# AI-LABS

## OPEN-SOURCE TOOLS, TECHNOLOGIES, AND PLATFORMS

PROBLEMS/USE CASES

COMPUTER VISION – AI LAB

Abstract

Instructions for a hackathon centred around problems using an open solution platform

AI TECH UK

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# Before you start

Think about what you hope to get out of this hackathon. Do you want to focus on just one technology and get the best model you possibly can, or do you want to understand all the technologies? Either is perfectly valid.
Remember learning is a journey not a destination, you can get a working model in a short period of time but what will you have learnt if you just stop there?

# Overview of Problem Uses

There are four areas of AI that can be explored as part of the AI Tech UK's – open-source Hackathon offering coding in Python. These are:

01 Data Exploration
02 Machine Learning Algorithms and Applications
**03 Computer Vision**
04 Natural Language Processing

Each area will have a series of problems with associated notebooks and data files. For each area a structured approach is provided detailing the objective, dataset, algorithms and models and accompanying libraries, useful links, success criteria and in some cases what to do next (a question, a discussion, use of your own data, refer to a specific link/lab/task, or simply reading further resources of your choice).

# 03 Computer Vision

## Introduction

Computer vision is a field of artificial intelligence that uses algorithms and deep learning models to analyse and extract information from visual data. It enables machines to perform various applications such as face recognition, visual attention, and image classification. Face recognition involves identifying an individual's identity using their facial features, while visual attention analyses an image or video to determine the relevant parts. Image classification uses deep neural networks to categorize images into various classes based on their content. Computer vision has significant applications in healthcare, security, retail, and entertainment industries, among others, where visual data analysis and interpretation are essential for informed decision-making and process improvement.

There are a series of problems for image and video analysis starting from basic image processing where you can manipulate a given image and add different artefacts in it. Other areas include face detection, face recognition, face emotion analysis and visual attention as listed below:
Simple digital image processing
Image classification
Face analysis – face detection, face recognition, age, gender, emotion and race prediction through face analysis
Visual attention modelling – predicting the area of interests in a given visual (image/videos)

## Objective

- Understand the Fundamentals of Image and Video Processing: learn the basic concepts of digital image and video processing, including image and video formats, pixel manipulation, filtering, and feature extraction.
- Learn Image Classification Techniques: learn about image classification techniques, including traditional machine learning models and deep learning models such as Convolutional Neural Networks (CNNs).
- Perform Comparative Analysis of Face Detection Models: learn about the most commonly used face detection models, including Haar cascades, and deep learning-based models. You will perform a comparative analysis of these models, evaluating their strengths and weaknesses.
- Explore Face Recognition and Emotion Analysis: learn about various face recognition techniques, including DeepFace.
- Understand Visual Attention Modeling: learn about various visual attention modeling techniques, including saliency-based models, which can help identify the most salient regions in an image or video.

## Approach

For each task, you will be providing with a dataset and a Python notebook that can be uploaded to your Google Drive and opened in Colab for testing, manipulation, and analysis. You will be guided through the notebook with step-by-step instructions and code snippets, and have the chance to experiment with different parameters and configurations to improve your results. We encourage you to go through the given codes, ask questions, and share your findings. By the end of the session, you will have a better understanding of image and video processing, face detection and recognition, emotion analysis, visual attention modelling, and how to use Google Colab and Python to implement these techniques in your own projects.

## Dataset

Some generic images and videos are provided for testing purposes, but we do not use any specific dataset. You are encouraged to use your own image and video datasets to test and analyse the computer vision algorithms covered. This will give you the opportunity to work with real-world data and tailor the techniques to your specific use cases. We will provide guidance on how to load and pre-process your own datasets in the Python notebooks, and offer suggestions for additional datasets that you can explore on your own.

## Libraries

Libraries that you would need to use are:

- OpenCV
- TensorFlow
- Keras
- RetinaFace
- DeepFace
- CV2
- MatPlotLib
- NumPy
- PIL

## Algorithms and models

- OpenCV is a popular computer vision library that includes tools for image and video processing, feature extraction, and machine learning.
- RetinaFace is a popular face detection algorithm that uses a deep learning model to detect faces in images and videos.
- DeepFace is a deep learning-based facial recognition library that can be used to identify and verify individuals in images and videos.
- Convolutional Neural Networks (CNNs) are a popular type of neural network used for image classification tasks.

## Success criteria

- To proficiently perform basic image processing tasks, showcasing a deep understanding of relevant techniques and their applications.
- To conduct comprehensive facial analysis, including face detection, recognition, and emotion analysis, utilizing appropriate methods and demonstrating expertise in the field.
- To gain a thorough understanding of the visual attention model, successfully building and testing it to identify important visual features in images.
- To extensively explore and test image classification using convolutional neural networks (CNNs).

## Useful links

- Face recognition with OpenCV, Python, and deep learning

- Deepface: A comprehensive facial analysis framework:

## What to do next

The potential of computer vision in the future is immense, especially for businesses. One can learn a lot from observing how customers navigate their stores, what items they focus on, where production lines slow down, or which inventory requires replenishment. However, it's not feasible for a human to keep track of every aspect of a business all the time. This is where computer vision comes into play.

AI and computer vision-based solutions have the potential to be deployed by enterprises today and can be adapted for future use cases. With computer vision, companies of all sizes can leverage AI on edge devices like cameras, edge servers, or even in the cloud. The applications of computer vision are vast, including biometrics such as face and gait recognition, visual surveillance, medical imaging analysis, and in-store customer behaviour analysis.

By utilizing computer vision, businesses can automate their processes, optimize their operations, and enhance their customer experience. Computer vision's potential to uncover valuable insights and trends in data analysis will continue to increase, leading to more effective decision-making and better overall performance.