

Dance Ontology: Towards a Searchable Movement Knowledge Base

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Motivation

- ▶ Dance Digital Libraries (text, music, videos, scores)
- ▶ What if ...
 - we can browse and search “the ingredients” of dance, the movement and its parameters ?

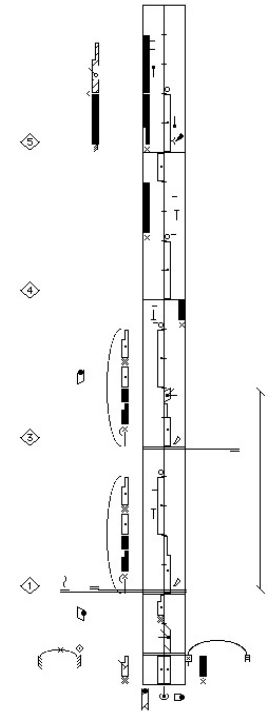


Searchable Dance Movement
Knowledge Base!

An ambitious vision...

“In a few years, if **whether** you can read notation **or not**,
the dances of the world will be as close to you as your ~~local~~
digital library”

N. Schurman , S.L. Clark, 1972
(Modern Dance Fundamentals)



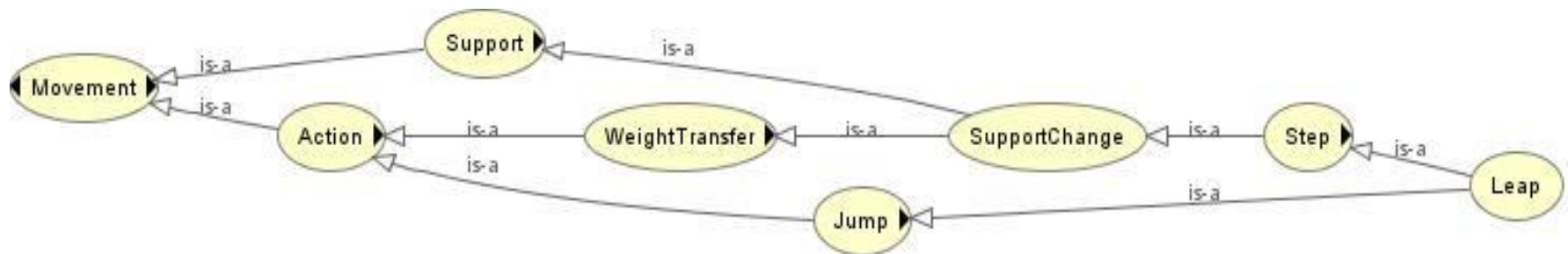
The idea ...

Organise Movement Knowledge :

- ▶ A strong structured theoretical basis, with clear semantics => **Labanotation!**
- ▶ An expressive, formal language to describe the domain => **Ontology Web Language (OWL) based on Description Logics**



Dance Ontology



Objectives and Challenges

“Interpret the symbols with **accuracy** & maintain Labanotation **expressivity** and **flexibility** in the ontology”

Challenge

Labanotation is a **symbolic language**, by migrating the semantics one-to-one relation is not guaranteed!

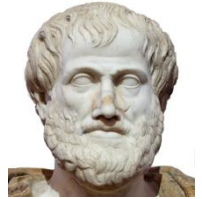
Approach

We do not develop a Labanotation Ontology, but a Dance ontology based on the concepts of Labanotation.

Ontology: from Aristotle to OWL

➤ **Philosophy** (Metaphysics, Science of Being)

*“a philosophical discipline—a branch of philosophy that deals with the nature and the **organisation** of reality”*



What characterizes being? How should things be **classified**?

➤ **Information Science**

- "formal, explicit specification of a shared **conceptualisation**"
- **OWL**: Web Ontology Language is based on **Description Logics**



Why Ontology?

In informatics, Web Semantics Technologies:

- **Web** technologies
- “**Meaningful**” data
- Rich **vocabularies** & descriptions
- Complex relationships & **rules**
- Taxonomies and hierarchies (**levels of details**)
- Logics & **Reasoning**

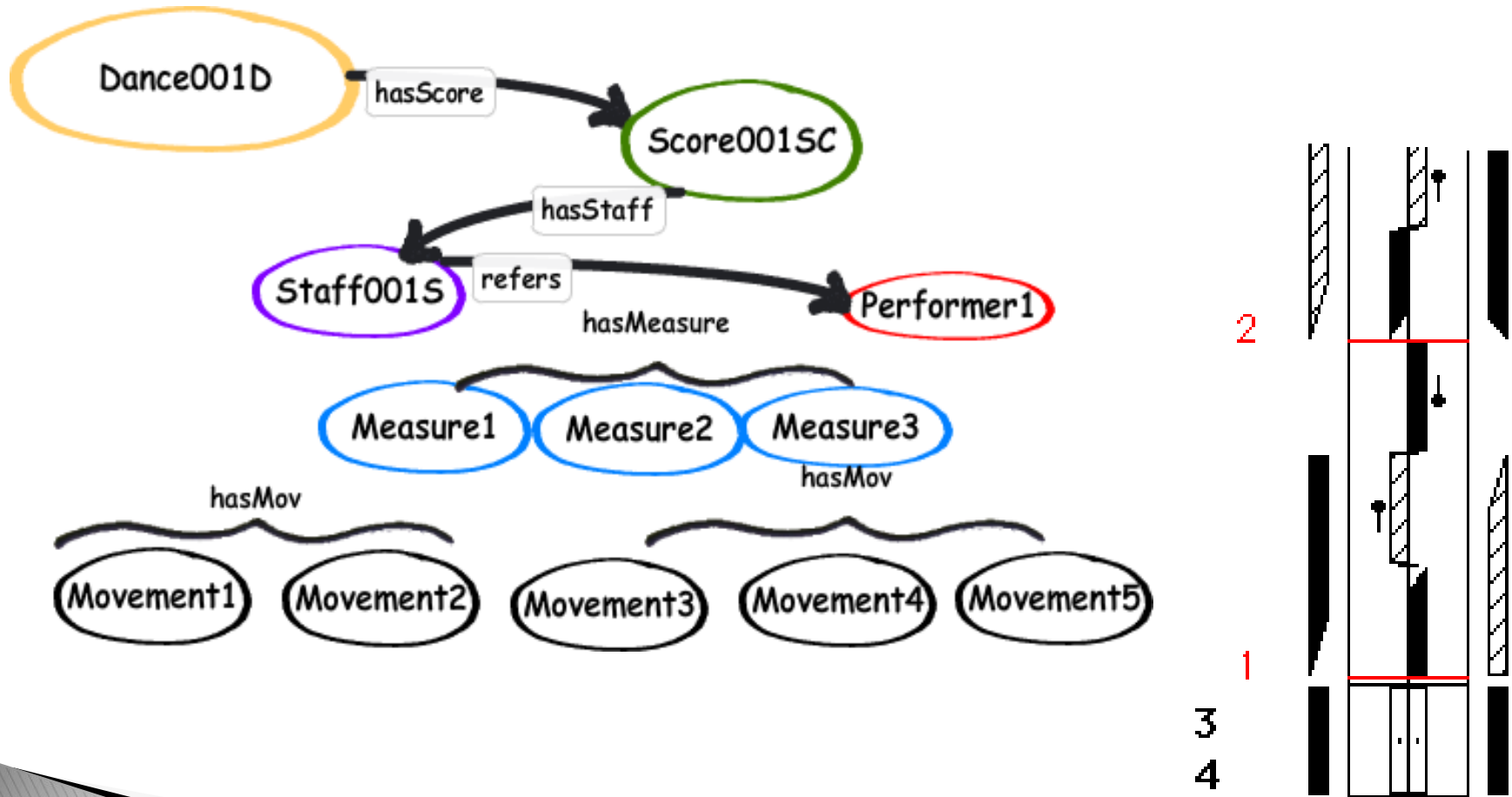
Dance Ontology Approach

- A **rich vocabulary** for describing movement
- Terms close to physical language → **human understandable**
- Dance Knowledge Base with OWL semantics → **machine understandable**
- Create new knowledge from existing: **Reasoning!**
- Labanotation serves as an excellent basis
 - 1) describes **all movement parameters** (who/what, where, when and how moves)
 - 2) dance style **independent**

The Ontology Language

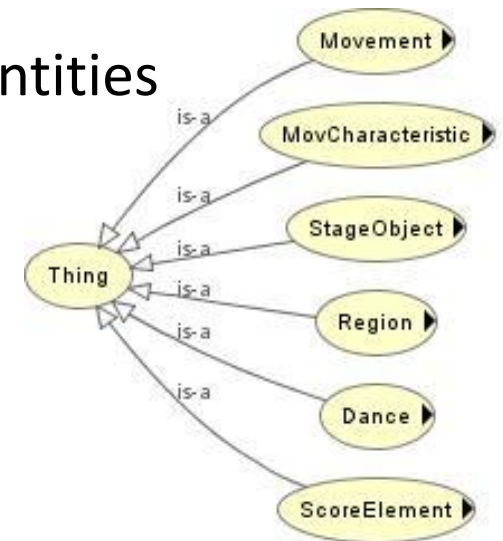
- **Classes:** Dance, Support, Step, Turn, ArmGesture, LeftFoot
- **Individuals:** D001 (is a Dance), Gest001 (is a Gesture)
- **Properties :** Gest001 hasDirection Forward
- **Rules :** e.g. *“LegGesture is a Movement acted by the LegZone and is not a Support”*
- **Cardinality Restrictions :** *“One body has only one torso”*

The General Model



Dance Classe

- **Dance:** Folk, Ballet, Contemporary, RoundDance
- **Movement:** action, position, step, an extension
- **MovCharacteristic:** direction, level, dynamics or movement parameters (time, space, weight)
- **ScoreElement:** phrases, measures, temporal entities
- **StageObject:** “dance stage” things, from inanimate objects and points in space to the dancers body and its parts.



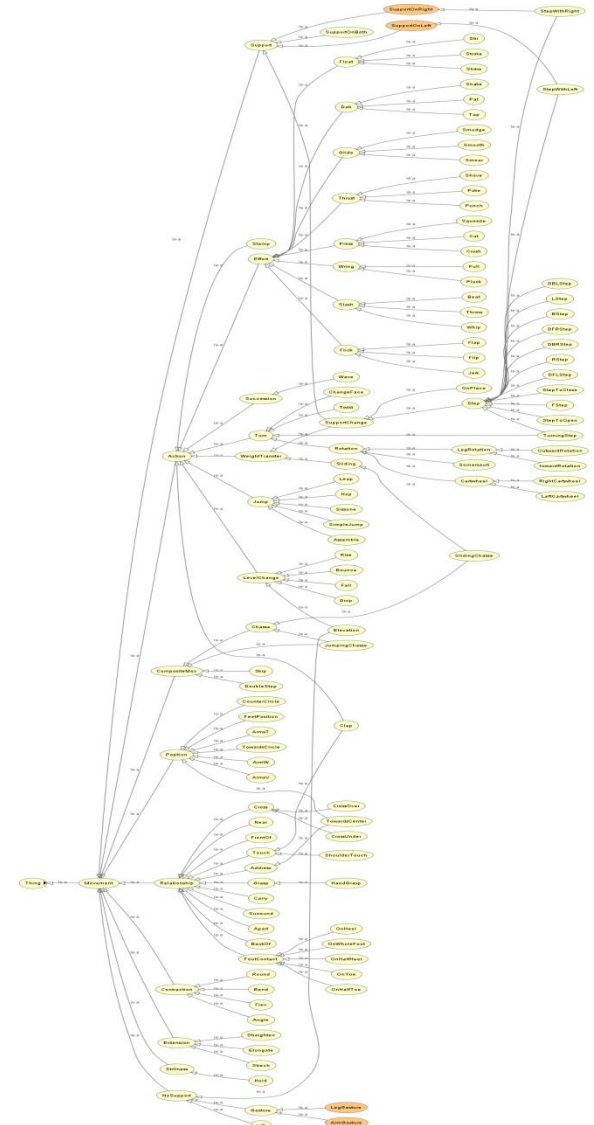
Movement

- **Space** : Level, Direction, Size...
- **Time** : ST01 hasNext ST02, isDuring AG, hasDuration 1/8
- **Body** : Right Elbow, Upper Left Leg
- **Dynamics** : Strong Accent, Tremolo, Efforts (Flick, Float...)
- **Class (type)**: Support, Turn, Relationship, Contraction

Movement Hierarchy

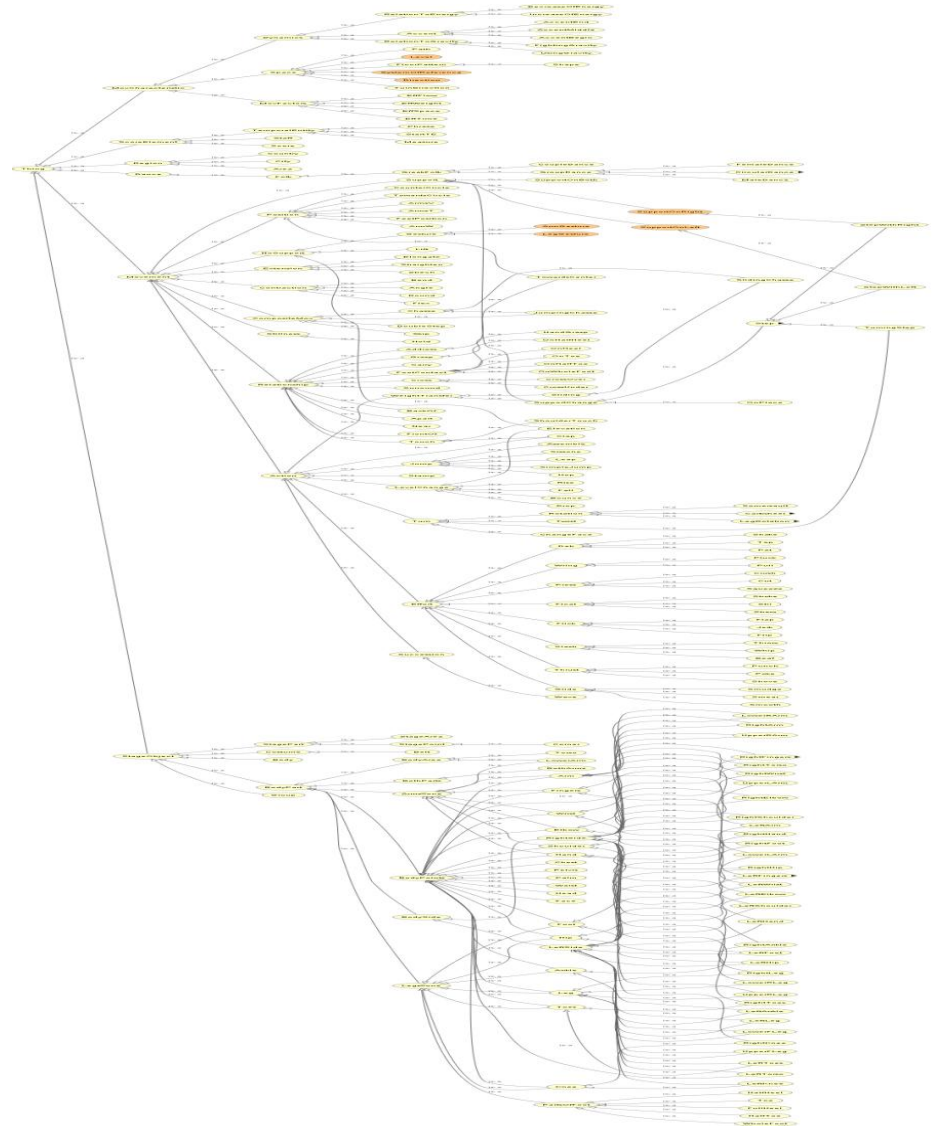
Movements Classes

1. One-to one relation to Labanotation Symbols (e.g., **Support**, **LegGesture**, **ArmGesture**)
2. Represent an interpretation of more than one symbol (**Jump**, **Clap**, **Rise**, **Stamp**)
3. Are used to cluster movements and create a higher level of detail on search (**WeightTransfer**, **ChangeLevel**)



The Dance Ontology

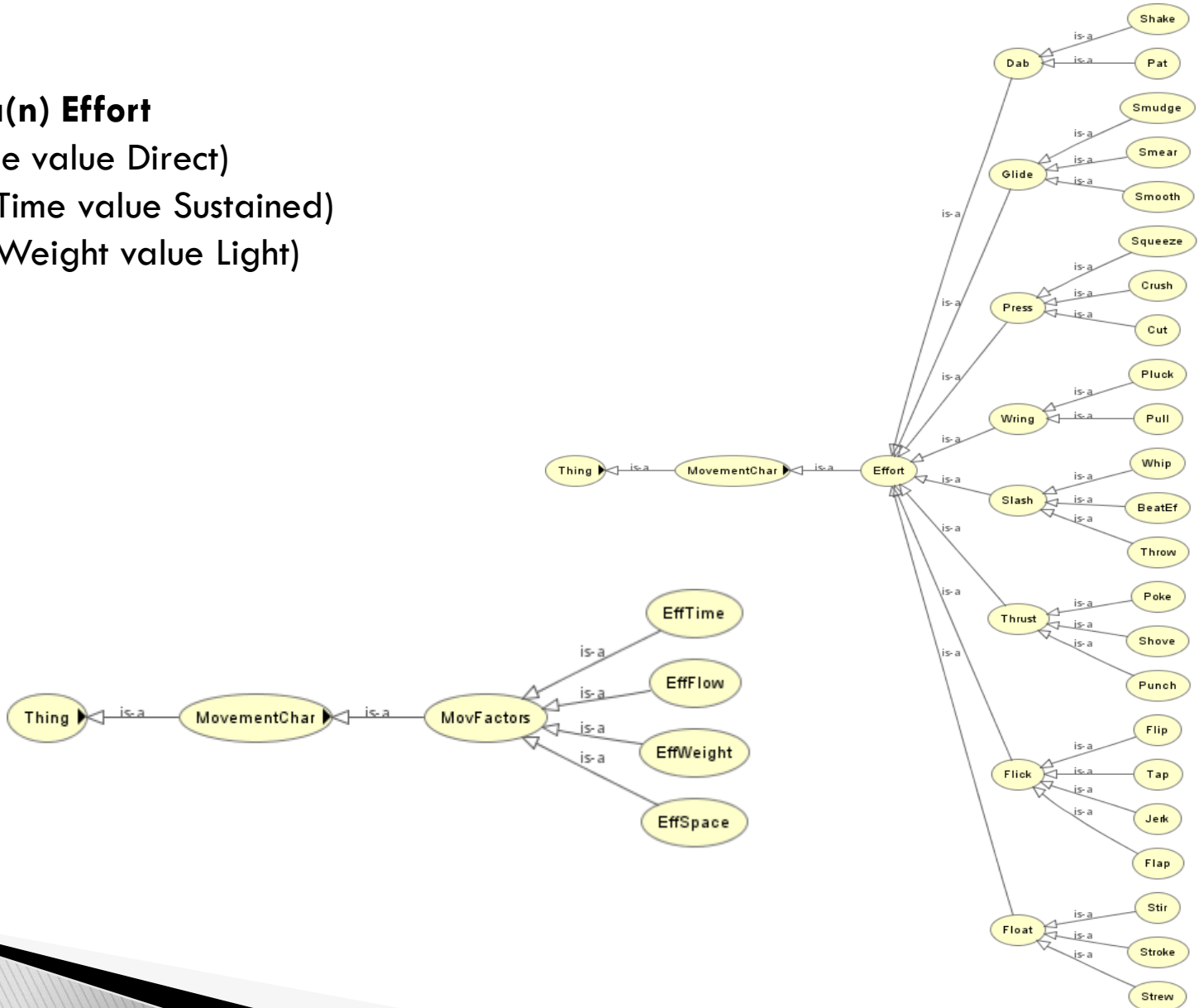
- ~300 concepts and rules
- ~100 relationships
- ~500 individuals
(experimental data)



Effort in Ontology

Glide is a(n) Effort

(hasSpace value Direct)
and (hasTime value Sustained)
and (hasWeight value Light)



The Dance Ontology

dnc.owl (http://www.semanticweb.org/ontologies/2010/1/dnc.owl) - [C:\Users\Katerina\Dropbox\MyPhD\Workspace\OWL\Feb.16.2012.owl]

File Edit Ontologies Reasoner Tools Refactor Tabs View Window Help

dnc.owl (http://www.semanticweb.org/ontologies/2010/1/dnc.owl) TS12

Active Ontology Entities Classes Object Properties Data Properties Individuals OWLViz DL Query

Class hierarchy (inferred)
Class hierarchy
Class hierarchy: Step

Individual Annotations Individual Usage

Annotations: TS12

Annotations +
label
"TS12"

Description: TS12

Types +
Float
and Step
Float
Step

Same individuals +
Different individuals +

Datatypes

Property assertions: TS12

Object property assertions +
hasDirection DiagonalFR
hasLevel Middle
actedBy LeftLeg1
hasWeight Light
hasEffort Light
hasEffort Sustained
hasEffort Indirect
hasEffort Flexible
hasMovChar DiagonalFR
hasMovChar Light
hasMovChar Middle
hasMovChar Sustained
hasMovChar Indirect
hasMovChar Flexible
hasTime Sustained
hasActedBy LeftLeg1

Querying Dance Knowledge

➤ **SPARQL:** SQL-like descriptive language

```
SELECT DISTINCT ?m1 ?m2 ?m3 ?m4 ?d ?s
WHERE
{ ?m1 rdf:type dnc:Hop . ?m1 dnc:isActedBy ?r . ?r rdf:type ?RightLeg.
  ?m2 rdf:type dnc:Step . ?m2 dnc:hasDynamic dnc: Weighty. ?m2 dnc:isActedBy ?r . ?r rdf:type
?LeftLeg.
  ?m3 rdf:type dnc:FeetTogether . ?m4 rdf:type dnc:ArmGesture. ?m4 dnc:
?t1 dnc:hasMov ?m1 . ?t2 dnc:hasMov ?m2 . ?t3 dnc:hasMov ?m3 . ?t4 dnc:hasMov ?m4.
?t1 dnc:hasNext ?t2 . ?t2 dnc:hasNext ?t3 . ?t3 dnc:hasNext ?t4.
?t1 dnc:isContentOf ?v . ?t2 dnc:isContentOf ?v . ?t3 dnc:isContentOf ?v .
?t4 dnc:isContentOf ?v ?v dnc:isScoreOf ?d .
?d rdf:type dnc:FolkDance }
```

“ Select all the name of folk dances that contain a sequence of a “hop on right leg, a weighty step with left, feet together, and a sudden arm gesture”

To Do...

- Experiment with larger datasets
- **Continuous enhancement** of the ontology
- Support **advanced search** and **comparative study** of dances
- Investigate automated integration of data in other formats

Thank you !!!

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Related Publication

K. El Raheb, Y.Ioannidis, “A Labanotation based Ontology for Representing Dance Movement”, in Proceedings of Gesture Workshop 2011, Athens (to be published by Springer-Verlag series on Lecture Notes in Artificial Intelligence)