

Introduction

First of all, I need to read through the requirements document and try to understand the facts and requirements. And also learn to understand the F1 terms, such as pit stops, grip loss, lap time, soft/ medium/ low compounds, linear phase and high-wear phase, etc.

The next thing is to write down everything the facts that I found on the requirements. The following is an example of the list of facts in the requirements document.

To calculate **the fuel effect**,

$$\text{Fuel effect} = (\text{Current fuel} / (6 * \text{total fuel})) + 0.83 = 0.83 \leq \text{Answer} \leq 1.0$$

- **Soft: 2.0, 0.02, 1.8, 1.55**
- **Medium: 1.5, 0.015, 1.3, 1.3**
- **Hard: 1.0, 0.01, 0.8, 1.25**

The next step is to write the skeleton structure of three classes (tyre, strategy and strategy annealer and the functions included in these classes).

There are three main classes.

Tyre class, strategy class and strategy_annealer class.

Firstly, set all the constant values.

Initial fuel load is 105 kg

Base lap time is 90 seconds

Total lap is 60

Fuel used per lap is 1.72

Pit stop time is 24 seconds.

Tyre Class

Tyre class has all the settings for tyres and laps time.

Init function accept the (tyre type) parameter and pass this value to change tyre function. And reset the tyre and other tyre and start loading the fuel with 105.

Eq function checks all four parameters of the two tyres are the same or not. If it is the same, returns true. If not, return false.

Add_lap function accepts current fuel and the fuel effect is calculated using the formula according to current fuel. This function measures the grip loss per lap as linear phase or high wear phase according to degradation and fuel effect. This is an important function because it measures all the grip loss for each lap.

In linear phase, grip loss is above switch point, thus, the grip loss is simply decreased by degradation and fuel effect.

In high wear phase, between switch point and 0.2, grip is decreased by switch degradation and fuel effect.

If grip is less than 0.2, then the tyre cannot be used and must change it to a new one because it is considered as no grip at all.

After that, reduce the fuel load by 1.72 kg in each lap.

Calculate lap time function starts with the base lap time, 90 seconds per lap. If the grip is 0.2 and above lap time is subtracted by the grip and if the grip is lower than 0.2, lap time is restarted with the value of 2 + lap time. (assume that the tyre has changed.)

For fuel, it starts with full fuel load and not deducted from lap time when the fuel load is full. If fuel is zero, lap time is subtracted by 2. If the fuel is between 1 and 105, lap time is deducted by twice fuel load.

Change tyre function accepts tyre type and set the four parameters of the tyre according to tyre types. Then it prints the changed tyre type. This function is also used when there is a pit stop in the lap to change the tyre type.

Reset function resets all four parameters to their initial states. This function is used not only for initial reset of the tyre type also used for resetting the tyre when the tyre type is changed at the pit stops in the laps.

Other tyre reset function is the same as tyre reset function. This is to reset all other tyres in order to use in the equality (eq) function.

Strategy class

Strategy class initialise with four parameters, initial tyre type, total number of pit stops, pit stops in laps, and chosen pit tyre types. An array storing each lap time is created and initialised.

In **is valid strategy function**, rules of the race are set. There must be at least one stop in the race. In pit tyre array, there must have at least two elements meaning we must use at least two different tyre compounds. Pit stops cannot be in the first lap or in the last lap. Pit stops must increase monotonically meaning the second pit stop must be in the later lap than the first pit stop. If one of these conditions are not met, the function returns false and if all the conditions are met, it will return true.

Simulate race function controls the entire race condition. It creates a tyre object and reset all tyres to their initial state and load the fuel with 105 kg. Then, check if the race strategy is valid or not according to constraints in valid strategy function.

And set the race to 60 laps (lap 0 to lap 59). Call the functions calculate lap time and add lap. Check if we found the pit stop in the current lap, add 24 seconds and change the tyre type according to pit tyres array. Then reset all tyres to new tyre type and recorded the current lap time into lap time array.

And print out all the statistics of the race. Here, I added round function and set for four decimal places for simplicity.