Quin
my health map

UvA DSP

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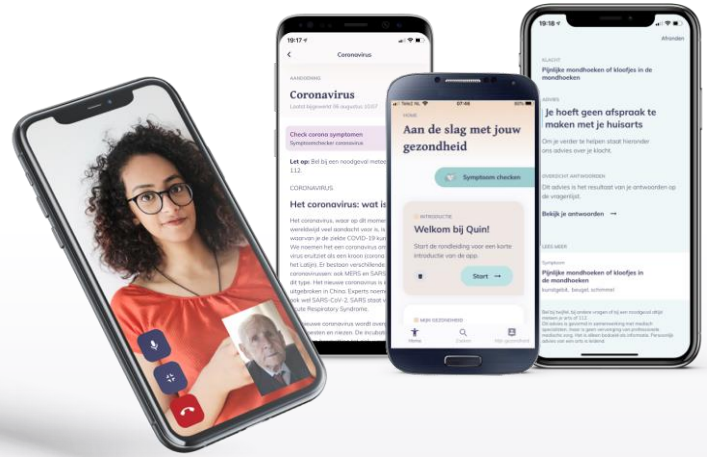
Computer Vision Team Lead

30.08.2021

Quin is developing a *Digital Health Platform*

Quin Consumer

For patients

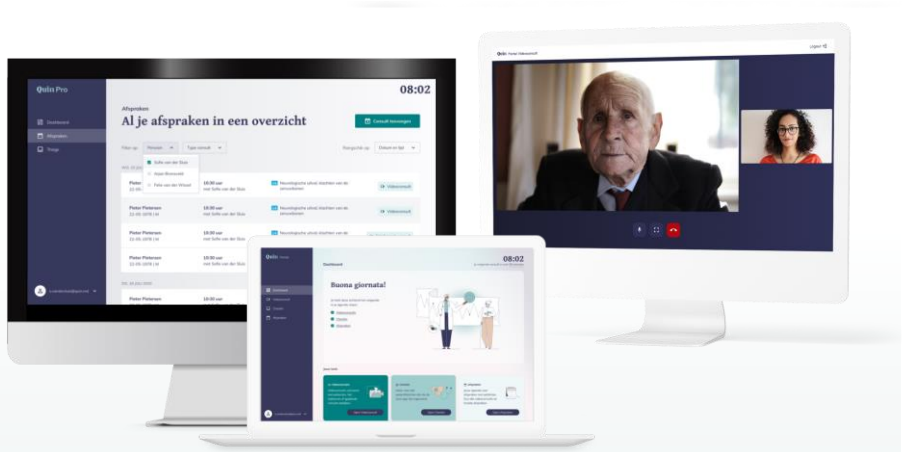


Key features

- Native app for smartphone, in a later stage available for iPad and desktop
- Available for iOS and Android
- Symptom checker, symptom monitoring, video consultations, appointment scheduling, context and information
- The app is CE certified as a medical device (Class 1) and follows the AVG (GDPR) guidelines

Quin Pro

For GPs and medical specialists



Key features

- Video consultation
- Online appointment scheduling
- **Specialist Care diagnostics via care pathways**
- Patient information from Quin app services as a check in
- Becoming a complete GP information system over the years
- Available in web browser for phones, tablets and computers

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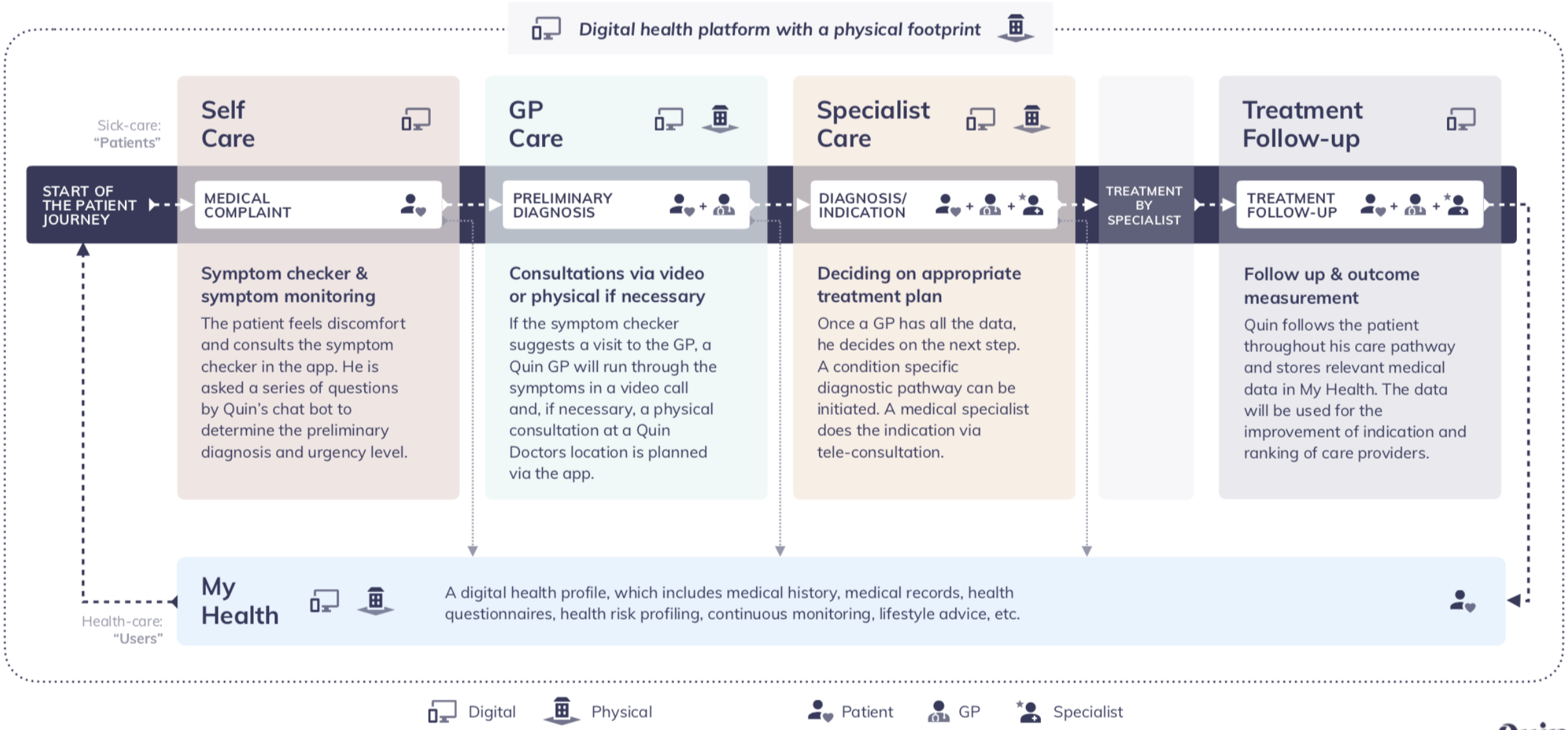
Quin's data driven care pathway



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Quin’s Hip OA Care Pathway

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We want to help GPs to uniformly and objectively assess hip osteoarthritis

Physical examination

Patient characteristics

Quin AI

Radiological findings from an X-ray by an **expert**

Automatic & More objective

Quin AI

Automatic & More objective

Quin AI

Expert

Hip replacement

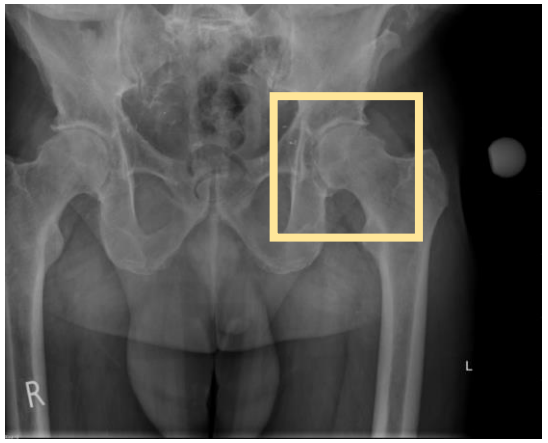
Automatic & More objective

Conservative treatment

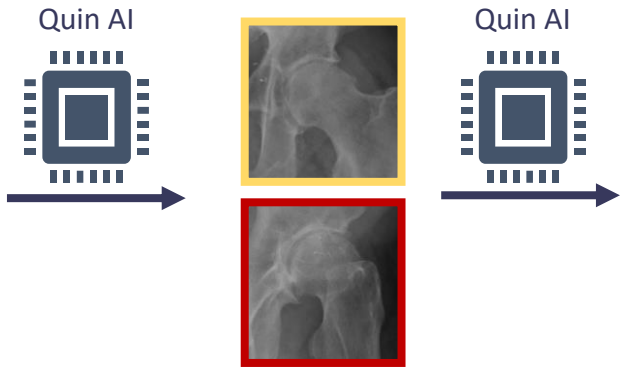
Quin AI for Hip OA Assessment in X-rays

We use convolutional neural networks (CNNs) to first **localize** the hip joints in AP and FP views and then to **predict** the osteoarthritis (OA) severity using KL-score* and other radiological features:

AP



FP

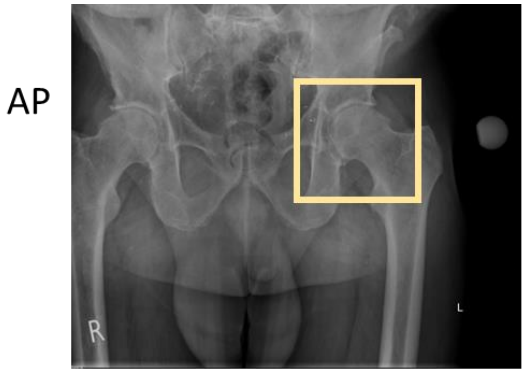


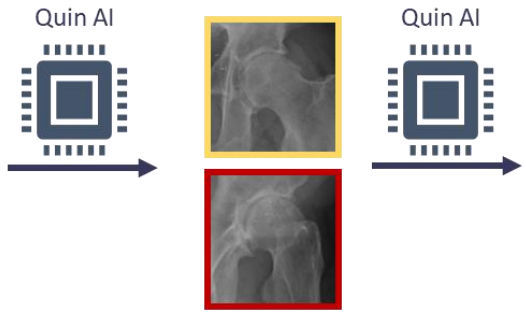
1. KL score [0-4]
2. Cysts [Absent /Present]
3. Joint-Space-Narrowing [None/Doubtful / Possible /Definite /Marked]
4. Deformation [Absent /Present]
5. Osteophytes [None/Possible /Definite/ Moderate/ Large]
6. Sclerosis [None /Some/ Severe]

* https://radiopaedia.org/articles/kellgren-and-lawrence-system-for-classification-of-osteoarthritis

Explainability of AI

- Explainable AI (XAI) is a technique used to **explain** the decision of an AI model.
- In computer vision, this means **emphasizing** regions in the input image that **contributed** the most to the decision of the CNN.
- This would increase the clinicians **trust** and **adoption** of AI in their daily work.





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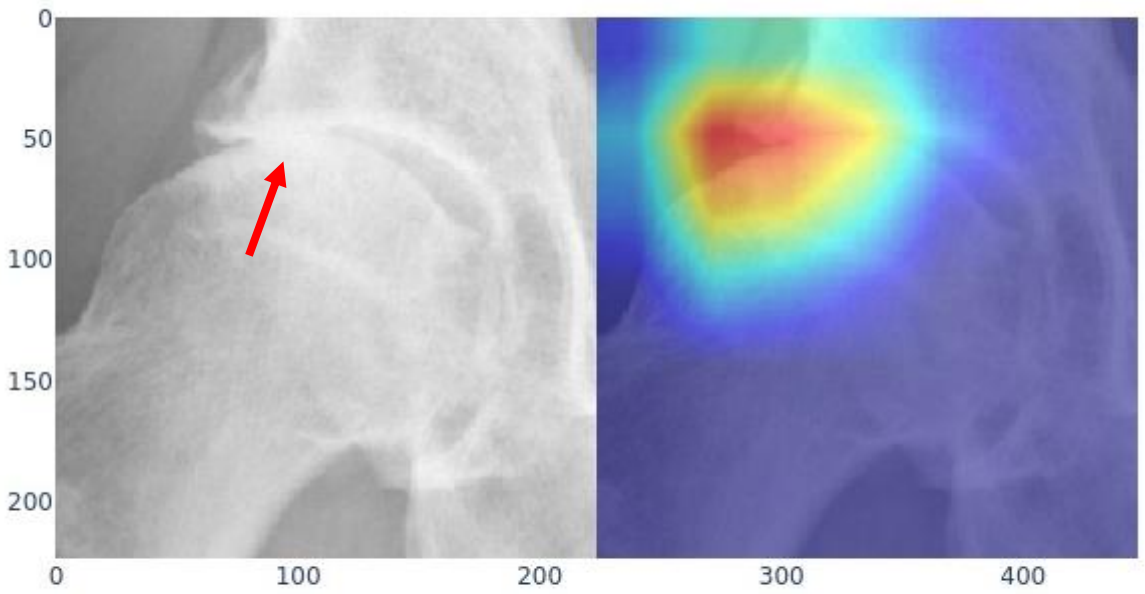
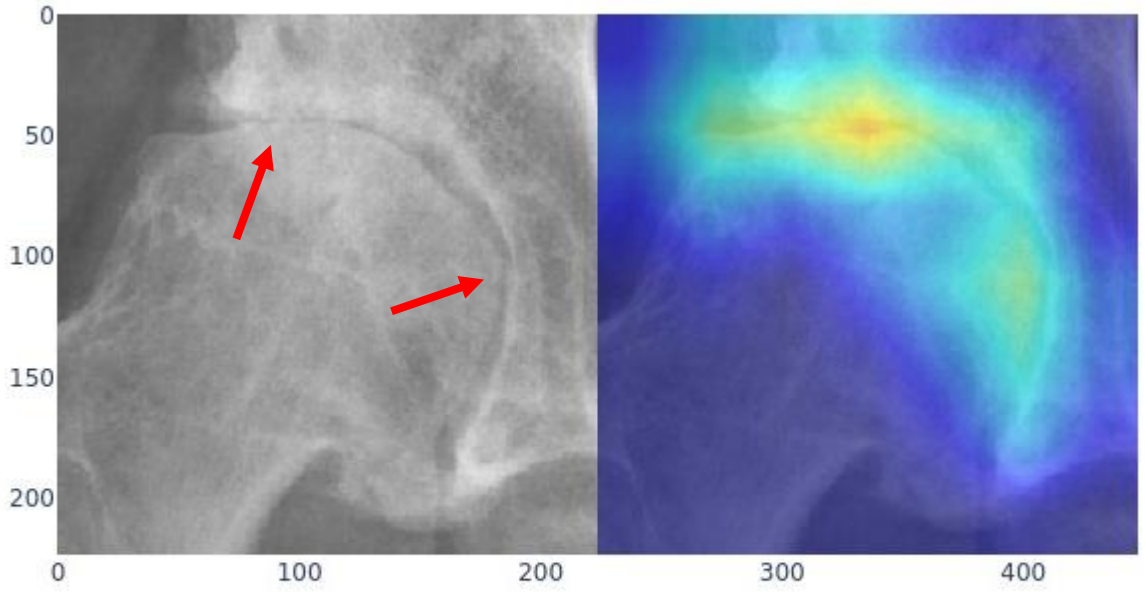
Instead of just predicting the value, we would like to provide some insights on "**why**" it was predicted

Explainability of AI – Good Examples

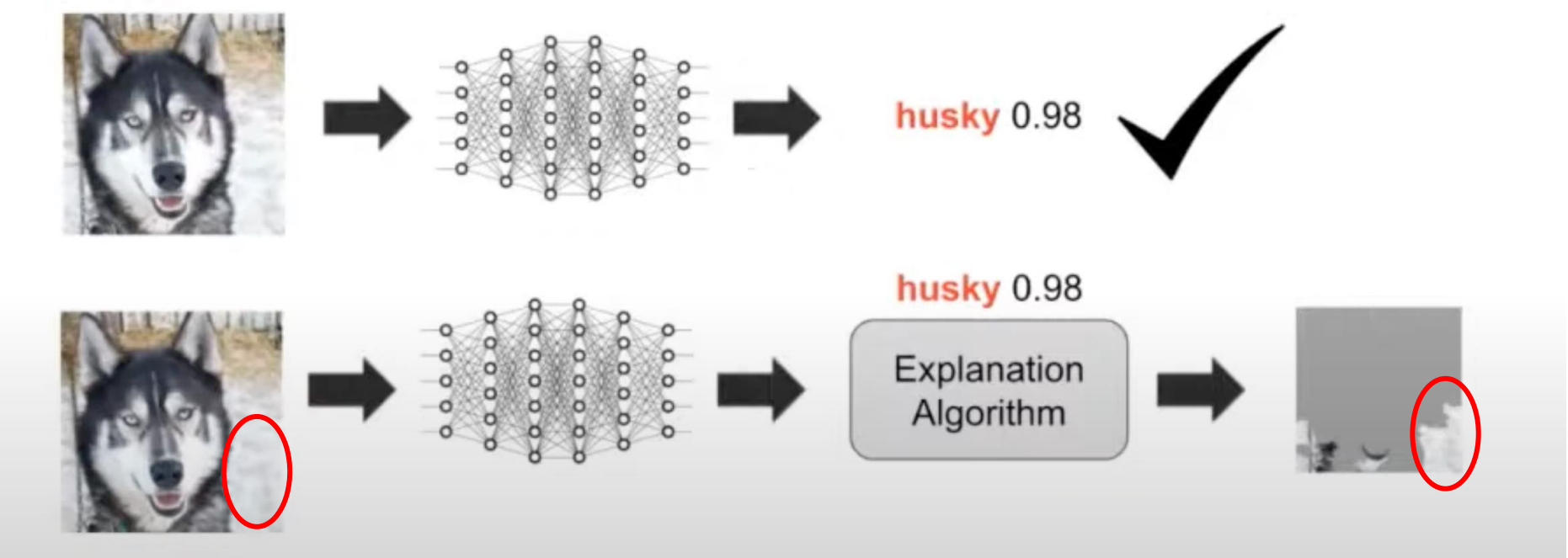
- Joint space **narrowing** (JSN) in the joint can be a result of osteoarthritis (OA).





Explainability of AI – Bad Examples

- Explainability is important for **debugging** AI models and for shedding some light on why do they (not) work.
- Although a model predicts correctly, it could be focusing on the **wrong** features:



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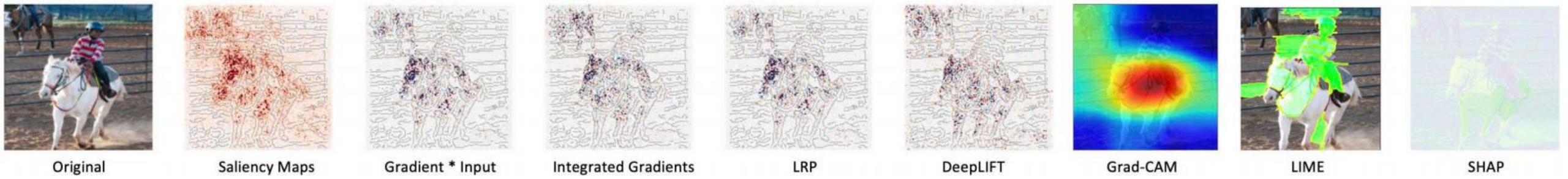
Data Systems Project - Overview

- AI is still seen as a magic **black-box**, it is non-intuitive, and difficult for people to understand and trust.
- In the medical image analysis field, this problem is **amplified** and leads to a limited adoption of such AI systems.
- The four pillars of the XAI project:
  - *Implement XAI*
  - *Evaluate XAI*
  - *Visualize XAI*
  - *Put it all together*

Data Systems Project - *Implement XAI*

- There are **numerous** methods to explain the predictions of an AI system.
- However, there is no central platform that can run several implementations on the same input image to provide the user an **easy way** to examine (and evaluate) the different results.
- In this project, we aim to:
  - Build a platform to run multiple XAI implementations on a given input image.
  - Build an intuitive graphical interface with a plug-and-play nature for the platform.
  - Support different architectures (ResNets, VGG, etc.)
  - Integrate other pillars (*Visualize XAI* and *Evaluate XAI*)



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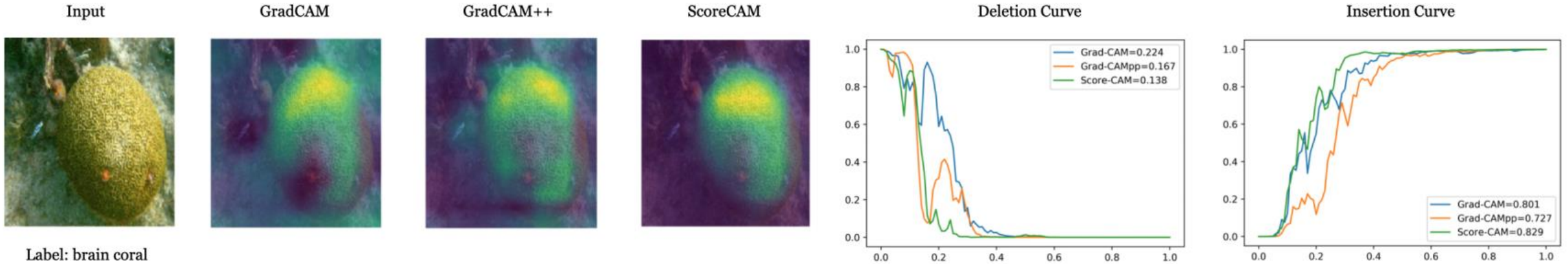
From: Arun et al., "Opportunities and challenges in explainable artificial intelligence (xai): A survey." arXiv preprint arXiv:2006.11371 (2020).

Data Systems Project - *Evaluate XAI*

- There are **numerous** methods to explain the predictions of an AI system.
- However, given a specific task, evaluating the **performance** of such methods is **hard**.
- In this project, we aim to:
  - Research for existing evaluation metrics and implement them.
  - Interview clinicians for new clinically relevant evaluation metrics and implement them.
  - Build a graphical interface to visualize those metrics for a given input image.
  - Define and build a feedback interface for clinicians to interact and evaluate the explainable outcomes on top of the input image.
  - Implement those visualizations into the platform.

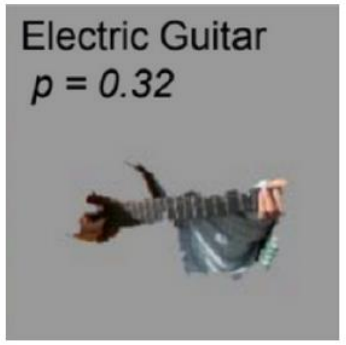


From: Wang et al. "Score-CAM: Score-weighted visual explanations for convolutional neural networks. 2020.

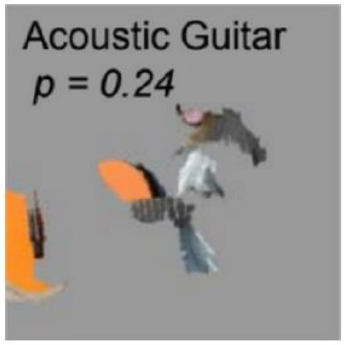
Data Systems Project - *Visualize XAI*

- The most common way to visualize the explainable result is by overlaying a colorful **heatmap** on top of the input image.
- For medical image analysis this is not optimal as it might **interfere** with the specialist reading the input image.
- In this project, we aim to:
  - Research ways of visualizing XAI results for the medical image analysis field.
  - Interview clinicians for new clinically optimized ways of visualizing XAI results for medical images.
  - Implement those visualizations into the platform.

(a) Original image



(b) Explaining *electric guitar*



(c) Explaining *acoustic guitar*

From: Arrieta et al. "Explainable Artificial Intelligence (XAI): Concepts, Taxonomies, Opportunities and Challenges toward Responsible AI. 2019.

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Data Systems Project – Technical Details

- A public dataset of X-ray images of knees suspected with osteoarthritis (OA) is available to download [1].
- The students would use the dataset to train* a CNN model of their choice (ResNet family, VGG, etc.) using PyTorch (or PyTorch Lightning) [2] or find a pretrained model [3].
- The model will solve a 5-class classification problem (kl-score of 0-4).
- Use the trained model to execute the different XAI projects.

[1] Dataset: https://data.mendeley.com/datasets/56rmx5bjcr/1
[2] Similar paper: https://pubs.rsna.org/doi/pdf/10.1148/ryai.2020190065
[3] Similar repo: https://github.com/MIPT-Oulu/DeepKnee

* You can ask Quin for help in training the model

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Final Words

- Why do you want to do this project?
    - XAI is a hot topic of research in the AI and computer vision communities.
    - A very hands-on experience
    - Get good grades at UvA
    - ***Bonus***: Outstanding students may be considered for:
        - Completing their Master thesis at Quin.
        - Starting an exciting internship in one of Quin's many computer vision projects.

Thank you!

Questions?