A TPTP Formalization of the Unified Foundational Ontology

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Abstract

This document presents a formalization of the Unified Foundation Ontology (UFO) expressed in first-order logics through the TPTP syntax. This formalization is intended to support verification of UFO's theory through automated provers and consistency checkers.

1 Introduction

This document presents a formalization of the Unified Foundation Ontology (UFO) expressed in first-order logics through the TPTP syntax. This formalization is intended to support verification of UFO's theory through automated provers and consistency checkers.

2 UFO's TPTP Specification
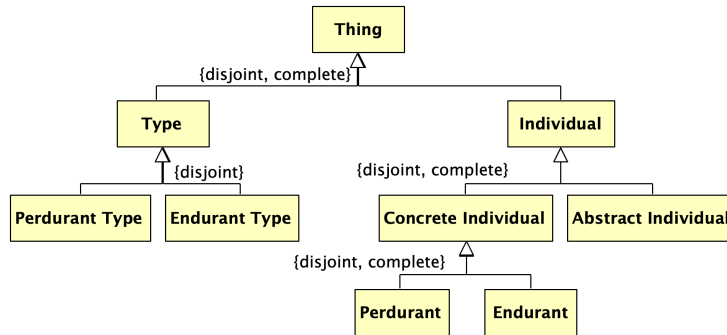
2.1 UFO Taxonomy

Figure 1: Partial Taxonomy of UFO – Thing.

```
4  % Thing
5
6  fof(ax_thing_taxonomy, axiom, (
7    ![X]: ((type(X) | individual(X)) <=> (thing(X)))
8  )).
9
10  fof(ax_thing_partition, axiom, (
11    ~?[X]: (type(X) & individual(X))
12  )).
13
14  % Individual
15
16  fof(ax_individual_taxonomy, axiom, (
17    ![X]: ((concreteIndividual(X) | abstractIndividual(X)) <=> (
         individual(X)))
18  )).
19
20  fof(ax_individual_partition, axiom, (
21    ~?[X]: (concreteIndividual(X) & abstractIndividual(X))
22  )).
23
24  % Concrete Individual
25
26  fof(ax_concreteIndividual_taxonomy, axiom, (
27    ![X]: ((endurant(X) | perdurant(X)) <=> (concreteIndividual(X)))
28  )).
29
30  fof(ax_concreteIndividual_partition, axiom, (
31    ~?[X]: (endurant(X) & perdurant(X))
32  )).
33
34  % Type
35
36  fof(ax_type_taxonomy, axiom, (
37    ![X]: ((endurantType(X) | perdurantType(X)) <=> (type(X)))
38  )).
39
40  fof(ax_type_partition, axiom, (
41    ~?[X]: (endurantType(X) & perdurantType(X))
42  )).
43
44  % Thing partial taxonomy instances
45
46  fof(ax_thing_instances, axiom, (
47    type(type1) & individual(individual1) & concreteIndividual(
        concreteIndividual1) & abstractIndividual(abstractIndividual1)
        & endurant(endurant1) & perdurant(perdurant1) & endurantType(
        endurantType1) & perdurantType(perdurantType1)
48  )).
49
50  % Abstract Individual
51
52  fof(ax_abstractIndividual_taxonomy_quale, axiom, (
53    ![X]: (quale(X) => (abstractIndividual(X)))
54  )).
55
56  fof(ax_abstractIndividual_taxonomy_set, axiom, (
57    ![X]: (set(X) => (abstractIndividual(X)))
```
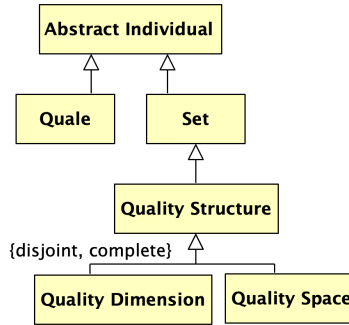
Figure 2: Partial Taxonomy of UFO – Abstract Individual.

```
58 )).
59
60 % Set
61
62 fof( ax_set_taxonomy_qualityStructure , axiom , (
63   ![X]: (qualityStructure(X) => (set(X)))
64 )).
65
66 % Quality Structure
67
68 fof( ax_qualityStructure_taxonomy , axiom , (
69   ![X]: ((qualityDimension(X) | qualitySpace(X)) <=> (
      qualityStructure(X)))
70 )).
71
72 fof( ax_qualityStructure_partition , axiom , (
73   ~?[X]: (qualityDimension(X) & qualitySpace(X))
74 )).
75
76 % Abstract Individual partial taxonomy instances
77
78 fof( ax_abstractIndividual_instances , axiom , (
79   set(set1) & quale(quale1) & qualityStructure(qualityStructure1) &
      qualityDimension(qualityDimension1) & qualitySpace(
      qualitySpace1)
80 )).

82 % Endurant
83
84 fof( ax_endurant_taxonomy , axiom , (
85   ![X]: ((substantial(X) | moment(X)) <=> (endurant(X)))
86 )).
87
88 fof( ax_endurant_partition , axiom , (
89   ~?[X]: (substantial(X) & moment(X))
90 )).
91
92 % Substantial
93
94 fof( ax_substantial_taxonomy , axiom , (
```
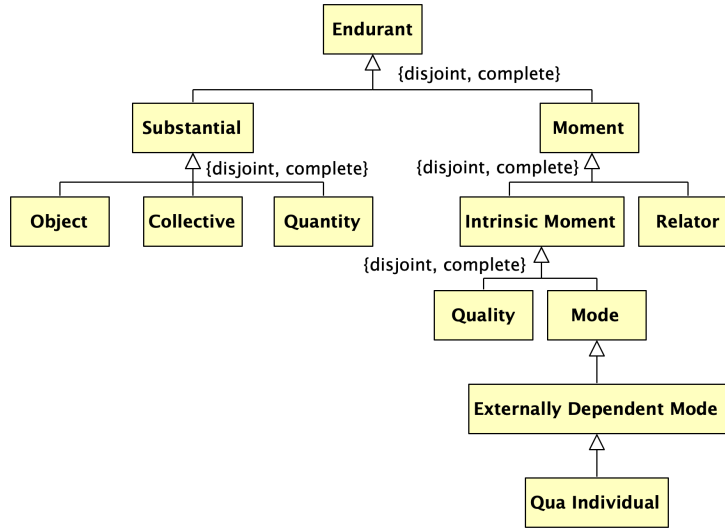
Figure 3: Partial Taxonomy of UFO – Endurant.

```
95     ![X]: ((object(X) | collective(X) | quantity(X)) <=> (substantial
         (X)))
96  )).
97
98  fof(ax_substantial_partition , axiom , (
99     ~?[X]: (object(X) & collective(X) & quantity(X))
100 )).
101
102 % Moment
103
104 fof(ax_moment_taxonomy , axiom , (
105    ![X]: ((intrinsicMoment(X) | relator(X)) <=> (moment(X)))
106 )).
107
108 fof(ax_moment_partition , axiom , (
109    ~?[X]: (intrinsicMoment(X) & relator(X))
110 )).
111
112 % Intrinsic Moment
113
114 fof(ax_intrinsicMoment_taxonomy , axiom , (
115    ![X]: ((quality(X) | mode(X)) <=> (intrinsicMoment(X)))
116 )).
117
118 fof(ax_intrinsicMoment_partition , axiom , (
119    ~?[X]: (quality(X) & mode(X))
120 )).
121
122 % Mode
123
124 fof(ax_mode_taxonomy_externallyDependentMode , axiom , (
125    ![X]: (externallyDependentMode(X) => (mode(X)))
```

```
126 )).
127
128 % Externally Dependent Mode
129
130 fof(ax_externallyDependentMode_taxonomy_quaIndividual, axiom, (
131   ![X]: (quaIndividual(X) => (externallyDependentMode(X)))
132 )).
133
134 % Endurant partial taxonomy instances
135
136 fof(ax_endurant_instances, axiom, (
137   substantial(substantial1) & moment(moment1) & object(object1) &
      collective(collective1) & quantity(quantity1) & intrinsicMoment
      (intrinsicMoment1) & relator(relator1) & quality(quality1) &
      mode(mode1) & externallyDependentMode(externallyDependentMode1)
       & quaIndividual(quaIndividual1)
138 )).
```
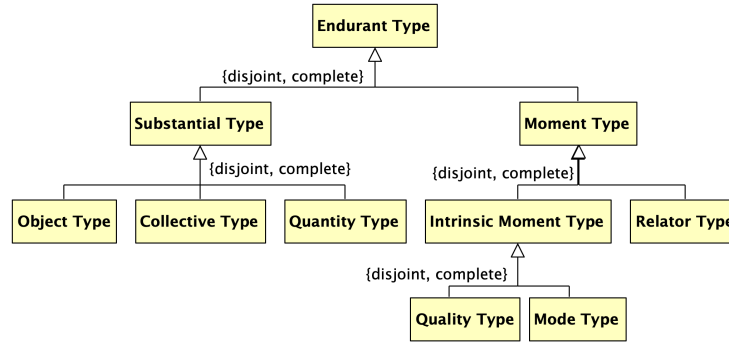

Figure 4: Partial Taxonomy of UFO – Endurant Types by ontological nature.

```
82 % Endurant
83
84 fof(ax_endurant_taxonomy, axiom, (
85   ![X]: ((substantial(X) | moment(X)) <=> (endurant(X)))
86 )).
87
88 fof(ax_endurant_partition, axiom, (
89   ~?[X]: (substantial(X) & moment(X))
90 )).
91
92 % Substantial
93
94 fof(ax_substantial_taxonomy, axiom, (
95   ![X]: ((object(X) | collective(X) | quantity(X)) <=> (substantial
      (X)))
96 )).
97
98 fof(ax_substantial_partition, axiom, (
99   ~?[X]: (object(X) & collective(X) & quantity(X))
100 )).
101
```

```
102  % Moment
103
104  fof(ax_moment_taxonomy, axiom, (
105    ![X]: ((intrinsicMoment(X) | relator(X)) <=> (moment(X)))
106  )).
107
108  fof(ax_moment_partition, axiom, (
109    ~?[X]: (intrinsicMoment(X) & relator(X))
110  )).
111
112  % Intrinsic Moment
113
114  fof(ax_intrinsicMoment_taxonomy, axiom, (
115    ![X]: ((quality(X) | mode(X)) <=> (intrinsicMoment(X)))
116  )).
117
118  fof(ax_intrinsicMoment_partition, axiom, (
119    ~?[X]: (quality(X) & mode(X))
120  )).
121
122  % Mode
123
124  fof(ax_mode_taxonomy_externallyDependentMode, axiom, (
125    ![X]: (externallyDependentMode(X) => (mode(X)))
126  )).
127
128  % Externally Dependent Mode
129
130  fof(ax_externallyDependentMode_taxonomy_quaIndividual, axiom, (
131    ![X]: (quaIndividual(X) => (externallyDependentMode(X)))
132  )).
133
134  % Endurant partial taxonomy instances
135
136  fof(ax_endurant_instances, axiom, (
137    substantial(substantial1) & moment(moment1) & object(object1) &
        collective(collective1) & quantity(quantity1) & intrinsicMoment
        (intrinsicMoment1) & relator(relator1) & quality(quality1) &
        mode(mode1) & externallyDependentMode(externallyDependentMode1)
         & quaIndividual(quaIndividual1)
138  )).
```