Postgraduate Diploma

Advanced Parallel Computing

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Postgraduate Diploma
Advanced Parallel Computing

- Modality: **online**
- Duration: **6 months**
- Certificate: **TECH Global University**
- Credits: **18 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: www.techtitute.com/us/information-technology/postgraduate-diploma/postgraduate-diploma-advanced-parallel-computing

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01

Introduction

A basic understanding has become insufficient due to the rapid development of parallel computing in recent years.. For the computer scientist to unlock their full potential and elevate their work to a higher level, delving deeper into the subject is essential. It is crucial to gain a comprehensive understanding of the information exchange system between processes on different machines and develop the ability to measure the performance of parallel algorithms. By doing so, they can effectively identify the aspects that may impede optimal performance. This is the premise of this university program, which delves into the most advanced issues of parallel computing from both an innovative and practical perspective. An essential academic option for any computer scientist looking for a quality boost in his or her professional career.

Thanks to this TECH Postgraduate Diploma, you can direct your career towards the most advanced computational research"

In parallel computing, it is essential for computer scientists to master the optimization of the various codes used. This allows them to extract maximum performance from the programming environment they are working with. To possess this ability, it is necessary to have not only knowledge of how to measure the performance of an algorithm or program but also a comprehensive understanding of how different computer systems communicate and coordinate.

Therefore, this Postgraduate diploma starts by laying the foundations of message-oriented communication, flows, multicast, and other forms of communication in parallel computing Following that, the Postgraduate diploma delves into the most sophisticated methods for analyzing and programming parallel algorithms. The discussion concludes with a comprehensive review of *benchmarking* and the various considerations that need to be taken into account regarding parallel performance.

All of these courses are conveniently offered in a 100% online format, eliminating the need for students to attend in-person classes or adhere to a pre-set schedule All the course content is available for download from the virtual classroom, enabling students to study conveniently from their preferred devices such as *tablets* , computers, or even smartphones. This Postgraduate Diploma also offers a decisive advantage for individuals who have demanding personal or professional responsibilities.

This **Postgraduate Diploma in Advanced Parallel Computing** contains the most complete and up-to-date program on the market. The most important features include:

- The development of case studies presented by experts in Parallel and Distributed Computing
- The program is designed with graphical, schematic, and highly practical content, which gathers essential information about disciplines that are crucial for the professional practice
- Practical exercises where self-assessment can be used to improve learning
- Its special emphasis on innovative methodologies
- The incorporation of theoretical lessons, interactive question-and-answer sessions with experts, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

Immerse yourself in state-of-the-art programming and computational performance models, guided by true experts in the field”

You will have at your disposal a large number of didactic and interactive resources that will help you to contextualize all the knowledge imparted"

You have the freedom to choose when, where, and how to tackle the entire course load, allowing you to distribute the study material according to your own preferences and schedule.

You can achieve the career goal you deserve with the unwavering support of a teaching team that possesses in-depth knowledge of the job market and the strategies needed for success.

The program features a teaching staff comprising professionals from the industry who bring their valuable work experience to the training. Additionally, renowned specialists from prestigious reference societies and universities contribute their expertise to further enrich the program.

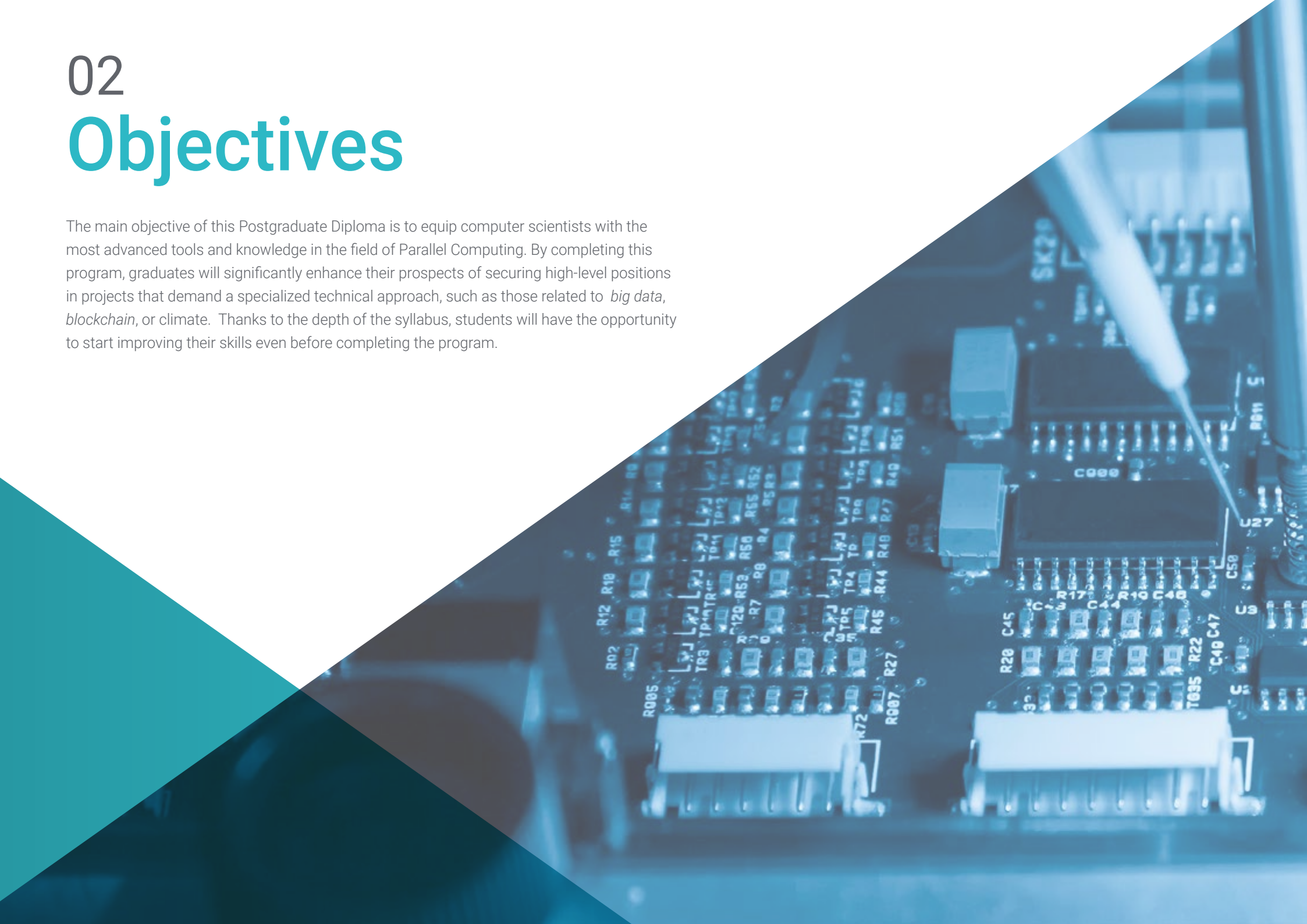
The program offers multimedia content developed using the latest educational technology, creating a contextual and immersive learning environment for professionals. This includes a simulated environment designed to provide training in real-life situations.

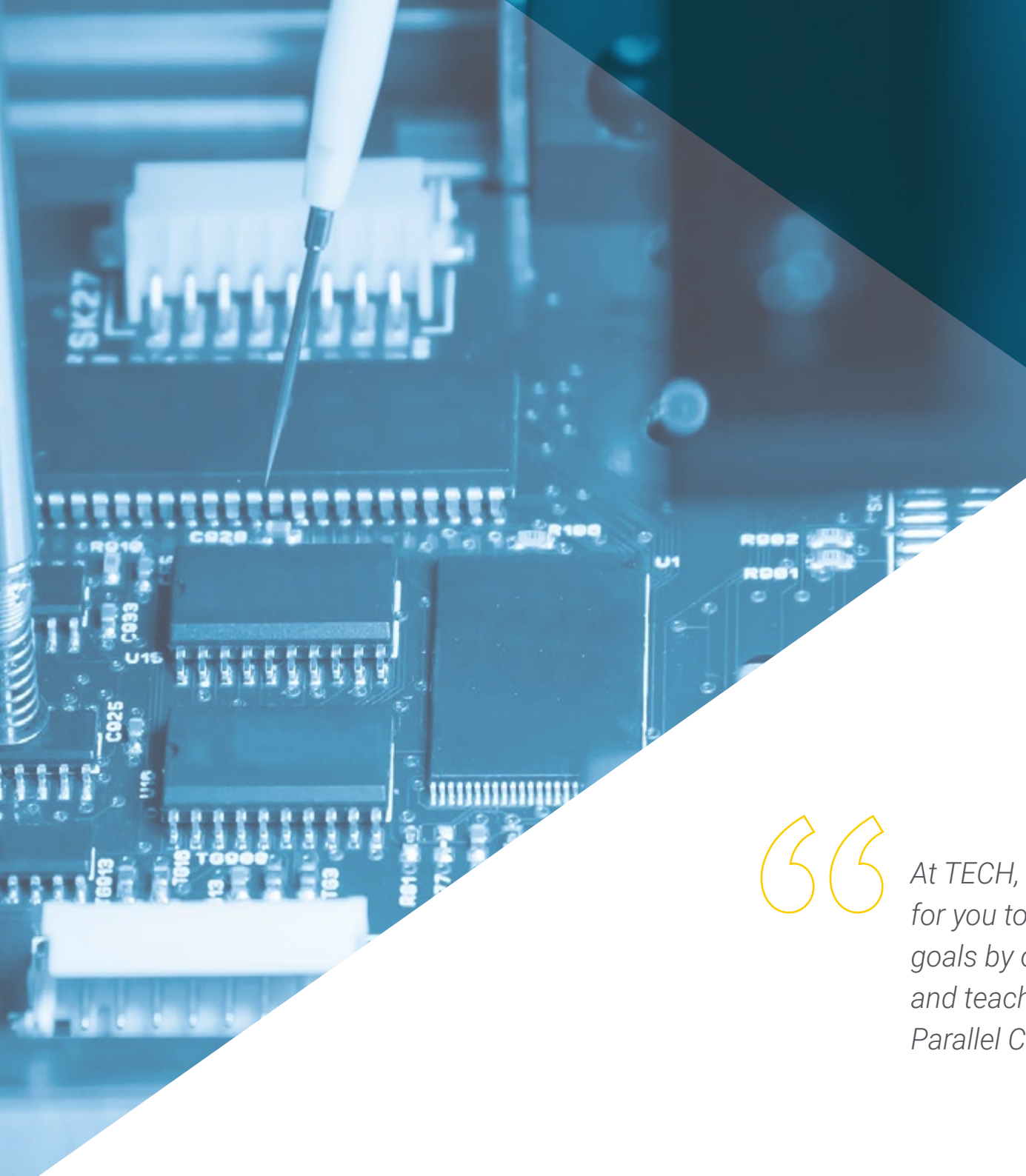
The program's design emphasizes Problem-Based Learning, requiring professionals to actively solve various real-world practice situations that are presented to them throughout the academic year. For this purpose, the student will be assisted by an innovative interactive video system created by renowned and experienced experts.

02

Objectives

The main objective of this Postgraduate Diploma is to equip computer scientists with the most advanced tools and knowledge in the field of Parallel Computing. By completing this program, graduates will significantly enhance their prospects of securing high-level positions in projects that demand a specialized technical approach, such as those related to *big data*, *blockchain*, or climate. Thanks to the depth of the syllabus, students will have the opportunity to start improving their skills even before completing the program.



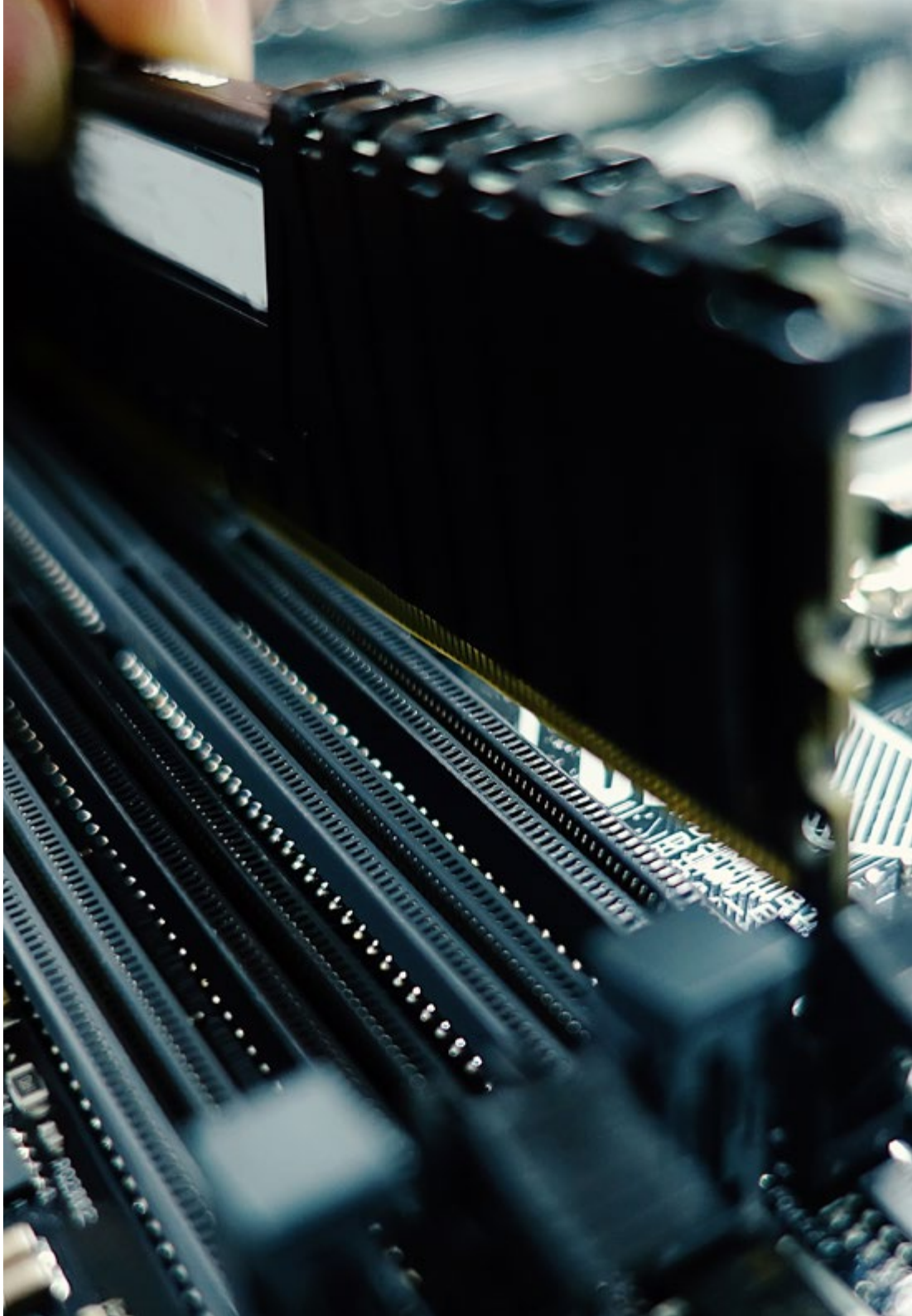


At TECH, we strive to make it effortless for you to achieve your most ambitious goals by offering the best possible lessons and teaching staff for studying Advanced Parallel Computing"

General Objectives

- Analyze the different components of Parallel and Distributed Computing
- Measure and compare their efficiency to analyze the performance of the set of components used
- Analyze in depth Multiplatform Parallel Computing to use task-level parallelism between different hardware accelerators
- Analyze in detail current software and architectures
- Develop in depth the relevant aspects of Parallel and Distributed Computing
- Specialize the student in the use of Parallel and Distributed Computing in different sectors

With our program, you will delve into the parallelization of processes and various communication methods from a modern perspective. The syllabus is regularly updated to ensure its alignment with the current market reality"



Specific Objectives

Module 1. Communication and Coordination in Computing Systems

- Analyze the different architectures and models of distributed systems
- Determine the characteristics of parallel and distributed systems
- Delve into the different communications that occur at the process level
- Examine remote, flow-oriented, message-oriented and multicast communications along with more recent examples and considerations
- Establish the types of communications that are emerging, their strengths and limitations
- Develop the processes to be followed in the choice of algorithms to be applied for name service, clock synchronization, coordination and agreement between the elements of the system
- Compile scenarios using different types of communication technologies that improve performance and scalability

Module 2. Analysis and Programming of Parallel Algorithms

- Analyze the different Parallel Programming paradigms
- Examine the most advanced tools to perform Parallel Programming
- Analyze parallel algorithms for fundamental problems
- Specify the design and analysis of parallel algorithms
- Develop parallel algorithms and implement them by using MPI, OpenMP, OpenCL/CUDA

Module 3. Parallel Performance

- Analyze the aspects of parallel algorithms that affect their performance and scalability
- Establish the main performance and scalability metrics of parallel algorithms
- Examine the main techniques for comparing parallel algorithms
- Identify the constraints that hardware resources impose on Parallelization
- In the program, you will learn the best practices for optimizing the performance of different types of parallel programs. This includes shared memory parallel programs, message passing parallel programs, hybrid parallel programs, and parallel programs with heterogeneous computation
- Compile state-of-the-art tools for analyzing the performance of parallel algorithms
- Introduce the main patterns of parallel processing
- Specify a robust procedure for the definition of high-performance parallel programs

03

Course Management

The direction of this Postgraduate Diploma has been entrusted to a team of leading experts in the field of Advanced Parallel Computing. The experience of the program's instructors in managing large projects for international entities enriches the program with not only an advanced theoretical perspective but also with the most current realities of Parallel Computing projects. Students will have the privilege of consulting their doubts with the teaching staff at any time, receiving personalized attention throughout the entire process.

This program provides you with the chance to connect with professionals who have a deep understanding of your field. Their motivation is to help you elevate your work to a new level of excellence"

Management

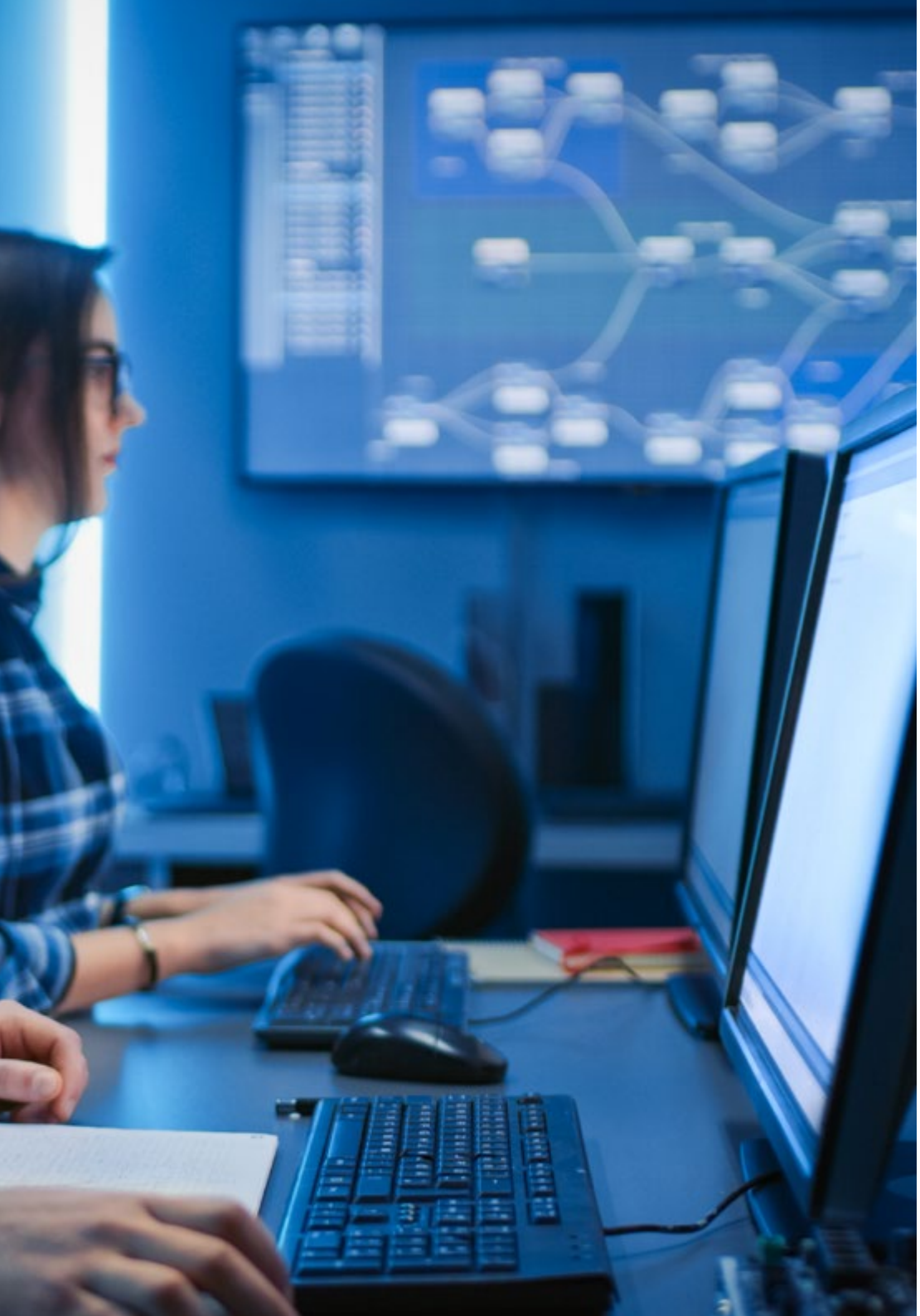
D. Olalla Bonal, Martín

- Senior Blockchain Practice Manager at EY
- Blockchain Client Technical Specialist for IBM
- Director of Architecture for Blocknitive
- Non-Relational Distributed Databases Team Coordinator for wedoIT (IBM Subsidiary)
- Infrastructure Architect at Bankia
- Head of Layout Department at T-Systems
- Department Coordinator for Bing Data Spain S.L

Professors

Mr. Villot Guisán, Pablo

- Chief Information Officer, Chief Technical Officer and Founder of New Tech & Talent
- Technology Expert at KPMG Spain
- *Blockchain* Architect at Everis
- J2EE Developer Commercial Logistics Area in Inditex
- Degree in Computer Engineering from the University of La Coruña
- Microsoft MSCA certification: *Cloud Platform*



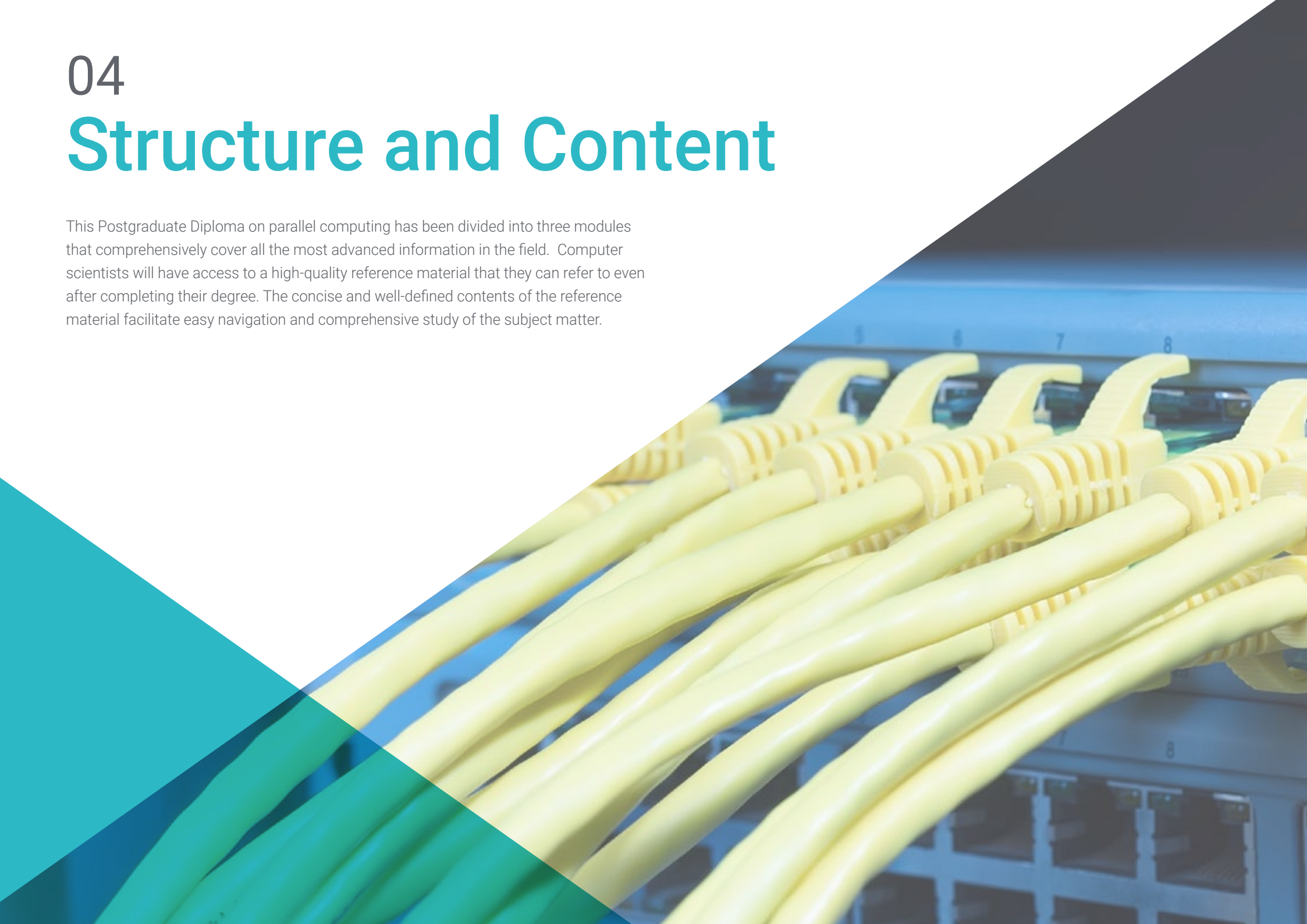
Dr. Almendras Aruzamen, Luis Fernando

- Date Engineer and Business Intelligence. Solutio Group, Madrid
- Data engineer at Indizen
- Data and *business intelligence* engineer at technology and people
- Database, *big* data and *business intelligence* support engineer at Equinix
- Data Engineer. Jalasoft
- Product Manager and responsible for the business analytics area at Goja
- Business Intelligence Sub-Manager. Pc's VIVA Nuevatel
- Responsible for the datrawarehouse and big data area at Viva
- Software Development Leader at Intersoft
- Degree in Computer Science from University Mayor de San Simón
- Doctorate in Computer Engineering. Complutense University of Madrid
- Master's Degree in Computer Engineering from the Complutense University of Madrid
- Master's Degree in Information Systems and Technology Management from the Mayor University of San Simon
- International instructor. Oracle Database Proydesa - Oracle, Argentina
- Project Management Professional Certification Scoping Consultancy, Chile

04

Structure and Content

This Postgraduate Diploma on parallel computing has been divided into three modules that comprehensively cover all the most advanced information in the field. Computer scientists will have access to a high-quality reference material that they can refer to even after completing their degree. The concise and well-defined contents of the reference material facilitate easy navigation and comprehensive study of the subject matter.



The educational method of relearning allows computer scientists to grasp the most important concepts in a natural manner, thereby reducing the need for extensive study hours"

Module 1. Communication and Coordination in Computing Systems

1.1. Parallel and Distributed Computing Processes
- 1.1.1. Parallel and Distributed Computing Processes
- 1.1.2. Processes and Threads
- 1.1.3. Virtualisation
- 1.1.4. Clients and Servers

1.2. Parallel Computing Communication
- 1.2.1. Parallel Computing
- 1.2.2. Layered Protocols
- 1.2.3. Communication in Parallel Computing. Typology

1.3. Remote Procedure Calling
- 1.3.1. Functioning of RPC (Remote Procedure Call)
- 1.3.2. Parameter Passing
- 1.3.3. Asynchronous RPC
- 1.3.4. Remote Procedure. Examples:

1.4. Message-Oriented Communication
- 1.4.1. Transient Message-Oriented Communication
- 1.4.2. Persistent Message-Oriented Communication
- 1.4.3. Message-Oriented Communication. Examples:

1.5. Flow-Oriented Communication
- 1.5.1. Support for Continuous Media
- 1.5.2. Flows and Quality of Service
- 1.5.3. Flow Synchronization
- 1.5.4. Flow-Oriented Communication. Examples:

1.6. Multicast Communication
- 1.6.1. Multicast at Application Level
- 1.6.2. Rumor-Based Data Broadcasting
- 1.6.3. Multicast Communication. Examples:

1.7. Other Types of Communication
- 1.7.1. Remote Method Invocation
- 1.7.2. Web Services / SOA / REST
- 1.7.3. Event Notification
- 1.7.4. Mobile Agents

1.8. Name Service
- 1.8.1. Name Services in Computing
- 1.8.2. Name Services and Domain Name System
- 1.8.3. Directory Services

1.9. Synchronization
- 1.9.1. Clock Synchronization
- 1.9.2. Logical Clocks, Mutual Exclusion and Global Positioning of Nodes
- 1.9.3. Choice of Algorithms

1.10. Communication Coordination and Agreement
- 1.10.1. Coordination and Agreement
- 1.10.2. Coordination and Agreement Consensus and Problems
- 1.10.3. Communication and Coordination. Currently

Module 2. Analysis and Programming of Parallel Algorithms

2.1. Parallel Algorithms
- 2.1.1. Problem Decomposition
- 2.1.2. Data Dependencies
- 2.1.3. Implicit and Explicit Parallelism

2.2. Parallel Programming Paradigms
- 2.2.1. Parallel Programming with Shared Memory
- 2.2.2. Parallel Programming with Distributed Memory
- 2.2.3. Hybrid Parallel Programming
- 2.2.4. Heterogeneous Computing- CPU + GPU
- 2.2.5. Quantum Computing New Programming Models with Implicit Parallelism

2.3. Parallel Programming with Shared Memory
- 2.3.1. Models of Parallel Programming with Shared Memory
- 2.3.2. Parallel Algorithms with Shared Memory
- 2.3.3. Libraries for Parallel Programming with Shared Memory

2.4. OpenMP
- 2.4.1. OpenMP
- 2.4.2. Running and Debugging Programs with OpenMP
- 2.4.3. Parallel Algorithms with Shared Memory in OpenMP

2.5. Parallel Programming by Message Passing
- 2.5.1. Message Passing Primitives
- 2.5.2. Communication Operations and Collective Computing
- 2.5.3. Parallel Message-Passing Algorithms
- 2.5.4. Libraries for Parallel Programming with Message Passing

2.6. Message Passing Interface (MPI)
- 2.6.1. Message Passing Interface (MPI)
- 2.6.2. Execution and Debugging of Programs with MPI
- 2.6.3. Parallel Message Passing Algorithms with MPI

2.7. Hybrid Parallel Programming
- 2.7.1. Hybrid Parallel Programming
- 2.7.2. Execution and Debugging of Hybrid Parallel Programs
- 2.7.3. MPI-OpenMP Hybrid Parallel Algorithms

2.8. Parallel Programming with Heterogeneous Computing
- 2.8.1. Parallel Programming with Heterogeneous Computing
- 2.8.2. AIH vs. GPU
- 2.8.3. Parallel Algorithms with Heterogeneous Computing

2.9. OpenCL and CUDA
- 2.9.1. OpenCL vs. CUDA
- 2.9.2. Executing and Debugging Parallel Programs with Heterogeneous Computing
- 2.9.3. Parallel Algorithms with Heterogeneous Computing

2.10. Design of Parallel Algorithms
- 2.10.1. Design of Parallel Algorithms
- 2.10.2. Problem and Context
- 2.10.3. Automatic Parallelization vs. Manual Parallelization
- 2.10.4. Problem Partitioning
- 2.10.5. Computer Communications

Module 3. Parallel Performance

3.1. Performance of Parallel Algorithms
- 3.1.1. Amdahl's Law
- 3.1.2. Gustarfson's Law
- 3.1.3. Performance Metrics and Scalability of Parallel Algorithms

3.2. Comparison of Parallel Algorithms
- 3.2.1. Benchmarking
- 3.2.2. Mathematical Analysis of Parallel Algorithms
- 3.2.3. Asymptotic Analysis of Parallel Algorithms

3.3. Hardware Resource Constraints
- 3.3.1. Memory
- 3.3.2. Processing
- 3.3.3. Communication
- 3.3.4. Dynamic Resource Partitioning

3.4. Parallel Program Performance with Shared Memory
- 3.4.1. Optimal Task Partitioning
- 3.4.2. Thread Affinity
- 3.4.3. SIMD Parallelism
- 3.4.4. Parallel Programs with Shared Memory. Examples:

3.5. Performance of Message-Passing Parallel Programs
- 3.5.1. Performance of Message-Passing Parallel Programs
- 3.5.2. Optimization of MPI Communications
- 3.5.3. Affinity Control and Load Balancing
- 3.5.4. Parallel I/O
- 3.5.5. Parallel Message Passing Programs Examples:

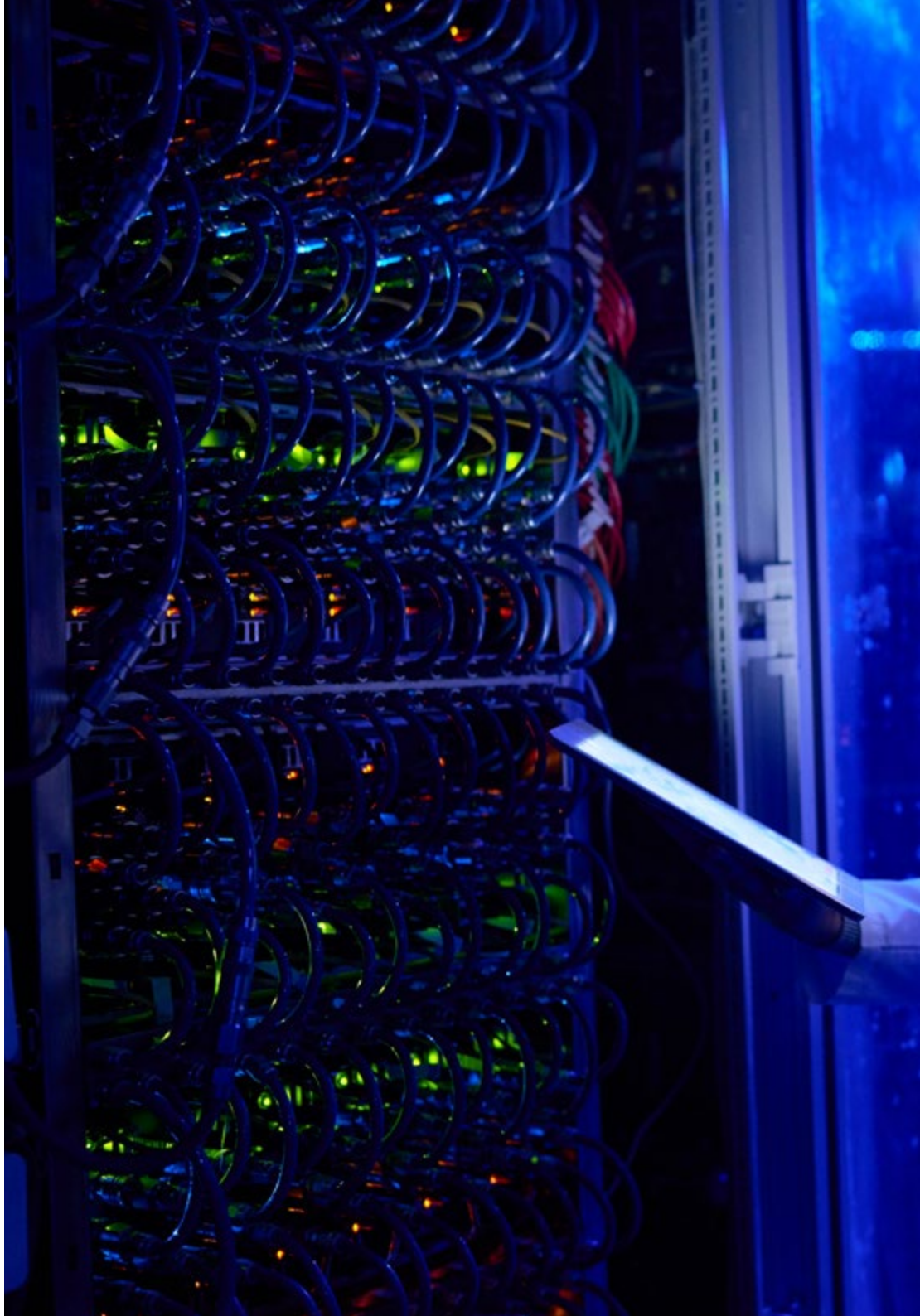
3.6. Performance of Hybrid Parallel Programs
- 3.6.1. Performance of Hybrid Parallel Programs
- 3.6.2. Hybrid Programming for Shared/Distributed Memory Systems
- 3.6.3. Hybrid Parallel Programs. Examples:

3.7. Performance of Programs with Heterogeneous Computation
- 3.7.1. Performance of Programs with Heterogeneous Computation
- 3.7.2. Hybrid Programming for Systems with Multiple Hardware Accelerators
- 3.7.3. Programs with Heterogeneous Computing. Examples:

3.8. Performance Analysis of Parallel Algorithms
- 3.8.1. Performance Analysis of Parallel Algorithms
- 3.8.2. Performance Analysis of Parallel Algorithms. Data Science
- 3.8.3. Performance Analysis of Parallel Algorithms. Recommendations

3.9. Parallel Patterns
- 3.9.1. Parallel Patterns
- 3.9.2. Main Parallel Patterns
- 3.9.3. Parallel Patterns Comparison

3.10. High Performance Parallel Programs
- 3.10.1. Process
- 3.10.2. High Performance Parallel Programs
- 3.10.3. High Performance Parallel Programs Real Uses



The detailed videos, summaries, real case studies, and various exercises provided will serve as essential supplementary materials for your study of Advanced Parallel Computing"

05

Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"

Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"

You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.

The student will learn to solve complex situations in real business environments through collaborative activities and real cases.

A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

> *Our program prepares you to face new challenges in uncertain environments and achieve success in your career"*

The case method has been the most widely used learning system among the world's leading Information Technology schools for as long as they have existed. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the course, students will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

Relearning Methodology

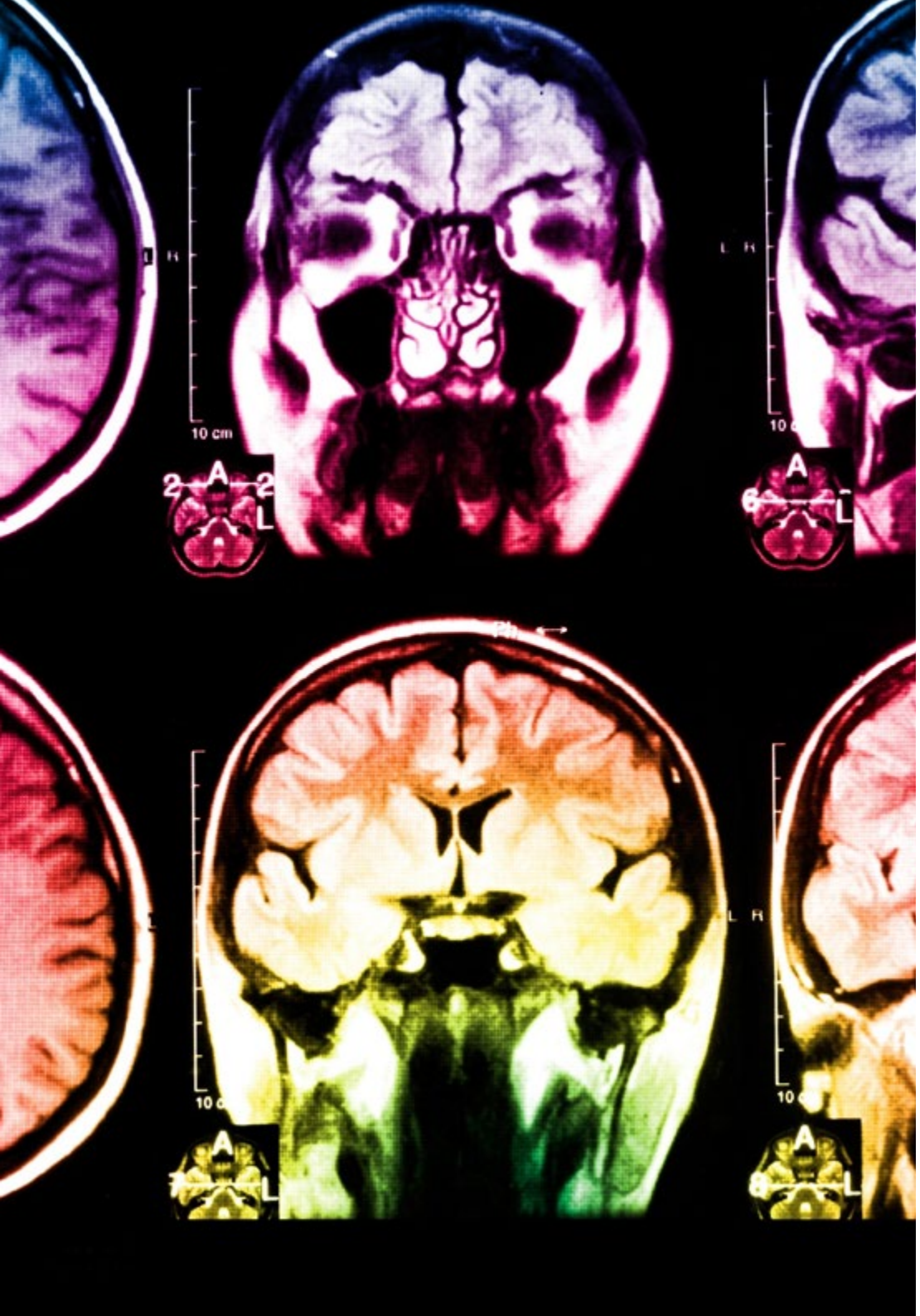
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

In 2019, we obtained the best learning results of all online universities in the world.

At TECH you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent e-learning, the different elements in our program are connected to the context where the individual carries out their professional activity.

This program offers the best educational material, prepared with professionals in mind:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

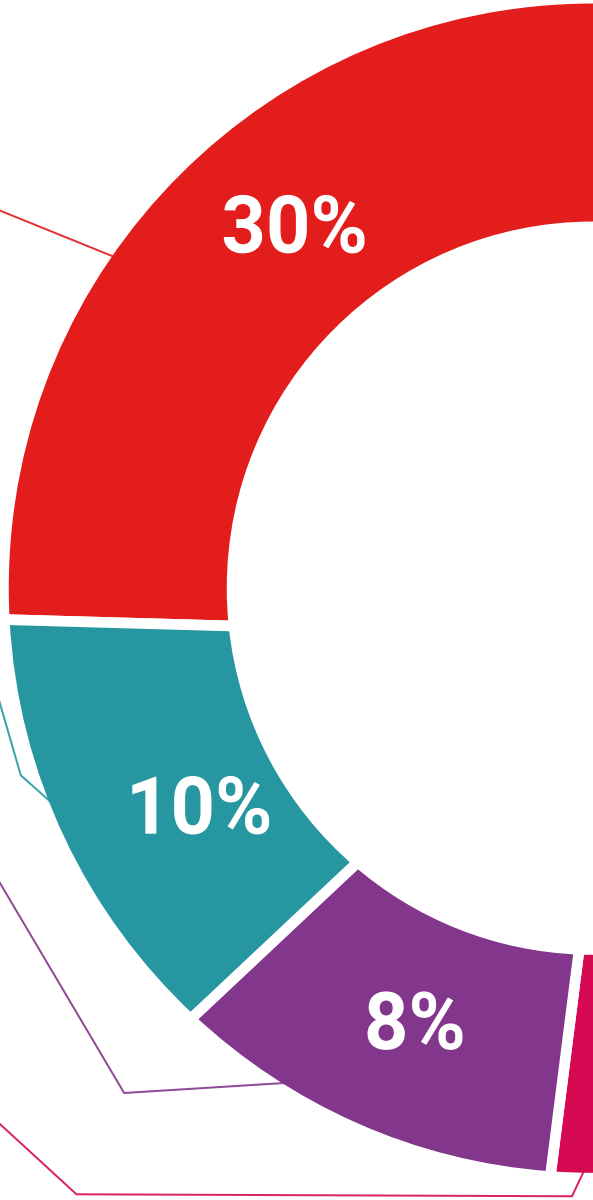
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

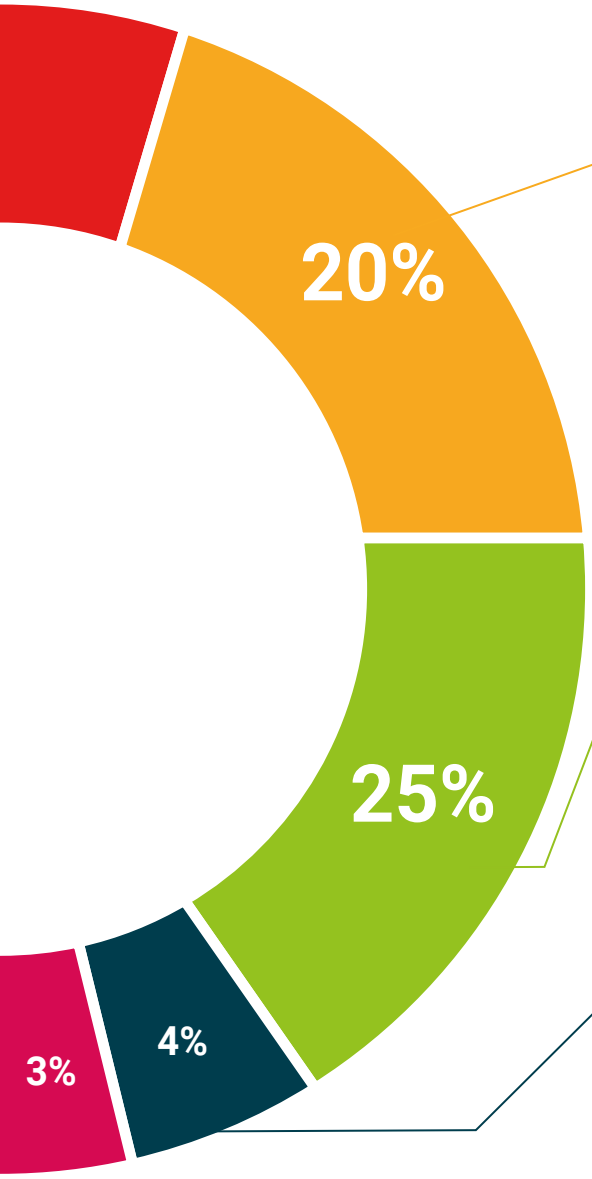
Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.





Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

06

Certificate

The Postgraduate Diploma in Advanced Parallel Computing guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Diploma issued by TECH Global University.

By successfully completing this program, you can obtain your certificate and without the need for travel or dealing with cumbersome paperwork"

This program will allow you to obtain your **Postgraduate Diploma in Advanced Parallel Computing** endorsed by **TECH Global University**, the world's largest online university.

TECH Global University is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Postgraduate Diploma in Advanced Parallel Computing**

Modality: **online**

Duration: **6 months**

Accreditation: **18 ECTS**


tech global university

Mr./Ms. _____, with identification document _____
has successfully passed and obtained the title of:

Postgraduate Diploma in Advanced Parallel Computing

This is a program of 450 hours of duration equivalent to 18 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

Unique TECH Code: AFWORD23S techtitute.com/certificates

*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

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