Postgraduate Diploma
Parallel Computing

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Postgraduate Diploma
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-parallel-computing

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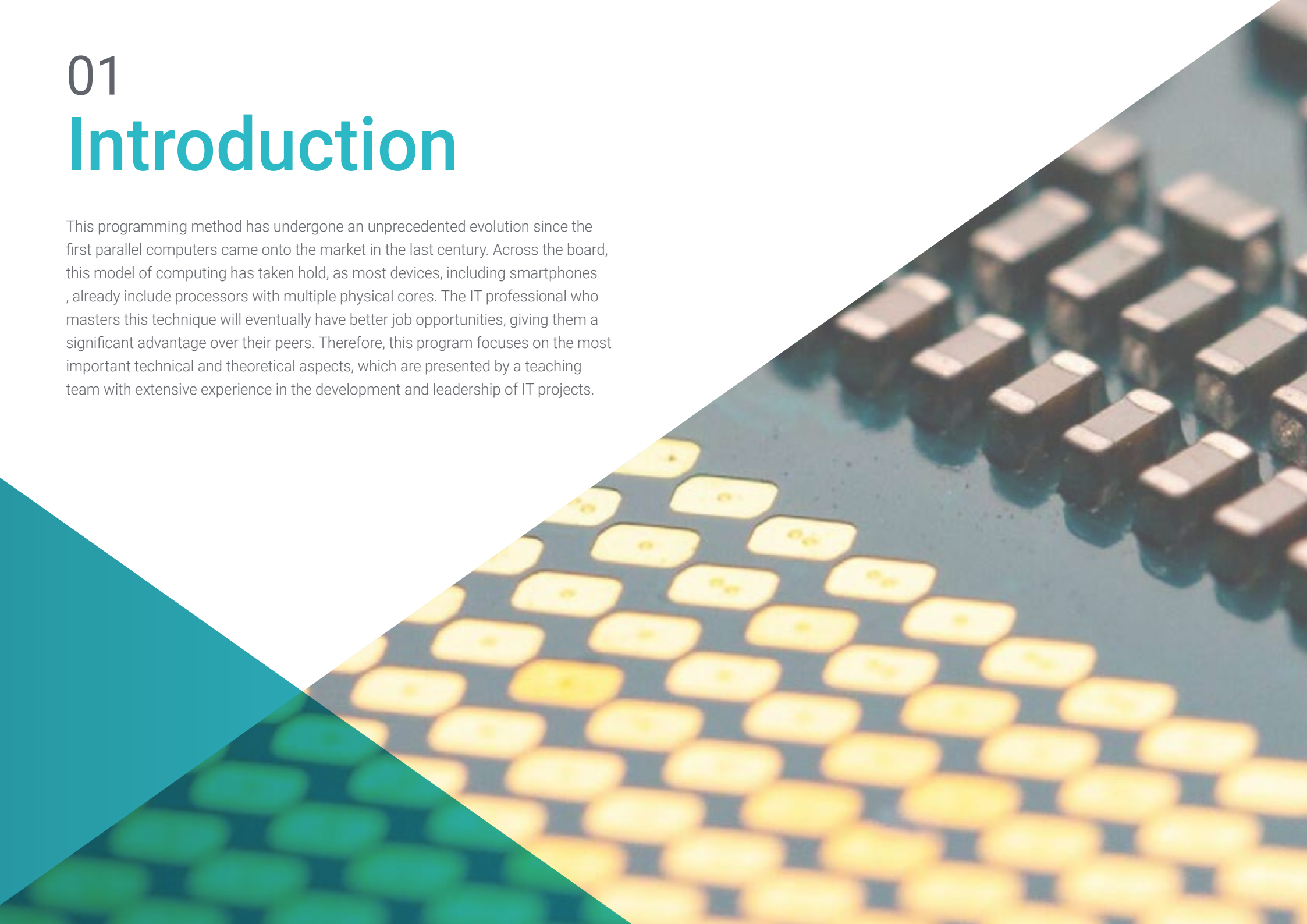
01

Introduction

This programming method has undergone an unprecedented evolution since the first parallel computers came onto the market in the last century. Across the board, this model of computing has taken hold, as most devices, including smartphones , already include processors with multiple physical cores. The IT professional who masters this technique will eventually have better job opportunities, giving them a significant advantage over their peers. Therefore, this program focuses on the most important technical and theoretical aspects, which are presented by a teaching team with extensive experience in the development and leadership of IT projects.



Achieve the desired quality improvement by leveraging the knowledge provided by this Postgraduate Diploma"

Parallel Computing encompasses a broad range, from the architecture of the systems themselves to the programming of algorithms. It includes the design of hardware devices and the subsequent implementation of software that takes full advantage of this configuration. To secure their place in the best projects and leadership positions, the computer scientist must not only have a deep understanding of one of today's most prevalent programming models but also master it.

Thus, this Postgraduate diploma starts by providing a general overview of what parallelism in Parallel Computing entails. It then delves into the programming of parallel algorithms and concludes with an in-depth analysis of the various types of parallel architectures.

The teaching team has devoted special attention to the development of all the contents of this degree, placing significant emphasis not only on the most advanced theory but also on their own professional experience. The program is thus enriched by the teachers' own contributions, as they adapt all the content of Parallel Computing to the realities of today's labor market.

The 100% online format of the diploma is also noteworthy, as it provides a preferred option for computer scientists who aim to delve deeper into the subject without having to compromise their personal and professional responsibilities. This program is accessible for download on any device with an internet connection, eliminating the need for in-person classes and rigid schedules.

This **Postgraduate Diploma in Parallel Computing** contains the most complete and up-to-date educational program in the market. Its most outstanding features are:

- The program incorporates the development of case studies that are presented by experts in Parallel 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 program incorporates 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

Enroll today in this Postgraduate Diploma in Parallel Computing and embark on a journey to uncover all the secrets of multiprocessors and OpenMP. Don't wait any longer to seize this opportunity!"

By enrolling in this program, you will gain exclusive access to a diverse array of multimedia resources. These resources include meticulously crafted videos, personally tailored by the professors themselves for each topic covered in the program"

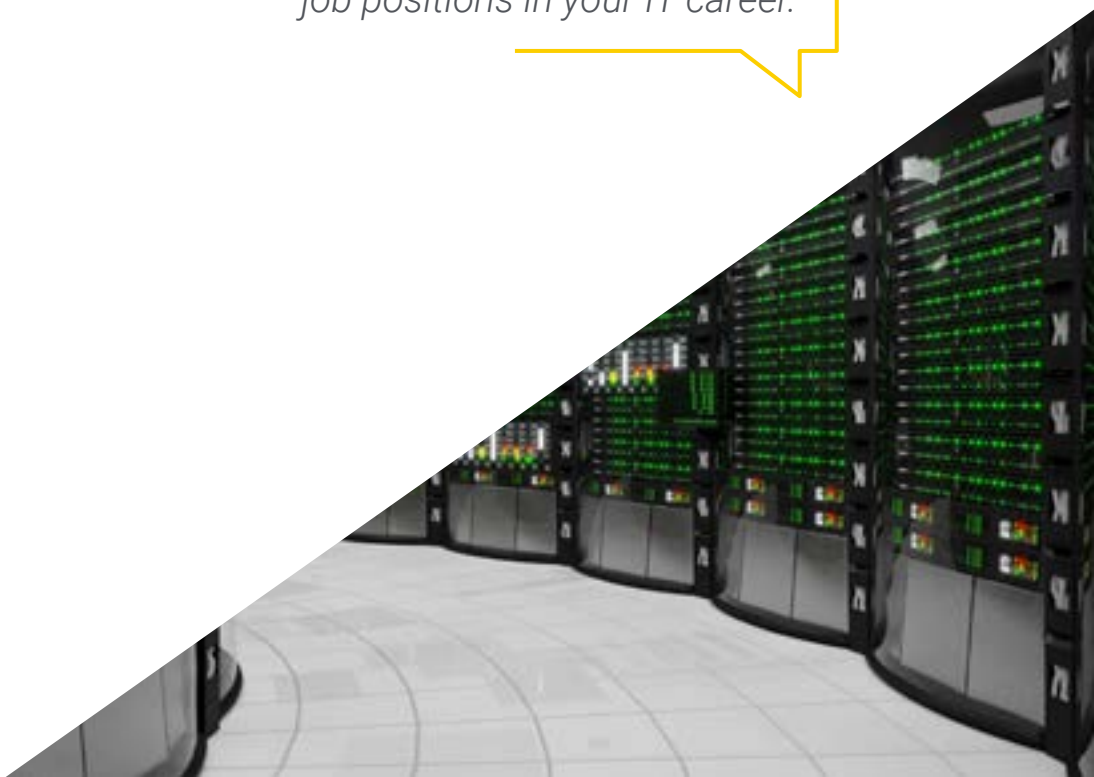
At TECH, you have the autonomy to make crucial decisions, such as determining when, where, and how to undertake the entire teaching load.

Give your resume a high-quality boost and position yourself advantageously to secure better job positions in your IT career.

The teaching staff of the program consists of professionals from the industry who bring their valuable work experience to the table. Additionally, renowned specialists from leading societies and prestigious universities contribute their expertise to enrich the program.

The program's multimedia content, created using state-of-the-art educational technology, enables professionals to learn in a contextual and situated learning environment. This simulated environment offers immersive education specifically designed to prepare individuals for real-world situations.

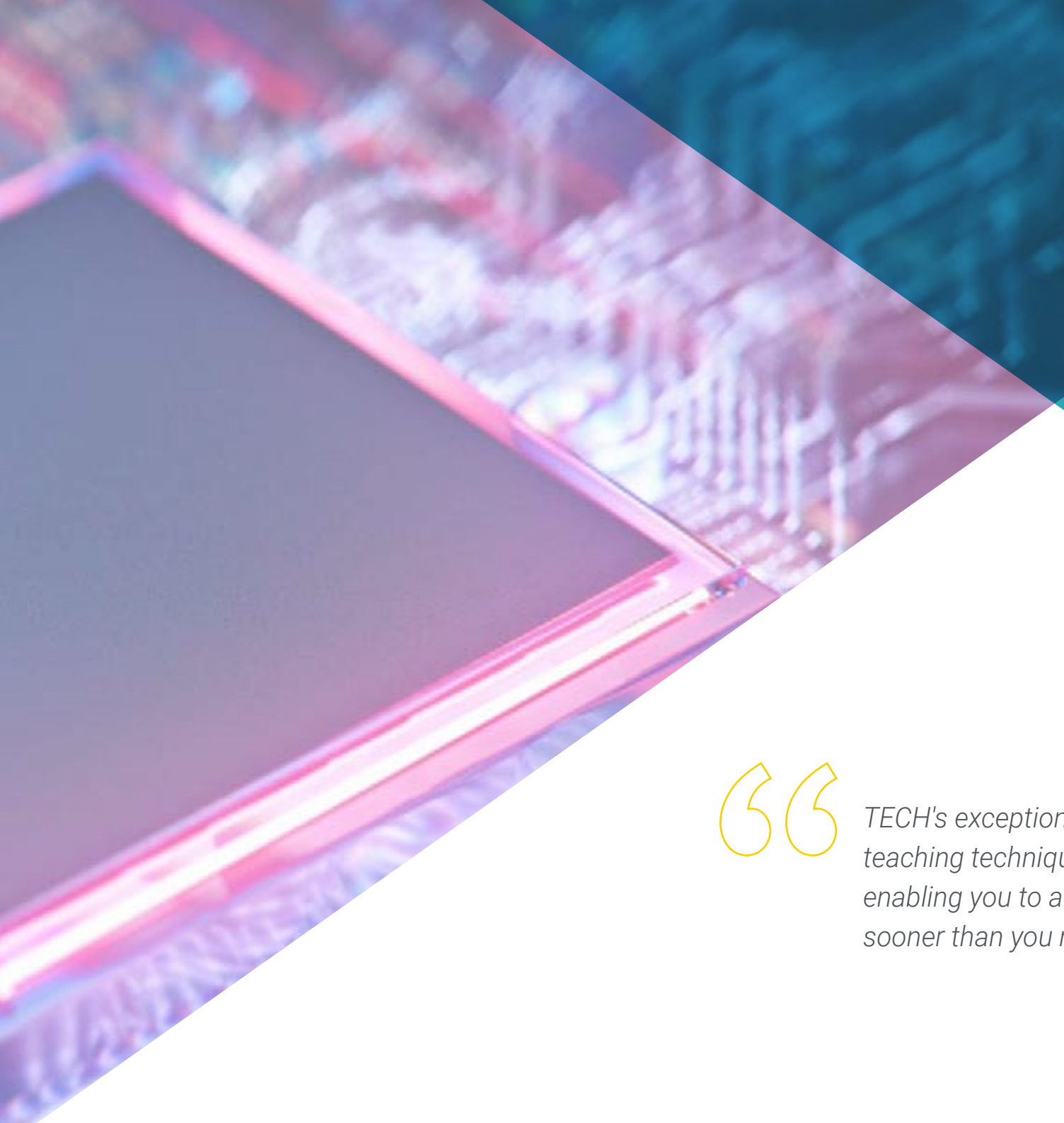
The design of this program places a strong emphasis on Problem-Based Learning. Throughout the academic year, professionals are presented with various real-world practice situations that they must strive to solve, enabling them to apply their knowledge in practical scenarios. For this purpose, the student will be assisted by an innovative interactive video system created by renowned and experienced experts.



02

Objectives

With the comprehensive knowledge acquired during this Postgraduate diploma, computer scientists can steer their careers not only towards programming or system architecture but also towards conducting their own research in the field of Parallel Computing. Parallel Computing has experienced steady growth in recent years, and this program ensures that participants are equipped with the latest developments in the field. It combines these advancements with a high-level theory to provide a complete and comprehensive teaching experience.

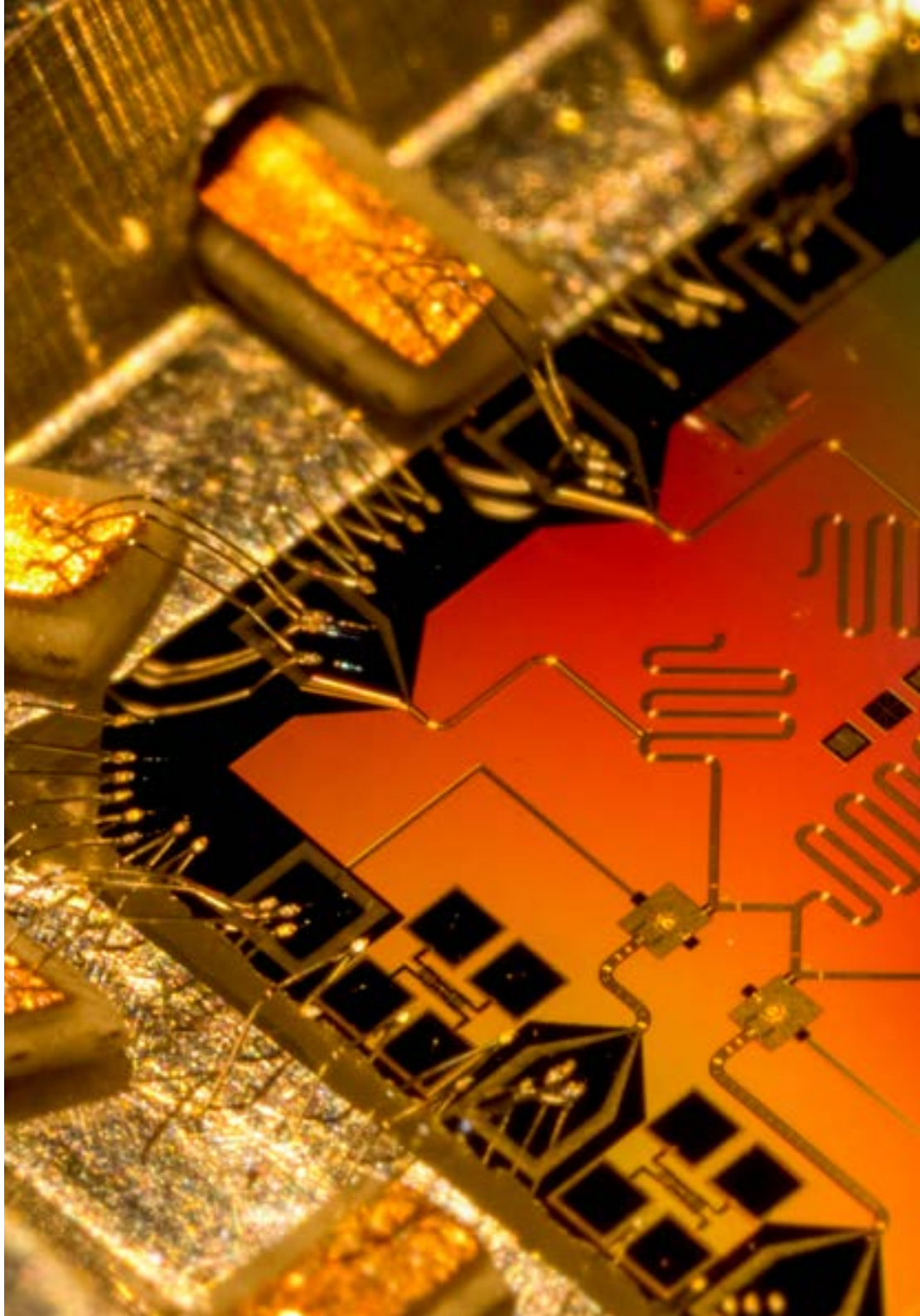


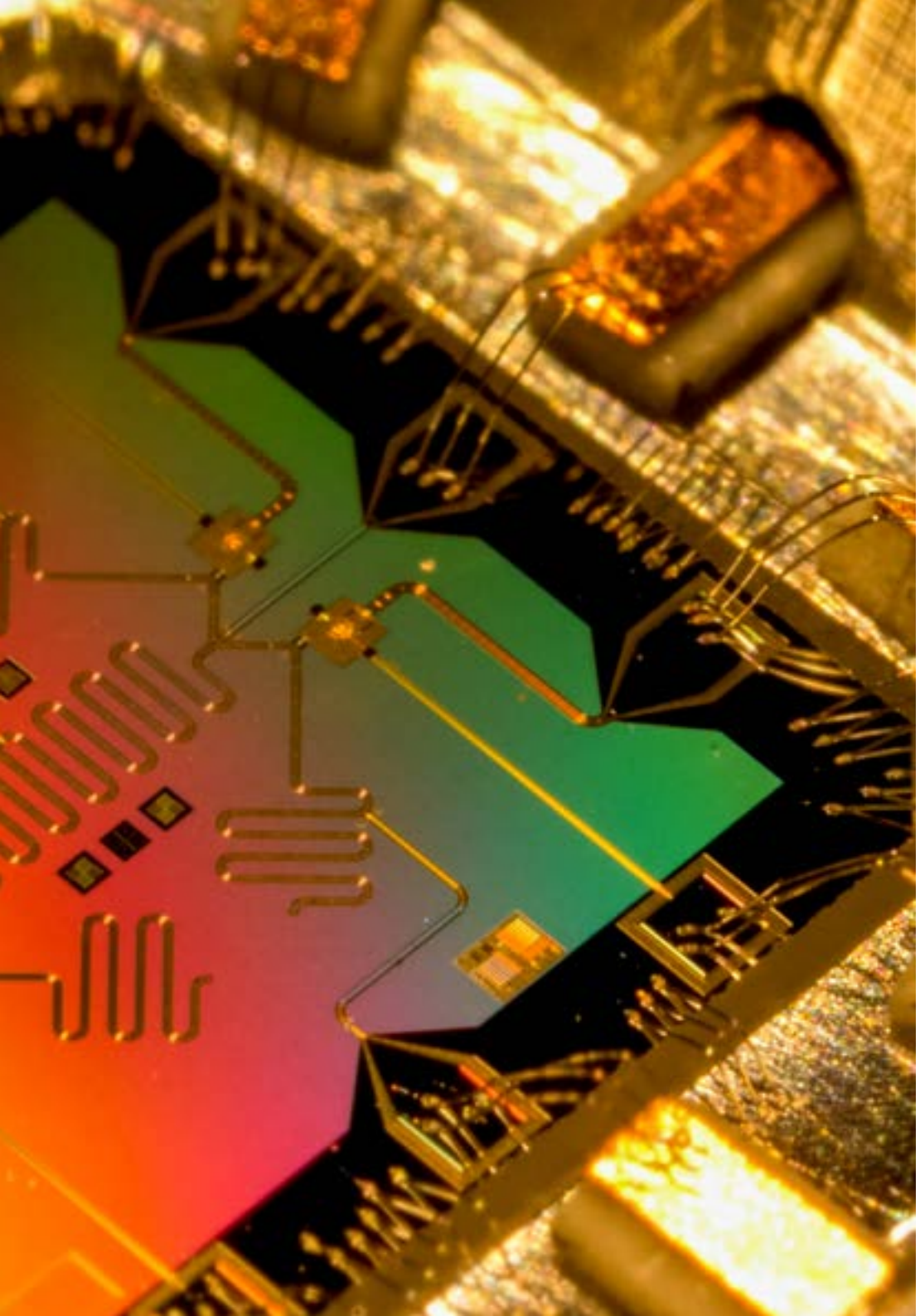
TECH's exceptional capacity and effective teaching techniques will accelerate your progress, enabling you to achieve your professional goals sooner than you might anticipate"

General Objectives

- Analyze the different components of Parallel and Parallel Computing
- Measure and compare their efficiency to analyze the performance of the set of components used
- Conduct a thorough analysis of multi-platform parallel computing to leverage task-level parallelism across different hardware accelerators
- Analyze in detail current software and architectures
- Develop in depth the relevant aspects of Parallel and Parallel Computing
- Specialize the student in the use of Parallel and Parallel Computing in different application sectors

You will have access to a highly skilled teaching and technical team, dedicated to addressing any questions or concerns you may have, ensuring a seamless learning experience"





Specific Objectives

Module 1. Parallelism in Parallel and Parallel Computing

- Analyze the processing components: processor or memory
- Delve into the Parallelism Architecture
- Analyze the different forms of Parallelism from the processor's point of view

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

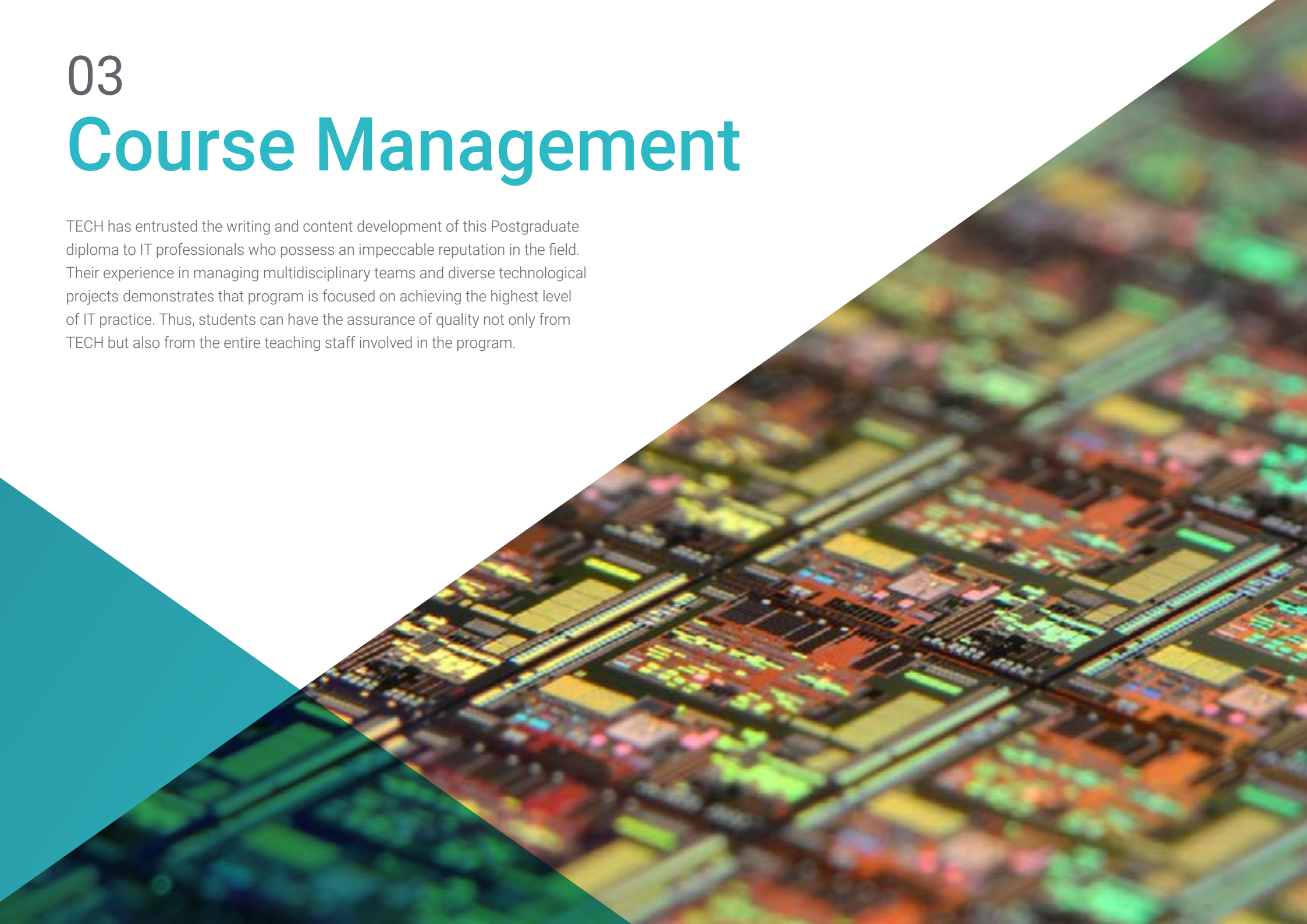
Module 3. Parallel Architectures

- Analyze the main computer architectures
- Deepen in key aspects such as process, service and execution threads
- Manage running processes in an operating system
- Use classes to launch and manage processes

03

Course Management

TECH has entrusted the writing and content development of this Postgraduate diploma to IT professionals who possess an impeccable reputation in the field. Their experience in managing multidisciplinary teams and diverse technological projects demonstrates that program is focused on achieving the highest level of IT practice. Thus, students can have the assurance of quality not only from TECH but also from the entire teaching staff involved in the program.

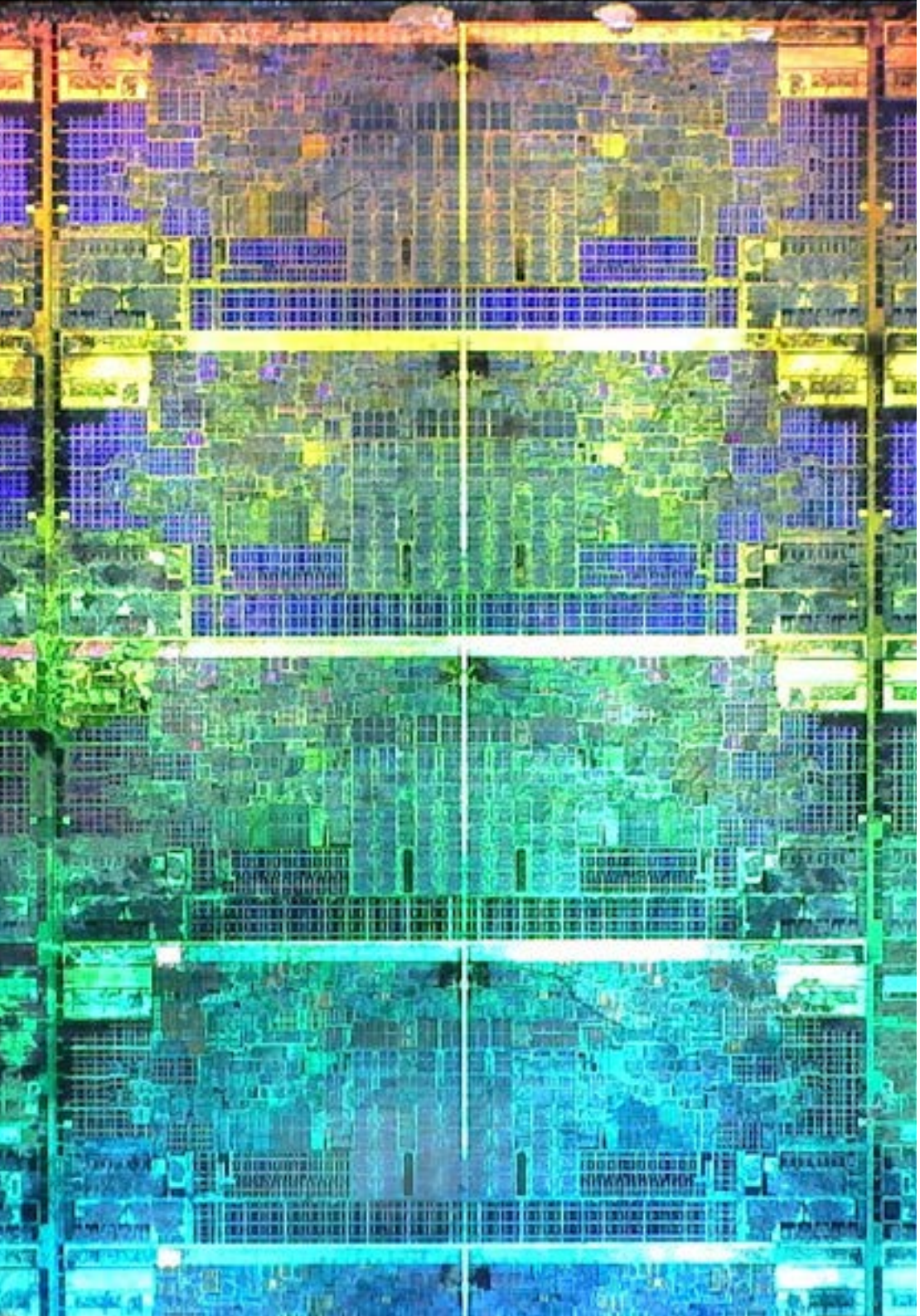


You will gain expertise in Parallel Computing from professionals who possess in-depth knowledge and have applied it to projects of international significance"

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

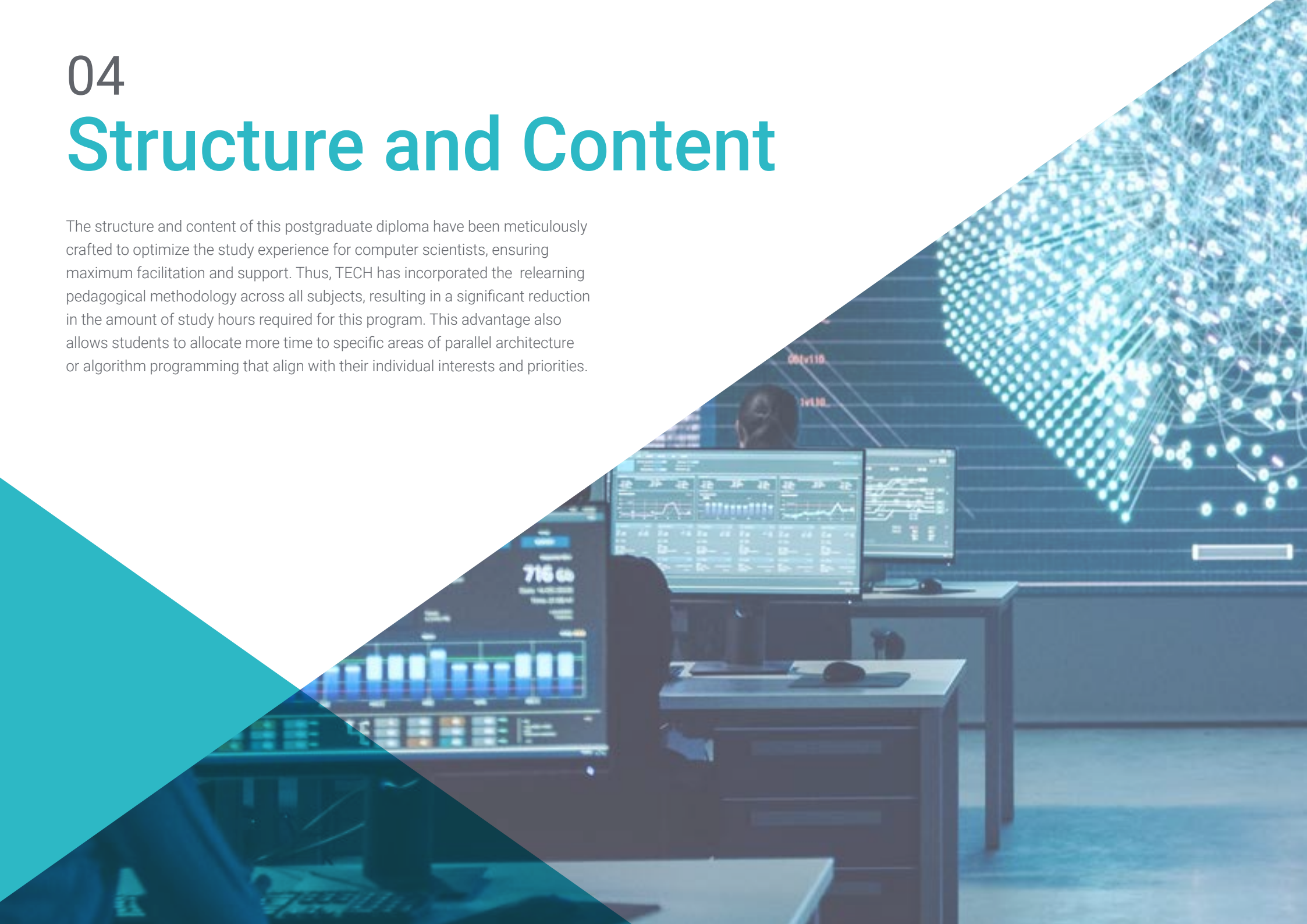
Dr. Carratalá Sáez, Rocío

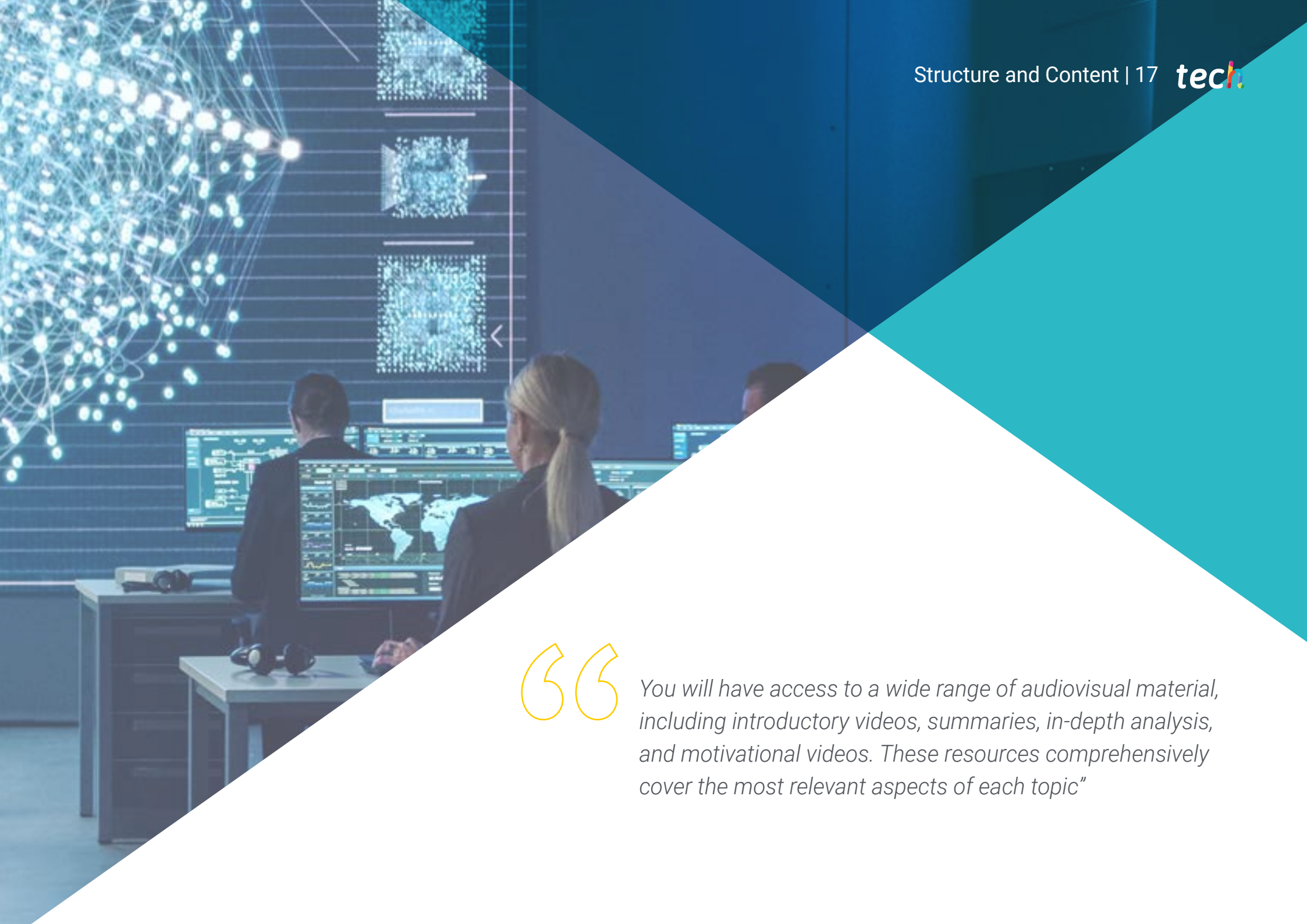
- Researcher specialized in Computer Science
- Teacher in university studies related to Computer Science
- Doctorate in Computer Science, Jaume I University
- Graduate in Computational Mathematics from the Jaume I University
- Master's Degree in Parallel and Parallel Computing from the Polytechnic University of Valencia
- Specialization courses related to computer science, mathematics and tools for academic research

04

Structure and Content

The structure and content of this postgraduate diploma have been meticulously crafted to optimize the study experience for computer scientists, ensuring maximum facilitation and support. Thus, TECH has incorporated the relearning pedagogical methodology across all subjects, resulting in a significant reduction in the amount of study hours required for this program. This advantage also allows students to allocate more time to specific areas of parallel architecture or algorithm programming that align with their individual interests and priorities.





You will have access to a wide range of audiovisual material, including introductory videos, summaries, in-depth analysis, and motivational videos. These resources comprehensively cover the most relevant aspects of each topic"

Module 1. Parallelism in Parallel and Parallel Computing

1.1. Parallel Processing:
- 1.1.1. Parallel Processing:
- 1.1.2. Parallel Processing in Computing. Purpose
- 1.1.3. Parallel Processing: Analysis

1.2. Parallel System
- 1.2.1. The Parallel System
- 1.2.2. Levels of Parallelism
- 1.2.3. Parallel System

1.3. Processor Architectures
- 1.3.1. Processor Complexity
- 1.3.2. Processor Architecture. Mode of Operation
- 1.3.3. Processor Architecture. Memory Organization

1.4. Networks in Parallel Processing
- 1.4.1. Mode of Operation
- 1.4.2. Control Strategy
- 1.4.3. Switching Techniques
- 1.4.4. Topology

1.5. Parallel Architectures
- 1.5.1. Algorithms
- 1.5.2. Coupling
- 1.5.3. Communication

1.6. Performance of Parallel Computing
- 1.6.1. Performance Evolution
- 1.6.2. Performance Measures
- 1.6.3. Parallel Computing. Study Cases

1.7. Flynn's Taxonomy
- 1.7.1. MIMD: shared memory
- 1.7.2. MIMD: distributed memory
- 1.7.3. MIMD: Hybrid systems
- 1.7.4. Data Flow

1.8. Forms of Parallelism: TLP (Thread Level Paralelism)
- 1.8.1. Forms of Parallelism: TLP (Thread Level Paralelism)
- 1.8.2. Coarse grain
- 1.8.3. Fine grain
- 1.8.4. SMT

1.9. Forms of Parallelism: DLP (Data Level Paralelism)
- 1.9.1. Forms of Parallelism: DLP (Data Level Paralelism)
- 1.9.2. Short Vector Processing
- 1.9.3. Vector Processors

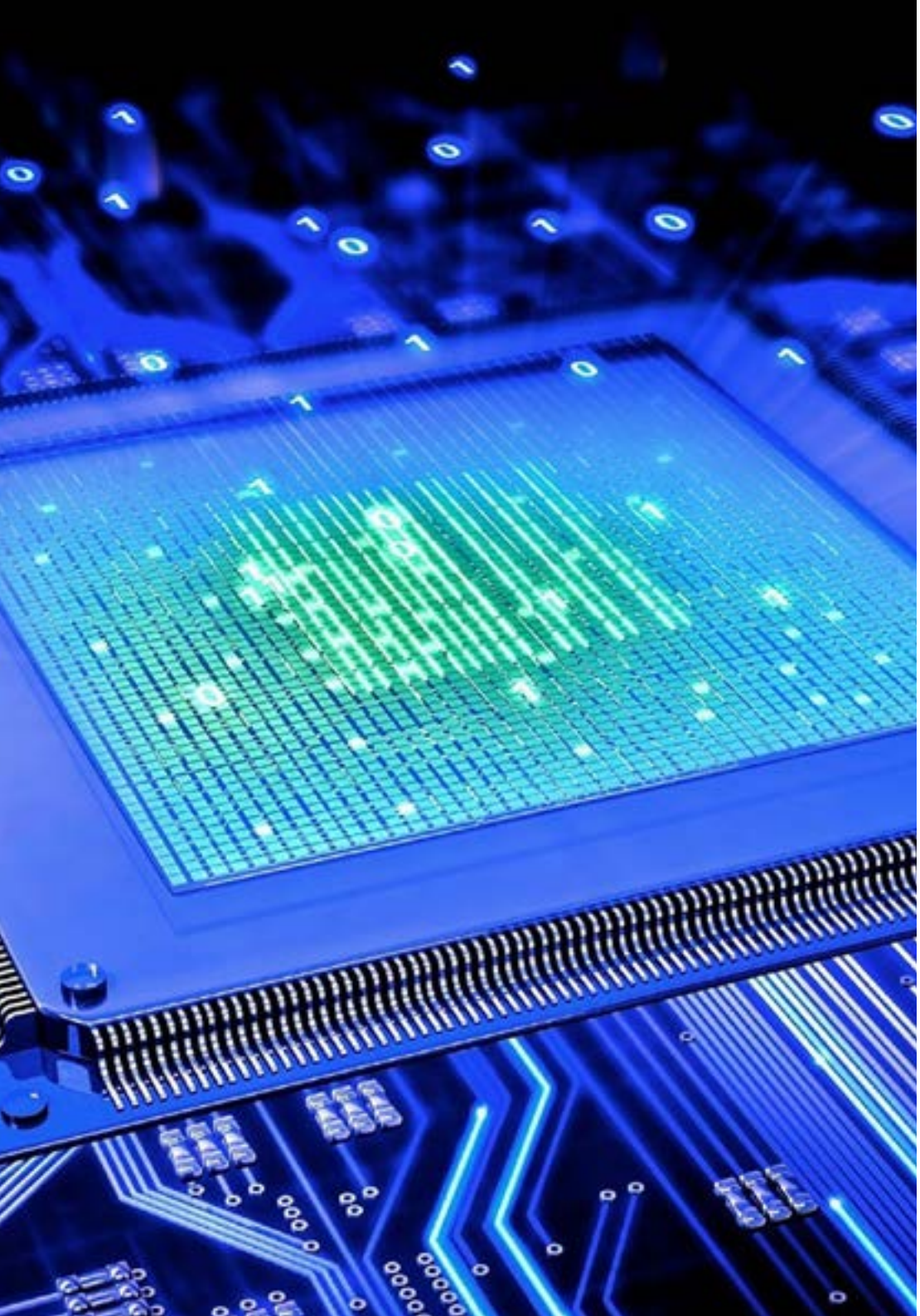
1.10. Forms of Parallelism: ILP (Instruction Level Paralelism)
- 1.10.1. Forms of Parallelism: ILP (Instruction Level Paralelism)
- 1.10.2. Segmented Processors
- 1.10.3. Superscalar Processor
- 1.10.4. Very Long Instruction Word (VLIW) Processor

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 Architectures

3.1. Parallel Architectures
- 3.1.1. Parallel Systems. Classification
- 3.1.2. Sources of Parallelism
- 3.1.3. Parallelism and Processors

3.2. Performance of Parallel Systems
- 3.2.1. Performance Metrics and Measurements
- 3.2.2. Speed-up
- 3.2.3. Granularity of Parallel Systems

3.3. Vector Processors
- 3.3.1. Basic Vector Processor
- 3.3.2. Interleaved or Interleaved Memory
- 3.3.3. Performance of Vector Processors

3.4. Matrix Processors
- 3.4.1. Basic Organization
- 3.4.2. Programming in Matrix Processors
- 3.4.3. Programming in Matrix Processors. Practical Example

3.5. Interconnection Networks
- 3.5.1. Interconnection Networks
- 3.5.2. Topology, Flow Control and Routing
- 3.5.3. Interconnection Networks. Classification According to Topology

3.6. Multiprocessors
- 3.6.1. Multiprocessor Interconnection Networks
- 3.6.2. Memory and Cache Consistency
- 3.6.3. Probe Protocols

3.7. Synchronization
- 3.7.1. Bolts (Mutual exclusion)
- 3.7.2. P2P Synchronization Events
- 3.7.3. Global Synchronization Events

3.8. Multicomputers
- 3.8.1. Multicomputer Interconnection Networks
- 3.8.2. Switching Layer
- 3.8.3. Routing Layer

3.9. Advanced Architectures
- 3.9.1. Data Stream Machines
- 3.9.2. Other Architectures

3.10. Parallel and Distributed Programming
- 3.10.1. Parallel Programming Languages
- 3.10.2. Parallel Programming Tools
- 3.10.3. Design Patterns
- 3.10.4. Concurrency of Parallel and Distributed Programming Languages

You will have access to the most advanced technological and educational resources that TECH can provide, enhancing your learning experience to the fullest possible extent"

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

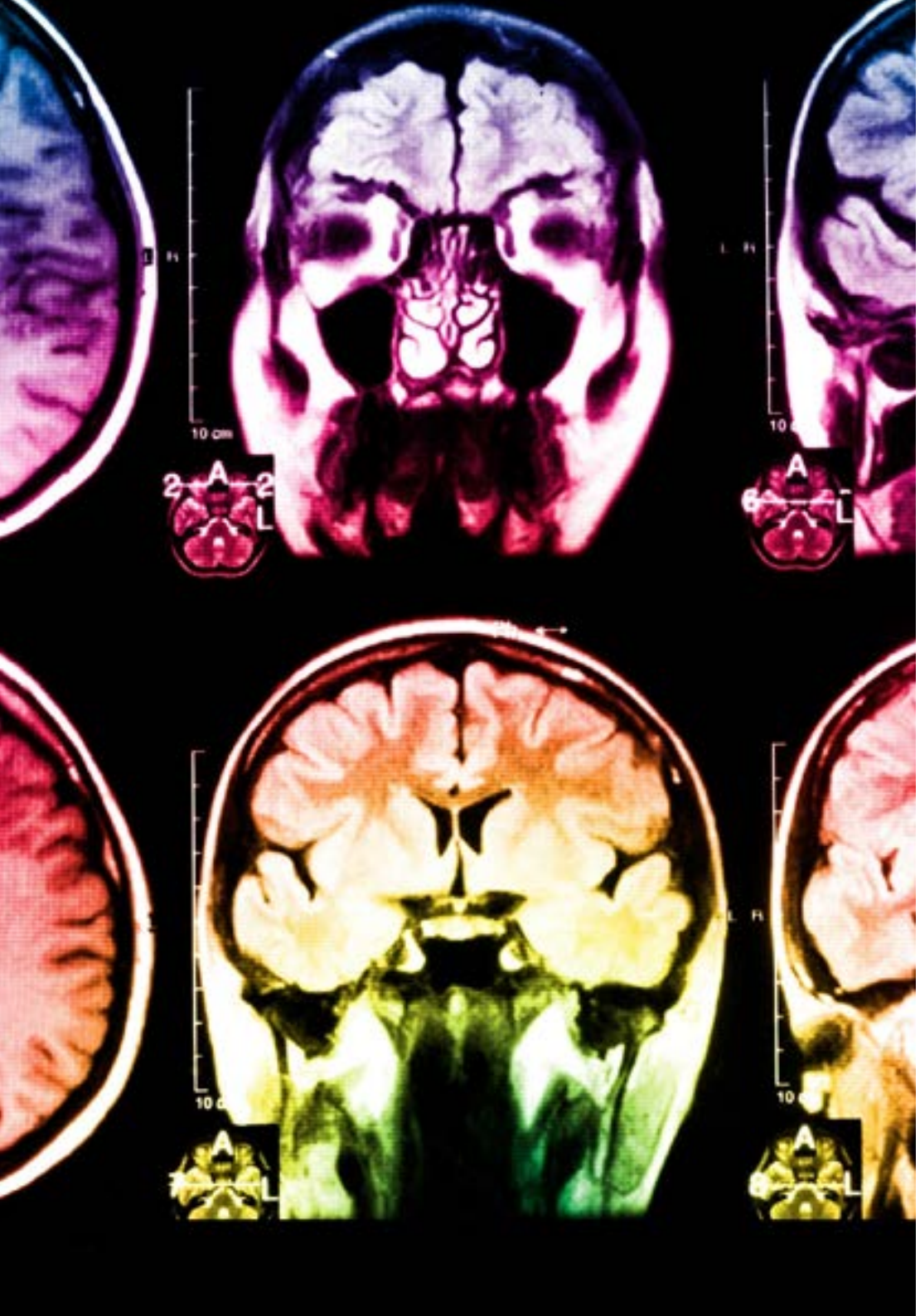
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

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.

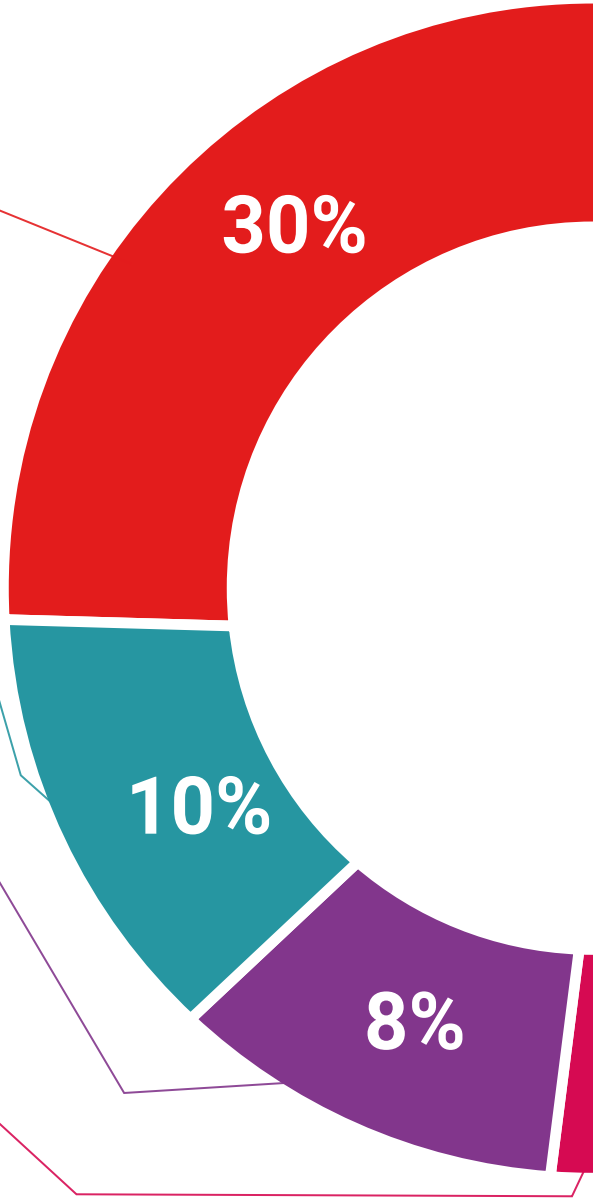
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

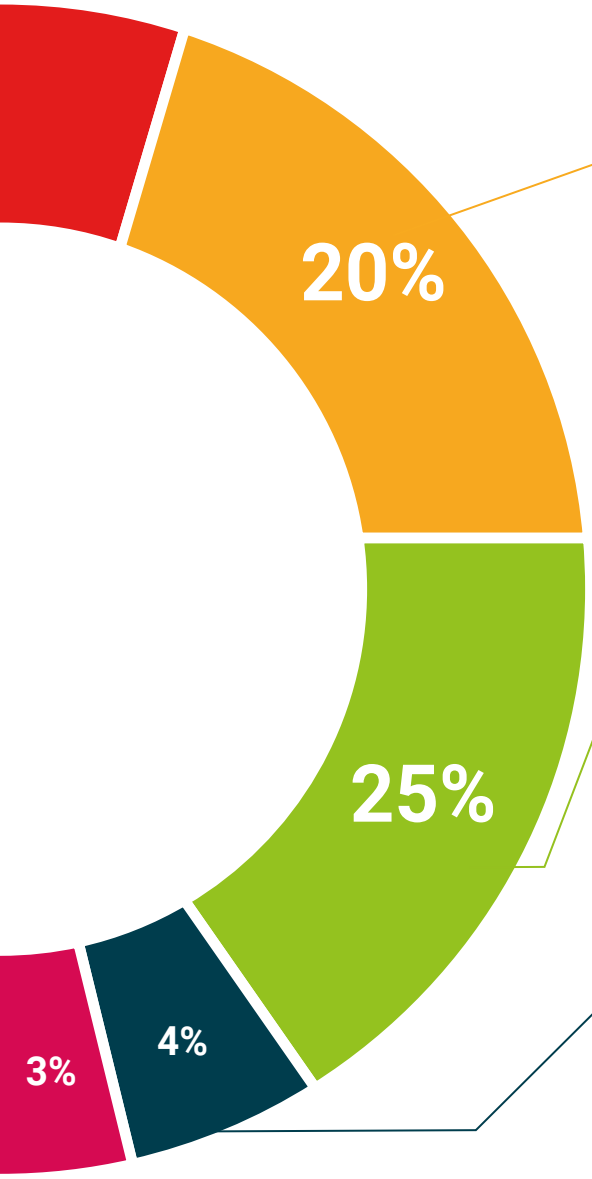
Practising Skills and Abilities

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 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 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.

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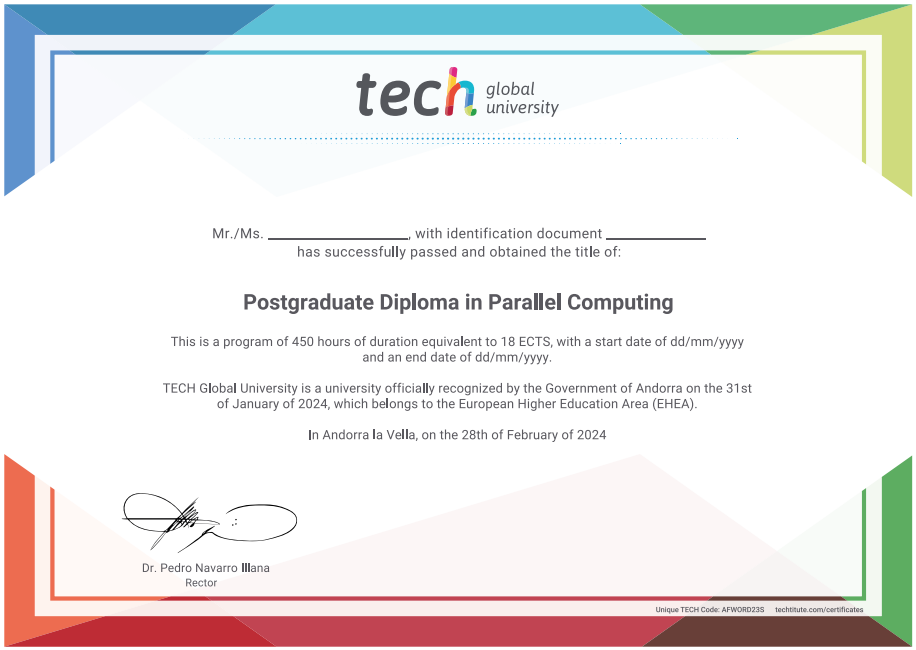
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Mr./Ms. _____, with identification document _____
has successfully passed and obtained the title of:

Postgraduate Diploma in 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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