Overview of the French ISN Syllabus[1]

A. PROGRAM ELEMENTS

The program is built around four sections: data representation, algorithms, programming languages, and hardware architectures. Teachers build instructional sequences by combining knowledge and skills extracted from the four parts of the program.

Organization: the elements of the program are presented in a table with three columns: Knowledge, Skills and Comments.

A part of the knowledge and capabilities identified by   are optional, and will be treated according to the equipment available, and selected by teachers' teaching guidelines.

A.1 Representation of data

In a computer context, data is represented by sequences of numbers. Scanning is the process associated with a real object, a description of the physical world with a set of data usable by a computer or, more generally, a digital machine. Because of the underlying sampling, scanning induces significant effects on the quality of the digital data. It leads to specific conditions for the creation, storage, processing and circulation of data.

Processing capabilities and computer storage have grown steadily since their advent. It is therefore crucial to organize the flow of data on a local machine or in a distributed manner over a network.

The increasing integration of digital technology in human activities and the digitization of data induce profound cultural, socio-economic, legal and political transformations that reveal new opportunities, new risks and new constraints, which should be studied.

Knowledge items	Skills	Comments
Binary representation A computer is a machine that manipulates numerical values represented in binary form.	Processing with elementary operations the three basic units: bit, octet, word	To highlight, by questioning, the presence of digital technology in personal and professional lives, through examples.
Boolean operations Presentation of the basic Boolean operations (and, or, not, xor)	Expressing simple logical operations by combining basic operators.	The basic logical operations are discovered using simple exercises; these operations are highlighted in research mechanisms. In parallel with the algorithmic sessions, we can explain the principle of addition of two bytes.
Digitization The computer handles only numerical values. A step aiming at digitizing objects from the physical world is necessary.	Coding a number, a character through a standard code, a text in the form of a list of digital values. Code an image or sound in the form of an array of digital values. - Change format, size, contrast or brightness of digital images. - Filter and detect specific information. - Create an image using modeling software	Here it is useful to refer to the technological concepts introduced concerning hardware architectures. Images and sounds are chosen as an application context and are handled through software processing or synthesis. The digital light and sound processing is linked to the underlying physical principles, which it is useful to recall when needed.
Formats The digital data are arranged so as to facilitate the storage and processing. The organization of digital data respects formats that are either	Identifying some document formats, images, sound data. Choose a suitable format relative to a given use or need, to a quality or size limit	The choice of an appropriate format leads to the problem of interoperability, which consists in ensuring unrestricted use of the same data on a different system.

[1] Translated by Monique Grandbastien, full document available in French on the Ministry website
http://www.education.gouv.fr/pid25535/bulletin_officiel.html?cid_bo=57572

de facto or prescribed standards.		
Compression The concept of data compression. Compression with and without loss of information.	Using compression software.	We can show the effect of the compression of an image or sound by comparing two compression systems (with or without loss).
Structuring and organizing information Large amounts of information are handled. It is necessary to organize them.	Classifying information, including in the form of a tree.	Here we can study the system for organizing files into folders. A set of documents linked by hyperlinks provides an example of graph type organization.
Persistence of information Data, including personal, may be stored for long periods without control by the concerned persons.	Awareness of the persistence of digital information on interconnected spaces. Understand the general principles to behave responsibly in relation to persons' rights in the digital space.	The persistence of information is particularly evident in hard disks, but also caches. It interacts with the right to privacy and gives rise to a claim for a "right to be forgotten".
Non-rivalry of information Existence of laws governing the holding and movement of digital data.	Awareness of the non-rivalry of immaterial goods Distinguish different types of licenses (free, proprietary).	Non-rivalry property is defined by the fact that its use by one person does not limit the use by others (for example, the radio device is rival but what is broadcast is not). On the occasion of presentations followed by discussions, students understand changes in values and rights (in France and elsewhere) induced by the emergence of intangible assets.

A.2 Algorithmics

An algorithm is defined as an operational method to solve a finite number of steps clearly specified in all instances of a given problem. A machine or a person can perform this method.

Students are faced with algorithms early in their school career (with the four arithmetic operations). Later on, the construction of figures in Euclidean geometry, the transcription of "formulas" in molecular chemistry, genetic code or functional analysis technology are also situations involving algorithms. High school mathematics classes contain an introduction to algorithms.

Through the study of some algorithms, the ability to read and understand an algorithm developed by others, and to design new one gradually develops. These algorithms are expressed in a programming language and run on a machine, or are informally defined.

Knowledge items	Skills	Comments
Simple algorithms - Find an element in a sorted array by dichotomy - Sort an array by selection - Add two integers expressed in binary format.	Understand an algorithm and explain what it does. Modifying an existing algorithm to obtain a different result. Designing an algorithm. Programming an algorithm. - Questioning the effectiveness of an algorithm.	The concepts of algorithm and program are presented simultaneously, and then they are distinguished. The goal is an understanding of these algorithms and the ability to implement them. Situations producing an error (division by zero, overflow) are highlighted.
More advanced algorithms merge sort finding a path in a graph by a depth-first traversal (DFS) finding a shortest path through a breadth-first traversal (BFS).	Understanding and explaining (orally or in writing) what an algorithm does. - Questioning the effectiveness of an algorithm.	The objective is limited to an understanding of the fundamental principles without requiring programming.

A.3 Languages and Programming

Programming is the expression of an algorithm in an executable language by a machine, and plays a central role in the development of systems and products.

Learning programming involves first planning an algorithm described in natural language and secondly understanding a program and expressing in natural language the underlying algorithm.

We begin by recalling the basic elements of any programming language (assignment, sequence and loop test) as they were presented in the high school math's classes. The notion of function to avoid duplication, to structure programs and organize their design is then introduced. Finally, we highlight the quality of programs by testing on different data sets.

The emphasis is on clarity and documentation to facilitate the resumption of code by other programmers. Finally, it shows the universality of the concept of language beyond programming.

The teacher chooses a programming language based on the following criteria: ease of use, freedom of installation, presence of associated tools, and the existence of a community of users and libraries to facilitate development.

Knowledge items	Skills	Comments
Data Types - Integer - Floating point - Boolean - Character - Table - String.	Choosing a data type based on a problem to be solved.	We adapt the presentation of these concepts based on the programming language used.
Functions - Concept of function - Scope of variables and passing arguments - Recursive definition of functions.	Designing the header (or interface) of a function and the function itself.	We adapt the presentation of these concepts based on the programming language used.
Fix a program - Test - Instrumentation - Error situations or bugs.	Developing and editing a program by testing Use a development. tool	Risks arising from incorrect programs and bugs that result is mentioned, sometimes with serious consequences.
Description languages Presentation of HTML and the principle of separation of content and formatting.	Creating and analyzing a web page in HTML.	It highlights the dual use of language, human readable and interpretable by machine. HTML is used to write a page "by hand" and then insists that this language also serves as a target for page generators. Page quality in terms of syntactic correctness and efficiency of the message is evaluated.

A.4 Hardware Architectures

Expressing an algorithm in a programming language is designed to make it executable by a digital machine. The discovery of the architecture of these machines is a key step in computer literacy. In addition, understanding the organization is required to program efficiently, taking into account the capabilities and limitations of digital machines.

The teaching progression follows the chronology of the development of computer systems: first centralized around direct access machines, then connected via a serial point-to-point connection, and then distributed through networks where information transport is based on routing methods. The development of these networks and their widespread use has led to major societal issues that are best addressed in the form of multidisciplinary activities. Finally, the study of a mini-robot allows discovery of the mechanisms of control and communication in the performance of complex tasks, interacting directly with the physical world.

Knowledge items	Skills	Comments
HARDWARE		
Architectural elements Basic components (CPU, memory, peripherals).	Explaining the role of computer components.	It is limited to an overview of these concepts around a machine with direct access (Random Access Machine).
Instruction Set Simple instructions (load, store, arithmetic and logical operations, conditional jump).	Explaining the execution of a sequence of simple instructions of typical machine language.	Activities and paper-based exercises are proposed without using a computer.
NETWORKS		
Point-to-point transmission Basic principles of a digital information transmission between a transmitter and a receiver.	Establishing a serial communication between two machines.	Establish a serial communication between two machines. One wonders about the quality of a serial point-to-point. We limit ourselves to the analysis of a traffic type "chat" (exchange of encoded characters). The notion of protocol (rules, formats and conventions to which it is necessary to agree to communicate) is introduced. Beyond two machines, the model of the point-to-point link is no longer appropriate.
Address on a network Addressing mechanisms to identify remote machines.	Describing an address on a particular type of network. Analyze traffic (frame) on a network and thus bringing out the concept of protocol.	These concepts are introduced by comparing different types of existing address processing (phone, mail). It uses an analysis tool to visualize the transmission of frames necessary to a dialogue between digital machines.
Routing Mechanisms induced by the communication on a network whose structure is of graph type. Notions about packet paths, routing.	Analyzing the headers of email messages to describe the path followed by the information.	It is limited to the implementation of a practical session, with analysis of predefined headers emails received (distributed appearance and unreliable networks of large size, difficulty of scaling). The difference between the tree-type networks and graph types is explained.
Supranational networks	Awareness of supranational networks and social, economic and political consequences.	It highlights the fact that some countries allow the online information, services or digital content, whereas such consultation is not allowed in other countries.
ROBOTICS INITIATION		
Discovery of a robotic system and its programming language	Identifying the different components of a mini-robot and understand their roles. Describing a simple events system using a finite state machine. Programming (in a high-level language) a mini-robot for performing a complex task.	It offers activities depending on equipment and software available in the school.