DEEPHEALTH

UC15 - BIMCV COVID19

Lab 2: pipeline presentation

Winter School 25/01/2022

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825111.

Contents

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825111.

Dataset Description

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Dataset Description

Data origin

Data from Medical Imaging Databank in Valencian Region Medical Image Bank (BIMCV)

2 datasets

BIMCV-COVID19+ (posi)

Images and medical data from COVID-19 patients

BIMCV-COVID19- (neg)

Images and medical data from NO COVID-19 patients

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Dataset Description

Dataset counts

Posi dataset

- 4.854 subjects
- 13.368 sessions
- 23.527 images

Neg dataset

- 5.201 subjects
- 7.565 sessions
- 18.573 images

Note

There are 810 common subjects between the posi and neg datasets. They have different subject ID in each dataset.

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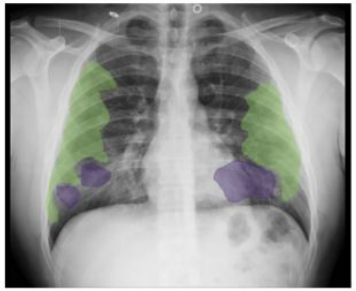
Dataset Description

Samples data



Report: opacidades de aspecto intersticioalveolar parcheadas y bilaterales que predominan en ambos lobulos inferiores sospechosas de infeccion por COVID-19 . senos costofrenicos libres .
Labels: COVID 19, alveolar pattern, interstitial pattern, pneumonia
Locations: costophrenic angle, lobar, bilateral, lower lobe

DICOM Fields
Study Date 20200317
Patient's Sex M
Patient's Birth Date 1986
Modality CR
Manufacturer GE Healthcare
...

Date	Test	Result
17.03.2020	PCR	NEGATIVE
18.03.2020	PCR	NEGATIVE
19.03.2020	IGG	POSITIVE
19.03.2020	IGM	POSITIVE
20.03.2020	PCR	POSITIVE
	...	...

- Image: PNG or NIfTI
- DICOM metadata
- Medical Report
- Labels
- Locations of radiological findings
- COVID tests (only for posi dataset)
- Segmentation (23 images in posi dataset)

[1] From BIMCV COVID-19+ preprint

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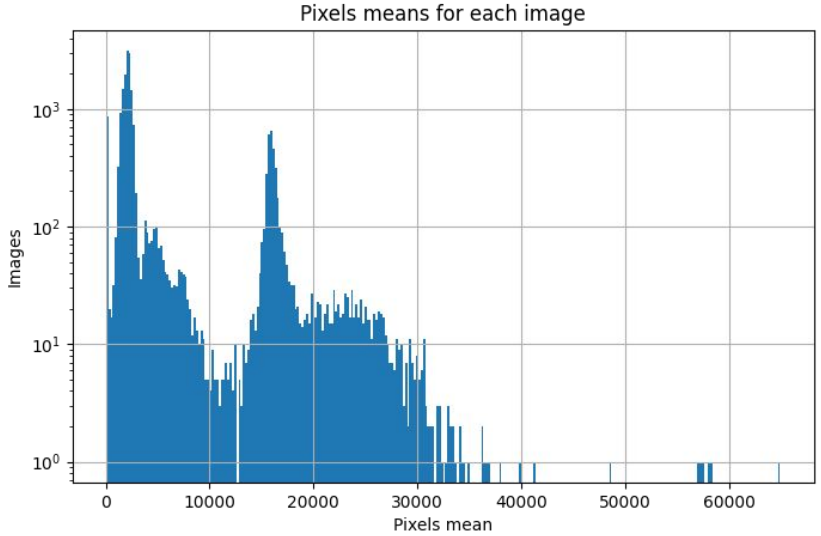
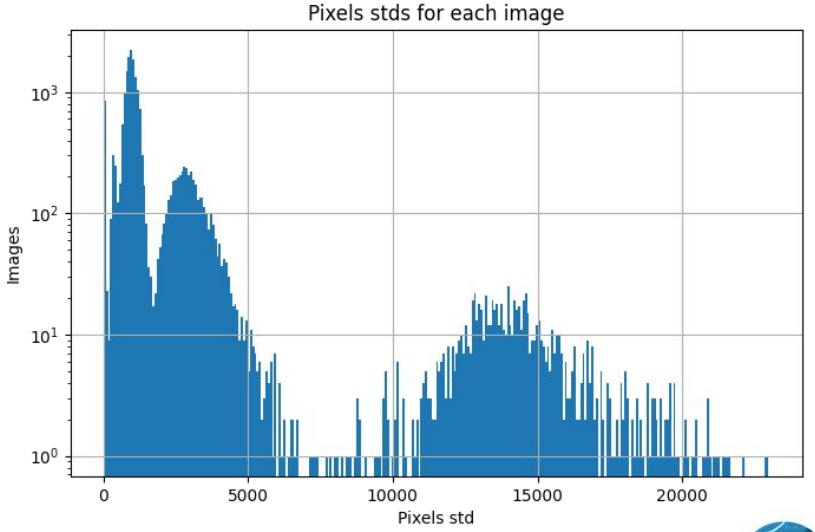
Dataset Description

Images pixel values distribution





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Dataset Description

Images shapes

Top 5 most popular shapes

Shapes	Number of images
2336 x 2836	1537
3480 x 4248	1241
3488 x 4256	1068
3480 x 4240	955
2544 x 3056	929

- 4082 different shapes
  - Most of them with only one image
- High resolution images
  - Between 2k and 3k pixels of height and width

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Dataset Description

Labels

Most popular labels

Label	Count
normal	3412
pneumonia	3214
increased density	2996
COVID 19	2820

- 190 different labels
- Each sample has a list of labels
- There are samples in the **posi** dataset **without** the "COVID 19" label
- There are samples in the **neg** dataset **with** the "COVID 19" label

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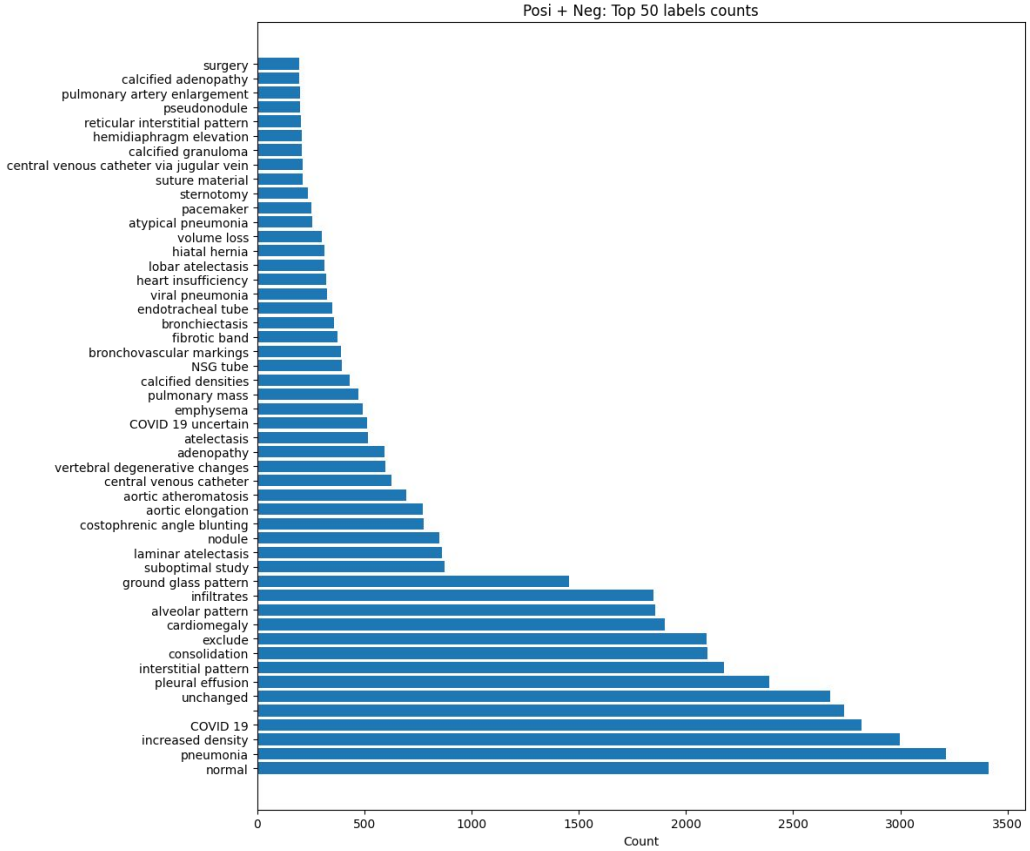
Dataset Description

Labels



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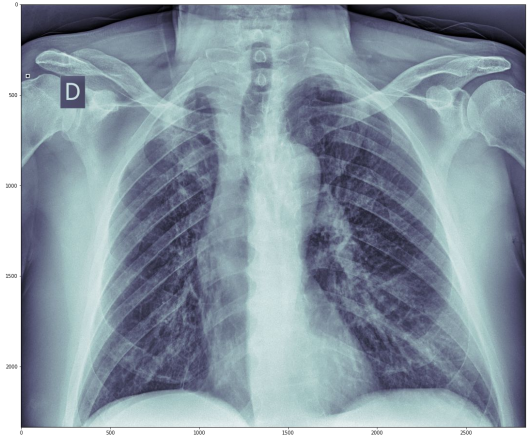
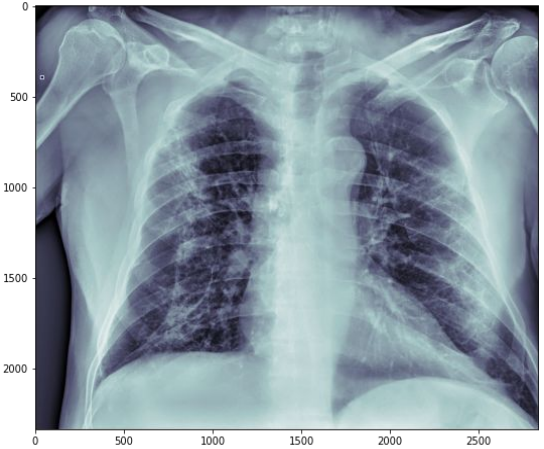
Dataset Description

Labels examples



Pneumonia



Infiltrates

COVID 19

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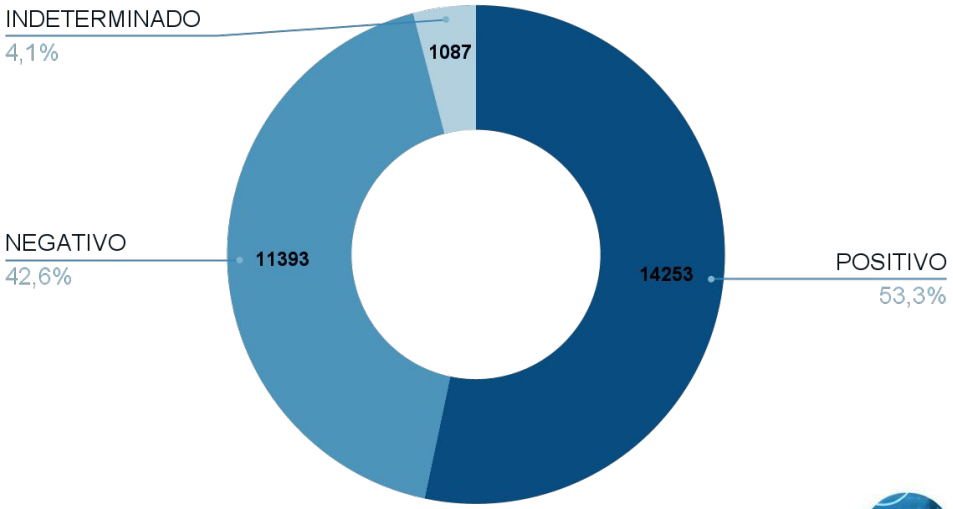
Dataset Description

COVID tests

Tests types

Test	Count
PCR	16442
IGG	4273
ACT	3294
IGM	2724

Tests results



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Data Preprocessing

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Data Preprocessing

Data selection steps

01

Relabel using COVID tests (not used)

Relabel the samples that don't have the "COVID 19" label and they have a positive COVID test

02

Filter by classification labels

Select the samples that have at least one of the labels that are going to be used for classification, e.g. "COVID 19" vs "normal"

03

Filter by view type

Select the samples that are Anterior-Posterior (AP) or Posterior-Anterior (PA)

04

Filter using manually cleaned data

We manually labeled the AP and PA samples from the posi dataset to remove the ones that are not correct

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Data Preprocessing

Image preprocessing steps

01

Invert the "MONOCHROME1" images

The "MONOCHROME1" images have the colors inverted, the background is white and the bones are black

02

Images normalization

Contrast Limited Adaptive Histogram Equalization (CLAHE)

03

Convert to RGB (not used)

Using the jet colormap and dividing the grayscale in ranges to apply the colors

04

Extract lungs ROI

Using manually labeled masks of the lungs. We trained a U-Net to segment the lungs to perform the ROI extraction

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Data Preprocessing

Data splits

- The original dataset doesn't have the training splits defined
- We created a 80-10-10 (train-val-test) split
- The splits are defined at patient level: to avoid having samples from one patient in different splits

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Pipeline

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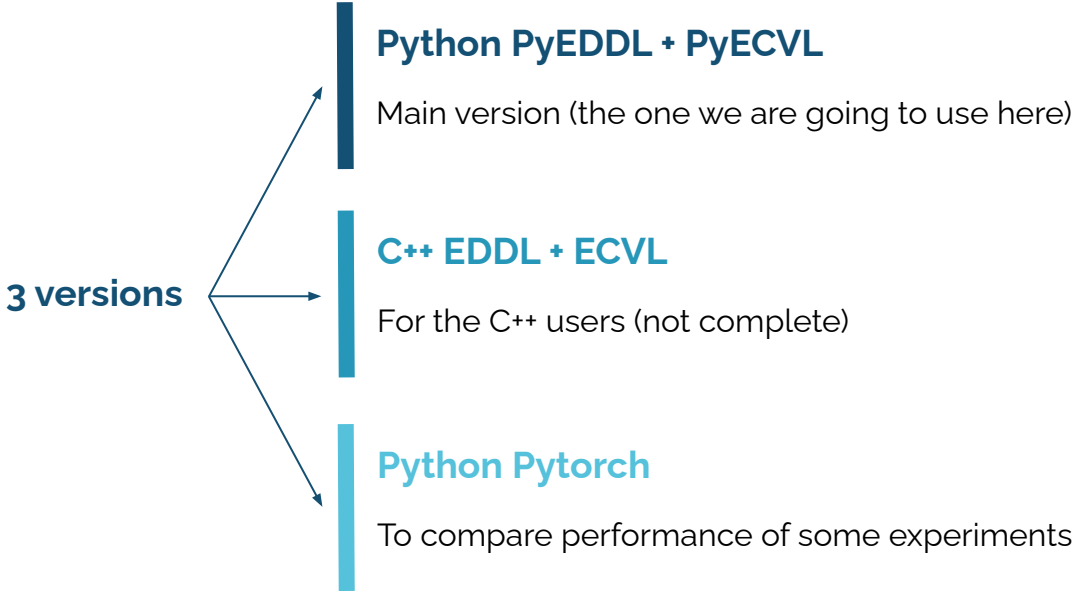
Pipeline

Versions



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Experiments

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Experiments

Configurations of the experiments

Models

Pretrained VGG and ResNet

Regularization

L2 regularization. From $1e^{-2}$ to $1e^{-6}$

Data shape

256x256 and 512x512

Data augmentation

Mirror, Rotation, Brightness and GammaContrast

Optimizers

Adam and SGD
LR: From $1e^{-4}$ to $1e^{-7}$

Losses

2 classes: CE and BCE
4 classes (multilabel): BCE and MSE

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Experiments

Best results

Exp.	Task	Model	Data shape	Optimizer	Learning rate	Regularization	DA
0	**normal** vs **COVID** (With BCE loss)	Pretrained ResNet101	256x256	Adam	$1e^{-5}$	L2($1e^{-5}$)	1.1
1	**normal** vs **COVID** vs **pneumonia** vs **infiltrates** (With BCE loss)	Pretrained ResNet101	512x512	Adam	$1e^{-5}$	L2($1e^{-5}$)	1.1

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Experiments

Experiment 0 results

Test loss (BCE)	Test accuracy (%)	Test balanced accuracy (%)
0,404	88,57	83,57

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Experiments

Experiment 1 results

Metric	normal	COVID	pneumonia	infiltrates
Accuracy	0,843	0,725	0,593	0,627
Precision	0,423	0,821	0,471	0,474
Recall	0,393	0,311	0,3	0,5
F1-score	0,407	0,451	0,366	0,486

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Resources

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Resources

[1] Dataset preprint: https://arxiv.org/abs/2006.01174

[2] BIMCV: https://bimcv.cipf.es/bimcv-projects/bimcv-covid19/

[3] Pipeline: https://github.com/deephealthproject/UC15_pipeline

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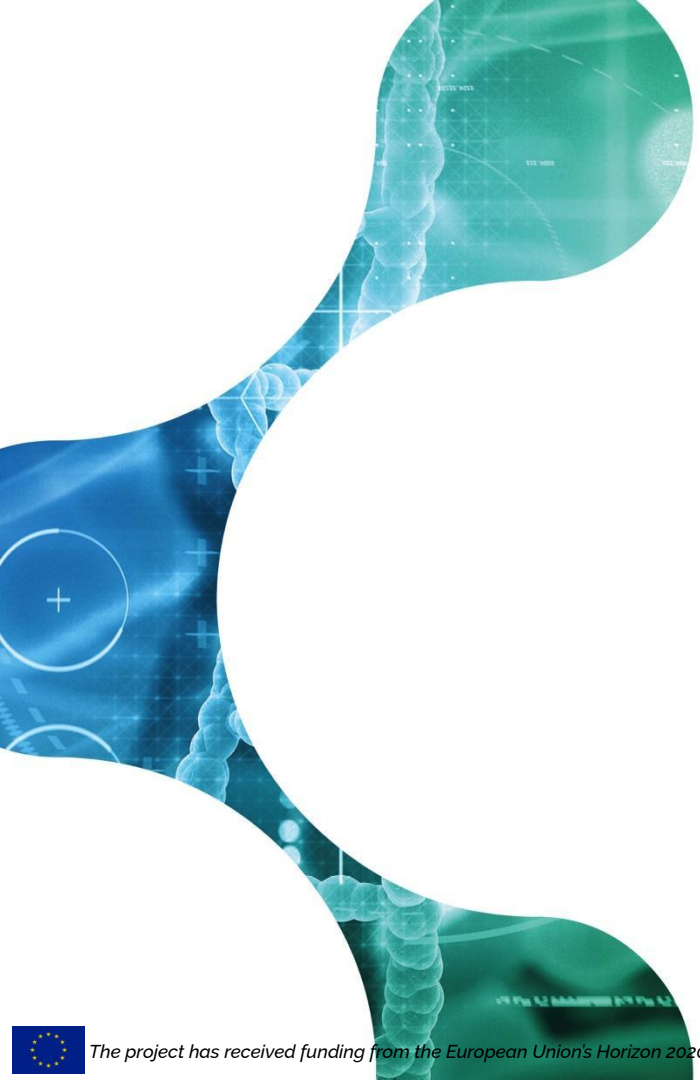

DEEPHEALTH

Thank you!

Álvaro López Chilet

allochi@prhlt.upv.es

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4 main concepts

YOU CAN INCLUDE IMAGES IN THE CIRCLES

ITEM 1

ITEM 2

ITEM 3

ITEM 4

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Our phillosophy

MORE QUALITY LESS QUANTITY

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  - Duis quis viverra urna, in ultricies diam.
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The project

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List items

List of items

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Concepts

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Double images

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Gallery image feature 01

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Gallery image feature 02

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- Triple images
- **PUT YOUR PORTFOLIO IMAGES HERE**

Gallery image feature 01

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Gallery image feature 02

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Gallery image feature 03

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Triple images

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Gallery image feature 03

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- Image with info
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Gallery image feature 04

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Image with info

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Bar charts

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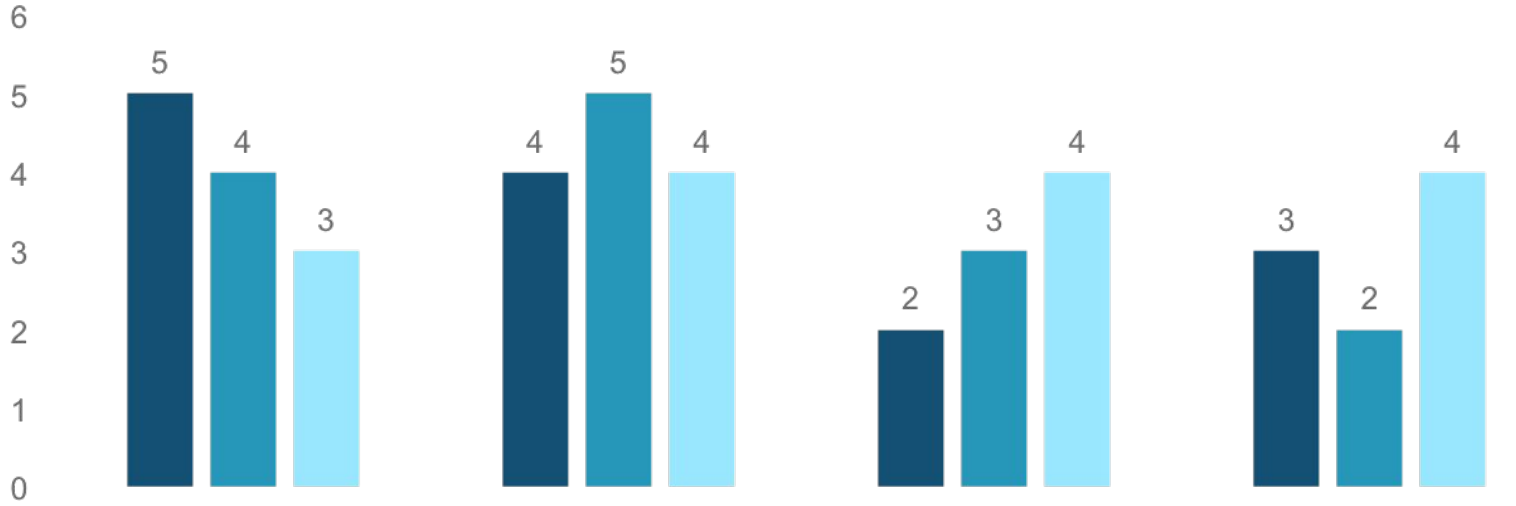

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Sharp line chart

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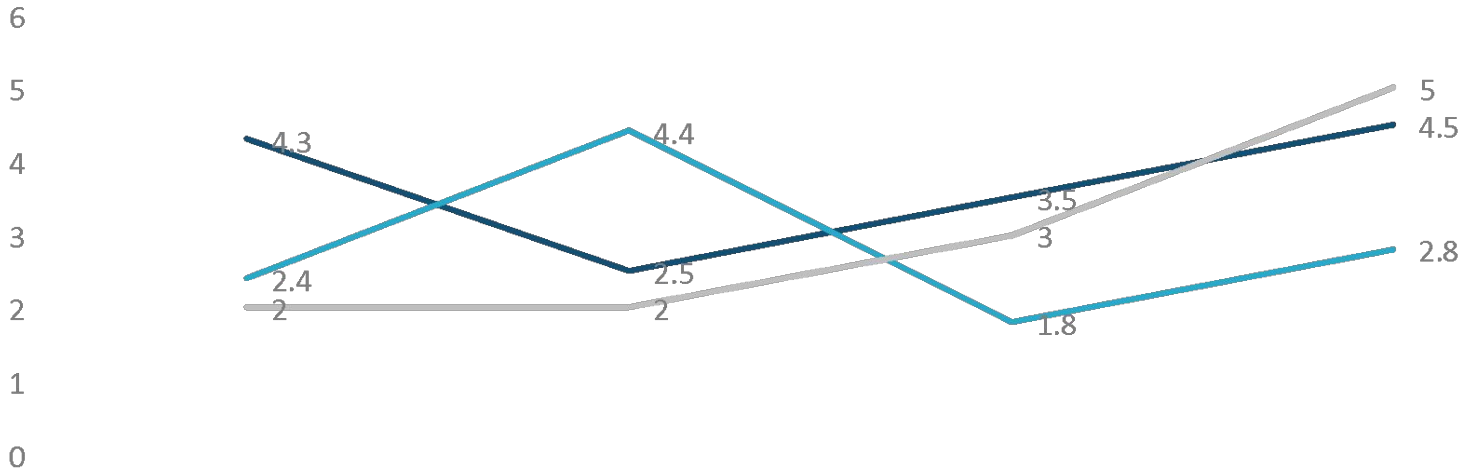

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Area chart

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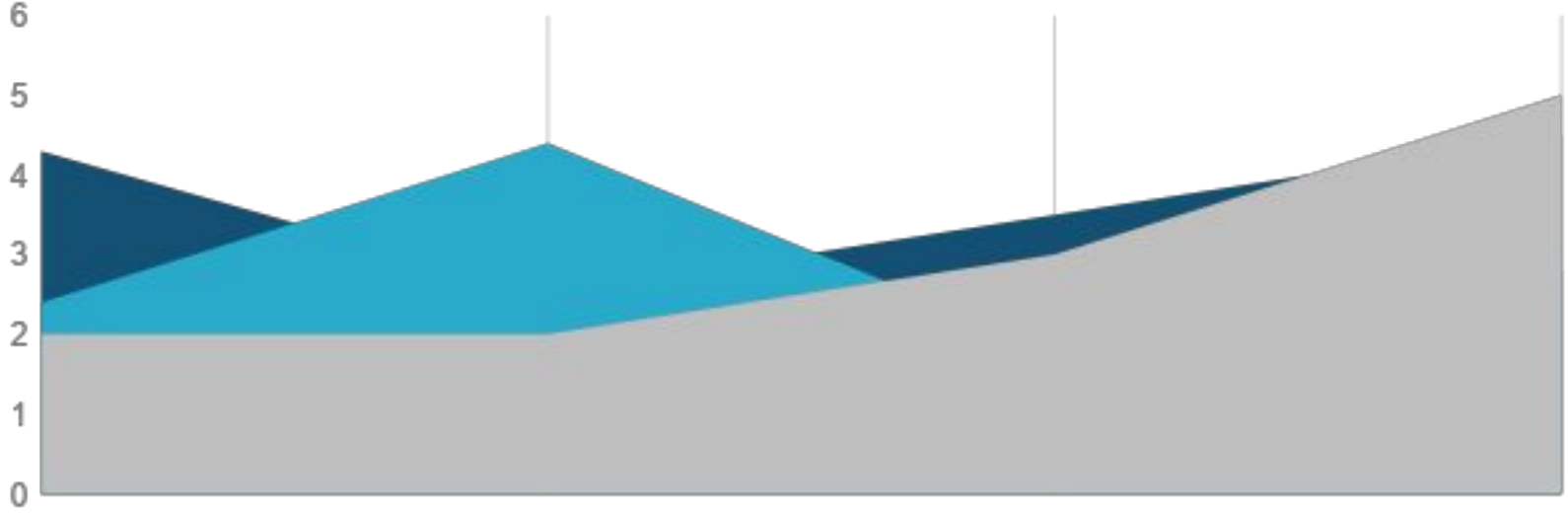

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Curve line chart

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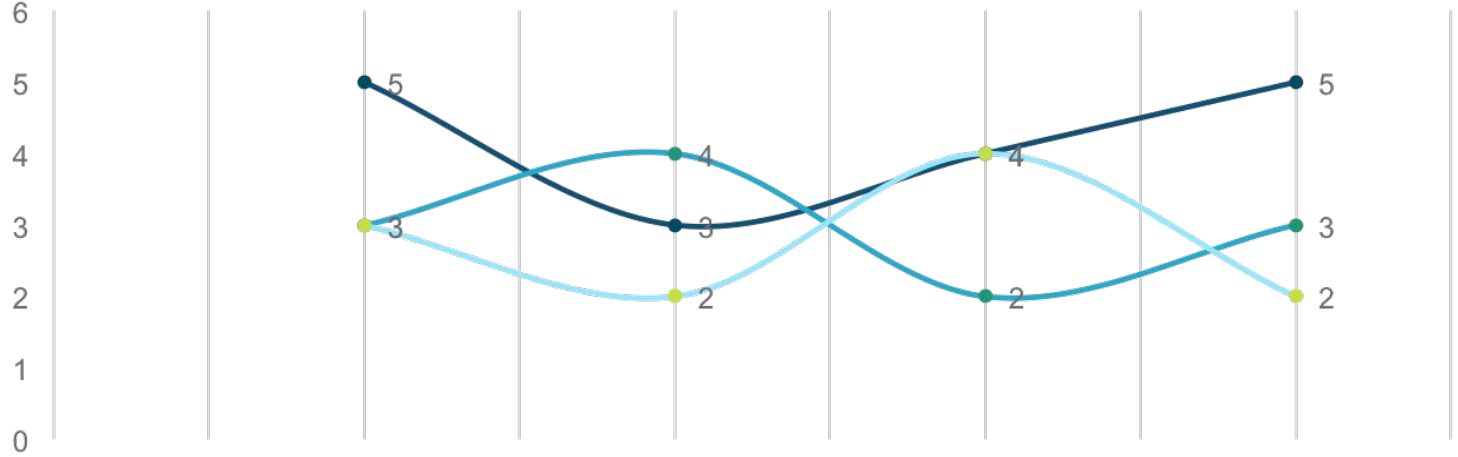

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Pie chart

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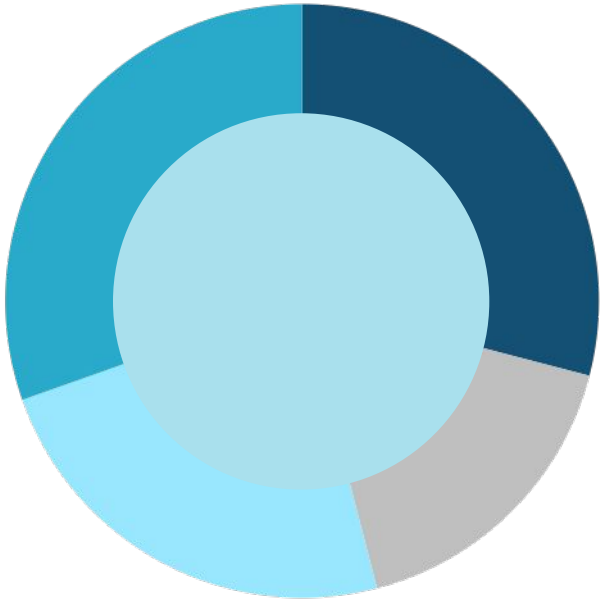

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Timeline one

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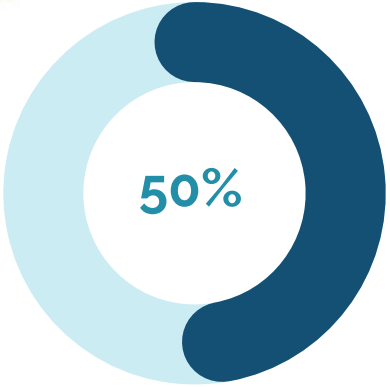

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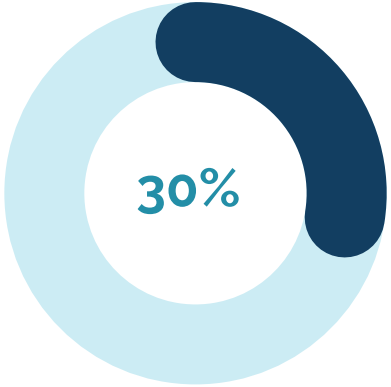

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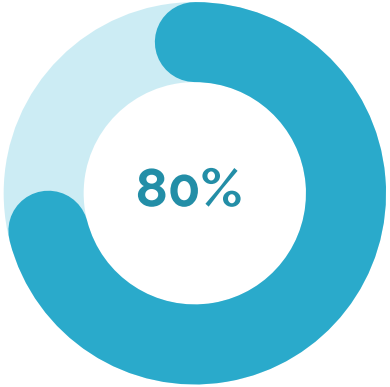

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Waves

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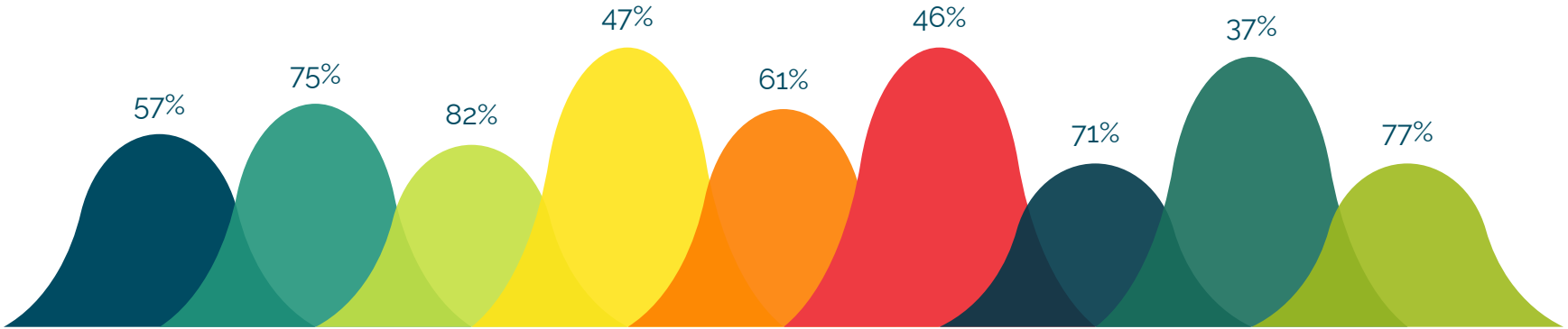

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Reach goals

SUBTITLE EXAMPLE HERE

01

02

03

04

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Resources

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More than see you

TEXT WITH IMAGE PLACEHOLDER

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  - Maecenas ut lacus nec mauris feugiat tristique et in metus. Duis congue eros vel lectus semper semper.
    - Nullam finibus nisl ut ligula vestibulum, ut semper ex suscipit.

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