European Network for Academic Integrity

Plagiarism Detection: Techniques, Tools and Policies

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Introduction

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- Literature review on Plagiarism detection
  - Overview of methods
  - Strengths, weaknesses
- Do PDS vendors learn from scientists?
- Plagiarism policies

Methodology

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- Keyword-based automated search
- Google Scholar
  - restricted time 2013 – 2018
  - manual review of titles
  - manual review of abstracts
  - exclusion of papers in journals on the Beall's list
- Topically related conferences
  - Plagiarism across Europe and Beyond 2013, 2015, 2017
  - PAN competitions
- Sort to categories, identify research gaps

Typology of plagiarism

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- Copy & Paste
  - Sources possibly mentioned (pawn sacrifice, cut & slide)
- Weak obfuscation
  - Technical disguise
  - Synonym substitution
- Translation
- Paraphrase
  - Mosaic, clause quilts
- Structural plagiarism
  - Boilerplate, template
  - Idea plagiarism
- Shake & Paste
  - Patch-writing, compilation, remix, mosaic, mash-up

Number of papers (Google Scholar)

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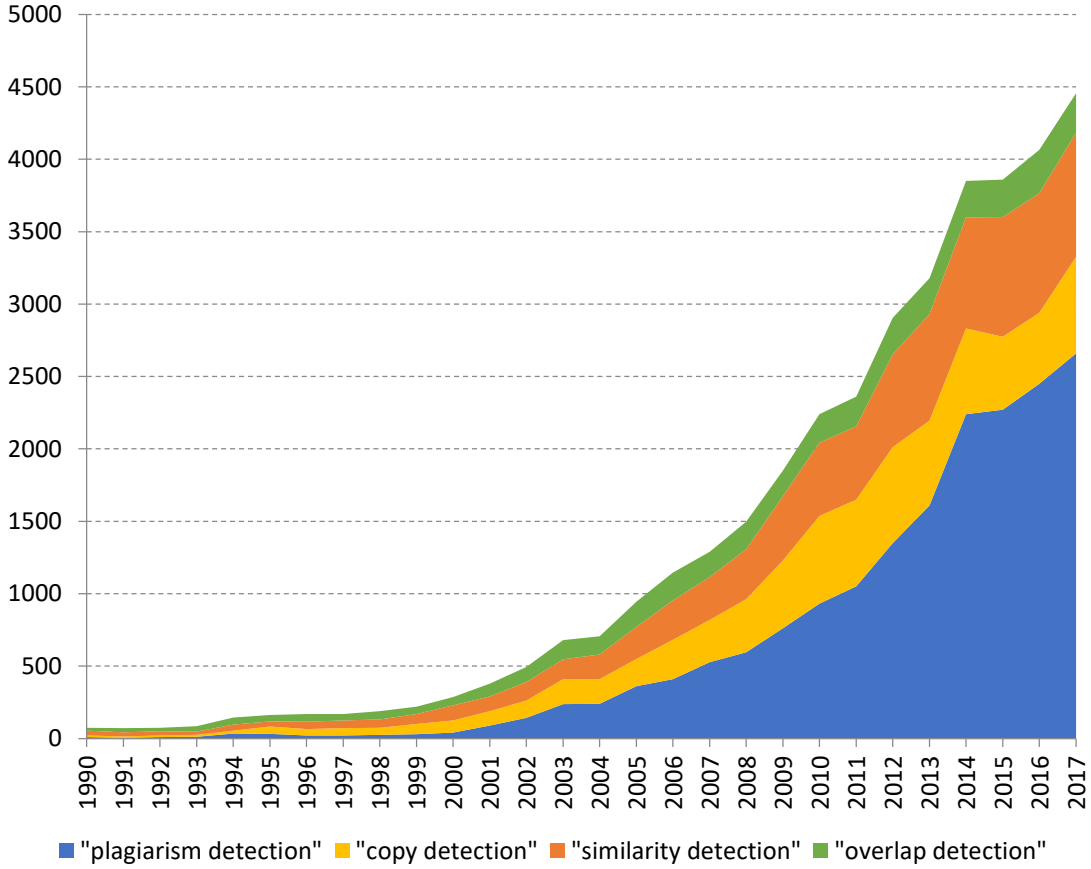

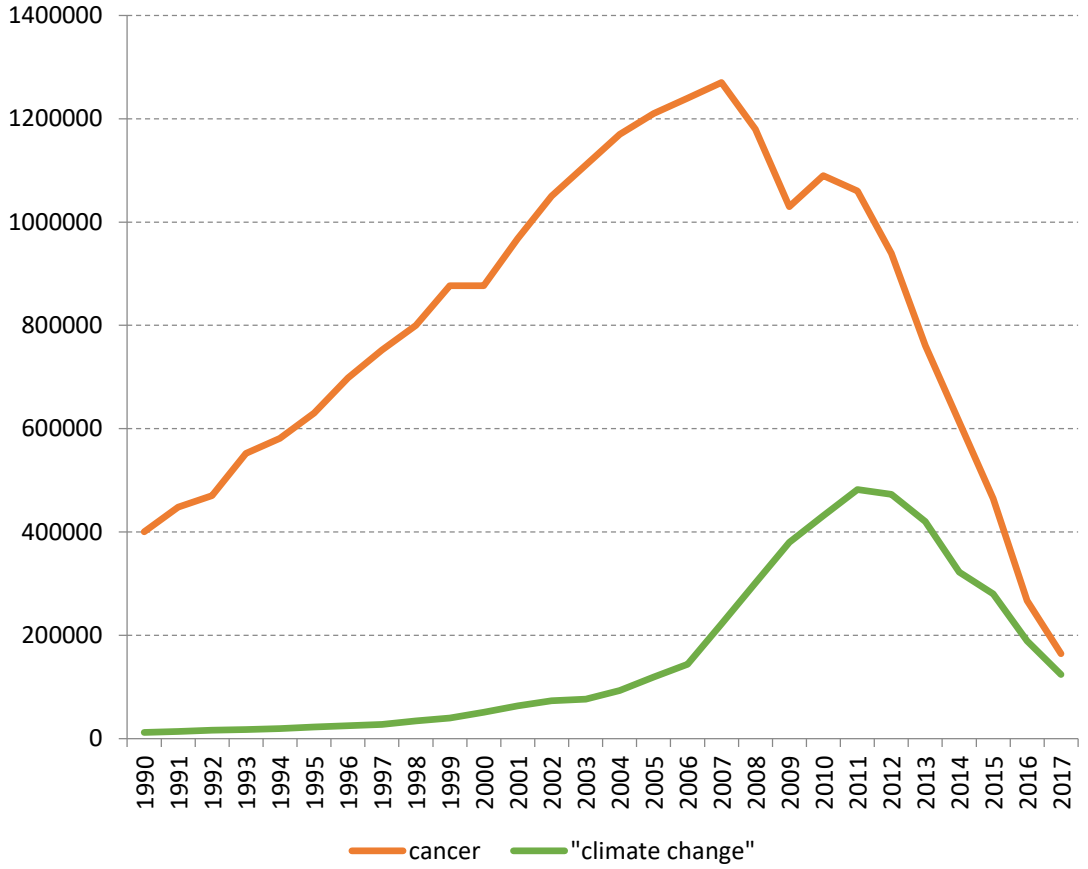

Three Layers of Plagiarism Detection

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Policies

IPPHEAE

COUNCIL OF EUROPE

CONSEIL DE L'EUROPE

Tools

turnitin®

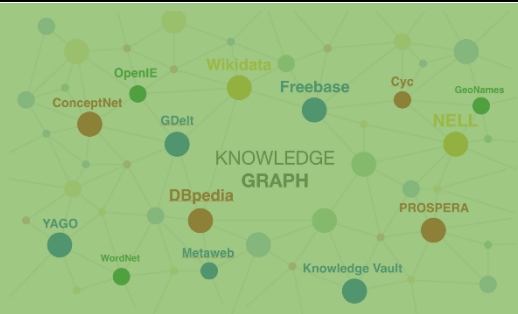
URKUND

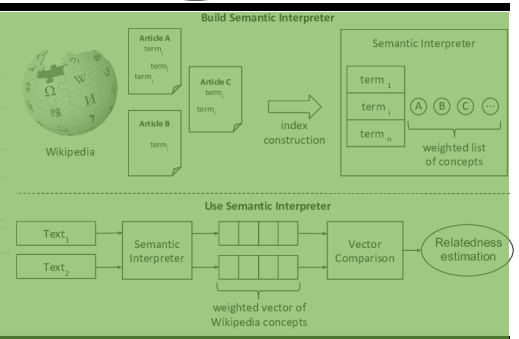
StrikePlagiarism.com

Techniques

$$A = U \begin{pmatrix} w_1 & & \\ & w_2 & \\ & & w_3 \end{pmatrix} V^T$$

$$\text{sim}(\mathbf{u}, \mathbf{v}) = \frac{\mathbf{u} \cdot \mathbf{v}}{\|\mathbf{u}\|\|\mathbf{v}\|} = \frac{\sum_{i=1}^{N} u_i v_i}{\sqrt{\sum_{i=1}^{N} u_i^2} \sqrt{\sum_{i=1}^{N} v_i^2}}$$





Plagiarism Detection Tasks

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- What “Plagiarism detection” means?
- Traditional task
  - Document Level Detection
    - Given suspicious document D and set of source documents
    - Select source document(s) **similar** to D
- Up-to-date tasks
  - Candidate retrieval
  - Text alignment
  - Paraphrase identification
  - Intrinsic PD

Extrinsic Plagiarism Detection

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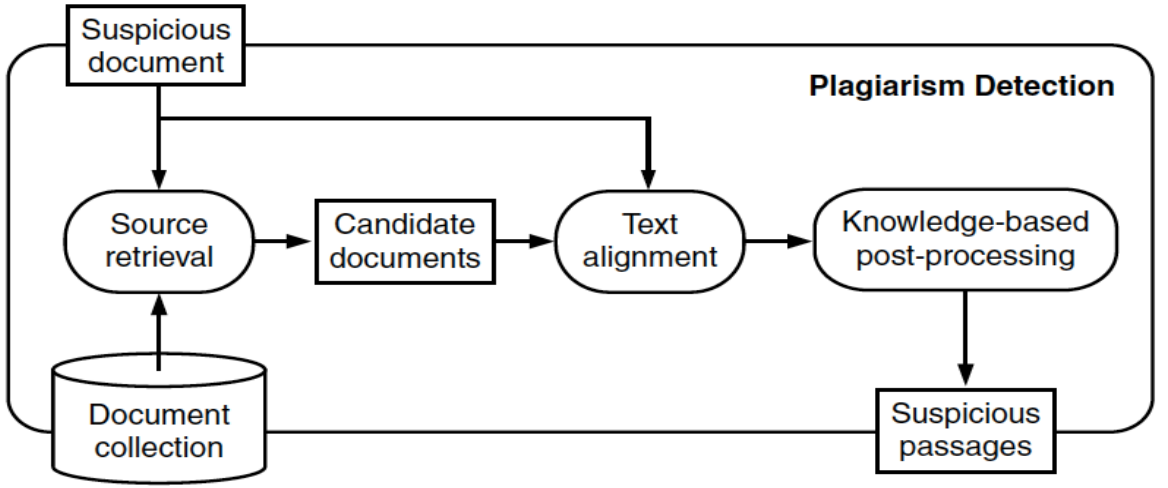
- Formerly Document Level Detection
- Candidate Retrieval
  - Given a suspicious document D and a search engine / database
  - Retrieve all documents from which the text was reused in D
    - with minimum costs
- Text alignment
  - Given a suspicious document D and a set of candidate documents S
  - Identify passages
    - from documents in S
    - which were re-used in D
- Paraphrase Identification
  - Given two passages, decide whether they have same meaning



Source: Potthast et al. (2014)

Intrinsic Plagiarism Detection

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- Given suspicious document
- Identify borders between parts with different style
- Group these parts according to authorship

- Stylometry
- Machine learning

- Related tasks
  - Author identification
  - Author profiling
- Applications: Marketing, law enforcement

Howe to Solve these Tasks?

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- Typology of Plagiarism Detection Techniques
  - Lexical-based
  - Syntax-based
  - Semantics-based

- Applications
  - Recommender systems
  - Detection of similar documents
    - related news
    - duplicated work

Lexical-based Methods

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- N-Grams
  - N consecutive characters/words
  - Former approach: Fingerprinting
- Vector Space Models
  - Bag-of-words approach
  - Each word is a dimension in a vector space
  - Values weighted (tf-idf)
  - Documents/passages treated as vectors
    - cosine similarity measure

Syntax-based Methods

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- Part-of-speech tagging
  - marks each word with its class (noun, verb,…)
  - pre-processing for semantic analysis
  - comparison within classes
- Syntactic graphs
  - sentence represented as a graph
  - syntactic relations marked
  - allows structural plagiarism detection

Semantics-based Methods

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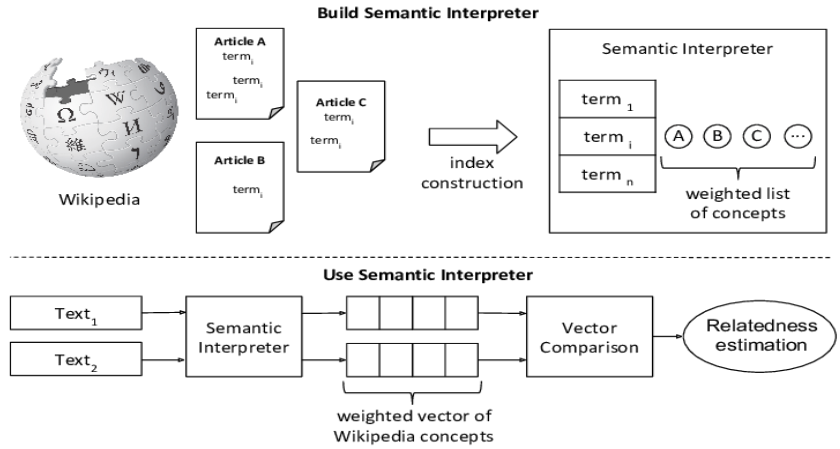
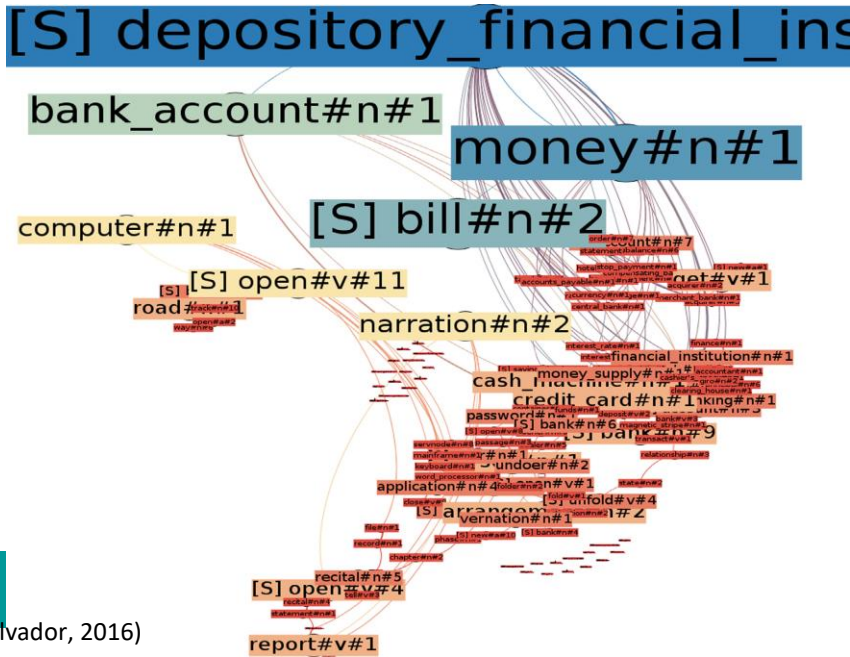
- Latent Semantic Analysis
  - Singular Value Decomposition
  - Grouping documents by meaning
- Explicit Semantic Analysis
  - Vector of concepts
- Knowledge Graph Analysis
  - Passage represented as a graph
  - Graph similarity metrics
- Bag of words – meaning problem
  - A loves B ≈ B loves A





Knowledge graph built from the sentence "I opened a new bank account" (Franco-Salvador, 2016)

Tools for Semantic Analysis

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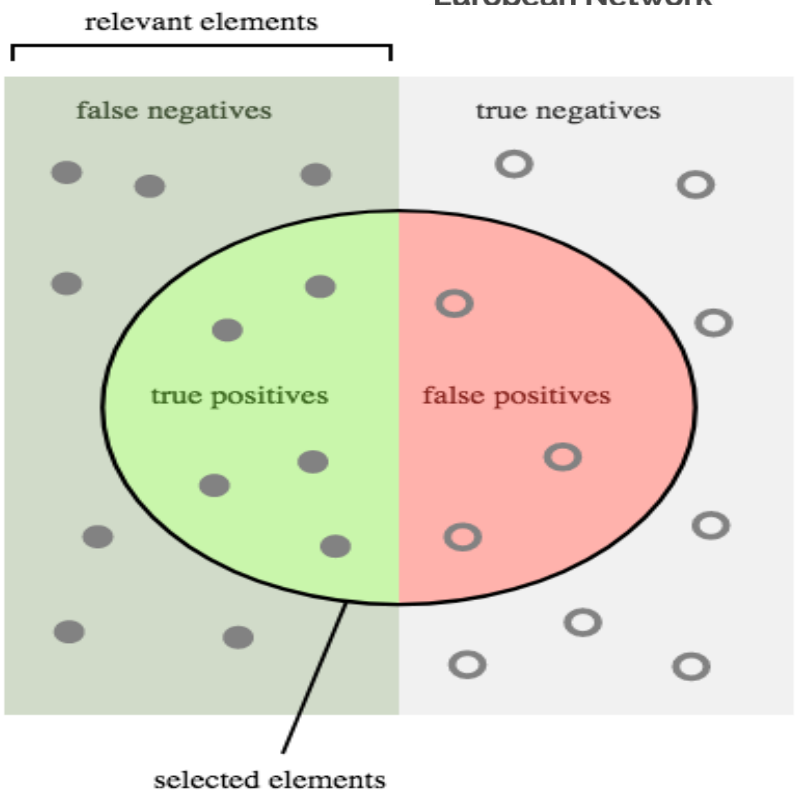
- WordNet (Princeton)
  - English dictionary + thesaurus
- EuroVoc (EU)
  - Multilingual thesaurus
- Wikipedia
- Wikidata
- BabelNet

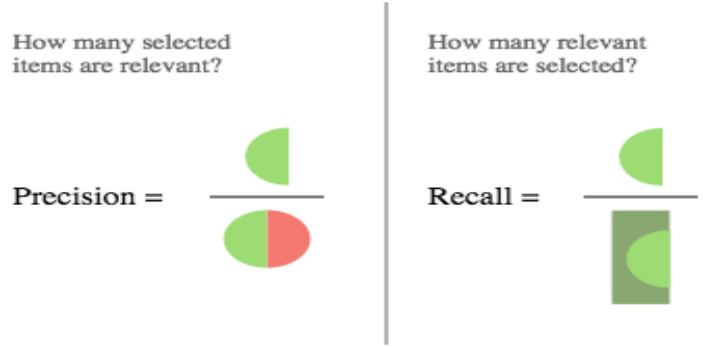
Evaluation of Techniques

- PAN corpuses, Microsoft Research Paraphrase Corpus, German Paraphrase Corpus, P4P…

- Recall
  - What portion of plagiarism was revealed?
  - R = TP/(TP+FN)
- Precision
  - What portion of revealed cases are plagiarism?
  - P = TP/(TP+FP)

- F-measure
  - Harmonic mean of Recall and Precision
  - F = 2*P*R/(P+R)





Accuracy of Extrinsic Plagiarism Detection

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- Copy-paste detection ≈ 100 %
- Synonym replacement detection ≈ 90 %
- Paraphrase identification ≈ 80 %
- Summary identification ≈ 75%
- Cross-language plagiarism detection ≈ 70 %
- Structure, idea,… ???

Author Identification & Profiling

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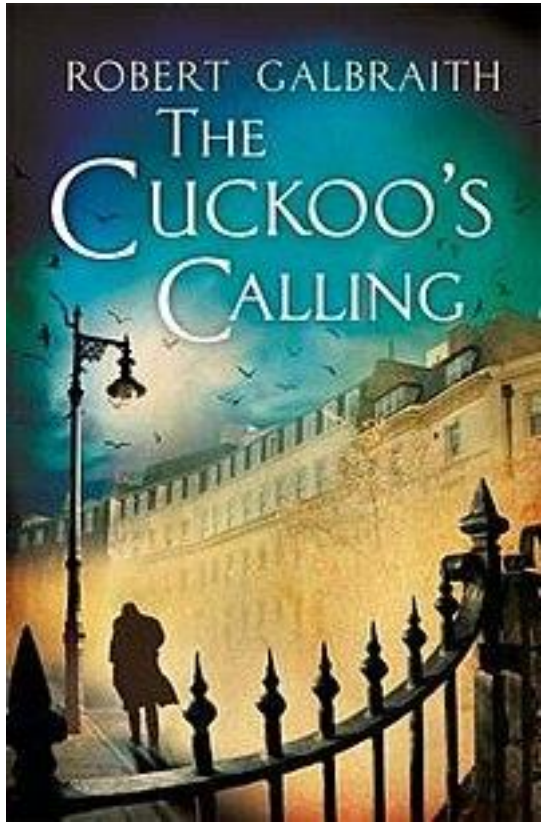
- Up-to-date accuracy
  - Style change identification ≈ 60 %
  - Grouping by authorship ≈ 60 %
  - Native language prediction ≈ 65 – 85 %
  - Gender identification ≈ 80 %
  - Age-group identification ≈ 50 – 55 %
- Robert Galbraith: *The Cuckoo's Calling* (2013)
- Real author: J.K. Rowling
- Related task: Author obfuscation



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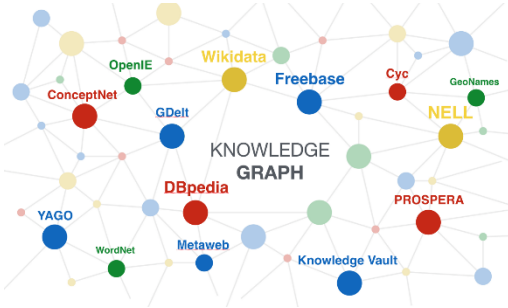

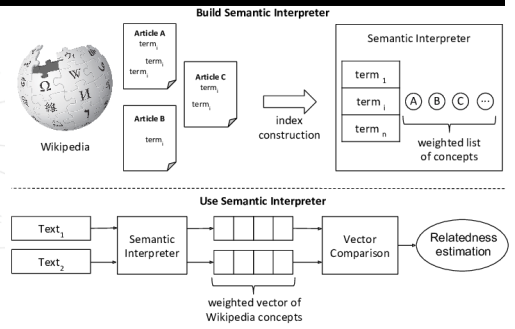

Layer 2: Plagiarism Detection Tools

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- Which one is the best?
  - For given language
  - For given type of plagiarism
  - Considering other criteria
- Prof. Debora Weber-Wulff Testing
  - 2004, 2007, 2008, 2010, 2013
- Less sound tests
  - Vani&Gupta, 2016; Chowdhury&Bhattacharyya, 2016

Technical Disguise Test

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System	Indexes IJEI	Homoglyphs	White characters	Synonyms	Text as image
Turnitin	YES	YES	NO	YES	NO
Urkund	NO	YES	NO (PLAINTEXT)		NO
Theses.cz	NO	NO (PLAINTEXT)	NO (PLAINTEXT)	NO	NO
Slovenia	NO	YES	YES	YES	YES
Slovakia	NO	NO (PLAINTEXT)	NO (PLAINTEXT)		NO

ENAI Standardized Testing

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- Research gap: No standardized testing in place

- Develop sound methodology
- Prepare good testing set
  - Various European languages
    - cross-language plagiarism
  - Various plagiarism types
  - Various types of sources
    - Wikipedia, Internet, OA papers, paid papers
- More evaluation criteria
  - Results, speed, user friendliness,…

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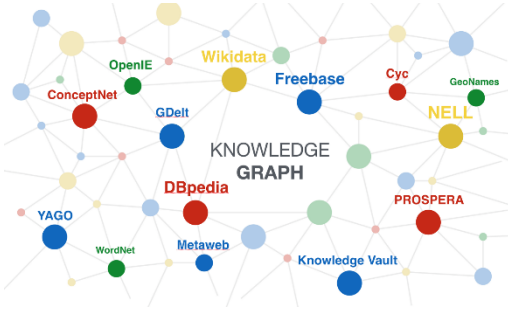

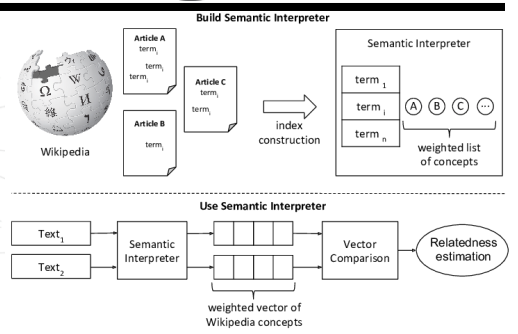

Layer 3: Policies for Plagiarism

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- Projects exploring policies
  - IPPHEAE project (2010-2013)
  - SEEPPAI project (2016-2017)
  - Follow-up (CoE) in 2018-2019
- Great books
  - Debora Weber-Wulff (2014): False Feathers
  - Tracey Bretag (2016): Handbook for Academic Integrity

Systemic Effort Works

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Curtis & Vardanega, 2016

- 10-years study (2004-2014)
  - Introduced course on academic writing
  - Started using Turnitin
  - Introduced criterion and standards-based assessment
  - Implemented educational changes
- All forms of plagiarism DECREASED
  - except recycling and ghostwriting

Owens & White, 2013

- 5-years study (2007-2011)
  - PD SW as both deterrent and formative tool
  - Educational about academic writing and authorship
- Self-reported plagiarism DROPPED significantly
- Nature of assessment has a central role

Academic Integrity Maturity Model

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- **Transparency** in academic integrity and quality assurance
- **Policies**: fair, effective and consistent
- **Sanctions**: standard range
- **Software tools**
- **Prevention** strategies and measures
- **Communication** about policies and procedures
- **Knowledge** and understanding about academic integrity
- **Training** for students and teachers
- **Research** and innovation in academic integrity

(IPPHEAE, 2013)

Institutional Policy

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- Problem identification
  - Students? Teachers? Scientists? Management?
  - Plagiarism? Exam cheating? Contract cheating?
  - Inconsistent approach of teachers?
  - Risk of a scandal?
- Propose set of measures
  - Inspiration from others
- Consider differences
  - Culture: focus on motivation or penalties?
  - Society: positive/negative examples
  - Field of study: type of assignments, type of assessment
  - Institution…

General Findings

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- One-fits-all strategy ineffective
- Multilayered, evidence-based, longitudinal strategy

- Central role of **assessment**
- Address both **educational approaches**
  - for “good” students
- and **deterrence strategies**
  - for “bad” students
  - students who cheat tend to cheat repeatedly
- Research for gathering **evidence** and impact evaluation

ENAI Tools Coming Soon

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- Glossary of terms
  - already published
- Guidelines for academic integrity
  - almost ready
- Self-evaluation tools
  - this autumn
- Manual for cross-sector cooperation
  - this summer
- Collection of educational materials
  - this summer
- Announcements in ENAI Newsletter

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Thank you for your attention

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