



Introduction to IE and ANNIE



About this tutorial

This tutorial comprises the following topics:

- Introduction to IE
- ANNIE
- Evaluation and Corpus Quality Assurance

After lunch, you'll learn how to use JAPE, the pattern matching language that many PRs use



Named Entity Recognition: the cornerstone of IE

Traditionally, NER is the identification of proper names in texts, and their classification into a set of predefined categories of interest

- Person
- Organisation (companies, government organisations, committees, etc)
- Location (cities, countries, rivers, etc)
- Date and time expressions

Various other types are frequently added, as appropriate to the application, e.g. newspapers, ships, monetary amounts, percentages.



Why is NE important?

-
- NE provides a foundation from which to build more complex IE systems
 - Relations between NEs can provide tracking, ontological information and scenario building
 - Tracking (co-reference): “Dr Smith”, “John Smith”, “John”, “he”
 - Ontologies: “Athens, Georgia” vs “Athens, Greece”



Typical NE pipeline

-
- Pre-processing (tokenisation, sentence splitting, morphological analysis, POS tagging)
 - Entity finding (gazetteer lookup, NE grammars)
 - Coreference (alias finding, orthographic coreference etc.)
 - Export to database / XML / ontology



Example of IE

John lives in London . He works there for Polar Bear Design .



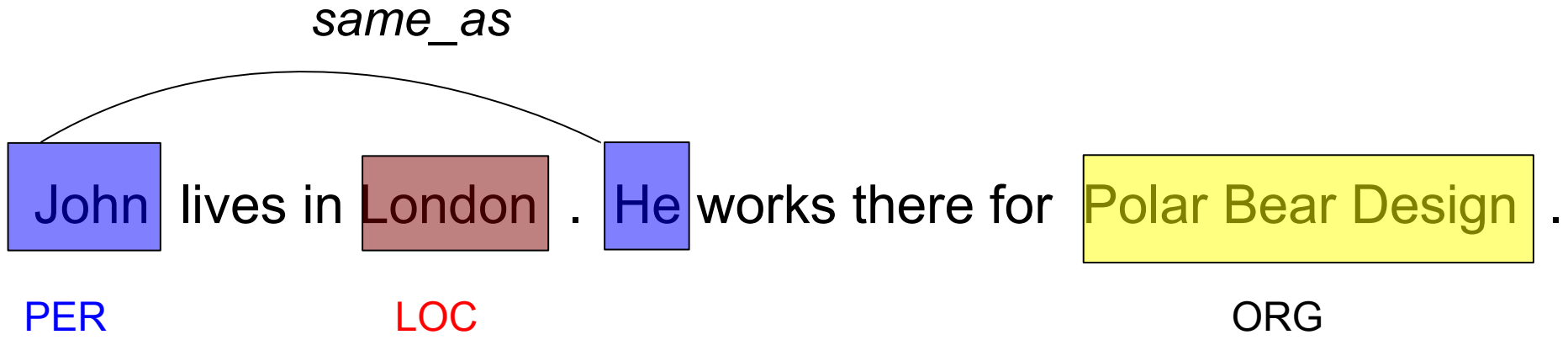
Basic NE Recognition

John lives in London . He works there for Polar Bear Design .

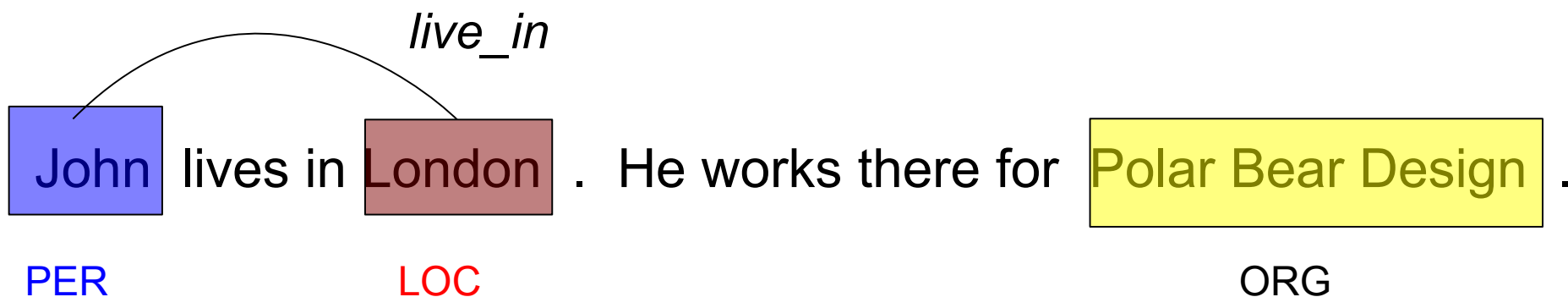
PER LOC ORG



Co-reference

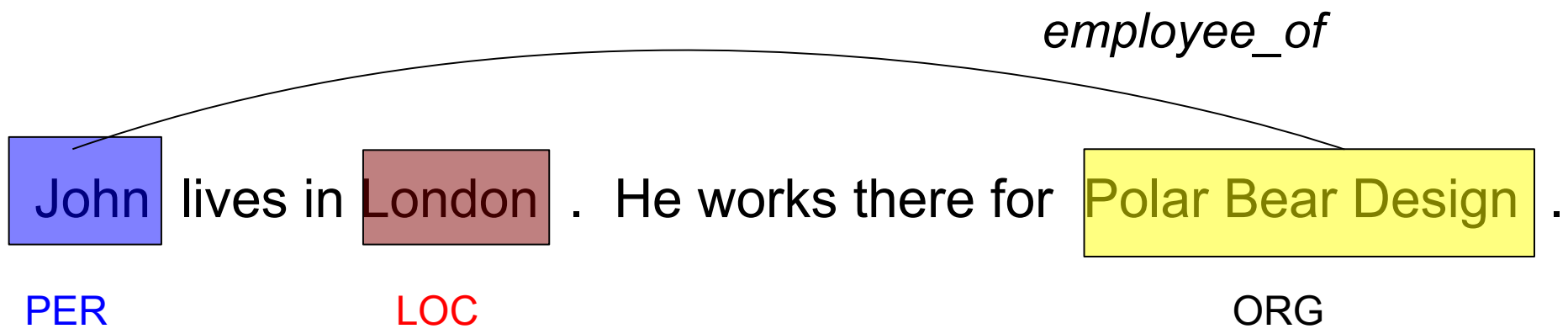


Relations



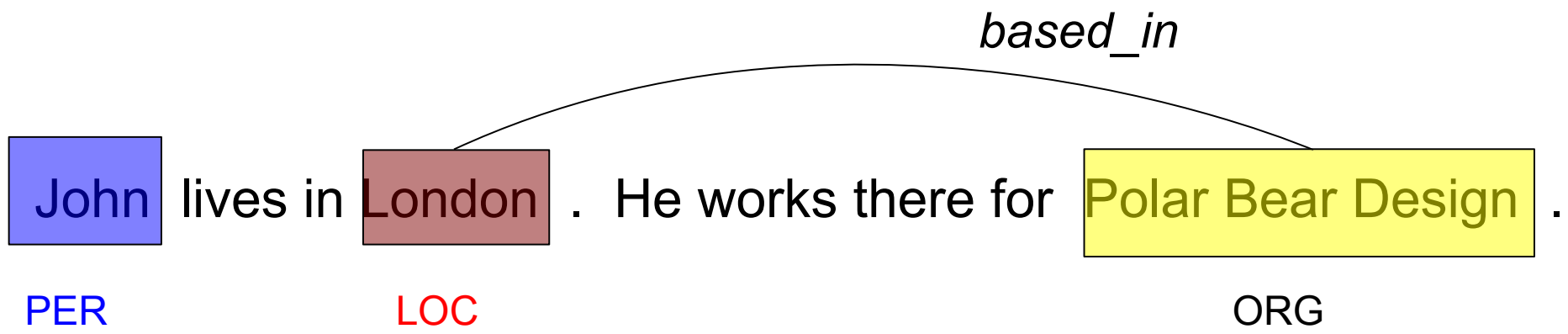


Relations (2)





Relations (3)





ANNIE: A Nearly New Information Extraction system



About this tutorial

- As before, this tutorial will be a hands on session with some explanation as you go.
- We will use a corpus of news texts in the file [annie-hands-on.zip](#). Unzip this file if it isn't already.
- Things for you to try yourself are in **red**.
 - There will be instructions for you to follow for each step
 - Each step will be demonstrated
 - Correct answers will be shown before moving on
- **Start GATE on your computer now (if you haven't already)**



Nearly New Information Extraction

- ANNIE is a ready made collection of PRs that performs IE on unstructured text.
- ANNIE is “nearly new” because
 - It was based on an existing IE system, LaSIE
 - We rebuilt LaSIE because we decided that people are better than dogs at IE
 - Being 14 years old, it's not really new any more

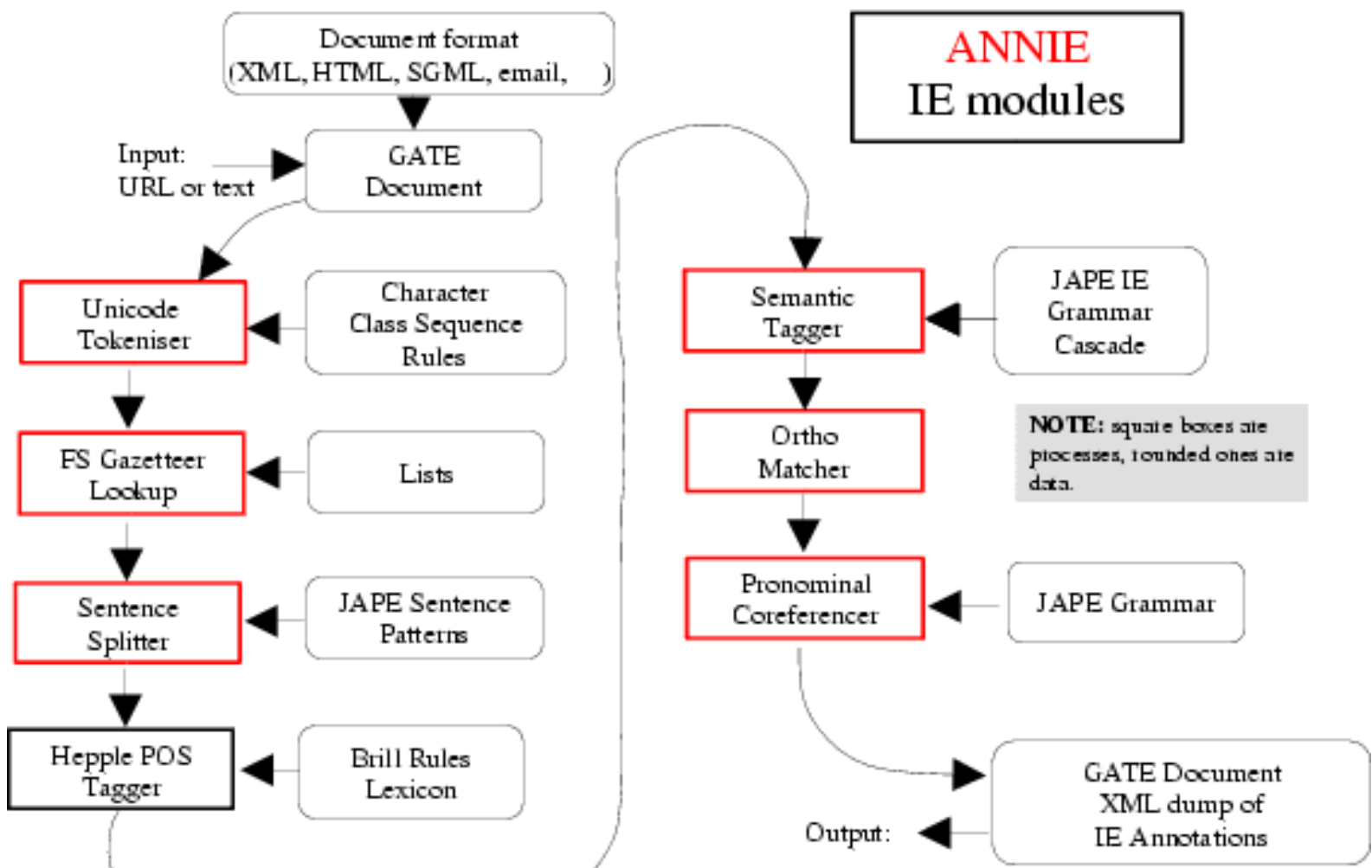


What's in ANNIE?

- The ANNIE application contains a set of core PRs:
 - Tokeniser
 - Sentence Splitter
 - POS tagger
 - Gazetteers
 - Named entity tagger (JAPE transducer)
 - Orthomatcher (orthographic coreference)
- There are also other useful PRs, which are not used in the default application, but can be added if necessary
 - NP chunker (Tagger_NP_Chunking plugin) and ANNIE VP Chunker (Tools plugin)




Core ANNIE components





Loading and running ANNIE

- Because ANNIE is a ready-made application, we can just load it directly from the menu
- Click the  icon from the top GATE menu OR
File → Ready Made Applications → ANNIE → ANNIE OR
right-click Applications → Ready Made Applications → ANNIE → ANNIE
- Select “with defaults”
- Load the hands-on corpus from the “news-texts” directory in the zip file
- Run ANNIE and inspect the annotations
- You should see a mixture of Named Entity annotations (Person, Location etc) and some other linguistic annotations (Token, Sentence etc)



Let's look at the PRs

-
- Each PR in the ANNIE pipeline creates some new annotations, or modifies existing ones
 - Document Reset → removes annotations
 - Tokeniser → Token annotations
 - Gazetteer → Lookup annotations
 - Sentence Splitter → Sentence, Split annotations
 - POS tagger → adds category features to Token annotations
 - NE transducer → Date, Person, Location, Organisation, Money, Percent annotations
 - Orthomatcher → adds match features to NE annotations



Document Reset

- This PR should go at the beginning of (almost) every application you create
- It removes annotations created previously, to prevent duplication if you run an application more than once
- It does not remove the Original Markups set, by default
- You can configure it to keep any other annotation sets you want, or to remove particular annotation types only



Document Reset Parameters

Loaded Processing resources

| Name | Type |
|------|------|
|------|------|

Selected Processing resources

| ! | Name | Type |
|-------------------------------------|-------------------------|-------|
| <input checked="" type="checkbox"/> | Document Reset PR_00016 | Docur |

Run "Document Reset PR_00016"?

Yes No If value of feature is

Corpus:

Runtime Parameters for the "Document Reset PR_00016" Document Reset PR:

| Name | Type | Required | Value |
|--|-----------|----------|-------------------------------------|
| <input type="checkbox"/> annotationTypes | ArrayList | | <input type="text" value="[]"/> |
| <input type="checkbox"/> keepOriginalMarkupsAS | Boolean | | <input type="text" value="true"/> |
| <input type="checkbox"/> setsToKeep | ArrayList | | <input type="text" value="[Key]"/> |

Run this Application

Specify any specific annotations to remove. By default, remove all.

Keep Original Markups set

Keep Key set



Tokenisation and sentence splitting



Tokeniser

- Tokenisation based on Unicode classes
- Declarative token specification language
- Produces Token and SpaceToken annotations with features **orthography** and **kind**
- **length** and **string** features are also produced
- Rule for a lowercase word with initial uppercase letter:

```
"UPPERCASE_LETTER" LOWERCASE_LETTER"* >  
  Token; orthography=upperInitial; kind=word
```



Document with Tokens

Annotation Sets Annotations List Annotations Stack Class Co-reference Editor Instance Text

Union Appeals For Talks To End BA Strike

Skip to navigation | Skip to content |
Home | Contact Us | News Search;
HubPage
Airwise News
Airport Guide
Airwise Travel
Search
Union Appeals For Talks To End BA Strike
March 22, 2010

Union leaders on Sunday called for talks with British Airways bosses to end strike action by cabin crew that has led to the cancellation of hundreds of flights and disrupted travel plans for thousands of passengers.

| Type | Features |
|-------|--|
| Token | { category=NNP, kind=word, length=5, orth=upperInitial, string=Union} |
| Token | { category=NNPS, kind=word, length=7, orth=upperInitial, string=Appeals} |
| Token | { category=IN, kind=word, length=3, orth=upperInitial, string=For} |
| Token | { category=NNS, kind=word, length=5, orth=upperInitial, string=Talks} |
| Token | { category=TO, kind=word, length=2, orth=upperInitial, string=To} |

- Date
- FirstPerson
- JobTitle
- Location
- Lookup
- Money
- Organization
- Percent
- Person
- Sentence
- SpaceToken
- Split
- Title
- Token
- Unknown
- Original markups



ANNIE English Tokeniser

- The English Tokeniser is a slightly enhanced version of the Unicode tokeniser
- It comprises an additional JAPE transducer which adapts the generic tokeniser output for the POS tagger requirements
- It converts constructs involving apostrophes into more sensible combinations
 - don't → do + n't
 - you've → you + 've



Looking at Tokens

- Tidy up GATE by removing all resources and applications (or just restart GATE)
- Load the news text hands-on corpus
- Create a new application (corpus pipeline)
- Load a Document Reset and an ANNIE English Tokeniser
- Add them (in that order) to the application and run on the corpus
- View the Token and SpaceToken annotations
- What different values of the “kind” feature do you see?



Sentence Splitter

- The default splitter finds sentences based on Tokens
- Creates Sentence annotations and Split annotations on the sentence delimiters
- Uses a gazetteer of abbreviations etc. and a set of JAPE grammars which find sentence delimiters and then annotate sentences and splits
- Load an ANNIE Sentence Splitter PR and add it to your application (at the end)
- Run the application and view the results



Document with Sentences

Annotation Sets Annotations List Annotations Stack Class Co-reference Editor Instance Text

the opposition conservatives, ahead in opinion polls, have been turning up the pressure on Labour over its links to Unite, saying the government had failed to take action quickly enough because it did not want to alienate its financial backers.

"We deplore the strike, and the prime minister and the transport secretary have said that absolutely clearly," Foreign Secretary David Miliband told Sky News.

"The way to resolve these disputes is through negotiation, it is damaging for the company, it is damaging for the crews and it is damaging for the country."

The dispute arose because BA, which has 12,000 cabin crew, wants to save an annual GBP£62.5 million pounds (USD\$95 million) to help cope with a fall in demand, volatile fuel prices and increased competition from low-cost carriers.

A spokesman said there was no estimate yet as to how much the industrial action would cost the company.

| Type | Features |
|-------------|----------|
| Sentence {} | |
| Sentence {} | |
| Sentence {} | |
| Sentence {} | |
| Sentence {} | |

- Date
- FirstPerson
- JobTitle
- Location
- Lookup
- Money
- Organization
- Percent
- Person
- Sentence
- SpaceToken
- Split
- Title
- Token
- Unknown
- ▶ Original markups



Sentence splitter variants

- An alternate set of rules can be loaded with the regular sentence splitter
- To do this, reload the sentence splitter using “main-single-nl.jape” instead of “main.jape” as the value of the grammar parameter
- The main difference is the way it handles new lines
- In some cases, you might want a new line to signal a new sentence, e.g. addresses
- In other cases, you might not, e.g. in emails that have been split by the email program
- A regular expression Java-based splitter is also available, called RegEx Sentence Splitter, which is sometimes faster
- This handles new lines in the same way as the default sentence splitter



Shallow lexico-syntactic features



POS tagger

-
- ANNIE POS tagger is a Java implementation of Brill's transformation based tagger
 - Previously known as **Hepple Tagger** (you may find references to this and to **heptag**)
 - Trained on WSJ, uses Penn Treebank tagset
 - Default ruleset and lexicon can be modified manually (with a little deciphering)
 - Adds **category** feature to **Token** annotations
 - Requires Tokeniser and Sentence Splitter to be run first



Morphological analyser

- Not an integral part of ANNIE, but can be found in the Tools plugin as an “added extra”
- Flex based rules: can be modified by the user (instructions in the User Guide)
- Generates **root** feature on Token annotations
- Requires Tokeniser to be run first
- Requires POS tagger to be run first if the considerPOSTag parameter is set to true

Shallow lexico-syntactic features



-
- Add an ANNIE POS Tagger to your app
 - Add a GATE Morphological Analyser after the POS Tagger
 - If this PR is not available, load the Tools plugin first
 - Re-run your application
 - Examine the features of the Token annotations
 - New features of category and root have been added



Gazetteers



Gazetteers

- Gazetteers are plain text files containing lists of names (e.g rivers, cities, people, ...)
- The lists are compiled into Finite State Machines
- Each gazetteer has an index file listing all the lists, plus features of each list (`majorType`, `minorType`, and `language`)
- Lists can be modified either internally using the Gazetteer Editor, or externally in your favourite editor
- Gazetteers generate `Lookup` annotations with relevant features corresponding to the list matched
- Lookup annotations are used primarily by the NE transducer

Running the ANNIE Gazetteer



-
- Various different kinds of gazetteer are available: first we'll look at the default ANNIE gazetteer
 - Add the ANNIE Gazetteer PR to the end of your pipeline
 - Re-run the pipeline
 - Look for “Lookup” annotations and examine their features



ANNIE gazetteer - contents

- Double click on the ANNIE Gazetteer PR (under Processing Resources in the left hand pane) to open it
- Select “Gazetteer Editor” from the bottom tab
- In the left hand pane (linear definition) you see the index file containing all the lists
- In the right hand pane you see the contents of the list selected in the left hand pane
- Each entry can be edited by clicking in the box and typing
- New entries can be added by typing in the “New list” or “New entry” box respectively



Gazetteer editor

GATE Developer 7.1-SNAPSHOT build 4319

File Options Tools Help

GATE

- Applications
- Language Resources
- Processing Resources
 - ANNIE Gazetteer_0007
 - GATE Morphological a
 - ANNIE POS Tagger_00
 - ANNIE Sentence Splitt
 - Document Reset PR_0
 - ANNIE English Tokenis

Messages Corpus Pipeline... in-whitbread-10... ANNIE Gazetteer...

airport.lst Add

| List name | Major | Minor |
|---------------------|---------------|--------------|
| abbreviations.lst | stop | |
| adbc.lst | adbc | |
| airports.lst | location | airport |
| charities.lst | organization | |
| city.lst | location | city |
| city_cap.lst | location | city |
| company.lst | organization | company |
| company_cap.lst | organization | company |
| country.lst | location | country |
| country_abbrev.lst | location | country_abbr |
| country_adj.lst | country_adj | |
| country_cap.lst | location | country |
| currency_prefix.lst | currency_unit | pre_amount |
| currency_unit.lst | currency_unit | post_amount |
| date_key.lst | date_key | |
| date_unit.lst | date_unit | |
| day.lst | date | day |

Filter Add +Cols 1989 entries Case Ins.

| Value |
|-------------|
| Aaccra |
| Aalborg |
| Aarhus |
| Ababa |
| Abadan |
| Abakan |
| Aberdeen |
| Abha |
| Abi Dhabi |
| Abidjan |
| Abilene |
| Abu |
| Abu Dhabi |
| Abuja |
| Acapulco |
| Acarigua |
| Accra |
| Adak Island |

Resource Features

Gazetteer Editor Initialisation Parameters

definition file entries

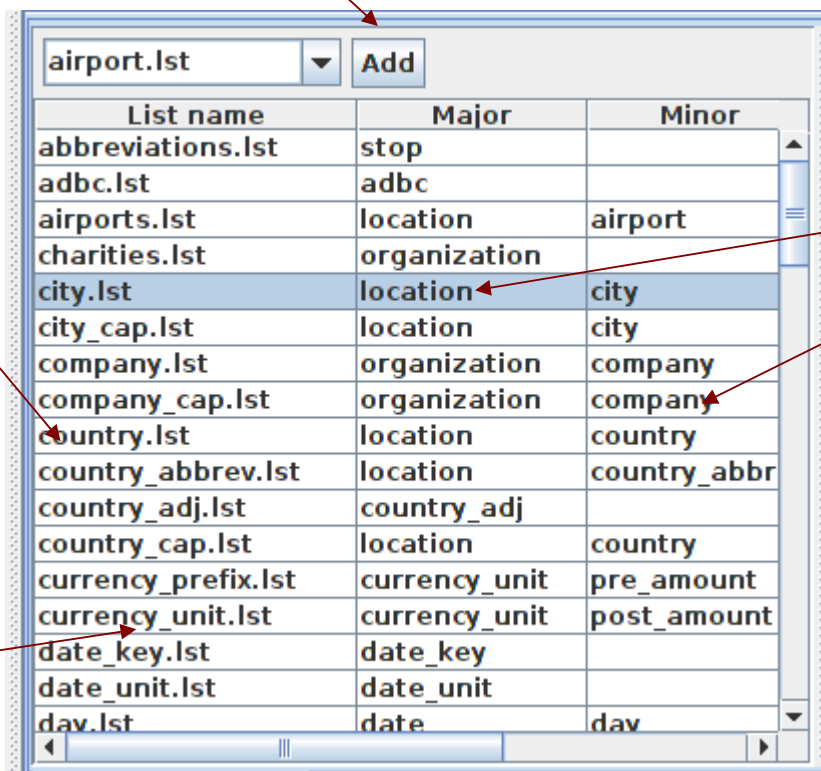
entries for selected list

Modifying the definition file

add a new list

edit an existing list name by typing here

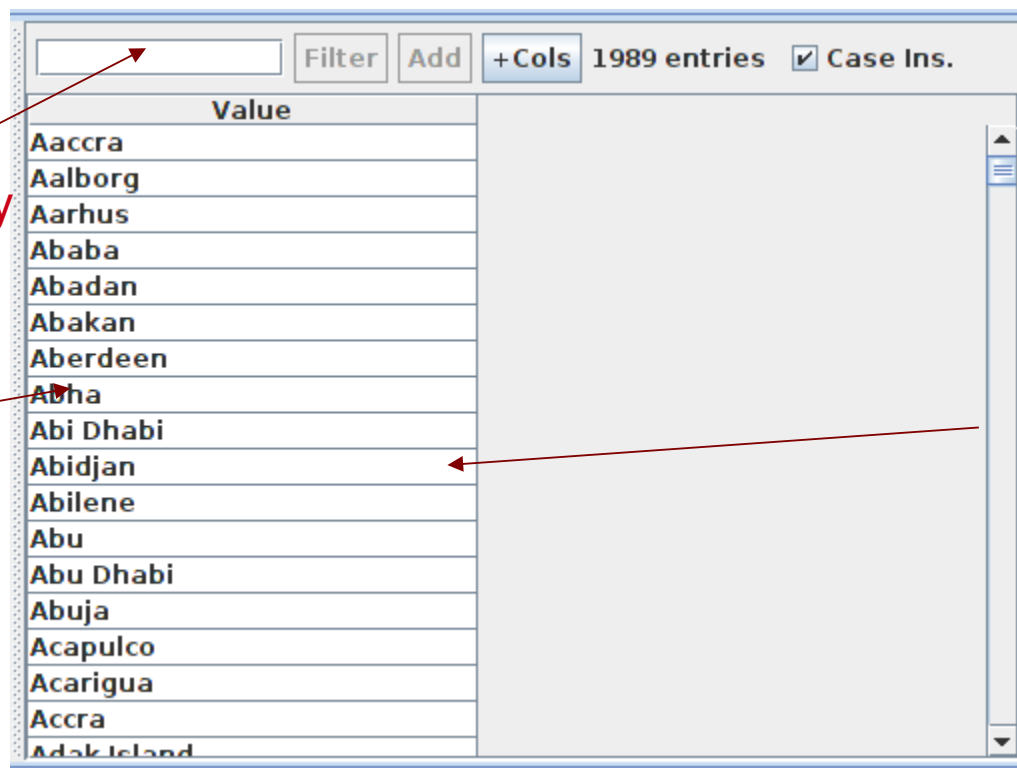
delete a list by right clicking on an entry and selecting Delete

The screenshot shows a window titled "airport.lst" with a table of list definitions. The table has three columns: "List name", "Major", and "Minor". The "city.lst" row is selected. A red arrow points from the "add a new list" text to the "Add" button. Another red arrow points from the "edit an existing list name by typing here" text to the "city.lst" row. A third red arrow points from the "delete a list by right clicking on an entry and selecting Delete" text to the "city.lst" row. A fourth red arrow points from the "edit the major and minor Types by typing here" text to the "location" and "city" cells in the "city.lst" row.

| List name | Major | Minor |
|---------------------|---------------|----------------|
| abbreviations.lst | stop | |
| adbc.lst | adbc | |
| airports.lst | location | airport |
| charities.lst | organization | |
| city.lst | location | city |
| city_cap.lst | location | city |
| company.lst | organization | company |
| company_cap.lst | organization | company |
| country.lst | location | country |
| country_abbrev.lst | location | country_abbrev |
| country_adj.lst | country_adj | |
| country_cap.lst | location | country |
| currency_prefix.lst | currency_unit | pre_amount |
| currency_unit.lst | currency_unit | post_amount |
| date_key.lst | date_key | |
| date_unit.lst | date_unit | |
| day.lst | date | day |

edit the major and minor Types by typing here

Modifying a list



add a new entry
by typing here

edit an
existing entry
by typing here

Delete an entry by
right clicking and
selecting "Delete"



Editing gazetteer lists

- The ANNIE gazetteer has about 60,000 entries arranged in 80 lists
- Each list reflects a certain category, e.g. airports, cities, first names etc.
- List entries might be entities or parts of entities, or they may contain contextual information (e.g. job titles often indicate people)
- **Click on any list to see the entries**
- Note that some lists are not very complete!
- **Try adding, deleting and editing existing lists, or the list definition file**
- **To save an edited gazetteer, right click on the gazetteer name in the tabs at the top or in the resources pane on the right, and select “Save and Reinitialise” before running the gazetteer again.**
- **Try adding a word from a document you have loaded (that is not currently recognised as a Lookup) into the gazetteer, re-run the gazetteer and check the results.**

Editing gazetteers outside GATE



-
- You can also edit both the definition file and the lists outside GATE, in your favourite text editor
 - If you choose this option, you will need to reinitialise the gazetteer in GATE before running it again
 - To reinitialise any PR, right click on its name in the Resources pane and select “Reinitialise”



List attributes

- When something in the text matches a gazetteer entry, a Lookup annotation is created, with various features and values
- The ANNIE gazetteer has the following default feature types: majorType, minorType, language
- These features are used as a kind of classification of the lists: in the definition file features are separated by “:”
- For example, the “city” list has a majorType “location” and minorType “city”, while the “country” list has “location” and “country” as its types
- Later, in the JAPE grammars, we can refer to all Lookups of type location, or we can be more specific and refer just to those of type “city” or type “country”



NE transducers



NE transducer

- Gazetteers can be used to find terms that suggest entities
- However, the entries can often be ambiguous
 - “May Jones” vs “May 2010” vs “May I be excused?”
 - “Mr Parkinson” vs “Parkinson's Disease”
 - “General Motors” vs. “General Smith”
- Hand-crafted grammars can be used to define patterns over the Lookups and other annotations
- These patterns can help disambiguate, and they can combine different annotations, e.g. Dates can be comprised of day + number + month
- NE transducer consists of a number of grammars written in the JAPE language
- This afternoon will be devoted to JAPE



ANNIE NE Transducer

- Load an ANNIE NE Transducer PR
- Add it to the end of the application
- Run the application
- Look at the annotations
- You should see some new annotations such as Person, Location, Date etc.
- These will have features showing more specific information (eg what kind of location it is) and the rules that were fired (for ease of debugging)



Co-reference



Using co-reference

- Different expressions may refer to the same entity
- Orthographic co-reference module (orthomatcher) matches proper names and their variants in a document
- [Mr Smith] and [John Smith] will be matched as the same person
- [International Business Machines Ltd.] will match [IBM]



Orthomatcher PR

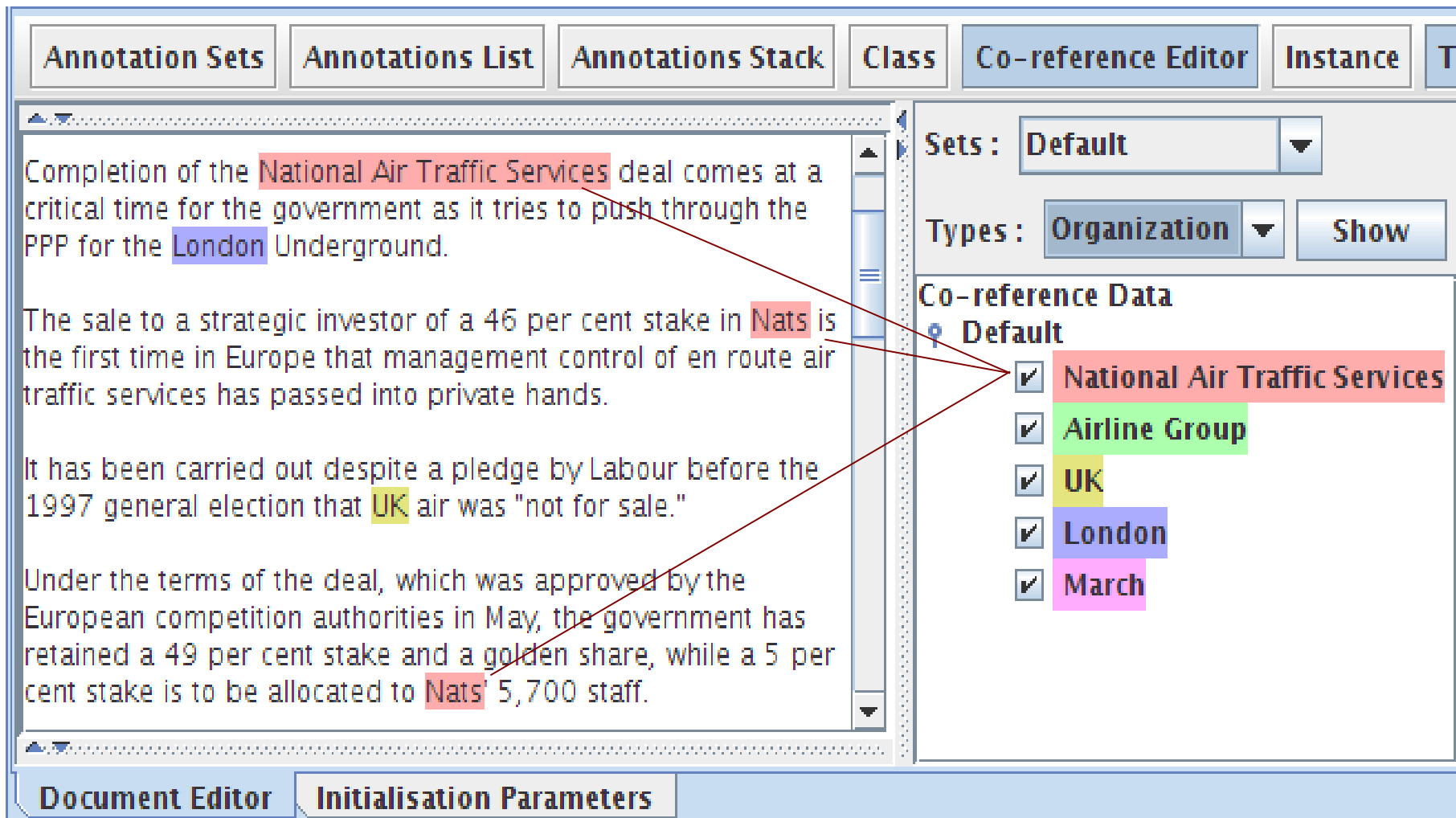
- Performs co-reference resolution based on orthographical information of entities
- Produces a list of annotation IDs that form a co-reference “chain”
- List of such lists stored as a document feature named “MatchesAnnots”
- Improves results by assigning entity type to previously unclassified names, based on relations with classified entities
- May not reclassify already classified entities
- Classification of unknown entities very useful for surnames which match a full name, or abbreviations, e.g. “Bonfield” <Unknown> will match “Sir Peter Bonfield” <Person>
- A pronominal PR is also available



Looking at co-reference

- Add a new PR: ANNIE OrthoMatcher
- Add it to the end of the application
- Run the application
- In a document view, open the co-reference editor by clicking the button above the text
- All the documents in the corpus should have some co-reference, but some may have more than others

Coreference editor

The screenshot shows the GATE Coreference Editor interface. At the top, there is a navigation bar with tabs: "Annotation Sets", "Annotations List", "Annotations Stack", "Class", "Co-reference Editor" (which is active), "Instance", and "T...". Below the navigation bar is a large text area containing four paragraphs of text. The first paragraph is: "Completion of the National Air Traffic Services deal comes at a critical time for the government as it tries to push through the PPP for the London Underground." The second paragraph is: "The sale to a strategic investor of a 46 per cent stake in Nats is the first time in Europe that management control of en route air traffic services has passed into private hands." The third paragraph is: "It has been carried out despite a pledge by Labour before the 1997 general election that UK air was 'not for sale.'" The fourth paragraph is: "Under the terms of the deal, which was approved by the European competition authorities in May, the government has retained a 49 per cent stake and a golden share, while a 5 per cent stake is to be allocated to Nats' 5,700 staff." To the right of the text area is a control panel. It includes a "Sets:" dropdown menu set to "Default", a "Types:" dropdown menu set to "Organization", and a "Show" button. Below this is a "Co-reference Data" section with a "Default" label and a list of five items, each with a checked checkbox and a colored background: "National Air Traffic Services" (red), "Airline Group" (green), "UK" (yellow), "London" (purple), and "March" (pink). Red lines connect the highlighted text in the text area to the corresponding items in the list. At the bottom of the interface, there are two tabs: "Document Editor" and "Initialisation Parameters".



Using the co-reference editor

- Select the annotation set you wish to view (Default)
- A list of all the co-reference chains that are based on annotations in the currently selected set is displayed
- Select an item in the list to highlight all the member annotations of that chain in the text (you can select more than one at once)
- Hovering over a highlighted annotation in the text enables you to Delete an item from the co-reference chain
- Try it!

Evaluation



“We didn’t underperform. You overexpected.”



Evaluation exercises: preparation

- Restart GATE, or close all documents and PRs to tidy up
- Load the ANNIE hands on corpus
- Take a look at the annotations.
- There is a set called “Key”. This is a set of annotations against which we want to evaluate ANNIE. In practice, they could be manual annotations, or annotations from another application.
- Load the ANNIE system with defaults
- Run ANNIE: You should have annotations in the Default set from ANNIE, and in the Key set, against which we can compare them.



AnnotationDiff

-
- Graphical comparison of 2 sets of annotations
 - Visual diff representation, like tkdiff
 - Compares one document at a time, one annotation type at a time


Annotations are like squirrels...



Annotation Diff helps with “spot the difference”



Annotation Diff Exercise

- Open the document “ft-airlines-27-jul-2001.xml”
- Open the AnnotationDiff (Tools → Annotation Diff or click the  icon)
- For the Key set (containing the manual annotations) select **Key** annotation set
- For the Response set (containing annotations from ANNIE) select **Default** annotation set
- Select the **Organization** annotation
- Click on “Compare”
- Scroll down the list, to see correct, partially correct, missing and spurious annotations



Annotation Diff

Annotation Diff Tool

Key doc: ft-airlines-27-jul-200... Key set: Key Type: Organization Weight: 1.0

Resp. doc: ft-airlines-27-jul-200... Resp. set: [Default set] Features: all some none

| Start | End | Key | Features | =? | Start | End | |
|-------|------|---|----------|----|-------|------|-------------|
| 1932 | 1936 | Nats | {} | = | 1932 | 1936 | Nats |
| 2456 | 2460 | Nats | {} | = | 2456 | 2460 | Nats |
| 2070 | 2075 | LATCC | {} | = | 2070 | 2075 | LATCC |
| 1354 | 1362 | Barclays | {} | = | 1354 | 1362 | Barclays |
| 1784 | 1788 | Nats | {} | = | 1784 | 1788 | Nats |
| 1751 | 1768 | The·Airline·Group | {} | ~ | 1755 | 1768 | Airline·Gro |
| 938 | 955 | The·Airline·Group | {} | ~ | 942 | 955 | Airline·Gro |
| 1669 | 1686 | the·Airline·Group | {} | ~ | 1673 | 1686 | Airline·Gro |
| 2412 | 2429 | The·Airline·Group | {} | ~ | 2416 | 2429 | Airline·Gro |
| 1266 | 1283 | The·Airline·Group | {} | ~ | 1270 | 1283 | Airline·Gro |
| 1052 | 1068 | Monarch·Airlines | {} | ~ | 1030 | 1068 | Britannia·A |
| 2029 | 2068 | London·Area·and·Terminal·Control·Centre | {} | ~ | 2045 | 2068 | Terminal·C |
| 634 | 640 | Labour | {} | -? | | | |
| 1030 | 1047 | Britannia·Airways | {} | -? | | | |
| | | | | ?- | 2029 | 2040 | London·Are |
| | | | | ?- | 2386 | 2395 | Hampshire |

10 documents loaded

| | | | | | |
|--------------------|----|----------|-----------|-----------|------|
| Correct: | 19 | Recall | Precision | F-measure | |
| Partially correct: | 7 | Strict: | 0.68 | 0.68 | 0.68 |
| Missing: | 2 | Lenient: | 0.93 | 0.93 | 0.93 |
| False positives: | 2 | Average: | 0.80 | 0.80 | 0.80 |

Statistics | Adjudication



Measuring success

- In IE, we classify the annotations produced in one of 4 ways:
- **Correct** = things annotated correctly
e.g. annotating “Donald Trump” as a Person
- **Missing** = things not annotated that should have been
e.g. not annotating “Sheffield” as a Location
- **Spurious** = things annotated wrongly
e.g. annotating “London” as a Location in “London Traffic Centre”
- **Partially correct** = the annotation type is correct, but the span is wrong
e.g, annotating just “Trump” as a Person (too short) or annotating “Unfortunately Donald Trump” as a Person (too long)

Finding Precision, Recall and F-measure



Annotation Diff Tool

Key doc: ft-airlines-27-jul-200... Key set: Key Type: Organization Weight: 1.0

Resp. doc: ft-airlines-27-jul-200... Resp. set: [Default set] Features: all some none 1.0

Compare

| Start | End | Key | Features | =? | Start | End | |
|-------|------|---|----------|----|-------|------|-------------|
| 1932 | 1936 | Nats | {} | = | 1932 | 1936 | Nats |
| 2456 | 2460 | Nats | {} | = | 2456 | 2460 | Nats |
| 2070 | 2075 | LATCC | {} | = | 2070 | 2075 | LATCC |
| 1354 | 1362 | Barclays | {} | = | 1354 | 1362 | Barclays |
| 1784 | 1788 | Nats | {} | = | 1784 | 1788 | Nats |
| 1751 | 1768 | The·Airline·Group | {} | ~ | 1755 | 1768 | Airline·Gro |
| 938 | 955 | The·Airline·Group | {} | ~ | 942 | 955 | Airline·Gro |
| 1669 | 1686 | the·Airline·Group | {} | ~ | 1673 | 1686 | Airline·Gro |
| 2412 | 2429 | The·Airline·Group | {} | ~ | 2416 | 2429 | Airline·Gro |
| 1266 | 1283 | The·Airline·Group | {} | ~ | 1270 | 1283 | Airline·Gro |
| 1052 | 1068 | Monarch·Airlines | {} | ~ | 1030 | 1068 | Britannia·A |
| 2029 | 2068 | London·Area·and·Terminal·Control·Centre | {} | ~ | 2045 | 2068 | Terminal·C |
| 634 | 640 | Labour | {} | -? | | | |
| 1030 | 1047 | Britannia·Airways | {} | -? | | | |
| | | | | ?- | 2029 | 2040 | London·Are |
| | | | | ?- | 2386 | 2395 | Hampshire |

10 documents loaded

| | Count | Strict | Lenient | Average | Recall | Precision | F-measure |
|--------------------|-------|--------|---------|---------|--------|-----------|-----------|
| Correct: | 19 | | | | | | |
| Partially correct: | 7 | 0.68 | 0.93 | 0.80 | 0.68 | 0.68 | 0.68 |
| Missing: | 2 | | | | | | |
| False positives: | 2 | | | | | | |

Statistics Adjudication

← scores displayed



Precision

- How many of the entities your application found were correct?
- Sometimes precision is called **accuracy**

$$\textit{Precision} = \frac{\textit{Correct}}{\textit{Correct} + \textit{Spurious}}$$



Recall

- How many of the entities that exist did your application find?
- Sometimes recall is called **coverage**

$$\text{Recall} = \frac{\text{Correct}}{\text{Correct} + \text{Missing}}$$



F-Measure

- Precision and recall tend to trade off against one another
 - If you specify your rules precisely to improve precision, you may get a lower recall
- If you make your rules very general, you get good recall, but low precision
- This makes it difficult to compare applications, or to check whether a change has improved or worsened the results overall
- F-measure combines precision and recall into one measure

F-Measure

- Also known as the “harmonic mean”
- Usually, precision and recall are equally weighted
- This is known as F1
- To use F1, set the value of the F-measure weight to 1
- This is the default setting

$$F = 2 \cdot \left(\frac{\textit{precision} \cdot \textit{recall}}{\textit{precision} + \textit{recall}} \right)$$



Annotation Diff defaults to F1

Annotation Diff Tool

Key doc: ft-airlines-27-jul-200... Key set: Key Type: Organization Weight: 1.0

Resp. doc: ft-airlines-27-jul-200... Resp. set: [Default set] Features: all some none 1.0 Compare

| Start | End | Key | Features | =/? | Start | End | |
|-------|------|---|----------|-----|-------|------|-------------|
| 1932 | 1936 | Nats | {} | = | 1932 | 1936 | Nats |
| 2456 | 2460 | Nats | {} | = | 2456 | 2460 | Nats |
| 2070 | 2075 | LATCC | {} | = | 2070 | 2075 | LATCC |
| 1354 | 1362 | Barclays | {} | = | 1354 | 1362 | Barclays |
| 1784 | 1788 | Nats | {} | = | 1784 | 1788 | Nats |
| 1751 | 1768 | The·Airline·Group | {} | ~ | 1755 | 1768 | Airline·Gro |
| 938 | 955 | The·Airline·Group | {} | ~ | 942 | 955 | Airline·Gro |
| 1669 | 1686 | the·Airline·Group | {} | ~ | 1673 | 1686 | Airline·Gro |
| 2412 | 2429 | The·Airline·Group | {} | ~ | 2416 | 2429 | Airline·Gro |
| 1266 | 1283 | The·Airline·Group | {} | ~ | 1270 | 1283 | Airline·Gro |
| 1052 | 1068 | Monarch·Airlines | {} | ~ | 1030 | 1068 | Britannia·A |
| 2029 | 2068 | London·Area·and·Terminal·Control·Centre | {} | ~ | 2045 | 2068 | Terminal·C |
| 634 | 640 | Labour | {} | -? | | | |
| 1030 | 1047 | Britannia·Airways | {} | -? | | | |
| | | | | ?- | 2029 | 2040 | London·Are |
| | | | | ?- | 2386 | 2395 | Hampshire |

10 documents loaded

| | | | | |
|--------------------|----|----------|-----------|-----------|
| Correct: | 19 | Recall | Precision | F-measure |
| Partially correct: | 7 | Strict: | 0.68 0.68 | 0.68 |
| Missing: | 2 | Lenient: | 0.93 0.93 | 0.93 |
| False positives: | 2 | Average: | 0.80 0.80 | 0.80 |

Statistics Adjudication

F-measure weight set to 1



Statistics can mean what you want them to....

-
- How we want to measure partially correct annotations may differ, depending on our goal
 - In GATE, there are 3 different ways to measure them
 - The most usual way is to consider them to be “half right”
 - Average: Strict and lenient scores are averaged (this is the same as counting a half weight for every partially correct annotation)
 - Strict: Only perfectly matching annotations are counted as correct
 - Lenient: Partially matching annotations are counted as correct. This makes your scores look better :-)



Strict, Lenient and Average

Annotation Diff Tool

Key doc: ft-airlines-27-jul-200... Key set: Key Type: Organization Weight: 1.0

Resp. doc: ft-airlines-27-jul-200... Resp. set: [Default set] Features: all some none

| Start | End | Key | Features | =? | Start | End | |
|-------|------|---|----------|----|-------|------|-------------|
| 1932 | 1936 | Nats | {} | = | 1932 | 1936 | Nats |
| 2456 | 2460 | Nats | {} | = | 2456 | 2460 | Nats |
| 2070 | 2075 | LATCC | {} | = | 2070 | 2075 | LATCC |
| 1354 | 1362 | Barclays | {} | = | 1354 | 1362 | Barclays |
| 1784 | 1788 | Nats | {} | = | 1784 | 1788 | Nats |
| 1751 | 1768 | The·Airline·Group | {} | ~ | 1755 | 1768 | Airline·Gro |
| 938 | 955 | The·Airline·Group | {} | ~ | 942 | 955 | Airline·Gro |
| 1669 | 1686 | the·Airline·Group | {} | ~ | 1673 | 1686 | Airline·Gro |
| 2412 | 2429 | The·Airline·Group | {} | ~ | 2416 | 2429 | Airline·Gro |
| 1266 | 1283 | The·Airline·Group | {} | ~ | 1270 | 1283 | Airline·Gro |
| 1052 | 1068 | Monarch·Airlines | {} | ~ | 1030 | 1068 | Britannia·A |
| 2029 | 2068 | London·Area·and·Terminal·Control·Centre | {} | ~ | 2045 | 2068 | Terminal·C |
| 634 | 640 | Labour | {} | -? | | | |
| 1030 | 1047 | Britannia·Airways | {} | -? | | | |
| | | | | ?- | 2029 | 2040 | London·Are |
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10 documents loaded

| | | | | | |
|--------------------|----|----------|-----------|-----------|------|
| Correct: | 19 | Recall | Precision | F-measure | |
| Partially correct: | 7 | Strict: | 0.68 | 0.68 | 0.68 |
| Missing: | 2 | Lenient: | 0.93 | 0.93 | 0.93 |
| False positives: | 2 | Average: | 0.80 | 0.80 | 0.80 |

Statistics | Adjudication



Comparing the individual annotations

- In the AnnotationDiff, colour codes indicate whether the annotation pair shown are correct, partially correct, missing (false negative) or spurious (false positive)
- You can sort the columns however you like



Comparing the annotations

Annotation Diff Tool

Key doc: ft-airlines-27-jul-200... Key set: Key Type: Organization Weight: 1.0

Resp. doc: ft-airlines-27-jul-200... Resp. set: [Default set] Features: all some none 1.0

| Start | End | Key | Features | =? | Start | End | |
|-------|------|---|----------|----|-------|------|-------------|
| 1932 | 1936 | Nats | {} | = | 1932 | 1936 | Nats |
| 2456 | 2460 | Nats | {} | = | 2456 | 2460 | Nats |
| 2070 | 2075 | LATCC | {} | = | 2070 | 2075 | LATCC |
| 1354 | 1362 | Barclays | {} | = | 1354 | 1362 | Barclays |
| 1784 | 1788 | Nats | {} | = | 1784 | 1788 | Nats |
| 1751 | 1768 | The·Airline·Group | {} | ~ | 1755 | 1768 | Airline·Gro |
| 938 | 955 | The·Airline·Group | {} | ~ | 942 | 955 | Airline·Gro |
| 1669 | 1686 | the·Airline·Group | {} | ~ | 1673 | 1686 | Airline·Gro |
| 2412 | 2429 | The·Airline·Group | {} | ~ | 2416 | 2429 | Airline·Gro |
| 1266 | 1283 | The·Airline·Group | {} | ~ | 1270 | 1283 | Airline·Gro |
| 1052 | 1068 | Monarch·Airlines | {} | ~ | 1030 | 1068 | Britannia·A |
| 2029 | 2068 | London·Area·and·Terminal·Control·Centre | {} | ~ | 2045 | 2068 | Terminal·C |
| 634 | 640 | Labour | {} | -? | | | |
| 1030 | 1047 | Britannia·Airways | {} | -? | | | |
| | | | | ?- | 2029 | 2040 | London·Are |
| | | | | ?- | 2386 | 2395 | Hampshire |

10 documents loaded

| | | | | | |
|--------------------|----|----------|-----------|-----------|------|
| Correct: | 19 | Recall | Precision | F-measure | |
| Partially correct: | 7 | Strict: | 0.68 | 0.68 | 0.68 |
| Missing: | 2 | Lenient: | 0.93 | 0.93 | 0.93 |
| False positives: | 2 | Average: | 0.80 | 0.80 | 0.80 |

Statistics | Adjudication

Key annotations

Response annotations



Corpus Quality Assurance

- Corpus Quality Assurance tool extends the Annotation Diff functionality to the entire corpus, rather than on a single document at a time
- It produces statistics both for the corpus as a whole (Corpus statistics tab) and for each document separately (Document statistics tab)
- It compares two annotation sets, but makes no assumptions about which (if either) set is the gold standard. It just labels them A and B.
- This is because it can be used to measure Inter Annotator Agreement (IAA) where there is no concept of “correct” set

Try out Corpus Quality Assurance

- Open your hands-on corpus and click the Corpus Quality Assurance tab at the bottom of the Display pane.

The screenshot shows the GATE Developer 5.2-snapshot build 3518 interface. The main window displays a list of documents in a corpus. The 'Corpus Quality Assurance' tab is selected at the bottom of the Display pane.

Messages Corpus Pipeline... in-whitbread-10... GATE Corpus_000...

All the documents loaded in the system are in this corpus.

| Index | Document name |
|-------|--|
| 0 | ft-BT-07-aug-2001.xml_0001B |
| 1 | ft-BT-briefing-02-aug-2001.xml_0001C |
| 2 | ft-BT-loop-01-aug-2001.xml_0001D |
| 3 | ft-GKN-09-aug-2001.xml_0001E |
| 4 | ft-SSL-10-aug-2001.xml_0001F |
| 5 | ft-WestLB-BT-05-aug-2001.xml_00020 |
| 6 | ft-airlines-27-jul-2001.xml_00021 |
| 7 | ft-airtours-08-aug-2001.xml_00022 |
| 8 | ft-bank-of-england-02-aug-2001.xml_00023 |
| 9 | ft-bank-of-uk-08-Aug-2001.xml_00024 |
| 10 | ft-bmi-09-may-2001.xml_00025 |
| 11 | ft-bmi-25-feb-2001.xml_00026 |
| 12 | ft-bmi-airline-07-aug-2001.xml_00027 |
| 13 | ft-bt-03-aug-2001.xml_00028 |
| 14 | ft-bt-26-jul-2001.xml_00029 |

Corpus editor Initialisation Parameters **Corpus Quality Assurance**



Select Annotation Sets

The screenshot shows the GATE software interface with the 'Annotation Sets A/Key & B/Responses' dialog box open. The dialog box is divided into several sections:

- Annotation Sets A/Key & B/Responses:** This section contains a list of annotation sets: '[Default set]', 'Key', and 'Original markups'. The 'Key' set is highlighted with a red box.
- Annotation Types:** This section is currently empty.
- Annotation Features:** This section is currently empty.
- Measures:** This section is currently set to 'F-Score' and lists several options: 'F1.0-score strict', 'F1.0-score lenient', 'F1.0-score average', 'F1.0-score strict BDM', and 'F1.0-score lenient BDM'.

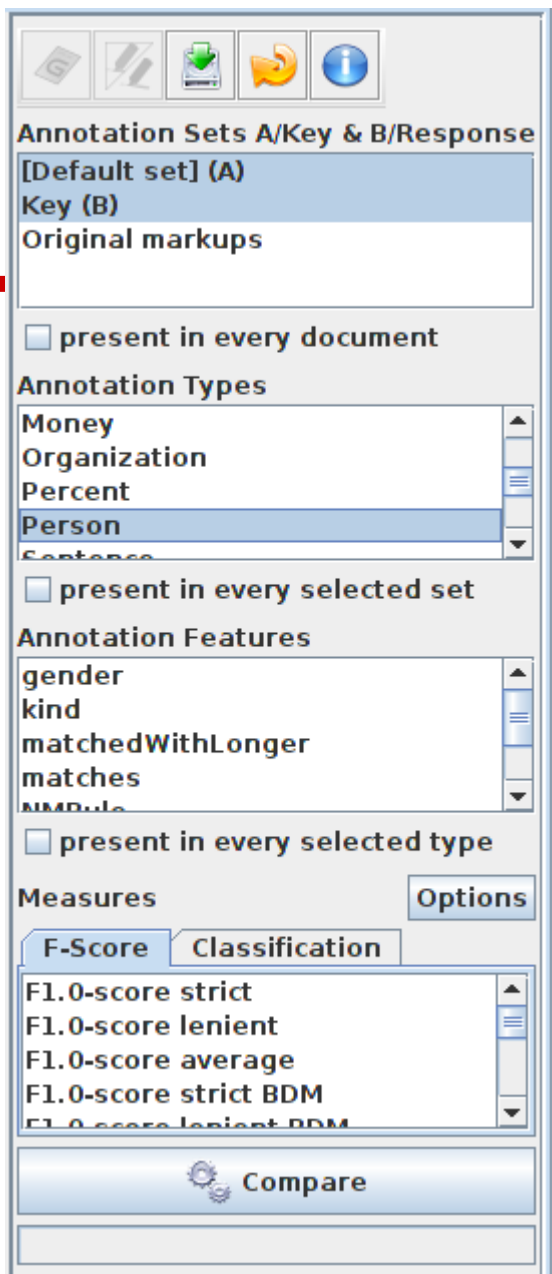
A 'Compare' button is located at the bottom of the dialog box.

Select the annotation sets you wish to compare.

Click on the Key annotation set – this will label it set A.

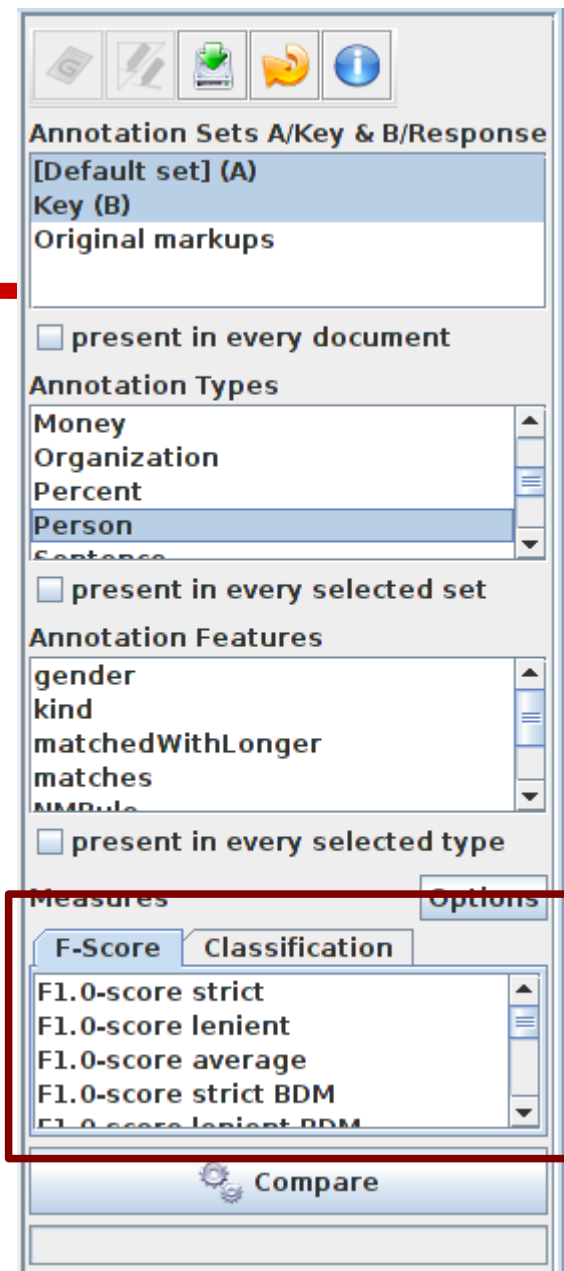
Now click on the default annotation set - this will label it set B.

Select Type



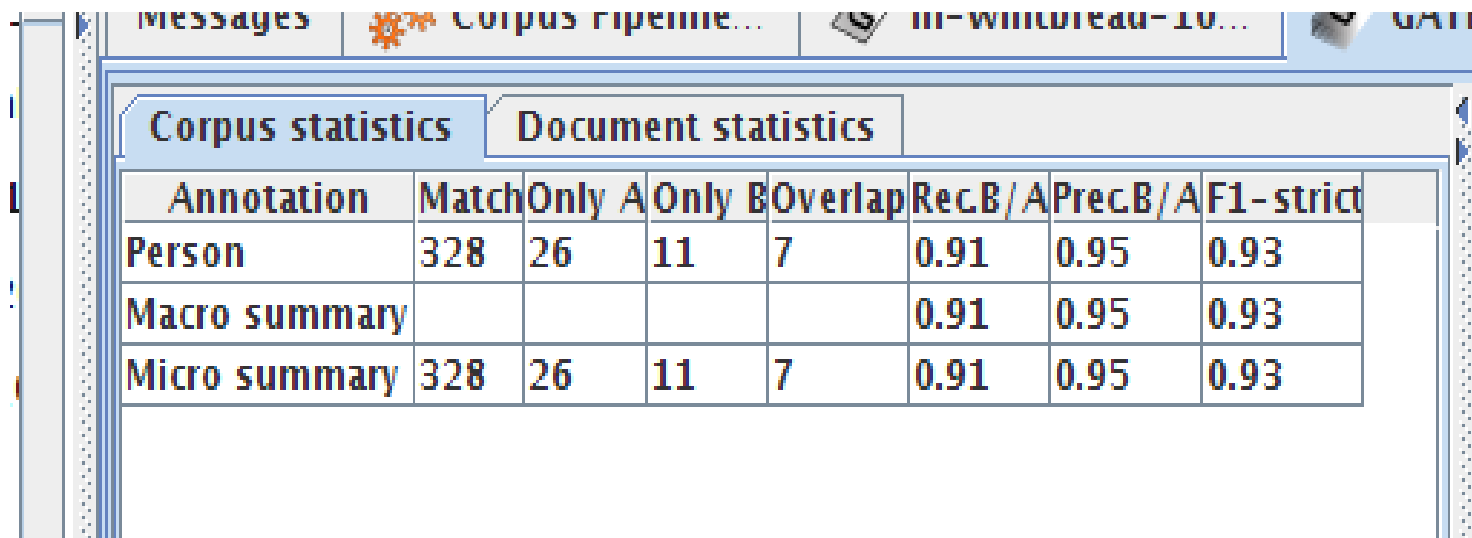
- Select the annotation type to compare (suggestion: select Organisation, Person and Location for now)
- Select the features to include (if any – leave unselected for now)
- You can select as many types and features as you want.

Select measure



- In the “Measures” box, select the kind of F score you want “Strict, Lenient, Average” or any combination of them. Suggestion: try just “lenient” at first
- Select Compare

Corpus Statistics Tab

A screenshot of the GATE software interface showing the 'Corpus statistics' tab. The window title bar includes 'messages', 'Corpus ripenne...', 'in-winbread-10...', and 'GATE'. The 'Corpus statistics' tab is active, displaying a table with two sub-tabs: 'Corpus statistics' and 'Document statistics'. The table has columns for 'Annotation', 'Match', 'Only A', 'Only B', 'Overlap', 'Rec.B/A', 'Prec.B/A', and 'F1-strict'. The data rows are 'Person', 'Macro summary', and 'Micro summary'.

| Annotation | Match | Only A | Only B | Overlap | Rec.B/A | Prec.B/A | F1-strict |
|---------------|-------|--------|--------|---------|---------|----------|-----------|
| Person | 328 | 26 | 11 | 7 | 0.91 | 0.95 | 0.93 |
| Macro summary | | | | | 0.91 | 0.95 | 0.93 |
| Micro summary | 328 | 26 | 11 | 7 | 0.91 | 0.95 | 0.93 |

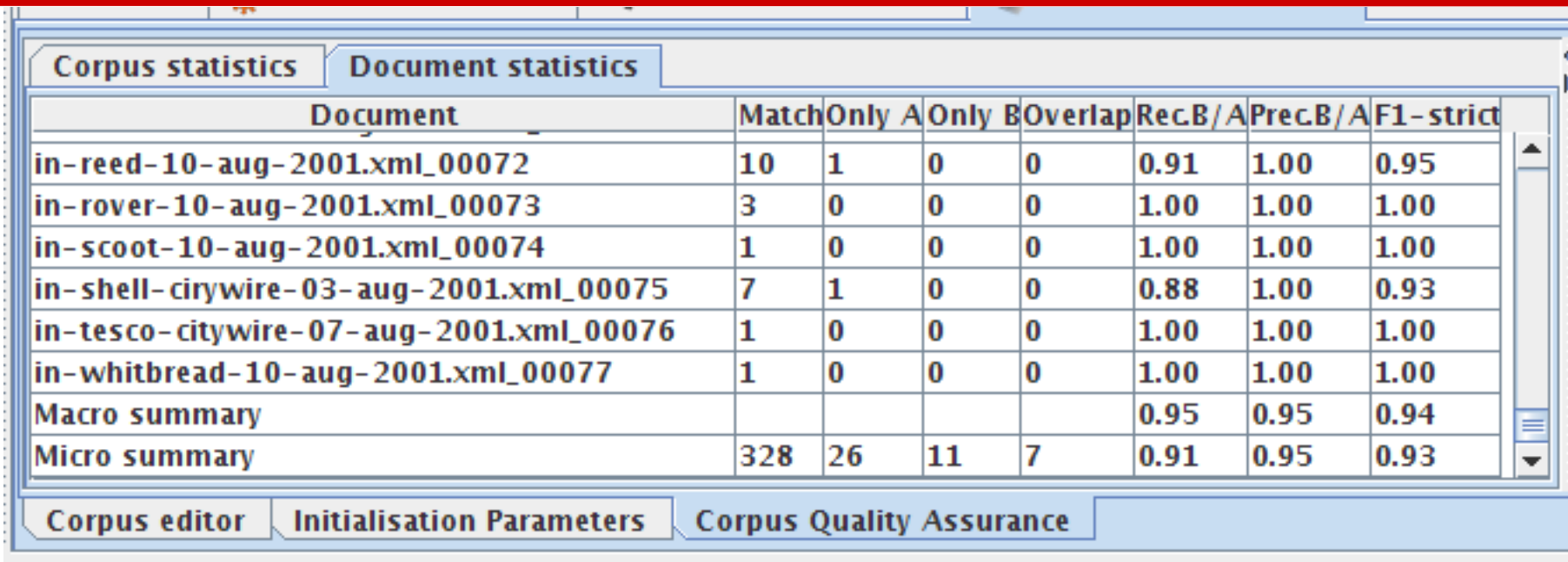
- Each annotation type is listed separately
- Precision, recall and F measure are given for each
- Two summary rows provide micro and macro averages



Micro and Macro Averaging

- Micro averaging treats the entire corpus as one big document, for the purposes of calculating precision, recall and F
- Macro averaging takes the average of the rows

Document Statistics Tab

A screenshot of the GATE software interface showing the 'Document statistics' tab. The window has a title bar and several tabs: 'Corpus statistics', 'Document statistics' (selected), 'Corpus editor', 'Initialisation Parameters', and 'Corpus Quality Assurance'. The main area contains a table with columns for 'Document', 'Match', 'Only A', 'Only B', 'Overlap', 'Rec.B/A', 'Prec.B/A', and 'F1-strict'. The table lists several documents with their respective statistics. At the bottom, there are two summary rows: 'Macro summary' and 'Micro summary'.

| Document | Match | Only A | Only B | Overlap | Rec.B/A | Prec.B/A | F1-strict |
|---|-------|--------|--------|---------|---------|----------|-----------|
| in-reed-10-aug-2001.xml_00072 | 10 | 1 | 0 | 0 | 0.91 | 1.00 | 0.95 |
| in-rover-10-aug-2001.xml_00073 | 3 | 0 | 0 | 0 | 1.00 | 1.00 | 1.00 |
| in-scoot-10-aug-2001.xml_00074 | 1 | 0 | 0 | 0 | 1.00 | 1.00 | 1.00 |
| in-shell-citywire-03-aug-2001.xml_00075 | 7 | 1 | 0 | 0 | 0.88 | 1.00 | 0.93 |
| in-tesco-citywire-07-aug-2001.xml_00076 | 1 | 0 | 0 | 0 | 1.00 | 1.00 | 1.00 |
| in-whitbread-10-aug-2001.xml_00077 | 1 | 0 | 0 | 0 | 1.00 | 1.00 | 1.00 |
| Macro summary | | | | | 0.95 | 0.95 | 0.94 |
| Micro summary | 328 | 26 | 11 | 7 | 0.91 | 0.95 | 0.93 |

- Each document is listed separately
- Precision, recall and F measure are given for each
- Two summary rows provide micro and macro averages



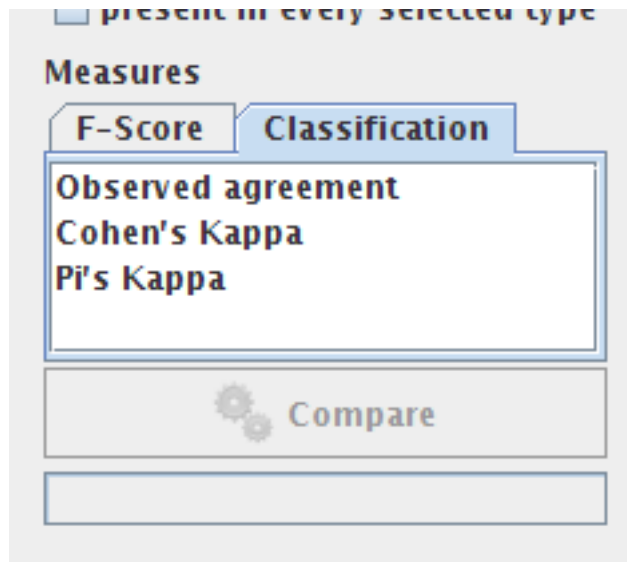
Summary

- This session has been devoted to IE and ANNIE
- You should now have a basic understanding of:
 - what IE is
 - how to load and run ANNIE, what each of the ANNIE components do, how to modify ANNIE components
 - Evaluation using Annotation Diff and Corpus QA



Optional

Classification Measures



- By default, Corpus Quality Assurance presents the F-measures
- However, classification measures are also available
- These are not suitable for entity extraction tasks