

C:/Users/torsten/GitHub/colore/ontologies/simple_features/sfc_fol.
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1. $\forall x \forall y \left[[\text{sf_geometry}(x) \leftrightarrow S(x)] \right]$
2. $\forall x \forall y \left[[\text{sf_relate}(x, y) \leftrightarrow (\text{sf_intersects}(x, y) \vee \text{sf_disjoint}(x, y))] \right]$
3. $\forall x \forall y \left[[\text{SC}(x, y) \rightarrow C(x, y)] \right]$
4. $\forall x \forall y \left[\left[\text{SC}(x, y) \rightarrow \neg \exists z \left[(\text{Cont}(z, x) \wedge P(z, y)) \right] \right] \right]$
5. $\forall x \forall y \left[\left[\text{SC}(x, y) \rightarrow \neg \exists z \left[(P(z, x) \wedge \text{Cont}(z, y)) \right] \right] \right]$
6. $\forall x \forall y \left[\left[\left(C(x, y) \wedge \forall z \left[\left(\neg (\text{Cont}(z, x)) \vee \neg (\text{Cont}(z, y)) \vee (\neg (P(z, x)) \wedge \neg (P(z, y))) \right) \right] \right) \right] \rightarrow \text{SC}(x, y) \right]$
7. $\forall x \left[\neg (\text{SC}(x, x)) \right]$
8. $\forall x \forall y \left[[\text{SC}(x, y) \rightarrow \text{SC}(y, x)] \right]$
9. $\forall x \forall y \left[\left[\text{SC}(x, y) \rightarrow \exists z \left[(\text{lt}(z, x) \wedge \text{lt}(z, y) \wedge \text{Cont}(z, x) \wedge \text{Cont}(z, y)) \right] \right] \right]$
10. $\forall x \forall y \left[\left[\text{SC}(x, y) \leftrightarrow \left(\exists z \left[(\text{Cont}(z, x) \wedge \text{Cont}(z, y)) \right] \wedge \forall z \left[\left[(\text{Cont}(z, x) \wedge \text{Cont}(z, y)) \rightarrow (\text{leq}(z, x) \wedge \text{leq}(z, y)) \right] \right] \right) \right] \right]$
11. $\forall x \forall y \left[[\text{EqDim}(x, y) \leftrightarrow (\text{leq}(x, y) \wedge \text{leq}(y, x))] \right]$
12. $\forall x \forall y \left[[\text{leq}(x, y) \rightarrow S(x)] \right]$
13. $\forall x \forall y \left[[\text{leq}(x, y) \rightarrow S(y)] \right]$
14. $\forall x \left[[\text{ZEX}(x) \rightarrow S(x)] \right]$
15. $\forall x \left[[S(x) \rightarrow \text{leq}(x, x)] \right]$

16. $\forall x \forall y \forall z \left[\left[(\text{leq}(x, y) \wedge \text{leq}(y, z)) \rightarrow \text{leq}(x, z) \right] \right]$
17. $\forall x \forall y \left[\left[(\text{ZEX}(x) \wedge \text{ZEX}(y)) \rightarrow =(x, y) \right] \right]$
18. $\forall x \forall y \left[\left[(\text{ZEX}(x) \wedge \text{S}(y)) \rightarrow \text{leq}(x, y) \right] \right]$
19. $\forall x \forall y \left[\left[\text{Cont}(x, y) \rightarrow \text{leq}(x, y) \right] \right]$
20. $\exists x \left[\text{MinDim}(x) \right]$
21. $\forall x \left[\left[\text{MaxDim}(x) \leftrightarrow \left(\text{S}(x) \wedge \neg (\text{ZEX}(x)) \wedge \forall y \left[\left[\text{S}(y) \rightarrow \text{leq}(y, x) \right] \right] \right) \right] \right]$
22. $\forall x \left[\left[\left[\text{MinDim}(x) \leftrightarrow \left(\text{S}(x) \wedge \neg (\text{ZEX}(x)) \wedge \forall y \left[\left[\left[(\text{S}(y) \wedge \neg (\text{ZEX}(y))) \rightarrow \text{leq}(x, y) \right] \right] \right] \right) \right] \right] \right]$
23. $\forall x \left[\left[\left(\text{S}(x) \wedge \neg (\text{ZEX}(x)) \right) \leftrightarrow \text{Cont}(x, x) \right] \right]$
24. $\forall x \forall y \left[\left[(\text{Cont}(x, y) \wedge \text{Cont}(y, x)) \rightarrow =(x, y) \right] \right]$
25. $\forall x \forall y \forall z \left[\left[(\text{Cont}(x, y) \wedge \text{Cont}(y, z)) \rightarrow \text{Cont}(x, z) \right] \right]$
26. $\forall x \forall y \left[\left[\text{ZEX}(x) \rightarrow \left(\text{S}(x) \wedge \neg (\text{Cont}(y, x)) \wedge \neg (\text{Cont}(x, y)) \right) \right] \right]$
27. $\forall x \forall y \left[\left[(\text{ZEX}(x) \wedge \text{ZEX}(y)) \rightarrow =(x, y) \right] \right]$
28. $\forall x \forall y \left[\left[\text{P}(x, y) \leftrightarrow (\text{Cont}(x, y) \wedge \text{EqDim}(x, y)) \right] \right]$
29. $\forall x \forall y \left[\left[\text{C}(x, y) \leftrightarrow \exists z \left[(\text{Cont}(z, x) \wedge \text{Cont}(z, y)) \right] \right] \right]$
30. $\forall x \left[\neg (\text{Inc}(x, x)) \right]$
31. $\forall x \forall y \left[\left[\text{Inc}(x, y) \rightarrow \text{Inc}(y, x) \right] \right]$

32. $\forall x \forall y \left[\left[\text{EqDim}(x, y) \rightarrow \neg (\text{Inc}(x, y)) \right] \right]$
33. $\forall x \forall y \left[\left[\text{Inc}(x, y) \rightarrow (\text{lt}(x, y) \vee \text{lt}(y, x)) \right] \right]$
34. $\forall x \forall y \left[\left[(\text{Cont}(x, y) \wedge \text{lt}(x, y)) \rightarrow \text{Inc}(x, y) \right] \right]$
35. $\forall x \forall y \forall z \left[\left[(\text{Inc}(x, y) \wedge \text{P}(y, z)) \rightarrow \text{Inc}(x, z) \right] \right]$
36. $\forall x \forall y \left[\left[\text{Inc}(x, y) \leftrightarrow \left(\exists z \left[(\text{leq}(z, x) \wedge \neg (\text{EqDim}(z, x)) \wedge \text{Cont}(z, x) \wedge \text{P}(z, y)) \right] \vee \exists z \left[(\text{leq}(z, y) \wedge \neg (\text{EqDim}(z, y)) \wedge \text{Cont}(z, y) \wedge \text{P}(z, x)) \right] \right) \right] \right]$
37. $\forall x \left[\left[(\text{S}(x) \wedge \neg (\text{ZEX}(x))) \rightarrow \text{PO}(x, x) \right] \right]$
38. $\forall x \forall y \left[[\text{PO}(x, y) \rightarrow \text{PO}(y, x)] \right]$
39. $\forall x \forall y \left[[\text{PO}(x, y) \rightarrow \text{EqDim}(x, y)] \right]$
40. $\forall x \forall y \left[\left[\text{PO}(x, y) \leftrightarrow \exists z \left[(\text{P}(z, x) \wedge \text{P}(z, y)) \right] \right] \right]$
41. $\forall x \left[\left[\text{Max}(x) \leftrightarrow \left(\text{S}(x) \wedge \neg (\text{ZEX}(x)) \wedge \forall y \left[\neg (\text{PP}(x, y)) \right] \right) \right] \right]$
42. $\forall x \left[\left[\text{Min}(x) \leftrightarrow \left(\text{S}(x) \wedge \neg (\text{ZEX}(x)) \wedge \forall y \left[\neg (\text{PP}(y, x)) \right] \right) \right] \right]$
43. $\forall x \forall y \left[\left[\text{PP}(x, y) \leftrightarrow (\text{P}(x, y) \wedge \neg (= (x, y))) \right] \right]$
44. $\forall x \forall y \left[\left[\text{BCont}(x, y) \rightarrow (\text{Cont}(x, y) \wedge \neg (\text{EqDim}(x, y))) \right] \right]$
45. $\forall x \forall y \forall v \forall z \left[\left[(\text{SC}(x, y) \wedge \text{Min}(x) \wedge \text{P}(x, v) \wedge \text{Cont}(y, v) \wedge \text{Cont}(z, x) \wedge \text{Cont}(z, y)) \rightarrow \text{BCont}(z, x) \right] \right]$
46. $\forall x \forall y \forall z \forall v \left[\left[(\text{SC}(x, y) \wedge \text{P}(x, v) \wedge \text{P}(y, v) \wedge \text{Cont}(z, x) \wedge \text{Cont}(z, y) \wedge \text{Covers}(v, z)) \rightarrow \neg (\text{BCont}(z, v)) \right] \right]$

47. $\forall x \forall y \forall z \left[\left[\left(\text{BCont}(x, y) \wedge P(y, z) \wedge \forall v \forall w \left[\left(P(v, z) \wedge \neg (PO(v, y)) \wedge P(w, x) \right) \rightarrow \neg (\text{Cont}(w, v)) \right] \right) \right] \right]$
48. $\forall x \forall y \forall z \left[\left[(\text{BCont}(x, y) \wedge \text{Cont}(z, x)) \rightarrow \text{BCont}(z, y) \right] \right]$
49. $\forall x \forall y \left[\left[\left[\text{Covers}(x, y) \leftrightarrow \left(\text{lt}(y, x) \wedge \forall z \left[\left[S(z) \rightarrow \neg (\text{lt}(y, z) \wedge \text{lt}(z, x)) \right] \right] \right) \right] \right] \right]$
50. $\forall x \forall y \left[[\text{gt}(x, y) \leftrightarrow \text{lt}(y, x)] \right]$
51. $\forall x \forall y \left[[\text{geq}(x, y) \leftrightarrow \text{leq}(y, x)] \right]$
52. $\forall x \forall y \left[\left[\text{lt}(x, y) \leftrightarrow (\text{leq}(x, y) \wedge \neg (\text{EqDim}(x, y))) \right] \right]$
53. $\forall x \left[\left[\text{Closed}(x) \leftrightarrow \forall y \left[\neg (\text{BCont}(y, x)) \right] \right] \right]$
54. $\forall x \forall y \left[\left[\text{sf_contains}(x, y) \leftrightarrow (\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \text{Cont}(x, y)) \right] \right]$
55. $\forall x \left[[\text{sf_multi_polygon}(x) \rightarrow \text{sf_multi_surface}(x)] \right]$
56. $\forall x \left[\left[\text{sf_geometry_collection}(x) \rightarrow \left(\neg (\text{sf_point}(x)) \wedge \neg (\text{sf_curve}(x)) \wedge \neg (\text{sf_surface}(x)) \right) \right] \right]$
57. $\forall x \left[\left[\text{sf_geometry_collection}(x) \leftrightarrow (\text{sf_multi_point}(x) \vee \text{sf_multi_curve}(x) \vee \text{sf_multi_surface}(x)) \right] \right]$
58. $\forall x \left[\left[\text{sf_point}(x) \rightarrow \left(\neg (\text{sf_curve}(x)) \wedge \neg (\text{sf_surface}(x)) \wedge \neg (\text{sf_geometry_collection}(x)) \right) \right] \right]$
59. $\forall x \left[\left[\text{sf_geometry}(x) \leftrightarrow (\text{sf_point}(x) \vee \text{sf_curve}(x) \vee \text{sf_surface}(x) \vee \text{sf_geometry_collection}(x)) \right] \right]$
60. $\forall x \left[\left[\text{sf_surface}(x) \rightarrow \left(\neg (\text{sf_point}(x)) \wedge \neg (\text{sf_curve}(x)) \wedge \neg (\text{sf_geometry_collection}(x)) \right) \right] \right]$
61. $\forall x \left[\left[\text{sf_curve}(x) \rightarrow \left(\neg (\text{sf_point}(x)) \wedge \neg (\text{sf_surface}(x)) \wedge \neg (\text{sf_geometry_collection}(x)) \right) \right] \right]$

62. $\forall x \left[\left[\text{sf_multi_line_string}(x) \rightarrow \text{sf_multi_curve}(x) \right] \right]$
63. $\forall x \left[\left[\text{sf_triangle}(x) \leftrightarrow \left(\text{sf_polygon}(x) \wedge \text{sf_tin}(x) \right) \right] \right]$
64. $\forall x \left[\left[\text{sf_tin}(x) \rightarrow \text{sf_polyhedral_surface}(x) \right] \right]$
65. $\forall x \left[\left[\text{sf_polyhedral_surface}(x) \rightarrow \text{sf_surface}(x) \right] \right]$
66. $\forall x \left[\left[\text{sf_polygon}(x) \rightarrow \text{sf_polyhedral_surface}(x) \right] \right]$
67. $\forall x \left[\left[\text{sf_linear_ring}(x) \rightarrow \text{sf_line_string}(x) \right] \right]$
68. $\forall x \left[\left[\text{sf_line_string}(x) \rightarrow \text{sf_curve}(x) \right] \right]$
69. $\forall x \left[\left[\text{sf_line}(x) \rightarrow \text{sf_line_string}(x) \right] \right]$
70. $\forall x \forall y \left[\left[\text{sf_overlaps}(x, y) \leftrightarrow \left(\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \text{PO}(x, y) \wedge \neg (\text{P}(x, y)) \wedge \neg (\text{P}(y, x)) \right) \right] \right]$
71. $\forall x \forall y \left[\left[\text{sf_within}(y, x) \leftrightarrow \text{sf_contains}(x, y) \right] \right]$
72. $\forall x \forall y \left[\left[\text{sf_contains}(x, y) \leftrightarrow \left(\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \text{Cont}(x, y) \right) \right] \right]$
73. $\forall x \forall y \left[\left[\text{sf_crosses}(x, y) \leftrightarrow \left(\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \left(\left(\text{Inc}(x, y) \wedge \neg (\text{Cont}(x, y)) \wedge \neg (\text{Cont}(y, x)) \right) \right) \right) \right] \right]$
74. $\forall x \left[\left[\text{Curve}(x) \leftrightarrow \left(\neg (\text{ZEX}(x)) \wedge \neg (\text{MinDim}(x)) \wedge \forall y \left[\left[\text{MinDim}(y) \leftrightarrow \text{Covers}(x, y) \right] \right] \right) \right] \right]$
75. $\forall x \forall y \left[\left[\text{sf_touches}(x, y) \leftrightarrow \left(\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \left(\text{SC}(x, y) \vee \text{BCont}(x, y) \vee \text{BCont}(y, x) \right) \right) \right] \right]$
76. $\forall x \forall y \left[\left[\text{sf_equals}(x, y) \leftrightarrow \left(\text{sf_contains}(x, y) \wedge \text{sf_within}(x, y) \right) \right] \right]$
77. $\forall x \forall y \left[\left[\text{sf_intersects}(x, y) \leftrightarrow \left(\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \neg (\text{sf_disjoint}(x, y)) \right) \right] \right]$

78. $\forall x \forall y \left[\left[\text{sf_disjoint}(y) \rightarrow \left(\text{sf_geometry}(x) \wedge \text{sf_geometry}(y) \wedge \neg (C(x, y)) \right) \right] \right]$
79. $\forall x \left[\left[\text{sf_geometry_collection}(x) \rightarrow (\text{Multipart_S}(x) \vee \text{Branched_S}(x)) \right] \right]$
80. $\forall x \left[\left[\text{sf_multi_polygon}(x) \leftrightarrow \left(\text{sf_multi_surface}(x) \wedge \forall y \left[\left[(P(y, x) \wedge \text{Min}(y)) \rightarrow \text{sf_polygon}(y) \right] \right] \right) \right] \right]$
81. $\forall x \left[\left[\text{sf_polygon}(x) \rightarrow \text{Simple_ArealRegion}(x) \right] \right]$
82. $\forall x \left[\left[\text{sf_polygon}(x) \rightarrow \exists y \exists z \left[(\text{sf_linear_ring}(y) \wedge \text{BCont}(y, x) \wedge \text{boundary}(z, y) \wedge P(x, z)) \right] \right] \right]$
83. $\forall x \left[\left[\text{sf_polygon}(x) \rightarrow \forall v \left[\left[\text{BCont}(v, x) \rightarrow \exists w \left[(P(v, w) \wedge \text{BCont}(w, x) \wedge \text{sf_linear_ring}(w)) \right] \right] \right] \right] \right]$
84. $\forall x \forall y \left[\left[\text{Cont}(x, \text{boundary}(y)) \leftrightarrow \text{BCont}(x, y) \right] \right]$
85. $\forall x \left[\left[\text{Simple_ArealRegion}(x) \leftrightarrow (\text{ArealRegion}(x) \wedge \text{Simple_S}(x)) \right] \right]$
86. $\forall x \left[\left[\text{Simple_S}(x) \leftrightarrow (\text{Connected_S}(x) \wedge \neg (\text{Branched_S}(x))) \right] \right]$
87. $\forall x \left[\left[\text{Branched_S}(x) \leftrightarrow \left(\text{Connected_S}(x) \wedge \exists p \exists q \exists r \exists s \left[(\text{PP}(p, x) \wedge \text{PP}(q, x) \wedge \text{PP}(r, x) \wedge \neg (\text{PO}(p, q))) \right] \right) \right] \right]$
88. $\forall x \left[\left[\text{Connected_S}(x) \leftrightarrow \left(S(x) \wedge \forall y \left[\left[\text{PP}(y, x) \rightarrow \text{SC}(y, \text{difference}(x, y)) \right] \right] \right) \right] \right]$
89. $\forall x \forall y \left[\left[(S(x) \wedge S(y) \wedge \neg (C(x, y))) \leftrightarrow \text{ZEX}(\text{intersection}(x, y)) \right] \right]$
90. $\forall x \forall y \left[\left[(S(x) \wedge S(y) \wedge \neg (\text{ZEX}(\text{intersection}(x, y)))) \rightarrow \text{Cont}(\text{intersection}(x, y), x) \right] \right]$
91. $\forall x \forall y \forall z \left[\left[(\text{Cont}(z, x) \wedge \text{Cont}(z, y)) \rightarrow \text{leq}(z, \text{intersection}(x, y)) \right] \right]$

92. $\forall x \forall y \forall z \left[\left[(\text{Cont}(z, x) \wedge \text{Cont}(z, y) \wedge \text{EqDim}(z, \text{intersection}(x, y))) \leftrightarrow \text{P}(z, \text{intersection}(x, y)) \right] \right]$
93. $\forall x \forall y \left[\left[\left(\text{S}(x) \wedge \text{S}(y) \wedge \neg (\text{ZEX}(\text{difference}(x, y))) \right) \rightarrow \text{EqDim}(x, \text{difference}(x, y)) \right] \right]$
94. $\forall x \forall y \left[[\text{lt}(y, x) \rightarrow \text{=(x, difference}(x, y))]] \right]$
95. $\forall x \forall y \forall z \left[\left[(\text{leq}(x, y) \wedge \text{Cont}(z, x) \wedge \text{lt}(\text{intersection}(z, y), z)) \rightarrow \text{Cont}(z, \text{difference}(x, y)) \right] \right]$
96. $\forall x \forall y \forall z \left[\left[(\text{leq}(x, y) \wedge \text{Cont}(z, \text{difference}(x, y))) \rightarrow \text{Cont}(z, x) \right] \right]$
97. $\forall x \forall y \forall z \left[\left[(\text{leq}(x, y) \wedge \text{P}(z, \text{difference}(x, y))) \rightarrow \text{lt}(\text{intersection}(z, y), z) \right] \right]$
98. $\forall x \forall y \left[\left[\text{ZEX}(\text{difference}(x, y)) \leftrightarrow (\text{ZEX}(x) \vee \text{Cont}(x, y)) \right] \right]$
99. $\forall x \left[\left[\text{ArealRegion}(x) \leftrightarrow \forall y \left[[\text{Curve}(y) \rightarrow \text{Covers}(x, y)] \right] \right] \right]$
100. $\forall x \left[[\text{sf_multi_surface}(x) \rightarrow \text{Multipart_ArealRegion}(x)] \right]$
101. $\forall x \left[\left[\text{Multipart_ArealRegion}(x) \leftrightarrow (\text{ArealRegion}(x) \wedge \text{Multipart_S}(x)) \right] \right]$
102. $\forall x \left[\left[\text{Multipart_S}(x) \leftrightarrow (\text{S}(x) \wedge \neg (\text{Connected_S}(x))) \right] \right]$
103. $\forall x \left[\left[\text{sf_multi_line_string}(x) \leftrightarrow \left(\text{sf_multi_curve}(x) \wedge \forall y \left[\left[(\text{P}(y, x) \wedge \text{Min}(y)) \rightarrow \text{sf_line_string}(y) \right] \right] \right) \right] \right]$
104. $\forall x \left[[\text{sf_multi_curve}(x) \rightarrow \text{Multipart_Curve}(x)] \right]$
105. $\forall x \left[\left[\text{Multipart_Curve}(x) \leftrightarrow (\text{Curve}(x) \wedge \text{Multipart_S}(x)) \right] \right]$
106. $\forall x \left[[\text{sf_multi_point}(x) \leftrightarrow \text{PointRegion}(x)] \right]$
107. $\forall x \left[\left[\text{sf_multi_point}(x) \rightarrow \left(\text{sf_geometry_collection}(x) \wedge \forall y \left[[\text{PP}(y, x) \rightarrow \text{sf_point}(y)] \right] \right) \right] \right]$
108. $\forall x \left[[\text{PointRegion}(x) \leftrightarrow \text{MinDim}(x)] \right]$