Week 3 Video 2

Data Synchronization and Grain-Sizes
You have ground truth training labels…

- How do you connect them to your log files?
- The problem of synchronization
- Turns out to be intertwined with the question of what grain-size to use
Grain-size

- What level do you want to detect the construct at?
Orienting Example

- Let’s say that you want to detect whether a student is gaming the system, and you have field observations of gaming.

- Each observation has an entry time (e.g. when the coder noted the observation), but no start of observation time.

- The problem is similar even if you have a time for the start of each observation.
Notice the gap; maybe students were off this day… or maybe the observer couldn’t make it.
Orienting Example

- What grain-size do you want to detect gaming at?
  - Student-level?
  - Day-level?
  - Lesson-level?
  - Problem-level?
  - Observation-level?
  - Action-level?
Student level

- Average across all of your observations of the student, to get the percent of observations that were gaming
Student level

Monday 8am

Monday 3pm

Friday 3pm

Gaming

5 Gaming
10 Not Gaming

This student is 33.33% Gaming

Not Gaming
Student level

- Monday 8am: 5 Gaming
- Monday 3pm: 10 Not Gaming
- Friday 3pm: This student is 33.33% Gaming
Seen early in behavior detection work, when synchronization was difficult (cf. Baker et al., 2004)

Makes sense sometimes

When you want to know how much students engage in a behavior

To drive overall reporting to teachers, administrators

To drive very coarse-level interventions

For example, if you want to select six students to receive additional tutoring over the next month.
Day level

- Average across all of your observations of the student on a specific day, to get the percent of observations that were gaming
Day level

Monday 8am

Monday 3pm

Friday 3pm

Monday 40%

Tuesday 0%

Wednesday 20%

Thursday 0%

Friday 40%
Affords finer intervention than student-level

Still better for coarse-level interactions
Lesson level

- Average across all of your observations of the student within a specific level, to get the percent of observations that were gaming.
Lesson level

- Monday 8am: 40% gaming
- Monday 3pm: 30% gaming
- Friday 3pm: 40% gaming
Notes

- Can be used for end-of-lesson interventions
- Can be used for evaluating lesson quality
Average across all of your observations of the student within a specific problem, to get the percent of observations that were gaming.
Problem level

Monday 8am

Monday 3pm

Friday 3pm
Can be used for end-of-problem or between-problem interventions

Fairly common type of intervention

Can be used for evaluating problem quality
Challenge

- Sometimes observations cut across problems
- You can assign observation to problem when observation entered problem which had majority of observation time both problems
Observation level

- Take each observation, and try to predict it
Observation level

Monday 8am
Gaming

Monday 3pm

Friday 3pm
Not Gaming
“Most natural” mapping

Affords close-to-immediate intervention

Also supports fine-grained discovery with models analyses
Challenge

- Synchronizing observations with log files
- Need to determine time window which observation occurred in

  Usually only an end-time for field observations; you have to guess start-time
  Even if you have start-time, exactly where in window did desired behavior occur?

How much do you trust your synchronization between observations and logs?

- If you don’t trust it very much, you may want to use a wider window
Challenge

- How do you transform from action-level logs to time-window-level clips?

  You can conduct careful feature engineering to create meaningful features out of all the actions in a clip

  Or you can just hack counts, averages, stdev’s, min, max from the features of the actions in a clip

  (cf. Sao Pedro et al., 2012; Baker et al., 2012)
Action level

- You could also apply your observation labels to each action in the time window
- And then fit a model at the level of actions
  Treating actions from the same clip as independent from one another
- Offers the potential for truly immediate intervention
Some models identify the overall construct at the action level, but validate at the clip level (Paquette et al., 2015)

Less certain, action by action, but allows more rapid and targeted intervention
There are several grain-sizes you can build models at.

Which grain-size you use determines:
- How much work you have to put in (coarser grain-sizes are less work to set up)
- When you can use your models (more immediate use requires finer grain-sizes)

It also influences how good your models are, although not in a perfectly deterministic way.
Next Lecture

- Feature Engineering