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# Raspberry Pi Platform – An Accessible and Capable Single Board Computer (S.B.C.)

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**Keywords:** : Raspberry Pi, Applications, Single Board Computers

**Introduction**

Raspberry Pi system is a micro single board computer that is compact size, very capable and has many of the features found on a desktop computer. It is developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. This system uses a quad-core 64-bit processor 2/4/8 GB of RAM depending of which version you prefer, wireless and wired networking, dual display output with 4k resolution. One of the advantages of using this system it is powerful, compact, affordable, silent and energy efficiency.

**Evolution**

First generation of Raspberry Pi Model B was released on 2012 followed by Model B+ in 2014. Raspberry Pi 2 was released in 2014 and had a 32-bit quad –core processor that was later on upgraded to a 64-bit quad-core processor with a clock speed of 900 MHz. In 2016 Raspberry Pi 3 Model B was released this version also had a 64-bit quad-core processor clocked at 1.2 GHz and this version was upgraded in 2018 to Raspberry Pi Model B+ a unit that uses the same processor as the previous version but it was clocked at 1.4 GHz. Also this version was the first one to introduce wireless networking. The latest version is Raspberry Pi 4 Model B released in 2019 and is has a 64-bit quad-core processor clocked at 1.5 GHz.

**Hardware**

As it was previously stated Raspberry Pi 4 Model B system has a processor architecture of 64-bit quad-core. Depending on the version the system comes with 2, 4 or 8 GB of RAM. Raspberry Pi 4 Model B also has Bluetooth, a full Gigabit Ethernet port, Wi-Fi, two micro HDMI ports, two USB 2.0 ports, two USB 3.0 ports, one audio out port, a GPIO (general purpose input-output port and a micro SD slot. Power is supplied to the system via a USB–C port enabling additional power to be supplied to the peripherals. The system requires 5 volts, 3.0A with 15 W - one of the of smaller power supplies on the market comparing with similar microcomputers of this type.

**Software**

Raspberry Pi uses Raspberry Pi OS which is a free operating system based on Debian – a Linux

distribution and it is free and open source. Raspberry Pi OS comes with over 35000 packages, precompiled software that are easy to install on the system. The wide range of software and applications are the reason for the popularity and versatility of this SBC and also the fact that the majority of the software are open source so it can continuously be improved.

**Applications**
Raspberry Pi system has a variety of use, from home use such a personal computer replacement to industry use such as robotics, automation or easy to configure servers. In the following we will look at some of the most common uses for Raspberry Pi system.

**Web server application**
One of the easiest ways to configure Raspberry Pi a web server is by using Apache – the most popular web server in the world because of its reliability and performance. The setup process is straight forward it requires few steps and by the end we will demonstrate a fully functional web page that is running on Raspberry Pi. [Step by step configuration process]

**Personal DNS Server for blocking adds "Pi-Hole"**
Pi-Hole is specially designed to block all ads on any device connected to a home network. It also can protect the network from unwanted software such as malware. Pi-Hole is also easy to install and when the configuration process is over all we need to do is to set the routers DNS server to Raspberry Pi IP address. [Step by step configuration process]

**Retropie**
Retropie is more like an operating system for Raspberry Pi that will transform it into a retro-gaming machine. It is basically an emulator built upon Raspbian and Emulation Station, RetroArch and many others and it can play arcade, home-console and classic PC games with a minimum set-up. Retropie can be installed on top of an existing operating system or it can run standalone. [Example]

**Network Attached Storage (NAS)**
A network attached storage allows its user to share files from a device to another through a network. Because of its power efficiency Raspberry Pi is ideal for such a task, all is needed is a spare hard disk and some configuration and the system can be up and running in a short period of time. [Example]

**Writing code Raspberry Pi**
Because Raspberry Pi is a small computer is can also run code blocks this allows its users to write code using C++ programing language. Also Raspberry Pi system supports Python a popular programming language. [Step by step configuration process]

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# Bitcoin and Money of Future

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**Keywords:** : Cryptocurrency, Banks, Money Analysis, Crypto Prediction.

**What is Bitcoin?**
Bitcoin is the largest and most valuable decentralized digital currency in the world at the moment. The cryptocurrency was invented in 2008 by an unknown person or group of people using the name Satoshi Nakamoto and the first transaction in Bitcoin was on May 22, 2010, when a Florida man negotiated to pay 10,000 BTC for two Papa John's pizzas priced at about 25 dollars. That transaction valued the price of one Bitcoin at roughly a fourth of a cent. Bitcoin Market Cap is at a current level of 320.98B, down from 338.01B yesterday and down from 1.260T one year ago.

The most remarkable increases in the price of Bitcoin were:

- July, 2010 – Bitcoin price was 0,09 dollars;
- December 15, 2017 – Bitcoin reached the first all-time high of 16.721 dollars;
- November 8, 2021 – Bitcoin reached its all-time high of 67,566.83 dollars;

The top markets where you can buy and stake Bitcoin are:

- *Binance* = is the largest cryptocurrency market,
- *Crypto.com* = is the most versatile cryptocurrency market. You can buy cryptocurrencies starting from the price of 0,25 euro,
- *Bitcoinmarket.com* = is the first cryptocurrency market, appeared in March 2010,
- *Metamask* = metamask is the largest cryptocurrency browser extension.,

**Crypto is the money of future?**
Cryptocurrencies are based on the blockchain system. Blockchain is a digital ever-growing list of data records. Such a list is comprised of many blocks of data, which are organized in chronological order and are linked and secured by cryptographic proofs.The first prototype of a blockchain is dated back to the early 1990s when computer scientist Stuart Haber and physicist W. Scott Stornetta applied cryptographic techniques in a chain of blocks as a way to secure digital documents from data tampering. The work of Haber and Stornetta certainly inspired the work of

Dave Bayer, Hal Finney, and many other computer scientists and cryptography enthusiasts - which eventually lead to the creation of Bitcoin, as the first decentralized electronic cash system (or simply the first cryptocurrency). The Bitcoin whitepaper was published in 2008 under the pseudonym Satoshi Nakamoto. Cryptocurrencies are the money of the future because they solve many of the problems of the current banking system, such as very high commissions, long waiting times for transactions, but the most important thing is that the central authority disappears, which leads to a system that is not controlled by a central bank or a state government. For now, the crypto system is not very well regulated, due to the lack of centrality.

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# The Category of Quiver Representations is Abelian

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**Keywords:** : quiver, category theory, representation theory.

Category Theory can be regarded as the closest one can get to a mathematical "theory of everything". By [2], Category Theory provides the language and the mathematical foundations for discussing properties of large classes of mathematical objects. In this framework, one may explore the commonality across classes of concepts and methods used in the study of each class. Moreover, this framework allows one to concretely define the notion of "mathematical naturality".

By definition, a quiver is a directed graph where loops and multiple arrows between two vertices are allowed. The aim of this paper is to show that the Category of Quiver Representations is abelian.

The first building block for the conclusion of this paper is the following lemma, given in [1].

**Lemma 1.** *Suppose that $\phi : V \to W$ is a morphism of quiver representations.*

1. *$\phi$ is injective $\iff$ $\phi$ is a monomorphism.*
2. *$\phi$ is surjective $\iff$ $\phi$ is an epimorphism.*
3. *$\phi$ is bijective $\iff$ $\phi$ is an isomorphism.*

This result has been proved using elementary Linear Algebra ideas. Following this, the following building blocks must be proved must be proved.

**Theorem 2.** *Let $V, W$ be two quiver representations. Consider the quiver representation morphism $\phi : V \to W$. Let $K$ be the kernel of $\phi$ and let $\iota : K \hookrightarrow V$ be the inclusion. Then $\iota$ is a categorical kernel of $\phi$. Moreover, any monomorphism of quiver representations is the kernel of some morphism.*

**Proposition 3.** *Let $V, W$ be two quiver representations. Consider the quiver representation morphism $\phi : V \to W$. Let $C(x)$ be the cokernel of $\phi(x)$ for all $x \in Q_0$, and define $\pi(x)$ as the projection $W(x) \to C(x)$. There is a unique way of defining $C(a)$ for all $a \in Q_1$ such that $\pi$ is a morphism.*

**Theorem 4.** *With the notations from Proposition 3, $\pi$ is a categorical cokernel of $\phi$. Moreover, any representation epimorphism is the cokernel of some morphism.*

**Theorem 5.** *If $V$ and $W$ are two quiver representations, $V \oplus W$ forms a categorical product together with the projections $\pi_1 : V \oplus W \to V$ and $\pi_2 : V \oplus W \to W$ .*

**Theorem 6.** *If $V$ and $W$ are two quiver representations, $V \oplus W$ forms a categorical coproduct together with the inclusions $\iota_1 : V \to V \oplus W$ and $\iota_2 : W \to V \oplus W$ .*

Lastly, using the above results, the proof of the main result is immediate.

**Theorem 7.** *The category of quiver representations (Q) is abelian.*

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# Midi Controller Using an Arduino Nano

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**Keywords:** MIDI Interface, Arduino Nano, AVR microcontroller, Line 6 M5 effects unit.

**What is the goal of this project?**

We wish to make an electronic controller using an Arduino Nano and some rudimentary electronic components. Our controller is supposed to communicate with an audio effects unit through the Musical Instrument Digital Interface protocol (MIDI for short). Such a device can be used by musicians during live events since its operation is very simple.

**Introduction to the Arduino Nano**

The Arduino Nano is a small sized and open-source electronic development board unit which is based on an 8-bit AVR microcontroller. It has multiple categories of pins, some of them are:
* data pins, capable of reading and writing digital values (0V or 5V)
* analog pins, reading Analog values using an Analog to Digital Converter
* Pulse Width Modulation pins, they allow for a granular voltage output (used for RGB LEDs)
... and many more. In total there are 36 pins.

Along with these pins, there's also enough on-board Flash memory for storing instructions and Random Access Memory to use for variables. Writing instructions for the Arduino Nano is easy thanks to its Mini-B USB interface, bootloader and Integrated Development Environment compatible with all popular Operating Systems.

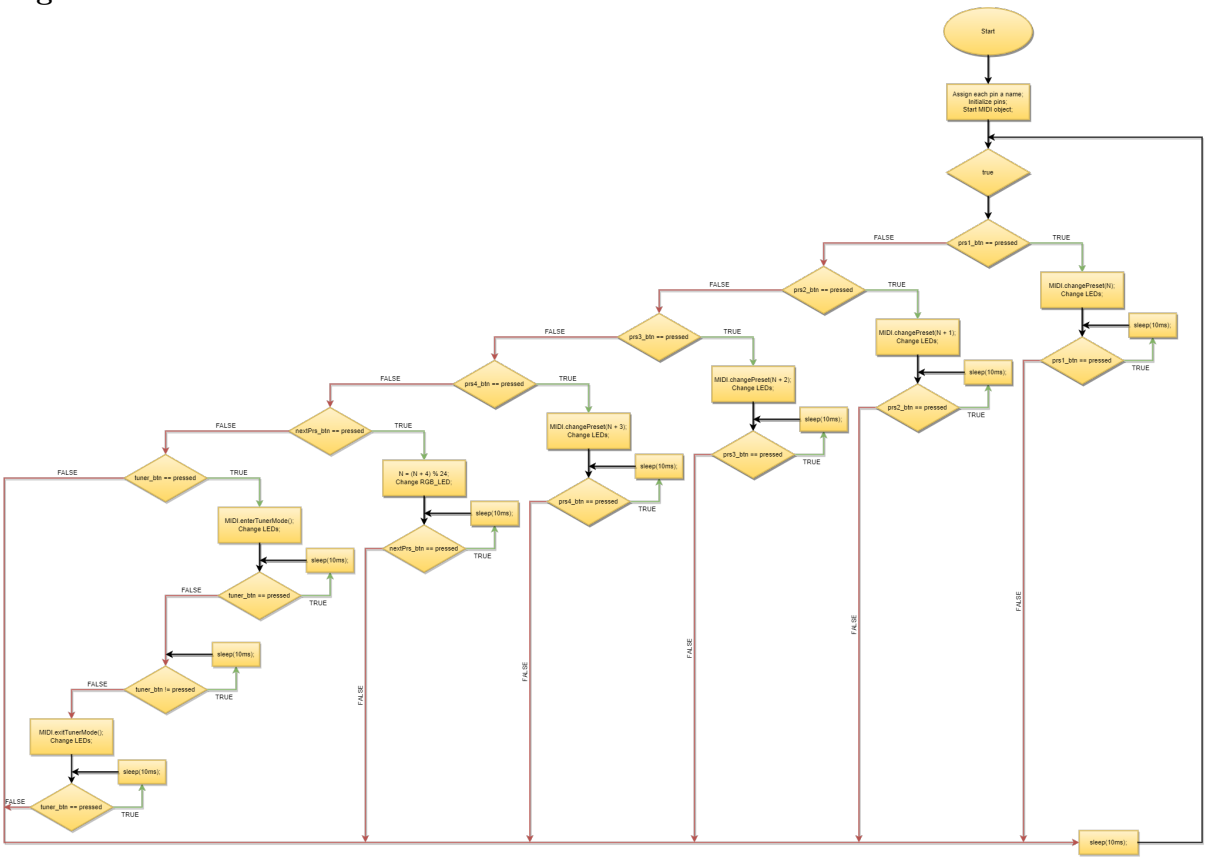
**Introduction to the Line 6 M5 effects unit**

Effects units capture electrical signals, transform them into digital values, perform a multitude of operations on these digital values, and then transmit them further down the pipeline of an audio system setup. Most effects units can be controlled through MIDI, and our model is no exception. The types of commands we want to give our unit are: *change preset to N (where N is an integer between 1 and 24); enter tuner mode; exit tuner mode.*

**Our plan of action implies the following steps**:

- Step 1 - Design the electrical schematic and software component in *Tinkercad*, a free online hardware simulator;
- Step 2 - Acquire the necessary electrical components (copper wires, cables, buttons, resistors, Light Emitting Diodes etc.);
- Step 3 - Assemble and solder the components together according to the electrical schematic;
- Step 4 - Connect our newly created MIDI controller to the *Line 6 M5 effects unit* and perform tests to ensure that everything works correctly.

**Logical Schema of code**




Note: The schema does not contain a "STOP" destination as the code is set to run in an infinite loop.

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# Applications of the Residue Theorem

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**Keywords:** complex integral, real integral, residue, holomorphic function, isolated singular point, contour.

**Abstract**

Complex Analysis is a classic, interesting and attractive branch of Mathematics. It is one of the branches that has its roots as far back as the 19th century and even earlier. Important figures who developed the discipline include Euler, Gauss, Riemann, Cauchy, Weierstrass and many others from the 20th century. Thus, Complex Analysis represents the culmination of more than 500 years of mathematical contributions and developments that have had a strong influence in Mathematics, Physics and Engineering.

In this paper we aim to present some very interesting applications of the Residue Theorem, a spectacular and a key result of Complex Analysis concerning complex integral calculus along a contour. There are multiple theorems endowed with the same purpose, such as Cauchy's Theorem or Cauchy's Formulas, but the Residue Theorem generalizes them, allowing the computation of the integral of a holomorphic function also in the case when in the "interior" of the contour there are isolated singular points of that function.
Regarding the structure of this scientific paper, it is divided in four major sections.

The first one develops multiple applications in which many different types of definite real integrals can be solved using residues. As we mentioned above, the purpose of the Residue Theorem is not only the integration of complex functions of complex variables. It is also used in calculating definite integrals of real functions. Basically, calculating real integrals can be reduced to calculating some residues. However, it cannot be generalized a way of calculating real definite integrals using residues. In this section we will deal only with a few classical types, indicating the optimal computational procedure. It is noted that residues can be used in many scientific fields, such as statistics, fluid mechanics, physics, economics, but also in subfields of mathematics, such as solving differential and partial differential equations, more precisely, in determining solutions of Dirichlet Problems, etc. The main bibliographic source is the treatise [5].
The integrals that are going to be discussed include $\int_{-\infty}^{\infty} R(x)dx$ and $\int_{0}^{\infty} R(x)dx$, where $R(x)$

is a real function, trigonometric integrals, such as $\int_0^{2\pi} R(\sin x, \cos x)dx$, Fourier integrals, which are of the form $\int_{-\infty}^{\infty} f(x)e^{i\alpha x}dx$, where $\alpha > 0$. Additionally, we have also chosen to illustrate other different types of real integrals that can be solved using the Residue Theorem and these include $\int_0^{\infty} R(x)\ln x dx$ and $\int_0^{\infty} \frac{R(x)}{x^a}dx$.

The next section presents how residues stand out in the process of calculating some special infinite series, which are of the form $\sum_{n=-\infty}^{\infty} f(n)$. The function $f$ is holomorphic on $\mathbb{C} \setminus A$, where the set $A = \{z_1, ..., z_k\}$ contains all the poles of the function $f$. Infinite series have applications in engineering, physics, fluid mechanics, computer science, finance and mathematics. More specifically, in engineering or even fluid mechanics, they are used for the analysis of current flow and sound waves. In physics, infinite series can be used to find the time it takes for a bouncing ball to stop or for the swing of a pendulum to stop.
In the third section we aim to see how the theory of analytic functions influences Laplace transform theory. Specifically, we want to illustrate another important application of the Residue Theorem which concerns the determination of the inverse of a Laplace transform (the Laplace transform of a function $f$ is also a function by form $F(z) = \int_0^{\infty} e^{-zt}f(t)dt$, defined for all $z \in \mathbb{C}$.) As an application, the impulse response of a system can be derived from the inverse of the Laplace transform of transfer functions. For example, the history of an aircraft's response to commands is easily obtained by finding the inverse Laplace transform of the corresponding transfer function. For this part the main bibliographic source is the treatise [2].
The last section is meant to illustrate another interesting application from Linear Algebra, involving residues and Cauchy (complex) integrals. This is summed up to the Jordan decomposition theorem of a matrix.
The originality of this scientific work lies in the suggestive examples given in the fundamental results presented, in particular in the illustration of the importance of the Residue Theorem, which is used to deduce multiple useful notions in different fields, as stated above.
We would like to mention that the present paper was presented at the Session of Scientific Communications of Students, organized by the Department of Mathematics of the Faculty of Mathematics and Computer Science of the Babeș-Bolyai University.

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# The Differences Between Universal Analytics and Google Analytics 4

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**Keywords:** Google Analytics 4,Universal Analytics, Measurement model,User code

**What are the differences between Universal Analytics and Google Analytics 4?**

Currently, Google Analytics (GA) offers users two measurement methods (data models), corresponding to the two types of properties you can create: Universal Analytics (GA3) and Google Analytics 4 (GA4) – the most recently installed.

**What is Universal Analytics**

Universal Analytics is an older version of Google Analytics, which offers the possibility of detailed measurement of user behavior and other data, exclusively at the website level (in comparison, the more recent version of Google Analytics 4 also allows measurement at the application level).
The various tracking codes in Universal Analytics allow measuring how users interact with the website, analyzing the mobile devices from which the website is accessed, and other devices.

**What is Google Analytics 4**

Google Analytics 4, the latest data model released, is currently the default property of creating a Google Analytics account and operates on the basis of event analysis, which allows both analysis of data from websites and mobile applications. In Google Analytics 4, every access is an event and there is no difference between the types of access. GA4 events do not include categories, shares, and tags, so they are not displayed in reports, unlike GA3 reports. It is therefore recommended to rethink the way data is collected according to the GA4 model, rather than loading the existing data structure into the GA4.
Google Analytics 4 events fall into four categories: Automatically collected events; Improved measurement events; Recommended events; Personalized events.

**Storage of data about users and events**

Google Analytics allows the storage of certain information from an inactive user (cookies, user identifiers or advertising) for a period of time before their final deletion. In Universal Analytics you can set a period of 14 months, 26 months, 38 months, 50 months or you can choose

the goal not automatically expire. Google Analytics only allows data to be stored for 2 months or 14 months.

**Tracking in eCommerce**

Currently, Google Analytics 4's eCommerce tracking capabilities are less powerful than Universal analysts'. GA3 provides information about purchases and ads, while GA3 provides information about purchasing behavior, check-out behavior, product performance, sales performance, product list performance, and details of marketing actions such as internal promotions, coupons order product coupons or affiliate codes.

**Parameters and custom values**

Custom parameters and values from Universal Analytics are used to add information to the collected data. In GA4 this role is played by events or parameters of events and user properties. Associate parameters and peronalized values as follows: Access level/HID-scopy, User/User-scopy level, Session/session-scopy level and Product/product-scopy level.

**Measurement model** In Universal analysts you have the possibility to group the content into a logical structure, with which to see and compare values according to the group name. For example, you can see the cumulative number of views of all pages in a group such as men/shirts, then you can see the details of each URL or page title in that group . Google Analytics 4 properties have a predefined event parameter for grouping by content (content group in gtag.jsor grouping by content. Additional parameters of the grouping according to the content Universal Analyticspot be implemented and operate in separate GA4 as the parameters of the personalized level of events.

**User code**

The user code function in Universal Analytics bghsi Google Analytics 4 has a similar purpose, to identify and provide more accurate information about the number of users in reports. From a data collection point, no specific modifgicars are required to associate user codes from a Universal Analytics property to a Google Analytics 4 property. If you need to get an overview of users from applications and from the web, the implementation of user code on the web must correspond to the implementation of user code in the application.

**Comparison of data from reports in properties of GA3 and GA4**

In addition to the differences between the data model, labeling and configuration settings can cause variations between data from Universal Analytics properties and Google Analytics 4.

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# The Conformal Mapping Approach. Applications in Fluid Mechanics

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**Keywords:** holomorphic function, univalent function, Cauchy-Riemann equations, simply connected, conformal mapping, Riemann Mapping Theorem, ideal fluid, potential flow, complex potential, complex velocity.

This paper aims to merge two core areas of Mathematics, focusing on how the notion of conformal mappings, a concept related to Complex Analysis, is echoed into the field of Fluid Dynamics, giving rise to impressive applications underlying our daily existence and the world surrounding us. We survey such applications related to the 2D potential flow of an ideal incompressible fluid around a solid particle.

We recall the most fundamental concepts of Complex Analysis, such as: holomorphic and analytic functions, univalence, conformal mappings and the Riemann Mapping Theorem, which we will apply in the modeling of fluid flow around solid obstacles.

While most modern engineering disciplines may focus on providing numerical solutions for the equations governing turbulent or laminar flows, we study the flow of ideal fluids, which can be described in terms of the so-called complex potential $F = \phi + i\psi$, whose real and imaginary parts (potential and stream function) are conjugate harmonic, meaning that they are both solutions to the Laplace equation which also satisfy the Cauchy-Riemann conditions. Furthermore, we provide a concrete depiction of the fluid flow, namely on the way streamlines are described, for some specific situations, like for instance the case where the encountered obstacle is circular.

Conformal (angle-preserving) mappings are utilized to ensure incompressibility, irrotationality and zero-flux condition along the solid boundary of the analyzed fluid flow. An outstanding contribution to the theory of conformal mappings is that of Bernhard Riemann, to whom we owe a number of remarkable results, including a theorem that bears his name, which proves that any simply connected domain in the complex plane, distinct from $\mathbb{C}$, can be mapped conformally on the unit disk U.

This result will enable us to explore the potential flow in case of an arbitrarily shaped obstacle, by proceeding as follows: composing the complex potential of a flow around a circular obstacle with a one-to-one conformal map, from the exterior of any domain to the exterior of the circle, leads us to a transformed complex potential on the corresponding arbitrary domain. By this means, the motion is entirely determined, since all its components are known.

Further research directions include:

- Study of fluid flow around multiple obstacles
- Study of fluid flow on domains with polygonal boundaries
- Study of Hele-Shaw flows by using the conformal mapping theory combined with methods of Geometric function theory of one complex variable.

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# Observing the natural world through mathematical eyes: An overview

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**Keywords:** : Mathematical modelling, Natural world, Ordinary differential equations, Partial differential equations, Economical forecasting, Societal trends.

The research of ordinary and partial differential equations spans many areas of economics, engineering, mechanics, physics, in fields of pure and applied mathematics. These domains are all focused on the characteristics of distinct forms of such equations.

While applied mathematics emphasizes the thorough explanation of the methods for approximating solutions, pure mathematics emphasizes the existence and uniqueness of solutions.

Virtually, almost every activity is modeled using ordinary and/or partial differential equations, including the investment market, the neuronal interactions or contemporary sociology.

One of the most effective approaches for describing natural events whose study is essential for progress that humans have created or discovered and continuously refined is the theory of ordinary differential equations.

However, its influence extends beyond purely mechanical, biological, or chemical processes. It is crucial to the understanding and design of mechanical engineering systems, as well as to the analysis and forecasting of biological, economical or societal trends in the actual world.

The theory of partial differential equations is a logical progression from the theory of ordinary differential equations and is unquestionably better suited to explaining phenomena with significant spatial dependence.

Nonetheless, without a solid theory for ordinary differential equations, the majority of conclusions about partial differential equations could not be obtained.

The aim of the present paper is to emphasize several mathematical models for phenomena belonging to the natural world, such as: biology, ecology, economics and medicine. The theoretical approach is underlined by several examples.

# Cryptocurrency Perspectives

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**Keywords:** : cryptocurrency, blockchain, Bitcoin, Etherum, Elrond, stablecoin, NFT.

**What is Cryptocurrency?**

A cryptocurrency is a digital currency, which is an alternative form of payment created using encryption algorithms. The use of encryption technologies means that cryptocurrencies function both as a currency and as a virtual accounting system. Cryptocurrency (or "crypto") is a class of digital assets created using cryptographic techniques that enable people to buy, sell or trade them securely. Unlike traditional fiat currencies controlled by national governments, cryptocurrencies can circulate without a monetary authority such as a central bank.

**What is Blockchain?**

Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack, or cheat the system. A blockchain is essentially a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain. Blockchain technology is used for many different purposes, from providing financial services to administering voting systems.

**Digital Wallets**

While private keys are essential to cryptocurrency, it is not necessary for a user to create or remember their own key pairs. Digital wallets are used to automatically create key pairs and store them safely. When a transaction is initiated, The wallet software creates a digital signature by processing the transaction with the private key. This upholds a secure system since the only way to generate a valid signature for any given transaction is to use the private key.
If a user loses their private key, they can no longer access the wallet to spend, withdraw, or transfer coins. It is, therefore, imperative to save the private key in a secure location. There are a number of ways that a digital wallet that contains a private key can be stored.

**What Is a Private Key?**

A private key is a secret number that is used in cryptography, similar to a password. In cryptocurrency, private keys are also used to sign transactions and prove ownership of a blockchain address. Is an integral aspect of bitcoin and altcoins, and its security makeup helps to protect a user from theft and unauthorized access to funds.
Cryptocurrency is controlled through a set of digital keys and addresses, representing ownership and control of virtual tokens. Anyone can deposit bitcoin or other tokens in any public address.

But even though a user has tokens deposited into their address, they won't be able to withdraw them without the unique private key.

*1.BITCOIN/ BTC (shorthand)* -A form of digital currency created in 2009, that is created and distributed on a peer-to-peer basis. It has no central bank - transactions are conducted directly between individuals:

- Bitcoin mining is the process of creating new bitcoins by solving extremely complicated math problems that verify transactions in the currency. When a bitcoin is successfully mined, the miner receives a predetermined amount of bitcoin.
- In 2011, the price started at $0.30 per bitcoin , growing to $5.27 for the year. The price rose to $31.50 on 8 June.Within a month, the price fell to $11.00.
- Research produced by the University of Cambridge estimated that in 2017, there were 2.9 to 5.8 million unique users using a cryptocurrency wallet, most of them using bitcoin.
- The validity of each cryptocurrency's coins is provided by a blockchain. A blockchain is a continuously growing list of records, called blocks, which are linked and secured using cryptography.

*2. ETHERUM* is the second-biggest cryptocurrency by market cap after Bitcoin. It is also a decentralized computing platform that can run a wide variety of applications — including a universe of decentralized finance apps and services.

*3. ELROND* is a blockchain-based platform that allows users to create and develop decentralized applications and cryptocurrencies to create a new internet economy. The project aims to resolve the burning problem of traffic congestion on blockchain networks by offering solutions for scalability. Elrond offers fast transactions and a scalable environment for developers, enterprises, and users, alongside a user-friendly experience and low transaction fees.

**Stablecoins**

Stablecoins are supposed to bridge the worlds of cryptocurrency and everyday fiat currency because their prices are pegged to a reserve asset like the U.S. dollar or gold. This should reduce volatility compared to something like Bitcoin and results in a form of digital money that is better suited to everything from day-to-day commerce to making transfers between exchanges. The combination of traditional-asset stability with digital-asset flexibility has proven to be a wildly popular idea. Billions of dollars in value have flowed into stablecoins like USD Coin (USDC) as they've become some of the most popular ways to store and trade value in the crypto ecosystem.

**A non-fungible token (NFT)** is a unique digital identifier that cannot be copied, substituted, or subdivided, that is recorded in a blockchain, and that is used to certify authenticity and ownership.

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# The Importance of Data Protection

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**Keywords:** : Data, Data backup, Data recovery, Data protection, Data encryption.

In this paper, I will present the importance of keeping our data safe from any malicious attacks or hardware failures, and some reliable backup solutions used to prevent any data loss. One of the most important things in a business or in our every day life is data. But let's start with the companies. Nowadays the success of a business often depends on how well the companies collect, organise and back up data. Customer management systems, internal work procedures or financial data are just a few examples of information without which a company could not function properly. Given their importance, storing them in a secure environment that allows easy access is necessary. Same things can be said about any person's data, such as old photos, memories, passwords, and the list could go on.

**How to make a backup?**
As i said, a backup is a copy of all the files in your company, in a storage medium dedicated to this purpose. However, in order to understand exactly how to make a backup and to store the data in a way that meets your needs and preferences, it is necessary to take into account two important aspects, which we will discuss next:

**The type of backup you want:**

- Full backup - As the name suggests, full backup is the method by which all data in a company will be backed up. It is usually used when making the first backup.
- Incremental backup - Because performing a full backup every time new files are generated would consume a lot of hardware resources, incremental backup was developed. This backup method only involves copying the data that was generated or modified recently and adding it to the already existing archive.
- Differential backup - This type of backup is similar to incremental with the difference that, in its case, all files generated after the full backup has been performed will be copied. Although this method may use more resources of the storage device, it allows quick recovery of lost data in case of an emergency.

**Where the backup will be stored?**
As I said, a backup can be made on any device that has a data storage technology, and the choice depends on the volume that your backup copy will have, the amount of money that you can allocate to this procedure and of how fast you want the data recovery to be.

**How often should you back up?**

- Daily - The data that must be backed up daily are those important data, the loss of which is unacceptable. Among them we mention: e-mail files, the telephone system, the customer management system or the network settings. If you believe that there are other important data that you cannot afford to lose, it is recommended to include them in the daily backup as well.
- Weekly - It is that data that is important to the company, but which consumes a lot of resources and would require too much time effort to be backed up daily. This category includes data associated with websites and general files, such as media.
- Every two weeks - Important files, but which are modified periodically, should be backed up approximately every 2 weeks. This category includes payroll and company finance data.

**How to properly maintain a data backup?**
Making a backup of your files is a measure that will ensure you have access to them, should those on your primary device be compromised. However, in order to be sure that you have access to the saved data, in the event of an unforeseen event, it is necessary to apply a series of measures to maintain the data that has a backup. Here they are:

- Make sure your backup was done correctly and is working. Periodically check the archive and check if the files are usable;
- Check the backup data to make sure the archive is complete. If you notice that several files are missing, we recommend that you make a full backup as soon as possible;
- Check if the storage medium is one you can rely on. Make sure that the devices you have stored the backup on are working in optimal parameters and inform yourself about the quality of the backup service you have chosen.

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# Starlike and Convex Functions in $\mathbb{C}$: Examples via MatLab

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**Keywords:** Univalent functions, starlikeness, convexity, numerical examples.

It is known that, in general, a convex combination of two univalent functions on the unit disc in $\mathbb{C}$ is not necessary univalent (see for example [2] or [3]).

$$f, g \text{ univalent} \quad \not\Rightarrow \quad (1-\lambda)f + \lambda g \text{ univalent}$$

Starting from this point, we present some classical results that solve (partially) the problem of univalence in $\mathbb{C}$ (selected from [1], [6] and [7]). Moreover, we can extend some of these results for the case of several complex variables (one may consult [4]).

Together with the theoretical results, we present some numerical examples of starlike (respectively, convex) functions obtained as convex combinations of univalent functions in $\mathbb{C}$. Finally, we discuss about a particular case of to the Hele-Shaw flow problem (based on the arguments obtained from the numerical examples presented; see also [5]).

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# Non-parametric Estimation of the Set-Indexed Conditional Empirical Process with functional ergodic data

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**Keywords:** Statistics, Vapnik-Chervonenkis classes, data analysis.

The theory of empirical processes plays a fundamental role in statistics with many applications can appear in too much theoretical and practical problems.

The purpose of this paper is to establish the invariance principle for the conditional set-indexed empirical process formed by functional ergodic random variables.

The limit theorems, discussed in this paper, are key tools for many further developments in functional data analysis involving empirical process techniques.

These results are proved under some standard structural conditions on the Vapnik-Chervonenkis classes of functions and some mild conditions on the model.

# Parallelization of Process of OCR for Book Digitization

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**Keywords:** OCR, neural network, parallel programming, Gustafson-Barsis law, Amdahlś law.

**Abstract**

Over the past few decades, technology has advanced considerably in the area of digitizing archives. What was once a challenge to store data and facilitate retrieval has now become commonplace. One of the key factors behind this change is OCR.

Optical Character Recognition (OCR) is the process of obtaining printed texts in a digitized format. There are millions of old books that are stored in vaults. The use of these books is forbidden due to their dilapidation and decrepitude, which is why the digitization of these books is so important. The main problem is cleaning the source from noise [1], recognizing the text in the image and converting it to text format. Which may also include the following steps: additional modification of the OCR mechanism itself and correction of post-processing errors.

Neural networks are used to improve text recognition. An image already processed by a convolutional network is sent to the input of a multilayer perceptron. In this case, the training sample for this network will be different from the sample for the convolutional network, since the networks process the image differently. The convolutional network is considered the main network and removes most of the noise in the image, while the multilayer perceptron processes what the convolutional one could not handle.

To speed up the process, it was proposed to use parallelization. First, it is necessary to check how many processes can be running on the device. After that, we can already run several threads, at different stages. The training cycle of the neural network includes a sequential pass through the training pairs, for each pair a forward move (calculation of the network output) and a reverse move (correction of weights and biases) are performed. These are the two parts of the body of the loop on training pairs, and a parallel approach can be used to optimize them [2]. As a result, on a typical neural network training task, we can get up to 50% speedup. The parallel approach also can be implemented on the stage with Pytesseract processing, where improvements can reach up to 15% [3].

But it is important to consider a few facts. The Gustafson-Barsis law, which is based on the assumption that the size of the task to be calculated grows linearly with the number of available processes. And Amdahl's law assumes that the size of the problem is fixed. When new processors are added, they work on parts of the task that were originally handled by fewer

processes. By adding more and more processes, their full capabilities are not being used, because eventually the size of what they can handle will bottom out. However, assuming that the size of the task increases with the number of processes added, all processes can be used at the desired level, and the speedup of the calculation being performed can be unlimited. The Gustafson-Barsis law implies that we are only limited by the size of the task that we can compute with the resources of the added processes. However, there are other factors that affect acceleration [4]. It is not possible to add processes and hope to really speed up all types of tasks. Instead, it is necessary to choose the best way to parallelize the task in order to get the maximum performance increase from the available hardware in order to get the best calculation time when solving a computational problem.

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# The Impact of Artificial Intelligence in Orthodoxism

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**Keywords:** : Christians, Bible, systematic test, conceptions.

**A current theological perspective on technology**

We live in an advanced world, a world where the need to adapt to what is new and developed is becoming greater and greater. This is also true in the Christian life. What does technology represent for today's Orthodox Christian? Probably until the advent of this epidemic, technology was not a point of interest for the common Christian, but things have changed. The need for Christians to always be connected, in one way or another, with services became paramount in their lives. So, technology, for contemporary Orthodox, represents a means of connection between them and the priest. The methods are very well known, we are talking about the live broadcasts on the various social networks, such as Facebook, Instagram, YouTube, etc. I want to believe that this is the beginning of technology in Crhistian's life.

**The pseudo-research. The codes of the Bible**

Many research efforts are conducted with the help of the computer and probably could not have been completed without it. The researches of some scientists have confirmed, in recent years, a hypothesis that claimed that the Bible includes, along with the obvious spiritual information, a certain secret code that can reveal events that took place thousands of years after the Bible was written. The Bible code was discovered in the original version of the Bible, the one in the hebrew language, in the Old Testament. In 1958, the czech rabbi Michael Dov Weissmandel was the one who revealed the first secret code. Studying the book of Genesis, he noticed that by removing every 50th letter from the first verses of Genesis, he obtained the word "Torah", which in Hebrew means "Law". One of his disciples, Rabbi Azriel Tauber, mentioned that, in those years, before the advent of computers, Weissmandel had transcribed the entire text of the Torah on sheets of 100 letters, arranged in 10 rows of 10 letters, and then he had searched for words from letters found at equidistant intervals. An israeli mathematician at the University of Jerusalem, Dr. Eliyahu Rips, decided to put Weissmandel's research to a systematic test; what he discovered made him known throughout the world. Rips transcribed the 304,805 characters of the Old Testament into his computer, eliminating the spaces between words, according to the biblical passage that tells that Moses received the text of the Law "without a break between words". With the help of the physicist Doron Witzum, he created

a computer program that allowed him to spot and analyze sequences of repetitive words. The computer divided the Bible into 62 lines of 4,772 letters each. The information is obtained by selecting every Nth letter, where N has a precise and appropriately chosen value - for example: 4, 5, 18, etc. With the help of a computer, words and phrases hidden by the interval codes are searched in this matrix formed by the biblical text. It starts from the first letter of the Bible and searches for each possible sequence of intervals for the words we request, which are deciphered with intervals of one, two, three letters, up to several thousand. Then the same search operation is repeated starting from the second letter and continuing in this way until the last letter of the Bible.

**Religion and Science**

The relationship between religion and science involves discussions that interconnect the study of the natural world, history, philosophy, and theology. Even though the ancient and medieval worlds did not have conceptions resembling the modern understandings of "science" or of "religion". Both science and religion are complex social and cultural endeavors that may vary across cultures and change over time. The great danger and temptation of secularism (modernity's greatest invention) is to lay claim to certain areas and domains of the world as a "neutral zone" – something self-existing that has nothing to do with God. This is patently untrue and represents an act of theft. This has particularly been a dangerous assertion regarding science and medicine. These things are the gift of God. This gift has a very deep history as part and parcel of faith. Even the ancient pagans saw the practice of medicine as a "theological" activity. St. Luke, the companion of St. Paul, was known as the "beloved physician." St. Paul himself dispensed medical advice to St. Timothy (which, incidentally, involved using a bit of wine rather than just water). The conclusion is an admonition to consider that issues of science and religion are almost always complex, and that the answers they entail are also complex. Only when we consider as many claims as possible and our own thinking about those claims can we grow in both faith and knowledge.

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# Real World Phenomena Modelled by Differential and Difference Equations

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**Keywords:** : Differential equations, Difference equations, Mathematical models, Real world examples.

An important amount of dynamical systems that describe the evolution of processes in economics, engineering, biology, chemistry, or physics are so complex that it is usually difficult to identify corresponding mathematical models. Many phenomena derived from real events and situations are modeled by ordinary, integral, or partial differential equations, as well as by means of difference equations.

Differential and difference equations describe, in general, the rate of change in a scientific model of a process and represent an important factor of progress that can not be ignored in the real world. This importance increases in proportion to the computing speed registered in modern technology. Due to the variety of applications, we often come across several theories and calculation methods. Among them are the linear existence problem and the principle of uniqueness of solutions.

In the present paper we intend to continue our study of differential and difference equations from the previous edition of StudMath-IT, by highlighting the following: an example from biology and geometry related to the logarithmic spiral, an example from thermodynamics reffering to the emptying of a tank as an apllication of the Torricelli-Borda's law, as well as an example from the theory of electricity such as the description of a circuit.

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# Fashion Design apps

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The practice of fashion design has its roots in the year 1826. Charles Frederick Worth is credited with being the world's first fashion designer. As a former draper, Charles founded a fashion house in Paris. He was the one who first established the norm of fashion houses advising their clients on proper clothing. Today, 196 years later, anyone can claim to be a fashion designer in some small way. Modern technology, such as desktop apps, webpages and even mobile apps help aspiring designers bring life to their ideas. Programs like Adobe Photoshop or Procreate make it possible for anybody to create a piece of clothing or to modify a sewing pattern to their preferred size.

Here are a few of the programs we'd like to discuss about:

- Adobe Illustrator – Adobe Illustrator is a vector graphics editor and design program developed and marketed by Adobe Inc, used to add the final touches and fine details to designs. Usually, Adobe Photoshop is used in tandem with it.
- Adobe Photoshop – Raster graphics editor Adobe Photoshop was created and released by Adobe Inc. for Windows and macOS. Thomas and John Knoll originally developed the app in 1988. Since then, the program has evolved into the industry standard for editing raster images as well as all forms of digital art.
- Corel DRAW – CorelDRAW is a graphics and drawing program that is vector-based and developed by a software company based in Ottawa called Corel.
- Optitex – The "Optitex" design product is meant for professionals in the fashion business who want to calculate every aspect of a product's cut, fit, and material in great detail. The application can be used to model two-dimensional components, although its focus is on working with three-dimensional objects.
- Spreadshirt – Spreadshirt is a website where you can make custom designs. It is designed as both an online tool for creating, as well as an online shop that provides the customer with their customized item of choice.

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