Use Case 1
TriageAssist

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Brief description:

During the recent COVID-19 pandemic, a group of machine learning engineers saw a business opportunity in creating an application that allows nurses to triage patients within a resource constrained hospital environment. After a year of development and testing they have launched their company, Prioritize, and their first major pilot at a local hospital.

Prioritize executives have partnered up with a local hospital in Montreal and decided to initially deploy their automated triage algorithm, called TriageAssist within the emergency unit. Emergency units receive a lot of cases related to cardiovascular issues and it often takes a long time for nurses and doctors to assess the patient when they come into the ER. Any tool that would help speed up the process of triaging patients would be highly beneficial for the hospital.

In a major hospital's emergency department, swift and accurate triaging can be the difference between life and death, especially for patients with potential heart conditions. TriageAssist is trained on a dataset containing medical and personal information of patients and whether they have a form of heart disease. Nurses and doctors could use TriageAssist to see whether a new patient at the ER is being classified as a patient with heart disease and use that to make decisions on their treatment of the patient. Upon patient's arrival triage nurses collect a summary of their symptoms, medical history, and any relevant personal details. These inputs, combined with immediate vitals like blood pressure, heart rate, and oxygen saturation, are fed into TriageAssist. The algorithm, trained on vast datasets of previous patient records and outcomes, predicts the likelihood of a heart failure.

The model categorizes patients into risk groups, ensuring that those with the highest probability of a life-threatening condition receive immediate attention. Meanwhile, those with lower predicted risks are appropriately queued, balancing urgency with the available resources and ensuring that everyone receives the necessary care.

This doesn't replace the expertise of medical professionals but acts as an invaluable tool, enhancing their decision-making abilities. With the aid of TriageAssist, the local hospital in Montreal has noted a significant reduction in wait times for high-risk patients, better allocation of resources, and, most importantly, improved patient outcomes in the emergency department for heart-related concerns

Technology description:

This section provides more information about specific technology. This can include details about **how the model was trained, the specifics about model architecture, how it is used with other models within a given product, how it is currently evaluated, necessary computing resource** and etc.

Technology related artifacts: dataset, datacard, model implementation, model card

Dataset: Cardiovascular diseases (CVDs) are the leading cause of death worldwide, resulting in 17.9 million deaths annually, or 31% of global deaths. Most of these deaths, four out of five, result from heart attacks and strokes, with a third occurring prematurely in those under 70. Heart failure is a significant event triggered by CVDs. This dataset, consisting of 11 attributes, can help predict potential heart diseases. For those with or at risk of CVD due to factors like hypertension, diabetes, or hyperlipidaemia, early detection and management are crucial. A machine learning model using this dataset can aid in this. The dataset features include age, sex, chest pain type, resting blood pressure, cholesterol, fasting blood sugar, resting ECG results, maximum heart rate achieved, exercise-induced angina, oldpeak, and ST slope. Compiled from five previously independent datasets, it provides the most extensive combined heart disease dataset, with a total of 918 unique observations. You can download the dataset and view the datacard for this dataset here.

Model: You can use the models presented in the following article and Github repository as a starting point for potential models that are being considered during development of TriageAssist. The article presents a Python-implemented code using various classification models, including SVM, Naive Bayes, Logistic Regression, Decision Tree, Random Forest, LightGBM, and XGboost.

In-depth contextual information:

This section provides more detailed information about the direct and indirect stakeholders. This can include information about **scale of use, personas of these stakeholders, details about the specific practices/traditions in a social group, macro cultural and socioeconomic context and particular laws and regulations** and etc.

Context related artifacts: qualitative and quantitative data from stakeholders, laws/regulations

We have included four interview transcripts including two interviews with triage assist nurses, one doctor and one patient.

Interview Transcript #1: Triage Assist Nurse in a Montreal Emergency Department

Interviewer (I): Thanks for taking the time today. To start off, could you explain the primary objective of your role as a triage assist nurse?
Triage Nurse (TN): Certainly. The primary objective of my role is to quickly assess each patient

that enters the emergency department and determine the urgency of their condition. This allows us to prioritize who needs to be seen first, ensuring that patients with the most critical conditions receive timely care.

I: What would you say is the core value or principle guiding your decisions in this triage process?

TN: The core value is always the well-being and safety of the patient. It's essential to be both swift and accurate in our assessments, ensuring that every patient gets the care they need based on the severity of their condition.

I: Can you walk me through what factors you look at when making your assessment?

TN: Sure. The main factors include the patient's vital signs, such as heart rate, blood pressure, respiratory rate, and temperature. We also consider their chief complaint, their pain level, and any immediate risks. For instance, a person with chest pain would likely be prioritized over someone with a minor cut, due to the potential risk of a heart attack.

I: Is there an underlying philosophy or ethical stance that influences how you interpret and weigh these factors?

TN: Absolutely. The underlying philosophy is that of equity and fairness. Every life is valuable, and our goal is to ensure that each patient, regardless of background or circumstance, receives care that is just and appropriate to their situation. This sometimes means making hard decisions, especially when resources are limited, but we always strive for the best possible outcome for each individual.

I: How do you handle the emotional stress of having to make these challenging decisions, especially when resources are scarce?

TN: It's certainly not easy. I lean on the core values of compassion and empathy. Remembering that every patient is someone's loved one helps ground me. We also have a supportive team, and we debrief regularly, ensuring that we're looking out for one another and sharing the emotional load.

I: Given the diversity of Montreal's population, how do you ensure that language and cultural differences do not impede the triage process?

TN: That's a great question. Communication is vital in our role. We often have interpreters available, and we've integrated tools and resources to bridge language gaps. Cultural sensitivity training is also part of our ongoing education, reinforcing the importance of treating every patient with respect and understanding their unique perspectives.

I: In your experience, what quality or trait has proven most essential in carrying out your duties effectively?

TN: I'd say adaptability. The emergency department is an unpredictable environment. Every day is different, and situations can change rapidly. Being able to quickly adapt to new information, unexpected scenarios, or sudden influxes of patients is crucial.

I: Lastly, if there was one message or value you'd want the general public to understand about the work you do, what would it be?

TN: I'd want them to understand the importance of collaboration. It's not just one nurse or doctor making decisions; it's a team effort, with everyone playing a part to ensure the best possible care for our patients. We're all interconnected, and when the community understands and supports this collaborative ethos, it makes our job easier and outcomes better.

Interviewer (I): Thank you for all your insights so far. I'd like to delve into the concept of using predictive algorithms in the triage process. To start, what's your initial impression of using an ML-based decision support system in your role?

Triage Nurse (TN): Thank you. The idea of integrating ML into our workflow is intriguing. On one hand, it promises efficiency and the possibility of catching nuances that might be overlooked in a high-stress environment. But on the other, there's a level of human intuition and understanding that machines might not yet capture.

I: Let's break it down. What advantages can you foresee with the implementation of such a system?

TN: Firstly, consistency. Humans can be influenced by fatigue, emotions, or even bias, whether it's conscious or not. An ML system would be consistent in its assessments. Moreover, it could quickly process vast amounts of data, perhaps identifying patterns or risk factors that aren't immediately obvious to us.

I: That's insightful. And the disadvantages?

TN: Well, the primary concern is the potential over-reliance on technology. Patient care is multifaceted. While algorithms can process data efficiently, they might not grasp the subtleties of human experience or the holistic context. Additionally, we have to be cautious about biases in the data the algorithms are trained on. If not carefully curated, these biases could be amplified in the system's decisions.

I: Given those pros and cons, how would you envision using such a system in your workflow?

TN: Ideally, I see it as a complementary tool, a second opinion of sorts. After making my initial assessment, I could consult the ML system to see if it aligns with my judgment or if it flags something I might've missed. It shouldn't replace human decision-making but rather enhance it.

I: There's a common worry that the introduction of such technologies might diminish the role of professionals like yourself. How do you feel about that?

TN: It's a valid concern. But I believe that the human element in healthcare, especially in emergency scenarios, is irreplaceable. Empathy, compassion, and understanding are things machines can't replicate. Technology can be a tool, but it can't replace the connection between a healthcare professional and a patient.

I: Could there be an ethical dilemma in deciding to act based on a machine's recommendation versus your own intuition?

TN: Absolutely. The crux of the matter is responsibility. If I were to follow a machine's advice that went against my intuition, and the outcome was negative, the ethical weight of that decision would be heavy. It's crucial to ensure that such systems are transparent in their recommendations, allowing us to understand the rationale behind their suggestions.

I: If these systems become a mainstay, do you think there's a specific value or principle that should guide their development and implementation?

TN: Integrity would be at the top of my list. These systems should be developed with the primary goal of enhancing patient care, not just efficiency or cost-saving. And as I mentioned earlier, transparency is vital. We need to understand how decisions are made and ensure that the

algorithms are free from harmful biases.

I: In conclusion, what message would you want to convey to developers or policymakers considering the adoption of ML in triage?

TN: Prioritize patient well-being above all else. Collaborate with frontline healthcare workers to understand the intricacies of our roles and the diverse needs of our patients. And always remember, while technology can be a powerful tool, the human touch in healthcare remains paramount.

I: Thank you once again for sharing your invaluable insights.

TN: It's been a pleasure. Thank you for exploring this crucial topic.

Interview Transcript #2: Triage Assist Nurse#2 in a Montreal Emergency Department

Interview Transcript: Triage and Heart Conditions in a Montreal Emergency Department

Interviewer (I): Thank you for joining us today. Let's start with the basics. What is the primary objective of your role as a triage assist nurse?

Triage Nurse (TN): The essence of my role is to rapidly evaluate each patient that comes into the emergency department to determine the urgency of their situation. This ensures those with the most critical needs are addressed promptly.

I: When you're evaluating a patient, what foundational principles guide your decisions?

TN: At the heart of our work, no pun intended, is the well-being and safety of the patient. Speed and accuracy are paramount, ensuring that every patient's situation is assessed with fairness and a focus on their immediate needs.

I: Let's delve deeper into heart-related cases. Given the urgency often associated with heart

conditions, how do you approach patients with potential cardiac issues?

TN: Cardiac cases always warrant high alert. We look for specific symptoms such as chest pain, shortness of breath, and palpitations. The patient's history, current medications, and any previous heart-related issues also play a significant role in our evaluation.

I: How would you prioritize a younger individual displaying minor symptoms over an older individual with a history of heart disease but currently stable?

TN: That's a challenging scenario. The younger patient's symptoms might be a precursor to a more severe event, while the older individual's history puts them at a higher risk. We'd look at the immediacy and severity of the symptoms and use that as our guiding principle. Both might be prioritized, but the immediate threat takes precedence.

I: Beyond the apparent symptoms, are there subtler cues or intuitions you rely on, particularly with heart conditions?

TN: Absolutely. The way a patient describes their pain, their level of anxiety, skin pallor, and even profuse sweating can be indicators. There's a level of intuition developed from experience that helps us "read" situations and symptoms beyond just the textbook definitions.

I: Heart conditions can sometimes manifest differently in women than men. How does gender factor into your triage process?

TN: That's an important point. Women might not always present the "classic" chest pain. They could have symptoms like fatigue, nausea, or pain elsewhere like the jaw or back. Gender, along with age and other factors, definitely influence our assessment, ensuring we're not missing atypical presentations.

I: Given the complexities and nuances involved, how do you ensure that your triage decisions maintain both fairness and accuracy, especially with heart conditions?

TN: Continuous education is key. We regularly undergo training to stay updated on the latest research and findings. Collaborative discussions with colleagues, where we analyze and learn from past cases, also play a role. It's a blend of knowledge, experience, and teamwork.

I: In your opinion, what qualities are essential for a triage nurse, especially when dealing with potential heart-related emergencies?

TN: Empathy, to connect with the patient; attentiveness, to pick up on subtle cues; and adaptability, because every case is unique and might not fit the mold of what we've seen before.

I: Lastly, if you could offer a message or insight to the general public about the triage process, especially regarding cardiac concerns, what would it be?

TN: Trust the process and always prioritize early intervention. If you feel something is off, especially with your heart, don't delay seeking medical attention. Early detection and intervention can make all the difference.

I: Thank you for offering these invaluable insights into the world of triage, especially concerning heart conditions. I would like focus on the use of ML-based systems to predict the likelihood of heart failure in emergency department visitors. To begin with, how do you feel about this specific application of machine learning?

TN: While I acknowledge the potential that machine learning has in revolutionizing many fields, I must admit I have reservations when it comes to its application in predicting heart failure in an emergency setting. It's a complex diagnosis with multifaceted elements.

I: What specific concerns do you have regarding the system's ability to diagnose heart failure?

TN: Heart failure isn't just about reading vitals or analyzing data points. It involves understanding patient history, current symptoms, and sometimes reading between the lines based on the patient's demeanor. My worry is that an algorithm, no matter how advanced, might miss out on these subtleties, leading to misdiagnoses.

I: Proponents argue that these tools could potentially reduce human errors and enhance diagnostic accuracy. What's your stance on this?

TN: While I understand the appeal of that argument, we must also consider the consequences of false positives or negatives from the system. A machine's "error" can lead to unnecessary treatments or missed interventions. My belief is that a seasoned medical professional's judgment, gained through years of hands-on experience, is invaluable.

I: In a scenario where such a system is implemented, how would you interact with it in the triage process?

TN: If we were to use it, I'd treat it as a supplementary tool, perhaps to cross-check my assessments. I would not rely on it as the primary diagnostic tool. The human touch, the patient-practitioner interaction, offers insights that a machine might overlook.

I: There's a belief that with ample data, these algorithms could foresee heart failure based on patterns not immediately obvious to humans. How do you perceive this?

TN: I don't deny the power of big data and pattern recognition. But medicine isn't just patterns. It's about individual stories, unique physiological responses, and sometimes anomalies that don't fit any pattern. Relying solely on patterns might overlook the outliers, and in medicine, those outliers can be critical.

I: Do you see any scenarios where such a system might be beneficial, even with your concerns?

TN: In a controlled environment, perhaps for preliminary screening or risk assessment, it might have value. If used to flag potential high-risk patients for a more in-depth human assessment, I can see some utility. But it should be a starting point, not a conclusion.

I: Lastly, what message would you like to convey to those keen on integrating these systems into emergency healthcare?

TN: Move cautiously. Engage with practitioners who are in the trenches, dealing with real-life scenarios. Understand that technology, while powerful, is not infallible. And always, always prioritize the well-being and holistic understanding of the patient.

I: Thank you for shedding light on this complex issue from a practitioner's standpoint.

TN: Thank you for facilitating this important dialogue. It's essential that all voices are heard as we navigate the future of healthcare.

Interview Transcript #3 - Doctor#1 in a Montreal Emergency Department

Interviewer (I): Thank you for your time, Doctor. Let's begin with the basics. Once a patient has been triaged, what is your primary responsibility when visiting them?

Emergency Doctor (ED): Thank you for having me. After triage, my primary role is to diagnose the patient, diving deeper into their symptoms, understanding their history, and determining the best immediate course of action.

I: In the myriad of cases you handle daily, what principles guide your diagnostic process, especially concerning heart conditions?

ED: First and foremost, every patient is unique. While we have guidelines and protocols, patient-centric care is paramount. Especially with heart conditions, a holistic view of their symptoms, history, and vitals is essential. Time is often of the essence.

I: How do you approach a situation where a patient's presentation might be atypical, especially in heart-related cases?

ED: That's a challenge. I've learned to never dismiss any symptom. Atypical presentations, especially in women or diabetics, are common in cardiac cases. It's about asking the right questions, being thorough, and sometimes relying on instinct honed from experience.

I: When time is critical, such as with potential heart attacks, how do you ensure accuracy while acting swiftly?

ED: Speed and accuracy are often seen as trade-offs, but in the ER, they must go hand in hand. Collaboration is key. I rely heavily on my team — nurses, technicians, and other specialists. Additionally, continuous training ensures we're always prepared.

I: Finally, if you were to underscore one value or principle in your interactions with emergency patients, particularly those with heart concerns, what would it be?

ED: Empathy. It's not just about diagnosing a condition but understanding the person behind the symptoms. This drives accurate diagnosis and genuinely patient-centered care.

I: Thank you for sharing your insights and shedding light on the intricacies of emergency care. Now we will be delving into predictive algorithms in the triage process. Recognizing your emphasis on efficiency, how do you view the potential integration of ML-based decision support systems in triage?

(ED): Thank you for having me again. Efficiency in the ER can literally be a lifesaver. An ML-based system promises a significant boost in that direction. I see it as a potential game-changer for ensuring patients get timely attention based on accurate, data-driven assessments.

I: Given your emphasis on efficiency, what advantages do you anticipate with such a system?

ED: Speed and accuracy, primarily. With a well-implemented system, we could drastically reduce the time it takes to triage, allowing us to treat critical patients faster. Moreover, patterns that might be missed by a fatigued human eye could be quickly detected by an algorithm, optimizing our response.

I: Every coin has two sides. What challenges or downsides might surface with an ML-based approach?

ED: As with any tool, there's the risk of over-reliance. Even if the system is efficient, it might not account for all human variables. We need to ensure that it doesn't replace human judgment but instead complements it.

I: How would such a system influence your interaction with patients?

ED: Ideally, it would grant me more quality time with each patient. With preliminary assessments handled efficiently, I can focus more on treatment and patient interaction, ensuring they not only receive care quickly but also feel cared for.

I: In our tech-driven age, with your clear value on efficiency, what core principle do you believe should guide our integration of such systems in healthcare?

ED: Efficiency, while crucial, should never compromise patient well-being. Any system we integrate must prioritize the patient's health and safety above all else. Speed is a means to that end, not the end itself.

I: Thank you for shedding light on this perspective, Doctor. It's invaluable to understand the balance between efficiency and care.

ED: Absolutely. It's essential to drive forward with technology but with a clear vision of why we're doing it: better patient outcomes.

Interview Transcript #4: Patient Perspective on Visiting the Emergency Department

Interviewer (I): Thank you for speaking with us today. From your experiences, what is the most crucial aspect you seek when visiting the emergency department?

Patient (P): Thank you for having me. Primarily, it's the sense of urgency. When my heart acts up, every second feels critical. I seek immediate attention and understanding.

I: In those tense moments, how important is the communication and clarity provided by the medical staff?

P: It's invaluable. It's not just about the medical care, but also feeling informed and reassured. Knowing what's happening with my body alleviates a lot of the anxiety.

I: Beyond immediate medical attention, what else holds significance for you during these visits?

P: Human empathy. The moments where a nurse or doctor takes a brief second to hold my hand or reassure me – it makes the overwhelming situation a tad more bearable.

I: Building on that, how do you perceive the balance between technological advancements in the emergency department and the personal touch of medical staff?

P: While I appreciate the advancements and believe they're crucial for better diagnosis and treatment, they shouldn't overshadow the human element. Machines can indicate what's wrong with my heart, but they can't understand my fears or comfort me.

I: To follow-up on that point, have you ever felt that the use of technology might have hindered your experience or communication with the staff?

P: A couple of times, yes. I recall once being hooked to several monitors, and the staff seemed more engrossed in the readings than in answering my questions. It felt a bit isolating.

I: Considering your condition, timeliness is essential. How do you value the efficiency of processes, from triage to treatment, during your visits?

P: Efficiency is of the essence. But it should be a harmony of swift processes and attentive care. When processes are efficient, but I'm kept in the loop with clear communication, that's the ideal situation for me.

I: Lastly, if you could suggest one improvement to the emergency department based on your experiences, what would it be?

P: Better post-visit care. Sometimes, once the immediate issue is addressed, I feel a bit lost about the next steps or follow-ups. A clearer roadmap post-visit would be beneficial.

I: Taking into consideration the patient experience, there's an increasing trend of implementing machine learning systems for triaging, especially concerning heart conditions. How has your experience shaped your view on this?

P: From my visits to the ER, the initial interaction is so crucial in setting the tone for the entire experience. The thought of a machine playing a significant role in that initial assessment is both intriguing and unsettling. It could speed things up, but at what cost to the personal touch?

I: Reflecting on your past visits, do you feel there were moments where machine-assisted decisions could've changed your experience for better or worse?

P: There were instances where the ER was swamped, and I felt my assessment was rushed. Perhaps a machine might've added thoroughness there. But there were also times when the nurse sensed something was off, just from our conversation. I'm not sure a machine would catch those intangible cues.

I: If a machine learning system were part of your triage process, how would you want it to

enhance your experience as a patient?

P: For one, I'd want to know what the machine recommends and why would make me feel more involved in my care. Also, if it could streamline processes, reduce wait times, or even predict potential complications, it would undoubtedly make the experience better.

I: Lastly, with the patient experience at the forefront, what values do you believe should steer the integration of these systems in emergency settings?

P: It's all about feeling cared for and being in the loop. Whatever tech is used should make the experience better for us, the patients, without losing that human touch.

I: Thank you for sharing. It's essential to keep patient experiences at the heart of any changes.

P: Absolutely. Using technology is great, but it should always be about making things better for the people.