

# REPRESENTATION THEORY

## WS 2022/23

### A. ORGANISATION

- LECTURES: → Mo. 10:00 - 11:30 / Room 48-538 ( + live stream → ? )  
→ Th. 8:15 - 9:45 / Room 48-538 ( + live stream → ? )
- EXERCISES: → Th. 12:00 - 13:30 / Room 48-538  
→ Assistant: MARIE ROTH (48-417)
- Registration: in the URM system by Fr. 28<sup>th</sup> of Oct, noon.

# REPRESENTATION THEORY

## WS 2022/23

- 2-week rhythm : tutorial/solution session / tutorial / solution session / ...
- Übungsschein: let us know this week if you to obtain one.
- Exercises : 6 Exercises per slot of two weeks

# REPRESENTATION THEORY

## WS 2022/23

### B. BEFORE AND AFTER

---

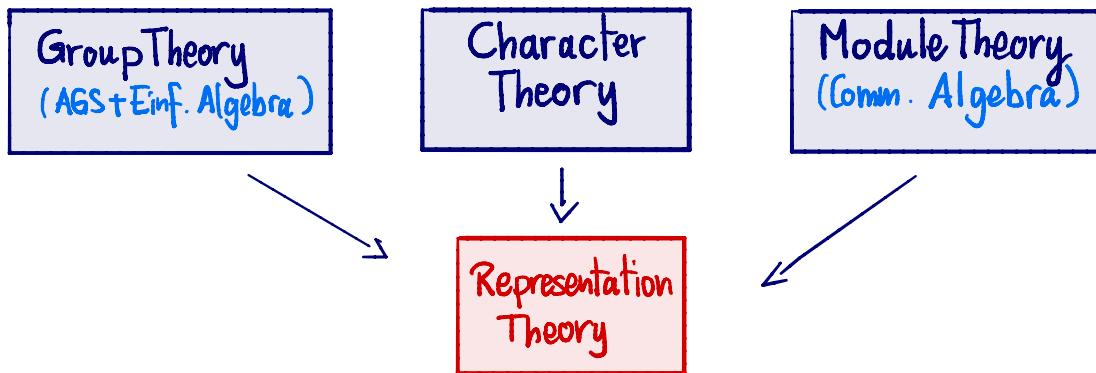
Representation  
Theory

# REPRESENTATION THEORY

WS 2022/23

## B. BEFORE AND AFTER

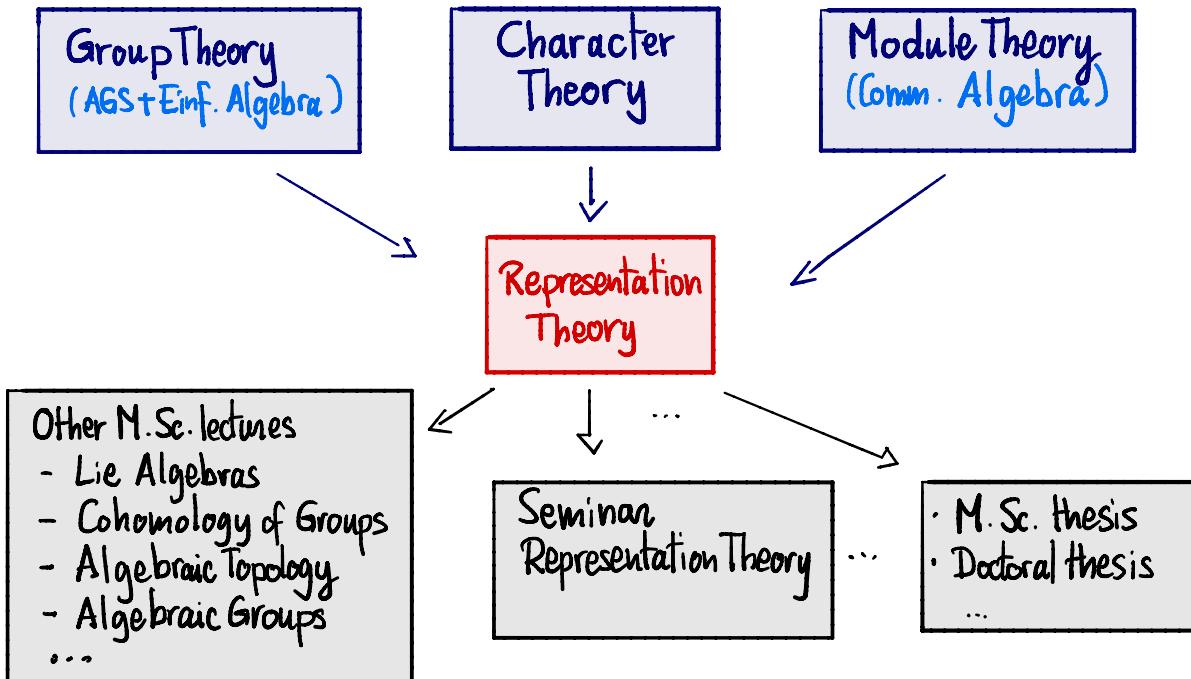
---



# REPRESENTATION THEORY

WS 2022/23

## B. BEFORE AND AFTER



# REPRESENTATION THEORY

## WS 2022/23

### C. BACKGROUND MODULE THEORY

The following elementary notions of module theory are assumed as known:

- Modules / submodules / homomorphisms / quotient modules
  - Free modules / projective modules
  - Direct sums / direct products
  - Exact sequences / short exact sequences
  - Tensor products
  - Algebras
- See Appendix 1 + Revision Sheet 0 (tutorial today 12:00 - 13:30)

# REPRESENTATION THEORY

## WS 2022/23

### D. AIMS OF THE LECTURE

1. Study representations of finite groups over fields  $K$  of positive characteristic

$\rho: G \rightarrow GL(V)$  with  $\begin{cases} \dim_K V < \infty \\ \text{char } K =: p \mid |G| \end{cases}$

$\Updownarrow$  equiv. to

2. in particular through module theory over the group algebra  $KG$

$KG$ -module structure on  $V$

Problems to overcome:

① Maschke's theorem not true  $\Rightarrow$  not every representation is semisimple!

② Character theory has major deficiencies! E.g.  $\chi_p(1_G)$  only gives  $\deg(\rho)$  modulo  $p$ .  
 $\Rightarrow$  Have to replace characters by "better" functions!  $\Rightarrow$  the "Brauer characters"