in the row.