AI Project Outline – AI Radiology

## Scenario: **Custom**.>

**What is the business problem that needs solving?**

An important hospital has many radiologists to evaluate medical radiographies. The process of evaluating a radiography is time consuming and expensive. Recently they experienced missed diagnostics and long waiting lines. The other other hospitals had better fund raising initiatives and afford to pay a larger number of doctors and technicians.

The business decided to encourage a research project which would evaluate AI assistants existing on the market. They decided to evaluate two possible solution a SaaS (which would make them fully dependable on an external vendor) and a CaaS system which would customize better the hospital needs.

One solution is based on Siemens proprietary AI RAD Companion and it does: Chest CT, Brain MR, Prostate MR, Chest X-ray and Organs RT.

The CaaS solution will be developed in collaboration with a data science company. It is based on NVIDIA Clara Train SDK running on Amazon. The advantage is flexibility – it can add more organs and classify more detailed the images. They already have a large medical archive MMAR which can be developed.

There is also a fact that diagnostics from AI RAD Companion can feed also the customized library MMAR.

Both solutions will be evaluated by another data science company working with specialists from the hospital. They estimate 90% cut in waiting time and 50% more precision for the same number of personnel.

**How can AI solve this problem?**

Human beings are prone to mistakes based on personal or contextual reasons. They also have limited computational capacities therefore diagnostic time is an issue.

1. AI can detect anomalies in images and assist the decisional process of the doctors.

On the market, machine learning researchers have created supervised algorithms such as Isolation forest, one-class SVMs, local outlier factor to detect outliers in images. RRCF (Robust Random Cut Forrest) is an unsupervised algorithm used for the same reason. Convolutional and Generate Adversarial Neural Networks are also capable to detect anomalies in images after training.

1. AI can also help with object detection. Object detection is a computer vision technique that allows to identify and locate objects in an image or video. With this kind of identification and localization, object detection can be used to count objects in a scene and determine and track their precise locations, all while accurately labeling them.
2. AI can help with better speed and precision. For now, given the legislation it will be assisting and not replacing the personnel.

There are many popular algorithms for object detection:

* Fast R-CNN
* Faster R-CNN
* Histogram of Oriented Gradients (HOG)
* Region-based Convolutional Neural Networks (R-CNN)
* Region-based Fully Convolutional Network (R-FCN)
* Single Shot Detector (SSD)
* Spatial Pyramid Pooling (SPP-net)
* YOLO (You Only Look Once)

1. AI can help also with image classification. Image classification can be accomplished by any machine learning algorithms (logistic regression, random forest and SVM).

AIOps methods can be used for rapid deployment on premises or cloud.

* Radiologists can feed the algorithms with image datasets that are used for training and test. The will also help with labeling and tagging the results.
* Data Scientists will use different sets of algorithms to train and test.
* AI Engineers will automate and deploy the solution on the right platform.

**What are tools/resources needed to implement the solution?**

There is no specific need for a tool which can interact with this 2 solutions. They would need IaaS machines to deploy and transfer data in cloud.

Of course many other solutions exist, like Amazon SageMaker, TensorFlow, PyTorch, or Apache MXNet. Also there is a strong databricks solution based on Spark.

SparkMLib has tools which can be used by users to create datasets for training and algorithms. AWS Recoknition can also be used for the same reason.

The programming language used by data scientist will be Python using PySpark dialect on Databricks. It uses Jupiter Notebook. Databricks can scale easily in the cloud and can use GPUs.

Libraries like Scikit, Tensorflow and Keras and NVIDIA Clara SDK will supply data scientists with the algorithms previously mentioned.

Spark ML Flow will be used by AI engineers to operationalize the system in MLOps or AIOps.

AWS SageMaker si considered for labelling and classification.

But having an already out of the box SaaS and customizable SDK can help a lot in critical projects where you need a large amount of pretrained specialized data. What they need is GPU machines able to deliver performance for the CaaS solution and an integration application between the SaaS based and CaaS solution.

And that is why the decision.

**What ethical challenges might arise?**

Three main ethical challenges.

* Data used for training and testing the algorithms is real health data and private. The data should not leak – for example insurance companies could have information which can be used to measure risk. In Quebec there is law 64 which puts pressure on the protection of PII data.
* There is unclear legislation on using AI Tools for diagnostics. Responsibilities have to be clearly determined
* The work has to be protected and the future utilization of the software for commercial reasons must be established between the data science companies and the private clinic.

**What are some tactics for addressing these ethical challenges?**

* Data will be protected in all three cases: at rest, in motion and in consumption. Access to data will be secure and data will be anonymized. The datasets will not contain PII data and possibilities of deidentification will be removed. The company will use specialized software for detecting PII data and deidentification risks.
* The clinic will open a consulting mandate to clarify the legislation and establish the responsibilities according to existing legislation.
* The work will be protected by patents. The software will be encrypted with hardware and software keys.