Crash course in Machine Learning

Teaching computers to help us teach language

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Brigham Young University

CALICO
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Outline

- Crash course in machine learning (using example of *automatic second-language readability classification*)
  - Collect gold-standard corpus
  - Extract "features"
  - Train and evaluate a model
  - Apply model to real-world texts
- Example application of a machine-learning model
  - Web search for language learning/teaching

Collect gold-standard corpus

- Lots of examples of human performance of the target task
- For readability: given a text, I want to output a difficulty score
  - CEFR levels: A1, A2, B1, B2, C1, C2
  - Get examples from all levels (even distribution is best)
- "There's no data like more data."

L2 readability corpora

	Total	A1	A2	B1	B2	C1	C2
CIE	145	28	57	60	–	–	–
news	50	–	–	–	–	–	50
LingQ	3481	323	653	716	832	609	348
RK	99	40	18	17	18	6	–
TORFL	168	31	36	36	26	28	11
Zlat.	746	–	66	553	127	–	–
Comb.	4689	422	830	1382	1003	643	409

Table: Distribution of documents per level for each corpus

Text complexity features

- Lexical variability
  - e.g., how often are words repeated?
- Lexical complexity
  - e.g., avg word length in letters/morphemes/syllables.
- Lexical frequency
  - based on a relevant corpus
- Morphology
  - based on automatic part-of-speech tagging
- Syntax
  - based on automatically generated sentence diagrams/trees
- etc.

Text complexity features

ID	label	doc_len	avg_word_len	type-t
01	A1	106	4.7	0.5
02	A1	101	4.5	0.4
03	A2	245	5.1	0.6
04	A2	151	5.0	0.5
05	B1	230	5.3	0.7
06	B1	272	5.2	0.7
07	B2	225	5.7	0.5
08	B2	401	5.4	0.8
09	C1	643	9.4	0.6
10	C1	530	7.4	0.7
11	C2	476	8.7	0.8
12	C2	760	9.8	0.8
...				

Train and evaluate model

- Set aside part of your data for evaluation (`test/validation`)
- Feed the remaining data into a machine-learning algorithm (`training/development`)
  - You don't have to know how these work to use them (but it helps!)
  - Your favorite programming language probably has multiple free libraries with many off-the-shelf algorithms included.
- Use the resulting model to predict labels from the `test` data.
- Compare the actual labels in your `test` data to your models predictions.

Random Forest classifier

Classifier	Precision	Recall	F-score
ZeroR	0.097	0.312	0.149
OneR	0.487	0.497	0.471
RandomForest	0.690	0.677	0.671

Table: Baseline and RandomForest results with Combined corpus

Combined corpus Random Forest confusion matrix

	A1	A2	B1	B2	C1	C2	<– classified as
A1	**234**	120	48	0	0	0	
A2	41	**553**	192	17	0	0	
B1	16	76	**1130**	90	5	5	
B2	1	57	311	**478**	83	4	
C1	1	20	66	98	**394**	6	
C2	0	3	40	58	9	**78**	

Table: Confusion matrix for RandomForest, all features, Combined corpus

Adjacent accuracy: 0.919

Use your model in real-world applications

- For each new text...
  - Extract features just like you did with the gold-standard corpus
  - Your model can make a prediction based on those features

Web search for language learners and teachers

- While preparing lessons and tests, how many hours have you spent looking for the perfect text?
  - right length
  - right reading level
  - target grammar topic
  - ...but NOT that other confusing grammar topic

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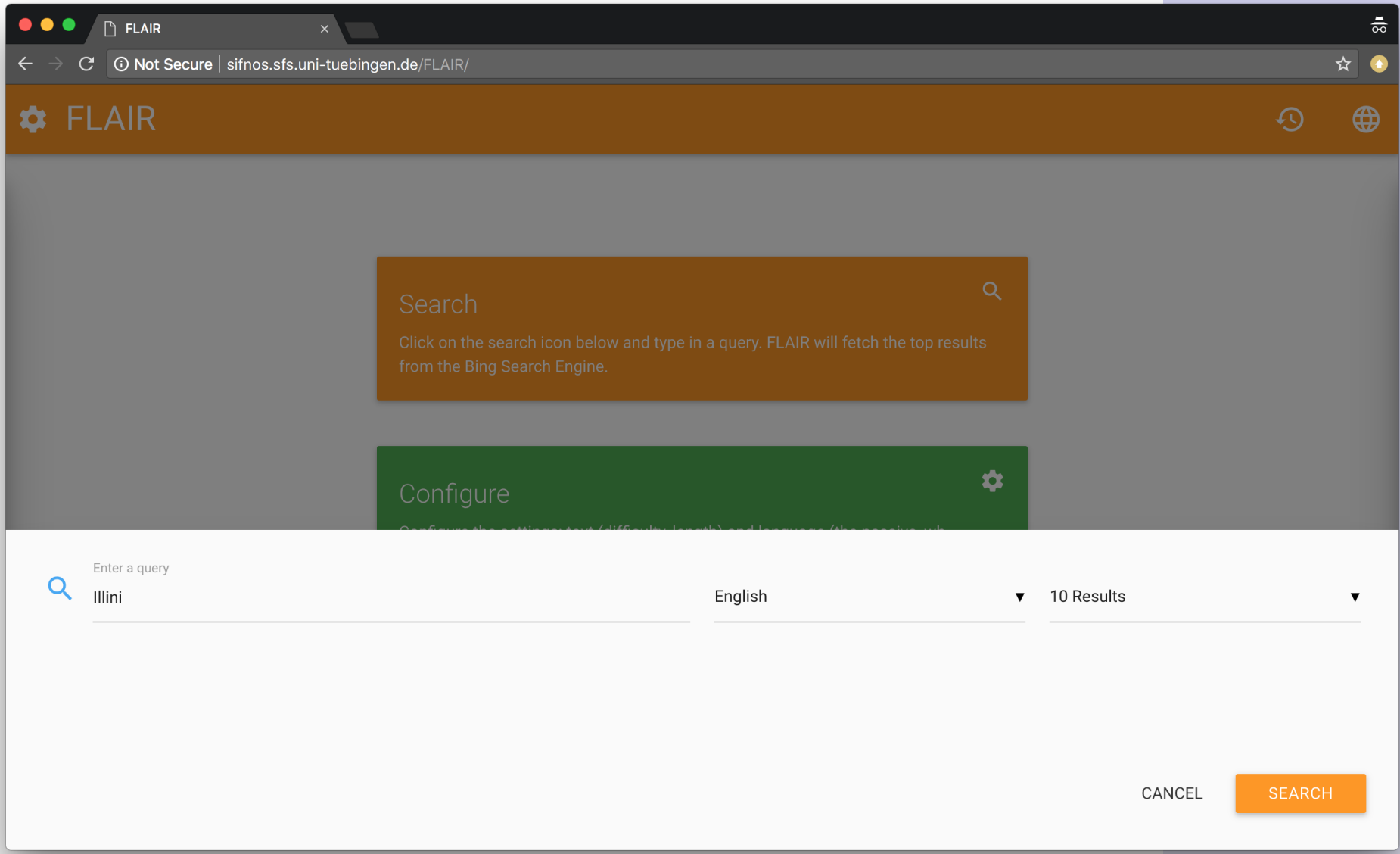
- `http://sifnos.sfs.uni-tuebingen.de/FLAIR/`
  - Chinkina & Meurers, 2016


FLAIR
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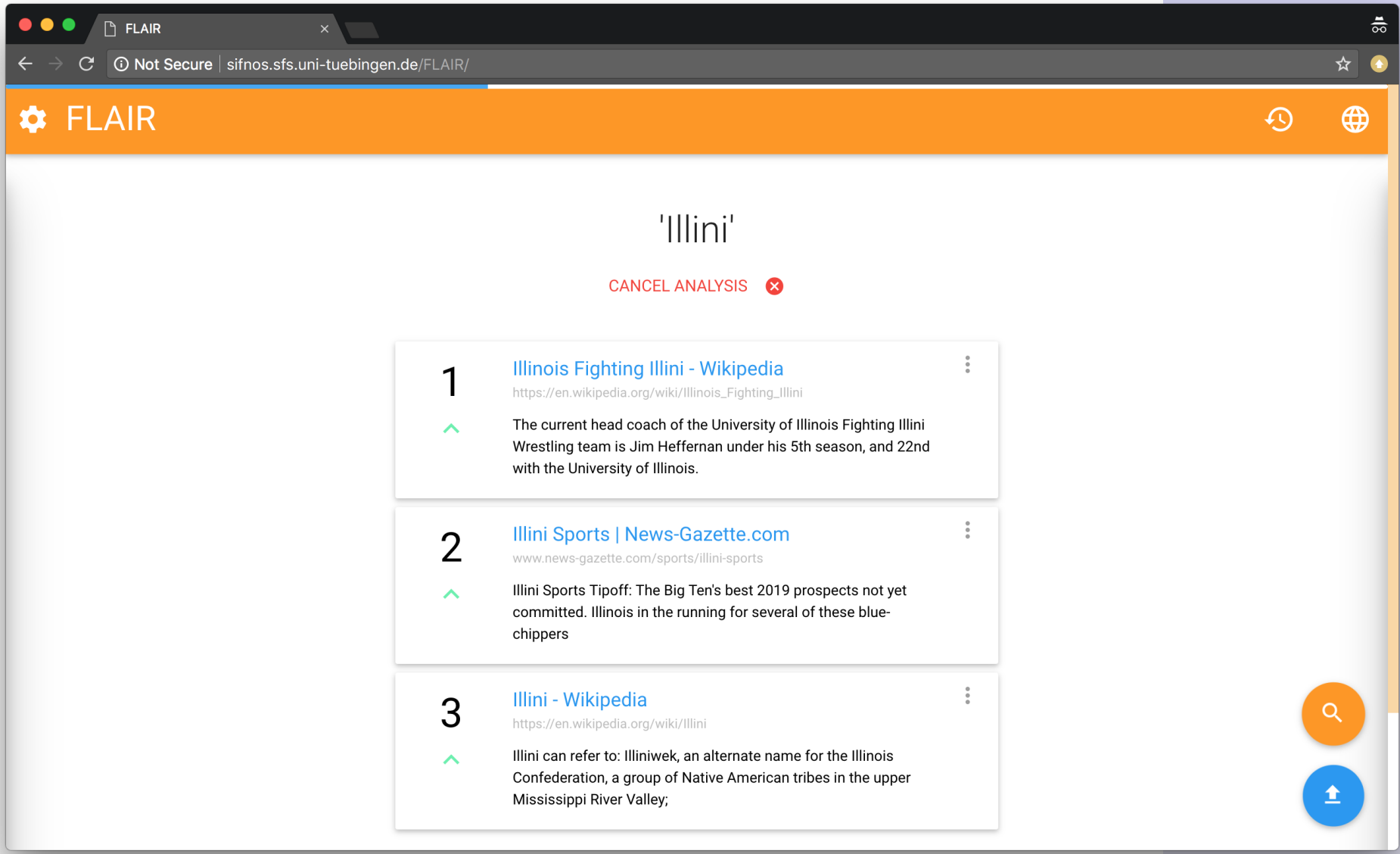
FLAIR
Search
Click on the search icon below and type in a query. FLAIR will fetch the top results from the Bing Search Engine.
Configure
Enter a query
Illini
English
10 Results
CANCEL
SEARCH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FLAIR
'Illini'
CANCEL ANALYSIS
1
Illinois Fighting Illini - Wikipedia
https://en.wikipedia.org/wiki/Illinois_Fighting_Illini
The current head coach of the University of Illinois Fighting Illini Wrestling team is Jim Heffernan under his 5th season, and 22nd with the University of Illinois.
2
Illini Sports | News-Gazette.com
www.news-gazette.com/sports/illini-sports
Illini Sports Tipoff: The Big Ten's best 2019 prospects not yet committed. Illinois in the running for several of these blue-chippers
3
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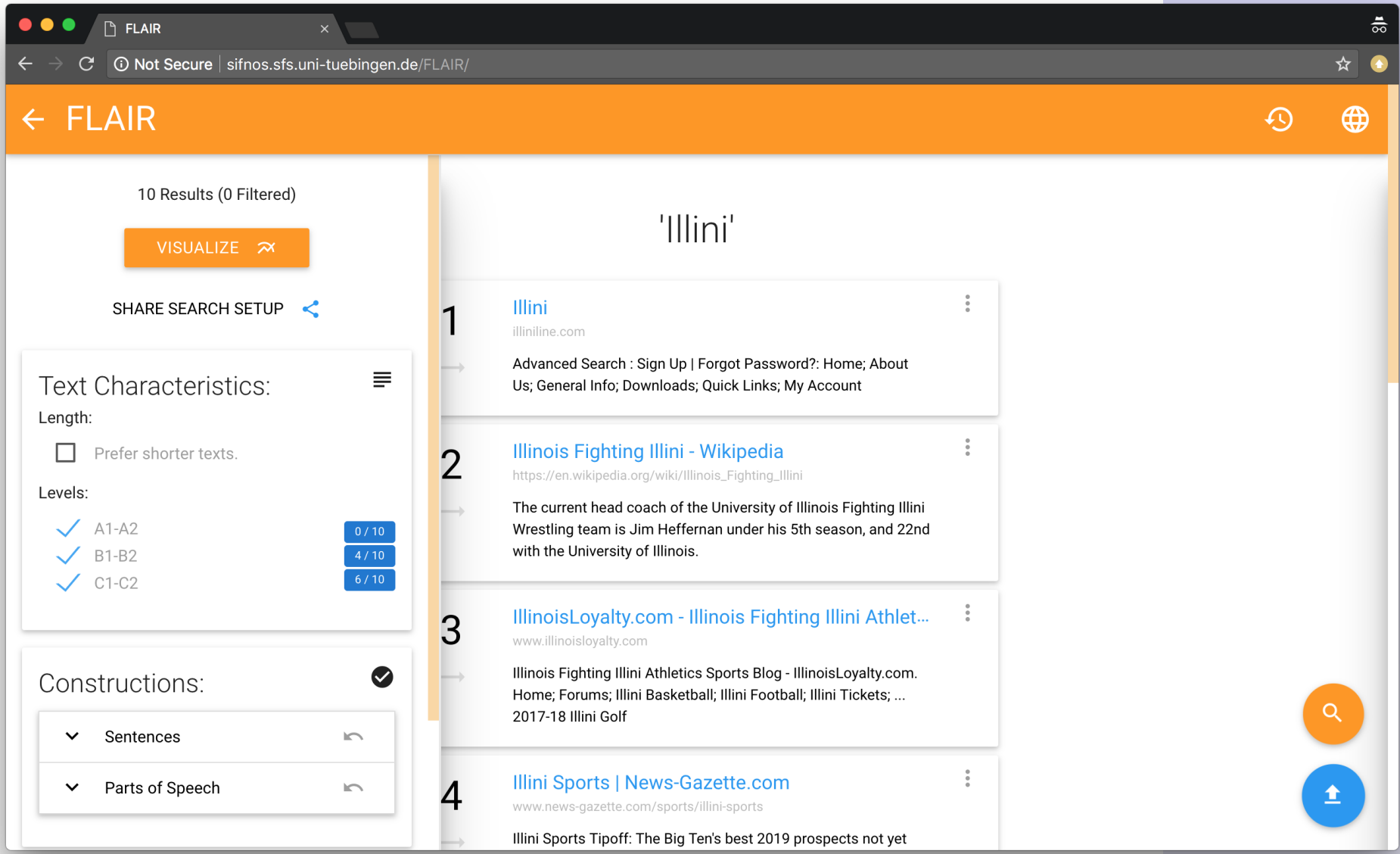
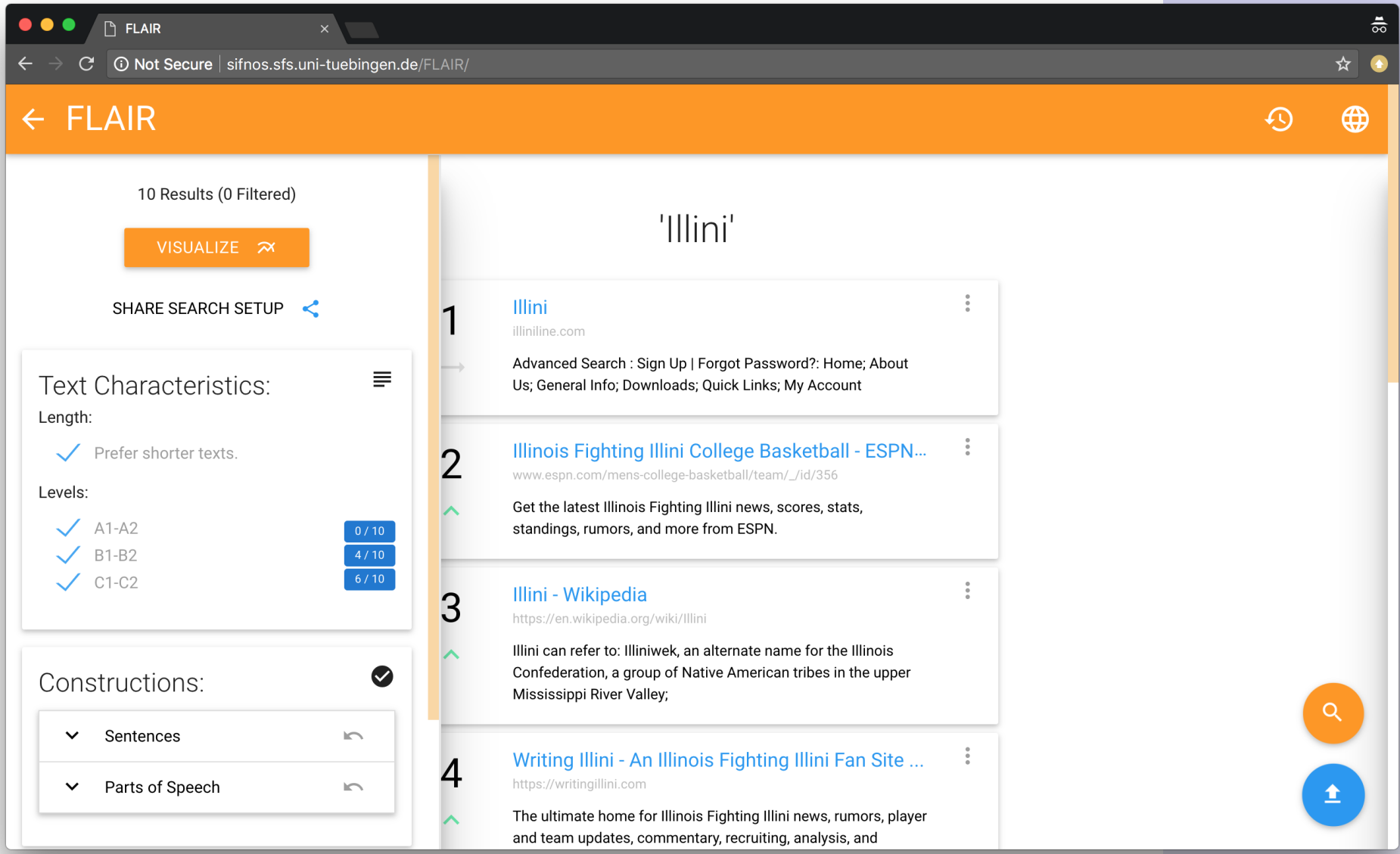

FLAIR
Not Secure | sifnos.sfs.uni-tuebingen.de/FLAIR/
FLAIR
10 Results (0 Filtered)
VISUALIZE
SHARE SEARCH SETUP
Text Characteristics:
Length:
Prefer shorter texts.
Levels:
A1-A2
B1-B2
C1-C2
0 / 10
4 / 10
6 / 10
Constructions:
Sentences
Parts of Speech
'Illini'
1
Illini
illiniline.com
Advanced Search : Sign Up | Forgot Password?: Home; About Us; General Info; Downloads; Quick Links; My Account
2
Illinois Fighting Illini - Wikipedia
https://en.wikipedia.org/wiki/Illinois_Fighting_Illini
The current head coach of the University of Illinois Fighting Illini Wrestling team is Jim Heffernan under his 5th season, and 22nd with the University of Illinois.
3
IllinoisLoyalty.com - Illinois Fighting Illini Athlet...
www.illinoisloyalty.com
Illinois Fighting Illini Athletics Sports Blog - IllinoisLoyalty.com. Home; Forums; Illini Basketball; Illini Football; Illini Tickets; ... 2017-18 Illini Golf
4
Illini Sports | News-Gazette.com
www.news-gazette.com/sports/illini-sports
Illini Sports Tipoff: The Big Ten's best 2019 prospects not yet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'Illini'
1
Illini
illiniline.com
Advanced Search : Sign Up | Forgot Password?: Home; About Us; General Info; Downloads; Quick Links; My Account
2
Illinois Fighting Illini College Basketball - ESPN...
www.espn.com/mens-college-basketball/team/_/id/356
Get the latest Illinois Fighting Illini news, scores, stats, standings, rumors, and more from ESPN.
3
Illini - Wikipedia
https://en.wikipedia.org/wiki/Illini
Illini can refer to: Illiniwek, an alternate name for the Illinois Confederation, a group of Native American tribes in the upper Mississippi River Valley;
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Writing Illini - An Illinois Fighting Illini Fan Site ...
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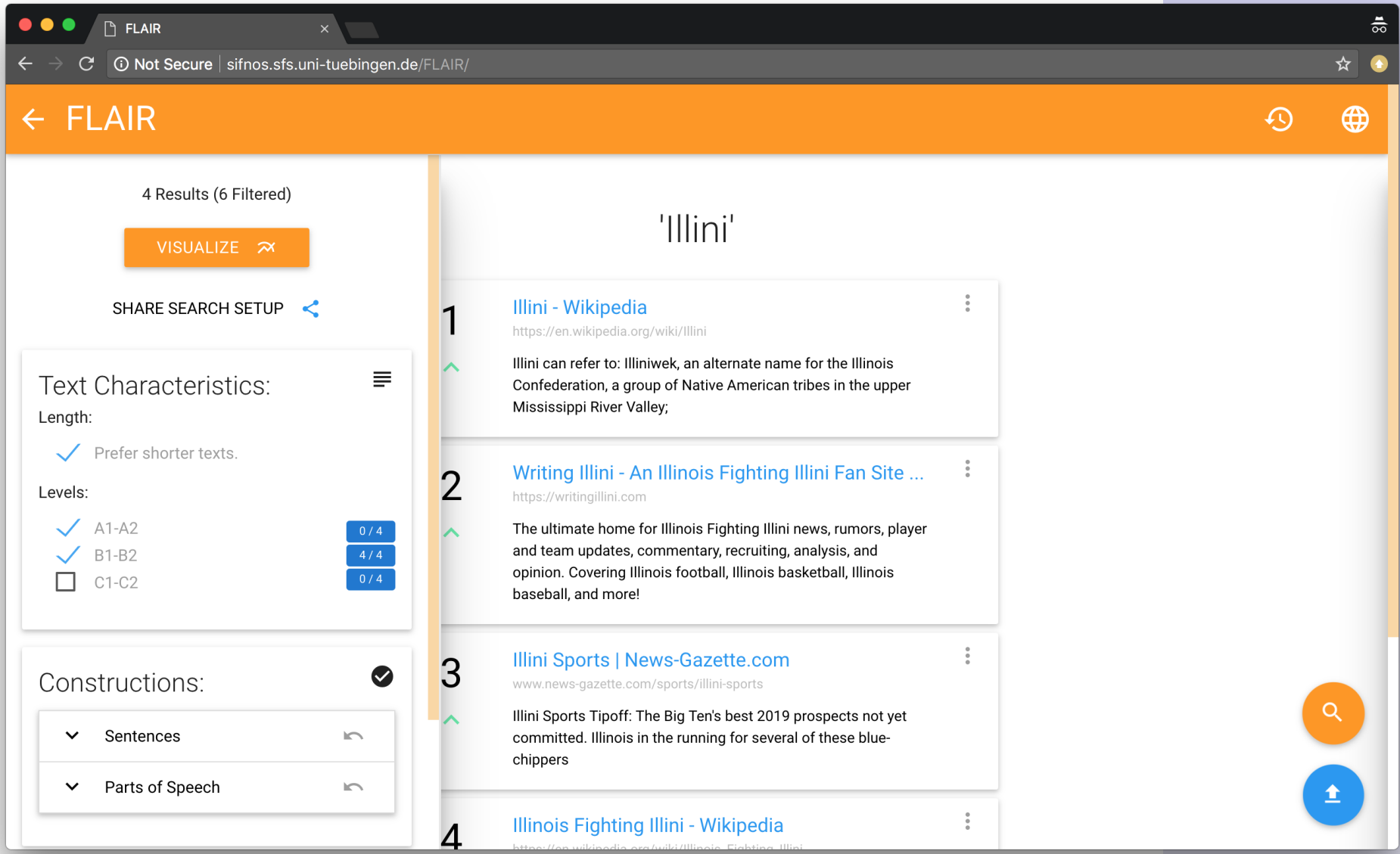
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4 Results (6 Filtered)
VISUALIZE
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Text Characteristics:
Length:
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A1-A2 0 / 4
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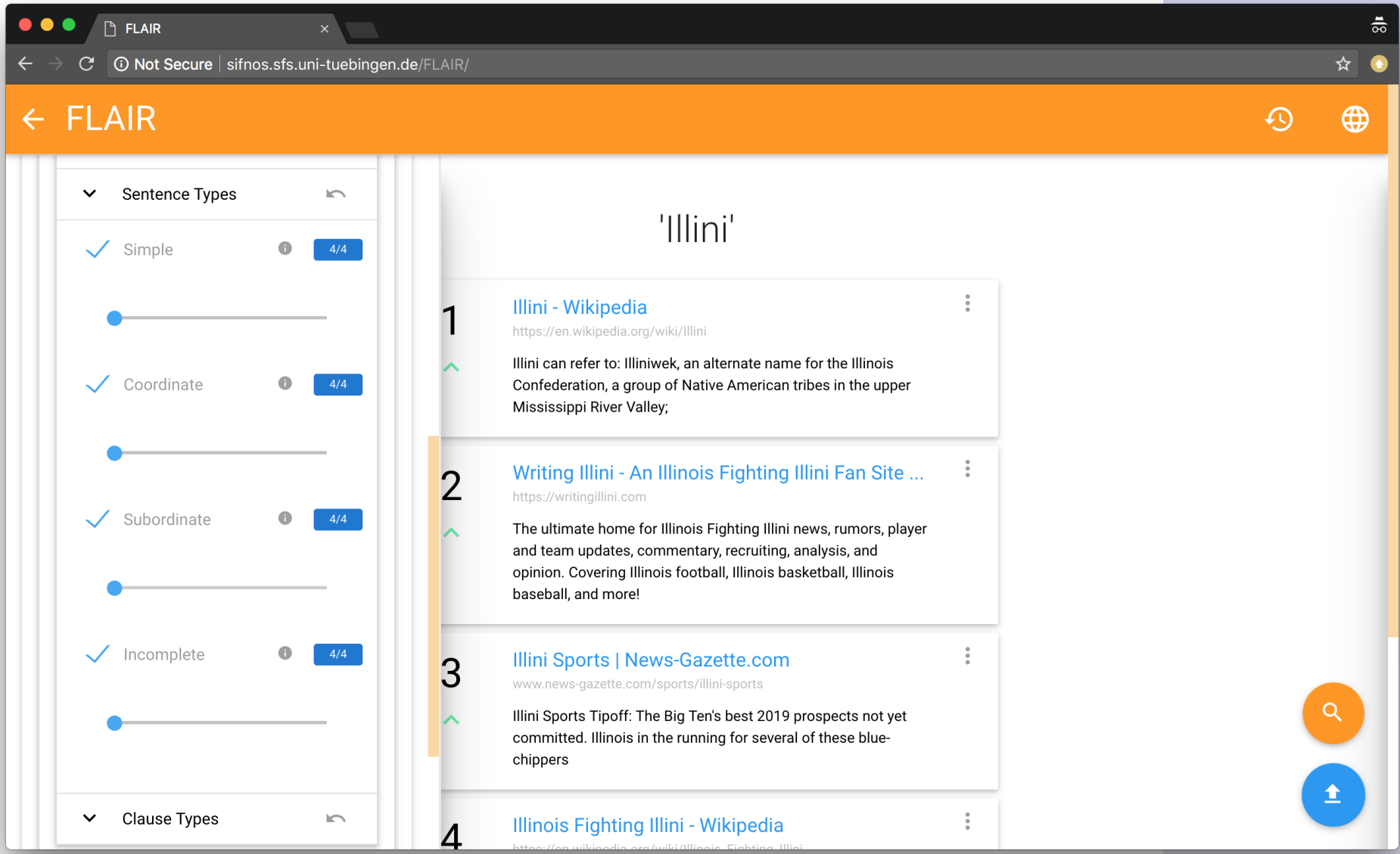
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Subordinate
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Incomplete
4/4
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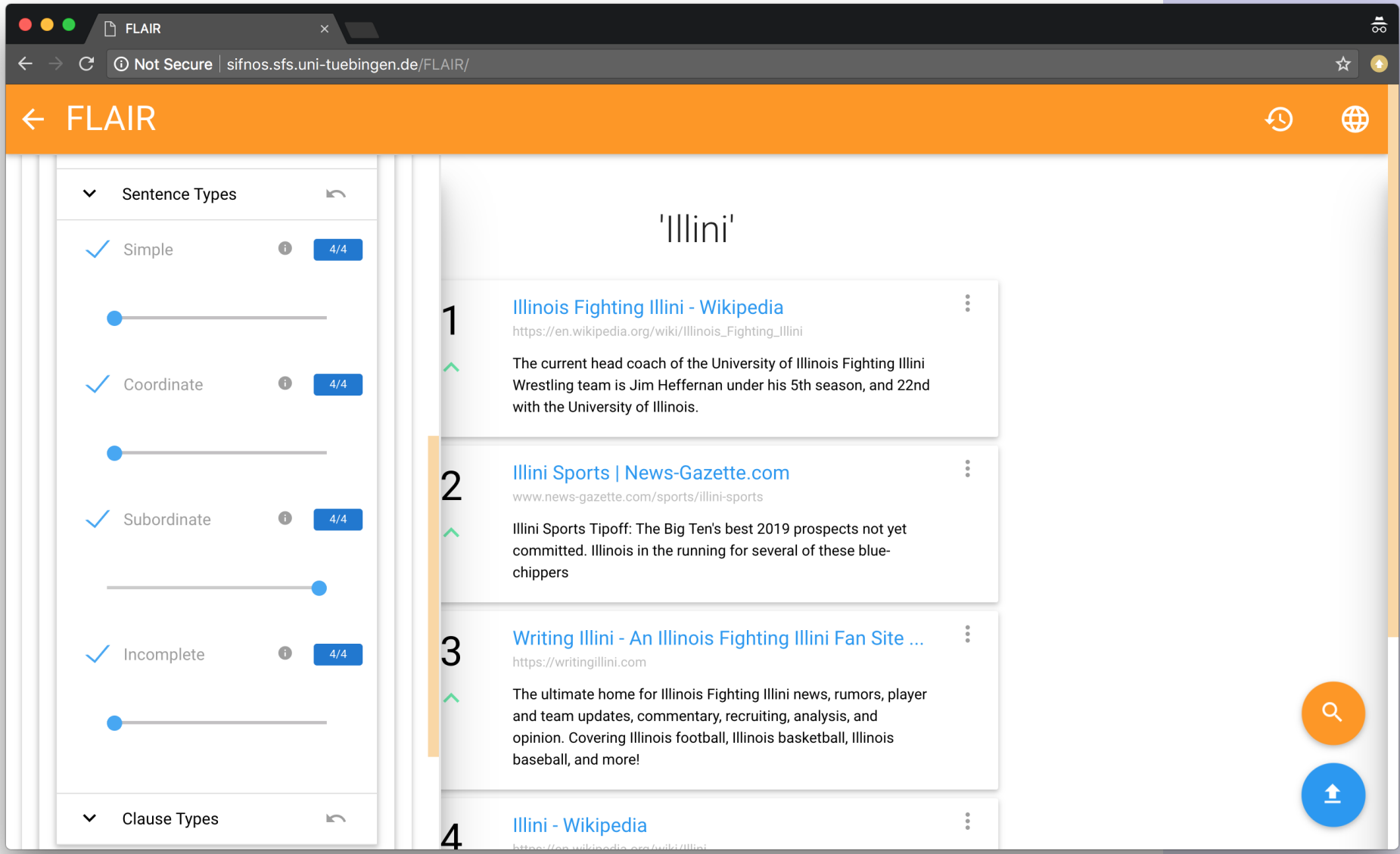
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Today's panel

- **Rob Reynolds**: readability of Russian authentic texts
- **Sowmya Vajjala**: readability of English authentic texts
- **Elena Cotos**: automated writing evaluation
- **Haiyang Ai**: correcting verb-noun miscollocations