

## **CS5232 Formal Specification and Design Techniques**

### **Default Project: Applying Probabilistic Model Checking in Sports Analytics**

The mathematical modeling techniques of this course are very **general, expressive** and **applicable to many research fields**. You are highly encouraged to choose a topic (application of formal specifications) which relates to your Honours/Master/PhD main research area or your current industry project. If you think that your own research/work is not suitable for formal modeling techniques using CSP# (PAT), then you can choose this default project.

**Project requirement** (for all projects, i.e. regardless whether you choose the default project or a project in your own research/work area):

- Use CSP# (PAT) to model and verify system properties.
- The main deliverable is a project report, which is about 20 pages (single spaced 11/12pt) and contains the following:
  - Describe the application you have chosen to model.
  - Properties to be verified, e.g. reachability probabilities.
  - Formal model in CSP# language.
  - Result and discussion.
  - Feedback on how to improve the PAT.
- Each team should have one to four persons.
- There is a mid-term project presentation scheduled on **21 Mar**, and a final project presentation on **11 Apr**.

#### **Project assessment:**

- Completeness (10 marks)
- Correctness (10 marks)
- Structure/clarity (10 marks)
- Innovative modeling/discussion/presentation (10 marks)

#### **Default project description:**

Traditionally, Probabilistic Model Checking (PMC) was mainly used to analyze the correctness and performance of the computer system and protocols, however, it can be applied in other areas too. For example, during the lecture, we have demonstrated an interesting case where PMC is applied to sports analytics to reason the relations between player strategy and his winning probabilities. That example models a tennis singles tiebreaker game. We ask you to apply the PMC technique to model a different sport, e.g. badminton, table tennis, soccer, or a different type of tennis, e.g. doubles game, etc. Through this project, we hope you gain experience in modeling a realistic system using CSP# (PAT).

To help you, we would like to offer the following tips:

- Use **proper abstraction** to model the states, the state transitions and the player's choices.
- **Part of the challenge is to estimate the probabilities** in your model. Please be innovative and use your knowledge in statistics or machine learning.

- Your model should be **realistic**. Ideally, the winning strategies or probabilities discovered by your model should be supported by real match results.

For project consultation and questions, please contact TA, Jiang Kan (Michael)  
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