A FAMILY RESEMBLANCE DEFINITION OF LIFE. E. Persson[1] and J. Abbott[2], [1]Pufendorf Institute of Advanced Studies, P.O.Box 117, 221 00 Lund, Sweden, erik.persson@fil.lu.se [2]Pufendorf Institute of Advanced Studies, P.O.Box 117, 221 00 Lund, Sweden, Jessica.abbott@biol.lu.se.

Introduction: Almost all attempts to define life today take the form of a list of necessary properties. This type of definition is based on an outdated theory of life called *Essentialism*. We want to propose a different type of definition that both acknowledges the possibility of life as we do not know it, and better represents a Darwinian view of life. To achieve this we are using Wittgenstein's theory of family resemblance [1] operationalized by help of statistical modeling.

Necessary vs contingent properties: One reason why the search for a list of necessary properties for life will not be fruitful under present circumstances is that we cannot know if the properties we share with each other are shared because they are necessary for being alive or just because all earth life is related and has evolved under more or less similar curcumstances (from a cosmological perspective). This indicates that it might be time to start looking for another way of defining life, preferably a method where we do not have to determine whether a property is necessary or not.

Essentialism vs. Darwinism: There is also another, very fundamental reason to stop trying to define life as a list of necessary properties. It was once assumed that there was an essence of life, meaning that all life shared a particular property, or set of properties, that set it appart from everything else, and made it alive. The same reasoning was used about species. Each species had its own essence. Defining a species was thus a matter of identifying which property of set of properties that set every member of the species apart from every other living thing. None of these approaches have been successful, however. It is usually possible to find properties that are strongly associated with a particular species, but there are always exceptions. Many properties have also been produced that are closely associated with life but it has not been possible to fit them strictly into a list of necessary properties. Why?

Today, we know that life is in constant change. Species change and species change into other species. It is thus not meaningful to look for any essence. As species change, so does, ipso facto, life. So do we continue trying to define life based on a pre-darwinian theory? Life did not just suddenly appear in its present form but did most probably evolve from non-life more or less the way species evolve from other species. Essentialism might therefore be just as inappropriate for life as for species.

Family Resemblance: We are not assigned to our family based on a set of joint properties. Members of the same family do tend to share properties, but not necessarily in such a way that they can be neatly summed up in a list of properties that is shared by all family members and that is unique for members of a particular family. Instead, some family members share certain properties while other family members share other properties. Each family member can thus be characterized by a cluster of properties sufficiently overlapping with, though not exactly the same as, the property clusters of other family members. This way, a family can be defined as a pattern of overlapping clusters made up by properties that are more or less closely associated with this family even though they cannot form a traditional list in the form of a sufficient set of necessary properties. Ludwig Wittgenstein called this approach "family resemblance" [1] and suggested that it could be used to define other things such as games.

Towards a Family Resemblance definition of Life: Family resemblance has been suggested as a possible solution [2], [3], but it has not actually been tried until now. What we attempt to do is to make use of properties that are commonly associated with life and order them into overlapping clusters by help of mathematical modelling techniques. Our aim is to produce an algorithm that can sort these properties into overlapping clusters that describe everything we know as being alive (animals, plants, etc.), that exclude everything we agree on as not being alive (tables, chairs, etc.), and that can help us decide the tricky cases (viruses, etc.). If we manage to achieve that we are confident that we have captured something that will (1) tell us something important about life, (2) help us focus our search for extraterrestrial life, and (3) help us decide whether a certain extraterrestrial finding is alive/a sign of life or not. If we are right, the same algorithm can be used to define life everywhere, even though more properties will be added in continuously overlapping overlapping clusters as we find more different forms of life.

References:
[1] Wittgenstein L. (1953) *Philosophische Untersuchungen.* [2] Neuman Y. (2012) *Journal of Biomolecular Structure and Dynamics 29.* [3] Persson E. (2013) "Philosophical aspects of astrobiology" in Dunér D. et al. *The History and Philosophy of Astrobiolgy.*