# Kaiaulu

Leilani, Nicholas, Malia

# Problem Statement

## What is Kaiaulu?

- Open source tool to mine software repositories to analyze their characteristics
- Composed of functions, notebooks, config files for notebooks
- *Fun fact: Kaiaulu was created and currently maintained by PhD alumni in UH ICS dept*

## Our Goal

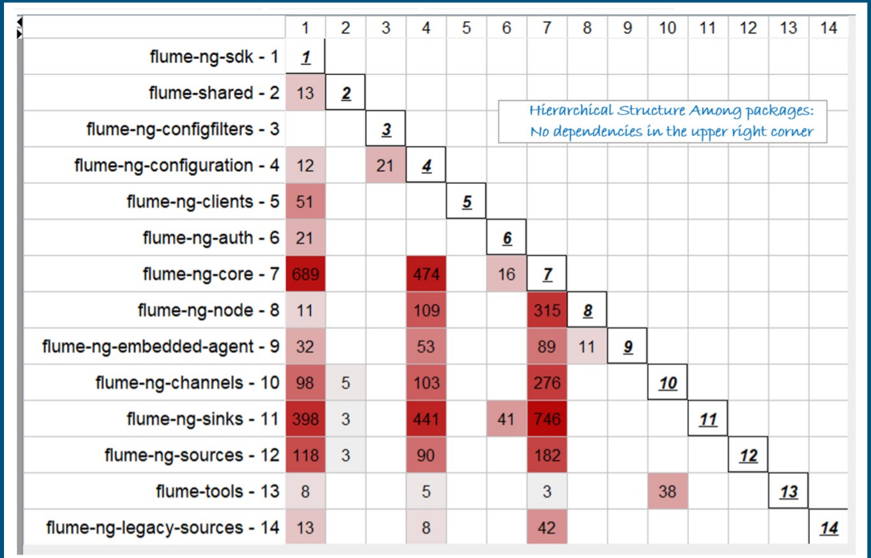
Extending capabilities of Kaiaulu to include design flaw detection

## Why?

- Software design analysis is hard
- Few tools available; they are standalone
- Help developers find social smell and architecture flaws and improve project efficiency

# What is DV8?

- Tool by ArchDia for detecting design flaws
- Measures codebase quality/design
- Facilitates project improvement
- Types of flaws:
    - Clique
    - Modularity Violation
    - Package Cycle
    - Unhealthy Inheritance
    - Crossing
    - Unstable Interface



|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| flume-ng-sdk - 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| flume-shared - 2 | 13 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |
| flume-ng-configfilters - 3 |  |  | 3 |  |  |  |  |  |  |  |  |  |  |  |
| flume-ng-configuration - 4 | 12 |  | 21 | 4 |  |  |  |  |  |  |  |  |  |  |
| flume-ng-clients - 5 | 51 |  |  |  | 5 |  |  |  |  |  |  |  |  |  |
| flume-ng-auth - 6 | 21 |  |  |  |  | 6 |  |  |  |  |  |  |  |  |
| flume-ng-core - 7 | 689 |  |  | 474 |  | 16 | 7 |  |  |  |  |  |  |  |
| flume-ng-node - 8 | 11 |  |  | 109 |  |  | 315 | 8 |  |  |  |  |  |  |
| flume-ng-embedded-agent - 9 | 32 |  |  | 53 |  |  | 89 | 11 | 9 |  |  |  |  |  |
| flume-ng-channels - 10 | 98 | 5 |  | 103 |  |  | 276 |  |  | 10 |  |  |  |  |
| flume-ng-sinks - 11 | 398 | 3 |  | 441 |  | 41 | 746 |  |  |  | 11 |  |  |  |
| flume-ng-sources - 12 | 118 | 3 |  | 90 |  |  | 182 |  |  |  |  | 12 |  |  |
| flume-tools - 13 | 8 |  |  | 5 |  |  | 3 |  |  | 38 |  |  | 13 |  |
| flume-ng-legacy-sources - 14 | 13 |  |  | 8 |  |  | 42 |  |  |  |  |  |  | 14 |

Hierarchical Structure Among packages:
No dependencies in the upper right corner

# Technical Solution Overview

Milestone 1:

Documentation/Unit Testing

- Surrounds Social Smells notebook

Milestone 2:

Bugzilla Wrapper/Crawler

- To download & parse bugzilla data

Milestone 3:

DV8 Integration

- Adding DV8 capabilities as Kaiaulu functions

# Technical Implementation

- Bugzilla
    - Bugzilla wrapper (Perceval traditional & REST API backends)
        - Created wrapper functions to call Perceval commands with system2() function
        - Created parser functions to parse bugzilla data
    - Bugzilla crawler (REST API)
        - Created downloader function to download bugzilla data
            - Use httr package to create get request
            - Use jsonlite package to write the bugs to a file
        - Created two parser functions to parse bugzilla issue data and comment data
            - Loop over the given folder and use jsonlite package to get bugzilla data
            - Look for desired data and create data table
- DV8
    - Created wrapper functions to call dv8 command with system2() function
    - Created parser functions and new data representations not available in DV8 for new analysis
    - Defined functionality to export any type of Kaiaulu graph to JSON for interoperability with tools like DV8

# Major Accomplishments

- Milestone 3: Fine-grained DV8 Integration with Kaiaulu
  - Wrapper functions around DV8 commands
  - Functions providing interoperability with Kaiaulu

- Revisiting Milestone 1 & 2:
  - Unit test revisions for parser, git, interval modules
  - Bugzilla wrapper & crawler revisions
  - Bugzilla showcase notebook

- Partially/Not Implemented (for now):
  - DV8 milestone 3.4 functions
  - Bugzilla wrapper & crawler unit tests

# DV8 Integration: : CHEAT SHEET

## About

The dv8_showcase.Rmd vignette introduces ArchDia's DV8 design structural matrices, architectural flaws, and decoupling level in Kaiaulu.

**Design Structure Matrix (DSM): A visual model for expressing dependencies.**

**Architectural Flaws: DV8 can detect 6 types of architectural flaws: Clique, Package Cycle, Improper Inheritance, Unstable Interface, Crossing, and Modularity Violation.**

**Decoupling Level: Measures how well a design is separated into modules based on the DRH clustering.**

## Project Config Setup

**The first part of running any vignette is setting up your project configuration file (examples in kaiaulu/conf).**

### Required Fields

```
•   tool:
    dv8:
     folder_path: ../../analysis/dv8/apr
     architectural_flaws:
      - cliqueDepends:
           - call
           - use
      - crossingCochange: 2
      - crossingFanIn: 4
      - crossingFanOut: 4
      - mvCochange: 2
      - uiCochange: 2
      - uihDepends:
         - call
         - use
      - uihInheritance:
         - extend
         - implement
         - public
         - private
         - virtual
      - uiHistoryImpact: 10
      - uiStructImpact: 0.01
```

### Indirect Fields

```
•   tool:
    depends:
      code_language: cpp
      keep_dependencies_type:
       - Cast
       - Call
       - Import
       - Return
       - Set
       - Use
       - Implement
       - ImplLink
       - Extend
       - Create
       - Throw
       - Parameter
       - Contain
```

**The file "tools.yml" must also be configured. See README.md for more information on 3rd party software dependencies.**

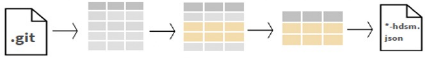
**Required Fields:**

- **Perceval (version 0.12.24)**
- **Depends (version 0.96a)**
- **DV8 (version 4.0-20210630.025325+)**

## Functions

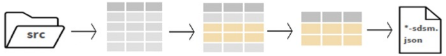
### parse_gitlog(), filter_by_*(), gitlog_to_hdsmj()

parse_gitlog() generates a table from a git project, which can be filtered via the filter functions, and then transformed into a history design structure matrix (hdsm.json) representation.



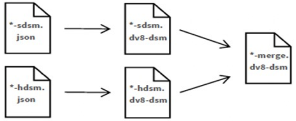
### parse_ dependencies(), filter_by_*(), dependencies_to_sdsmj()

parse_dependencies() generates a table of dependencies from Depends, which can be filtered via the filter functions, and then transformed into a structural design structure matrix (sdsm.json) representation.



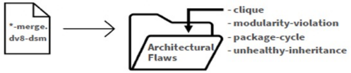
### dv8_dsmj_to_dsmb(), dv8_hdsmb_sdsmb_to_mdsmb()

Converts dsm.json files into .dv8-dsm files (historical DSM and structural DSM). Merges these matrices into one new matrix in a *-merge.dv8-dsm file (merged DSM file).



### dv8_mdsmb_to_flaws()

Detects architecture anti-patterns from a merged DSM binary file and returns an architectural flaws folder.



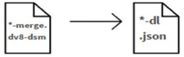
## Related Vignettes

**See the following notebooks for related analyses:**

1. **dv8_showcase.Rmd**
2. **gitlog_showcase.Rmd**
3. **depends_showcase.Rmd**
4. **social_smells_showcase.Rmd**

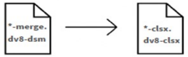
### dv8_mdsmb_to_decoupling_level()

Takes as a parameter a *-merge.dv8-dsm binary file and returns the Decoupling Level metrics as a *.json file.



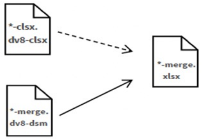
### dv8_mdsmb_to_hierclsxb()

Takes in a *-merge.dv8-dsm binary file and computes the design rule hierarchy as a *-merge.dv8-clsx binary file.



### dv8_mdsmb_drhier_to_excel()

Takes as a parameter a *-merge.dv8-dsm binary file and optionally a *-clsx.dv8-clsx and exports it to an excel spreadsheet for further analysis.



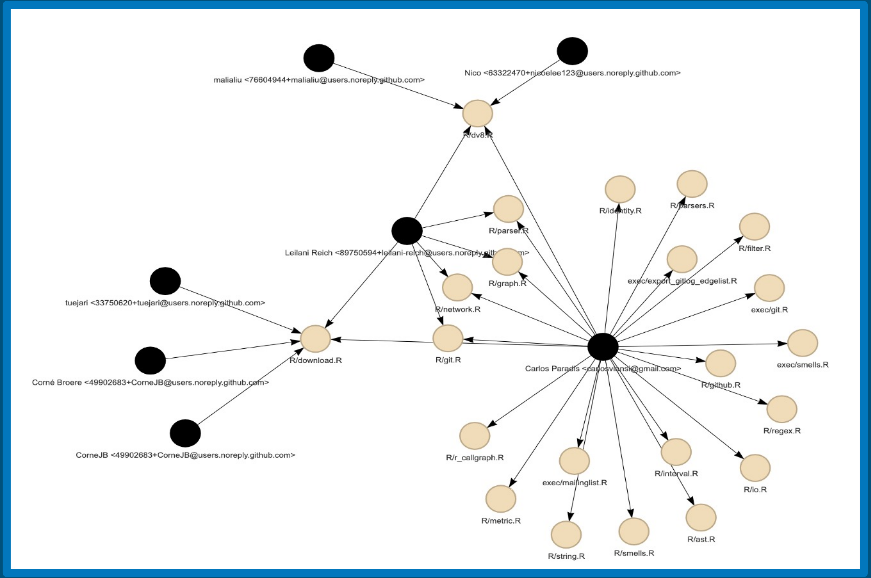
Parser functions are also available on the Kaiaulu API for various DV8 json files.

Kaiāulu

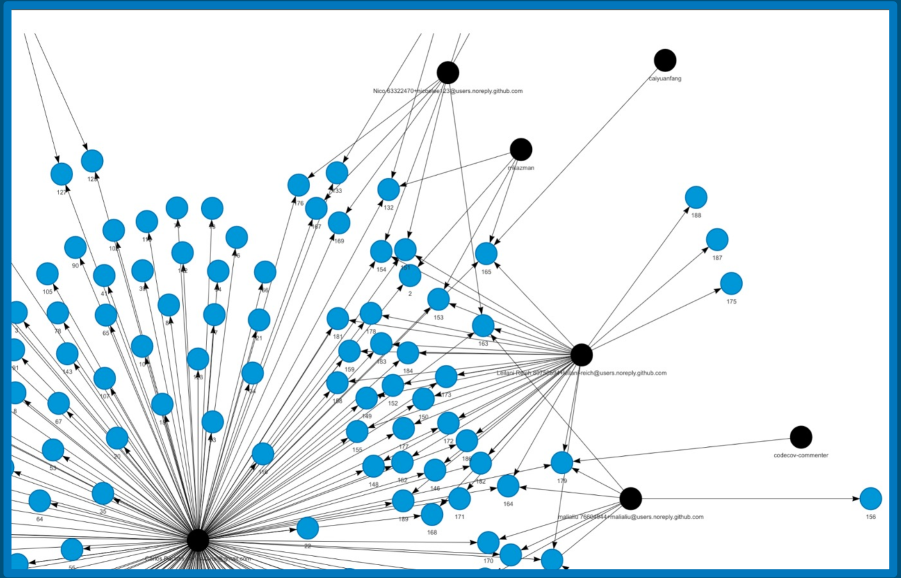
Leilani Reich, Carlos Paradis • Learn more with the dv8_showcase.Rmd vignette • Kaiaulu package version 0.0.0.9600 (in development) • Updated: 2023-04

For DV8 downloads and license information see ArchDia.com.

# Client Feedback



malialiu <76604944+malialiu@users.noreply.github.com>
Nico <63322470+nicoelee123@users.noreply.github.com>
R/dv8.R
R/identity.R
R/parsers.R
R/parser.R
Leilani Reich <89750594+leilani-reich@users.noreply.github.com>
R/filter.R
R/graph.R
exec/export_gitlog_edgelist.R
tuejari <33750620+tuejari@users.noreply.github.com>
R/network.R
exec/git.R
R/download.R
R/git.R
exec/smells.R
Carlos Paradis <carlosviansi@gmail.com>
Corné Broere <49902683+CorneJB@users.noreply.github.com>
R/github.R
R/regex.R
CorneJB <49902683+CorneJB@users.noreply.github.com>
R/r_callgraph.R
exec/mailinglist.R
R/interval.R
R/io.R
R/metric.R
R/string.R
R/smells.R
R/ast.R



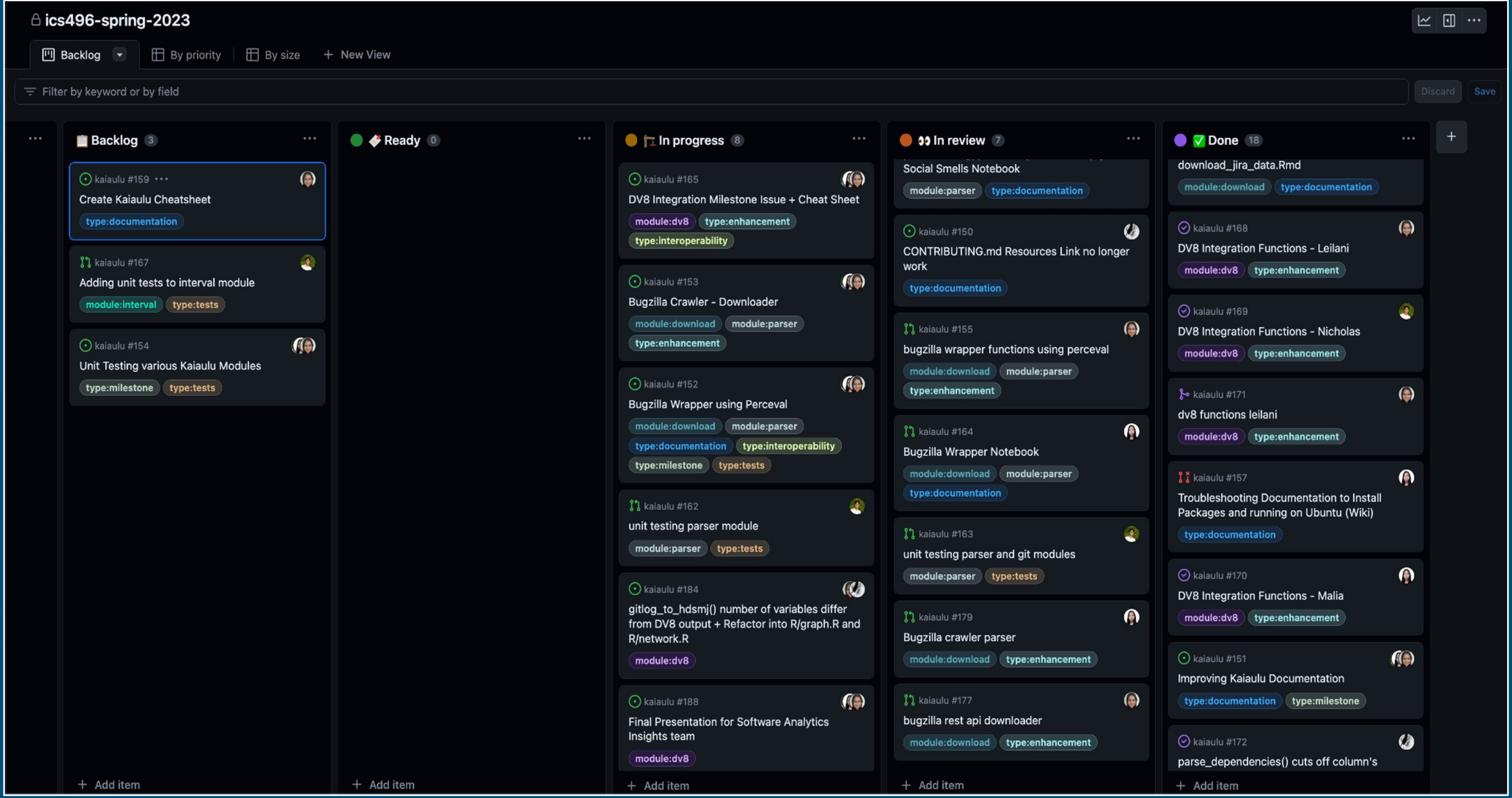
# Quality Assurance

- Unit testing
    - Testthat R package
    - Test inputs & outputs of functions
    - Enables users to figure out issues in their setup beforehand
        - Incorrect config file parameters
        - Wrong or missing package version
    - Enables contributors to not break code that already exists

- End-To-End testing
    - Bugzilla Showcase Notebook
    - DV8 Showcase Notebook
    - Testing chained use of functions

# Project Management and Delivery

- Contributions:
  - Made publicly via GitHub Pull Request/Issue Tracker system
  - Unit tested on every commit/pull request
- Task Management:
  - Github project board
  - Member task list under each issue
  - Milestone timeline
- Communication:
  - Github Issues
  - Github pull requests
  - Weekly meetings
    - Tuesdays: 9:30-10:30am
    - Thursdays: 10:30-11:45am



ics496-spring-2023

Backlog | By priority | By size | + New View

Filter by keyword or by field

Discard | Save

**Backlog** 3

kaiaulu #159
Create Kaiaulu Cheatsheet
type:documentation

kaiaulu #167
Adding unit tests to interval module
module:interval type:tests

kaiaulu #154
Unit Testing various Kaiaulu Modules
type:milestone type:tests

+ Add item

**Ready** 0

+ Add item

**In progress** 8

kaiaulu #165
DV8 Integration Milestone Issue + Cheat Sheet
module:dv8 type:enhancement type:interoperability

kaiaulu #153
Bugzilla Crawler - Downloader
module:download module:parser type:enhancement

kaiaulu #152
Bugzilla Wrapper using Perceval
module:download module:parser type:documentation type:interoperability type:milestone type:tests

kaiaulu #162
unit testing parser module
module:parser type:tests

kaiaulu #184
gitlog_to_hdsmj() number of variables differ from DV8 output + Refactor into R/graph.R and R/network.R
module:dv8

kaiaulu #188
Final Presentation for Software Analytics Insights team
module:dv8

+ Add item

**In review** 7

Social Smells Notebook
module:parser type:documentation

kaiaulu #150
CONTRIBUTING.md Resources Link no longer work
type:documentation

kaiaulu #155
bugzilla wrapper functions using perceval
module:download module:parser type:enhancement

kaiaulu #164
Bugzilla Wrapper Notebook
module:download module:parser type:documentation

kaiaulu #163
unit testing parser and git modules
module:parser type:tests

kaiaulu #179
Bugzilla crawler parser
module:download type:enhancement

kaiaulu #177
bugzilla rest api downloader
module:download type:enhancement

+ Add item

**Done** 18

download_jira_data.Rmd
module:download type:documentation

kaiaulu #168
DV8 Integration Functions - Leilani
module:dv8 type:enhancement

kaiaulu #169
DV8 Integration Functions - Nicholas
module:dv8 type:enhancement

kaiaulu #171
dv8 functions leilani
module:dv8 type:enhancement

kaiaulu #157
Troubleshooting Documentation to Install Packages and running on Ubuntu (Wiki)
type:documentation

kaiaulu #170
DV8 Integration Functions - Malia
module:dv8 type:enhancement

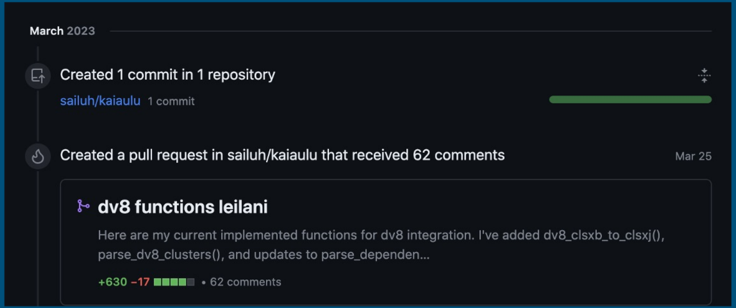
kaiaulu #151
Improving Kaiaulu Documentation
type:documentation type:milestone

kaiaulu #172
parse_dependencies() cuts off column's

+ Add item

# Reflections

- What went right?
  - Successfully created deliverables for each milestone
- What went wrong?
  - Missing messages on GitHub issues/pull requests
- What could have been done differently?
  - Should switch from Windows to Linux earlier
  - Falling behind on task/milestone due dates
  - More planning on task distribution
- Technical/soft skills
  - Learning Git (instead of GitHub Desktop)
  - Learning R & RStudio
  - Using GitHub pull requests
  - Communication with clients



March 2023

Created 1 commit in 1 repository

sailuh/kaiaulu 1 commit

Created a pull request in sailuh/kaiaulu that received 62 comments Mar 25

**dv8 functions leilani**

Here are my current implemented functions for dv8 integration. I've added dv8_clsxb_to_clsxj(), parse_dv8_clusters(), and updates to parse_dependen...

+630 −17 • 62 comments

# Next Steps

- Our Next Steps
  - Finishing up DV8 functions
  - Finishing up Bugzilla functions, notebook, and unit testing
- Client Next Steps
  - Adding new functionality
    - e.g. NLP to extract concepts

# Acknowledgements

Rick Kazman: Sponsor, Shidler College of Business

Carlos Paradis: Stakeholder/Mentor, Ph.D. in Computer Science