Grade 7/8 Math Circles  
October 28, 2020

**Propositions and Control Flow - Problem Set**

1. Find the truth valuation for each of the given propositions if P is false, Q is true, and R is true.
   (a) \((P \land Q) \lor (\neg R)\)  
   (b) \((Q \land (\neg P)) \land (R \land P)\)  
   (c) \(P \lor (R \land Q)\)  
   (d) \((P \land (Q \lor (R \land (\neg P)))) \lor (Q \land (P \lor R))\)

2. Find a proposition that is only true when either P and Q are both true or P is not true and R is true.

3. Find a proposition with P and Q that always has a true truth value (no matter the truth valuation).

4. Find a proposition with P and Q that always has a false truth value.

5. Draw the truth tables for the following propositions.
   (a) \((P \land Q) \land (\neg P)\)  
   (b) \(P \land (Q \lor (R \lor (\neg Q)))\)  
   (c) \((P \land R) \lor (Q \land (\neg(Q \land P)))\)  
   (d) \(((P \lor Q) \lor (R \land (\neg P))) \lor (\neg Q)\)

6. Write a boolean expression that can be used to determine if both \(x\) is less than 5 and \(y\) is 6.

7. Write a program that will print True if \(x\) is between or equal to \(y\) and \(z\) and \(x\) is not a multiple of 5. Assume that \(y\) is smaller than \(z\).

8. Write a program that will print all the numbers between, but not equal to, \(y\) and \(z\) that are not multiples of 2, but are multiples of 3. Assume you do not know which of \(y\) and \(z\) are smaller.

9. Write a program that, given three numbers, \(a\), \(b\) and \(c\), finds the smallest, greatest and middle number. Assume none of the numbers are equal.

10. Write a program that does something interesting. This could be helping to solve a math problem, a short game or anything you want to code. Share your code on Piazza!