

Portada

Instituto Tecnológico de Estudios Superiores de Monterrey



Maestría en Inteligencia Artificial Aplicada (MNA) Curso: TC5035 Proyecto Integrador

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Proyecto: Reconocimiento y Clasificación de Objetos basado en Colores para Detección en Vivo en Cámaras de Seguridad

Avance 1. Análisis exploratorio de datos

Equipo 43

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▼ 1 - Introducción

En el presente avance del Proyecto Integrador **Reconocimiento y Clasificación de Objetos basado en Colores para Detección en Vivo en Cámaras de Seguridad**, se realiza un análisis exploratorio de los datos describiendo los mismos utilizando técnicas estadísticas y de visualización para describir los aspectos más relevantes el conjunto de datos para justificar y planificar operaciones de preprocesamiento en próximos avances.

Se desarrolla la justificación de la selección de un nuevo dataset y las características principales del mismo así como la descripción a mayor detalle de las técnicas de ML a aplicar.

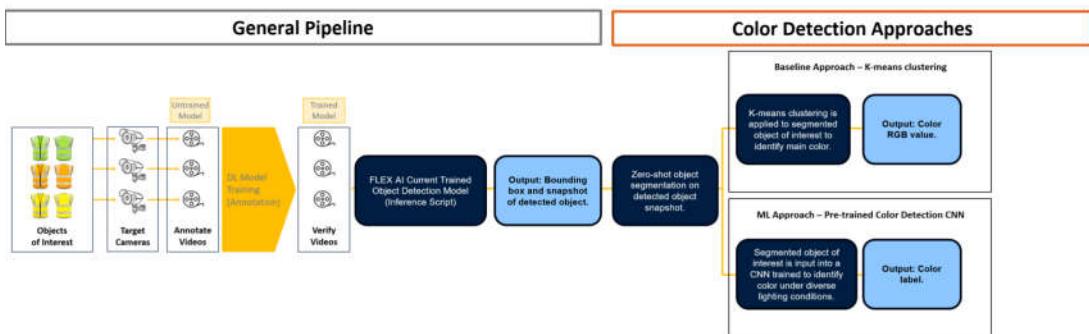
Contexto del Proyecto

Actualización de las técnicas de aprendizaje de máquina (ML) aplicables

Considerando una revisión complementaria de literatura [5][6][11], se describen a mayor detalle los 2 acercamientos propuestos para la investigación sobre las técnicas a aplicar para la resolución del problema propuesto donde se considera lo siguiente:

1. La implementación de una fase general de segmentación sobre el objeto de interés detectado por el modelo actual del producto. La segmentación se propone para aislar la información de color del objeto de interés del fondo o contexto de imagen inmediato dentro del bounding box region.
2. Enfoque 1 (Línea Base) - Técnicas de computer vision como agrupación de k-means para identificar el color principal.
3. Enfoque 2 (Utilizando ML) - Técnica de ML utilizando una red neuronal convolucional (CNN) pre entrenada para identificar el color en diversas condiciones de iluminación.

Proposed ML Approach



TC5035 - CAPSTONE PROJECT MNA - PROGRESS REPORT 1



Actualización de la selección del dataset

Se expuso en el avance anterior, que se utilizaría como conjunto de datos base para el proyecto el dataset CIFAR-10 considerando su conjunto de imágenes multiclase. Sin embargo, posterior a revisiones de documentación relevante asociada al tema de investigación, se encontraron los siguientes retos al considerar el dataset de CIFAR-10:

1. Dataset directamente aplicable a tareas de clasificación de imagen. El dataset de CIFAR-10 no cuenta con información de contexto, es decir metadatos por imagen asociados a detección de objetos (bounding box, labels, object and instance segmentation).
2. Tamaño de dataset pequeño y de poca diversidad de objetos (10 clases, 60K imágenes) en comparación otros datasets estándar para uso en tareas de visión computacional.
3. Falta de imágenes de escenarios de mundo real, objetos en contexto.

Considerando estas limitantes, se determinó seleccionar un dataset alternativo para continuar con el proyecto.

Selección de Dataset

Considerando el enfoque de las técnicas de aprendizaje de máquina (ML) aplicables propuestas y considerando el benchmark propuesto en literatura de referencia [1][2], se determina utilizar el dataset de Common Objects in Context (COCO) en su versión de 2017.

Table 1. Overview of the six most commonly used benchmark computer vision datasets (2004–2018) (based on Everingham et al., 2010; Fei-Fei et al., 2004; Griffin et al., 2007; Kuznetsova et al., 2018; Lin et al., 2014; Russakovsky et al., 2015). Citations from Google Scholar (4 December 2020).

Name	Categories	Tasks	Images	Instances	Average instances/ image	Provenance	Citations
Caltech 101	101	• image classification	9247 (30–400 image/ category)	n/a	n/a	Google Image Search	3825
Caltech 256	256	• image classification	30607 (80–800 image/category)	n/a	n/a	Google Image Search/ PicSearch	2161
PASCAL VOC	20	• image classification • object detection	11000	270000	2.3	Flickr	9626
ImageNet	• 21841 synsets • 1000 image classification • 200 object detection	• image classification • single object localization • object detection	14197122		3.0	Flickr	19745
MS COCO	91	• object detection • object segmentation • semantic scene labelling	328000	2500000	7.7	Flickr	12701
Open Images	• 19794 image classification • 600 object detection • 326 visual relationships	• image classification • object detection • visual relationships	9178275	15440132 (bounding boxes)	8.1 (object detection)	Flickr	376

Descripción de Dataset Seleccionado - Common Objects in Context (COCO)

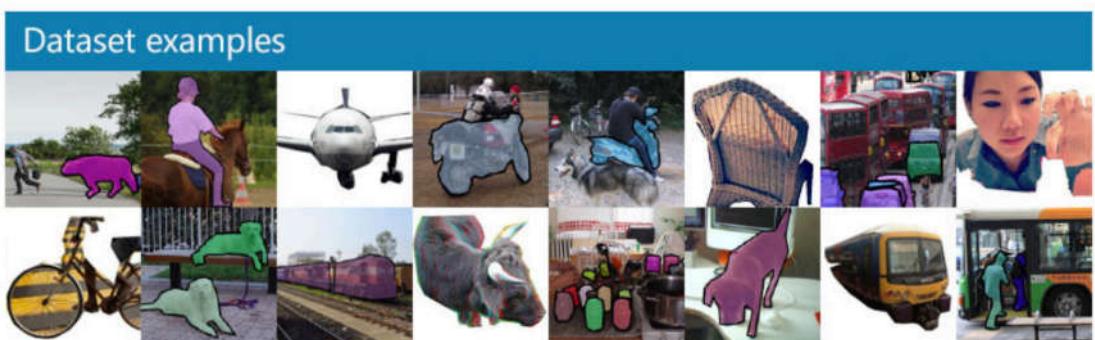


El dataset COCO (Common Objects in Context) es un conjunto de datos de imagen clave para la visión computacional. Desarrollada por Microsoft,

contiene más de 200,000 imágenes etiquetadas (330,000 en total) en 80 categorías de objetos y 91 categorías de materiales. Estas imágenes están contextualizadas en entornos reales, lo que lo convierte en un estándar para proyectos de detección de objetos, segmentación de imágenes y generación de descripciones.

Características principales:

- Las imágenes se dividen en 80 categorías de objetos diferentes, desde personas y animales hasta objetos y vehículos.
- Proporciona anotaciones precisas para cada objeto en las imágenes, incluyendo sus posiciones y contornos.
- Las imágenes están recopiladas de diferentes fuentes, lo que garantiza una amplia variedad de contextos y escenas.
- El conjunto de datos COCO se utiliza para una variedad de tareas en visión por computadora, como detección de objetos, segmentación semántica y generación de texto a partir de imágenes.
- Se utiliza como referencia en la evaluación de algoritmos y modelos de aprendizaje automático en visión por computadora.
- COCO se actualiza regularmente, lo que garantiza que sea un recurso valioso y actualizado para la comunidad de investigación y desarrollo en visión por computadora.



▼ 2 - Importando el Dataset

Para la descarga y uso avanzado del dataset seleccionado (COCO), se determina utilizar la herramienta open-source FIFTY ONE de Voxel 51 [7][9]. Fifty One opera como un paquete de Python que facilita el acceso, visualización, y evaluación de modelos en el dataset COCO.

Fifty One permite descargar subconjuntos específicos de una serie de datasets, visualizar datos y etiquetas, y ejecutar análisis de componentes y exploración de datos con múltiples opciones. En el presente informe se utilizan las herramientas básicas de exploración de datos y se inicia el uso de agrupación por conjuntos de imágenes utilizando embeddings (Clustering Images with Embeddings) [10].



▼ Instalación de dependencias

```
# Instalar aplicación y librerías de Fifty One para la importación y análisis  
!pip install fiftyone
```

```
Requirement already satisfied: fiftyone in /usr/local/lib/python3.8/site-packages  
Requirement already satisfied: aiofiles in /usr/local/lib/python3.8/site-packages
```

```
Requirement already satisfied: argcomplete in /usr/local/lib/python3.10/site-packages/argcomplete-1.12.2-py3.10.egg/argcomplete
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.10/site-packages/beautifulsoup4-4.12.0-py3.10.egg/beautifulsoup4
Requirement already satisfied: boto3 in /usr/local/lib/python3.10/site-packages/boto3-2.1.0-py3.10.egg/boto3
Requirement already satisfied: cachetools in /usr/local/lib/python3.10/site-packages/cachetools-4.2.0-py3.10.egg/cachetools
Requirement already satisfied: dacite<1.8.0,>=1.6.0 in /usr/local/lib/python3.10/site-packages/dacite-1.6.0-py3.10.egg/dacite
Requirement already satisfied: Deprecated in /usr/local/lib/python3.10/site-packages/Deprecated-1.2.0-py3.10.egg/Deprecated
Requirement already satisfied: ftfy in /usr/local/lib/python3.10/site-packages/ftfy-0.13.2-py3.10.egg/ftfy
Requirement already satisfied: humanize in /usr/local/lib/python3.10/site-packages/humanize-0.13.2-py3.10.egg/humanize
Requirement already satisfied: hypercorn>=0.13.2 in /usr/local/lib/python3.10/site-packages/hypercorn-0.13.2-py3.10.egg/hypercorn
Requirement already satisfied: Jinja2>=3 in /usr/local/lib/python3.10/site-packages/Jinja2-3.1.2-py3.10.egg/Jinja2
Requirement already satisfied: kaleido!=0.2.1.post1 in /usr/local/lib/python3.10/site-packages/kaleido-0.2.1-py3.10.egg/kaleido
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/site-packages/matplotlib-3.5.1-py3.10.egg/matplotlib
Requirement already satisfied: mongoengine==0.24.2 in /usr/local/lib/python3.10/site-packages/mongoengine-0.24.2-py3.10.egg/mongoengine
Requirement already satisfied: motor>=2.5 in /usr/local/lib/python3.10/site-packages/motor-2.5.0-py3.10.egg/motor
Requirement already satisfied: numpy in /usr/local/lib/python3.10/site-packages/numpy-1.23.5-py3.10.egg/numpy
Requirement already satisfied: packaging in /usr/local/lib/python3.10/site-packages/packaging-23.1-py3.10.egg/packaging
Requirement already satisfied: pandas in /usr/local/lib/python3.10/site-packages/pandas-1.5.2-py3.10.egg/pandas
Requirement already satisfied: Pillow>=6.2 in /usr/local/lib/python3.10/site-packages/Pillow-6.2.2-py3.10.egg/Pillow
Requirement already satisfied: plotly>=4.14 in /usr/local/lib/python3.10/site-packages/plotly-4.14.3-py3.10.egg/plotly
Requirement already satisfied: pprintpp in /usr/local/lib/python3.10/site-packages/pprintpp-0.8.2-py3.10.egg/pprintpp
Requirement already satisfied: psutil in /usr/local/lib/python3.10/site-packages/psutil-3.4.1-py3.10.egg/psutil
Requirement already satisfied: pymongo>=3.12 in /usr/local/lib/python3.10/site-packages/pymongo-3.12.3-py3.10.egg/pymongo
Requirement already satisfied: pytz in /usr/local/lib/python3.10/site-packages/pytz-2022.1-py3.10.egg/pytz
Requirement already satisfied: PyYAML in /usr/local/lib/python3.10/site-packages/PyYAML-5.4.1-py3.10.egg/PyYAML
Requirement already satisfied: regex in /usr/local/lib/python3.10/site-packages/regex-2022.12.1-py3.10.egg/regex
Requirement already satisfied: retrying in /usr/local/lib/python3.10/site-packages/retrying-1.3.2-py3.10.egg/retrying
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/site-packages/scikit-learn-1.1.3-py3.10.egg/scikit-learn
Requirement already satisfied: scikit-image in /usr/local/lib/python3.10/site-packages/scikit-image-0.19.3-py3.10.egg/scikit-image
Requirement already satisfied: scipy in /usr/local/lib/python3.10/site-packages/scipy-1.9.3-py3.10.egg/scipy
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/site-packages/setuptools-63.0.0-py3.10.egg/setuptools
Requirement already satisfied: sseclient-py<2,>=1.7.2 in /usr/local/lib/python3.10/site-packages/sseclient-py-1.7.2-py3.10.egg/sseclient-py
Requirement already satisfied: sse-starlette<1,>=0.10.3 in /usr/local/lib/python3.10/site-packages/sse-starlette-0.10.3-py3.10.egg/sse-starlette
Requirement already satisfied: starlette>=0.24.0 in /usr/local/lib/python3.10/site-packages/starlette-0.24.0-py3.10.egg/starlette
Requirement already satisfied: strawberry-graphql==0.138.1 in /usr/local/lib/python3.10/site-packages/strawberry-graphql-0.138.1-py3.10.egg/strawberry-graphql
Requirement already satisfied: tabulate in /usr/local/lib/python3.10/site-packages/tabulate-0.8.9-py3.10.egg/tabulate
Requirement already satisfied: xmltodict in /usr/local/lib/python3.10/site-packages/xmltodict-0.18.0-py3.10.egg/xmltodict
Requirement already satisfied: universal-analytics-python3<2,>=1.0.0 in /usr/local/lib/python3.10/site-packages/universal-analytics-python3-1.0.0-py3.10.egg/universal-analytics-python3
Requirement already satisfied: fiftyone-brain<0.17,>=0.16.1 in /usr/local/lib/python3.10/site-packages/fiftyone-brain-0.16.1-py3.10.egg/fiftyone-brain
Requirement already satisfied: fiftyone-db<2.0,>=0.4 in /usr/local/lib/python3.10/site-packages/fiftyone-db-0.4.0-py3.10.egg/fiftyone-db
Requirement already satisfied: voxel51-eta<0.13,>=0.12.6 in /usr/local/lib/python3.10/site-packages/voxel51-eta-0.12.6-py3.10.egg/voxel51-eta
Requirement already satisfied: opencv-python-headless in /usr/local/lib/python3.10/site-packages/opencv-python-headless-4.5.3.62-py3.10.egg/opencv-python-headless
Requirement already satisfied: graphql-core<3.3.0,>=3.2.0 in /usr/local/lib/python3.10/site-packages/graphql-core-3.2.0-py3.10.egg/graphql-core
Requirement already satisfied: python-dateutil<3.0.0,>=2.7.0 in /usr/local/lib/python3.10/site-packages/python_dateutil-2.7.0-py3.10.egg/python_dateutil
Requirement already satisfied: typing_extensions<5.0.0,>=3.7.4 in /usr/local/lib/python3.10/site-packages/typing_extensions-3.7.4-py3.10.egg/typing_extensions
Requirement already satisfied: h11 in /usr/local/lib/python3.10/site-packages/h11-0.13.0-py3.10.egg/h11
Requirement already satisfied: h2>=3.1.0 in /usr/local/lib/python3.10/site-packages/h2-3.1.0-py3.10.egg/h2
```

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Requirement already satisfied: priority in /usr/local/lib/python3.10/site-packages/priority-1.0.0-py3.10.egg
Requirement already satisfied: taskgroup in /usr/local/lib/python3.10/site-packages/taskgroup-1.0.0-py3.10.egg
Requirement already satisfied: tomli in /usr/local/lib/python3.10/site-packages/tomli-2.0.1-py3.10.egg
Requirement already satisfied: wsproto>=0.14.0 in /usr/local/lib/python3.10/site-packages/wsproto-0.14.0-py3.10.egg
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/site-packages/MarkupSafe-2.0.1-py3.10.egg
Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.10/site-packages/tenacity-6.2.0-py3.10.egg
Requirement already satisfied: dnspython<3.0.0,>=1.16.0 in /usr/local/lib/python3.10/site-packages/dnspython-1.16.0-py3.10.egg
Requirement already satisfied: enviro<5.0--3.1.0 in /usr/local/lib/python3.10/site-packages/enviro-4.0.0-py3.10.egg
```

Instalación de dependencias para Clustering Analysis

```
!pip install -U scikit-learn fiftyone
```

```
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/site-packages/scikit-learn-1.1.3-py3.10.egg
Requirement already satisfied: fiftyone in /usr/local/lib/python3.10/site-packages/fiftyone-0.10.0-py3.10.egg
Requirement already satisfied: numpy>=1.19.5 in /usr/local/lib/python3.10/site-packages/numpy-1.19.5-py3.10.egg
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Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.10/site-packages/beautifulsoup4-4.11.1-py3.10.egg
Requirement already satisfied: boto3 in /usr/local/lib/python3.10/site-packages/boto3-1.20.10-py3.10.egg
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Requirement already satisfied: ftfy in /usr/local/lib/python3.10/site-packages/ftfy-5.0.1-py3.10.egg
Requirement already satisfied: humanize in /usr/local/lib/python3.10/site-packages/humanize-3.0.0-py3.10.egg
Requirement already satisfied: hypercorn>=0.13.2 in /usr/local/lib/python3.10/site-packages/hypercorn-0.13.2-py3.10.egg
Requirement already satisfied: Jinja2>=3 in /usr/local/lib/python3.10/site-packages/Jinja2-3.1.2-py3.10.egg
Requirement already satisfied: kaleido!=0.2.1.post1 in /usr/local/lib/python3.10/site-packages/kaleido-0.2.1-py3.10.egg
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/site-packages/matplotlib-3.6.3-py3.10.egg
Requirement already satisfied: mongoengine==0.24.2 in /usr/local/lib/python3.10/site-packages/mongoengine-0.24.2-py3.10.egg
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Requirement already satisfied: packaging in /usr/local/lib/python3.10/site-packages/packaging-23.1-py3.10.egg
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Requirement already satisfied: plotly>=4.14 in /usr/local/lib/python3.10/site-packages/plotly-4.14.3-py3.10.egg
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Requirement already satisfied: pymongo>=3.12 in /usr/local/lib/python3.10/site-packages/pymongo-3.12.0-py3.10.egg
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Requirement already satisfied: PyYAML in /usr/local/lib/python3.10/site-packages/PyYAML-6.0-py3.10.egg
Requirement already satisfied: regex in /usr/local/lib/python3.10/site-packages/regex-2023.3-py3.10.egg
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Requirement already satisfied: retrying in /usr/local/lib/python3.10/site-packages/retrying-1.3.2-py3.10.egg
Requirement already satisfied: scikit-image in /usr/local/lib/python3.10/site-packages/scikit-image-0.19.3-py3.10.egg
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/site-packages/setuptools-63.0.0-py3.10.egg
Requirement already satisfied: sseclient-py<2,>=1.7.2 in /usr/local/lib/python3.10/site-packages/sseclient-1.7.2-py3.10.egg
Requirement already satisfied: sse-starlette<1,>=0.10.3 in /usr/local/lib/python3.10/site-packages/sse_starlette-0.10.3-py3.10.egg
Requirement already satisfied: starlette>=0.24.0 in /usr/local/lib/python3.10/site-packages/starlette-0.24.0-py3.10.egg
Requirement already satisfied: strawberry-graphql==0.138.1 in /usr/local/lib/python3.10/site-packages/strawberry_graphql-0.138.1-py3.10.egg
Requirement already satisfied: tabulate in /usr/local/lib/python3.10/site-packages/tabulate-0.8.9-py3.10.egg
Requirement already satisfied: xmltodict in /usr/local/lib/python3.10/site-packages/xmltodict-0.18.0-py3.10.egg
Requirement already satisfied: universal-analytics-python3<2,>=1.0.0 in /usr/local/lib/python3.10/site-packages/universal_analytics_python3-1.0.0-py3.10.egg
Requirement already satisfied: fiftyone-brain<0.17,>=0.16.1 in /usr/local/lib/python3.10/site-packages/fiftyone_brain-0.16.1-py3.10.egg
Requirement already satisfied: fiftyone-db<2.0,>=0.4 in /usr/local/lib/python3.10/site-packages/fiftyone_db-0.4.0-py3.10.egg
Requirement already satisfied: voxel51-eta<0.13,>=0.12.6 in /usr/local/lib/python3.10/site-packages/voxel51_eta-0.12.6-py3.10.egg
Requirement already satisfied: opencv-python-headless in /usr/local/lib/python3.10/site-packages/opencv_python_headless-4.5.3.62-py3.10.egg
Requirement already satisfied: graphql-core<3.3.0,>=3.2.0 in /usr/local/lib/python3.10/site-packages/graphql_core-3.2.0-py3.10.egg
Requirement already satisfied: python-dateutil<3.0.0,>=2.7.0 in /usr/local/lib/python3.10/site-packages/python_dateutil-2.7.0-py3.10.egg
Requirement already satisfied: typing_extensions<5.0.0,>=3.7.4 in /usr/local/lib/python3.10/site-packages/typing_extensions-3.7.4-py3.10.egg
Requirement already satisfied: h11 in /usr/local/lib/python3.10/site-packages/h11-0.12.0-py3.10.egg
Requirement already satisfied: h2>=3.1.0 in /usr/local/lib/python3.10/site-packages/h2-3.1.0-py3.10.egg
Requirement already satisfied: priority in /usr/local/lib/python3.10/site-packages/priority-1.0.0-py3.10.egg
Requirement already satisfied: taskgroup in /usr/local/lib/python3.10/site-packages/taskgroup-1.0.0-py3.10.egg
Requirement already satisfied: tomli in /usr/local/lib/python3.10/site-packages/tomli-2.4.0-py3.10.egg
Requirement already satisfied: wsproto>=0.14.0 in /usr/local/lib/python3.10/site-packages/wsproto-0.14.0-py3.10.egg
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/site-packages/markupsafe-2.0.1-py3.10.egg
Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.10/site-packages/tenacity-6.2.0-py3.10.egg
Requirement already satisfied: dnspython</3.0.0,>~1.16.0 in /usr/local/lib/python3.10/site-packages/dnspython-1.16.0-py3.10.egg
```

```
!fiftyone plugins download https://github.com/jacobmarks/clustering-plugin
```

```
Downloading jacobmarks/clustering-plugin...
```

```
Skipping existing plugin '@jacobmarks/clustering'
```

```
!pip install umap-learn git+https://github.com/openai/CLIP.git
```

```
Collecting git+https://github.com/openai/CLIP.git
  Cloning https://github.com/openai/CLIP.git to /tmp/pip-req-build-1133
    Running command git clone --filter=blob:none --quiet https://github.com/openai/CLIP.git
      Resolved https://github.com/openai/CLIP.git to commit a1d071733d7
        Preparing metadata (setup.py) ... done
Requirement already satisfied: umap-learn in /usr/local/lib/python3.10/site-packages/umap_learn-0.5.1-py3.10.egg
Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.10/site-packages/numpy-1.21.2-py3.10.egg
Requirement already satisfied: scipy>=1.3.1 in /usr/local/lib/python3.10/site-packages/scipy-1.7.3-py3.10.egg
Requirement already satisfied: scikit-learn>=0.22 in /usr/local/lib/python3.10/site-packages/scikit_learn-0.22.2-py3.10.egg
```

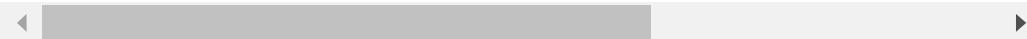
```
Requirement already satisfied: numba>=0.51.2 in /usr/local/lib/python3.10/site-packages/numba-0.51.2-py3.10.egg
Requirement already satisfied: pynndescent>=0.5 in /usr/local/lib/python3.10/site-packages/pynndescent-0.5.0-py3.10.egg
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/site-packages/tqdm-4.64.0-py3.10.egg
Requirement already satisfied: ftfy in /usr/local/lib/python3.10/site-packages/ftfy-5.1.0-py3.10.egg
Requirement already satisfied: regex in /usr/local/lib/python3.10/site-packages/regex-2023.1.1-py3.10.egg
Requirement already satisfied: torch in /usr/local/lib/python3.10/site-packages/torch-2.0.0-py3.10.egg
Requirement already satisfied: torchvision in /usr/local/lib/python3.10/site-packages/torchvision-0.18.0-py3.10.egg
Requirement already satisfied: llvmlite<0.42,>=0.41.0dev0 in /usr/local/lib/python3.10/site-packages/llvmlite-0.41.0dev0-py3.10.egg
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.10/site-packages/joblib-1.0.1-py3.10.egg
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/threadpoolctl-2.0.0-py3.10.egg
Requirement already satisfied: wcwidth<0.3.0,>=0.2.12 in /usr/local/lib/python3.10/site-packages/wcwidth-0.2.12-py3.10.egg
Requirement already satisfied: filelock in /usr/local/lib/python3.10/site-packages/filelock-3.4.0-py3.10.egg
Requirement already satisfied: typing-extensions>=4.8.0 in /usr/local/lib/python3.10/site-packages/typing_extensions-4.8.0-py3.10.egg
Requirement already satisfied: sympy in /usr/local/lib/python3.10/site-packages/sympy-1.15.0-py3.10.egg
Requirement already satisfied: networkx in /usr/local/lib/python3.10/site-packages/networkx-2.8.2-py3.10.egg
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/site-packages/jinja2-3.1.2-py3.10.egg
Requirement already satisfied: fsspec in /usr/local/lib/python3.10/site-packages/fsspec-2023.1.0-py3.10.egg
Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in /usr/local/lib/python3.10/site-packages/nvidia_cudnn_nvrtc_cu12-12.1.105-py3.10.egg
Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105 in /usr/local/lib/python3.10/site-packages/nvidia_cudnn_runtime_cu12-12.1.105-py3.10.egg
Requirement already satisfied: nvidia-cuda-cupti-cu12==12.1.105 in /usr/local/lib/python3.10/site-packages/nvidia_cudnn_cupti_cu12-12.1.105-py3.10.egg
Requirement already satisfied: nvidia-cudnn-cu12==8.9.2.26 in /usr/local/lib/python3.10/site-packages/nvidia_cudnn_cu12-8.9.2.26-py3.10.egg
Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in /usr/local/lib/python3.10/site-packages/nvidia_cublas_cu12-12.1.3.1-py3.10.egg
Requirement already satisfied: nvidia-cufft-cu12==11.0.2.54 in /usr/local/lib/python3.10/site-packages/nvidia_cufft_cu12-11.0.2.54-py3.10.egg
Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in /usr/local/lib/python3.10/site-packages/nvidia_curand_cu12-10.3.2.106-py3.10.egg
Requirement already satisfied: nvidia-cusolver-cu12==11.4.5.107 in /usr/local/lib/python3.10/site-packages/nvidia_cusolver_cu12-11.4.5.107-py3.10.egg
Requirement already satisfied: nvidia-cusparse-cu12==12.1.0.106 in /usr/local/lib/python3.10/site-packages/nvidia_cusparse_cu12-12.1.0.106-py3.10.egg
Requirement already satisfied: nvidia-nccl-cu12==2.19.3 in /usr/local/lib/python3.10/site-packages/nvidia_nccl_cu12-2.19.3-py3.10.egg
Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in /usr/local/lib/python3.10/site-packages/nvidia_nvtx_cu12-12.1.105-py3.10.egg
Requirement already satisfied: triton==2.2.0 in /usr/local/lib/python3.10/site-packages/triton-2.2.0-py3.10.egg
Requirement already satisfied: nvidia-nvjitlink-cu12 in /usr/local/lib/python3.10/site-packages/nvidia_nvjitlink_cu12-1.0.0-py3.10.egg
Requirement already satisfied: pillow!=8.3.*,>=5.3.0 in /usr/local/lib/python3.10/site-packages/pillow-5.3.0-py3.10.egg
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/site-packages/markupsafe-2.0-py3.10.egg
Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.10/site-packages/mpmath-1.2.1-py3.10.egg
```

```
# Carga de aplicación y herramienta de importación de datasets de FiftyOne
import fiftyone as fo
import fiftyone.brain as fob
import fiftyone.zoo as foz
from fiftyone import ViewField as F
```

▼ COCO Dataset - Train Split

```
# Download and load the train split of COCO-2017
dataset_train = foz.load_zoo_dataset("coco-2017", split="train")

Downloading split 'train' to '/root/fiftyone/coco-2017/train' if ne
INFO:fiftyone.zoo.datasets:Downloading split 'train' to '/root/fift
Found annotations at '/root/fiftyone/coco-2017/raw/instances_train2
INFO:fiftyone.utils.coco:Found annotations at '/root/fiftyone/coco-
Images already downloaded
INFO:fiftyone.utils.coco:Images already downloaded
Existing download of split 'train' is sufficient
INFO:fiftyone.zoo.datasets:Existing download of split 'train' is su
Loading 'coco-2017' split 'train'
INFO:fiftyone.zoo.datasets:Loading 'coco-2017' split 'train'
    100% |██████████| 118287/118287 [11.3m elapsed, 0s remaining, 195
INFO:eta.core.utils: 100% |██████████| 118287/118287 [11.3m elapse
Dataset 'coco-2017-train' created
INFO:fiftyone.zoo.datasets:Dataset 'coco-2017-train' created
```



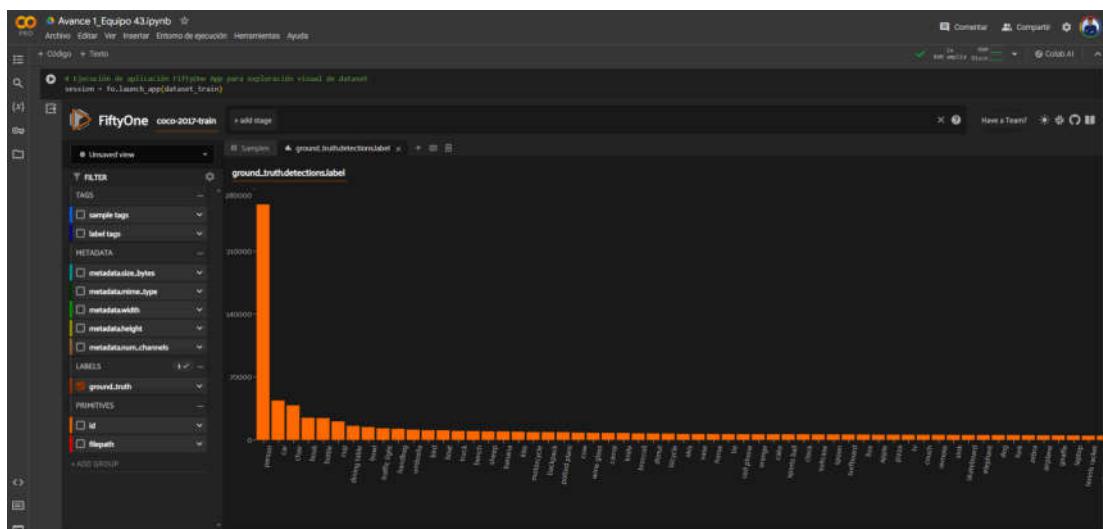
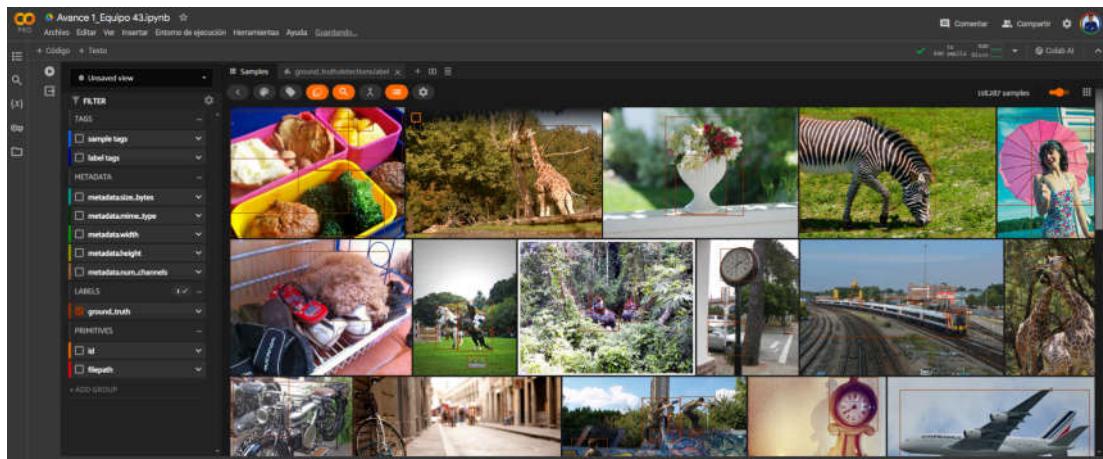
```
# Resumen general del dataset split creado
print(dataset_train)
```

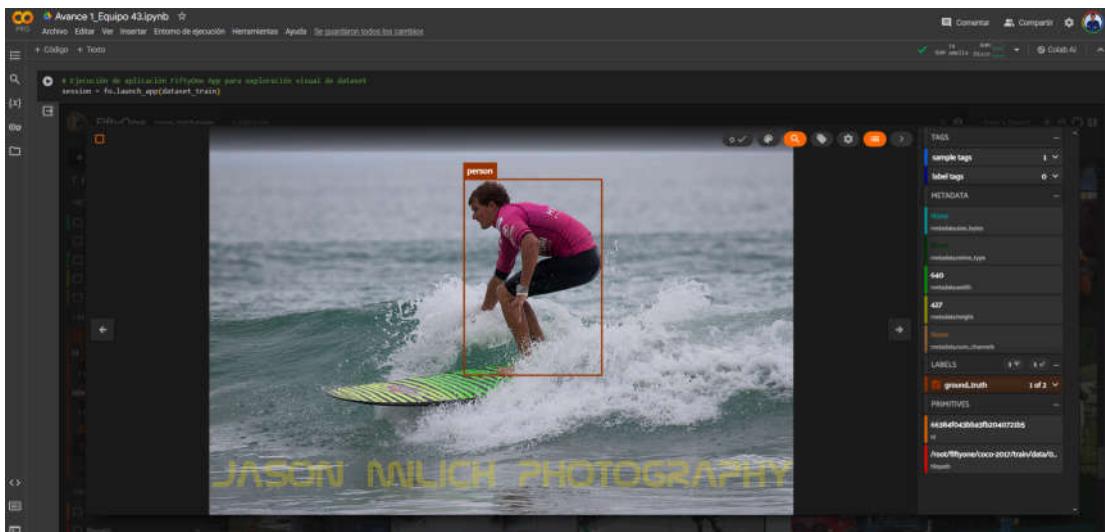
```
Name:      coco-2017-train
Media type: image
Num samples: 118287
Persistent: False
Tags:      []
Sample fields:
    id:          fiftyone.core.fields.ObjectIdField
    filepath:    fiftyone.core.fields.StringField
    tags:        fiftyone.core.fields.ListField(fiftyone.core.fiel
    metadata:    fiftyone.core.fields.EmbeddedDocumentField(fiftyo
    ground_truth: fiftyone.core.fields.EmbeddedDocumentField(fiftyo
```



```
# Ejecución de aplicación FiftyOne App para exploración visual de datos
session = fo.launch_app(dataset_train)
```


Capturas de Exploración inicial





▼ COCO Dataset - Validation Split

```
# Download and load the validation split of COCO-2017
dataset_val = foiz.load_zoo_dataset("coco-2017", split="validation")

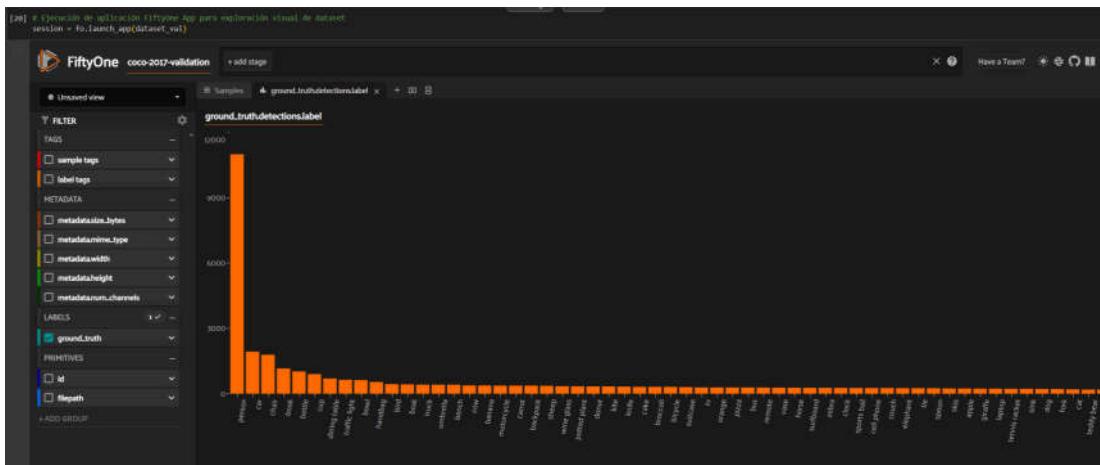
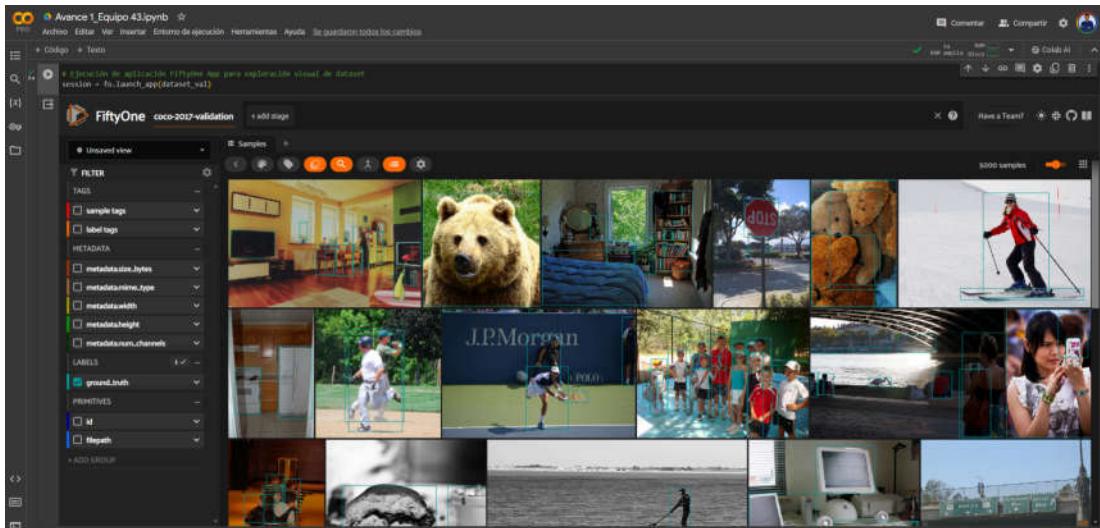
Downloading split 'validation' to '/root/fiftyone/coco-2017/validation'
INFO:fiftyone.zoo.datasets:Downloading split 'validation' to '/root/fiftyone/coco-2017/validation'
Found annotations at '/root/fiftyone/coco-2017/raw/instances_val2017'
INFO:fiftyone.utils.coco:Found annotations at '/root/fiftyone/coco-2017/raw/instances_val2017'
Images already downloaded
INFO:fiftyone.utils.coco:Images already downloaded
Existing download of split 'validation' is sufficient
INFO:fiftyone.zoo.datasets:Existing download of split 'validation'
Loading 'coco-2017' split 'validation'
INFO:fiftyone.zoo.datasets:Loading 'coco-2017' split 'validation'
100% |██████████| 5000/5000 [26.7s elapsed, 0s remaining, 203.0 samples/s]
INFO:eta.core.utils: 100% |██████████| 5000/5000 [26.7s elapsed, 0s remaining, 203.0 samples/s]
Dataset 'coco-2017-validation' created
INFO:fiftyone.zoo.datasets:Dataset 'coco-2017-validation' created
```

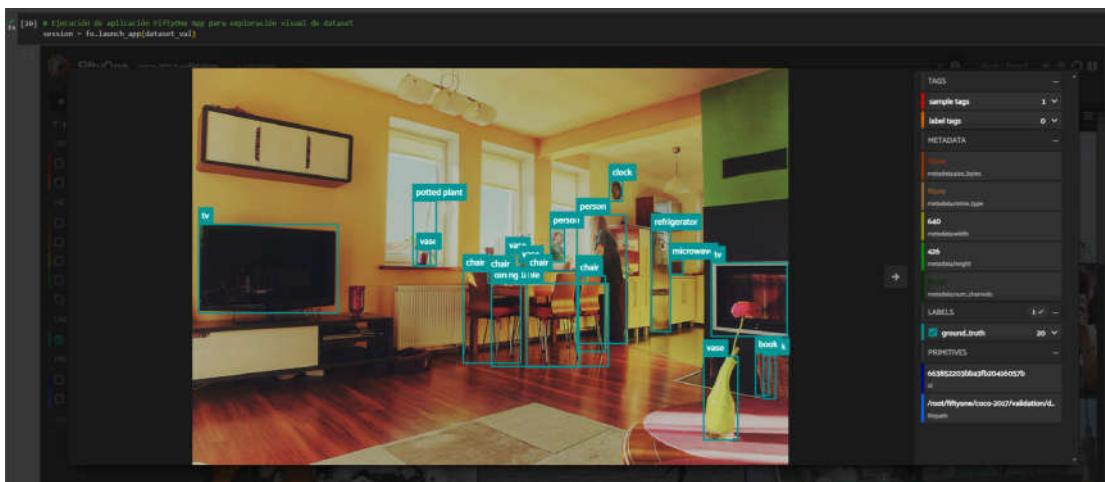
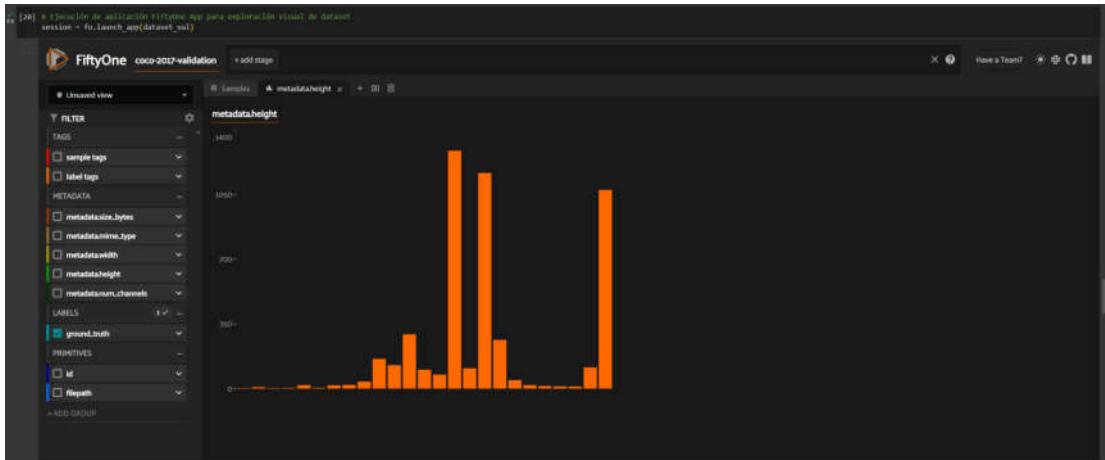
Resumen general del dataset split creado
print(dataset_val)

```
Name: coco-2017-validation
Media type: image
Num samples: 5000
Persistent: False
Tags: []
Sample fields:
  id: fiftyone.core.fields.ObjectIdField
  filepath: fiftyone.core.fields.StringField
  tags: fiftyone.core.fields.ListField(fiftyone.core.fiel
  metadata: fiftyone.core.fields.EmbeddedDocumentField(fiftyo
  ground_truth: fiftyone.core.fields.EmbeddedDocumentField(fiftyo
```



```
# Ejecución de aplicación FiftyOne App para exploración visual de datos
session = fo.launch_app(dataset_val)
```



▼ COCO Dataset - Test Split

```
# Download and load the test split of COCO-2017
dataset_test = foz.load_zoo_dataset("coco-2017", split="test")
```

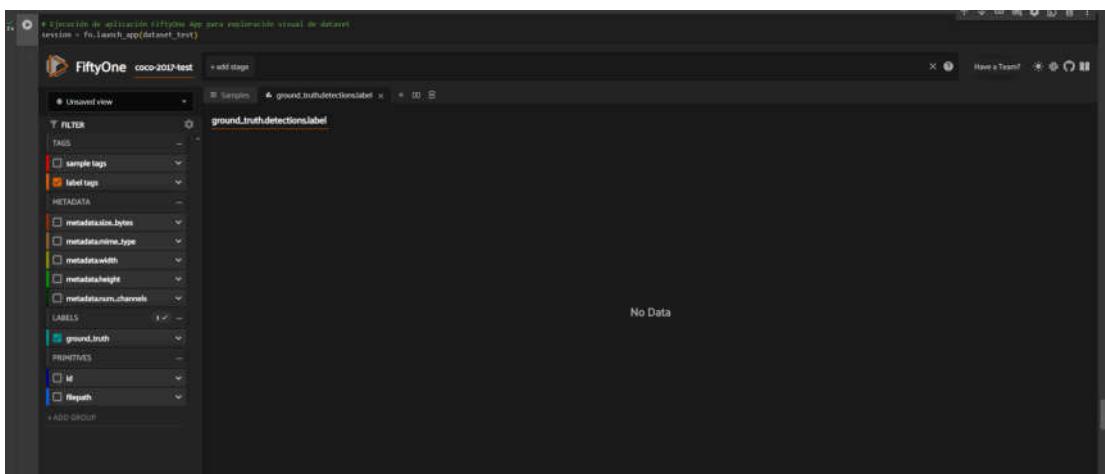
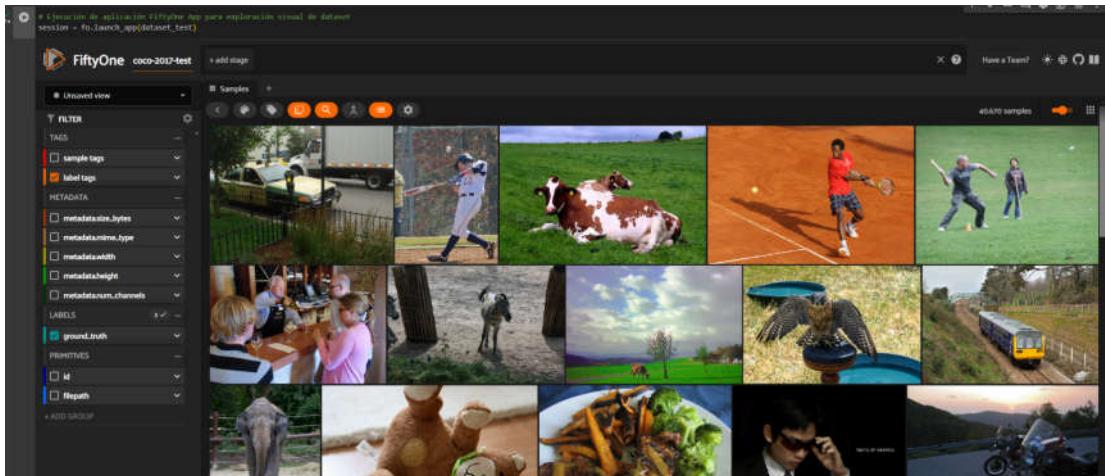
```
Downloading split 'test' to '/root/fiftyone/coco-2017/test' if nece
INFO:fiftyone.zoo.datasets:Downloading split 'test' to '/root/fifty
Found test info at '/root/fiftyone/coco-2017/raw/image_info_test201
INFO:fiftyone.utils.coco:Found test info at '/root/fiftyone/coco-20
Images already downloaded
INFO:fiftyone.utils.coco:Images already downloaded
Existing download of split 'test' is sufficient
```

```
INFO:fiftyone.zoo.datasets:Existing download of split 'test' is suf
Loading 'coco-2017' split 'test'
INFO:fiftyone.zoo.datasets:Loading 'coco-2017' split 'test'
  100% |██████████| 40670/40670 [12.9s elapsed, 0s remaining, 3.3
INFO:eta.core.utils: 100% |██████████| 40670/40670 [12.9s elapse
Dataset 'coco-2017-test' created
INFO:fiftyone.zoo.datasets:Dataset 'coco-2017-test' created
```

```
# Resumen general del dataset split creado
print(dataset_test)
```

```
Name:      coco-2017-test
Media type: image
Num samples: 40670
Persistent: False
Tags:      []
Sample fields:
  id:      fiftyone.core.fields.ObjectIdField
  filepath: fiftyone.core.fields.StringField
  tags:      fiftyone.core.fields.ListField(fiftyone.core.fiel
  metadata: fiftyone.core.fields.EmbeddedDocumentField(fiftyo
  ground_truth: fiftyone.core.fields.EmbeddedDocumentField(fiftyo
```

```
# Ejecución de aplicación FiftyOne App para exploración visual de datos
session = fo.launch_app(dataset_test)
```

▼ 3 - Análisis Exploratorio de Datos

▼ Clustering Analysis

El clustering es una técnica esencial de aprendizaje no supervisado que permite descubrir patrones ocultos en los datos. El clustering, o análisis de grupos, es un conjunto de técnicas para agrupar puntos de datos. Los

algoritmos de clustering toman una serie de objetos y devuelven asignaciones para cada objeto.

A diferencia de la clasificación, el clustering no comienza con una lista de clases para categorizar los objetos, obligando a los objetos a caer en grupos predefinidos. Más bien, el clustering intenta descubrir los grupos dados los datos. En otras palabras, el clustering trata de descubrir la estructura en los datos, no predecir etiquetas en una estructura preexistente [10].

Análisis sobre validation dataset

```
# delete labels to simulate starting with unlabeled data
dataset_cluster_val = dataset_val
dataset_cluster_val.select_fields().keep_fields()
dataset_cluster_val.name = "clustering-demo"
dataset_cluster_val.persistent = True

# Creacion de variable local para uso en cálculo de embeddings
dataset = dataset_cluster_val

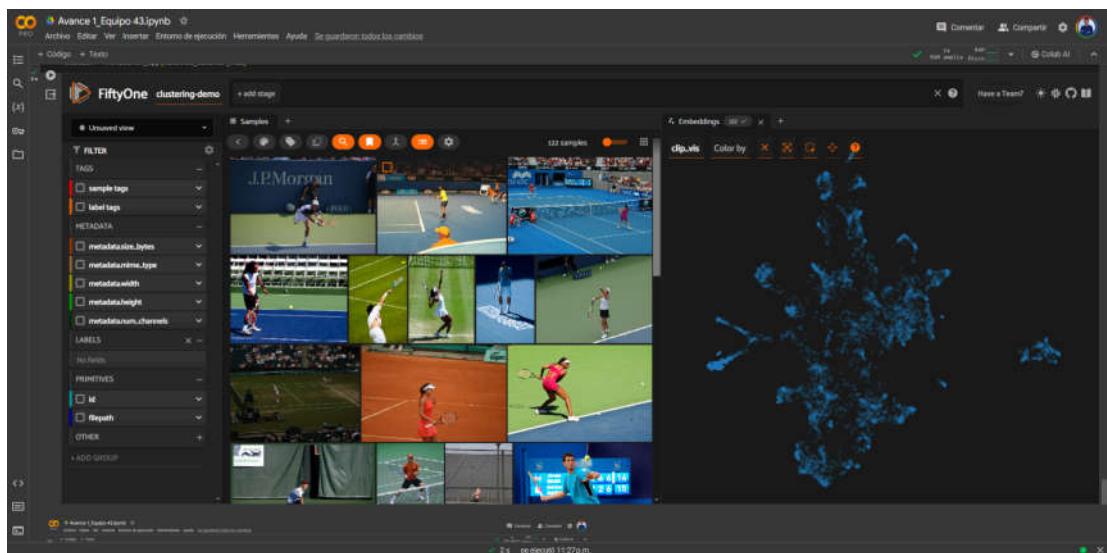
# Definición de reducción de dimencionalidad por cálculo de embeddings
res = fob.compute_visualization(
    dataset,
    model="clip-vit-base32-torch",
    embeddings="clip_embeddings",
    method="umap",
    brain_key="clip_vis",
    batch_size=10
)
dataset.set_values("clip_umap", res.current_points)
```

```
Downloading model from 'https://openaipublic.azureedge.net/clip/mod'  
INFO:fiftyone.core.models:Downloading model from 'https://openaipub'  
 100% |██████████| 2.6Gb/2.6Gb [39.9s elapsed, 0s remaining, 73.0Mb/  
INFO:eta.core.utils: 100% |██████████| 2.6Gb/2.6Gb [39.9s elapsed, 0  
Downloading CLIP tokenizer...  
INFO:fiftyone.utils.clip.zoo:Downloading CLIP tokenizer...  
 100% |██████████| 10.4Mb/10.4Mb [171.9ms elapsed, 0s remaining, 60.2M  
INFO:eta.core.utils: 100% |██████████| 10.4Mb/10.4Mb [171.9ms elapsed,  
Computing embeddings...  
INFO:fiftyone.brain.internal.core.utils:Computing embeddings...  
/usr/lib/python3.10/multiprocessing/popen_fork.py:66: RuntimeWarning:  
    self.pid = os.fork()  
 100% |██████████| 5000/5000 [23.2s elapsed, 0s remaining, 235  
INFO:eta.core.utils: 100% |██████████| 5000/5000 [23.2s elapse  
Generating visualization...  
INFO:fiftyone.brain.visualization:Generating visualization...  
UMAP( verbose=True)  
Mon May  6 05:27:23 2024 Construct fuzzy simplicial set  
Mon May  6 05:27:23 2024 Finding Nearest Neighbors  
Mon May  6 05:27:23 2024 Building RP forest with 9 trees  
Mon May  6 05:27:28 2024 NN descent for 12 iterations  
    1 / 12  
    2 / 12  
    3 / 12  
    4 / 12  
Stopping threshold met -- exiting after 4 iterations  
Mon May  6 05:27:41 2024 Finished Nearest Neighbor Search  
Mon May  6 05:27:43 2024 Construct embedding  
Epochs completed: 100%| 500/500 [00:05]
```

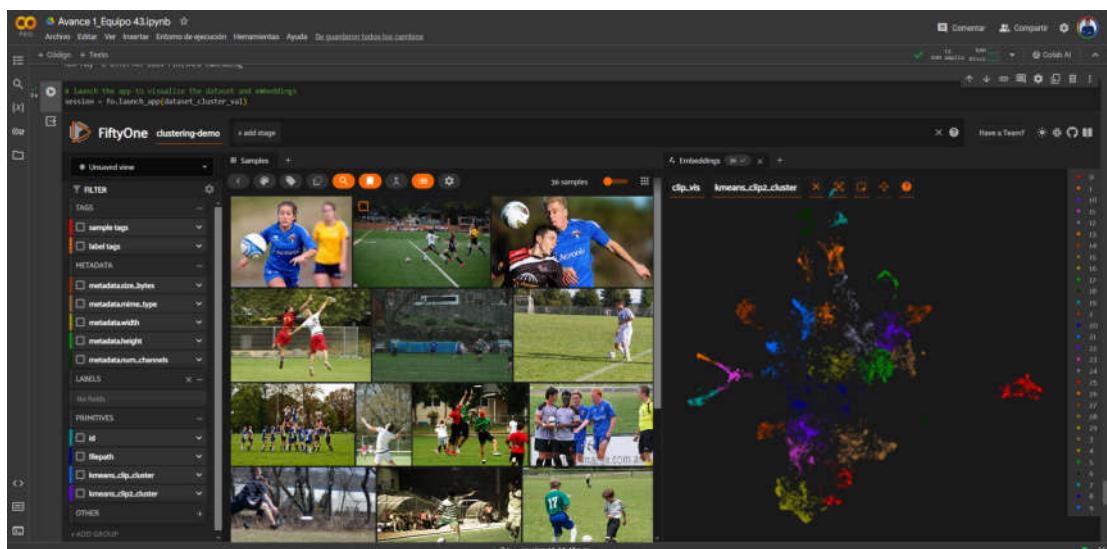
```
completed 0 / 500 epochs  
completed 50 / 500 epochs  
completed 100 / 500 epochs  
completed 150 / 500 epochs  
completed 200 / 500 epochs  
completed 250 / 500 epochs  
completed 300 / 500 epochs  
completed 350 / 500 epochs  
completed 400 / 500 epochs
```

```
# launch the app to visualize the dataset and embeddings  
session = fo.launch_app(dataset_cluster_val)
```


Control de visualización de dataset utilizando mapa de embeddings.



Actualización de mapa de embeddings utilizando agrupación por clusters utilizando K-means.



✓ Preguntas de Análisis

3.1 - ¿Cuáles son las estadísticas resumidas del conjunto de datos?

El dataset de COCO contiene más de 200,000 imágenes y más de 2 millones de instancias de objetos segmentado en 3 splits (train, validation, test). Se divide en 80 categorías de objetos y 91 categorías de "stuff" o materiales.

3.2 - ¿Cuál es la distribución de clases en el conjunto de datos?

La distribución de clases en COCO es desigual, con algunas categorías que contienen muchas más instancias que otras. La clase predominante es la de personas.

3.3 - ¿Se deberían normalizar las imágenes para visualizarlas mejor?

Se determina explorar técnicas de augmentación de datos para generar variantes de las imágenes del dataset que simulen diferentes condiciones de iluminación con el objetivo de preparar el modelo a entrenar para alta precisión.

3.4 - ¿Cuál es la variabilidad en términos de tamaño y resolución de las imágenes en el dataset?

Las imágenes en COCO varían en tamaño y resolución, con un promedio de 640x480 píxeles, pero con imágenes tanto más grandes como más pequeñas.