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From AI and Electromyography to Financial Market: A Philosophical Perspective

Gabriel Cirac Souza[1], Robson Moreno[2] and Tales Pimenta[3]
[1](*Microelectronics Group, Federal University of Itajubá, Brazil)*
[2](*Microelectronics Group, Federal University of Itajubá, Brazil)*
[3](*Microelectronics Group, Federal University of Itajubá, Brazil)*

Abstract: *Artificial Intelligence (AI) is helping to deploy various solutions in different areas: independent cars, integrated smart objects, and medical applications are just a few. This article provides an overview of AI and makes two case studies focused on real-world applications. The first case aims to develop robotic prostheses: through the bioelectric signal, it is possible to use deep learning techniques to classify the various movements and reproduce them in a mechanical arm. Development issues should not be limited to technical aspects, and the individual should play a central role in this process. The second study addresses a regression problem where market dynamics are determined with some accuracy. This approach facilitates decision making in predictive models, but it is necessary to create mechanisms that homogeneously ensure competitiveness. The article discusses the technical similarity of each approach, the current challenges, and raises some questions. Although each application has its nature it is necessary to create a solid ethical basis for both.*

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I. INTRODUCTION

Artificial Intelligence (AI) is the scientific branch whose purpose is to develop techniques that mimic human intelligence, interact with a particular environment and, allows the implementation of many decision-taking systems[1, 2]. Several sectors are using AI tools to automate a specific process. It is already possible to perform a medical pre-diagnosis by analyzing blood variables, determining the load demand of the electrical grid, or labeling a user profile on the internet using machine-learning.

There are two ways to use the tools provided by AI. The first is called classification, where the objective is to separate particular classes of objects, and according to the characteristics presented by a sample, classify it accurately. The second mode is regression, where through previously captured data, the model can provide a predictive approach.

The use of AI techniques is multifaceted, and their application may be for a beneficial purpose or not. While some products have innate beneficial qualities, others may have improper goals, a system whose objectives are unclear must have a rigorous apparatus capable of regulating its use. The first part of the work discusses the construction of intelligent prostheses that use deep learning techniques[3] and aims to address some aspects of the current scenario of rehabilitation engineering (aims to enrich the experience of life). The second case study presents a financial series regression model (intends to gain some competitive advantage) that uses a couple of machine-learning concepts in its design[4, 5].

Classification: Many problems come down to a rating system[6]: disease diagnosis, adjustment of humidity and temperature of a controlled planting, identification of a battery charging, or even the labeling of different consumer profiles in an advertising campaign. Convolutional Neural Network (CNN)[7, 8] is an emerging deep learning technique that was inspired by the visual apparatuses of cats. Commonly used in computer vision, this network has elevated classificatory power and can capture the relationship between features.

Companies that work with large amounts of data and requiring information refinement for decision making will benefit from intelligent classification methods[9, 10]. Government agencies responsible for statistical analysis can save money by using these networks for their strategic planning and services[11]. On the other hand, schemes that classify people, customers, and specific human characteristics may come across ethical and legal issues. Intelligent rating systems still require a comprehensive approach that does not restrict their use and facilitate implementation across different areas. The medical industry has begun to employ grading systems in its research and development of smart prosthetics benefits from this technique.

Prediction: Predictive models aim to anticipate a specific type of information based on past events and certain system characteristics. For example, one can predict the weather according to pressure and temperature, but an algorithm that collects materials from previous days or months can do so with much greater predictability. Neural networks are unable to implement such a system because they do not consider previous cases. Neural feedback networks emerge to eliminate this limitation because, in practical terms, they add memory to traditional networks[12]. This approach can mitigate the consequences of natural disasters by making it easier to allocate resources before the event occurs, as they correlate various variables and factors that are not obvious. The financial market has started using these algorithms, and the robots are trading on the stock exchange. However, it is necessary to adopt ethical measures so that competitiveness is a natural part of the system.

Decision: Intelligent decision-making models do not have yet a single strategy, and they generally use the two previously presented concepts. A decision-oriented system faces fundamental issues, such as the man's secondary role within a given process. Also, social and cultural relations and society itself can be shaped by technological determinism that may place human beings in the background.
This model has advanced a lot, for example, with the development of autonomous cars and robots operating on stock exchanges. The Business Intelligence (BI) sector since 2006 is one of the priorities in the Information Technology area, surpassing the security area[13]. BI uses a set of techniques based on classification and data mining to gain some kind of business advantage (web sales, political advertising, financial markets, and many others). We will discuss in the next sections some philosophical aspects of AI; we will present two distinct applications that use the same technique to mitigate their problems. Moreover, the examples show how technology can embody values that are somewhat opposed. Figure 1 shows some areas that use Artificial Intelligence.

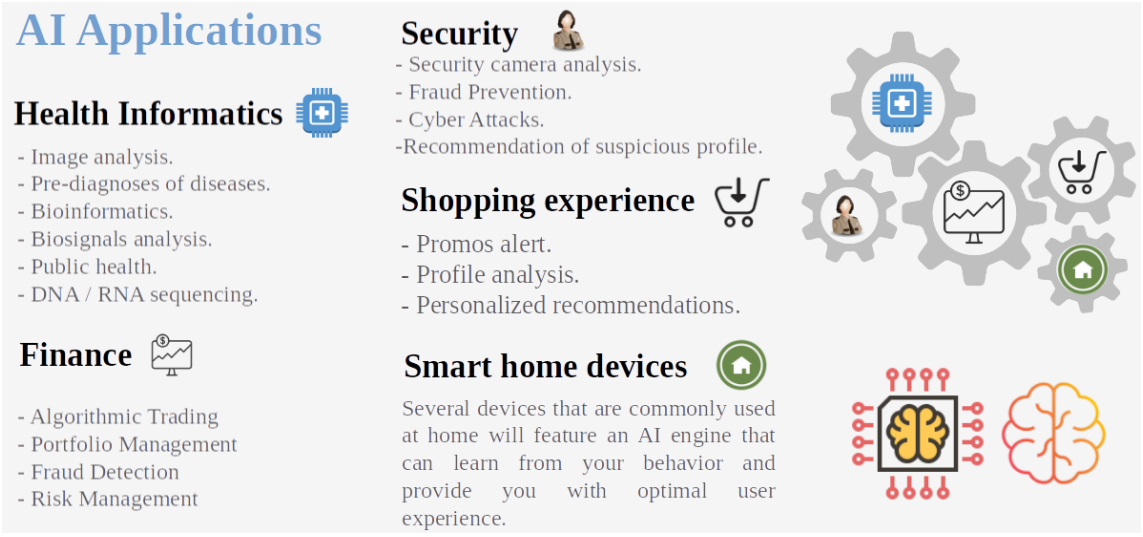

Fig. 1: Sectors that adopt AI to develop their products.

II. ELELCTROMYOGRAPHY

Electromyography (EMG) is the technique of monitoring the electrical signal collected from the skin surface during a muscle contraction. This signal comes from the brain command and is responsible for the control of movements. Electromyography serves as a technique for diagnosing muscle problems, physical assessments, and developing prostheses for people who have lost limbs.

In general, myography uses neural networks to classify each movement according to the EMG and subsequently reproduce it on a mechanical prosthesis. Recently, the literature has presented many deep learning techniques that can perform classification more robustly (response time, accuracy, and training time)[14]. The resources that feed the algorithm have hardly changed in the last 20 years, so networks capable of autonomous resource extraction have become a big draw. Although the use of the myoelectric signal is intuitive and functional to recognize the movement of interest, it is still unable to accurately indicate the strength and speed at which the user wishes to perform such a task.

A key point for the classification paradigm is the appropriate choice of features that can increase the class separability boundary[15, 16]. The characteristics mentioned are statistical values, collected at the time or frequency domains and, serve to describe the behavior of a member at a given instant. One of the central challenges is to obtain the data more homogeneously, considering that the wave has a stochastic and non-stationary nature. Before extracting the feature set, it is necessary to capture, filter and segment the signal.

There is no universal standard for classification, and sometimes an analysis between different classifiers is required. Promising algorithms, such as Long Short-Term Memory (LSTM) and CNN, have become viable due to increased hardware power at affordable costs, and these solutions are currently the flagship of AI. Despite the advance in the classification process, the products offered by the market are not robust. The usability of the prosthesis varies considerably between individuals.

What are the challenges? There are many challenges in this area: the question of the use of efficient batteries and the development of humanized mechanical arms would raise several articles. Some factors (Electrode Position, Humidity and Temperature, User Fatigue, and Slow Response Time) affect the rating capability and diminish the robustness of the system. Besides, the signal characteristics vary widely among individuals, while one person can achieve accuracy at 96%, others reach only 81%, which is impractical for a system considered critical. Such differences arise from factors related to the individual, such as the location in the limb where the trauma occurred or the desire to perform such a task. Another problem is creating a closed-loop device that can predict the strength and speed of movement. Such aspects impact usability and are one of the factors linked to the rejection rate among the injured.

III. THE INDIVIDUAL

The process of including these people in society is not trivial. Simple activities, such as opening a door or preparing a meal, will become vital for these individuals, harming their self-esteem. Rehabilitation is something that should be treated sensitively by all spheres of society, and the human being should be the central object of the investigation. Research centers must have a strict ethical protocol when dealing directly with people. Moreover, efforts should not be directed solely to the technical side, it is essential to provide these individuals with an apparatus capable of minimizing their trauma. Psychological counseling, integration activities, and lectures should be available, including family members. In recent years, some governments have developed public policies to make their lives easier: access to public places and quotas are some of the actions taken to include these people, but more is needed. Medical sectors are also directing efforts to mitigate some issues. Some works[17] try to use stem cells to rebuild organs or limbs, but this research is still incipient, bumps into legal issues, and has a degree of skepticism.

The Role of Engineering: An inattentive look may regard the engineer as an adjunct in this process. Although not strictly related to rehabilitation issues, engineering touches this issue on several points. Even before trauma occurs, some problems must be taken into account by engineers in various fields. A car or airplane designer should always take into account vehicle safety requirements, just as the electrical engineer must have an instruction normative to develop her job. According to Donald Schön, engineers should always think about what they did, how they did it, and what they could have done better, inducing deep thinking. Ibo Poel et al., in his work[18], cites a detailed discussion of the subject in philosophical terms, where he presents three different types of values that technology can embark:

1) The real purpose of use;
2) Its indirectly embodied characteristics;
3) Its actual use.

Take as an example a pacemaker, an instrument used by people who have certain types of heart problems. Project values, embedded values, and their use are intimately associated, so the project aligns the design and realization of use. On the other hand, a knife whose value is to facilitate food preparation may serve a completely different purpose. In the case of prosthesis development, the three values converge to the same point: improving the life of amputees. Taking a closer look at this issue, Basart et al proposes a list of 10 characteristics that are complementary to the technical responsibility of the 21st-century engineer. One is the need for a socially responsible conscience[19]. Engineers must apply values aligned with social progress, ensuring a sustainable development model for humans.

Philosophy of Rehabilitation: According to Zambroni et al.[20], philosophy has three fundamental functions: analytical, critical, and directive. The first help in formulating essential questions, such as "How to develop an artificial arm?". The second helps to make judgments about the current state of something and, the third is to make adjustments and corrections. In the case of the development of an advanced prosthesis, Rehabilitation Engineering must maintain an alignment between the three fundamental questions. In general, analytical questions are already well formulated, but the critical and directive analysis are still unprecedented. No matter how incisive the efforts are, the results are still preliminary, and there is no solution or general consent among rehabilitation professionals.

Max Ortiz et al.[21] took a significant step in creating the platform BioPatRec a centered and open-source environment where researchers can work on prosthesis construction. But developing something so complicated requires joint efforts in a variety of areas, from materials science aimed at producing the cosmetic arm to electrical engineering focused on highly efficient batteries. Rehabilitation Engineering is a consortium between several fields, each with specific knowledge that will help in building a greater good. Providing publicly licensed computational data is an attitude that supports innovation and adds value to current and future society[22].

Asking some questions is essential to start the project. Is the prosthesis functional? Is the price affordable for everyone? Is it possible to improve? Is it difficult to use? Is it heavy and tiresome to carry? The success of a solution is linked to the answers to these question. In summary, this text has already done a critical and analytical analysis, but there is still a need for directive discussion and an alignment between professionals from different areas.

IV. FINANCIAL MARKET

Contrary to the myography that seeks to classify a movement according to the instantaneous characteristics of the signal, a predictive model of financial series aims to predict if a given stock will rise or fall in the coming days, taking into account data obtained from previous days or months. Thus, a series forecast model is called regression.

Because past events must be taken into account in predictive approaches, recursive networks are the most obvious choices for forecasting financial series. Those algorithms learn from certain situations, for instance, if an asset is oversold (undergoing a severe devaluation move), the trend becomes high because the price is already too low. An LSTM network is an example used in this context[12]. Another deep learning technique is the CNN network, which is capable of extracting the main features.

There are several techniques in economics for analyzing whether an asset is worth it or not. The engineer models these methods through features capable of feeding the regression algorithms. In a predictive financial paradigm, the goal is always the price, but there are two problems; volatility and uncertainty, which make the future price very variable. Volatility is a natural feature of markets that reflects human psychology. The second is an intrinsic characteristic of such systems. Creating a price-based series may not be a good idea, as regression algorithms will use volatile values as the basis. Some engineering and economics applications use the Kalman filter [23] to smooth noisy processes and make the system more stable. With appropriate data, regression algorithms are trained based on a noiseless curve, reducing uncertainty. Thus it is feasible to build the target with typical values and without the dilemma of variations.

V. THE NEW DISRUPTION

Predicting the future accurately is an ancient desire of humanity. Financial institutions and their analysts somehow already do so, using statistical techniques, sentiment analysis, and geometric analysis. With the advent of computing, data mining, and artificial intelligence, these companies can improve their predictability and generate stock market instability. Large corporations with more resources can create sophisticated structures, thus having an unfair competitive advantage. Looking at the three use-values, in this case, things are not in balance:

1) The purpose is to gain a financial advantage with information refinement and automation of operations;
2) It is possible to embark more intelligence than most and to practice acts that diminish competitiveness;
3) Historically, human beings have used inside information for their benefit.

Again, technological determinism becomes part of this scenario, where financial analysts will be replaced by robots that do not rest and lack psychological instability. In this case, the professional of the future will be the data scientists. Business operations will move away from human nature and, the focus will be on intelligent information extraction. The scenario we know will progressively migrate to an automated paradigm capable of guiding and shaping the modern way of life. The question is how safe it is to delegate so much power to the machine and how we can build reliable security mechanisms in addition there is a legal discussion on the subject[24]. The most intuitive answer is to create protocols to regulate the use of such technologies in the financial market. The problem is that technology grows faster than security policies. Another solution is the moral education of professionals, who must have trustworthy and well-defined obligations regarding the products they develop. A different critical point is how it will be to integrate such a complicated environment. Secure transactions, well-defined business rules, cultural approaches in each country, preventive policing measures, methods to ensure competitiveness, and a mechanism that can promote system scalability are structural points that can become chaotic.

A classic ethical problem is the transparency of companies that do not always have a culture of compliance in their environment. Two recent examples are the Facebook and Cambridge Analytica scandals[26] and Volkswagen's scheme for manipulating the pollutant emission system[27]. How to ensure that companies will engage in ethically developing a product? The practice of spoofing is an example in the business context. Through a commodity buying and selling scheme, a robot virtually alters the value of a stock. Making small orders and then canceling them until the price reaches a certain level. Fraud of all kinds has always occurred during the history and, man has systematically created mechanisms for establishing rules. Is it possible to create a universal blockchain-based protocol (with firm premises) to regulate this industry?

Our responsibility: When a critical system fails, a sequence of three events inevitably occurs. Agents employ contour measures, designers look for faults, and the search for culprits begins. In an intelligent system, who or what are we to blame? Is the responsibility of the system itself, its designers, the testers, or the regulatory body? Everyone involved can be blamed, in which case separation of duties is necessary so that human agents do not attempt to transfer their obligations to the system. Assigning responsibility to a human being is simple but often not sufficient, as we have an innate ability to break them. In the case of a system, the contrary is true. It is hard to create ethical rules for a machine, but once we have developed such an approach, the computer can follow them faithfully. Embedding humane values in an autonomous system is an ideal principle to begin to delimit responsibilities. The question is how to create a simple and efficient protocol to cover so many models in a fast-moving world.

Targeted Choices: A hypothetical model using both technological ideas would be a differentiated tool. With a collection of features that represent human activities, it is possible to create various classification and regression contexts. The union of the two concepts would expand the companies' strategic possibilities, and they would have access to sensitive information. If we can accurately classify something as delicate as the movement of a limb, we can create the most varied classifying situations. Any process that we are interested in pattern recognition could be automated. An airport security system, a profile assessment method with a high probability of income fraud, or even credit evaluation are examples of situations that will be managed by AI in the future. If it is possible to predict the price of a stock, we can also predict a behavior. At these points, things get more delicate. Imagine collecting data, page access, location, and navigation patterns to create a predictive model that can suggest personalized advertising, predict your location, or tell you when people are most likely to buy a particular product. In this way, our choices would not be original. In many aspects of our lives, we would act unconsciously. A mechanism that can predict individual behavior is also capable of shaping future actions and all without our even knowing. Someday our creation will control us?

Intervention through education: The result of dialectic is often the dilemma. How can we build a sustainable model in which agents do not conflict and, technology-derived products are ethical? The key to this is education. We mentioned that a product may have its moral values intrinsic to its construction, engineers must follow a strict ethical protocol and, companies should be clear about the products they develop. Aligning these three points goes through a cyclical process of education, and in this sense, there are already some initiatives, such as the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems[28], the Everyday Ethics for Artificial Intelligence[29], and other movements. The second example is a framework created by IBM to guide AI-related ethical actions in a corporate environment. Its orientation adopts five principles based on trust and transparency:

1. Accountability: AI designers and developers are responsible for considering AI design, development, decision processes, and outcomes.
2. Value Alignment: AI should be designed with consideration of the norms and values of your user group.
3. Explainability: AI should be designed for humans to easily perceive, detect, and understand its decision process.
4. User Data Rights: AI should be designed to protect user data and preserve the user's power over access and uses.
5. Fairness: AI should be designed to minimize bias and promote inclusive representation.

The text[30] discusses the importance of developing products based on human values and presents the benefits of adopting such conduct. The existence of such codes does not imply that people or corporations will follow them in their entirety but facilitate the necessary educational process. One of the differences between humans and other species is their cooperative behavior and their ability to pass information, which allows a cyclical way of teaching where everyone involved teaches and learns. Therefore it is necessary to develop an ethical philosophy in schools, universities, homes, and corporations.

VI. DISCUSSION

An intelligent decision system presents potential problems. Evolution is not a theory but an observable fact, people, species, cultures, and products evolve over time and of course, AI is evolving fast. Therefore, we do not know what the implication will be if AI develops its own consciousness. Engineers can determine opposite values using the same technique, but what would be the values and objectives of artificial consciousness[31]?

The text provided an overview of two distinct technologies that benefited from AI methods. Although applications serve different purposes, professionals in different areas similarly model their products. The design of both is presented in Figure 2.

In both cases, it is necessary to filter and perform resource engineering. The extracted characteristics are different and have specific contexts, but they are used to feed deep learning techniques capable of performing both classification and regression. Each has its abilities and shortcomings. Despite the different circumstances, the need for ethical discussion falls on both. The same AI strategy and the need for a process capable of creating social values for both unite the two topics, where the technical responsibilities must be in line with the moral duties of the engineer of the future. Products must imbue characteristics (environmental, cultural, economic and social) that guarantee the well-being of society and others in the future.

The development of smart prostheses has great social value. The rehabilitation process improves the quality of life by enabling certain activities that were previously impossible. With the development of modern techniques, the AI field will also benefit from the addition of new algorithms and procedures presented by rehabilitation engineering. The same algorithms that will improve people's lives and facilitate the work of many professionals will control sensitive information. The purposes will be varied, but the techniques are the same. The truth is that we do not know the impact it will have on the social construction of the human being.

When it comes to AI, ethical issues emerge naturally. Such an approach frees us from the decision. What would a world be like where humans share their verdicts with the machine? If doctors, engineers, and economists automated their processes, they would work less. What would be the impact on future generations? Would it improve human relations? We consciously deal with decisions for a long time, removing them would break an evolutionary mechanism. When faced with difficult situations, we exercise our creativity and use a skill set to solve it. Would a more comfortable life without so much pressure free us for grandiose activities or restrict some skills?

VII. CONCLUSION

This text linked two distinct technologies that benefit from Artificial Intelligence techniques and addressed some ethical issues related to each one. Technological determinism, the role of professionals, and the culture of complicity in corporations were presented to the reader reflectively and inductively. The implications and unfolding of the technology were hypothetically confronted, and the products were examined concerning the value and purpose of use, considering the embedded technology and its end activity. Reading is an invitation to reflection.

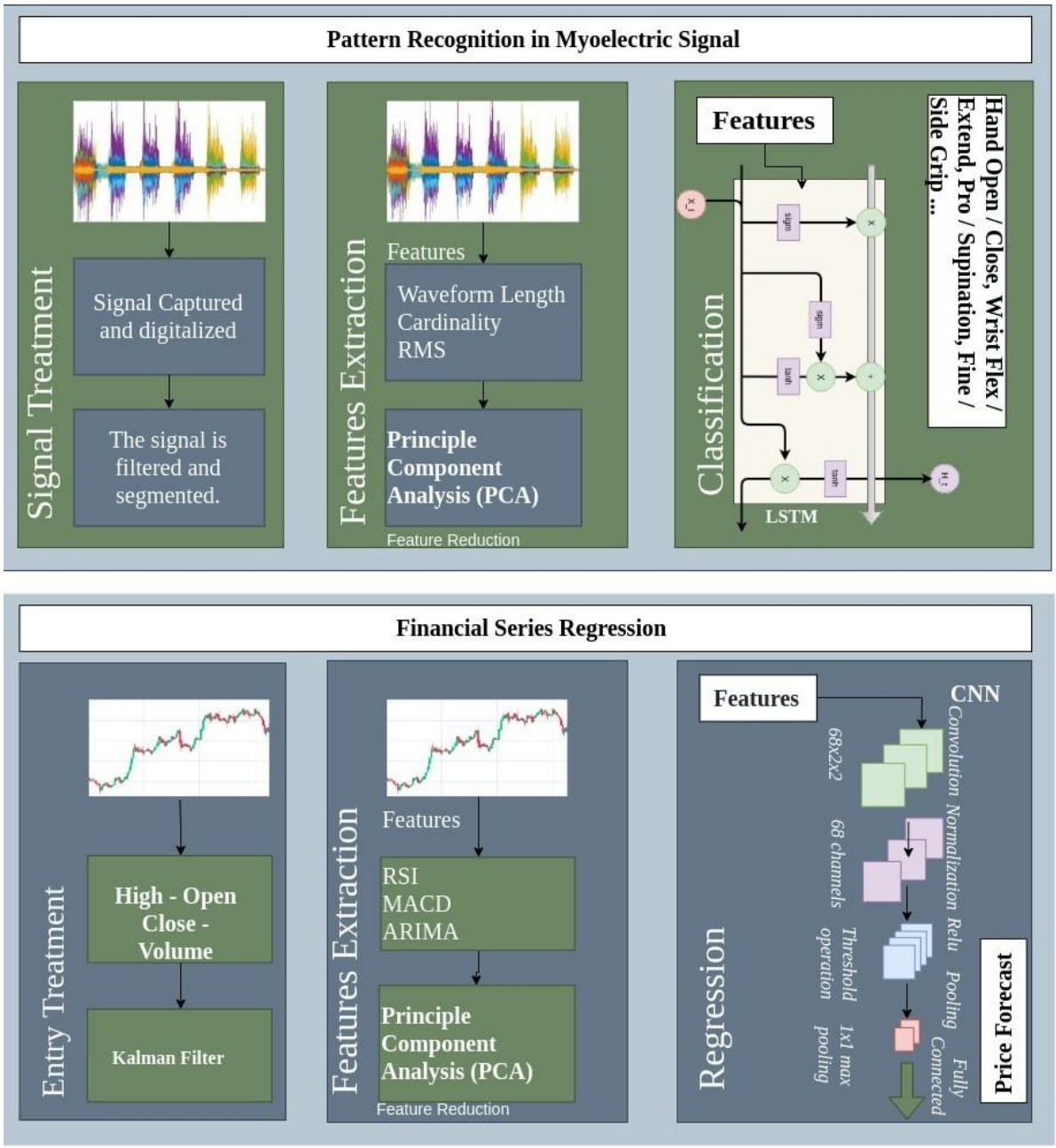

Fig. 2: Regressive and classificatory models, despite specific purposes, have a similar structure. First, you need to sample the data. Then you need to extract the relevant features for each context. And finally, some deep learning algorithm takes care of the regression or classification process.

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