Multilingual Language Technology in the age of Artificial Intelligence and Deep Neural Networks

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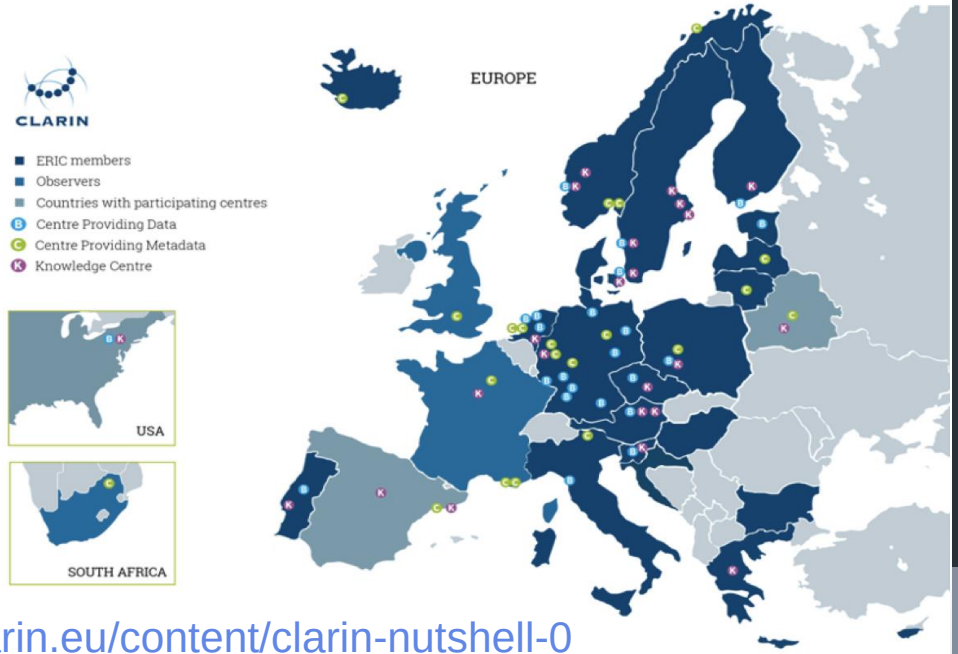
Using pictures created by Francesca Frontini, Fnaciska de Jong, Dieter van Uytvanck, Georg Rehm, Andy Way, Pavel Straňák

Outline

- European Networks
  - Language Resources & Technology
  - Fostering Language Equality
- Example of a complex Research Infrastructure
  - LINDAT/CLARIAH-CZ: resources, tools, services
- Future of Language Technology
  - AI methods / Large Language and Translation Models
  - Natural Language Understanding
- Conclusions

European Language Technology Networks: CLARIN

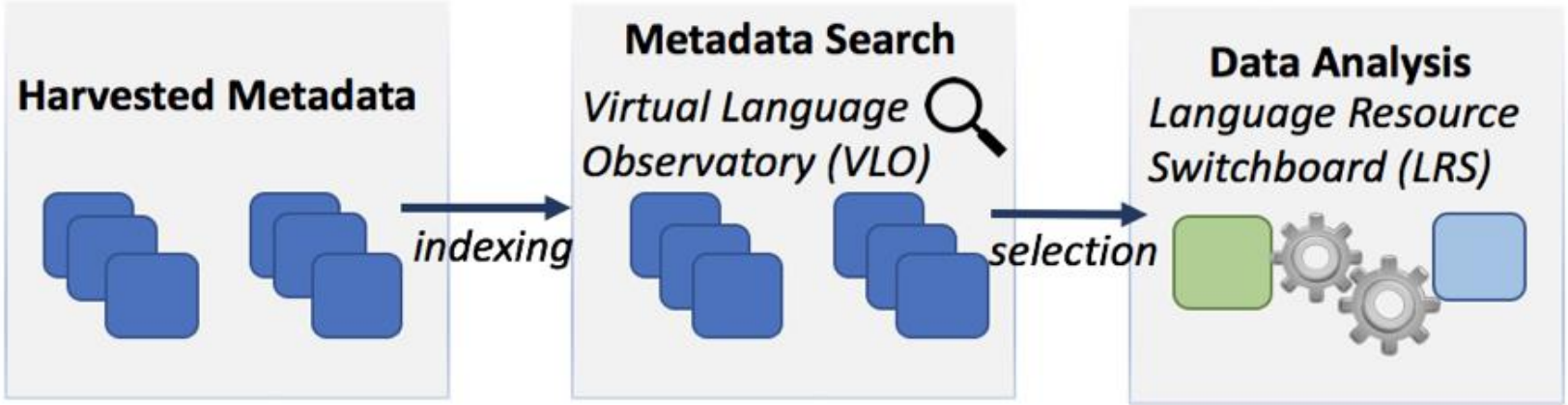
- CLARIN: since 2008, CLARIN ERIC since 2012
  - >50 centres
  - 21 members + 3 observers
- Provides
  - Resources
  - Tools
  - Services
- Standardized, open, virtual, distributed research infrastructure



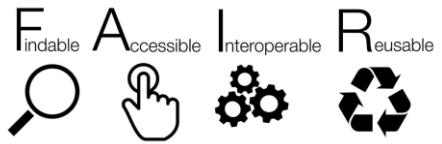
https://www.clarin.eu/content/clarin-nutshell-0

European Language Technology Networks: CLARIN

- The technical infrastructure



https://vlo.clarin.eu/
https://switchboard.clarin.eu/



European Language Technology Networks: CLARIN

https://www.clarin.eu/content/clarin-for-researchers

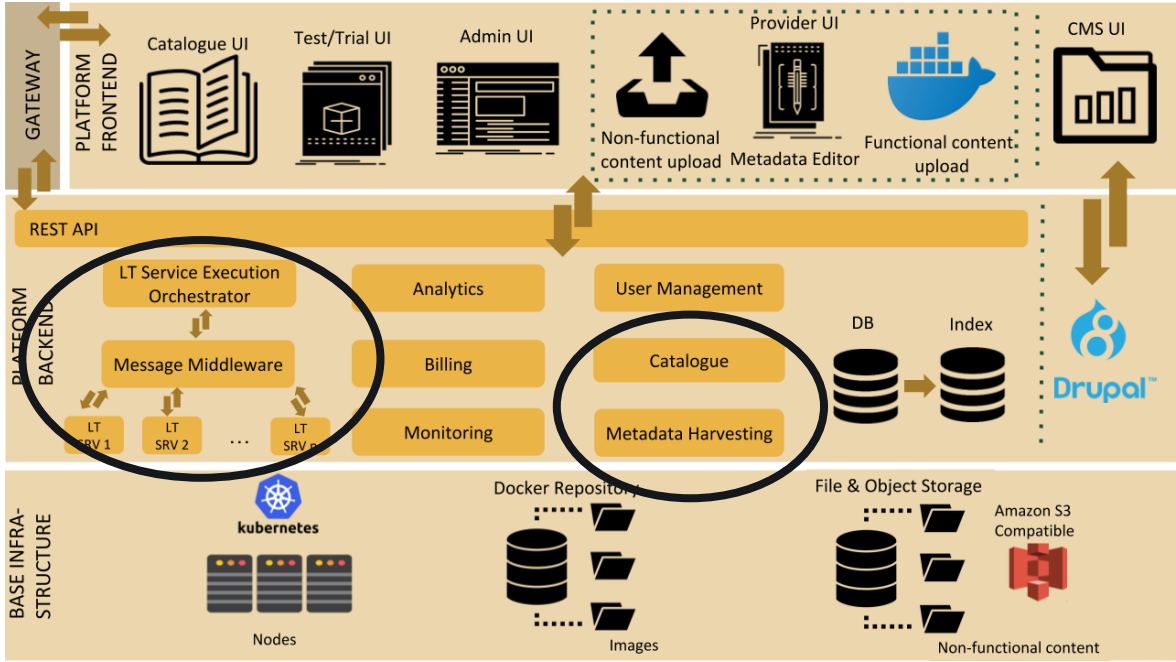
https://www.clarin.eu/content/knowledge-sharing

European Language Technology Networks: ELG

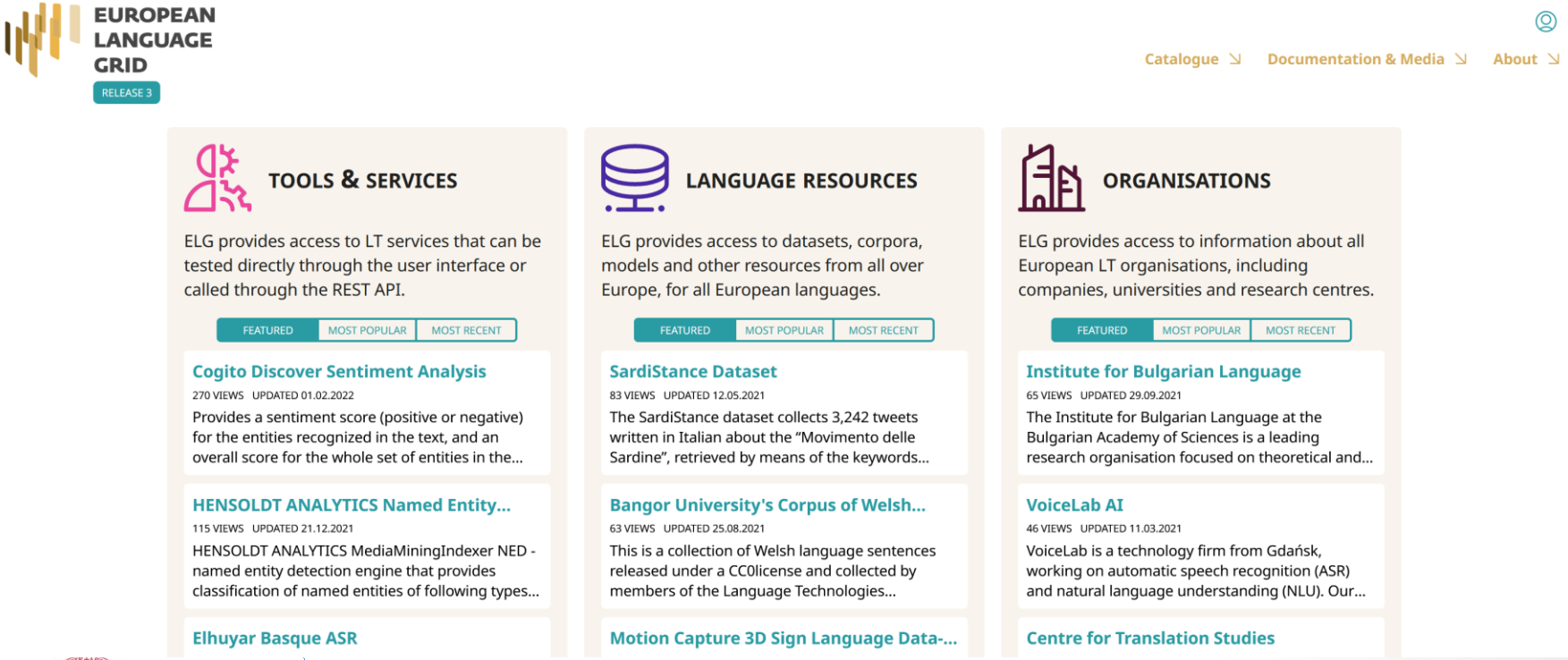
- European Language Grid
  - Centralized, all-in-one:
    - Language Resources (data, metadata, links to existing repositories)
    - Software tools, packages
    - (Running) services
    - Demos, catalogues (resources, institutions, stakeholders)
  - Marketplace for the European LT business space
  - Contributed from 15 external projects (FSTP funding)
    - And previous and concurrently running H2020 and infra projects
  - https://www.european-language-grid.eu

European Language Technology Networks: ELG

- Architecture
  - Services
    - Dockers
  - Data
    - Copied
    - Harvested
      - (CLARIN nodes)
    - Created
    - Curated

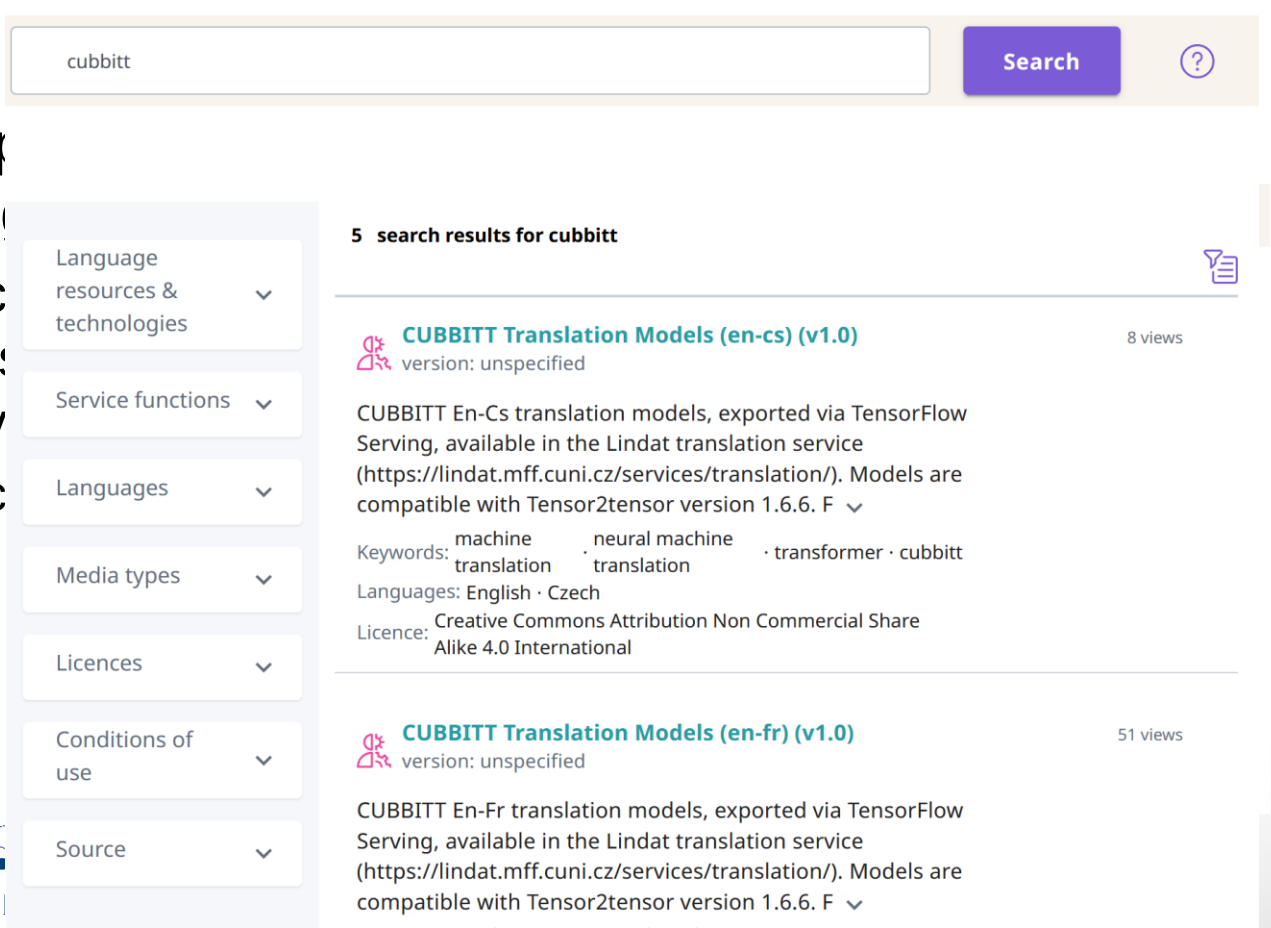


European Language Technology Networks: ELG



CLARIN
EUROPEAN LANGUAGE GRID
EUROPEAN LANGUAGE EQUALITY
Hippolyta

- Examp
  catalo
  - Mac
    trans
    serv
    - c

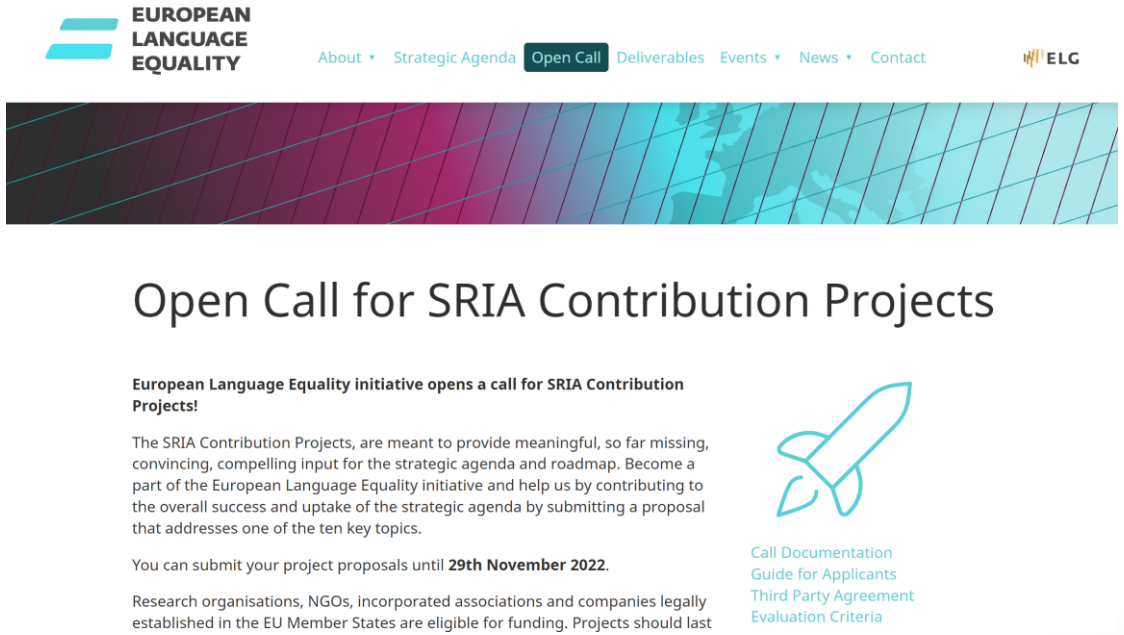


European Language Technology Networks: ELE/ELE2

- European Language Equality
  - https://european-language-equality.eu/
  - Foster and promote multilinguality and equal (digital technology) treatment of European languages
  - Draw up **strategic research agenda and roadmap**
    - From current state of Language Technology to **Digital Language Equality**
    - Provide path for implementing the agenda by 2030
- Now in second phase (2022-2023)
  - Open Call for contributions – everybody welcome

European Language Technology Networks: ELE/ELE2

- Open Call



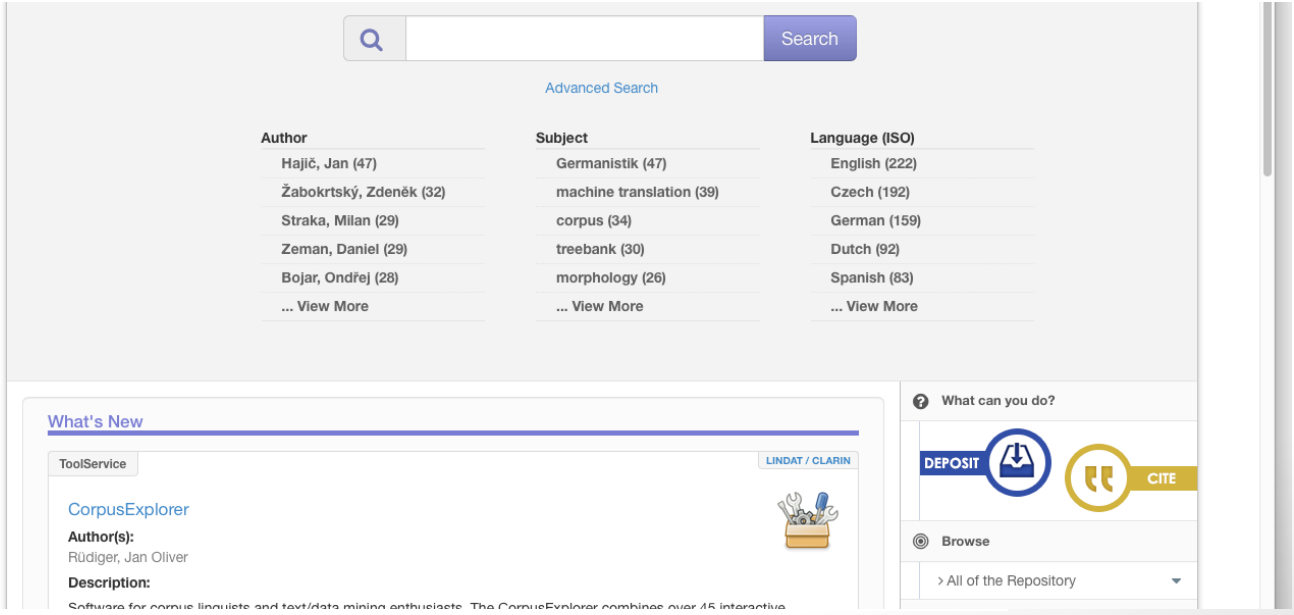
- https://european-language-equality.eu/open-call/

LINDAT/CLARIAH-CZ

- CLARIN “node” at https://lindat.cz
- Certified technical centre
  - Repository
    - Data, tools, metadata, licensing information
    - Single sign-on, persistent IDs
  - Services
  - Distributed network for Digital Humanities and Arts
    - Libraries, gallery, film archive, historical and other academy partners
    - Also part of DARIAH ERIC and (soon) of EHRI ERIC

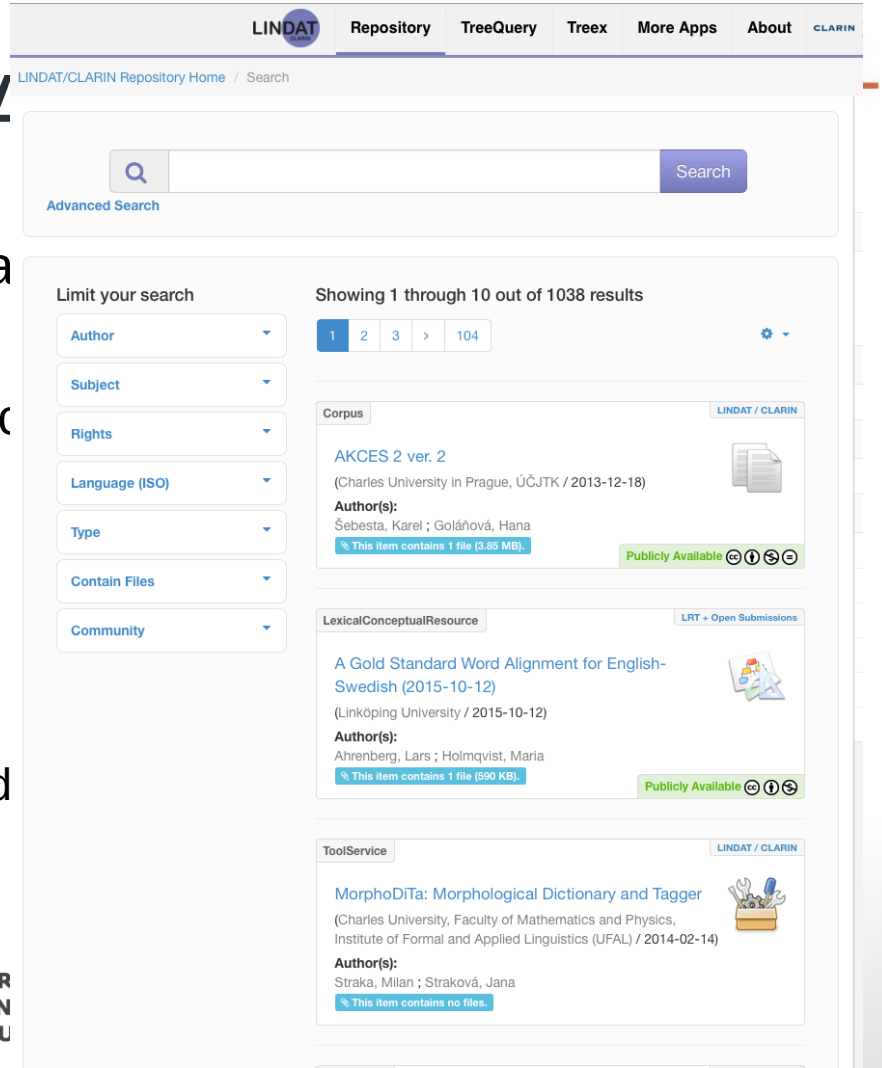
LINDAT/CLARIAH-CZ

- Core point: data repository – standardized, certified
  - Preserve and find language data and NLP tools



LINDAT/CLA

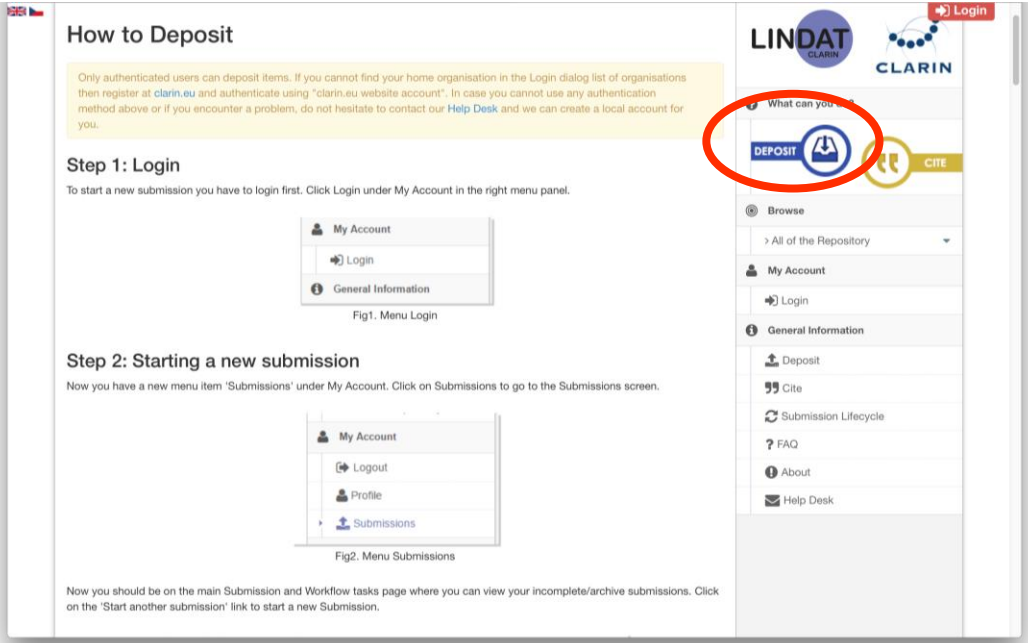
- OPEN ACCESS (as much as it ca
- > 500 registered users
  - submitters & users signing lic
- 200+ Data Records
  - > 1000 Metadata Records
- 1001 languages
  - 200 TB+ Data in Repository
    - + 1PB of UCS Shoah Found
- 40,000 accesses per month



CLARIN
EUROPEAN LANGUAGE GRID

LINDAT/CLARIAH-CZ

- Safe preservation
  - upload and don’t worry
- Discovery & Reuse
- Direct data citation
  - Google Scholar, Datasets
- Licensing
  - Open Access
  - … more options
- Versioning
- Worldwide (for everyone)

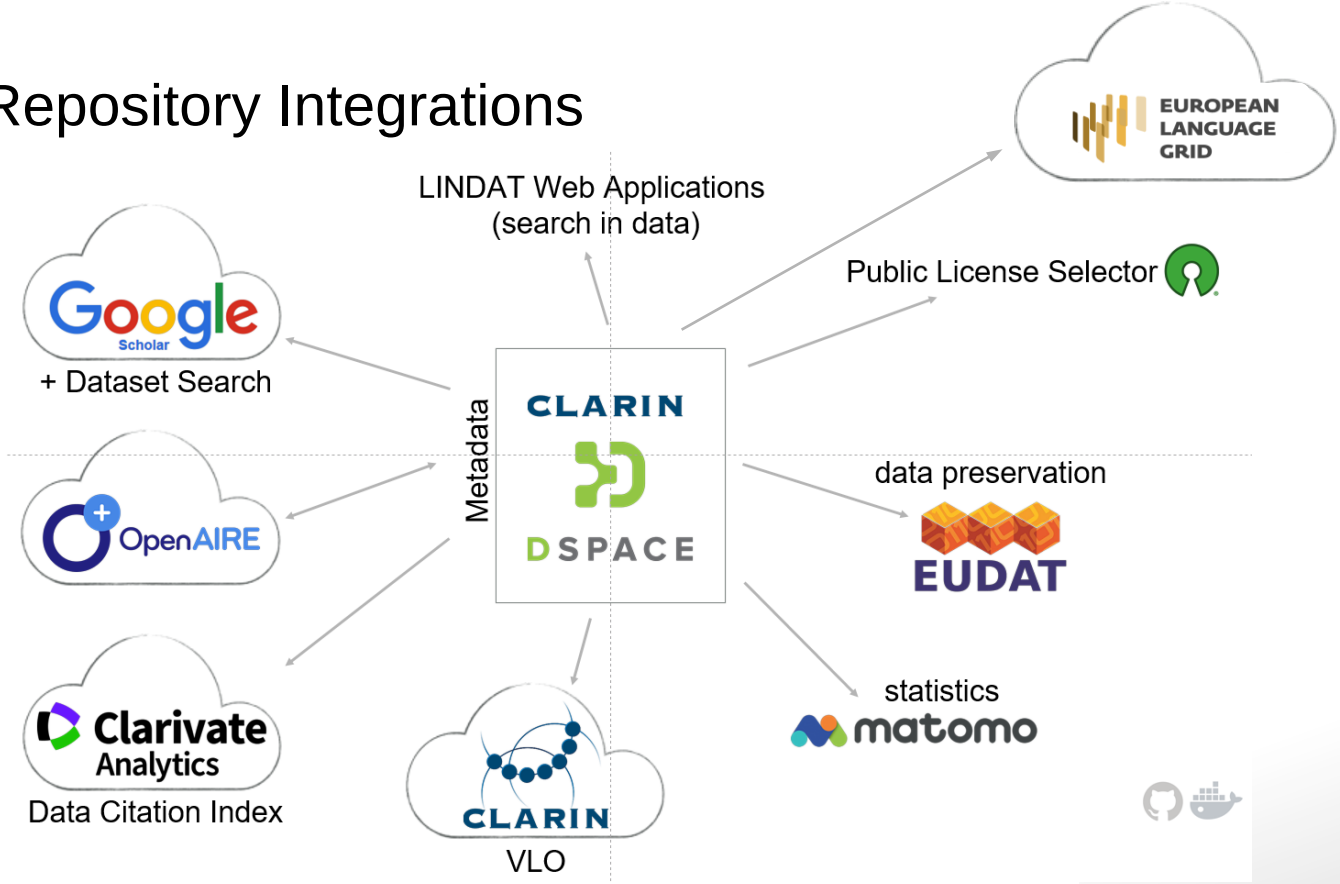


OPEN ACCESS FORCE11 The Future of Research Communications and e-Shcolarship GO FAIR OpenAIRE

CLARIN EUROPEAN LANGUAGE GRID EUROPEAN LANGUAGE EQUALITY Hippolyta

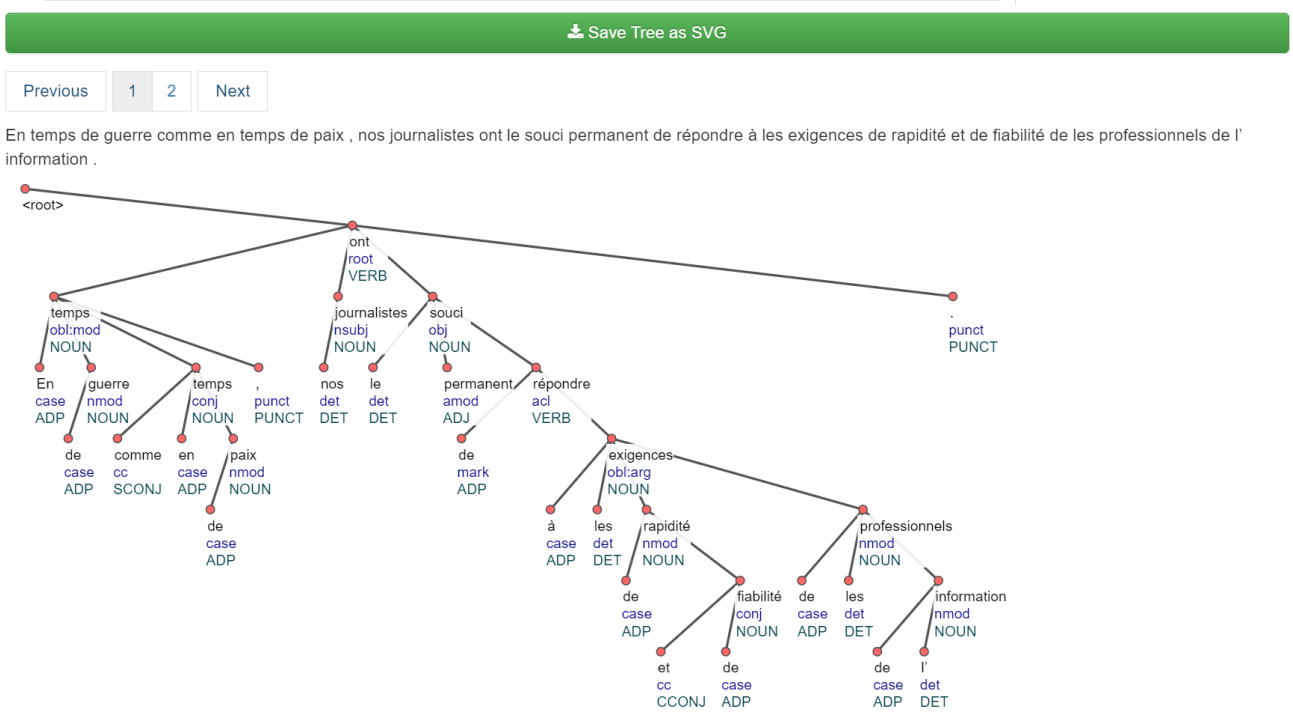
LINDAT/CLARIAH-CZ

- Repository Integrations



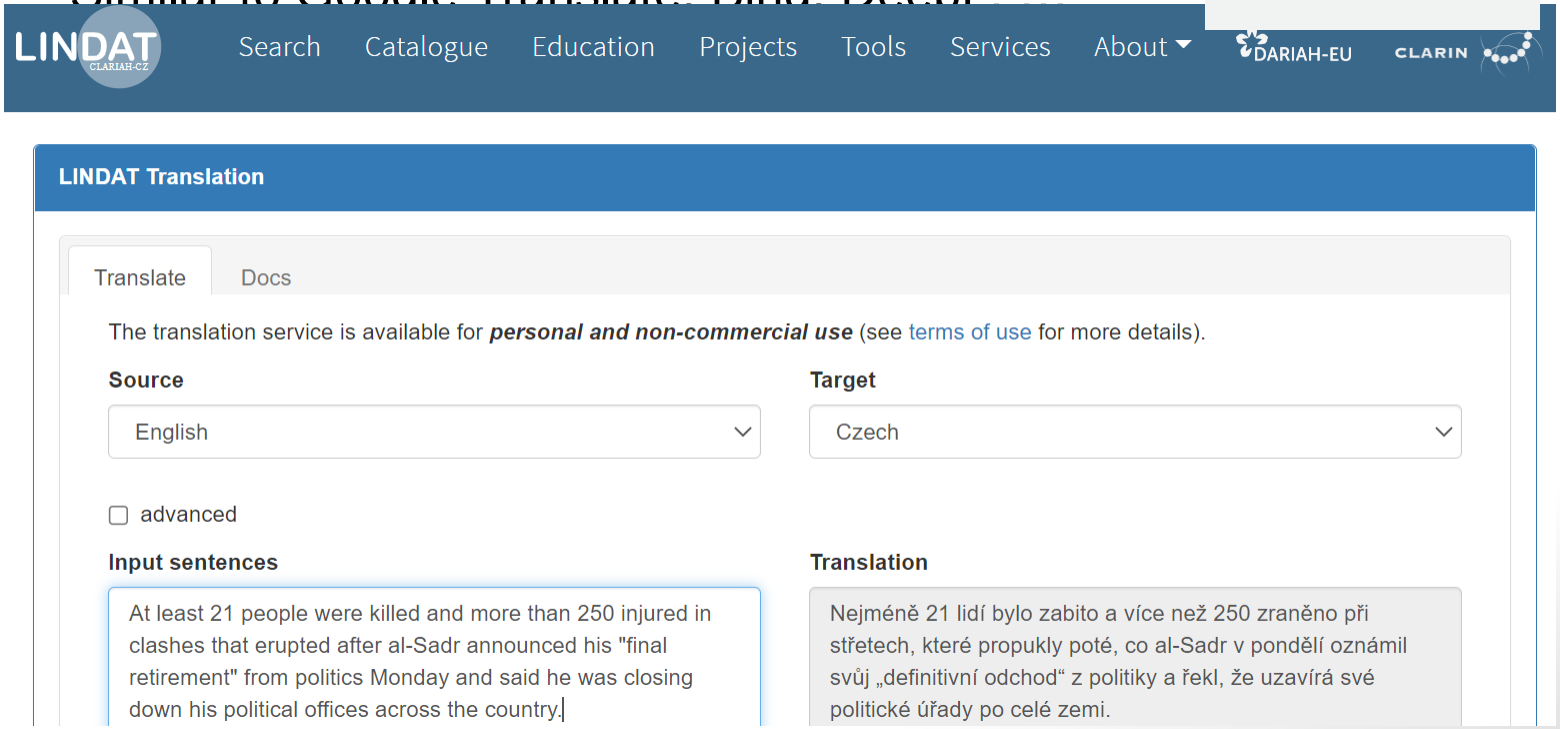
LINDAT/CLARIAH-CZ

- Text analysis services – UDPipe 2.0 (and other)



LINDAT/CLARIAH-CZ

- Machine Translation service
  - Similar to Google Translate, Bing, DeepL, ...



Charles Translator

Language Technology Future

- In past few years…
  - Huge success in applying Deep Learning
    - End2end systems, large language models, Multilanguage models
  - Need for large data (and computing resources)
  - Advances in applications
    - Speech
    - Language
    - Multimodal (vision, image, video, …)
    - Integrated structured and unstructured data

Language Technology Future

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The HPLT (Hippolyta) project

- High-Performance Language Technology
- Horizon Europe DATA call, 2022-2025
- Goals
  - Collect large data from Internet Archive (SF, CA, USA)
    - Approx. 12 PB
  - Extract text, clean, identify, deduplicate, pseudonymize, describe, …
  - Train language and translation models: 24 EU + min. 16 other
    - xBERTy, GPT-x, Transformer, future SoTA
    - make them openly available (OpusMT, Huggingface, possibly other repos)
  - Evaluate models – keep a dashboard
  - Demonstrate use of EU HPC Centres in a distributed manner
    - Huge compute demands: just for cleaning, 20 mil. CPU hours

The HPLT (Hippolyta) project

- Project partners
  - University of Edinburgh (Ken Heafield): scientific coordinator,
  - Charles University (UFAL/LINDAT, Jan Hajic, Dusan Varis, Jindrich Helcl, Martin Popel, Pavel Stranak, Barbor Hladka)
    - coordinator
  - University of Helsinki (Finland, Jorg Tiedemann, OpusMT)
  - University of Turku (Finland, Sampo Pyysalo, Filip Ginter)
  - University in Oslo (Norway, Stephan Oepen)
  - Prompsit (Spain, Gema Ramirez)
  - HPCs:
    - CESNET (Czechia, Ludek Matyska, David Antos)
    - Sigma2 (Norway, Hans Eide)
    - Cooperation with LUMI, EuroHPC, Karolina (IT4Innovations), possibly others

Natural Language Understanding

- Common theme of many roadmaps, agendas, etc.
- Are we there yet?
  - Large language models (esp. GPT-x) can generate fluent text (incl. theatre plays! See e.g. the TheAItre project)
  - Translation beats humans (some domains)
  - Dialog systems can pass Turing test (in the order of minutes or low tens of minutes)
- Questions remain:
  - Explainability, interpretability, post-output error detection, (de)bias(ing), ethical issues, …

Natural Language Understanding

- Possible direction of further research
  - Both large(r) language models and symbolic methods
    - Combination?
- Can knowledge representation be useful?
  - What “knowledge representation”?
- Goal of many research projects
  - Building ontologies: Cyc (and successors), Babelnet, but also Wikipedia, wikidata, databases, …
  - Building semantic representations
    - From the language point of view
    - From the logical/reasoning/inference side

Natural Language Understanding

- Human-like perception of read/heard language (text, voice)

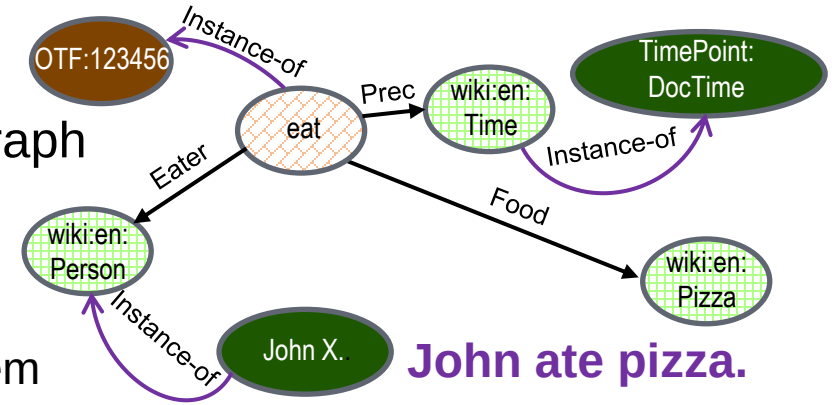
  - Key point: ***representation*** (of the knowledge/content acquired)
  - Unclear how people remember and structure knowledge and facts…
    - … Mathematics and Logic to the rescue
      - Graphs (with known properties and algorithms)
      - Graph search, graph transformations, graph matching
    - Ontologies to include contents
    - Logic: inferencing, contradiction detection, deduction, …

Natural Language Understanding

- LUSyD: Language Understanding: from Syntax to Discourse
  - Project 2020-2024, Czech Science Foundation
    - Linguistic & Computational (DNN, Language Models)
  - Relation between language form and knowledge representation
    - Morphology, syntax, semantics, discourse
  - Come up with ***Knowledge Representation***
    - Link to existing language (annotation/lexical) resources
    - Demonstrate on ***multiple*** (as many as possible) ***languages***
      - Plan: Czech, English, German, Spanish, Chinese, Korean (Arabic, …)
    - Create ***eventive grounding ontology***, populated with multiple languages (SynSemClass), linked to FrameNet, WordNet etc.

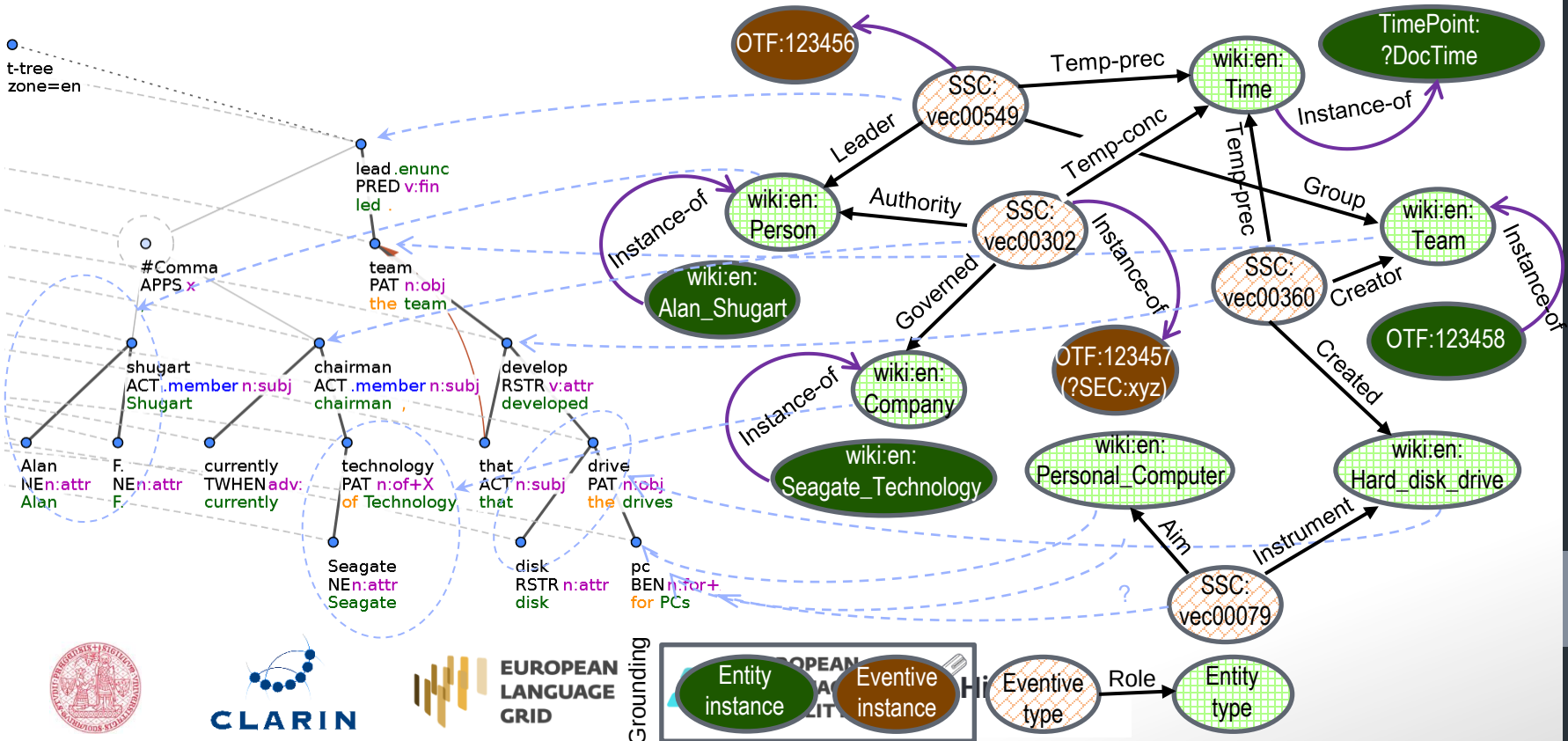
Natural Language Understanding

- The Principles
  - Knowledge Representation Graph
    - Nodes representing
      - ***Events***
      - ***Entities***
    - Edges: ***relations*** between them
  - All nodes ***grounded***
    - *Ontologies*
  - Relations: fixed set
  - Nodes linked to original text/speech/…
    - For Machine Learning in general, applications



NLU: real example (WSJ)

Alan F. Shugart, currently chairman of Seagate Technology, led the team that developed the disk drives for PCs.



Thank you!

https://ufal.mff.cuni.cz
https://lindat.cz
https://lindat.cz/services
Twitter: @LindatClariahCZ
Twitter: @ufal_cuni

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