

COURSE OUTLINE 2024 - 2025

MASTER OF TECHNOLOGY

ELECTRONIC EMBEDDED SYSTEMS

In partnership with

INSA
ROUEN NORMANDIE

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A

PROGRAMME OBJECTIVE

The **Master in Technology - Electronic Embedded Systems** degree, awarded by ESIGELEC and INSA Rouen Normandie*, is accredited by the French Ministry of Higher Education and Research.

The Master's Program seeks to equip students with the relevant knowledge, professional skills and practical experience for industry or for research. The training involves design, creation, testing and implementation of embedded systems. Students will also acquire basic managerial skills. The international environment at ESIGELEC allows students to discover new cultures and languages. Students must appear for the TCF/TEF certification exam in French (or TOEIC for French speaking students). The mandatory internship gives the students a hands-on experience in the work environment. Our graduates find job opportunities as developers, project managers, consultants or researchers.

B

COURSE STRUCTURE

The Master's Program comprises:

- Semester 1 – Academic (on campus) – 30 credits
- Semester 2** – Academic (on campus) – 30 credits
- Semester 3 – Academic (on campus) – 30 credits
- Semester 4 – Internship (company/laboratory) – 30 credits

The first three academic semesters are offered between September 2024 and January 2026***.

Each academic semester and the internship semester carry a total of 30 ECTS credits. A student must score a minimum of 10/20 in a course, to earn the corresponding ECTS credits i.e. 120 credits to be awarded the Master's degree.

*INSA Rouen Normandie is a public institution of higher education that comes under the French Ministry of Higher Education, Research and Innovation. ESIGELEC & INSA Rouen Normandie are jointly accredited to award the Master's Degree

**Students with a 4-year Bachelor's Degree and a specialisation in Electronics or related fields, may be offered direct entry into semester two.

***The first two academic semesters are offered between February 2025 and January 2026 for students granted direct entry into the second semester

C

THE ACADEMIC SEMESTERS

Lectures, tutorials, lab work, practical work, projects and/or seminars make up the academic semesters. Evaluation, in the form of tests, quizzes, exams, etc. is conducted on a regular basis. Faculty members are from ESIGELEC and/or INSA Rouen Normandie*, from partner companies and from partner universities in France or abroad.

D

THE INTERNSHIP SEMESTER

Students must intern either in a company or in a research laboratory, for a duration of 4 months (min.) to 6 months (max). The internship can be done anywhere in the world. While ESIGELEC and INSA Rouen Normandie* will provide assistance, students are expected to play an active part, as the internships are not offered automatically.

Once a student has found an internship, the internship form, providing all required information must be filled and submitted to the Internship Department at ESIGELEC. The Head of the Internship Department and the Academic Coordinator of the Master's Program must approve, thereafter the company / research laboratory, ESIGELEC and the student will sign the Internship Agreement. A copy of this agreement is retained by ESIGELEC, the company / research laboratory and the student.

A faculty member of ESIGELEC or INSA Rouen Normandie will be assigned the task of visiting or contacting the student at least once during the internship

After completion of the internship, the student must submit a thesis and make an oral presentation before a Board of Examiners who convene four times per year, i.e. March, June, September and November.

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The thesis:

The topic of the thesis, chosen by the student, must be communicated to the Academic Coordinator of the Master's Program for approval, within one month of starting the internship. A soft copy of this thesis must be submitted to ESIGELEC via intranet at least 2 weeks before the oral presentation.

The oral presentation:

A Board of examiners comprising a President, one faculty member from ESIGELEC or INSA Rouen Normandie and the industrial tutor (if possible) will be convened for the oral presentation conducted by the student and it must be done within four months, at the latest, of completion of the internship. The total duration of the oral presentation will be of 60 minutes (Presentation – 30 minutes + Q&A - 15 minutes + Deliberation among members of the Board of examiners).

The faculty member assigned for supervision and the Academic Coordinator of the Master's Program will be the contact persons for any questions the student may have about the internship, the thesis or the oral presentation.



SNAPSHOT – COURSES, MODULES, DURATION, WEIGHT & ECTS CREDITS

Courses	Modules	Duration (hours)	Weight	ECTS Credits
Semester 1: 30 Credits / 354 hours				
Computer Science 1	Introduction to Object Oriented Programming with Java	40	3	8
	Fundamentals of Data Communication and Networking	24	2	
	Fundamentals of Web-Centric Development	30	3	
Digital Electronics	Binary Logic & Digital Functions	30	3	9
	LabView	30	3	
	C Programming	30	3	
Communication & Language	Cross Cultural Awareness and Working in a Team	36	3	6
	French as a Foreign Language OR English as a Foreign Language	60	3	
Specialized Courses for EES	Bibliographical Study	12	1	7
	Digital Electronics Project	32	3	
	Fundamentals of Electronics	30	3	
Total Credits				30

SNAPSHOT – COURSES, MODULES, DURATION, WEIGHT & ECTS CREDITS

Courses	Modules	Duration (hours)	Weight	ECTS Credits
Semester 2: 30 Credits / 392 hours				
Digital Systems	Microprocessors	60	4	8
	VHDL & Logic Synthesis	30	2	
	Communication Buses	30	2	
Embedded Operating Systems	Real Time Operating Systems	30	3	6
	Embedded Linux	30	3	
Embedded Software	Embedded C Programming	30	2	6
	Analysis & Design with UML	32	2	
	Embedded Java	30	2	
Instrumentation	Smart Sensors	30	3	6
	Specific Instrumentation	30	3	
Communication & Language 2	French as a Foreign Language OR English as a Foreign Language	60	4	4
Total Credits				30

SNAPSHOT – COURSES, MODULES, DURATION, WEIGHT & ECTS CREDITS

Courses	Modules	Duration (hours)	Weight	ECTS Credits
Semester 3: 30 Credits / 334 hours				
Embedded Communication	MtoM Communication	30	4	10
	Python Programming & Image Treatments	30	3	
	Android Programming	30	3	
Embedded Electronics	System on Chip	20	2	6
	DSP Processors	20	2	
	Safety Systems	20	2	
Communication & Language 3	Oral Communication & Presentation Skills	14	1	5
	French as a Foreign Language OR English as a Foreign Language	60	4	
Project Development & Management	Project Management	30	2	9
	R&D Project	80	7	
Total Credits				30
Semester 4: Internship of 4 to 6 months				

All modules are delivered face-to-face, on campus, with all required safety measures. However, modules may be delivered partially or totally online and/or through distance mode.

F

COURSE CURRICULUM & SYLLABUS

Introduction to Object-Oriented Programming with JAVA

Module Code: MSTSI12 Duration: 40h

Objectives

At the end of this module students will be able to:

- Write, test and set up a Java programme and documentation from a given situation
- Use vocabulary relating to OO languages within the framework of Java
- Explain the design and set up for the life-cycle of a Java programme / explain the design
- Process and working of a Java program (define bytecode and explain the role of a JVM)
- Document code and create the Javadoc
- Respect Java writing code structures
- Use existing classes and packages
- Use basic Eclipse functions: editing, compiling, operating, importing and debugging

List of topics

- Storing information, communicating information, making choices, creating repetitions
- Initiation to Object-Oriented programming
- From algorithms to writing functions, classes and objects, UML classes
- Collecting objects (a fixed amount and undetermined amount), using UML

Fundamentals of Data Communication & Networking

Module Code: MSTSI13 Duration: 24h

Objectives

At the end of this module students will be able to:

- Understand the very basic operation of communication networks
- Distinguish between different communication technologies
- Distinguish between different communication services
- Choose communication technologies and services appropriate for given requirements
- Get a better understanding of the Internet communication services they use in everyday life

List of topics

- Basics of information transmission
- Classical telecommunications services
- Integration of telecommunication services
- Principles of networking and protocols
- TCP/IP communication architecture
- LAN/WLAN technologies
- Mobility Fundamentals of Web-centric Development

Fundamentals of Web-centric Development

Module Code: MSTSI14 Duration: 30h

Objectives

At the end of this module students will be able to explain:

- How the web relates to the Internet
- What HTTP is
- The notions of web server and web client
- The role of PHP, HTML, CSS, Javascript languages
- The major steps of a web project implementation
- The value of validation for web site security

The student will also be able to create a Web site which:

- Is dynamic
- Follows the separation of content and presentation principle
- Is in keeping with HTML5 and CSS standards
- Is secured against SQL injections and defacement attacks
- Is in project mode, using especially the Git version control system

List of topics

- Introduction to the internet and World Wide Web
- HTML (Hypertext Markup Language)
- Editing and viewing HTML
- Headers, titles, meta-tags
- Special characters
- Lists
- Tables
- Basic forms
- Metatags
- Cascading Style Sheets
- Embedded Anchors, Images, Links, Objects
- Dynamic web pages with PHP
- Introduction to javascript

Binary Logic & Digital Functions

Module Code: MSTEE11 Duration: 30h

Objectives

At the end of this module, students will be able to: analyse and design digital functions

List of topics

- Basic concepts of probability:
- Number representation
- Fundamentals of Boolean algebra
- Construction of elementary gates
- Circuits developed from combinatory logic (comparator, decoder and demultiplexer)
- Introduction to sequential logic and its basic components (D, RS, RSH, and JK flip flop circuits)
- Registers and counters
- Designing and creating a sequential system

LabView

Module Code: MSTEE15 Duration: 30h

Objectives

- Design a program with LabVIEW for an electrocardiogram that monitors real and “noisy” data. This program must:
- respect design standards
- use standard programming and signal processing tools seen in the 2nd year
- The application must respect standard LabVIEW practices (taken from the Certified LabVIEW Developer (CLD) test) and use a modular and evolving architecture

List of topics

- Fundamental programming notions in LabVIEW
- LabVIEW programming
- Creating an interface
- Learning good LabVIEW practices for form and structure in programming

C Programming

Module Code: MSTEE10 Duration: 30h

Objectives

At the end of this module, students will be able to write and develop a programme in C language, using:

- Functions: definitions, interests, prototypes
- 1 & 2 D arrays: syntax, use, parameters
- String functions: manipulating chains of characters
- Pointers: syntax, manipulation, using them correctly
- Structures: syntax, manipulation, establishing parameters
- Binary and text files: manipulation and relation to structures
- Dynamic allocation

List of topics

- Algorithms, processors, fundamentals, environment and variables
- Simplified architecture of a computer
- C Language: programming structure, declarations, control structures (if, switch, while, do while, for), entries / exits (printf, scanf, fflush role)
- Environment for development
- 1D arrays
- Review of general notions for arrays, functions, character chains, structures, pointers, dynamic allocation, files

Cross Cultural Awareness and Working in a Team

Module Code: MSTCCAWT

Duration: 36h

Objective

At the end of this module students will be able to:

- Recognise the different elements that make up culture
- Demonstrate the role culture plays on general and professional communication and behaviour
- Suggest ways to begin respecting and reconciling the cultural differences that make a difference
- Analyse the cultural elements inherent in different situations
- Evaluate the relative importance of different cultural elements in different communication situations
- Apply different cultural orientations to correctly analyse different situations
- Interact more sensitively within international teams
- Develop a capacity for culturally sensitive critical analysis
- Sensitively interpret different elements of verbal and non-verbal communication
- Sensitively analyse critical incidents
- Clearly distinguish between objective and subjective culture
- Integrate a new team from an initial team

List of topics

- Modern leadership models and their application
- The influence of national cultures on leadership
- The building and management of international, multi-discipline, remote and virtual teams

Bibliographical Study

Module Code: MSTEE40 Duration: 12h

Objectives

At the end of the module, students will be able to :

- Learn to create and conduct a short oral presentation on a technical topic given to them at the beginning of the semester
- Acquire basic skills and methods on searching for information and oral presentations
- Enhance their skills to search for information and conduct oral presentations
- Learn to deliver an effective oral presentation in order demonstrate their understanding of the subject

List of topics

- Team working
- Information searching
- Oral presentation

Digital Electronics Project

Module Code: MSTEE41 Duration: 32h

Objectives

At the end of the module, students will be able to:

- Acquire basic practical skills in Digital Electronics
- Familiarise themselves with a real-world situation similar to that of future professional environments
- Acquire skills to exercise their initiative and independence
- Improve their organizational, interpersonal and communication skills
- Acquire time management skills

Fundamentals of Electronics

Module Code: MSTEE13 Duration: 30h

Objectives

At the end of this module, students will be able to:

- Put together an electrical circuit in the form of a four-terminal network (transmit gain, input / output impedance)
- Transcribe a situation into a simulation diagram
- Choose the type of analysis (polarisation or time-frequency analysis)
- Identify function block diagrams
- Design a cabling schema from a given electric schema (using BNC connectors correctly)
- Measure voltage using oscilloscopes, multimeters and dB meters
- Create various wave forms, recognize them using an oscilloscope and change settings
- Measure input/output impedance
- Measure frequency response
- Interpret results of the aforementioned measurements
- Use Excel to plot graphs and schemas

List of topics

- Electrical circuits
- Simulation schema
- Block diagrams
- Cabling and electric schema
- Measurement
- Generation of various signals
- Generation of plot graphs

Microprocessors

Module Code: MSTSEE21

Duration: 60h

Objectives

At the end of this module, students will be able to:

- Understand the architecture of microprocessors
- Program microprocessors
- Study the evolution of their architecture

List of topics

- Microprocessor architecture (ALU, control unit, registers, buses)
- Data and processors (address decoding, synchronization)
- Vital signals of processors (clocks, power supply, reset)
- Microprocessor programming (languages, registers, addresses, instructions)
- Execution time, routines, passing parameters
- Principles and how exceptions/interruptions work
- Inputs/outputs
- Case study (MSP430)

VHDL & Logic Synthesis

Module Code: MSTSEE22

Duration: 30h

Objectives

At the end of this module, students will be able to:

- Program logic devices (PLD)
- Develop programs using VHDL language

List of topics

- Review of combinatory and sequential logic
- The different families of programmable logic devices

- Practice with synthesis tools (Xilinx or Altera targets, Quartus or ISE tools, Modelsim)

Communication Busses

Module Code: MSTSEE23

Duration: 30h

Objectives

At the end of this module, students will be able to:

- Use the most widely used communication busses in the field of embedded processors
- Understand technical specifications

List of topics

- RS-485
- I2C BUS, SPI BUS
- CAN BUS
- ARINC bus

Real Time Operating Systems

Module Code: MSTSEE24

Duration: 30h

Objectives

At the end of this module, the students will be able to:

- Understand why real-time executive is used in embedded systems
- Describe the four major categories of services provided by an executive
- Describe the necessary required materials to implement an executive in real-time
- Learn the various commercial aspects of executive suppliers
- Describe the role of scheduling, how it works and the major variations
- Calculate task times for simple situations
- List attribution rules for task priority
- Describe how the principle elements for synchronization are presented in executives
- Describe the characteristics and how an email inbox works
- Design and develop a simple multitasking application with MicroC / OSI

List of topics

- Fundamentals of multitasking and real-time
- A scheduler: its role and how it works
- Why real-time executives are used in embedded systems
- Necessary materials
- Categories of executives and their markets
- A real-time kernel: MicroC/OSII (Micro-Controller Operating Systems Version 2)
- Memory management
- Intertask communication and synchronization tools
- Using MicroC/OSII and microcontrollers

Embedded Linux**Module Code: MSTSEE25****Duration: 30h****Objectives**

At the end of the module, the students will be able to:

- Understand the possibilities and uses of the Linux kernel for an embedded IT project.
- Learn the principle software tools used in the Linux/Unix world and how to use them to develop.
- Write a device driver for specific Linux run material
- Combine tools to create advanced functions with a minimum of programming

List of topics

- Introduction to Linux.
- How an OS fits in an embedded system.
- History of Linux and Unix systems.
- Linux compared to other embedded operating systems.
- Fundamental tools: command lines, shell scripts.
- Linux development tools.
- C programming with embedded systems.
- Linux drivers.
- Web connections and Remote Administration Tools (RATs).t

Embedded C Programming

Module Code: MSTSEE26

Duration: 30h

Objectives

At the end of this module, students will:

- Be familiar with the C coding practices for embedded systems
- Be familiar with the elements and tools for embedded software validation
- Develop, write and test a C language program (as per design specifications) to be used with a microprocessor with respect of good practices like MISRA-C rules
- Analyse and enumerate the various phases of development for a software project: the V cycle

List of topics

- Specificities of C Language for embedded systems (variables, memory organization, physical address access, etc.)
- Programming methods
- Software analysis and validation tools and principles for embedded systems

Analysis & Design with UML

Module Code: MSTIS12A

Duration: 32h

Objectives

At the end of this module students will be able to:

- Be familiar with the process for designing software applications, with a special focus on the Unified Modelling Language (UML) and Java as design tools
- Be familiar with the major steps in software design, including the development of user requirements, specifications, data bases, user interfaces, and software models

List of topics

- Overview of software design: challenges, accomplishments, and failures
- Overview of software lifecycle model and its variants
- Overview of object oriented design – Java classes, objects, inheritance, associations
- Requirements analysis and use case design – UML use case and sequence diagrams
- Class design – UML class diagrams
- Modeling activities and interactions – UML activity and state diagrams

Embedded Java**Module Code: MSTSEE27****Duration: 30h****Objectives**

At the end of this module, students will:

- Be familiar with a computer language which can be used to develop graphic applications under Windows for personal embedded systems like Pocket PCs

List of topics

- Java ME environment: interface and syntax
- Basics of programming in the Java ME environment

Smart Sensors**Module Code: MSTSEE32****Duration: 30h****Objectives**

At the end of this module, students will:

- Be familiar with the principles and the advantages of smart sensors through different applications

List of topics

- Sensors and interfacing circuits
- Applications of smart sensors
- Architecture and components of smart sensors
- Practice with smart sensors

Specific Instrumentation

Module Code: MSTSEE29

Duration: 30h

Objectives

At the end of this module, students will be able to:

- Manage the entire information sampling chain in an instrumentation-type embedded system

List of topics

- The measurement chain: physical signal to digital processing
- Sensors: types, technology
- Signal conditioning: transport, filtering, amplification
- Sampling: period, response time
- Information security: accuracy, lifetime, redundancy

MtoM Communication

Module Code: MSTSEE31

Duration: 30h

Objectives

At the end of this module, students will:

- Be familiar with the principles of communication between machines, needing no human action

List of topics

- Sensors and servers
- Cellular networks
- Applications
- Protocols of MtoM communication

Python Programming & Image Treatments

Module Code: MSTSEE36

Duration: 30h

Objectives

The Python language is today, one of the most useful programming tool for engineers and is used in several applicative areas including embedded systems. The objective of this elective is to understand the environment, the tools and the scope of this language.

List of topics

- Python Development Environment
 - Python distribution and their installation
 - Python as a script language
 - Python as a programming language
 - Interactive Python (Jupyter-notebook)
 - Comparison with other programming languages
 - Installing important libraries (PIP)
- Python Basics
 - The first program
 - Docstrings
 - Blocks and indentation
 - First Control structures
- Simple data types and expressions
 - Boolean
 - Integer
 - Float
 - Complex numbers
 - Strings
 - Bytes
- More data types
 - Lists
 - Tuples
 - Sets
 - Dictionaries
 - Strings
 - Numpy
 - Arrays
- Control structures
 - Loops
 - Alternatives
 - Exceptions
- Comprehension and slicing
- Object oriented Python
 - Class definition
 - Class instantiation
 - Generators and iterators

- Files
 - Files
 - Serialization
 - Important file formats
- Specialized topics (optional)
 - Writing and installing your own libraries
 - Regular expressions

Android Programming

Module Code: MSTSEE32

Duration: 30h

Objectives

At the end of this module, students will be able to:

- Understand the challenges and possibilities of mobile platforms
- Use the Android development environment
- Create a user interface
- Develop communication applications
- Develop an application using persistent data
- Develop a multimedia application
- Develop an application that works with Googlemaps
- Make and publish an Android application

List of topics

- Embedded applications, possibilities, Android SDK
- Using views, creating advanced user interfaces
- Intent classes
- Persistent data
- Multimedia
- Geolocalisation
- Publishing Embedded applications, possibilities, Android SDK
- Using views, creating advanced user interfaces
- Intent classes
- Persistent data
- Multimedia
- Geolocalisation
- Publishing

System on Chip

Module Code: MSTSEE33

Duration: 20h

Objectives

At the end of this module, students will understand and be able to implement a complete embedded system on a chip (SoC)

List of topics

- Main components of SoC systems
- Related embedded solutions on chips
- Defining an intellectual property tool
- Integration of a solution
- Xilinx Spartan or Microsemi SmartFusion components

DSP Processors

Module Code: MSTSEE34

Duration: 20h

Objectives

At the end of this module, students will:

- Be familiar with the main DSP (digital signal processing) algorithms and their impact on DSP architecture

List of topics

- Sampling, convolution
- Linear filtering
- Fourier transforms
- STM32F407VC ARM based processor

Safety Systems

Module Code: MSTSEE35

Duration: 20h

Objectives

At the end of this module, students will:

- Understand the role EMC phenomena play in the field of embedded systems, by studying automotive examples

List of topics

- EMC (Electromagnetic Compatibility) issues for electronics
- Cause and effect
- Prevention and solutions
- The automotive field: an overview

Oral Communication & Presenting Skills

Module Code: MSTOCPS

Duration: 14h

Objectives

At the end of this module students will:

- Have a clear model of what constitutes successful and unsuccessful presentations
- Have practiced giving formal presentations in English.
- Be more aware of their own downfalls when presenting

List of topics

- Methods for putting together an oral presentation
- Practice

Project Management

Module Code: MSTPM

Duration: 30h

Objectives

At the end of this module students will be able to:

- Appreciate the need for project management including formal methods, as a recognised discipline
- Appreciate the need for effective planning, control and delivery mechanisms
- Understand the complexities of different types of computing projects and some of the methods used to manage them
- Apply some of the skills and knowledge learned in any future project (including during other module(s) of this course, and, in particular, documentation for development project)

List of topics

- What is a project? The need for PM, formal methods
- Managing large, complex, international projects
- Un peu de franglais (PM culture and language in English and in French)
- Management of projects, project life cycle, roles of the project manager and stakeholders
- Stakeholder management, scope, creep
- Work planning, project breakdown structures and estimating
- Resource planning, estimating, management
- Risk identification, analysis, management
- PERT and Gantt charts, their use and shortcomings
- PM planning tools (including practical sessions with MS Project)
- Change control, documentation, configuration management
- Project control, quality, documentation, delivery management
- Project closure; maintenance projects
- Types of computing projects and risks; computing PM methods
- Cost-benefit analysis and project accounting may be touched upon, but are not in the scope of this course

Research & Development Project

Module Code: MSTPRDP

Duration: 80h

Objectives

At the end of this module students will be able to:

- Improve their organizational skills (within a team, facing deadlines) and manage their time
- Improve their communication skills
- Work in a real-world situation close to their future professional environments
- Filter and identify relevant online information according to a targeted subject
- Constitute a bibliographical study
- Develop functional specifications and success strategies
- Estimate the workload of each identified task
- Analyse their production capacity

- Design and build computer applications with current standards and new opportunities
- Integrate research approaches
- Evaluate the quality level for a developed application
- Present their work and justify the outcome

List of topics

- State of the art practices
- Technical / feasibility studies
- Research methodologies and approaches
- Information processing
- Experimental results and evaluation

French as a Foreign Language

Module Code: MSTFRE1, MSTFRE2, MSTFRE3

Duration: 180h

Objectives

At the end of this module students will be able to:

- Oral comprehension
 - Understand standard French used in everyday situations at work, school, etc.
- Written comprehension
 - Understand texts written in standard French used in everyday situations such at work, school, etc.
- Oral expression
 - Participate in a regular day-to-day conversation on familiar topics
 - Ask and exchange information
 - Prepare and give a short formal presentation
- Written expression
 - Write short, clear and coherent texts on familiar / everyday situations with basic grammar and vocabulary

List of topics

- Revision of grammar and vocabulary

- Preparation for the Test of French Language (TCF or TEF)

English as a Foreign Language

Module Code: MSTENG1 MSTENG2 MSTENG3

Duration: 180h

Objectives

At the end of this module students will be able to:

- Oral comprehension
 - Understand standard English used in everyday situations at work, school, etc.
- Written comprehension
 - Understand texts written in standard English used in everyday situations such at work, school, etc.
- Oral expression
 - Participate in a regular day-to-day conversation on familiar topics
 - Ask and exchange information
 - Prepare and give a short formal presentation
- Written expression
 - Write short, clear and coherent texts on familiar / everyday situations with basic grammar and vocabulary

List of topics

- Revision of grammar and vocabulary
- Preparation for the Test of English for International Communication (TOEIC)



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