

# Human Computer Interaction

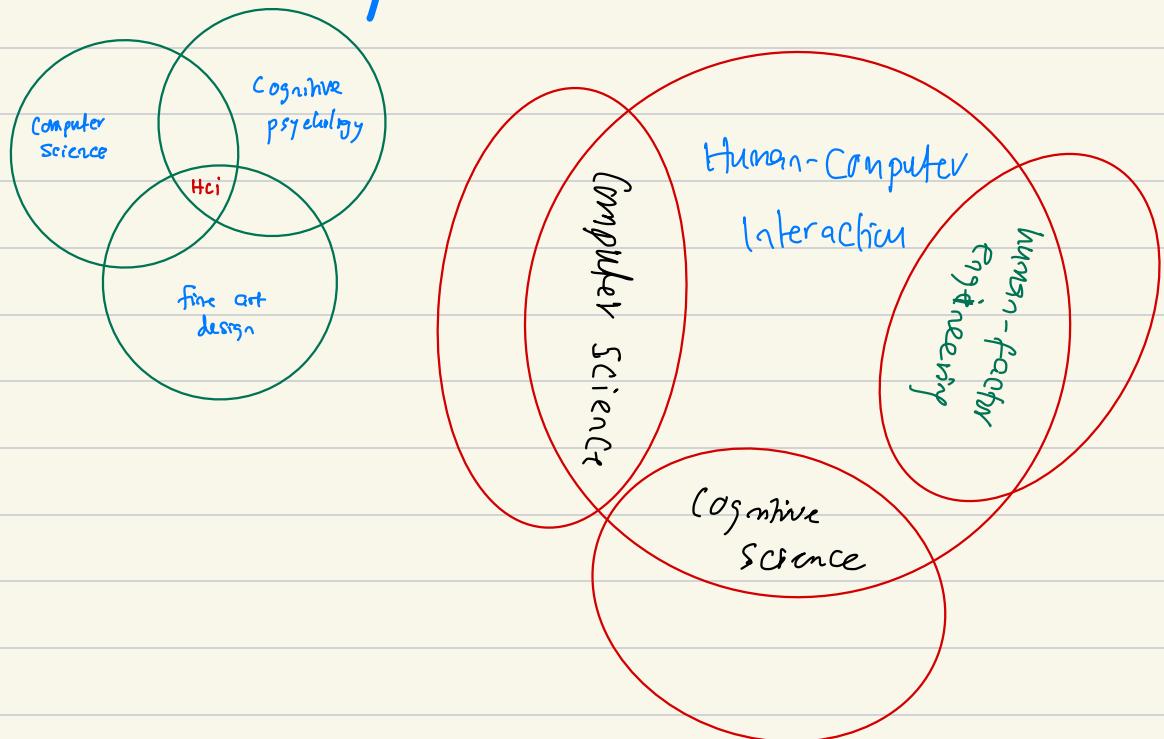
**HCI:** is a multidisciplinary field of study focusing on the design of computer technology and in particular, the interaction between humans (users) and computers.

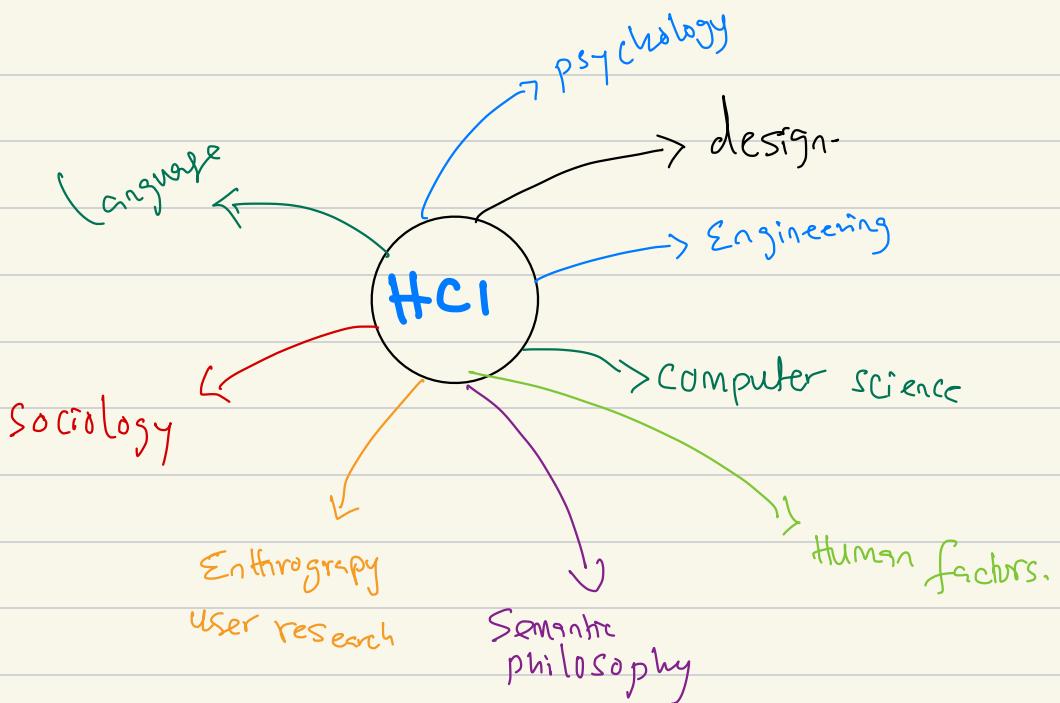
## The meteoric rise of HCI: (1980s)

early computers:

- \* Large and expensive
- \* Extremely difficult to use
- \* Used by specialist

## Multidisciplinary field of HCI

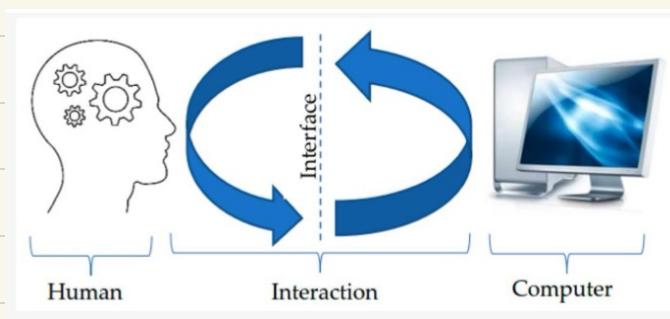




## Principle of HCI

\* Useful    \* Usable    \* Used

## Foundation of HCI

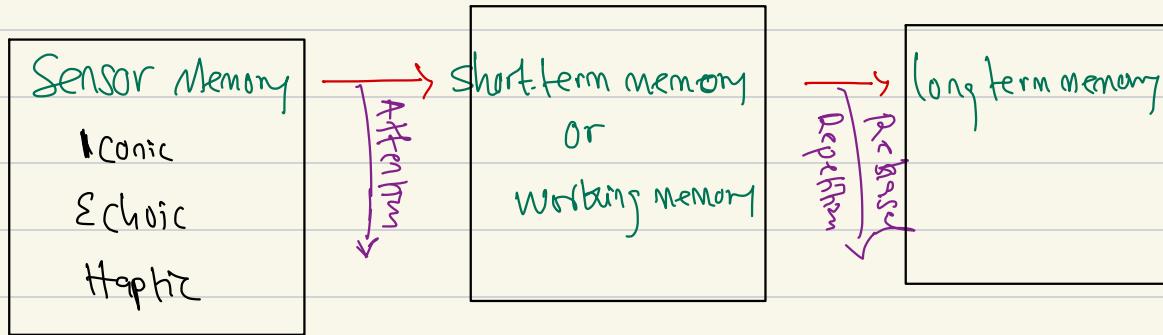


# THE HUMAN

\* limited in their capacity to process information

**Memory:** is our ability to encode, store, retain and subsequently recall information and past experience in the human brain.

## Structure of Memory



## Chapter 4: User persons

(final exam start)

User persona: is a character that represents a potential user of your website or app.

### How user persona works

- \* help you know who you are designing for.
- \* turn abstract content into a person with thoughts and emotions
- \* Represent a group of users with similar goals & characteristics.
- \* help you get to know users more closely to create better experience.

### Why user persons

- \* Serves as a guide, making sure all design decision are centered around the user.

### When to use user persons

- \* to avoid generalisation.
- \* the right moment:
- \* to capture the right user.

### How to create user persons

- \* who is your ideal user?
- \* what are the current behaviour pattern of my user?
- \* what are the goal and pains of my user?

Qualitative data: interview, open questions, direct observation

Quantitative data: Survey, meta data, CRM data, Traffic analysis

meta data: age, gender etc

## Types of persons

- \* primary persona: target the main user.
- \* Secondary persona: represent a group of users but not primary.
- \* Supplementary persona: represent a group of user that has minor influence on the design process

## Design stages

- \* wireframe
- \* mockup
- \* prototype

### Wireframe

\* is a low-fidelity that focuses on the functionalities of your website or app. visual details are not important in this stage.

#### Types of wireframes

- \* Hand-drawn sketch
- \* Digital wireframe.

### Mockups

\* is an intermediary stage, static and details are not yet final. is the visual design, with colors, typography and image.

#### Objective of mockup

- \* to visualise : page layout , essential features, info. architect
- \* also to validate concepts: in terms of interface, user experience

## prototype

\* **prototype**: is an interactive, dynamic representation of the final product. It's the high-fidelity representation of the look and feel of your final product.

### Objectives of prototype

- \* to have the real visual of your website.
- \* preview user interaction and flows
- \* share and iterate on ideas
- \* get feed-backs from collaborators
- \* test user interaction
- \* present your design to stakeholders

## Chapters: Evaluation techniques

**Evaluation**: is the systematic process of assessing interactive system or interface to understand their usability, effectiveness, and user satisfaction.

### When to evaluate

- \* **Formative**: taking place during the development of the project
- \* **Summative**: drawing lesson from a completed project later.

### Goals of evaluation

- \* assess extend of system functionality
- \* assess effect of interface on user
- \* identify specific problems

## Evaluation process

- \* test Usability and functionality of system.
- \* evaluate both design & implementation.
- \* Consider it at all stage in the design life cycle.
- \* Occur in laboratory, field and/or in collaboration with users

### Approaches & method of evaluation

#### \* Usability testing :

- \* user of terms
- \* System responds
- \* User's performance
- \* technique to obtain data
- \* consistency in navigation structure.

#### \* field study :

- \* Natural settings
- \* evaluate technology
- \* establish requirement
- \* identify opportunity for new technology
- \* facilitate the introduction of technology
- \* techniques :

- \* Recorded audio and video
- \* Interview
- \* Observation.

# Usability testing & field study.

## \* Context:-

\* **field study**: Conducted in natural environment where the users typically interact with the system.

\* **usability testing**: Conducted in a controlled environment such as lab or dedicated testing facilities.

## \* Scope :

\* **field study**: focus on observing user's behaviour and interaction with a system in their real-world context.

\* **usability testing**: focus on evaluating a specific task or features of a system in a controlled setting.

## \* Data Collection:

\* **field study** :- involved qualitative data collection

\* **usability testing** :- involve both qualitative & quantitative evaluation design

\* Cognitive walk through

\* Heuristic evaluation

\* review-based evaluation

## Cognitive walk through

is a task-based usability testing method that involve cross functional team of reviewers walking through each step of task.

## Cognitive walk through : Questions (label)

- \* will user try to achieve the right result?
- \* will user notice that the correct action is available?
- \* will user associate the correct action with the result they want?
- \* After action is performed, will user see that progress is made toward the goal? (feedback)

## Cognitive walk-through : Simple question

- \* is effect of current action same as user's goal?
- \* is action visible
- \* will user recognise action as correct one: labelling?
- \* will user understand feedback?

## Heuristic evaluation

- is a usability inspection method for Computer Software that help to identify usability problems in the user interface. its based on set of principles or common-sense rules.
- \* How many evaluators are needed?

Nielsen recommend at least 3, but go for 5.

- \* which heuristic to use?

Nielsen's Usability heuristics

## Heuristic evaluation (10)

- \* visibility of system status
- \* user control and freedom
- \* match b/w system and real world
- \* error prevention
- \* consistency and standard
- \* recognition rather than recall
- \* flexibility and efficient of use
- \* Aesthetic & minimalist design
- \* Help and documentation
- \* Help user recognise, diagnose, and recover from errors.

## Chapter b: Universal design

\* Universal design :- is the process of creating product that are accessible to people with wide range of abilities, disabilities, and other characteristics. (age, culture, etc.)

### Seven principle of Universal design

- \* equitable use :- useful and marketable to people with diverse abilities. eg. general website
- \* flexibility in use :- to accommodate a wide range of individual preferences and abilities. eg. museum
- \* simple and intuitive to use :- easy to understand regardless of the users experience, knowledge, language skills etc.
- \* perceptible information :- communicate necessary information effectively to the user.

- \* Tolerance for error :- minimises risks and harmful consequences of accidental or unintentional actions.
- \* low physical efforts:- used efficiently and comfortably and with minimum of fatigue.
- \* size and space for approach and use :- provide appropriate size and space for approach, reach, manipulation and use regardless of the user's size or mobility.

### multi-modal system

- \* use more than one human input channel in the interaction

### Designing for diversity

- \* user with dis-abilities:
  - \* Visual, hearing, physical, speech impairment
  - \* dyslexia
  - \* autism
- \* users with different age group
  - \* Old people
  - \* children
  - \* Shabab

## Chapter:7 future of HCI: XR (AR, VR, MR)

### The future of Human-Computer Interaction

the PET - design

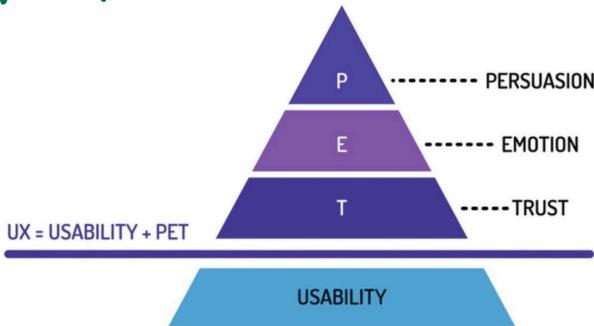


Figure 2-3 UX is more than usability. Persuasion, emotion, and trust are just as important (image by C. Hillmann)

\* **Virtual Reality** :- is an immersive experience that completely blocks out the real world and replaces it with computer-generated environment.

Application of VR technology

\* gaming \* education \* training and simulation

\* **Augmented Reality** :- it adds digital element to the real world, creating a hybrid reality.

Application of AR technology

\* gaming \* education \* Navigation

How AR Works

\* **Detection and recognition** :- uses sensors and cameras to detect and recognise object or environment in the real world.

- \* **tracking** :- Once object or environment are recognised, AR system track their position and orientation in real-time.
- \* **Rendering** :- They system then overlay digital content onto the real world, aligned with the tracked object or environments.
- \* **Interaction** :- You can interact with the AR content through gesture, voice commands, or touch inputs.

### How is Augmented Reality is created

- \* Understanding the purpose
- \* Choosing the right tools and platforms:
  - ARKit (Apple)
  - ARCore (Google)
  - Mugen (Boyle)
- \* User interface design
- \* Programming language
  - \* 3D modelling and animation
  - \* Integration with AR SDK

### Difference b/w AR and VR

- VR = Immersive experience
- AR = non-immersive experience
- VR = mostly entertainment
- AR = mostly visualisation

### Similarities b/w AR and VR

- \* They can be both used for education and commerce

## Mixed reality

\* refers to the merging of the physical and digital world, creating a hybrid environment where virtual object and the real world coexists and **interact in real-time**.

## Application of Mixed Reality

\* game \* education \* health care \* manufacturing \* architecture

## Different b/w AR, VR and MR & ER

AR = add digital element to your existing world **But** it can't interact with the real world.

VR = gives you a complete immersive experience by changing your environment into a digital environment.

MR = Similar to AR, adding digital element to your existing world **But** this can interact with the real world.

ER = is a generic term that encompasses all the real and environment generated by computing and portable equipment.



## Chapter 8: Digital twin

Digital twin :- is a detailed virtual representation of a physical object or system, that mirror its physical counter part's real-time status and working condition.



### Why digital twins technology is important?

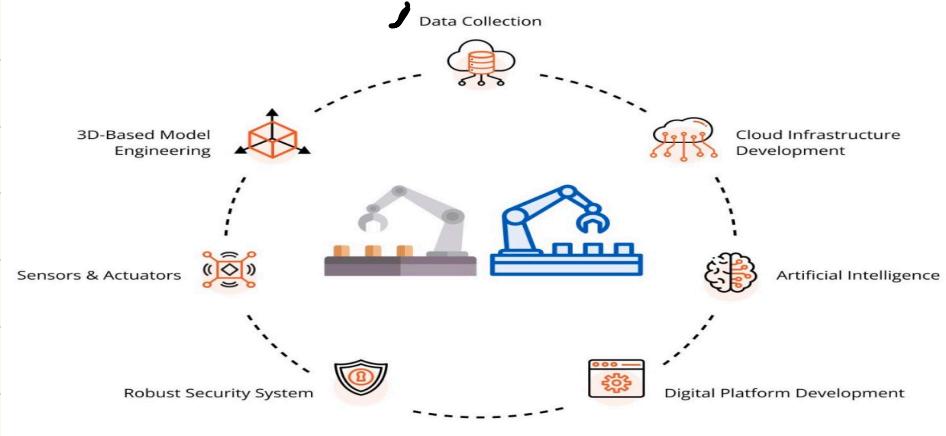
- \* **Real-time monitoring** :- The up-to-date information on the state and behaviour of the physical object, reflect in the digital object as well. making them identical.
- \* **Predictive insights** :- by analysing historical data, trends and patterns, digital twin can generate predictive insight into future of this behaviour or potential outcomes.
- \* **Efficient operation and optimization** :- the technology allows simulation and optimization of processes, enhancing overall operation efficiency.
- \* **Remote management and control** :- it facilitates remote monitoring and control of assets.
- \* **The global market of digital twin will reach 63.5 billion dollars by 2027.**

# Element of Digital twins

- 1- real world entity or process
- 2- Virtual representation
- 3- Data that connects the two

essential task for digital twin

- \* Data Collection      \* Cloud Infrastructure development
- \* Artificial Intelligent      \* Digital platform development
- + Robust Security System      \* Sensors & Actuators
- \* 3D-based Model Engineering



# Applications of Digital twins

- \* in **Automotive** :- Companies creating virtual vehicles and testing them at minimal cost.
- \* in **Aerospace** :- Airline manufacturers have achieved record improvement rates in first time quality. (e.g. Simulation)

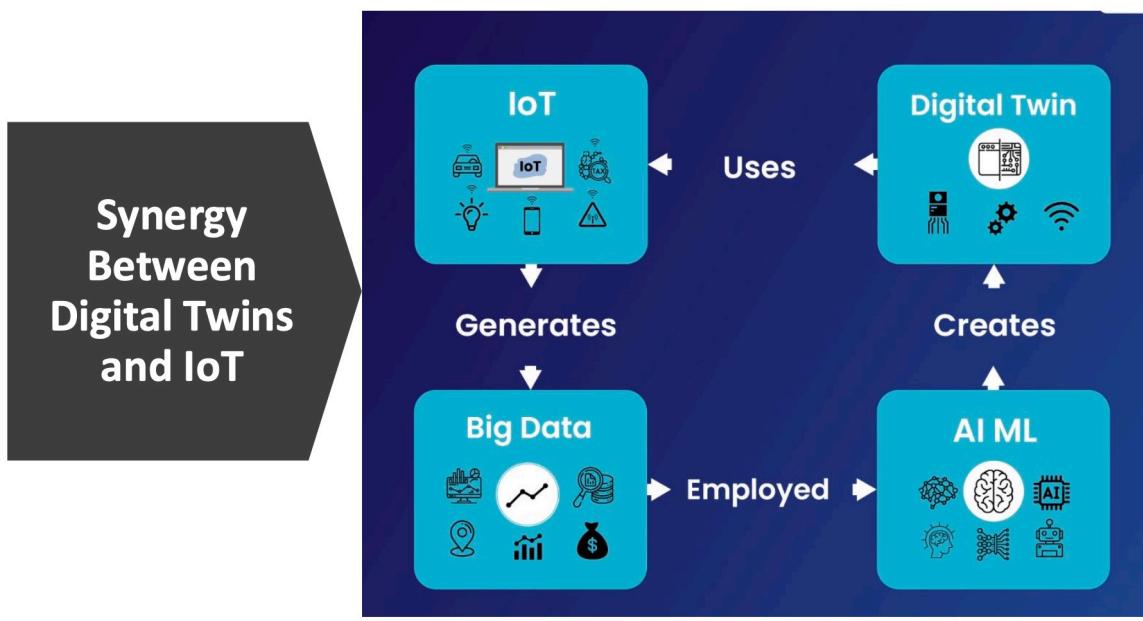
- \* In Manufacturing :- You can test many solutions before product one created, to ensure quality & efficiency.
- \* In Retail :- To monitor shopping behaviour to make better predictions.
- \* In Health Care :- Help professionals and researchers to conduct trials, observe health outcome overtime.

### Synergy b/w IoT & digital twin

- Digital twin uses IoT
- IoT generates big data
- big data employed AI/ML
- AI/ML creates Digital twin

#### Class Activity

- Difference between Digital twins and VR
- Difference between Digital twins and AR
- Difference between Digital twins and MR



# How IoT is being utilised by digital twin

## 1- Data collection :-

- \* Real time data Ingestion
- \* Diverse data points

## 2- Real-time Monitoring & Analysis:-

- \* Synchronisation
- \* Scenario Simulation

## 3- Feedback loop and Continuous Iterations:-

- \* Optimisation
- \* predictive maintenance
- \* Dynamic adjustment

## 4- Virtual prototyping & Testing:-

- \* Before physical development
- \* Training and development

## 5- Enhanced User experience & personalisation:-

- \* Consumer insight
- \* personalization

## 6- Integration with other system:-

- \* System Inter-play

## Challenges with digital twins

- \* Data privacy and security
- \* Integration challenge
- \* initial setup cost
- \* Ensuring data Accuracy.

## Chapter 9: Metaverse and HCI

Meta :- Something beyond physical world

Verse :- Universe or Space

metaverse - is a new virtual Universe created beyond the real world. Can be any 3D virtual space, powered by technology - including AR, VR, AI, IoT, blockchain. that allow people to interact with each other.

### History Of Metaverse

1992 => Neal Stephenson

2016 => Pokémon Go

2023 => more milestones

2030 => \$ 5 trillion revenue for business

### Use Of Metaverse

- \* Gaming and entertainment
- \* Virtual event and conferences
- \* education and training
- \* socialising and networking
- \* healthcare simulation
- \* Collaborative work space.

### Impact and potentials of Metaverse

- \* Enhanced connectivity
- \* New Economic Models

## \* Innovative Learning Opportunities

- \* Transformation in work and Collaboration
- \* Entertainment and Media Evolution
- \* advancement in health care.

## The Key technologies and developed pillars in metaverse

### 1- Artificial Intelligence (AI):

- \* Create avatars
- \* Digital agent with Spontaneous Conversation
- \* Creating New Knowledge without Human Intervention

### 2- Internet of Things (IoT):

- \* Connect 3D virtual spaces with real world.

### 3- Extended Reality (XR):

- \* In form of AR, VR and MR to visualise data in 3D Space

### 4- Brain-Computer Interface:

- \* replace traditional Computer Control Screen and hardware

### 5- 3D modelling | Reconstruction:

- \* Capture real object
- \* provide 3D prototypes

### 6- Spatial | edge Computing:

- \* Response to user actions that mimic reality.

### 7- Blockchain:

- \* Decentralised Metaverse
- \* Secure digital content
- \* Avoid delays.

# Challenges of metaverse

- \* privacy concern      \* security risk
- \* ethical consideration
- \* addiction and behavioural impacts
- \* legal and regulatory challenge
- \* Infrastructure and technology challenges

## Class activity

- Difference between digital twins and metaverse
- Difference between MR and AR
- Difference between Metaverse and VR

# Chapter 10: Human - AI partnership (H-AI-P)

H-AI-P :- represent a transformative approach to problem solving, innovation, and everyday tasks.

## Potentials of Human-AI partnership

- \* Task Automation : automating repetitive task
- \* Decision support : data-driven recommendation
- \* personalisation : adapt interfaces
- \* Accessibility : creating more accessible interface
- \* Realtime assistance : chat bot and virtual assistance

## Use of AI in HCI

### User Interface design :

- \* AI can analyse user behavior and preference to inform the design of intuitive and user friendly interface.
- \* personalisation :
- \* AI algorithm can tailor interfaces and content to individual user by learning from their preference, historical interactions, and feedback.

### Voice and Natural language processing :

- \* AI powered Voiced recognition enable more natural and conversational interaction b/w user and Computer  
↳ Siri, bixby and Alexa.

## \* Gesture Recognition:

- \* AI algorithms can interpret gestures, body language, and facial expressions, allowing for more natural and immersive interaction.
- \* predictive typing and AutoCorrect
- \* Acting intelligently
- \* User assistance and Support
- \* Emotion recognition
- \* Eye Tracking
- \* Adaptive interface
- \* Accessibility features
- \* User Behaviours Analysis
- \* powering HCI/UX activities for efficiency.

## Conclusion

- The collaboration between humans and AI signifies a revolutionary method for addressing problems, fostering innovation, and handling daily tasks.
- By combining the unique strengths of humans, such as creativity, empathy, and complex reasoning, with the computational power, efficiency, and data-processing capabilities of AI, we unlock a myriad of possibilities across various domains.

