The goal in writing an experimental research paper is typically to present one or more hypotheses and data supporting those hypotheses. If you are presenting more than one hypothesis the hypotheses should all be closely related. The data should be convincing, although definitive proof is rarely possible.

This outline is only meant as a general guideline. Depending on the content of the paper, its length, intended audience, etc. some of these sections may be omitted or others added. For example, a more analytical paper could include a theory/analysis section.

Paper outline – main sections

Title

Author(s)

Abstract

Typically 1-2 paragraphs describing what was done in the paper, what the results were and the significance of the results. Often written last, although if you can write a good abstract before writing the rest of the paper it's a very good sign that you know exactly what you want to say and that the paper will be easy to write.

Introduction

Often introductions begin by explaining very broadly why the area of research is important. Next they discuss the unanswered questions, current problems, or open hypotheses. Then they describe the specific question, problem, or hypothesis being addressed in the paper and possibly the method used to address it. Finally they include a very brief summary of the results.

For example:

"X is important because …"
"Despite the importance of X; Y and Z are currently unknown."
"We hypothesize H."
"We tested H by/with M."
"Our results showed …"

Note that the general structure starts with the general (the importance of the whole topic) and becomes increasingly specific.

Background

The background section includes previous research related to the topic: what other researchers have done that is relevant to the current work, what they found, and what is still unknown.

The research cited in the background and the order it's presented in should be structured to lead up to your hypothesis/research question and should follow the

introduction's order. The goal of the background is to show that the research in the paper is the obvious next step next to pursue.

For example:
"Researcher A found X"
"Researcher B did Y"
"Researcher C's analysis shows Z"
Etc.
"These results suggest that hypothesis H is true, so we are going to test it."
Or
"Previous work did not include/consider M so we are going to perform experiments with M included."

The background section may also include more general information such as a description of the general techniques being employed. This depends on the target audience. In this case the background section can be divided into two (or more) subsections.

Experiment (Materials and Methods)

Be careful to include all relevant parameters and details. Evolutionary computation papers include a table with all of the algorithms specific parameters (populations size, number of generations, crossover rate, etc.).

In describing the experiment you need to explain how the experiment's design helps to answer your hypotheses. E.g. "The experiment was designed this way so that…"

You also need to explain all of the important design decisions you made. E.g. "This value was chosen because …" Many papers are rejected because the reviewers are saying 'why did they do it that way? I would have done it differently.' Even if you can't convince them your approach is best (and often you can't) you can at least convince them that your methodology is reasonable.

Results

The length of the results section varies considerably. This section describes the results of the experiments. It should contain graphs, tables, charts, etc. as necessary. The goal is to make the results, and the conclusions that can be drawn from them, as obvious as possible. Tell the reader what you want them to conclude from the data.

Figures

The text should refer to the figures directly. The text should describe what the figure shows, then explain the importance of what the figure shows. Ideally the reader should be able to understand the results without looking at the figures and should be able to understand each figure without reading (much of) the text.

An example of text explaining a figure: "Figure X shows the average fitness for a GA using different mutation rates. The best results are obtained for mutation rate M, with both higher and lower mutation rates producing poorer results. Thus, for this problem the optimal performance is obtained for a moderate mutation rate supporting our

hypothesis that a mutation rate above or below the optimal rate will degrade performance."

Discussion

Depending on the field and the journal a discussion section that is separate from the conclusion section may or may not be standard. In general, conclusions are what you found; the discussion covers the implications of those findings.

Conclusions

The conclusion should explain the most significant results and why they are important. It is often helpful to refer back to specific examples/figures from the results section to support a conclusion. Make sure to list the key results that the reader should remember. Often the writer will remind the reader that these are original results: "we are the first to show that …"

Future Work

A separate section for future work is usually not required. However, at least a paragraph of the conclusions section is usually devoted to future work. This doesn't have to be work you are planning to do, it can just be possible next steps. One advantage to including possible future work is that other researchers may decide to try them, thus encouraging my research in the area.

Some General Comments

Papers tend to be repetitive. For example, the results are mentioned in the abstract, the introduction, described in their own section and summarized in the conclusion.

The main goal is clarity. Tell the reader exactly what you want them to know as clearly as possible.

It is definitely worth your time to write a detailed outline before writing any paper. An outline will make sure that you include all of the important points in a clear, understandable order. If you write an outline detailed to the paragraph level (every 1-2 paragraphs gets an entry in the outline) before starting a paper, the paper will be much easier to write and the final paper will be much clearer.

Weak phrases to avoid:
"we study X"
"we look at X"
"we examine X"
These are all very weak phrases because they don't say that you actually found or proved or learned anything. It's much better to be more concrete and more direct. For example,
"we prove …"
"we determine …"
"we show …"