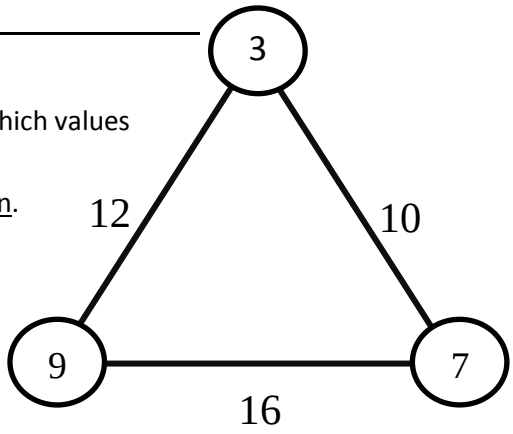
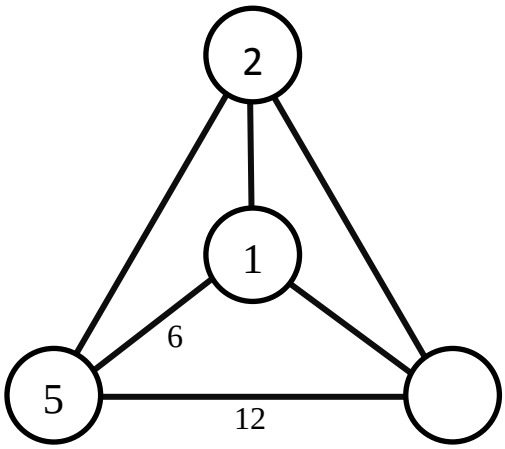
Introduction to Arithmagraphs

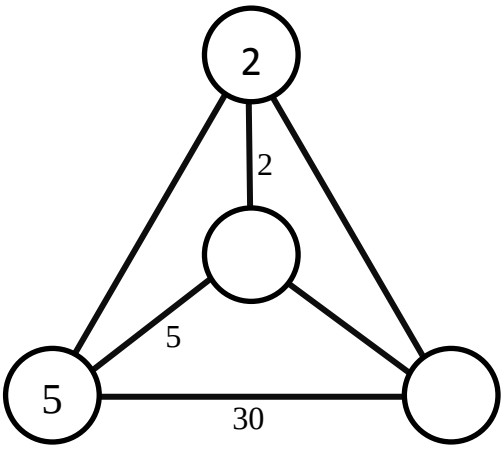
Define an ***arithmagraph*** to be a diagram of vertices and edges in which values at adjacent vertices combine to equal values at the edges using an operation. For example, the arithmagraph on the right uses <u>addition</u>.



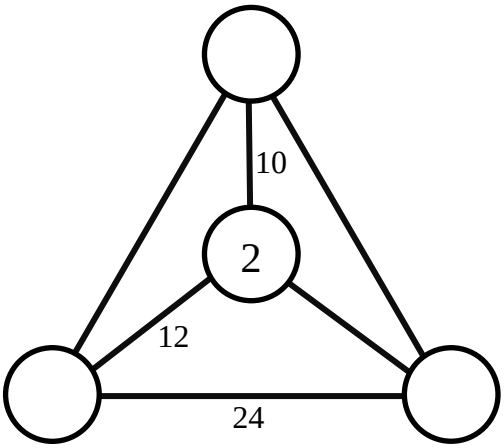
1. Complete the following arithmagraph using <u>ADDITION</u>.



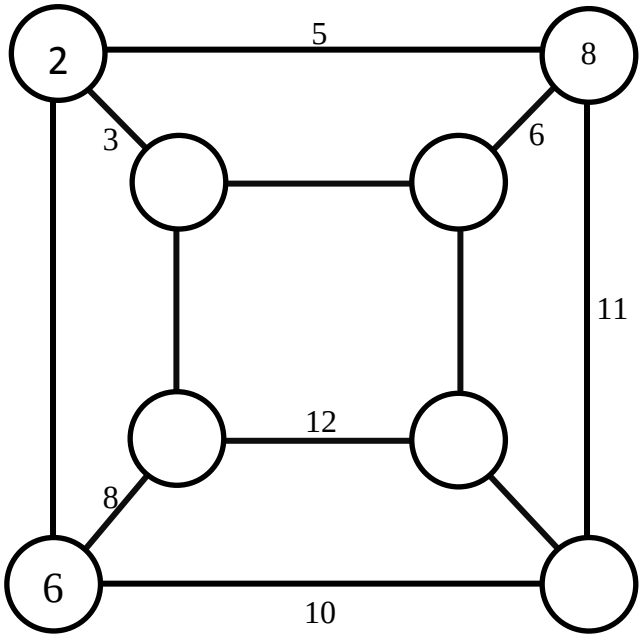
2. Complete the following arithmagraph using <u>MULTIPLICATION</u>.



3. Complete the following arithmagraph using MULTIPLICATION.



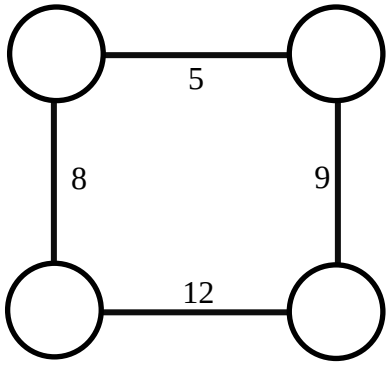
4. Complete the following arithmagraph using AVERAGE.



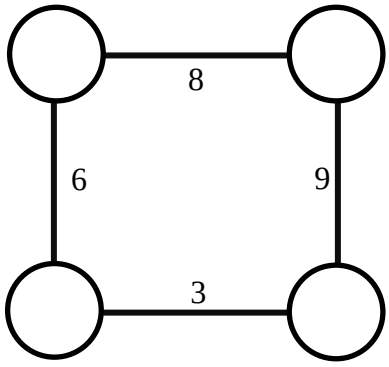
5. What questions come to your mind after doing these arithmagraph problems?

Arithmagraphs with Edge Labels

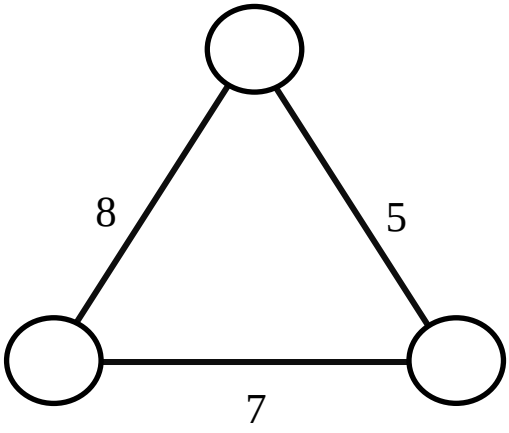
1. The following arithmagraph can be completed in more than one way using ADDITION. In how many ways can it be completed using WHOLE NUMBERS? Explain your reasoning.

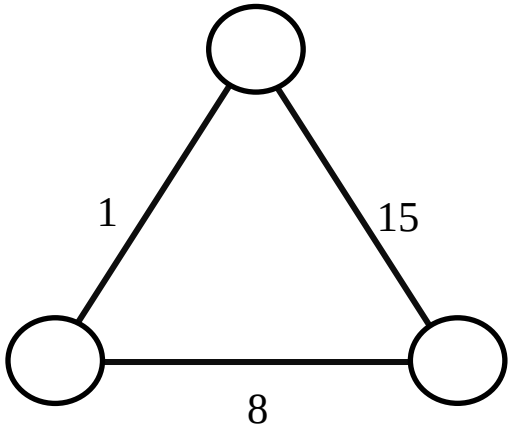


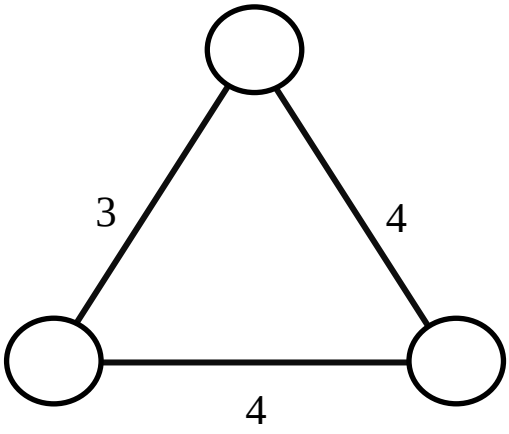
2. In how many ways can the following arithmagraph using ADDITION be completed using WHOLE NUMBERS? How about using ANY NUMBERS?

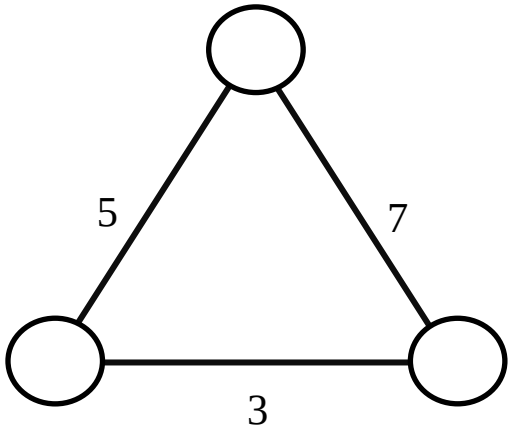


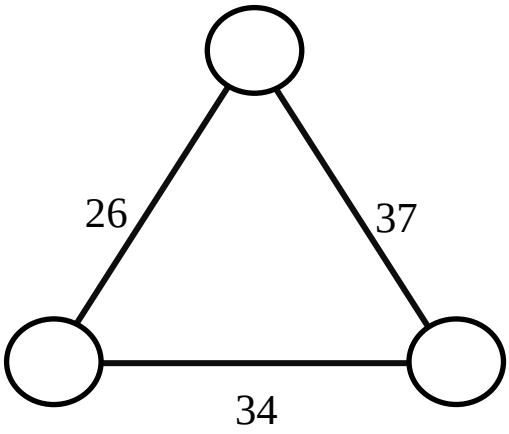
3. Complete the following arithmagraphs using ADDITION.

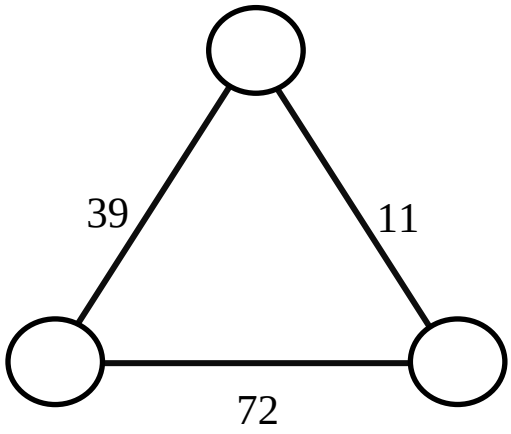




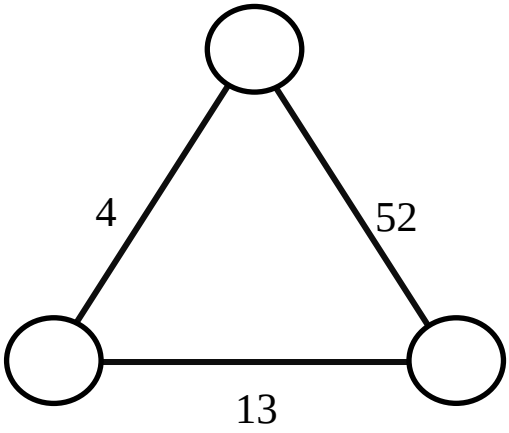


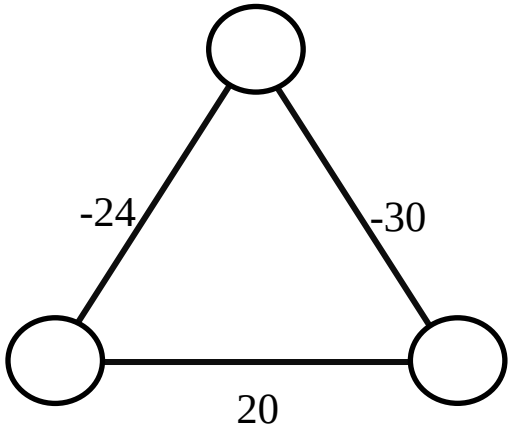


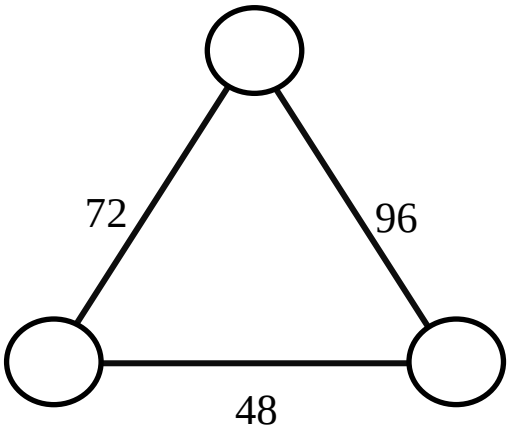


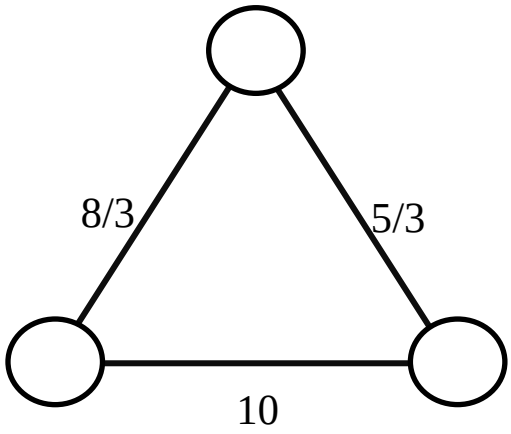


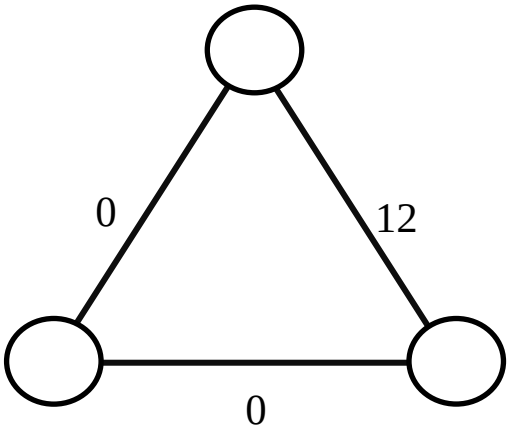
4. Complete the following arithmagraphs using MULTIPLICATION:

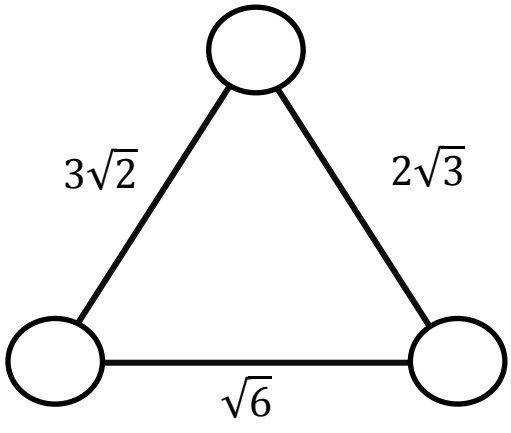












5. Try creating and solving more triangular arithmagraph problems in order to answer the following questions:
   a. What types of triangular arithmagraphs using ADDITION can ALWAYS be solved?

   b. How many ways are there to solve a triangular arithmagraph using ADDITION?
      How do you know?

   c. What types of triangular arithmagraphs using MULTIPLICATION can ALWAYS be solved?

   d. How many ways are there to solve a triangular arithmagraph using MULTIPLICATION?
      How do you know?

   e. What's the fastest way you can think of to solve a triangular arithmagraph?

6. [Challenge] Do you know modular arithmetic? If so, try creating and solving triangular arithmagraph problems using mod 8 arithmetic. Then, try using mod 7 arithmetic. What things do you notice?