F1 season planification

Quentin Lemboulas

1 Project description

This project aims to model the planning of Formula 1 race weekends for a full season. It falls into the category of logistic and resource allocation problems, where the goal is to determine the optimal scheduling of races while taking into account multiple geographical and temporal constraints.

The challenge of this problem lies in the need to schedule each race on a unique weekend, ensuring that no two races are planned on the same date. In addition, the model must account for geographical constraints, including continent transitions and optimal travel routes between races, to minimize the logistical burden on teams.

2 Justification of choice

This problem is particularly interesting because it reflects a real-world challenge faced by Formula 1 organizers: how to plan a race calendar that minimizes logistical difficulties while adhering to various regulations and restrictions.

3 High-Level Modelization Choices

The main objective is to ensure that each race is scheduled exactly once on a distinct weekend while minimizing logistical challenges related to travel between continents.

Our model is structured around three key components:

- **Objects:** These include circuits, weekends, and continents. Each circuit is associated with a specific continent to facilitate geographical reasoning, and weekends are treated as distinct entities to manage scheduling.
- **Predicates:** We defined several predicates to capture the state of the plan:
  - **Race Assigned:** To indicate whether a race has already been scheduled.
  - **Weekend Occupied:** To track if a given weekend has already been assigned to a race.
  - **Continent Association:** To link each circuit with its corresponding continent.
  - **Sequential Order:** To establish a temporal relationship between consecutive weekends.
  - **Geographical Transition:** To detect changes in continent when moving from one race to another.
  - **Same continent:** To check whether two races are on the same continent.
- **Actions:** The model includes actions that represent race scheduling:
  - **Plan Race:** Assigns a specific race to a weekend while marking both as occupied.
  - **Manage Transitions:** Plans a week break if needed.

The modelization focuses on minimizing unnecessary transitions between continents while respecting traditional race orders when possible. There are other constraints that would be added, relatively to the complexity of the problem (easy, medium, hard)

4 Illustration on a Simple Instance

To better illustrate the problem, we consider a simple instance with four circuits and five weekends. There is also a condition on the beginning and ending of the season that should respectively take place in Melbourne and Abu Dhabi.

- **Circuits:** Melbourne (Oceania), Sepang (Asia), Shanghai (Asia), Yas Marina (Asia)
- **Weekends:** Weekend1, Weekend2, Weekend3, Weekend4.

In this simplified scenario, the solution would:

1. Schedule Melbourne on Weekend1 (to respect the tradition of starting the season in Australia).
2. Allocate Sepang and Shanghai, then Yas Marina to the following weekends. Take a break after the Melbourne weekend. Respect the ending season criteria in Abu Dhabi

This small instance serves as a proof of concept to ensure that the model correctly handles unicity and geographical constraints.