Satellite Images Classification
Final Presentation

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Fundamentals of Data Science

2023/2024 Final Project

Dataset preparation

	image_path	label
0	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Cloudy
1	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Cloudy
2	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Cloudy
3	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Cloudy
4	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Cloudy
...	...	...
5626	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Water
5627	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Water
5628	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Water
5629	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Water
5630	C:\Users\nephr\Desktop\Uni Nuova\FDS\FDS_PROJE...	Water

5631 rows × 2 columns

- Firstly, we created a dataset from the downloaded Kaggle folder. This dataset includes, for each image, its path and the its corresponding category

- As expected, the dataset contains 1500 images for each category, with the exception of the ‘Desert’ category

```
{'Cloudy': 1500, 'Desert': 1131, 'Green_Area': 1500, 'Water': 1500}
```

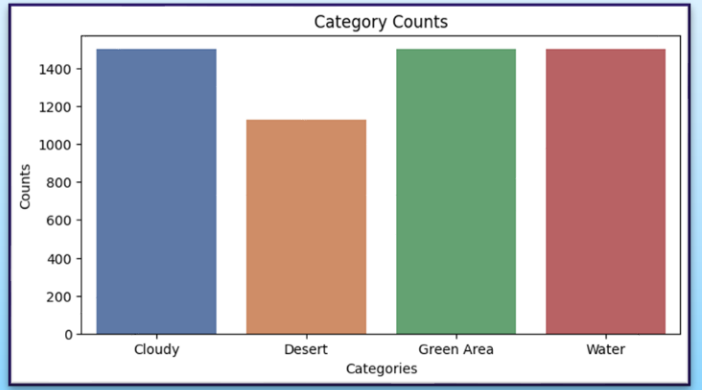
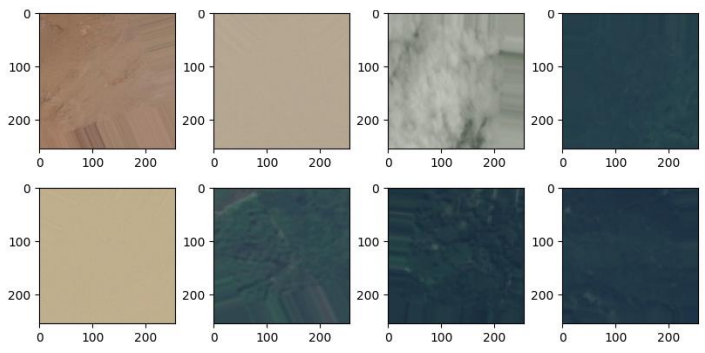


Image Pre-processing

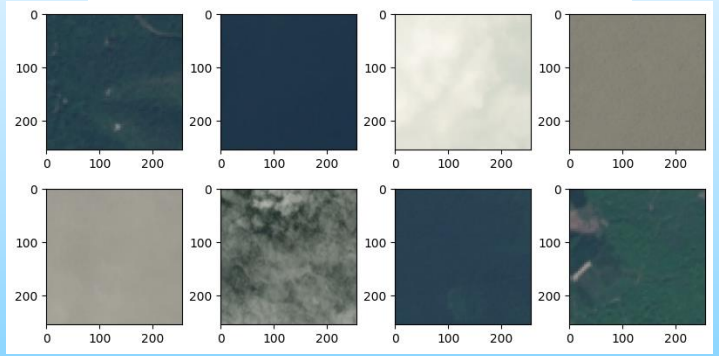
Pre-processed **Training** Data Samples



- The dataset was then divided in training and testing sets. We opted for a 80-20 split
- Images from the training test were zoomed, sheared, horizontally and vertically flipped, and rotated randomly to allow the model to learn new pattern and improve robustness

- Both the images from the training and testing set were resized to 256 x 256 pixel for normalization purposes
- Beyond resizing, we didn't make other alterations to testing images because as testing should be conducted on real-world images without modification

Pre-processed **Testing** Data Samples



Model Creation and Training

```python
def create_model():
    model = keras.models.Sequential([
        # First convolutional layer with 32 filters, each of size (2,2)
        layers.Conv2D(32, (2,2), activation='relu', input_shape=(255, 255, 3)),
        layers.MaxPooling2D(2,2),
        # Second convolutional layer with 64 filters, each of size (2,2)
        layers.Conv2D(64, (2,2), activation='relu'), #second convolutional layer
        layers.MaxPooling2D(2,2),
        # Third convolutional layer with 64 filters, each of size (3,3)
        layers.Conv2D(64, (3,3), activation='relu'),
        layers.MaxPooling2D(2,2),
        layers.Flatten(),
        layers.Dropout(0.1),
        layers.Dense(512, activation='relu'),
        layers.Dropout(0.1),
        # Output layer with 4 neurons
        layers.Dense(4, activation='softmax')
    ])

    # Model compilation
    model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])
    return model
```

- We defined a function for the creation of the CNN model, containing various layers, such as:
  - Convolutional layers
  - Pooling layers
  - Fully connected layers
  - Dropout layers

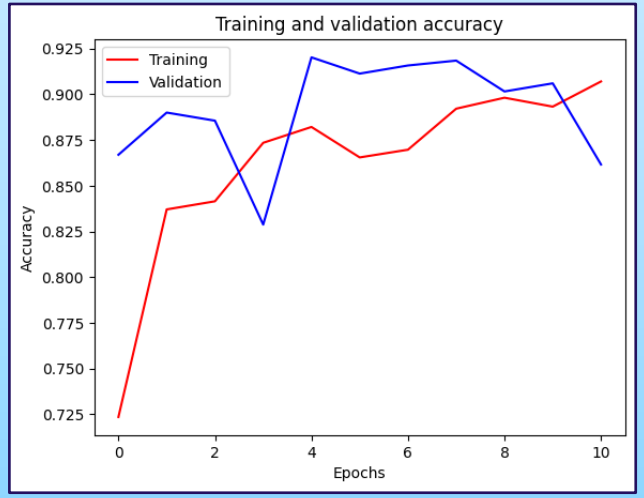
```python
# Creating an instance of the untrained model
model = create_model()

# Training the creared model
history = model.fit(train_generator,
                    epochs=11,
                    verbose=1,
                    validation_data=test_generator)
```

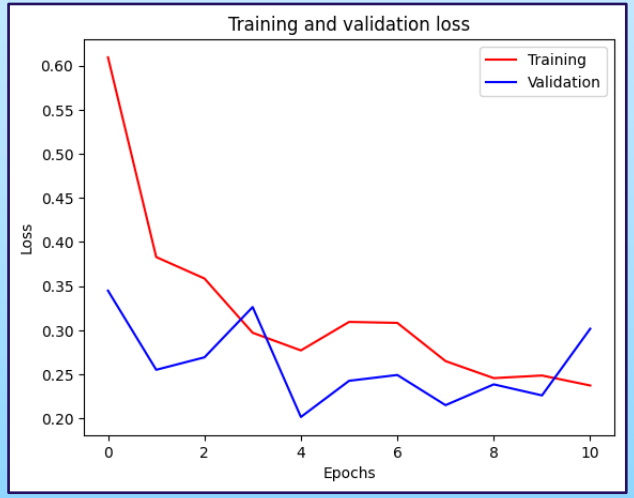
- We trained the model using the pre-processed training images generator. We decided to choose 11 epochs since it's generally considered an optimal number of iteration for training a dataset

Accuracy and Loss

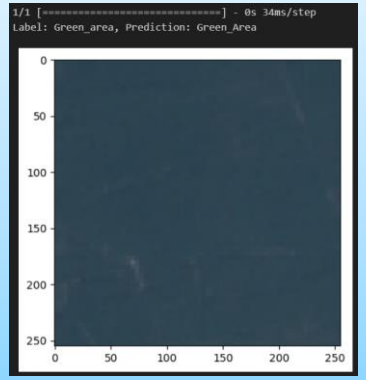
- Accuracy graph:

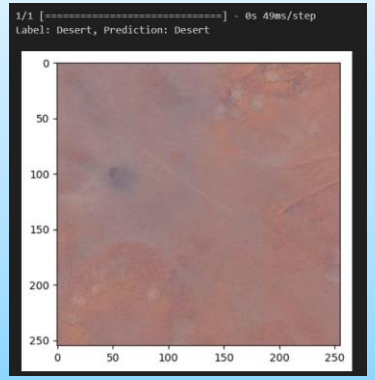


- Loss graph:



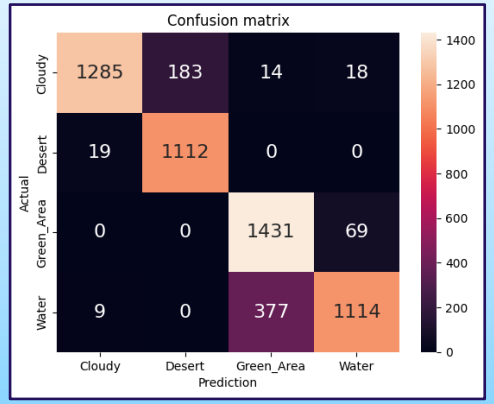
Predictions and Confusion Matrix

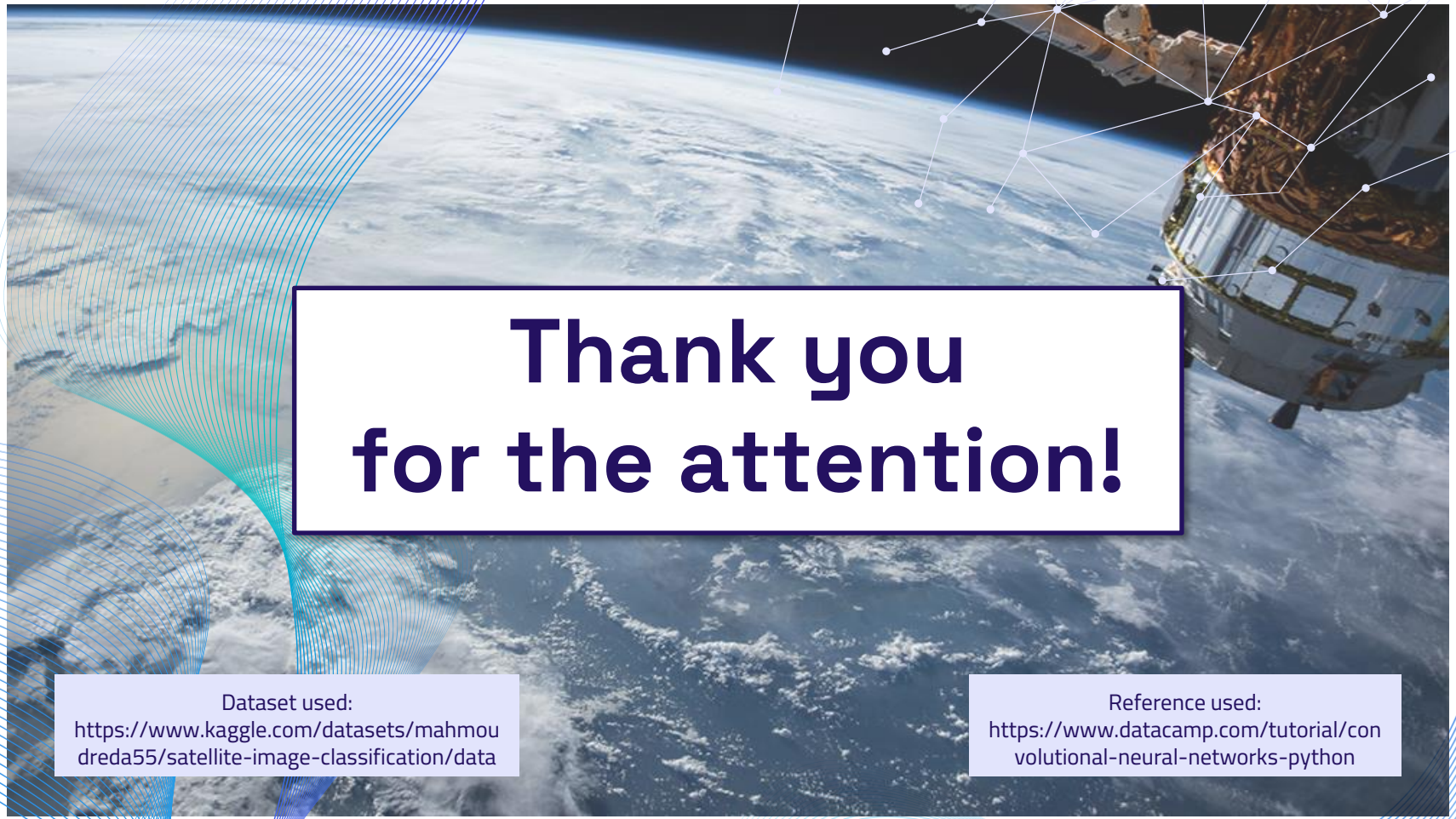




- Next, we used the trained model to generate predictions on randomly selected images from the dataset
- All the predictions so far were correct

- Lastly, we constructed a confusion matrix to test the accuracy of the predictions on the entire dataset.





Thank you for the attention!

Dataset used:
https://www.kaggle.com/datasets/mahmoudreda55/satellite-image-classification/data

Reference used:
https://www.datacamp.com/tutorial/convolutional-neural-networks-python