Basic NLP Tools

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IXA group

Departamento de Lenguajes y Sistemas Informáticos

UPV/EHU

Content

- Tools and Applications
  - Introduction
  - Basic Tools & frameworks
    - Basic processing (Unix for Poets)
      - Tokenization, Sentence Splitting, Language detection, ..
    - Stemming, lemmatization, POS tagging, …
    - Named Entity Recognizers and Categorizers (NERC)
    - Parsing
    - Word Sense Disambiguation (WSD)
    - Coreference resolution: anaphoric references, …
    - Semantic Role Labelling (SRL)
    - Time detection and normalization
    - …
    - Complete NLP suites

Basic NLP Tools
Introduction

- Public Catalogues
  - http://sinai.ujaen.es/timm/wiki/index.php/Recursos
  - http://ixa2.si.ehu.es/know2/index.php/Inventario_recursos
  - http://aclweb.org/aclwiki
  - ...
- NewsReader Deliverable D4.1
  - http://www.newsreader-project.eu/files/2012/12/NewsReader-316404-D4.1.pdf
- Plataformas y sistemas de procesamiento lingüístico de alto rendimiento
  - http://www.agendadigital.gob.es/tecnologias-lenguaje/actuaciones/Documents/informe_nlpar.pdf

Basic Processing

- Unix for poets
- Tika
  - https://tika.apache.org/
- Language Identification
  - Compact Language Detector (Chromium)
    - https://github.com/google/cld3
- Sentence splitter
  - https://pypi.org/project/sentence-splitter/

Morphological Analysis

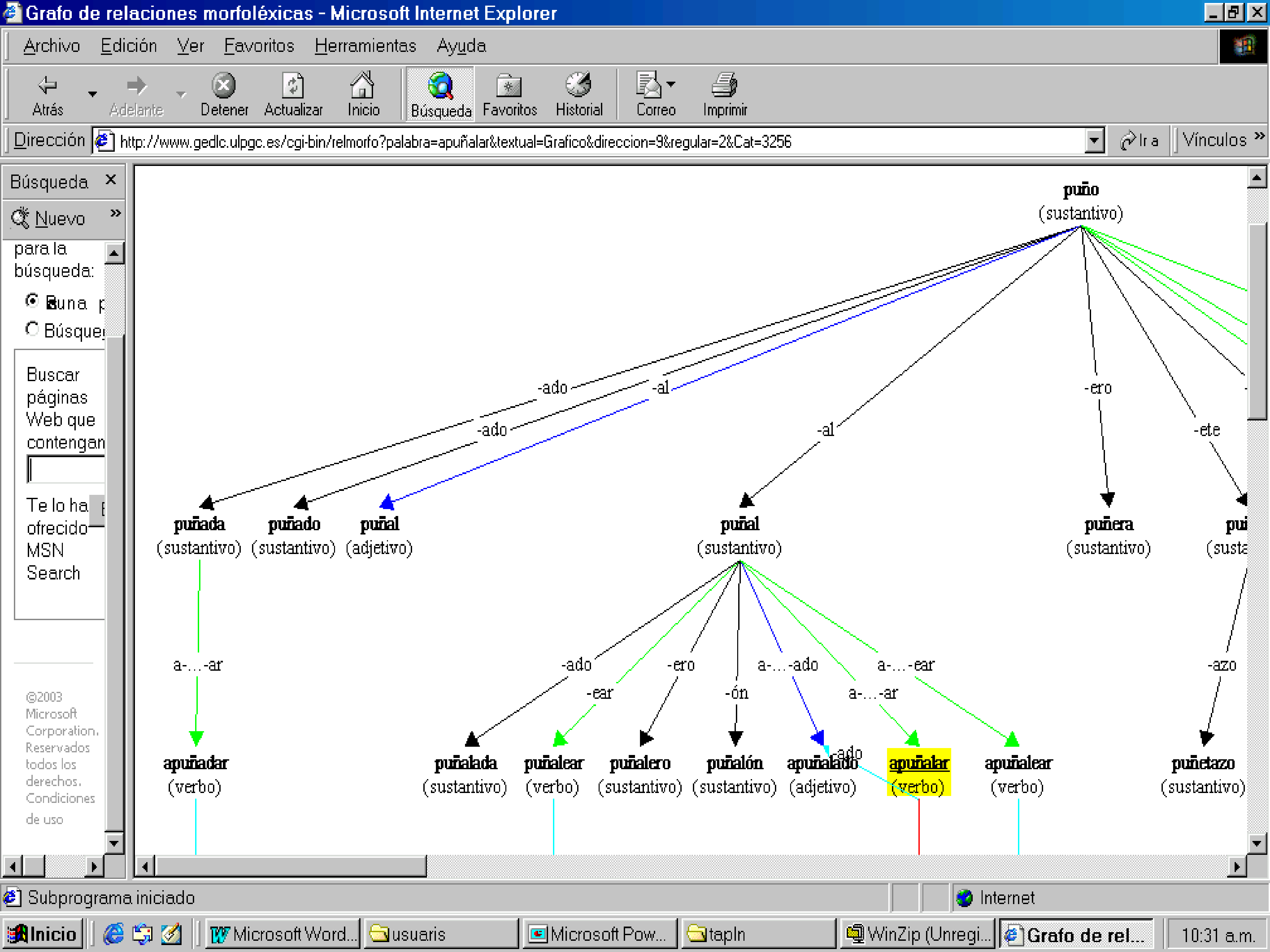
- Setting
- Systems
  - Morpholexical relationships (Octavio Santana)
  - Freeling (Lluís Padró)
  - IXA-pipeline
  - English stemmers
  - ...

Morphological Analysis

- Morphology deals with the orthographic form of the words
- Morphological processes
  - Inflection: prefixes + root + suffixes (root, lemma, form)
  - Derivation: change of category
- Multi-word expressions: compounds, idioms, phrasal verbs, ...
- Grammatical categories, parts-of-speech
  - Open categories and closed (functional) categories
  - Lexicon
  - POS tags

Morphological Analysis

- Main Parts-of-Speech
  - Open class words
    - Noun: common noun, proper noun (gender, number, ...)
    - Adjective: attributive, comparative ...
    - Verb: (number, person, mode, tense), auxiliary verbs
    - Adverb: place, time, manner, degree, ...
  - Closed class words
    - Pronoun: nominative, accusative, ... (anaphora)
    - Determiner: articles, demonstratives, quantifiers ...
    - Preposition:
    - Conjunction:



Grafo de relaciones morfoléxicas - Microsoft Internet Explorer

http://www.gedlc.ulpgc.es/cgi-bin/relmorfo?palabra=apuñalar&textual=Grafico&direccion=9&regular=2&Cat=3256

para la búsqueda:

Buscar páginas Web que contengan

Te lo ha ofrecido MSN Search

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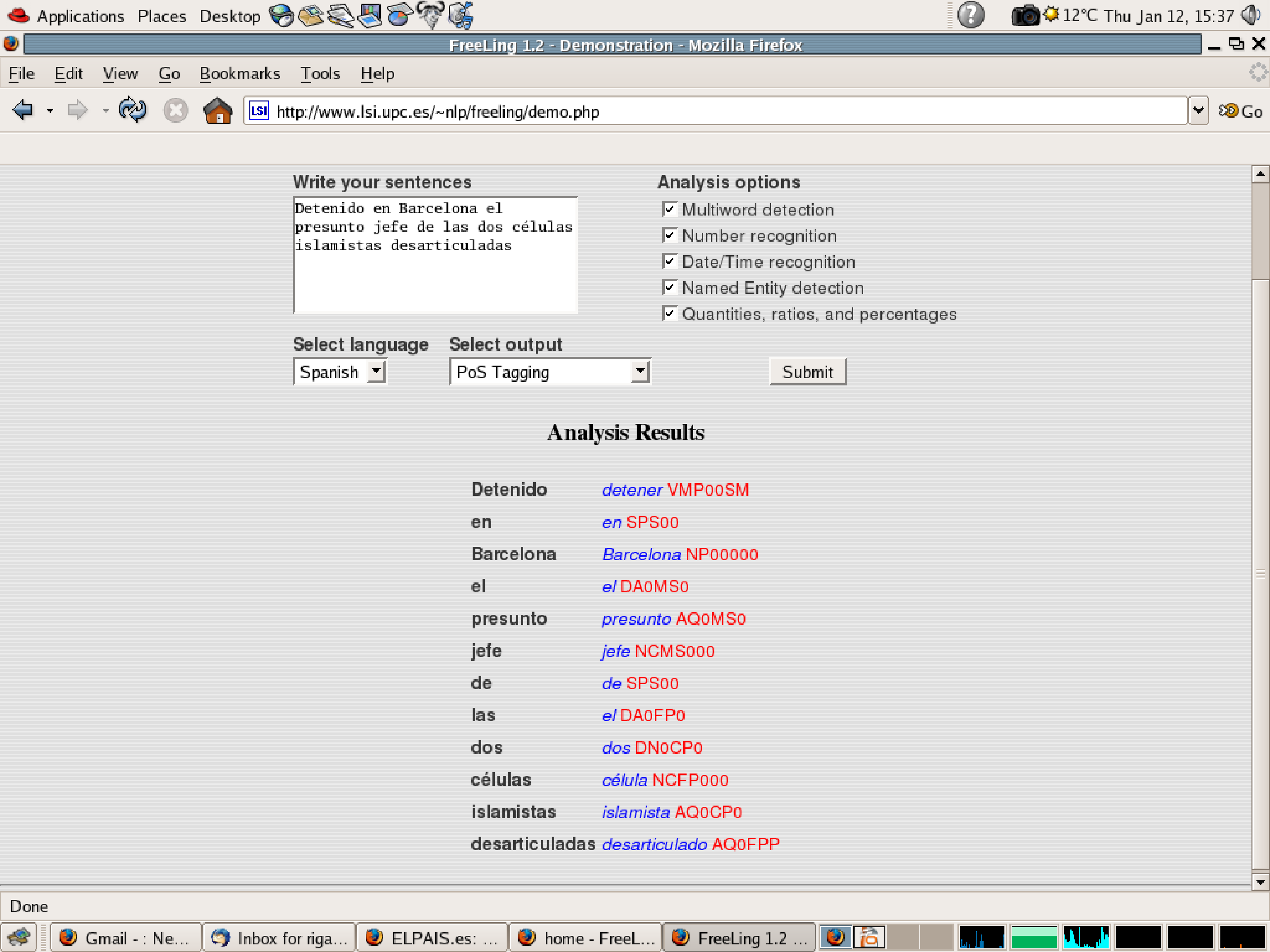
Subprograma iniciado



FreeLing 1.2 - Demonstration - Mozilla Firefox

http://www.lsi.upc.es/~nlp/freeling/demo.php

Write your sentences

```
Detenido en Barcelona el
presunto jefe de las dos células
islamistas desarticuladas
```

Analysis options

☑ Multiword detection
☑ Number recognition
☑ Date/Time recognition
☑ Named Entity detection
☑ Quantities, ratios, and percentages

Select language Spanish

Select output PoS Tagging

Submit

Analysis Results

```
Detenido       detener VMP00SM
en             en SPS00
Barcelona      Barcelona NP00000
el             el DA0MS0
presunto       presunto AQ0MS0
jefe           jefe NCMS000
de             de SPS00
las            el DA0FP0
dos            dos DN0CP0
células        célula NCFP000
islamistas     islamista AQ0CP0
desarticuladas desarticulado AQ0FPP
```

Named Entity Recognition and Classification

- Setting
- Datasets
- Systems

Named Entity Recognition and Classification (NERC) **Setting**

- NER is a subtask of Information Extraction.
- Named entities are phrases that contain the names of persons, organizations, locations, times and quantities.

[ORG U.N.] official [PER Ekeus] heads for [LOC Baghdad] .

- Evaluation campaings
  - Message Understanding Conference in 1995 (MUC6)
  - Message Understanding Conference in 1997 (MUC7)
  - CONLL 2002 shared task
  - CONLL 2003 shared task

NER example

- **NERC**

Nothing special really. Comfortable and clean but very boring decor in comparison to other **NH hotels**. I stayed in **NH** in **Brussels** and **Zurich** and I really liked them because of their modern and stylish design and big rooms. This one was just like any other hotel. Basic rooms with basic and dull decor - bit disappointing. The customer service was average. The rate was very expensive and I still had to pay for Internet and **20 euros** for breakfast!!! It was good but way overpriced! The best thing about the hotel was the location - city centre, 2min from a metro stop.

NER example

- **Co-reference**

Nothing special really. Comfortable and clean but very boring decor in comparison to **other** **NH hotels**. I stayed in **NH** in **Brussels** and **Zurich** and I really liked **them** because of **their** modern and stylish design and big rooms. **This one** was just like any **other** hotel. Basic rooms with basic and dull decor - bit disappointing. The customer service was average. The rate was very expensive and I still had to pay for Internet and **20 euros** for breakfast!!! It was good but way overpriced! The best thing about **the hotel** was **the location** - city centre, 2min from a metro stop.

NER example

- **Wikification (Named Entity Linking)**

Nothing special really. Comfortable and clean but very boring decor in comparison to **other** **NH hotels**. I stayed in **NH** in **Brussels** and **Zurich** and I really liked **them** because of **their** modern and stylish design and big rooms. **This one** was just like any **other** hotel. Basic rooms with basic and dull decor - bit disappointing. The customer service was average. The rate was very expensive and I still had to pay for Internet and **20 euros** for breakfast!!! It was good but way overpriced! The best thing about **the hotel** was **the location** - city centre, 2min from a metro stop.

http://en.wikipedia.org/wiki/NH_Hoteles
http://es.wikipedia.org/wiki/NH_Hoteles ... http://dbpedia.org/page/NH_Hoteles
http://en.wikipedia.org/wiki/Brussels
http://en.wikipedia.org/wiki/Zurich
http://en.wikipedia.org/wiki/Euro

Another NER example

- **Domain extension tools**

I looked for not very expensive hotels in **Luxembourg** capital, and based on internet-info, **hotel-restaurant "Italia"** seemed to be a good choice. And **it** has appeared to meet **my** expectations. Of course, **those** that are looking for luxurious accommodation or are spoilt with everything excellent, should not stay there.

http://dbpedia.org/page/Luxembourg
http://dbpedia.org/page/Hotel-Restaurant-Italia-in-Luxembourg (**NEW**!)

- Using Named Entity Repository ...

Named Entity Recognition and Classification

- NERC Datasets
  - CONLL 2002 datasets
  - CONLL 2003 datasets
  - BBN Corpus
  - Wikigold and WikiNER
  - German Europarl
  - JRC Names
  - Ontonotes 4.0
  - Ancora
  - Synthema Entity Knowledge Base
  - Italian Content Annotation Bank (I-CAB)
  - EVALITA 2011 NER dataset
  - SWiiT: Semantic WIkipedia for Italian
  - ...

Named Entity Recognition and Classification

- NERC Systems
  - OpenCalais
  - BBN Identifinder
  - LingPipe
  - Stanford CoreNLP
  - Freeling
  - Illinois Named Entity Tagger
  - SuperSense Tagger
  - OpenNLP
  - C&C tools
  - GATE
  - IXA-pipeline
  - ...

Named Entity Recognition and Classification

- Named Entity Datasets & Repositories
  - WePS (Web People Search Corpus) Datasets
  - CSWA
  - KBP at TAC
  - Cucerzan 2007
  - Fader 2009
  - Dredze 2010
  - ACEtoWiki
  - AIDA CoNLL Yago
  - TAGME Datasets
  - Illinois Wikifier Datasets
  - Wikipedia Miner
  - Google Wikipedia Concepts Dictionary
  - DBpedia
  - Freebase
  - YAGO2
  - GeoNames
  - LinkedGeoData
  - ...

Named Entity Recognition and Classification

- Named Entity Linking Systems
  - OKKAM
  - The Wiki Machine
  - Zemanta
  - AlchemyAPI
  - CiceroLite from LCC
  - Illinois Wikifier
  - DBpedia Spotlight
  - WikiMiner
  - TAGME
  - ...

Parsing (Syntactic Analysis)

- Setting
- PARSEVAL evaluation exercices
  - http://nlp.stanford.edu/software/stanford-dependencies.shtml
- Systems
  - RASP (John Carroll & Ted Briscoe)
  - Minipar (Dekang Lin)
  - VISL (Eckhard Bick)
  - Stanford CoreNLP
  - Freeling
  - IXA-pipeline
  - ...

Parsing (Syntactic Analysis)

- Syntax and grammar
- Phrase structure
  - Word order
  - Syntagma, phrase, constituent
    - NP, VP, AP, head, relative clause
- Grammars
  - Syntax vs. lexicon
  - Coverage: complete, partial ...
  - Chunking, clausing, ...
  - Context-free grammars
    - Terminals, no terminals, parse trees, recursivity
    - Non-local dependencies

      The woman who found the wallet were given a reward

Word Sense Disambiguation

- Setting
- WSD Tutorial (Navigli 09)
- WSD Book (Agirre & Edmonds 07)
- SENSEVAL 1, 2, 3, SEMEVAL2007, 2010, ...
- Systems
  - Knowledge-based WSD
    - Conceptual Distance (Ted Pedersen)
    - SSI (Roberto Navigli), SSI-Dijkstra (Cuadros & Rigau)
    - UKB (Soroa & Agirre)
  - Corpus-based WSD
    - GAMBL (Walter Daelemans)
    - SenseLearner (Raha Mihalcea)
    - Base Concept (Rubén Izquierdo)

Word Sense Disambiguation
Setting

- WSD is the problem of assigning the appropriate meaning (sense) to a given word in a text
- “WSD is perhaps the great open problem at the lexical level of NLP” (Resnik & Yarowsky 97)
- WSD resolution would allow:
  - acquisition of knowledge: SCF, Selectional Preferences, Predicate Models, etc.
  - improve existing Parsing, IR, IE
  - Machine Translation
  - Natural Language Understanding
  - ...

Word Sense Disambiguation
Setting

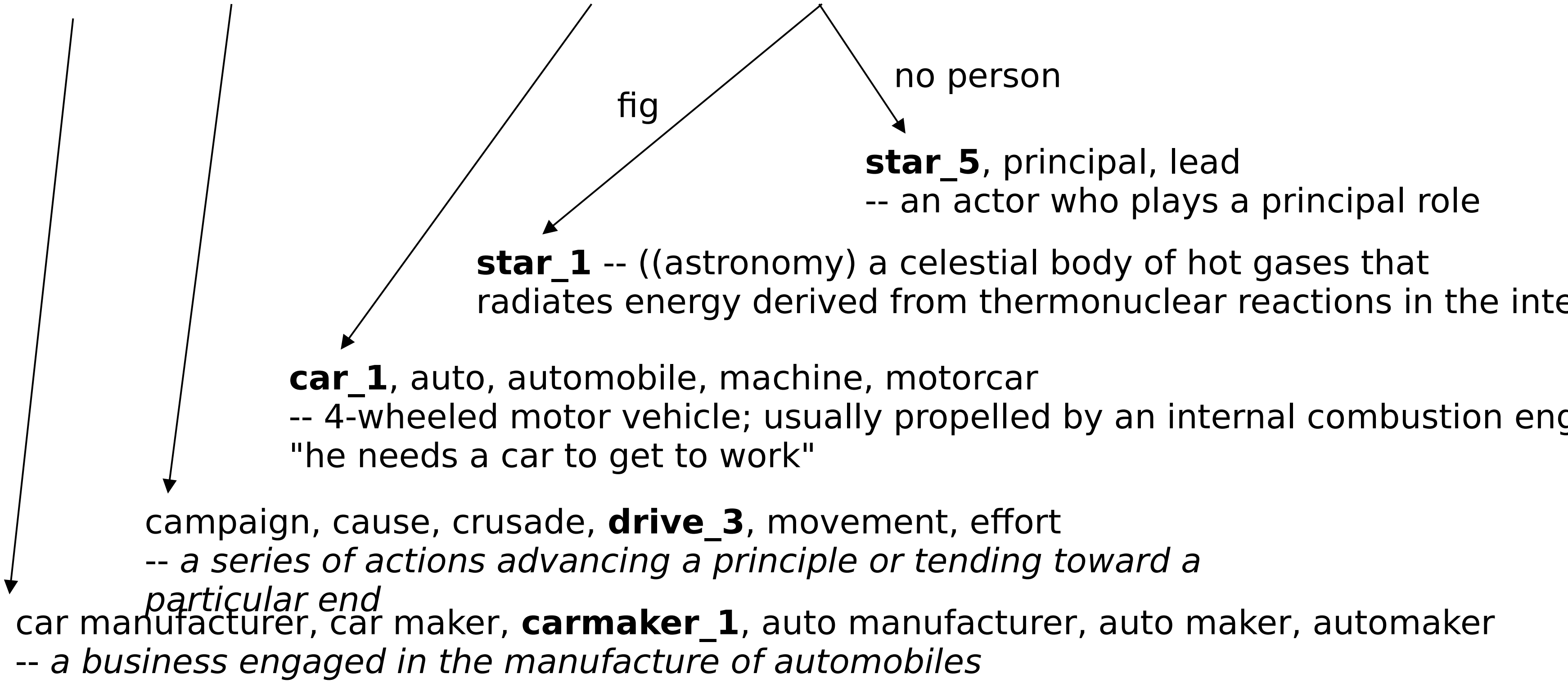
- From Financial Times

GM’s drive to make Saturn a star again

Word Sense Disambiguation
Setting

- From Financial Times

GM’s drive to make Saturn a star again



fig

no person

star_5, principal, lead
-- an actor who plays a principal role

star_1 -- ((astronomy) a celestial body of hot gases that
radiates energy derived from thermonuclear reactions in the inte

car_1, auto, automobile, machine, motorcar
-- 4-wheeled motor vehicle; usually propelled by an internal combustion eng
"he needs a car to get to work"

campaign, cause, crusade, **drive_3**, movement, effort
-- *a series of actions advancing a principle or tending toward a particular end*

car manufacturer, car maker, **carmaker_1**, auto manufacturer, auto maker, automaker
-- *a business engaged in the manufacture of automobiles*

Word Sense Disambiguation
Setting

- Knowledge-Driven WSD
  - knowledge-based WSD
  - No Training Process (~ unsupervised)
  - Large scale lexical knowledge resources
    - WordNet, MRDs, Thesaurus, ...
  - 100% coverage
  - ~70% accuracy (SensEval)
  - ...

Word Sense Disambiguation
Setting

- Corpus-Driven WSD
  - statistical-based WSD
  - Machine-Learning,
    - Deep Learning WSD
  - Training Process (~ supervised)
    - learning from sense annotated corpora
    - (Ng 97) effort of 16 man/year per year per language
  - no full coverage
  - ~80% accuracy (SensEval)

Coreference Resolution

- Setting
- Datasets
- Systems

Coreference Resolution

- **Co-reference** occurs when multiple expressions in a sentence or document refer to the same thing
- Mary said she would help me.
- I saw Scott yesterday. He was fishing by the lake.

Coreference Resolution

- Datasets
  - MUC-6 (1995) and MUC-7 (1997)
  - ACE (2002 -)
  - Ontonotes
  - Ancora-CO
  - Corea
  - ...

Coreference Resolution

- Systems
  - GUITAR
  - Bart
  - Illinois coreference Package
  - ARKref
  - Reconcile
  - MARS
  - CherryPicker
  - Stanford CoreNLP
  - RelaxCor
  - JavaRAP
  - IXA-pipeline
  - ...

Semantic Role Labelling

- Setting
  - SRL Tutorial (Lluís Màrquez 05)
- Datasets
  - CONLL'04 shared task
  - CONLL'05 shared task
  - https://github.com/System-T/UniversalPropositions
- Systems

Semantic Role Labelling
Setting

- SRL is the problem of recognizing and labelling semantic roles of a predicate
- A **semantic role** in language is the relationship that a syntactic constituent has with a predicate.
- Typical semantic arguments include:
  - Agent, Patient, Instrument, etc.
- and also adjunctive arguments:
  - Locative, Temporal, Manner, Cause, etc.
- Useful for answering "Who", "When", "What", "Where", "Why", etc.
  - IE, QA, Summarization and Semantic Interpretation

Semantic Role Labeling
Setting

- From PropBank

  [A0 He] [AM-MOD would] [AM-NEG n't] [V **accept**][A1 anything of value] from [A2 those he was writing about] .

- Roleset
  - V: verb
  - A0: acceptor
  - A1: thing accepted
  - A2: accepted-from
  - A3: attribute
  - AM-MOD: modal
  - AM-NEG: negation

Semantic Role Labelling

- Systems
  - Using **PropBank** rolesets …
    - **Assert** http://cemantix.org/software/assert.html
    - **Illinois** Semantic Role Labeler
    - **SwiRL** http://www.surdeanu.name/mihai/swirl/index.php
    - **Senna** http://ml.nec-labs.com/senna
    - **MATE** tools … http://barbar.cs.lth.se:8081
    - **Mateplus** … https://github.com/microth/mateplus
    - **Neural / Deep SRL** …
      - https://github.com/hiroki13/neural-semantic-role-labeler
      - https://github.com/sanjaymeena/semantic_role_labeling_deep_learning
      - https://github.com/luheng/deep_srl
      - https://github.com/diegma/neural-dep-srl
    - …

Semantic Role Labelling

- Systems
  - Using **FrameNet** rolesets ...
    - **Shalmanesser** ...
      - http://www.coli.uni-saarland.de/projects/salsa/shal
    - **LTH**
      - http://nlp.cs.lth.se/software/semantic_parsing_framenet_frames
    - **SEMAFOR**
      - http://www.ark.cs.cmu.edu/SEMAFOR
    - **Framat**
      - https://github.com/microth/mateplus
    - **Open-SESAME**
      - https://github.com/Noahs-ARK/open-sesame
      - ...

Time detection and normatization
Setting

- Detection of time expressions and normalization
- Annotations follow TimeML TIMEX3 standard
  - http://www.timeml.org/site/publications/timeMLdocs/timeml_1.2.1.html#timex3
- Resolves relative times with respect to reference date (usually Document Creation Time, DCT)
- Main Temporal types
  - Time – A instance in time (2011-08-11), can be partially specified (Friday), with limited granularity
  - Duration - A length of time (3 days)
  - Range – Time interval with start and end points
  - Set – A set of temporals
  - Periodic sets: Every Friday

Time detection and normatization
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Time detection and normatization
Setting

- Time
  - Standard date and times (in years, months, days, day of week, hours, minutes, seconds, milliseconds)
  - Common times: Seasons (e.g. winter), Time of day (e.g. morning), Weekend
  - Partial Times (June => XXXX-06)
  - Relative Time (last week)
- Duration
  - Exact durations (specified in milliseconds or in fields)
  - Inexact durations (a few years => PXY)
  - Duration ranges (2 to 3 months => P2M/P3M)

Time detection and normatization
Examples

- Reference Date is 2015-11-17
- next Christmas :
  - <TIMEX3 tid="t1" TYPE="DATE" ALT_VAL="20151225">next Christmas</TIMEX3>
- Every third Sunday :
  - <TIMEX3 tid="t1" value="XXXX-WXX-7" type="SET" quant="every third" periodicity="P3W">Every third Sunday</TIMEX3>
- 5:05 in the afternoon
  - <TIMEX3 tid="t1" value="2015-11-17T17:05:00" type="TIME">5:05 in the afternoon</TIMEX3>
- two to three months
  - <TIMEX3 tid="t1" alt_value="P2M/P3M" type="DURATION">two to three months</TIMEX3>

Time detection and normatization
Datasets

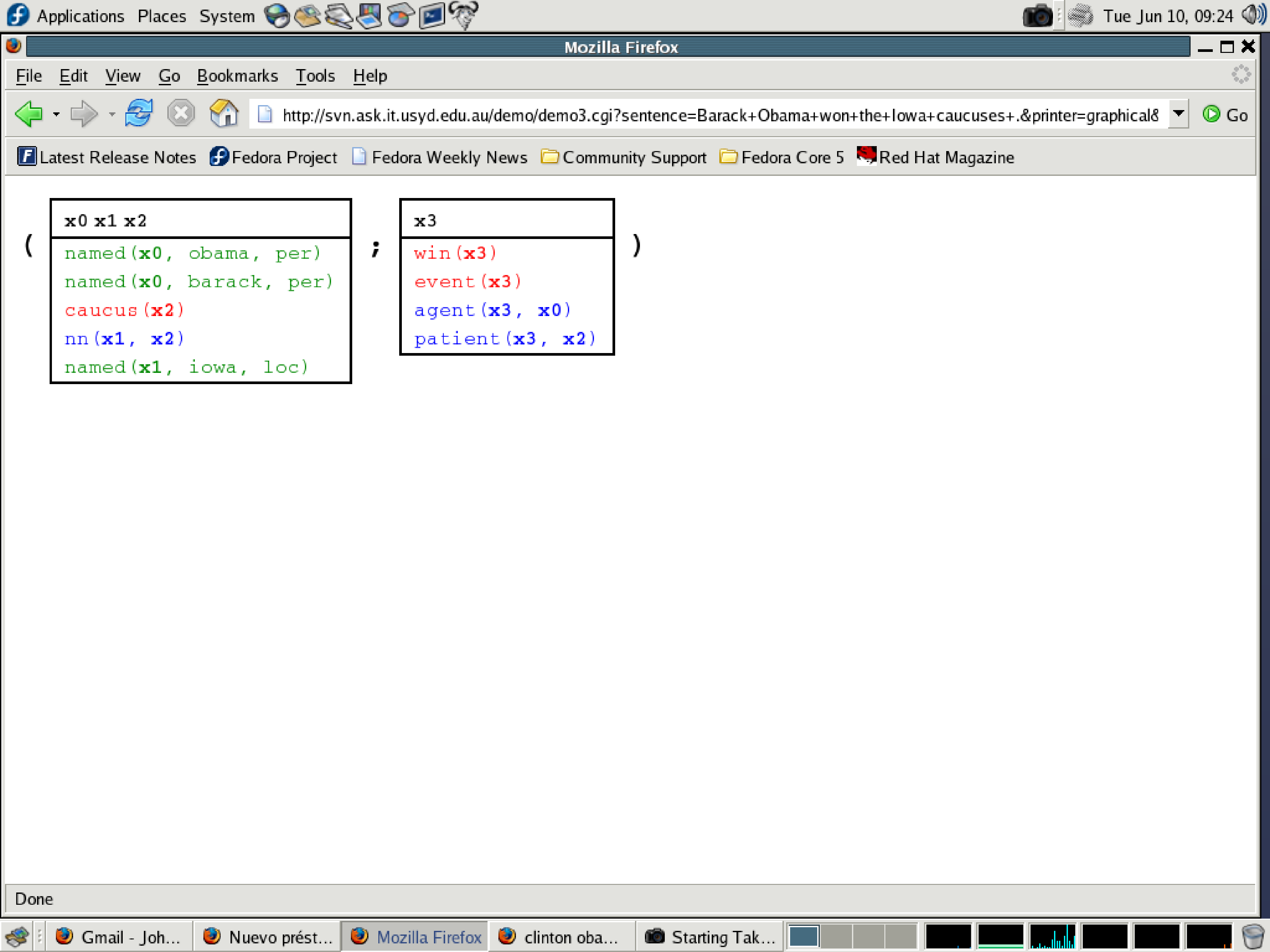
- MUC6, MUC7
- ACE-2004, 2005, 2007
- Timebank 1.1, 1.2
- AQUAINT TimeML Corpus
- WikiWars
- ModeS TimeBank 1.0
- TempEval1, TempEval2, TempEval3
- TimeTrack@ SemEval, Timelines, …
- …

Time detection and normatization
Systems

- SUTime : http://nlp.stanford.edu/software/sutime.shtml
- TimeNorm: https://github.com/bethard/timenorm
- HeidelTime: https://github.com/HeidelTime/heideltime
- Tipsem : https://github.com/hllorens/otip
- Tarsqui : http://www.timeml.org/site/tarsqi/index.html
- Mantime : https://github.com/filannim/ManTIME
- ...

NLU

- Towards NLU
  - Boxer: ... http://svn.ask.it.usyd.edu.au/trac/candc/wiki/boxer ...
  - ...



http://svn.ask.it.usyd.edu.au/demo/demo3.cgi?sentence=Barack+Obama+won+the+Iowa+caucuses+.&printer=graphical8

```
   +-------------------------+     +--------------------+
   | x0 x1 x2                |     | x3                 |
   +-------------------------+     +--------------------+
(  | named(x0, obama, per)   |  ;  | win(x3)            |  )
   | named(x0, barack, per)  |     | event(x3)          |
   | caucus(x2)              |     | agent(x3, x0)      |
   | nn(x1, x2)              |     | patient(x3, x2)    |
   | named(x1, iowa, loc)    |     +--------------------+
   +-------------------------+
```

Done

NLP suites

- Complete suites for NLP
  - GATE ... http://gate.ac.uk
  - NLTK … http://www.nltk.org/ …
  - LingPipe ... http://alias-i.com/lingpipe/ ...
  - C&C tools … http://svn.ask.it.usyd.edu.au/trac/candc/wiki
  - Freeling … http://nlp.lsi.upc.edu/freeling/ …
  - Stanford CoreNLP … http://nlp.stanford.edu/software/corenlp.shtml
  - Apache OpenNLP … https://opennlp.apache.org/
  - IXA-pipes … https://github.com/ixa-ehu
  - NewsReader … http://www.newsreader-project.eu/results/software
  - Polyglot … https://github.com/aboSamoor/polyglot
  - SpaCy … https://spacy.io
  - NLP-Cube https://github.com/adobe/NLP-Cube
  - ...

NLP suites

- Deep Learning Toolkits
  - Stanford Stanza … https://stanfordnlp.github.io/stanza/
  - AllenNLP … https://github.com/allenai/allennlp
  - Flair … https://github.com/zalandoresearch/flair
  - Transformers … https://github.com/huggingface/transformers
  - SimpleTransformers … https://simpletransformers.ai/
  - Fairseq … https://github.com/pytorch/fairseq
  - OpenNMT … https://opennmt.net/
  - MarianNMT … https://marian-nmt.github.io/
    - OpusMT … https://github.com/Helsinki-NLP/Opus-MT
  - …

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