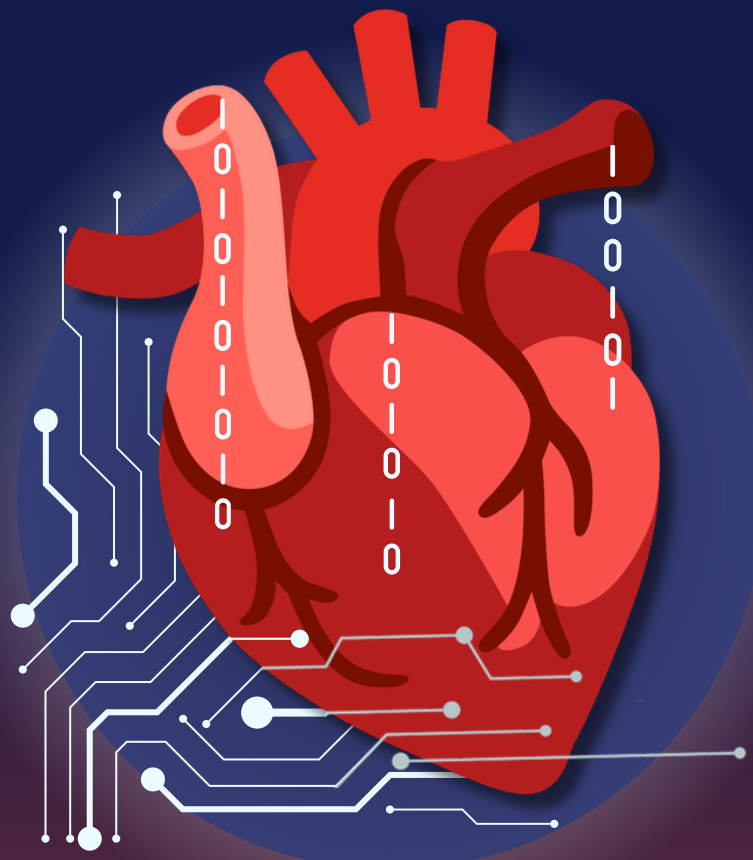
EMERGENT

November 4th & 5th

DATA 4 GOOD CHALLENGE

DOCUMENTATION



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1. Introduction

What is Emergent? What is the D4GC?

Emergent, the Data Science & AI student community

We believe that Data Science & AI will change every aspect of our future society. We aim to be the leading student community in this field, welcoming people from all backgrounds. We prepare students to reach their full potential and effect positive change with Data Science & AI throughout their lives.

One of our ways of achieving this vision is by letting students apply their skills to real-life problems through competitions like the D4GC.

The Data 4 Good Challenge, our flagship event

The D4GC allows students to solve a real case. Participants work together in multidisciplinary teams. Together, they are tasked with solving a socio-economic problem through the use of data. In a truly Emergent fashion, participants will have to think through all aspects of their solution, not only considering the economical effects but also the social and ethical consequences of their plan.

Since the challenge is two-fold, 1) produce insights from data, 2) then develop a strategy based on the insights, an **interdisciplinary collaboration** is the best way to tackle this challenge successfully.

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2. The Challenge

Opening the Black Box: Trustworthy AI for Surgical Skill Assessment

Precise and reliable skill evaluation in surgical training is essential. Yet today, many assessments remain manual, subjective, and difficult to scale. While machine learning models have opened the door to automated evaluation, their lack of transparency has slowed adoption in clinical practice, where surgeons demand explanations they can trust and learn from.

This year, we are excited to collaborate with **Orsi Academy**, the world's leading training center for robotic and minimally invasive surgery, under one shared mission: **"Building Trust in Automated Skill Assessment."** Together, we aim to bridge the gap between cutting-edge AI and clinical acceptance by developing explainable AI solutions that make surgical skill assessment both transparent and credible. Winning teams will have the unique opportunity to further develop their ideas alongside Orsi Academy, ensuring their solutions have real-world impact beyond the event.

The challenge is to **design an explainable AI framework that sheds light on how automated techniques judge surgical skill, turning predictions into insights surgeons can understand and trust.** By combining explainability techniques with intuitive, clinician-friendly visualizations, participants will unlock the potential of AI-driven training without sacrificing reliability.

Participants will have access to a pre-trained skill classification model, along with anonymized video data and expert-annotated ratings of surgical performance. They will be tasked **to create interpretable methods that reveal which spatial and temporal elements of the video drove the model's predictions, and to present these findings in ways surgeons and educators can meaningfully engage with.**

The objective is to develop a solution that addresses the most critical aspects: **1) developing explainability techniques that highlight decision-making patterns**, **2) building clear visual narratives that foster clinical trust**, and **3) validating that the explanations are faithful and credible**. They will not only propose technical solutions but also outline a roadmap for integrating them into surgical training workflows.

Join us in "Opening the Black Box: Trustworthy AI for Surgical Skill Assessment" Together, we will pioneer solutions that make AI more transparent, foster trust among clinicians, and help shape the future of surgical education.

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3. About our Challenge Partners

Meet our challenge partner for this edition:

Orsi Academy

Orsi Academy is an internationally recognized knowledge and innovation hub dedicated to advancing best practices in minimally invasive and robotic surgery. Originally founded by urologist Prof. Alexandre Mottrie and Dr. Geert Vandenbroucke in 2010, the Academy brings together healthcare professionals, the medical technology industry, and academic researchers in a unique, multidisciplinary ecosystem. Rather than working in isolation, these communities collaborate closely, sharing expertise and insights to accelerate innovation and improve surgical outcomes. Orsi Academy acts as a facilitator in this process, ensuring that knowledge flows seamlessly across domains.

Located in Melle, Belgium, Orsi Academy opened its new campus in 2018 and was designated the World Centre for Robotic Surgery. It was inaugurated by Philippe Muyters, then Flemish Minister for Innovation, as a flagship initiative for medical innovation in Europe. The Academy houses state-of-the-art facilities and cutting-edge robotic surgery platforms, providing surgeons and trainees with hands-on experience in the latest technologies.

Each year, the Academy trains and supports up to 3,500 surgeons from across the globe. Its programs focus not only on technical proficiency but also on building evidence-based training methods, surgical safety, and continuous innovation. Through its partnerships with hospitals, universities, and medical device companies, Orsi Academy plays a pivotal role in shaping the future of surgical education and healthcare delivery.

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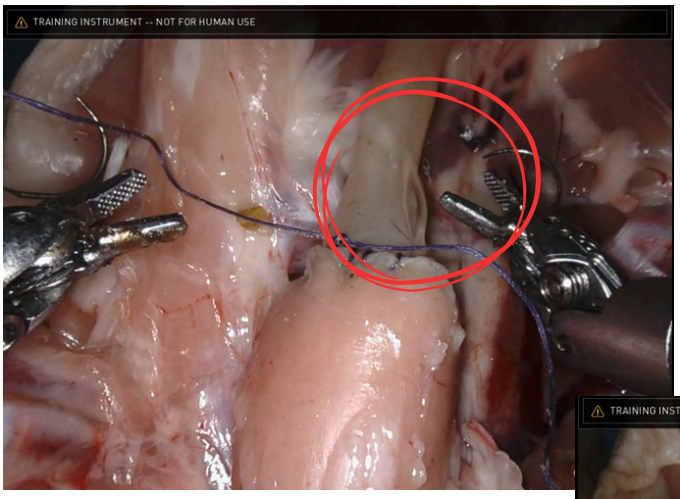
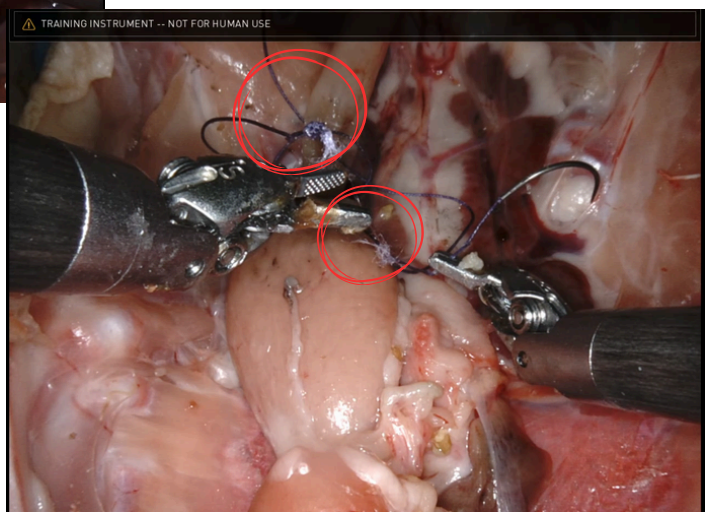
4. The Data

Dig in & gain some insights!

For the first time in the history of the Data for Good Challenge, we are partnering with Orsi Academy to introduce an **image-based dataset** derived from recorded **surgical training sessions** of **Proficiency-Based Progression (PBP) Anastomosis** exercise performed in Orsi Academy clusters by surgical trainees. The dataset consists of **frames** extracted from videos of surgical trainings performed on **chicken intestines** following the **PBP methodology**. **PBP** is a structured training method that uses objective, evidence-based metrics to ensure surgeons achieve a certain level of skill and proficiency before moving on to the next stage of training. In this specific exercise, surgeons practice the vesico-urethral anastomosis phase, where the bladder (vesico-) and the urethra are connected typically after the removal of the prostate gland, most commonly during a **radical prostatectomy**.



Critical Error:
Suture Wire Broken



Critical Error:
Water Leakage Test Failed

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4. The Data

Dig in & gain some insights!

Tipically the two main critical errors that might happen during a PBP Anastomosis exercises are:

- **Suture Wire Broken**: when the surgical trainee applies excessive tension to the suture, causing the thread to snap. It indicates poor handling technique or inadequate control of the needle driver and tension during knot tying. In a real surgical setting, a broken suture can compromise the integrity of the anastomosis, increase operative time, and risk tissue damage or incomplete closure.
- **Water Leakage Test Failed**: when, during the water leakage test at the end of the anastomosis, fluid escapes from the anastomotic line. It signifies that the connection between the bladder neck and urethra is not watertight, likely due to gaps, uneven suture placement, or inadequate knot tightening. In real surgery, such leakage could lead to urinary extravasation, infection, or delayed healing.

These two errors immediately lead to the termination of the exercise because they are considered critical failures that would seriously compromise the outcome of a real surgical procedure. The surgical trainee must therefore retake the test after reviewing and correcting their technique.

The PBP Anastomosis dataset will serve as the foundation for participants to develop strategies for explainable, automated evaluation of surgical performance.

Each recording is accompanied by detailed **metadata**, including dataset origin, procedure name, video duration, and annotations specifying whether **critical errors** occurred and **at which point** in the video they were committed.

Pretrained Model

In addition, participants will receive a **pretrained deep learning model** capable of **classifying whether a critical error was made** during a given recording. We will also provide **precomputed feature-importance maps**, highlighting the image regions most influential in the model's predictions.

By combining the dataset, metadata, pretrained models, and feature-importance maps, participants will have the opportunity to **integrate multiple sources of information to generate explainable insights**. The goal is to produce outputs that are both **reliable** and **interpretable**, offering value to surgical trainees seeking to understand and improve their performance.

5. Inspiration

How to approach the problem?

Structure your approach

Instead of analyzing all aspects of the problem, it often makes more sense to dive deep into one or two crucial aspects of the problem. What follows is a **non-exhaustive** list of aspects to the problem coupled with some of the ways you can tackle that aspect of the problem.
Begin by organizing your team's efforts and responsibilities. Allocate tasks based on individual strengths and expertise to ensure a cohesive approach to the challenge.

1. Craft your problem statement

Clearly define how you will incorporate the three main pillars of the challenge into one problem statement. Remember that your goal is to develop a solution that is explainable, and that can be easily understood and trusted by surgeons. A well-articulated problem statement sets the foundation for your solution.
Your statement should be formulated concisely. You should deliver your "solution" to the jury which consists of a mix of different profiles and hence it should be understood easily even by non-technical background personnel.

2. Decide a direction

After having built your problem statement, it might be a good idea to **narrow down the scope** of your research. Consider the data at your disposal and decide on the direction of your analysis. Are you focusing on developing new explanation methods, benchmarking existing methods, developing a tool to convert explanations into insights or a combination of all of the above? Define a clear and feasible path to guide your research.
Don't forget that **you are given 8 hours** to not only build your solution, but also prepare a slide deck for a presentation.

3. Develop a data-driven solution

We recommend spending around 1-2 hours completing the first two steps. Now, you should carefully analyze the given data to support (or modify if needed) your statement or prove whether your hypothesis is correct or not. Utilize the insights gathered from your analysis to develop a strategy and leverage the data sources provided to develop your solution.

5. Inspiration

Where to start?

To successfully tackle the challenge, you should combine solid data analysis with strategic insight. On which areas you focus is completely up to your team. Here, we have listed a couple of starting points to solve the challenge. **We have prepared a code sample (both in Python and R).**

Note that these are just guidelines. You can solve the challenge any way you want.

Idea 1: Convert feature importance maps into interactive visualizations

Develop interactive visualizations of the feature importance maps to make model outputs more understandable for surgeons. You could create a simple platform where highlighted regions can be explored through clickable insights, enriched with external knowledge such as anatomical references or surgical guidelines. You could leverage Large language models to generate concise summaries, helping translate explanations into surgeon-friendly feedback.

Idea 2: Detect errors and biases in the model

Machine learning models are sensitive to biases in the training data, and can sometimes learn patterns in the data that do not necessarily map to facts or real-world observations, often called the Clever Hans effect. Use the trained model, its learned weights, and the feature importance maps to see if they reflect existing biases or imbalances in the training data.

Idea 3: Leverage all explanations to find general patterns in surgeons' errors

Instead of looking only at single feature importance maps, combine explanations across many cases to see overall trends. Identify how the model classifies errors in the training data, and use this to discover common mistakes that surgeons might be making repeatedly.

5. Inspiration

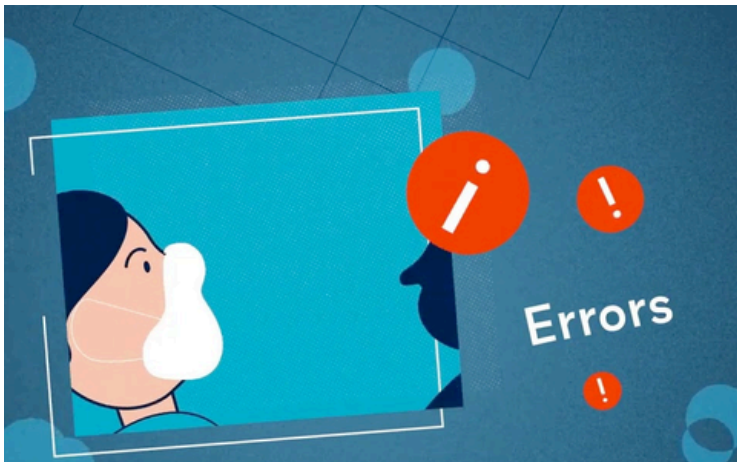
Interesting sources to dig deeper

Proficiency-based progression: Orsi's scientifically-validated and objective way of training

Learn how Orsi's Proficiency-based progression (PBP) training produces performances that are 40 to 60% better than the traditional approach here.

Impact of proficiency-based progression simulation training on performance outcomes

Dive deeper into the analyses performed to compare clinical training approaches and how proficiency-based progression (PBP) training achieved the best performance outcomes.



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6. Scoring

How do I evaluate the pitches?

The solutions that participants present will be judged on 4 main categories:

Business Strategy

Develop a solution that is feasible, valuable and tackles the problem or opportunity you identified in a complete way. Don't forget to clearly communicate what your solution tries to achieve and why it is valuable.

Technical Solution

Your solution should be a technical solution that uses the most appropriate techniques to successfully tackle this challenge. You should not be afraid of using more advanced methods as long as they are the right tool for this problem.

Data Visualisation

Convince the jury by creating stunning visualizations that contribute to the case you are trying to build. Make sure to present the insights you gained in a clear and understandable way, and link it to impact.

Pitch

Focus on delivering a pitch that can convince stakeholders of your solution. Clearly communicate in a structured and comprehensive way. When one of the judges asks questions, answer them in an insightful way.

7. FAQ

Frequently asked questions by participants.

Do we have to use all of the available datasets?

No, it's up to you to decide what data to work with.

Do we have to use a particular software / product?

No, you can choose either Python or R for your analysis. You can of course use both if needed. Additionally you're allowed to use whatever other software you find necessary or useful

Can we use data from the internet?

Yes, in this case you MUST provide the source of the dataset(s) you used.

Can we use information from the internet?

Yes, in this case you must provide the source of the information you used.

Do we need to prepare a slideshow presentation?

Yes, you need to prepare a slideshow presentation and upload a PDF version of it along with your code/BI tool files.

Does everyone from the team need to present to the jury?

No, you may decide among yourselves, but at least one person should present.

How much time do we have to present?

You have 6 minutes to present your strategy and 4 minutes to answer the questions from the jury.

Do we have to do a technical analysis?

No, it is not necessary. That is up to you.
You can opt for a purely strategic approach, of course, grounded in data.
If you want to include a technical approach, you can. But, keep in mind that your presentation time is limited to 6 minutes only.