Embodiment & Reference

- The ability of reference — linking a sequence of signals (text in case of LLMs) to an object in the real world — is argued to be decisive when it comes to a „real understanding“
- Example: an octopus learns to use words correctly by eavesdropping on a conversation between two people on land will not be able to determine which object is a coconut, even though it knows how to use the word [4]
- Opinion: since the training data for LLMs is only form, they do not have access to meaning [5] (just like that octopus)
- Opinion: reference does **not** define meaning
  - Many terms that are meaningful to us have no real referent [4]
  - There are terms that cannot have a referent [4]
  - Absence of embodiment — which is claimed to be a precondition for being capable of reference — does not always hinder this ability

Embodiment & Reference

- Embodiment — existence in the real world, groundedness, and contact with physical things — is thought to be a precondition for intelligence [2]
- However, evidence from both humans and LLMs support that the lack of embodiment does not always hinder reference
  - Helen Keller, who was both blind and deaf, had a color scheme that she inferred from smells and touches; she projected one dimension on another [2]
  - Experiments show LLMs trained only on text can recover key geometry of color space, navigation, shapes [2, 4, 7]: e.g. text-only LLMs can draw und understand what they are drawing [3]
  - While LLMs cannot actually see or perform actions, they can do so via a surrogate [3]
  - Given a textual feedback from the environment, LLMs can adjust their generations accordingly [3]
- => LLMs end up learning a „great deal of embodied knowledge“ [2]
- Imagine an world with another physics we cannot access; given textual description detailed enough, we can understand how things work there and can imaginary „live“ there [2]