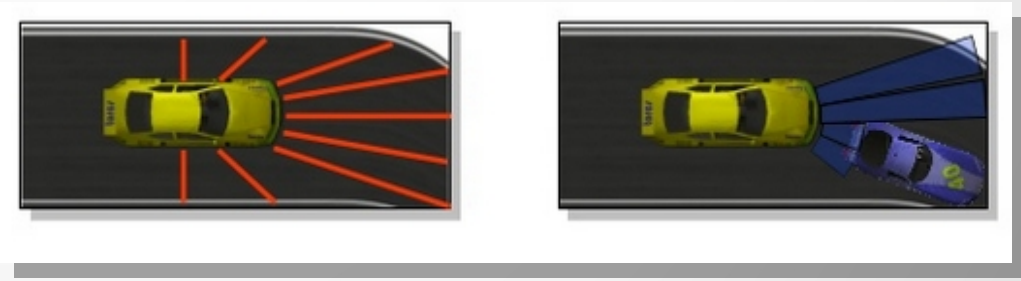
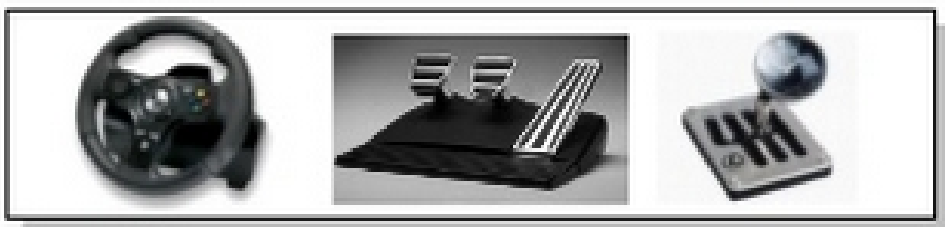
SCRC 2015 @ GECCO

Introduction

- The competitors are asked to design a controller for a racing car that will compete on a set of unknown tracks.
- The controllers perceive the racing environment through a number of sensors
  - the track limits, the position of near-by obstacles,
  - the car state (the fuel level, the engine RPMs,
  - the current gear, etc.),
  - and the current game state .

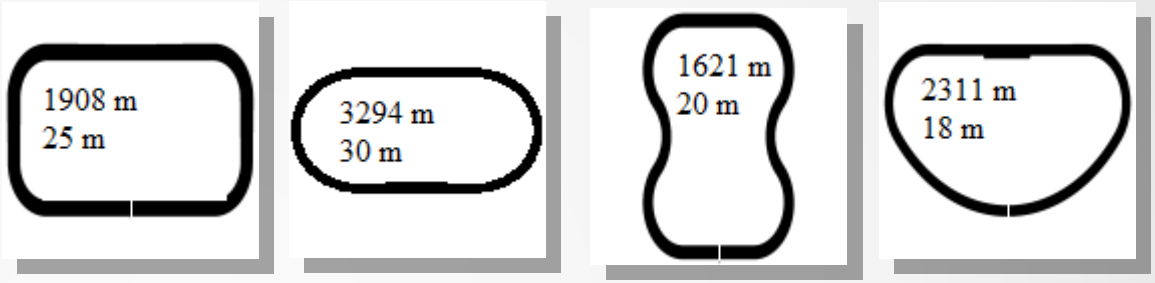


- The controller can perform the typical driving actions
  - clutch, changing gear, accelerate, break, steering the wheel, etc.



Competition Setting

- Software setting is based on a modifed version (SCR patched) of the open car racing simulator (TORCS)
- 2 Modes
  - No sensor noise
  - 10% noise is applied to sensors
- 12 Tracks
  - 12 tracks representing different road conditions (previously unknown to the drivers)



- 3 Stages
  - **Warm up** : For each track **5 laps** are given to each driver to learn the track or do any tuning.
  - **Qualify** : Drivers race alone on each track for **5 laps**.
  - **Race** : Drivers race together for **5 laps**. The starting position is based on the results of the qualify stage for each track.
- **Formula 1** evaluation system

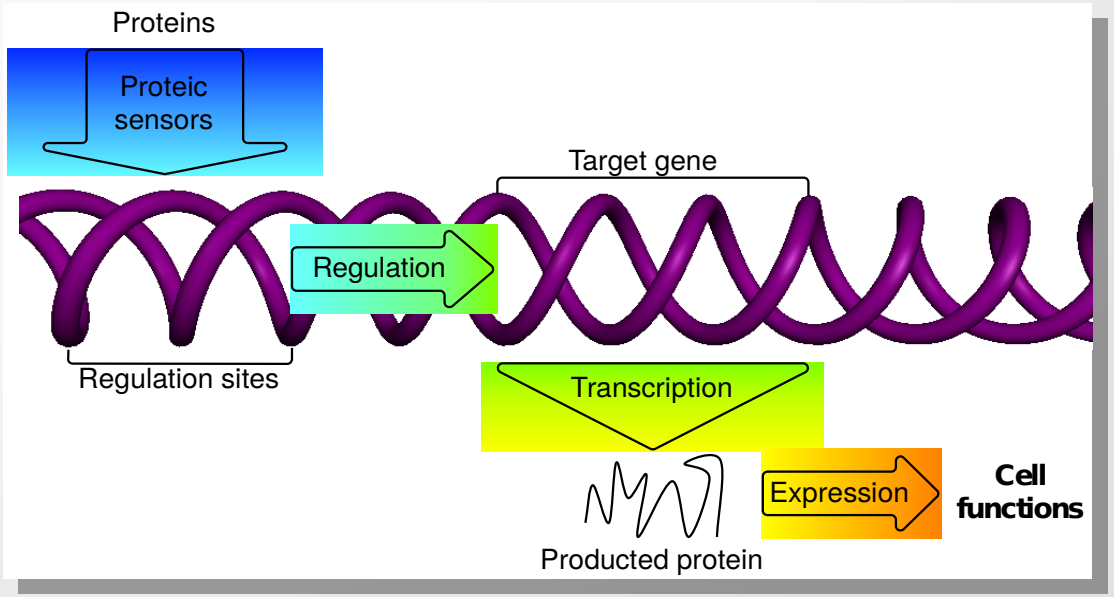
Competitors

- GRN Driver
- Mr.Racer 2015
- SnakeOil
- Need4SS
- EC-SCR
- Autopia (reference entry- noisy mode)
- Ahura 1.1 (reference entry - noiseless mode)

GRN Driver by Stéphane Sanchez, SylvainCussat-Blanc & Jean Disset University of Toulouse, France

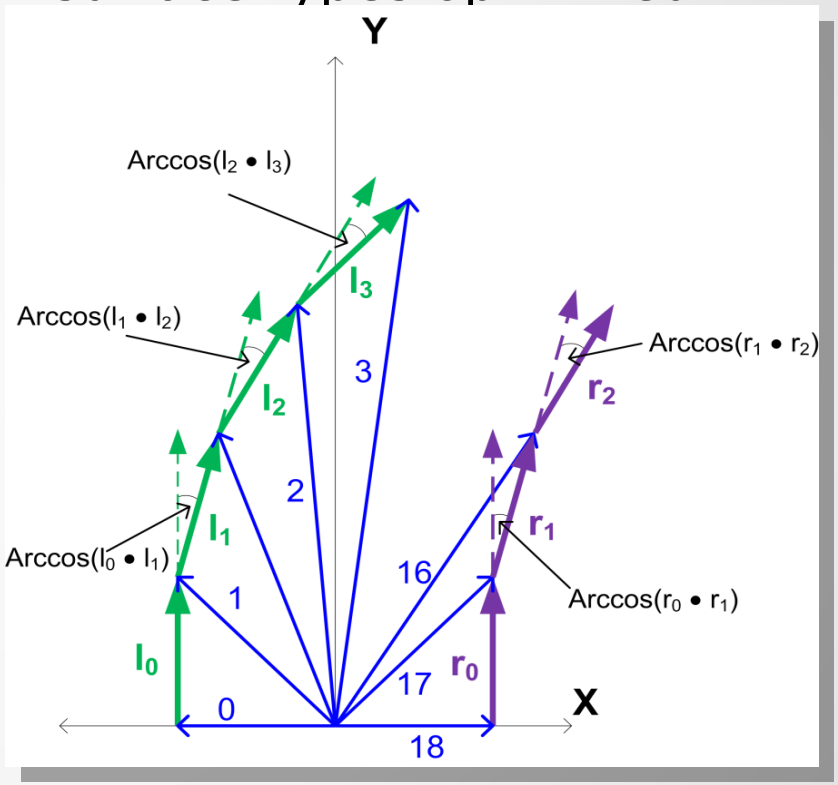
A Gene Regulatory Network (GRN) regulates the car steering and throttle.

- A GRN is a network of proteins (inputs, outputs and regulatories).
- Each protein regulates the production of the other ones according to their affinities.
- Proteins are encoded in a genome and are evolved by a standard GA. Hence, naturally adaptative.



Mr.Racer 2015 by Jan Quadflieg, Tim Delbruegger, Kai Verlage and Mike Preuss, Dortmund University, Germany

- Four sets of 28 parameters for different surface types optimized offline with the SMS-EOA
- Learns the track during warm up
- Law pass filtering for noise handling
- Observer module recommends
  - overtaking lines,
  - blocking lines or
  - target speeds



- Planning module incorporates recommended target speed and racing line into the plan

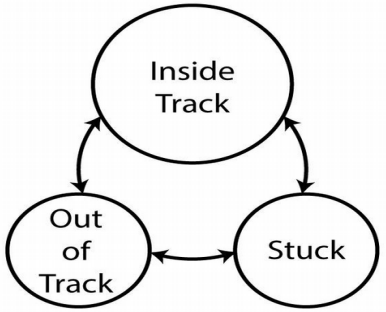
SnakeOil by Chris X Edwards

- A python client interface for the SCRC server
- A driver developed based on this client interface
- More information at http://xed.ch/project/snakeoil/

Need4SS

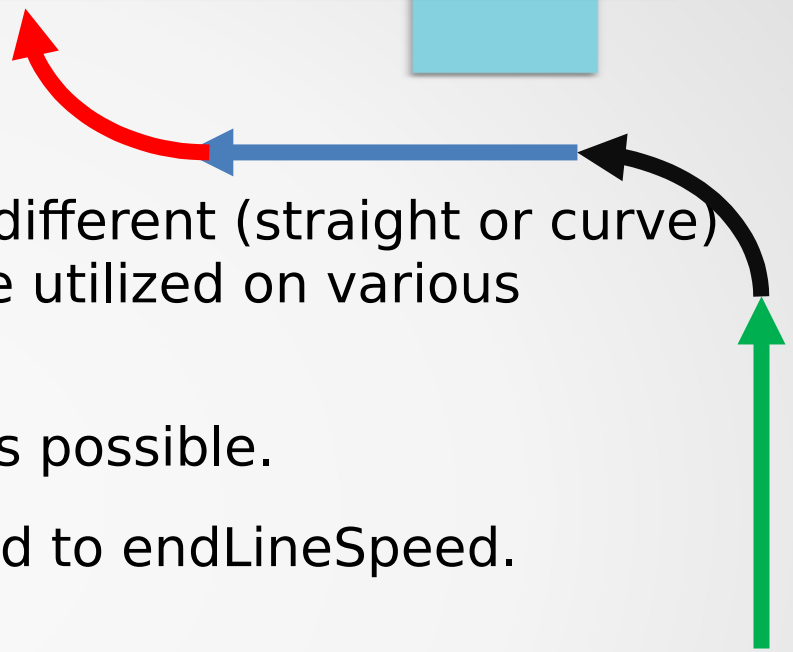
by Bruno Macedo, Gabriel Araujo, Gabriel Sousa, Guilherme Ramos, Matheus Crestani, and Yuri Galli, University of Brasilia, Brasil

- The controller was developed using a Finite State Machine.
- GA was applied for tuning Need4SS's parameters.
- Evaluation considered 3 different sets of tracks aiming to maximize the sum of distances covered for all tracks.
- Online Learning:
  - track category analysis for deciding on controller for race;
  - mapping of critical track sections for adaptive behavior.

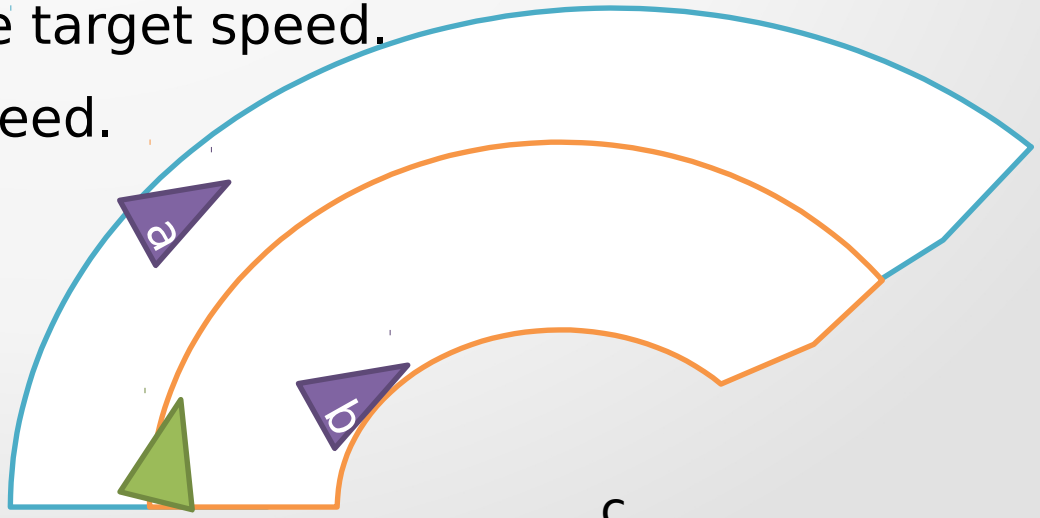


EC-SCR

by Samaneh Salimian, Xuying Yao, Afarin Rajabzadeh, Fatimah Alshehri and Sohaib Irshad, University of Adelaide, Australia



- Learns the track by splitting track into different (straight or curve) segments so that several strategies are utilized on various segments.
- On straight line segments run as fast as possible.
  - at the end of segment, reduce speed to endLineSpeed.
- On curve segments
  - near track middle, increase target speed.
  - out track, reduce target speed.



Autopia (Reference entry) by Enrique Onieva Caracuel, Tech Mobility & University of Deusto, Spain

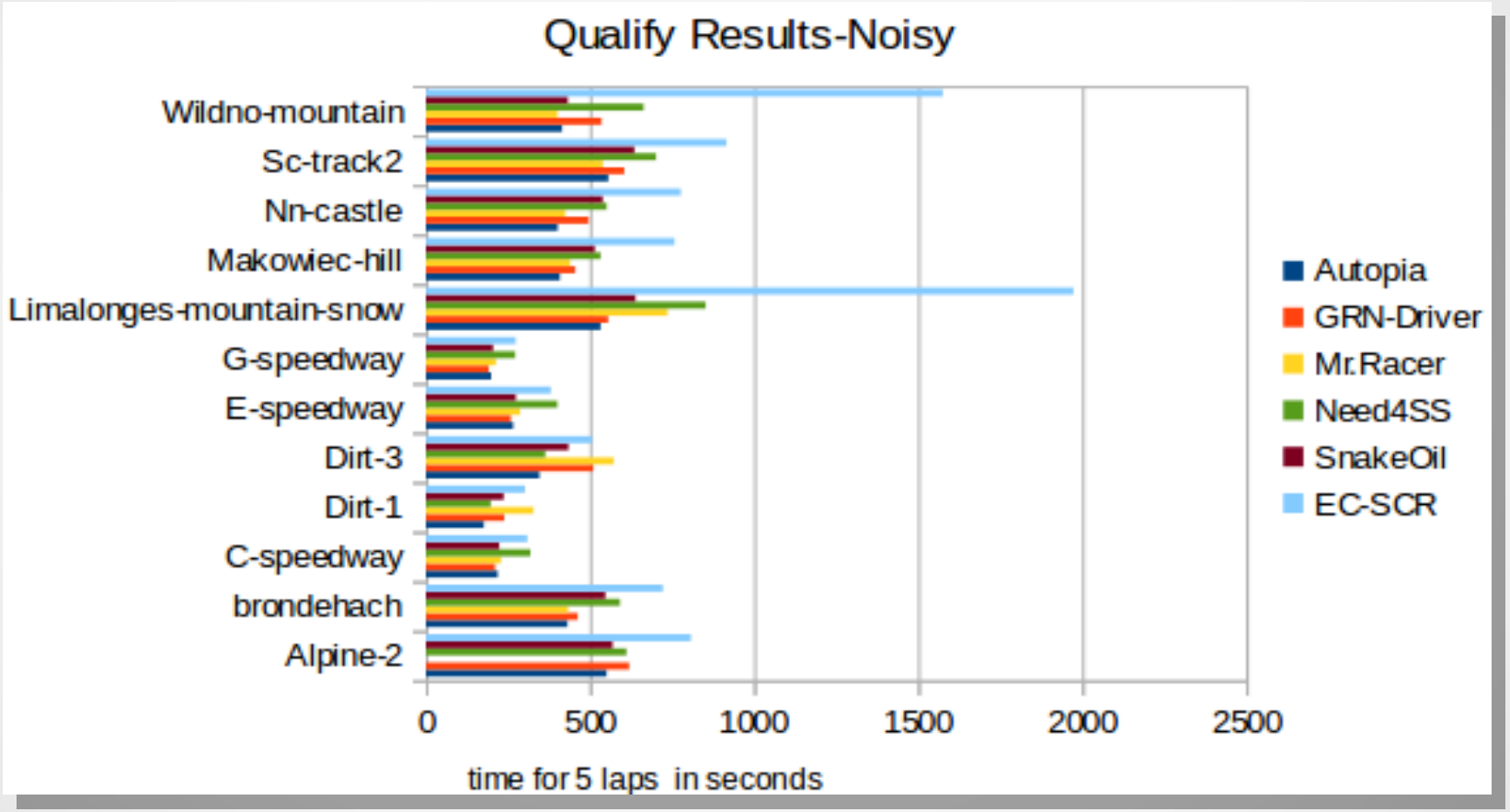
- Three basic modules:
  - Gear control:
    - Basic gear control based on rpm
    - Simple stuck detection and management
  - Steering control
  - Speed control
- Opponents Module:
  - Acts on steering and brake signal to overtake opponents and avoid collisions.
- Learning Module in Warm-up Stage
  - Factor over the target speed in certain track segments
- The version used for SCRC 2013 is considered for SCRC 2015.

Ahura 1.1 (Reference entry)

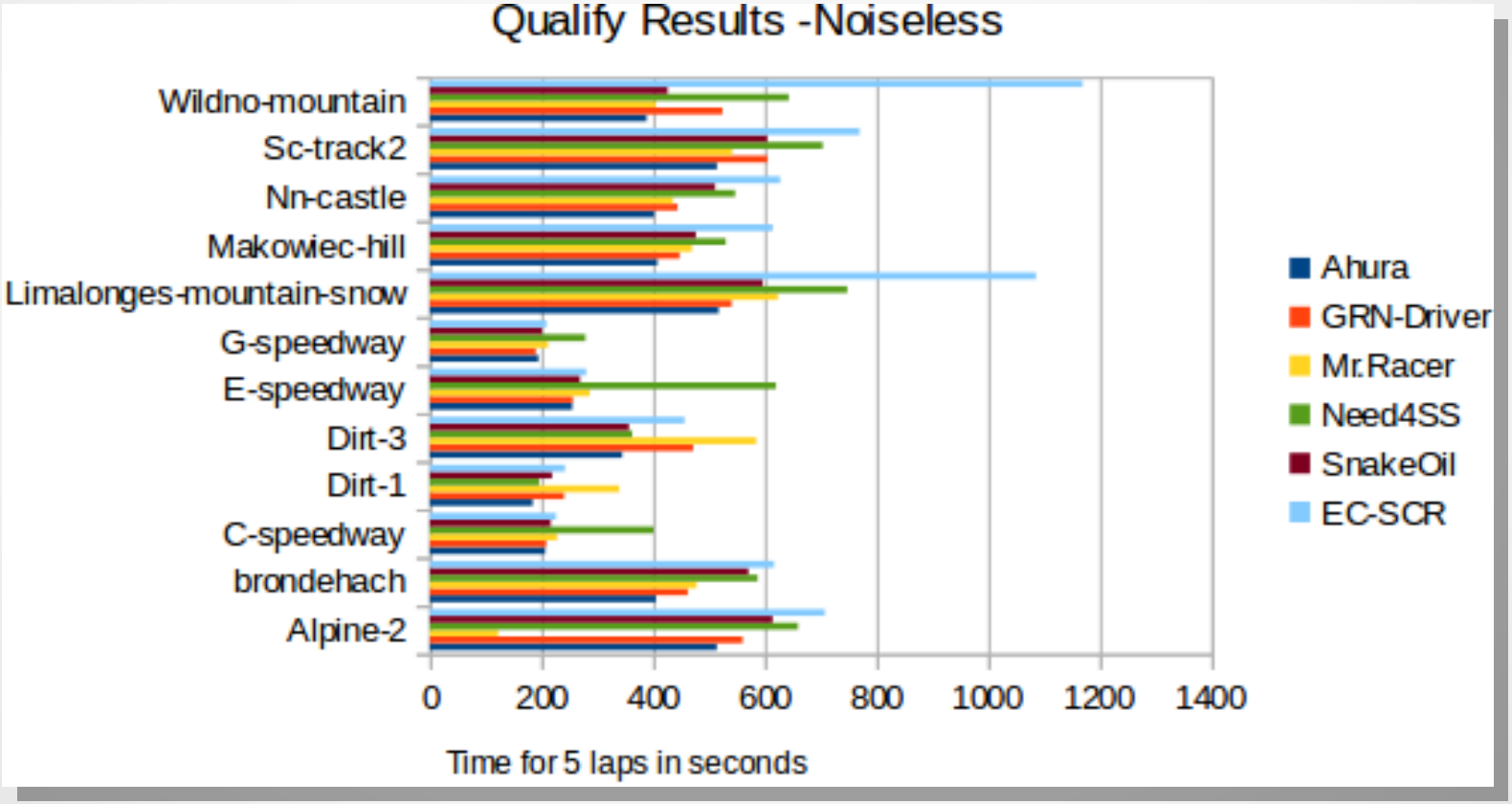
by Mohammad Reza Bonyadi, Zbyszek Michalewiz, Samadhi Nallaperuma and Frank Neumann, University of Adelaide, Australia

- Offline parameter tuning using an evolutionary stratergy
  - Tunes parameters that are used to control a car, such as clutch, steering, brake, gear, and acceleration pedal.
- Online parameter adaptation
  - during the run based on the friction of the road (determined by a supervised neural network) and sharpness of the turns.
- Learns the track during the warm up.
- More information at https://sites.google.com/site/mohammadrezabonyadi/standarddatabases/simulated-car-racing

Competiton Results – Qualify Stage



Competiton Results – Qualify Stage



Competition Results – Race Stage

- Noiseless mode

track\driver	Ahura	GRN-Driver	Mr.Racer	Need4SS	SnakeOil	EC-SCR
Alpine-2	rank 1 - points 25	rank 2 - points 18	rank 6 - points 8	rank 5 - points 10	rank 3 - points 15	rank 4 - points 12
brondehach	rank 1 - points 25	rank 3 - points 15	rank 2 - points 18	rank 5 - points 10	rank 4 - points 12	rank 6 - points 8
C-speedway	rank 1 - points 25	rank 2 - points 18	rank 4 - points 12	rank 6 - points 8	rank 5 - points 10	rank 3 - points 15
Dirt-1	rank 1 - points 25	rank 5 - points 10	rank 6 - points 8	rank 2 - points 18	rank 4 - points 12	rank 3 - points 15
Dirt-3	rank 1 - points 25	rank 6 - points 8	rank 5 - points 10	rank 2 - points 18	rank 3 - points 15	rank 4 - points 12
E-speedway	rank 2 - points 18	rank 1 - points 25	rank 4 - points 12	rank 6 - points 8	rank 5 - points 10	rank 3 - points 15
G-speedway	rank 2 - points 18	rank 1 - points 25	rank 4 - points 12	rank 6 - points 8	rank 5 - points 10	rank 6 - points 8
Limalonges-mountain-snow	rank 1 - points 25	rank 2 - points 18	rank 4 - points 12	rank 5 - points 10	rank 3 - points 15	rank 6 - points 8
Makowiec-hill	rank 1 - points 25	rank 2 - points 18	rank 4 - points 12	rank 5 - points 10	rank 5 - points 10	rank 6 - points 8
Nn-castle	rank 1 - points 25	rank 3 - points 15	rank 2 - points 18	rank 4 - points 12	rank 5 - points 10	rank 6 - points 8
Sc-track2	rank 1 - points 25	rank 3 - points 15	rank 2 - points 18	rank 5 - points 10	rank 4 - points 12	rank 6 - points 8
Wildno-mountain	rank 1 - points 25	rank 4 - points 12	rank 2 - points 18	rank 4 - points 12	rank 3 - points 15	rank 6 - points 8
total - points	286 points	197 points	158 points	134 points	146 points	110 points

Competition Results – Race Stage

- Noisy mode

track\driver	Autopia	GRN-Driver	Mr.Racer	Need4SS	SnakeOil	EC-SCR
Alpine-2	rank 1 - 25 points	rank 3 - 15 points	rank 6 - 8 points	rank 2 - 18 points	rank 4 - 12 points	rank 5 - 10 points
brondehach	rank 1 - 25 points	rank 3 - 15 points	rank 2 - 18 points	rank 5 - 10 points	rank 4 - 12 points	rank 6 - 8 points
C-speedway	rank 3 - 15 points	rank 1 - 25 points	rank 4 - 12 points	rank 6 - 8 points	rank 5 - 10 points	rank 2 - 18 points
Dirt-1	rank 1 - 25 points	rank 5 - 10 points	rank 6 - 8 points	rank 2 - 18 points	rank 4 - 12 points	rank 3 - 15 points
Dirt-3	rank 1 - 25 points	rank 4 - 12 points	rank 5 - 10 points	rank 2 - 18 points	rank 3 - 15 points	rank 6 - 8 points
E-speedway	rank 2 - 18 points	rank 1 - 25 points	rank 5 - 10 points	rank 6 - 8 points	rank 3 - 15 points	rank 4 - 12 points
G-speedway	rank 1 - 25 points	rank 2 - 18 points	rank 4 - 12 points	rank 5 - 10 points	rank 6 - 8 points	rank 3 - 15 points
Limalonges-mountain-snow	rank 1 - 25 points	rank 2 - 18 points	rank 3 - 15 points	rank 5 - 10 points	rank 4 - 12 points	rank 6 - 8 points
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Nn-castle	rank 1 - 25 points	rank 3 - 15 points	rank 2 - 18 points	rank 4 - 12 points	rank 5 - 10 points	rank 6 - 8 points
Sc-track-2	rank 1 - 25 points	rank 3 - 15 points	rank 2 - 18 points	rank 5 - 10 points	rank 4 - 12 points	rank 6 - 8 points
Wildno-mountain	rank 1 - 25 points	rank 4 - 12 points	rank 2 - 18 points	rank 5 - 10 points	rank 3 - 15 points	rank 6 - 8 points
total points	283 points	198 points	155 points	144 points	148 points	128 points

Winners

- Second runner up – SnakeOil
- First runner up – Mr.Racer 2015
- Winner – GRN Driver

Congratulations !!!

Sponsors

- Complexica - http://www.complexica.com/
- School of Computer Science, University of Adelaide, Australia - https://cs.adelaide.edu.au/

Organizers

- Mohammad Reza Bonyadi, Samadhi Nallaperuma and Frank Neumann from Optimization and Logistics, University of Adelaide, Australia
  - http://cs.adelaide.edu.au/~optlog/index.php
- Daniele Loiacono from Politecnico de Milano, Italy
  - home.deib.polimi.it/loiacono/

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- SCRC organizers thank **GECCO 2015** organizers and the competiton chair **Mike Preuss** for the giving the opportunity to host the competiton at GECCO and providing kind support throughout the competition.

Reference

- Competiton website
  - http://cs.adelaide.edu.au/~optlog/SCR2015/index.html

Thank you!