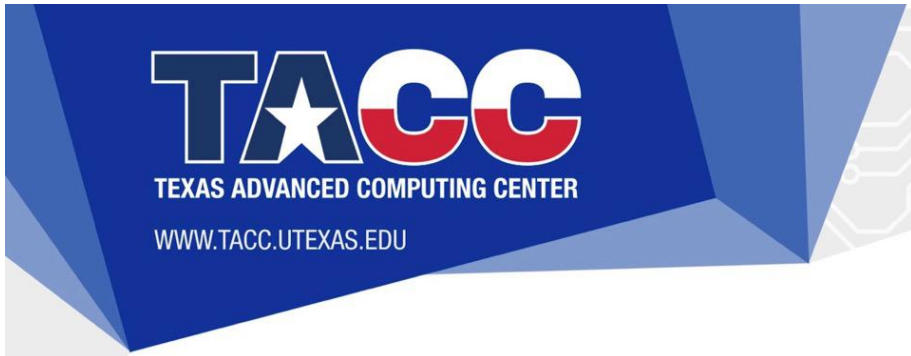

Facilitating Remote Resources usage via User Driven Web Applications

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Texas Advanced Computing Center

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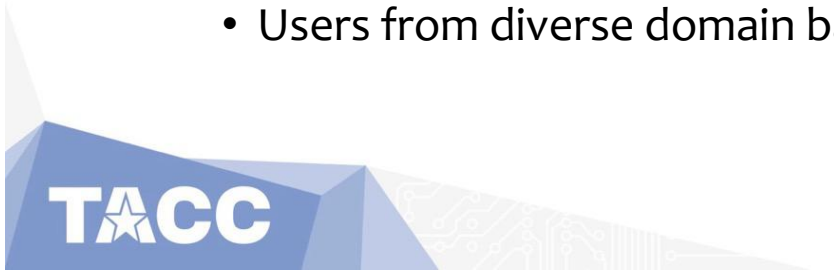
Background

- Data-driven AI analytics help organizations gain new insights
  - Decision making
  - Scientific discovery
  - Marketing potentials
- Due to increasing data storage requirement, computing complexity, there is an increasing trend to move to remote advanced computing resources
  - Commercial cloud
  - Cyberinfrastructure

Observations of new user needs on cyberinfrastructure

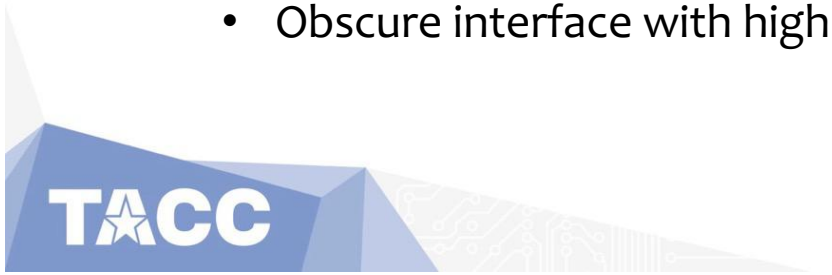
- Interact with data and analysis process
  - Data review
  - Data curation
  - Results review.
- Sharing data access and analysis
- More interdisciplinary research project
  - Users from diverse domain backgrounds with less computing background.



Traditional Service Models

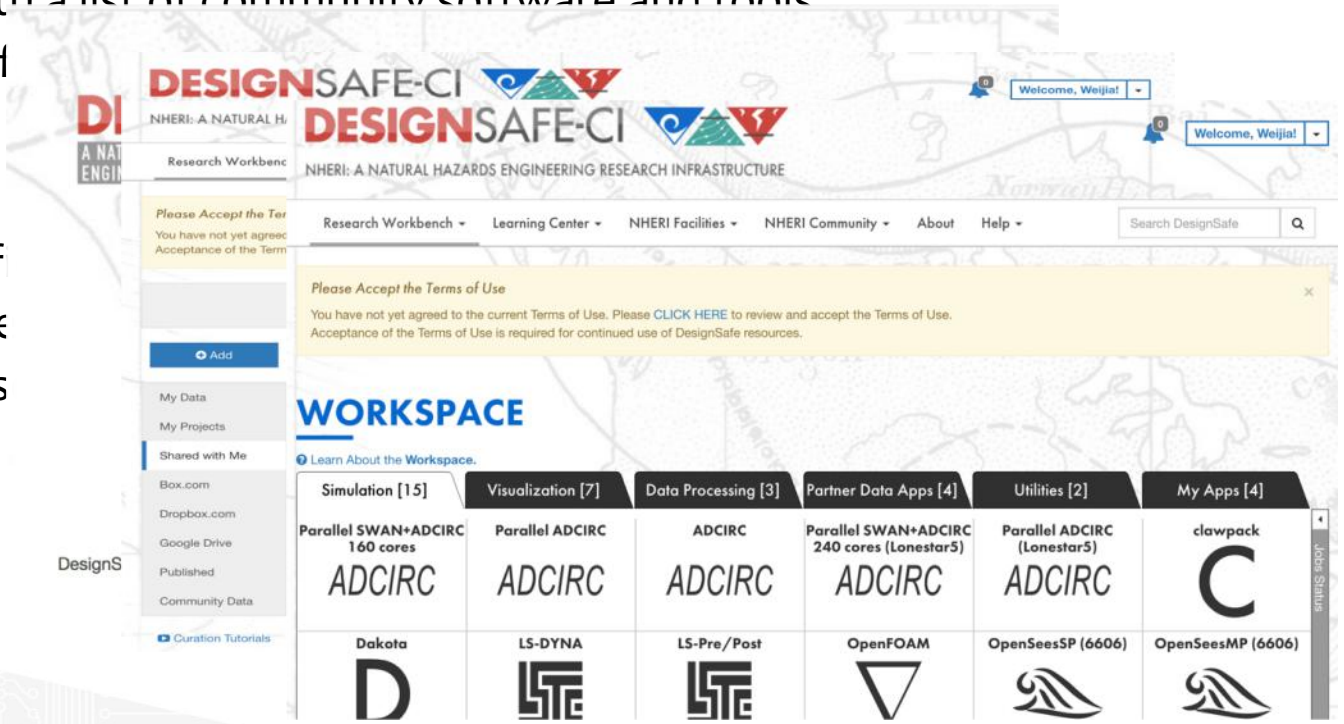
- Command line based interface
  - Users log on and transfer files using SSH terminal via login nodes
  - Users request computing resources via resource managers, such as *Slurm*
  - Different pre-built software tools and environment can be dynamically managed and switched as modules.

- Concerns
  - Batch processing oriented with very little interactivity support.
  - Obscure interface with high initial learning curve



Web Portal Model

- Community focused web portal deployment.
  - Integration with a list of community software and tools
  - Web platform t
- Concerns
  - Requires signif
  - Service provide
  - Not easy for us



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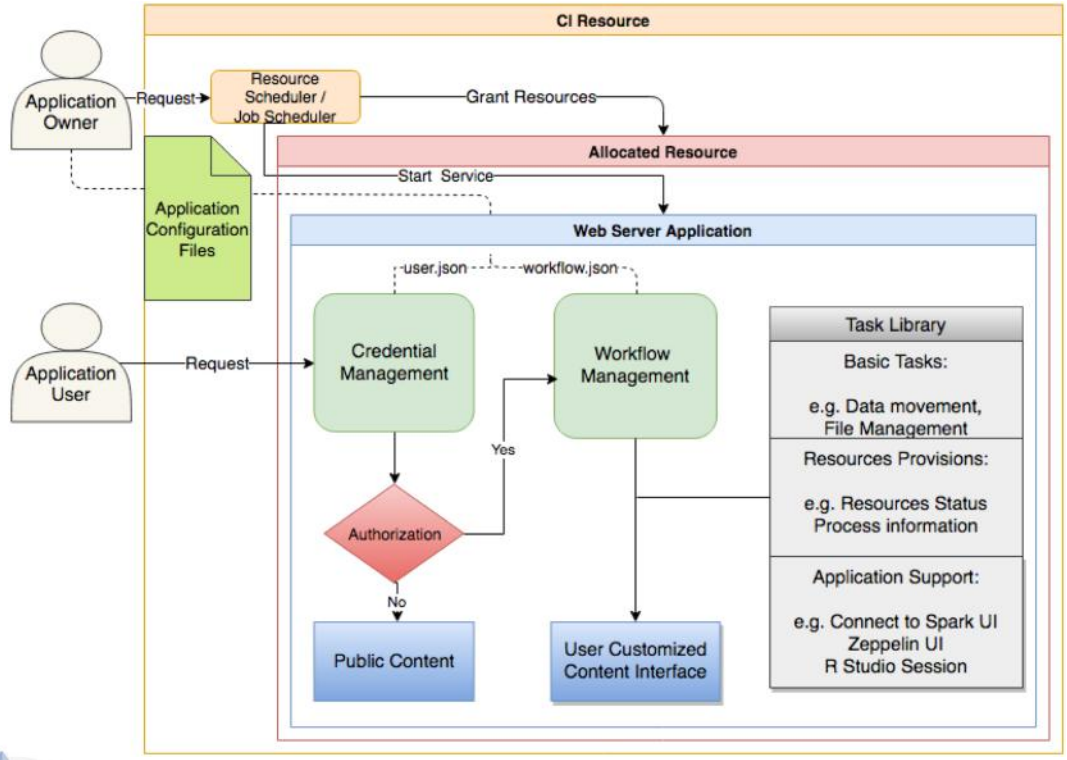
Project Goals

- A user driven model that empowers users to easily setup and deploy applications on supercomputers with web UIs for interactivities.
- Enable user to share the session dynamically with collaborators and/or students.
- Hide resources and allocation details from end users.
- Portable and extensible
- Easy Access Control
  - Temporary access support
  - Authentication through other service providers.

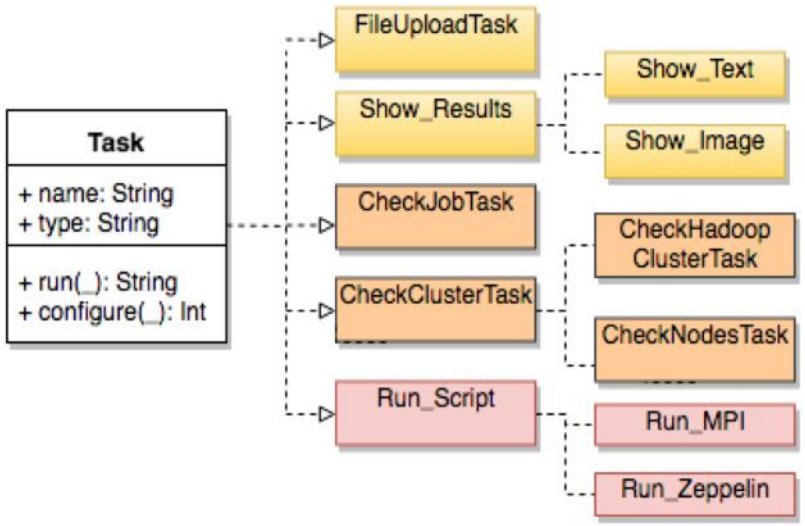
Architecture Design



Implementation

- Enable initialization of web UI through a configuration file.
  - The web UI consists of multiple tasks
  - Implemented with Play web framework, a reactive web framework implemented in Scala/java
  - Self-contained packages with no additional software other than Java needed on the host system.
- Tasks and web applications can be specified through json files.
  - User can customize individual pre-built task or extend the code to develop new task
  - Tasks can run in a given order or in parallel based on dependencies.
- Support dynamic credential management with Oauth2
  - Enable creating temporary password by admin account.
  - Connecting with existing credential on the remote resources
  - Connecting with existing social credentials.

TASK Classes



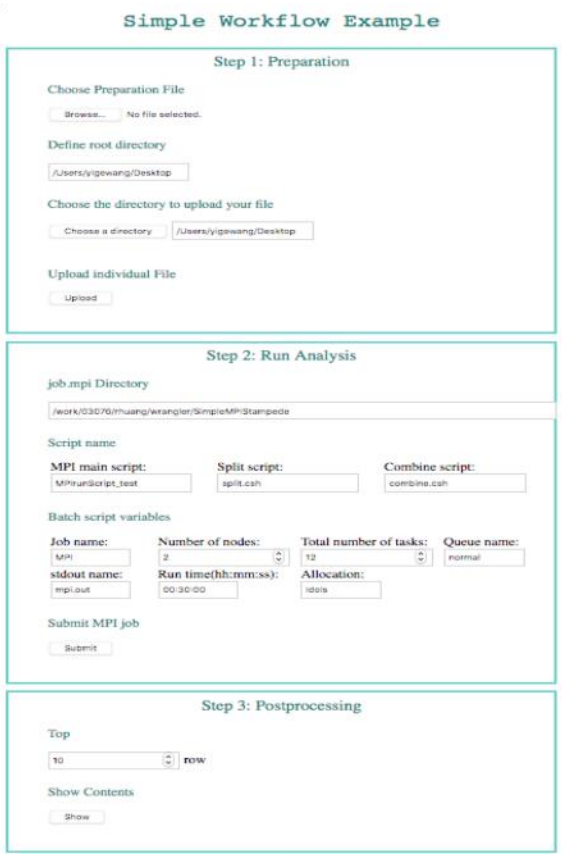
Examples:

- Define Task:

```
{
  "head":"Simple Workflow Example",
  "description":"This is a workflow example.",
  "tasks":
    [
      {
        "task_name":"Preparation",
        "task_type":"fileUpload",
        "description":"Upload file for execution"
      },
      {
        "task_name":"Run Analysis",
        "task_type":"runMPITask",
        "description":"Run analysis using MPI"
      },
      {
        "task_name":"Postprocessing",
        "task_type":"showResultTask",
        "description":"Display result of analysis."
      }
    ]
}
```

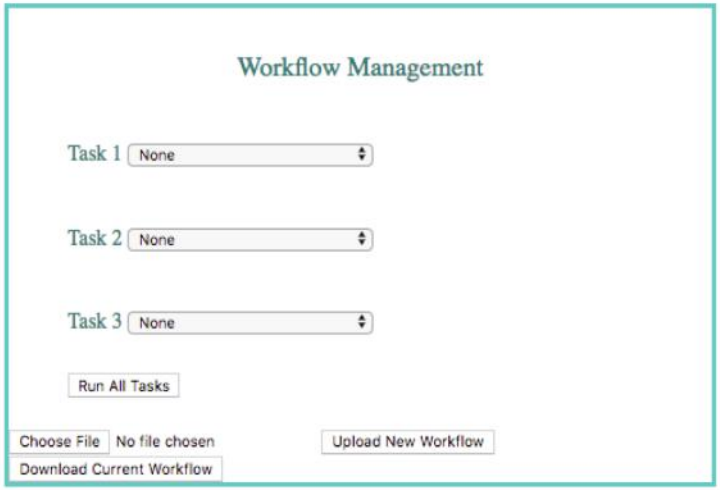
Example:

- Generate Web Application



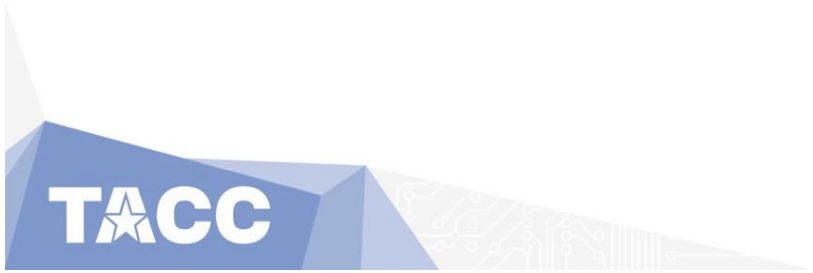
Example:

- Workflow Management for admin user



Use case Example: Twitter Data Analysis Pipeline

- Motivation
  - Twitter analysis has gained increasing popularity across many fields.
  - Not just traditional computational fields, but also many others.
    - Culture trends, political campaigns, social movements etc.
- Challenges
  - knowledge/skills to access real-time tweets
  - resource to store and carry out large-scale computation



Generic Twitter Analysis Workflow

1. Login to the remote resources via ssh connection through a command line interface
2. Move libraries/tools required to the remote resource.
3. Submit a request to start collecting tweets using a Python script.
4. While the Tweets are being accumulated, an R script is used to perform statistical analysis on metadata of tweets, such as its origination locations.
5. After a number of tweets have been accumulated, sentimental analysis are conducted through a zeppelin notebook service.
6. Download the analysis results for inspection

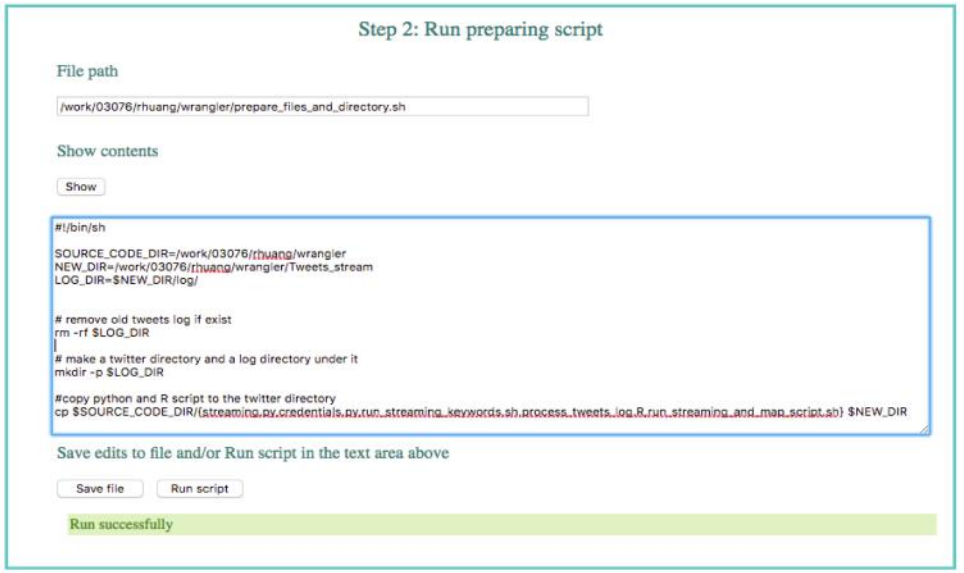
Exemplar Solution

```
{
  "head":"Tweets Aggregationa and Analysis Workflow",
  "description":"test",
  "tasks":
    [
      {
        "task_name":"Upload files",
        "task_type":"fileUpload",
        "description":"upload prepare_files_and_directory.sh,streaming.py
          ,credentials.py,run_streaming_keywords.sh
          ,run_streaming_and_map_script.sh, process_tweets_log.R files"
      },
      {
        "task_name":"Run preparing script",
        "task_type":"runScript",
        "description":"In prepare_files_and_directory.sh, edit
          SOURCE_CODE_DIR to your upload directory, edit NEW_DIR to create a
          new directory to store required scripts and log folder"
      },
      {
        "task_name":"Run streaming script and map script",
        "task_type":"runScript",
        "description":"In run_streaming_and_map_script.sh, edit NEW_DIR to
          point to the new directory created "
      },
      {
        "task_name":"Show Result",
        "task_type":"showResult",
        "description":"Input tweets_map.png path and show tweets map"
      },
      {
        "task_name":"Hapdoop Reservation Information",
        "task_type":"checkHadoop",
        "description":"check Hapdoop reservation Information"
      },
      {
        "task_name":"Launch Zeppelin",
        "task_type":"startZeppelin",
        "description":"start Zeppelin server and load analysis notebook"
      }

    ]
}
```

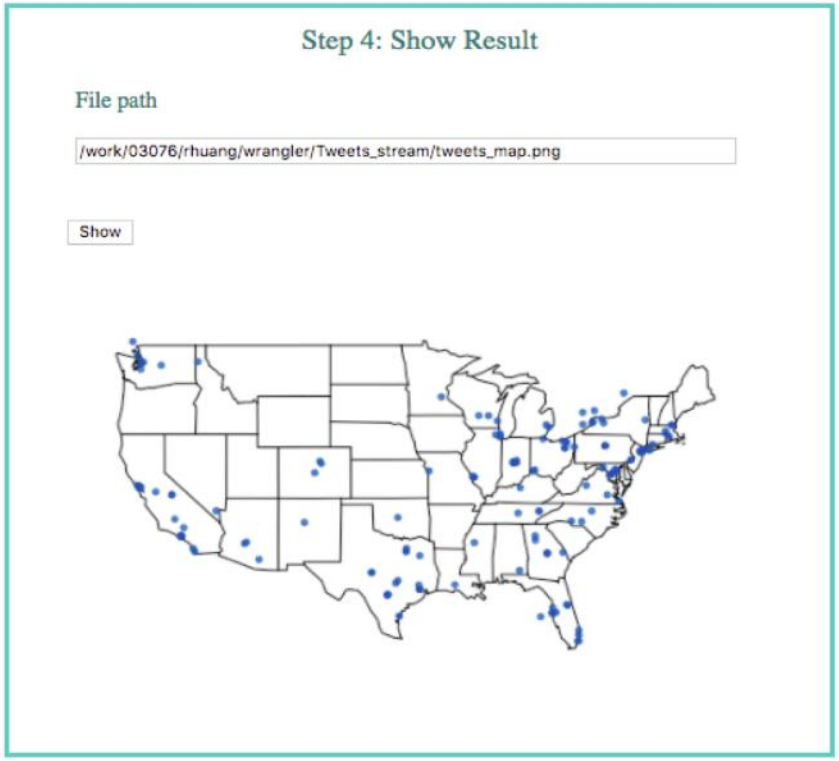
User Driven Analsyis

- User may choose different subset of tasks
- User can further customize their analysis details
- User can customize and specify dependencies among tasks.



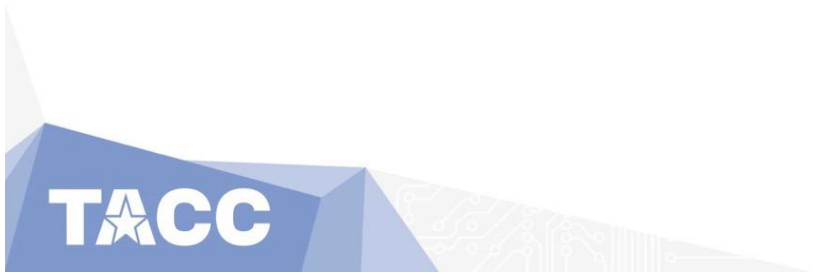
Post Analysis Support

- Visualizing the results

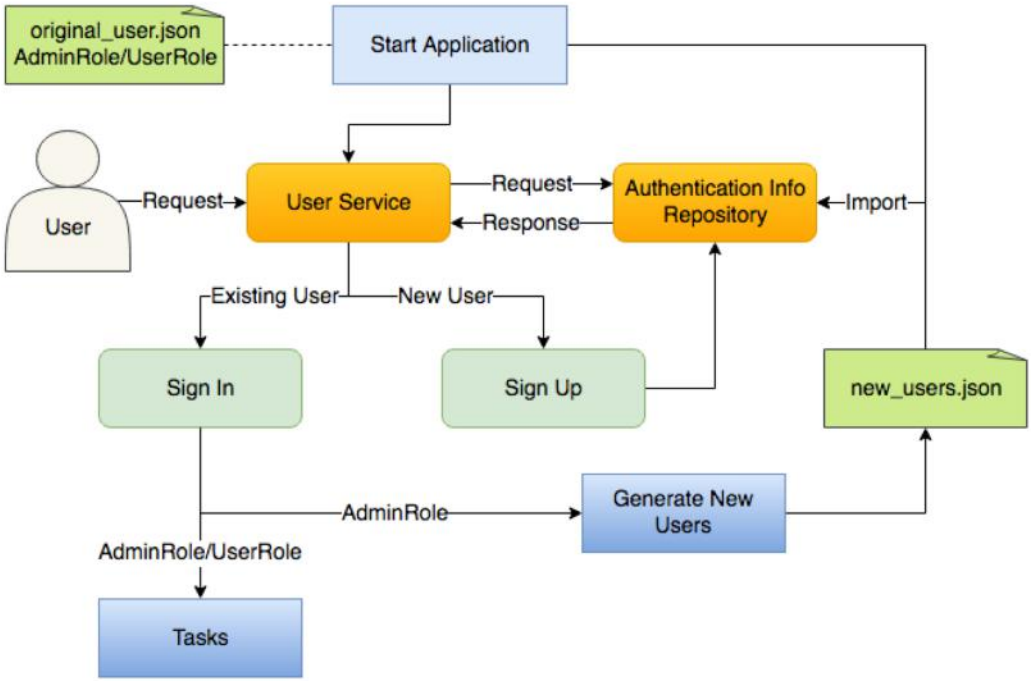


Supporting Education Activities using Cluster

- Instructor can start application for student to access temporarily during the class.
- Providing credential management to support temporary access.
  - Typical process requires handling out temporary training password to students or ask them to set up account ahead of time.
- User may launch additional GUI tool such as notebook, R studios



Credential Management Design Overview



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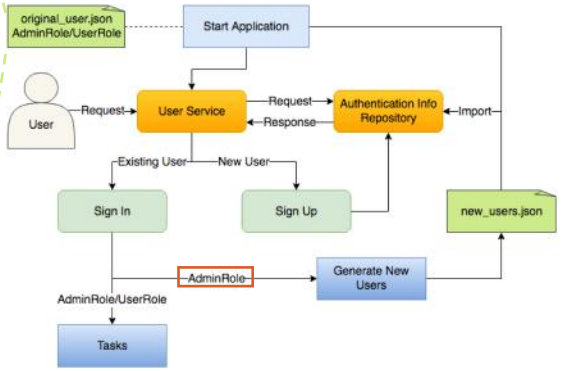
User Management

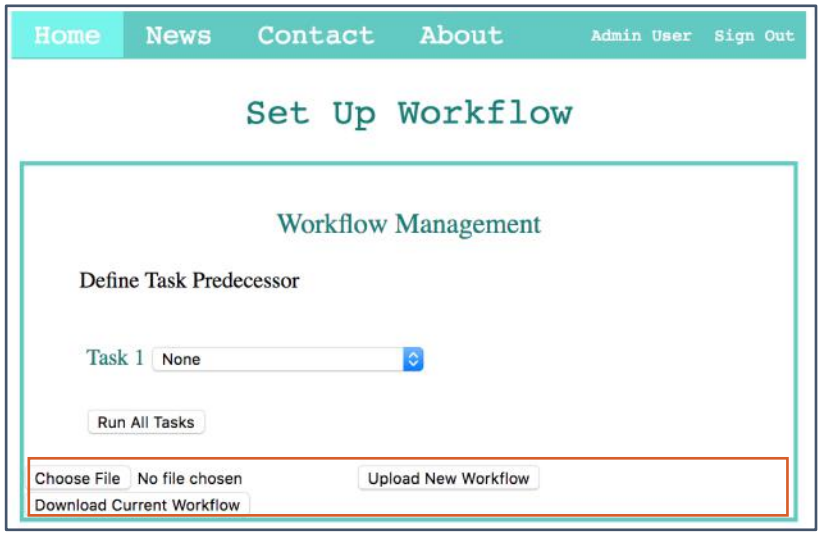
User
+ First Name
+ Last Name
+ Email
+ Password
+ Role

```
{
  "users" :
    [
      {
        "firstName":"Admin",
        "lastName":"User",
        "password":"1111",
        "email":"admin@utexas.edu",
        "role":"AdminRole"
      },
      {
        "firstName":"General",
        "lastName":"User",
        "password":"1111",
        "email":"general@utexas.edu",
        "role":"UserRole"
      }
    ]
}
```

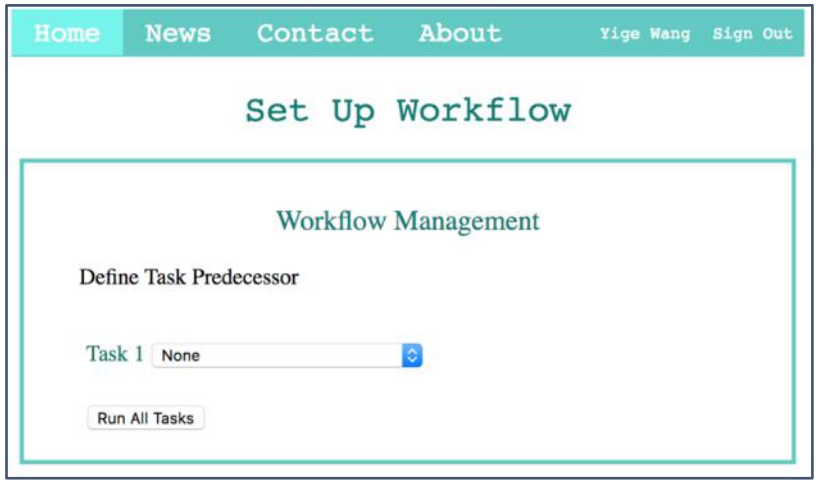


Different User Roles

AdminRole



UserRole



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Different User Roles

AdminRole

UserRole

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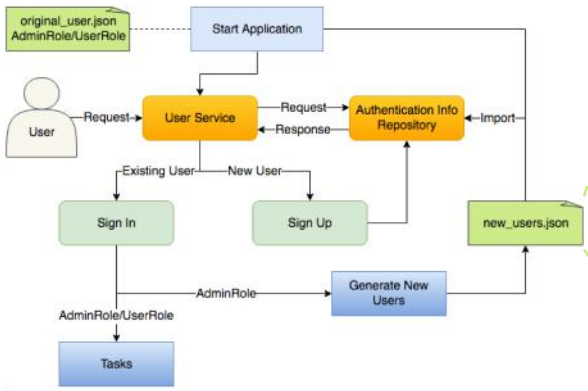
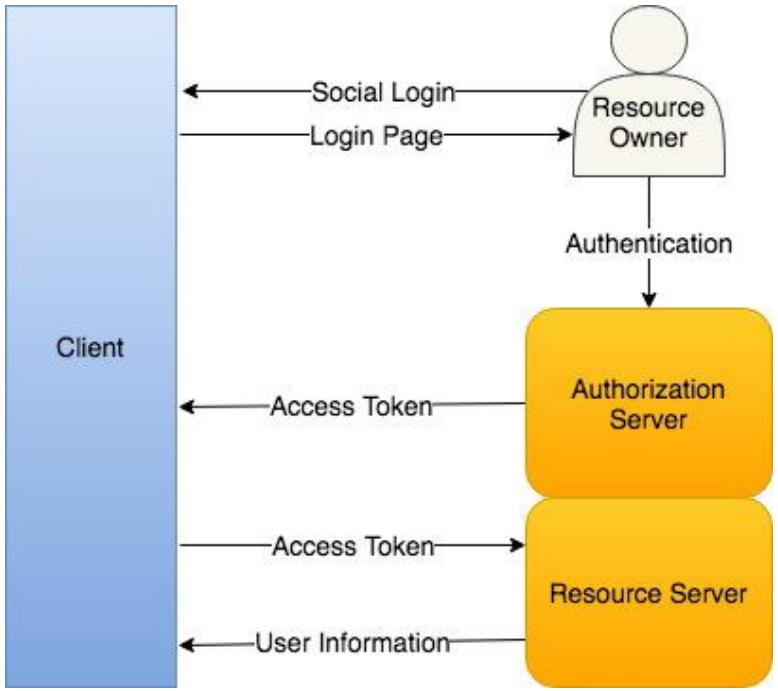
Generating New User




```
{
  "users" : [ {
    "firstName" : "training1",
    "lastName" : "auto",
    "password" : "uo57APcL2T",
    "email" : "training1@utexas.edu",
    "role" : "UserRole"
  }, {
    "firstName" : "training2",
    "lastName" : "auto",
    "password" : "Stq2KwIWp4",
    "email" : "training2@utexas.edu",
    "role" : "UserRole"
  }, {
    "firstName" : "training3",
    "lastName" : "auto",
    "password" : "qyeJTrGXvx",
    "email" : "training3@utexas.edu",
    "role" : "UserRole"
  } ]
}
```

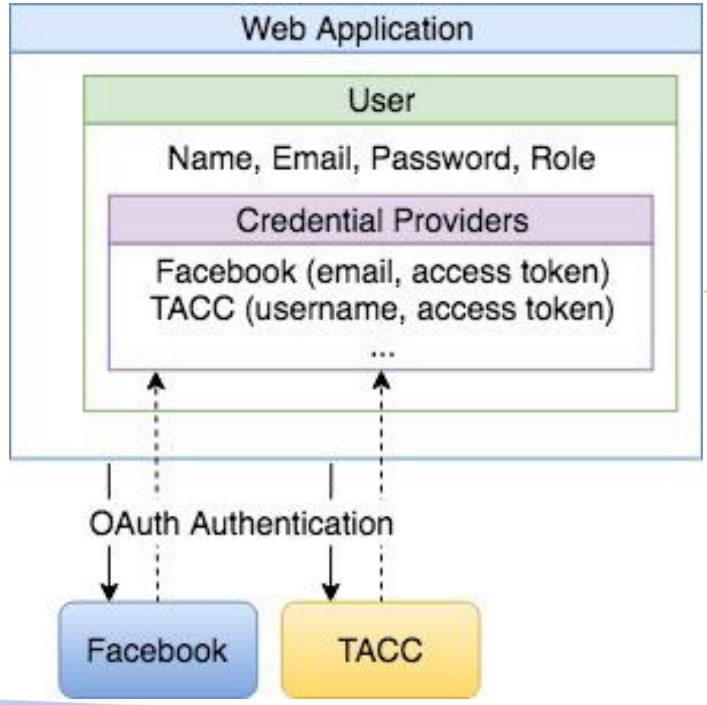
Other Authentication Support

- OAuth 2.0



Social Platforms:
Facebook
Google
…

Mapping other credential to internal accounts.




```
{
  "training_accounts" :
    [
      {
        "username": "train250",
        "password": "U8@L3#z4"
      },
      {
        "username": "train251",
        "password": "e8^d8!s5"
      },
      {
        "username": "train252",
        "password": "7H(7Y^9e"
      },
      ...
    ]
}
```

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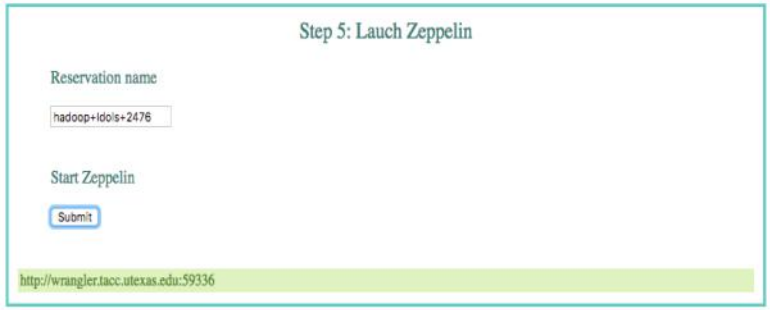
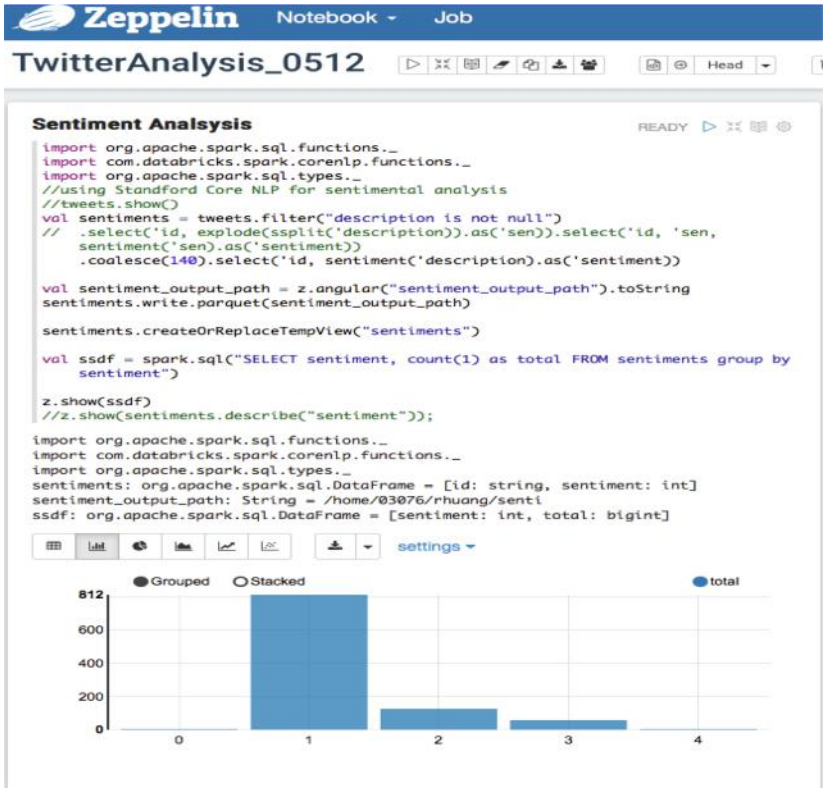
Integration with other GUI tools.

- Integration with Additional Tool





Support on Spoken Audio Processing using Machine Learning for Libraries, Archives and Museums (LAM)

- Need new ways to procure access to large-scale audio collections.
- Machine Learning (ML) can accelerate and improve audio processing.
- Use ML to describe audio data.
- Operationalize and embed LAM values, best practices, and needs in the ML system.
- Road ahead: design, explore, and implement ML methods.
- Requires interdisciplinary work.

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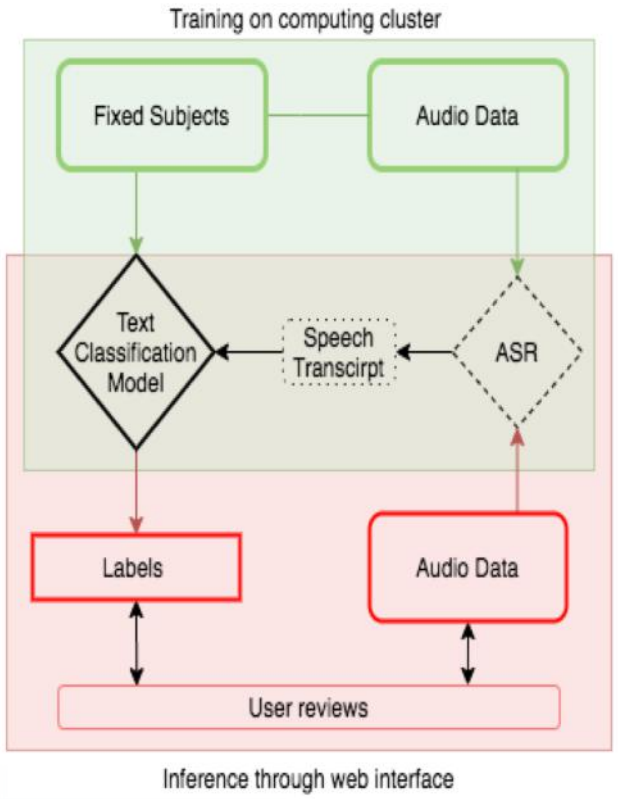
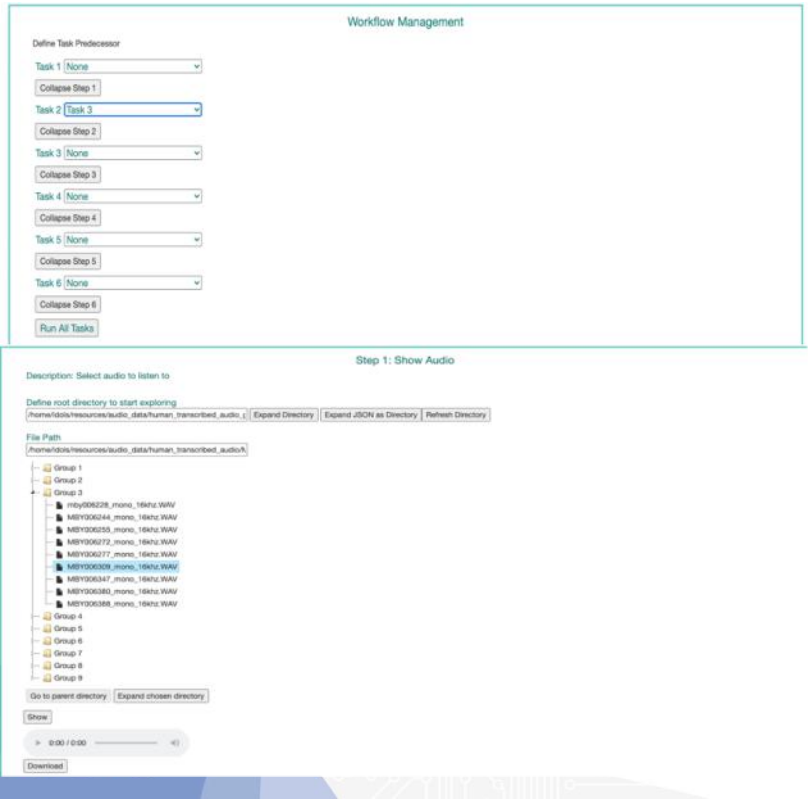
Typical Workflow



1. Login to the remote resources via ssh connection through a command line interface
2. Installing libraries/tools required to the remote resource. (very hard for librarian)
3. Moving data to the remote resources.
4. Submit a batch script to run speech recognition
5. Download the analysis results check and possibly repeat from 3.

Interfaces for Transparency and Reproducibility



What the interface enables:

- Review audio files: a large audio collections stored on the storage clusters
- Start transcribing the results and review results
- Run additional processing scripts.
- Provide feedbacks on label inference results
- The web application can run dynamically by users or setting up on a separate VM.

Integration with Javascripting

- A use case web application for traffic camera video analysis.

Summary

- A new model for serving remote computing resources
- Focus on empowering users to carry out data driven analysis
- Customizable and extensible by users
- Complimentary to existing services models used in the

Thank You!

- Acknowledgement:

  - TACC: Yige Wang, Ruizhu Huang, Peter Cui (current)
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- Questions?
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