Anomaly detection for treatment planning and a learning health system in radiotherapy

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Project Review

Review

Overall Purpose:

- Improve the quality and integrity of clinical data in order to minimize the risk for radiation overdose for patients.

Specific Project Goal:

- Create the framework for a learning health system that can that can identify potentially erroneous data with statistical anomaly detection.
- The system will allow the implementation of unique integrity check classes from the user.

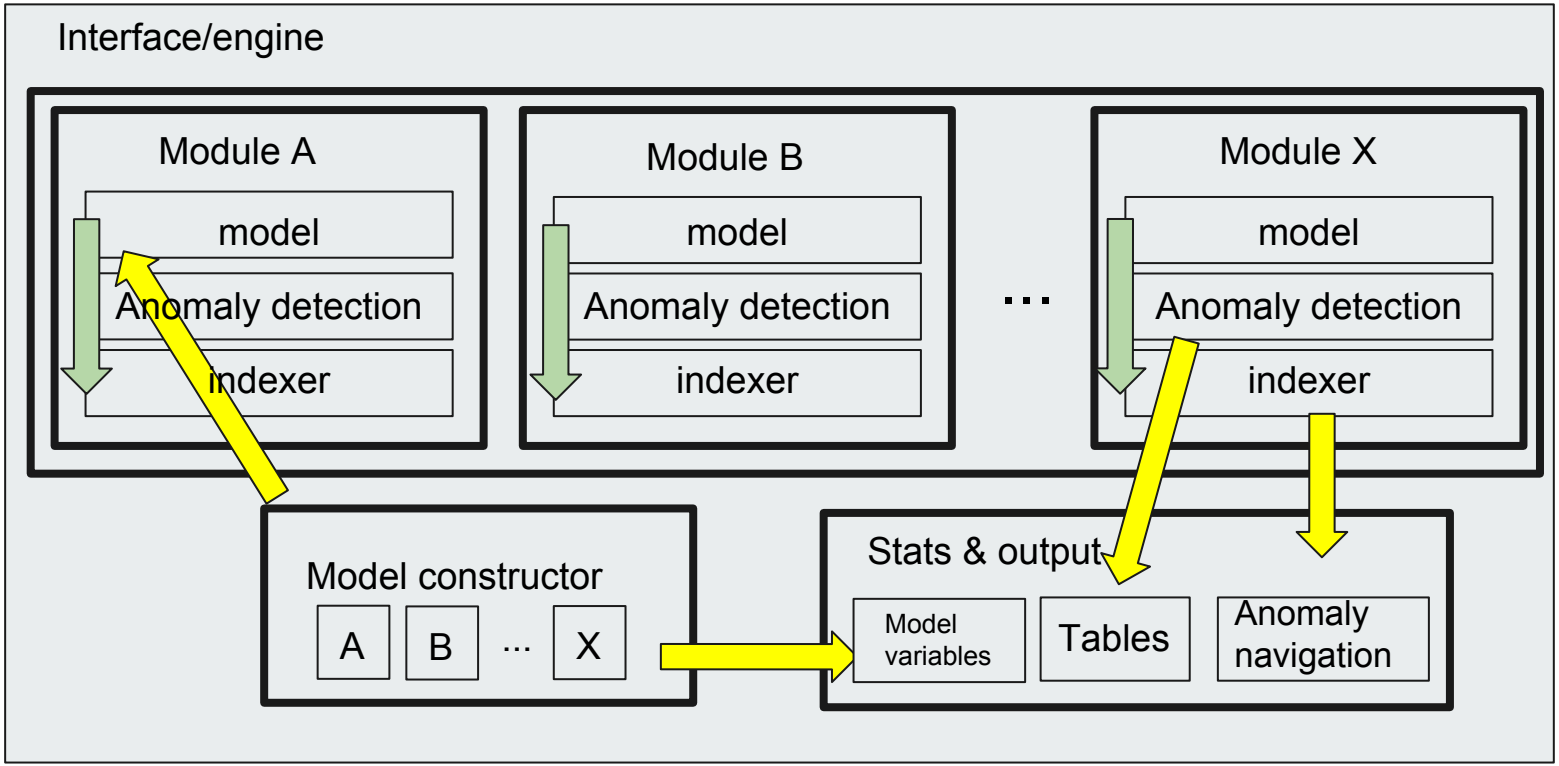
Review

Significance:

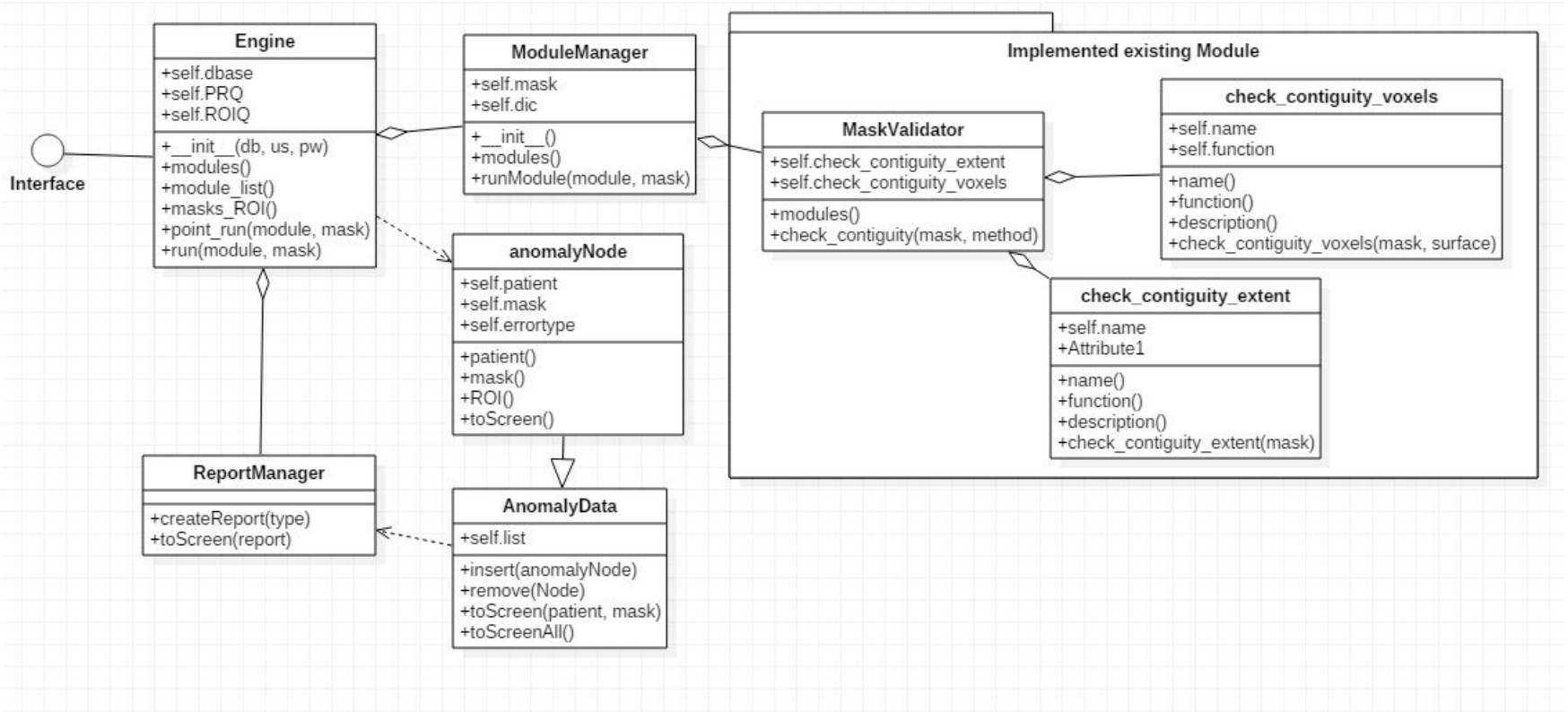
- As average lifespan increases, cancer rate increases.
  - 22.5% total deaths in USA in the past 5 years
- Radiation therapy is one of the primary treatment methods
  - By 2020, 35% of patients will use radiotherapy
  - Radiotherapy can have harmful side effects
- How can we improve radiotherapy?
  - This is the problem our project addresses.

Technical Details

Initial design



Current Architecture



Program run details

Input and output is currently texted based

Run through command line

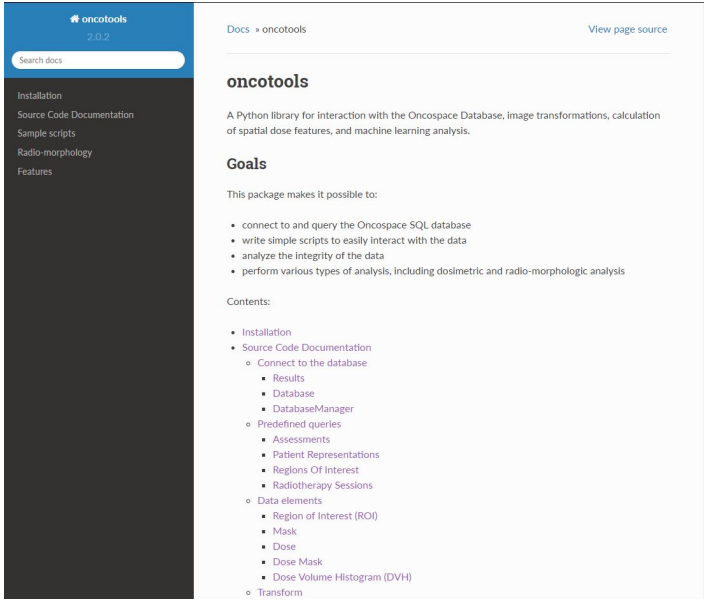
Requires to be on hopkins network (CS account or VPN)

Code snippet from our engine

```
def point_run(self, modules = "All", masks = "All"):
    '''
    Runs data set through error detection modules prompting user every time error is detected

    Keyword arguments:
        :modules:    (default='All') Which modules should be used?
        Options are "All" or an array of modules indicating which modules to use moduleList() to see list

        :masks:       (default='All') Which masks should be analysed?
        Options are "All" or an array of Roi masks names indicating which masks to look at use masks_ROI() to see list of masks
    '''
    #create patient list
    patients = self.PRQ.get_patient_id_LUT()

    if modules == "All":
        module = self.module_List()
    if masks == "All":
        masks = self.masks_ROI()
    #iterate through patients
    for key in patients:
        for name in masks:
            #pull mask from ROI
            ROI_ID = self.ROIQ.get_id_by_patient_rep_id_name(key, name)
            mask = self.ROIQ.get_mask(ROI_ID)
            for module in modules:
                valid = Validator.runModule(module, mask)
                if valid[1] == False:
                    self.anamoly_insert(key, mask, valid[3], name)
```

Documentation

- Keeping record of progress
- Code functions well-documented with expected inputs/outputs and comments
- Website recently updated (March 30th)
- Will update documentation website on pastebin
- Paper-style report



Project Status

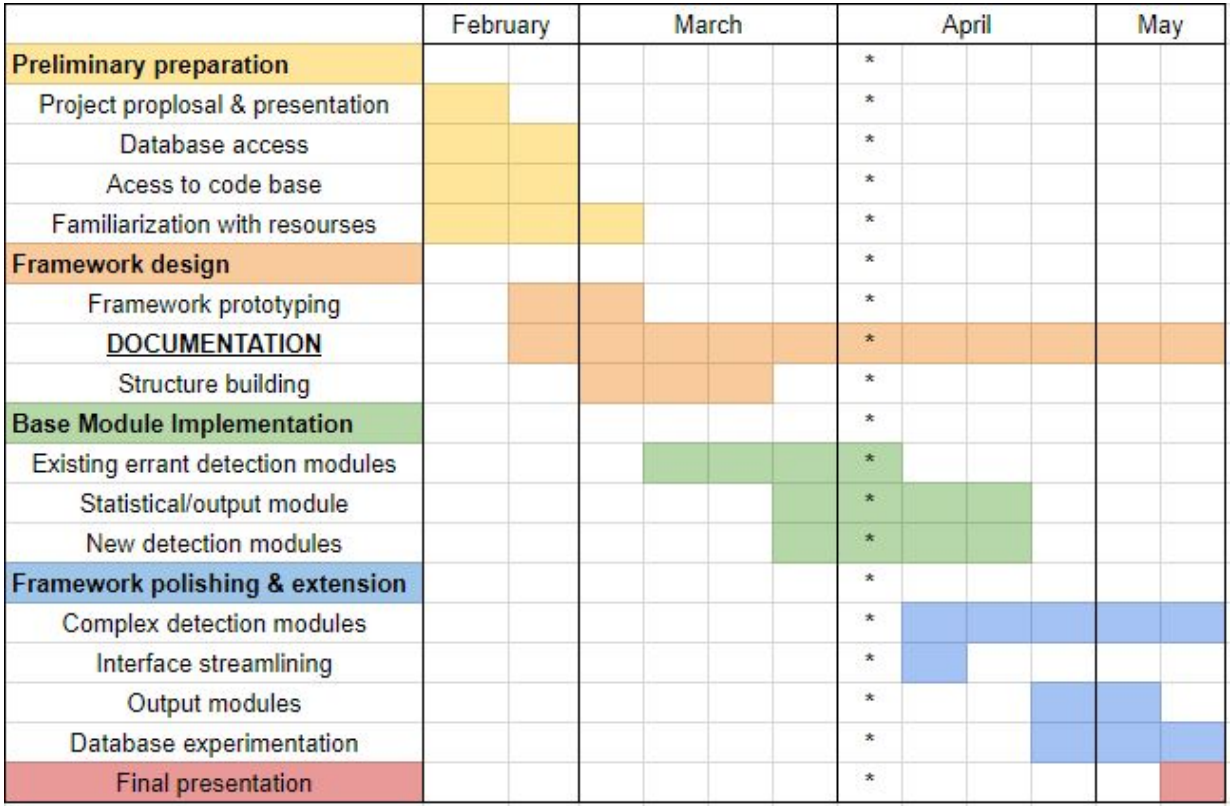
Updated Deliverables

Minimum	● Working framework that allows for modular insertion of new integrity checks ● Documented API to develop new integrity checks
Expected	● Implemented existing errant detection modules into working framework ● Implement new anomaly detection modules
Maximum	● Develop and implement numerous new integrity checks ● Implement compatibility packet to allow other programs access to results easily

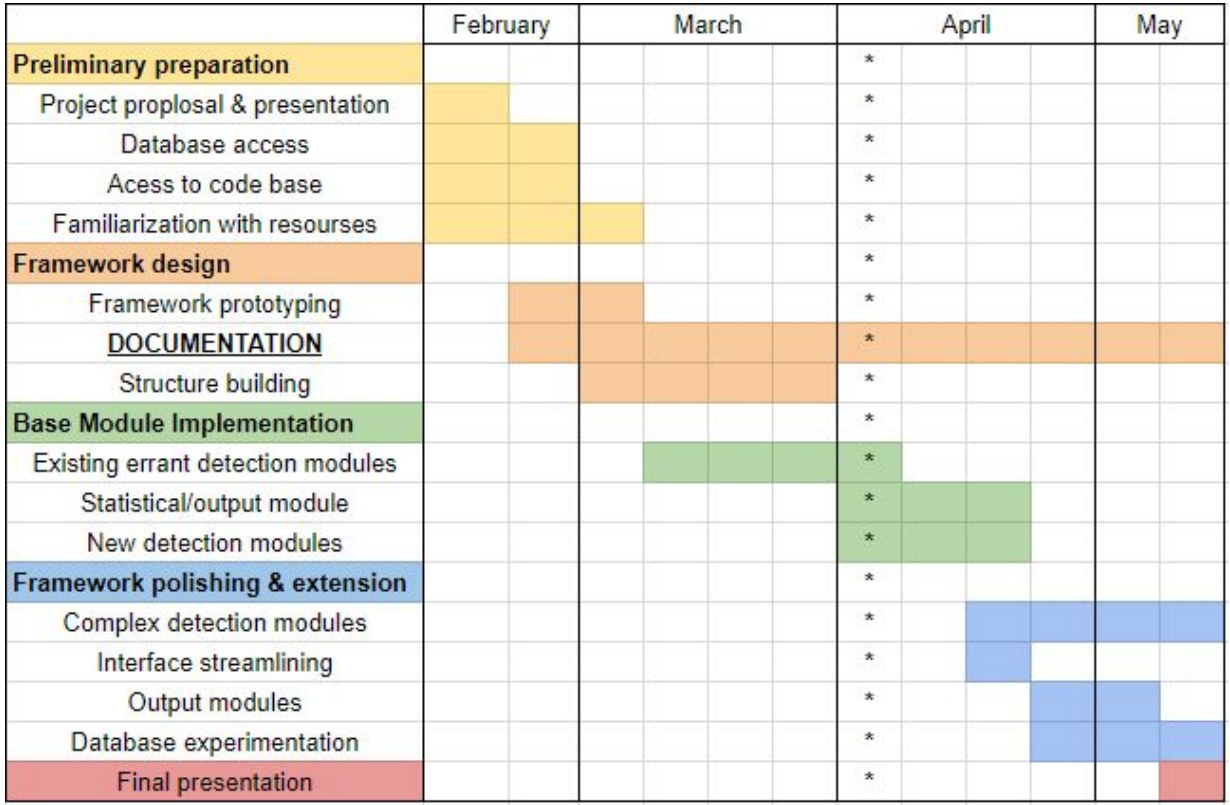
Dependencies Statuses

Dependency	Solution	Status	Plan B
Access to Clinical Database	Coordinate with Dr. McNutt and Pranav	Resolved	Try to find other databases to work with
Access to Previous Code	Request code base from Pranav	Resolved	Implement and develop own modules
Access to Computational Power	Coordinate with Dr. McNutt and Pranav	In progress (insignificant impact)	Work with smaller sample sizes as a proof of concept

Original Timeline



Updated Timeline



Updated Milestones

Accomplishment	Estimated Date (mm/dd/yyyy)	Current Status
Presentation	02/20/2018	Done
Proposal	02/26/2018	Done
Framework design	03/15/2018	Done
Existing module implementation	03/25/2018	Done
Statistical module	04/07/2018	In progress
First new module	04/07/2018	TBD
More complex modules	04/23/2018	TBD
Final presentation	05/11/2018	TBD

Management

Weekly meetings with mentors

- Default time: Friday afternoons
- Communicate through slack and email

Bi-weekly meetings between team members

- Default time: Saturday afternoon and Tuesday after class
- Last website update: April 2nd, 2018 (updated during meetings)

Acknowledgements

Our mentors, Dr. McNutt and Pranav

Our professor, Dr. Taylor

Our TA, Ehsan Azimi

Questions?