PyMedTermino: an open-source generic API for advanced terminology services

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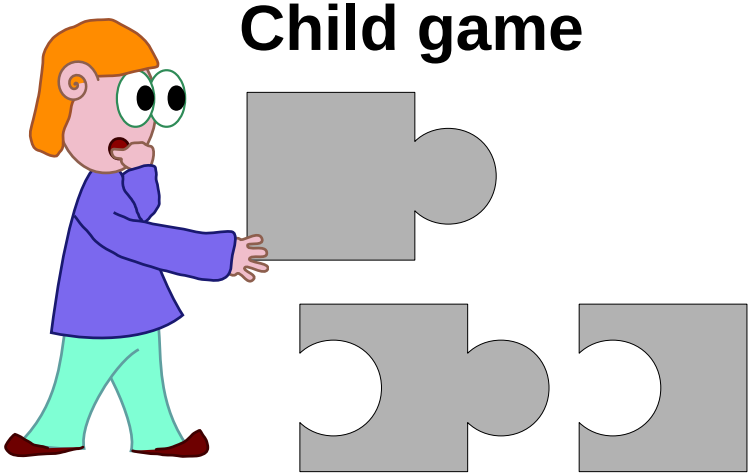
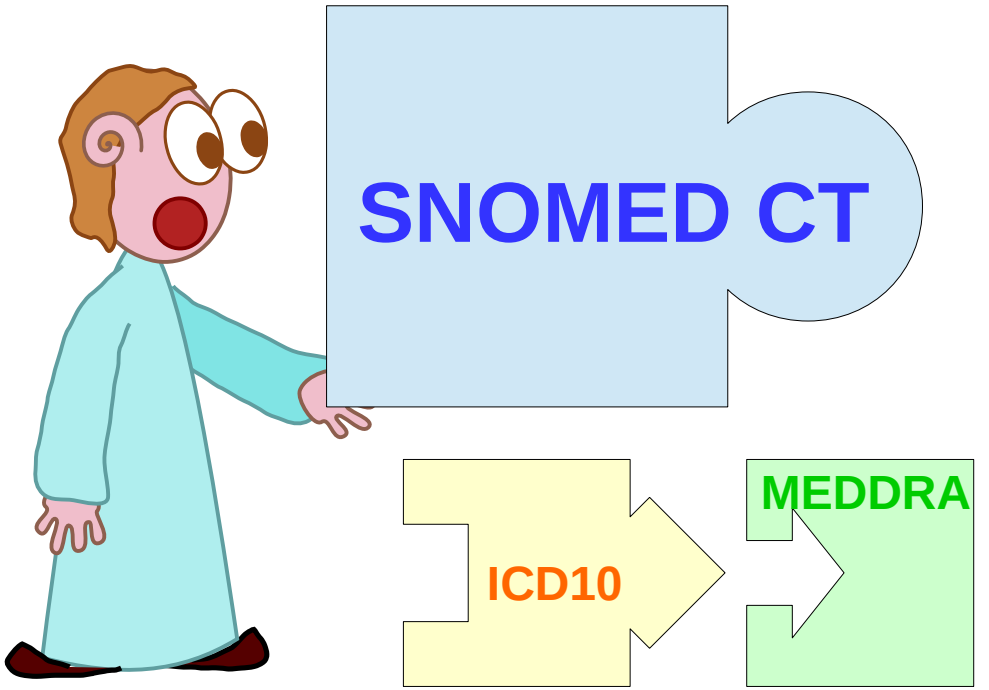
Introduction

- Terminological resources play a crucial role in medical informatics research and software applications but...
- Heterogeneity between terminologies :
  - Monoaxial *vs* multiaxial
  - Single *vs* multiple language
  - Pre- *vs* post-coordinated
  - Textual *vs* graphical

Child game



Medical informatics



Introduction

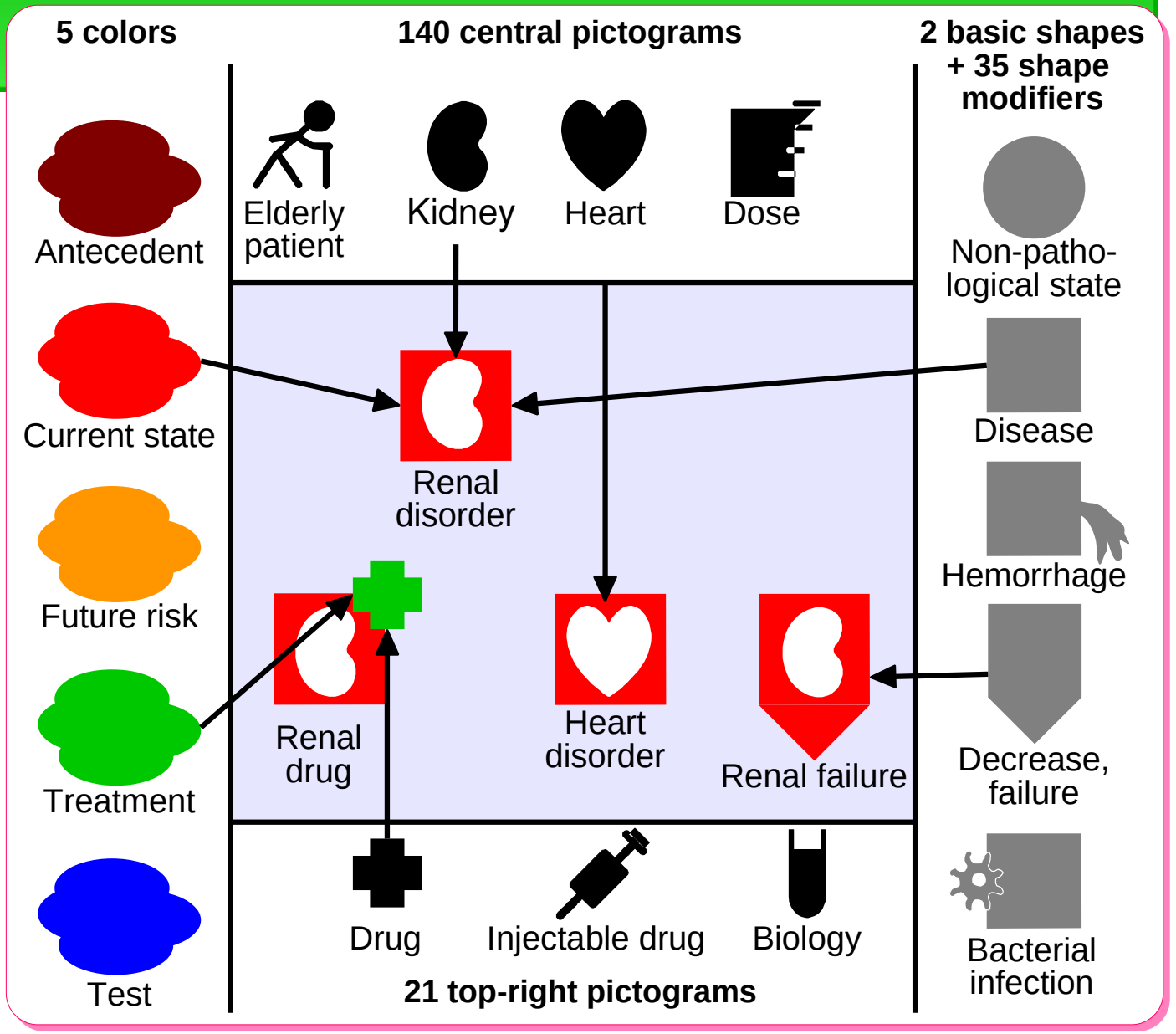
- **PyMedTermino**: a generic API for a multi-terminology multilingual terminology service
- Mainly for research and educational purposes
  - Batch processing of terminologies
  - Advanced terminological operations
- Implemented in the Python programming language
- Support 5 terminological resources + UMLS
- “Write once, code with every terminologies”

- Based on the terminological services that were developed for managing VCM icons (Visualization of Concept in Medicine)
  - VCM icons are post-coordinated
  - Mappings with other terminologies

Material: the VCM iconic language

A compositional language

- Color is for the temporal aspect (**past**, **current** or **risk** of disorder)
- Central pictogram is for **anatomico-functional location**
- Shape modifiers are for **generic pathological processes** and **transversal anatomical structures**



http://vcm.univ-paris13.fr/

Materials: terminological resources

- **ICD10**
  International Classification of Diseases
  version 10-2010 (English, French)
- **SNOMED CT**
  Systematized NOmenclature of MEDicine Clinical Terms
  version 2014-01-31 (English)
- **UMLS**
  Unified Medical Language System
  version 2012AA (Multilingual)
- **VCM icons**
  Visualization of Concept in Medicine
  version 2014 (Graphical, post-coordinated)

Used for designing the generic model

- **MedDRA**
  Medical Dictionary for Regulatory Activities
  version 17.1 (Multilingual)
- **CDF**
  CoDiFication from the Thériaque drug databank
  version 2014 (French)

Added after the design of the generic model for validation

Basic and **derived** operations in the generic model

On a terminology

- Iterate over all concepts
- Obtain the first level concepts
- Obtain a concept from a code
- Free-text search

On a concept

- Obtain the code of the concept
- Obtain the preferred term in a given language
- Obtain all the terms in a given language
- Obtain parent concepts
- Obtain children concepts
- Obtain the lists of available (non is-a) relations
- Obtain the values of a given relation
- Test if a concept *is a* descendant of another concept
- Iterate over ancestor concepts, with or without doubles
- Iterate over descendant concepts, with or without doubles

On a set of concepts

- Find all concepts in the set that are, or are not, another concept
- Keep only the most generic or the most specific concepts in the set
- Compute the lowest common ancestors
- Test if set A is a *semantic* subset of set B
- Perform usual set operations (union, intersection, difference, etc)

On a mapping

- Map a concept to another terminology
- Map a set of concepts
- Create the reverse mapping
- Chain the mapping to another mapping, resulting in a new mapping

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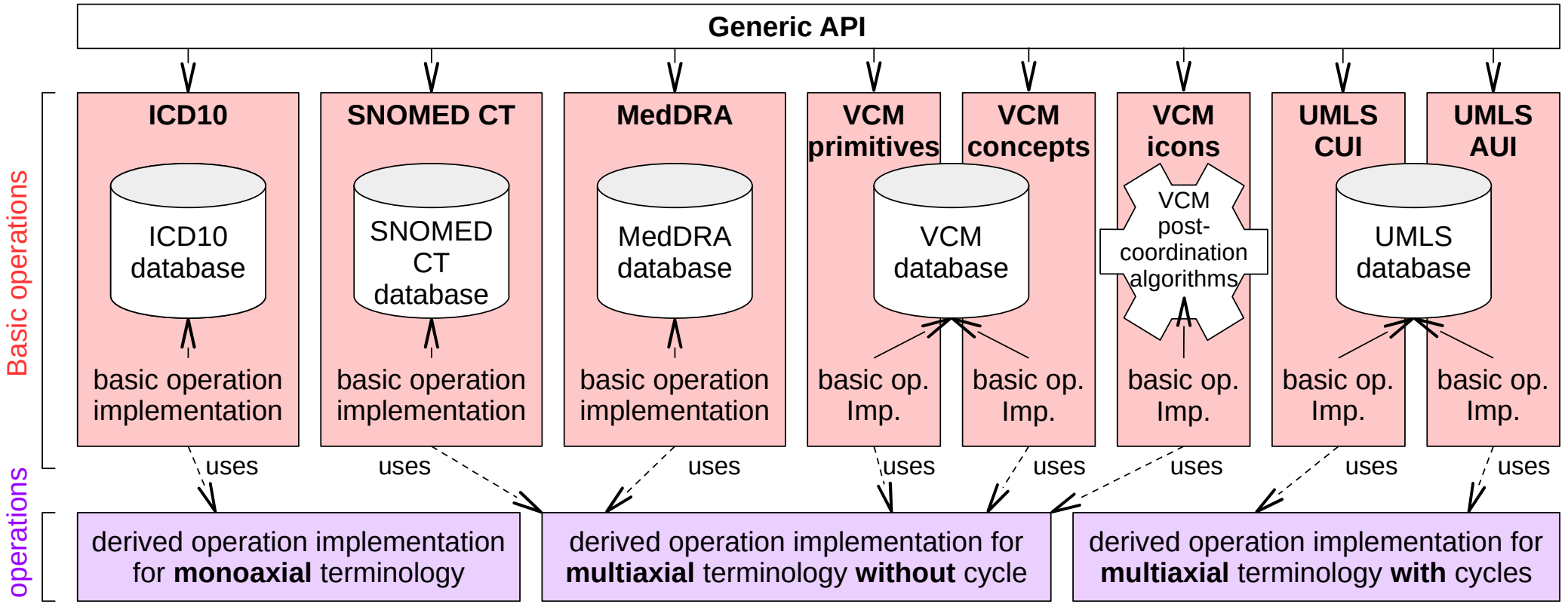
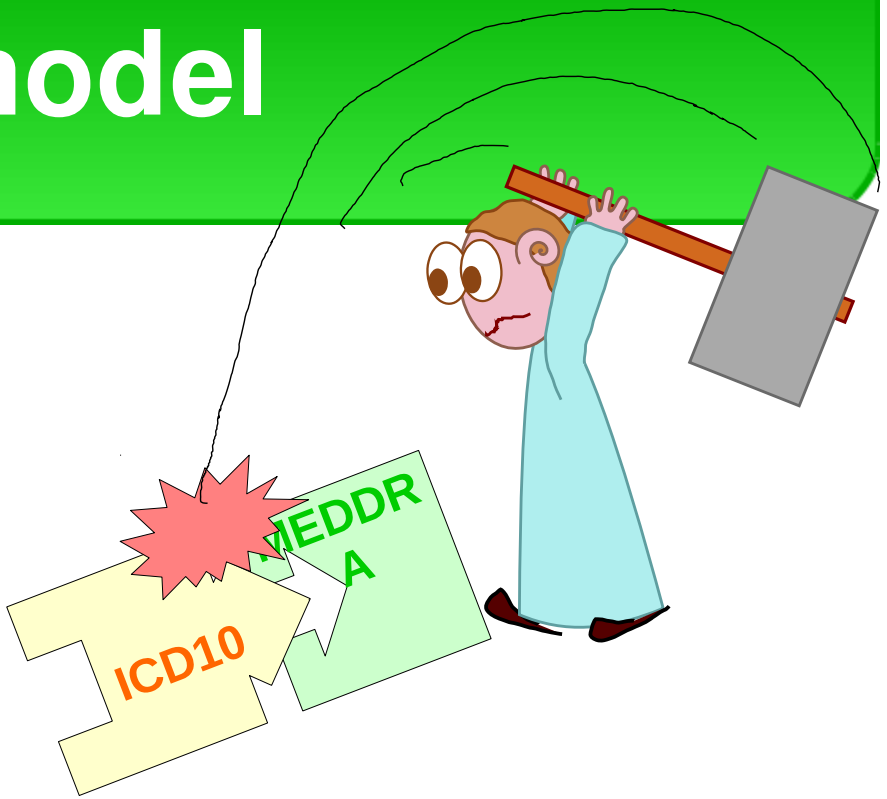
General architecture

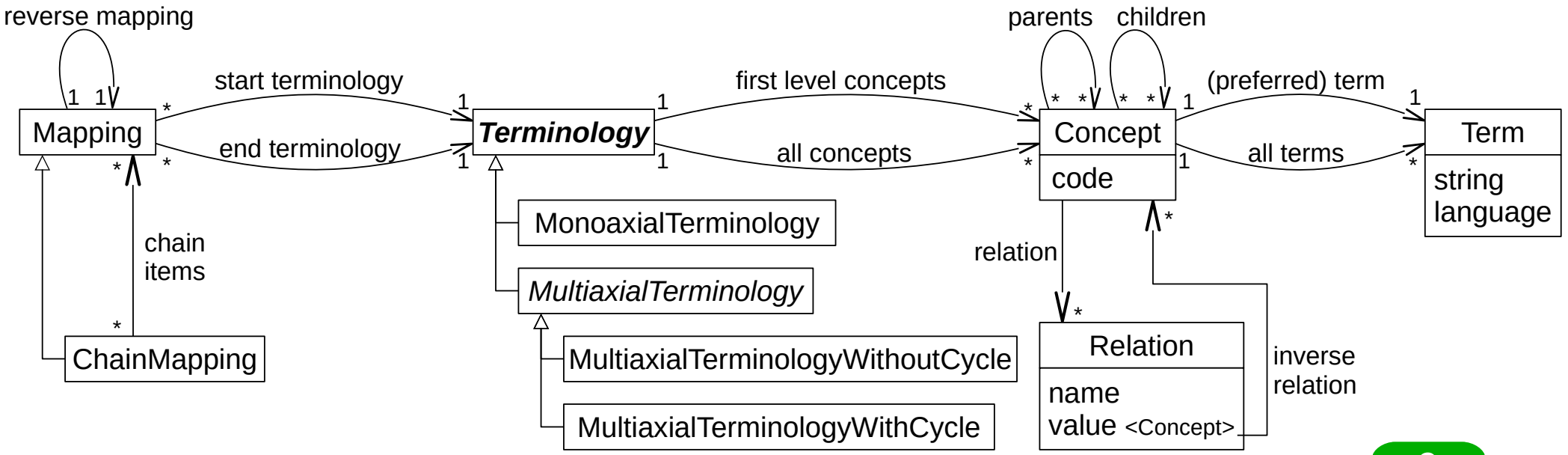
- No big database (*e.g.* UMLS): SQL is not sufficient for terminology (no recursion)
- **Basic operations**, implemented for each terminology using:
  - A terminology-specific database, or
  - Post-coordination algorithms
- **Derived operations**, whose implementation depends on the terminology structure



Generic model

- Five main classes:
  - Mapping
  - Terminology
  - Concept
  - Term
  - Concepts (set of concepts)





Examples of use

- Command-line interface or program
- Search SNOMED CT for ulcer of duodenum:

```
>>> SNOMEDCT.search("ulcer duoden*")
[SNOMEDCT[6761005]  # Familial hypergastrinemic duodenal
ulcer (disorder)
, SNOMEDCT[12355008]  # Duodenal ulcer with hemorrhage,
with perforation AND with obstruction (disorder)
, SNOMEDCT[12847006]  # Acute duodenal ulcer with
hemorrhage (disorder)
, SNOMEDCT[15115006]  # Duodenal ulcer with hemorrhage AND
with perforation but without obstruction (disorder)
, SNOMEDCT[16516008]  # Familial duodenal ulcer associated
with rapid gastric emptying (disorder)
, SNOMEDCT[18169007]  # Duodenal ulcer without hemorrhage
AND without perforation but with obstruction (disorder)
...] # 71 results :-(
```

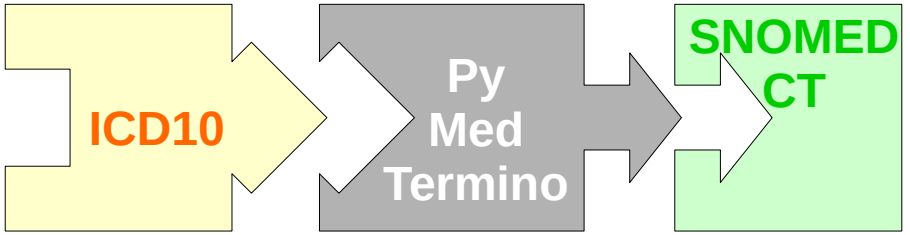
Examples of use

- Search and use the "**keep most generic**" derived operation:

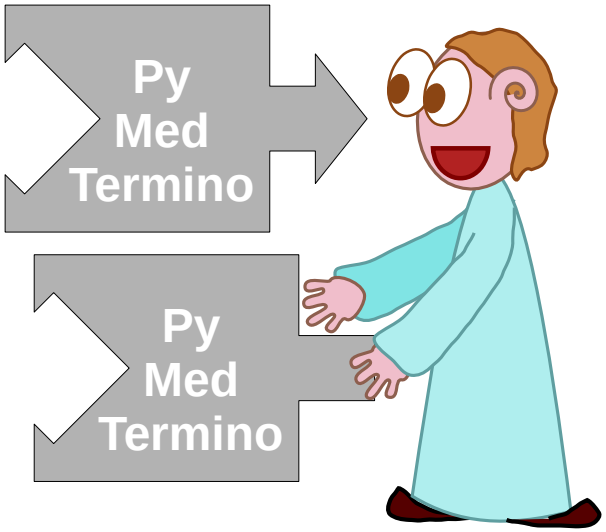
```
>>> concepts = Concepts(SNOMEDCT.search("ulcer duoden*"))
>>> concepts.keep_most_generic()
>>> concepts
Concepts([
  SNOMEDCT[275127005]  # Family history: Duodenal ulcer
, SNOMEDCT[275547005]  # History of duodenal ulcer
, SNOMEDCT[473216000]  # Suture plication of artery for
control of duodenal ulcer hemorrhage (procedure)
, SNOMEDCT[314627002]  # Endoscopic injection hemostasis of
duodenal ulcer (procedure)
, SNOMEDCT[413213005]  # Ulcerogenic deformed duodenum
, SNOMEDCT[173887007]  # Duodenal ulcer operation
, SNOMEDCT[51868009]  # Duodenal ulcer disease (disorder)
]) # 7 results :)
```

Examples of use

- Mapping example:




```
>>> SNOMEDCT[51868009] >> VCM
Concepts([
  VCM[u"current--lesion--intestine"] # ulcer of intestine
])
```



- Chaining mappings:

```
>>> ICD10["I10"] >> SNOMEDCT >> VCM
Concepts([
  VCM[u"current--hyper-vessel_bp"]  # hypertension
])
```

Examples of use

Search for all clinical findings (id 404684003) in SNOMED CT

with "hemorrhag" in their term

but not associated with the hemorrhage morphology (id 50960005)

Script:

```
from pymedtermino.snomedct import *
for concept in SNOMEDCT.search("hemorrhag*"):
   if not concept.is_a(SNOMEDCT[404684003]): continue
   has_hemorrhage = False
   for hemorrhage in SNOMEDCT[50960005].self_and_descendants_no_double():
      if hemorrhage in concept.associated_morphology:
         has_hemorrhage = True
         break
   if not has_hemorrhage: print(concept)
```

Output:

```
SNOMEDCT[37442009] # Peptic ulcer without hemorrhage AND without
perforation (disorder)
SNOMEDCT[240523007] # Viral hemorrhagic fever (disorder)
... (154 concepts listed)
```

Discussion

- PyMedTermino has been used in research projects :
  - **VCM** (iconic terminology)
  - **SiFaDo** (tools for facilitating medical coding, ANR)
  - **VIIIP** (comparison of new drugs with older ones, ANSM)
- The advanced terminological operations we proposed were useful
  - *e.g.* keep most generic, operations on a set of concepts
- PyMedTermino has been used in training sessions with students in master of biomedical informatics (M1 and M2)
  - Students can compare ICD10 and SNOMED CT
  - Technically more interesting than navigating in a terminology browser
- Main limits: quality of UMLS mappings, available only for Python

Discussion

- In the literature, Most terminological services
  - propose similar basic operations [Pathak J]
  - are aimed at browsing terminologies, such as **Hetop** [Grosjean J]
  - or at hospital use (rather than research and education)
- PyMedTermino is a **Free Software** (GNU LGPL license)
  - http://pypi.python.org/pypi/PyMedTermino
  - Terminology contents are not included (due to copyright)
  - But PyMedTermino includes:
    - Links for free downloads of terminologies (ICD10, SNOMED CT, etc)
    - Scripts for converting terminologies into optimized SQLite databases
    - The generic API previously described, built over these databases

References

Lamy JB, Duclos C, Bar-Hen A, Ouvrard P, Venot A. An iconic language for the graphical representation of medical concepts. BMC Medical Informatics and Decision Making. 2008;8:16.

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