

Computer science

These subject guidelines should be read in conjunction with the “Introduction”, “Outline” and “Details—all essays” sections of this guide.

Overview

An extended essay in computer science provides students with an opportunity to investigate a particular aspect of computing and its implications for society and the world. Within this context, they can research the latest developments and future possibilities in a subject that changes with increasing speed and is continually breaking new barriers. There are many possible areas to be explored, each with a wealth of topics: advances in hardware and software development, comparison of the efficiency of algorithms designed to speed up data transmission or to encrypt data, network systems, computer control systems and so on.

Choice of topic

It is important that the chosen topic and its treatment reflect a firm emphasis on computing. Students must show that they have gained an understanding of the topic and the relevant theory and practices of computer science.

It is also important that the work goes beyond a summary of journalistic views on a particular topic. It is not sufficient for the student simply to describe new advances and developments in computing. Students are expected to analyse their findings and consider the implications.

Often, the ethical and social effects of the topic chosen will be important and may well have a part within the essay, for example, in the conclusion. However, an essay that makes these considerations a major focus is not appropriate and would be better submitted as an information technology in a global society (ITGS) essay. An in-depth analysis of trends and advances in computing should include aspects of the theory of computer science, which would necessarily demonstrate a high degree of technical knowledge and understanding.

Data for analysis may be generated from a program written by the student. This is often an appropriate method of investigation but the code itself, and its development, will not be rewarded under the assessment criteria. The extended essay is not in any way to be confused with the program dossier that is completed as the internal assessment component for the computer science course. If the data analysed is not directly related to computer science, the extended essay should be registered in another, more relevant, subject.

The chosen topic may be inspired by a magazine article, an Internet site, one of the case studies published in connection with computer science paper 2 examinations, a conversation or simply an idea that could fall into one of the following areas of interest.

- Aspects of the current computer science syllabus that are not treated in depth
- Current aspects of computing that are set to change or be challenged in the near future

- Future developments that are currently experimental but beginning to look possible
- Solutions to limitations that are evident in current hardware or software
- Comparisons between different computer systems that are actually in place

The topic chosen should allow the student to make a full appropriate analysis, putting forward his or her own point of view. Historical aspects of computing do not lend themselves to this treatment. However, there may sometimes be a place for summarizing developments that have occurred until now, to put the topic in perspective or to use as a basis for predicting the future.

Availability of resources should be a consideration when deciding on a topic. The student should not choose to investigate a complex computing topic for which they have little or no access to appropriate background material and/or resources.

The following examples of titles for computer science extended essays are intended as guidance only. The pairings illustrate that focused topics (indicated by the first title) should be encouraged rather than broad topics (indicated by the second title).

- “Comparison of symbolic algorithmic approach and fuzzy logic in constructing an expert system” **is better than** “Artificial Intelligence”.
- “Has the increase in processing power diminished the need for complicated sorting algorithms?” **is better than** “Sorting algorithms and processor speed”.
- “What level of data compression in music files is acceptable to the human ear?” **is better than** “Data compression techniques”.
- “How secure is Secure Sockets Layer protocol?” **is better than** “Internet security”.

It may help for the student to start with a broad topic or area of interest, refine this further into a research question and then add a statement of intent that indicates which broad process is going to be used in answering the question.

Topic	Advances in computer processing
Research question	Will fuzzy logic replace binary logic in the near future?
Approach	An investigation into the current state of implementation of multi-state logic and the differences between this and binary state logic.
Topic	Networking system
Research question	Is wireless networking a feasible alternative to cabled networking within a whole-city context?
Approach	A feasibility study of the hardware and communications needed to set up a city-wide network in wireless and cabled systems.

It should be noted that a research question is not the only way of specifying the topic, but it does help in the development of the essay as the student and supervisor can come back to the question as a reference point.

Treatment of the topic

An extended essay in computer science is not intended as a vehicle to demonstrate programming skills. These are demonstrated in the program dossier (the internal assessment requirement of the computer science course). The extended essay is an opportunity for students to be creative in a different sphere—that of independent, personal research.

While an extended essay may refer to a programming exercise, such as a compiler for a new language designed by the student, the emphasis in such a case should be on the design, development and analysis of the compiler and on language design. Some evaluation of the compiler in relation to those already existing is also expected. Although program fragments may be included in the body of the extended essay to support the design and the discussion, the **full** program code (including internal documentation) should appear in an appendix as evidence. Each line of code that appears in the body of the essay should count as two words when calculating the length of the essay, while any internal documentation of a program fragment should be ignored.

Futuristic topics in computer science should be based on sound theory and projections of well-known computer and information science authorities. Students are expected to support personal conclusions by the theories presented. This is an area where students need to be particularly careful that the analysis they apply to information gathered is their own independent analysis and that the information they use is from reliable sources.

Students are likely to turn to the Internet for sources of information. When doing so, they need to verify the reliability of sources and also ensure that they are not relying too heavily on these sources to collate, rather than analyse, information. Students are expected to evaluate critically the resources consulted during the process of writing the essay.

Frequent reference to the assessment criteria by both the supervisor and the student will help keep a sharper focus on the project.

Interpreting the assessment criteria

Criterion A: research question

Although the aim of the essay can best be defined in the form of a question, it may also be presented as a statement or proposition for discussion. It must be:

- specific and sharply focused
- appropriate to the particular area of computer science being explored
- centred on computer science and not on peripheral issues such as the history of computing or the social implications of technology
- stated clearly early on in the essay.

Criterion B: introduction

The introduction should relate the research question to existing subject knowledge, putting it into context. Basic computing knowledge can be assumed and it is not expected that students write lengthy sections explaining theory that is common knowledge or part of the syllabus of the computer science course.

Criterion C: investigation

The range and type of sources available will be influenced by various factors, but above all by the topic chosen. For example, if runs of a program are carried out to test an algorithm for efficiency against an alternative one then the data must be adequate.

Any statistics collected should be reliable and relevant to the research question. It is also important to consult a large number of sources. Particular care should be taken in such a rapidly changing area to ensure that all sources (books, magazines and Internet sites) used are up to date.

Criterion D: knowledge and understanding of the topic studied

The student is expected to be capable of coherently discussing the topic, hence demonstrating a sound knowledge of computing within the chosen area and an ability to explain academic concepts to a degree that shows a full understanding. The knowledge and concepts should go beyond those called for in the current *Computer science guide*.

Criterion E: reasoned argument

Students should be aware of the need to give their essays the backbone of a developing argument. Personal views should not simply be stated but need to be supported by reasoned argument or experimentation to persuade the reader of their validity. Straightforward descriptive or narrative accounts that lack analysis do not usually advance an argument and should be avoided.

Criterion F: application of analytical and evaluative skills appropriate to the subject

A computer science extended essay demands that the student applies logical, critical and creative thinking to a specific topic, as well as showing an appreciation of the consequences arising from technological development.

Criterion G: use of language appropriate to the subject

The effective use of computer science terminology includes the appropriate use of technical vocabulary. Layman terms for computer parts and systems should not be used.

Criterion H: conclusion

“Consistent” is the key word here: the conclusion should develop out of the argument and not introduce new or extraneous matter. It should not repeat the material of the introduction; rather, it should present a new synthesis in light of the discussion. It should be evident from the conclusion that the student has fully understood the implications of the topic and is able to make a clear, independent evaluation.

Criterion I: formal presentation

This criterion relates to the extent to which the essay conforms to academic standards about the way in which research papers should be presented. The presentation of essays that omit a bibliography or that do not give references for quotations is deemed unacceptable (level 0). Essays that omit one of the required elements—title page, table of contents, page numbers—are deemed no better than satisfactory (maximum level 2), while essays that omit two of them are deemed poor at best (maximum level 1).

Program code should generally be placed in an appendix. Where it needs to be included within the body of the essay, each line of code should count as two words when calculating the length of the essay, while any internal documentation of a program fragment should be ignored.

Criterion J: abstract

The abstract is judged on the clarity with which it presents an overview of the research and the essay, not on the quality of the research question itself, nor on the quality of the argument or the conclusions.

Criterion K: holistic judgment

Qualities that are rewarded under this criterion include the following.

- Intellectual initiative: Ways of demonstrating this in computer science essays include using sources other than the Internet and printed resources to gain information that could not have been found otherwise.
- Insight and depth of understanding: These are most likely to be demonstrated as a consequence of detailed research, reflection that is thorough and well-informed, and reasoned argument that consistently and effectively addresses the research question.
- Creativity: This can be shown in many ways, for example, by using an unusual but effective approach, by taking a controversial, but credible, stance or by extrapolating an extra logical step when forming a conclusion.