TagCurate: Crowdsourcing the Verification of Biomedical Annotations to Mobile Users

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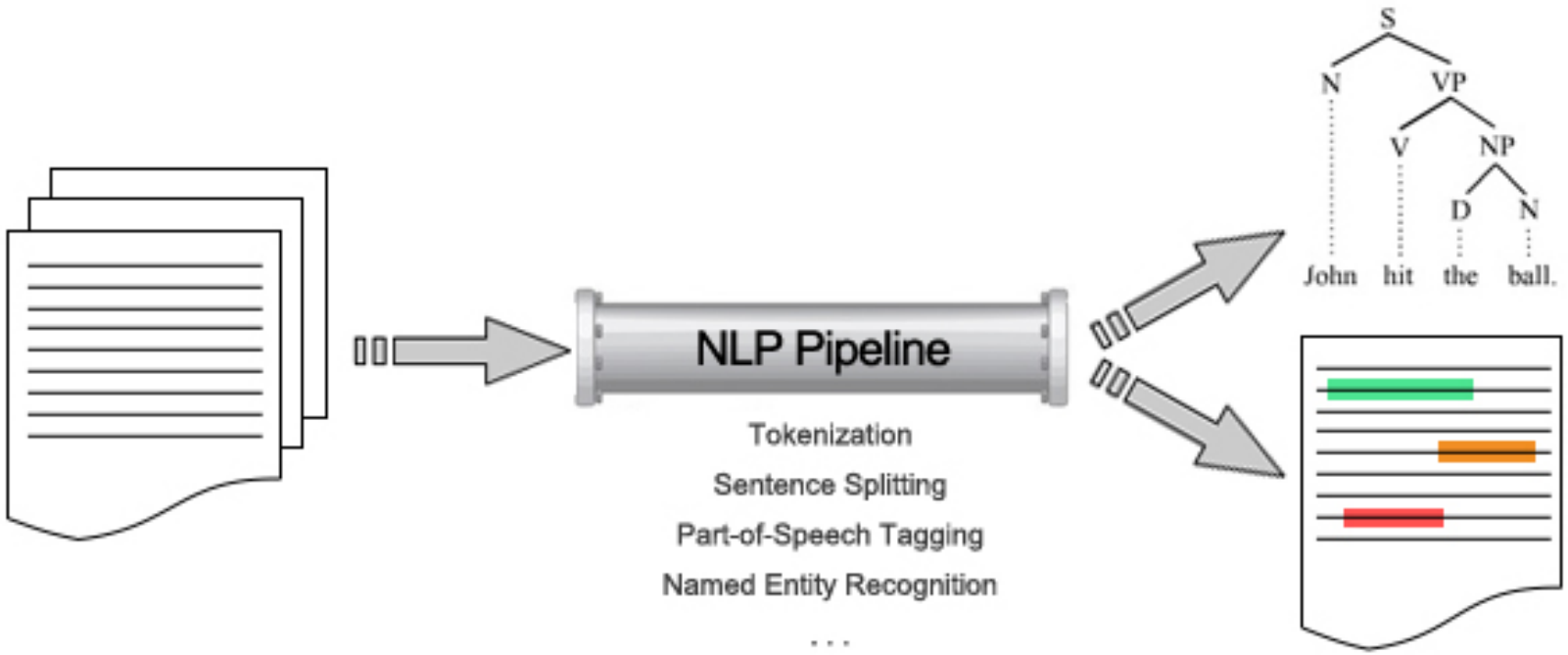
Natural Language Processing (NLP)

Definition

A branch of Artificial Intelligence that uses various techniques to process content written in a natural language, e.g., English or German.

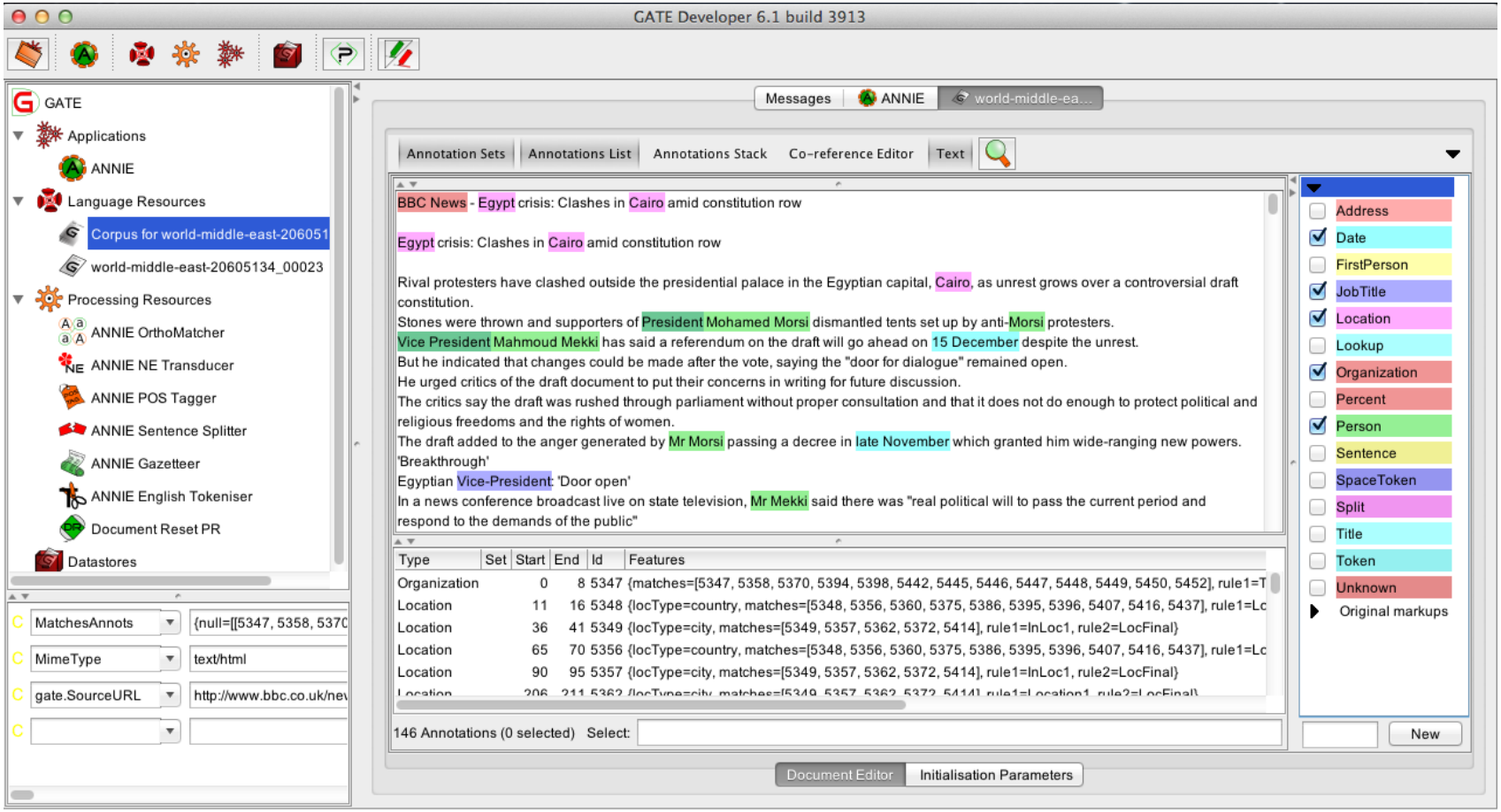


Bottleneck: Gold Standard Corpora

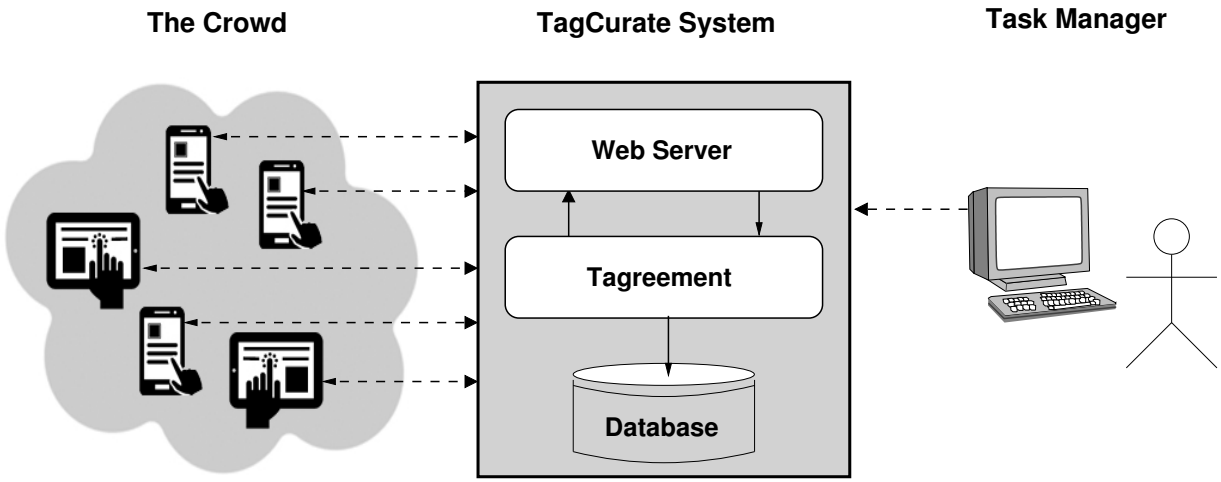
Manually annotated documents required for training & testing NLP pipelines (especially for machine learning components).

Can we 'crowdsource' some of this work to mobile users?

Challenge: Current Web-based annotation frameworks (e.g., GATE Teamware) not designed for mobile use



System Architecture



Client-Server Model

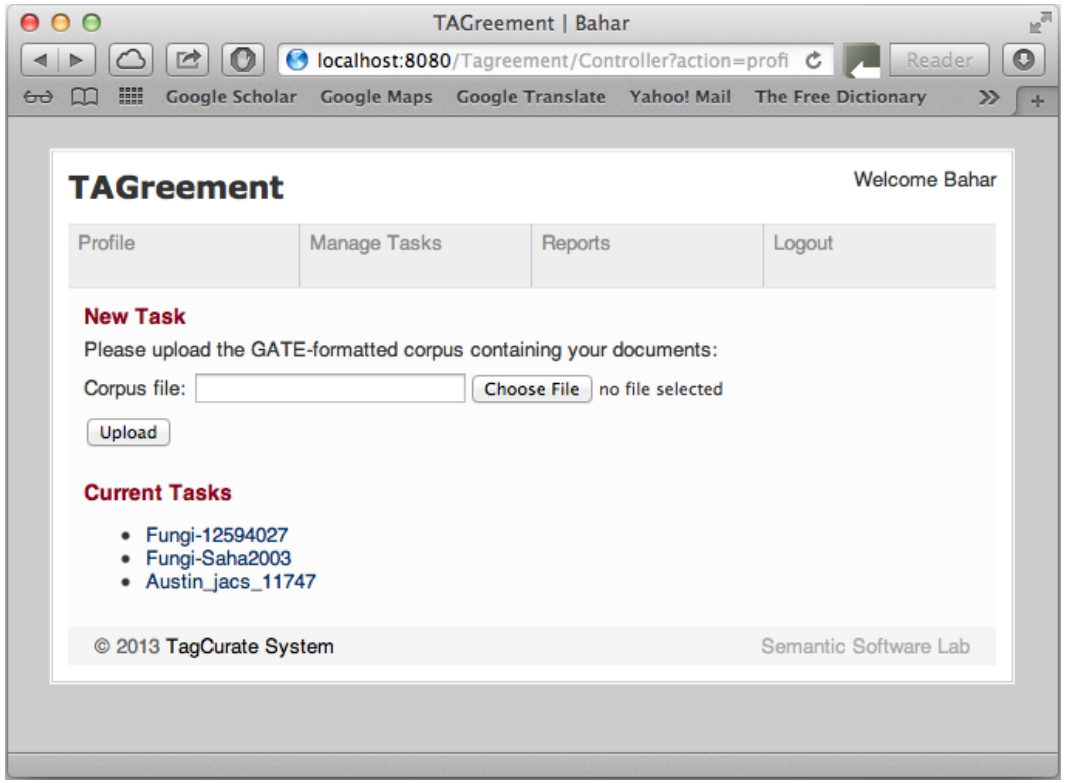
- RESTful communication over HTTP
- *Tagreement* component is responsible for managing the crowdsourcing as well as measuring (dis)agreements

User Groups

- **Task Managers**, define verification tasks using the web-based interface
  - e.g., *NLP pipeline developers, literature curators, . . .*
- **The Crowd**, verify (biomedical) annotations using the Android app
  - i.e., *Virtually anyone with access to an Android-enabled device*

Tagreement Web-based Interface

- *Task Managers* can define and supervise crowdsourcing tasks
- Currently, only accepts GATE-formatted corpora



Tagreement Web-based Interface

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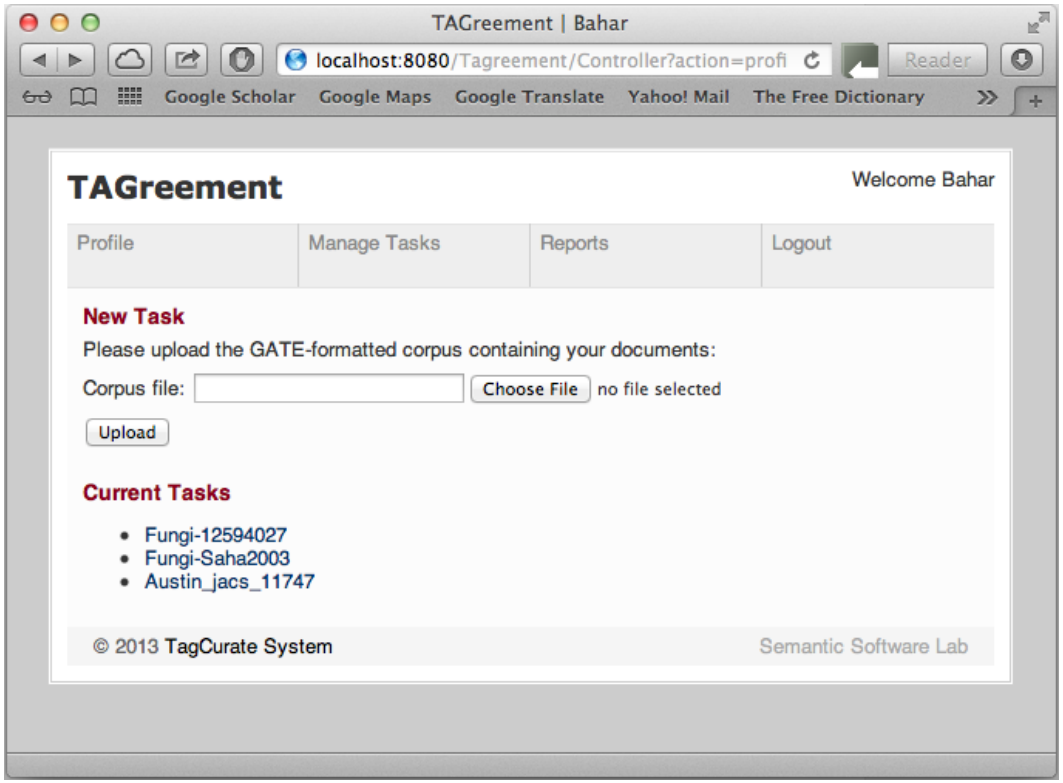
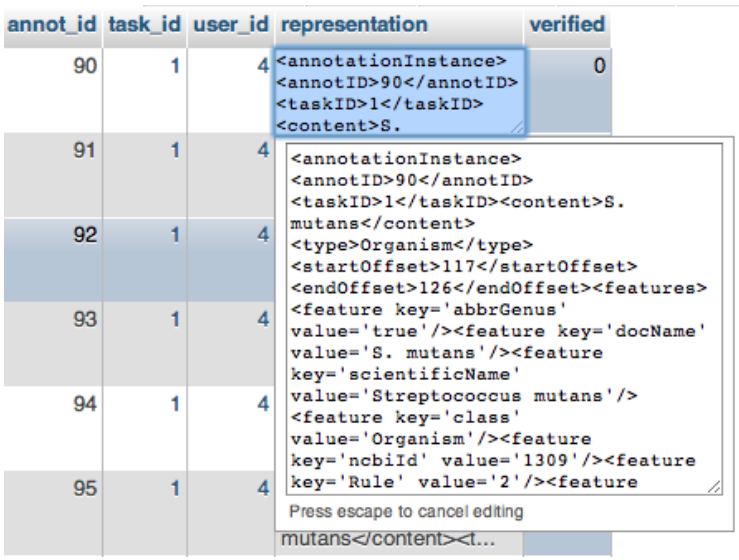
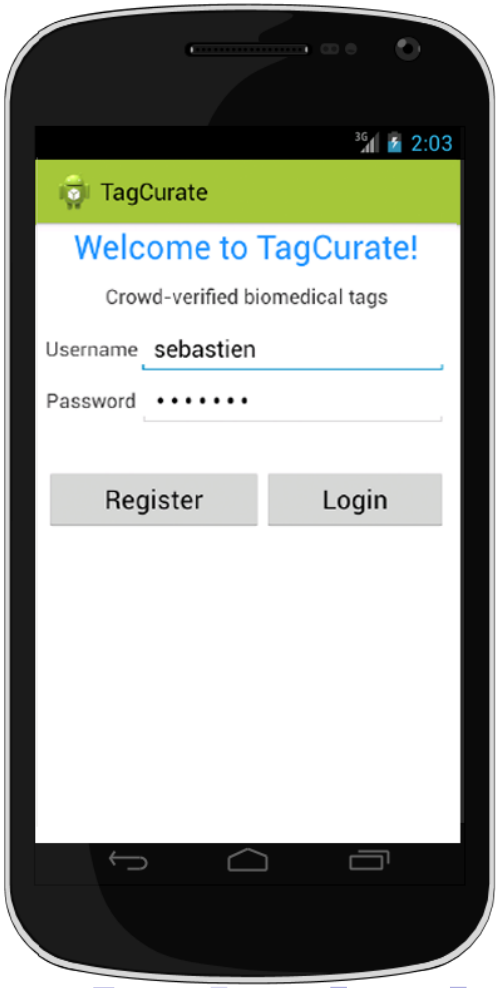
- Stores an internal representation of each tag for distributed verification





TagCurate Android App

- Developed based on the latest Android distribution (Jelly Bean version 4.3)
- Responsive design for phones and tablets



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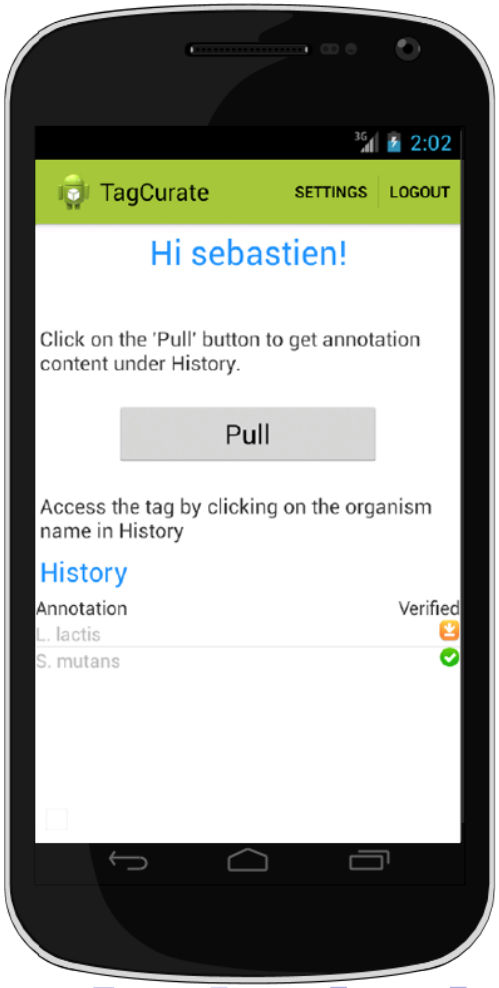
- Temporary storage of verification history



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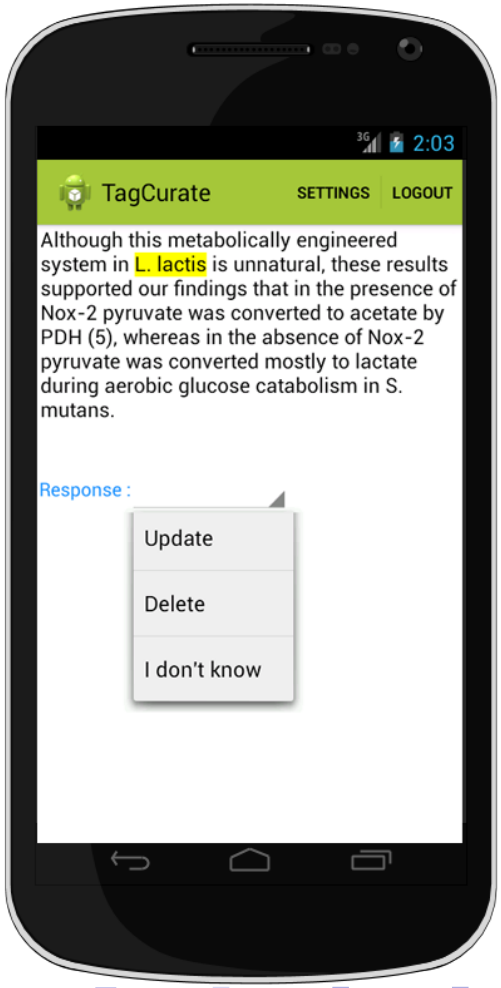
- Verify whether a tag is a case of:
  - True Positive (correct)
  - False Positive (spurious)



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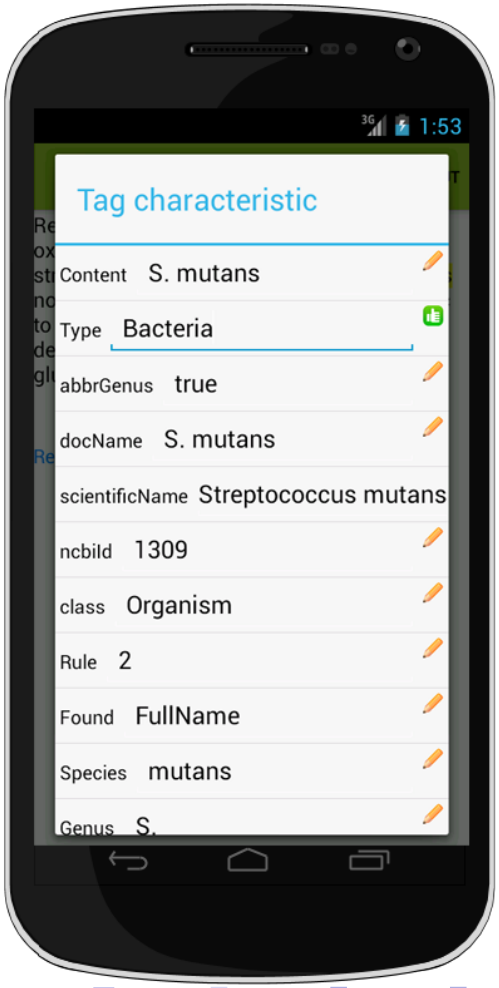
- Modify tags features
  - Pairs of $<$ key, value $>$
  - Modifications reflect in the tag representation



What about the missing tags?

Manual Annotation

Users select a text span and assign type and features to the generated tag.

Pros

- Human-generated tags usually have a higher quality

Cons

- Difficult task on devices with small screen
- Difficult to achieve an adequate inter-annotator agreement
- Requires well-established annotation guidelines

Automatic Annotation

Users invoke domain-specific text mining pipelines that generate various tags from text.

Pros

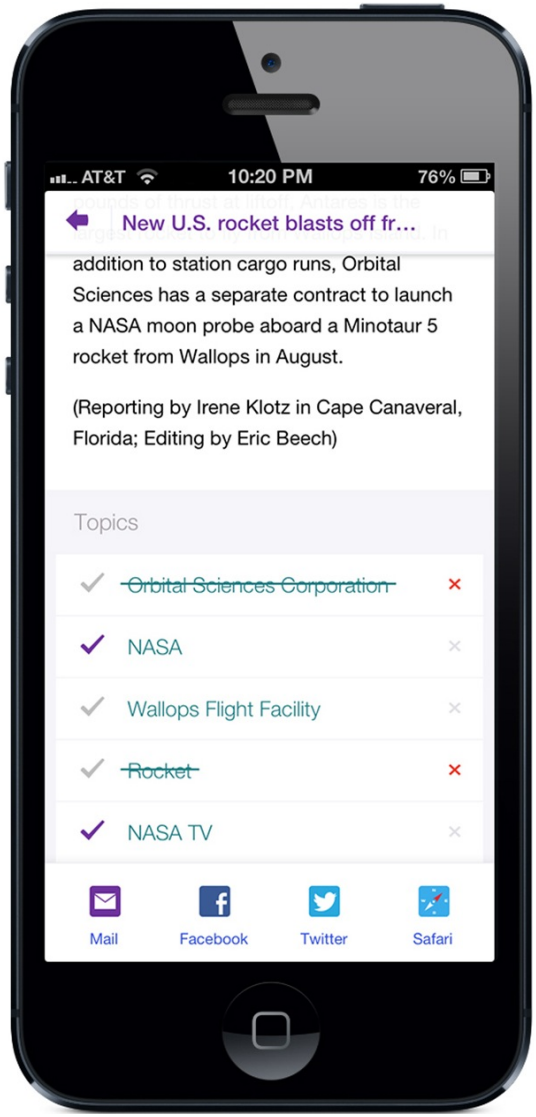
- Reuse existing text mining pipelines

Cons

- Text mining techniques are resource-intensive

Mobile Applications of NLP

- **Automatic Summarization**
  - Condensed version of document(s)
  - Various types: Generic, Focused, Update
  - e.g., Summly



(Image Courtesy of Yahoo!)

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  - Combining other NLP services
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- **Other domain-specific services**
  - e-Health, e-Learning, etc.

Mobile Natural Language Processing

What we know

- Numerous mobile applications can benefit from NLP support
- Robust, open-source NLP frameworks are already available
- However, NLP analysis is a very resource-intensive task!

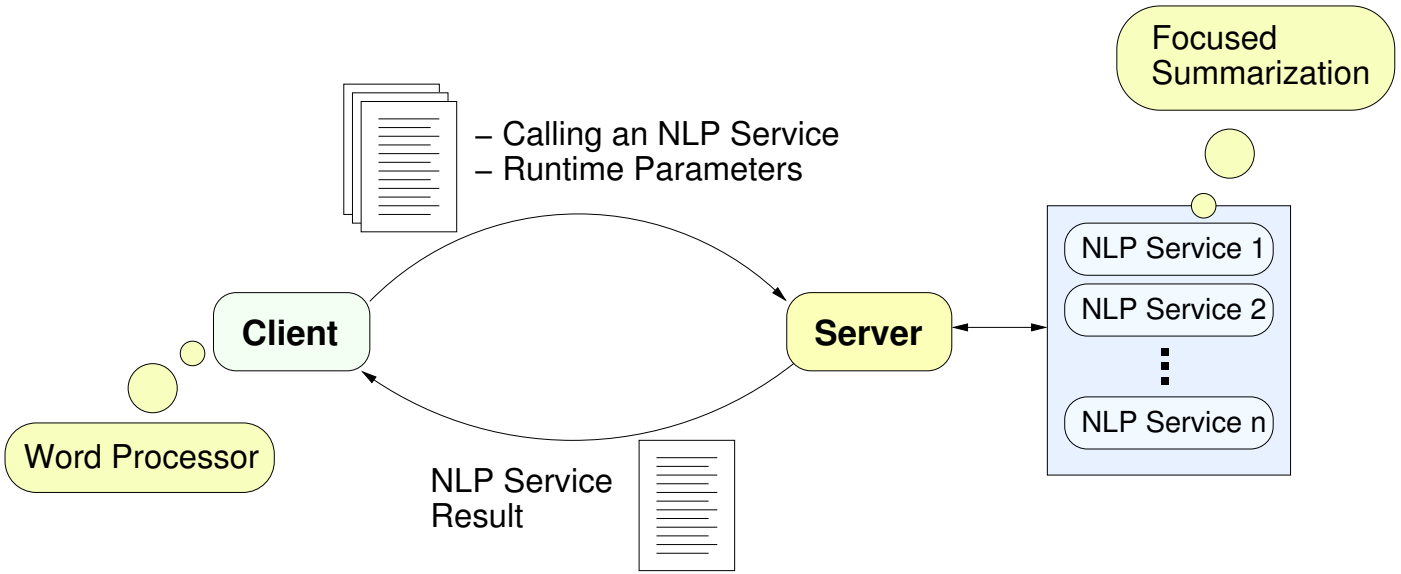
Semantic Assistants Android-NLP Integration

- Novel Android-NLP integration approach
- Provides Separation of Concerns
  - NLP developer does not need to know Android
  - Android app developer does not need to know NLP
- Android *library* for NLP service execution, rather than multiple apps
- Enable users to benefit from complex NLP services in their tasks

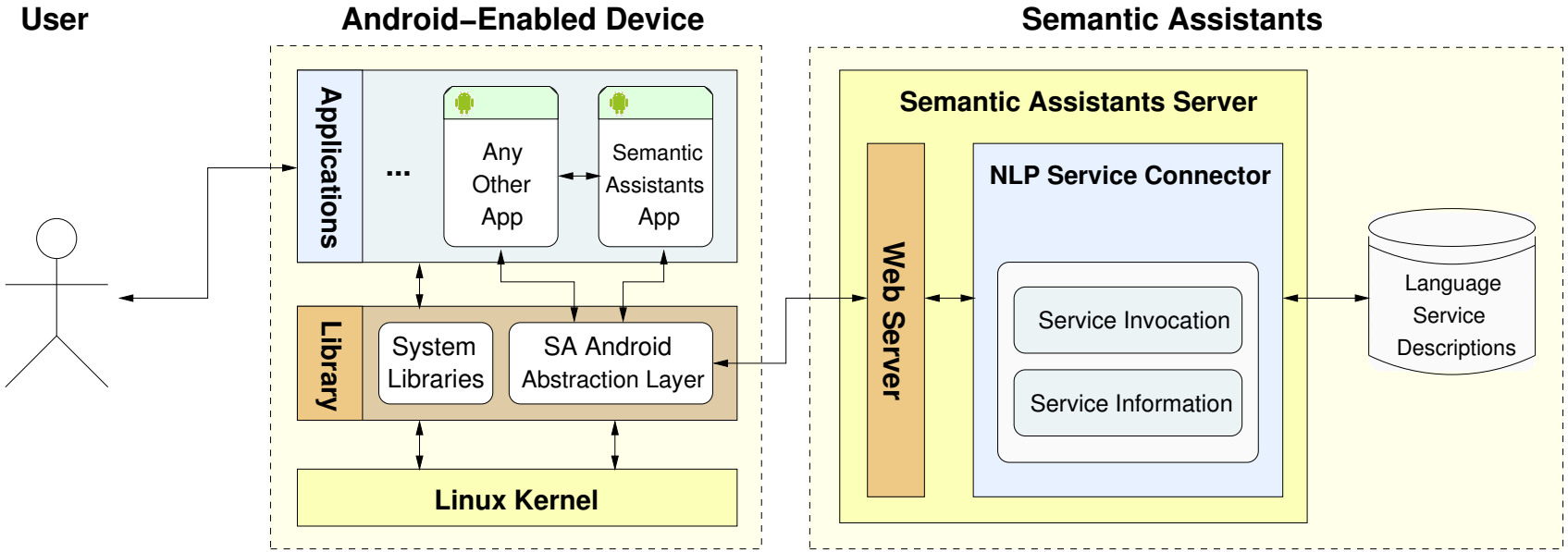
[B. Sateli, G. Cook, R. Witte, *"Smarter Mobile Apps through Integrated Natural Language Processing Services"*, MobiWIS 2013]

Semantic Assistants Framework

- Existing open-source (AGPL3) service-oriented architecture
- Brokers NLP pipelines as standard W3C Web services
- Avoids context-switching of user to external text mining applications
- Brings NLP analysis directly to various applications via plug-ins



Semantic Assistants NLP Intents



- Client-Server Model
  - Client is an Android app
  - Server-side component is the Semantic Assistants server
- RESTful communication over HTTP(S)
- Handles various NLP service result formats
  - *Annotation*, e.g., a person name in text
  - *Document*, e.g., summary of a long webpage
  - *Files*, e.g., an HTML document

Developing NLP Android Apps

Separation of Concerns

Android Developer

- Identify the NLP task
- Extend the SA intents by choosing a unique package name for this new service
- Embed the SA Android library in a new Android app
- Invoke the intent in app using the library

NLP Developer

- Develop the concrete NLP pipeline
- Deploy the pipeline on a SA server

Summary and Outlook

Summary

- Distribute annotation jobs to large user groups
- Expert annotators can focus on quality control and difficult cases
- Easily bring NLP pipelines to (Android) mobile apps

Ongoing work

- TagCurate app facelift
- Expanding the user profiles
- Finding incentives and introducing social aspects
- Add annotation capabilities (both manual and semi-automatic)

Find out more...

- Twitter: @SemSoft
- Web: `http://www.semanticsoftware.info/`