Adaptive Engine

Version 1.0

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General

Adaptive Domains

Server Side Processing

We utilize three methods to create impressions of user's behavior:

- **Prediction (short term)**: Our platform examines learner characteristics such as motivation or time management. We call these *Aptitudes*. We also examine their *Skills* in the subject of the lesson. Aptitudes and Skills are the two domains we measure users in.

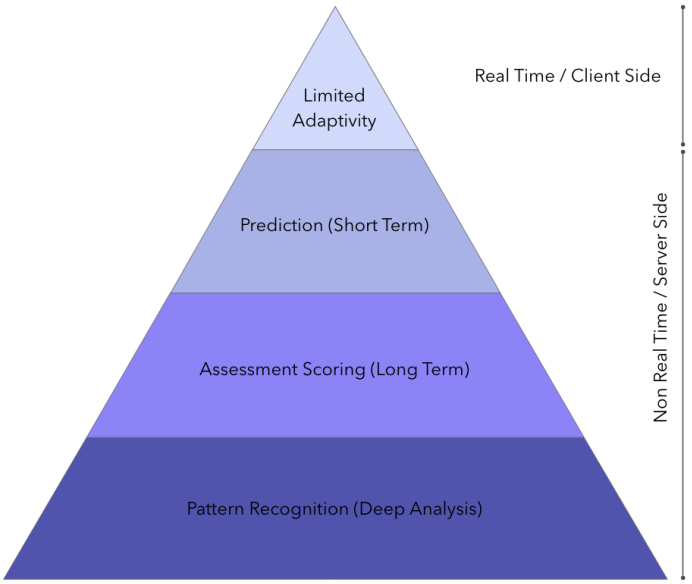
  We treat aptitudes and skills as *hidden states* of the learner since there is no direct way to measure them. An example of an explicit measurement is height. We can measure someone's height by using a meter and achieve an absolute measurement on a scale that is easily comparable to others. When measuring motivation we can only use indirect, or implicit methods and infer something about motivation which is hidden from us. For example, if someone is consistently late to class, it *may be* because they have low motivation.

  Quonder is striving to base its assessment on research so that any conclusion made in regards to aptitudes is likely to be true. However, much like a classroom teacher, an adaptive platform still needs to make certain assumptions even before it processes all of the data points necessary to empirically reach a conclusion. Therefore, a *prediction* needs to be made based on partial data and a statistical model assisting in making a decision. For example, we can estimate if a user has low motivation and let our robot, Q intervene to provide positive reinforcements even before we are certain that the user has an issue with motivation. In fact, we may never know for certain if the user has an issue with motivation since it is a hidden state, and the best way to know is to try and intervene. If the intervention is successful then the conclusion is that it was an issue with motivation and a plan can be developed for future lessons. Prediction is needed for short term since it is based on partial or incomplete data. Furthermore, prediction being used for short term purposes strives to use the least resources possible. It does so by relying on lookup tables instead of calculating user data.

- **Assessment Scoring (long term)**: When enough data is available, it is possible to use it for assessment and generating a *score*. For example, a user seems to have issues with completing assignments and arriving on time only for subjects involving math. We can arrive to this conclusion only after we spent enough time with the user over different subjects. When we have that data our conclusion carries more weight

compared to the prediction, and we can generate a *score:* a number representing a specific characteristic of the user. That number may be used to make future predictions and actions. Assessment also requires a statistical model of a different kind. Assessment Scoring requires more resources, data and calculations. It is therefore slower and not run as frequently as the prediction.

- **Pattern recognition**: As assessment scoring and predictions occur, we can identify patterns in the learner's behavior. For example, if a learner *sometimes* fails and *sometimes* succeeds, what are the recurring conditions which may be contributing to this outcome? It may be a subject a learner feels insecure in or is less interested in. It may also be a behavioral change related to outside factors (a "responsible" student who has problems at home and starts behaving differently). Pattern recognition can reveal learning strategies employed by a learner by examining their actions and then provide tools to assist them with learning. Pattern recognition is the "deepest" mode of analysis and requires the most resources and data.

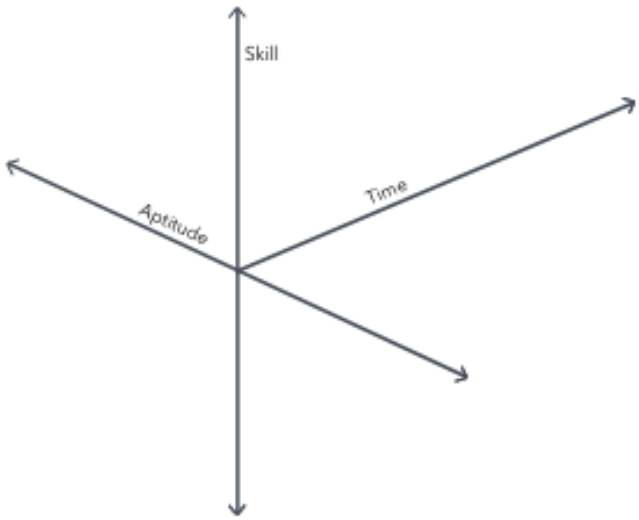


Adaptive Lessons

In regular classroom lessons, a group of people share a lesson, and also share the time. It is not possible for an individual to spend more time on a subject or for the learning to be personalized, unless the larger group of people is split into smaller groups. This may seem trivial but it is a concept that should be remembered. The more individualized the learning - the more personalized it can be. The more social, the less personalized it can be. These two extremes exist in online learning.

For the time being, Quonder is focusing on individualized, self paced learning. This provides maximum potential for adaptability.

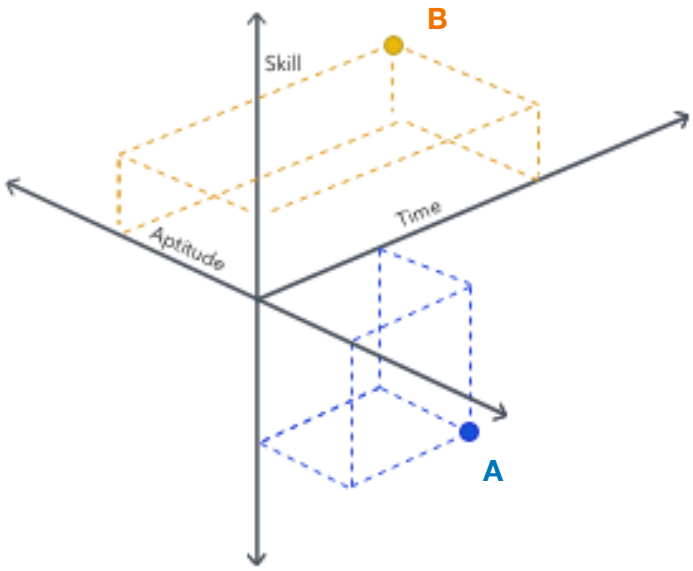
Quonder adaptive lessons operate in three dimensions: time, skill and aptitude.



There have already been attempts at implementing adaptive lessons, some of them very successful. They all focus on personalizing skill level based on the ability of the learner. We propose the additional dimension of aptitudes.

A lesson always moves forward in time, hence the time axis (X) has no possible negative values as the other axis' do . The skill (Y) and Aptitude (Z) axis' have the possibility of negative values. The 0 point for skill. And aptitude represents an assumption made by the course author - an assumed skill and aptitude level.

Consider the following two points on the three dimensional graph:



Assume the two positions represent students. Student B is making more progress (time) in a lesson compared to student A. In addition, the skill level of student B is higher and they have a higher degree of aptitude as well. Either the low skill or the aptitude issue could explain the reason why student A is lagging behind. The map may assist in an intervention so that student A can be helped. If multiple students are displayed on such a graph, we could group them together based either on skill level, aptitude level, area in the lesson, or more than one parameter. We could also create groups of students who can assist each other by mixing these groups.

Now, assume the two positions represent units of content in a lesson. Units in a lesson appear in sequence (One unit comes after another unit and so on). Mapping units with correlating skill and aptitude levels may help link students with units that are relevant to them in terms of both skill and aptitude, and not just progress (time).

This shows that both learners and content should have measures of skill and aptitude.

An adaptive lesson performs the following functions:

- It continuously assesses learners as they learn and generates scores for skill and aptitudes