## Major Project

# Melanoma Detection: An Automated Approach

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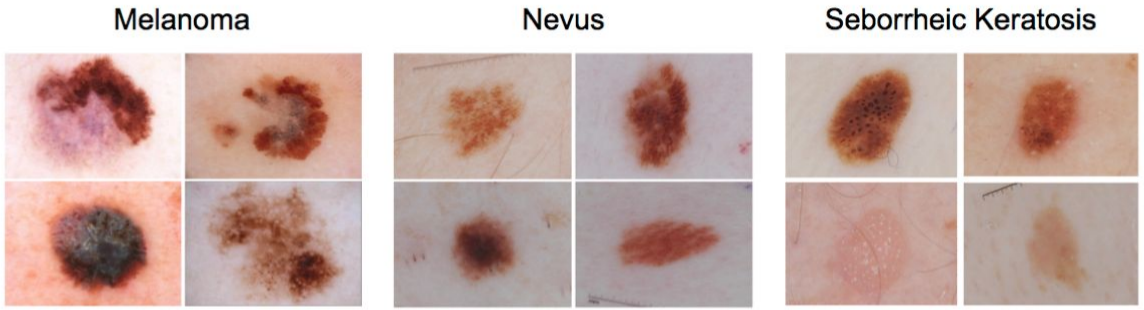
# Challenge 2017

- International Skin Imaging Collaboration (ISIC)
- Two binary classification tasks:
  - In the first, distinguish between (a) melanoma and (b) nevus and seborrheic keratosis.
  - In the second, distinguish between (a) seborrheic keratosis and (b) nevus and melanoma.
- 2000 images are provided as training data, including 374 "melanoma", 254 "seborrheic keratosis", and the remainder as benign nevi (1372).



# Literature Review

| Lequan, Hao | RoR | Resnet | Deep Transfer Learning | Sparse Coding |
|---|---|---|---|---|
| • **Dataset** : ISBI 2016 Skin Lesion Analysis Towards Melanoma Detection Challenge dataset.<br>• 2 stage framework- FCRN for lesion segmentation + Deep Residual network for classification | • **Dataset** : benchmark datasets CIFAR-100<br>• Uses residual mapping function in two layers<br>• Two methods of stochastic depth and linear decay weightage | • **Dataset** : International Skin Imaging Collaboration (ISIC) dataset<br>• Concept of shortcut connections using identity function<br>• Image is resized and randomly cropped in a 10-crop testing style<br>• Plan 18 and 34-layer nets are evaluated | • **Dataset** : International Skin Imaging Collaboration (ISIC) dataset<br>• Uses pre-trained Caffenet model from the ILSVRC<br>• The preprocessing step involves resizing the image and Subtract the model's input mean image to "centralize"<br>• **Classifier** : Non-linear SVM using a histogram intersection | • **Dataset** : International Skin Imaging Collaboration (ISIC) dataset<br>• Unsupervised methods - learns a dictionary of sparse codes<br>• SPAMS sparse coding dictionary learning algorithm- based on stochastic approximations.<br>• Images are rescaled to pixel extraction of 8x8 patches, to learn 2 dictionaries (color/gray)<br>• **Classifier** : Non-linear SVM using a histogram intersection kernel |

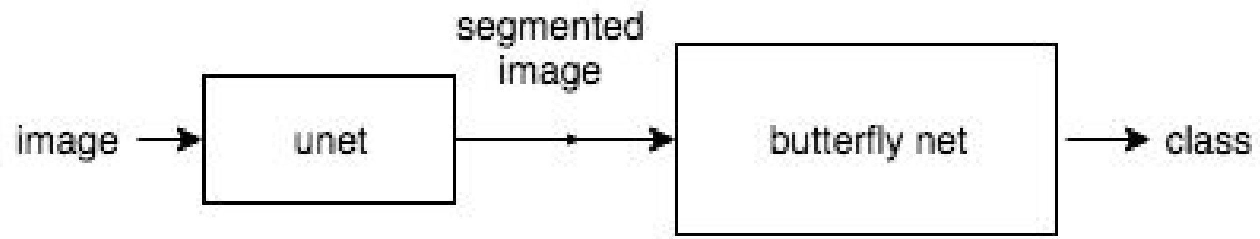
# Algorithm

Concept

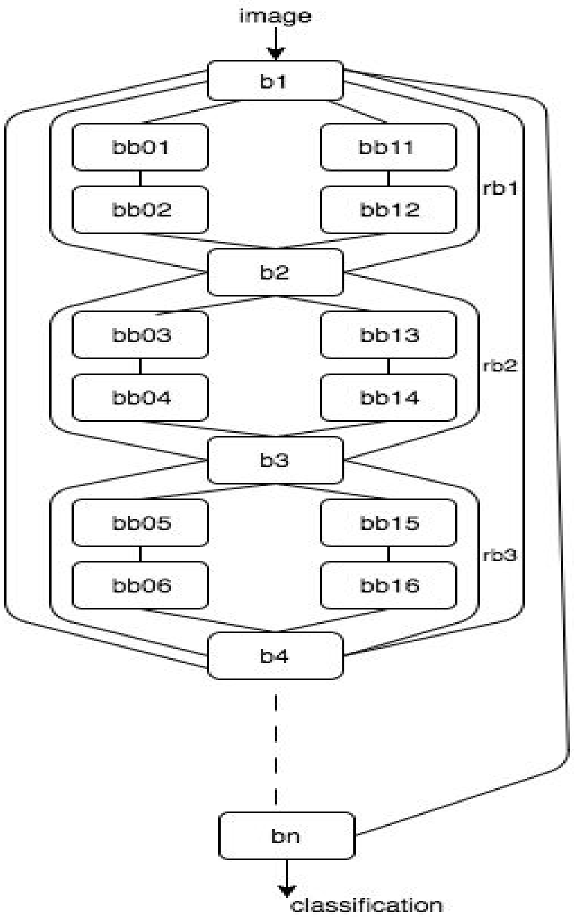
- Widening the network to increase the learning parameters
- Each layer is an ensemble of 2 networks
- Weighted-Identity function + multi layer shortcuts
- Images are segmented

Characteristics

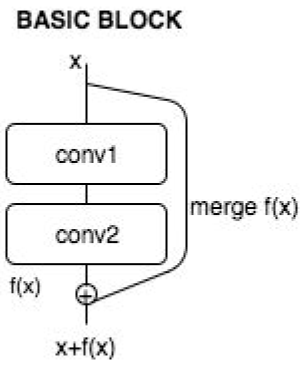
- Wider model (equivalent of a 100+ layer model)
    - Keras limitation (depth)
- Saving all weights is not necessary

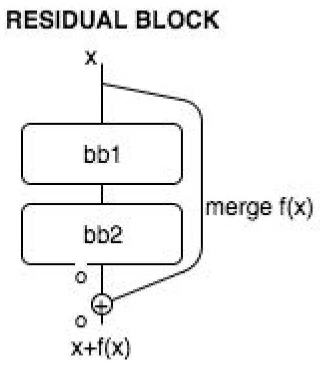


# Architecture



# Block Structure




**Basic block layer ordering**

- Batch normalization
- Convolution
- ReLu layer

Butterfly algorithm performs the merge function for each layer parallely and sums the output so it becomes…

$$(x1+f(x1)) + (x2+f(x2))$$

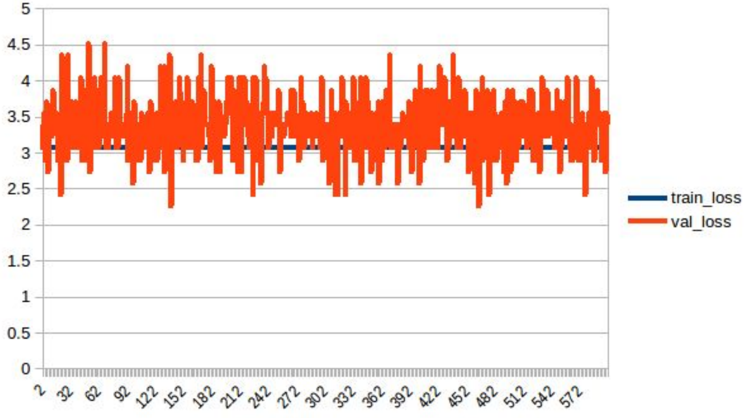
See __ paper__

# Issues

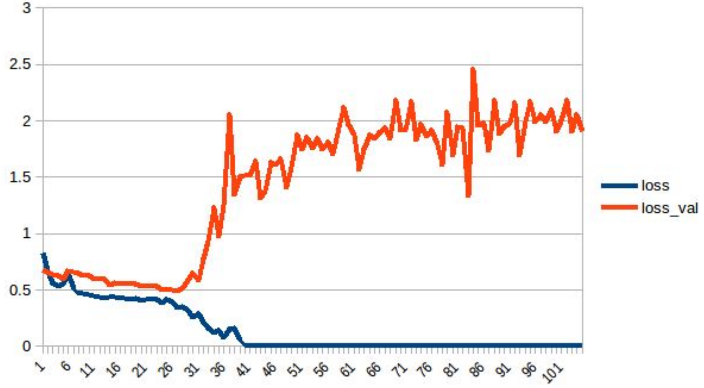
1. Vanishing gradients
   - Delta change in weights approach 0
2. Overfitting
   - Higher than necessary # of params
3. Diminishing feature reuse
   - Too abstract info in deeper layers
4. Internal co variation
   - Distribution of each layer’s inputs changes during training, as the parameters of the previous layers change

1. Shortcut connection
2. Forward previous layer through identity shortcuts
3. Multi layer connections
4. Batch normalization

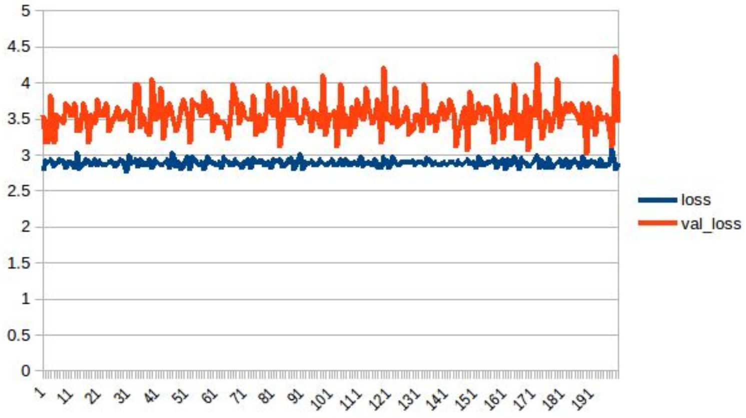
# Results



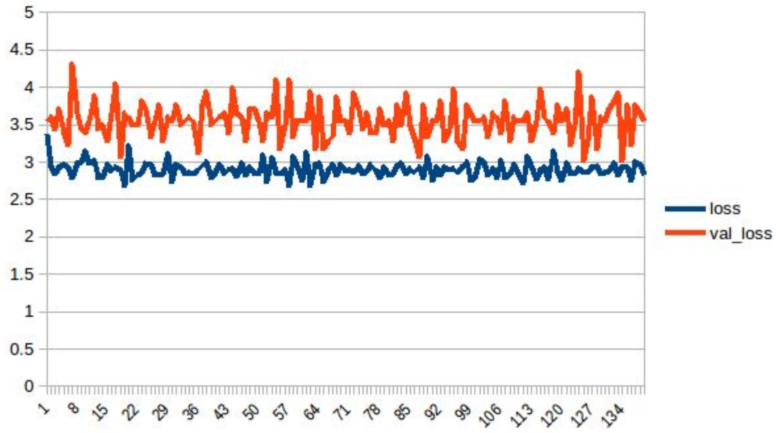

Butterfly Classifier



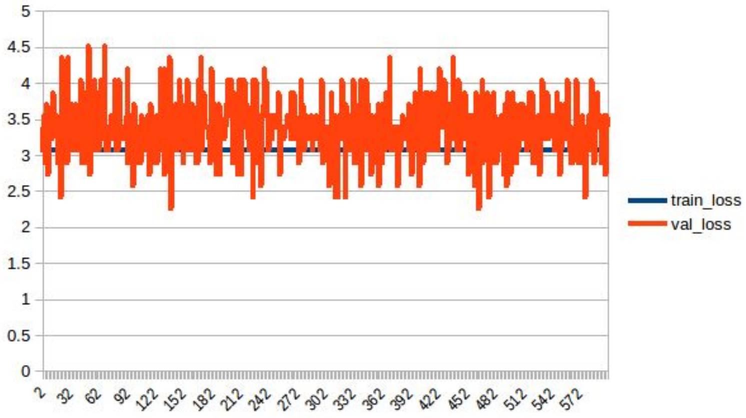

Resnet-18



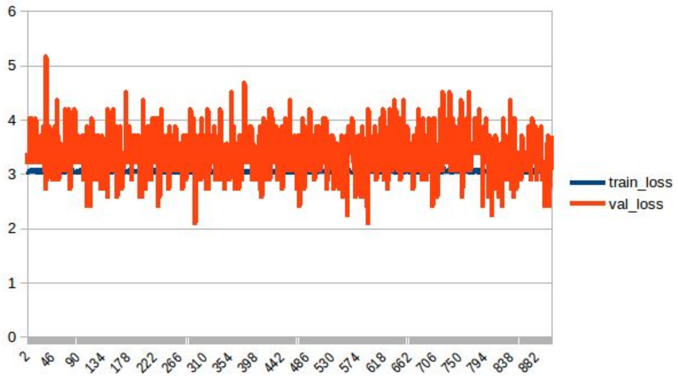

RoR-20




RoR-SD-20




Butterfly Classifier

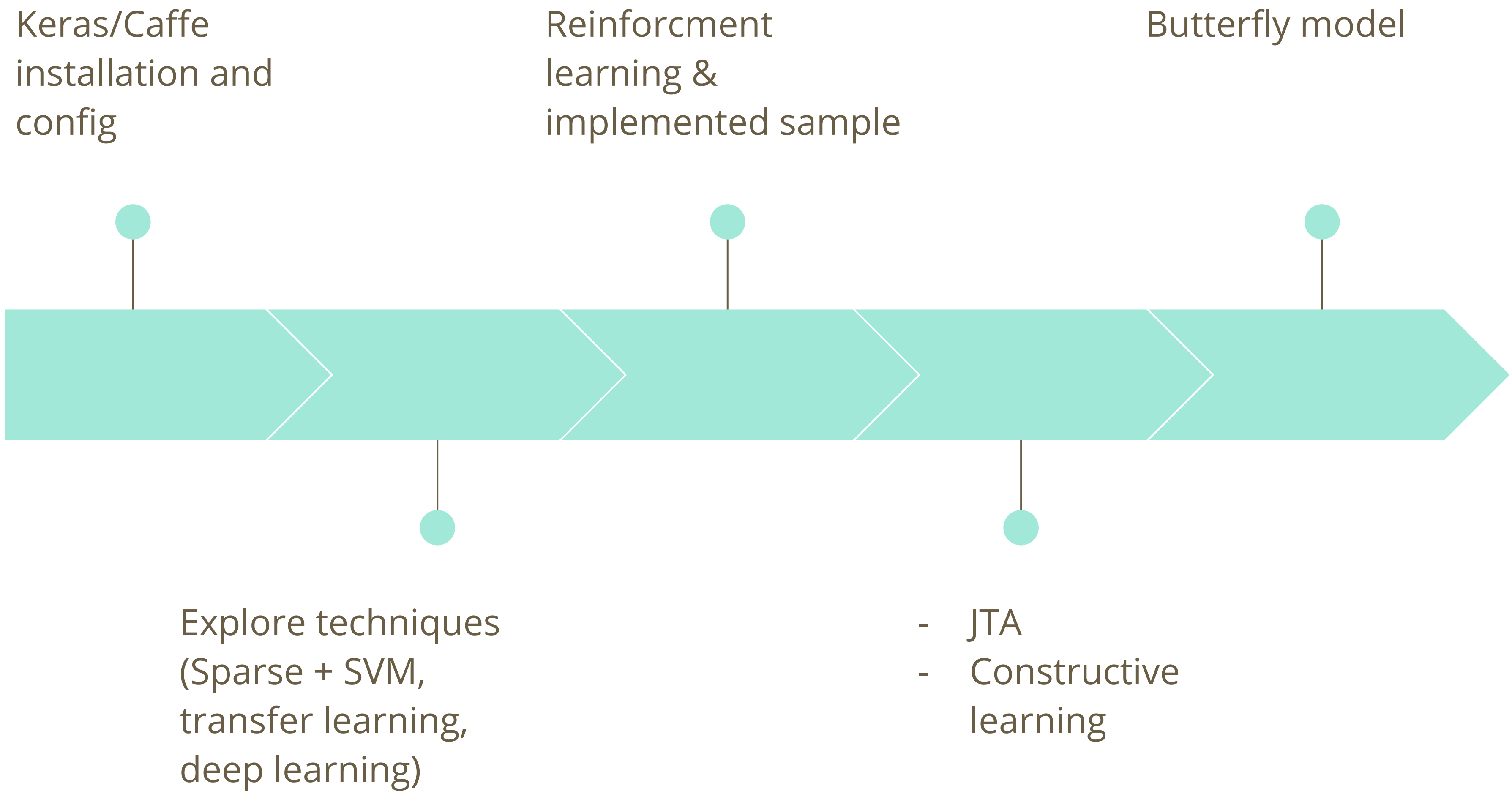



RoR-SD weighted

**Accuracy:**

| Automated Melanoma | ROR-SD | Butterfly GT | Butterfly Unet |
|---|---|---|---|
| 85.5% | 82% | 87% | 86% |

# The End


Keras/Caffe installation and config
Explore techniques (Sparse + SVM, transfer learning, deep learning)
Reinforcment learning & implemented sample
- JTA
- Constructive learning
Butterfly model

# Challenges in Frameworks

## Caffe

- Very limited customization of architecture

## Keras

- Issues in saving complicated model
- Issues in matrix multiplication

# Extensions on the butterfly model

## Modify weightage

Implement equal weightage of all RoR blocks for the butterfly model via linear decay

## Image Input

Split the image evenly and feed into the two ‘wings’ of the model