Dynamic prediction of student progress rate and completion time during activities in classrooms

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FNSNF
Fonds National Suisse
Schweizerischer Nationalfonds
Fondo Nazionale Svizzero
Swiss National Science Foundation

EPFL
École Polytechnique
Fédérale de Lausanne

Context

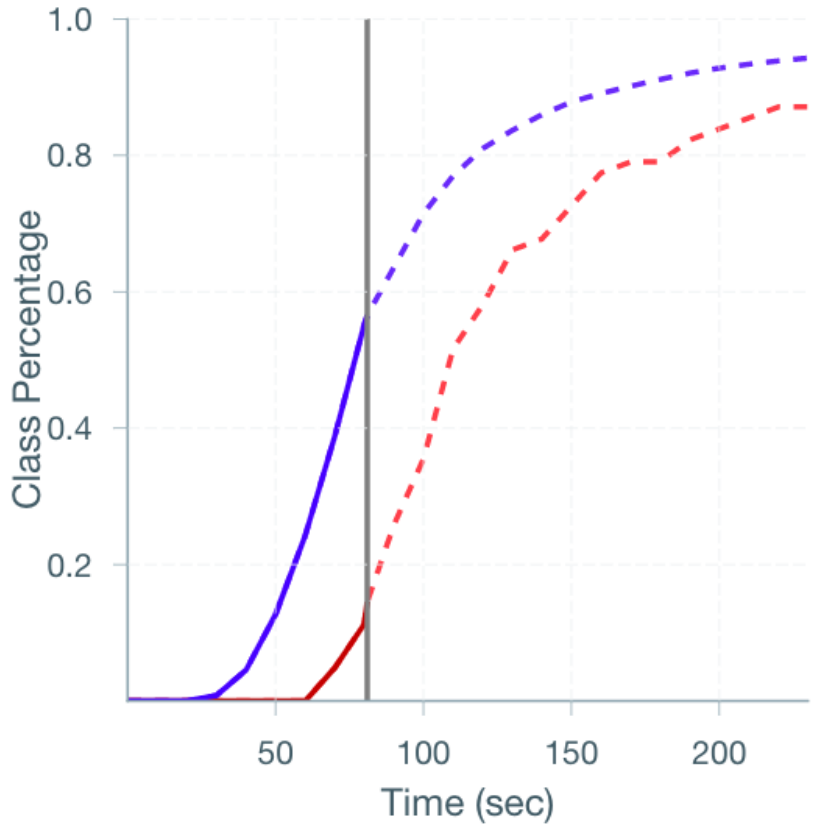
- In (large) classroom
- Supporting the teacher to make timing decisions
- Showing the real-time progress of students augmented with prediction of future progress
- Learning activity done on laptops (or other digital device)
- Learning activity divisible in sub-tasks (for example a quiz)

Trade-off between wait time and completion rates

- Average proportion of the activity completed by the students (blue)
- Proportion of the students who already finished the activity (red)

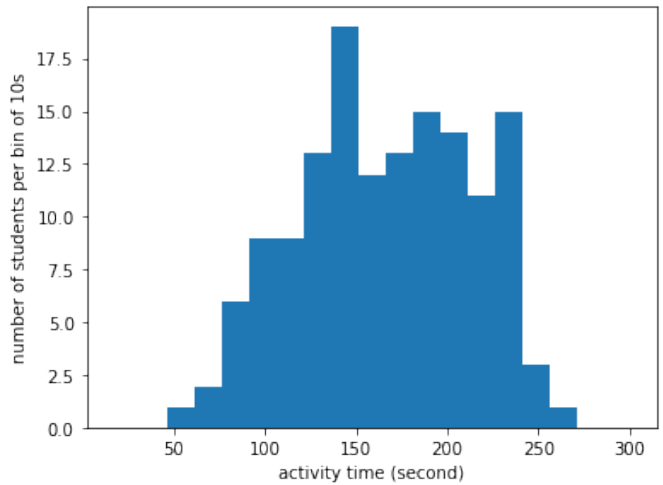
Giving more time means:

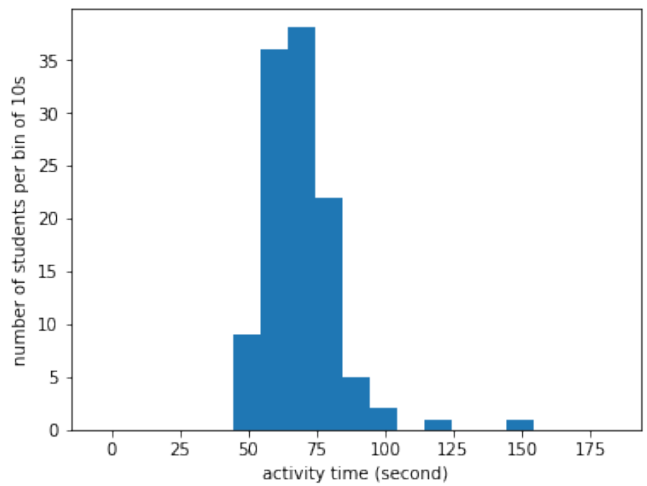
- More students complete the activity
- Fast students wait longer



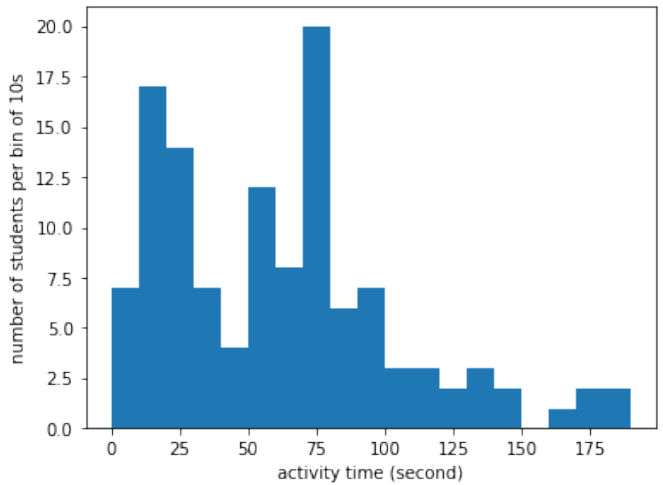
Differences in pace and delay

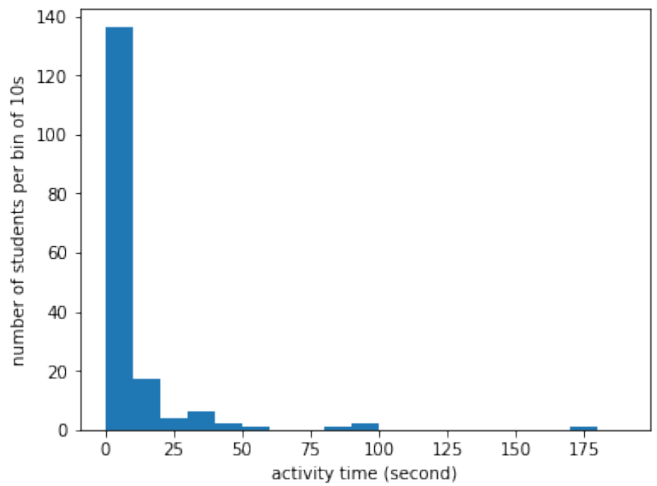
Examples of distribution of the pace





Examples of distribution of the delay



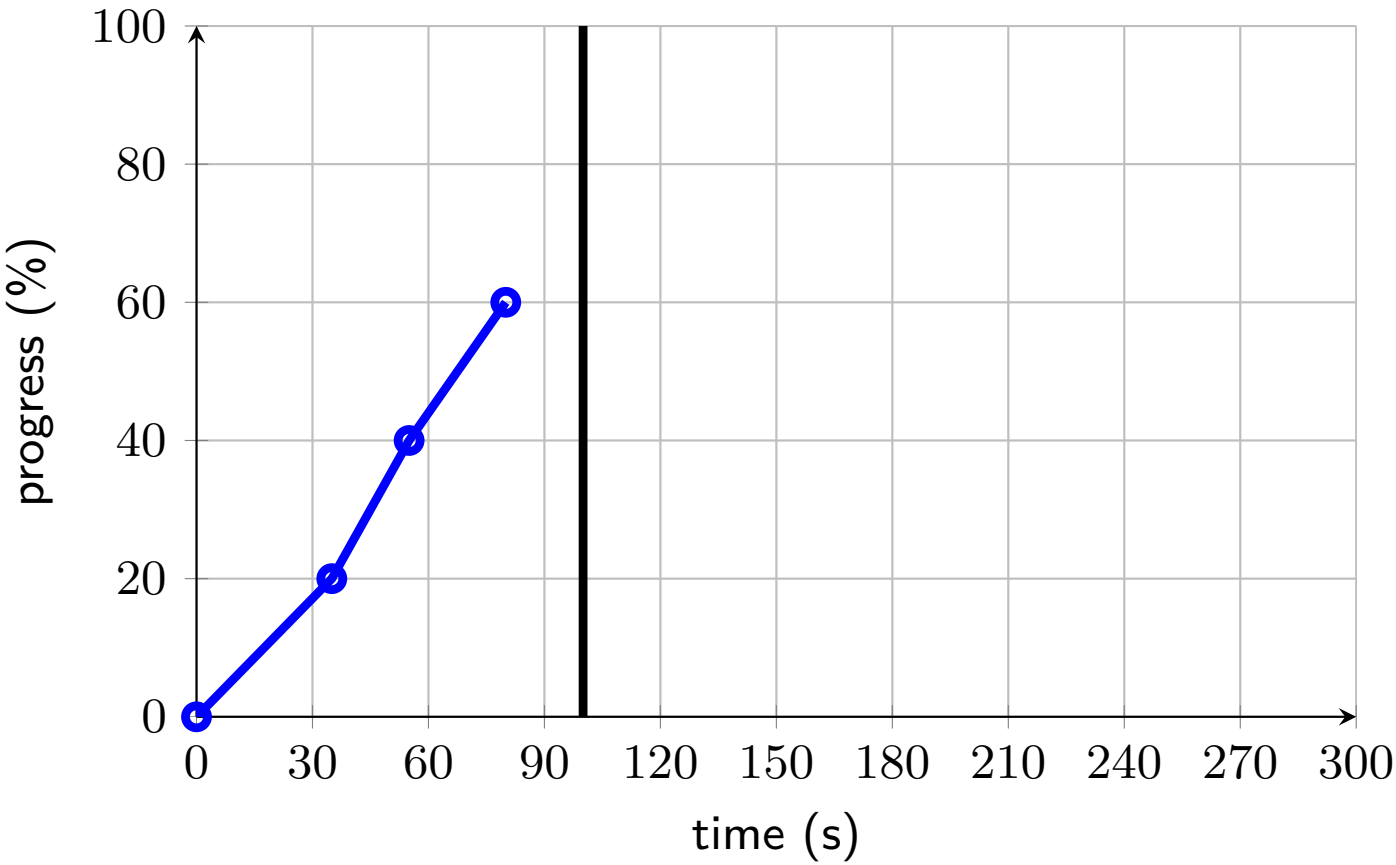


Measuring progress

- The system produces logs: $(t_0^s, p_0^s), (t_1^s, p_1^s), ..., (t_N^s, p_N^s)$
- Usually $p_i = i/N$ for an activity divided in N sub-tasks
- The time t_i is the time when the i-th sub-task is completed

Predicting future progress

When do you expect the student to be finished with the activity?



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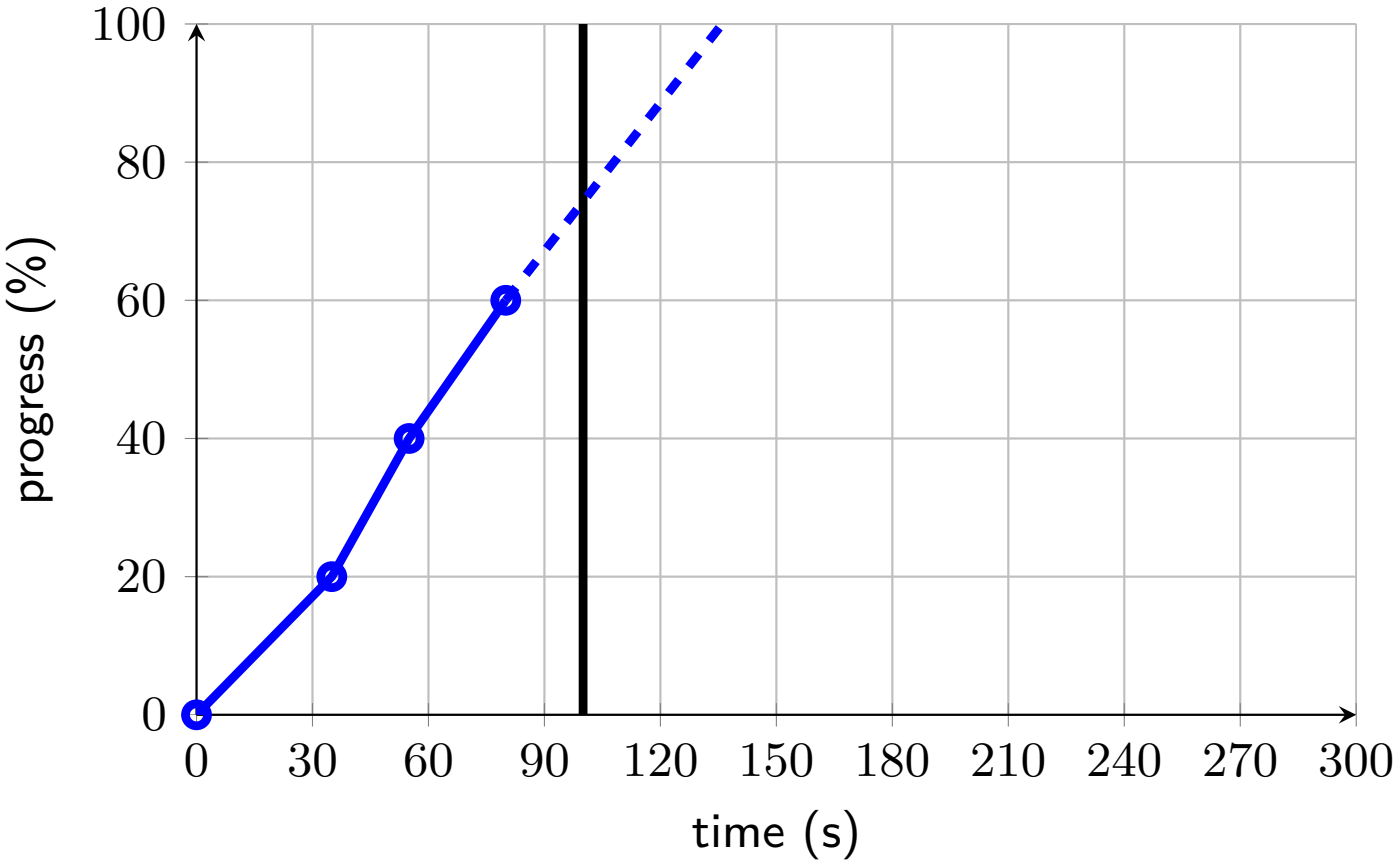


Constant rate progress

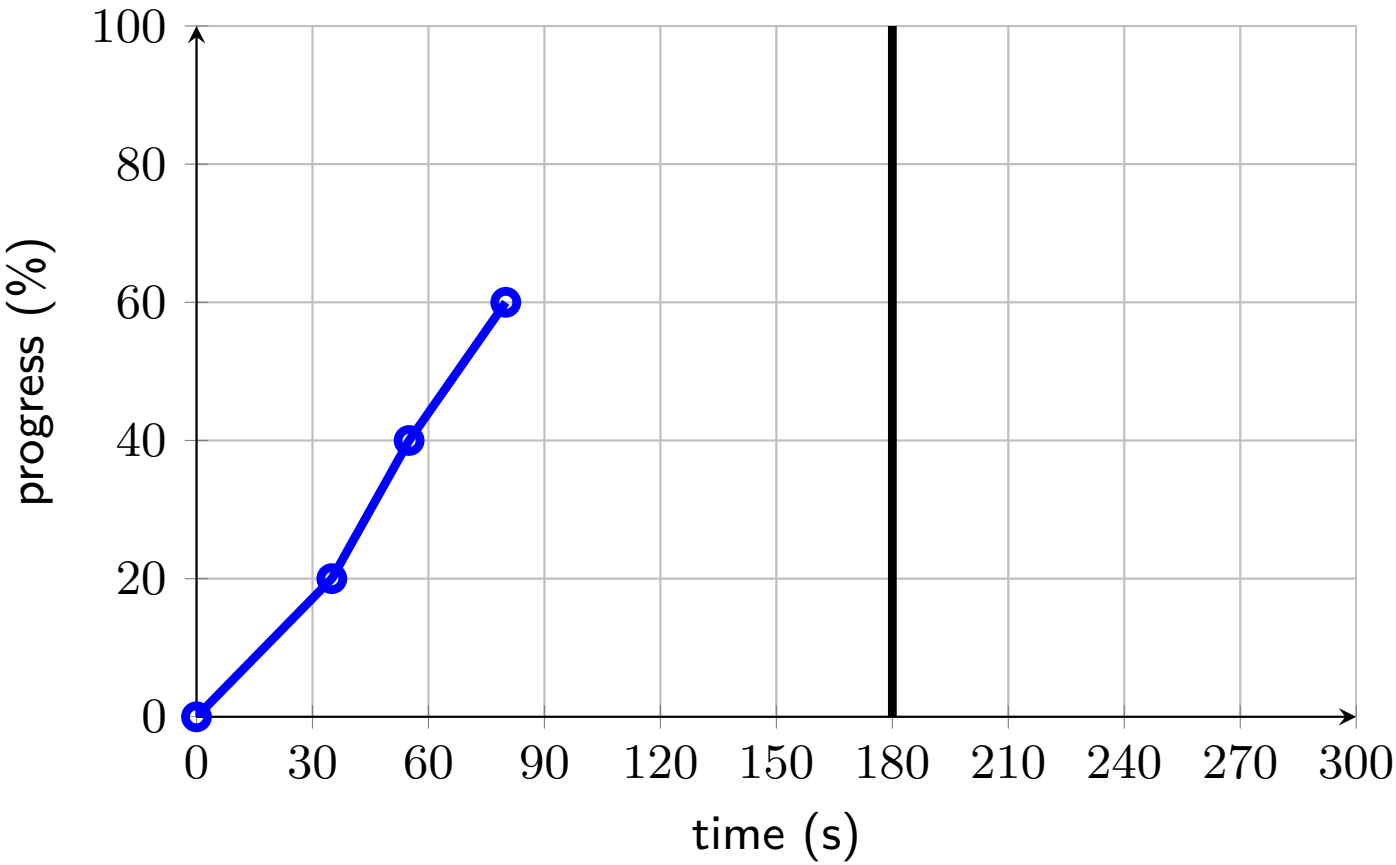
Problem

At any time t, from the logs received from a student $(t_0^s, p_0^s), ..., (t_k^s, p_k^s)$ with $t_k^s < t$, predict the rest of the progress curve of the student.

- Students have a constant progress rate R_s: $P_s(t) = R_s * (t - t_0^s)$
- We can evaluate $R = (p_k - p_0)/(t_k - t_0)$

Adapting to student pauses and dropout

When do you expect the student to be finished with the activity?



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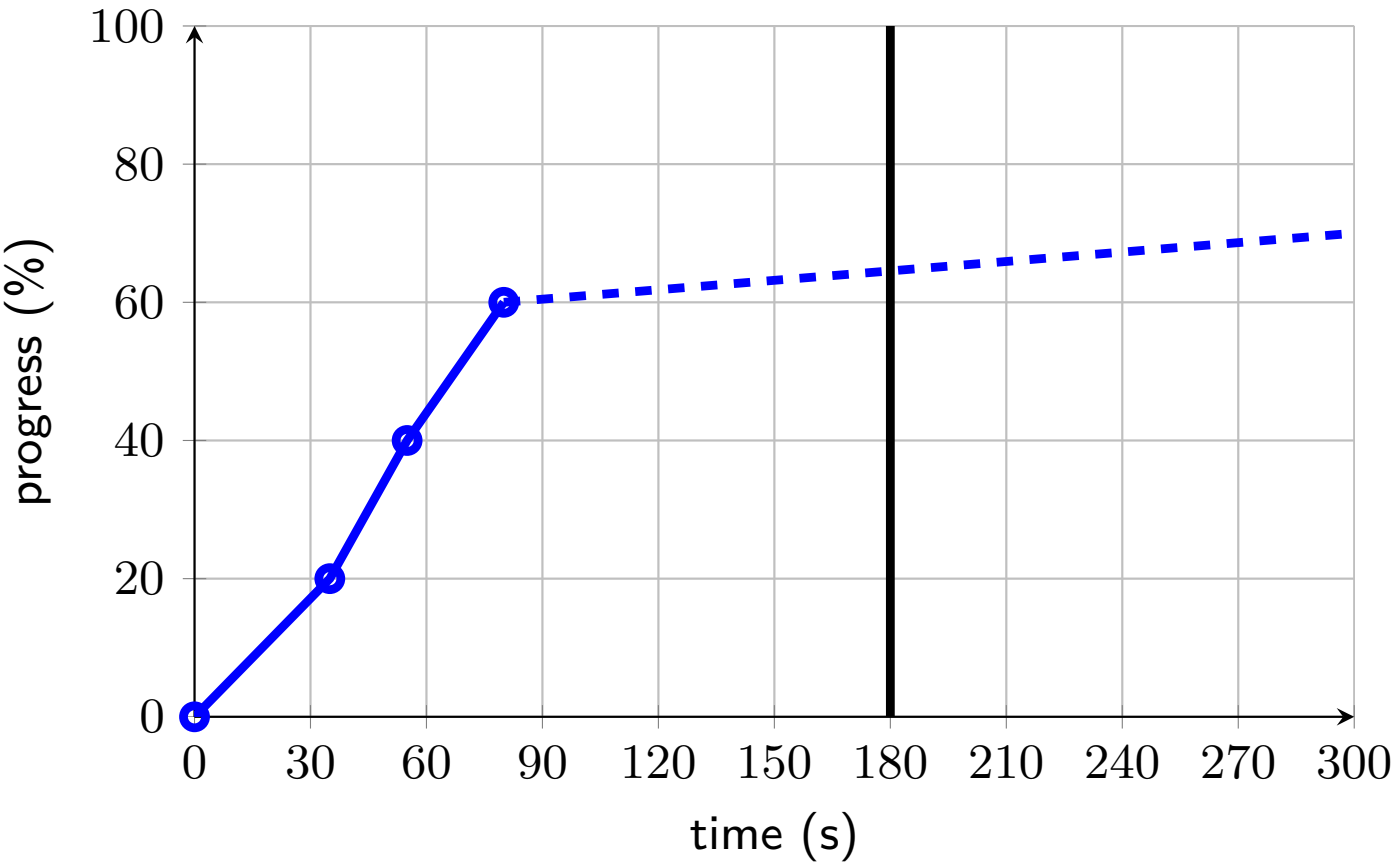
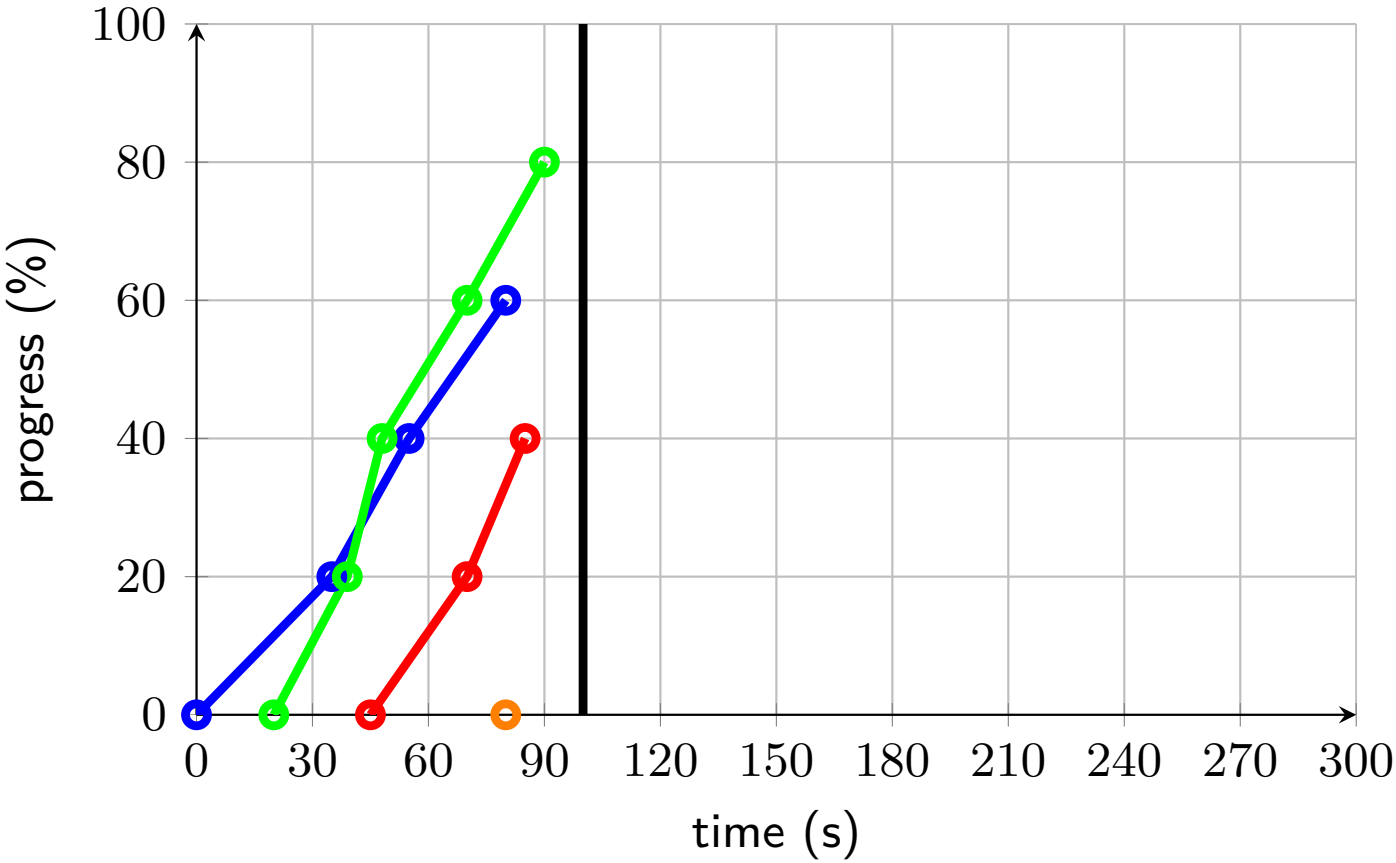


Adapting to student pauses and dropout

- As no log has been received we know that the progress at $t = 180$ lies between 60% and 80%
- The expectation of the student still making progress decreases over time

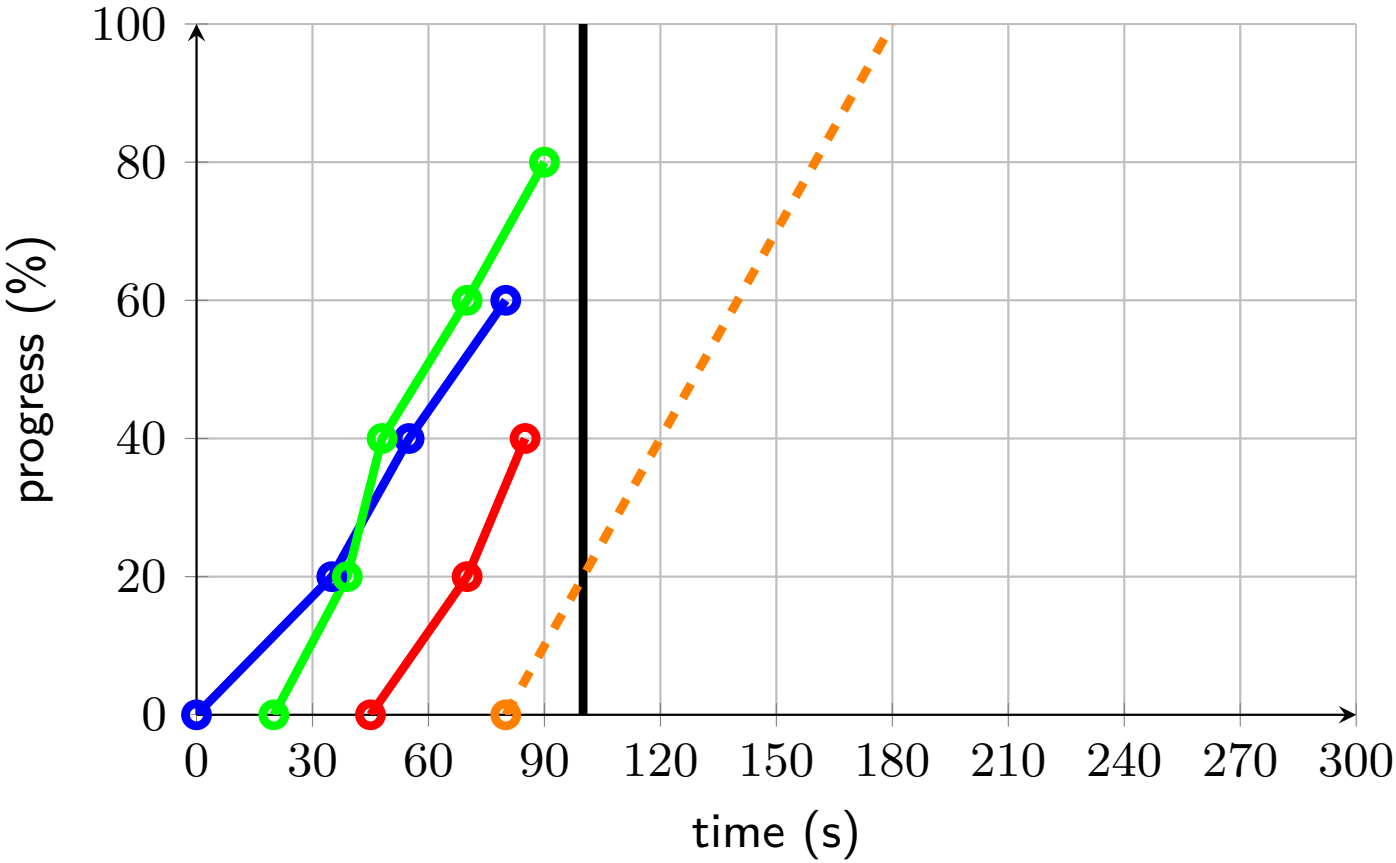
Using the average progress rate

When do you expect the Orange student to be finished with the activity?



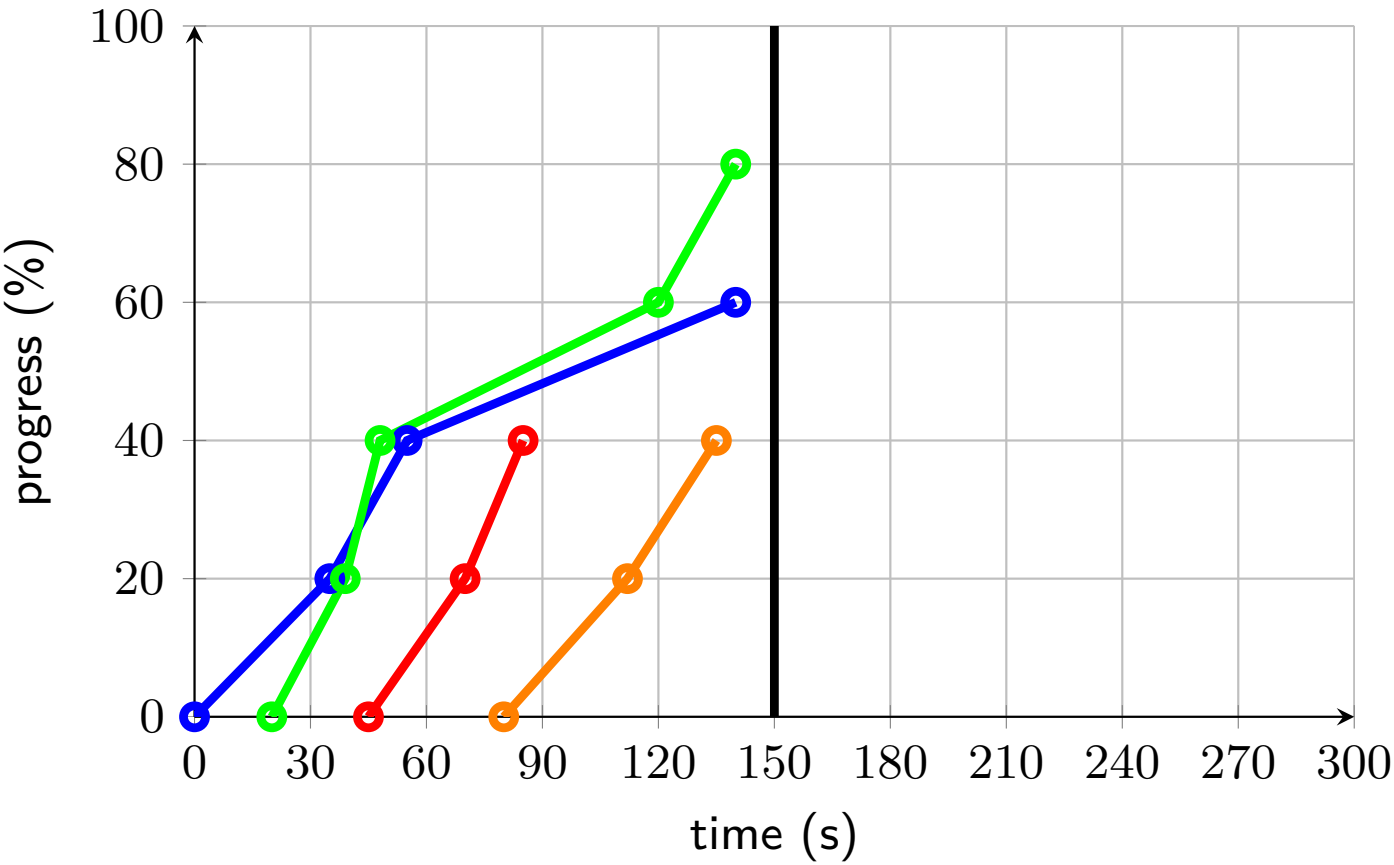
Using the average progress rate

When do you expect the Orange student to be finished with the activity?



Accouting for time differences between sub-tasks

When do you expect the Orange student to be finished with the activity?



Accouting for time differences between sub-tasks

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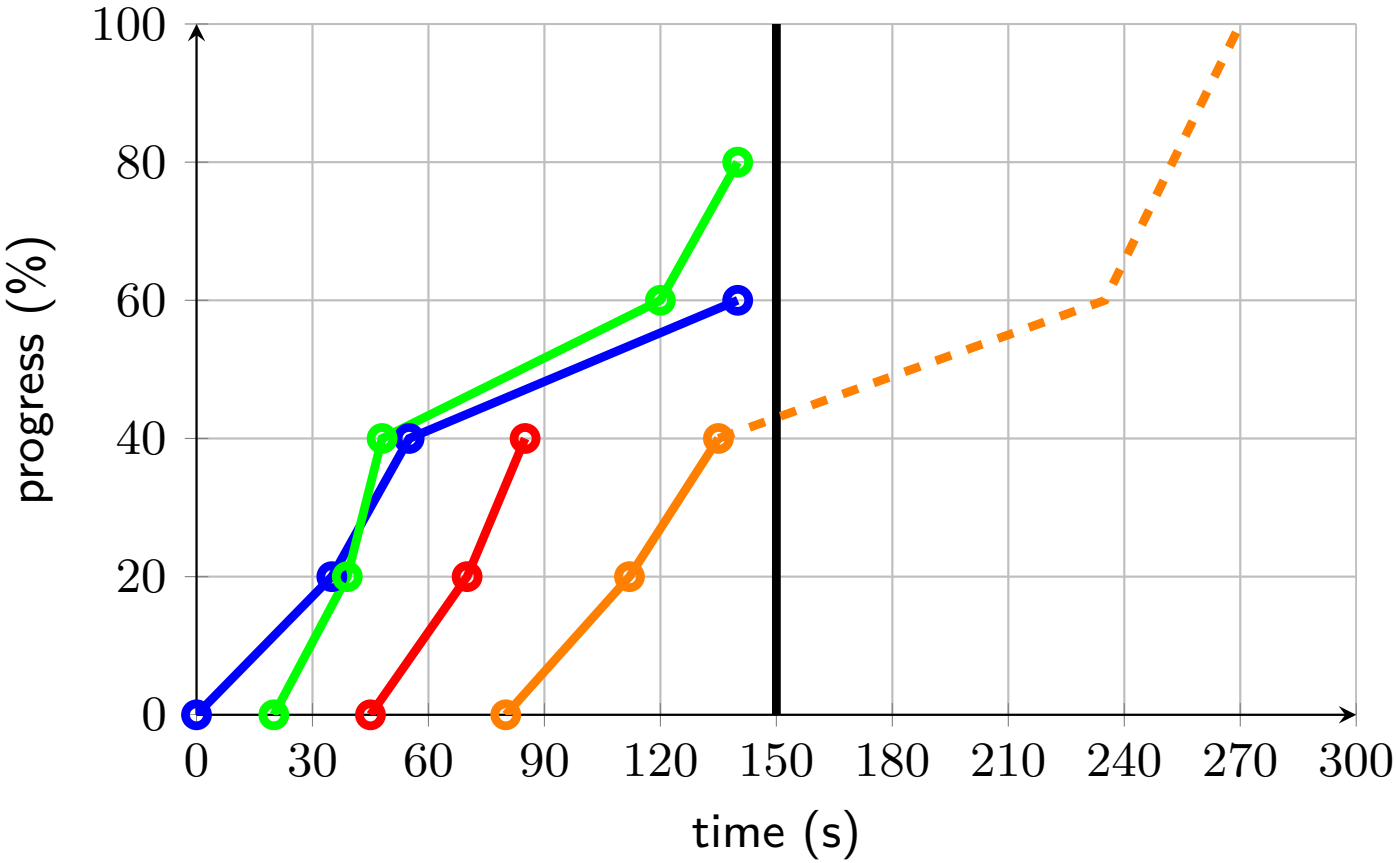
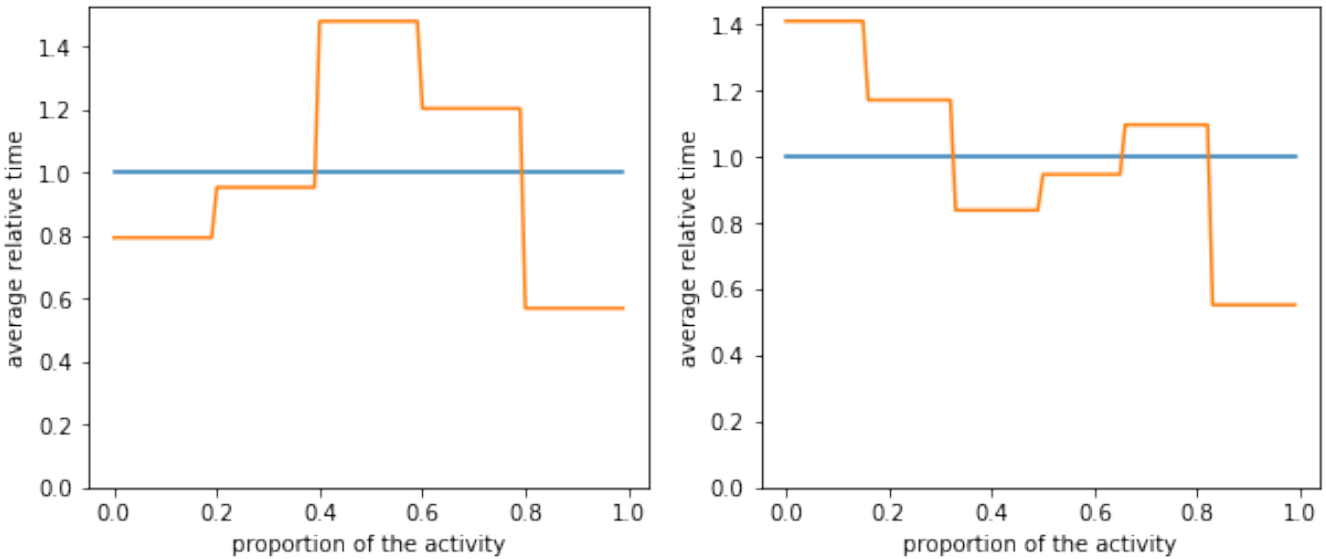


Accouting for time differences between sub-tasks



- Compute a model from all the collected logs to estimate the proportion of time taken by each sub-task
- Use these models to rectify non-linearity of the progress curves

Conclusion

What we want to do to improve our model:

- Measuring progress for activities which are not easily divisible in subtask
- Reusing data from the same class doing subsequent activities
- Reusing data from the same activity done in different classes