

AI in information extraction

How we can use AI to visualize data from text

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Who am I?

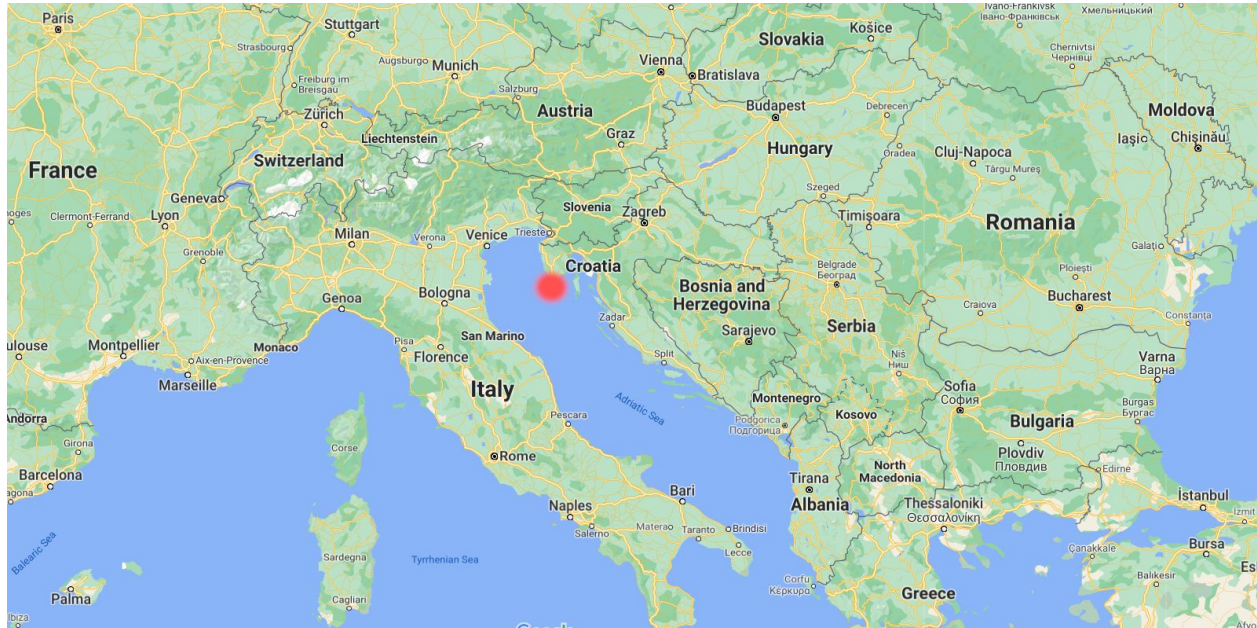
- 15+ years of experience with programming (Java, Haskell, ...) and the last 5+ years experience with AI/ML
- Products using NLP (entity recognition, sentiment analysis):
 - <https://www.emprovio.com/>
 - <https://alenn.ai/>
 - <https://contetino.com/>
- [Mobile application for recognizing the sign language alphabet](#) (for “deaf” people)
- [Application for recognizing breast cancer](#)
- Application for detecting epilepsy (in progress, cooperation with doctors in Croatia)
- Application for chest radiograph diagnosis (CheXpert, in progress, cooperation with a doctor)
- Non-medical:
 - Web application for detecting parking spaces, working on a small device (think Raspberry Pi)
 - Application for recognizing roads and road signs, “Mini Tesla” project on a small car
 - Application for automatic fault detection in automation
- <https://exact-byte.com/en-blog/>
- Not a ML researcher, but ML practitioner - “take” things that really smart people did and try to use them to build something practical

Why this presentation?

- A series of **free** applications/articles to promote myself and my company
- An opportunity to open up doors with a hospital or somebody interested to cooperate
- Taking a relatively known/researched problem(s) and create a ML solution that can actually bring value and show you the result
- Create something that can actually help people?

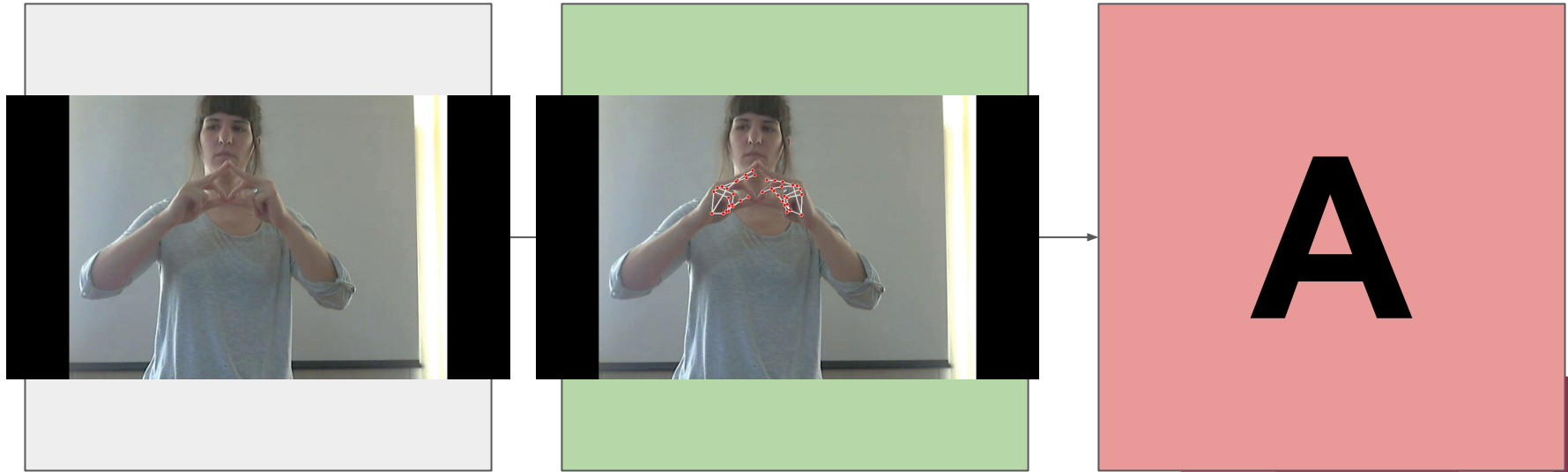
Where do I live?

- Pula, city in Croatia, on the coast, near Italy - <https://en.wikipedia.org/wiki/Pula>



Mobile application for recognizing the sign language alphabet (for deaf people)

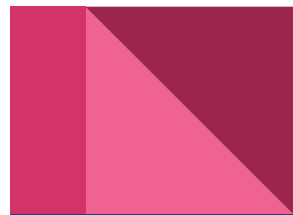
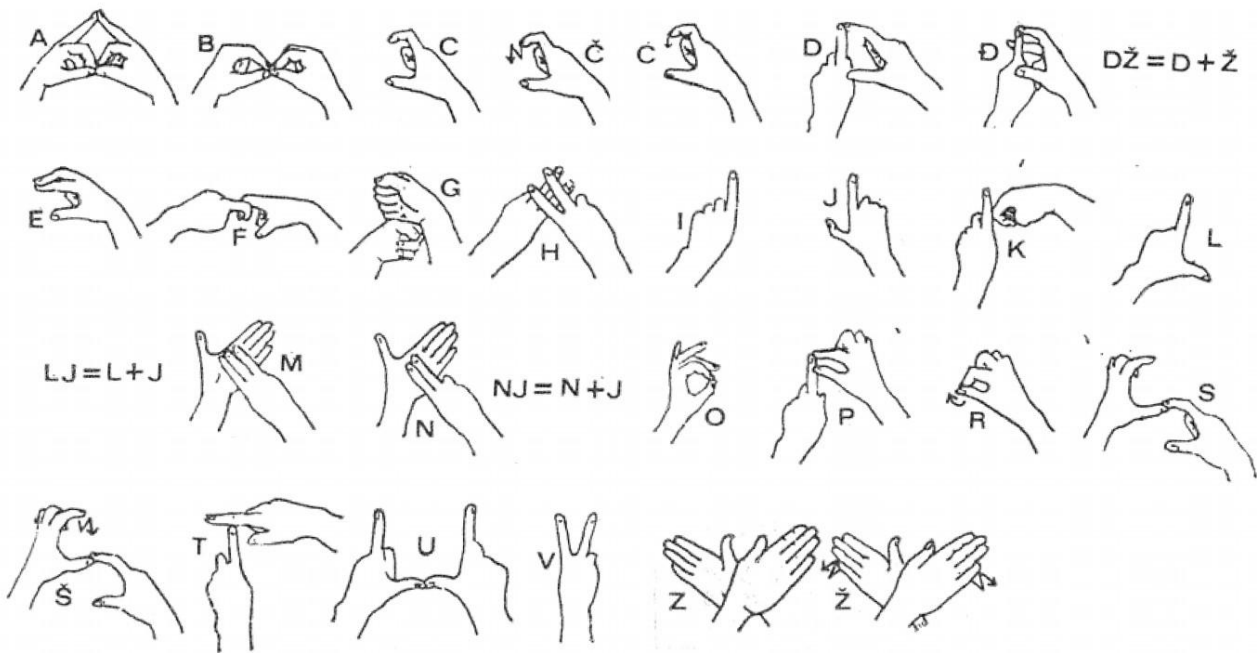
<https://youtu.be/7fXDFWrAA6Q>



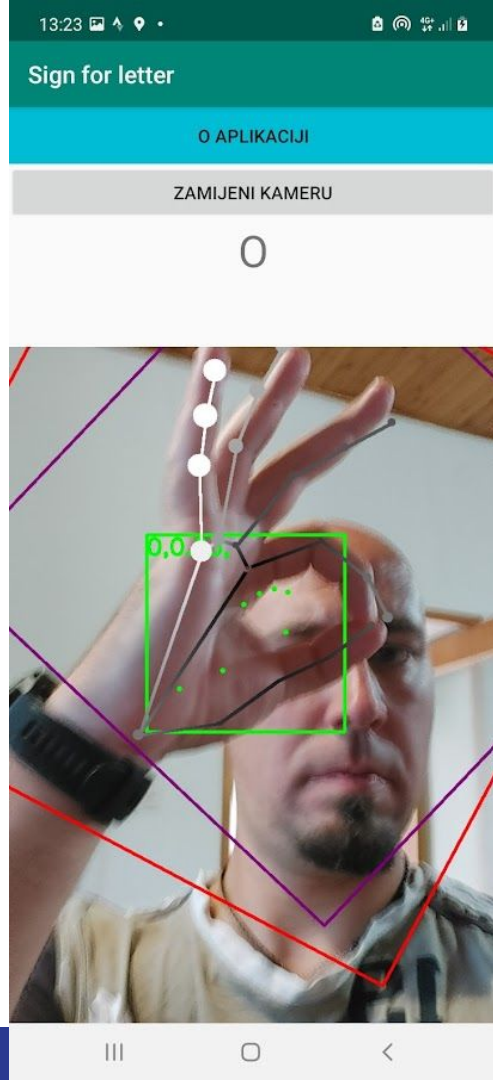
What does it do?

Dvoručna abeceda

HZJ

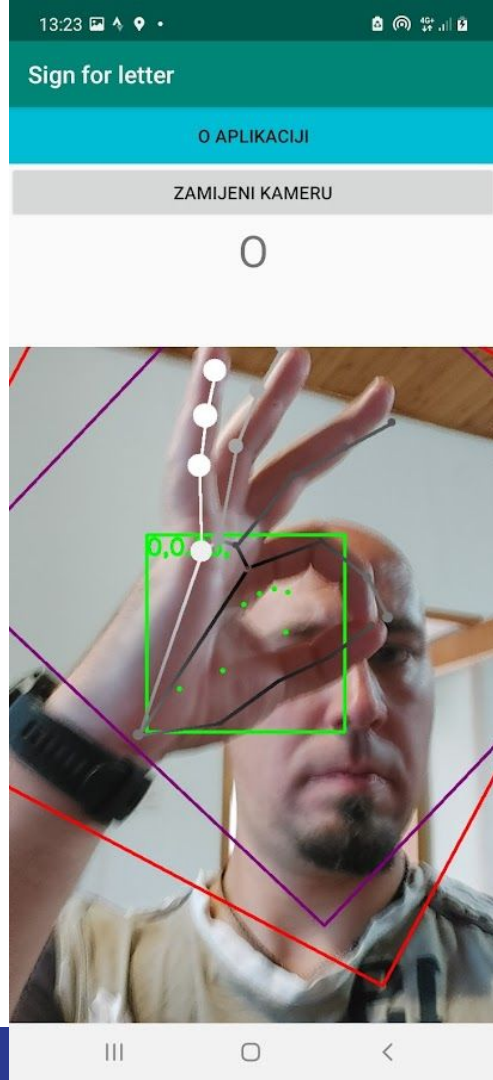


What does it do?



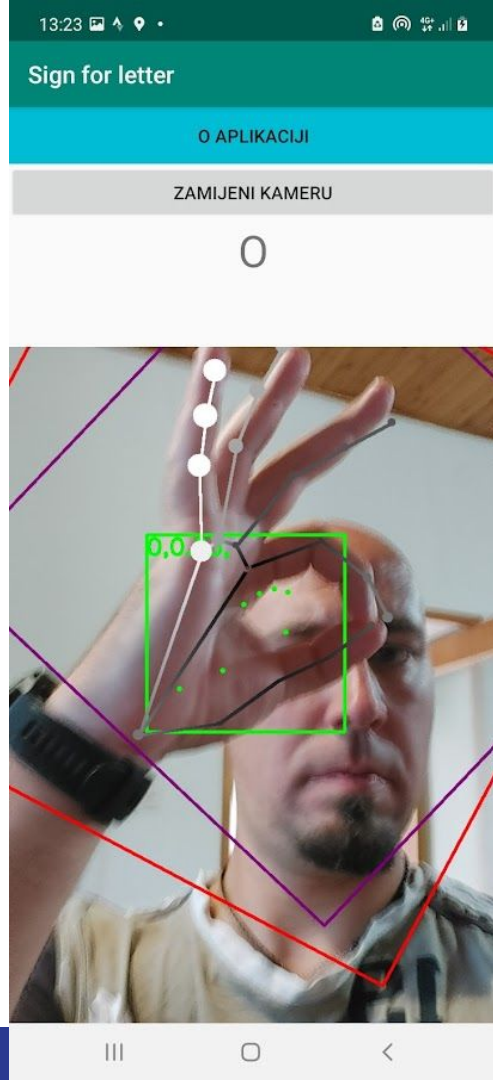
What does it do?

In real-time!



What does it do?

In real-time!
On weak
devices!
GPU
accelerated!



What does it do?

- It helps people? No?
- Demonstrates HZJ hands real-time detection/tracking without any additional tools for the *first time*!
- It shows that AI/ML applications can be very useful to people?
- Demonstrates integration between mobile application and AI/ML (TensorFlow Lite and PyTorch)
- Current limits regarding recognition
- I get to practice uselessness
- <https://play.google.com/store/apps/details?id=com.eb.hsgn>

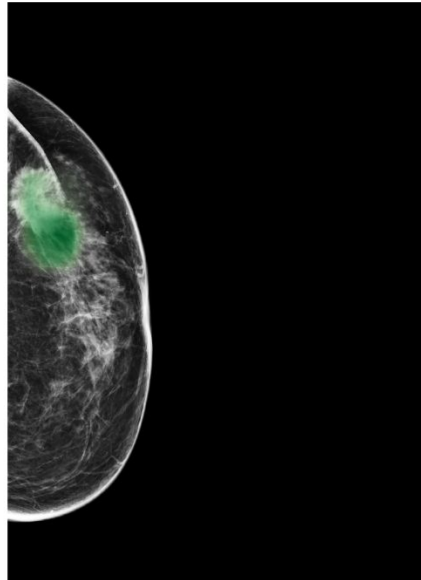
Application for recognizing breast cancer

<https://youtu.be/HBCfqNEEYfU>

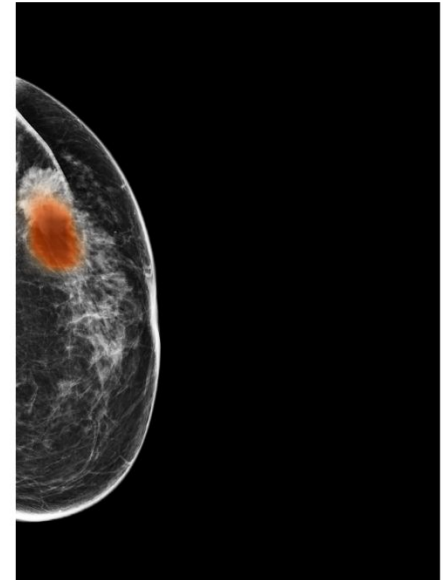
R-CC

Image	Benign (percentage)	Malignant (percentage)
R-CC	39.7 %	99.04 %

benign



malignant



Solution

Program that help in
detection/diagnosis

The user presents the same images
a radiologist would look at and
based on that images, presents the
result back with his own opinion
where the suspect area is and what
should be considered

Result

Program that interprets images from mammography and shows critical regions for each of the mammography images (L-CC, R-CC, L-MLO, R-MLO)



OB Pula

A doctor checked the results of the program after training (*fine-tuning*) the program on **1000** images (OB Pula has around **6000** images yearly)

After the analysis of the results I got after analyzing around 30 patients on the program you provided,

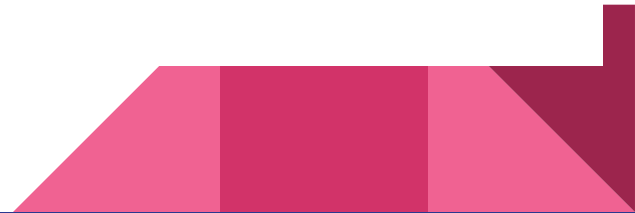
I consider that the program can help in the detection of the shadows that the radiologists needs to analyze, but not in (more) certain differentiation of benign and malignant shadows.

The current program thus cannot be of a significant help to the radiologist.

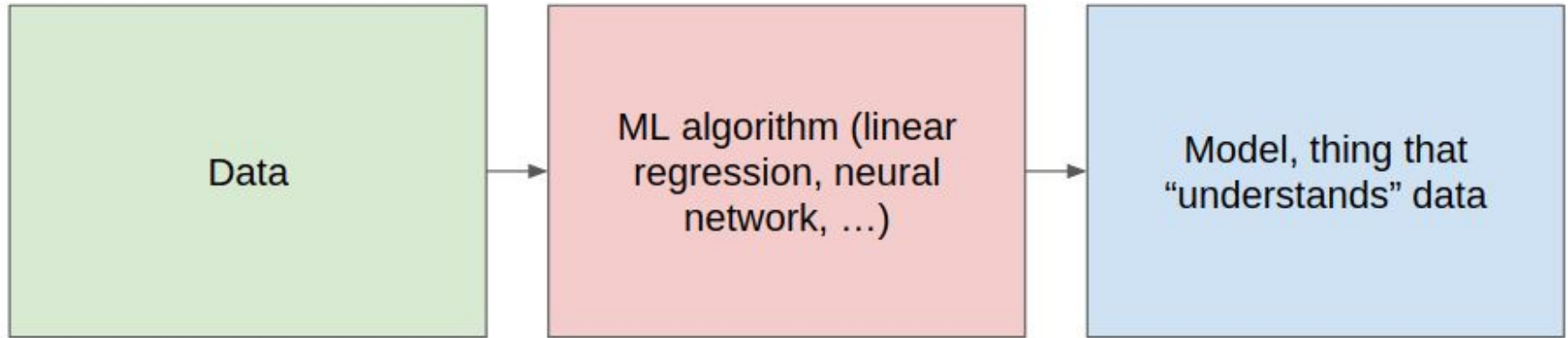
Implementation of the program

- Ideally, we would like to have a team of doctors who would annotate our data set
- Realistically, you first need to gain their trust and show them something that works
- We want to be as time efficient as possible, not waste the precious time doctors have and show them something valuable
- So, a lot of data (images), deep neural network to *exclude feature extraction as much as possible*, and a result which can be visually interpretable
- Based on the work of “An interpretable classifier for high-resolution breast cancer screening images utilizing weakly supervised localization” - <https://arxiv.org/abs/2002.07613>
- We requested images from patients, BI-RADS grading
- Wrapped the application in a web application, made some minor modifications/tweaks

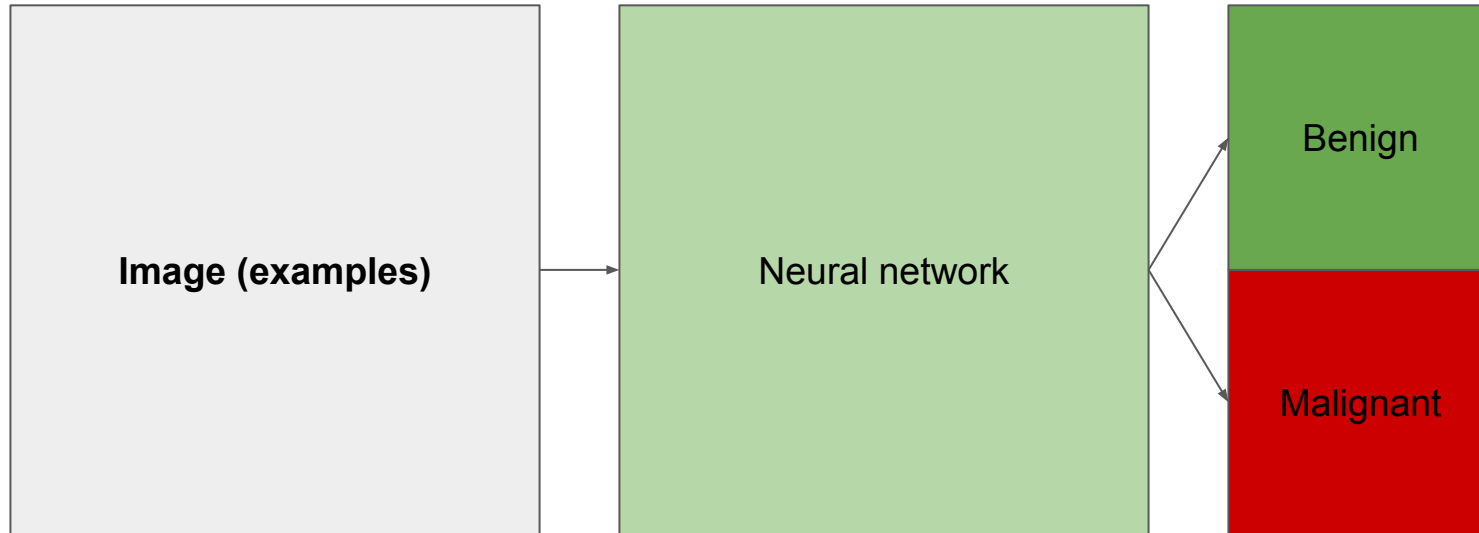
Machine learning



Machine learning



Machine learning



CheXpert

<https://stanfordmlgroup.github.io/competitions/chexpert/>

The logo for CheXpert is displayed on a red background with a white hexagonal grid pattern. The word "CheX" is written in a white, cursive script font, while "PERT" is written in a white, bold, sans-serif font directly below it.

CheX
PERT

A Large Chest X-Ray Dataset And Competition

CheXpert

- Cooperation with a doctor, dr. Marko Bukna, he was impressed
- Decent results, comparable to SOTA (State Of The Art)
- Model has achieved radiologist-level performance (even on baseline)
- Very big dataset (400+ GB)
- Takes long to train/test/modify
- Ensembles take even longer
- Ended up using GPU/TPU (Tensor Processing Unit) for training the mc
 - 320, BS=256, NVIDIA V100 -> 3551.679718017578 seconds ~ 1 hour / epoch
 - 320, BS=512, 4 X NVIDIA T4 -> 4221.291954755783 seconds ~ 70 min / epoch
 - 320, BS=128, NVIDIA GeForce RTX 2080 Super with Max-Q Design -> 3449.3205976486206 se
 -
 - 224, BS=256, NVIDIA GeForce RTX 2080 Super with Max-Q Design -> 1529.4829297065735 se
 - 224, BS=256, NVIDIA GeForce RTX 3080 -> 1100.0 seconds ~ 16 min / epoch

Leaderboard

Will your model perform as well as radiologists in detecting different pathologies in chest X-rays?

Rank	Date	Model	AUC	Num Rads Below Curve
1	Aug 31, 2020	DeepAUC-v1 <i>ensemble</i> https://arxiv.org/abs/2012.03173	0.930	2.8
2	Sep 01, 2019	Hierarchical-Learning-V1 (ensemble) <i>Vingroup</i> <i>Big Data Institute</i> https://arxiv.org/abs/1911.06475	0.930	2.6
3	Oct 15, 2019	Conditional-Training-LSR <i>ensemble</i>	0.929	2.6
4	Dec 04, 2019	Hierarchical-Learning-V4 (ensemble) <i>Vingroup</i> <i>Big Data Institute</i> https://arxiv.org/abs/1911.06475	0.929	2.6
5	Oct 10, 2019	YWW(ensemble) <i>JF&NNU</i> https://github.com/jfhealthcare/Chexpert	0.929	2.8

Conclusion

- ***If you are a doctor/medical staff and want to join me in this project in any way - do contact me, I'm considering actually partnering to implement ideas like these ones - radiology, cytology/pathology***
- ***The applications I presented were applications I did for free, in my (unpaid) time***
- No hospital, private or public and no KBC did not respond to my emails or showed interest in cooperation, except OB Pula and Selvita (Vesna Erakovic Haber, Selvita).

NLP

- **NLP** = Natural Language Processing
- Field of processing “unstructured data/text”
- A little bit of history:
 - Neural network
 - RNN
 - LSTM
 - Attention based neural network (<https://alenn.ai/>, at that point a couple of months old research)
 - Transformer (BERT, **GPT**, ...), pretrained
- Fields of **NLP**:
 - Entity/Sentiment analysis (<https://contetino.com/>)
 - Question and answering (<https://alenn.ai/>)
 - ...
- https://en.wikipedia.org/wiki/Outline_of_natural_language_processing#Processes_of_NLP

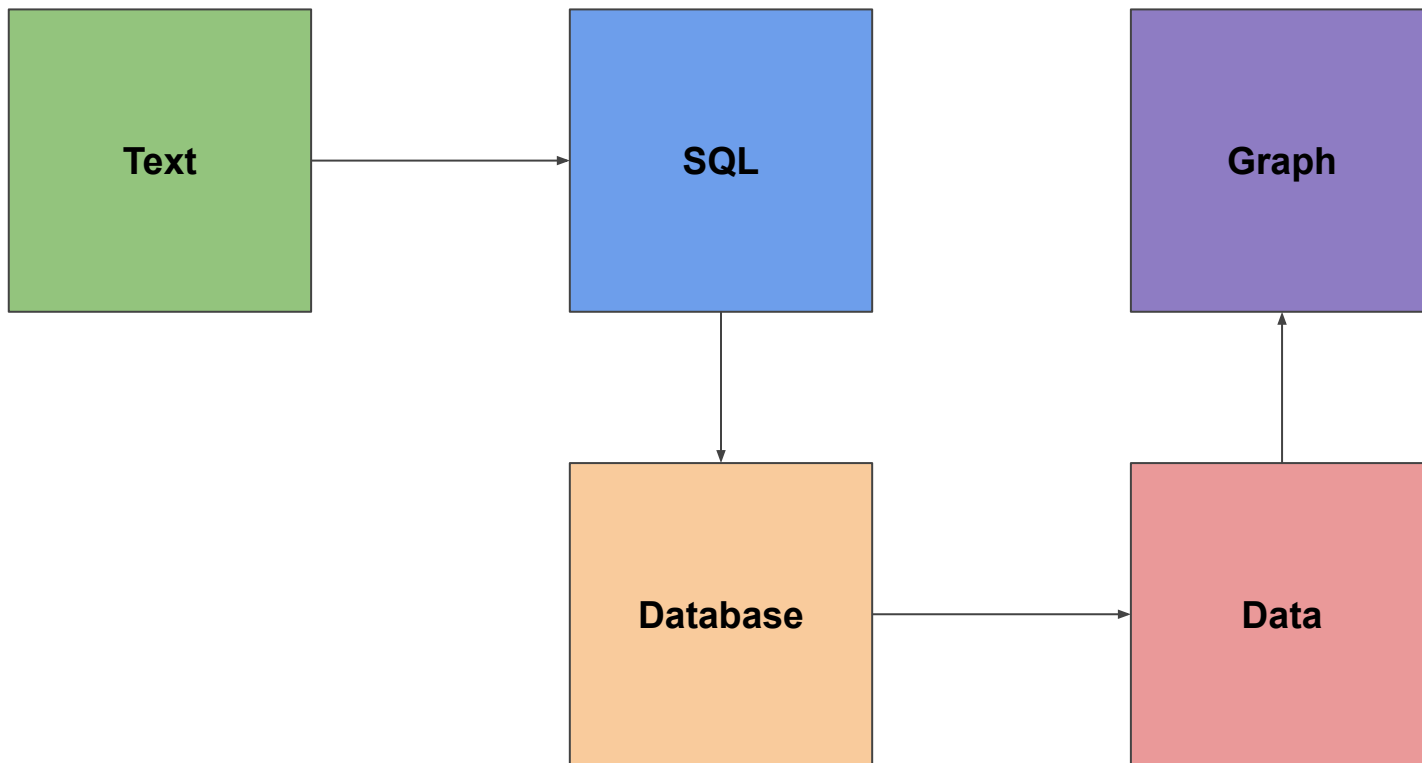
OpenAI

- GPT-3 - <https://www.theguardian.com/commentisfree/2020/sep/08/robot-wrote-this-article-gpt-3>
- OpenAI, AI research (Elon Musk, ...):
 - Jukebox
 - AlphaFold (protein folding - Cancer?, Alzheimer's disease, Parkinson's disease, Huntington's disease, Creutzfeldt-Jakob disease, cystic fibrosis, Gaucher's disease and many other degenerative and neurodegenerative disorders)
 - ...
 - GPT-3
- Google DeepMind:
 - Google GO
 - ...
- Very rich research contributing
- A massive budget
- “Competing” against DeepMind, Google company

Application

- Limited, currently showing a simple example with **no training**
- We need inputs to train it so it can actually learn how to respond to your domain queries (finance, tourism, ...)
- Three simple tables in the application
- The application can be adapted to your needs to work in your domain

Application process



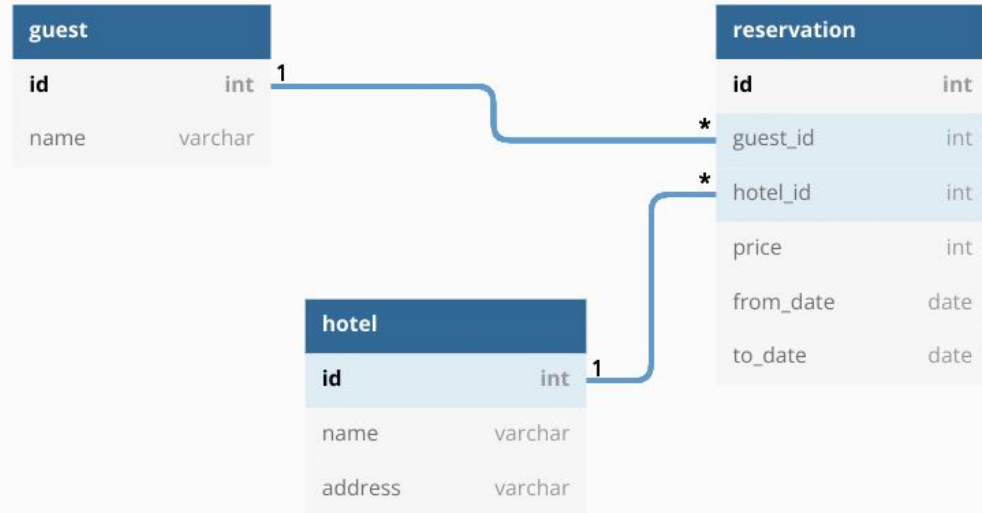
Text to SQL

- "A query to see the top ten most profitable hotels in the last 3 years"
- "A query to see the number of guests in hotel Splendid"
- "A query to see the average number of guests in July in all hotels"

NO TRAINING, WE DIDN'T TEACH IT ANYTHING!

Hidden assumption - the year is 2019

ER diagram



Text to SQL

- "A query to see the top ten most profitable hotels in the last 3 years"

```
SELECT TOP 10 hotel.NAME
FROM reservation
JOIN hotel
    ON reservation.hotel_id = hotel.id
WHERE reservation.from_date >= Dateadd(yyyy, -3, Getdate())
GROUP BY hotel.NAME
ORDER BY Sum(reservation.price) DESC
```

Text to SQL

- "A query to see the number of guests in hotel Splendid"

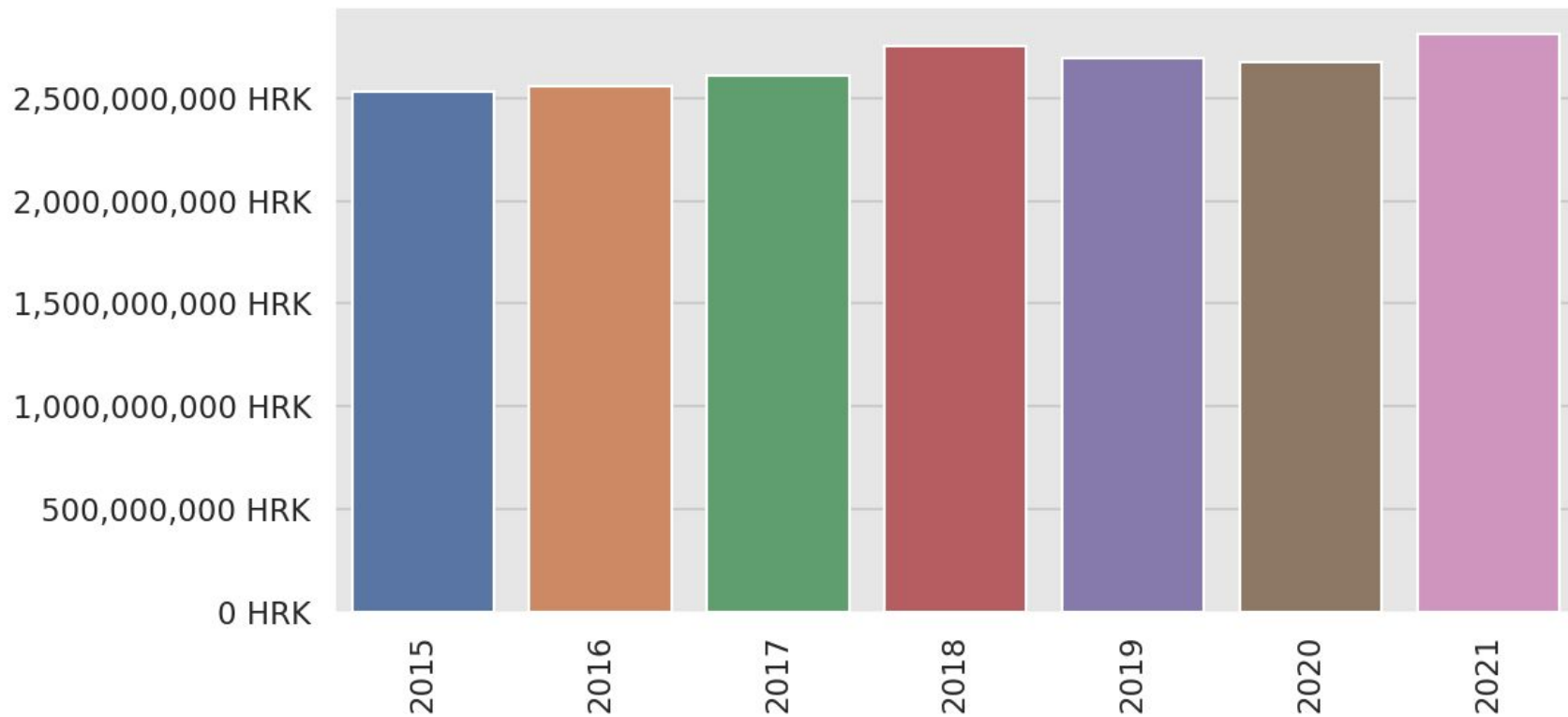
```
SELECT Count(*)
FROM   guests
      JOIN reservations
        ON reservations.guest_id = guests.id
      JOIN hotels
        ON reservations.hotel_id = hotels.id
WHERE  hotels.NAME = 'Splendid'
```

Text to SQL

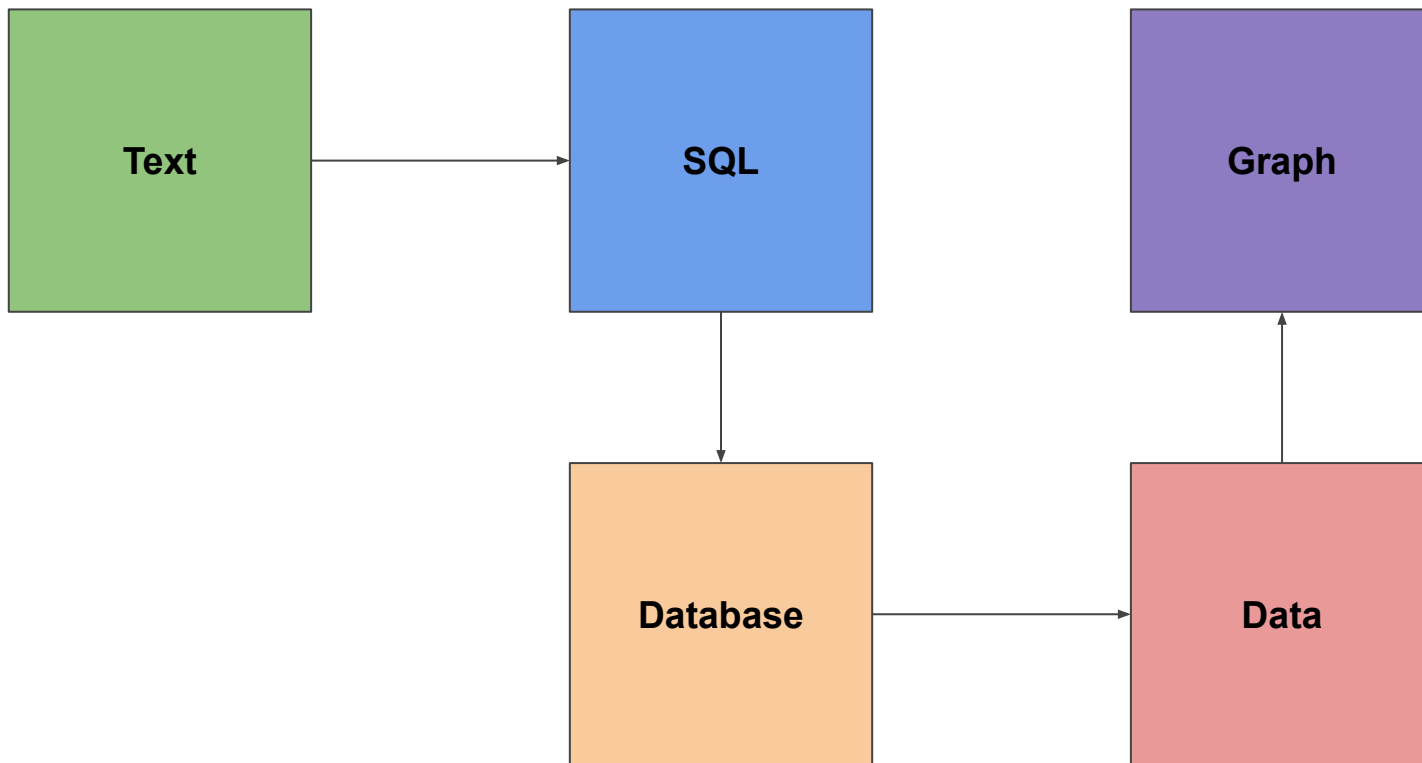
- "A query to see the average number of guests in July in all hotels"

```
SELECT Count(r.id) / Count(DISTINCT h.id)
FROM   reservation r
       join hotel h
         ON r.hotel_id = h.id
WHERE  from_date >= '2019-07-01'
       AND to_date <= '2019-07-31'
```

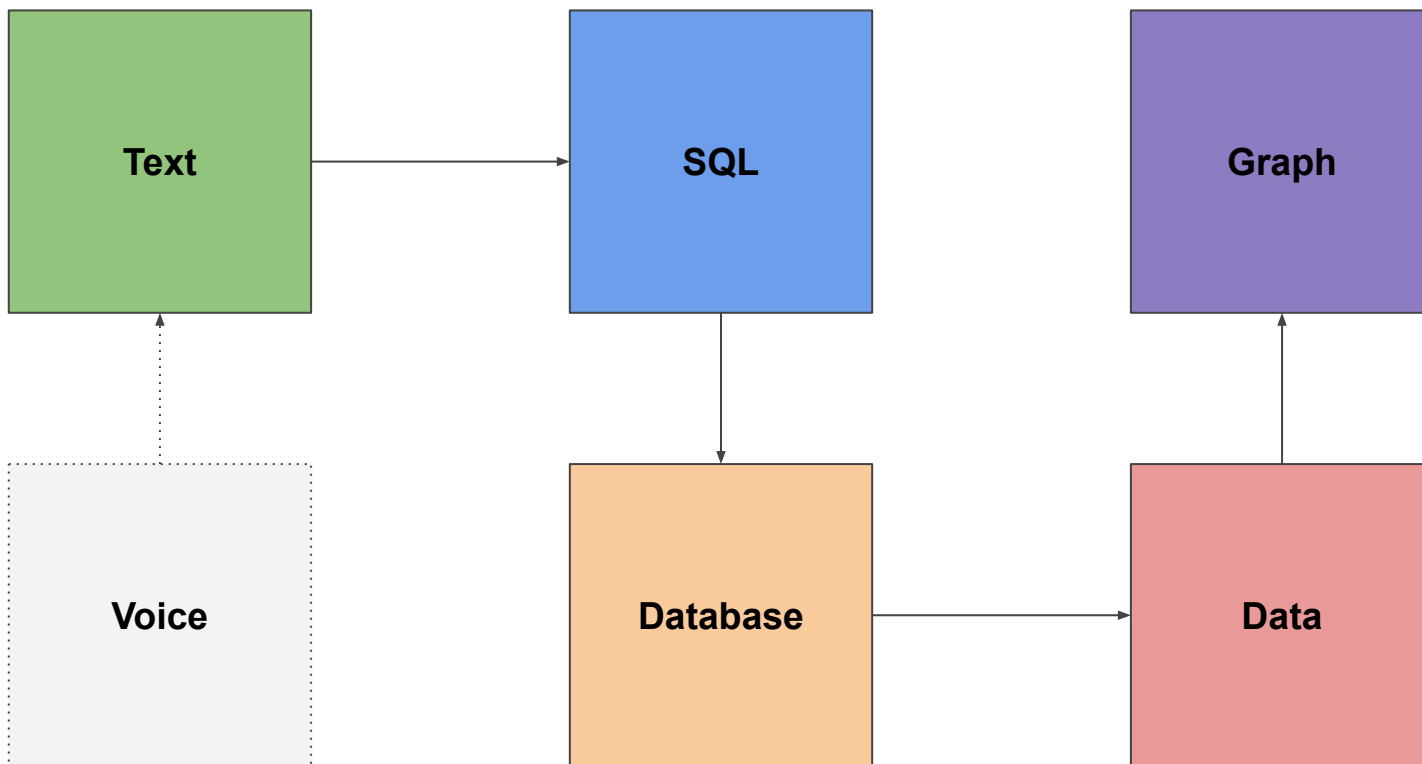
Data to graph



Application process



Application process, what is possible?



What do I want?

- A pilot project I will do (a small pilot project for free, if money is of any concern)
- An opportunity to collaborate with different domains (finance, turism, ...)
- Your feedback about what you think about this and where this could be useful?
- Any ideas who would want this?

Thank you!

Any questions?