Candidates must complete this page and then give this cover and their final version of the extended essay to their supervisor.

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Diploma Programme subject in which this extended essay is registered: **Computer Sciences**

(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay: **The Effects of Advances in Computer Science on Artificial Intelligence**

Candidate's declaration

*This declaration must be signed by the candidate; otherwise a mark of zero will be issued.*

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

This is the final version of my extended essay.

Candidate's signature: ___________________________ Date: 21/7/2015
Supervisor’s report and declaration

The supervisor must complete this report, sign the declaration and then give the final version of the extended essay, with this cover attached, to the Diploma Programme coordinator.

Name of supervisor (CAPITAL letters) ____________________________________________

Please comment, as appropriate, on the candidate’s performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate’s own work. You may attach an additional sheet if there is insufficient space here.

The candidate gave her honest effort when researching and reporting on her topic of artificial intelligence. She spent (on her account) many hours and days on this report. She told me that most of the research she could find were online resources as the information at the library was outdated.

This declaration must be signed by the supervisor; otherwise a mark of zero will be issued.

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

As per the section entitled “Responsibilities of the Supervisor” in the EE guide, the recommended number of hours spent with candidates is between 3 and 5 hours. Schools will be contacted when the number of hours is left blank, or where 0 hours are stated and there lacks an explanation. Schools will also be contacted in the event that number of hours spent is significantly excessive compared to the recommendation.

I spent 1 hours with the candidate discussing the progress of the extended essay.

Supervisor’s signature: ___________________________ Date: 2/17/15
The Effects of Advances in Computer Science on Artificial Intelligence

Session: May 2015

Author: 

Supervisor:
Abstract

Technology has become a large part of the daily lives of millions of people, proving the field of computer science to be more important than ever. The high demand for cutting edge technology has created a boom in computer science research, which in turn only encourages researchers to strive for greater heights. Among the topics impacted by this boom is the study of artificial intelligence. We are closer now to creating true artificial intelligence than we have ever been before.

By looking at how advances in software and hardware have affected AI development as well as looking at the history of artificial intelligence and modern examples of AI, a fair conclusion can be reached for the question to what extent have advances in computer science allowed for better AI? This essay is divided into sections that separate major topics that should be considered for this research question.

By considering information from all of the above topics it is apparent that the advancement of AI technology has been boosted by a large extent. Much progress has been made in the past few years that all pave the way for more advanced AIs in the future.
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I. Introduction

Computer technology has been constantly advancing since the invention of the ‘modern’
computer in the 1800’s by Charles Babbage. Before this invention it was a person’s job to be a
‘computer’ and they would work all day crunching numbers to be used for various tasks. The
invention of the computer revolutionized the way people interact with math and also, more
recently, each other. The computer was made to be a piece of equipment that would and make
more accurate computations in a shorter amount of time. Since the time of its invention, the
computer has evolved greatly, giving us portable laptops, reliable home computers and even
phones that perform much like a laptop would. The saturation of society with technology has
caused a boost in the necessity for more in-depth research into programming and how to expand
programming languages to better accommodate the growing market for intelligent programs,
including AI. For many people artificial intelligence exists only in fiction but it is quickly
becoming a part of reality. AI can already be found in video games, speech recognition software,
and picture recognition software to some extent. But are these intelligent programs truly paving
the way for more advanced artificial intelligence? To what extent have advances in computer
science allowed for better AI? To answer this question it is important to look into the history of
AI, what makes an AI, as well as how improvements in both programming languages and
hardware have affected the creation of artificial intelligence.

II. History of Artificial Intelligence

The term “artificial intelligence” was coined at the Dartmouth conference in the summer
of 1956 by John McCarthy; just after Alan Turing introduced the Turing Test. However, this
was not the first time that the idea of intelligent programs had been considered. Throughout
history, mankind has been fascinated with the idea of creating robots that behave like humans. This is evident in science fiction as well as the actual creation of clockwork mechanisms that performed tasks in the seventeenth century. The first examples of artificial intelligence were game playing AI that played an assortment of games from chess to checkers. A notable AI from this time is Arthur Samuel’s checker playing program, made in 1950, which had the ability to learn from experience and apply what it learned to later matches. This is a prime example of a skill that has since been developed further in examples of today’s AI and is still being improved on.

Many of the AI programs made from the 50’s to the 70’s were psychology driven, as AI gave people a new way to examine how the human brain works and learns. They were created to analyze a human thought process which ranged from testing short and long term memory to putting together a puzzle. There were also a few programs that experimented with translating between languages but they ultimately failed due to an over simplification of the problem while simultaneously giving critics reason to cut funding from the projects. There were also a lot of advances regarding the mathematical capabilities that computers had. These early AI are the base for every AI that has been made since, as they defined what a computer could really do.

III. What Makes an AI?

Modern AI programs have come a long way from their beginnings in the chess playing robots of the eighteenth century, a time when AI research was still in its infancy. This is because of advances over the past 60 years, focused on improving search algorithms, machine learning algorithms, and integration of statistical analysis. All of these advances focus on processes that are necessary to an AI if it is to be able to ‘think’ and are also present in human thought.
processes. Current AIs work by searching through an array of information, to provide responses to stimuli that they are programmed to respond to; therefore improving search algorithms allows AIs to work more efficiently (and more independently of hard-coded functions, which make it hard for an AI to truly be ‘thinking’ on its own). This information can be provided entirely by the programmers, partially by the programmers and partially by the user, or entirely by the user. However, as they are now, AIs cannot solve problems that they were not programmed to solve, something that maybe programmers have tried to implement into their programs. Currently there are only a few functioning AI that can learn, and even those AIs only have a limited capacity for learning. This can prove to be a problem when AIs are put up against the Turing Test.

IV. The Turing Test

The Turing Test represents the ultimate goal for AI researchers, even over fifty years after its creation. It is considered to be the ultimate standard for success when it comes to creating an AI as it determines if the AI is truly intelligent. The test itself is rather simple though, a judge chats with individuals using a computer. Most of the time the judge is talking with another human, but one of the individuals the judge talks to is the AI. The test is run with various judges and if the AI convinces 30% of the judges that it is human, it is deemed to have passed the test. Some variations of the test exist, with both higher and lower standards, but the 30% bar has been dubbed as the ultimate guideline. This test has held strong since 1950 when it was coined by Alan Turing in his paper “Computing Machinery and Intelligence” and while there exist many different versions of the Turing test, many with higher standards, the original detailed in Turing’s paper has been the standard many programmers have strived for. Since the date of its creation, only a handful of AIs have passed the Turing test. One such AI goes by the name
Eugene Goostman and pretends to be a 13 year old Ukrainian boy. It was made by a team in Russia, who spent many hours perfecting the AI and also hosted a copy of the AI on a website for public use. In the tests that were run, the AI was able to convince 33% of the judges that it was a human, deeming it 'intelligent'.

V. Modern AI

Like Eugene, many AIs are tested by hosting them on a website and having people interact with them. A popular example of this is CleverBot, which blew people away with the results of its Turing Test. CleverBot was able to fool 59% of the judges in its Turing Test, deeming it an intelligent program. CleverBot came online for the first time in 1997 and has since been gathering and saving information from its over 65 million conversations. This is what makes CleverBot sound genuinely human; it uses the responses it has received for a question in the past to answer questions asked of it in the present. Many people believe, however, that CleverBot's status as intelligent is false because it does not generate its own answers like many other modern AIs do. This has not changed the results of the test though, and CleverBot is still considered to be an intelligent program.

Another modern AI of note is the Philip K Dick android. Modeled after science fiction writer Philip K Dick, it was an ambitious project undertaken by a team of programmers that were originally working on a teaching AI in 2012. The android was more than just visibly similar to Dick; the programming team used countless interviews with the author in addition to letters and other personal correspondences to create a database of information for the AI to pull from. It is also unlike its peers because it resided in a physical body modeled after Dick and interacted with the environment by speaking, moving its face into recognizable expressions, and moving its
arms. It took in audio input as people talked to it and then formulated its response. The system it used to respond was similar to that of CleverBot in that it searched through the array of information provided by Dick’s interviews, writing, etc, for what Dick would have responded with. Unfortunately, after the head of the AI was lost in transportation to a convention the project was shelved and hasn’t been touched since. The Philip K Dick android did, however, represent a huge step towards AI that looked and behaved like a human.

VI. Advances in Programming

Advances in programming languages are much of the reason for recent advances in AI. Early AI was written in now obsolete programming languages like Basic, but with modern programming languages like LISP and Prologue that are tailored to creating AI, programmers now have a finer set of tools to use that are tailored to what they are making. Modern AI is also written in common programming languages like C++ and MATLAB which are constantly being updated but are not the favorite of AI programmers. Undoubtedly though, Basic was the base for modern programming languages. It was the first programming language that could be coded directly on the computer instead of on punch cards. Programmers could see the results of their programs as they were working on them, something that previous programming languages did not offer. However, the use of Basic eventually petered out as other programming languages took its place. Modern programming languages like LISP also offer unique attributes that Basic did not have. One reason LISP is so well suited to programming AI is that the language itself is programmable, allowing the programmer to always have the tools that they need for a program. It also is a language that is well suited to exploratory programming, making it easier for the programmer to turn their ideas into working code.
VII. Advances in Hardware

Early AI programs were limited in scope by the size and speed of memory and processors that existed at the time. Early computers had very little memory, which meant that they could not run many functions at once and this severely limited programmers in what they could make their AI do. If a program was too complex there was also the chance that the computer would not even run it. Now, computers have much more memory, often with the option at add more manually as well, and can run large programs with ease, meaning that the size parameters for a program have gotten larger, enabling programs to be able to do more. This makes it possible for programs that are proven to work to be improved upon and crafted into even more advanced AIs. Computers have also grown smaller over time, changing from something that used to take up a whole room to something that can be easily carried around with you. While this doesn't have a specific impact on the programs that can be made, other than through increased convenience, it is a large part of the computer's life cycle. Processors have also come a long way since Babbage's computer, enabling programs to run smoother and faster as well as enabling them to do an ever growing array of actions. This means that as computers grow faster and more diverse in its available actions, it will continue to become easier for programmers to create artificial intelligence.

VIII. Conclusion

Artificial intelligence has come a long way since its beginnings in science fiction. What was once considered to be a dream has come to be reality over many years of dedicated and hard work. As computer science has advanced, so too have the complexity and abilities of programs advanced. Because of advances in both software and hardware as well as the implementation of
better information sorting methods, AIs have advanced to a large extent when compared to AI in previous years. This shows that as the demand for intelligent programs increases, so does the driving force behind advancements. This is a pattern that can be seen throughout history and it shows that humans will strive to create better and better versions of what we believe we need to survive and thrive. It can also be said that AI will continue to advance under the current conditions in the world of technology and it is entirely possible that one day there will be functioning AI as a part of society.

IX. Sources


"Fifty Years of BASIC, the Programming Language That Made Computers Personal." Time, April 29, 2014.


