COS 214 Project

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- Date Issued: **25 September 2020**
- Date Due: **9 November 2020** at **8:00am**
- Submission Procedure: **Upload via ClickUP**
- Submission Format: **archive (zip or tar.gz)**

1 Introduction

In this project you will be designing a system to simulate running your own Formula 1 team. In a Formula 1 season there are two championships, the constructors championship and the drivers championship. Each team has two cars racing in every race. The goal of a Formula 1 team is to score the most possible points at every race and win both the constructors and drivers championship. You would be simulating running an entire Formula 1 team and this involves managing and simulating many different departments within the team.

1.1 Objectives

In this project you will:

- identify the requirements for managing a Formula 1 team using the description given in this document,
- translate the requirements into a design using design patterns,
- highlight aspects of the design that are important in the implementation of the design using UML,
- implement the design in C++, and
- compile a design document that is to be used to understand the design and implementation of the project.

1.2 Outcomes

When you have completed this project you will:

- have designed and modelled a system and experienced integrating design patterns,
- be able to say with conviction that you have completed a relatively large project,
- have experience of working in a relatively large design and development team, and
- be ready for COS301 next year.

2 Constraints

1. You must complete this project in teams of 5 to 7.
2. At least 10 design patterns must be included in the design and the implementation thereof.
3. UML diagrams showing the design and aspects of the system that need additional explanation.

3 Time line

1. 5 October 2020 - Teams of 5 to 7 registration to be completed.
2. 12 October 2020 - Submit initial design. This will form Practical Assignment 5 (PA05).
3. 9 November 2020 - Submission of project.
4. 10 to 12 November 2020 - Project demos.

4 Project Description

4.1 Logistics

Running a Formula 1 team is a logistics marvel. There are 21 races in a year, on 5 different continents. The races can be divided into two different categories. European races and non European races.

Non European races involve planning months in advance. Containers are prepared 3 months in advance and are shipped to the race track. These containers contain everything a Formula 1 team needs to run a race except the cars. These containers contain garage equipment, catering equipment and everything necessary to build your motor at the race track.

European races are much easier to manage as they are one after another and all tracks are accessible by road. Each formula 1 team has a few trucks that transport all their equipment from race track to race track.

The cars are not transported by truck or ships. These cars cost in the millions of Euros. Extreme care is taken of them and they are transported from race to race with chartered planes. After each race these cars are flown back to the factory where they are serviced and once they are serviced they are flown to the next race track.

4.2 Engineering

Formula 1 is an engineering marvel. There are many specialists within their respected fields all working on a singular goal to make the car go faster. These massive engineering teams are split up into two groups. The first group is working on the current season's car while the second group is working on the car for the next season. Your team should at least have the following departments: Aerodynamics, Engine, Electronics and Chassis. If your team has a higher budget you would have many more departments and sub-departments.

4.3 Testing

The two main ways you can test if your components you develop for the car will make your cars go faster is by using computer software simulations or the more accurate method is testing them in a wind tunnel. There are restrictions in the regulations on how many times you can run your wind tunnel in a season (400 times per season). You should make sure that your team is using your wind tunnel tokens efficiently and not wasting them.

4.4 Simulators

It is essential for your team to have an extremely sophisticated and reliable simulator. These simulators are used to test new components and the drivers use them to familiarise themselves with tracks.

4.5 Racing Strategy

Your race strategy is extremely important and your team has an entire team of strategists. This strategy must be decided well in advance before each race. All the Formula 1 teams use the same tyre supplier and they require you to give your order of what compounds you would need for each race a month before the race. Each race has 3 different compounds: soft, medium and hard. This is important as each car is only allowed 5 sets of tyres for each race. Your strategists are also in close communication with your engineering teams as they work on deciding what component specs they would need for each race.

4.6 Racing

A race weekend starts on Friday and ends on Sunday. On Friday and Saturday morning is free practice, this is when the drivers get to learn the track and engineers get to test the car and new parts on track. Saturday afternoon is qualifying. During qualifying each car will set timed laps and with these times from the timed laps the grid order is set. On Sunday is the race and your team's goal is to score maximum points. Points are assigned as follows:

- 1st: 25 points
- 2nd: 18 points
- 3rd: 15 points

- 4th: 12 points
- 5th: 10 points
- 6th: 8 points
- 7th: 6 points
- 8th: 4 points
- 9th: 2 points
- 10th: 1 point

Refer to `https://en.wikipedia.org/wiki/Formula_One_racing` for a detailed set of rules.

5 Tasks

Task 1: Design ..... (20 marks)

1.1 Identify the functional requirements

1.2 Design the processes using Activity diagrams

1.3 Decide on the patterns to address the functionality defined by the functional requirements and processes

1.4 Design the classes for each of the identified patterns taking their interrelationships into account

1.5 Draw a class diagram of your system and submit it as Practical Assignment 5 (PA05).

1.6 Draw Sequence and communication diagrams showing the message passing between objects.

1.7 Design state diagrams showing how an object (which could also be a composite) changes state.

Task 2: Implementation ..... (50 marks)

Implement and test the code for each class and grouping of design pattern participants before integrating the classes of the design patterns into the project.

Task 3: Report ..... (30 marks)

A report stating how you applied the design patterns to address the functionality required by the system. This report should include UML diagrams to augment the explanation. This Task goes hand-in-hand with the Design task. Much of the design must be reported on in this task.

6 Submission Instructions

Submit the following in an archive to the ClickUP submission slot before the deadline. Failure to upload the project to ClickUP will result in the team receiving 0.

- Your system, this includes all your source files (that is `.h` and `.cpp`) and your Makefile, in a folder called `System`.
- Any data files you may have created and are needed to run your program in a `Data` folder.
- A readme (`readme.txt`) explaining how to compile and run the program and the placement of any data files you may have created.
- The report in a folder named `Report`. The report must be written in Google Docs and a link to the Google Docs version of the report included in the PDF version of the document.

You will be required to demonstrate your system during the last week (that is the week of 9 November) of the semester.