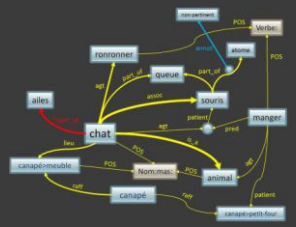
Mathieu LAFOURCADE
TEXTE team, LIRMM, U. of Montpellier, France




# GAMES FOR BUILDING LEXICO-SEMANTIC RESOURCES

...

# AND A SMALL OVERVIEW OF GWAPS

October 2015

# LIRMM - www.lirmm.fr

Attached to Montpellier University and the French National Center for Scientific Research (CNRS). Its activity developed within three scientific research departments (Informatics, Microelectronics, Robotics) and 19 teams.

TEXTE team : Exploration et exploitation de données textuelles

Head : M. Lafourcade – 11 people

Syntax, Textual Semantic, Lexical Semantics, Algebric Models, Vector Models, Dialog Models

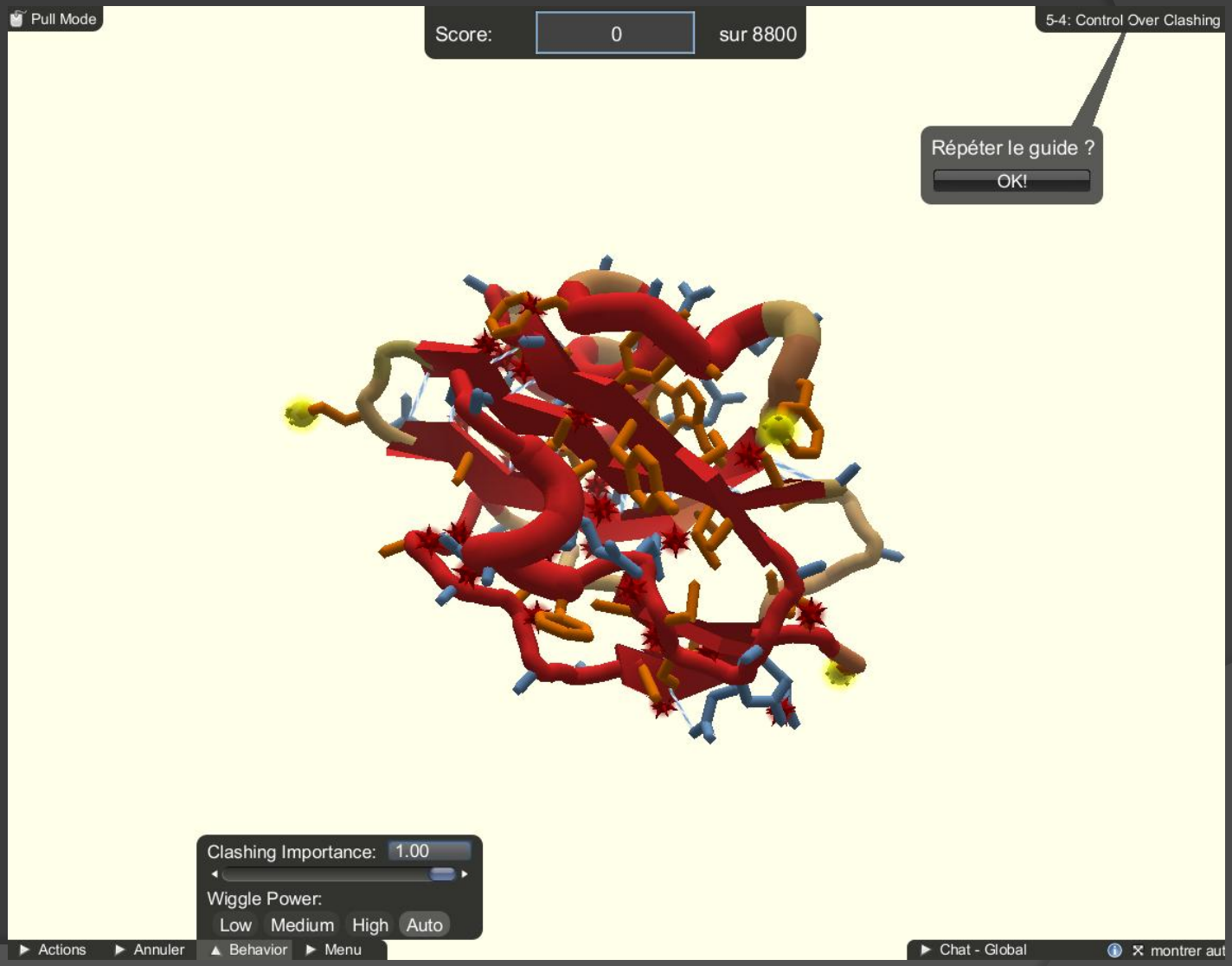
# What are GWAPs?

- Games (supposed to be funny, addictive, pleasant…)
- Designed for
  - Data acquisition
  - Problem solving
- Dubbed as collective intelligence
- Hypothesis

A large number of ordinary people
is more efficient than
a small number of specialists

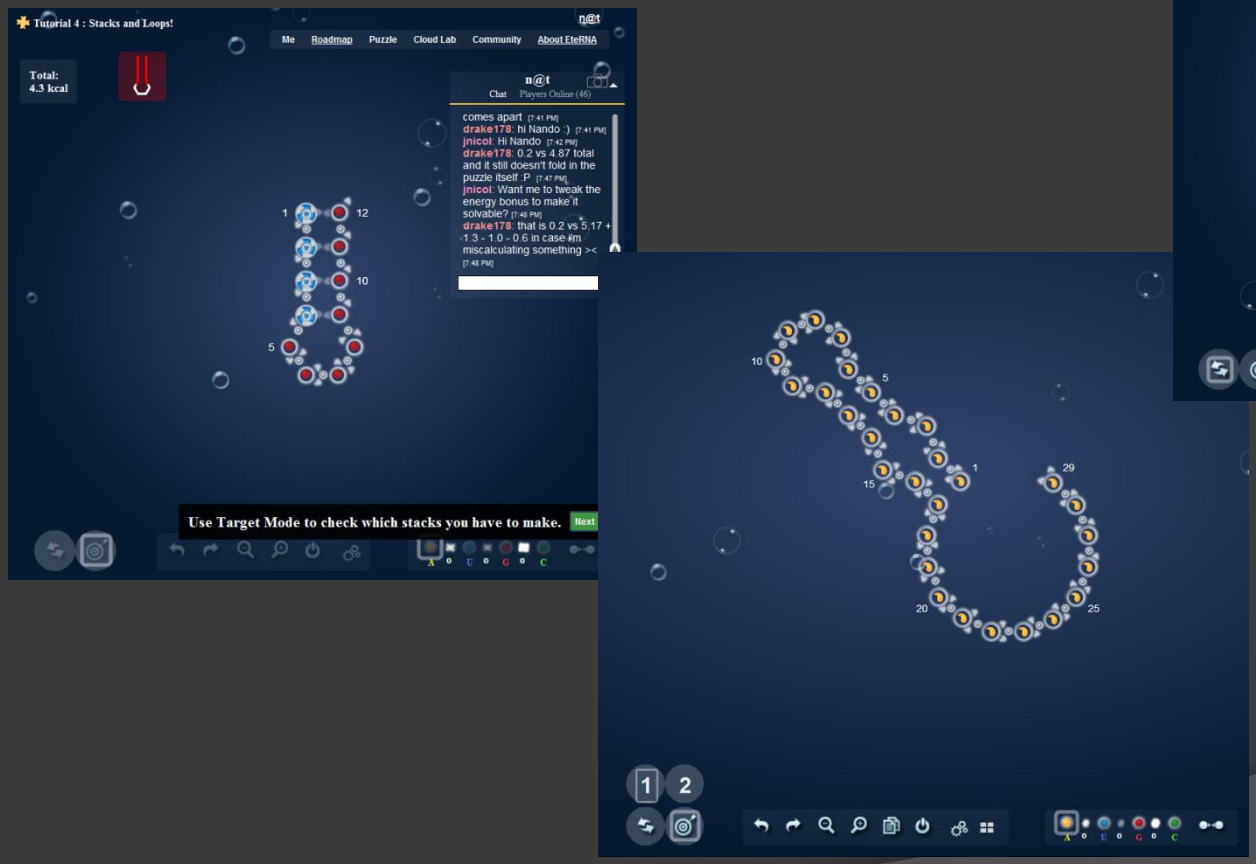
# Some GWAPs in Biology

- Foldit



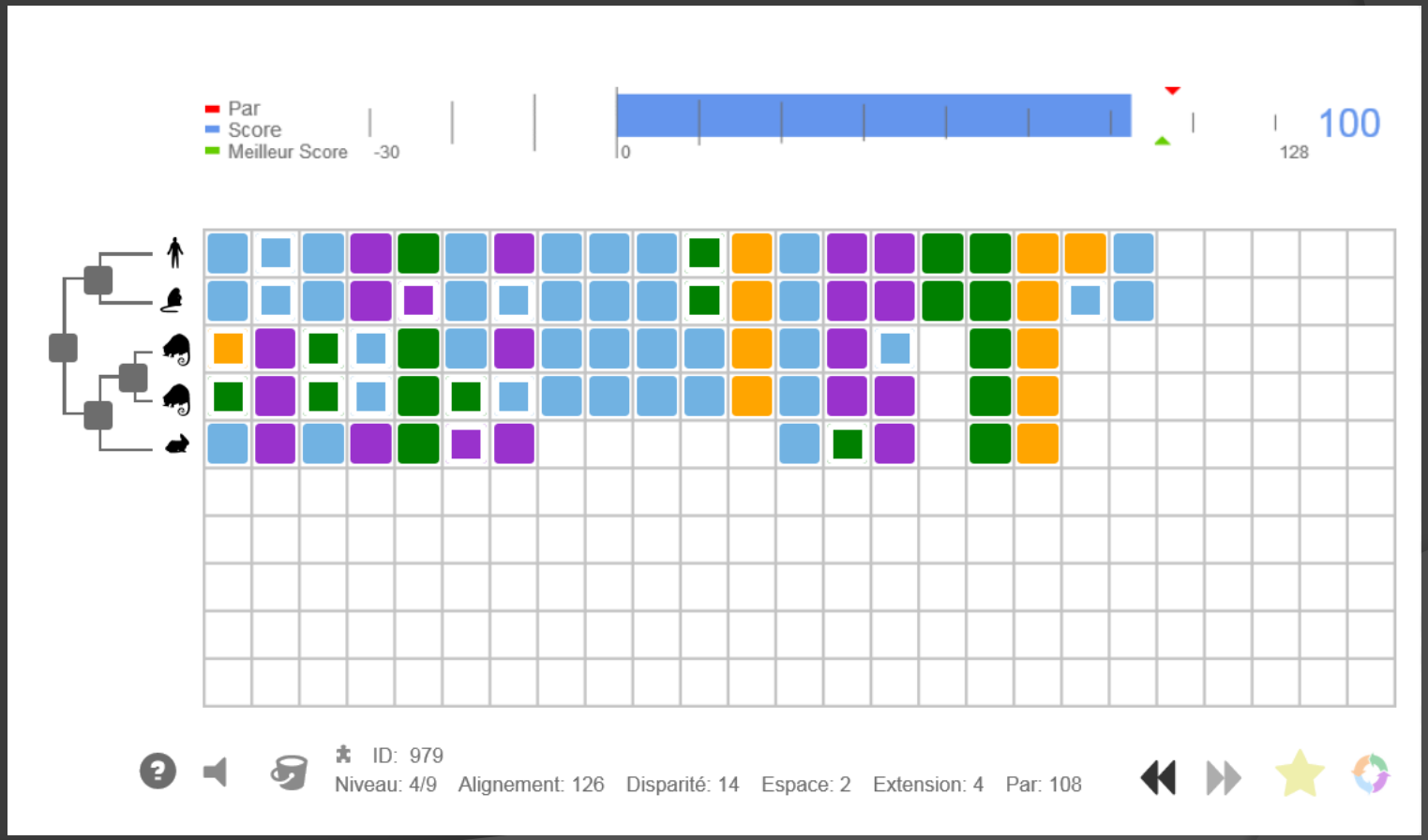
# Some GWAPs in Biology

- Eterna



# Some GWAPs in Biology

- Phylo

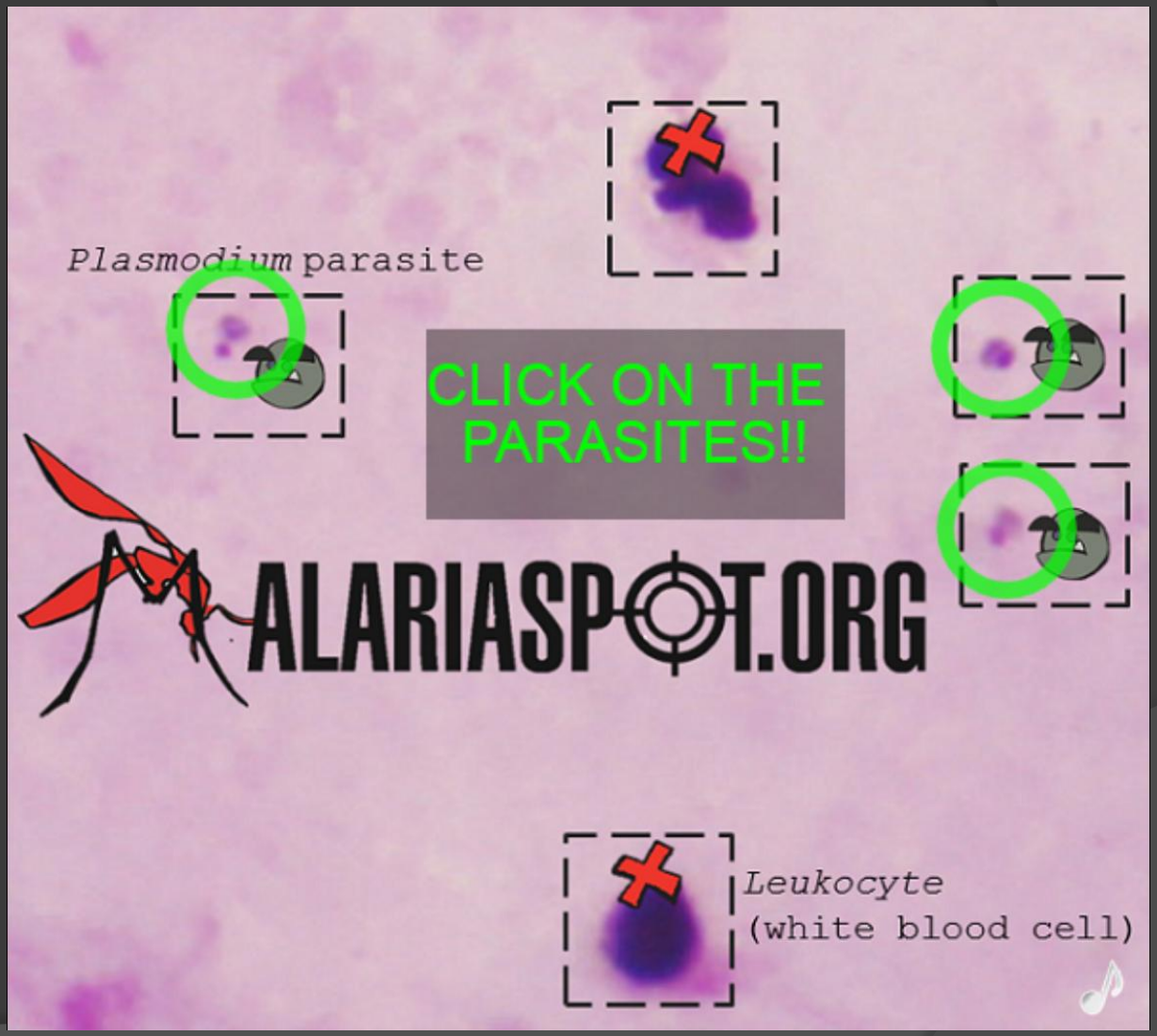


# Some GWAPs in Biology

- Nightjar

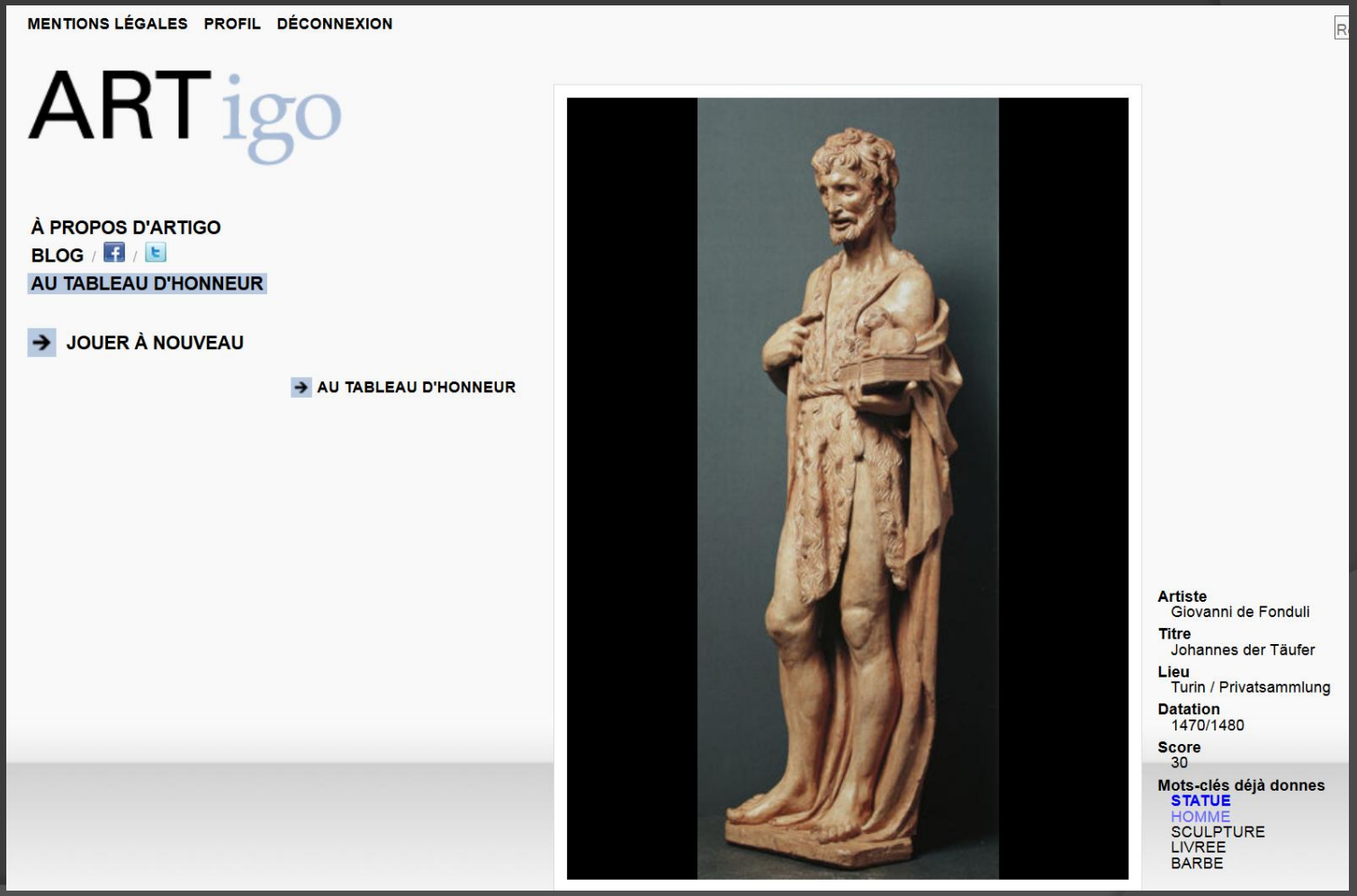
# Some GWAPs in Medecine

- Malaria Spot



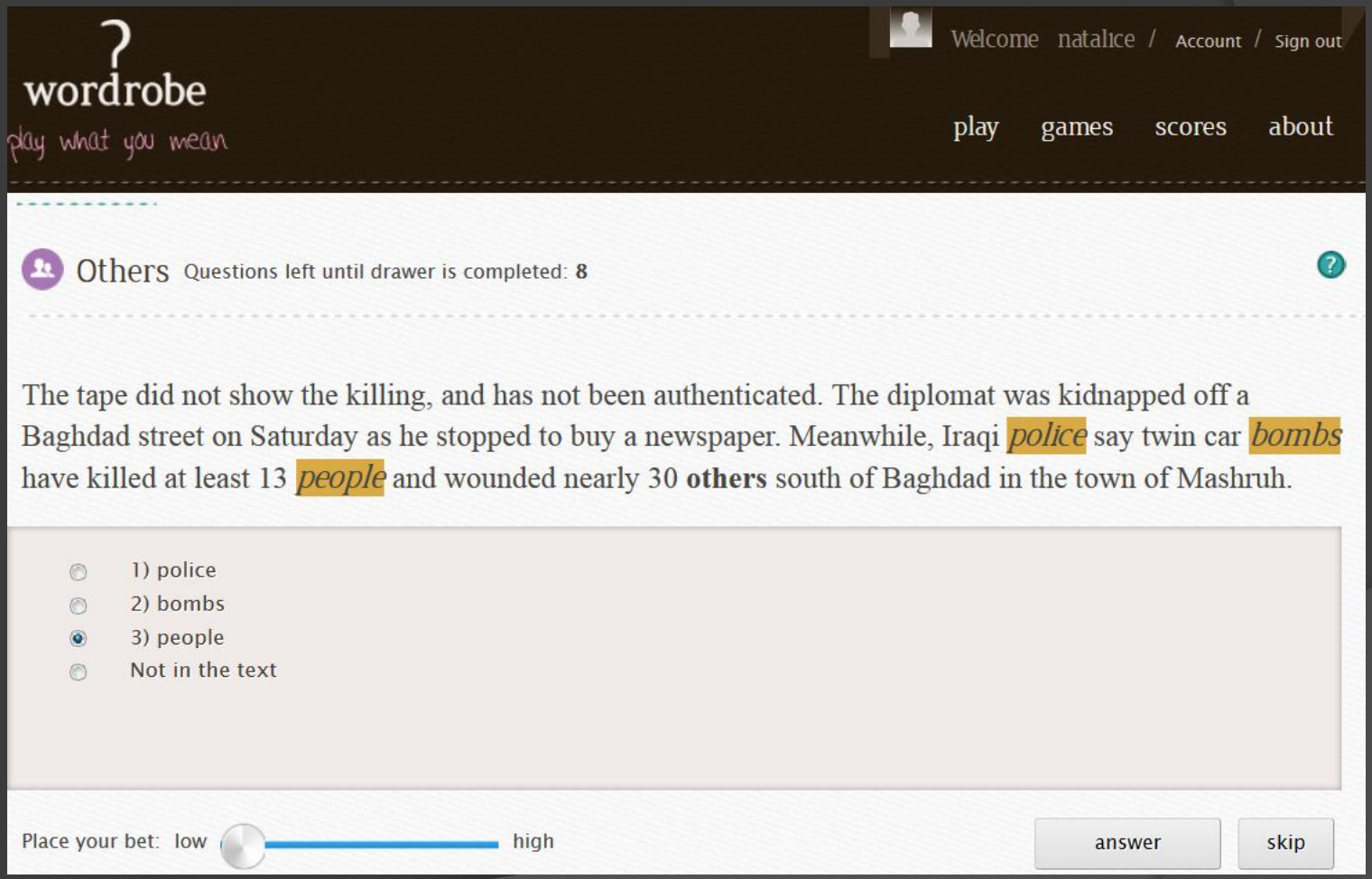
# Some GWAPs in …

- Artigo



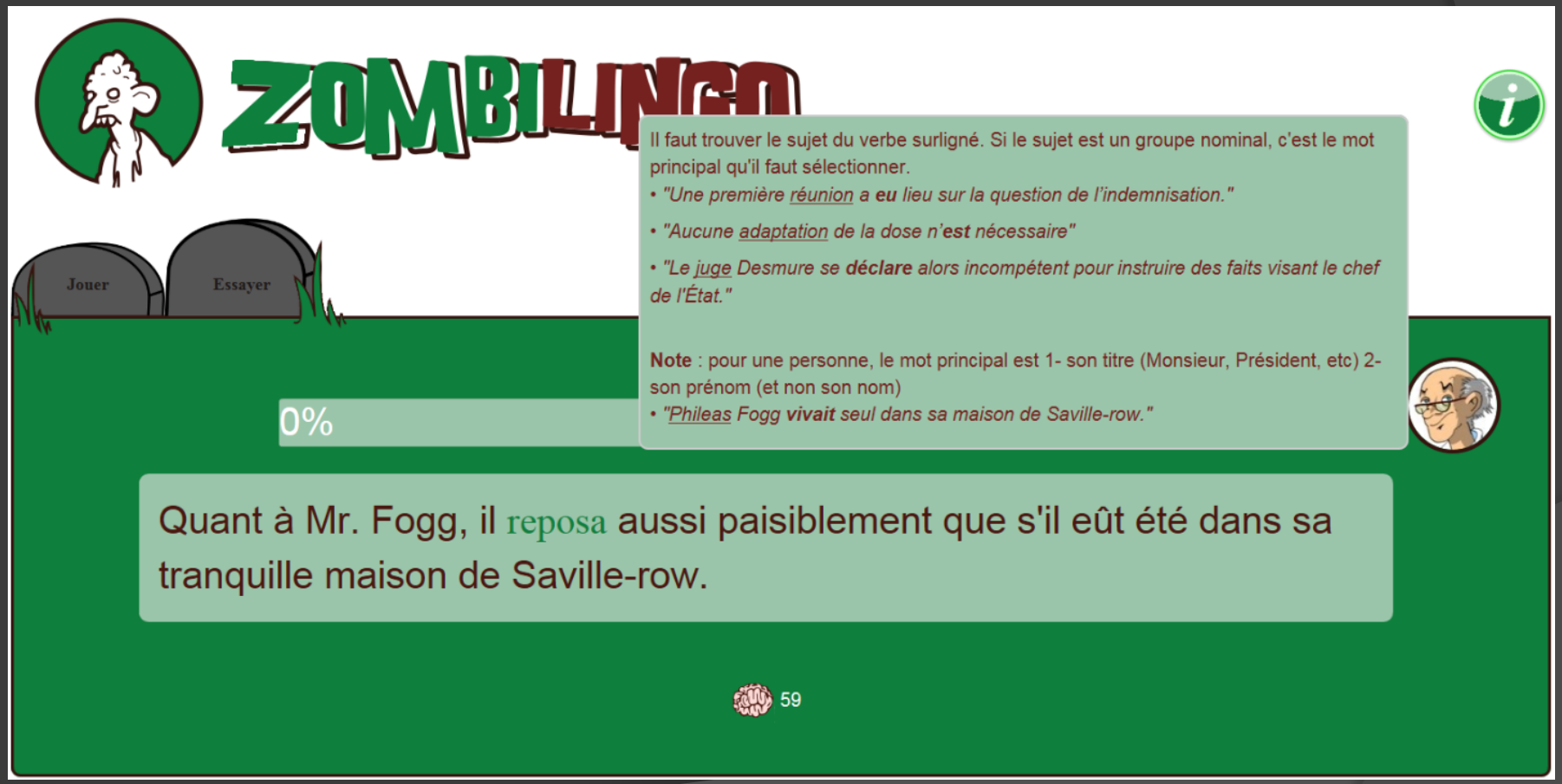
# Some GWAPs in NLP

- Wordrobe



# Some GWAPs in NLP

- Zombilingo



# GWAPs… some properties

- Playing well <=> creating good data
- Beware of various bias
- Difficult to be funny AND efficient

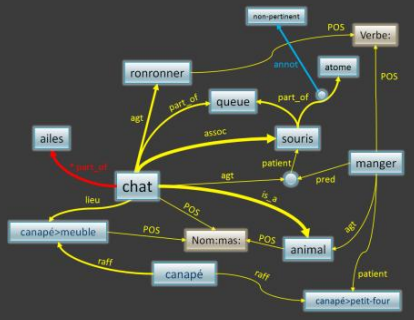
- In general, short life span (many gwaps are dead before long)
- Often over inflated expectation

# CONTEXT OF Jeux de mots

## SEMANTIC ANALYSIS OF TEXTS WITH PROPAGATION ALGORITHMS ON/WITH A LEXICO-SEMANTIC NETWORK

## =

## A KNOWLEDGE BASE, A GRAPH WITH WORDS, SENSES/USAGES/RELATIONS



# ACQUISITION OF LEXICAL, TERMINOLOGICAL, ONTOLOGICAL INFORMATION …

- What for ?
  - applications needing lexical, common sens and specialized field knowledge
    - Report analysis in medical imaging (Imaios)
    - Offer/demand matching in tourism (Bedycasa)
    - Debate management (SucceedTogether)
    - Class factorization in software eng. (Orange, Berger Levrault)
- How ?
  - Automatically (extracting for corpora) ?

    knowledge is not always explicitly present in texts

    not exclusively, not totally – a lot of implicit knowledge
  - By hand? Long – (too) costly – normative – static data

# … ALTOGETHER AS A LEXICAL NETWORK

## Nodes

- Terms, textual segments, NP
- Usages, concepts
- Various symbolic informations

## Relations

- Typed
- Directed
- Weighted

free idea associations

hypernyms – hyponymes – part-of – whole– matter/substance …
synonyms – antonyms– locutions – magn/antimagn …
agent - patients – instruments – locations– causes/consequences – telic role– temporal values…

# … ALTOGETHER AS A LEXICAL NETWORK

## Nodes

- Terms, textual segments, NP
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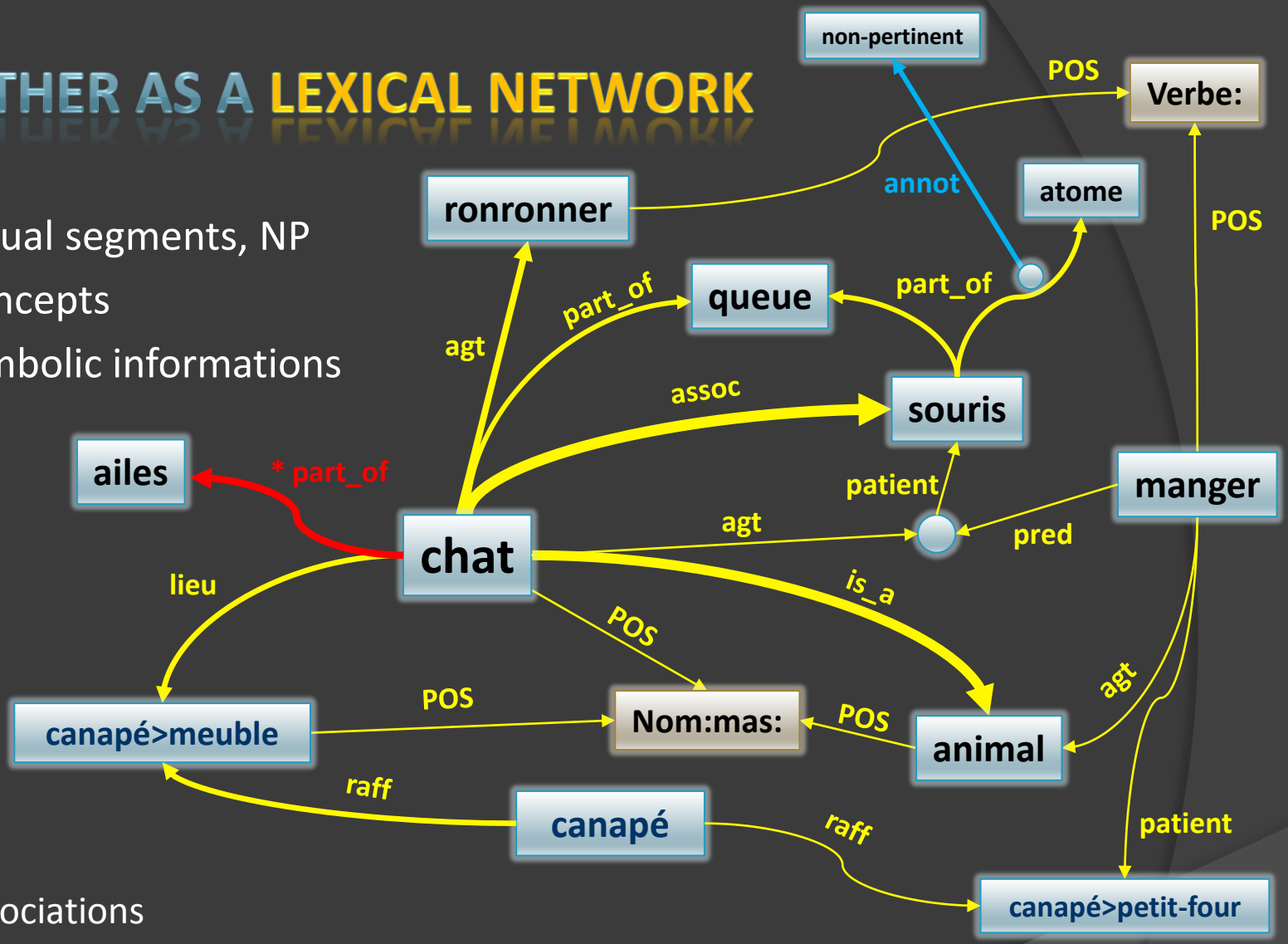
## Relations

- Typed
- Directed
- Weighted




free idea associations

hypernyms – hyponymes – part-of – whole– matter/substance …
synonyms – antonyms– locutions – magn/antimagn …
agent - patients – instruments – locations– causes/consequences – telic role– temporal values…

# LEXICAL ACQUISITION WITH GWAPS

## (GAME WITH A PURPOSE)

HYPOTHESIS :

FOR THE DEVELOPER, DATA ACQUISITION THROUGH GWAP IS
FREE • FAST • EFFICIENT •PROVIDE NON-NEGOCIATED ANSWERS

AND FOR PLAYERS THE GAME WILL/MUST BE
EXCITING • REWARDING • ADDICTIVE

# JDM PLAY EXAMPLE

# lutin

Niveau : 51

Réponses données par kaput : petit • agaçant • taquin • pétulant • espiègle • enfant • gobelin • gnome • farfadet • tourmenter • esprit follet • Bretagne • être fantastique • lutiner • petit

Réponses données par egaillat : grelot • oreille • habit • Schtroumpfs • malicieux • nez • créature légendaire • taquin • oreilles • elfe • fée • forêt • nuton • Puck • Père Noël • espiègle • mythologie • légende • vert • esprit follet • bonnet • créature • conte • être imaginaire • gnome • chapeau • petit • troll • korrigan • farfadet

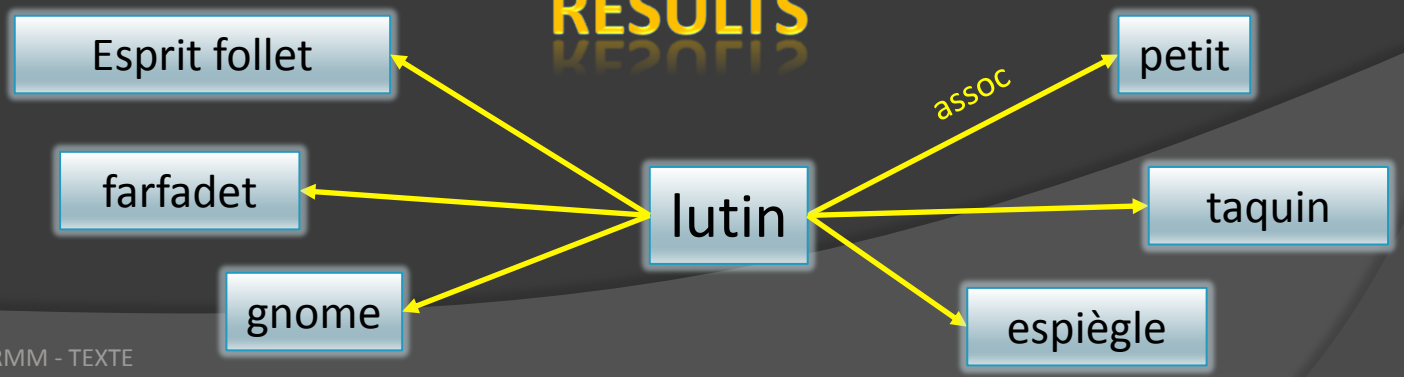
petit • taquin • espiègle • gnome • farfadet • esprit follet

HOMOLOGUÉ RECORD JEUX DE MOTS

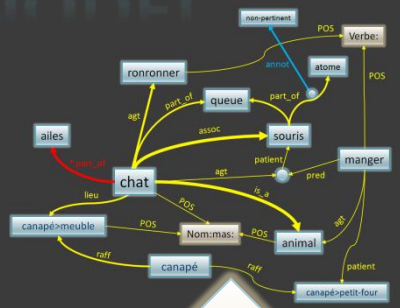
Vous gagnez 300 crédits et 8 point(s) d'honneur

J'aime Soyez le premier de vos amis à indiquer que vous aimez ça.

## RESULTS



# INTERACTION MODEL




lexical network

game 1

term
+
instruction

game 2

term
+
instruction

**creation / strengthening of relations**

confrontation

propositions **Intersection** propositions

player 1

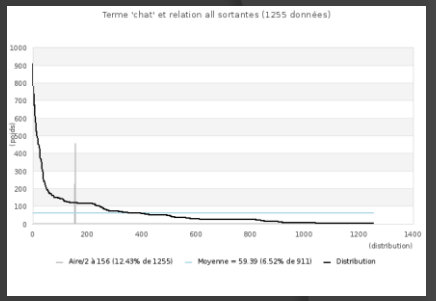
**rewards**

player 2

# PLAYER ACTIVITY REGULATION

## Filtering – matching of player pairs

- Iterated Minimal Consensus (weighting)
- Minimizing noise, maximizing recall (long tail)




## Features

- Word pseudo-randomly selected
- Other player(s) unknown during play
- Asynchronous games

## Points

- more if relation is weak
- less if relation is strong

PLAYER DILEMNA

THINKING LIKE WE THINK
THE OTHER PLAYER THINKS
AND
BEING ORIGINAL

# QUANTITATIVE EVALUATION

- > 570 000 terms in the network
  - > 490 515 terms with at least one associated idea
- > 23 000 000 lexical relations
  - > 544 458 terms with at least one outgoing relation (A → B)
  - > 548 178 terms with at least one incoming relation (A ← B)
- > 549 814 with a POS (part of speech) (4.5 % no pos)
  - Noun, Verb, Adjective, Adverb
- > 10 970 refined terms and > 33 000 usages
- > 10 400 labelled as polysemous (coverage 94 %)
- > 210 800 inhibitory (negative) relations (less than 1%)

never ended learning

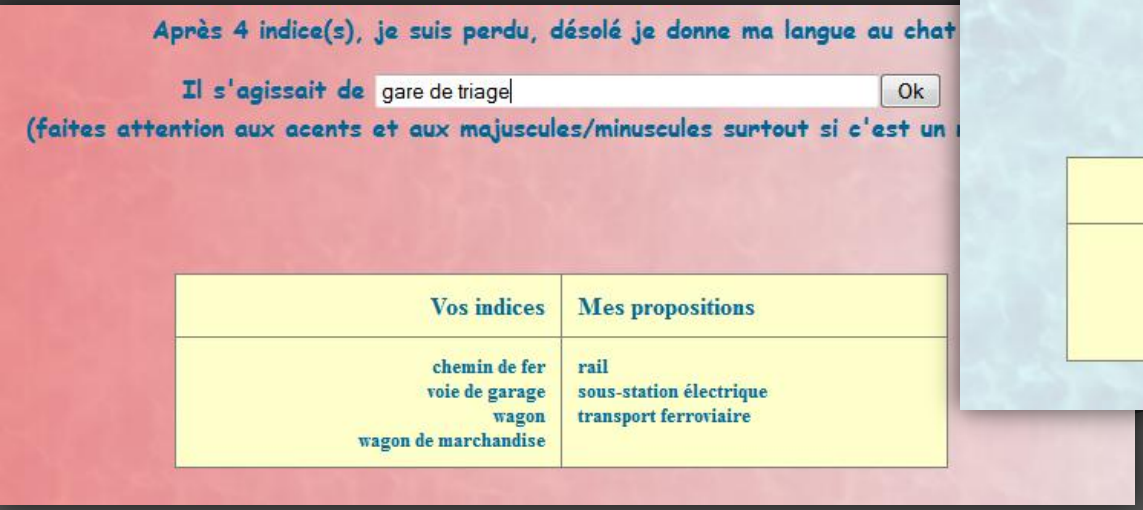
new words, NP, refinements… new relations

# QUALITATIVE EVALUATION WITH COUNTER-GAMES

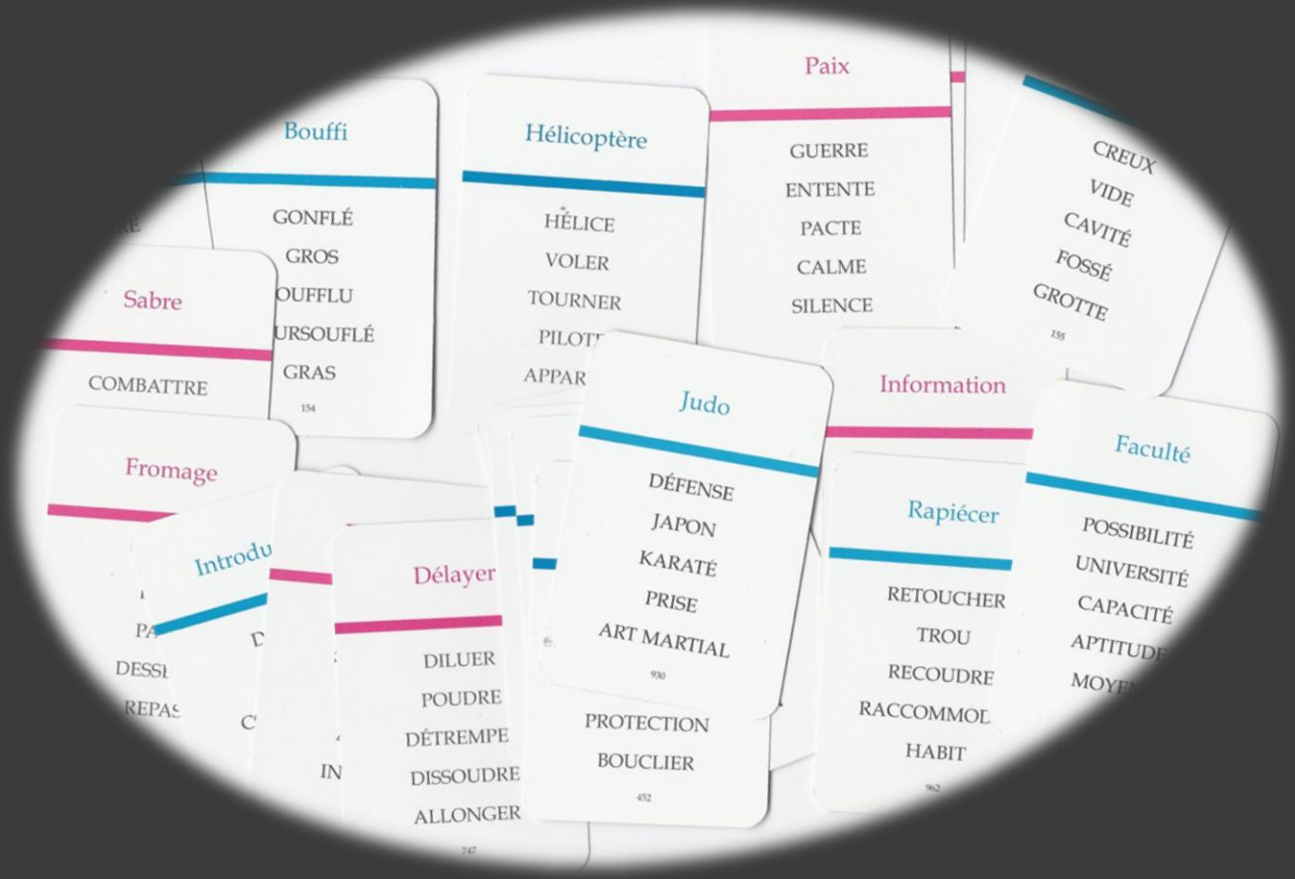
Indirect approaches :

Totaki – a guessing game/ AskIt – a question game/ …

- Totaki : {clues} => term
  - Player = clue giver (+ optional relation type)
  - Totaki = guesser (lexical network + learning + short term memory)
- Looking for quasi intersection in the lexical network
- Hypothesis : if the target term is found
  → the network is properly built/informed for this term



# REVERSED TABOU – FREQUENT TERMS

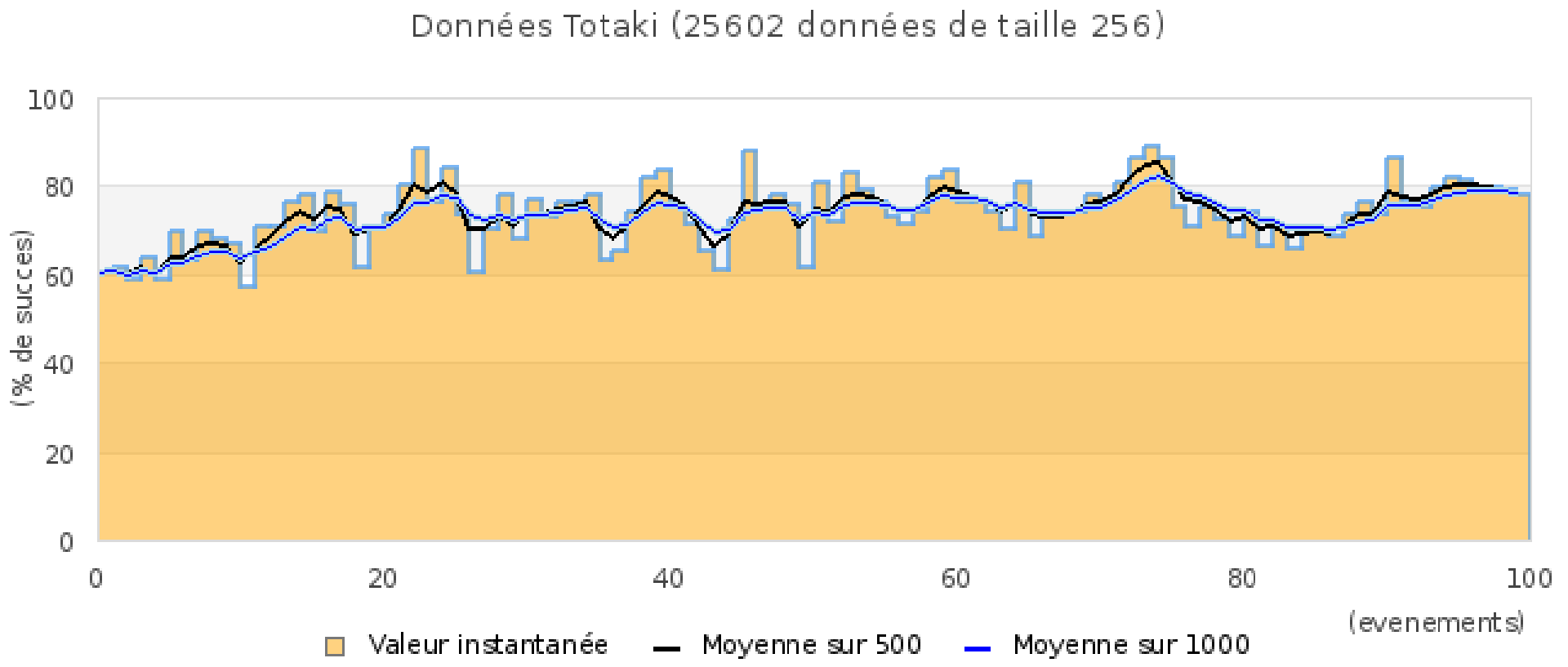



Can we find terms from the clue?
With the 500 riddles of the original game : AKI 494 – humans : 398

Totaki 98,8 %

Humans 79,6 %

# RESULTS FOR OPEN VOCABULARY




## Totaki ~ 80 %

Tests over 25 000 games where terms are chosen by players

## Utilisateur ~ 43 %

Tests over 300 terms on which players made some guesses (controled env.)

# Other games

Counter games

# Other games

Counter games

# A POLARITY GAME

Est-ce que vous aimez l'idée de

aller chez le dentiste

# LIKE IT

# A POLARITY GAME

immediate replay → addiction

# CANDIDATE SELECTION THROUGH A PROPAGATION ALGORITHM

(pseudo random walk in the network)

## Infinite iteration of

- Random selection of a term T having a positive or a negative polarity (or both)
- 50% proposing T
  50% proposing one neighbor of T in the network
- Seed with: bien = 1 positive vote
  mal = 1 negative vote

# SOME RESULTS

## 449 211 polarized terms

- 383,892 positive polarities (35.4 %)
- 445,122 neutral polarities (41 %)
- 256,296 negative polarities (23.6 %)
- Total of 1,085,310 **polarities** (100 %)

- 66,254,573 positive votes (50.5 %)
- 44,538,722 neutral votes (34 %)
- 20,383,344 negative votes (15.5 %)
- Total of 131,176,639 votes (100 %)

- 292 votes per term on average

Diko

A navigation tool for the lexical network

# fracture du tibia

Nom | Informations diverses | wiki | polarité

**Associations d'idées** (34) fracture ▹ ▪ tibia ▪ jambe ▹ ▪ fracture (lésion) ▪ plâtre ▹ ▪ traumatisme ▹ ▪ fracture spiroïde ▪ lésion ▪ os (squelette) ▪ os ▹ ▪ médecine ▹ ▪ lésion physique ▪ ostéosynthèse ▪ blessure sportive ▪ traumatisme (physique) ▪ accident ▹ ▪ blessure ▹ ▪ plâtre (médecine) ▪ douleur (physique) ▪ lésion osseuse ▪ fracture du plateau tibial ▪ fracture de Segond ▪ clou centro-médullaire ▪ fissure (médecine) ▪ douleur ▹ ▪ fracture ouverte ▪ chute ▹ ▪ jambe (membre) ▪ blessé ▪ blessure (lésion physique) ▪ traumatologie ▪ orthopédie ▪ fracture du (9) fracture ▹ ▪ tibia ▪ traumatologie ▪ orthopédie ▪ médecine ▹ ▪ lésion physique ▪ fracture (lésion) ▪ lésion ▪ lésion osseuse

**Est accompagné par** fracture du péroné ▪ fracture de la fibula

**Thèmes/domaines** médecine (science) ▪ médecine ▹ ▪ traumatologie ▪ orthopédie ▪ radiologie

**Génériques** H fracture (lésion) ▪ fracture ▹ ▪ lésion osseuse [↓] ▪ lésion physique ▪ lésion [↓] ▪ * fracture (sociologie)

**Symptôme(s)** déformation (médecine) ▪ déformation ▹ ▪ douleur (physique) ▪ douleur ▹ **Diagnostique(s)** scanner (médecine, technique) ▪ scanner (médecine) ▹ ▪ radiographie (cliché) ▪ radiographie ▹

**Plus intense que *fracture du tibia*** fracture double ▪ double fracture **Moins intense que *fracture du tibia*** foulure ▪ entorse ▹

**Locutions/termes composés** tibia ▪ fracture ▹ ▪ fracture du ▪ fracture (lésion)

**Caractéristiques de *fracture du tibia*** (12) fermée ▪ ouverte [↓] ▪ grave ▹ ▪ non déplacée [↓] ▪ spiroïde ▪ douloureuse (souffrance) ▪ complexe (compliqué) ▪ diaphysaire ▪ comminutive [↓] ▪ douloureuse ▹ [↓] ▪ complexe ▹ [↓] ▪ * hépatique ▹

**A quoi *fracture du tibia* peut-il s'opposer/combattre ?** marche (mouvement) ▪ marche ▹

**Lieux incluant/contenant *fracture du tibia* ?** tibia ▪ jambe (membre) ▪ jambe ▹ [↓] ▪ corps ▹ [↓] ▪ * bras ▹

**Que peut faire *fracture du tibia* ? (agent)** faire souffrir ▪ faire mal ▹ **Que peut-on faire à/de *fracture du tibia* ? (patient)** réduire ▪ visualiser ▪ radiographier ▪ plâtrer ▪ opérer ▹ ▪ opérer (chirurgie) ▪ diagnostiquer

**Causes associées à *fracture du tibia*** (21) ski (sport) ▪ ski ▹ ▪ se blesser ▪ se battre ▪ sport ▹ ▪ sport (activité physique) ▪ traumatisme (physique) ▪ traumatisme ▹ ▪ tomber ▹ ▪ glisser ▹ ▪ coup (choc) ▪ accident de ski ▪ accident de moto ▪ accident de la route ▪ accident ▹ ▪ activité physique ▪ blessure sportive ▪ coup ▹ ▪ chute ▹ ▪ choc ▹ ▪ Sport

**Conséquences associées à *fracture du tibia*** (11) radio ▹ ▪ radiographie ▹ ▪ soin ▹ ▪ soin (acte médical) ▪ plâtre (médecine) ▪ plâtre ▹ ▪ broche (médecine) ▪ douleur (physique) ▪ immobilité ▪ marcher avec des béquilles ▪ broche ▹

**Sentiments/émotions associés à *fracture du tibia*** (22) fatalité ▪ contrariété ▪ amertume (tristesse) ▪ malchance ▪ ennui ▹ ▪ ennui (contrariété) ▪ mécontentement ▪ tracas ▪ souffrance ▪ rage ▹ ▪ dépit ▪ découragement ▪ consternation ▪ colère ▪ calamité ▪ culpabilité ▪ dépendance (assujettissement) ▪ abattement ▹ ▪ déception ▪ douleur ▹ ▪ amertume ▹ ▪ horrible

**Rôles agentifs *fracture du tibia*** se faire ▪ provoquer ▪ occasionner

Diko

A navigation tool fort he lexical network

# fracture du tibia

Nom | Informations diverses | wiki | polarité

**Associations d'idées** 34 fracture ▹ ▪ tibia ▪ jambe ▹ ▪ fracture (lésion) ▪ plâtre ▹ ▪ traumatisme ▹ ▪ fracture spiroïde ▪ lésion ▪ os (squelette) ▪ os ▹ ▪ médecine ▹ ▪ lésion physique ▪ ostéosynthèse ▪ blessure sportive ▪ traumatisme (physique) ▪ accident ▹ ▪ blessure ▹ ▪ plâtre (médecine) ▪ douleur (physique) ▪ lésion osseuse ▪ fracture du plateau tibial ▪ fracture de Segond ▪ clou centro-médullaire ▪ fissure (médecine) ▪ douleur ▹ ▪ fracture ouverte ▪ chute ▹ ▪ jambe (membre) ▪ blessé ▪ blessure (lésion physique) ▪ traumatologie ▪ orthopédie ▪ fracture du 9 fracture ▹ ▪ tibia ▪ traumatologie ▪ orthopédie ▪ médecine ▹ ▪ lésion physique ▪ fracture (lésion) ▪ lésion ▪ lésion osseuse

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**Caractéristiques de *fracture du tibia*** 12 fermée ▪ ouverte [↓] ▪ grave ▹ ▪ non déplacée [↓] ▪ spiroïde ▪ douloureuse (souffrance) ▪ complexe (compliqué) ▪ diaphysaire ▪ comminutive [↓] ▪ douloureuse ▹ [↓] ▪ complexe ▹ [↓] ▪ * hépatique ▹

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**Lieux incluant/contenant *fracture du tibia* ?** tibia ▪ jambe (membre) ▪ jambe ▹ [↓] ▪ corps ▹ [↓] ▪ * bras ▹

## Sentiments/émotions associés à *fracture du tibia* 26

colère ▪ fatalité ▪ amertume (tristesse) ▪ contrariété ▪ malchance ▪ ennui (contrariété) ▪ ennui ▹ ▪ mécontentement ▪ rage ▹ ▪ triste (malheureux) ▪ tracas ▪ souffrance ▪ dépit ▪ peur ▪ découragement ▪ consternation ▪ calamité ▪ angoisse (médecine) ▪ amertume ▹ ▪ culpabilité ▪ douleur ▹ ▪ déception ▪ dépendance (assujettissement) ▪ douleur (physique) ▪ abattement ▹ ▪ horrible

Diko

A contribution tool for the lexical network

le dictionnaire d'associations lexicales contributif et libre de JeuxDeMots

kaput - 1000

Chercher | la forme | fracture du tibia

# fracture du tibia

Nom

- Natures grammaticales | ok | Lemme

Forme incorrecte de | Informations diverses | wiki | - Informations lexicales | ok

- Informations sémantiques | ok | pôlarité | Masculin équivalent | Féminin équivalent

Variantes

Raffinements morpho

Raffinements sem

Gloses (termes évoquant les sens possibles) | Inhib

Associations d'idées | béquille

fracture ▷ ▪ tibia ▪ jambe ▷ ▪ fracture (lésion) ▪ plâtre ▷ ▪ traumatisme ▷ ▪ fracture spiroïde ▪ lésion ▪ médecine ▷ ▪ lésion physique ▪ os ▷ ▪ lésion osseuse ▪ ostéosynthèse ▪ traumatisme (physique) ▪ accident ▷ ▪ plâtre (médecine) ▪ blessure (lésion physique) ▪ os (squelette) ▪ jambe (membre) ▪ douleur (physique) ▪ fissure (médecine) ▪ douleur ▷ ▪ clou centro-médullaire ▪ blessé ▪ chute ▷ ▪ blessure ▷ ▪ blessure sportive ▪ fracture du plateau tibial ▪ fracture de Segond ▪ fracture ouverte ▪ Médecine ▪ traumatologie ▪ radiologie ▪ orthopédie ▪ médecine (science) ▪ fracture du

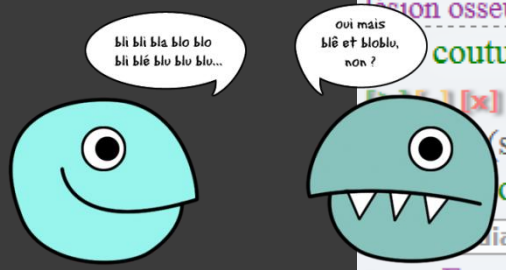
fracture ▷ ▪ tibia ▪ médecine ▷ ▪ médecine (science) ▪ Médecine ▪ radiologie ▪ orthopédie ▪ traumatologie ▪ lésion physique ▪ fracture (lésion) ▪ lésion osseuse

fracture tassement [>] [-] [x] [!] ▪ maladie (médecine) [>] [-] [x] [!] [?] ▪ fatigue [>] [-] [x] couture [>] [-] [x] [!] ▪ panser [>] [-] [x] [!] ▪ maladie [>] [-] [x] [!] ▪ pansement [>] [-] [x] [!] ▪ plaie [>] [-] [x] [!] ▪ stress [>] [-] [x] [!] ▪ avoir mal [>] [-] [x] [!] ▪ médecine (remède) [>] [-] [x] [!] [?] ▪ (sociologie) [>] [-] [x] [!] [?] ▪ urgences [>] [-] [x] [!] ▪ cassé [>] [-] [x] [!] ▪ hospitalisation [>] [-] onvalescence [>] [-] [x] [!] ▪ AVP [>] [-] [x] [!]

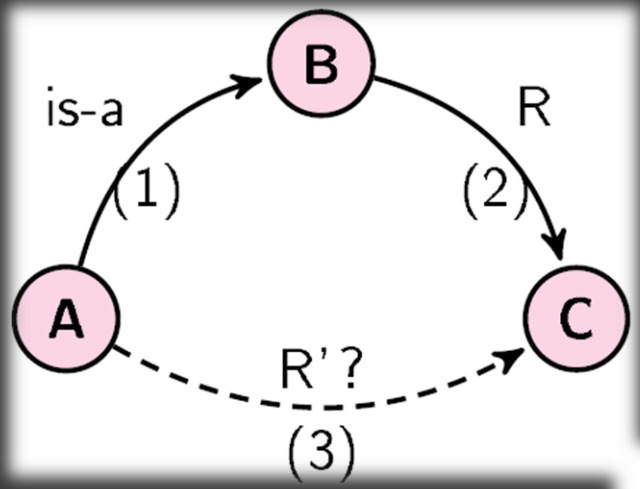
péroné ● ▪ ski ▷ ● ▪ tibia ● ▪ genou ● ▪ fracture ▷ ● ▪ Genou ● ▪ cheville ▷ ● ▪ consolidation ▷ ● ▪ Fracture ●

double fracture ●

Est accompagné par | fracture du péroné ● ▪ fracture de la fibula ● | Liens sociaux/familiaux



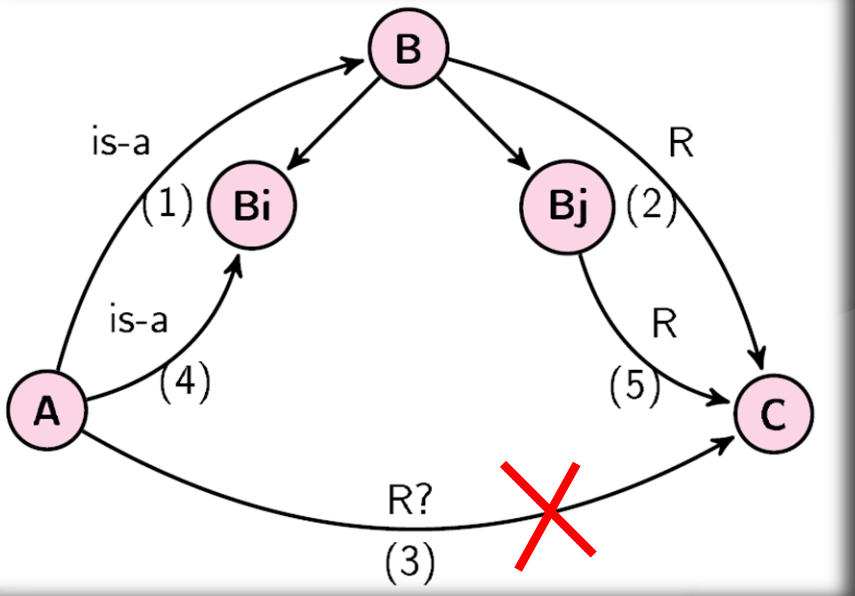
# CONSOLIDATION AND CHECKING WITH INFERENCES - DEDUCTION




From the most general toward the most specific

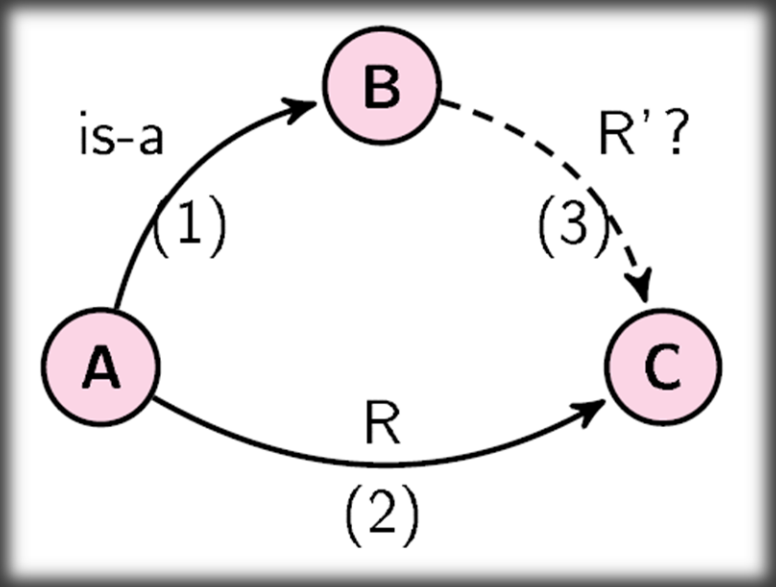
Logical and statistical blocking because of polysemy - for example:

- livre > lecture
- livre > monnaie
- livre > masse

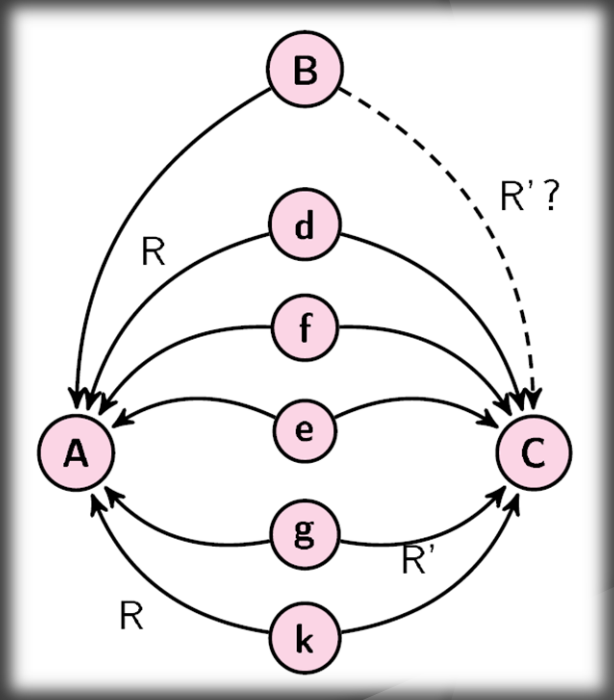



* Bible *is-a* livre & livre *carac* convertible
=> Bible *carac* convertible

# CONSOLIDATION AND CHECKING USING INFERENCES – INDUCTION AND ABDUCTION




From specific to general



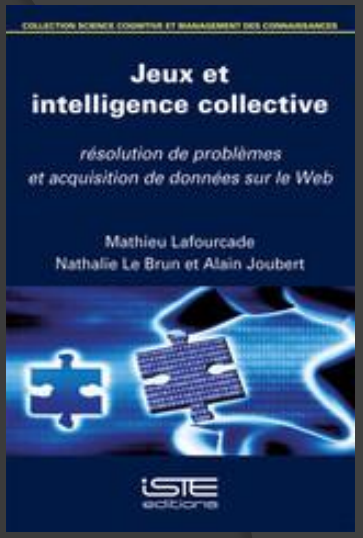

imitation of examples

The 3 inference types = detector

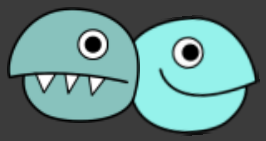
- of error in premises (1%)
- of exceptions (< 1%)
- of missing refinements (3%)
- of not relevant correct relations (3%)

Around 93 % of the inferred relations are correct and relevant

# SOME CONCLUSIONS



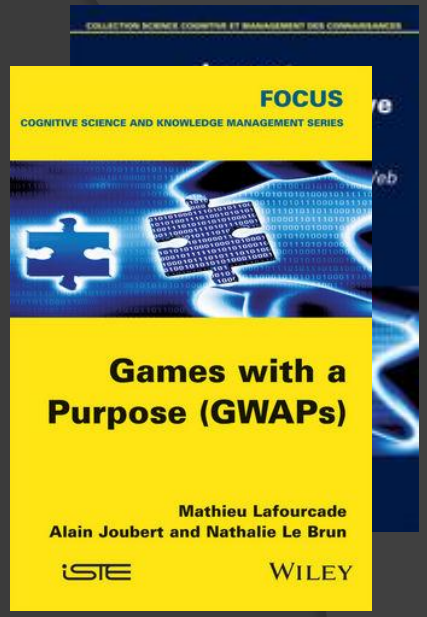

- Since sept. 2007 (8 years)
  - > 23 million relations between 570 000 terms and 80 relation types
  - annotated relations (relevant, possible, not relevant)
    - → the largest network of this type
    - → already used for research and by some companies
- Evaluation
  - Collation of various points of view – negociated (diko) or not (games)
  - Implicit relations (not present in texts) are captured by instruction forcing (players are invited to be explicit)

gwap  crowdsourcing

principles are globally validated for lexical networks

- Relevant for general knowledge but also for specific domains (good surprise!)
- With GWAP (JDM, Askit, LikeIt, …) but also with contributions (Diko)
- In general, vertuous loop is difficult to identify
  playing well ←→ producing proper data

# SOME CONCLUSIONS

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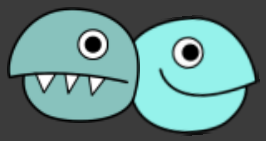
gwap  crowdsourcing

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playing well ←→ producing proper data

# MORE CONCLUSIONS

Some ethical aspects

- many involved players (some with more than 2000 hrs of play)
- no memory in the lexical network of who has made what
  (only temporary storage of games waiting to be fechted)
- players are anonymous (login + pwd + email)
- less than 1% troll / vandalism – corrected as soon as discovered

- The data are made by the crowd...
  ... and should return to the crowd

→ Freely available

# THANK YOU

Jeux de mots

JEUXDEMOTS.ORG

DEMONSTRATIONS
QUESTIONS

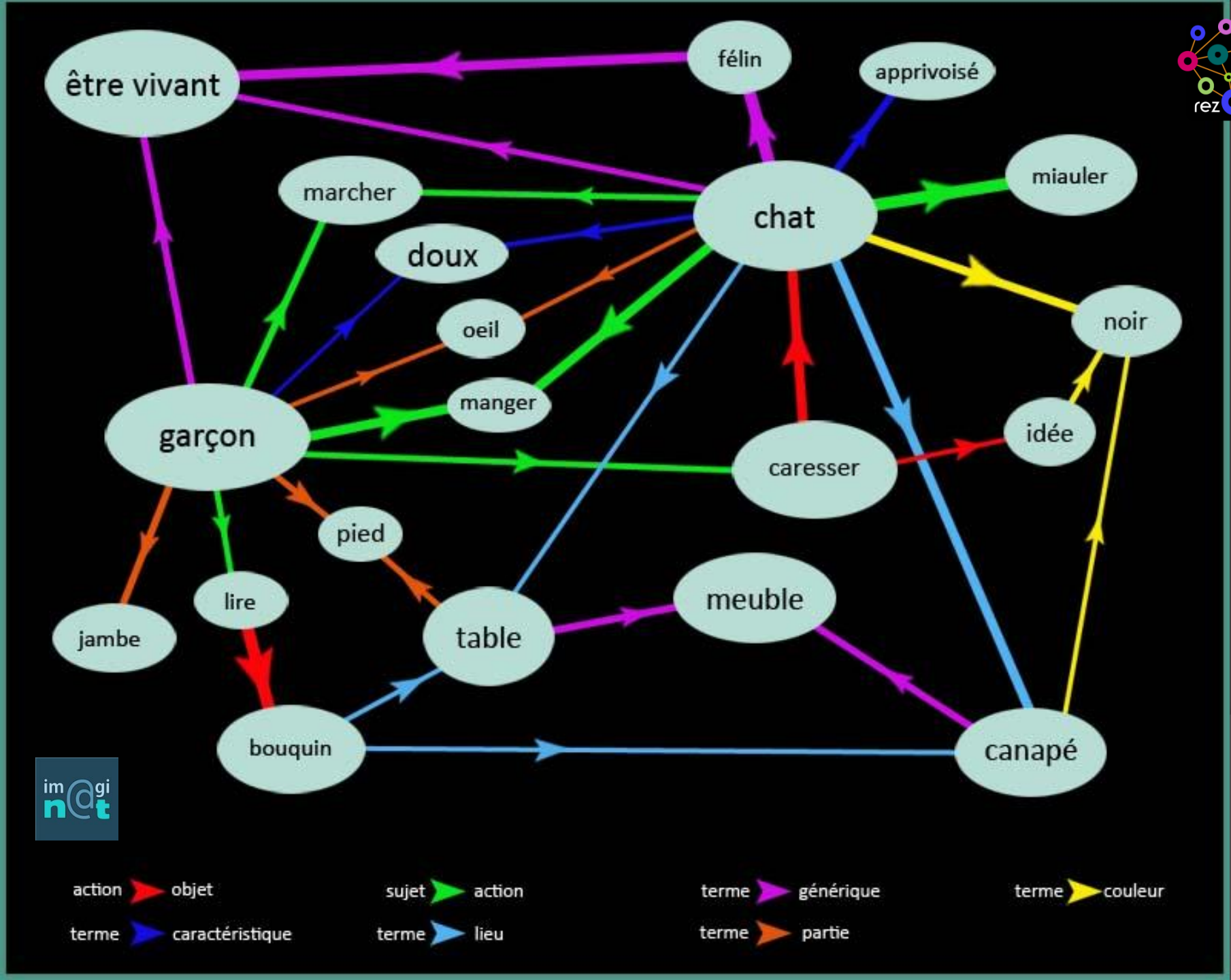
# DETAIL OF RELATIONS DISTRIBUTION

6542950 r_associated (0) - 30.467 %
1531831 r_pos (4) - 7.133 %
454401 r_hypo (8) - 2.116 %
191855 r_flpot (12) - 0.893 %
24636 r_instr (16) - 0.115 %
7168 r_magn (20) - 0.033 %
259958 r_agent-1 (24) - 1.21 %
93092 r_lieu-1 (28) - 0.433 %
21873 r_sentiment (32) - 0.102 %
1133563 r_infopot (36) - 5.278 %
6540 r_action-verbe (40) - 0.03 %
460 r_verbe-adj (44) - 0.002 %
1245 r_chunk_instr (48) - 0.006 %
3075 r_successeur-time (52) - 0.014 %
3397 r_against-1 (56) - 0.016 %
154 r_fem (60) - 0.001 %
121344 r_instance (64) - 0.565 %
83 r_set>item (68) - 0 %
1674 r_syn_strict (72) - 0.008 %
435 r_der_morpho (99) - 0.002 %
6882 r_has_actors (103) - 0.032 %
215 r_cible (107) - 0.001 %
112 r_predecesseur-space (111) - 0.001 %
28 r_descend_de (151) - 0 %
1005096 r_anotation (998) - 4.68 %
81 r_termgroup (1002) - 0 %

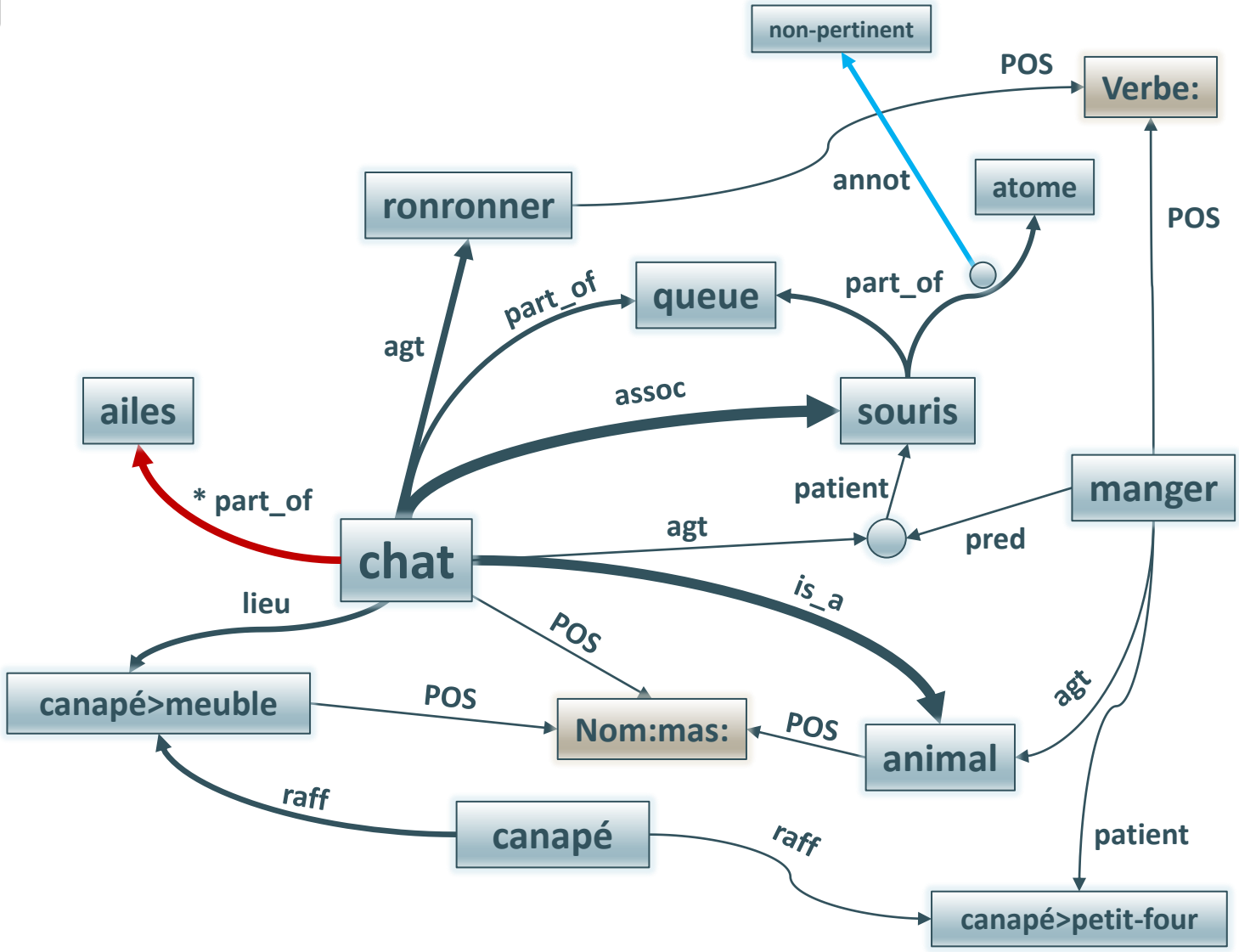
25083 r_raff_sem (1) - 0.117 %
236897 r_syn (5) - 1.103 %
640038 r_has_part (9) - 2.98 %
254829 r_agent (13) - 1.187 %
113062 r_carac (17) - 0.526 %
6644 r_antimagn (21) - 0.031 %
10032 r_instr-1 (25) - 0.047 %
7469 r_chunk_pred (29) - 0.035 %
923 r_error (33) - 0.004 %
6909 r_telic_role (37) - 0.032 %
41072 r_conseq (41) - 0.191 %
2813 r_chunk_sujet (45) - 0.013 %
1632 r_time (49) - 0.008 %
4155 r_make (53) - 0.019 %
403 r_implication (57) - 0.002 %
1809 r_equiv (61) - 0.008 %
67 r_verb_real (65) - 0 %
202 r_item>set (69) - 0.001 %
1406 r_bigger_than (73) - 0.007 %
1489 r_has_auteur (100) - 0.007 %
52 r_deplac_mode (104) - 0 %
448 r_symptomes (108) - 0.002 %
37 r_successeur-space (112) - 0 %
82108 r_aki (666) - 0.382 %
48238 r_inhib (999) - 0.225 %
6 r_learning_model (2001) - 0 %

33727 r_raff_morpho (2) - 0.157 %
585836 r_isa (6) - 2.728 %
632055 r_holo (10) - 2.943 %
43111 r_patient (14) - 0.201 %
11298 r_data (18) - 0.053 %
17113 r_family (22) - 0.08 %
43098 r_patient-1 (26) - 0.201 %
25166 r_lieu_action (30) - 0.117 %
15213 r_maner (34) - 0.071 %
3921 r_agentif_role (38) - 0.018 %
41000 r_causatif (42) - 0.191 %
3736 r_chunk_objet (46) - 0.017 %
5580 r_object>mater (50) - 0.026 %
2634 r_product_of (54) - 0.012 %
635 r_quantificateur (58) - 0.003 %
655 r_maner-1 (62) - 0.003 %
0 r_chunk_head (66) - 0 %
280 r_processus>agent (70) - 0.001 %
1546 r_smaller_than (74) - 0.007 %
80 r_has_personnage (101) - 0 %
1 r_has_interpret (105) - 0 %
744 r_predecesseur-time (109) - 0.003 %
7 r_social_tie (113) - 0 %
5777889 r_wiki (777) - 26.905 %
0 r_prev (1000) - 0 %

188145 r_domain (3) - 0.876 %
18417 r_anto (7) - 0.086 %
532905 r_locution (11) - 2.481 %
101387 r_lieu (15) - 0.472 %
78976 r_lemma (19) - 0.368 %
102743 r_carac-1 (23) - 0.478 %
186970 r_domain-1 (27) - 0.871 %
25063 r_action_lieu (31) - 0.117 %
38718 r_meaning (35) - 0.18 %
6632 r_verbe-action (39) - 0.031 %
468 r_adj-verbe (43) - 0.002 %
0 r_chunk_loc (47) - 0 %
622 r_mater>object (51) - 0.003 %
1411 r_against (55) - 0.007 %
362 r_masc (59) - 0.002 %
265 r_agentive_implication (63) - 0.001 %
466 r_similar (67) - 0.002 %
4479 r_variante (71) - 0.021 %
554 r_accomp (75) - 0.003 %
241 r_can_eat (102) - 0.001 %
40742 r_color (106) - 0.19 %
466 r_diagnostique (110) - 0.002 %
40 r_beneficiaire (150) - 0 %
6 r_anotation_exception (997) - 0 %
0 r_succ (1001) - 0 %




A typed directed and weighted lexical network: example

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