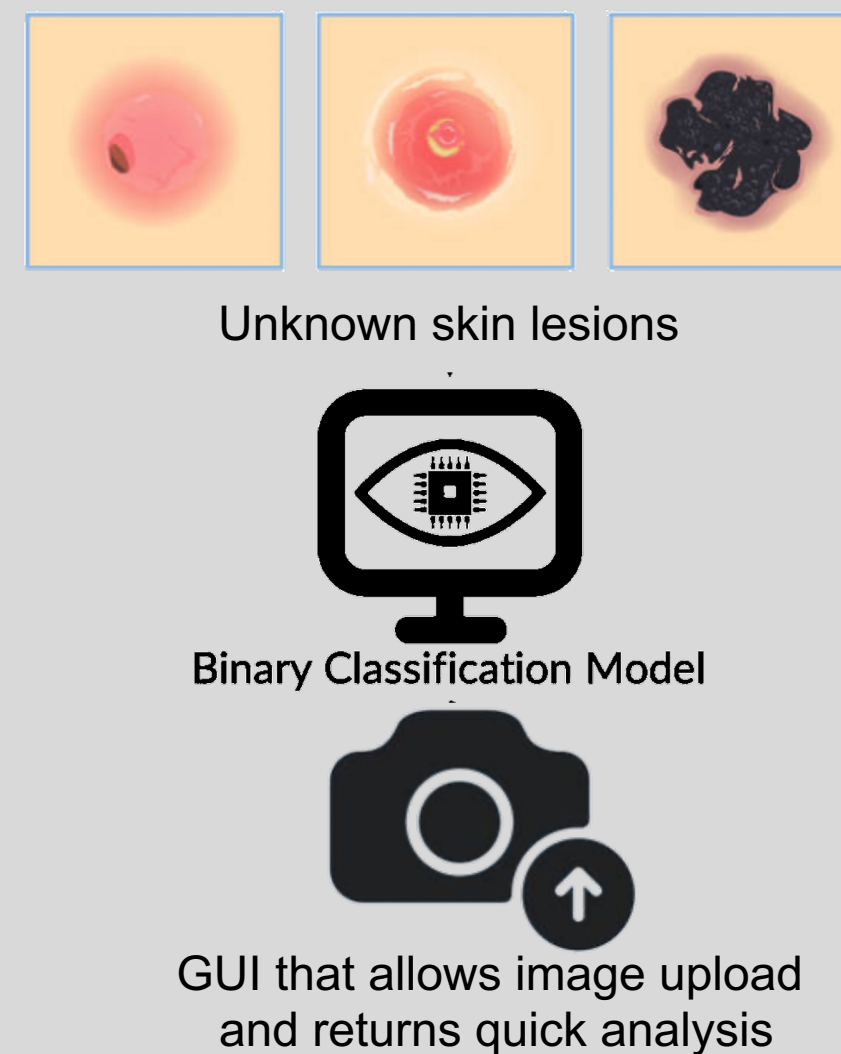


Asad Abdalla, Rashed Alyammahi, Mohammed Elbermawy, Yannick Fumukani, Richard Gonzalez, Meet Patel, Adam Sweiger  
Client/Advisor: Dr. Ashraf Gaffar

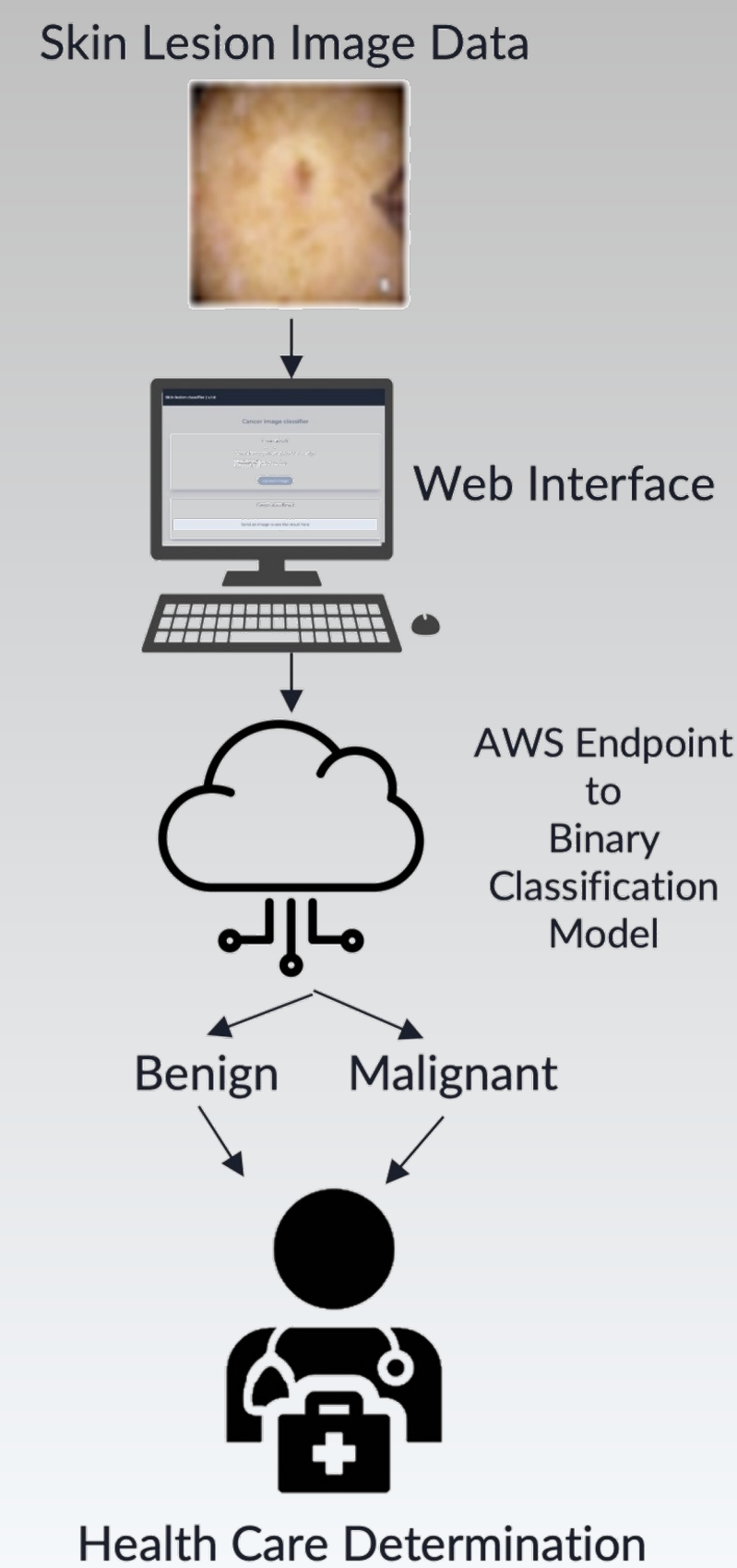
## Introduction

- Goal 1: Collection and organization of skin lesion image data
- Goal 2: Development of binary image classification AI model tailored to identifying the malignancy of collected image data
- Goal 3: Graphical User Interface utilizing the model for simple predictive capabilities



## Overview

- Classification of skin lesions
  - Benign
  - Malignant
- Develop binary image classification AI model
  - Evaluate and Compare Performance on:
    - Local Environment
    - Cloud Environment
- Graphical User Interface for easy utilization by such target audiences as medical professionals and laypeople (i.e. patients)

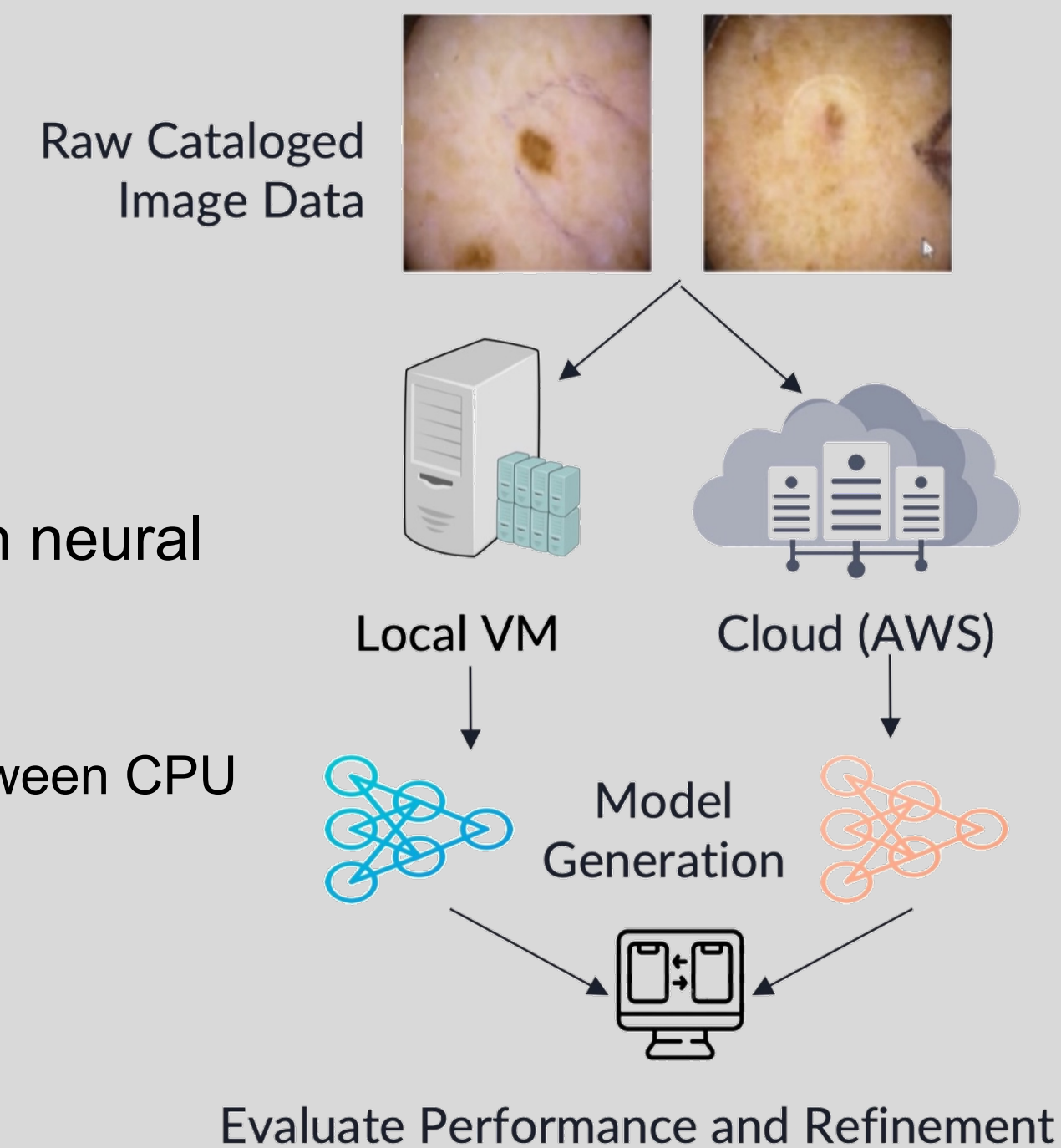


## Results

- **Ground:** Binary image classification model for identifying benign/malignant
  - Dataset scaled to over 67,000 images
  - Achieved accuracy of 92%
- **Cloud:** Efficiently scaled research using AWS (200,2K,10K Images)
  - Achieved comparable results to expensive equipment used at Iowa State ETG
- **User Interface:** Single-Paged web-based Application for ease of interaction between user and the backend
  - AWS Endpoint built upon existing trained model [On-cloud training]
  - AWS Lambda Function created to link API gateway and endpoint

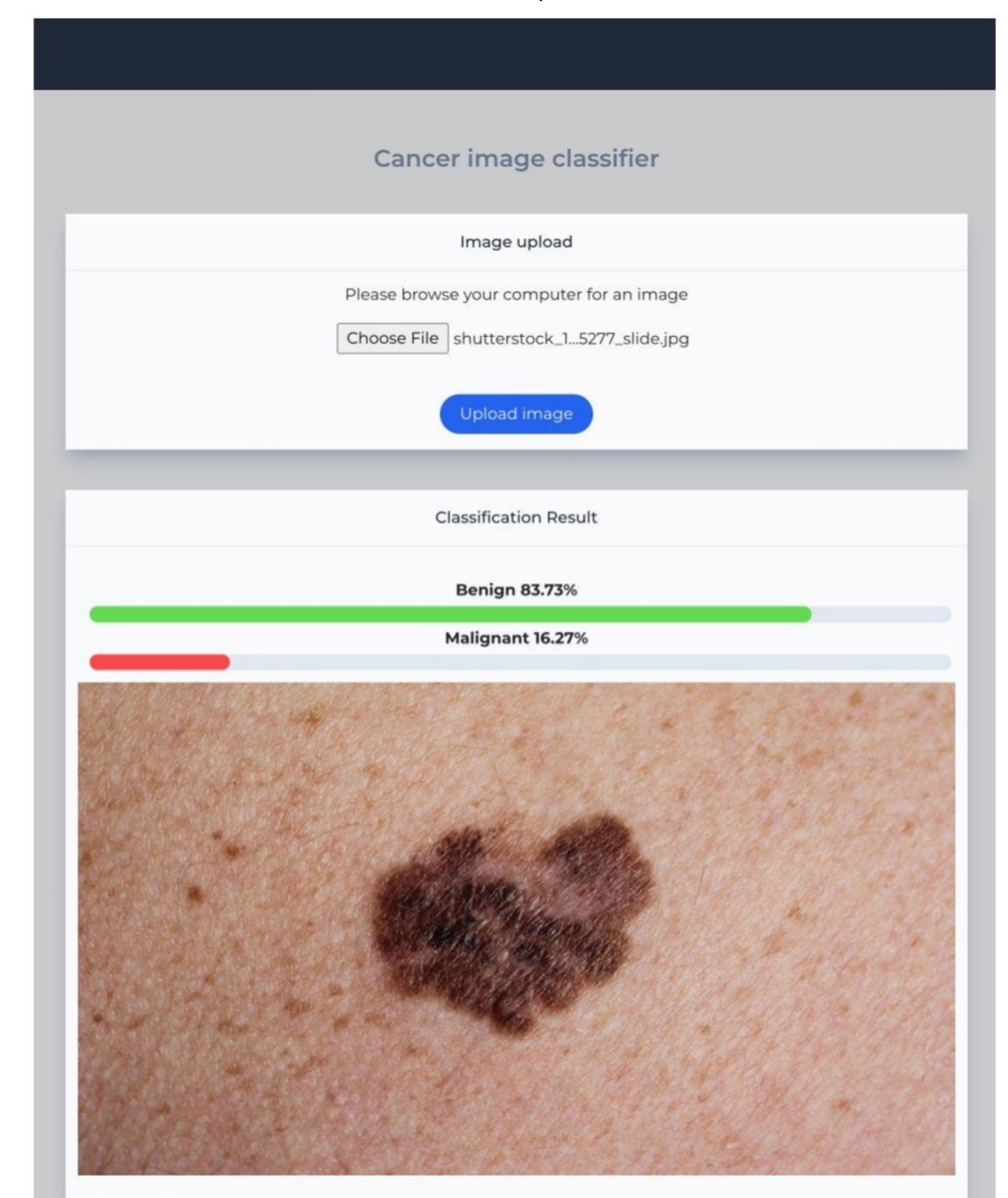
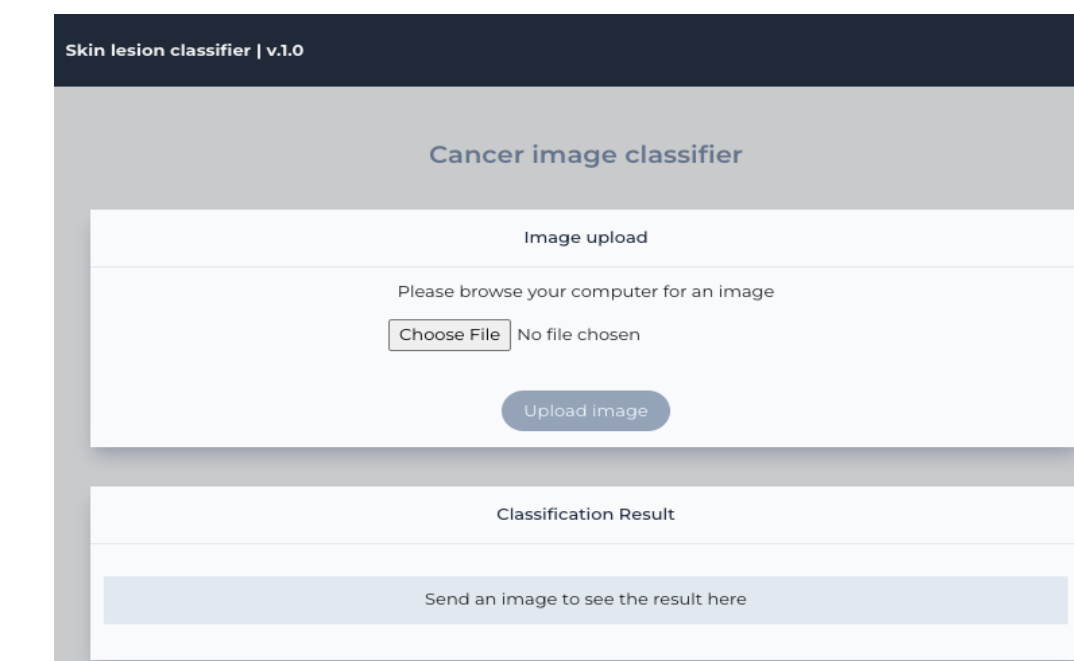
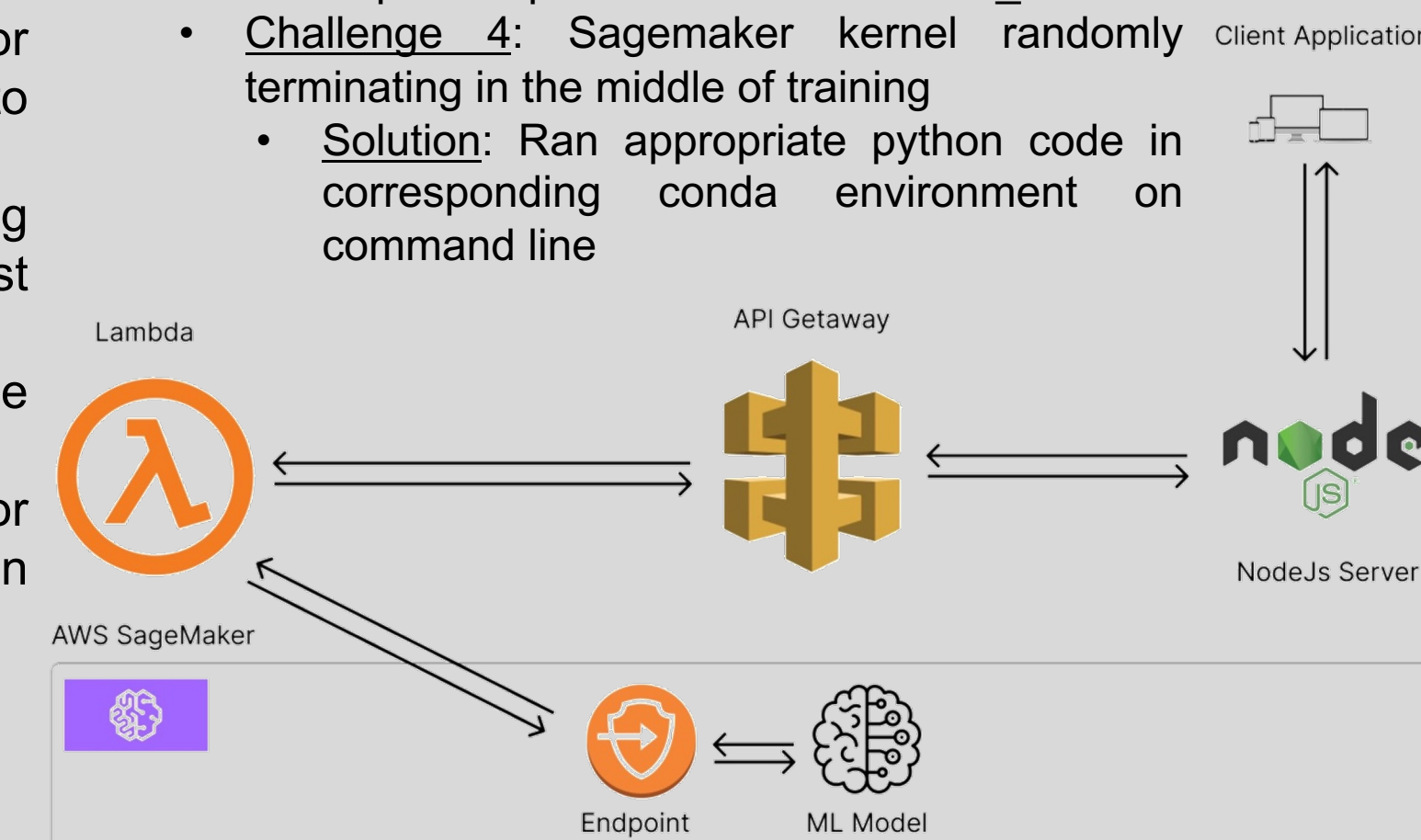
## Methodology

- Initial Literature Review
  - Seven highly cited articles on deep learning applications toward image classification of melanoma and other skin abnormalities
- Development of AI Model
  - Generated binary image classification neural network with over 60,000 images
  - Virtual Machine (Ground)
    - Evaluate performance difference between CPU and GPU resources
  - Amazon Web Services (Cloud)
    - Evaluate performance against comparable libraries run locally
- Development of User Interface
  - Creation of single page application with straightforward sections for image upload and results rendering



## Implementation

- **Data Collection**
  - International Skin Imaging Collaboration (ISIC)
  - Publicly-available library of skin lesions
- **Model Generation**
  - JupyterLab IDE (Ground and Cloud)
  - Conda, TensorFlow, and Keras for training
  - Exported as h5
- **User Interface**
  - AWS Endpoint: back end for harnessing web gateway into generated model
  - AWS Lambda Function: Linking Endpoint to API Gateway and post method
  - Node.JS: Helper back end for image conversion with Heroku
  - React.JS: Web interface (front end) for uploading and requesting prediction from model
- **Challenges and Solutions**
  - Challenge 1: Limited Resources (storage space, computing power, time)
    - Solution: Increased disk size on VM, upgraded computing resources on AWS
  - Challenge 2: Frontend team unable to send uploaded image from the client to the backend directly
    - Solution: Encode image to 64-bit before sending to the server for model prediction
  - Challenge 3: Keras data format error only when training on AWS
    - Solution: Sagemaker's TensorFlow backend requires input data to be 'channels\_last'
  - Challenge 4: Sagemaker kernel randomly terminating in the middle of training
    - Solution: Ran appropriate python code in corresponding conda environment on command line



## Impact

- Improve ability to detect and diagnose skin cancer and other skin abnormalities
- Quick analysis for medical professionals without need for invasive testing (i.e. biopsy)
- cursory evaluation for general public without access to sophisticated medical care
- Provide guidance for large-scale machine learning projects to transition to the cloud

## Conclusion

- Developed and trained AI model to classify skin lesions as benign or malignant with high accuracy
- Developed User Interface to run predictions on user-uploaded images
- Trained model in local and cloud environments and documented comparisons of results
- Result of comparisons: training on AWS with similar computing resources produces comparable results at a fraction of the cost