**Task 1: Manual Annotation**

The following three sentences were extracted from the Wikipedia page about Edward Snowden. Mark the named entities and time expressions in these sentence and insert them into the table.

For time normalization, express each time expression as an interval in the following format: "[yyyy-MM-dd,yyyy-MM-dd]" (e.g. "[2018-04-19,2018-04-26]").

1: In **2013**, Snowden was hired by an **NSA** contractor, **Booz Allen Hamilton**, after previous employment with **Dell** and the **CIA**.

2: On **May 20, 2013**, Snowden flew to **Hong Kong** after leaving his job at an **NSA** facility in **Hawaii**, and in **early June** he revealed thousands of classified **NSA** documents to journalists **Glenn Greenwald**, **Laura Poitras**, and **Ewen MacAskill**.

3: **Snowden** came to international attention after stories based on the material appeared in **The Guardian** and **The Washington Post**.

<table>
<thead>
<tr>
<th>Sent. No.</th>
<th>Entity</th>
<th>Entity Type²</th>
<th>Time Expression</th>
<th>Time Expression (normalized)</th>
</tr>
</thead>
</table>
| 1        | Edward Snowden
NSA
Booz Allen Hamilton
DELL
CIA | PER
ORG
PER
ORG
ORG | 2013 | [2013-01-01, 2013-12-31] |
| 2        | Edward Snowden
Hong Kong
NSA
Hawaii
NSA
Glenn Greenwald
Laura Poitras
Ewen MacAskill | PER
LOC
ORG
LOC
ORG
PER
PER
PER | May 20, 2013
early June | [2013-05-20]
[2013-06-01, 2013-06-10]³ |
| 3        | Edward Snowden
The Guardian
The Washington Post | PER
ORG
ORG | | |


² ORG: Organization, LOC: Location, PER: Person

³ This decision for a time interval representing “early June” is ambiguous.
Task 2: Extraction Tools

Insert the text from Task 1 into the following tools and insert their output into the table:

Entity Linking
- DBpedia Spotlight: http://demo.dbpedia-spotlight.org/
- Babelfy: http://babelfy.org/

Temporal Taggers
- SUTime: http://nlp.stanford.edu:8080/sutime/
- Heideltime: http://heideltime.ifi.uni-heidelberg.de/heideltime

<table>
<thead>
<tr>
<th>Sent. No.</th>
<th>Entity</th>
<th>Entity</th>
<th>Time Expression (normalized)</th>
<th>Time Expression (normalized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Edward Snowden NSA Booz Allen Hamilton DELL CIA</td>
<td>Booz Allen Hamilton</td>
<td>[2013-01-01,2013-12-31]</td>
<td>[2013-01-01,2013-12-31]</td>
</tr>
</tbody>
</table>

2.1 Which input options do you have when using the HeidelTime demo?
*Use the annotation for “Document Type: Narratives”.*

2.2 What are the differences between the DBpedia Spotlight and Babelfy output?
*Babelfy extracts concepts and named entities. Some annotations are erroneously extracted as concepts (e.g., NSA). DBpedia Spotlight finds more named entities, but some of them are wrong.*

2.3 What are the differences between the SUTime and HeidelTime output?
*SUTime maps “early June” to the most recent June (in 2017), as there is no year available. With the “narratives” option, HeidelTime extracts the correct year.*

Task 3: Precision and Recall

*Due to the difficulty with defining a time interval for “early June”, we mark this as a correct extraction.*
Compare the results from Task 2 to your manual annotation in Task 1. Insert the numbers of correctly extracted, wrongly extracted and missing annotations into the following table. Compute the precision and recall scores as well as the F-measure of each extractor (see repetition).

<table>
<thead>
<tr>
<th></th>
<th>#correct</th>
<th>#wrong</th>
<th>#missing</th>
<th>Precision</th>
<th>Recall</th>
<th>F-measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DBpedia</strong></td>
<td>5+7+3 = 15</td>
<td>0+1+1 = 2</td>
<td>0+1+0 = 1</td>
<td>(\frac{15}{15+2} \approx 0.88)</td>
<td>(\frac{15}{15+1} \approx 0.94)</td>
<td>2 (\cdot \frac{0.88}{0.94}) (\approx 0.91)</td>
</tr>
<tr>
<td><strong>Spotlight</strong></td>
<td>1+5+2 = 8</td>
<td>0+1+0 = 1</td>
<td>4+3+1 = 8</td>
<td>(\frac{8}{8+1} \approx 0.88)</td>
<td>(\frac{8}{8+8} = 0.5)</td>
<td>2 (\cdot \frac{0.88}{0.5}) (\approx 0.64)</td>
</tr>
<tr>
<td><strong>Babelfy</strong></td>
<td>1+1+0 = 2</td>
<td>0+0+1 = 1</td>
<td>0+0+1 = 1</td>
<td>(\frac{2}{2+1} \approx 0.67)</td>
<td>(\frac{1}{1+1} = 0.67)</td>
<td>2 (\cdot \frac{0.67}{0.67}) (\approx 0.67)</td>
</tr>
<tr>
<td><strong>SUTime</strong></td>
<td>1+2+0 = 3</td>
<td>0+0+0 = 0</td>
<td>0+0+0 = 0</td>
<td>(\frac{3}{3+0} = 1)</td>
<td>(\frac{1}{3+0} = 1)</td>
<td>2 (\cdot \frac{1}{1+1} = 1)</td>
</tr>
<tr>
<td><strong>Heidel-</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Repetition: Precision and Recall**

Precision: Proportion of correctly extracted annotations among all extracted annotations.

\[
Precision = \frac{|\{\text{correct annotations}\}|}{|\{\text{correct annotations}\} \cup \{\text{wrong annotations}\}|}
\]

Recall: Proportion of annotations found by the algorithm to all annotations in the collection.

\[
Recall = \frac{|\{\text{correct annotations}\}|}{|\{\text{correct annotations}\} \cup \{\text{missing annotations}\}|}
\]

F-measure: The weighted harmonic mean of precision and recall.

\[
F_1 = 2 \cdot \frac{Precision \cdot Recall}{Precision + Recall}
\]

**More Information**

- SUTime: https://nlp.stanford.edu/software/sutime.shtml
- Stanford CoreNLP: https://stanfordnlp.github.io/CoreNLP/
- Ollie: https://knowitall.github.io/ollie/