Information on ontologyIndex object

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```
setwd("~/my-papers-2017/phyloBayesHMM/ontoFast/ontoFast/data/Other-ontologies")
library(ontologyIndex)
```

Structures of main Anatomy Ontologies

```
uberon=get_OBO("UBERON.obo", extract_tags="everything", propagate_relationships = c("part_of", "is_a"))
```

```
## Warning in (function (parents, id = names(parents), name = id, obsolete =
## setNames(nm = id, : Some parent terms not found: BFO:0000002, BFO:0000003,
## UBERON:0005187 (4 more)
```

```
drosoph<-get_OBO("fbbt.obo", extract_tags="everything", propagate_relationships = c("part_of", "is_a"))
amphib<-get_OBO("AAO_v3.obo", extract_tags="everything", propagate_relationships = c("part_of", "is_a"))
tron<-get_OBO("TrOn.obo", extract_tags="everything", propagate_relationships = c("part_of", "is_a"))
spiders<-get_OBO("spd.obo", extract_tags="everything", propagate_relationships = c("part_of", "is_a"))
hao_new<-get_OBO("hao_new.obo", extract_tags="everything", propagate_relationships = c("part_of", "is_a
```

```
print(sort(names(uberon)))
```

```
##   [1] "aboral_to"
##   [2] "adjacent_to"
##   [3] "alt_id"
##   [4] "ambiguous_for_taxon"
##   [5] "anastomoses_with"
##   [6] "ancestors"
##   [7] "anteriorly_connected_to"
##   [8] "anterior_to"
##   [9] "attaches_to"
##  [10] "attaches_to_part_of"
##  [11] "bounding_layer_of"
##  [12] "branching_part_of"
##  [13] "capable_of"
##  [14] "capable_of_part_of"
##  [15] "channel_for"
##  [16] "channels_from"
##  [17] "channels_into"
##  [18] "children"
##  [19] "comment"
##  [20] "composed_primarily_of"
##  [21] "conduit_for"
##  [22] "confers_advantage_in"
##  [23] "connected_to"
##  [24] "connects"
##  [25] "consider"
##  [26] "contains"
##  [27] "contains_process"
```

```
##  [28] "continuous_with"
##  [29] "contributes_to_morphology_of"
##  [30] "created_by"
##  [31] "creation_date"
##  [32] "data-version"
##  [33] "dc-contributor"
##  [34] "dc-creator"
##  [35] "deep_to"
##  [36] "def"
##  [37] "default-namespace"
##  [38] "developmentally_induced_by"
##  [39] "developmentally_replaces"
##  [40] "develops_from"
##  [41] "develops_from_part_of"
##  [42] "develops_in"
##  [43] "directly_develops_from"
##  [44] "disjoint_from"
##  [45] "distally_connected_to"
##  [46] "distalmost_part_of"
##  [47] "distal_to"
##  [48] "domain"
##  [49] "dorsal_to"
##  [50] "drains"
##  [51] "dubious_for_taxon"
##  [52] "ends"
##  [53] "ends_with"
##  [54] "equivalent_to_chain"
##  [55] "existence_ends_during"
##  [56] "existence_ends_during_or_before"
##  [57] "existence_ends_with"
##  [58] "existence_starts_and_ends_during"
##  [59] "existence_starts_during"
##  [60] "existence_starts_during_or_after"
##  [61] "existence_starts_with"
##  [62] "expand_assertion_to"
##  [63] "expand_expression_to"
##  [64] "extends_fibers_into"
##  [65] "fma_set_term"
##  [66] "format-version"
##  [67] "functionally_related_to"
##  [68] "has_boundary"
##  [69] "has_component"
##  [70] "has_developmental_contribution_from"
##  [71] "has_fused_element"
##  [72] "has_member"
##  [73] "has_muscle_antagonist"
##  [74] "has_muscle_insertion"
##  [75] "has_muscle_origin"
##  [76] "has_part"
##  [77] "has_potential_to_develop_into"
##  [78] "has_potential_to_developmentally_contribute_to"
##  [79] "has_quality"
##  [80] "has_skeleton"
##  [81] "holds_over_chain"
```

```
##  [82] "id"
##  [83] "immediately_anterior_to"
##  [84] "immediately_deep_to"
##  [85] "immediately_posterior_to"
##  [86] "immediately_preceded_by"
##  [87] "immediately_superficial_to"
##  [88] "immediate_transformation_of"
##  [89] "implements_design_pattern"
##  [90] "in_anterior_side_of"
##  [91] "in_central_side_of"
##  [92] "in_deep_part_of"
##  [93] "indirectly_supplies"
##  [94] "in_distal_side_of"
##  [95] "in_dorsal_side_of"
##  [96] "in_innermost_side_of"
##  [97] "in_lateral_side_of"
##  [98] "in_left_side_of"
##  [99] "innervated_by"
## [100] "innervates"
## [101] "in_outermost_side_of"
## [102] "in_posterior_side_of"
## [103] "in_proximal_side_of"
## [104] "input_of"
## [105] "in_right_side_of"
## [106] "in_superficial_part_of"
## [107] "in_taxon"
## [108] "intersection_of"
## [109] "intersects_midsagittal_plane_of"
## [110] "in_ventral_side_of"
## [111] "inverse_of"
## [112] "is_a"
## [113] "is_class_level"
## [114] "is_metadata_tag"
## [115] "is_symmetric"
## [116] "is_transitive"
## [117] "layer_part_of"
## [118] "located_in"
## [119] "location_of"
## [120] "lumen_of"
## [121] "luminal_space_of"
## [122] "name"
## [123] "namespace"
## [124] "negatively_regulates"
## [125] "obsolete"
## [126] "only_in_taxon"
## [127] "ontology"
## [128] "output_of"
## [129] "overlaps"
## [130] "owl-axioms"
## [131] "parents"
## [132] "participates_in"
## [133] "part_of"
## [134] "positively_regulates"
## [135] "postaxialmost_part_of"
```

```
## [136] "posteriorly_connected_to"
## [137] "posterior_to"
## [138] "preaxialmost_part_of"
## [139] "preceded_by"
## [140] "precedes"
## [141] "present_in_taxon"
## [142] "produced_by"
## [143] "produces"
## [144] "property_value"
## [145] "protects"
## [146] "proximally_connected_to"
## [147] "proximalmost_part_of"
## [148] "proximal_to"
## [149] "range"
## [150] "regulates"
## [151] "remark"
## [152] "replaced_by"
## [153] "seeAlso"
## [154] "serially_homologous_to"
## [155] "sexually_homologous_to"
## [156] "simultaneous_with"
## [157] "site_of"
## [158] "skeleton_of"
## [159] "source_atlas"
## [160] "starts"
## [161] "starts_with"
## [162] "subdivision_of"
## [163] "subset"
## [164] "subsetdef"
## [165] "superficial_to"
## [166] "supplies"
## [167] "surrounded_by"
## [168] "surrounds"
## [169] "synapsed_by"
## [170] "synonym"
## [171] "synonymtypedef"
## [172] "transformation_of"
## [173] "transitive_over"
## [174] "treat-xrefs-as-equivalent"
## [175] "treat-xrefs-as-has-subclass"
## [176] "treat-xrefs-as-is_a"
## [177] "treat-xrefs-as-reverse-genus-differentia"
## [178] "tributary_of"
## [179] "trunk_part_of"
## [180] "union_of"
## [181] "ventral_to"
## [182] "xref"
```

```
print(sort(names(drosoph)))
```

```
##  [1] "alt_id"                        "ancestors"
##  [3] "auto-generated-by"             "capable_of"
##  [5] "capable_of_part_of"            "children"
##  [7] "comment"                       "composed_primarily_of"
##  [9] "connected_to"                  "consider"
```

```
## [11] "created_by"                      "creation_date"
## [13] "data-version"                    "date"
## [15] "def"                             "default-namespace"
## [17] "develops_directly_from"          "develops_from"
## [19] "disjoint_from"                   "domain"
## [21] "electrically_synapsed_to"        "expand_expression_to"
## [23] "expresses"                       "fasciculates_with"
## [25] "format-version"                  "has_part"
## [27] "has_postsynaptic_terminals_in"   "has_presynaptic_terminals_in"
## [29] "has_soma_location"               "has_synaptic_terminals_in"
## [31] "has_synaptic_terminals_of"       "holds_over_chain"
## [33] "id"                              "inheres_in"
## [35] "innervated_by"                   "innervates"
## [37] "intersection_of"                 "inverse_of"
## [39] "is_a"                            "is_metadata_tag"
## [41] "is_transitive"                   "name"
## [43] "namespace"                       "obsolete"
## [45] "occurs_in"                       "ontology"
## [47] "overlaps"                        "owl-axioms"
## [49] "parents"                         "partially_overlaps"
## [51] "part_of"                         "property_value"
## [53] "range"                           "regulates"
## [55] "remark"                          "replaced_by"
## [57] "saved-by"                        "subset"
## [59] "subsetdef"                       "synapsed_by"
## [61] "synapsed_to"                     "synapsed_via_type_Ib_bouton_to"
## [63] "synapsed_via_type_II_bouton_to"  "synapsed_via_type_III_bouton_to"
## [65] "synapsed_via_type_Is_bouton_to"  "synonym"
## [67] "synonymtypedef"                  "transitive_over"
## [69] "xref"
```

```
print(sort(names(tron)))
```

```
##  [1] "ancestors"         "auto-generated-by" "children"
##  [4] "created_by"        "creation_date"     "date"
##  [7] "def"               "default-namespace" "format-version"
## [10] "id"                "is_a"              "name"
## [13] "namespace"         "obsolete"          "parents"
## [16] "part_of"           "saved-by"          "subset"
## [19] "subsetdef"         "synonym"           "xref"
```

```
print(sort(names(spiders)))
```

```
##  [1] "adjacent_to"       "ancestors"         "auto-generated-by"
##  [4] "children"          "comment"           "consider"
##  [7] "created_by"        "creation_date"     "data-version"
## [10] "date"              "def"               "default-namespace"
## [13] "format-version"    "id"                "is_a"
## [16] "is_transitive"     "name"              "namespace"
## [19] "namespace-id-rule" "obsolete"          "ontology"
## [22] "parents"           "part_of"           "saved-by"
## [25] "synonym"           "xref"
```

```
print(sort(names(hao_new)))
```

```
##  [1] "ancestors"                     "auto-generated-by"
```

```
##  [3] "BFO:0000050"                    "children"
##  [5] "comment"                        "date"
##  [7] "def"                            "default-namespace"
##  [9] "default-relationship-id-prefix" "disjoint_from"
## [11] "format-version"                 "HAO:attached_to"
## [13] "id"                             "intersection_of"
## [15] "is_a"                           "is_anti_symmetric"
## [17] "is_reflexive"                   "is_transitive"
## [19] "name"                           "namespace-id-rule"
## [21] "OBO_REL:0000004"                "obsolete"
## [23] "ontology"                       "parents"
## [25] "remark"                         "saved-by"
## [27] "synonym"                        "xref"
```

```
ontology_list=list(uberon=uberon, drosoph=drosoph, tron=tron, spiders=spiders, hao_new=hao_new)
```

Synonyms in ontologies; get structure

```
for (i in seq_along(ontology_list)){
  print(names(ontology_list)[i])
  print("##############################################")
print(ontology_list[[i]]$synonym[lapply(ontology_list[[i]]$synonym, length)>0][1:5])
}
```

```
## [1] "uberon"
## [1] "##############################################"
## $`CL:0000001`
## [1] "\"primary cell culture cell\" EXACT []"
## [2] "\"primary cell line cell\" RELATED []"
## [3] "\"unpassaged cultured cell\" EXACT []"
##
## $`CL:0000002`
## [1] "\"continuous cell line cell\" EXACT []"
## [2] "\"permanent cell line cell\" EXACT []"
##
## $`CL:0000003`
## [1] "\"cell in vivo\" NARROW []"
##
## $`CL:0000006`
## [1] "\"neuronal receptor cell (sensu Animalia)\" EXACT []"
##
## $`CL:0000009`
## [1] "\"xylem initial\" RELATED []"     "\"xylem mother cell\" RELATED []"
##
## [1] "drosoph"
## [1] "##############################################"
## $`FBbt:00000001`
## [1] "\"Drosophila\" RELATED []"     "\"whole organism\" RELATED []"
##
## $`FBbt:00000005`
## [1] "\"acron\" RELATED []"
##
## $`FBbt:00000007`
```

```
## [1] "\"cephalic segment\" RELATED []" "\"pregnathal segment\" EXACT []"
## [3] "\"preoral segment\" EXACT []"    "\"procephalon\" RELATED []"
##
## $`FBbt:00000008`
## [1] "\"clypeo-labrum\" RELATED []"
##
## $`FBbt:00000011`
## [1] "\"postoral segment\" RELATED []"
##
## [1] "tron"
## [1] "################################################"
## $`TrOn:0000002`
## [1] "\"A1_musculature\" EXACT []"
##
## $`TrOn:0000008`
## [1] "\"pleopod\" RELATED []"
##
## $`TrOn:0000009`
## [1] "\"A2_musculature\" EXACT []"
##
## $`TrOn:0000010`
## [1] "\"A3_musculature\" EXACT []"
##
## $`TrOn:0000011`
## [1] "\"A4_musculature\" EXACT []"
##
## [1] "spiders"
## [1] "################################################"
## $`SPD:0000001`
## [1] "\"whole organism\" EXACT [SPD:Ramirez]"
##
## $`SPD:0000002`
## [1] "\"cephalothorax\" EXACT [SPD:Michalik]"
##
## $`SPD:0000003`
## [1] "\"abdomen\" EXACT [SPD:Michalik]"
##
## $`SPD:0000005`
## [1] "\"dorsal shield of the prosoma\" EXACT [SPD:Ramirez]"
##
## $`SPD:0000007`
## [1] "\"epigastric area\" EXACT [SPD:Ramirez]"
##
## [1] "hao_new"
## [1] "################################################"
## $`HAO:0000001`
## [1] "\"fu2-fu1v\" [http://api.hymao.org/api/ref/67864]"
## [2] "\"mesothoracic interfurcal muscle\" [http://api.hymao.org/api/ref/68619]"
## [3] "\"ventral mesofurco-profurcal\" [http://api.hymao.org/api/ref/67864]"
##
## $`HAO:0000012`
## [1] "\"whole organism\" [http://api.hymao.org/api/ref/68619]"
##
## $`HAO:0000015`
```

```
## [1] "\"der Hinterleib\" [http://api.hymao.org/api/ref/78598]"
##
## $`HAO:0000020`
## [1] "\"abdominal petiole\" [http://api.hymao.org/api/ref/96670]"
## [2] "\"first metasomal segment\" [http://api.hymao.org/api/ref/96581]"
## [3] "\"petiole\" [http://api.hymao.org/api/ref/36874, http://canacoll.org/Hym/Staff/Gibson/apss/chal
##
## $`HAO:0000022`
## [1] "\"postpetiole\" [http://api.hymao.org/api/ref/97831]"
```

Common names in all ontologies

```
Reduce(intersect, lapply(ontology_list, names))
```

```
##  [1] "id"                "name"              "parents"
##  [4] "children"          "ancestors"         "obsolete"
##  [7] "def"               "default-namespace" "format-version"
## [10] "is_a"              "synonym"           "xref"
```

```
uberon$id[1:5]
```

```
##   BFO:0000004   BFO:0000015   BFO:0000030   BFO:0000040   BFO:0000141
## "BFO:0000004" "BFO:0000015" "BFO:0000030" "BFO:0000040" "BFO:0000141"
```

```
uberon$name[1:5]
```

```
##       BFO:0000004       BFO:0000015       BFO:0000030       BFO:0000040
##                NA                NA          "object" "material entity"
##       BFO:0000141
##                NA
```

```
hao_new$id[1:5]
```

```
##   HAO:0000000   HAO:0000001   HAO:0000002   HAO:0000003   HAO:0000004
## "HAO:0000000" "HAO:0000001" "HAO:0000002" "HAO:0000003" "HAO:0000004"
```

```
hao_new$name[1:5]
```

```
##                          HAO:0000000                          HAO:0000001
##                  "anatomical entity" "ventral mesofurco-profurcal muscle"
##                          HAO:0000002                          HAO:0000003
##                            "A1 flap"              "anatomical structure"
##                          HAO:0000004
##      "portion of organism substance"
```