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

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Professor: Dr. Taylor

What is radiation therapy?

Treatment utilizing high energy waves (x-rays, gamma rays, etc.) to bombard, shrink, and kill cancer cells by damaging DNA and preventing cell division.

It is projected that by 2020, at least 35% of cancer patients (7 million individuals in the US) will have radiotherapy as part of their primary treatment.

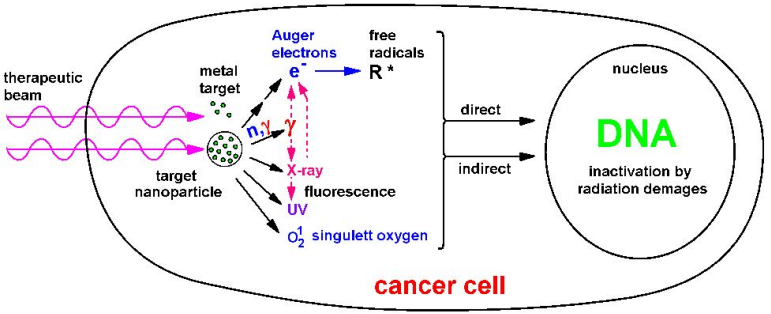


Image from: http://www.mpsd.de/irt/IRT.html

What are the problems?

High energy waves are not selective. They will kill both cancer cells and healthy cells.

Killing healthy cells can cause many other health issues.

Even well targeted treatments can have a variety of side effects, from short term nausea to long term permanent disabilities.

Current solutions

Current radiotherapy plans involve mapping organ contours in order to better understand patient anatomy, which allows for increased accuracy and consistency.

This used to be done completely manually. Some automation is now involved in the workflow, but there are still margins of error that can have a significant effect on the future treatment of patients if not detected.

Image from: http://www.acoustic-neuroma-brain-tumour.org/english/acoustic-neuroma-cyberknife.php

Now what?

Integrity checking for mapped organ contours to detect anomalies.

Use clinical databases to develop and test models for different classes of contour integrity checks.

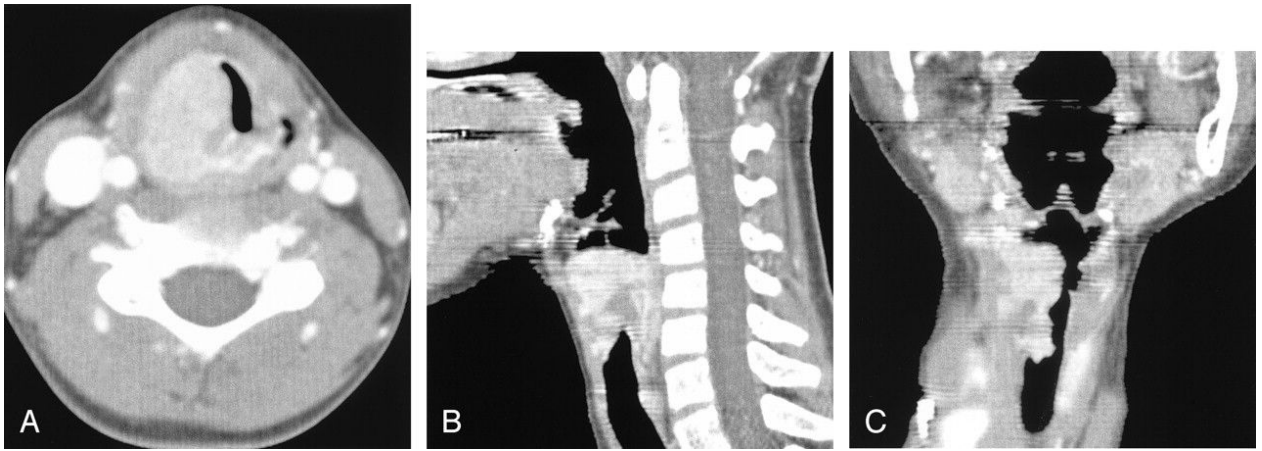


Image from: https://sites.google.com/a/wisc.edu/neuroradiology/image-acquisition/the-basics

Our 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.

Overall Goal

The final goal is to improve the quality and integrity of clinical data in order to minimize the risk for radiation overdose for patients.

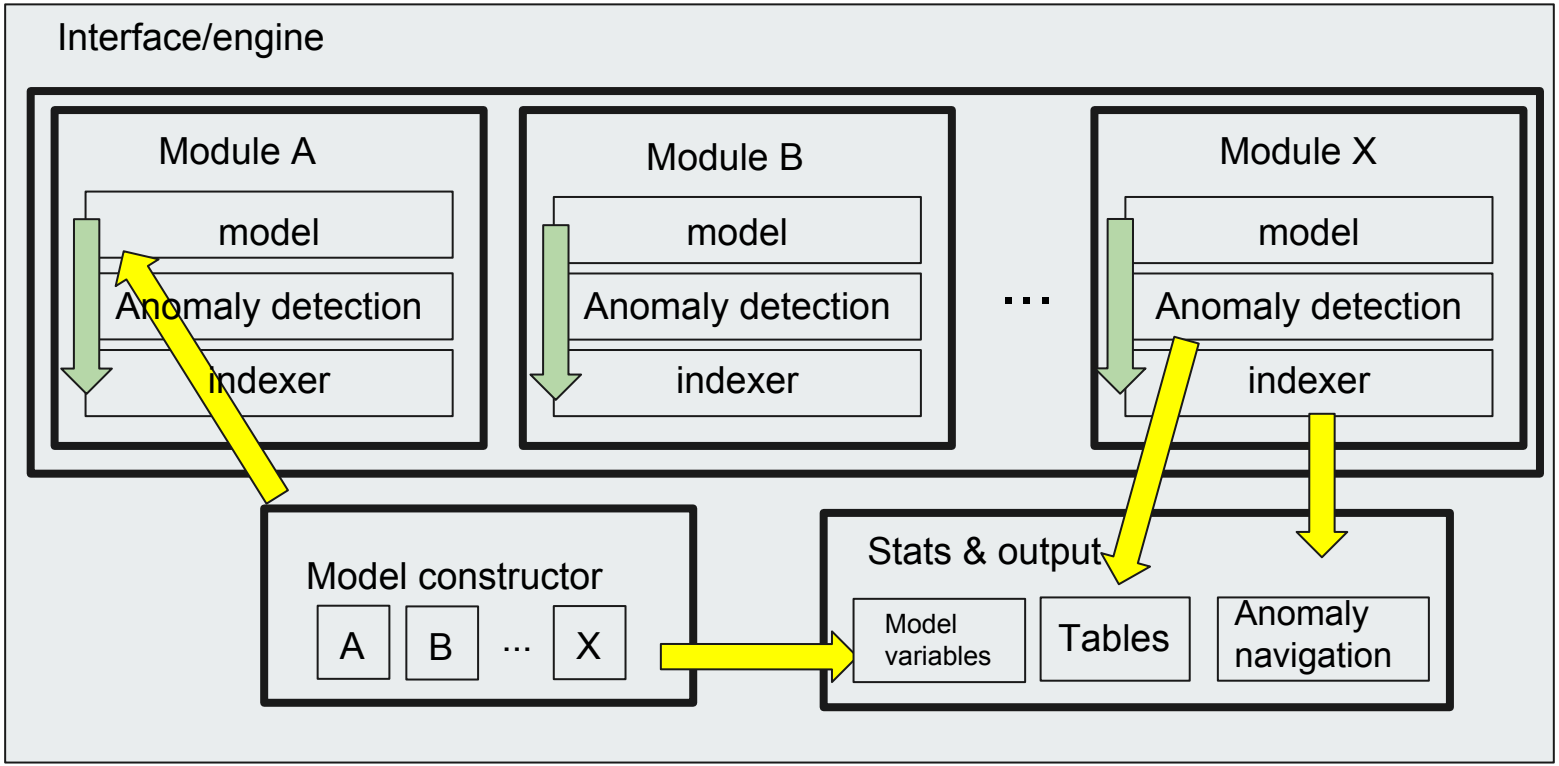
Deliverables

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

Dependency	Plan to resolve	Estimated resolution Date	Plan B
Access to Database	Coordinate with Dr. McNutt and Pranav	February 26th	Try to find other databases to work with
Access to previous code	Request code base from Pranav	February 26th	Implement and develop own modules
Access to computation power	Coordinate with Dr. McNutt and Pranav	Unknown	Work with smaller sample sizes as a proof of concept

Framework (alpha concept)



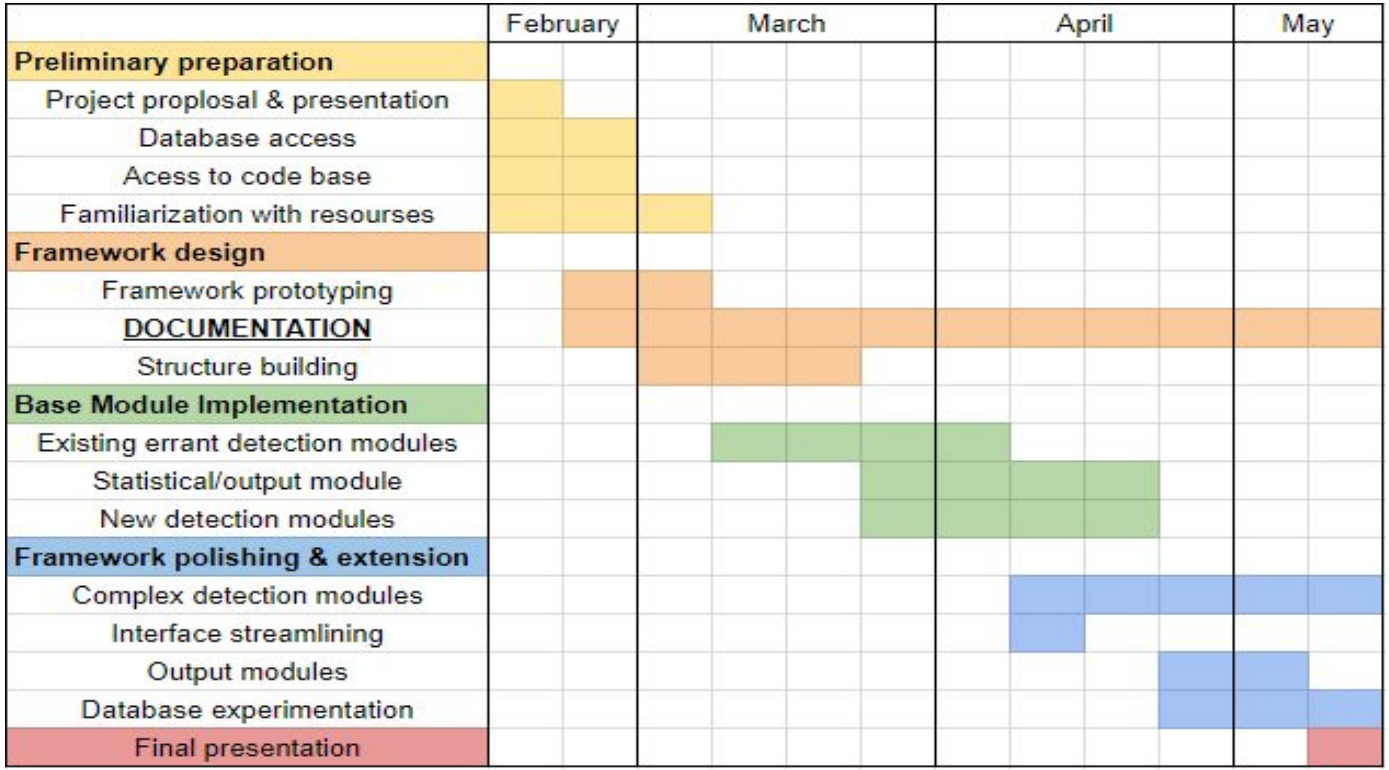
Management Plan

- Time management
  - Weekly Friday meeting with mentors
- Responsibilities

Daniel	Vincent
Framework implementation	Framework implementation
Model construction	Statistic analysis & output
New Module design	New Module design

- Project close-out
  - Final poster presentation

Timeline


February
March
April
May
Preliminary preparation
Project proplosal & presentation
Database access
Acess to code base
Familiarization with resourses
Framework design
Framework prototyping
DOCUMENTATION
Structure building
Base Module Implementation
Existing errant detection modules
Statistical/output module
New detection modules
Framework polishing & extension
Complex detection modules
Interface streamlining
Output modules
Database experimentation
Final presentation

Milestones

Accomplishment	Estimated Date (dd/m/yyyy)	Current Status
Presentation	20/2/2018	Right now!
Proposal	26/2/2018	To Do
Framework design	15/3/2018	To Do
Existing module implementation	25/3/2018	To Do
Statistical module	7/4/2018	To Do
First new module	7/4/2018	To Do
More complex modules	23/4/2018	To Do
Final presentation	11/5/2018	To Do

Acknowledgements

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Our professor, Dr. Taylor

Our TA, Ehsan Azimi

References

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Questions?