

PSL: An Expert System to Evaluate Degree Plans

Robert Swanson

Summary

PSL implements a system that can evaluate a college degree plan based on a highly personalized set of requirements and preferences.

The system is composed of two primary components:

1. The PSL grammar, which allows for highly expressive textual representation of requirements and preferences
2. The evaluation engine, which defines a library to create a specification object, which can evaluate degree plans

The evaluation engine also makes reference to an internal database of course information which are input to the system as json files. A degree plan json file specifies the plans that the system will pass into the evaluation engine.

Example PSL File

```
1 student_preferences (moderately=2.0, strongly=10.0) {
2   require plan starting in fall 2018.
3   require plan ending on or before spring 2022.
4
5   prefer strongly starting at or after 9:00 AM.
6   prefer strongly more courses.
7   prefer strongly taking course "COS-121".
8
9   if taking course "COS-120" then {
10    prefer moderately taking course "COS-120" before fall 2019.
11  } otherwise if taking course "SYS-120" then {
12    prefer moderately taking course "SYS-120" before fall 2019.
13  }
14
15  for terms where less than 16 credits {
16    prefer not meeting at 12:00 PM - 12:50 PM.
17
18    for days where less than 120 meeting minutes {
19      prefer ending before 1:00 PM.
20    }
21  }
22
23  for days where (at least 2 courses or not meeting at 12:00 PM - 12:50 PM) {
24    prefer meeting at 11:00 AM - 11:50 AM.
25  }
26
27  for thursdays prefer strongly not meeting at 2:00 PM - 4:00 PM.
28 }
```



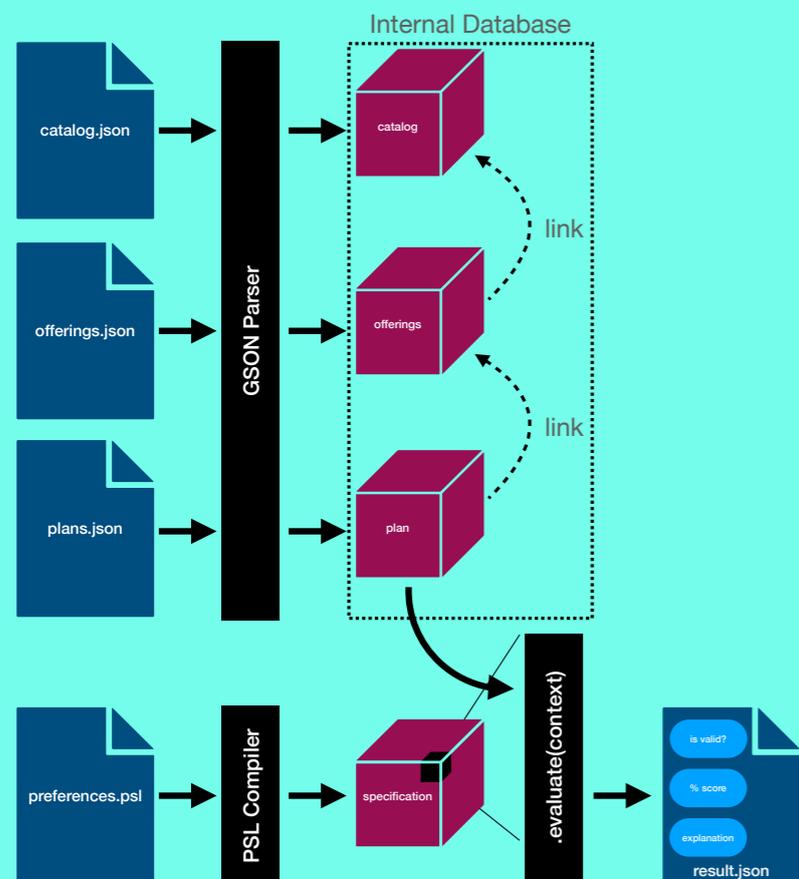
Evaluation Engine

The evaluation engine implements an object structure to represent specifications, constraints, conditions, context, evaluators, and evaluator results.

Constraints use different scoring functions to map the numerical degree features (domain of \mathbb{R}) to a percentage (domain from 0% to 100%). The sigmoid function facilitates inequalities such as a constraint to maximize credits. The optimal function facilitates equalities such as a constraint for a certain number of credits.

Every component is designed to be able to explain how it calculated its last value. The system uses this recursive definition to produce an output file that indicates whether or not the degree plan meets all the requirements, a percentage score indicating how well it meets the preferences, and a full explanation for both values.

System Overview

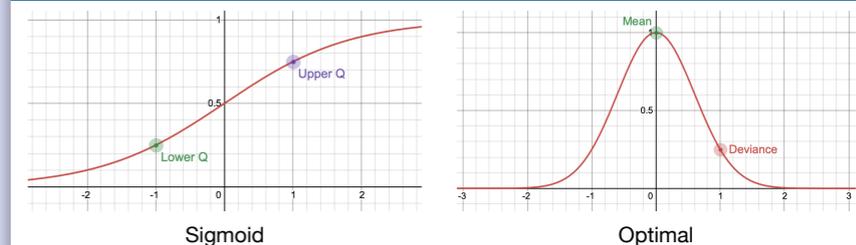


PSL Grammar

The PSL grammar parser is implemented in ANTLR for Java. The grammar essentially contains a list of specifications. There are 5 types of specifications:

1. A **requirement** specification describes a constraint that must be fulfilled in order for the plan to be considered
2. A **preference** specification describes a constraint whose validity has a weighted impact on the score of a plan rather than its validity
3. A **specification list** serves as a curly-brace surrounded container for multiple specifications
4. A **conditional** specification defines a set of condition-specification pairs, such that only the specification paired with the first condition to evaluate to true will be evaluated
5. A **contextual** specification specifies a context filter that will constrain the context within which the contained specification will be evaluated

Scoring Functions



Explanation

Root	Object
planContext	Object
specification	Object
specifications	Array
Item(0)	Object
constraint	Object
evaluator	Object
result	String
description	String
score	String
Item(1)	Object
Item(2)	Object
Item(3)	Object
Item(4)	Object
Item(5)	Object
Item(6)	Object
condition	Object
context	Object
specification	Object
score	String
description	String
Item(7)	Object
Item(8)	Object
score	String
description	String
score	String
description	String

Conclusion

The PSL system demonstrates how student preferences can be expressed and used to evaluate a degree plan. Additional work could explore how to use this system to generate a plan optimized to a student's personalized preferences.