Research Paper - Evolutionary Computation

Aim

The aim of this assignment is to understand and communicate a specific research contribution within the broader area of *Evolutionary Computation*. The assignment allows you to explore a topic of interest within that research area.

The deliverable has two parts: a *critical précis* of a research paper (80%), and a comparison with an "AI's" précis of the paper (20%).

A critical précis has two main purposes:

- to summarise the main points of the paper in a shorter form, and

- to critically assess the contribution of the paper.

The assignment is primarily related to Learning Outcome 2.

The assignment may be done individually or in pairs.

Scope and Sources

In order to ensure the reading is right up-to-date, the scope of this assignment covers the most recent versions of the two predominant[1] evolutionary computation conferences, run under the auspices of the two main computing professional societies.

- ***2023 IEEE Congress on Evolutionary Computation*** **(CEC) (Chicago, USA)**

This is the main conference of the IEEE's Computational Intelligence Society (CIS). Further information and the conference programme can be accessed through the conference link above. The proceedings of the conference are published in the ***IEEExplore*** repository.

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[1] And known for their impressive nature-inspired artwork!

- ***GECCO'23: Proceedings of the 2023 Genetic and Evolutionary Computation Conference**, ACM (Lisbon, Portugal)*

This is the main conference of the ACM's Special Interest Group on Genetic and Evolutionary Computation (SIGEVO). Further information and the conference programme can be accessed through the conference link above. The proceedings of the conference are published in the **ACM** (Association for Computing Machinery) **Digital Library**.

The repositories can both be found through the "DATABASES" tab in the library's OneSearch.

Selecting a Paper

You will find there are literally hundreds of papers to choose from. You should select a paper within the following constraints.

- It must be a *full paper* or "research article" (not a keynote or plenary presentation, workshop, tutorial or competition). These will normally be 8-9 two-column pages.

- It should come primarily within the scope of *evolutionary computation* (rather than, for example, machine learning, deep learning or natural language processing). The majority of papers will satisfy this requirement.

- It should introduce, modify, and/or evaluate an *algorithm* of some kind. This will normally be to "solve" some optimisation or assignment problem. Again the majority of papers will satisfy this requirement. However some papers may focus, for example, on describing a problem set or test suite (perhaps for benchmarking or a competition), or applying an existing algorithm to a new application area and focussing more on the outcomes than the algorithm itself (sometimes these appear in "Applications" sessions in the programme). While these papers are also important, we are primarily concerned with implementable algorithms, and a chance to explore ideas that might be used in the practical project (Assignment 2).

- It should not be a paper already selected by someone else (see below).

It is suggested that you peruse a range of papers before deciding on the paper to review. This will give you a feel for which papers fit the criteria, and perhaps which ones are better written than others. A paper that has a good introduction to the topic and the starting point of the paper's specific contribution, for example, may be more accessible than one with a lot of assumed specific knowledge. Comparing some papers and their readability will also help you develop your own writing (not only for this unit but for others such as project units). A key part of good writing is putting yourself in the place of the reader!

While the conference websites and programmes are useful for perusing the papers and the topics or sessions they appear in, when working with a paper it is strongly recommended that you download the PDF version rather than try to work off the web version. This will give you the actual published paper as the authors intended it to appear.

It is not expected that you will understand every detail in the paper immediately, and it is anticipated that some background reading will be necessary. In particular, the introduction to a paper will typically provide references to some of the "seminal" work in the area.

Once you have selected a paper (or to reserve it as a work in progress) you should enter it in the Paper Selection spreadsheet, which can be found at the top of the page in the *Assignment 1* channel in Teams. Papers are reserved on a first-come-first-served basis.

Where working in a pair, only one person needs to enter the paper in the spreadsheet to reserve it. You may optionally fill the Co-Author field in the spreadsheet to help us cross-check the names on submissions.

Structure of Your Paper

Part 1

As you work through the selected paper (and any supporting literature) you should seek to address the following questions, and reflect this in your own document.

These are the kinds of questions you would be asking yourself as a Reviewer for the conference, in deciding whether you would recommend the paper be included for presentation and publication. (They are also questions you should ask yourself if submitting your own research as a dissertation or for publication.)

1. What is the problem that the paper is attempting to solve?

By this we mean primarily what is the paper seeking to demonstrate (rather than what is the application problem that the paper is seeking to optimise, although the two are often related). It is often described as the "hypothesis" of the paper.

In the context of an algorithm, it may be a new algorithm, but is more frequently some modification or addition to an existing technique with the aim of improving some measure of performance (be it accuracy, speed, scale, storage, and so on).

The application domain problem is also of (secondary) interest as it helps to provide context for the work.

2. Why, or in what respect, have previous attempts failed?

The work will have been done because of a perceived deficiency in previous approaches, or lack of solution to a problem. Your job is to understand and convey the motivation for the work.

3. What is the new idea presented in this paper?

How does this paper seek to improve on previous work? What is its novelty?

4. How is the new approach demonstrated?

This is the "method" of the paper. Is it demonstrated, for example, by an implementation and experiments, or perhaps by a mathematical proof, or human feedback/surveys from use cases? Does it build on previous work? Is enough information (or references, links) provided that you are confident the results could be replicated?

5. What are the results or outcomes and how are they validated?

How are the results validated? Was the approach compared/benchmarked against previous results? Were the comparisons against other "evolutionary" approaches (similar to the paper) or more "traditional" approaches? Did the results show substantive differences? Were they improvements, or perhaps improvements on some metrics and not others?

6. What is your assessment of the conclusions?

Did the authors claim positive results? (Note that negative results can also be useful results.) Do you think they were justified in any claims from the content of the paper?

Part 2

The goal of the second part of the assignment is to compare your analysis with the analysis that you can get from an AI bot, such as ChatGPT or ChatPDF.

The most recent AI bots are undoubtably impressive at writing a fluid and confidently stated précis or summary on most topics, including academic topics. As you have examined a paper in detail, this is an ideal opportunity to explore how "deep" the bot's analysis goes.

You might give thought to the following kinds of questions (among others of your own):

• is what the bot says correct?

• to what degree does it convey "understanding" of the content, versus paraphrasing and "regurgitation"?

• has the bot focussed on the most important issues?

• has the bot missed any key issues?

Try to give specific examples from your selected paper and your own précis (as opposed to generalised statements) as evidence for your conclusions.

You should include relevant passages of bot responses in an Appendix, and only draw attention to key points in your main paper.

Marking Criteria

The following criteria will be taken into account within the marking:

1. Exposition

- Well written and clear.

- Well structured, answers to the above questions can easily be found.

- Appropriately referenced and submitted.

2. Understanding conveyed

- Written in own words.

- Right level of abstraction for the size of the précis.

- Points flow one from another and arguments can be followed.

3. Critical analysis

- Insights into credibility (of paper)
  (Authors are "held to account" - how well have they demonstrated what they claim?)

- Insights into contribution (of paper)
  (What have the papers' authors achieved? Is it "solid" or "puffery"?)

- Insights into bot response(s)
  (In an absolute sense, and in comparison to your own review.)

Where the marker has queries about your submission you may be required to attend a short *viva voce* (interview) as part of the assessment.

Requirements and Practicalities

- The assignment is due by **11:59pm, Thursday 28th March**. Late assignments will be penalised according to the University's standard rules for late submissions described in the Unit Outline.

- The précis should be a **maximum of 2400** words, excluding references and appendices. A word count must be included on the title page (along with your name and student number). Text beyond the maximum word count will not be marked.

- The assignment must be submitted as a **pdf** file.

- Referencing must follow the IEEE style (as covered in the first lecture).

- Submission is through the LMS (via Turnitin).

- The assignment may be done individually or in pairs. Points you may wish to consider: an advantage of working in pairs is that the content can be discussed/ debated, different perspectives brought and understanding tested; a disadvantage is that it may be more challenging to make the report flow

coherently in content and style. Both have their own potential benefits and challenges.

- Where an assignment is done in a pair it should be submitted only once by one author. Both authors and their student numbers must be provided under the title.

- In submitting the assignment you are undertaking that it is solely the work of the author(s). Text or images taken from sources must be referenced.

- *Contributions from AI tools are permitted only for Part 2 of the assignment.*

- A Teams channel has been provided for queries relating to the assignment.