

MELT

Matching Evaluation Toolkit



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

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Joint Work



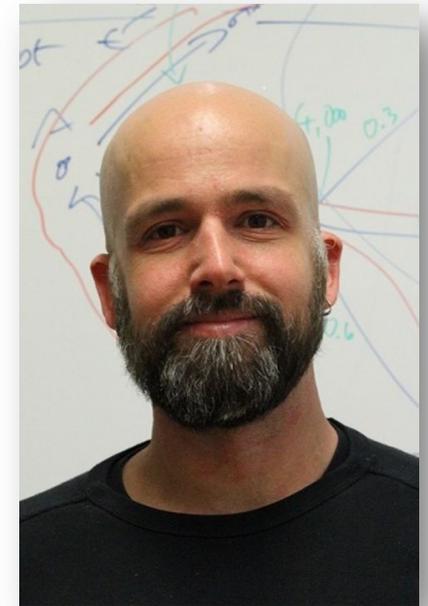
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Agenda



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

MOTIVATION

Ontology Alignment Evaluation Initiative (OAEI)



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



Semantic Evaluation at Large Scale

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



Holistic Benchmarking of Big Linked Data

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

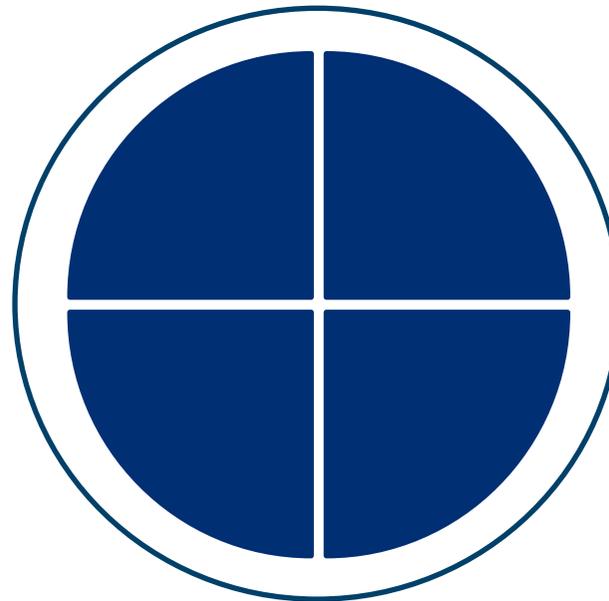
Pain Points

- **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**

What is MELT?

What is MELT?

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



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

- Allow for **parameter optimization**

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

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

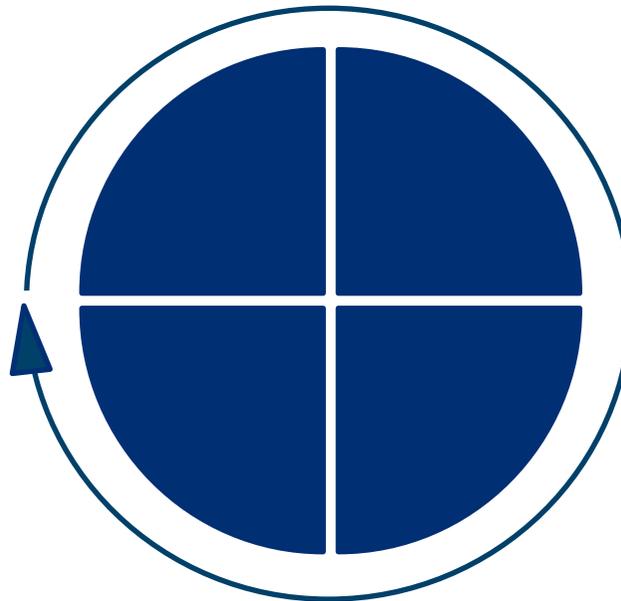
What is MELT?

Matcher
Development

Matcher
Fine-Tuning

Matcher
Submission

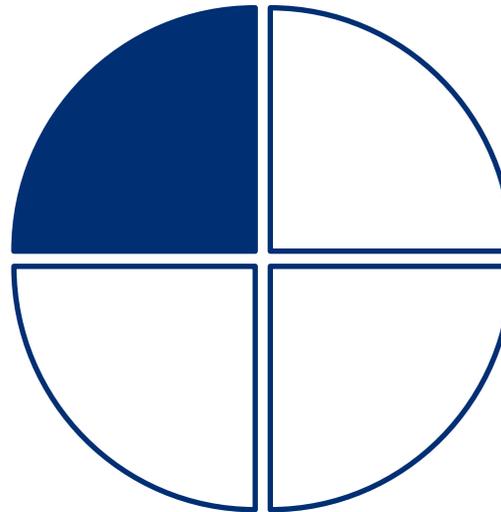
Matcher
Evaluation



What is MELT?

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Development

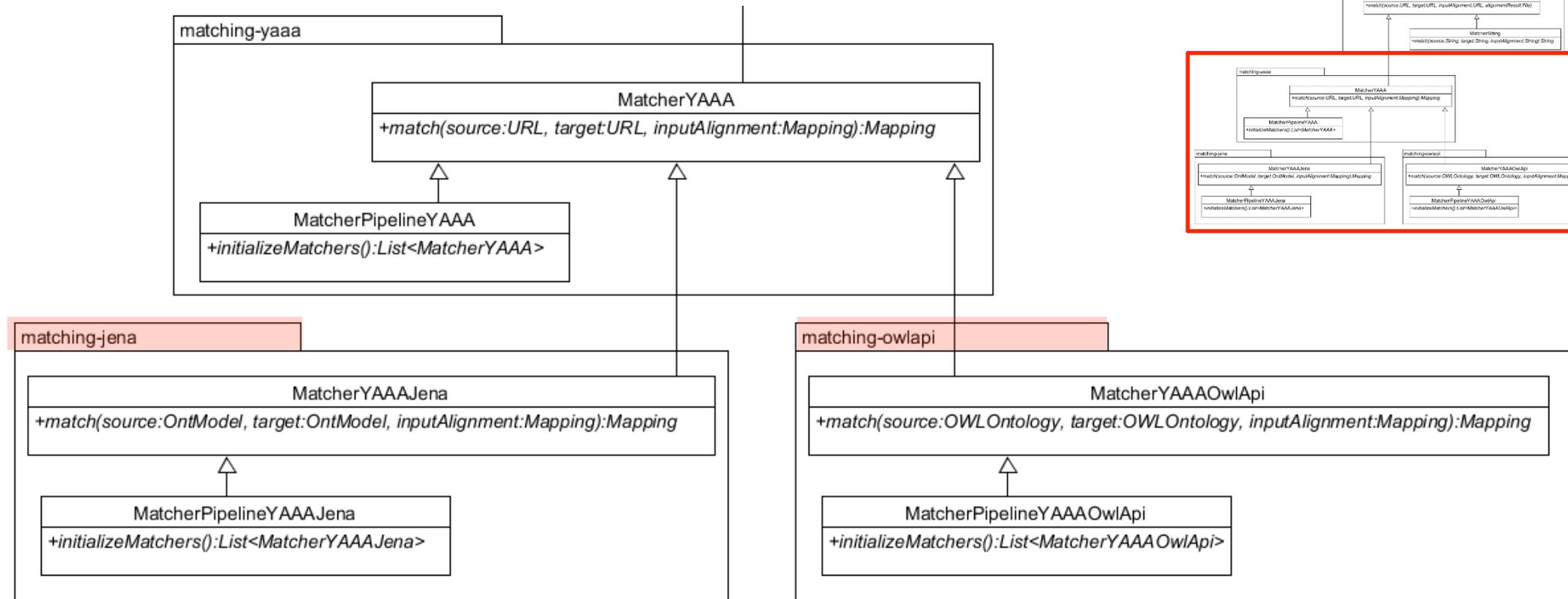
Matcher
Fine-Tuning



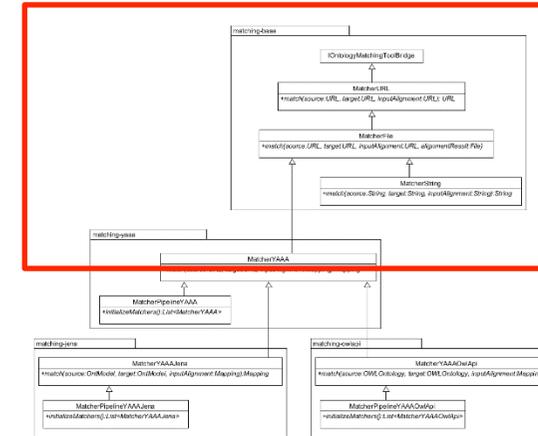
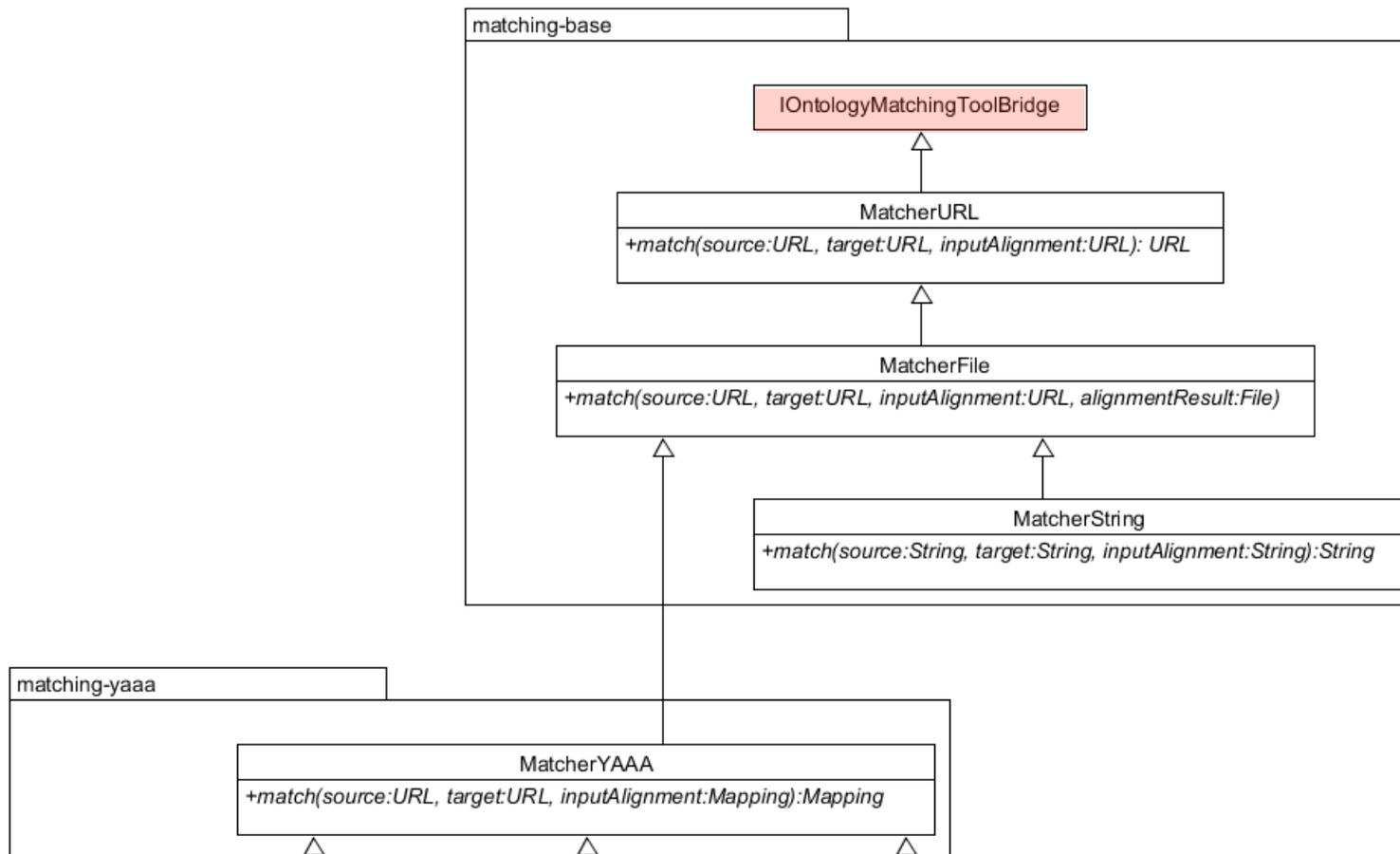
Matcher
Submission

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Evaluation

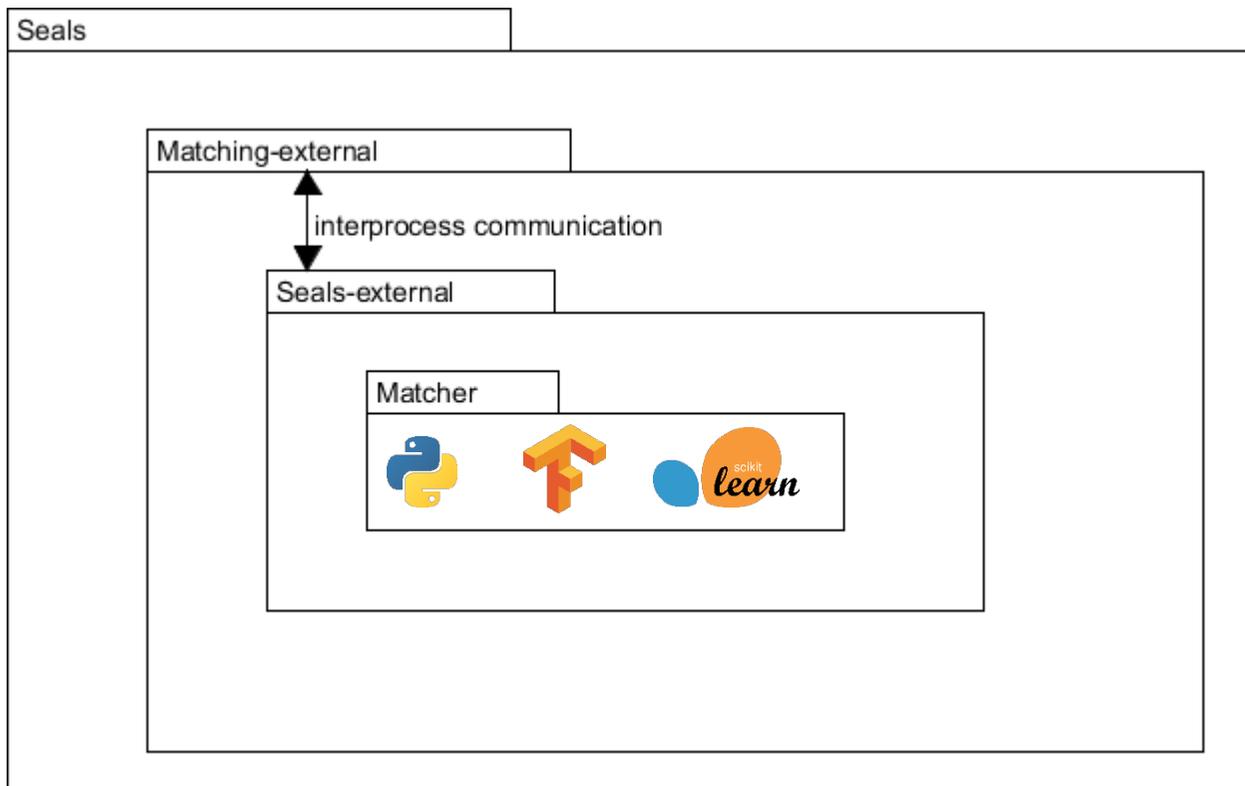
Yet Another Alignment API (YAAA)



Full SEALS/HOBBIT Support



External Matching

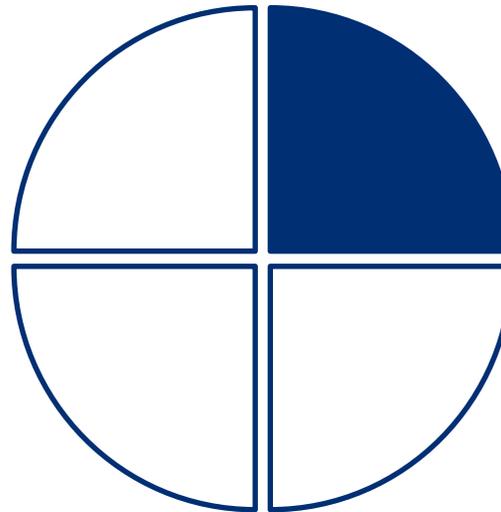


- Simple wrapping
- Packageable for HOBBIT and SEALS
- Matcher can still be evaluated in MELT
- Documentation and demo project available on GitHub

What is MELT?

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Fine-Tuning



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Parameter Tuning

- 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

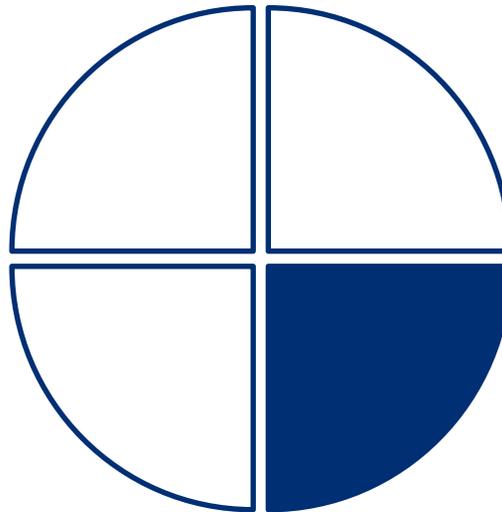
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Evaluation

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

```
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();
```

Multiple evaluators available, extensible.

Exemplary Evaluation

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

 de-en_de-en-v2	14.08.2019 13:07	File folder	
 alignmentCube.csv	14.08.2019 13:07	OpenOffice.org 1....	237 KB
 testCasePerformanceCube.csv	14.08.2019 13:07	OpenOffice.org 1....	10 KB
 trackPerformanceCube.csv	14.08.2019 13:07	OpenOffice.org 1....	1 KB

Exemplary Evaluation

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Exemplary Evaluation

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

WiktionaryMatcher														
B	C	D	E	F	G	H	I	J	K	L	M	N		E
Case	Matcher	Label	Comment	Type	URI	Relation	Confidence	URI	Label	Comment	Type	Residual	True Positive	
asted-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		fa
asted-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		fa
asted-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		fa
of-sigkdd-de	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		fa
of-sigkdd-de	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		fa
conference-de	WiktionaryMatcher	[Dokument@de]		[http://www.w3.org/2002/07/owl#Class]	http://cmt_de#c-330	=	1.0	http://confer	[paper@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
conference-de	WiktionaryMatcher	[Gutachter@de]		[http://www.w3.org/2002/07/owl#Class]	http://cmt_de#c-500	=	0.5	http://confer	[reviewer@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-sigkdd	WiktionaryMatcher	[Konferenz@de]		[http://www.w3.org/2002/07/owl#Class]	http://conference_d	=	1.0	http://sigkdd	[conference@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-sigkdd	WiktionaryMatcher	[Zusammenfassun		[http://www.w3.org/2002/07/owl#Class]	http://conference_d	=	0.5	http://sigkdd	[review@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-iasted	WiktionaryMatcher	[Zusammenfassun		[http://www.w3.org/2002/07/owl#Class]	http://conference_d	=	0.5	http://iasted	[review@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-iasted	WiktionaryMatcher	[Vorsitzender@de]		[http://www.w3.org/2002/07/owl#Class]	http://conference_d	=	1.0	http://iasted	[speaker@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-iasted	WiktionaryMatcher	[Präsentation@de]		[http://www.w3.org/2002/07/owl#Class]	http://conference_d	=	1.0	http://iasted	[presentation@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-iasted	WiktionaryMatcher	[Konferenz@de]		[http://www.w3.org/2002/07/owl#Class]	http://conference_d	=	0.5	http://iasted	[lecture@en]		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-sigkdd	WiktionaryMatcher	[review@en]		[http://www.w3.org/2002/07/owl#Class]	http://conference_e	=	0.5	http://sigkdd	[Zusammenfassung@		[http://www.w3.org/2002/07/owl#Class]	false		fa
rence-sigkdd	WiktionaryMatcher	[conference@de]		[http://www.w3.org/2002/07/owl#Class]	http://conference_e	=	1.0	http://sigkdd	[Document@de]		[http://www.w3.org/2002/07/owl#Class]	false		fa

More Evaluation

Filter for Scores or Correspondences

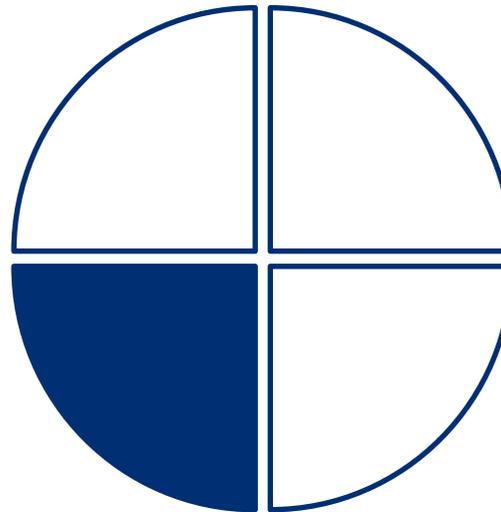
- **Micro Average Precision** and **Macro Average Precision** over track *Conference*
- All **residual true positives** for track *Anatomy*
- **Macro Average Class-F₁** for all tracks
- ...

What is MELT?

Matcher
Development

Matcher
Fine-Tuning

Matcher
Submission



Matcher
Evaluation

Matcher Submission



```
> mvn install  
> mvn deploy
```

(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**

Usage Example

Usage Example

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

Table 1. OAEI Anatomy 2018 Alignment Similarity

	<i>ALIN</i>	<i>ALOD2Vec</i>	<i>AML</i>	<i>DOME</i>	<i>FCAMapX</i>	<i>Holontology</i>	<i>KEPLER</i>	<i>Lily</i>	<i>LogMap</i>	<i>LogMapBio</i>	<i>LogMapLt</i>	<i>POMAP++</i>	<i>SANOM</i>	<i>XMap</i>
<i>ALIN</i>	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
<i>ALOD2Vec</i>	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
<i>AML</i>	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
<i>DOME</i>	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
<i>FCAMapX</i>	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
<i>Holontology</i>	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
<i>KEPLER</i>	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
<i>Lily</i>	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
<i>LogMap</i>	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
<i>LogMapBio</i>	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
<i>LogMapLt</i>	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
<i>POMAP++</i>	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
<i>SANOM</i>	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
<i>XMap</i>	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

Table 2. OAEI Conference 2018 Alignment Similarity

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

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

Results for Anatomy

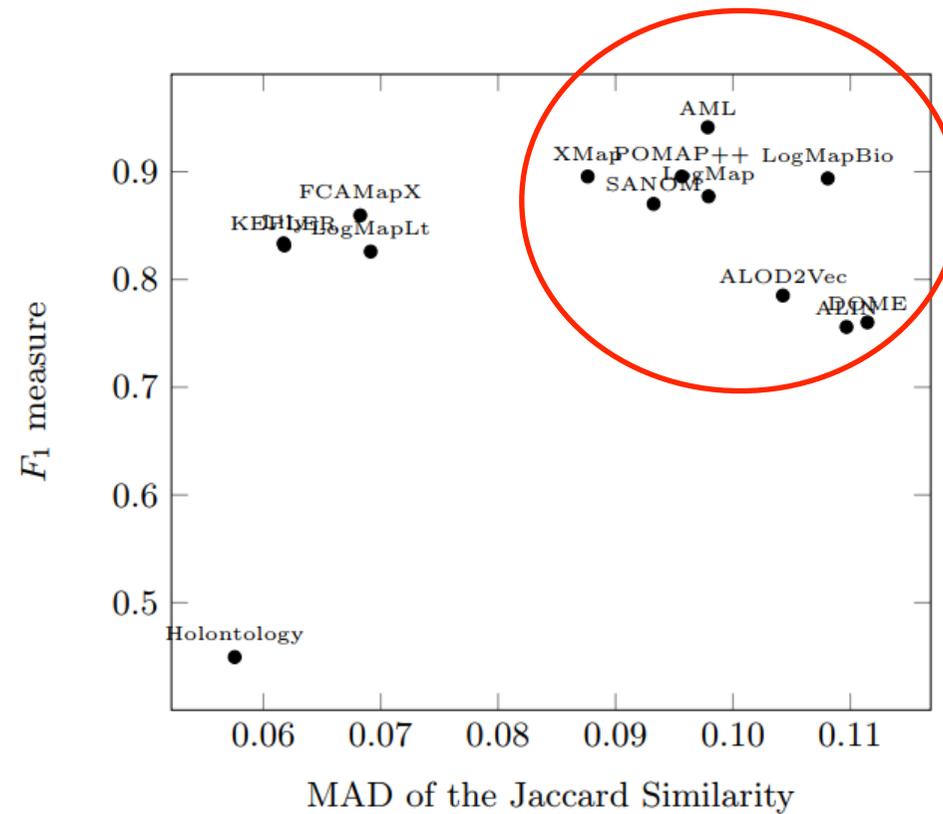


Fig. 2. Matcher comparison using MAD and F_1 on the *Anatomy* data set

Results for Conference

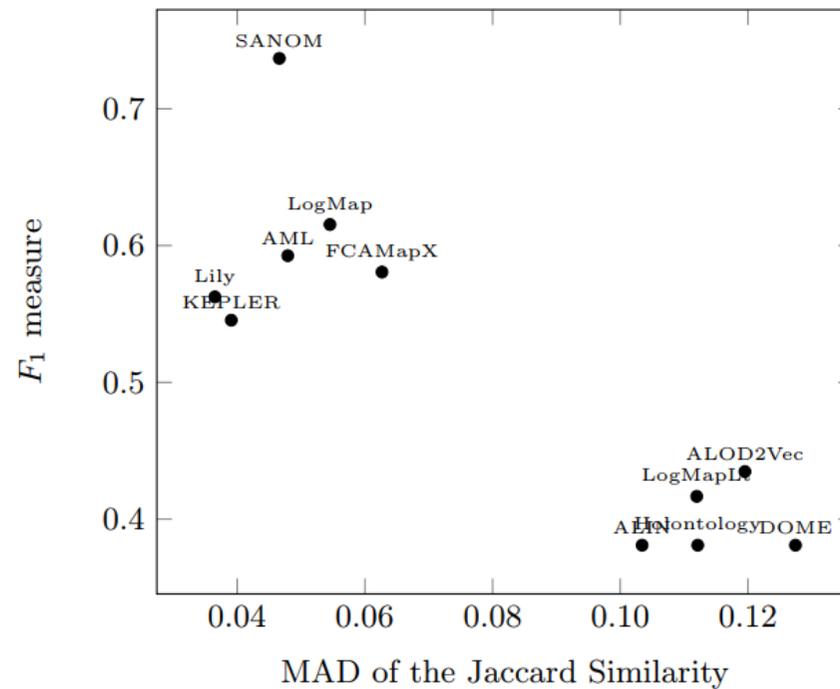


Fig. 3. Matcher comparison using MAD and F_1 on the *Conference* data set

There is MUCH more to MELT



Multi-Threaded Matcher
Execution

Ontology **Caching** Services

Baseline **Matchers**

Execution of **SEALS**
packages from within
MELT

TRY IT!



Alignment **Refinement**

Alignment **Extension**

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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