

How to Cite:

Fatiha, B., & Djamila, B. (2025). Artificial intelligence and its algorithms in higher education. *International Journal of Economic Perspectives*, 19(3), 876–887. Retrieved from <https://ijeponline.org/index.php/journal/article/view/911>

Artificial intelligence and its algorithms in higher education

Bentaiba Fatiha

Laboratory of Creativity and Organizational Change, University of Lounici Ali
Blida2 (Algeria)

Email: bentaibafatiha2016@gmail.com

Bentaiba Djamila

Laboratory of Creativity and Organizational Change, University of Lounici Ali
Blida2, (Algeria)

Email: bentaiba.dj2017@gmail.com

Abstract---The term “artificial intelligence” has become increasingly prevalent in the era of the Fourth Industrial Revolution, where artificial intelligence technology has advanced significantly. It represents the science of engineering the creation of intelligent machines capable of performing tasks that require human intelligence. Artificial intelligence algorithms are the fundamental components of artificial intelligence systems that determine how this technology works. To better understand artificial intelligence, it is essential to know these algorithms, their types, how they work, and their applications. The service of artificial intelligence in education and higher education has revolutionized the field of learning and teaching, which will be elaborated in this research.

Keywords---Artificial intelligence, Artificial intelligence algorithms, Higher education.

JEL Classification: 0130

1. Introduction

Artificial intelligence (AI) represents one of the most significant outcomes of the Fourth Industrial Revolution, with diverse applications across military, economic, industrial, technological, medical, educational, and service sectors. Predictions suggest limitless innovations in the field of AI, which could lead to a radical change in human life. AI is poised to be a driving force for progress, growth, and prosperity in the coming years, paving the way for a world that currently seems

like a figment of imagination, yet current indicators confirm that the creation of this world is imminent.

AI algorithms are the fundamental components of AI systems, providing the rules and instructions for how machines learn from data, solve problems, and generate results. This research paper explores the concept of artificial intelligence, its algorithms and applications, and the role of AI in improving higher education. Therefore, a better understanding of artificial intelligence requires knowledge of these algorithms, their design, and their implementation, which we will elucidate in this paper. In light of the above, the following main question arises:

What is the concept of AI? What are its types, algorithms and applications in the field of higher education and the learning process?

The adoption of a certain topic by any researcher aims to satisfy his intellectual curiosity by clarifying certain issues. According to our study, we want to achieve several objectives:

- Highlight the term “artificial intelligence”.
- Explain the nature of algorithms, their types, how they are designed, and how they work.
- Highlight the role of artificial intelligence in learning.
- Highlight the significant services that AI provides to higher education.

Methodology of the study:

In order to adequately address the problem of this study, we relied primarily on the descriptive-analytical approach, as it is the most appropriate method for discussing various social and human issues in general. Consequently, the researcher used a number of sources and references, including books, journals, theses, and others, in addition to the use of the Internet, which significantly influenced the study

2. Theoretical and Intellectual Framework of Artificial Intelligence:

Technological transformations and scientific research have enabled specialists to develop models and applications that simulate human intelligence under the term “artificial intelligence.” This section addresses the history and concept of artificial intelligence, focusing on this direction.

2.1 History of Artificial Intelligence

The idea of “thinking machines” dates back to ancient Greece. However, the history of artificial intelligence began in 1943 with the emergence of computer science, coinciding with the publication of an article titled “Logical Calculus of Ideas Immanent in Nervous Activity” by Warren McCulloch and Walter Pitts. In this article, the authors presented the first mathematical model for creating a neural network.

In 1950, Snarc, the first neural network computer, was created by two Harvard University students, Minsky Dean and Edmonds Marvin. In the same year, Alan Turing published the Turing Test, which is still used to evaluate artificial

intelligence. This test laid the foundations of artificial intelligence, its vision, and goals, aiming to replicate or simulate human intelligence in machines.

The term “artificial intelligence” was not used until 1956, during the first time at the “Dartmouth Summer Research Project on Artificial Intelligence” led by John McCarthy. Researchers at this conference presented goals and a future vision for artificial intelligence, which many consider the true birth of the field.

Years passed, and work on artificial intelligence continued. In 1959, Arthur Samuel coined the term “machine learning” while working at IBM.

In 1989, French researcher Yann Lecun developed the first neural network capable of recognizing handwritten digits, which was a significant step toward the development of deep learning.

A decade later, in 1997, a major event marked the history of artificial intelligence when IBM’s Deep Blue system defeated world chess champion Gary Kasparov for the first time, demonstrating a machine’s ability to triumph over a human.

In 2004, John McCarthy wrote an article titled “What is Artificial Intelligence?” providing a widely cited definition of the field.

In 2011, IBM Watson defeated Ken Jennings and Brad Rutter, champions of the game “Jeopardy!”

In 2015, Baidu’s Minwa computer used a special type of deep neural network called a convolutional neural network to identify and classify images more accurately than the average human.

In 2016, DeepMind’s AlphaGo program, powered by deep neural networks, defeated Lee Sedol, the world Go champion, in a five-game match. This victory was significant due to the vast number of possible moves in the game (over 14.5 billion after just four moves). Later, Google acquired DeepMind for approximately \$400 million.

By 2023, the rise of large language models (LLMs), such as ChatGPT, has led to a significant shift in artificial intelligence performance and its ability to create value for business enterprises. With these new practices in generative artificial intelligence, deep learning models can be pre-trained on vast amounts of unlabeled raw data.

2.2 Definition of Artificial Intelligence

There is no universally accepted definition of artificial intelligence; however, it can be succinctly described as a branch of science that focuses on machines capable of solving problems that typically require human intelligence. This definition was presented by Marvin Minsky, one of the most prominent scientists in cognitive science and artificial intelligence, in his book “The Society of Mind” (Al-Fara, 2012, p. 7). Based on this definition, not all machines performing specific tasks fall under the term artificial intelligence.

“Understanding the nature of human intelligence by creating computer programs capable of finding solutions to specific problems based on the simulation of intelligent human behavior” (Bonnier, 1993, p. 11). This refers to the ability of these programs to find solutions to specific problems through a set of inferential operations that they have been pre-equipped with. Thus, artificial intelligence is concerned with simulating human cognitive activities through artificial means. Consequently, artificial intelligence research primarily focuses on developing

computational methods for intelligent behavior. The objectives of this research are twofold:

- To make machines and automated processes smarter (more useful).
- To understand intelligence.

All researchers agree that achieving precise artificial intelligence is challenging; however, the most widely accepted definition is “making computers smart.” Another broadly accepted definition globally is “producing automatic models of human intelligence,” which can be summarized as “building machines that mimic intelligent human behavior.”

2.3 Types of Artificial Intelligence

Artificial intelligence is a set of programs that can act and learn independently from current situations or past experiences, and perform various tasks typically performed by humans with the help of computer systems. Different types of AI can write, translate, process images, analyze data, program industrial machines and robots, and incorporate neural perception algorithms that mimic the human brain, with the goal of making AI act and interact like humans.

There are types of artificial intelligence that vary based on the functions and capabilities offered by each software system. The first classification of artificial intelligence types is based on their functions, which includes: limited systems, systems capable of deep and precise thinking, and those limited to performing routine and repetitive tasks; these systems are classified according to their functions.

The second classification of artificial intelligence types is based on the programming capabilities of each machine. There are artificial intelligence systems with simple capabilities, systems with moderate capabilities, and others with enormous capabilities that are constantly evolving.

1. Types of Artificial Intelligence by Functions There are four types of artificial intelligence, classified by the functions performed by the machine:

Reactive machines:

These are the oldest types of AI and the first machines ever created. This type cannot gather information through machine learning or rely on previous information to make connections because it lacks the ability to learn. Reactive machines only think about the current event, which means they do not remember past situations to benefit from experience. However, they can still make good decisions based on what they observe in the present.

Limited Memory

This type of AI, unlike the previous one, can rely on its past memory by learning skills and incorporating reference data through prior training. All this information is stored in a limited memory for later use. Facial recognition technologies and chatbots are examples of this type.

Theory of Mind:

This is the most advanced type, still under research, which attempts to understand human emotions, needs, behaviors, and thought processes, as well as the environment. Theory of mind philosophy works to imitate everything around it, such as eye contact, body language, and speech during conversation. It falls into the highly advanced categories of artificial intelligence and its various practical applications.

Self-aware AI: This is considered the most worrisome type, and remains hypothetical for now. It refers to artificial intelligence that can think, feel, and act independently like a real human being, free from any control systems. Researchers are currently striving to improve and develop this first type of networked systems that have unlimited self-awareness and can perform various tasks autonomously, while at the same time being aware of what is happening around them using their own unique intelligence capabilities.

2. Types of Artificial Intelligence Based on Capabilities

The other classification of artificial intelligence consists of three types that differ based on capabilities:

Artificial Narrow Intelligence (ANI):

This type of artificial intelligence is known for its limited and specific capabilities, confined to what it has learned previously. It cannot perform any new self-initiated tasks.

Artificial General Intelligence (AGI):

This general type of intelligence can react autonomously like an ordinary human, based on its analysis of the people and objects around it, along with its understanding of them. It can also provide unique features based on its past experiences.

Artificial Superintelligence (ASI):

This type represents a very high level of artificial intelligence that can make correct decisions entirely on its own by analyzing data and providing logical interpretations for any classification in any field.

3. Methodologies of Artificial Intelligence

- Behavioral Approach: This aims to program computers to act intelligently.
- Cognitive Approach: This seeks to model human thinking processes to better understand the human mind.
- Mechanical Approach: This focuses not only on software but also on building machines. (Abdouni, 1995, p. 11)

4. Algorithms of Artificial Intelligence and Their Types:

All tasks performed by artificial intelligence, without exception, operate according to specific algorithms. By changing these algorithms, the tasks can change entirely, from system operation to internet browsing. Algorithms enable computers to predict patterns, assess trends, calculate accuracy, and optimize

processes. In this section, we will explore the types of algorithms, their concepts, and how they operate.

1.3 Algorithms

The term dates back to the 19th century, named after the Arab scholar Al-Khwarizmi, who excelled in mathematics and astronomy. He was the first to establish the principles of algebra and arithmetic, and the concept of algorithms is now associated with the programming of electronic computers.

Definition of Algorithm:

Algorithms are defined as “a set of ordered and clear steps that are executable for a specific task that has an endpoint” (Dali, 2019, p. 6).

From this definition, it is clear that an algorithm:

1. Is a set of rules designed to solve a mathematical problem, either manually or by machine.
2. Is a series of finite steps to achieve the desired result.
3. Is a sequence of computational steps to convert inputs to outputs.
4. Involves operations on data that must be organized in the form of structures and data.

Types of Algorithms:

Algorithms can be categorized into two main types:

- Computational Algorithms:
These refer to algorithms that deal with arithmetic mathematics, which cannot be termed as any mathematical operation unless they are accompanied by a sequence in execution, starting from inputs to outputs or solving the problem.
- Non-computational algorithms:
These are the most commonly used algorithms, including those that process text, store and retrieve information, manage databases, and assist in decision making in all aspects of life. For example, the algorithm that performs a spell check on a text is a non-computational algorithm (Ali, 2009, p. 72).

2.3 Conditions and Characteristics of Algorithms

These are defined as follows:

- Inputs: The algorithm must present the values it needs as inputs, which can be zero or more.
- Outputs: The algorithm clarifies the actual expected results from its application, and there must be at least one value (Al-Hanash, 2002).

Every step in the algorithm must be clearly defined and unambiguous.

- Definiteness: Each step must be understandable to everyone.
- Finiteness: All steps in the algorithm can be resolved within a limited time frame. For example, the phrase “divide 10 by 3 with high precision” is not finite and should not be allowed within the program.
- Effectiveness: Every step in the algorithm must be feasible or effective. For instance, the expression $\sqrt{0/3}$ cannot be solved at all.

3.3 Methods of Writing Algorithms

Algorithms can be formulated in various ways that differ in terms of expression accuracy and ease of understanding. The most important methods include (Al-Dweik, 2013):

- Using Natural Language: Instructions in the algorithm are executed sequentially as they appear in the text, in the form of clear and specific numbered steps that define the context of execution. This method relies on commonly used natural languages such as Arabic or English, and it is considered the easiest and best method when the steps are clear.
- Using Symbolic Method: This method is based on specific rules derived from mathematical concepts and can be represented through the following two mechanisms:

Various programming languages, including C++.

Mathematical notation of concepts within the algorithm, during representation by different methods.

- Using Graphical Method: This involves representing the algorithm using commonly recognized graphical representations, where the steps of the algorithm are illustrated using specific geometric shapes and arrows connecting them, in addition to natural language phrases or mathematical expressions. This method is preferred when the algorithm is simple and short.

4.3 Machine Learning Algorithms Machine Learning (ML) emerged in the 1980s as an application of statistical methods to algorithms to make them smarter. The challenge of ML is to build curves that approximate data and allow for easy generalization. Therefore, it relies on the ability of algorithms to receive large amounts of data and “learn” from it (through correct approximation curves).

Machine learning is a large field that includes many algorithms. Among the most famous are

- Regression (linear, multivariate, polynomial, regularized, logistic, etc.) - Naive Bayes algorithm: This algorithm provides the probability of a prediction given prior events. For example, what is the most likely price given that the apartment is 43.7 square meters?
- Clustering: Always, thanks to mathematics, we cluster data into packets so that the data in each packet are as close to each other as possible. This is particularly useful for recommending movies that are “close” to movies you have already seen.
- Decision trees: By answering a certain number of questions and following the branches of the tree that contain those answers, we reach a conclusion (with a probability score).

In addition, there are more advanced algorithms based on various statistical techniques: Random Forest (a forest of decision trees that vote), Gradient Boosting, Support Vector Machines.

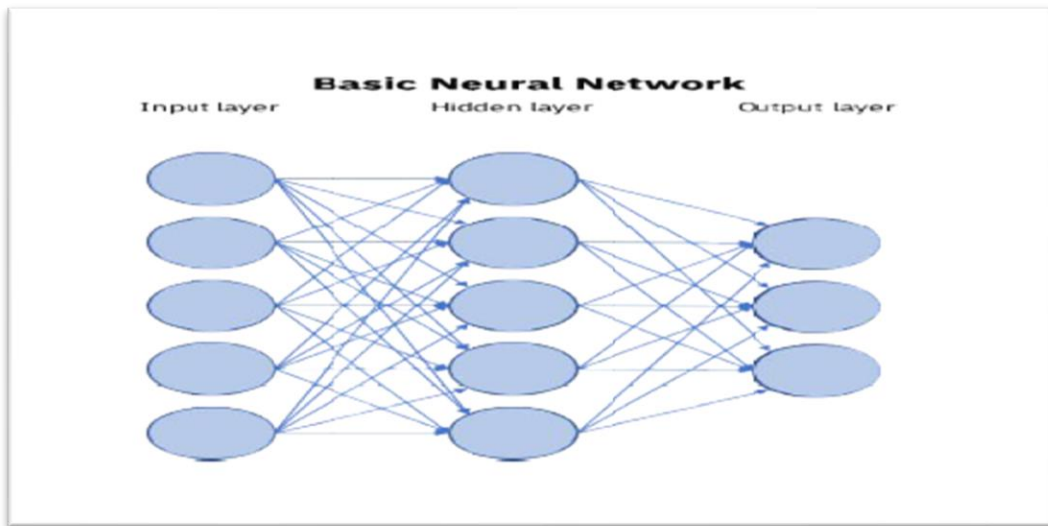


Figure 1: Depicts machine learning on a simple neural network

3-5 Deep Learning Algorithms

The idea of deep learning (DL) emerged around 2010. This concept was inspired by the functioning of our brains (through neural networks) to push analysis further and understand how to extract data independently. Therefore, DL is a subfield of machine learning (ML) and is referred to as artificial (deep) neural networks, which consist of a set of neurons organized in multiple layers leading to the output neurons. Thanks to this architecture, DL is capable of recognizing faces, clustering texts, or driving autonomous vehicles.

Do you have trouble understanding where statistics fit into all this? In fact, the algorithm will adapt the connections between its neurons (strengthening or weakening them) so that the output for the input data is approximately accurate.

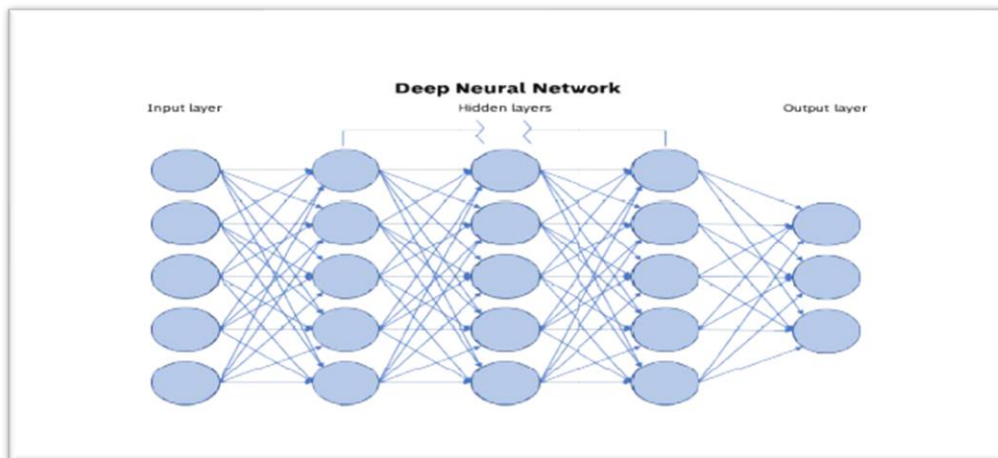


Figure 2: Deep learning on a deep neural network

Deep Learning Algorithms

Below are some examples of deep learning algorithms:

- Artificial Neural Networks: These are the simplest and are often used as complements because they sort information well.
- Convolutional Neural Networks: Specialized in image processing, these apply filters to the data to produce new information (for example, edge recognition in an image can help locate a face).
- Recurrent Neural Networks: Among the most famous is Long Short-Term Memory (LSTM), which has the ability to retain information and reuse it after a short period. They are used for text analysis, as each word depends on the few preceding words (so that the rules are correct).

In addition to more advanced versions, such as autoencoders, Boltzmann machines, and Self-Organizing Maps (SOM), deep learning allows for the elimination of human experts in data sorting, as the algorithm will find its correlations independently. For example, in facial recognition, a deep learning algorithm will autonomously determine whether to consider the distance between the eyes (between pixel units) or whether this information is not critical enough compared to others.

4. The use of artificial intelligence in education (Bakari, 2020, pp. 256-306)

Machine learning (ML) programs analyze information, draw conclusions, and then make necessary decisions. Therefore, a machine learning-based system can be taught through large amounts of data, allowing it to perform other tasks. Artificial intelligence is used to identify and adapt to individual student needs. Many major education platforms, such as Carnegie Learning, are investing in AI to provide more personalized courses that allow for the creation of individualized instructions, tests, and feedback to help students and learners bridge gaps in their knowledge and studies.

In addition, researchers in the field of AI in education believe that as their techniques and programs become smarter, AI-based platforms could scan and analyze students' facial expressions, allowing the system to tailor instruction to their needs. Voice assistants are also among the applications of AI in education, allowing students to interact with educational materials without direct communication with a professor or teacher. This capability allows educational platforms to be used anytime, anywhere. One example is Arizona State University, which uses the Alexa voice assistant for routine campus needs, such as answering frequently asked questions or keeping track of a student's schedule.

In terms of educational content, the use of AI in content creation is intriguing, leading to what is known as "smart content," a collection of diverse educational materials ranging from digital textbooks to customized interfaces. This has prompted smart solutions companies to develop smart content programs and platforms for education, such as Content Technologies, Inc. and Netex Learning.

Artificial Intelligence in Machine Learning and Services Provided to Universities

In the field of machine learning, universities can benefit from the diverse services offered by artificial intelligence. Some of these services include (R & A, 2018, pp. 571-606):

- Access to Libraries and Machine Learning Tools:

Universities can access libraries and frameworks for machine learning such as TensorFlow, PyTorch, and scikit-learn. These tools enable researchers and students to develop and implement machine learning models efficiently.

- Computing and Storage Infrastructures:

Universities can benefit from powerful computing infrastructures, such as computing clusters or cloud computing services, to perform intensive computational tasks, such as training machine learning models on large datasets. Additionally, large-scale storage solutions can be provided to facilitate the data necessary for research projects.

- Collaboration with Researchers and AI Experts:

Universities can establish partnerships and collaborations with researchers and AI experts, either within their own network or with external institutions. This collaboration provides opportunities for knowledge exchange, conducting joint projects, and leveraging expertise in specific areas of machine learning.

- Access to databases and datasets:

Access to high-quality datasets is essential for machine learning research. Some institutions and organizations provide databases or specific datasets to universities in various domains such as health, imagery, natural language, etc.

- Training and workshops :(Siemens & Baker, 2012, pp. 252-254) Universities can organize training sessions, workshops, and conferences on machine learning and artificial intelligence, inviting experts in the field to share their knowledge and experience. These events allow students and researchers to learn about the latest developments in machine learning and build professional networks.

- Technical support and guidance:

Some institutions and research labs offer technical support to universities, providing advice and expertise to solve problems related to machine learning, whether it is selecting algorithms, preprocessing data, or optimizing models.

These services may vary from university to university, depending on the resources and partnerships available at each institution. It is important to contact the artificial intelligence research departments or machine learning labs at universities for specific information about the services offered.

Conclusion

Artificial Intelligence has evolved from theories and philosophies into rules and principles governing machine intelligence, and today represents an industrial revolution similar to the invention of the steam engine, electricity, and digital chips. AI is based on algorithms, which are rooted in mathematical equations and form the basis of artificial intelligence systems. Its increasing use in various fields, including administration and education, has significantly changed traditional learning and teaching methods. This shift has improved the quality of education and provided numerous benefits to both teachers and students, freeing the latter from the confines of traditional classroom learning.

While these modern technologies have the potential to replace humans in various administrative and educational tasks, thereby improving the efficiency of complex operations, they cannot replace human intelligence. The presence of a human being remains irreplaceable, as machines lack emotional understanding.

References Foreign language references:

Magazines

- Abdouni Abd el Hamid (1995). Informatique, Intelligence, Et Intelligence Artificielle, Revue des Sciences Sociales et Humaines, V1, N°4.
- Adams, R., & Ng, A. (2018). Artificial intelligence in education: Promises and implications for teaching and learning Instructional Sciences, Vol. 46, N°4.
- George Siemens, Ryan Baker (2012). Learning analytics and educational data mining: Towards In Proceedings of the 2nd International Conference on Learning Analytics and Knowledge.

Websites:

- Jérémy Robert, L'histoire de l'intelligence artificielle, 3/9/2024, available at: [DataScientest](https://datascientest.com/intelligence-artificielle-definition) (accessed 17/09/2024).
- Qu'est-ce que l'intelligence artificielle (IA), available at: [IBM](https://www.ibm.com/fr-fr/topics/artificial-intelligence) (accessed 17/09/2024).

References in Arabic books

- Suleiman Yaqub Al-Fara (2012). Artificial Intelligence, Al-Badr Journal, Volume 4, Issue 1.
- Alain Pounier (1993). Artificial Intelligence: Its Reality and Future, translated by Ali Sabri Farghali, Knowledge World Publications, Kuwait.
- Ali Suleiman. Introduction to Computers and Algorithms, Tishreen University Publications, Syria.
- Muhammad Al-Hanash (2002). The Arabic Language and Computers: A Quick Overview of Linguistic Engineering, United Arab Emirates University.
- Muhammad Dali (2019). Introduction to Computer Science, Al-Kamil University, Saudi Arabia.
- Musab Al-Dweik (2013). The impact of expert systems on performance improvement in external auditing. Amman, Jordan: University of Amman.
- Musab Al-Dweik: The Impact of Expert Systems on Performance Improvement in External Auditing. Research submitted to complete the course of scientific research in accounting, Arab University of Amman, Jordan.
- Mukhtar Bakari (2020). Challenges of Artificial Intelligence and its Applications in Education, Al-Muntada Journal for Economic Studies and Research, Volume 6, Issue 1.

Websites:

- What is Artificial Intelligence, available at: [SAP](https://www.sap.com/mena-ar/products/artificial-intelligence), accessed on 03/10/2024 at 15:00.
- Types of Artificial Intelligence, available at: [Bakkah](https://bakkah.com/ar/knowledge-center), accessed on 03/10/2024 at 14:30.

- The Future of Knowledge: Artificial Intelligence in Education, available at: [M of Knowledge](<https://www.m-ofknowledge.com/2020/07/Applications-of-Artificial-Intelligence-in-Education.com.html>), accessed 20/09/2024.
- Abdul Wahab Shadi et al. (2018). Opportunities and Threats of Artificial Intelligence in the Next Ten Years. (Future Center for Studies and Research, Editor) Retrieved from [Academia.edu](<http://www.academia.edu>).