Extreme Optimization
Optimizing Radiation treatment

AM121/ES121
School of Engineering and Applied Sciences
Harvard University

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Saving Lives: Radiotherapy

- Radiation kills normal and cancer cells.
- But repair mechanisms for cancer cells are less efficient.
- Radiotherapy as cancer treatment
  - Advances in imaging (CT, MRI)
  - Advances in radiation delivery (Intensity modulated radiotherapy)
Radiation Delivery
Conventional Radiotherapy

- 4 to 7 beams.
- Oncologist and physicist work together to determine beam angles and intensities by manual trial and error.
- Goal is hard to satisfy with so few beams.

Goal: Maximize delivery to tumor area and minimize delivery to critical area.
The issue at hand

- Technologies allow for accurate delivery using many more beams.
- Missing piece: optimization to determine the intensity of a set of beams to best deliver radiation.
- Oncologist provided us with beam data and example images of critical and tumor areas.
- We will convert the data and give it to you.
Logistics

**Posted:** this Thursday 9/29 by 5pm. *We will be forming teams of four. Announced tomorrow.*

**Contribute:** all team members equally!

**Due:** Friday 10/7 at 5pm. **No late days.** Submit your write-up (use \LaTeX) with solution visualizations and all AMPL files to canvas.

**ALSO:** Submit slides by 5pm Tue 10/11 to Google slides.

**Present:** Wednesday 10/12 during lecture, the oncologist will send cake! **Everyone must attend.**

**Come to office hours!**
Project performance evaluation

- **Creativity**
  - coming up with interesting ideas and models that are justifiable but not the most obvious

- **Correctness**
  - are your linear programming models fully and precisely specified?
  - will they achieve the optimal solution your team has decided to look for (if it exists)?

- **Clarity**
  - clear explanation of your ideas
  - justification for your decisions
  - description of objective functions and constraints
  - discussion of the solutions you obtain, with reference to the models you use (e.g. compare the visualizations)