

Extreme Optimization

Optimizing Radiation treatment

AM121/ES121

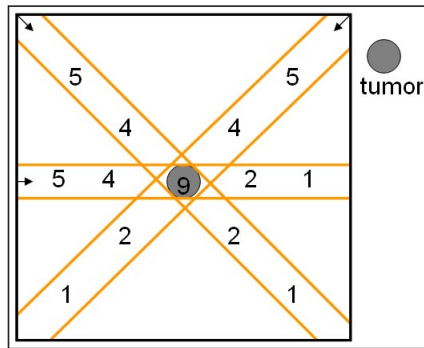
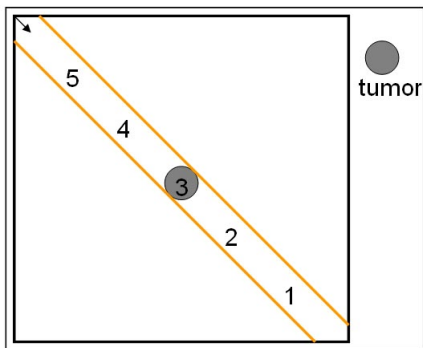
School of Engineering and Applied Sciences
Harvard University

Fall 2016

Saving Lives: Radiotherapy

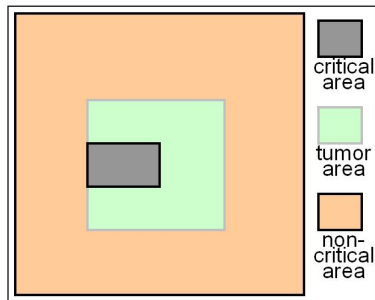
- Radiation kills normal and cancer cells.
- But repair mechanisms for cancer cells are less efficient.
- Radiotherapy as cancer treatment
 - Advances in imaging (CT, MRI)
 - Advances in radiation delivery (Intensity modulated radiotherapy)

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)