Example

- Note that $12 \equiv 2 \pmod 5$.
- Therefore $12^2 = 12 \cdot 12 \equiv 2 \cdot 2 \pmod 5$, or $4 \pmod 5$.
- Of course we could check this directly: $12^2 = 144$ is in fact $\equiv 4 \pmod 5$.
- But now we have

$$12^{10} \equiv 2^{10} \pmod 5 \equiv 1024 \pmod 5 \equiv 4 \pmod 5.$$

This is harder to check directly, but with a computer we can see that

$$12^{10} = 61,917,364,224.$$