MELT

Matching EvaLuation Toolkit

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Sven Hertling; **Jan Portisch**; Heiko Paulheim

Joint Work

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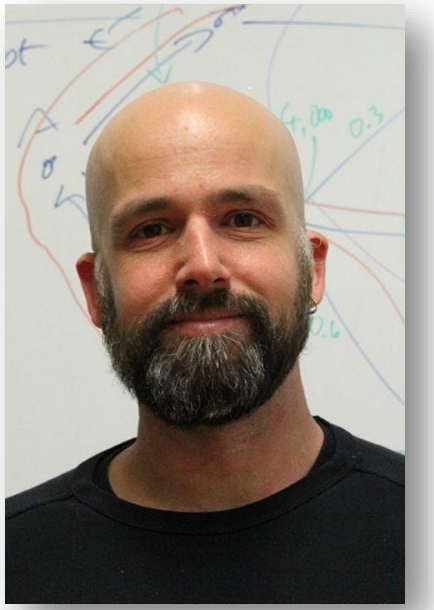

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Agenda

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- Motivation
- What is MELT?
- Usage Example
- Q&A

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MOTIVATION

Ontology Alignment Evaluation Initiative (OAEI)

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Ontology Alignment Evaluation Initiative

- running campaigns **since 2005**
- structured in **tracks** (similar to task sets)
- researchers **submit their implementation**
  - centrally evaluated by track organizers
  - results published

Tooling

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SEALS

Semantic Evaluation at Large Scale

- (among others) packaging and evaluation
- OAEI support since 2010

HOBBIT
Holistic Benchmarking of Big Linked Data

Holistic Benchmarking of Big Linked Data

- (among others) packaging and evaluation
- OAEI support since 2017
- OAEI 2018: **6/19** matchers support HOBBIT

Pain Points

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- **Limited evaluation capabilities** in SEALS, HOBBIT, and the Alignment API
- No easy-to-use **parameter tuning**
- **Packaging process might be complicated** for new entrants to the community
- Tooling **Java-focused** (no **Python**)
- Implementation of the Alignment API **not maven-based**
- **Tool breaks**

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What is MELT?

What is MELT?

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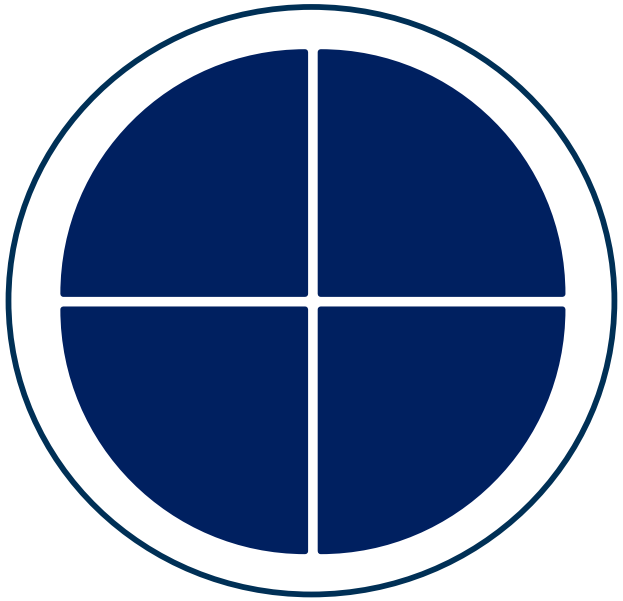
- **Easy** matcher development
- **Non-Java** matcher development
- **Maven** support

- Allow **for parameter optimization**



- Facilitate **matcher packaging**
- Facilitate **matcher submission**

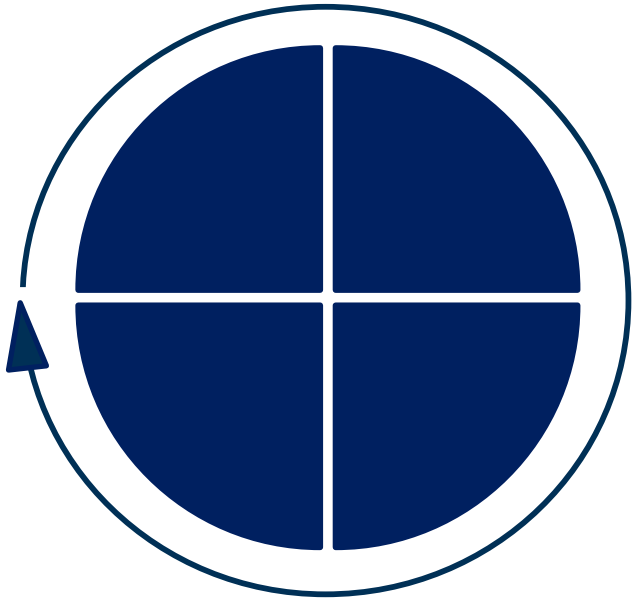
- **Advanced evaluation** capabilities
- **Evaluation before packaging**
- Allow for **interactive visualization**

- **Streamlined** development process
- **Integration** with existing tooling
- **OAEI support**
- **Extensibility**

What is MELT?

Matcher
Development

Matcher
Fine-Tuning



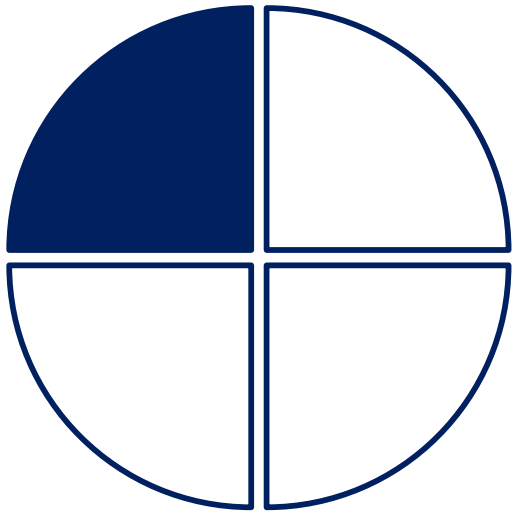
Matcher
Submission

Matcher
Evaluation

What is MELT?

Matcher
Development

Matcher
Submission



Matcher
Fine-Tuning

Matcher
Evaluation

Yet Another Alignment API (YAAA)

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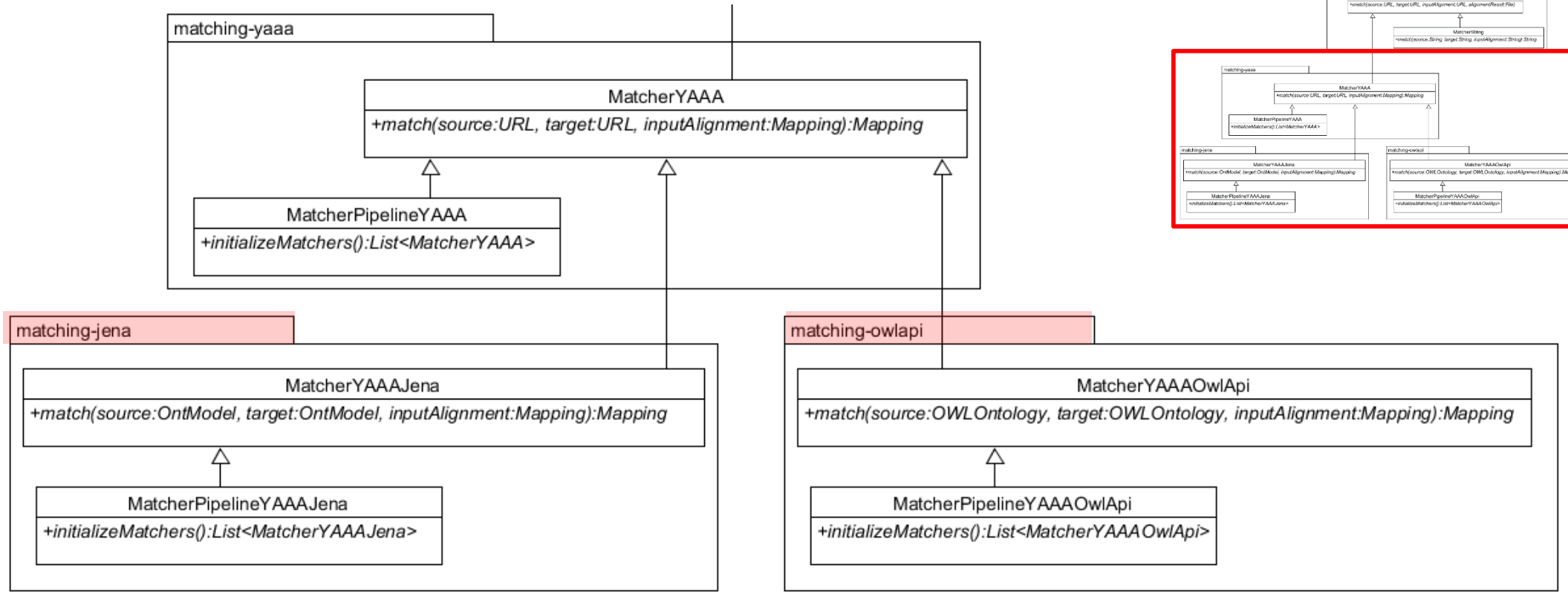
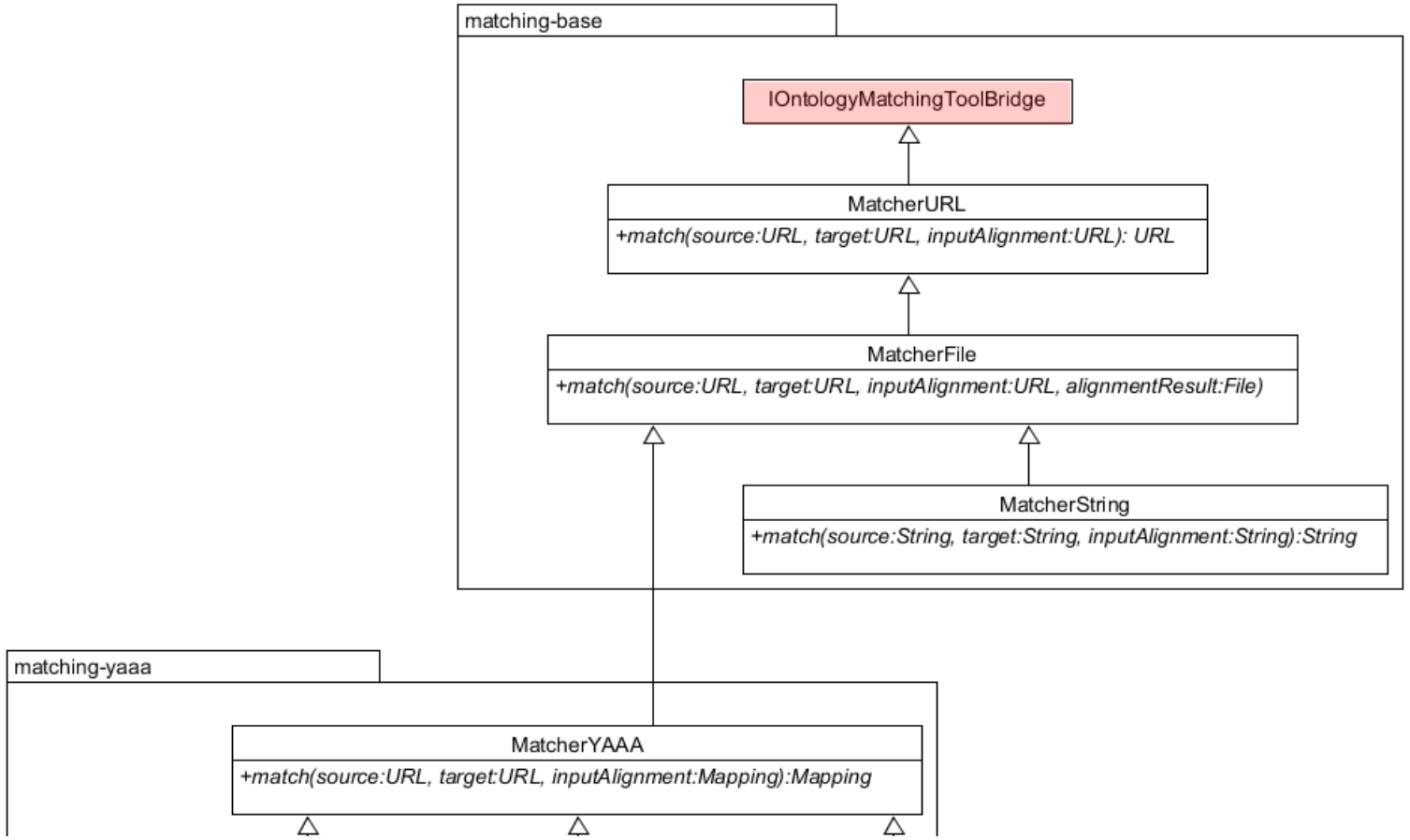
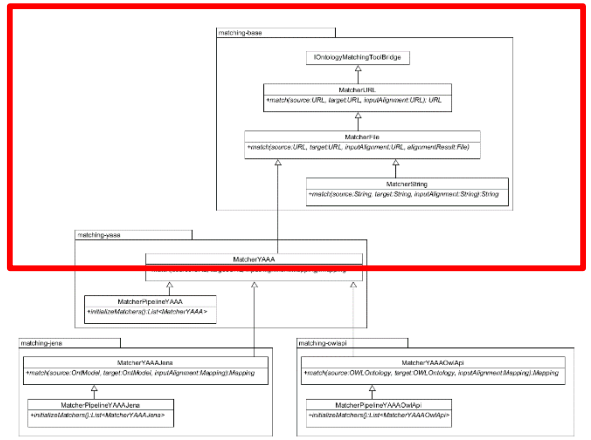
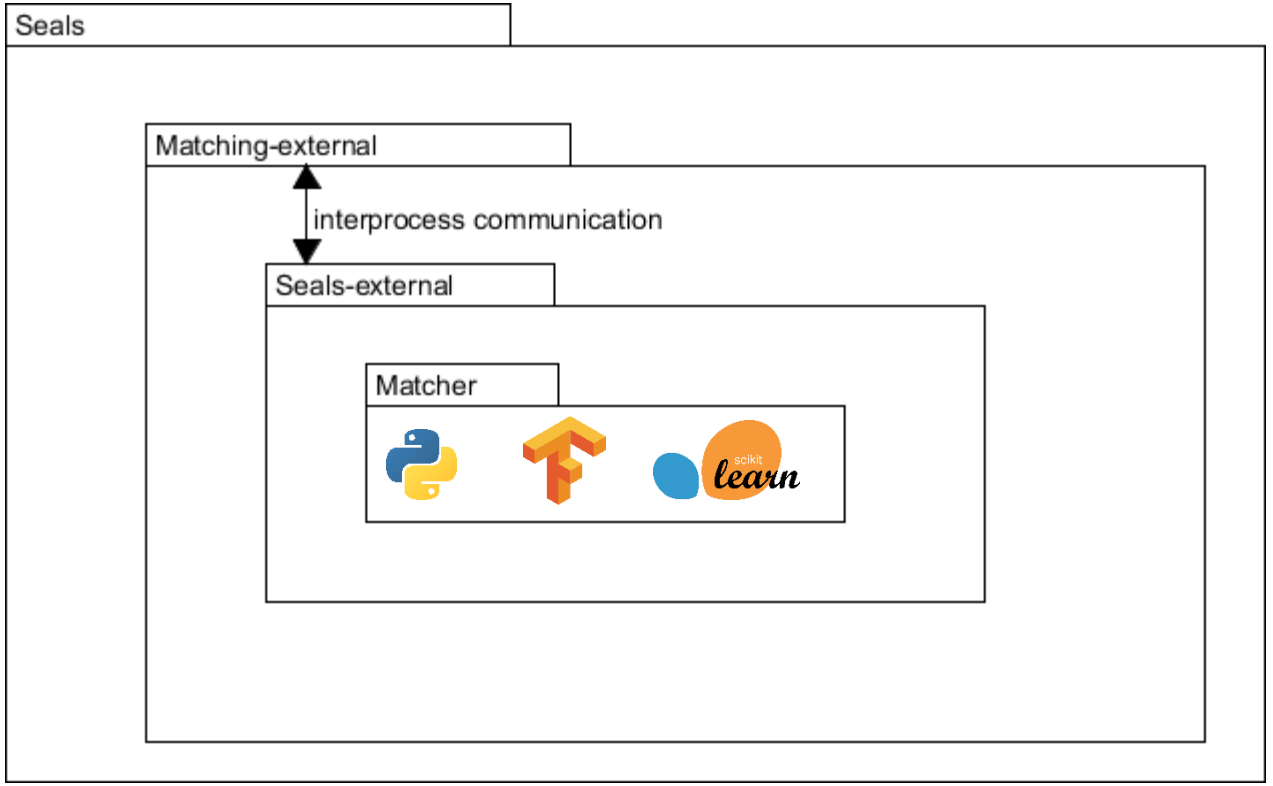


Full SEALS/HOBBIT Support





External Matching



- Simple wrapping
- Packageable for HOBBIT and SEALS
- Matcher can still be evaluated in MELT
- Documentation and demo project available on GitHub

What is MELT?

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Matcher
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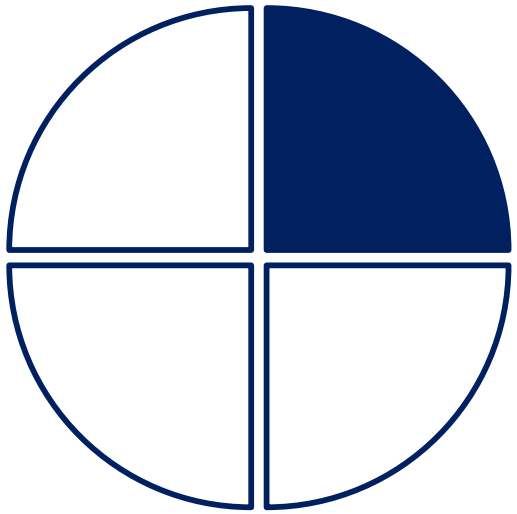
Fine-Tuning



Matcher
Submission

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Parameter Tuning

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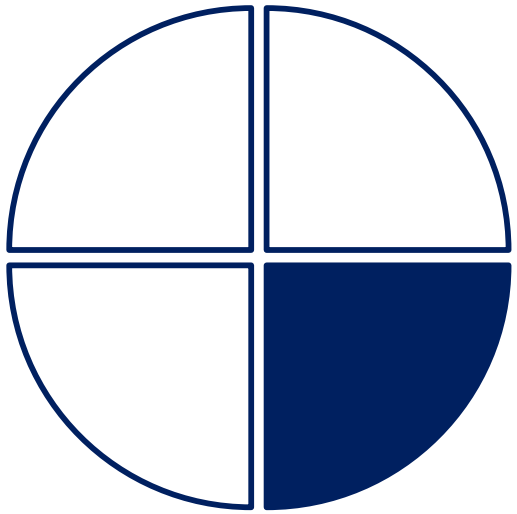
- Run matcher configurations in **parallel** (i.e., multi-threaded)
- Hand over `ExecutionResultSet` to `Evaluator` and pick best value **according to what you want to optimize**
- **Out-of-the-box classes** that assist you

What is MELT?

Matcher
Development

Matcher
Fine-Tuning



Matcher
Submission

Matcher
Evaluation

Evaluation

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```
Track track = TrackRepository.Multifarm.getSpecificMultifarmTrack("ar", "cn");

ExecutionResultSet ers = new ExecutionResultSet();

ers.addAll(Executor.run(track.getTestCases(), new Matcher(), "Matcher"));

EvaluatorCSV evaluatorCSV = new EvaluatorCSV(ers);

evaluatorCSV.write();
```

Evaluation

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Full OAEI support: All tracks available (one-time automated download)

```
Track track = TrackRepository.Multifarm.getSpecificMultifarmTrack("ar", "cn");

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evaluatorCSV.write();
```

Multiple evaluators available, extensible.

Exemplary Evaluation

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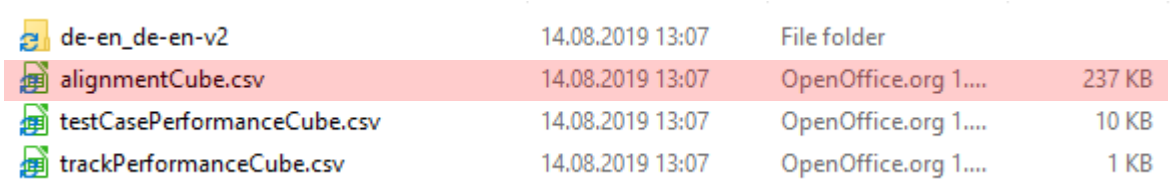
"Show me the false positive class-class mappings for *Multifarm* on track en-de for matcher WiktionaryMatcher."



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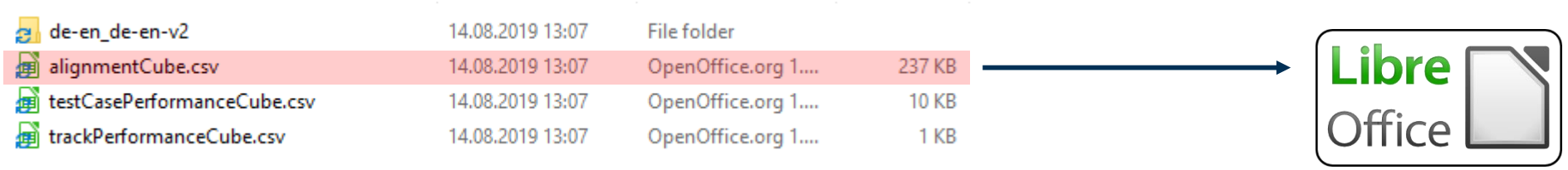

Exemplary Evaluation

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"Show me the false positive class-class mappings for *Multifarm* on track en-de for matcher WiktionaryMatcher." → Just filter the correspondences!

C340 | WiktionaryMatcher

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Trac	TestCase	Matcher	Label	Comme	Type	URI	Relatio	Confide	URI	Label	Comme	Type	Residual True Positive	Evaluation Resu
4	de-en	cmt-iasted-en-de	WiktionaryMatcher	[conference@en]	[]	[http://www.w3.org/2002/07/owl#Class]	http://cmt_en#c-302	=	0.5	http://iasted	[Vortrag@de]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
6	de-en	cmt-iasted-en-de	WiktionaryMatcher	[bid@en]	[]	[http://www.w3.org/2002/07/owl#Class]	http://cmt_en#c-301	=	0.5	http://iasted	[Präsentation@de]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
8	de-en	cmt-iasted-en-de	WiktionaryMatcher	[bid@en]	[]	[http://www.w3.org/2002/07/owl#Class]	http://cmt_en#c-301	=	0.5	http://iasted	[Vorstellung@de]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
13	de-en	confOf-sigkdd-de-e	WiktionaryMatcher	[Land@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://confOf_de#c-	=	0.5	http://sigkdd	[place@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
15	de-en	confOf-sigkdd-de-e	WiktionaryMatcher	[Papier@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://confOf_de#c-	=	1.0	http://sigkdd	[document@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
33	de-en	cmt-conference-de	WiktionaryMatcher	[Dokument@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://cmt_de#c-338	=	1.0	http://confer	[paper@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
35	de-en	cmt-conference-de	WiktionaryMatcher	[Gutachter@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://cmt_de#c-506	=	0.5	http://confer	[reviewer@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
37	de-en	conference-sigkdd	WiktionaryMatcher	[Konferenz@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_de	=	1.0	http://sigkdd	[conference@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
42	de-en	conference-sigkdd	WiktionaryMatcher	[Zusammenfassung	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_de	=	0.5	http://sigkdd	[review@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
54	de-en	conference-iasted-	WiktionaryMatcher	[Zusammenfassung	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_de	=	0.5	http://iasted	[review@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
56	de-en	conference-iasted-	WiktionaryMatcher	[Vorsitzender@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_de	=	1.0	http://iasted	[speaker@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
58	de-en	conference-iasted-	WiktionaryMatcher	[Präsentation@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_de	=	1.0	http://iasted	[presentation@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
62	de-en	conference-iasted-	WiktionaryMatcher	[Konferenz@de]	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_de	=	0.5	http://iasted	[lecture@en]	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive
71	de-en	conference-sigkdd	WiktionaryMatcher	[review@en]	[]	[http://www.w3.org/2002/07/owl#Class]	http://conference_en	=	0.5	http://sigkdd	[Zusammenfassung@d	[]	[http://www.w3.org/2002/07/owl#Class]	false	false positive

More Evaluation

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Filter for Scores or Correspondences

- **Micro Average Precision** and **Macro Average Precision** over track *Conference*
- All **residual true positives** for track *Anatomy*
- **Macro Average Class-F_1** for all tracks
- …

What is MELT?

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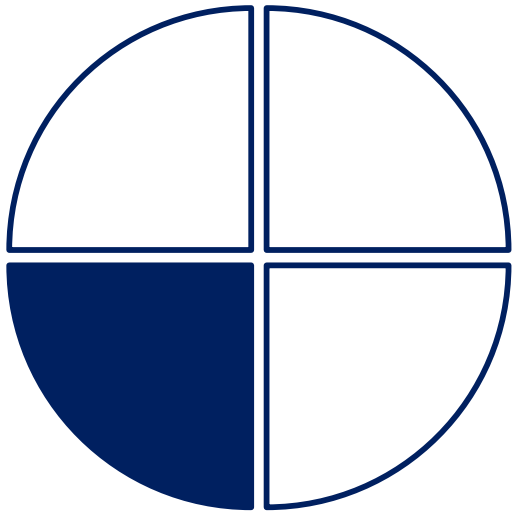
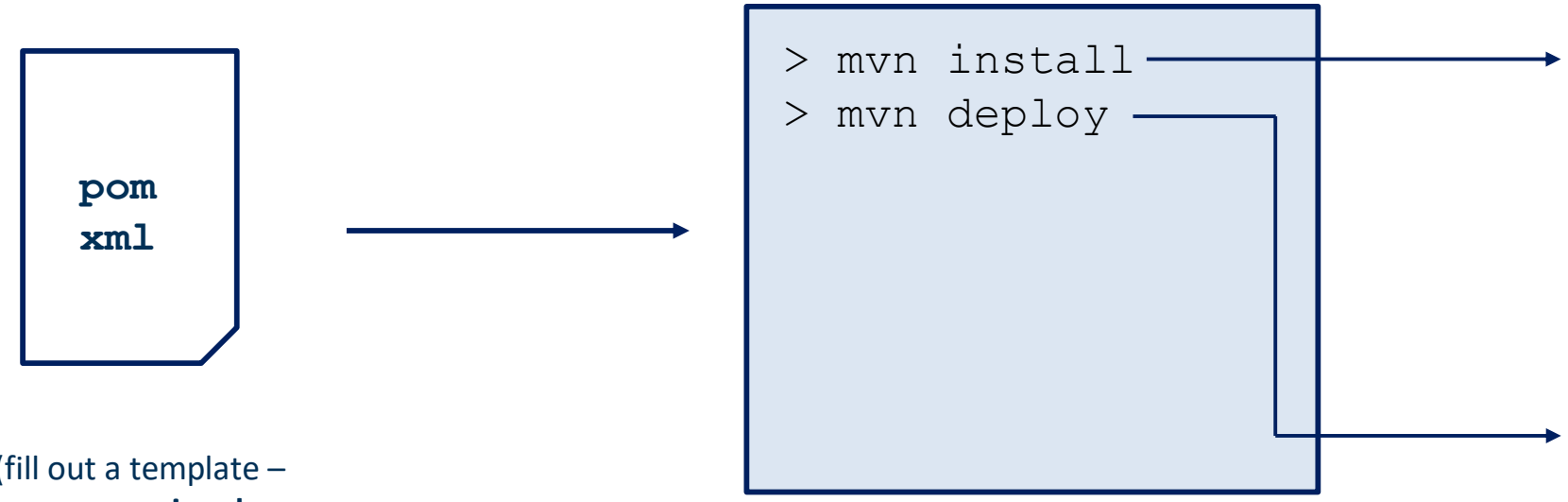


Matcher
Submission

Matcher
Evaluation

Matcher Submission



(fill out a template – **no maven wizardry required**)

- Creates **SEALS zip file** → can be submitted right away
- Creates **HOBBIT docker container**

- **Uploads and deploys** container directly in HOBBIT **automatically**

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Usage Example

Usage Example

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Motivation

“Which matchers are interesting candidates for combination?”

→ Matchers with a high F_1 score and high “diversity”.

Quantitative Analysis I

Analysis OAEI 2018 results for Conference and Anatomy: **Jaccard overlap of Alignments** rendered as heatmap in LaTex.

$$J(a_1, a_2) = \frac{|corr(a_1) \cap corr(a_2)|}{|corr(a_1) \cup corr(a_2)|}$$

```
Executor.loadFromAnatomyResultsFolder("myPath");
// few lines of other code (available on GitHub as
// example)
```

Results for Anatomy

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Table 1. OAEI Anatomy 2018 Alignment Similarity

	ALIN	ALOD2Vec	AML	DOME	FCAMapX	Holontology	KEPLER	Lily	LogMap	LogMapBio	LogMapLt	POMAP++	SANOM	XMap
ALIN	1	0.93	0.62	0.97	0.72	0.47	0.79	0.63	0.66	0.6	0.81	0.63	0.62	0.65
ALOD2Vec	0.93	1	0.65	0.94	0.77	0.45	0.81	0.67	0.7	0.63	0.84	0.66	0.64	0.68
AML	0.62	0.65	1	0.62	0.76	0.3	0.74	0.72	0.8	0.82	0.72	0.83	0.79	0.83
DOME	0.97	0.94	0.62	1	0.73	0.47	0.79	0.64	0.66	0.6	0.81	0.63	0.62	0.66
FCAMapX	0.72	0.77	0.76	0.73	1	0.35	0.75	0.69	0.82	0.77	0.89	0.77	0.75	0.78
Holontology	0.47	0.45	0.3	0.47	0.35	1	0.38	0.3	0.32	0.29	0.39	0.31	0.3	0.31
KEPLER	0.79	0.81	0.74	0.79	0.75	0.38	1	0.69	0.78	0.72	0.75	0.76	0.71	0.76
Lily	0.63	0.67	0.72	0.64	0.69	0.3	0.69	1	0.7	0.68	0.69	0.72	0.72	0.72
LogMap	0.66	0.7	0.8	0.66	0.82	0.32	0.78	0.7	1	0.9	0.81	0.81	0.8	0.81
LogMapBio	0.6	0.63	0.82	0.6	0.77	0.29	0.72	0.68	0.9	1	0.74	0.8	0.78	0.78
LogMapLt	0.81	0.84	0.72	0.81	0.89	0.39	0.75	0.69	0.81	0.74	1	0.74	0.74	0.75
POMAP++	0.63	0.66	0.83	0.63	0.77	0.31	0.76	0.72	0.81	0.8	0.74	1	0.79	0.83
SANOM	0.62	0.64	0.79	0.62	0.75	0.3	0.71	0.72	0.8	0.78	0.74	0.79	1	0.78
XMap	0.65	0.68	0.83	0.66	0.78	0.31	0.76	0.72	0.81	0.78	0.75	0.83	0.78	1

Results for Conference

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Table 2. OAEI Conference 2018 Alignment Similarity

	ALIN	ALOD2Vec	AML	DOME	FCAMapX	Holontology	KEPLER	Lily	LogMap	LogMapLt	SANOM	XMap
ALIN	1	0.75	0.65	0.84	0.63	0.77	0.53	0.43	0.72	0.76	0.52	0.6
ALOD2Vec	0.75	1	0.58	0.87	0.67	0.75	0.61	0.37	0.67	0.86	0.5	0.54
AML	0.65	0.58	1	0.61	0.58	0.56	0.53	0.45	0.71	0.59	0.63	0.64
DOME	0.84	0.87	0.61	1	0.67	0.81	0.59	0.39	0.7	0.86	0.52	0.56
FCAMapX	0.63	0.67	0.58	0.67	1	0.6	0.55	0.41	0.62	0.66	0.51	0.53
Holontology	0.77	0.75	0.56	0.81	0.6	1	0.53	0.37	0.64	0.72	0.49	0.52
KEPLER	0.53	0.61	0.53	0.59	0.55	0.53	1	0.41	0.57	0.62	0.5	0.54
Lily	0.43	0.37	0.45	0.39	0.41	0.37	0.41	1	0.46	0.39	0.48	0.51
LogMap	0.72	0.67	0.71	0.7	0.62	0.64	0.57	0.46	1	0.7	0.63	0.66
LogMapLt	0.76	0.86	0.59	0.86	0.66	0.72	0.62	0.39	0.7	1	0.51	0.56
SANOM	0.52	0.5	0.63	0.52	0.51	0.49	0.5	0.48	0.63	0.51	1	0.61
XMap	0.6	0.54	0.64	0.56	0.53	0.52	0.54	0.51	0.66	0.56	0.61	1

Quantitative Analysis II

Mean Absolute Deviation (MAD) of Similarities plotted against F_1.

$$MAD = \frac{1}{n} \sum_{i=1}^{n} |x_i - mean(X)|$$

Results for Anatomy

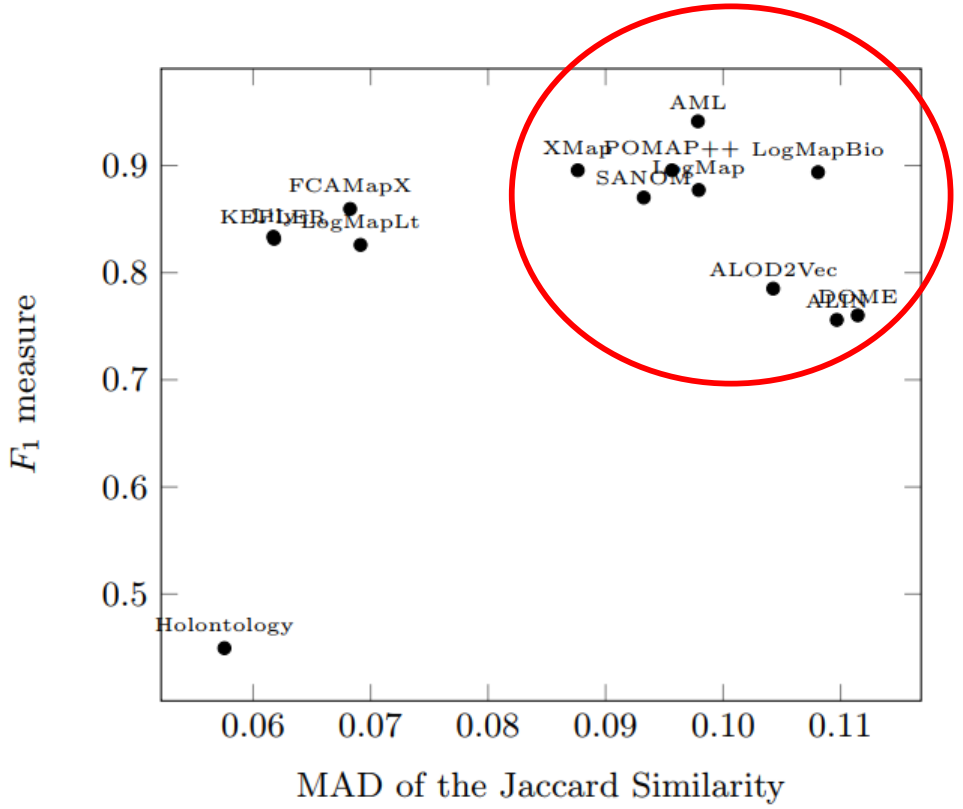
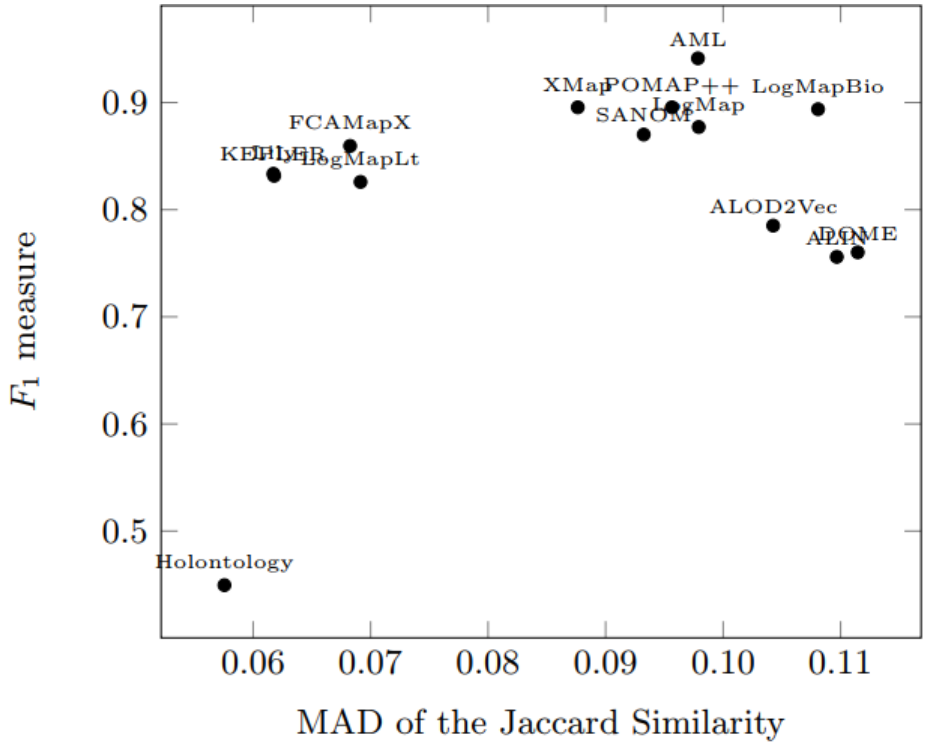


Fig. 2. Matcher comparison using MAD and F_1 on the *Anatomy* data set

Results for Anatomy



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Results for Conference

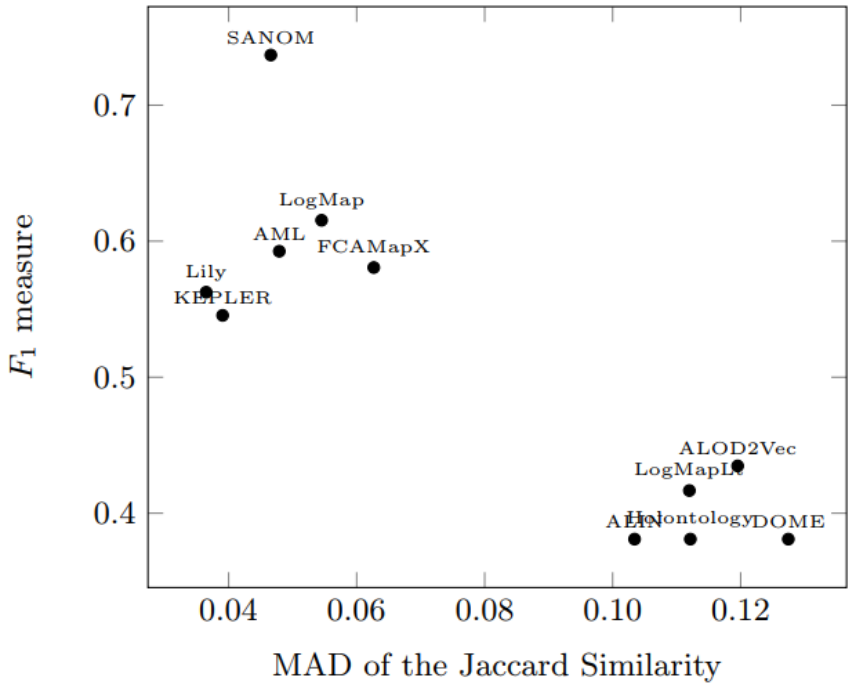

Fig. 3. Matcher comparison using MAD and F_1 on the *Conference* data set

There is MUCH more to MELT

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Multi-Threaded Matcher Execution

Ontology **Caching** Services

Baseline **Matchers**

Execution of SEALS packages from within MELT

Alignment **Refiners**

TRY IT!

Alignment **Extensions**

OAEI-Track Organizer Tools

Automatic Reading of OAEI Result Alignments

ExecutionResult **Indexing**

One-Time **Auto-Download** of OAEI Tracks

Matcher **Pipelining**

Thank you!

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