# From Slot Mereology To A Mereology Of Slots (Extended Abstract)

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## Abstract

This is an extended abstract of Tarbouriech, C. et al. From Slot Mereology to a Mereology of Slots. *Applied Ontology* 19:2, 181–230 (2024).

In 2013, Karen Bennett proposed a mereological theory as a first step towards a solution to a mereological problem: how can an entity have the same part multiple times? This question is raised by entities like *structural universals* or *informational entities*. Due to the *isomorphism principle*, expressed by David Lewis in 1986, if such entities exist, it is expected that they are isomorphic to their instances. The word-token "potato" contains two letters "o". Thus, it is expected that the word-type "POTATO" has the letter-type "O" as a part two times (as a letter-type is unique). To solve this problem, Bennett proposed to define the parthood relation on the basis of two primitive relations: $a$ is a part of $b$ iff $a$ fills a slot owned by $b$. Consequently, if $b$ has two slots filled by $a$, it can be considered that $a$ is part of $b$ two times.

This theory, later called *Slot Mereology* by Anthony Fisher (2013), provides a new mereological framework for entities that can have the same part multiple times. It provides seven axioms, aiming to mimic expected behaviour of classical mereology. However, it suffers from some problems. Besides the philosophical concerns discussed by Aaron Cotnoir (2015), Anthony Fisher (2013) and Paweł Garbacz (2016), the theory has problems with its axiomatisation. The theory presented by Bennett accomodates three classically expected properties of the parthood relation (antisymmetry, reflexivity and transitivity). Moreover an axiom tries to mimic the behaviour of classical strong supplementation. From that axiom are derived two theorems, that resemble the classical ones: weak supplementation and extensionality. However, Garbacz showed that extensionality was, in fact, not a theorem. Furthermore, we showed that the axiom of slot strong supplementation derives from another axiom. Hence it fails to capture the idea behind strong supplementation. Missing composition principles from the beginning and now deprived of any decomposition principles, Bennett's theory reduces to a slot ground mereology: an order relation, based on slots. Finally, Slot Mereology suffers from another problem: counting how many times an entity is part of another is not possible.

In our work, we showed that all the problems rely on one axiom: the inheritance of slots. This axiom entails that slots of parts are inherited. For example, if $s$ is a slot of $b$ and $b$ is a part of $a$ (by filling of its slots), then $s$ is inherited by $a$. The direct consequence is that the filler of $s$, that is a part of $b$, is also a part of $a$. In other words, thanks to this axiom, parthood in transitive.

In the first part of our proposition, we removed this axiom and replaced it with a new mechanism, that we called "*contextualisation*". This mechanism can be explained as follows: "when an entity is part of another multiple times, the structure of this entity is repeated as many times as necessary". The axiomatisation of contextualisation is such that, besides making parthood transitive, it enables proper counting of the parts of an entity. With contextualisation, Slot Mereology 2.0 is a ground mereology for entities that can have the same part multiple times.

In the second part of our proposition, we built upon Slot Mereology 2.0 to obtain a better theory than a slot ground mereology. Besides parthood relations between fillers, we considered parthood relations between slots. From there, we introduced slot versions of classical mereological notions. After defining relations of parthood, proper parthood and overlap between slots, we added slot decomposition principles (strong supplementation, weak supplementation and extensionality) and slot composition principles (sum and fusion). At the end, we obtained a *Mereology of Slots*: a theory of General Extensional Slot Mereology.

Our work, whose theorems have been all proved using the proof assistant Coq, provides an advanced theoretical framework to describe the mereological structures of entities that can have the same part multiple times. It provides a solution to the problem of representing the mereology of structural universals and informational entities.

## Keywords

mereology, slot mereology, supplementation, mereological sum, mereological fusion, structural universal, informational entity,

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