Practical Deep Learning:
A quick glance

Image classification and object detection

Alberto Castillo Lamas
albertocl@ugr.es

Image classification
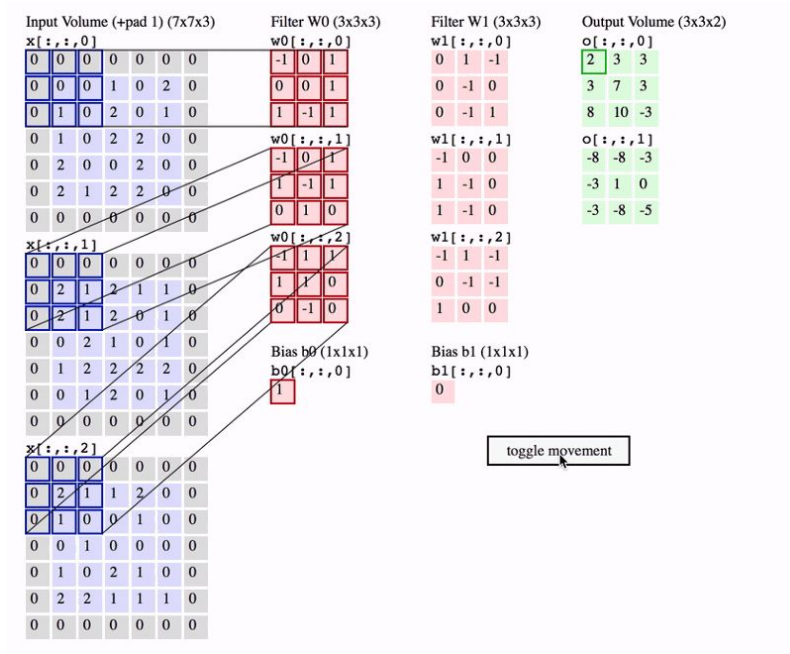
Convolution layers are the eyes of a CNN
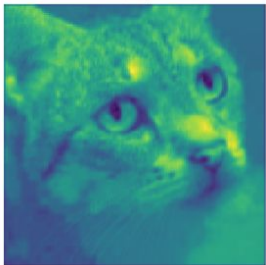

Input

Image classification

Eyes? How CNNs extract features

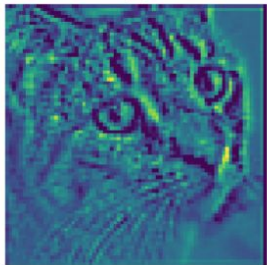Each kernel extract some features

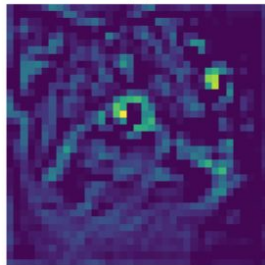More depth -> more abstraction
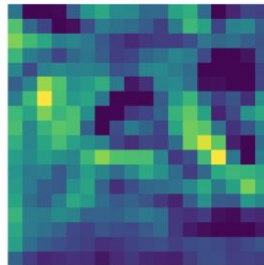

block1_conv1 block2_conv1 block3_conv1 block4_conv1 block5_conv1

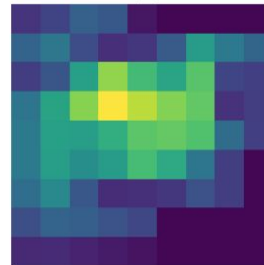# Image classification

Architecture of CNNs:

- Feature extraction
- Dimension reduction

State-of-the-art models

conv (180w + 5b)

maxpool   conv (450w + 10b)

non-linear

non-linear

non-linear

maxpool

fully-connected
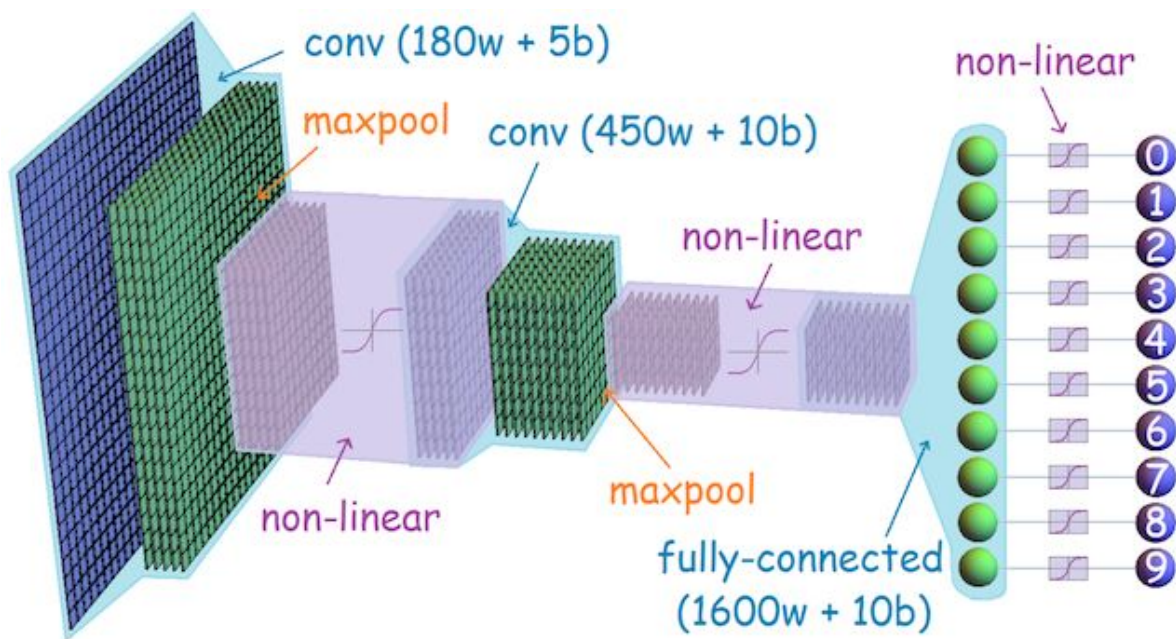(1600w + 10b)

0
1
2
3
4
5
6
7
8
9

Image classification

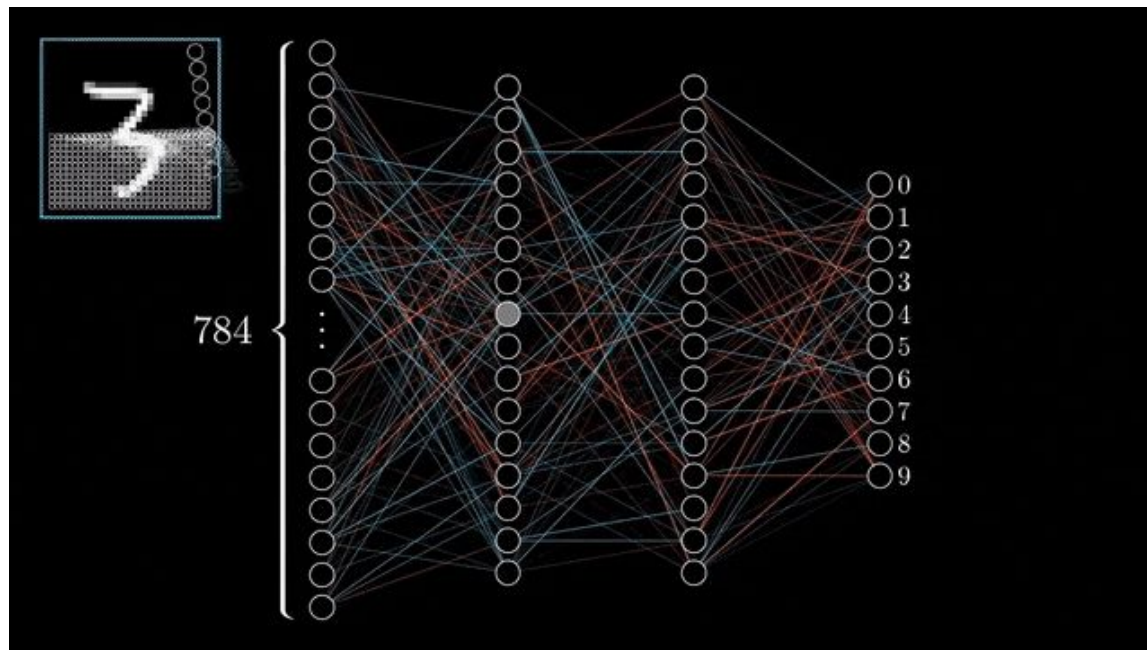Feature extraction is the input of the dense layer classification stage
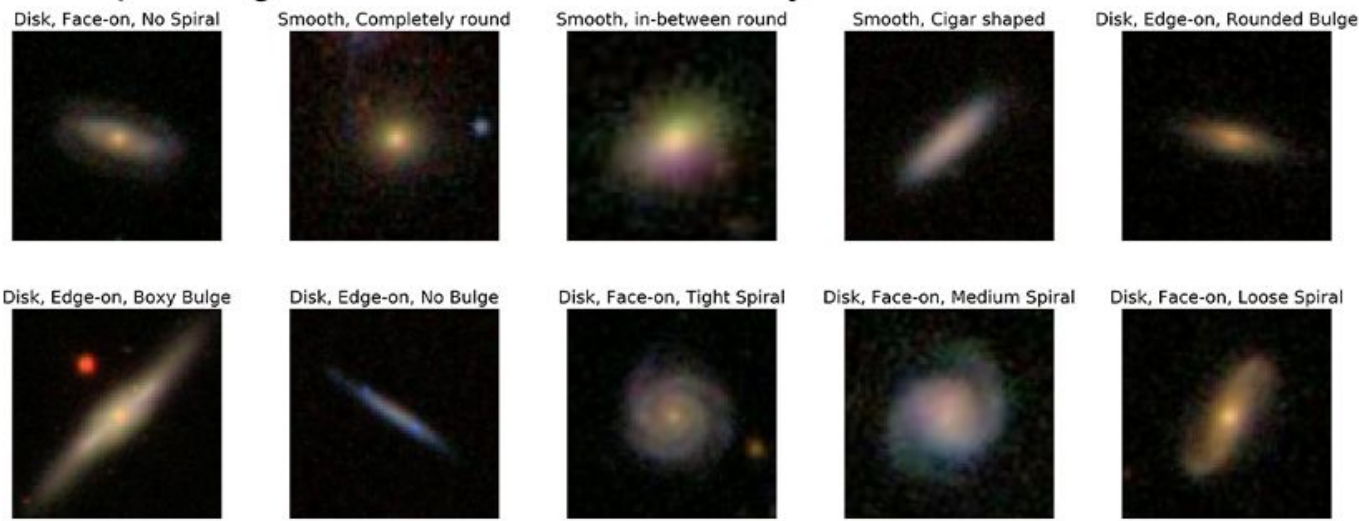
Image classification

Galaxy10 toy dataset

([astroNN web](#))

```
Galaxy10 dataset (21785 images)
├── Class 0 (3461 images): Disk, Face-on, No Spiral
├── Class 1 (6997 images): Smooth, Completely round
├── Class 2 (6292 images): Smooth, in-between round
├── Class 3 (394 images): Smooth, Cigar shaped
├── Class 4 (1534 images): Disk, Edge-on, Rounded Bulge
├── Class 5 (17 images): Disk, Edge-on, Boxy Bulge
├── Class 6 (589 images): Disk, Edge-on, No Bulge
├── Class 7 (1121 images): Disk, Face-on, Tight Spiral
├── Class 8 (906 images): Disk, Face-on, Medium Spiral
└── Class 9 (519 images): Disk, Face-on, Loose Spiral
```

Example images of each class from Galaxy10 dataset

| Disk, Face-on, No Spiral | Smooth, Completely round | Smooth, in-between round | Smooth, Cigar shaped | Disk, Edge-on, Rounded Bulge |
| Disk, Edge-on, Boxy Bulge | Disk, Edge-on, No Bulge | Disk, Face-on, Tight Spiral | Disk, Face-on, Medium Spiral | Disk, Face-on, Loose Spiral |

Object detection

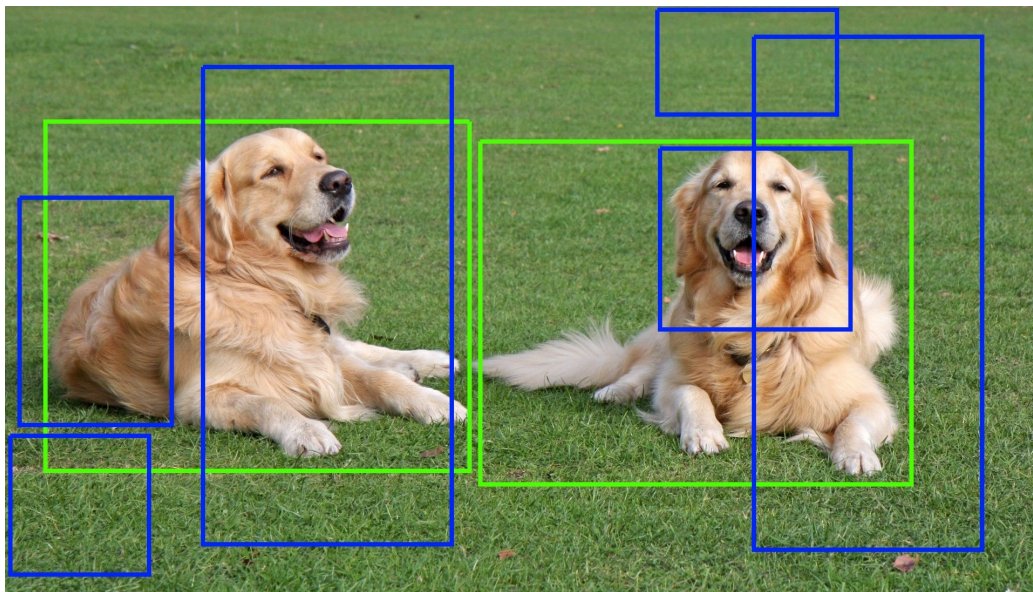Provide the object (class) and location (bounding box/region)
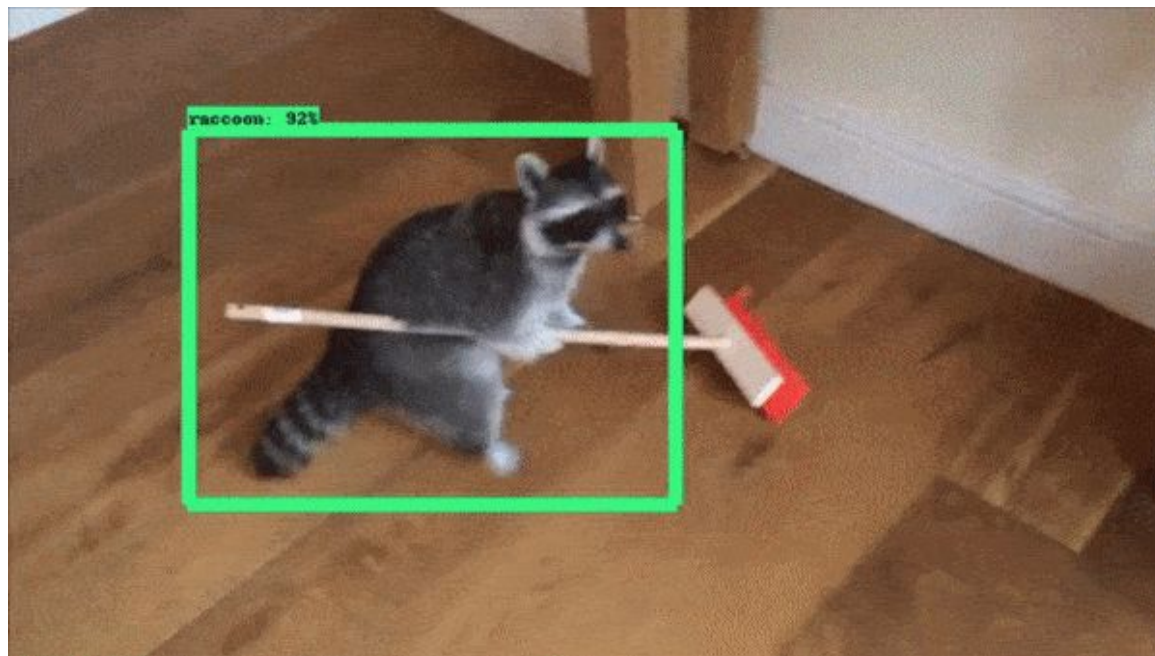
Object detection

Object detection models:

Simultaneously learns

- Region proposal
- Object classification

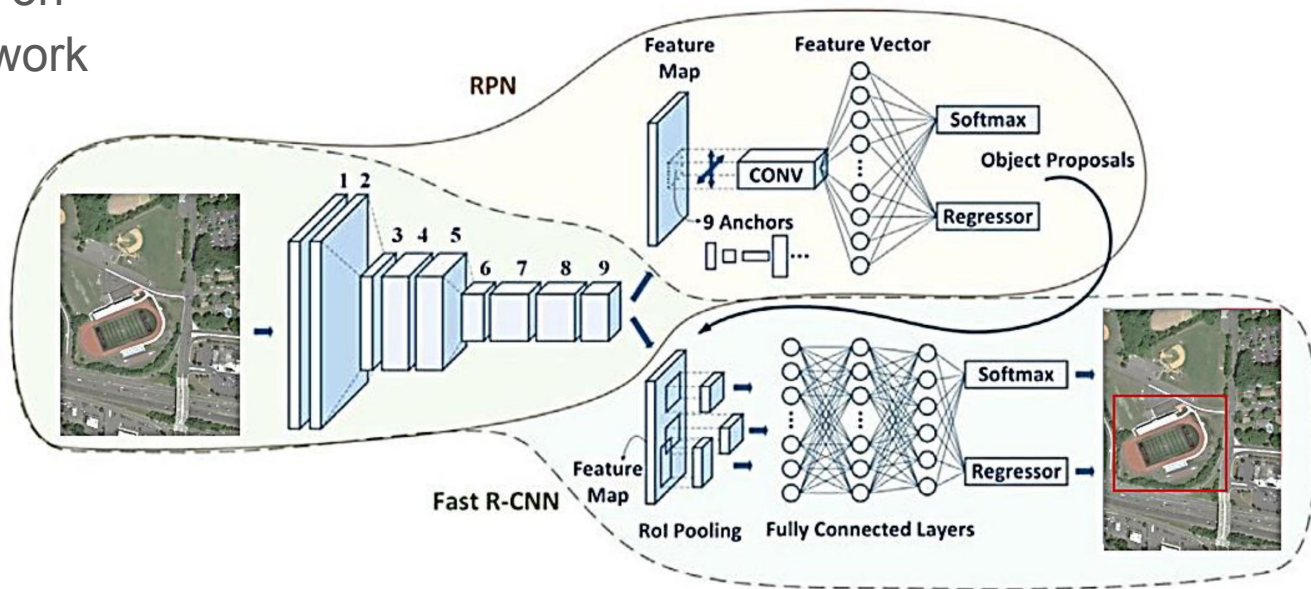Output a set of candidates
regions-class and confidence

Object detection

Faster R-CNN architecture:

Region proposal based on
a Region Proposal Network
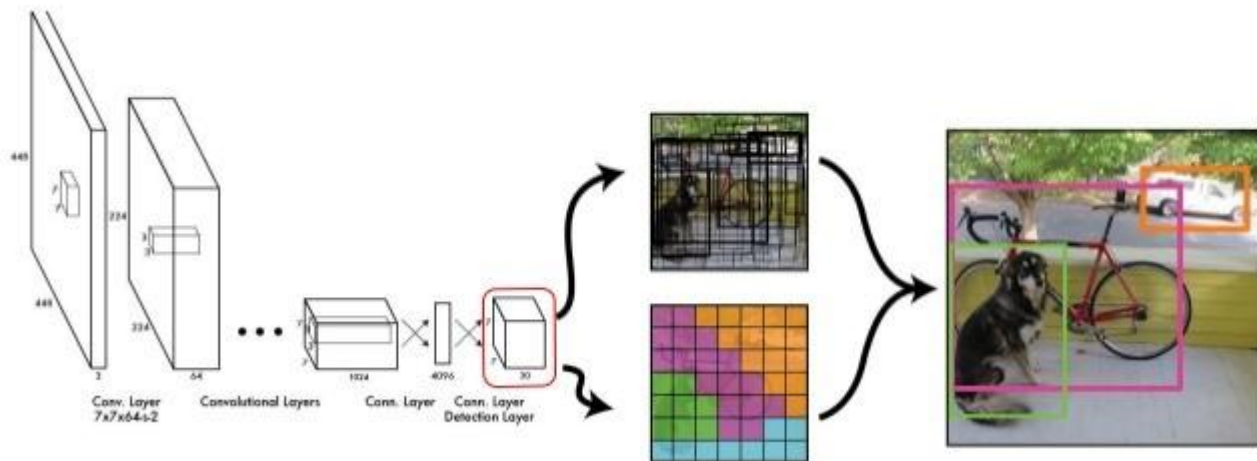
- Slower
- More accurate
- Small objects

Object detection

SSD or YOLO

Region proposal based on grid

- Faster
- Less accurate
- Common objects

YOLO: You Only Look Once

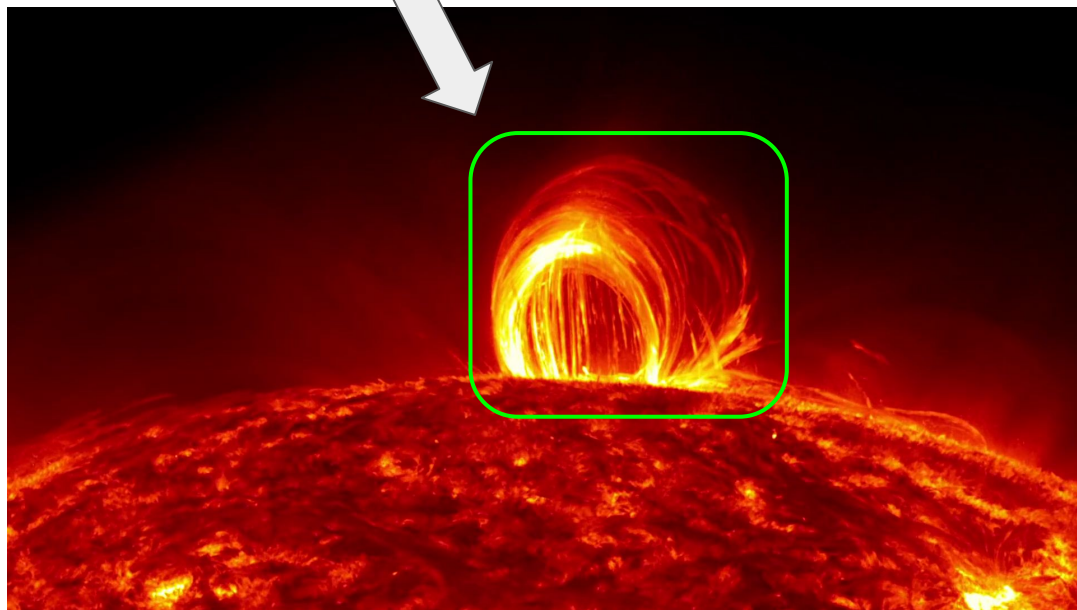# Object detection

Detect fiery looping rain on the Sun

Video

A recurrent pattern in a structured signal can be learned

- RGB images
- Texture, color, shape

(X, Y, W, H)

Location
Color properties
Dimension
Movement

...

Object detection

Detection annotation

- Image information
- Objects
  - Class
  - Region

```xml
1  <annotation>
2      <folder>train</folder>
3      <filename>FieryLoopingRainSun-187.jpg</filename>
4      <path>/home/alcasla/Escritorio/Astro/Solar-FieryLoop/train/FieryLoopingRainSun-187.jpg</path>
5      <source>
6          <database>Unknown</database>
7      </source>
8      <size>
9          <width>1280</width>
10         <height>720</height>
11         <depth>3</depth>
12     </size>
13     <segmented>0</segmented>
14     <object>
15         <name>fiery_loopw</name>
16         <pose>Unspecified</pose>
17         <truncated>0</truncated>
18         <difficult>0</difficult>
19         <bndbox>
20             <xmin>699</xmin>
21             <ymin>376</ymin>
22             <xmax>820</xmax>
23             <ymax>471</ymax>
24         </bndbox>
25     </object>
26 </annotation>
27
```
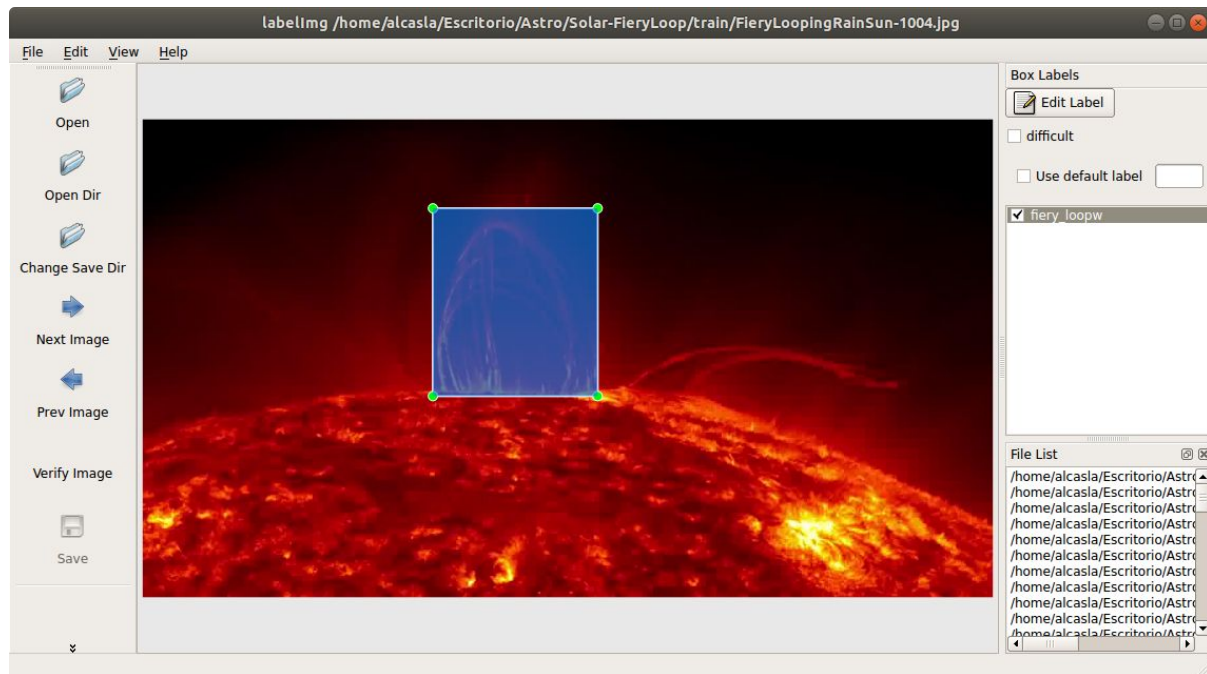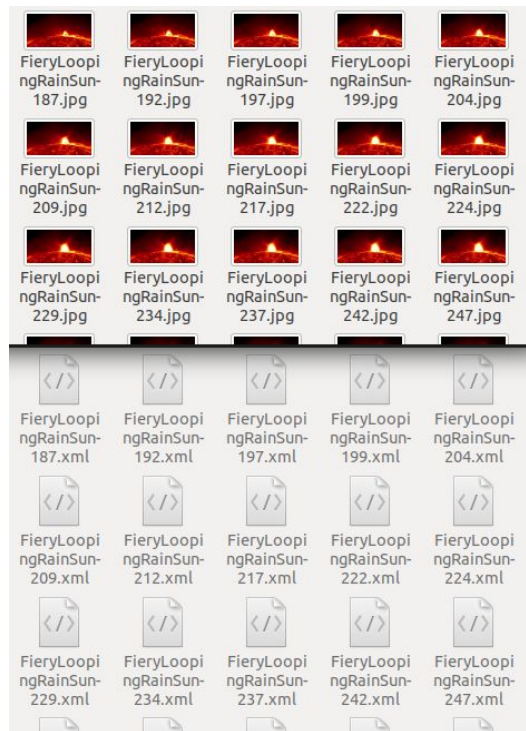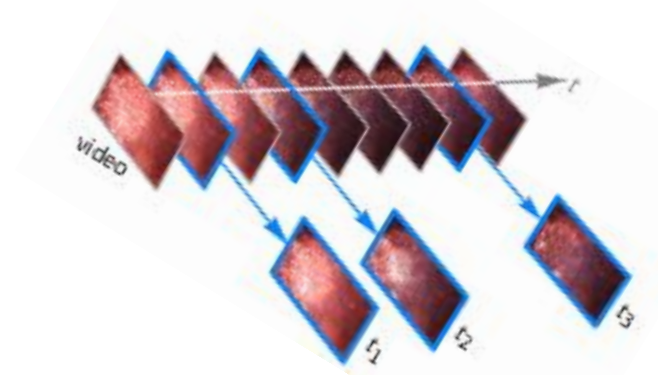
Object detection

LabelImg

Repository

github.com/tzutalin/labelImg
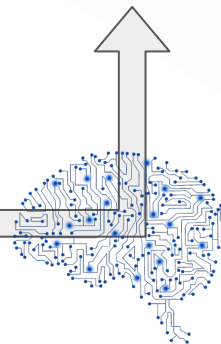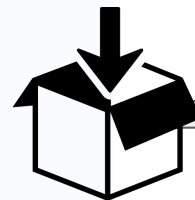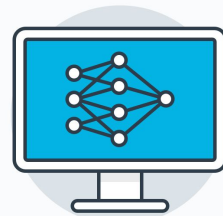
Installer file

tzutalin.github.io/labelImg/

Object detection

Object detection

Object detection framework

github.com/tensorflow/models/tree/master/research/object_detection

Software configuration

github.com/spsrc/somachine2020

Build conda environment using .yml file

Model Zoo

We provide a large collection of models that are trained on several datasets in the Model Zoo.

Guides

- Configuring an object detection pipeline
- Preparing inputs
- Defining your own model architecture
- Bringing in your own dataset
- Supported object detection evaluation protocols
- TPU compatible detection pipelines
- Training and evaluation guide (CPU, GPU, or TPU)

Extras:

- Exporting a trained model for inference
- Exporting a trained model for TPU inference
- Inference and evaluation on the Open Images dataset
- Run an instance segmentation model
- Run the evaluation for the Open Images Challenge 2018/2019
- Running object detection on mobile devices with TensorFlow Lite
- Context R-CNN documentation for data preparation, training, and export