RESET

SUBMISSION OF QUESTION 2015/2016

DUE DATE: TUES., OCTOBER 27, 2015

THIS FORM MUST BE COMPLETED PRIOR TO STARTING EXPERIMENTATION. **Your scientific question must be submitted so that your project meets all requirements and guidelines of proper research.**

- **Your question will be submitted under the headings below.**
- **This submission form is interactive which means you will type directly on the form to provide the information needed. *DO NOT* complete by hand. FIRST SAVE A BLANK COPY TO YOUR DESKTPOP THEN COMPLETE.**
- **You will then print out the form and submit the completed form to the teacher.**
- **Print a copy for yourself and file it in your research binder. This form can be saved (save as a blank first).**

Student's Name (Last, First, Middle): Kim, Nathaniel Jongmin

Period: ☐ 6 ☐ 7 ☑ 8 **Grade:** ☐ Freshman ☑ Sophomore ☐ Junior ☐ Senior

Proposed Project Title (Give an appropriate title. It may change later if you think of a better one.)

Predicting El Niño using Evolutionary Algorithms

Category: (Select one of the following.)

- ☐ Animal Sciences
- ☐ Behavioral & Social Sciences
- ☐ Biochemistry
- ☐ Cellular and Molecular Biology
- ☐ Chemistry
- ☑ Computer Science
- ☐ Earth Science
- ☐ Engineering
- ☐ Energy & Transportation
- ☐ Environmental Science
- ☐ Mathematics
- ☐ Medicine & Health Sciences
- ☐ Microbiology
- ☐ Physics and Astronomy
- ☐ Plant Sciences

Research Question: State the scientific unanswered question that you hope to solve by experimentation. You may ask a scientific question or you may make a problem statement.

Can a predictive model of El Niño be developed with the use of evolutionary algorithms?

Independent variable(s): List the factor(s) that you will control or manipulate.

General structures of the algorithm and model; which factors (e.g. SOI, SST indices) are incorporated in the algorithm and model

Dependent variable(s): List factor(s) that respond to control or manipulation. These factors produce collectable data.

Specific model resulting from the algorithm; efficacy and accuracy of the model

Hypothesis(es): Formulate one or more statements that predict the possible outcome(s) of your research. These statement(s) should describe how changing an independent variable will affect the dependent variable.

El Niño can be predicted to some degree using an evolutionary algorithm model, and these predictions can be made more accurate by incorporating more factors.

Control (if applicable): Describe the standard of comparison you will use to assess experimental effects. For example: if you are studying the effects of fertilizer on plant growth, your control is one plant growing without fertilizer.

Other predictive models of El Niño currently in use; various evolutionary algorithm models incorporating different factors

Constants: **List factors that remain the same throughout the experimentation.**

Use of an evolutionary algorithm

Special Categories: **Indicate if your project involves the following (check "YES" or "NO" for each). The page number refers to the page in the INTEL Rules and Guidelines Booklet. Refer to the booklet to get a description of each. Get the booklet from the teacher, or, the full booklet is at the website: http://student.societyforscience.org/forms**

☐ YES	☑ NO	Human Subjects	P. 8
☐ YES	☑ NO	Vertebrate Animals	P. 11
☐ YES	☑ NO	Potentially Hazardous Biological Agents	P. 14
☐ YES	☑ NO	Hazardous Chemicals	P. 18
☐ YES	☑ NO	Hazardous Devices	P. 18
☐ YES	☑ NO	Radiation	P. 18
☐ YES	☑ NO	Prescription Drugs	P. 18
☐ YES	☑ NO	Alcohol and tobacco	P. 18

Is this a continuation of a previous project? ☐ YES ☑ NO

Mentor information: If you are working with a mentor, give the following information:

Mentor's name: --

Title:

Phone number:

E-mail:

INTRODUCTION:

You will submit an introduction which will serve as a background for your research. The section on HOW TO WRITE AN INTRODUCTION" from the Research Manual has been included on the pages at the end of this form. Please follow the Introduction instructions. **PLACE YOUR INTRODUCTION ON THE NEXT PAGE (PAGE 3).**

REFERENCES:

You will include at least three (3) references. These references are sources of information that you used to gather your background information or sources you consulted. These sources may be books, articles, wbsites, research papers, etc. See the notes about citations and references *AFTER* the INTRODUCTION notes at the end of this form. Follow the instructions and look at the examples given. **PLACE YOUR REFERENCES ON THE PAGE AFTER THE INTRODUCTION (PAGE 4).**

INTRODUCTION:

El Niño, one of the major meteorological phenomena of today's world, is a period in which ocean temperatures in the Equatorial Pacific are unusually warm (Tropical Ocean Atmosphere Project) and is more formally defined as the occurrence of a "sea surface temperature departure from normal (for the 1971-2000 base period) in the Niño 3.4 region greater than or equal in magnitude to 0.5 degrees C (0.9 degrees Fahrenheit), averaged over three consecutive months" (NOAA News Online). It is characterized by "unusually high atmospheric sea level pressures… in the western tropical Pacific and Indian Ocean regions, and unusually low sea level pressures… in the southeastern tropical Pacific" (Tropical Ocean Atmosphere Project). El Niño causes increased rainfall across the southern tier of the US and in Peru, which has caused destructive flooding, and drought in the West Pacific, sometimes associated with devastating brush fires in Australia. Unfortunately, these damages linked to El Niño can cause billions of dollars in damages (Pielke and Landsea 2030), making methods of predicting El Niño so important.

There are many different methods which can be used to develop El Niño predictions, one of which is the use of an evolutionary algorithm. An evolutionary algorithm is a method of developing a predictive model and follows the following basic structure (What is an Evolutionary Algorithm?):

1) Generate many random models
2) Test each model for effectiveness/accuracy
3) Create new models using characteristics of the better models of step 2
4) Repeat steps 2 and 3 until desired effectiveness/accuracy is reached

As can be seen, the evolutionary algorithm is named as such due to its similarity with Charles Darwin's theory of evolution.

Previous work has been done demonstrating the effectiveness of an El Niño prediction model which made use of a evolutionary algorithm (Álvarez et al.). However, this work is quite limited. First, the model only looked at the Japan Meteorological Agency (JMA) Index, the sea surface temperature of a region in the tropical Pacific. Other El Niño prediction models use many other factors, such as sea surface temperatures in other regions or air pressure deviations from the norm. Furthermore, the study only produced a model but did not test it for accuracy. These issues could be improved through the incorporation of additional and diverse factors into the model. In fact, by developing different models using different factors, insights regarding the importance of each factor in predicting El Niño may arise. Also, the models could be tested for accuracy by looking at how well they would have predicted past El Niños. Finally, rather than simply predicting the occurrence of an El Niño, the new model could also predict the event's severity—arguably the more important measure.

REFERENCES

"Definitions of El Nino, La Nina, and ENSO." Tropical Ocean Atmosphere Project. Pacific Marine Environmental Laboratory, n.d. Web. 27 Oct. 2015.

Álvarez, Alberto, Pedro Vélez, Alejandro Orfila, Guillermo Vizoso, and Joaquín Tintoré. "Evolutionary Computation for Climate and Ocean Forecasting: “El Niño Forecasting”." Proceedings of the Second International Conference on Euro (1999): n. pag. DIGITAL.CSIC. Web. 26 Oct. 2015.

"NORTH AMERICAN COUNTRIES REACH CONSENSUS ON EL NIÑO DEFINITION." El Nino Definition. NOAA News Online, 23 Feb. 2005. Web. 26 Oct. 2015.

Pielke, Roger A., Jr., and Christopher N. Landsea. "La Niña, El Niño, and Atlantic Hurricane Damages in the United States." Bulletin of the American Meteorological Society (1999): 2027-033. Hurricane Research Division. Atlantic Oceanographic & Meteorological Laboratory of NOAA, 7 Apr. 1999. Web. 26 Oct. 2015.

"What Is an Evolutionary Algorithm." What Is an Evolutionary Algorithm? Department of Computer Sciences at VU University Amsterdam, n.d. Web. 26 Oct. 2015.

INTRODUCTION

Definition The **Introduction** sets the scene for your report. Is a literature and concept review and discusses the results and conclusions of previously published studies to help explain why the current study is of scientific interest. The introduction is organized to move from general information to specific information. The background must be summarized but should not be itemized. Take care not to go too far in providing too much background information. Limit the introduction to studies that relate directly to the present study. Emphasize your specific contribution to the topic.

Contents The **Introduction** should contain:

- Sufficient background information to allow the reader to understand and evaluate the results of your study.
- A brief literature review. Cite and discuss previous research from relevant literature, and state how your research relates to or differs from others' work;
- The rationale for your study. Why did you choose that subject and why is it important? (What prompted your research?)
- A simple statement of the most important point(s) that you will address in your paper.

Rules The **Introduction** should:

- Proceed from the general to the specific. It should introduce the problem, present necessary background information, show the continuity between previous work and the work you did, and indicate what you hope to achieve (lead into why the present study was done).
- Include only background information and studies that are relevant to the present study. ***Do not*** try to include everything that you know about the topic.
- Cite the relevant literature sources in the text.
- Assume that the reader is scientifically literate but not familiar with the specifics of the study.

Checklist When finished, check the following:

- Is there a critical mass of published articles?
- Is the literature correctly cited?
- Is the previously cited literature developed into a paragraph(s) organized in a logical progression (i.e. general to specific) leading to the present research effort?

HOW TO CITE SOURCES IN THE INTRODUCTION SECTION (Refer to and use the MLA format.)

Introduction It is important to cite sources in the introduction section of your paper as evidence of the claims you are making. There are ways of citing sources in the text so that the reader can find the full reference in the literature cited section at the end of the paper, yet the flow of the reading is not badly interrupted. All scientific papers rely to some degree on previously published work. When a fact or an idea is borrowed (whether directly or paraphrased) from another source, it must be acknowledged, or cited, in the text and the origin of the information must be revealed.

Definition A **citation** is the formal acknowledgement within the text. The citation serves as a link between the text in which it appears and the formal, alphabetical list at the end of the paper called ***REFERENCES*** (Ebel, 1987). All citation in text must appear in the ***REFERENCES***; and all references in the list must be cited in the text. A references list differs from a Bibliography, in which you list everything you have read, whether it is cited or not.

Citing in Text There are several systems for formatting citation in text and References, including the American Psychological Association (APA) and **Modern Language Association (MLA**). The **MLA** format is the one you most commonly use in your English and Language classes. You should know how to cite references in text and how to list references.
Shown below is an example of citations in a written project report and also the **References** page (using the MLA format).

Consistency Use the **MLA** style and make sure you remain consistent with the selected style guide.

SHOWN BELOW IS *A PORTION* OF AN INTRODUCTION FROM A STUDENT RESEARCH PAPER. BELOW THAT IS THE REFERENCE OR CITATION PAGE AT THE END OF THE PAPER. NOTE HOW THE REFERENCES ARE CITED IN THE TEXT BY THE USE OF PARENTHESIS AND HOW THE PAGE NUMBER IS NOTED.

Example –Part of an Introduction with citations:

Currently, there is great concern about flooding the wild gene pool with a more restricted selection from hatchery stock. However, for this to occur, cultured individuals must escape, survive in an unfamiliar environment, and breed successfully with indigenous species (Skaala 77). The impact of cultured fish escapees is dependent on several factors, especially at what life stage they escape. Individuals released at an earlier point in life have a better chance at survival, as they have more time to adapt before reproducing (Skaala 83). If inputs of cultured fish are frequent, as is often the case in the real world, the gene pool of native species will be reduced, even with the lowered reproductive success of farmed fish. (Gumpie's Guide to Fish 34)

EXAMPLE OF REFERENCES **The references go at the end of the research paper.**

References

Bugg, R. L, C. S. Brown, and J. H. Anderson. "Restoring Native Perennial Grasses to Rural Roadsides in the Sacramento Valley of California: Establishment and Evaluation." *Restoration Ecology 5*. 1997: 214-228.

"Cover Crop Fundamentals." Ohio State University Department of Horticulture and Crop Science. http://ohioline.osu.edu/afg-fact/0142.html

"Gumpie's Guide to Fish." The Fava Project. http://members.efn.org/~rossr/cont/html

Ghoshal, Kalpana., Samson T. Jacob. "Ara-ATP Impairs 3'-end Processing of Pre-mRNAs by Inhibiting both Cleavage and Polyadenylation." Oxford University Press 19: 21 (1991) 5971-5875.

"Legume Seed Inoculants." Colorado State University. http://ext.colostate.edu/pubs/crops/00305.html

Martin, Georges., Andreas Moglich, Walter Keller, Sylvie Doublie. "Biochemical and Structural Insights into Substrate Binding and Catalytic Mechanism of Mammalian Poly A) Polymerase." J. Mol. Biol. 341 (2004) 911-925.

Proudfoot, Nick., Justin O'Sullivan. "Polyadenylation: A Tail of Two Complexes." *Current Biology* 12 2002: 855-857.

Skaala, Oynstein. "Ecological Effects of Escaped Salmonids in Aquaculture." *OECD Documents: Environmental Impacts of Aquatic Biotechnology*. Paris: Organization for Economic Co-Operation and Development, 1995. 71-86.

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THIS FORM MAY BE SAVED.