TIRA: Configuring, Executing, and Disseminating Information Retrieval Experiments

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TIRA: Configuring, Executing, and Disseminating Information Retrieval Experiments

Outline
- Introduction
- Architecture
- Case Studies
- Demonstration
- Summary
A longitudinal study has shown consistent selection of weak baselines in ad-hoc retrieval tasks leading to “improvements that don’t add up”.

[Armstrong et al., 2009]

A polarizing article describes how biases in research approaches lead to the consideration of “why most published research findings are false”.

[Ioannidis, 2005]

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[Allan et al., 2012]

“We have to explore systematically the independent parameters of experiments.”

[Fuhr, Salton Award Speech, SIGIR 2012]
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Introduction

Survey of 108 Full Papers at SIGIR 2011

- Users I
- Query Analysis I
- Learning To Rank
- Personalization
- Retrieval Models I
- Social Media
- Content Analysis
- Web IR
- Collaborative Filtering I
- Users II
- Query Analysis II
- Communities
- Classification
- Retrieval Models II
- Image Search
- Indexing
- Web Queries
- Collaborative Filtering II
- Latent Semantic Analysis
- Multimedia IR
- Summarization
- Vertical Search
- Query Suggestions
- Linguistic Analysis
- Clustering
- Effectiveness
- Multilingual IR
- Efficiency
- Recommender Systems
- Test Collections
Introduction

Survey of 108 Full Papers at SIGIR 2011

Provision of experiment data
Introduction

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Provision of experiment data

Provision of experiment software
Introduction

Survey of 108 Full Papers at SIGIR 2011

Provision of experiment data 51%

Provision of experiment software 18%

Provision of experiment service 0%

Provision of experiment service
Introduction

Incentives for Reproducible Research

- Increase acknowledgment for publishing experiments, data, and software.
  - Encourage a paradigm shift towards open science.
- Decrease the overhead of publishing experiments.
  - The concept of TIRA is to provide “experiments as a service”.

[Diagram of a person using a computer]
Architecture

Design Goals

1. Local Instantiation
   - Enables public research on private data.
   - Enables comparisons with private software.

2. Unique Resource Identifiers
   - Enables linkage of experimental results in papers with the respective experiment service.
   - Enables reproduction of results on the basis of the resource identifier (digital preservation).

3. Multivalued Configuration
   - Enables the specification of whole experiment series.
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```bash
localhost:2306/programs/examples/MyProgram?p1=42&p2=Method1&p2=Method2
tira@node1:~$ ./myprogram.sh -p1 42 -p2 "method1"
tira@node2:~$ ./myprogram.sh -p1 42 -p2 "method2"
```

<table>
<thead>
<tr>
<th>Parameter 1</th>
<th>Parameter 2</th>
<th>Output Directory</th>
<th>Performance</th>
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<tr>
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<td>output-directory</td>
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4. System Independence

- Enables a widespread usage of the platform.
- Enables the deployment of any experiment software without internal modifications.

5. Distributed Execution

- Enables efficient computation of pending experiments.

6. Result Storage

- Enables retrieval and maintenance of raw experiment results.

... and Peer to Peer Collaboration

- Conduct shared work on the same platform.
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## Architecture

### Design Goals: Existing Experimentation Frameworks

<table>
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</tr>
</tbody>
</table>

1. Local instantiation
2. Web dissemination
3. Platform independence
4. Result retrieval
5. Peer-to-peer collaboration
Architecture

“Experiments as a Service”
Architecture

“Experiments as a Service”

Diagram:
- Front-end process
- Back-end process
- Experiment
- Database
- Program
- Record

ProgramRecord
- A JSON-based program deployment descriptor. Example:

```json
{
  "MAIN": "java -jar websearch.jar '{$Query' $Results $Engine',
  "Results":[1,10,100],
  "Query":".+",
  "Engine": ["CHATNOIR","WIKIPEDIA","BING","GOOGLE"]
}
```
Architecture
“Experiments as a Service”

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ExperimentDatabase

- Stores completed as well as pending experiments.
- Indexes the input parameters and provides basic retrieval functionality.
Architecture

“Experiments as a Service”

TiraServer

- Retrieves experiments based on (partial) experiment query.
- Requests execution of experiment series based on query.
- Realizes web abstraction and creation of TIRA networks.

HttpClient

- Either a Web browser, a client program using the TIRA API, or a remote TiraServer.
- Can access program-specific information.
Architecture
“Experiments as a Service”

ProgramWrapper
- Continuously queries the ExperimentDatabase for pending experiments.
- Registers matching experiments with the ProgramScheduler execution queue.
- Updates the ExperimentDatabase with notifications and results.

ProgramScheduler
- Maintains a pool of system threads.
- Requests execution of the next experiments in the queue.
Architecture

“Experiments as a Service”

A TIRA network:
Case Studies

PAN 2012

PAN is a competition on plagiarism detection hosted at CLEF. [pan@clef]

- Detailed comparison subtask:
  “Given a pair of suspicious and source document, record all passages in the suspicious document that are plagiarized from the source document.”

- Evaluation metric is the $\text{plagdet}$ score:

  $$\text{plagdet}(\text{Det}, \text{Truth}) = \frac{F_1(\text{Det}, \text{Truth})}{\log_2(1 + \text{granularity}(\text{Det}, \text{Truth}))}$$

- TIRA has been used for the training and evaluation phases.
Case Studies

PAN 2012 – Training Phase

- Participants upload detection results for a specific training set.
- From the user inputs the program execution command is generated through substitution.
- Detection results are unzipped and evaluated with an implementation of *plagdet*.
- Participants receive performance results in a result table.
- The training service served as a leaderboard during the competition.

```bash
tira@node1:~$
unzip -o $Detection -d det &&
python $PROGRAM/perfmeasure.py
-p /pan12-training-sets/$Testset/
-d det > scores.txt
```
Case Studies
PAN 2012 – Evaluation Phase

- TIRA servers are provided for two operating systems, Windows and Ubuntu.
- Participants submit their plagiarism detection software for deployment on the appropriate TIRA server.
- A third TIRA server controls the overall evaluation of all deployed submissions on the private test set and provides the overall results.
Case Studies

Others

Search Result Clustering

- **Task.** Group the ranked lists from search results into coherent clusters to reduce human effort.  
  [Stein et al., 2012]

- **Benefit.** Fetch search results from multiple search engines for storage as static resources and reusable assets.

Simulation Data Mining

- **Task.** Pre-compute structural design behavior through learning from large volumes of existing simulation results.  
  [Burrows et al., 2011]

- **Benefit.** Easily walk through large parameter spaces and avoid duplication of system simulations.
Summary
Lessons Learned — Old and New

Initial versions of TIRA:
- Keep it simple.
- System independence is a key requirement.

TIRA at PAN 2012:
- Create more incentives to use TIRA as a leaderboard.
- The powerful parameter-substitution mechanism made it easy to get valid PAN software submissions running.

For the future:
- Automated program deployment, e.g. Google App Engine.
- Move from open source to open development.
Summary

1. A clear need exists for a community evaluation service.

2. An ideal solution should consider local instantiation, platform independence, result retrieval, web dissemination, and peer-to-peer collaboration.

3. None of the existing solutions meet all of these goals.

4. The TIRA solution is “Experiments as a Service”, which takes a locally executable program and transforms it into a web service.

5. TIRA was applied at PAN 2012 with success on the detailed comparison plagiarism detection task.

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Thank you!