Racing is about mastering the race track, perfect car control, high-speed decision making and risk taking. Race drivers are constantly working to improve their physical and mental strength \citep{Ebben2010}. In many racing series the track testing time is limited. This has led to an increased focus on simulators \citep{MercedesF1}. Simulators offer experience to the drivers and data to the engineers. The technology is similar to commercial racing games but the level of detail is no way comparable. Motorsport teams and car manufactures are constantly pushing their boundaries which leave a lot of room for innovations in the simulation and video game market. Simulator games offer ways to play inside the recreated reality \citep{Kapell2013}.

While simulators can be used for driver education, optimize car setups in racing and car development, racing games are only used for entertainment. To combine the educational aspects of driving simulators with the enjoyment created by racing games we have developed a universally applicable method to improve enjoyment, education and performance in racing simulators.

Figure~\ref{fig:rel:overviewobjectives} illustrates the theoretical background of the work. We mix traditional approaches of improving enjoyment in games with an algorithm to automatically adjust the difficulty to improve motivation.

We created a prototype that demonstrates the functionality of the implemented tools to create, enforce and measure enjoyment, education and performance of drivers. Our prototype provides a realistic environment for the evaluation of driver performance.

## Goals and Objectives

The barriers between driving simulation and real world driving are blurring. The tools we use to perform better in racing games may be implemented in future cars. Car manufactures already develop virtual assists, like racing lines with braking guidance and ghost cars \citep{Rezaei2017}. We focus on the improvement of entertainment and performance in educational driving games. For the creation of our Virtual Rival prototype the game engine Unity has been used. Unity provides tools to design immersive experiences and game worlds, as well as developer tools to implement high-performance game logic \citep{Unity2019}. The development of Virtual Rivals in Unity includes:

* Research factors that improve enjoyment, performance and education.
* The implementation of a prototype racing game that supports and motivates drivers.
* The evaluation of the created prototype and psychological effects on the drivers.

The development of Virtual Rivals should display a first prototype of how to improve racing games and simulators. The created tools can are especially designed be resource-saving and simple to implement.

## Methodology and Structure

This thesis is divided into three main parts. The first part outlines the theoretical background of the work (see Chapter~\ref{sec:rel:background}). The second part focuses on the practical approach (see Chapters~\ref{sec:drq:designrequirement} and~\ref{sec:imp:implementation}). The third part addresses a first evaluation of the racing simulation prototype (\ref{sec:evl:evaluation}). Figure~\ref{fig:rel:thesisstructure} gives an overview of the isolated steps of this work.

Chapter~\ref{sec:rel:background} comprises a literature review on racing games, learning and the various aspects of psychology involved in enjoyment and motivation. First we discuss the traits of traditional racing games and simulators. After a brief introduction of common psychological models in games, we focus on what creates enjoyment, motivation and a good learning environment in driving. After that, we discuss key game design principles and how they relate to player enjoyment. Finally, we describe different technologies and algorithms related to learning, motivation and enjoyment and how they can be integrated in racing games.

Chapter~\ref{sec:drq:designrequirement} identifies the requirements and lists the different challenges of the \textit{Virtual Rival} design, with a focus on learning, motivation and enjoyment. On this basis, \textit{Unity} is subsequently selected as the appropriate platform for building the project. To conclude the chapter, the conceptional architecture and developed tools are outlined. Special attention is paid to the competitive skill adjustment module.

Chapter~\ref{sec:imp:implementation} introduces the developed Virtual Rival modules and how they fulfil the defined requirements. We introduce the specific structure and functionality of each module and how they work together. This chapter should form a good understanding on how a competitive, motivating and exiting racing game can be developed.

Chapter~\ref{sec:imp: evaluation} describes the preliminary evaluation of the developed Virtual Rival driving simulator. We conducted a study to estimate the effect on Education, Motivation and Enjoyment. We outline the procedure, methodology and the tasks for the participants. Furthermore, we present the psychological questionnaires for Enjoyment and Motivation. At the end we summarize and discuss the results of the user study.

Chapter~\ref{} explains different advancements. Furthermore, we outline different ideas for future development.

Chapter~\ref{} sums the results up. We also outline potential outcasts.