

A Note on Properties in Multi-Level Modeling

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Building Better Multi-Level Conceptual Models

We need all the help we can get!

- Sanity-checking/error detection, guidelines

A typology of properties of high-order types:

- direct, resultant and regularity properties

Draw:

1. Implications to Specialization (“Inheritance” of Properties)
2. Implications to the Dynamics of Properties
3. Implications to Properties in Potency-Based Approaches

High-order types

5% of all classes in Wikidata
involved in multi-level
classification hierarchies (+17k)

Watercraft Type

Ship Type

first-order types

Watercraft

Ship

Supercarrier

Submarine

Nimitz-class
aircraft carrier

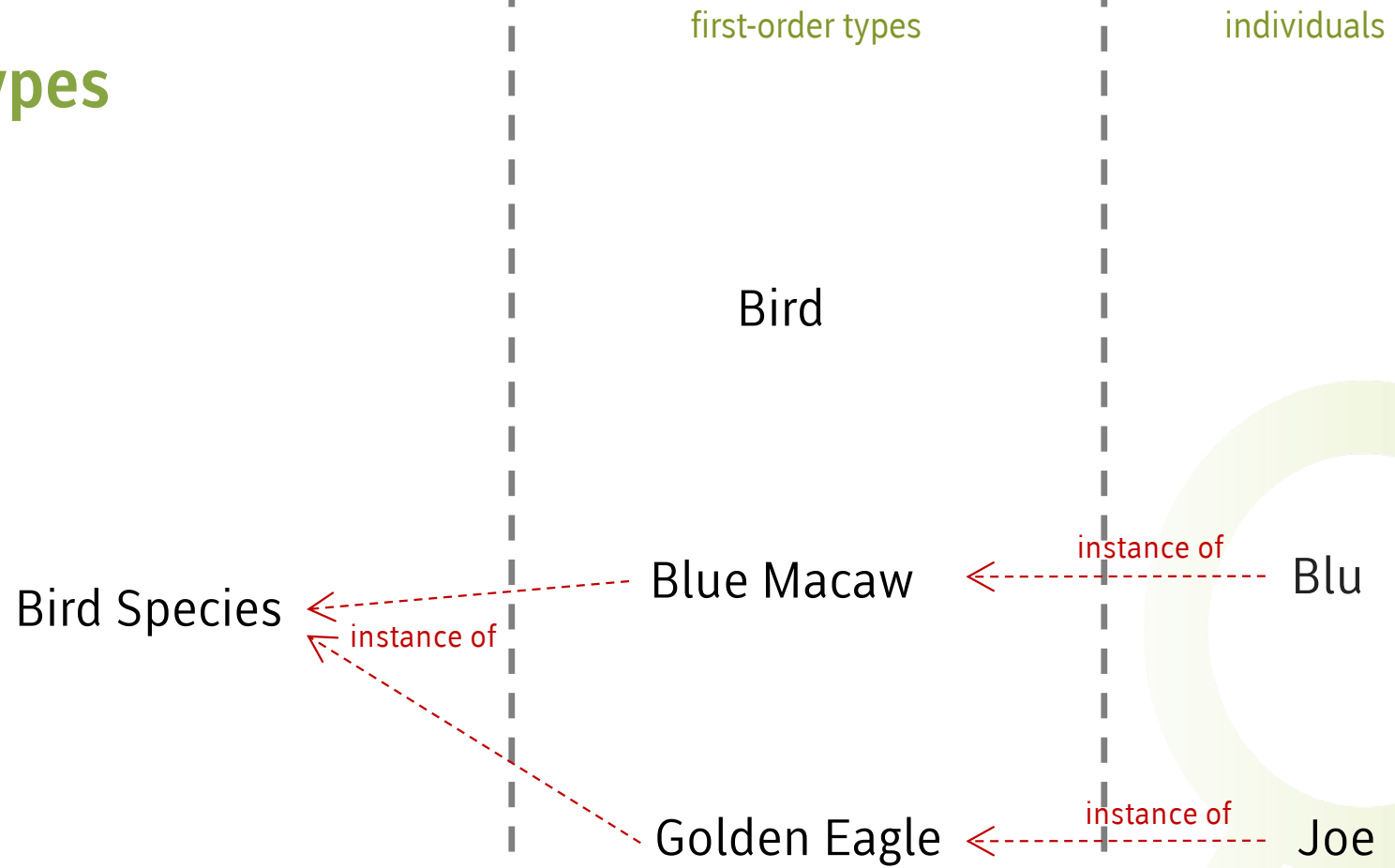
Gerald R. Ford-class
aircraft carrier

individuals

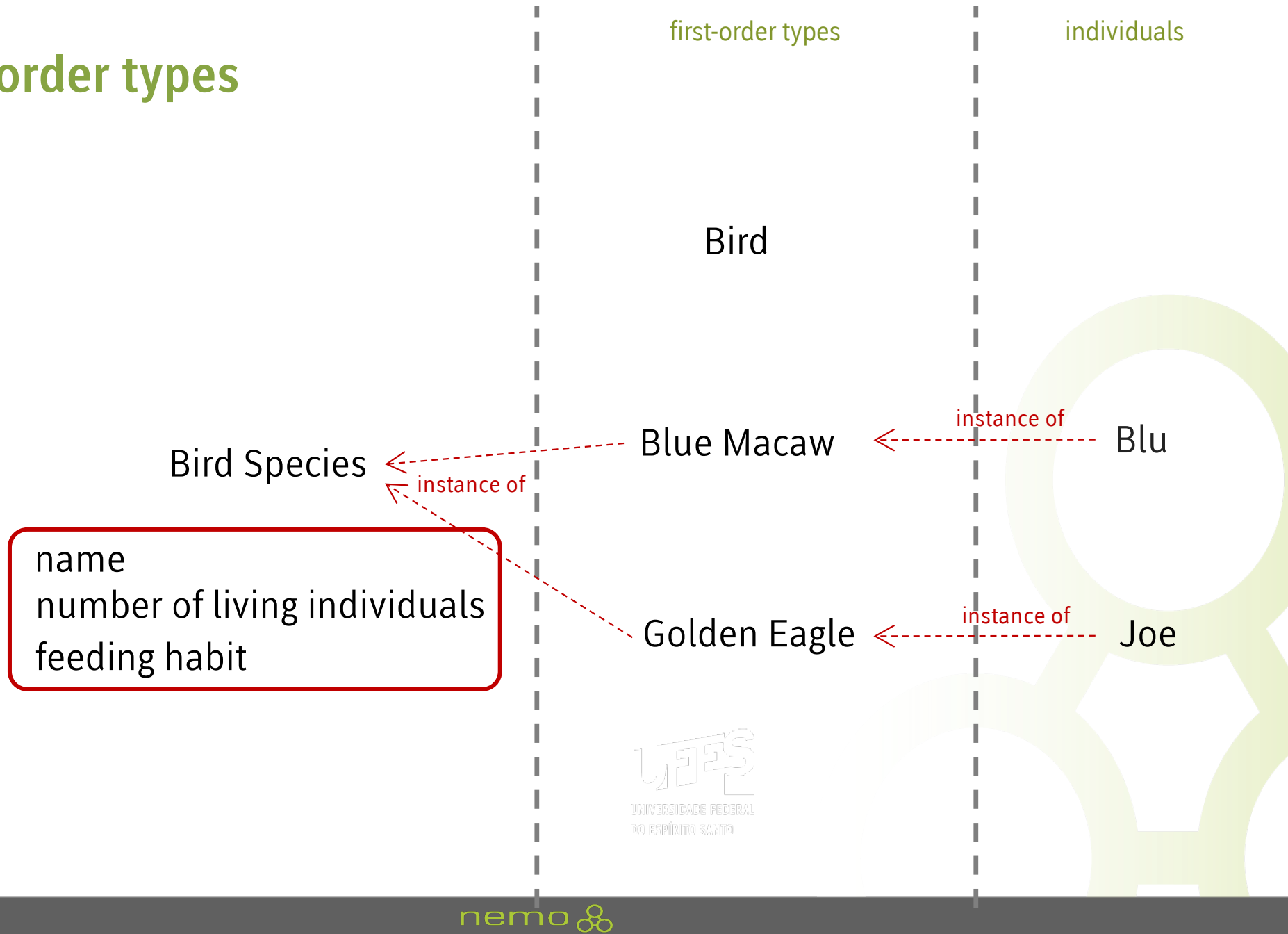
USS George
Washington

Newport News
Shipbuilding

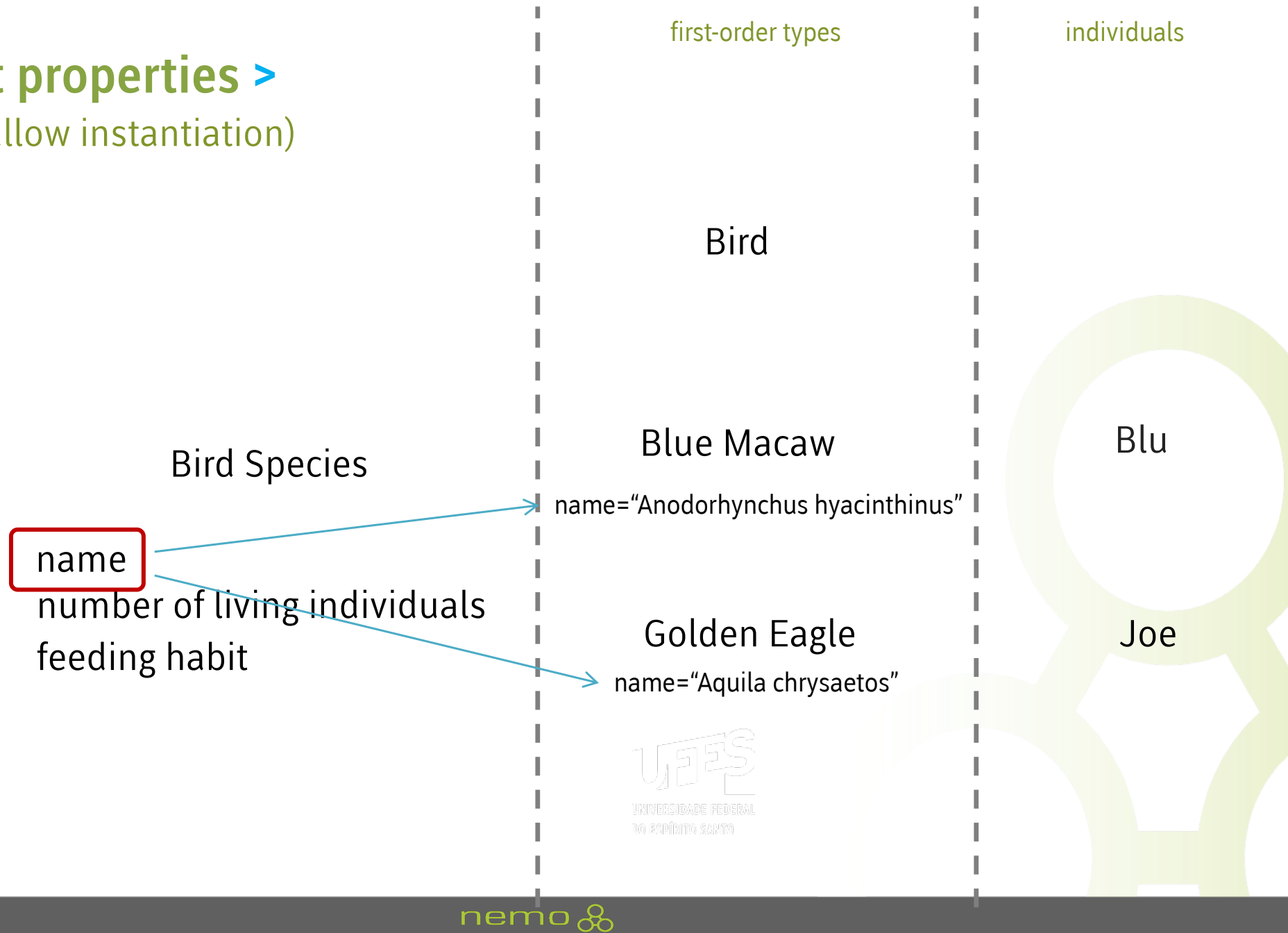
High-order types



High-order types

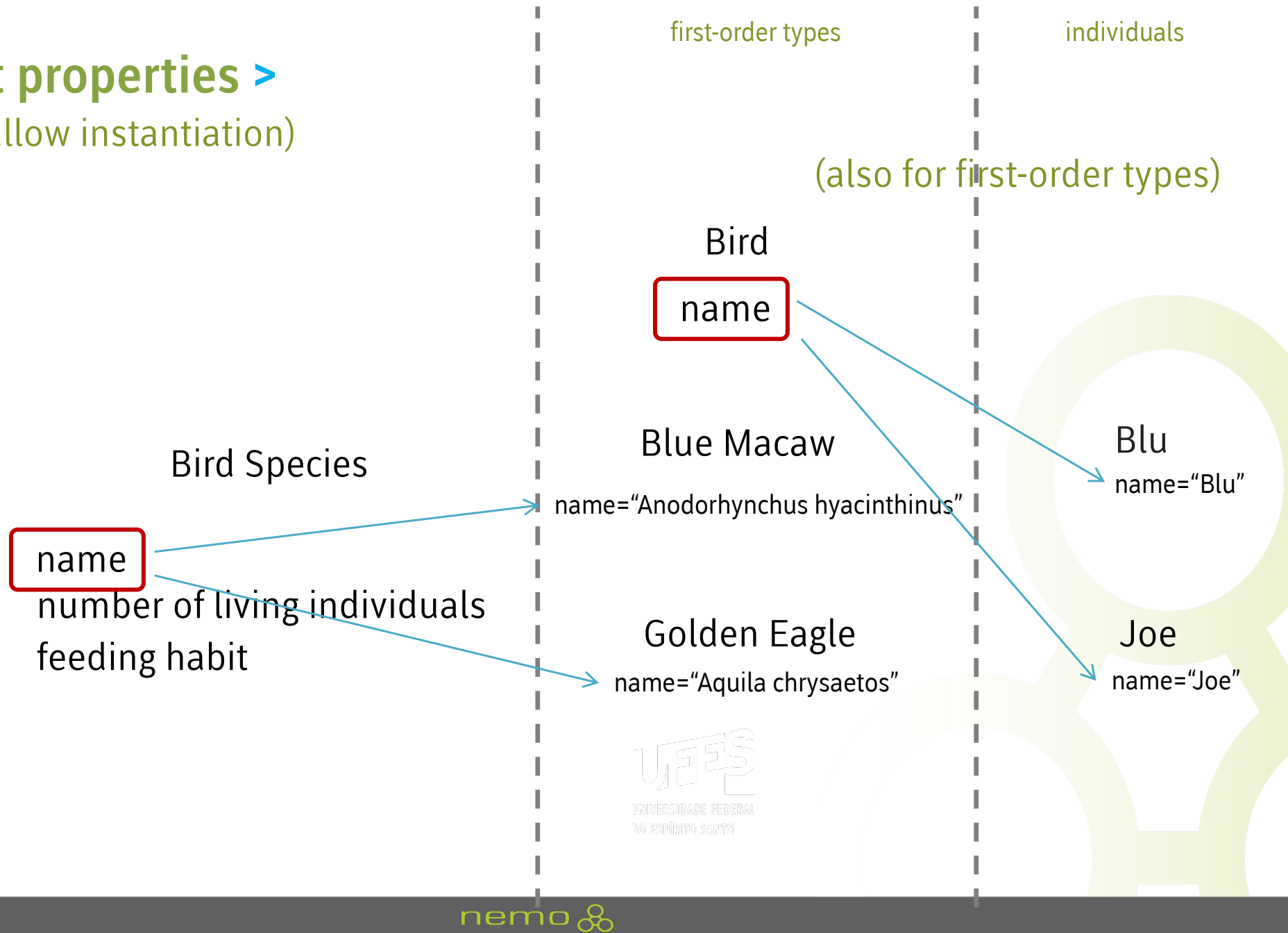


Direct properties > (shallow instantiation)



Direct properties >

(shallow instantiation)



Resultant properties <

Bird Species

name
number of living individuals
feeding habit

first-order types

individuals

Bird

Blue Macaw
number of living indiv. =300

Golden Eagle
number of living indiv. =250,000

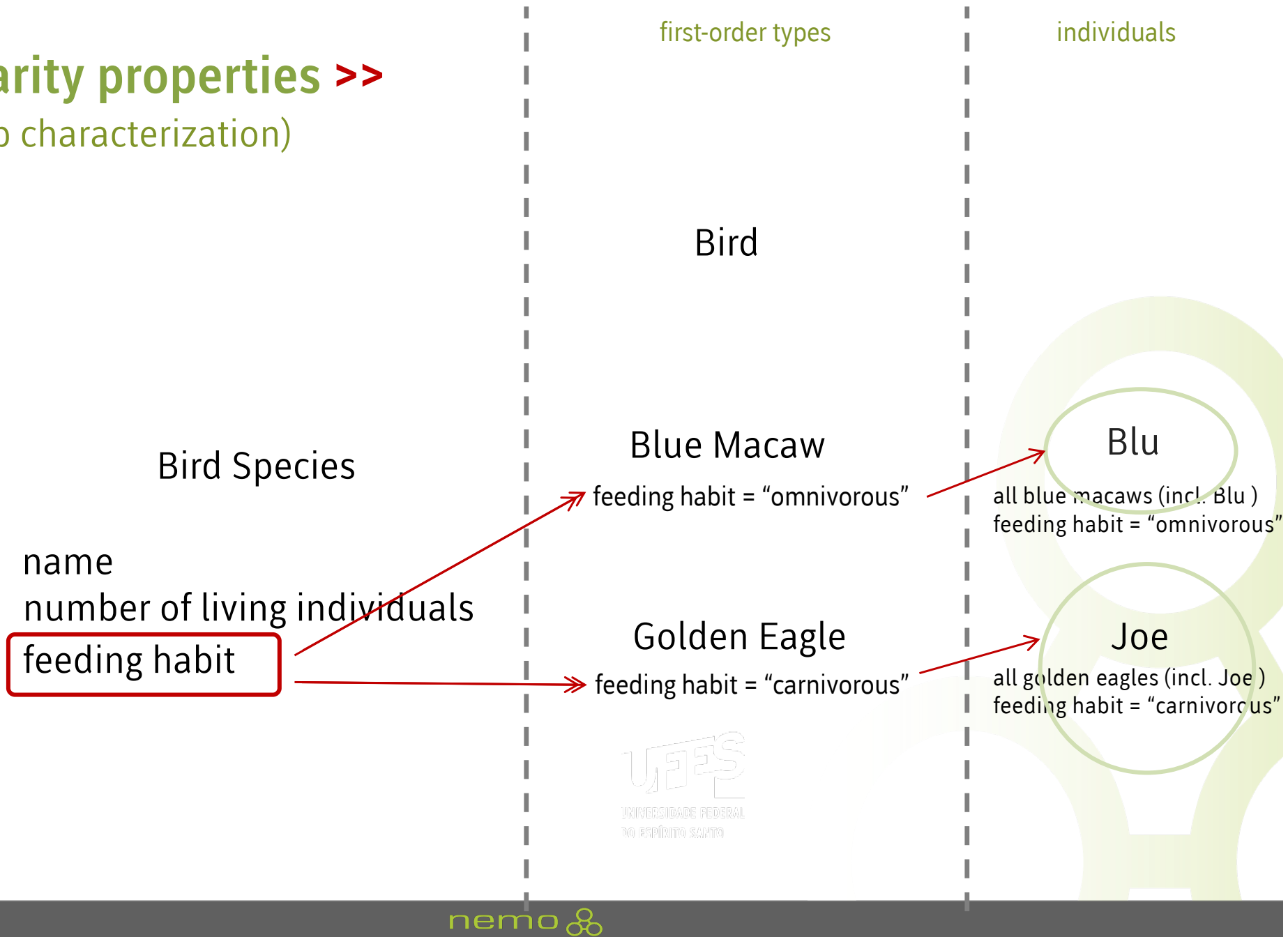
Blu

Joe

Joe does not have a
number of living individuals!

Regularity properties >>

(deep characterization)



Implications to Specialization

- Regularity properties >>
 - values are “inherited” by subtypes: Female Golden Eagles also “omnivorous”
 - regularity properties establish invariant aspects of the instances of a type
 - the instances of a subtype are also instances of the supertype
 - hence, the invariants defined for the instances of the supertype must also be respected by instances of the subtypes.
- Resultant properties <
 - Since the extension changes in subtypes, values not “inherited”
 - But can be conceived of for all subtypes (definition inherited in MLT subordination, e.g., Bird Breed is subordinate to Bird Species)
- Direct properties >
 - Not “inherited” in any sense

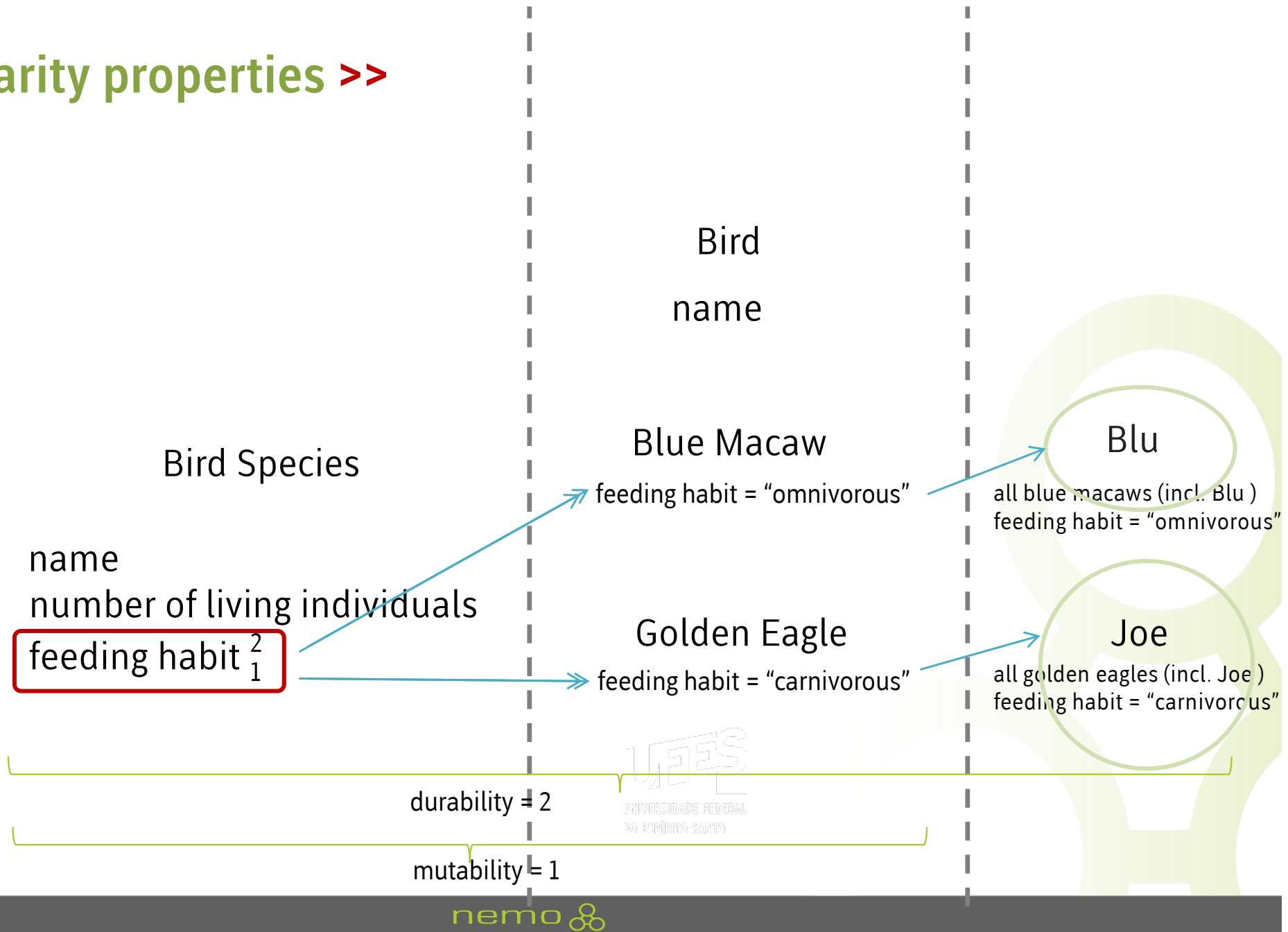
Implications to Dynamics of Properties

- Regularity properties >>
 - any alleged change of the value of a regularity property is actually the creation of another type
- Resultant properties <
 - the value of a resultant property may change as long as the extension of the type changes, or the property of instances in the extension changes
- Direct properties >
 - may be mutable (e.g., is currently in production for Mobile Phone Model) or not (e.g., launch date), in a way that does not depend on the instances of lower-level types.

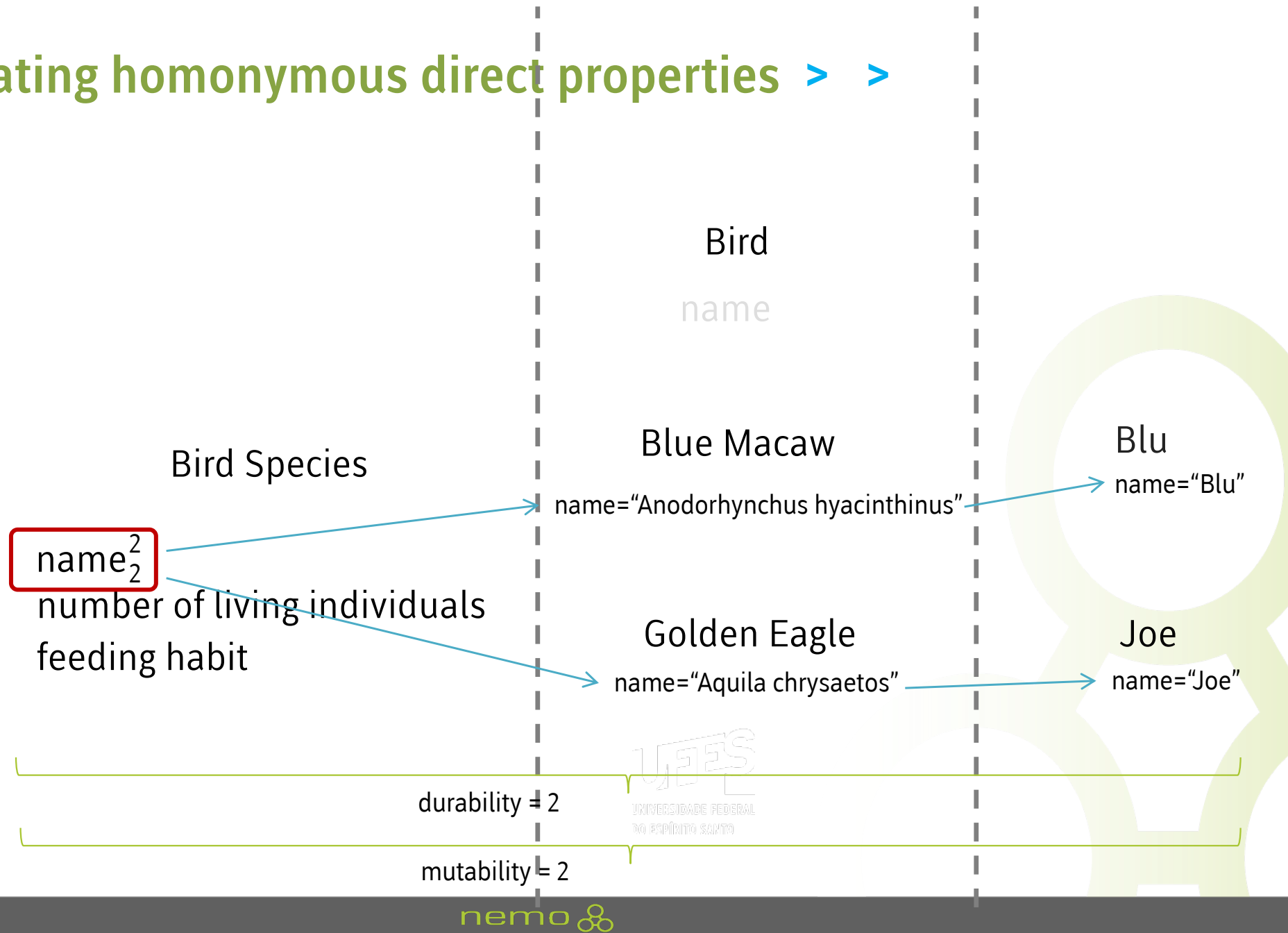
Implications to Potency-based Approaches

- Assume here Melanie with durability and mutability for properties
- Durability defines the endurance of the attribute over the instantiation chain
- Mutability defines how often its value can be changed over the instantiation chain
- Direct properties >
 - mutability=durability=1 (plain-old shallow characterization)
- Resultant properties <
 - mutability=durability=1 (no special support)
- Regularity properties >>
 - durability>mutability

Regularity properties >>



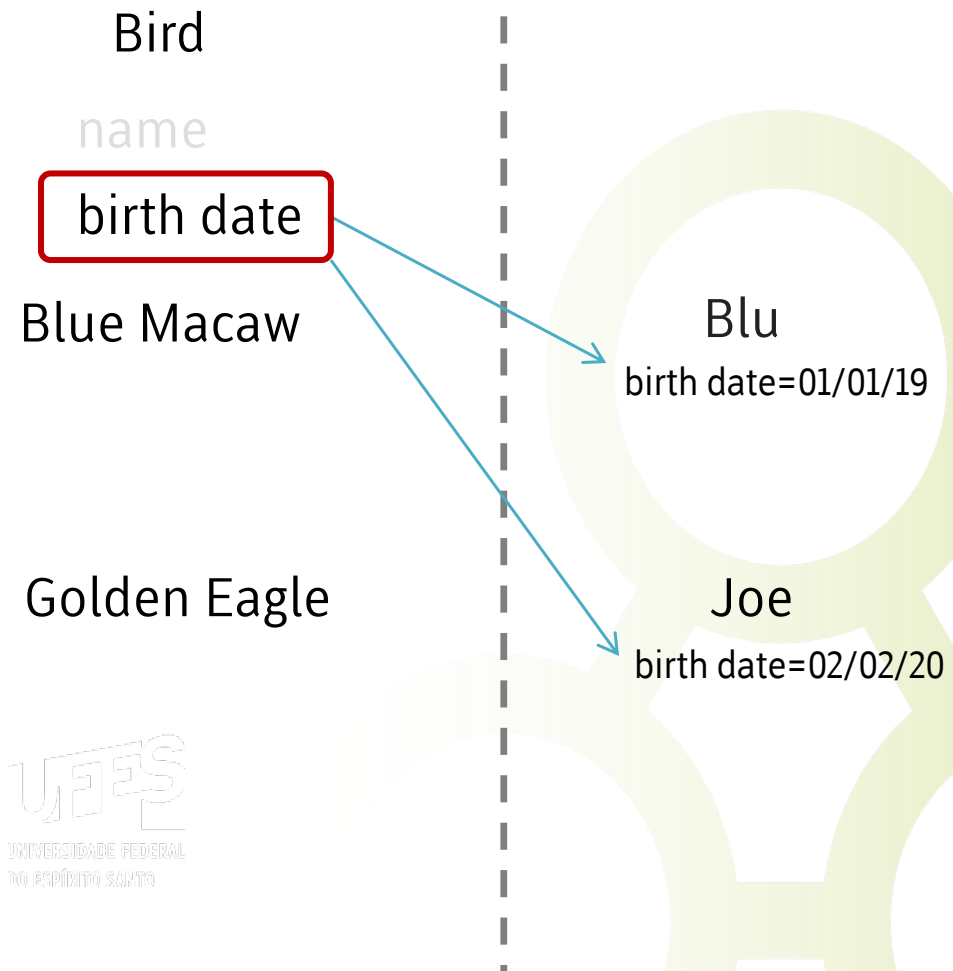
Conflating homonymous direct properties > >



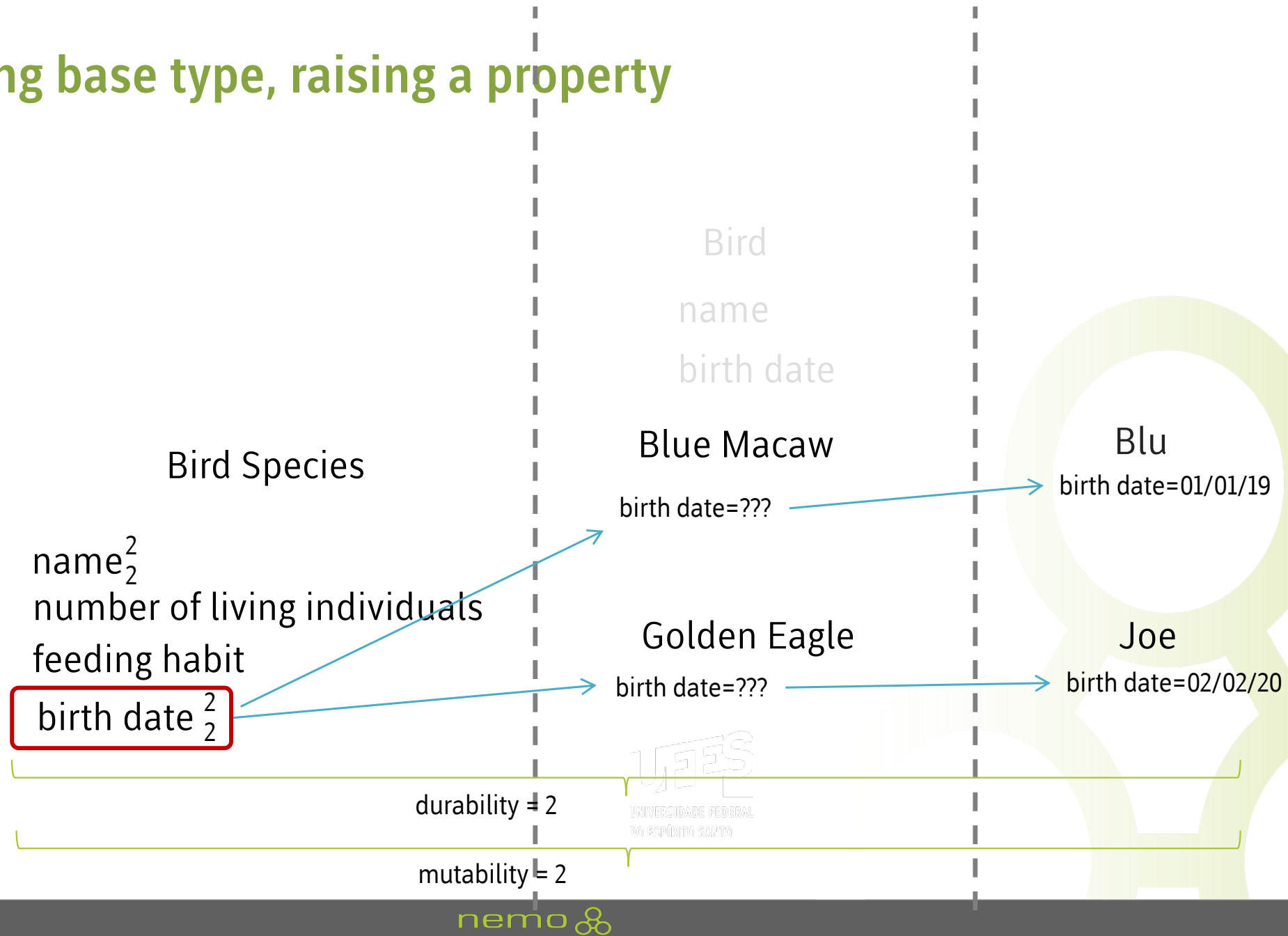
Omitting base type, “promoting” a property

Bird Species

name₂²
number of living individuals
feeding habit



Omitting base type, raising a property



Conclusions

- We need all the help we can get!
- A micro theory of properties of high-order types
 - Regularity properties >>
 - Resultant properties <
 - Direct properties >
- Incorporate these distinctions as constructs in multi-level modeling languages, provide automated support
- More background:
- *Towards an Ontological Analysis of Powertypes*, Giancarlo Guizzardi, João Paulo A. Almeida, Nicola Guarino, Victorio Carvalho
- <http://ceur-ws.org/Vol-1517/>