

Division algorithm

Integer division and remainders (aka The Division Algorithm) Let n be an integer and d a positive integer. There are unique integers q and r , with $0 \leq r < d$, such that $n = dq + r$. In this case, d is called the divisor, n is called the dividend, q is called the quotient, and r is called the remainder.

Because these numbers are guaranteed to exist, the following functions are well-defined:

- **div** : $\mathbb{Z} \times \mathbb{Z}^+ \rightarrow \mathbb{Z}$ given by **div** ((n, d)) is the quotient when n is the dividend and d is the divisor.
- **mod** : $\mathbb{Z} \times \mathbb{Z}^+ \rightarrow \mathbb{Z}$ given by **mod** ((n, d)) is the remainder when n is the dividend and d is the divisor.

Because these functions are so important, we sometimes use the notation $n \text{ div } d = \text{div} ((n, d))$ and $n \text{ mod } d = \text{mod} ((n, d))$.

Pro-tip: The functions **div** and **mod** are similar to (but not exactly the same as) the operators `/` and `%` in Java and python.

Example calculations:

$20 \text{ div } 4$

$20 \text{ mod } 4$

$20 \text{ div } 3$

$20 \text{ mod } 3$

$-20 \text{ div } 3$

$-20 \text{ mod } 3$