Software Architecture and Engineering 2018
Project 1 (Part 2: Alloy Modeling Task)

Published: March 17th, 2018
Firm submission deadline: April 6th, 2018 (23:59 CET)

Your task is to design a system for managing a simplified version of the Olympic Games, described in the earlier UML modeling task. The system consists of a *general part* (for all the Olympic sports) and *sport-specific parts*.

You will present your solution to this and the previous project part during the exercise session from the week 9th–13th of April. *The presentation is a mandatory part of the project and it is graded.*

The emphasis of this task is on designing the data model for the Olympic Games, formalizing it in Alloy, and checking whether certain properties hold for your Alloy model.

You should start from the (incomplete) Alloy file from the course website. In particular, implement all the functions and predicates that we provided. *You are* ***not*** *allowed to change any of the signatures from the template file. They are used to automatically test your solutions, so changing them will significantly affect the number of points obtained for this task.*

If you have questions for the customer (your assistants), ask us during the project part of the exercise session or send an e-mail to the mailing list: sae-students@lists.inf.ethz.ch.

1 Alloy Model

Task A. (27 points) Create a static Alloy model of all the data structures from the general part of the Olympic Games. You should use the UML diagram from Fig. 1 to guide your design (i.e., *do not use the UML model you submitted*). In this diagram, we included two additional relations: *nextPhase* and *next*. They are used to represent the ordering between *Phases* and between *Time*.

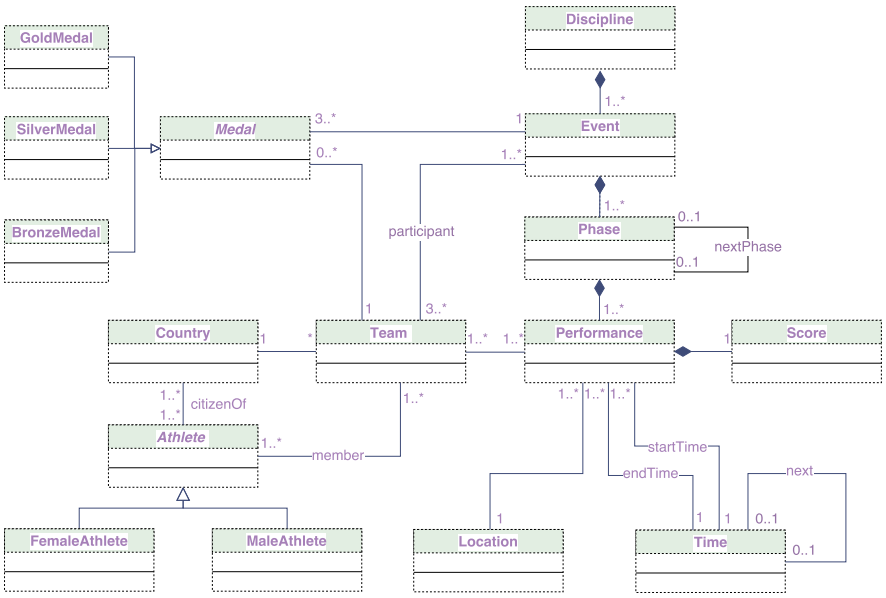

Figure 1: UML model

Then, extend the general model for your specific sport, taking into account the **simplifications** described in the following sections. *Each project team has to model* ***only*** *the sport it has been assigned to.* Include all the relevant details, relations and facts. In addition, document any detail that cannot be encoded in the Alloy model. Make sure to implement all the provided functions and predicates, without changing their names or signatures.

Note: Alloy may have performance issues if your models are too large. If that is the case, try limiting the number of instances of each signature by using the `run ... for ... but` command. You are allowed to make further simplifications for your specific sport, by removing or altering constraints from the project description which do not affect the overall structure or important properties of the model.

1.1 Figure Skating

It is sufficient to model just the event Ice Dancing. Also, as an additional constraint, all the performances within a phase should take place in the same location. Both the technical score and the score for presentation are integer values $\in [0, 6]$.

1.2 Ice Hockey

As the rules for both Ice Hockey Tournaments are the same, it is sufficient to model just the Women's Tournament. Also, you can consider that the tournament starts in quarter-finals, with 8 teams. The way in which they form pairs and play the quarter-final matches is arbitrary.

1.3 Ski Jumping

You may omit the Women's Individual event.

1.4 Taekwondo

As the rules for all Taekwondo events are the same, it is sufficient to model just one event (you may decide which one).

1.5 Tennis

You may omit the Women's Doubles tournament and start the tournament in the semifinals.

1.6 Volleyball

As the rules for both Volleyball Tournaments are the same, it is sufficient to model just one of them (you may decide which one). You may omit modeling the qualification round.

Task B. (18 points) Generate the following instances using Alloy, showing that your model is not overly restricted, or explain why they are infeasible if you cannot generate them:

1. **From the general model**: There are exactly 7 performances, exactly 2 locations and exactly 4 instances of time.
2. **From the general model**: An athlete participates in a performance from a discipline and immediately after this performance ends, the athlete participates in another performance from another discipline.
3. **From the general model**: A country has no team that represents it in any discipline.
4. **From the general model**: An athlete wins two gold medals in the same discipline.
   Note: We consider that an athlete wins a medal if it belongs to a team which wins that medal.

5. **Sport specific**: A team is not among the best teams in one of the phases of an event from your discipline, but it still wins the gold medal.
   Note: We consider that a team is among the best teams in a phase if that team has the highest score or if it wins all the performances it participates to within that phase. Only one of these definitions should apply for your specific sport.
6. **Sport specific**: Exactly one gold medal and one or more bronze medals are given for an event from your discipline.

For each instance, create a predicate called `static_instance_n`, with n replaced by the number of the instance, which generates the instance when run with the `run` command. Export all feasible models as images and explain them in a few sentences.

2 Deliverables

Submit your solution by email to alexandra.bugariu@inf.ethz.ch. Each team should submit a single .zip file named **teamName_alloy.zip** that includes:

1. An Alloy file with all the required code from the Tasks A and B (1-4) for the general model. The file must include short comments that explain your formalization.
2. An Alloy file with all the required code from the Tasks A and B (5-6) for your specific sport. The file must include short comments that explain your formalization.
3. A PDF file that includes:
   - Image exports of all the generated instances from Task B, with short descriptions.
   - A list of instances from Task B that you were not able to generate, together with a short explanation why the instance is not feasible.
   - A list of simplifications you made to improve Alloy's performance. For each of them, explain why they do not affect the overall model in a significant way.
   - A list of requirements from the project description that cannot be expressed in the Alloy model.

3 Resources

- Alloy: http://alloy.mit.edu/alloy/
- Use LaTeX, Microsoft Word, or Google Docs to create your project report, then export it to PDF.