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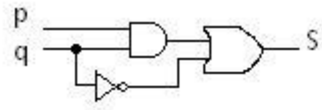
Discrete Structures Test #1 S 2009

1) Determine a **simplified** circuit for S = ($p \wedge q$) v $\neg q$. *Show your reduction work and draw the simplified circuit.*



2) Verify the logical equivalence $p \wedge q \to r \equiv \neg p \vee (q \to r)$ by using Theorem 1.1, 1.2 and the alternate representation of the conditional $p \to q \equiv \neg p \vee q$.

3) Reduce $A \cup (B \cap C^c)^c \cup C$:

4) *Symmetric difference* between two sets A and B is: $A \Delta B = A \backslash B \cup B \backslash A$. Verify the identity stated below.
$(A \cap B \cap C^c) \cup (A \cap B^c \cap C) = A \cap (B \Delta C)$

5) T/F
   a) $\{4\} \subseteq \{\{2\}, \{4\}, \{6\}\}$
   b) $4 \in \{n \mid n = 2k, \forall k \in Z\}$
   c) $4 \in \{\{2\}, \{4\}, \{6\}\}$
   d) $\{4\} \in P(\{1, 2, 3, 4\})$
   e) $\{4\} \subseteq \{1, 2, 3, 4\}$
   f) $\{2, 4, 6\} \subset \{2, 4, 6\}$

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6) Write out the symbolic representation of the Quotient-Remainder Theorem. Given any integer *n* and any positive integer *d*, there exist integers *q* and *r* such that:

7) Use Euclid's Division Algorithm to find gcd(330, 156). *Show your work.*

8) Let *g* be the function given by

$$g(n) = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even} \\ \frac{3n+1}{2} & \text{if } n \text{ is odd} \end{cases}$$

Show that for positive integer $n = 10$, starting from *n* and iterating *g*, the function value eventually returns to 1.

9) Given the Java integer: 1100 0010 0000 0011 1000 0001 1001 0100
Java uses 2's complement representation and a 32 bit word size.
a) Hexadecimal Representation:
b) Decimal Value:

10) Convert 188.09375 to octal and to binary:

11) Consider the Java bytes A = 1010 1010, B = 0101 0101. Convert their sum, A + B, to decimal:

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12) Write the **negation** of the given statement symbolically and **determine** whether the original or the negation is **true**.
There is a natural number n such that, for every real number x, x^n is nonnegative.

13) Prove: The product of an even integer and an odd integer is even.

14) Complete the values table for the following algorithm with a[] = {1, 5, 6}, s = 8, and length = 3.

```
int decimalValue (int a[], int s, int length) {
   int i, n = 0;
   for (i = 0; i < length; i++) {
      n += a[length - 1 - i] * pow(s,i);
   }
   return n;
}
```

i	a[length - 1 - i]	pow(s, i)	a[length - 1 - i] * pow(s, i)	**n**
0				
1				
2				
3				
4				