dermcheck.ai

final presentation | week 15

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team

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problem

Doctor's Appointments

Are costly in terms of time and money

Patients

should not have to wait to get an idea of their possible diagnosis

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can help

because

some skin conditions are more serious than others

impact

1 in 4
Americans are affected by a skin condition at any given time

$15 billion
Expected size of global skin cancer treatment market by 2027

85%
of Americans have a smartphone

Clinicians
Clinicians can use dermcheck.ai to check their diagnosis with AI-backed inference

Patients
Patients can check their possible diagnosis before seeing a doctor, to understand if their condition is serious or not

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with your photo, dermcheck.ai can classify up to 5 categories of skin conditions
encompassing ~120 different skin abnormalities
ranging from the most malignant skin cancers to the most common skin diseases

product

User Outcomes

Benign
Moles
Nevi
Dermatofibroma

Skin Condition
Eczema
Acne
Dermatitis

Infection
Warts
Fungus
Ringworm

Malignant
Melanoma
Carcinoma
Keratosis

Unclassified

product

User Outcomes

✓	Benign	No Action Required
🩹	Skin Condition	Contact Physician (lower risk)
🦠	Infection	
☢	Malignant	Contact Physician (higher risk)
?	Unclassified	

product

◉ Benign	Moles Nevi Dermatofibroma		No Action Required
◉ Skin Condition	Eczema Acne Dermatitis		Contact Physician (lower risk)
◉ Infection	Warts Fungus Ringworm		
◉ Malignant	Melanoma Carcinoma Keratosis		Contact Physician (higher risk)
◉ Unclassified			

product

App
Demo
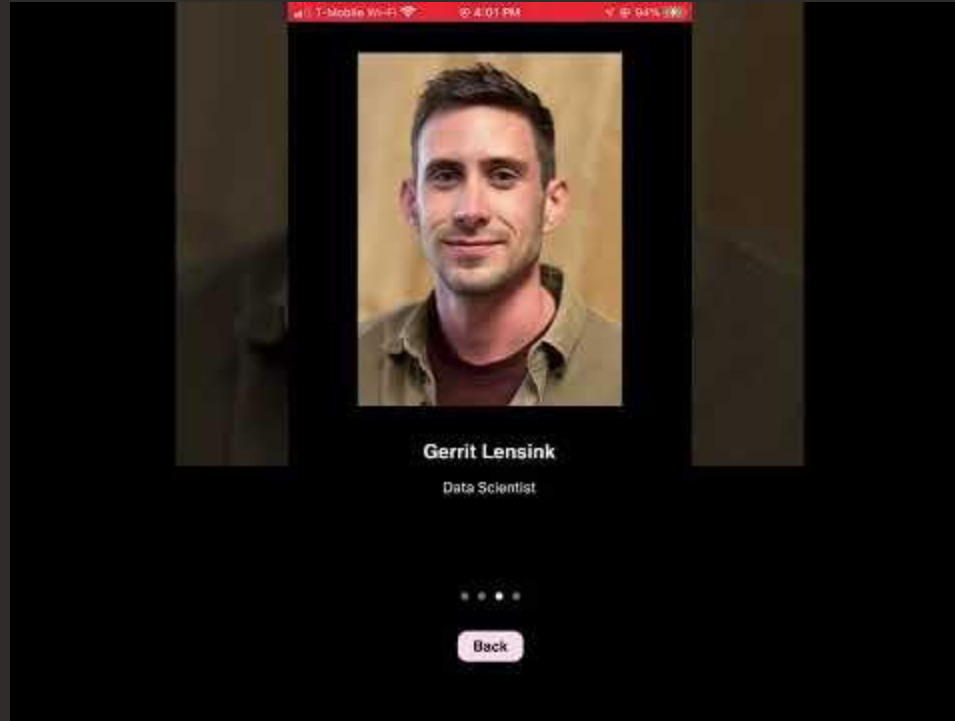
data

ISIC

The International Skin Imaging Collaboration (ISIC) is an academia and industry partnership designed to facilitate the application of skin imaging to help reduce melanoma mortality. ISIC has a large and open source skin image library, creating resources for dermatology and CS communities. We have leveraged data from the ISIC 2018, 2019, and 2020 datasets.

58k images

Dermnet

The Dermnet datasets contains images of around 23 types of skin diseases. Dermnet is the largest dermatology online source built for the purposes of providing online medical education. Dermnet helps thousands of people make informed, evidence-based decision on how to care for skin conditions by providing reliable information.

20k images

Stanford Diverse

To ascertain potential biases in algorithm performance in this skin disease detection, the Diverse Dermatology Images (DDI) dataset was curated. It is the first publicly available, deeply curated, and pathologically confirmed image dataset with diverse skin tones. The DDI was retrospectively selected from reviewing pathology reports in Stanford Clinics from 2010-2020.
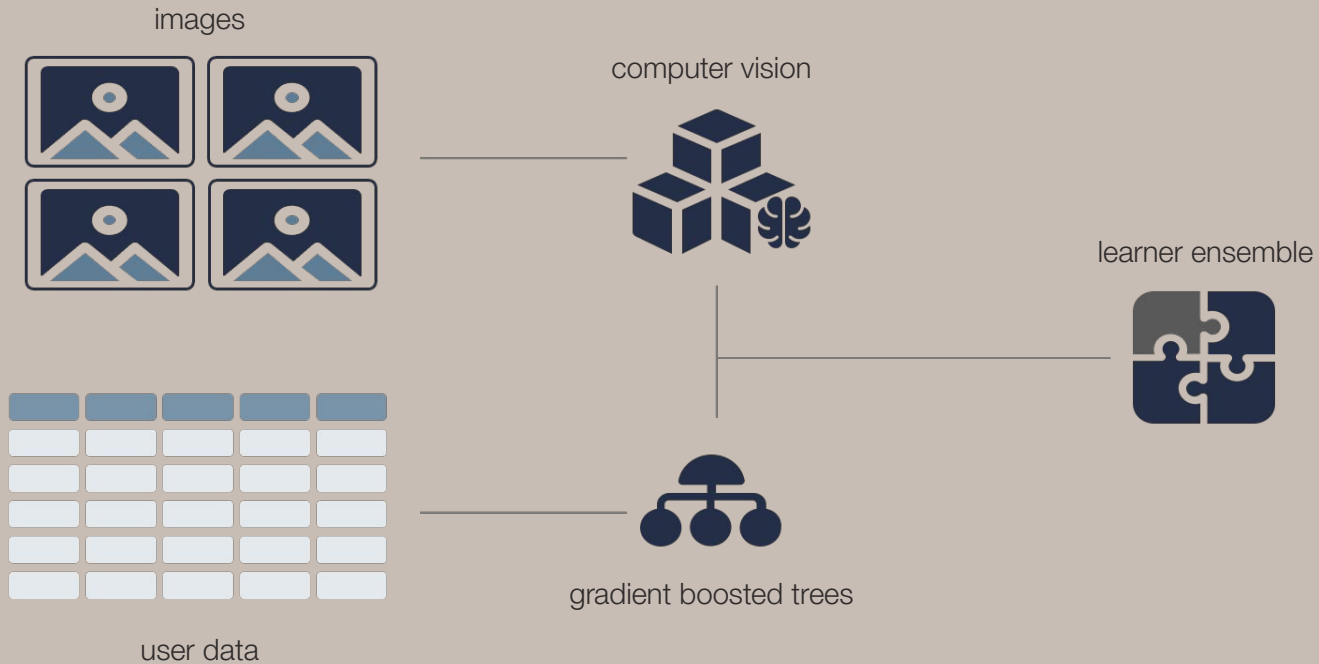
600 images

data

Most of the readily available skin disease image data out there is heavily biased towards lighter skin tones. In order to combat this we have used image blending by overlaying two images over one another with the goal of darkening the skin tones in our dataset.

We have leveraged the darkest classification in the Fitzpatrick classification of skin phenotypes in order to do this, and 33% of the images in our final dataset are of this classification.

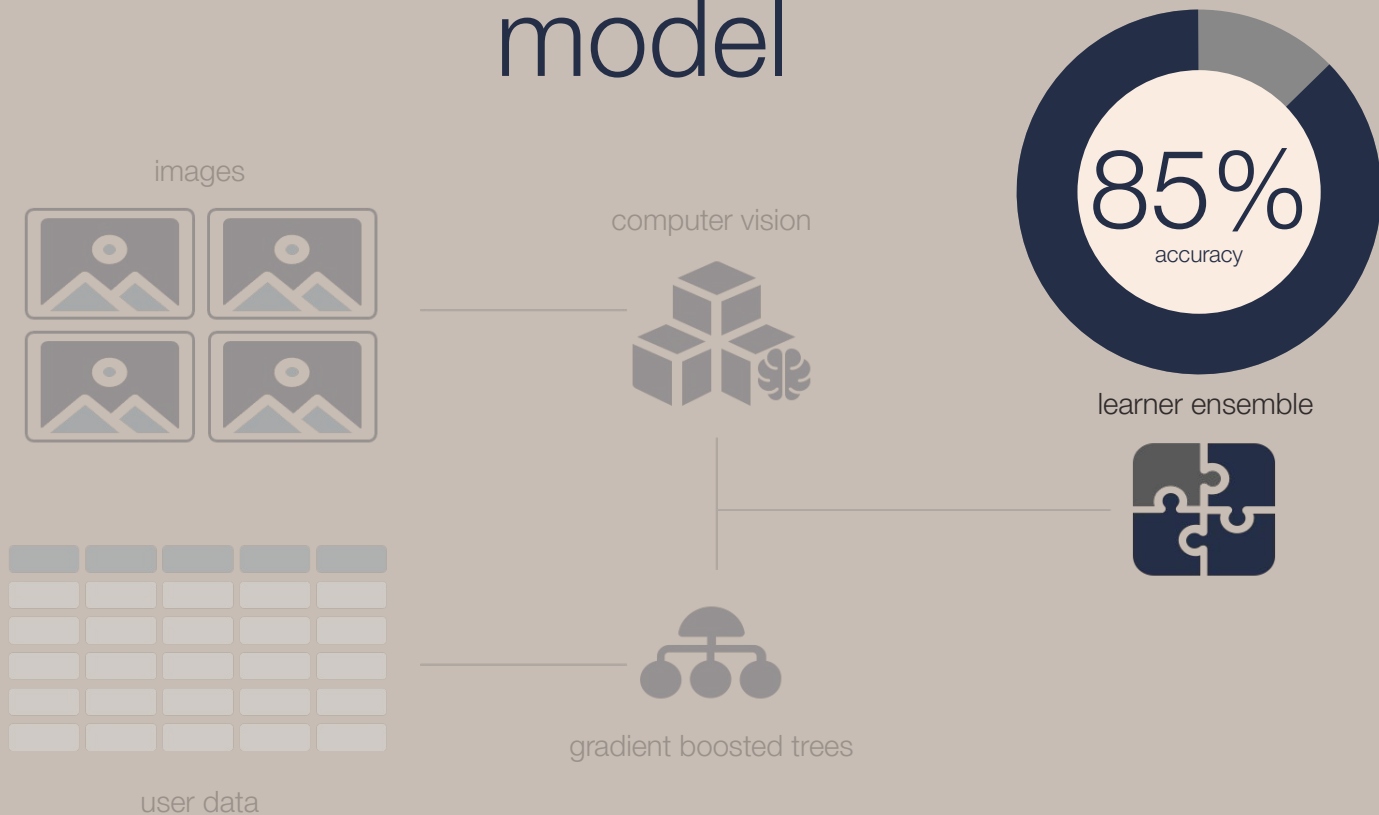## THE FITZPATRICK SCALE

Type I	Type II	Type III	Type IV	Type V	Type VI
Light, pale white	White, fair	Medium, white to olive	Olive, moderate brown	Brown, dark brown	Brown, very dark, brown to black

model

images

computer vision

learner ensemble

user data

gradient boosted trees

model

images

computer vision

85%
accuracy

learner ensemble

user data

gradient boosted trees

model

images

computer vision

80%

accuracy

learner ensemble

user data

gradient boosted trees
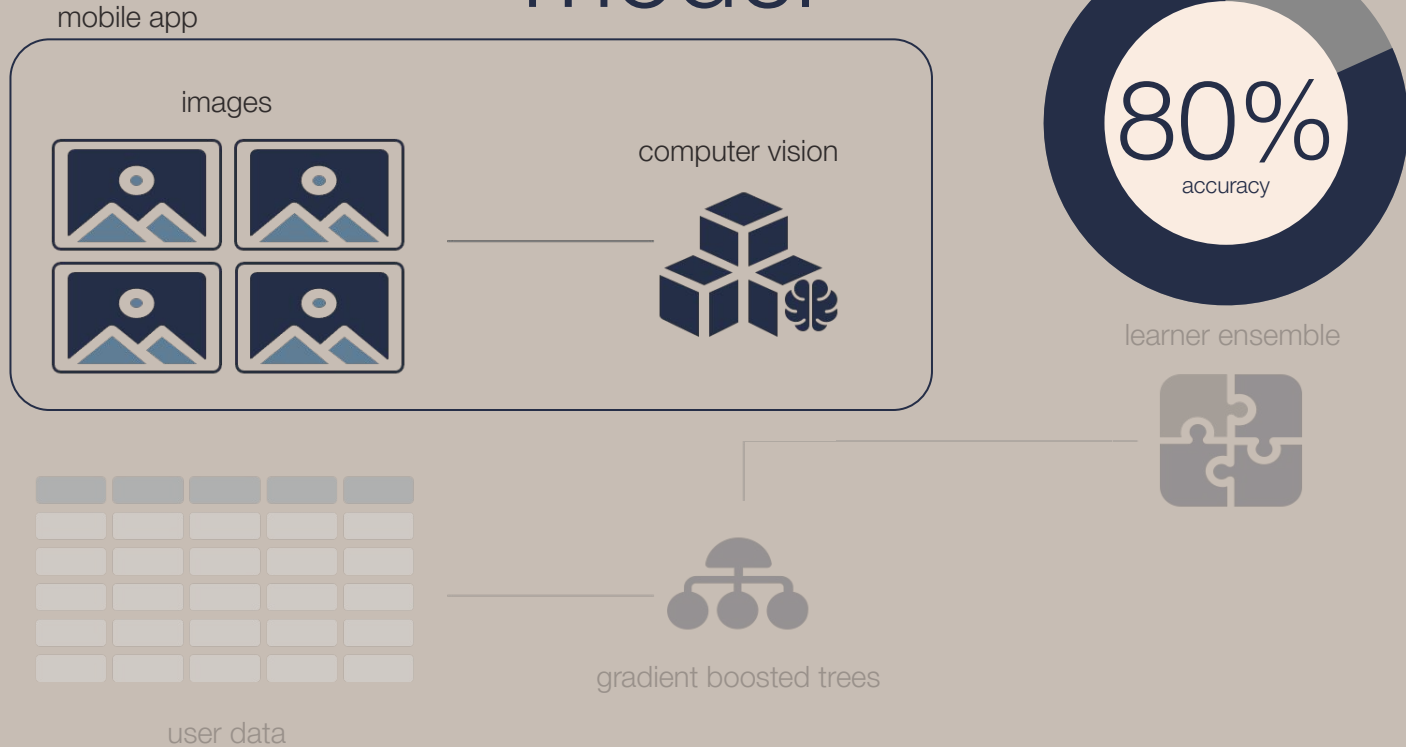
Image model

computer vision

Architecture*

Framework: **Pytorch**
Pretrained Models: **Resnet, VGG**
Epochs: **10, 15, 20, 50**
Learning Rate: **.000559, .0025, .003, .0035,**
Optimizer: **SGD, Adam**
Batch Size: **64**
Workers: **24**
Code Base:

* final learner model spans 9 different CV models. Attributes above reflect range of attributes over final models
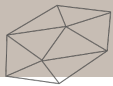
Metadata model

Decision Tree

Architecture
Framework: gradient boost
Tree Depth: 2
Min_child_weight: 0.81
Learning Rate: 0.025
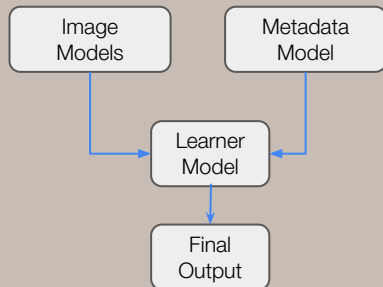Gamma: .10
Subsample: 0.80
Colsample_by_tree: 0.42

Key Inputs/Learning
Color of the image (Most Important)
Gender
Age
Location of the Image (Least Important)

Ensemble Models

Stacking Ensemble


```
Image Models        Metadata Model
        \            /
         Learner Model
              |
         Final Output
```

Architecture

Ensemble Framework:
- Stacking

Learner Model Framework:
- Gradient Boost

# of Input Models: 9

Learner Model Hyperparameter:
- Tree Depth: 1
- Min_child_weight: 0.16
- Learning Rate: 0.033
- Gamma: .25
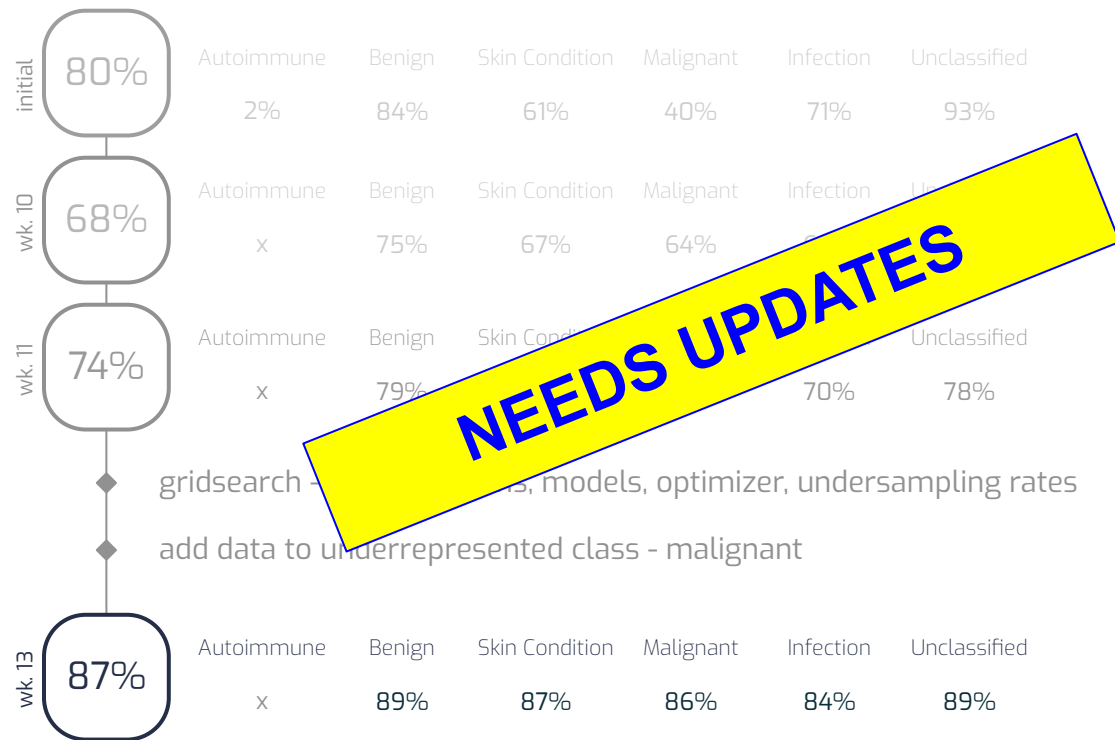- Subsample: 0.80
- Colsample_by_tree: 0.40

Key Learning

Ensemble result depends on several factors:
- # of models stacked
- accuracy of the models
- how different the models are

Improvements

		Autoimmune	Benign	Skin Condition	Malignant	Infection	Unclassified
initial	80%	2%	84%	61%	40%	71%	93%
wk. 10	68%	x	75%	67%	64%		
wk. 11	74%	x	79%			70%	78%

◆ gridsearch - ~~~~~, models, optimizer, undersampling rates

◆ add data to underrepresented class - malignant

		Autoimmune	Benign	Skin Condition	Malignant	Infection	Unclassified
wk. 13	87%	x	89%	87%	86%	84%	89%

NEEDS UPDATES

evaluation

Performance

- (H) Notable improvement from baseline models
- (M) Ensemble Model Accuracy > 95%
- (M) Image Model Accuracy Accuracy > 90%
- (L) Deployed App Accuracy > 90%
- (H) Balanced classification across classes
- (H) High sensitivity to classifying the most dangerous categories wrong

Inclusion

- (M) Include diverse data to ensure model is usable for all skin types

Success Level
- ● high
- △ medium
- ▢ low

recommendation

Data	Final Deployment	Inclusivity
more out-of-sample test data	expand app to include metadata input	increase the amount of skin types included in data
wider variety of image types across classes	focus on out-of-sample failures in deployment	research state-of-the-art methods for adding more diverse images

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system architecture
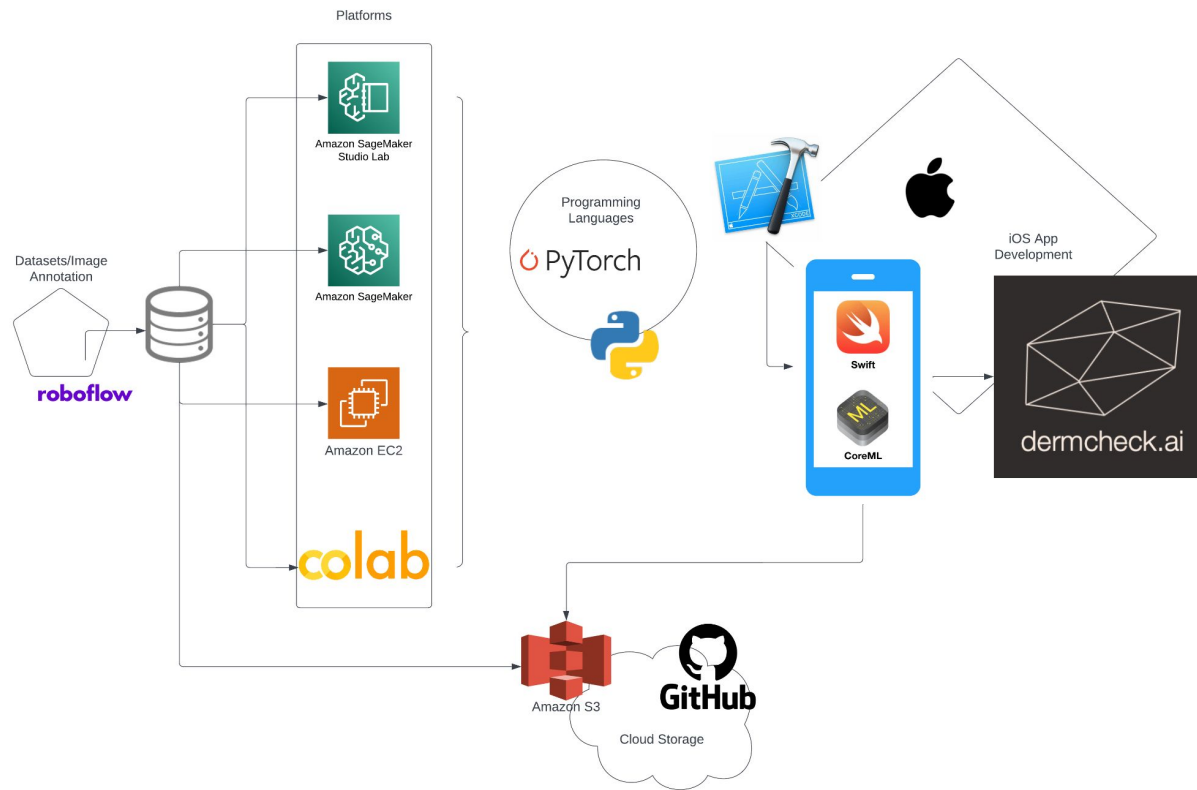
Platforms

Amazon SageMaker
Studio Lab

Amazon SageMaker

Amazon EC2

colab

Datasets/Image
Annotation

roboflow

Programming
Languages

PyTorch

iOS App
Development

Swift

CoreML

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Amazon S3

GitHub

Cloud Storage
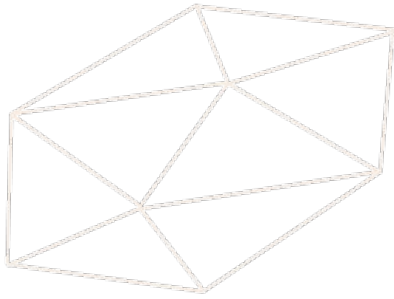
evaluation

Performance

⭘
high success

Notable improvement from baseline models

△
med. success

Ensemble model accuracy > 95%

△
med. success

Image model accuracy > 95%

▢
low success

Deployed app accuracy > 95%

⭘
high success

Balanced classification across classes

⭘
high success

High sensitivity to classifying the most dangerous categories wrong

Inclusion

△
med. success

Include diverse data to ensure model is usable for all skin types

Success Level

⭘ high

△ medium

▢ low

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Final Presentation - Dry Run

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Template