

Programming

The programming component allows teams to develop and showcase their ability to program a robot so that it can perform a series of tasks autonomously. Teams run their programs on a robot provided by CRC Robotics and are evaluated on the performance of the code as it achieves the required tasks. Refer to the Survival Guide for tips and suggestions.

5.1 Scope

5.1.01 Goal

This year's edition of the programming component is "out-of-the-box". Instead of solely relying on pure coding and programming platform knowledge, it mixes mathematics, algorithms, game theory, and psychology in a true multidisciplinary CRC Robotics way.

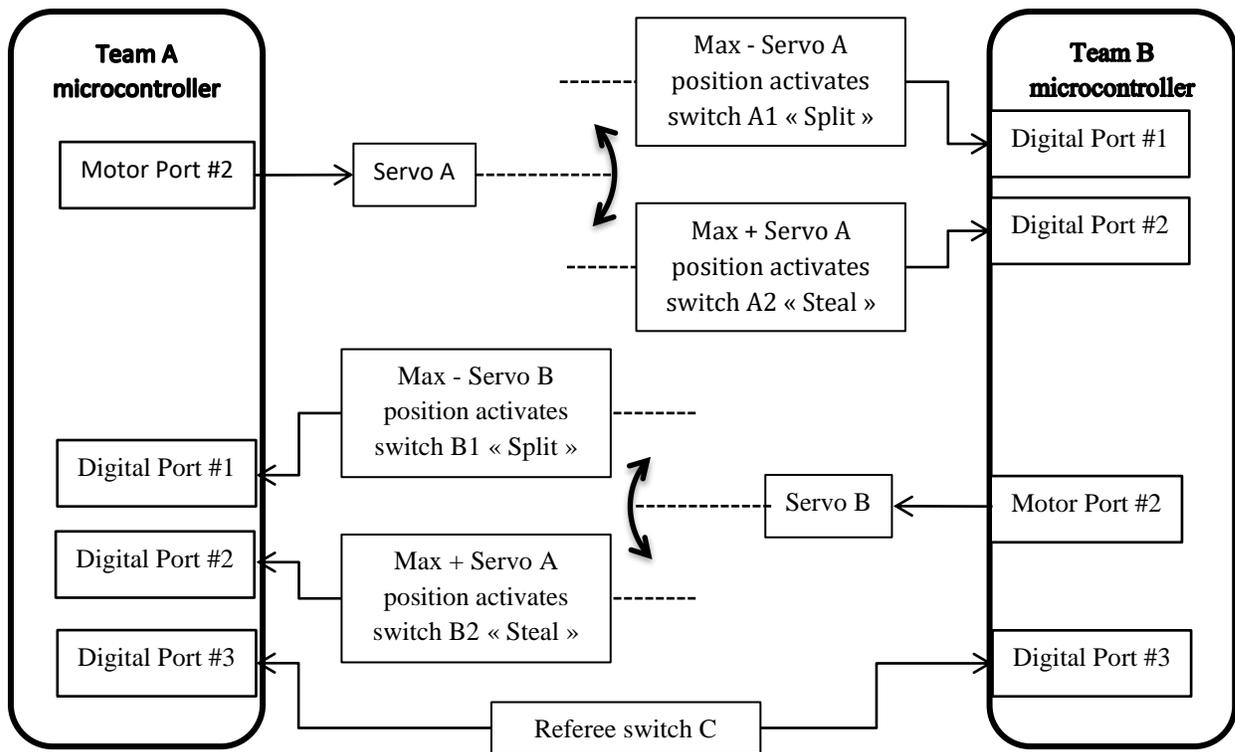
5.1.02 Summary

Teams will face each other in a Swiss-style bracket tournament, with the robots playing "Split or Steal", a head-to-head game version of the prisoner's dilemma, where two competitors play against each other to accumulate the highest possible final score in a heat.

5.2 Platform

5.2.01 Components

Opposing teams, A and B, face each other using 2 independent microcontrollers. Team A controls a servo-motor that, when rotated to its maximum positive value, activates switch A1 ("Split") and that, when rotated to its maximum negative value, activates switch A2 ("Steal"). Team B controls a servo-motor that, when rotated to its maximum positive value, activates switch B1 ("Split") and that, when rotated to its maximum negative value, activates switch B2 ("Steal"). The microcontrollers are wired according to the following scheme:



5.2.02 Microcontroller

The microcontrollers used are VEX ARM Cortex-based Microcontrollers (VEX EDR Part Number: 276-2194).

5.2.03 Servo-Motor

The servo-motors used are 3-wire *hobby* servos (VEX EDR Part Number: 276-2162).

5.2.04 Switch

The switches used are NO (Normally Open) limit switches (VEX EDR Part Number: 276-2174).

5.3 Challenge

5.3.01 Heat Duration

Each heat is composed of 12 to 20 face-offs. The number of face-offs of any given heat is unknown to the teams.

5.3.02 Face-off

A face-off starts with the referee holding down Switch C for 3 seconds. Once Switch C is released, both robots must immediately activate their respective servo so that it presses

either their “Split” or their “Steal” switch. Each robot’s servo must hold down the chosen switch until the referee presses and immediately releases Switch C, indicating the end of a face-off. Once the referee presses and immediately releases Switch C at the end of the face-off, each robot’s servo must return to a neutral position, ready for the next face-off. Instead of a press and immediate release, the last face-off of a heat ends Switch C being held down for 5 seconds. Robots must send their servos to a neutral position at the end of the heat and hold this position even if the referee presses Switch C again.

5.3.03 Scoring

The objective is to accumulate the most points during the face-offs to win the heat. During a face-off, if

- a) both robots select “Split”, each team will acquire 1 point;
- b) one robot selects “Split”, and the other selects “Steal”, the team that stole will acquire 2 points and the team that split will receive 0 points;
- c) both robots select “Steal”, no points are awarded to either team.

The following table summarizes the points awarded depending on the outcome of a face-off. CRC Robotics reserves the right to modify this point table up to two weeks before the Competition.

Team B Team A	Team B Splits	Team B Steals
Team A Splits	Team A receives 1 point Team B receives 1 point	Team A receives 0 points Team B receives 2 points
Team A Steals	Team A receives 2 points Team B receives 0 points	Team A receives 0 points Team B receives 0 points

5.3.04 Penalties and Limit Cases

- a) A two-point penalty is given to a robot if it presses the same switch for more than 3 consecutive face-offs. If the robot keeps pressing the same switch on the 5th, 6th, ..., nth consecutive face-off, the penalty will be given for each of these consecutive face-offs.
- b) If a robot does not press any switch during a face-off or delays the pressing of a switch, it will receive a 2-point penalty while its opponent will gain 2 points. If both robots do not press a switch, they both receive a 2-point penalty.

- c) A 5-point penalty is given to a robot that does not stay in the neutral position after a face-off (before the next face-off begins) or at the end of the heat.

5.3.05 Minimum Score

The minimum score that can be earned by a team for a single heat is -5 points.

5.3.06 Scoring Example

The following is a scoring example. It constitutes an integral part of the rules and acts as a reference for scoring disputes. This heat contains 17 face-offs.

Face-off	Switch pressed by		Points awarded to		Penalty given to		Faceoff score	
	Team A	Team B	Team A	Team B	Team A	Team B	Team A	Team B
#1	None	Split	0	2	-2	0	-2	2
#2	None	None	0	0	-2	-2	-2	-2
#3	Steal	Split	2	0	0	0	2	0
#4	Split	Steal	0	2	0	0	0	2
#5	Steal	Steal	0	0	0	0	0	0
#6	Steal	Split	2	0	0	0	2	0
#7	Steal	Steal	0	0	0	0	0	0
#8	Split	Split	1	1	0	0	1	1
#9	Steal	Split	2	0	0	0	2	0
#10	Split	Split	1	1	0	0	1	1
#11	Steal	Split	2	0	0	-2	2	-2
#12	Split	Split	1	1	0	-2	1	-1
#13	Split	Steal	0	2	0	0	0	2
#14	Steal	Split	2	0	0	0	2	0
#15	Steal	Steal	0	0	0	0	0	0
#16	Steal	Split	2	0	0	0	2	0
#17	Steal	Steal	0	0	-2	0	-2	0
Heat score							9	3

5.4 Logistics

5.4.01 Download Platform

Team A and Team B must use the CRC Robotics computers provided to download their programs into their respective robots. Teams must use their own USB key to transfer their program onto the designated computer for download.

5.4.02 Download Time

Team A and Team B have 2 minutes to download their program into their assigned microcontroller. If both teams indicate they are ready before the 2-minute period ends, the referee can start the heat before the end of the 2-minute period.

5.4.03 Tournament Structure

The preliminary phase is played in the Swiss bracket format, while finals are played in a round-robin tournament format with the top 4 teams from the preliminary phase participating. The complete schedule will be announced in the days prior the Competition on the website: www.robo-crc.ca/participant-portal.

5.4.04 Punctuality

Due to the nature of the bracket-style system, teams must check-in and present themselves at the designated programming competition area within two minutes of the scheduled start time. A team which fails to present itself within the designated start time will forfeit the heat. The team that did not show up will earn -5 points for the heat it did not attend, while the opposing team (the team that was scheduled to play against the “no-show”) will earn 5 points for the heat. Both teams will receive -5 points if they both do not show up to a heat.

5.4.05 Tournament Registration

Due to the planning required to hold a Swiss-style bracket tournament, teams must register to participate in the programming component on the date and platform outlined in the Season Calendar, available in the Foreword of this document.

5.4.06 Ranking

Rankings for teams that do not advance to the finals are based on their performance in the Swiss bracket. The rankings of the 4 teams that advance to the finals will be determined by their performance in the finals.

5.4.07 Total Face-offs Played

The total number of face-offs played during the Preliminary rounds will be the same for each team. The total number of face-offs played during the Finals rounds will be the same for each of the four teams.