Project Title\* (use style: paper title)

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In circuit motorsport, like Formula 1 or Nascar, race strategy, in theory, ensures the shortest time wasted at the pit stop. Depending on the motorsport, during the pitstops, teams will be changing tire compounds, changing drivers, refueling, or repairing the car. Given an assumption of a ‘free track’ meaning no opponents are present on the track, the optimal strategy can be determined by solving a quadratic optimization problem. However, for actual teams competing, this simple approach is insufficient. In motorsport, complex simulations are used to evaluate all possible strategies. In such simulations, the results are used to find the most suitable strategy. This project will focus on the initial stage of strategic decision-making, based on previous lap data. Since this project is based on Formula 1 the algorithm will have to evaluate different compound combinations and provide the user with an initial strategy for the race. The algorithm will be trained using the data from 2014 to 2019 since this was the era when the cars stayed relatively similar.

# Introduction (*Heading 1*)

This template, modified in MS Word 2007 and saved as a “Word 97-2003 Document” for the PC, provides authors with most of the formatting specifications needed for preparing electronic versions of their papers. All standard paper components have been specified for three reasons: (1) ease of use when formatting individual papers, (2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and (3) conformity of style throughout a conference proceedings. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

# Related Work

## Background research

This section focuses on the background of the topic. In the case of this project Data analysis is only used as a tool, therefore will not be referenced further in this section. Related literature reveals that data analytics in sports has become the main focusing point of sport-related research. This is the case due to 2 reasons: increasing availability of accurate related data and success of the Machine learning algorithms that enabled evaluation of said data. Possible targets for analytics in sports include talent recognition, results prediction, performance evaluation, and strategy assessment. As a result, many stakeholders are involved, e.g. teams, commentators, fans and bookmakers.

## Literature review

2.1.1 Horse/ greyhound racing.

Result prediction in betting sports like Greyhound or horse racing has been analysed in multiple publications. Various ML methods were tested, and in all cases, they outperformed human experts in various betting formats. As an example for horse racing [harville] uses a purely mathematical approach to winner prediction, while other work like [13,14] uses NNs in predicting the results.

2.1.2 American Football

ML methods (decision trees, neural networks, support vector machines, etc.) are often used for predicting the outcome of the matches. As an example [Delen et al.] concluded that classification-based predictions are more accurate than regression-based ones. While others, like [ leung et al.] choose to use a statistical method rather than Machine Learning.

2.1.3 Soccer

Machine Learning methods are also commonly used here for the result prediction []. Although there are some tricks and caveats that can be used. For example [Tax et al.] found that cross-validation method does not work with time-ordered data, which is a common occurrence in Sports. Also [ Joseph et al.] concluded that Bayesian networks created by domain experts often outperform data-based models. Other examples involved simulations, like [ Prasetio et al.] combined real-world data with video games to increase the amount of training data for their logistic regression model.

2.1.4 Motorsport

Machine Learning is also a widespread occurrence in motorsports. Every single Formula 1 team uses, some kind of an algorithm, to determine their pit-stop strategies, those algorithms are always kept a secret, and even if they were not, the amount of data the team has during the race, is incomparable with the tiny amount of data available in open-source. This result on very few works being produced on the topic. Most of the examples in Formula 1 focus on predicting the results, like the works of [stoppels], who studied the predictions of race results in the 2017 F1 championship, based on the data known right before the race, as well as race results of the season so far. Lack of data is a significant limiting factor in machine learning approaches for the motorsports. Most of the teams guard their data, together with constant regulations changes, and car development in Formula 1, results in limited datasets for those problems, as the changes in regulations and cars are not always reflective of the way their performance is going to change. Motorsport-related literature most oftenly uses American NASCAR series as a subject for investigation. Some examples include [graves et. Al.) created a probability model to predict final positions in a NASCAR race, while [Pfitzer] predicted the final race outcomes using correlation analysis. Main variables to correlate to the wining position include: car speed, pole position and their qualifying speeds. While [Allander] states that the starting position as well as drivers experience are the most import factors in predicting NASCAR.

2.1.5 Broader result prediction

Previous examples all required a specific sport-domain to be studied. In contrast, several publications studied possibilities of multi-sport predictions. [McCabe et al.] use a Neural Network, that can capture the quality of sport teams in American football, rugby, and football. While [Dubbs] predicts the results of a baseball, basketball, and football games, using a regression model. The overall trend is emphasized in [Haghitat], stating that for most sports lack of publicly available data, making it difficult to discuss the result of different publications.

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2.2 Conclusions

As a conclusion, from engineering perspective, most of the publication focus on either two-class or tree-class classification problems. Many papers like this, focus on feature generation based off the domain knowledge. Most often Machine Learning algorithms are used with the rising popularity of Neural Networks.

From a topical perspective, limited literature is available to analyze in-sport events. Mostly due to sportsmanship and the competition between the teams. The data in this domain is extremely limited, only to results. Most of the Machine Learning algorithms require a certain prediction in-advance, as they have to base their learning on a certain formula. As is the case in this article, the program will focus on evaluating base strategies, which can further be improved upon using Machine Learning.

# methodology

Before you begin to format your paper, first write and save the content as a separate text file. Complete all content and organizational editing before formatting. Please note sections A-D below for more information on proofreading, spelling and grammar.

Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

## Requirements

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

## Design

* Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.
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* Do not mix complete spellings and abbreviations of units: “Wb/m2” or “webers per square meter”, not “webers/m2”. Spell out units when they appear in text: “. . . a few henries”, not “. . . a few H”.

Identify applicable funding agency here. If none, delete this text box.

* Use a zero before decimal points: “0.25”, not “.25”. Use “cm3”, not “cc”. (*bullet list*)

## Implementation

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). To create multileveled equations, it may be necessary to treat the equation as a graphic and insert it into the text after your paper is styled.

Number equations consecutively. Equation numbers, within parentheses, are to position flush right, as in (1), using a right tab stop. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

*a**b* 

Note that the equation is centered using a center tab stop. Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1)”, not “Eq. (1)” or “equation (1)”, except at the beginning of a sentence: “Equation (1) is . . .”

## Testing

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
* Do not use the word “essentially” to mean “approximately” or “effectively”.
* In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

# Results

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

## Experiment results

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Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. Styles named “Heading 1”, “Heading 2”, “Heading 3”, and “Heading 4” are prescribed.

# Conclusions

#### Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1”, even at the beginning of a sentence.

1. Table Type Styles

| Table Head | Table Column Head | | |
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| Table column subhead | Subhead | Subhead |
| copy | More table copya |  |  |

1. Sample of a Table footnote. (*Table footnote*)
2. Example of a figure caption. (*figure caption*)

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Future Work*(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

##### References

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Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors’ names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
6. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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To have non-visible rules on your frame, use the MSWord “Format” pull-down menu, select Text Box > Colors and Lines to choose No Fill and No Line.