Practical work with a spectrometer

Presentators: Trinh Hoang Dieu Ngan and Do Duc Hinh

Measuring the spectral reflectance and its applications in NDWI

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Introduction

The objective, requirement, purpose ...

Introduction: *Members*

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Introduction: *Objective*

- Having a better understand of the theory on reflectance wave, understanding the mechanism of the spectrometer in remote sensing.
- Obtain the data for the deeper research on reflectance of the natural object to calculating the Normalized difference water index (NDWI) for the region of Ho Tay.

Introduction: *How?*

- Go to the field and collect the nature sample to measure their reflectance using an optical spectrometer.

- Using the specview app to Visualize then Analyze the collected data.

02

Data and Method

Type of data, material, tool, method...

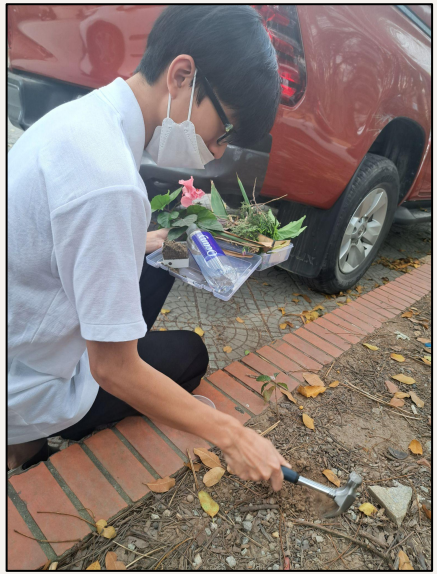
Required Data

Purpose: Investigate the spectral reflectance of objects in the Lab and on the images and calculate the Normalized difference water index (NDWI) of satellite image.

→ Required Data: Reflectance spectrum of the sample, the data in number format for the calculation.

Methods: Phase I: Collecting data

Step 1: Collecting the physical sample for measurement, which include *green leaf*, *dry leaf*, *water (clean*, *dirty)*, *soid*...

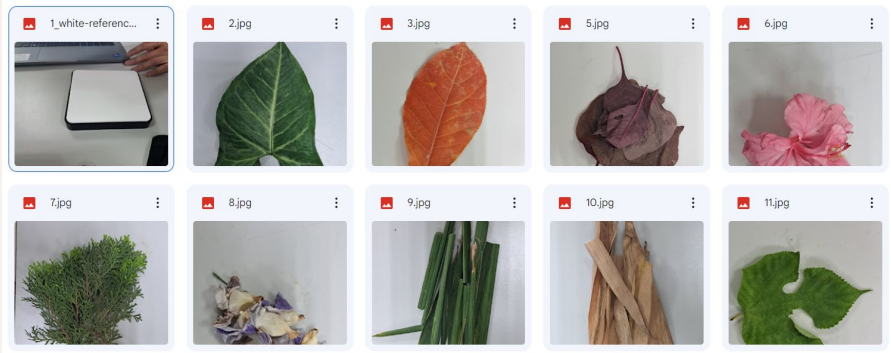


Methods: Phase I: Collecting data

**List of all sample: Clean water, dirty water, sand, dirt, cement,, dryleaf, different types (color) of leaf, flower...*

** Note that the leaves for each type of vegetation to be sure each samples cover an area of around 100 cm^2.*

Sample 1	Lá tre khô
Sample 2	Lá đỏ
…	…
Sample n	…



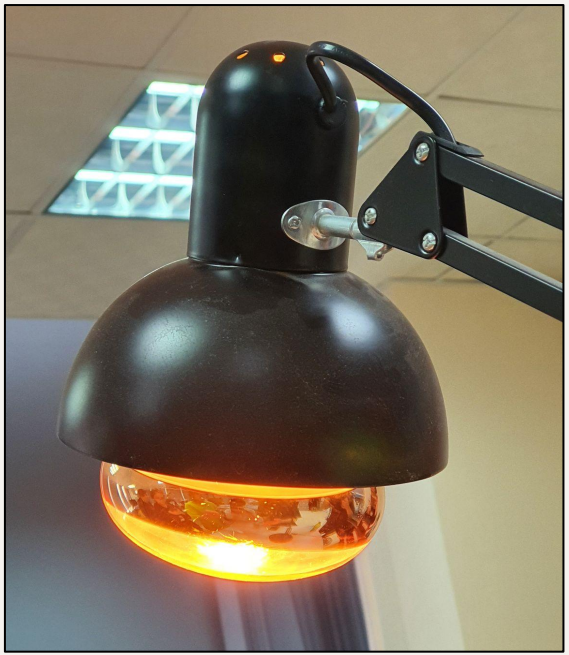
Methods: Phase I: Collecting data

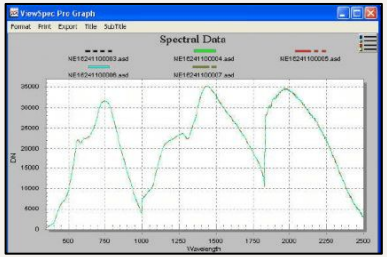
Step 2: Setting up the *equipment/ Instrument*

- Main Component of the **Setup**:
  + Halogen lamp: simulate the light of the sun
  + Sensor/machine: read the reflectance wave from the sample
  + Computer: Running the software to read and compute the data from the sensor.
  + TriPod: Holding the lamp

** The software using is ViewSpec Pro to open, view... data*

Methods: Phase I: Collecting data



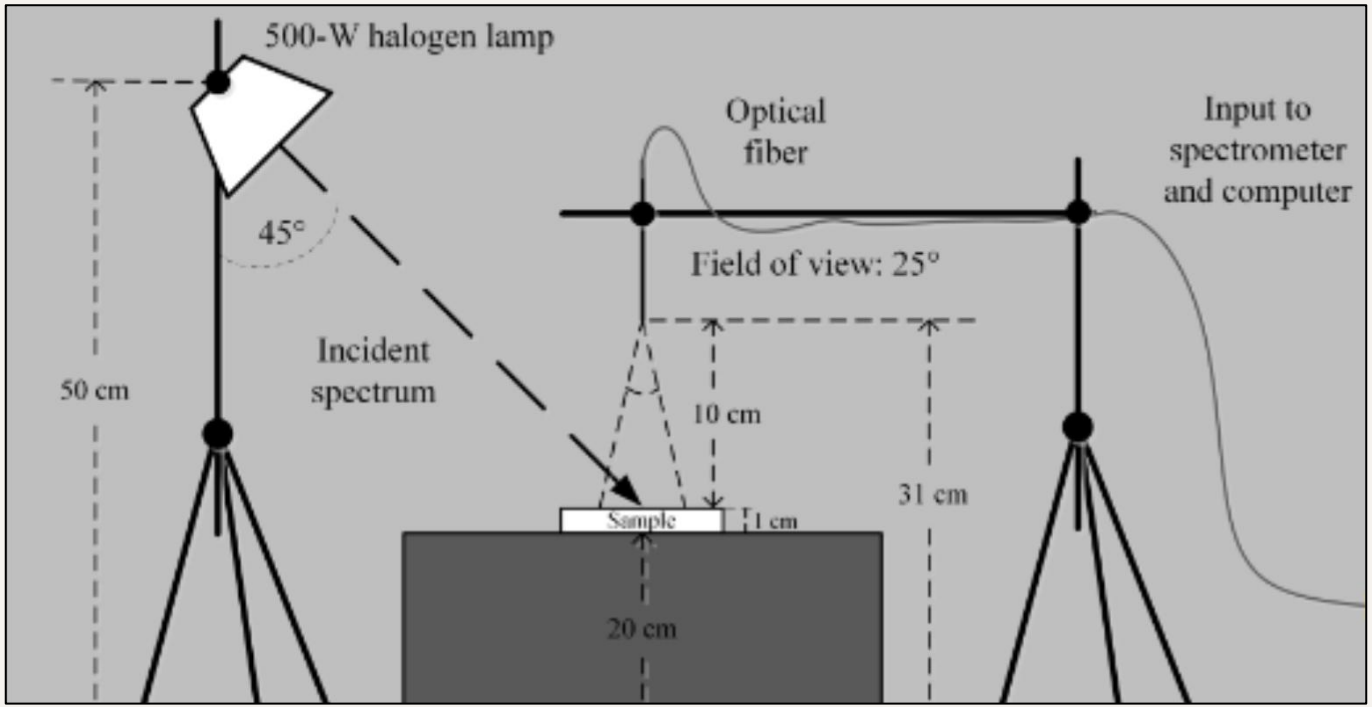


Methods: Phase I: Collecting data

Step 2: Setting up the *equipment/Instrument*

- Adjusting the hardware:
  + Puting the tray holding the sample on the table
  + Puting the halogen lamp about 25-35 cm away from the tray, adjust the it 45° toward the sample.
  + Mouth the sensor on the tripod about 20-25 cm above the tray, note down the height for later calculation
  + Connect the sensor to a spectrometer through a optical fiber cable and turn on all the equiment
- Note thats not pointing the sensor direcly toward the halogen lamp because it can burn out the sensor.

Methods: Phase I: Collecting data



Methods: Phase I: Collecting data

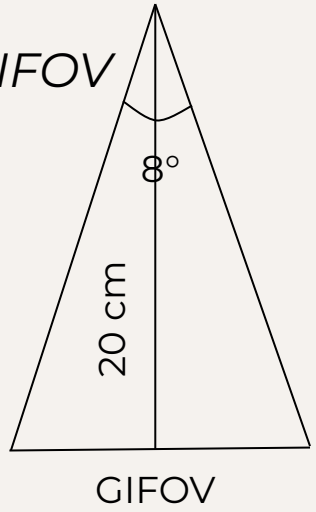
Step 2: Setting up the *equipment/Instrument*

- Calculating the Instantaneous field of view (IFOV): solid angle through which a detector is sensitive to radiation.
- We have: *tan(IFOV/2) = r/2h → small IFOV then r = h*IFOV*
- *For Our setup we have IFOV = 8°*

→ Ground Instantaneous Field of View:

GIFOV = tg4 x 20cm x 2 = 2.8 cm

- This mean the sensor will look at the sample in the circle with the diameter 2.8cm



Methods: Phase I: Collecting data

Step 3: Measuring

- Measuring the temperature of the light source: **Wien's Displacement Law: $\lambda_{max} = b/T$**
- Measuring the background:
- Measuring White Reference: Put the white plate under the sensor and the press "calibrate" in the software

Method: Phase I: Collecting data

Why measure the background and white reference?

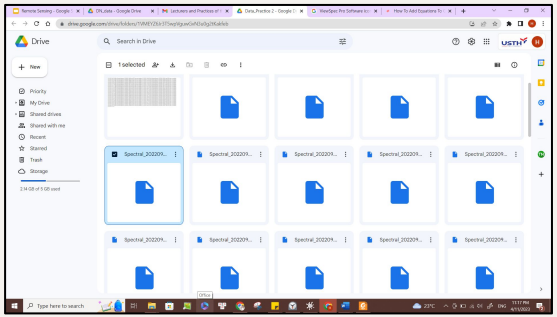
To ensure accurate and reliable measurements of the sample's spectral reflectance.

- Background measurement: external factors that could affect the spectral measurement (ambient lighting, dust or dirt on measuring surface, variations in the optical properties of the instrument) => subtract any unwanted effects from the sample measurement.
- White reference measurement: calibrate the instrument and ensure consistency in the measurement of spectral reflectance across different samples => provides a known reference point for the instrument.

Method: Phase I: Collecting data

Step 3: Measuring

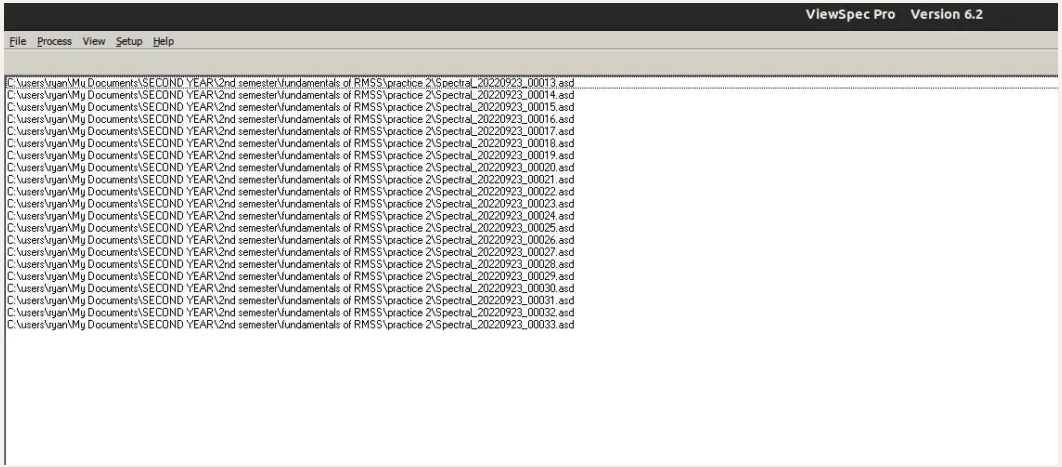
- Measuring Reflectance:
  + Put the sample in the tray under the sensor:
  + Look at the spectrum on the screen till it stable
  + Press spacebar key on the computer to capture the data
  + Repeat for all the sample



Method: Phase II: Visualize data

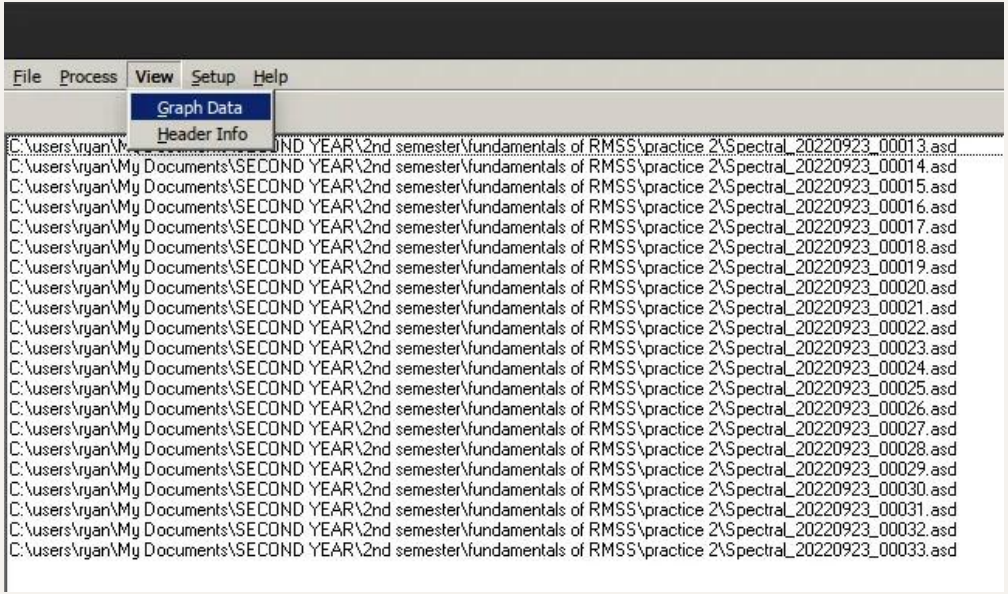
Step 1: Classify the file to visualize, name it properly

Step 2: Open ViewSpec Pro software, click *File/Open* to open the .asd file from the spectrometer



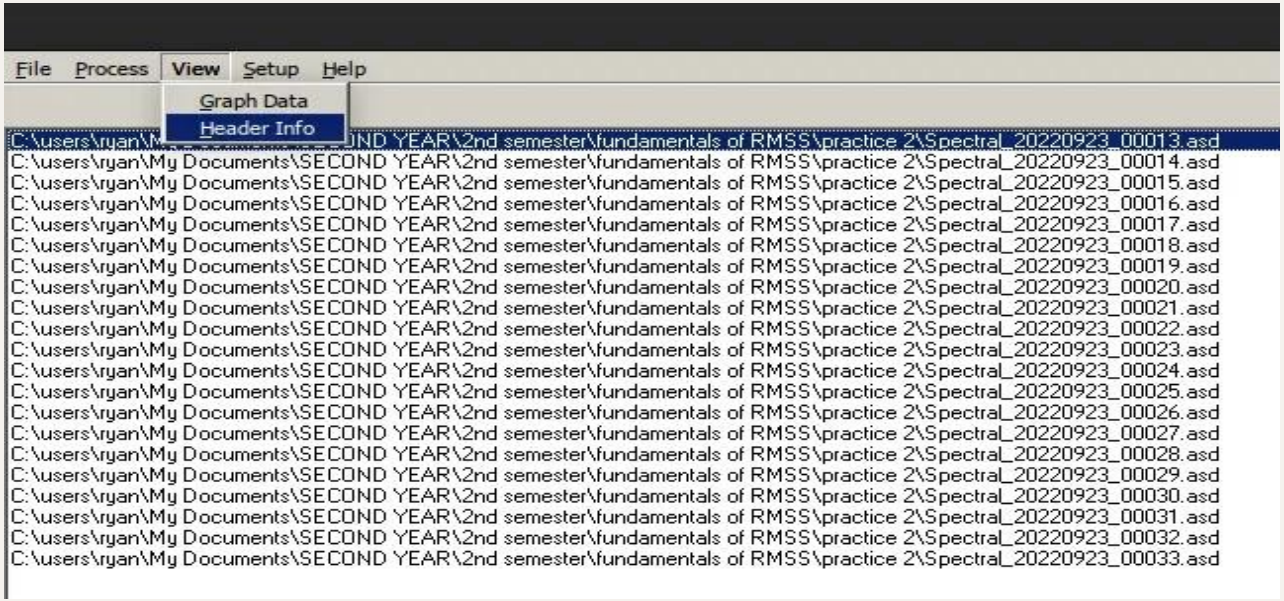
Method: Phase II: Visualize data

Step 3: Click *View/Graph data* to view the file as a graph

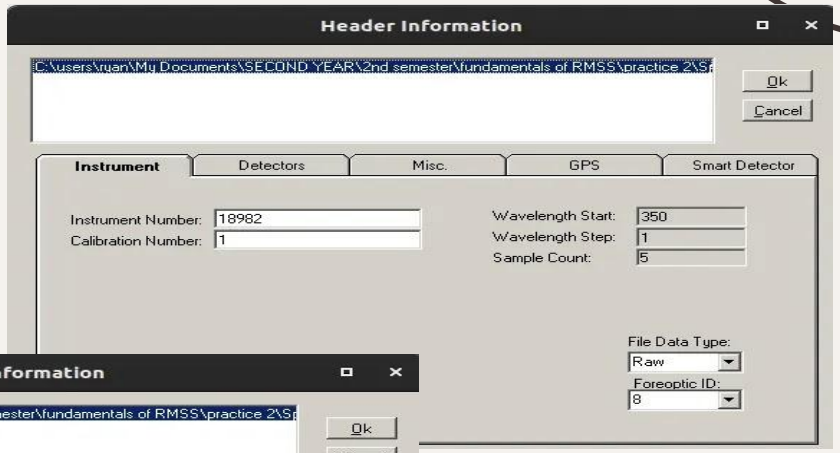


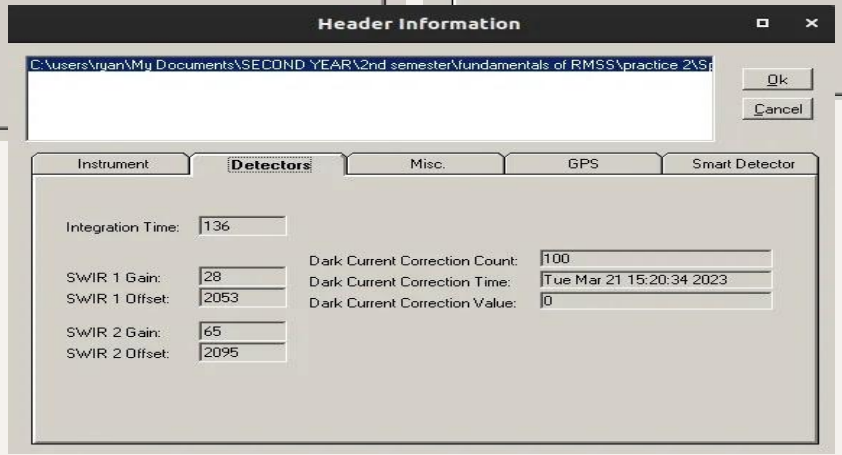
Method: Phase II: Visualize data

Step 3': Click *View/header info* to look at other information



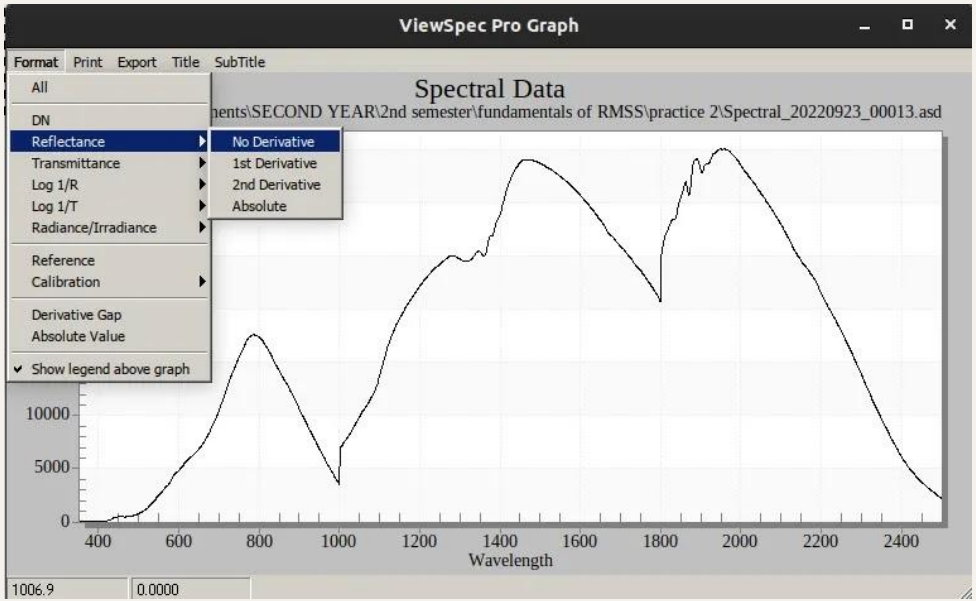
Method: Phase II: Visualize data





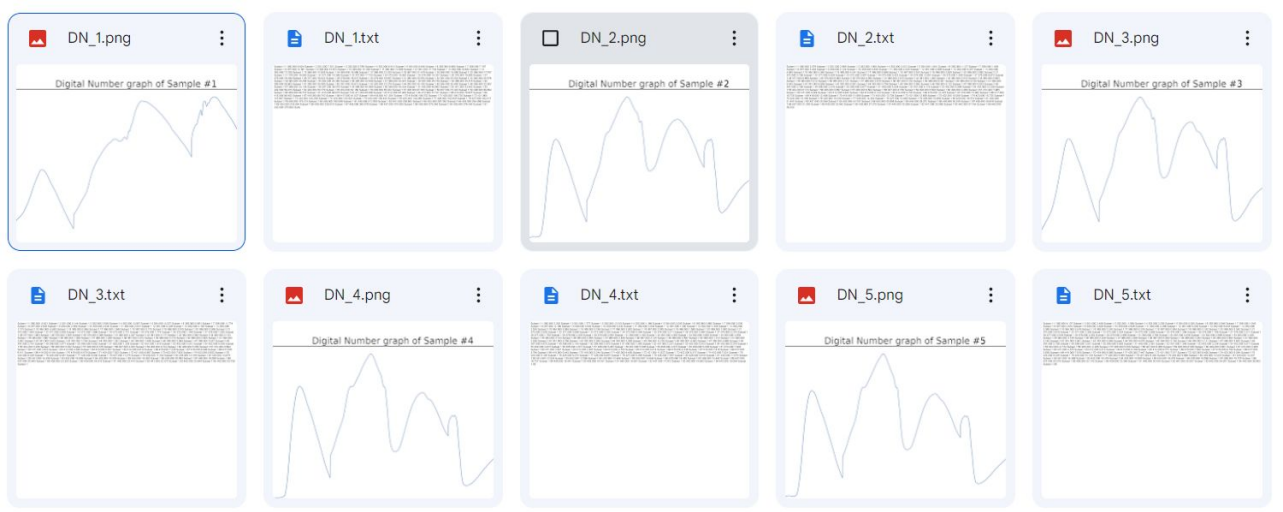
Method: Phase II: Visualize data

Step 4: Click *Format/Reflectance/no derivative* we will obtain desired reflectance graph



Method: Phase II: Visualize data

Step 5: Finally we can export the data as different format such as .png or .txt to get the data for later calculation.



*.txt file was calculated using python and matlab and will be talk in next part

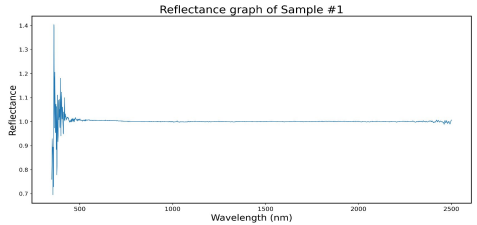
03

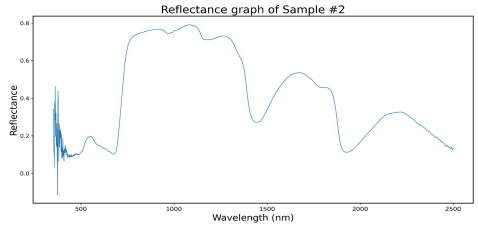
Results

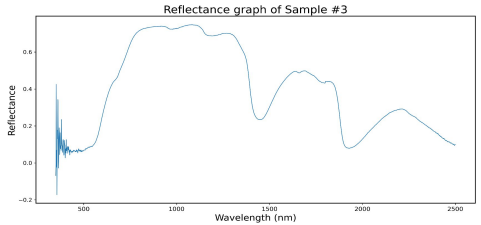
Figures, results

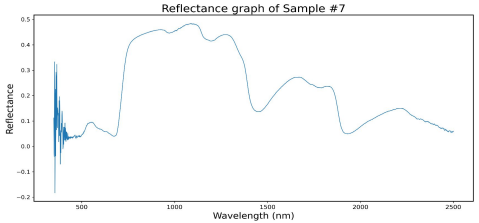
Results:

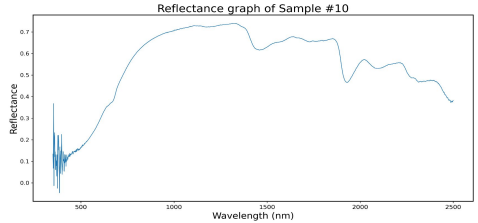
40 graphs in total.

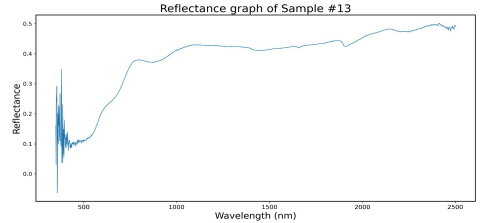


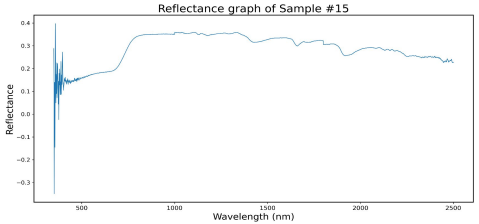


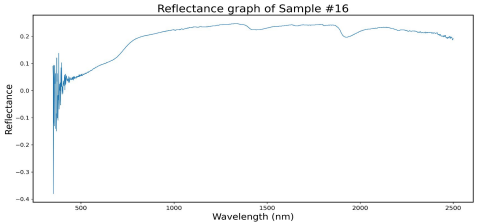


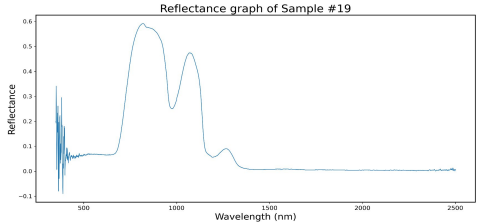




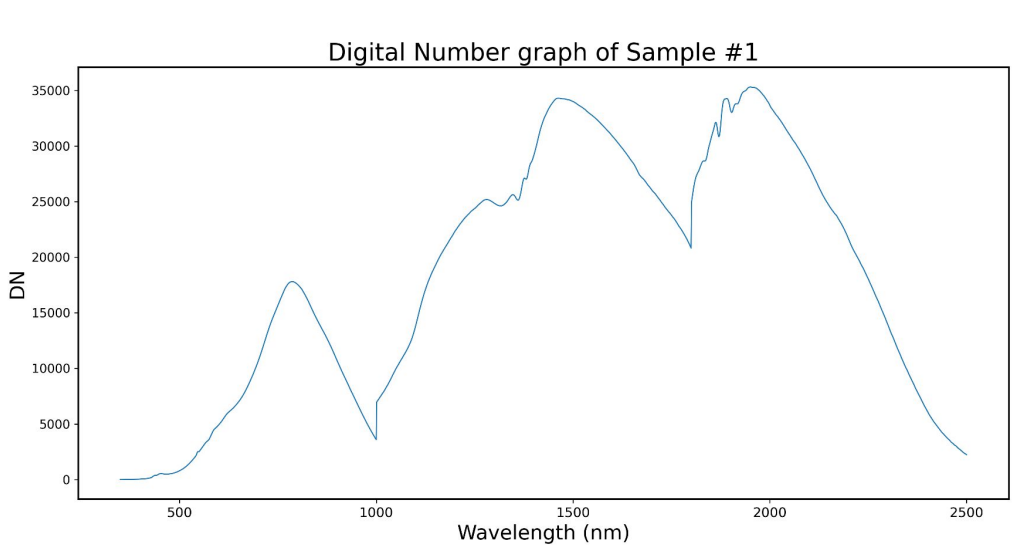








Results:



Wien's Displacement Law:

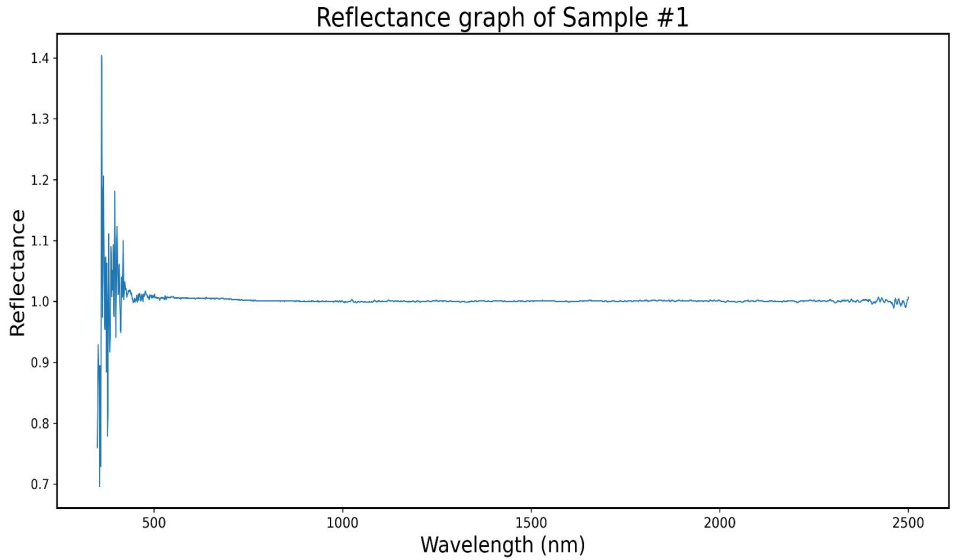
$$\lambda_{max} = b/T$$

Light source temperature:

=> $T = b/\lambda_{max} = 2898\ \mu mK / 0.787\ \mu m$

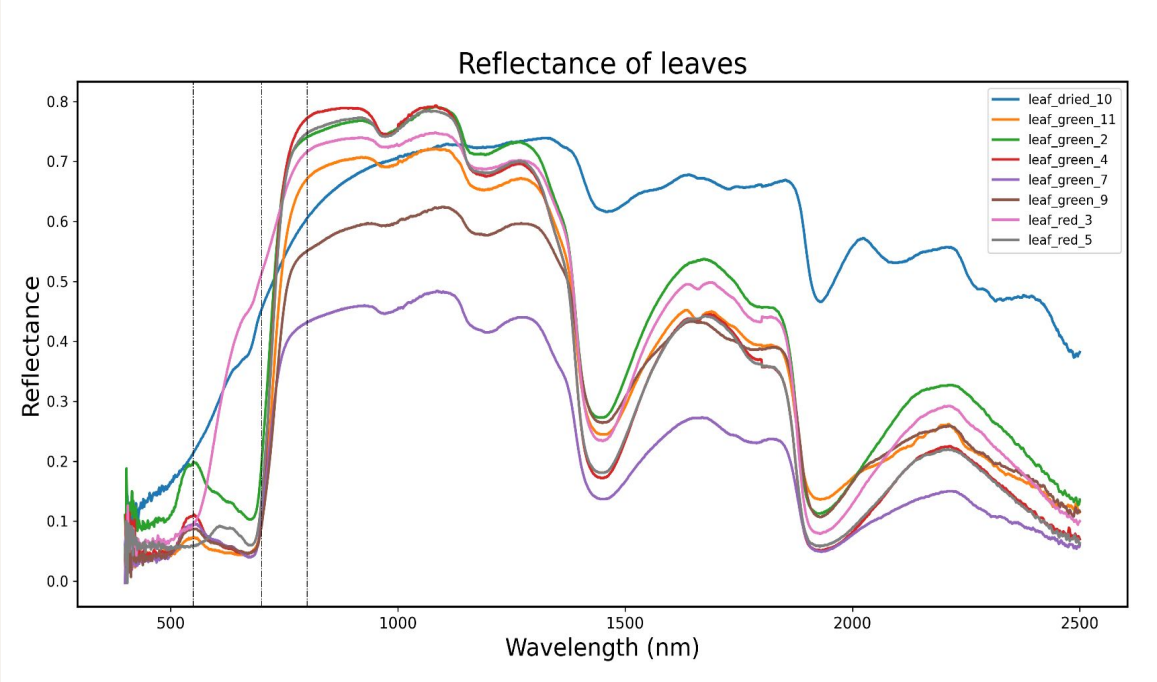
=> $T \cong 3700K$

Results:



- The **white reference** reflectance value is used as a **standard** against which all other reflectance values are compared, representing the amount of light reflected by a **perfectly diffusing, ideal white reflector**.
- With the white reference reflectance value as 1, we establish a **consistent scale** for measuring reflectance values across different surfaces and materials. Any reflectance value that is less than 1 indicates that the surface reflects less light than a perfect white reflector.

Results:

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3


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5

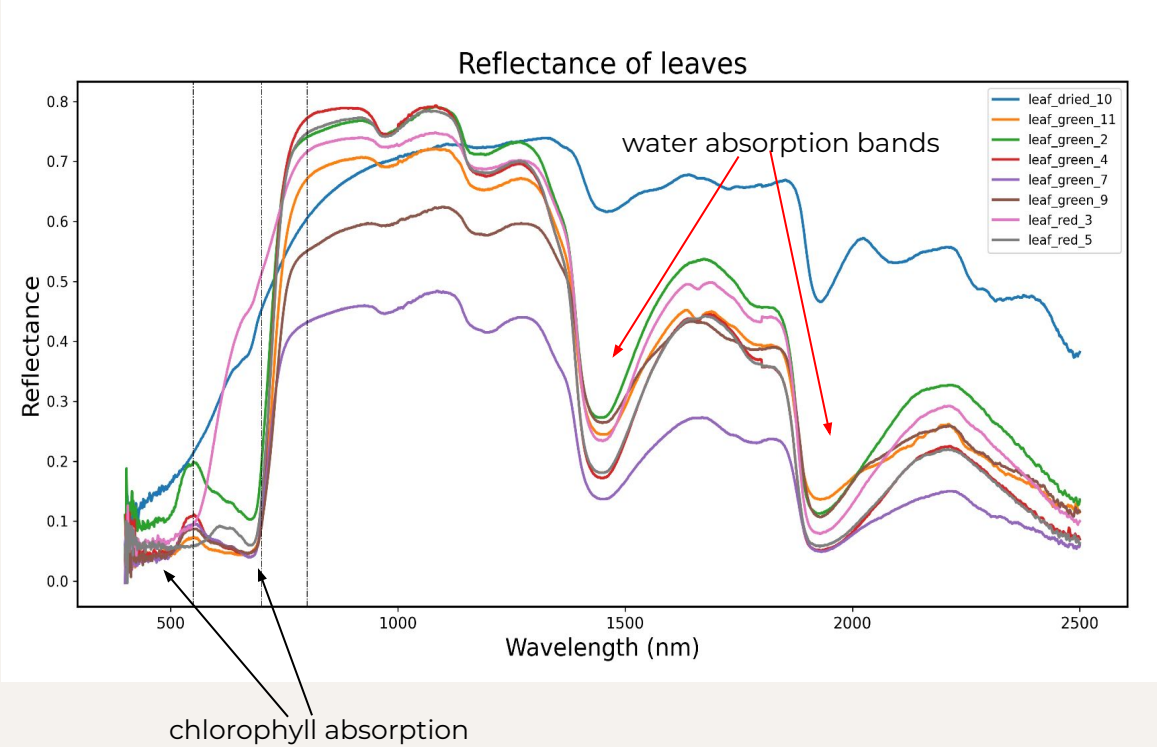

7


10


11

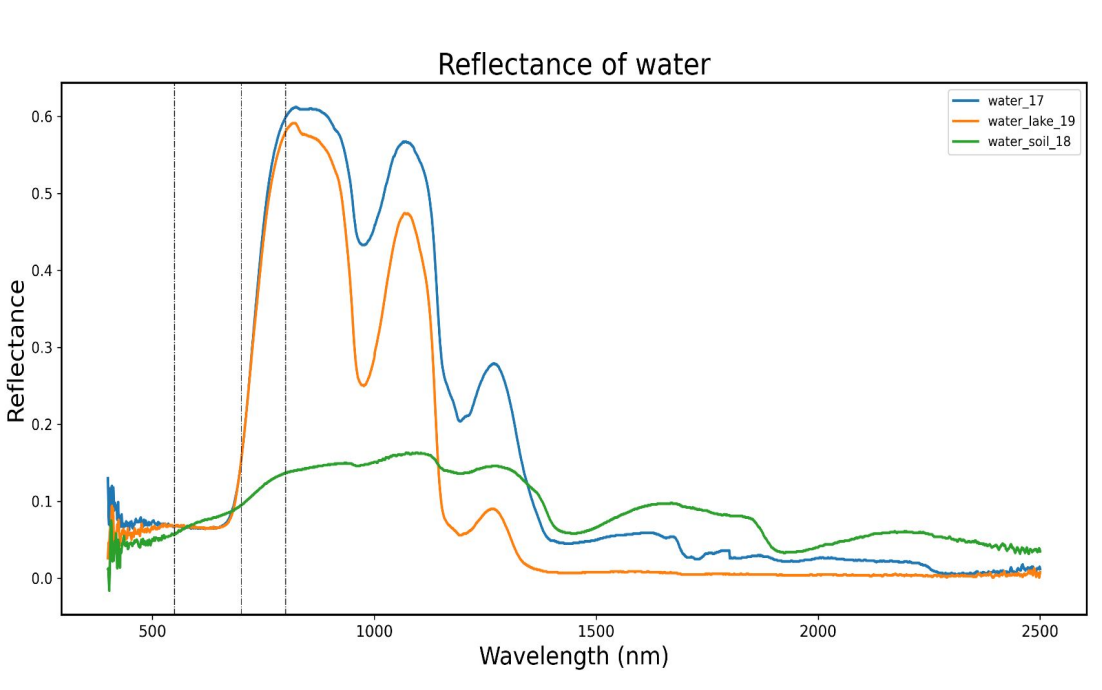

9

Results:



- **Chlorophyll** in plants absorbs blue and red light, resulting in lower reflection of these wavelengths.
- The plant reflects more green light, and the reflectance in the near-infrared (NIR) range is highest, but it depends on leaf development and cell structure.
- In the shortwave infrared (SWIR) range, the reflectance is mainly determined by the amount of free water in the leaf tissue.
- When plants dry out, the reflectance of SWIR increases, and the reflectance of NIR may decrease.

Results:



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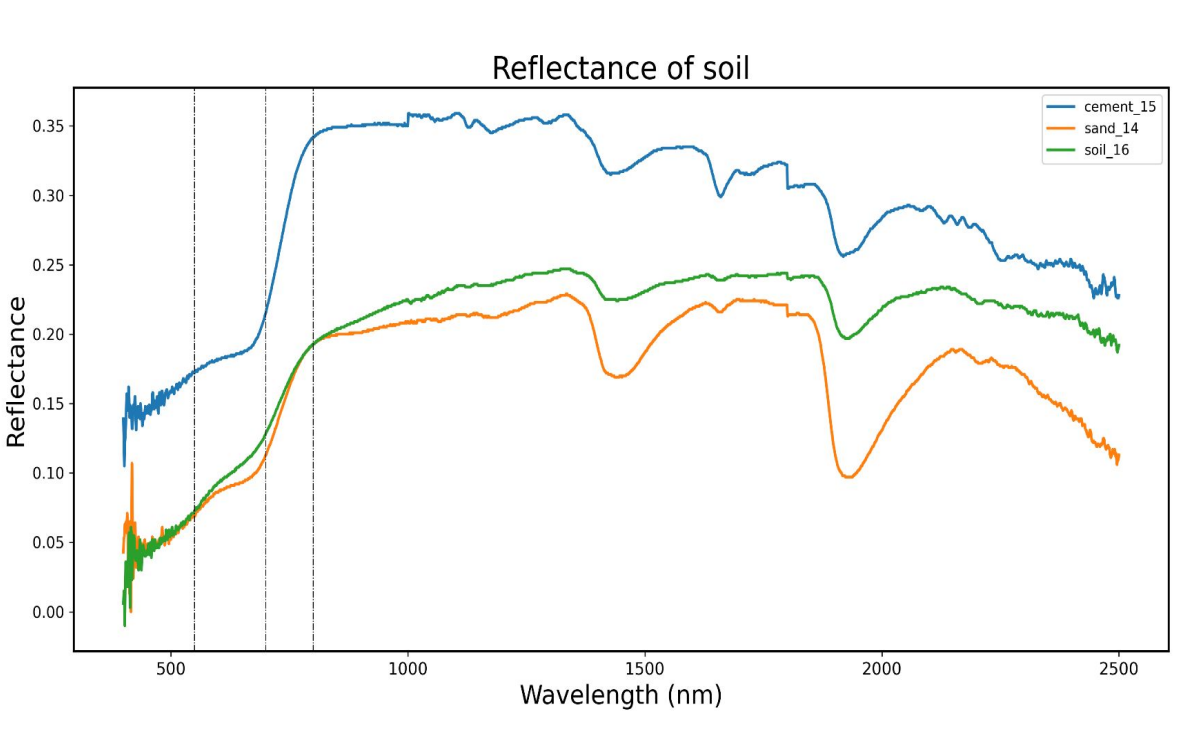
Results:



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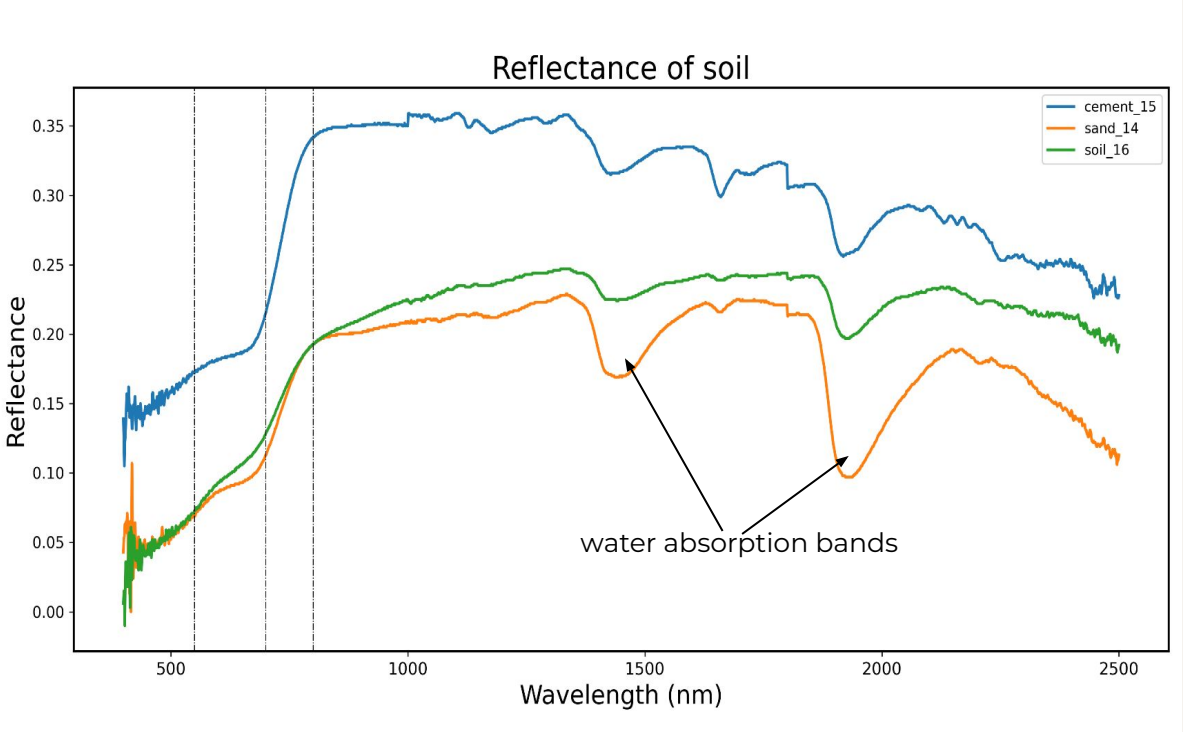
Results:



- Low reflectance in the visible range (400-700 nm) due to the absorption of light by the soil particles, and a higher reflectance in the near-infrared (NIR) range (700-1300 nm)

=> Due to the **scattering of light by soil particles**, which are relatively larger than the wavelength of light in this range.

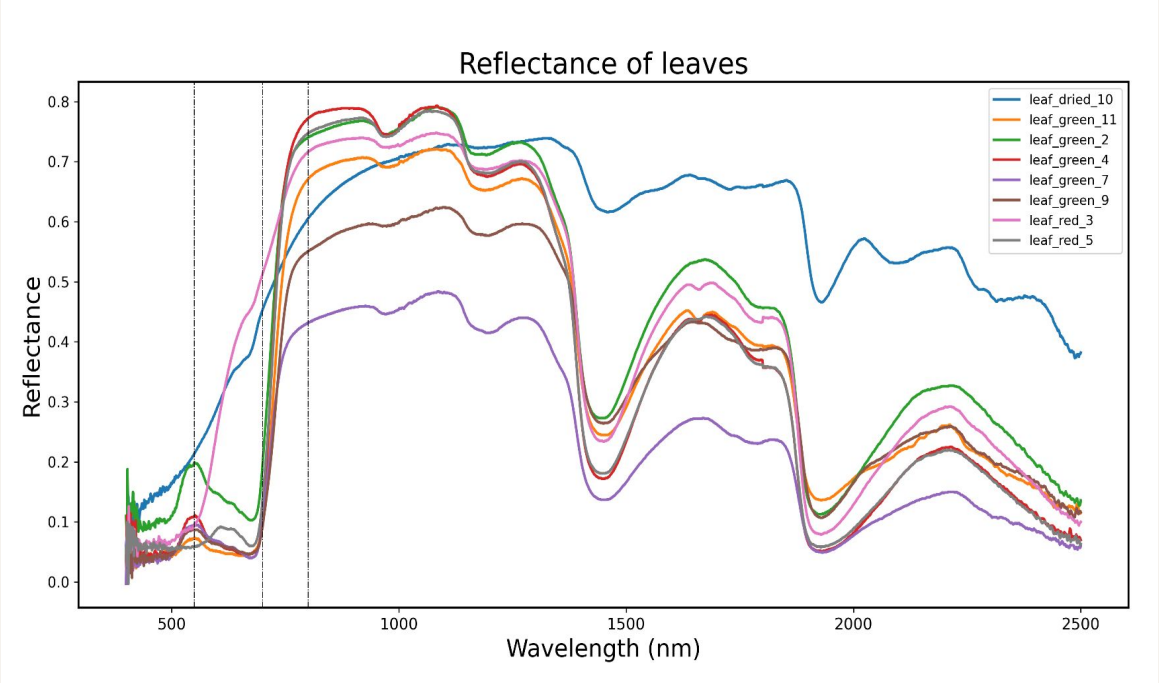
- Dips at 1.45 µm and 1.95 µm: we have **water absorption bands**, c caused by the presence of soil moisture.

04

Discussion

Quality of the results, how to improve it

Discussions:



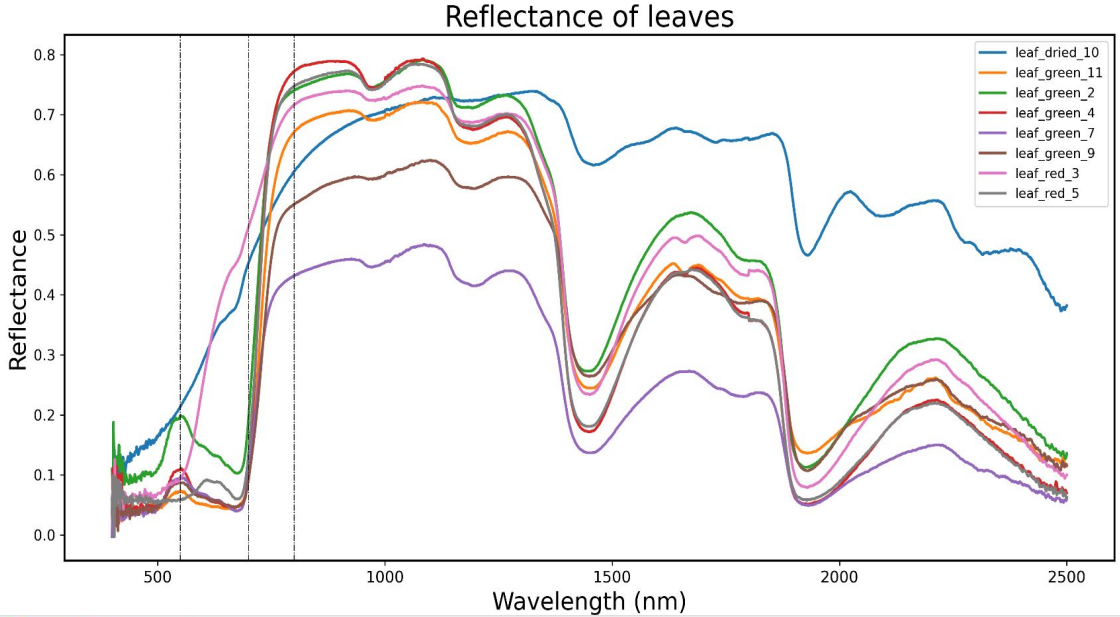
NDVI = (NIR - Red)/(NIR + Red)

"Red" refers to the reflectance value in the red band of the electromagnetic spectrum, not a single value but a range of wavelengths around 650-700 nm.

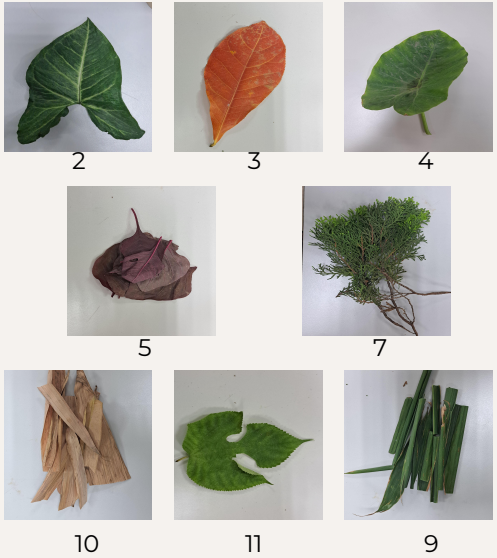
=> The "Red" value used in the NDVI calculation is the **average or representative value** of the reflectance of the red band.

NDVI is typically used to assess the **overall health and density** of vegetation at a **larger scale**, such as agricultural fields or forested areas, **rather than individual leaves**.

Discussions:

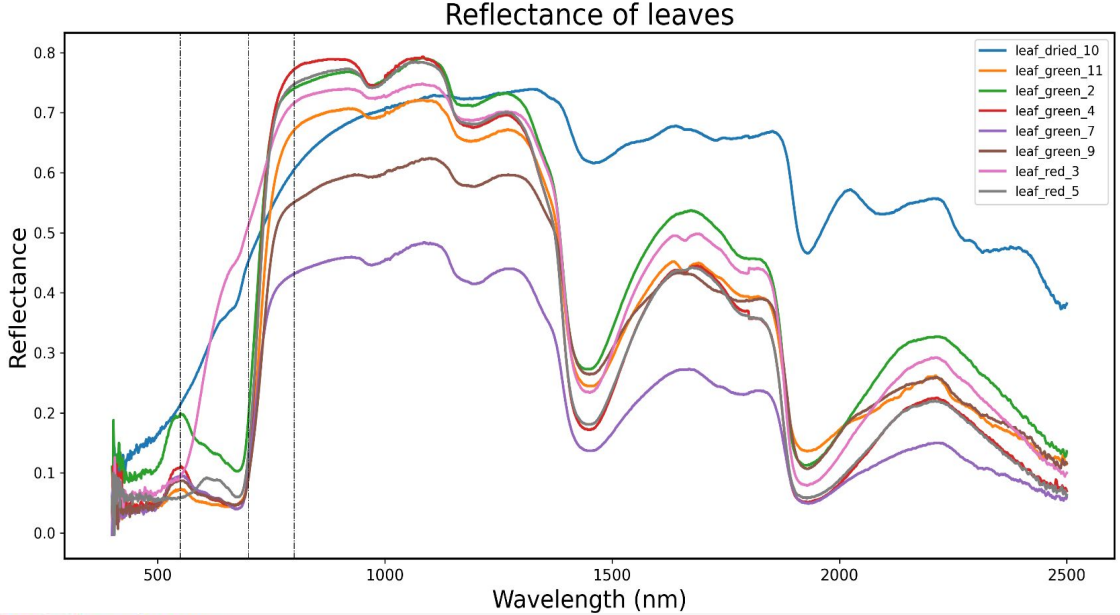



```
for i in testnames:
    test = pd.read_csv(i,delim_whitespace=True,header=None,index_col=3,encoding='utf-16')
    test = test.loc[:,3:4]
    ndvi = (test.loc[nir,4]-test.loc[red,4])/(test.loc[nir,4]+test.loc[red,4])
    name = i[17:].rstrip('_.txt')
    print(f'NDVI of {name}:{ndvi}')
```

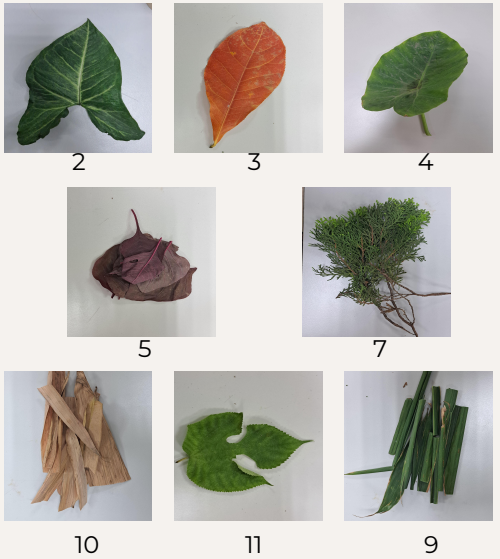


- NDVI of leaf_green_2: **0.67**
- NDVI of leaf_green_11: **0.86**
- NDVI of leaf_green_4: **0.85**
- NDVI of leaf_green_7: **0.73**
- NDVI of leaf_green_9: **0.80**

Discussions:




```
for i in rednames:
    test = pd.read_csv(i,delim_whitespace=True,header=None,index_col=3,encoding='utf-16')
    test = test.loc[:,3:4]
    ndvi = (test.loc[nir,4]-test.loc[red,4])/(test.loc[nir,4]+test.loc[red,4])
    name = i[17:].rstrip('_.txt')
    print(f'NDVI of {name}:{ndvi}')
```



- NDVI of leaf_dried_10: **0.33**
- NDVI of leaf_red_3: **0.43**

Discussions:

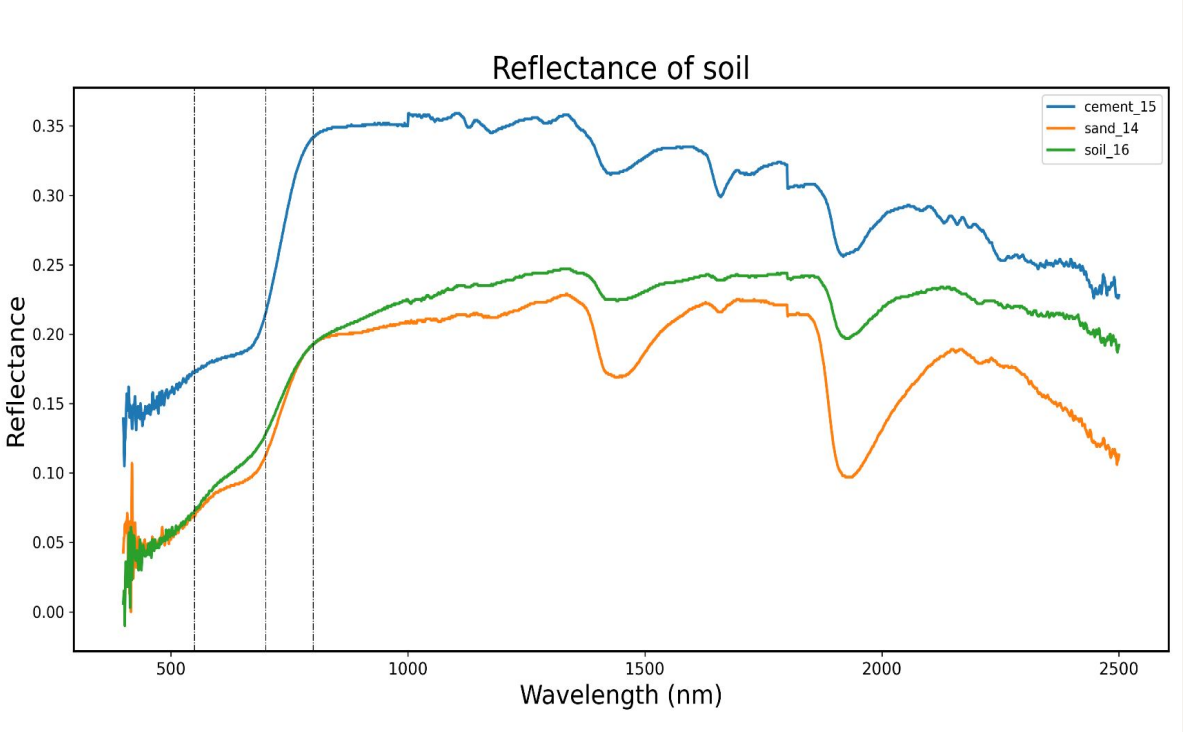
- NDVI of leaf_green_2: **0.67**
- NDVI of leaf_green_11: **0.86**
- NDVI of leaf_green_4: **0.85**
- NDVI of leaf_green_7: **0.73**
- NDVI of leaf_green_9: **0.80**

- NDVI of leaf_dried_10: **0.33**
- NDVI of leaf_red_3: **0.43**

Does this imply anything?

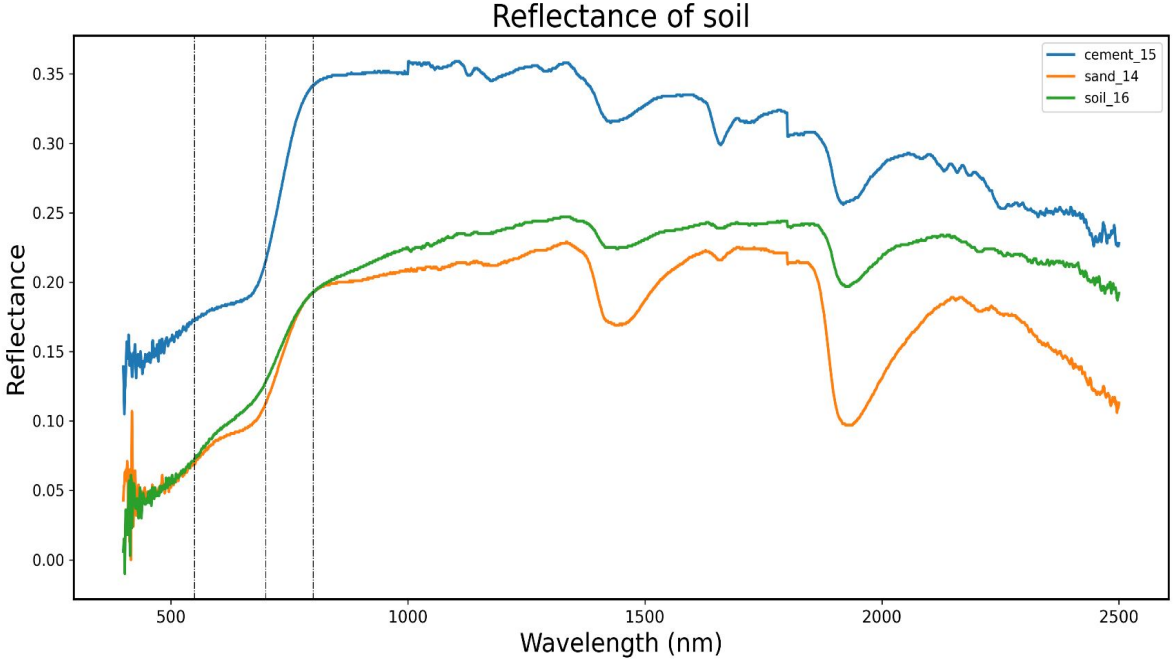
- In general, healthy green leaves typically have NDVI values between 0.3 and 0.8. However, it's important to note that NDVI values can **vary widely** depending on factors such as the *amount of vegetation*, *soil type*, and *atmospheric conditions*.
- As leaves dry out, their NIR reflectance decreases while their red reflectance remains relatively constant, which can result in a **decrease in NDVI values**. However, the exact NDVI value of dried leaves can vary widely depending on the specific conditions and the initial NDVI value of the fresh leaves.
- Again, we should note that NDVI is typically used to assess the **overall health and density** of vegetation at a **larger scale**, such as agricultural fields or forested areas, **rather than individual leaves**.

Discussions:



- **Cement** tends to have a **higher reflectance** than sand and soil in the visible and near-infrared regions of the electromagnetic spectrum.
- Cement is lighter in color and smoother in texture than sand, which allows it to reflect more light.

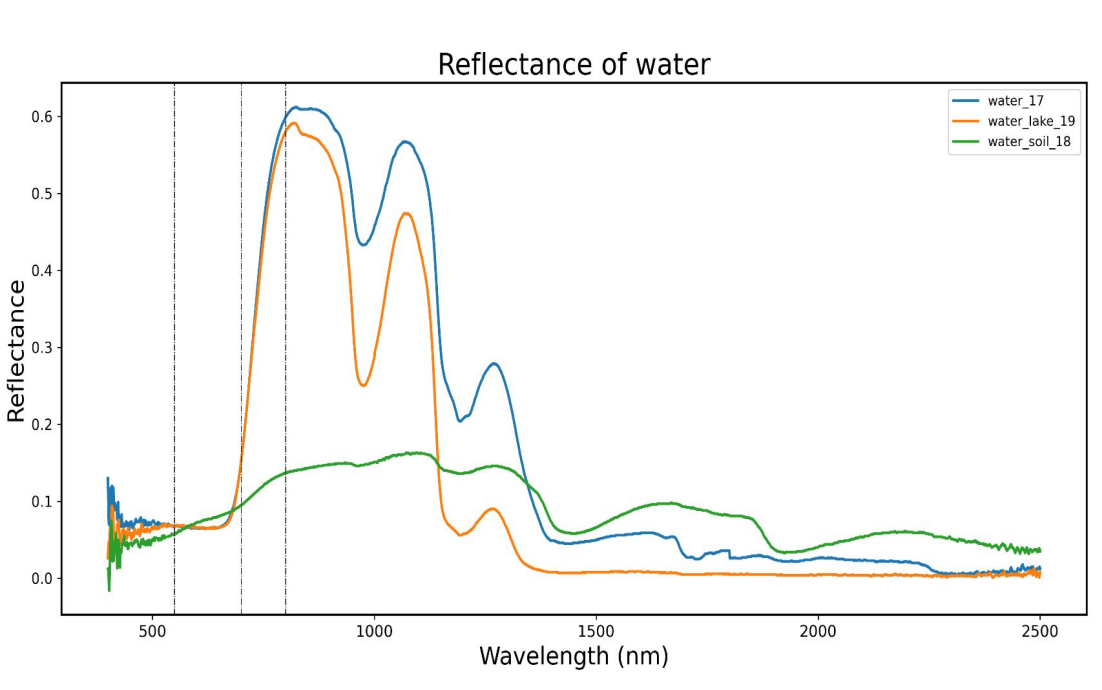
Discussions:

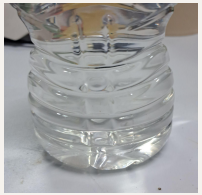


However, there are **many different factors** that can influence the reflectance of sand, soil and cement: *particle size*, *moisture content*, and the presence of *other materials or additives*.

Soil is a complex mixture of organic matter, minerals, and water, which can have varying reflectance properties depending on its composition and moisture content.

Discussions:





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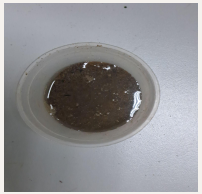
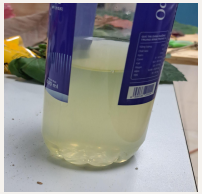
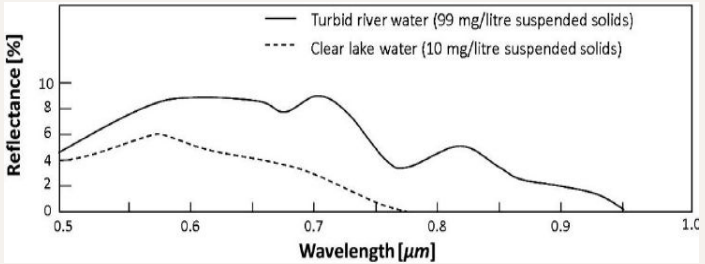


18

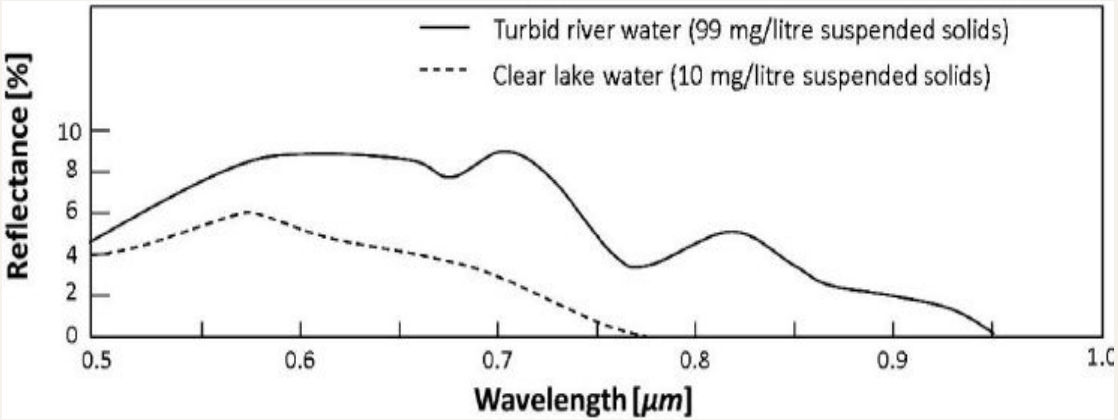


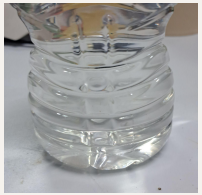
19

=> Very odd curves

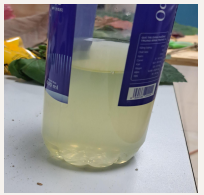


Discussions:

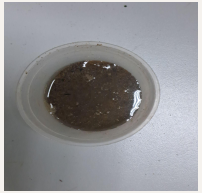




17



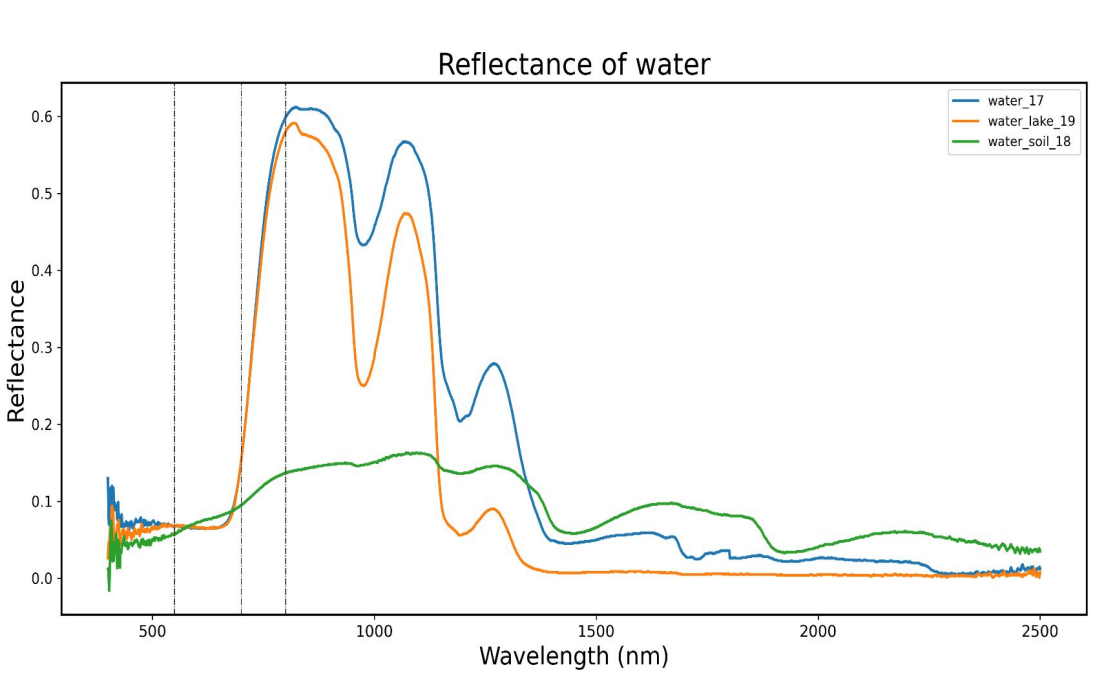
19



18

Water reflects at most 10% of the incident energy. Water reflects EM energy in the visible range and a little in the NIR range. Beyond 1.2 μm all energy is absorbed

Discussions:



Why?

- Probably *human errors* or *confusion* while conducting the experiment.
- Less likely: the presence of *dissolved organic matter* or *suspended particles*. It could came from the water samples or from the equipment used to contain the sample.

05

Conclusion

Main results, applications

Conclusion:

General conclusion on our results:

- The reflectance curves of the samples that were obtained were generally in line with our initial expectations, based on academic research. For instance, the reflectance curves of leaves and various soil types were in agreement with theoretical predictions. However, there were some limitations in our analysis as we lacked detailed information about the composition and structure of these materials, which would have enabled a more comprehensive and detailed interpretation of the results.

- On the other hand, we found that the reflectance curves of different types of water exhibited peculiar and unexpected properties. This could be due to the experimental setup, where we may have used inappropriate containers or other factors that interfered with the measurements. As a result, we may need to modify the experimental design in future studies to obtain more accurate and reliable data.

Conclusion:

General conclusion on our results:

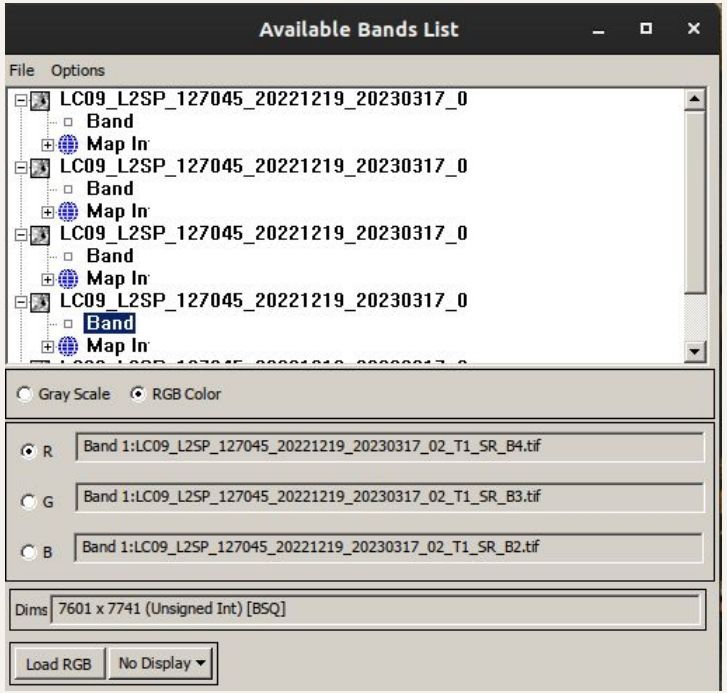
- Overall, our findings suggest that while our initial expectations were mostly met, there were some inconsistencies in the results that suggest further investigation. With more detailed knowledge about the materials and careful experimental design, we may be able to better understand the properties of these samples and improve our measurements.

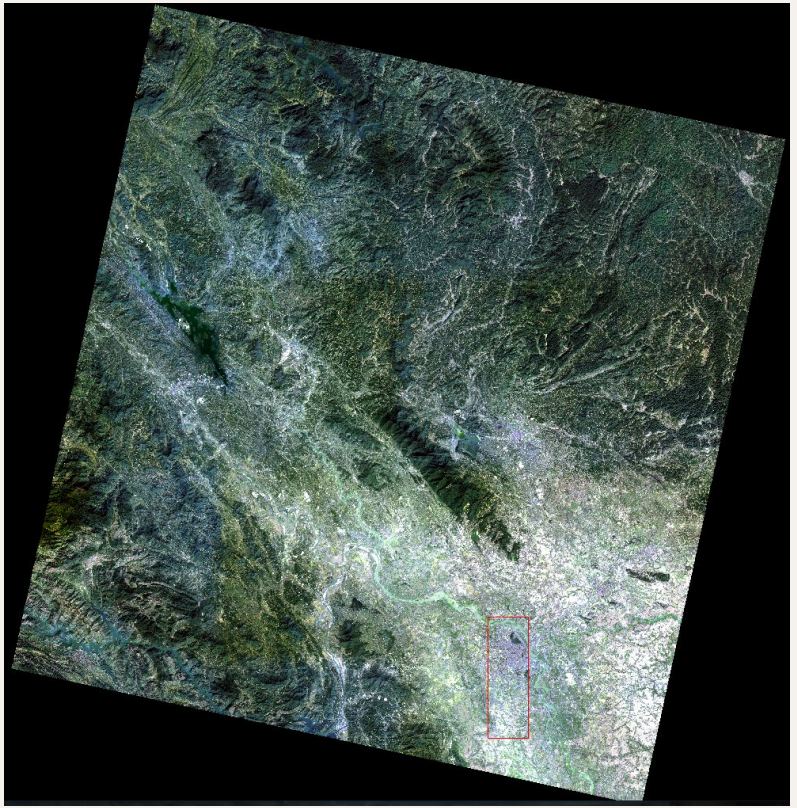
- Spectral reflectance measurements are important in a wide range of fields, including remote sensing, colorimetry, and imaging. By analyzing the spectral reflectance properties of materials and surfaces, we can gain valuable information about their physical and chemical properties, such as their composition, texture, and color.

- in remote sensing, spectral reflectance measurements are used to identify and map different types of vegetation, water bodies, and minerals based on their unique spectral signatures.

Conclusion:

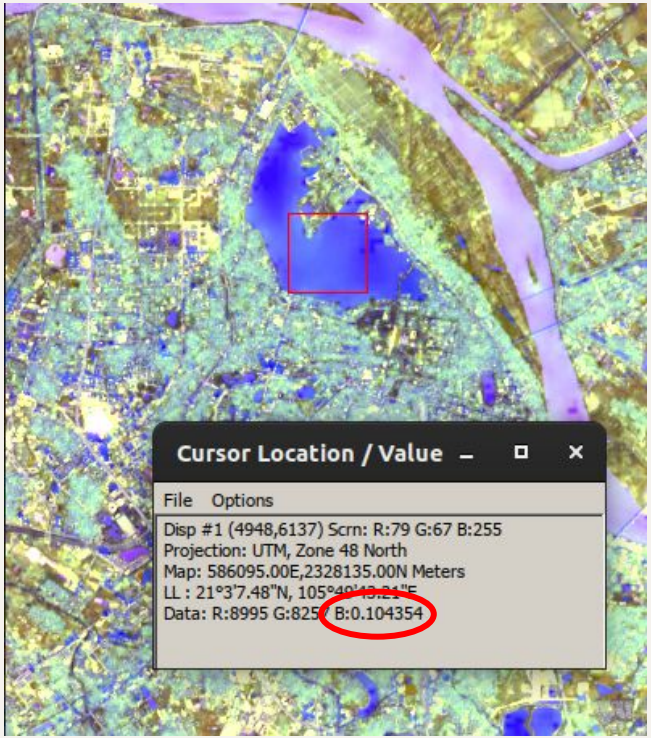
Our application: Using NDWI to identify water bodies (ENVI)

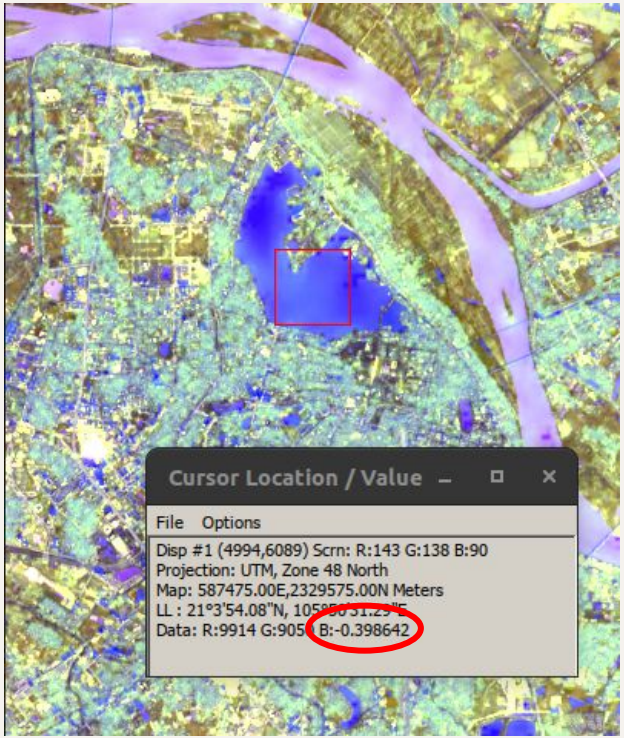




Conclusion:

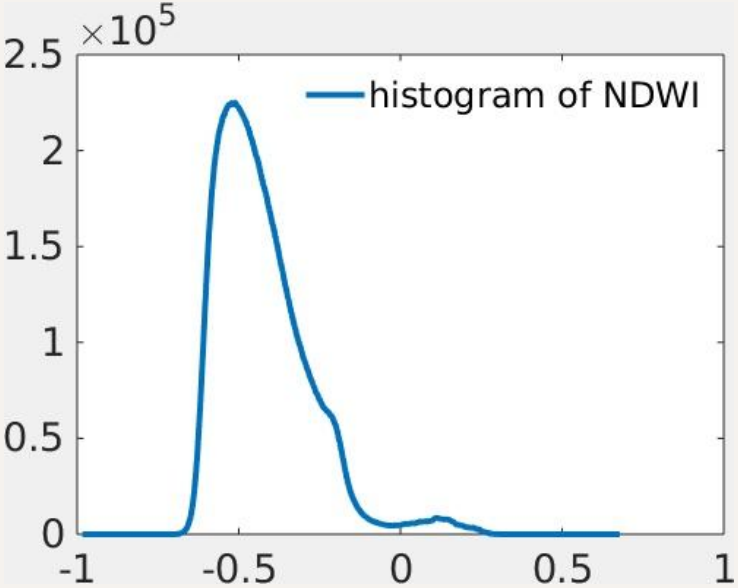
Our application: Using NDWI to identify water bodies (ENVI)

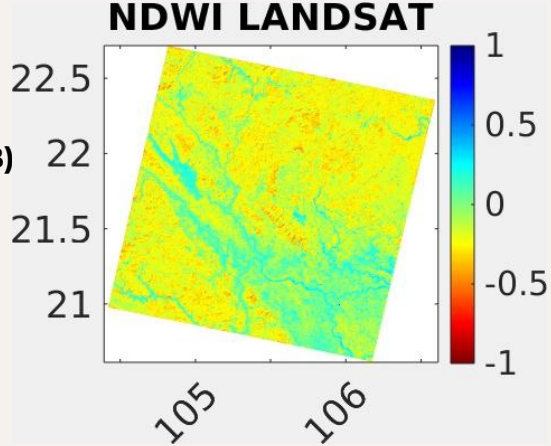


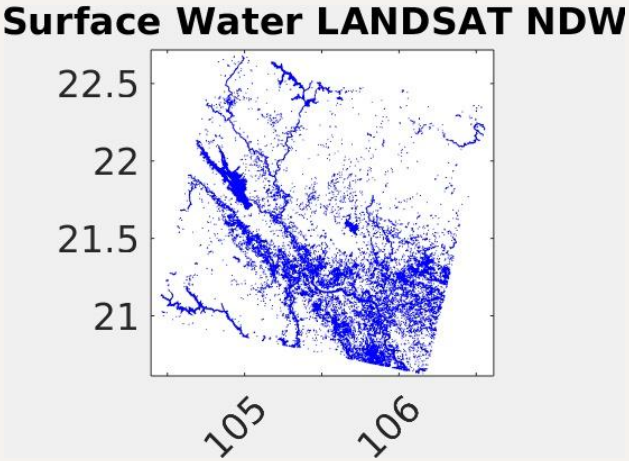


Conclusion:

Our application: Using NDWI to identify water bodies (MATLAB)

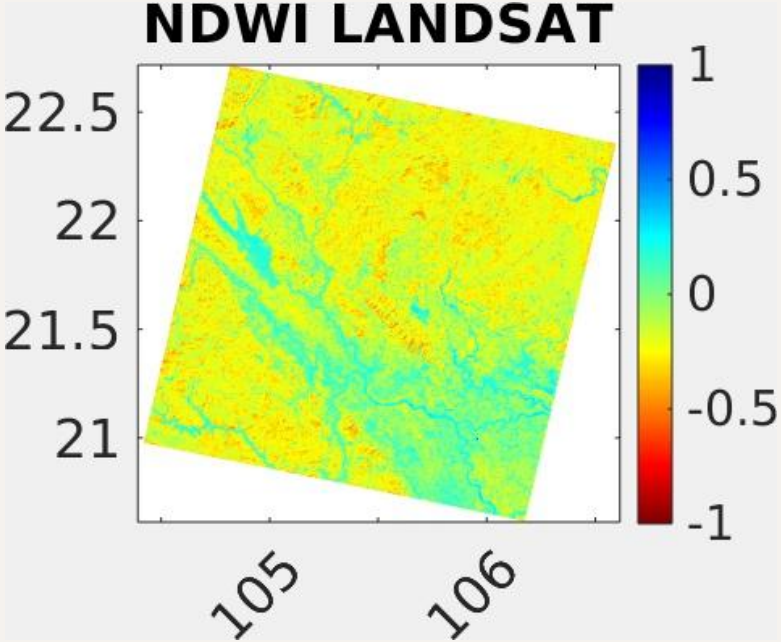


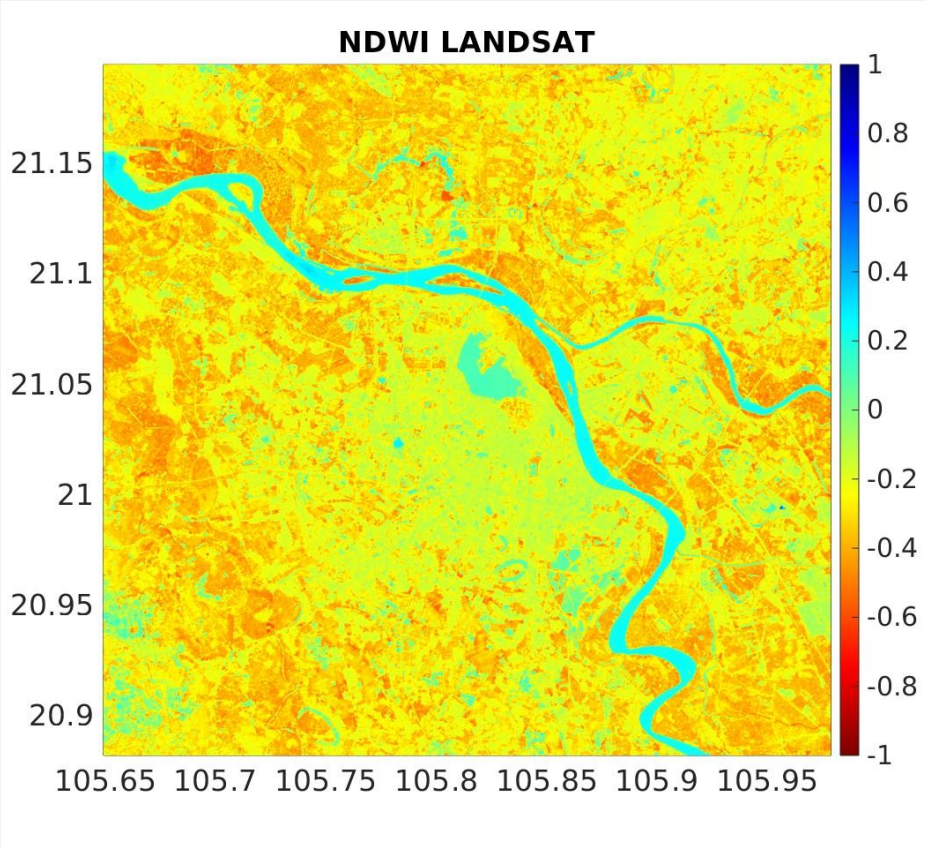




Conclusion:

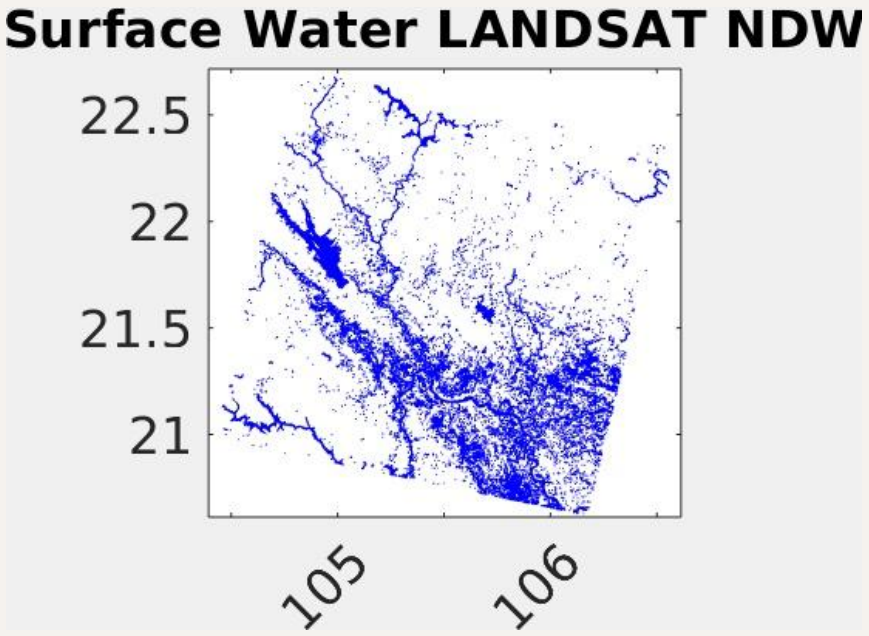
Our application: Using NDWI to identify water bodies

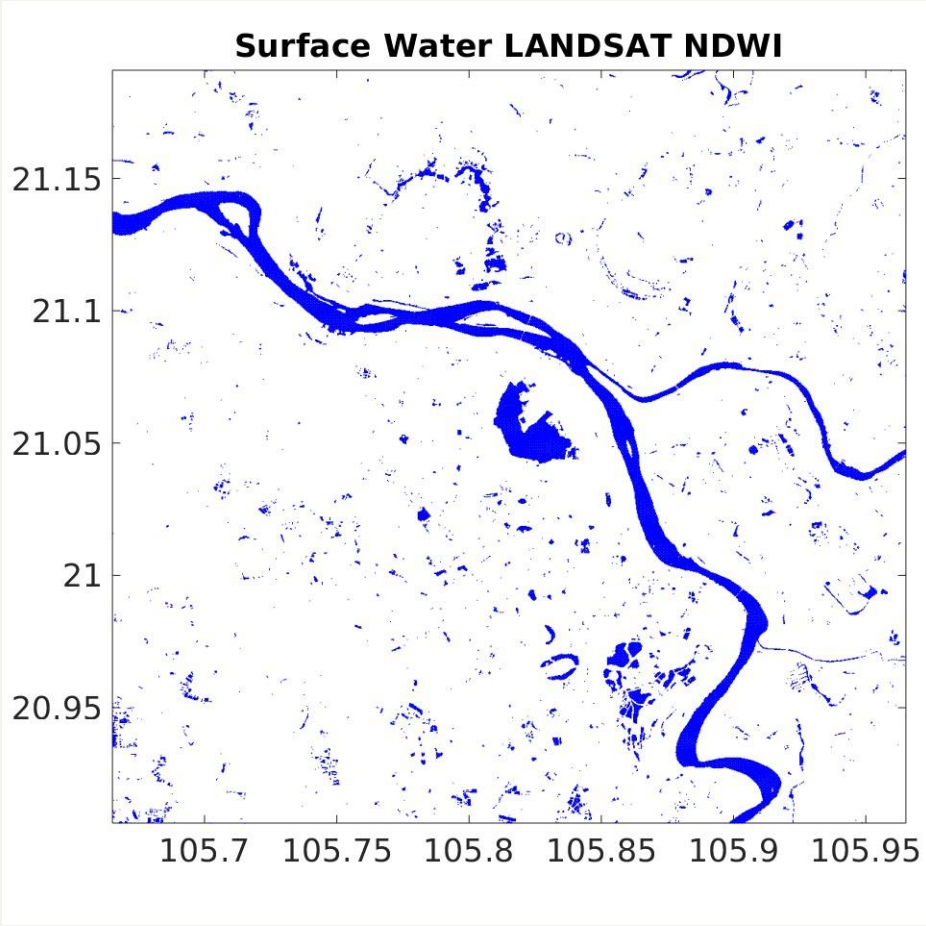




Conclusion:

Our application: Using NDWI to identify water bodies





Conclusion:

Our application: Machine Learning for classification

dfML

3	400.0	401.0	402.0	403.0	404.0	405.0	406.0	407.0	408.0	409.0	...	2491.0	2492.0	2493.0
target														
brick	0.122	0.100	0.088	0.097	0.107	0.118	0.128	0.133	0.101	0.088	...	0.485	0.485	0.484
brick	0.460	0.456	0.464	0.501	0.429	0.423	0.479	0.468	0.468	0.449	...	0.781	0.781	0.779
cemen	0.139	0.122	0.105	0.121	0.126	0.134	0.146	0.157	0.152	0.145	...	0.239	0.234	0.230
flower	0.023	0.019	0.032	0.037	0.078	0.077	0.048	0.063	0.061	0.041	...	0.129	0.126	0.128
flower	0.077	0.068	0.087	0.109	0.111	0.140	0.159	0.074	0.098	0.135	...	0.078	0.078	0.079
flower	0.143	0.194	0.214	0.152	0.184	0.190	0.167	0.192	0.206	0.191	...	0.079	0.078	0.081
leaf_dried	0.061	0.074	0.080	0.100	0.146	0.142	0.102	0.102	0.109	0.092	...	0.378	0.379	0.377
leaf_green	0.049	0.035	0.037	0.042	0.026	0.044	0.080	0.070	0.087	0.079	...	0.129	0.127	0.125
leaf_green	0.110	0.084	0.111	0.188	0.136	0.092	0.098	0.123	0.084	0.064	...	0.139	0.139	0.135
leaf_green	0.028	0.065	0.111	0.097	0.081	0.077	0.082	0.083	0.069	0.080	...	0.077	0.076	0.072
leaf_green	-0.003	0.057	0.076	0.008	0.026	0.064	0.076	0.041	0.025	0.051	...	0.058	0.055	0.054
leaf_green	0.044	0.025	0.025	0.054	0.043	0.032	0.044	0.083	0.044	0.015	...	0.123	0.120	0.117
leaf_red	0.027	0.037	0.076	0.073	0.054	0.085	0.126	0.067	0.066	0.082	...	0.101	0.102	0.099
leaf_red	0.057	0.027	0.061	0.100	-0.003	-0.003	0.089	0.091	0.096	0.084	...	0.068	0.065	0.065
sand	0.043	0.053	0.054	0.063	0.063	0.064	0.065	0.057	0.071	0.067	...	0.117	0.115	0.112
soil	0.006	0.015	0.006	-0.010	0.023	0.036	0.024	0.029	0.020	0.018	...	0.196	0.196	0.196
water	0.130	0.088	0.070	0.117	0.086	0.067	0.075	0.073	0.107	0.120	...	0.009	0.011	0.013
water_lake	0.026	0.046	0.041	0.048	0.058	0.066	0.067	0.061	0.090	0.094	...	0.002	0.004	0.006
water_soil	0.012	0.013	-0.008	-0.016	0.011	0.037	0.055	0.075	0.071	0.046	...	0.038	0.036	0.035
white_reference	1.022	1.102	1.123	1.083	1.039	1.011	1.013	1.059	1.061	1.028	...	0.992	0.991	0.990

Conclusion:

Our application: Machine Learning for classification

```python
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score

# Define target labels for each sample
labels = dfML.index

# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(dfML, labels, test_size=0.2)

# Define decision tree classifier with default parameters
clf = DecisionTreeClassifier()

# Train the classifier on the training set
clf.fit(X_train, y_train)

# Predict the labels of the testing set
y_pred = clf.predict(X_test)

# Calculate the accuracy of the classifier
accuracy = accuracy_score(y_test, y_pred)

# Print results
print("Predicted Labels:", y_pred)
print("True Labels:", y_test)
print("Accuracy:", accuracy)
```

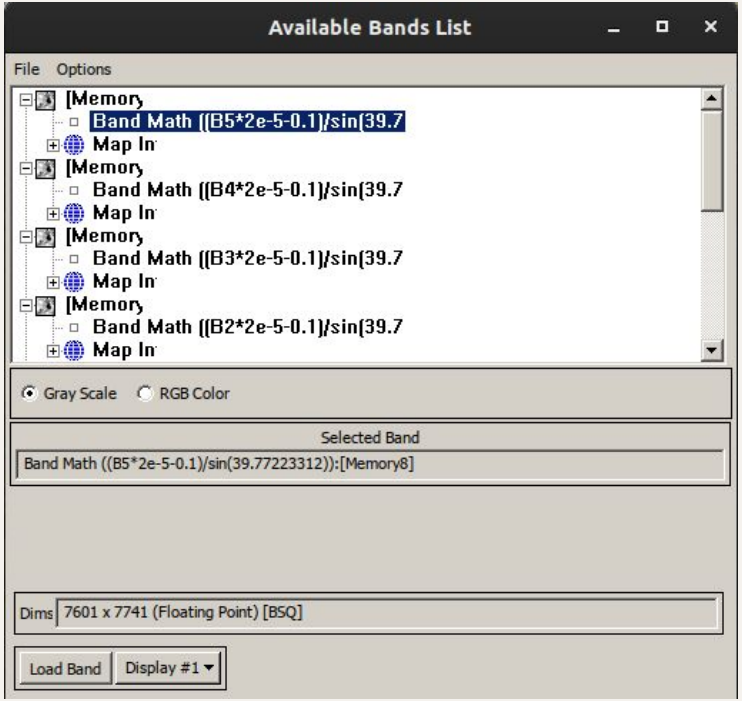
```
Predicted Labels: ['water_soil' 'leaf_red' 'leaf_green' 'leaf_green']
True Labels: Index(['sand', 'leaf_red', 'brick', 'leaf_green'], dtype='object', name='target')
Accuracy: 0.5
```

Thanks

Do you have any questions?

Conclusion:

Our application: Using NDWI to identify water bodies



01

Introduction

Insert a subtitle here if you need it

This is a graph

Jupiter

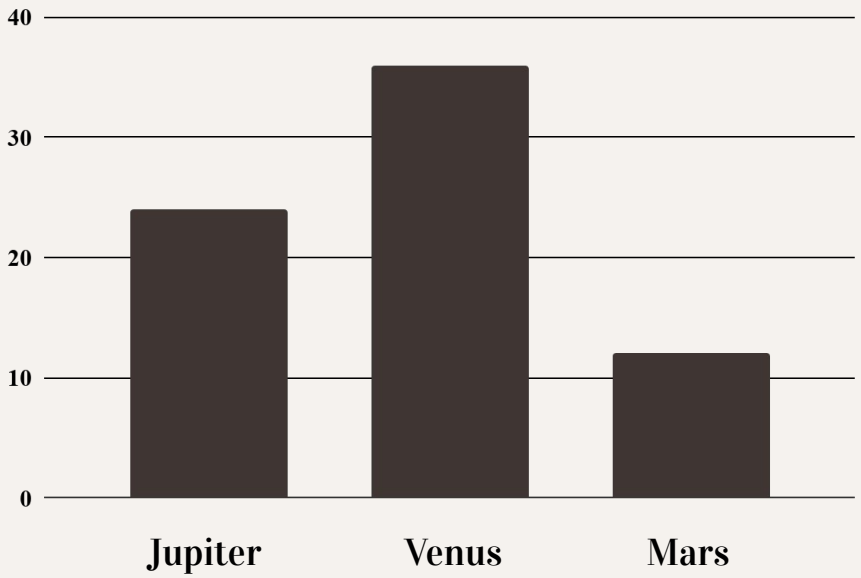
It's a gas giant and the biggest planet

Venus

Venus has a beautiful name

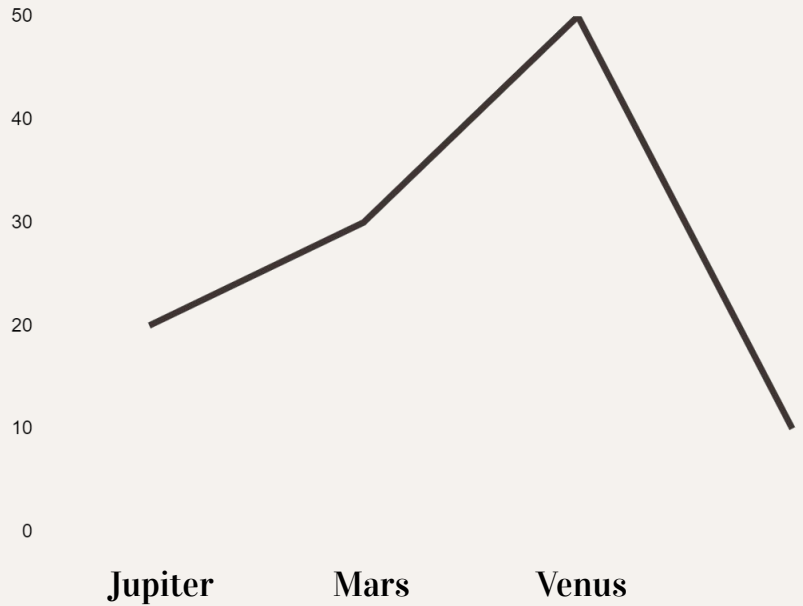
Mars

Mars is a cold place, not hot



Follow the link in the graph to modify its data and then paste the new one here. For more info, click here

This is a graph



20% Mars

Mars is a cold place, not hot

30% Jupiter

Jupiter is the biggest planet

50% Venus

Venus has a beautiful name

Follow the link in the graph to modify its data and then paste the new one here. **For more info, click here**

Maybe you need to divide the content

Mercury

Mercury is the closest planet to the Sun and the smallest one

Venus

Venus has a beautiful name and is the second planet from the Sun

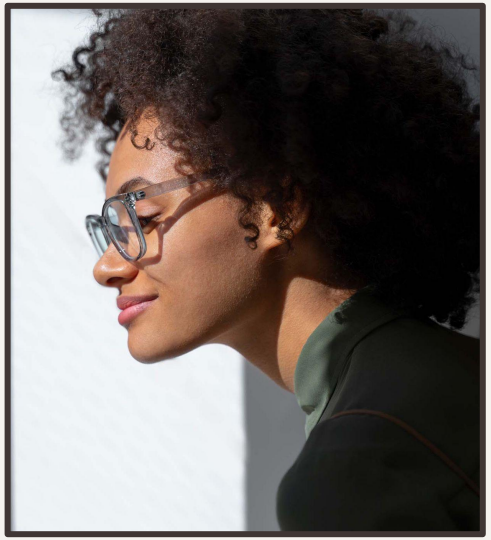
Maybe you need to divide the content

Mercury

Mercury is the closest planet to the Sun

Venus

Venus has a beautiful name and it’s hot



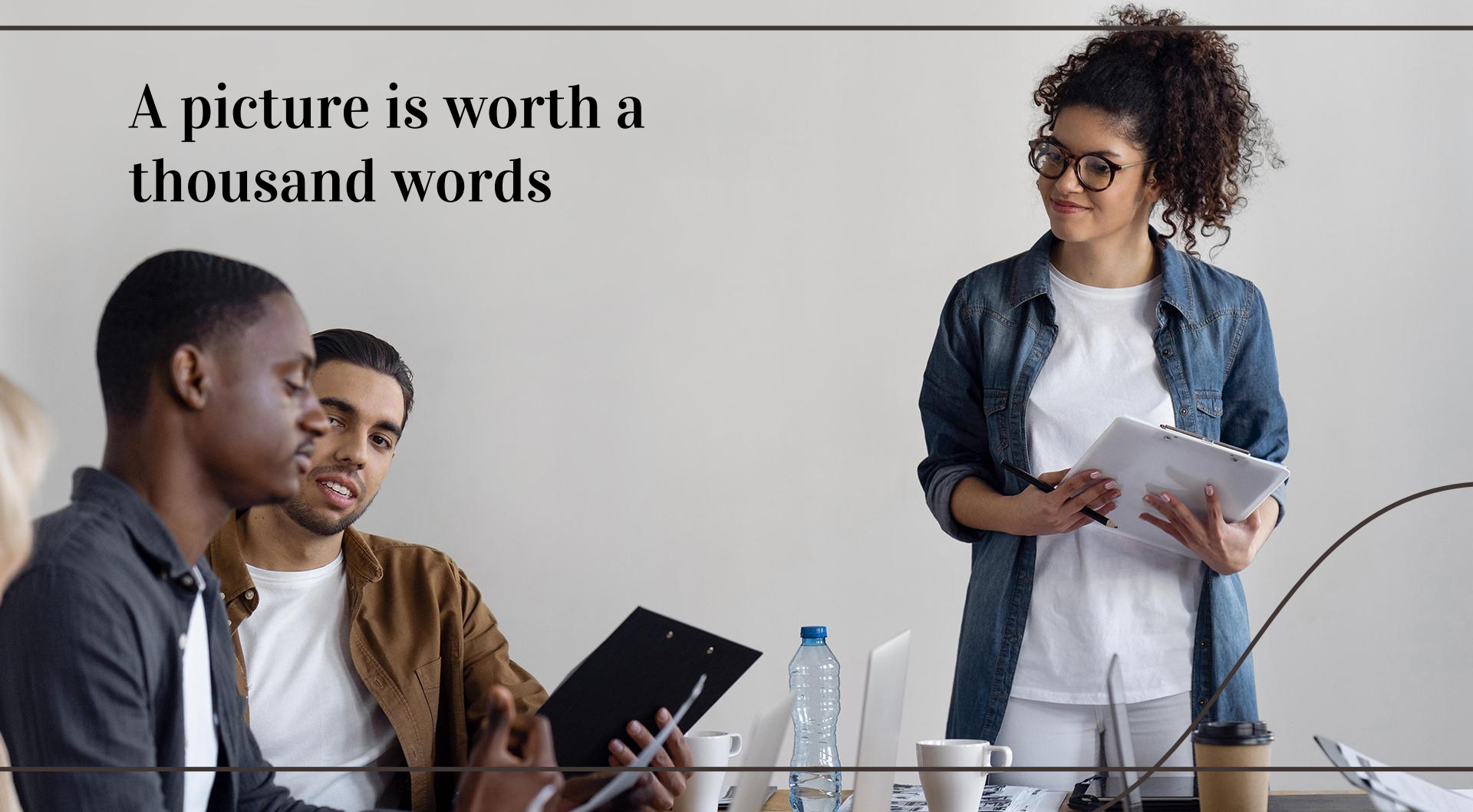
Jupiter

It’s a gas giant and the biggest planet

Mars

Despite being red, Mars is actually a cold place

A picture is worth a thousand words



A picture is worth a thousand words

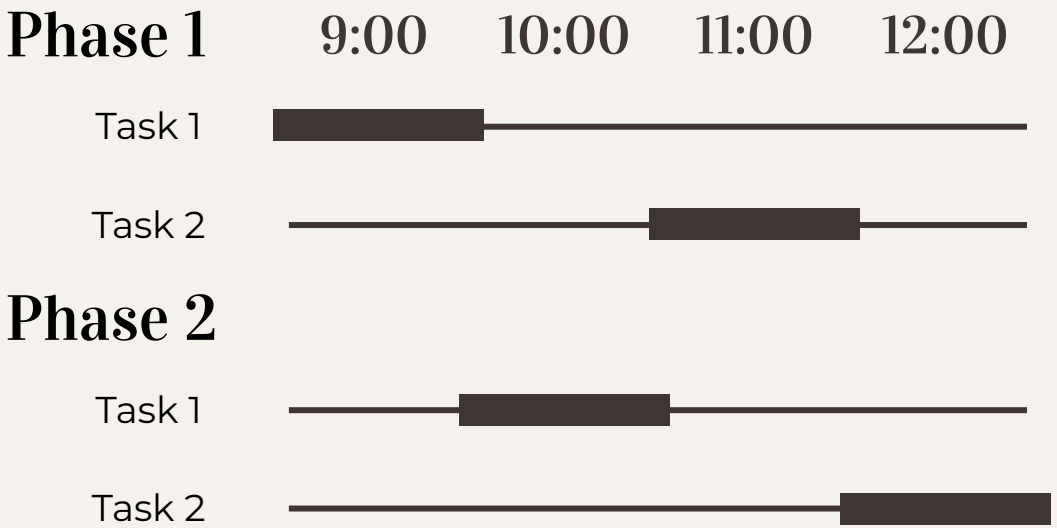
145,245

Big numbers catch your audience’s attention

795,321

Big numbers catch your audience’s attention

Schedule



Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
08:15	Task 1	Meeting	Idea	Project	Test
10:20	Meeting	Idea	Task 3	Chat	Task 4
12:15	Proposal	Meeting	Meeting	Idea	Idea
14:30	Test	Task 2	Project	Test	Meeting

02

Company

Insert a subtitle here if you need it

This is a graph

1,254

Jupiter

It's a gas giant and the biggest planet

4,215

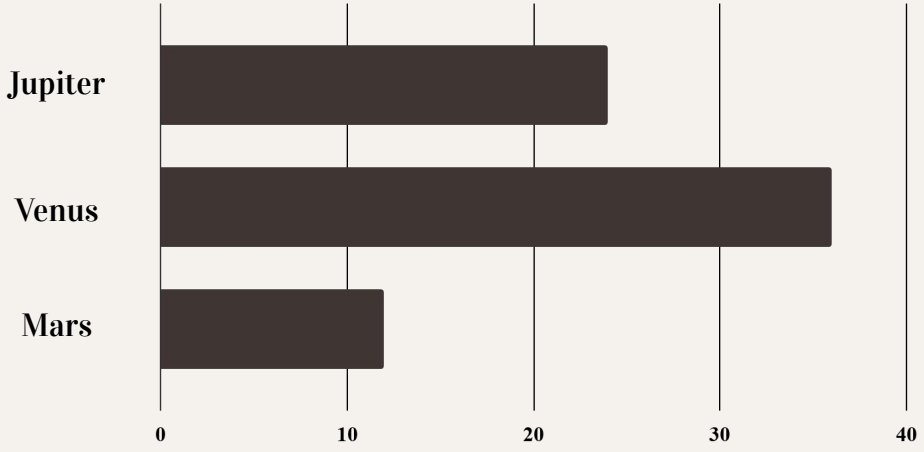
Venus

Venus has a beautiful name

8,554

Mars

Mars is a cold place, not hot



Follow the link in the graph to modify its data and then paste the new one here. For more info, click here

More graphs

35% Jupiter

Jupiter is the biggest planet

20% Mars

Mars is a cold place, not hot

10% Venus

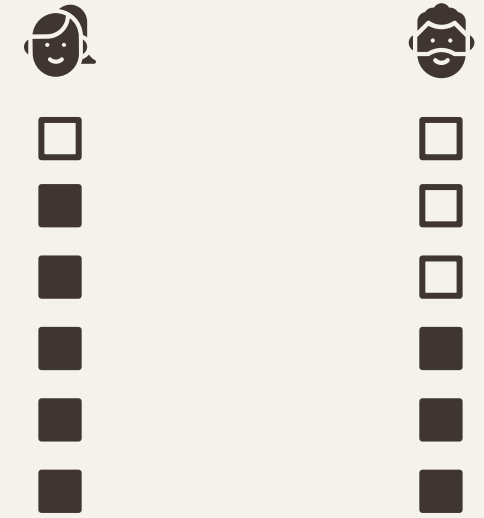
Venus has a beautiful name

35% Mercury

Mercury is the smallest planet

Target

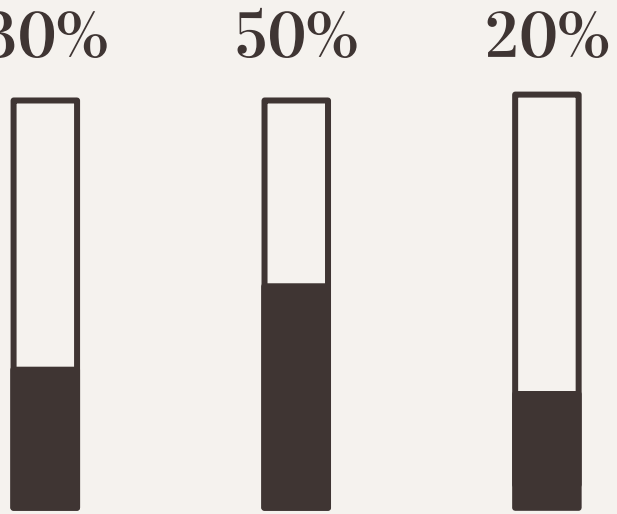
Gender



70%

30%

Age



30%

50%

20%

18 - 25

26 - 35

+36

Target

Gender

60%

Saturn is a gas giant and has rings

40%

Mercury is the closest planet to the Sun

Most selled products

- Write the best-selling products
- Write the best-selling products
- Write the best-selling products
- Write the best-selling products
- Write the best-selling products

Annual expenses

Avg. expense: $5000

Age

25-38

39-50

A picture always reinforces the concept

Images reveal large amounts of data, so remember: use and image instead of long texts

A picture always reinforces the concept

Images reveal large amounts of data, so remember: use and image instead of long texts

Your can use three columns

Mars

Mars is actually a cold place. It’s full of iron oxide dust

Venus

Venus is the second planet from the Sun. It’s really hot

Mercury

Mercury is the closest planet to the Sun and the smallest one

You can use six columns

Mercury

It’s the closest planet to the Sun

Venus

It’s a planet with very high temperatures

Mars

Mars is actually a very cold place

Jupiter

Jupiter is the biggest planet of them all

Saturn

It’s composed of hydrogen and helium

Neptune

It’s the farthest planet from the Sun

This is a timeline

01

Mercury

Mercury is the smallest planet

02

Jupiter

Jupiter is the biggest planet

03

Neptune

Neptune is far away from Earth

04

Mars

Mars is a cold place, not hot

How the company generates income

Mercury

Mercury is a small planet

Jupiter

Jupiter is the biggest planet

Mars

Mars is actually very cold

Neptune

Neptune is far away from Earth

Saturn

Saturn is a gas giant with rings

This is a table

	Mars	Venus	Jupiter
Task 1	✓	✗	✓
Task 2	✗	✓	✗
Task 3	✓	✗	✓
Task 4	✗	✓	✗

This is a table

	Task 1	Task 2	Task 3	Task 4
Description	Jupiter is the biggest planet	Mercury a small planet	Saturn has several rings	Neptune is far away from us
Year	2019	2020	2021	2022
Duration	Three months	Two weeks	Six months	Four months

Percentages

Mars

Mars is actually a cold place

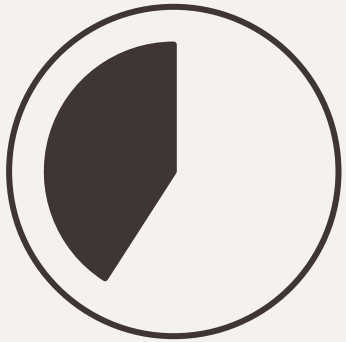
Venus

Venus has a beautiful name

Mercury

Mercury is the smallest planet

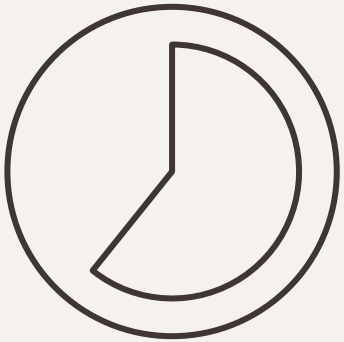
Percentages



40%

Mercury

Mercury is the smallest planet



60%

Mars

Mars is actually a very cold place

You can use six columns

Mars

Mars is actually a cold place

Venus

Venus has a beautiful name

Mercury

Mercury is the smallest planet

Neptune

Neptune is far away from Earth

Jupiter

Jupiter is the biggest planet

Saturn

Saturn is a gas giant with several rings

Competitors

Mars

Despite being red, Mars is cold

Mercury

Mercury is the smallest planet

Jupiter

Jupiter is the biggest planet

Neptune

Neptune is far away from Earth

Saturn

Saturn is a gas giant with rings

Awesome words

You can use four columns

Mars

Mars is actually a cold place

Venus

Venus has a beautiful name

Neptune

It’s the farthest planet from the Sun

Jupiter

Jupiter is the biggest planet

Awesome words

This is a map

Jupiter

It’s a gas giant and the biggest planet

Venus

Venus has a beautiful name

Mars

Mars is a cold place, not hot

Mercury

Mercury is the smallest planet

This is a map

Jupiter

Jupiter is the biggest planet

Mars

Mars is a cold place, not hot

Venus

Venus has a beautiful name

Mercury

Mercury is the smallest planet

You can use three columns

01

Neptune

Neptune is far away from Earth

02

Mars

Mars is actually a cold place

03

Jupiter

Jupiter is the biggest planet

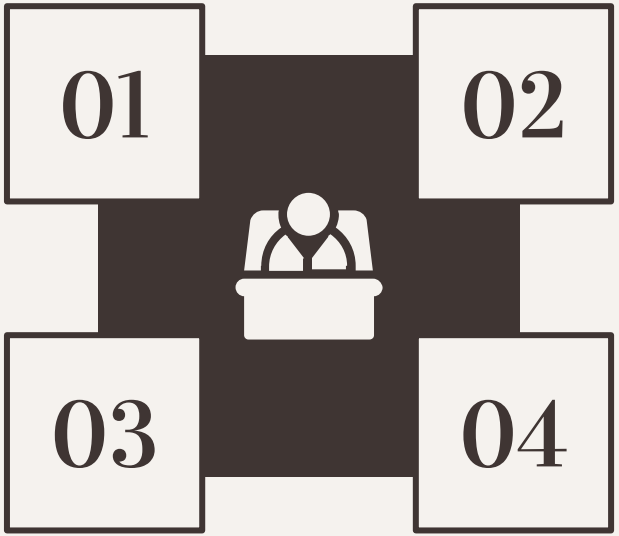
This is an infographic

Mars

Mars is a cold place, not hot

Jupiter

Jupiter is the biggest planet



Venus

Venus has a beautiful name

Saturn

Saturn is a gas giant with rings

This is an infographic

Idea

Mercury

Mercury is the closest planet to the Sun

Venus

Venus is the second planet from the Sun

Mars

Despite being red, Mars is actually a cold place

Product

Monthly data

125K

January

Mars is actually a cold place

250K

June

Venus has a beautiful name

540K

November

Mercury is the smallest planet

Percentages

25%

Venus

Venus has a beautiful name and it's very hot

20%

Jupiter

Jupiter is the biggest planet of them all

40%

Mars

Despite being red, Mars is actually a cold place

15%

Neptune

It’s the farthest planet from the Sun

Our goals

Mars

Mars is actually a cold place

Venus

Venus has a beautiful name

Neptune

It’s the farthest planet from the Sun

Jupiter

Jupiter is the biggest planet

Our goals

Neptune

It’s the farthest planet from the Sun

Venus

Venus has a beautiful name

Jupiter

Jupiter is the biggest planet

Statistics

	Phase 1	Phase 2	Phase 3
Mercury	1,254	9,145	8,145
Mars	5,214	6,541	3,214
Saturn	3,418	3,214	5,415

Statistics

	2019	2020	2021	2022
Avg. spen	$15,225	$40,000	$45,000	$65,000
Description	Mercury is very small	Venus has a nice name	Jupiter is the biggest planet	Mars is a cold place, not hot
Customers	12,000	20,000	19,000	40,000

9h 55m 23s

Jupiter’s rotation period

333,000

The Sun’s mass compared to Earth’s

386,000 km

Distance between Earth and the Moon

354

Mars

Despite being red, Mars is actually a cold place

789

Mercury

Mercury is the smallest planet of them all

912

Neptune

Neptune is the farthest planet from the Sun

Desktop mockup

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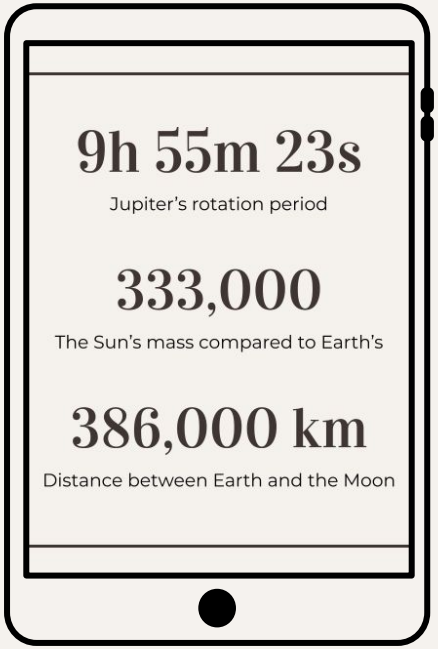

Tablet app

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Mobile web

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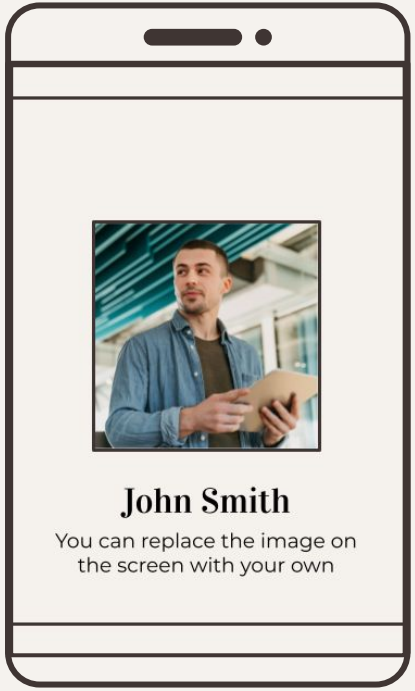

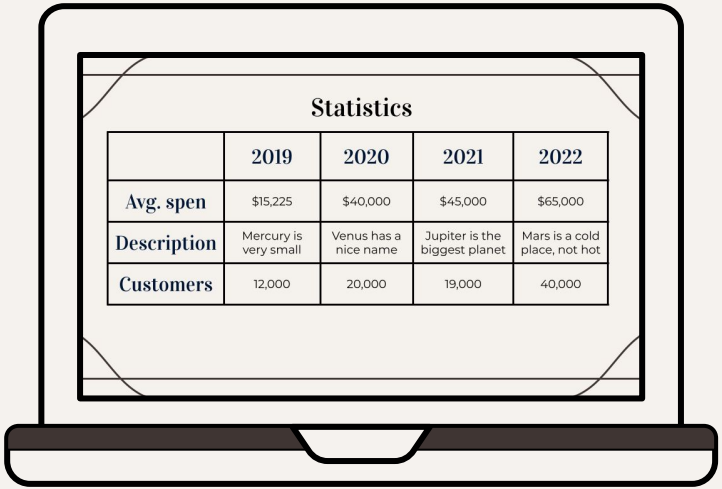

Laptop mockup

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Our team

Jenna Doe

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John Smith

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Our team

Dalila Roge

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Joe Smith

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Janice Clarke

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Thanks

Do you have any questions?
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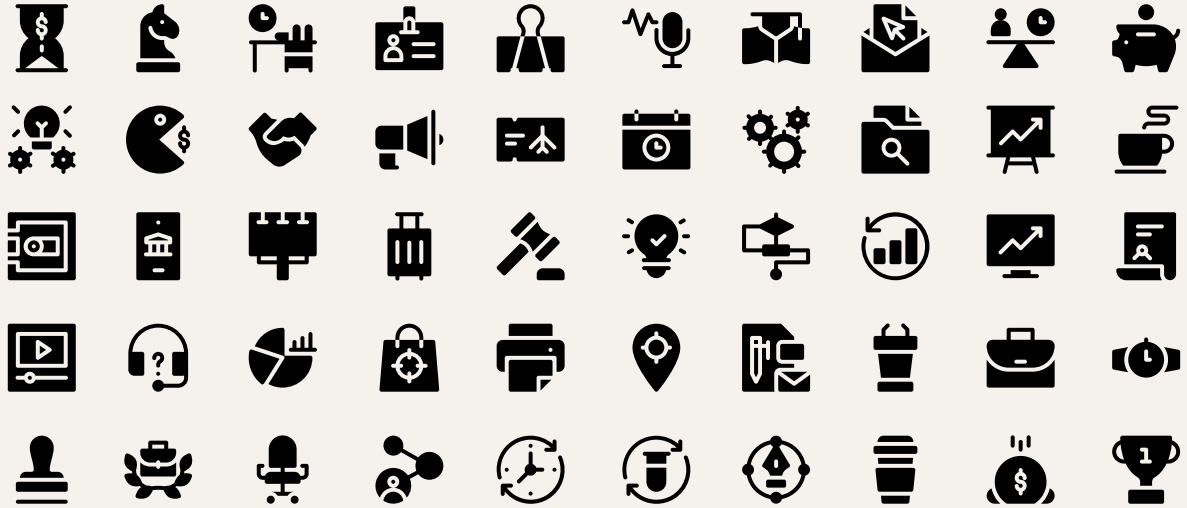
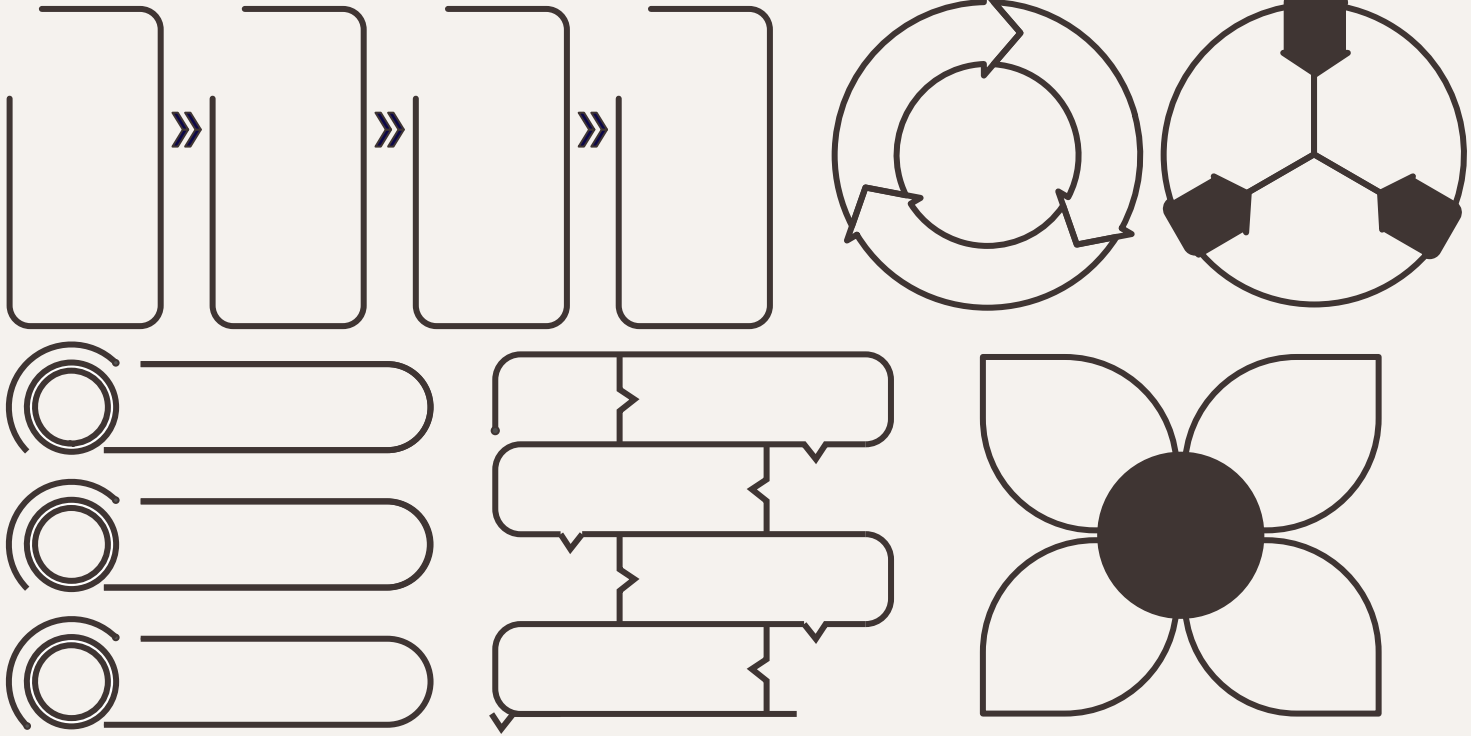
Business icon pack



Alternative infographics elements



Alternative resources

Photos

- People in business meeting high angle
- Front view of people meeting over a cup of coffee
- Businessman at office with laptop
- Smiley redhead business woman working
- Business women talking while looking
- Medium shot smiley business woman

Alternative resources

Photos

- Smiling young woman working at laptop in office
- Medium shot woman with box
- Medium shot business people with devices
- Startups entrepreneurs discussing strategies
- Close up business people at tablet
- Man and woman discussing a new project
- Business people discussing a new project

Alternative resources

Photos

- Coworkers discussing a new project together
- Smiley man holding project documents
- Businessman respecting safety measures at the office
- Young man using laptop with coffee cup

Icons

- Business Icon Pack

Resources

Photos

- Business people doing their job
- People having a meeting in the office
- Low angle businessman
- Women working together on a project
- Young businesswoman posing with copy
- Smiley woman at business meeting

Resources

Photos

- Low angle womens team meeting
- Close up on company employee smiling
- Close up on young businesswoman
- Low angle womens team meeting I
- Blond woman sitting back and smiling with closed eyes at workplace
- Brunette businesswoman posing

Resources

Photos

- Business people working on a new project together
- Business man and woman working together
- Business team working together in the office with laptop
- Front view business woman at office

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Cuate

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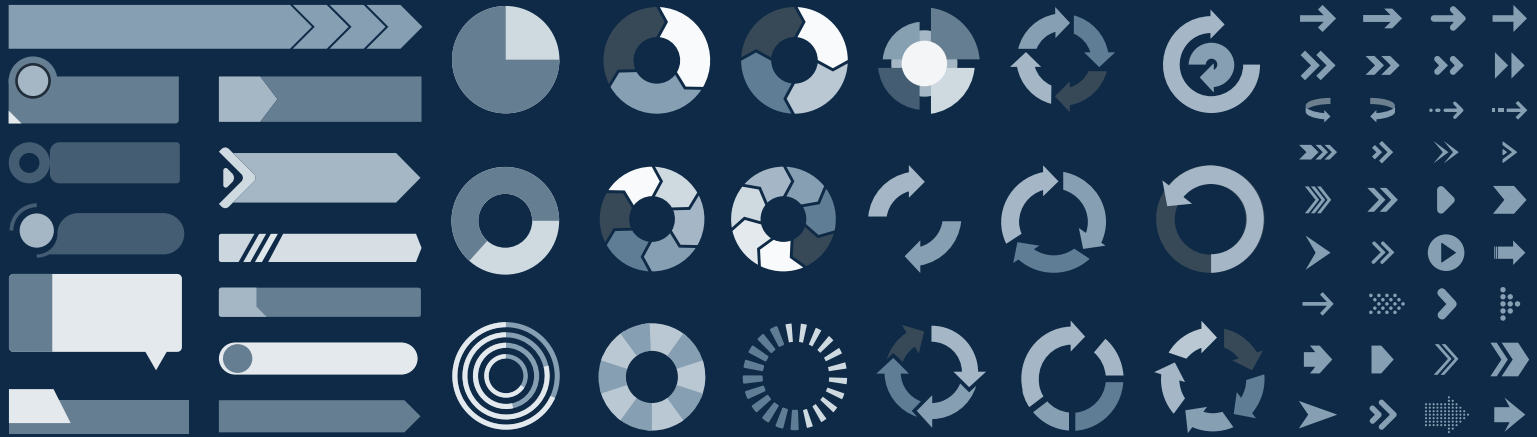






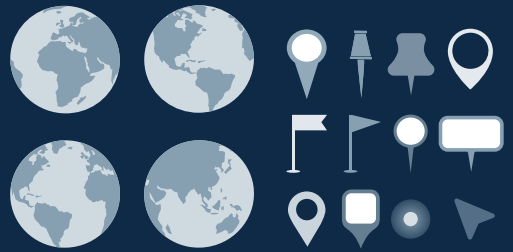

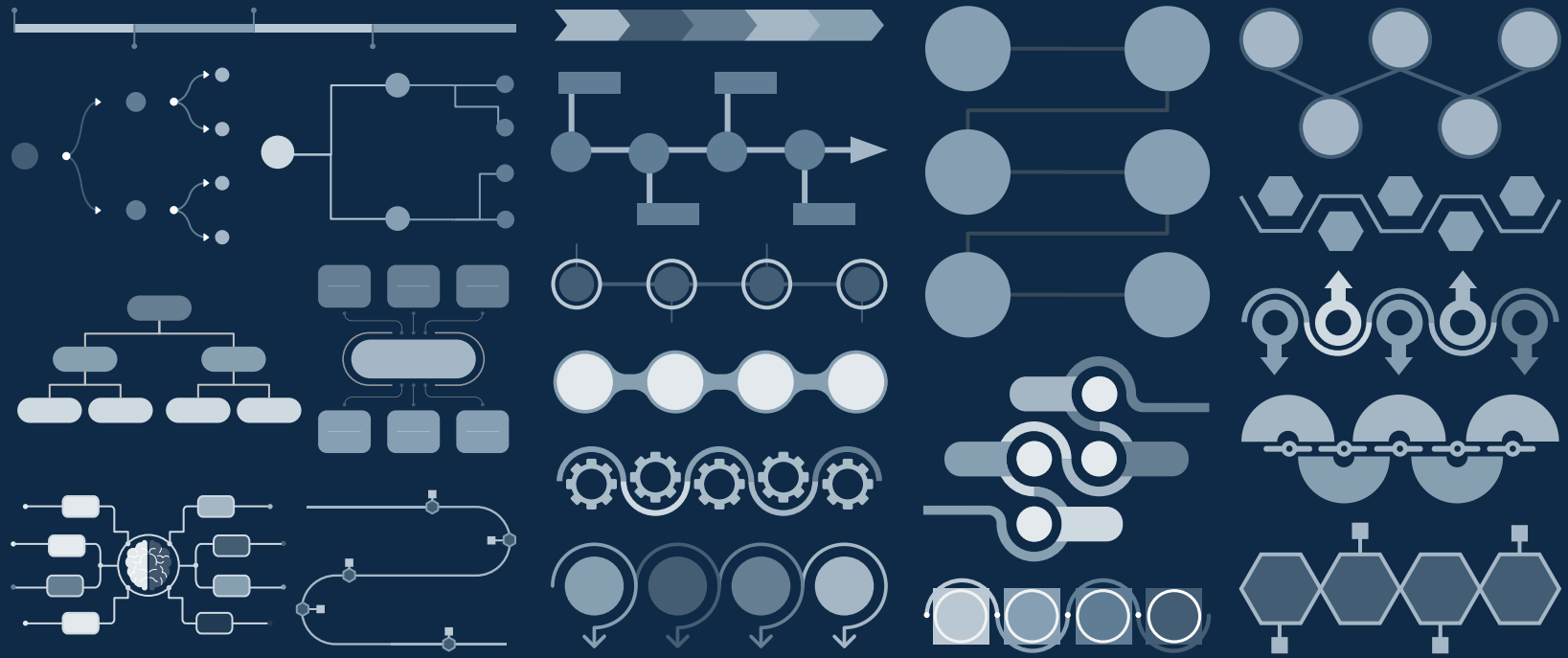

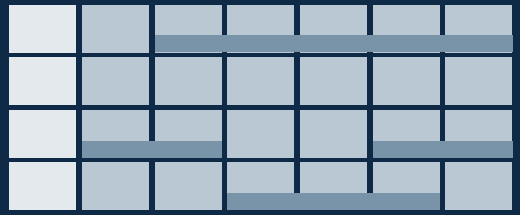

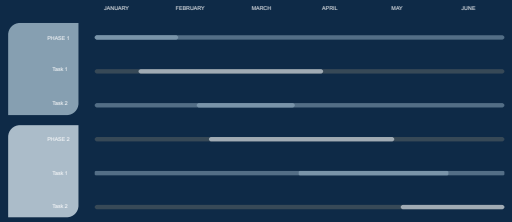
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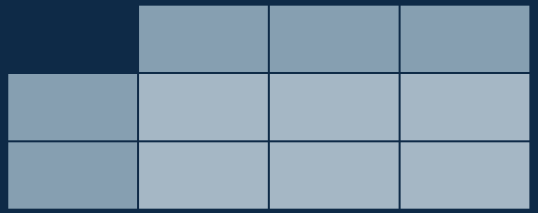

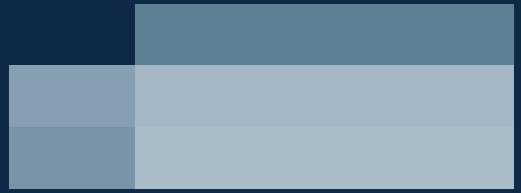

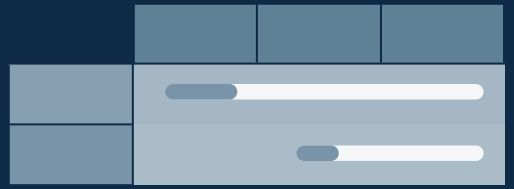

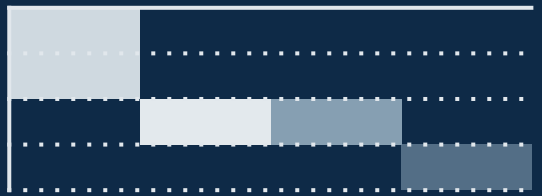

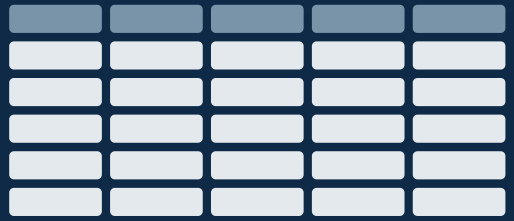

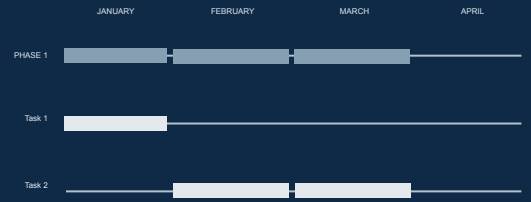
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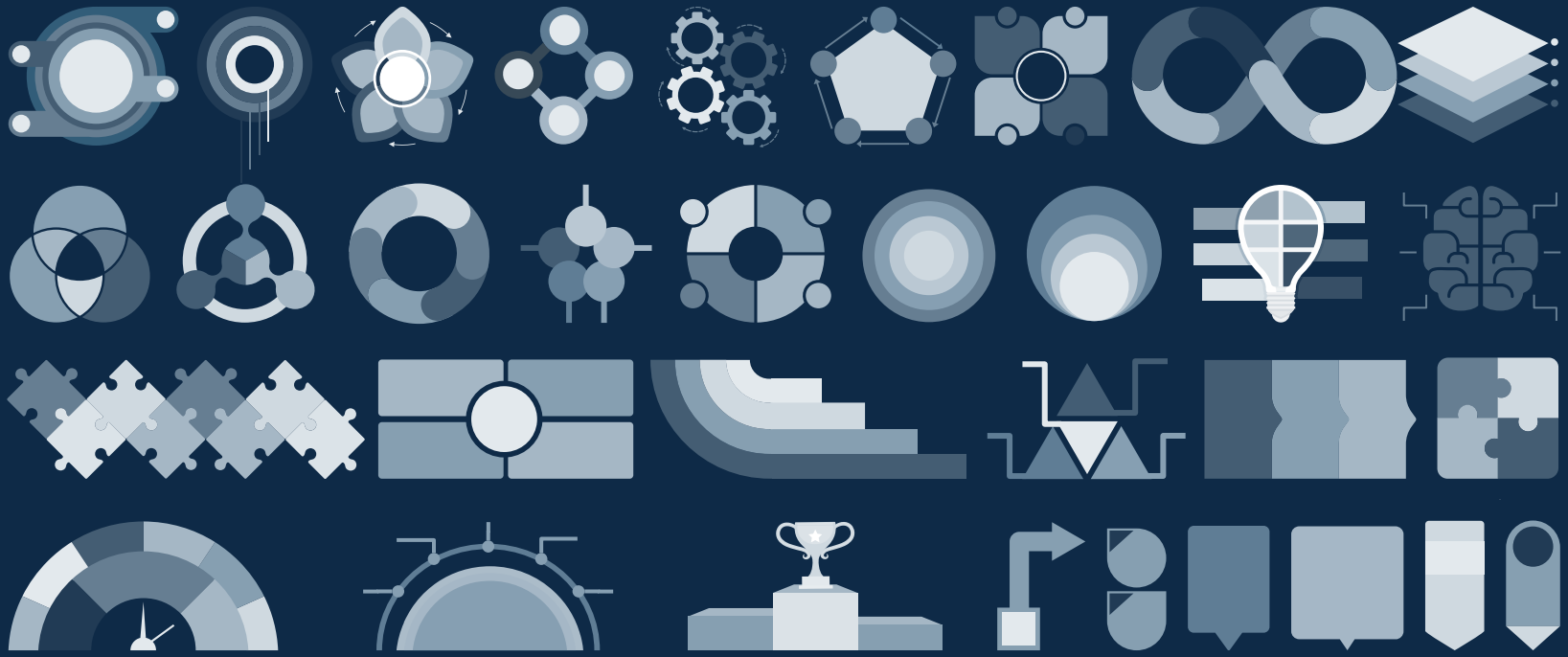

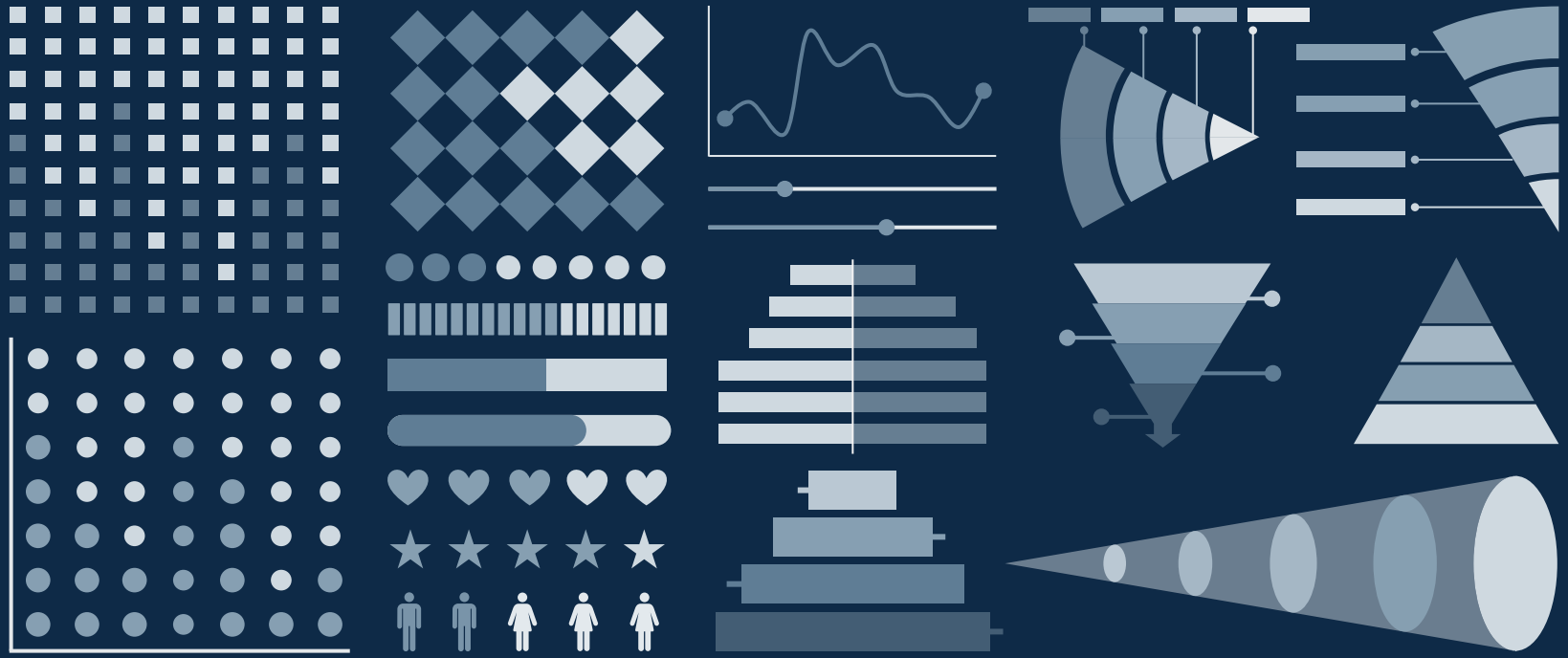

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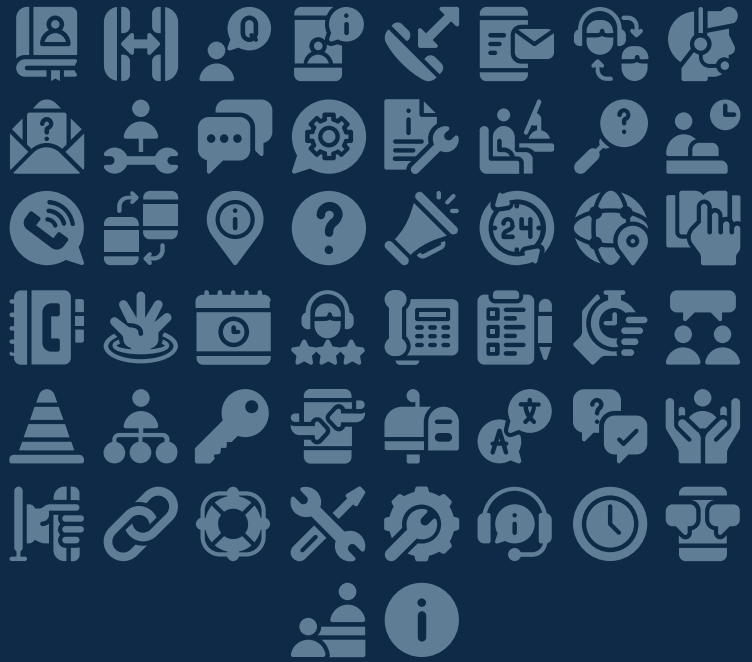

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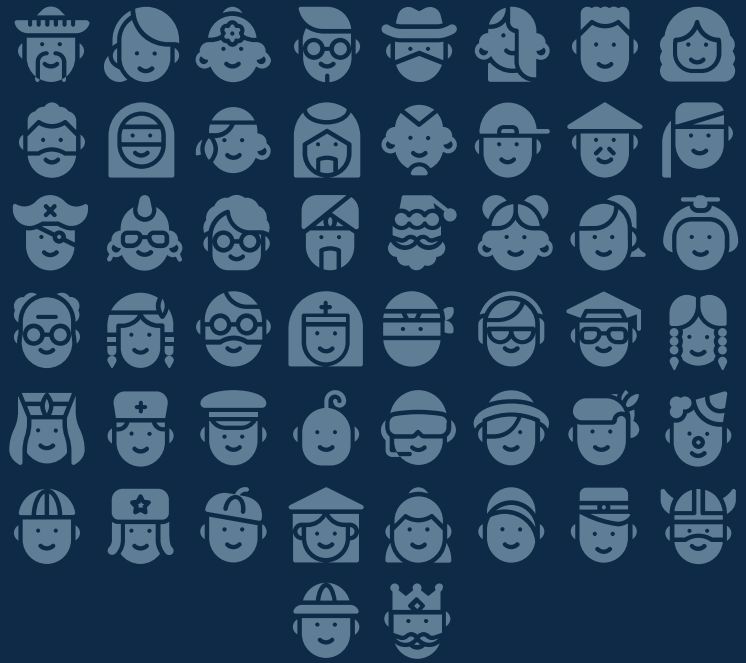

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