Radiotherapy Dose-Toxicity Analysis UI

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Goal

Develop a **web-based user interface** for refined dose-toxicity analysis**:**

- Compatible with existing online **SQL database** for obtaining the medically related data
- Create interactive **3D** visualizations of objects using **JavaScript** libraries such as D3.js
- Allow physician to **segment** biological objects into regions, **select** and **drag** regions, and run analysis on new regions
- **Display the results** using interactive histograms on the website
- Allow **new** feature analysis scripts to be **easily added** to the existing user interface

Paper Selection

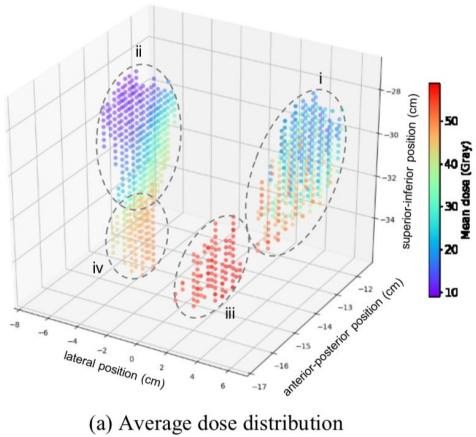
- Our project focuses on providing a way to **visualize radiation therapy data** to assist in its exploratory analysis.
- As a background paper, I chose the paper *“How Will Big Data Impact Clinical Decision Making and Precision Medicine in Radiation Therapy?”* to study the **relevance and motivation** for creation of our web-based UI.
- This paper is written by Dr. Chen and our mentor Dr. McNutt.

Technical Background/Solution

- There currently exists a **website** that **visualizes static photos** created by **C#** And a **SQL database** containing all relevant data
- **Python** feature analysis code that can run dose-toxicity analysis on 3D objects
- **3D static images** produced through **Python**.

Our Solution:

- **Interactive UI** produced through **JavaScript**. https://bl.ocks.org/niekes/1c15016ae5b5f11508f92852057136b5



(a) Average dose distribution

Deliverables

Minimum: A UI for cutting and analyzing 3D objects in planes using manual input and existing analysis scripts.

Expected: A UI for cutting and analyzing 3D objects in planes and additional cutting features using manual input. A few additional analysis scripts are integrated into UI, future analysis scripts can be easily added.

Maximum: An interactive UI for cutting and analyzing 3D objects with draggable planes and additional cutting features. UI has additional features for regional analysis, and future analysis scripts can be easily added. Additional feature list can be used for machine learning analysis.

Timeline

	February			March				April				May	
	Feb 12 - Feb 16	Feb 19 - Feb 23	Feb 26 - Mar 2	Mar 5 - Mar 9	Mar 12 - Mar 16	Mar 19 - Mar 23	Mar 26 - Mar 30	Apr 2 - Apr 6	Apr 9 - Apr 13	Apr 16 - Apr 20	Apr 23 - Apr 27	Apr 30 - May 4	May 7 - May 11
Getting Familiar with existing code and SQL database													
Choosing Visualization Library													
Color Coding the 3D Object Based on given Data													
Interacting with the 3D Object (Zoom, Drag, Rotate)													
Segmentation based on Input Parameters													
Add Customizable draggable shapes for Segmentation													
Analyze separate sub objects through existing script													
Visualize Results from Python using JavaScript													
Final Presentation, Check Points													

Milestones

Milestone	Date - End	Status	Measureable
Familiarity with code and database	2/20	Ongoing	Be able to edit website and run existing analysis
Choosing visualization library	2/22	Ongoing	Successfully visualize sample data
Basic UI with DVH	2/27	Ongoing	Display DVH for any selected patient anatomy
Cut and click objects using manual input	3/15	Not Started	Segment objects that are compatible with analysis scripts
Integrate user interface with existing analysis	3/27	Not Started	Get matching results to command line analysis
Cut objects into regions by dragging planes; add new features	4/16	Not Started	Segment objects that are compatible with new analysis scripts

Dependencies

Dependency	Plan to resolve	Resolution Date
Access to database	Pranav and Dr. McNutt are emailing IT	2/13
Access to Pranav's code	Meet with Pranav	2/13
Availability of radiologists for feedback	Coordinate with Dr. McNutt, he can be our first tester	He is on campus every Tuesday

Management Plan

- Weekly **meetings** with Pranav and/or Dr. McNutt
- **Alex** -
  - 3D rendering,
  - JavaScript and Front-end Rendering
  - Data Visualization, Interactivity Management
- **Willie** and **Santi** -
  - Focus on passing data between JavaScript, Python and SQL;
  - write new analysis scripts;
  - Back-end Management

Reading List

- Lakshminarayanan, P. (2017). Radio-morphology: Parametric Shape-Based Features in Radiotherapy (Unpublished master's thesis). Johns Hopkins University.
- McNutt, T., PhD., & Lakshminarayanan, P. (2018, February 6). User Interface to Extract radio-morphologic features for refined dose-toxicity analysis in radiotherapy. Lecture presented at CIS II Lecture in Hackerman B17, Baltimore, MD.
- Chen R, Gabriel P, Kavanagh B, McNutt T, “How will big data impact clinical decision making and precision medicine in radiation therapy?” Int’l J. of Radiation Oncology, Biology, Physics. Published online: November 27 2015