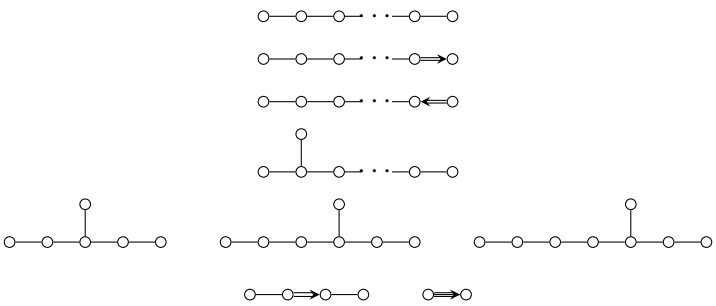
Topics in Ring and Representation Theory (MATH11144)

In mathematics, you are probably not yet aware of any sensible structures that are not associative, i.e. structures for which

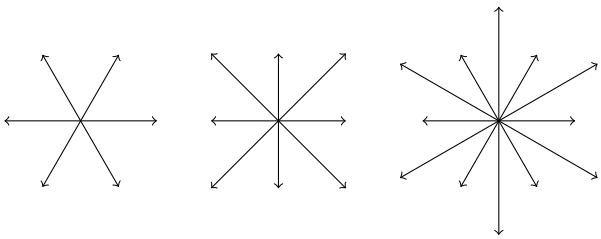
$$a * (b * c) \neq (a * b) * c.$$

However, one important class of such objects are *Lie algebras*, and this course will study their properties and their representation theory. Lie algebras are related to Lie groups, and can in some ways be viewed as an algebraic approach to them.

One of the main theorems of the course will be to classify *semisimple* Lie algebras by means of Dynkin diagrams, which are the graphs:



In the process of proving this theorem, we need to study *root systems* which are beautiful combinatorial gadgets such as



The importance of this subject stems from the fact that Lie algebras, Dynkin diagrams and root systems appear in many different, seemingly unrelated areas.

If there is time, we will also cover *affine* Lie algebras, which are related to affine Dynkin diagrams, and whose root systems are related to tilings of the plane and higher dimensional vector spaces: