Definition 5.3. [1ZG](Solved on 2022-11-15) *A **ring** is a set A with two binary operations*

- *$+$ (called sum or addition) and*
- *$\cdot$ (called "multiplication", also indicated by the symbol $\times$ or $*$, and often omitted),*

such that

- *$A+$ is a commutative group (usually the neutral element is denoted by 0);*
- *the operation $\cdot$ has neutral element (usually the neutral element is indicated by 1) and is associative;*
- *multiplication distributes on addition, both on the left*

  $$a \cdot (b + c) = (a \cdot b) + (a \cdot c) \quad \forall a, b, c \in A$$

  and on the right

  $$(b + c) \cdot a = (b \cdot a) + (c \cdot a) \quad \forall a, b, c \in A$$

*A ring is called **commutative** if multiplication is commutative. (In which case the right or left distributions are equivalent.)*