UNIVERSITY OF M'SILA FACULTY OF MATHEMATICS AND COMPUTER SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

CHAPTER 1: INTRODUCTION TO HMI

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COURSE PLAN

- **Introduction to HMI**
- **Objectives of HMI**
- **Interface vs Interaction**
- **Design Approaches for HMIs**
- **Adaptation of HMIs**
- **Evolution of HMI**
- **Challenges of HMI**

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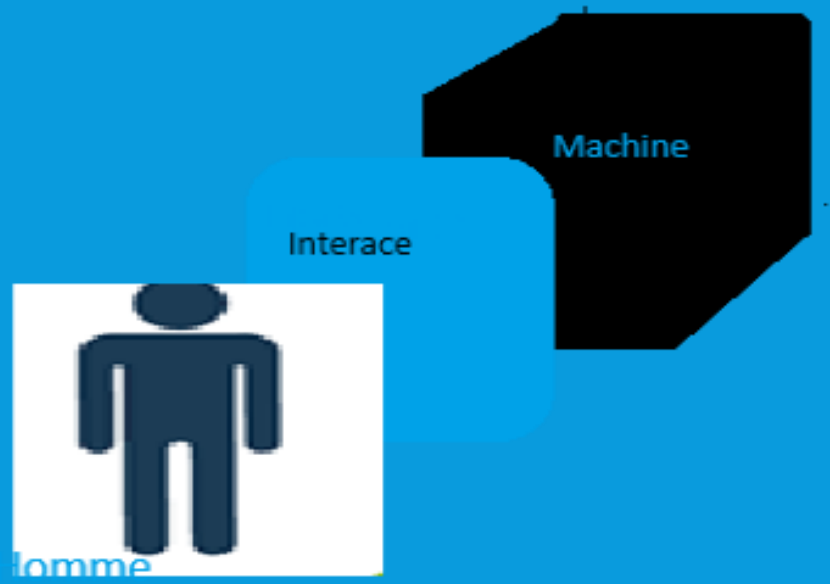
INTRODUCTION TO HCIS

- **HMI**
  - **Human-Machine Interface**
  - **Human-Machine Interactions**



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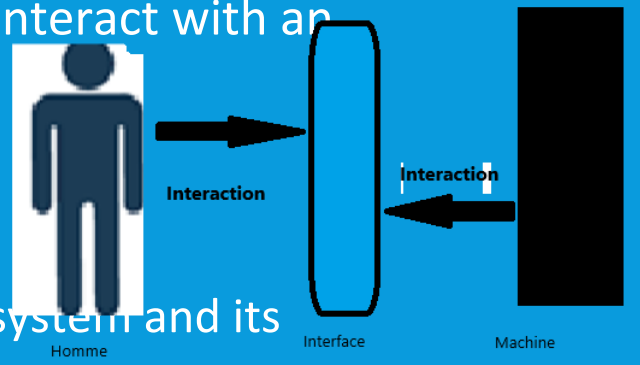
INTRODUCTION TO HMI

- **Human-Machine Interface**

  The set of hardware and software devices that allow a human user to interact with an interactive digital system



- **Human-Machine Interaction**
  - the set of actions enabling communication between an interactive digital system and its human user
  - reciprocal action (between human and machine) commands of machines by humans
  - feedback from the machine to the human
- **The interface is the communication portal with the machine**

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INTERFACE WITH INTERACTION

- **The presence of an interface: Window, Menu, Icons, buttons, is not sufficient to make a system usable**
- **Usability: is the capacity of a system to provide functions that are easily usable by a person**
- **How to measure usability?**
  - time required to learn
  - speed of use (benchmarks)
  - error rates
  - ease of remembering
  - subjective satisfaction

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DESIGN APPROACHES

- **Machine-Centred Approach**
  - focused on the machine and its capabilities
  - the user must adapt to the machine

- **User-Centred Approach**
  - focused on the human and their needs
  - the machine must adapt to the user

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ADAPT THE HMI

- **To the characteristics of the user**
  - physical differences (age, disability)
  - knowledge and experience (novice, expert, professional)
    - in the domain of the task
    - in computing, on the software
  - (psychological characteristics)
    - visual/auditory, logical/intuitive, analytical/synthetic…
  - socio-cultural characteristics
    - format of numbers
    - direction of writing
    - meaning of icons, colours

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ADAPT THE HMI

- In the general public context (providing immediate usability)
  - leisure (making the product attractive)
  - industry (increasing productivity)
  - critical systems (ensuring zero risk)
- To the characteristics of the task
  - occasional, regular, daily use, repetitive task
  - sensitive to environmental changes, risky, time-constrained...
- To the technical constraints
  - Operating system, memory, processor, battery life, screen…

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HMI: A MULTIDISCIPLINARY FIELD

- **Computer science:**
  - **Programming**
  - **Software engineering**
  - **Speech synthesis and recognition, natural language**
  - **Artificial intelligence, image processing...**
- **HMI is a multidisciplinary field**
  - **Cognitive psychology**
  - **Education science, didactics**
  - **Cognitive ergonomics, software ergonomics**
  - **Communication, graphics, audio-visual, design**

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IMPORTANCE OF HMI

- From the users' perspective,
  - the interface is the means that facilitates the use of the product.

- From a technical standpoint
  - Most computer applications are interactive
  - HCI is often a key element in software evaluation
  - Interaction design accounts for more than 50% of development costs
  - HCI can represent 80% of an application's code

- From a social and commercial perspective,
  - a poor interface costs money and even lives (Crash during landing of the Airbus A320 in 1992)
  - Mont St-Odile (France), 87 dead, 9 injured and 9 survivors
  - Same button for two distinct functions (speed and descent angle)

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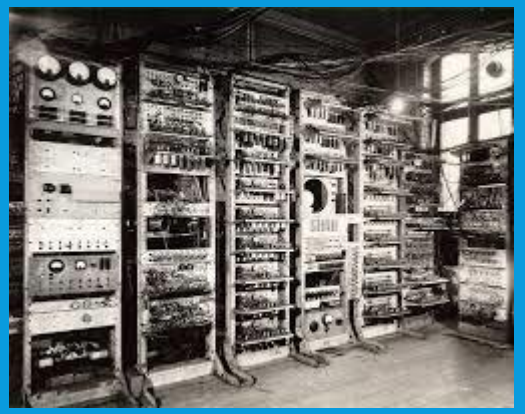
HISTORY & EVOLUTION OF HMI

- **1945-1956: First computers**
  - **Hardware only**
  - **Reserved for experts**



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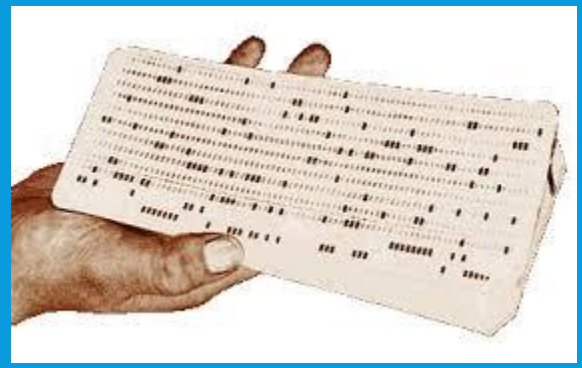
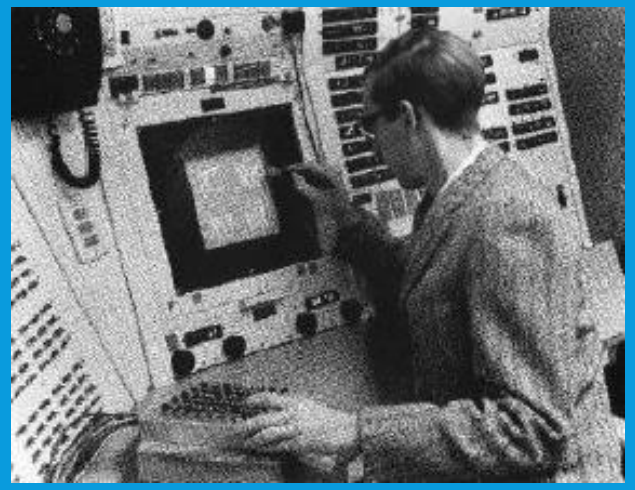
HISTORY & EVOLUTION OF HMI

- **1956-1971: 2nd and 3rd generations of computers**
  - **Separation of hardware/software:**
    - **OS: DOS, VMS**
    - **Language: COBOL, Fortran**
  - **Input/output device: punch card reader, indicators, printers**
  - **Interaction reserved for experts**



- **New input-output devices**
  - **1963: graphical screen and optical pen**
  - **1968: first mouse**
  - **1980: consumer applications**



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HISTORY & EVOLUTION OF HCI

- **1980s: Personal computers**
  - **Windowing system and use of the mouse and keyboard**

- Xerox 8010 Star Apple Lisa Macintosh Windows 3.0
- 1981 1982 1984 1990

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HISTORY & EVOLUTION OF HCI

- **1993: The Digital Desk**
- by Pierre Wellner is the first augmented reality system.
- Thanks to a projector and a camera mounted above a traditional desk, the computer can track the manipulation of physical objects placed on the desk.
- Overlaying an image of a virtual model onto an image of reality
  - the virtual is integrated into the real
  - in real time
  - on screen

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HISTORY & EVOLUTION OF HMI

- **Virtual Reality**
- VR simulates the physical presence of a user in an artificially generated environment by software.
- It creates an environment with which the user can interact.

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HISTORY & EVOLUTION OF HMI

- **Wearable computing**
  - **Embedded computing**
    - **In clothing**
    - **In accessories**

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HISTORY & EVOLUTION OF HMI

- **Mobile computing**
- Mobile devices
  - small, powerful, connected

- **Compatibility issues between different devices**
  - platform
  - technical constraints
    - bandwidth
    - memory
    - storage space
    - **screen size → responsive design**

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HISTORY & EVOLUTION OF HMI

- **Computing in everyday objects**
  - Washing machine, multi-cooker, surveillance camera, heating, etc.

- **The intelligent personal assistant Alexa (1st version November 2014) is capable of:**
  - voice interaction: answering questions
  - creating task lists, setting alarms, playing audiobooks, and providing real-time weather, traffic, and other information.
  - Alexa can also control several smart devices acting as a home automation hub.

CHALLENGES OF HMI

- An interactive system is different from an algorithmic system: it must be able to respond at any moment, even when it is already doing something

1. computer scientists are often trained in algorithms, calculation, but not in interactivity…
2. the most widely used programming languages were designed for computation, not for interactivity
3. Interface designers face numerous challenges: a wide range of users, of different ages, abilities, levels, and cultures, translation into multiple languages, with different hardware configurations