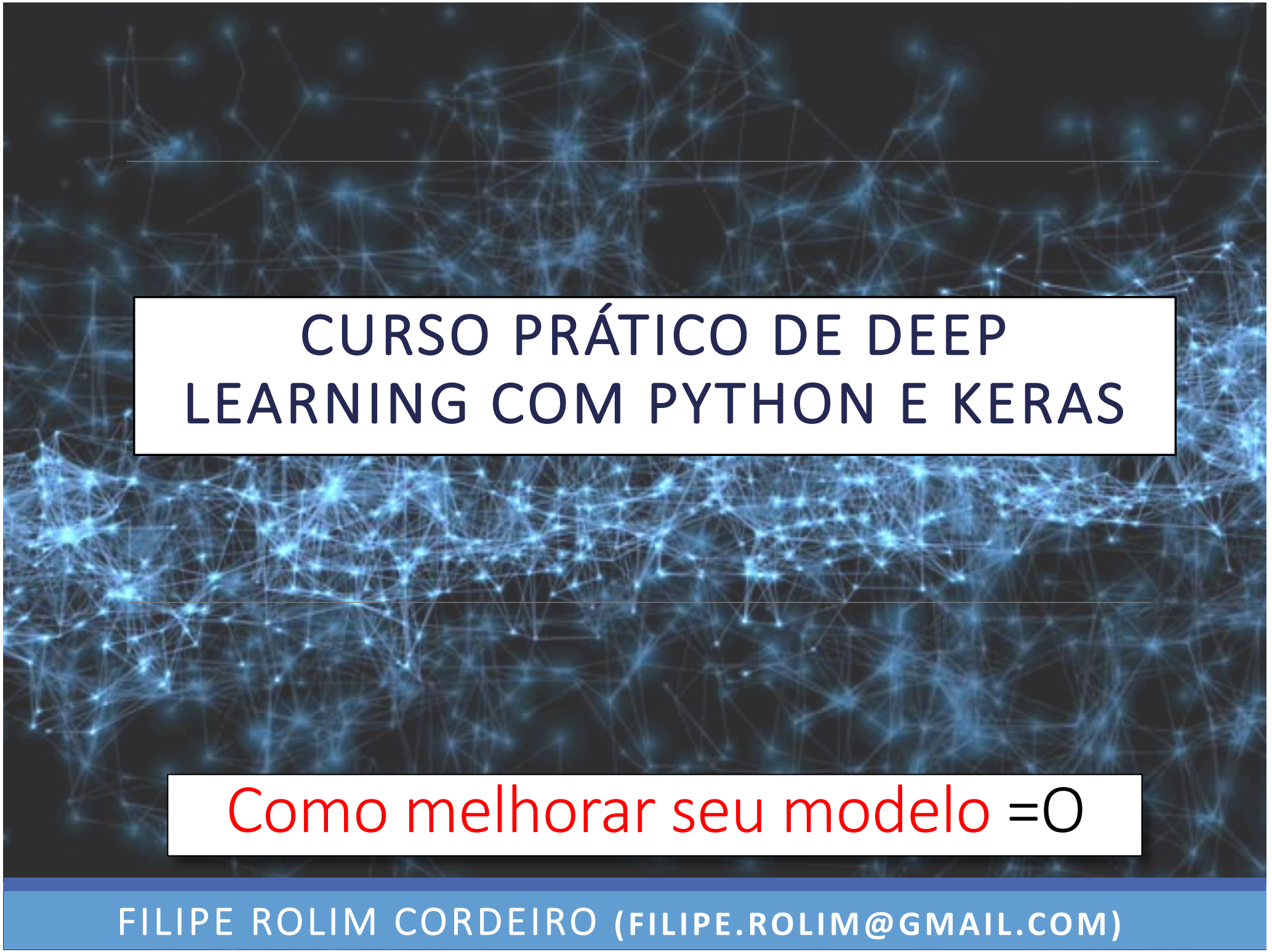


FILIPE ROLIM CORDEIRO (FILIPE.ROLIM@GMAIL.COM)

Conjuntos de treinamento/teste

- Divisões usadas: 70/30, 60/20/20, 50/25/25
- Big data (1.000.000)
  - 98/1/1/

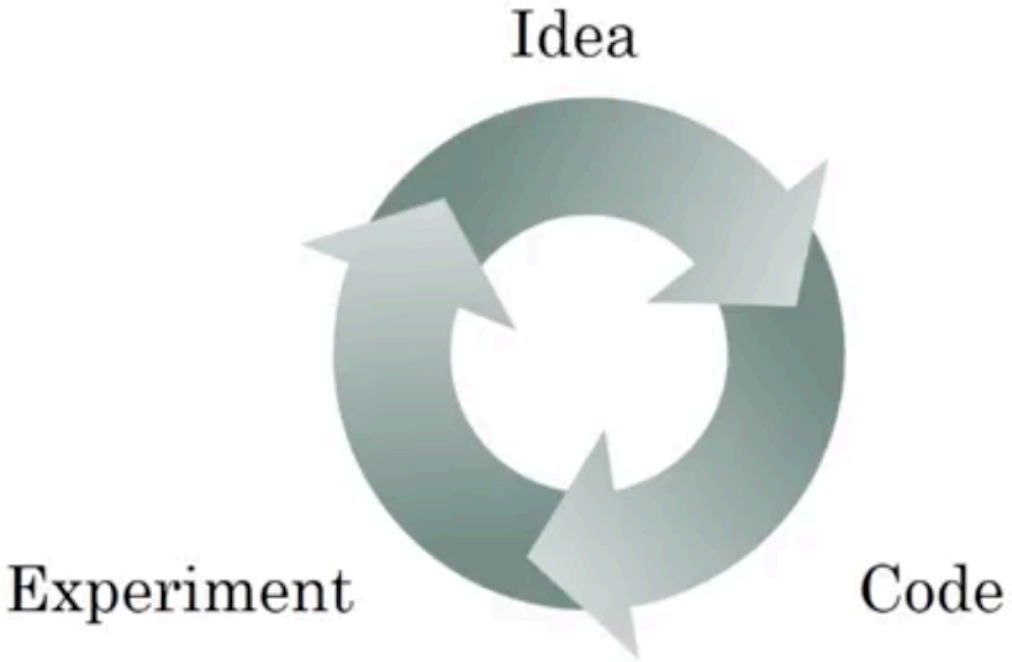
Distribuição incorreta

Conjunto de treino: figuras de gatos de webpages

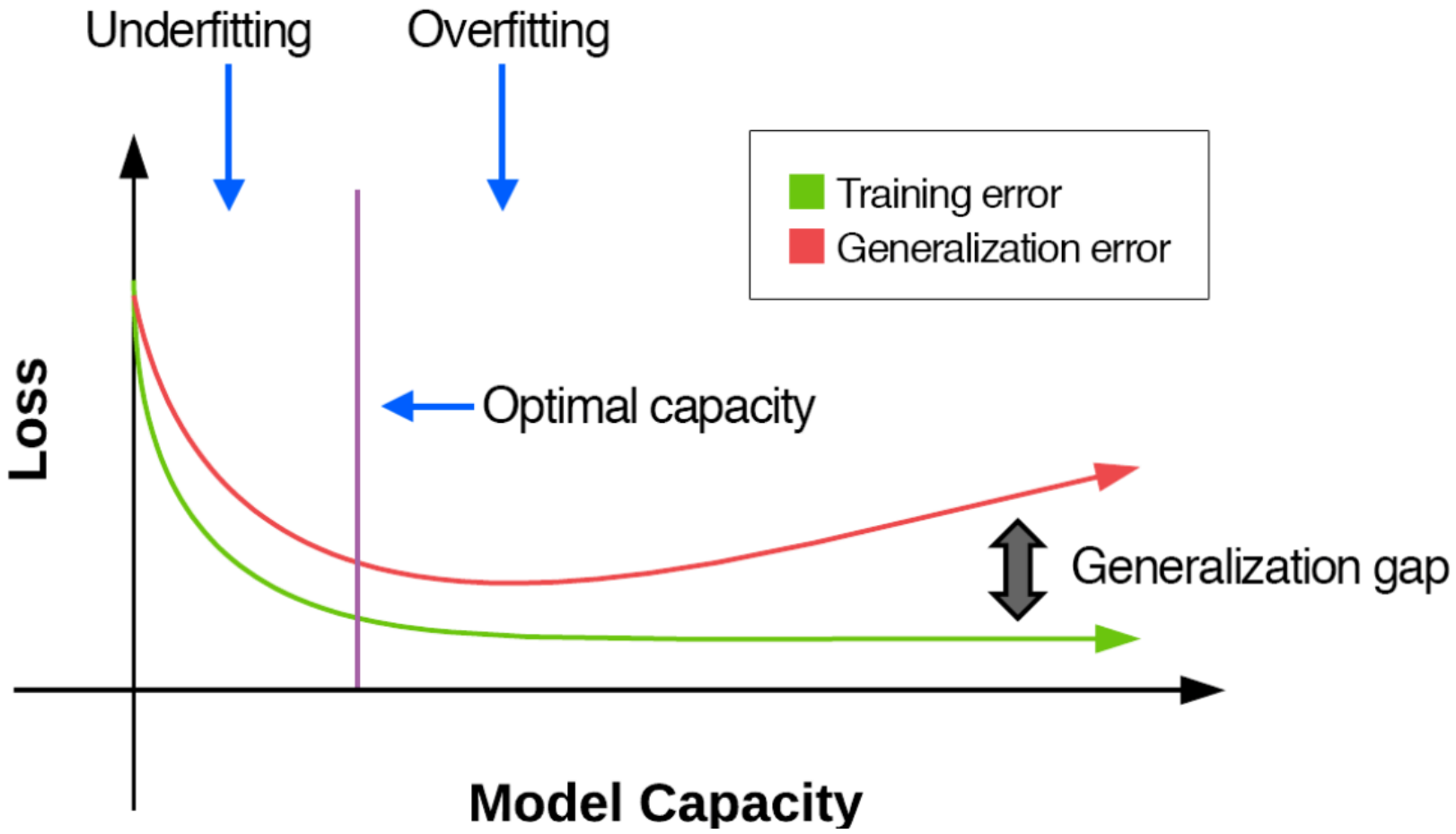
Conjunto de Valid./teste: Figuras de gatos usando seu aplicativo

ML é um processo iterativo

- # camadas
- # unidades escondidas
- Taxas de aprendizado
- Funções de ativação



Overfitting e Underfitting

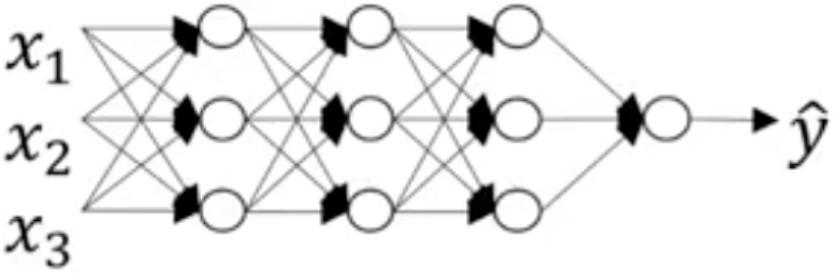


Regularização

$$L = \frac{1}{N}\sum_{i=1}^{N}[-log(e^{s_{y_i}} / \sum_j e^{s_j})] + \lambda \sum_i \sum_j W_{i,j}^2$$

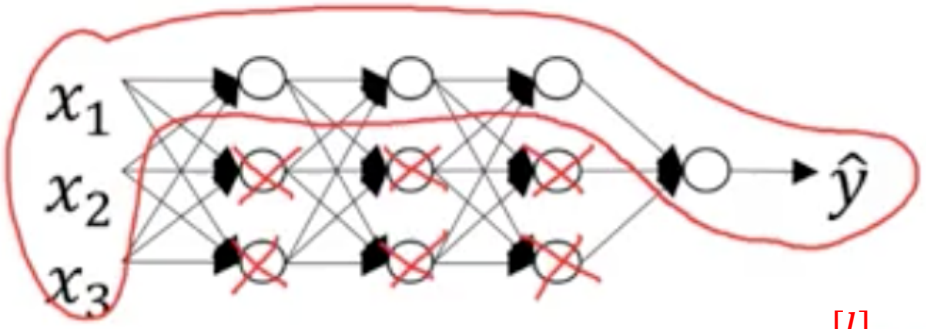
- Adiciona uma penalidade para valores altos de pesos
  - Parâmetro de ajuste λ

Por que a regularização previne overfitting?



$$L = \frac{1}{N}\sum_{i=1}^{N}[-log(e^{s_{y_i}}/\sum_j e^{s_j})] + \lambda \sum_i \sum_j W_{i,j}^2$$

Por que a regularização previne overfitting?



$$L = \frac{1}{N}\sum_{i=1}^{N}[-log(e^{s_{y_i}}/\sum_j e^{s_j})] + \lambda \sum_i \sum_j W_{i,j}^2$$

$$w^{[l]} \approx 0$$

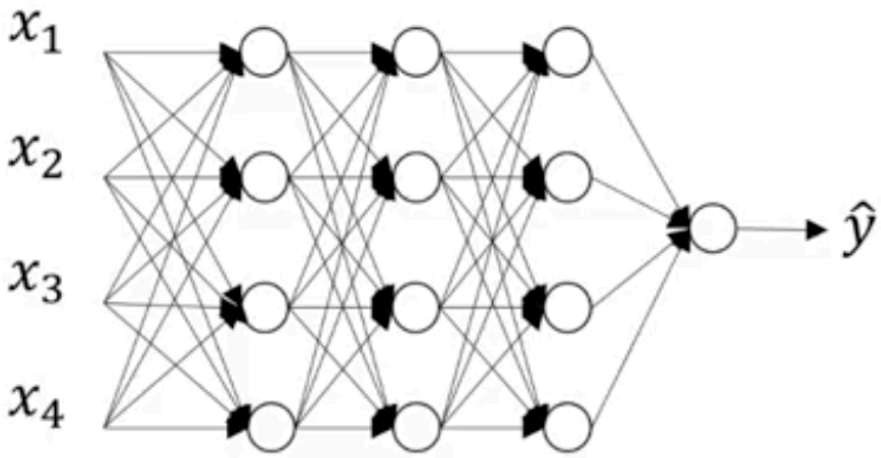
Regularização no Keras

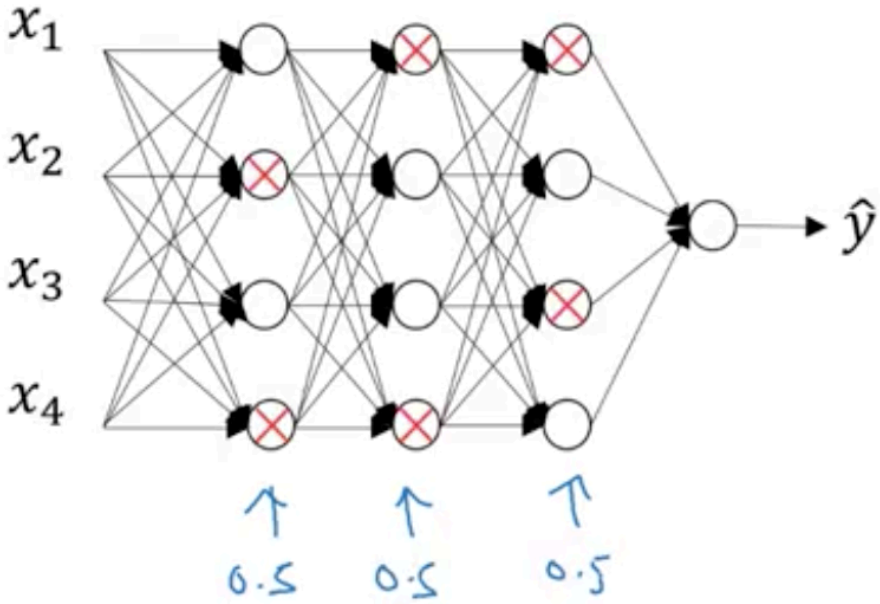
```
from keras import regularizers
model.add(Dense(64, input_dim=64,
                kernel_regularizer=regularizers.l2(0.01),
                activity_regularizer=regularizers.l1(0.01)))
```

Exercício

- Adicionar regularização
  - LeNet_optimizer.ipynb

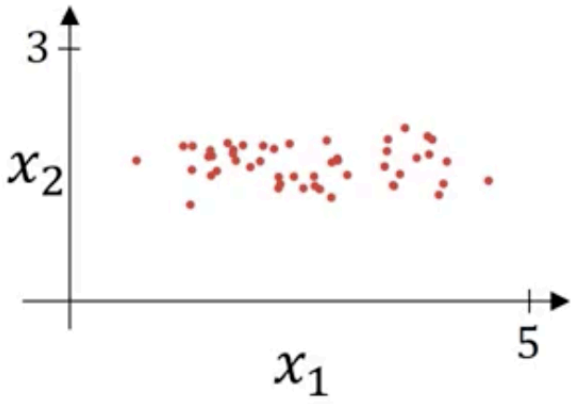
Dropout

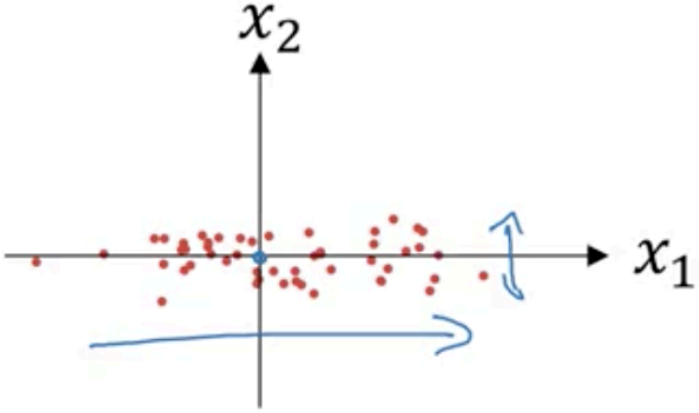


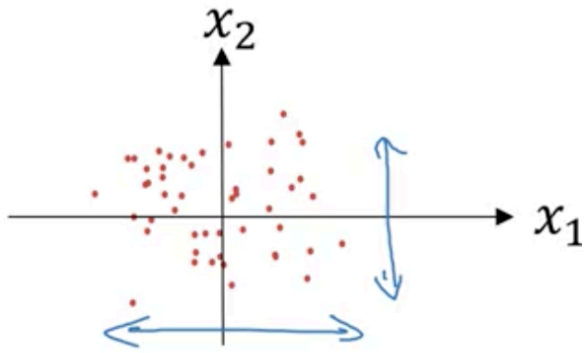


Normalizando Conjunto de Treino

- Média zero







Subtract mean:

$$\mu = \frac{1}{m} \sum_{i=1}^{m} x^{(i)}$$

$$x := x - \mu$$

Normalize variance

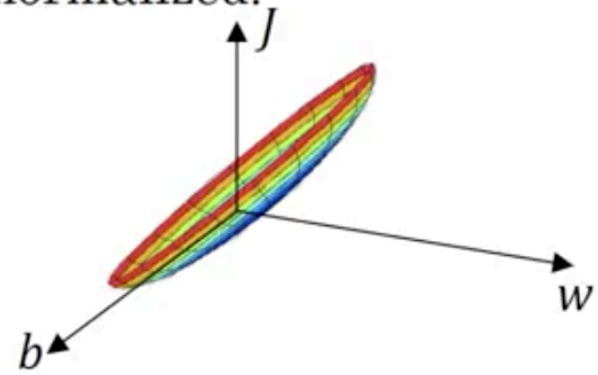
$$\sigma^2 = \frac{1}{m} \sum_{i=1}^{m} x^{(i)} **2$$

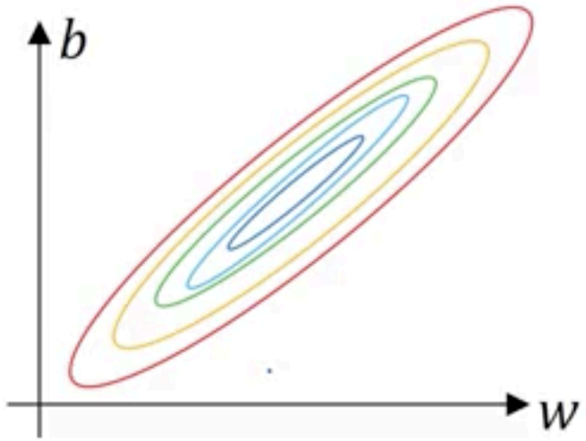
↖ element-wise

$$x /= \sigma^2$$

Por que normalizar entradas?

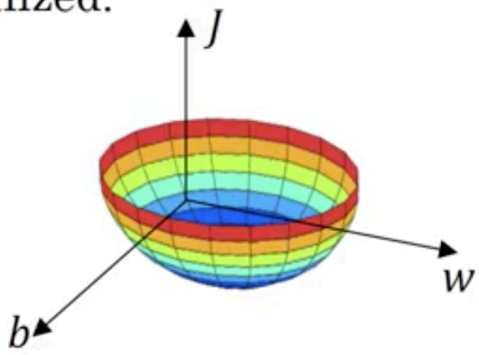
Unnormalized:

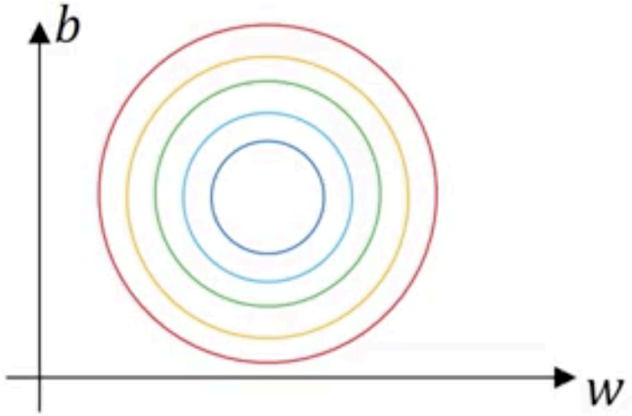




$$J(w,b) = \frac{1}{m}\sum_{i=1}^{m} \mathcal{L}\left(\hat{y}^{(i)}, y^{(i)}\right)$$

Normalized:



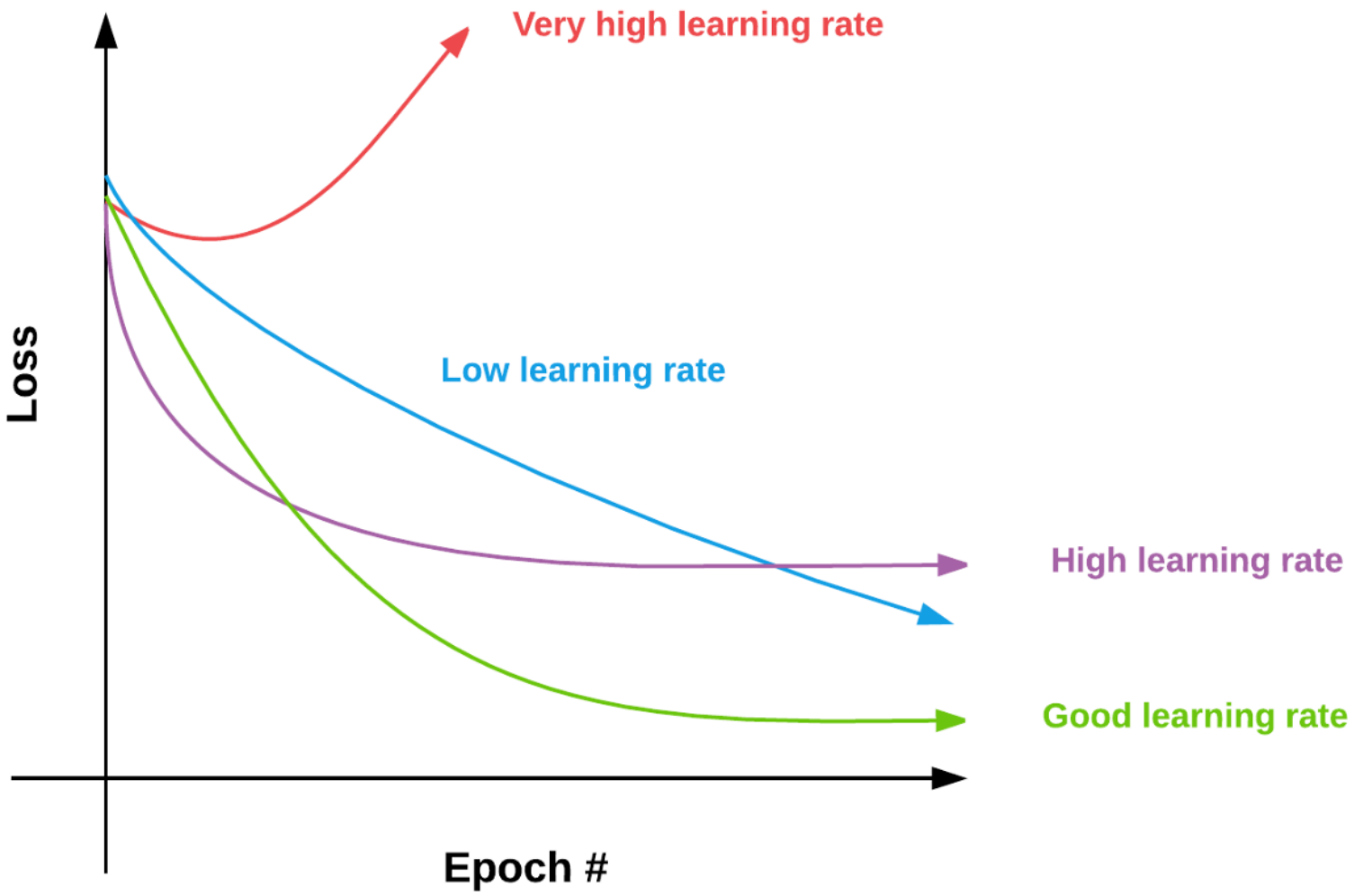


Métodos de Otimização

- SGD
- Adagrad
- Adadelta
- RMSProp
- Adam
- NAdam

Taxa de Aprendizado

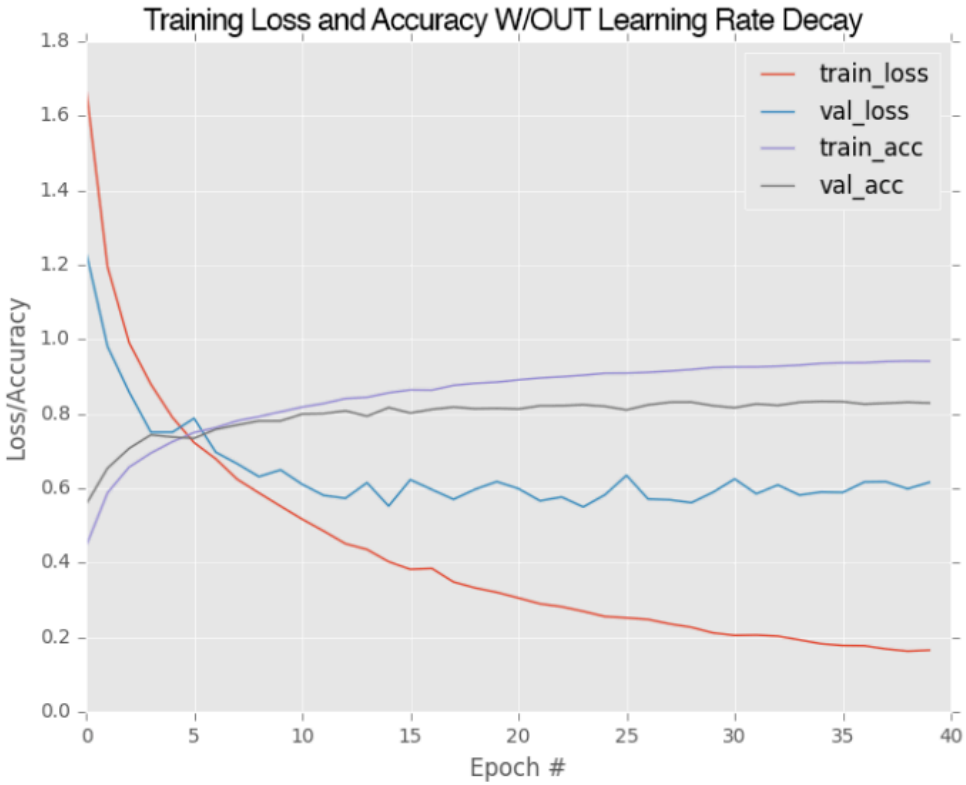
Efeitos da taxa de aprendizado



Learning Rate Decay

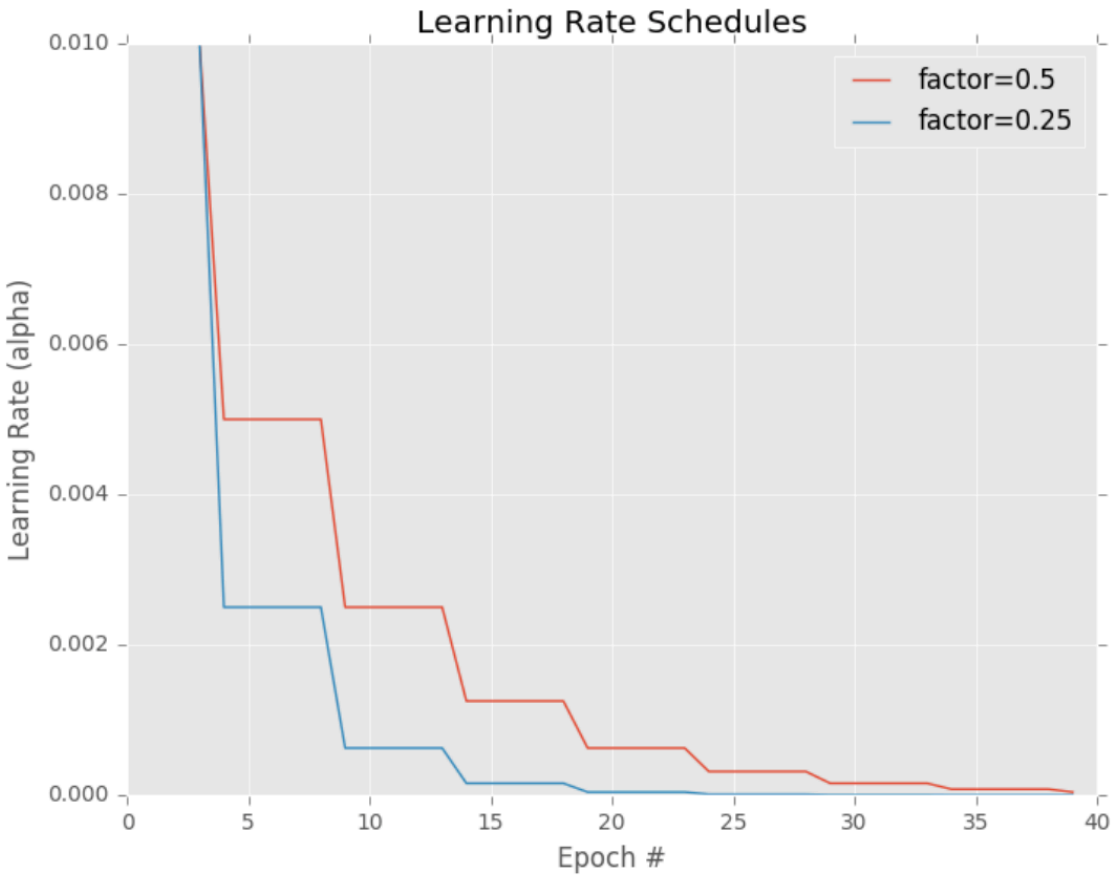
```
# initialize the optimizer and model
print("[INFO] compiling model...")
opt = SGD(lr=0.01, decay=0.01 / 40, momentum=0.9, nesterov=True)
model = MiniVGGNet.build(width=32, height=32, depth=3, classes=10)
model.compile(loss="categorical_crossentropy", optimizer=opt,
     metrics=["accuracy"])
```

Epoch	Learning Rate (α)
0	0.01000
1	0.00836
2	0.00719
...	...
37	0.00121
38	0.00119
39	0.00116


Training Loss and Accuracy W/OUT Learning Rate Decay
train_loss
val_loss
train_acc
val_acc
Loss/Accuracy
Epoch #
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
0
5
10
15
20
25
30
35
40


Training Loss and Accuracy WITH Learning Rate Decay
train_loss
val_loss
train_acc
val_acc
Loss/Accuracy
Epoch #
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
0
5
10
15
20
25
30
35
40

Step-based Decay



Exercício

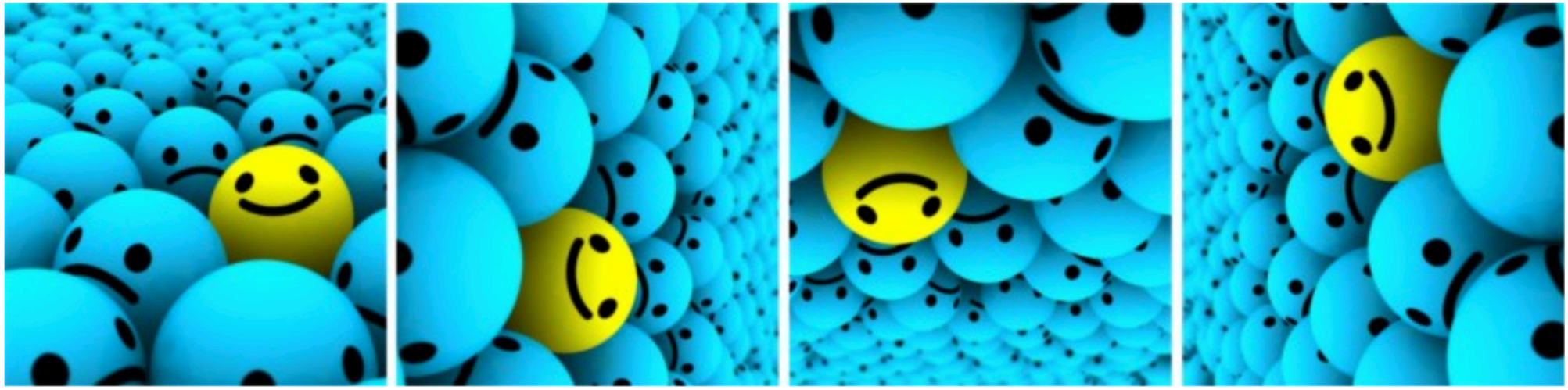
- Adicionar no LeNet
  - Dropout
  - Batch normalization
  - Usar otimizador diferente de SGD
  - Usar learning rate com decaimento

Data Augmentation

- Aplicar transformações na imagem:
  - Translação
  - Rotação
  - Escala
  - Flips
  - ...

Flip

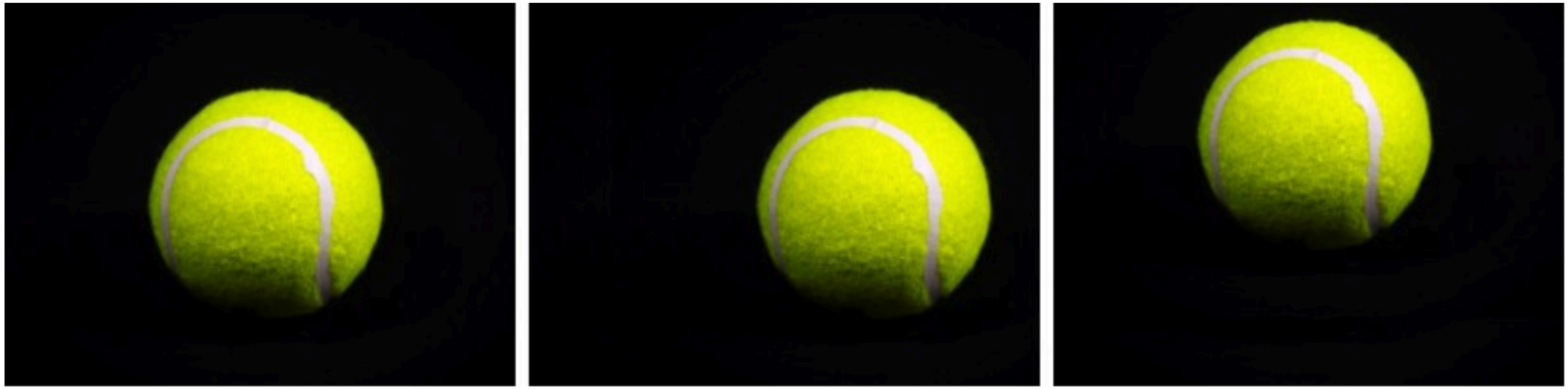
Rotação



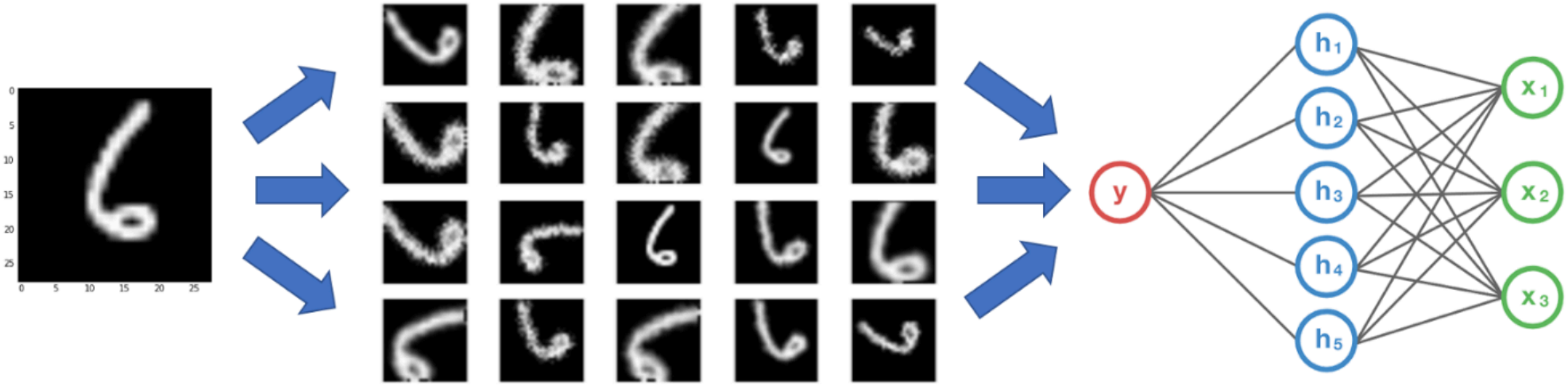
Escala

Crop

Translação



Ruído Gaussiano


0
5
10
15
20
25
0 5 10 15 20 25
y
h1
h2
h3
h4
h5
x1
x2
x3

Data Augmentation no Keras

```
from keras.preprocessing.image import ImageDataGenerator

generator = ImageDataGenerator(rescale = 1./255,
                               width_shift_range=0.1,
                               height_shift_range=0.1,
                               rotation_range = 20,
                               shear_range = 0.3,
                               zoom_range = 0.3,
                               horizontal_flip = True)
```

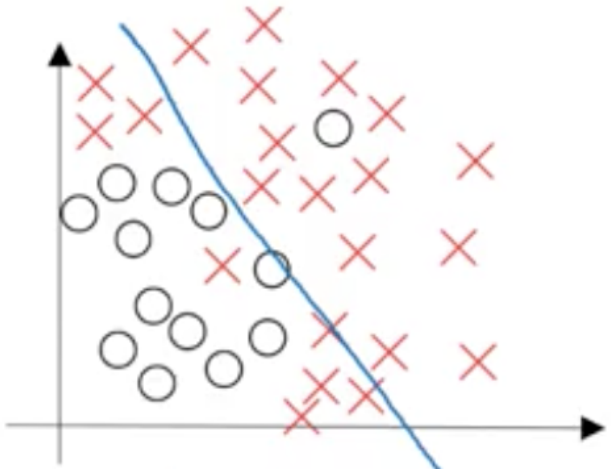
```
train = generator.flow_from_directory('../data/generator',
                                      target_size = (128, 128),
                                      batch_size = 32,
                                      class_mode = 'binary')
```

```
H = model.fit_generator(
  aug.flow(trainX, trainY, batch_size=BS),
  validation_data=(testX, testY),
  steps_per_epoch=len(trainX) // BS,
  epochs=EPOCHS, verbose=1)
```

Data augmentation

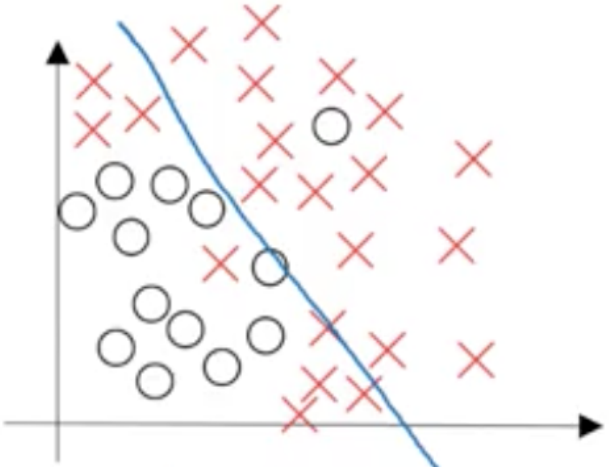
- Código
  - Augmentation.ipynb

Bias x Variância

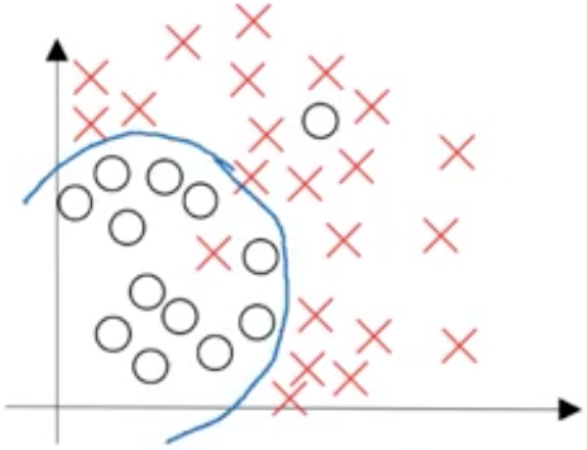


Bias alto

Bias x Variância

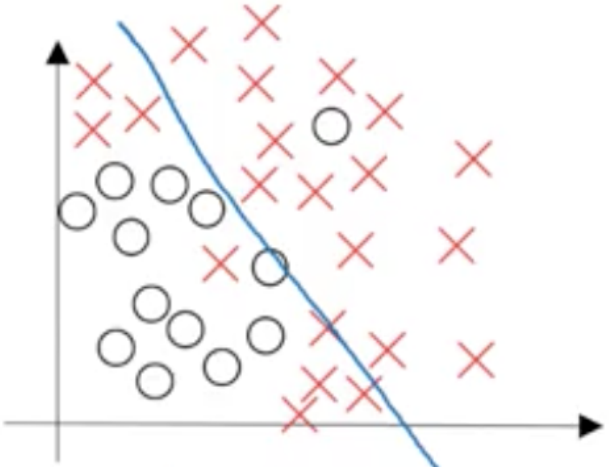


Bias alto

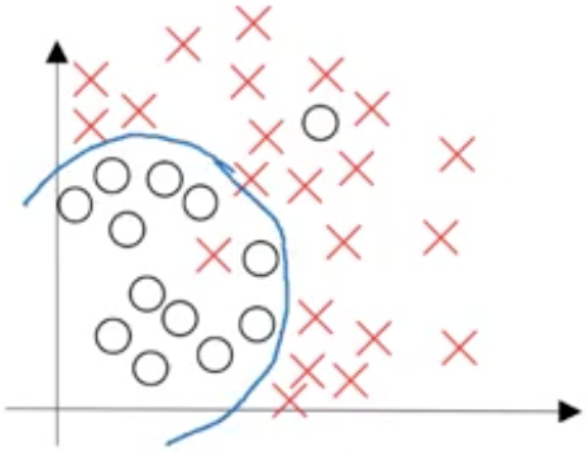


”Ok”

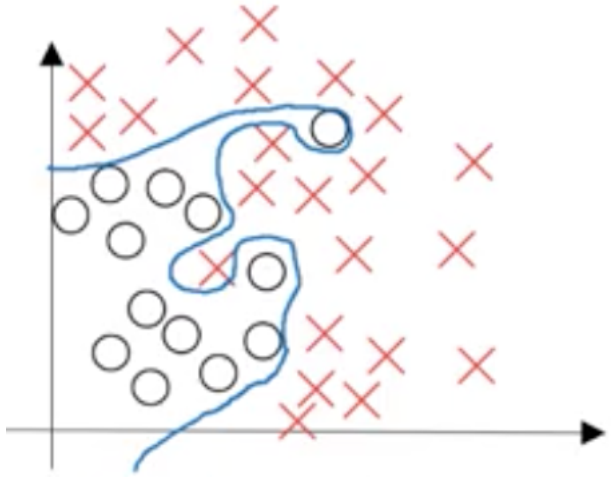
Bias x Variância



Bias alto

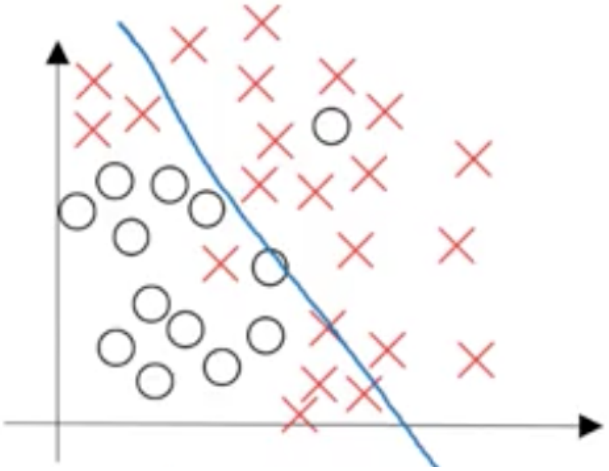


”Ok”



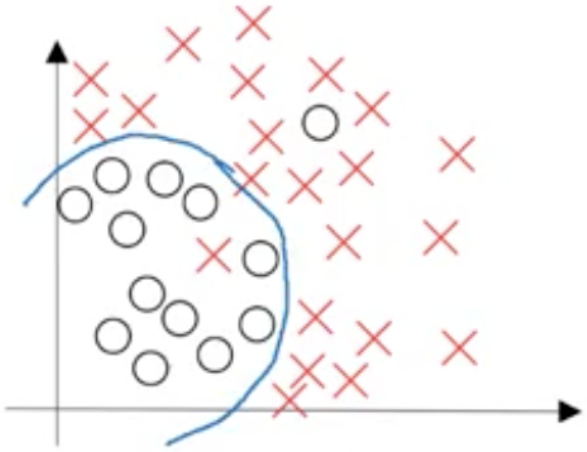
Variância alta

Bias x Variância

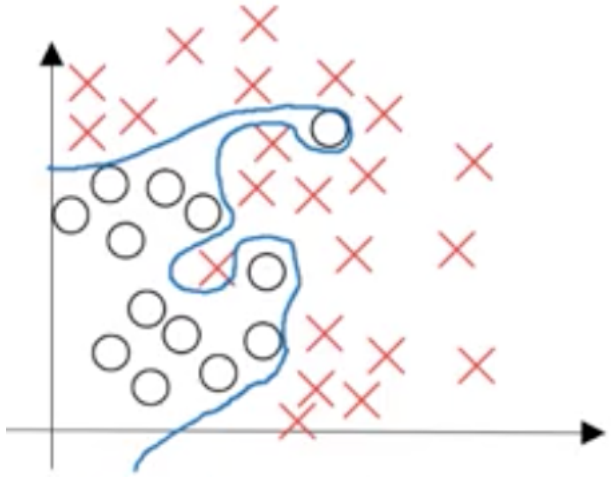


Bias alto

underfitting



”Ok”



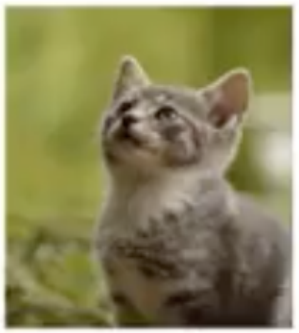
Variância alta

overfitting

Bias e Variância

Classificação de gato

y=1



y=0

Erro do conjunto de treino: 1%

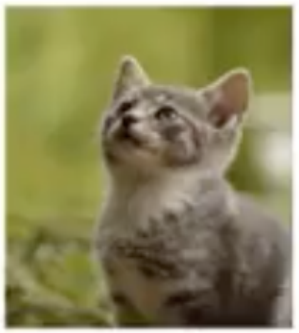
Erro do conjunto de teste: 11%

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

Erro do conjunto de treino: 1%

Erro do conjunto de teste: 11%

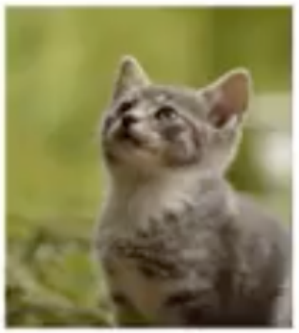
Variância alta

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

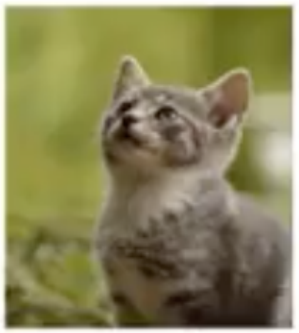
Erro do conjunto de treino:	1%	15%
Erro do conjunto de teste:	11%	16%
	Variância alta	

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

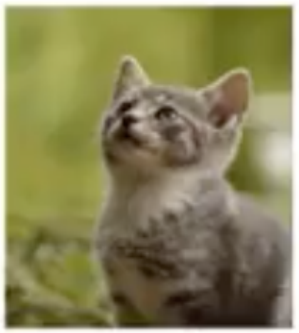
Erro do conjunto de treino:	1%	15%
Erro do conjunto de teste:	11%	16%
	Variância alta	Bias alto

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

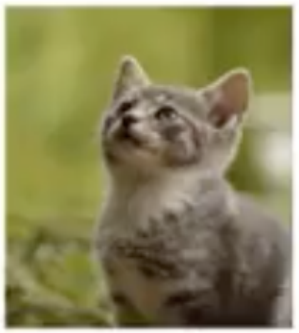
Erro do conjunto de treino:	1%	15%	15%
Erro do conjunto de teste:	11%	16%	30%
	Variância alta	Bias alto	

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

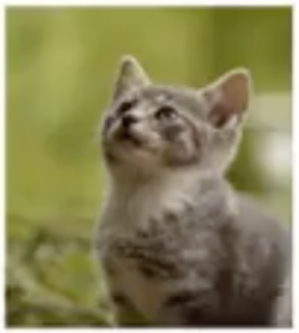
Erro do conjunto de treino:	1%	15%	15%
Erro do conjunto de teste:	11%	16%	30%
	Variância alta	Bias alto	- Variância alta - Bias alto

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

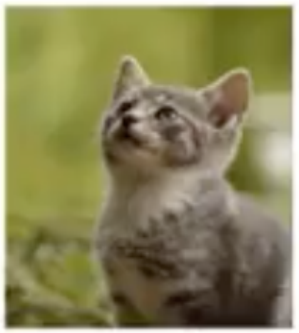
Erro do conjunto de treino:	1%	15%	15%	0.5%
Erro do conjunto de teste:	11%	16%	30%	1%
	Variância alta	Bias alto	- Variância alta - Bias alto	

Humano: $\approx 0\%$

Bias e Variância

Classificação de gato

y=1



y=0

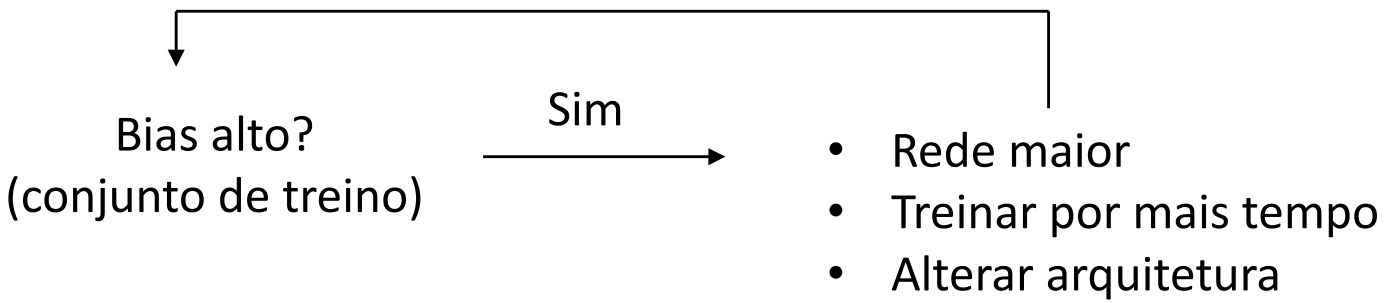
Erro do conjunto de treino:	1%	15%	15%	0.5%
Erro do conjunto de teste:	11%	16%	30%	1%
	Variância alta	Bias alto	- Variância alta - Bias alto	- Variância baixa - Bias baixo

Humano: $\approx 0\%$

Receita básica para ajustar modelo

Bias alto?
(conjunto de treino)

Receita básica para ajustar modelo



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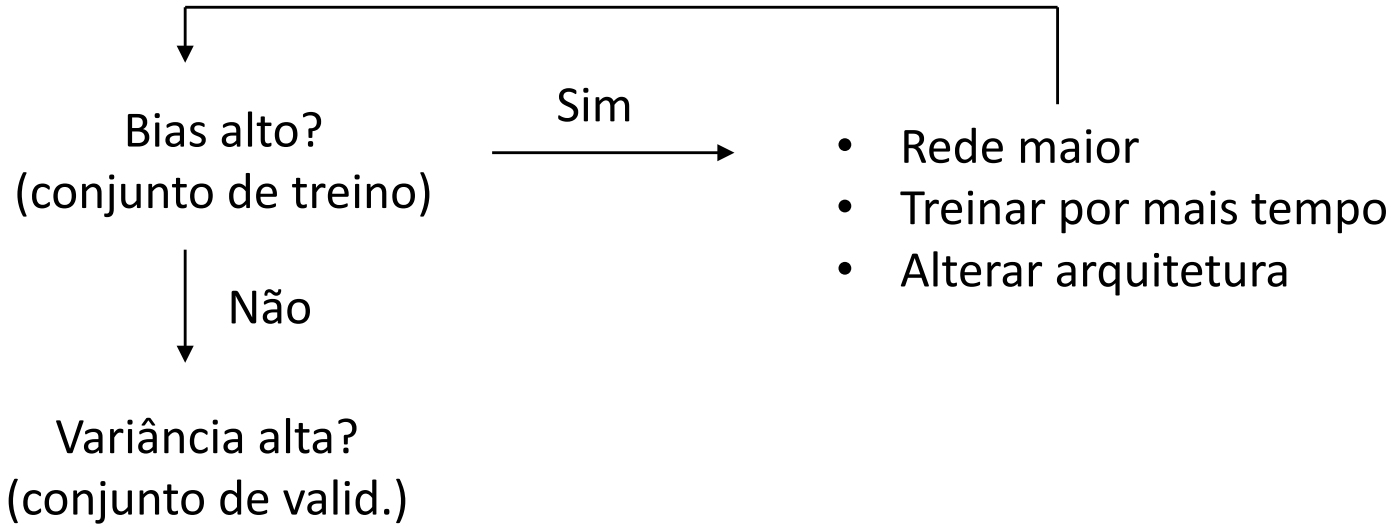

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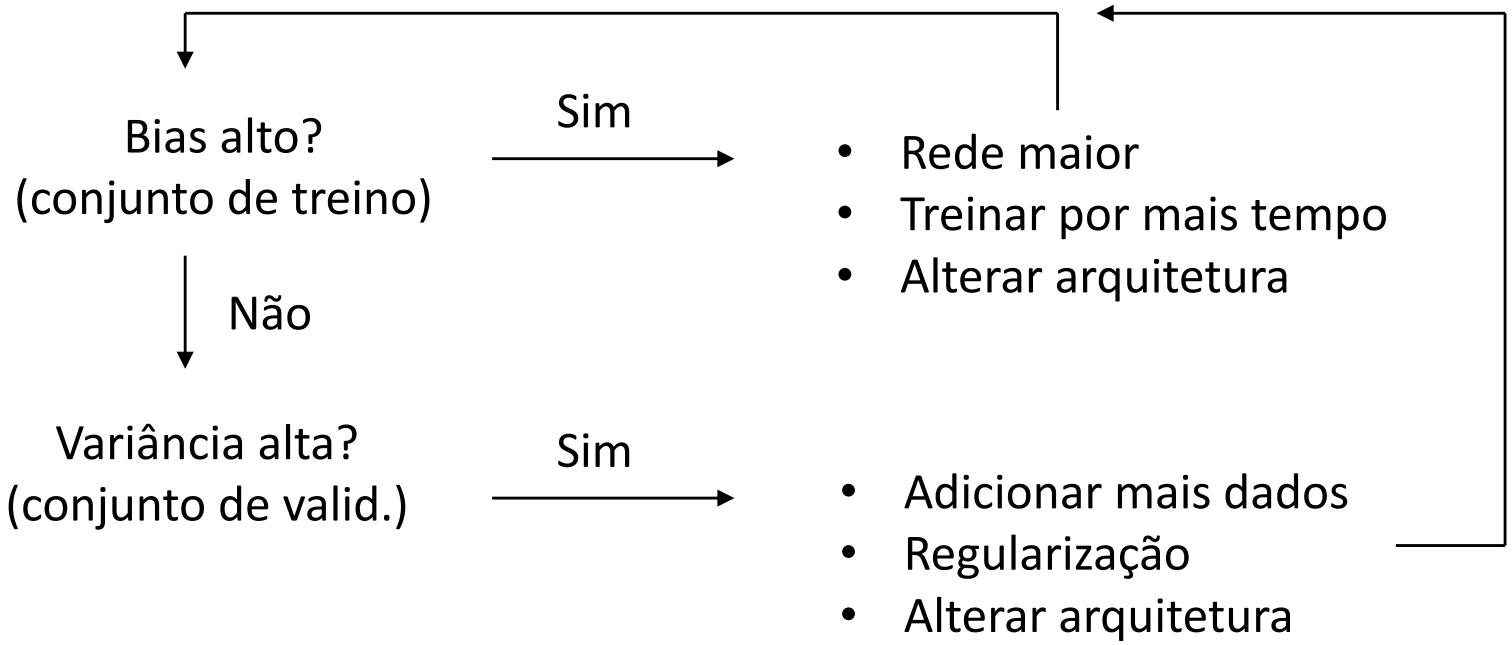
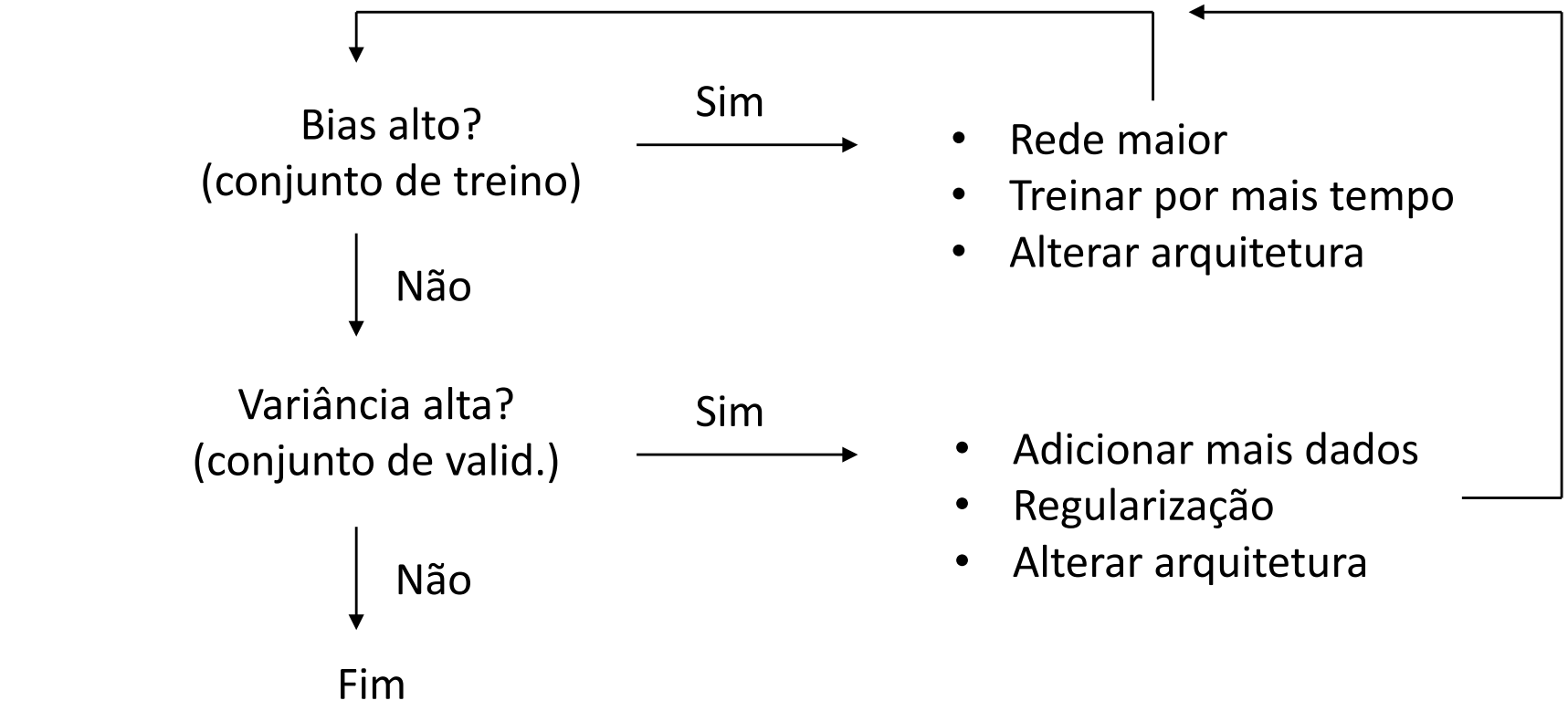
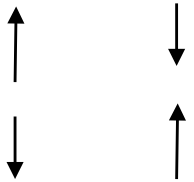


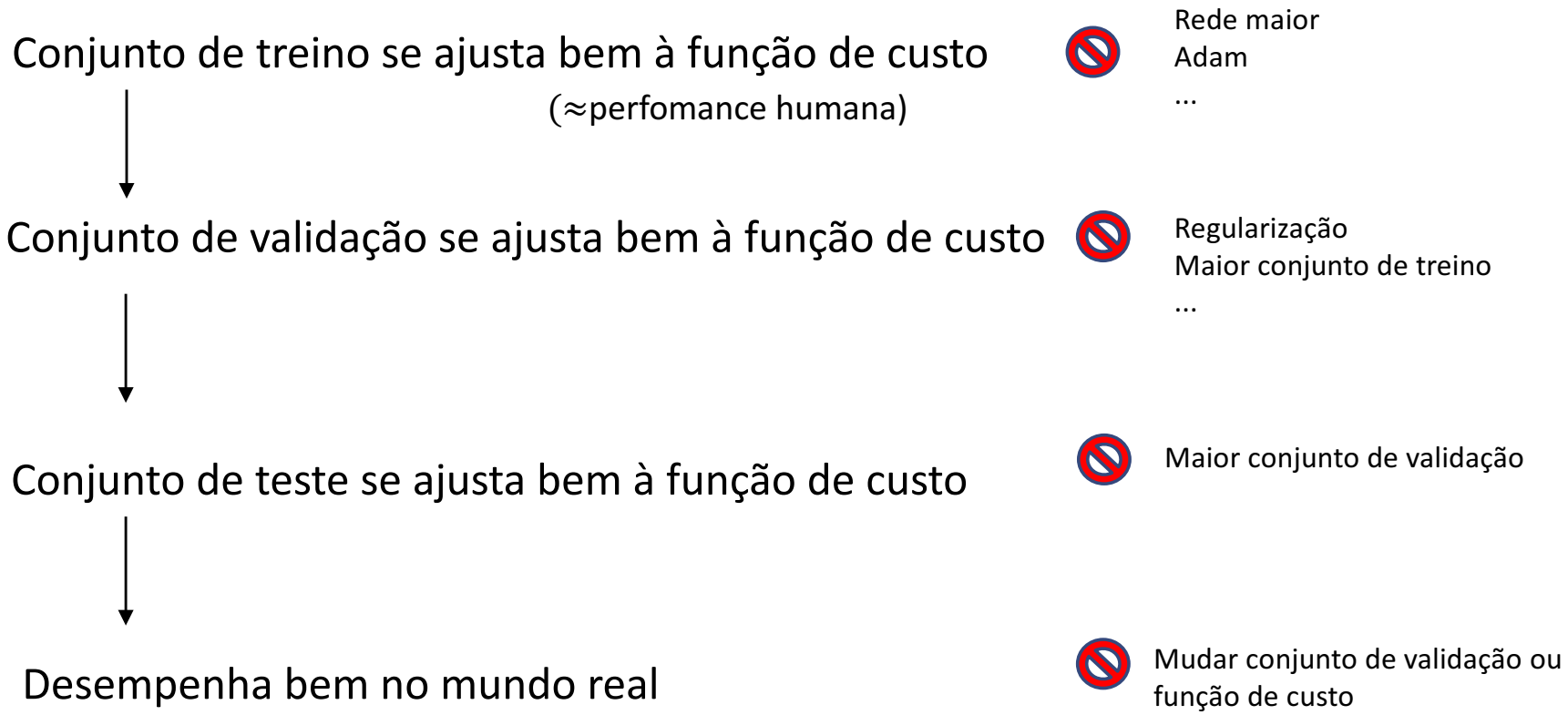
Receita básica para ajustar modelo



”Bias variance tradeoff”



Cadeia de validações em ML



Resumo

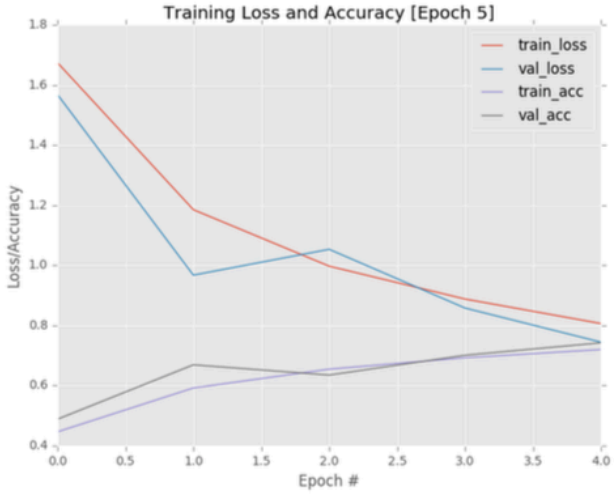
- Ideias
  - Coletar mais dados
  - Adquirir conjunto de treino mais diverso
  - Treinar o algoritmo por mais tempo
  - Tentar Adam ao invés de Gradiente descendente
  - Tentar rede maior
  - Tentar rede menor
  - Adicionar dropout
  - Adicionar Regularização L2
  - Ajustar arquitetura da rede
    - Função de ativação
    - # camadas escondidas
    - Taxa de aprendizado
    - ...

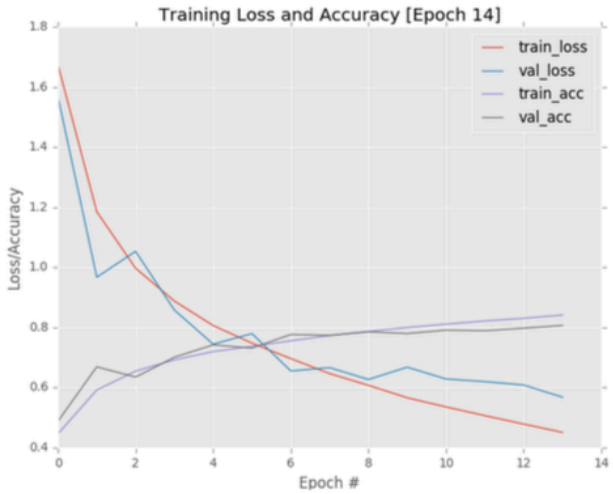
Estudo de Caso 1

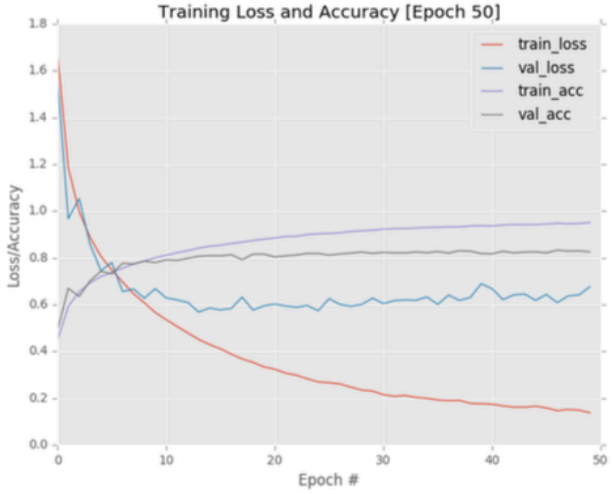
- Esse problema é adaptado de uma aplicação real

- Estudo de Caso1.ipynb

Monitorando o processo de treino







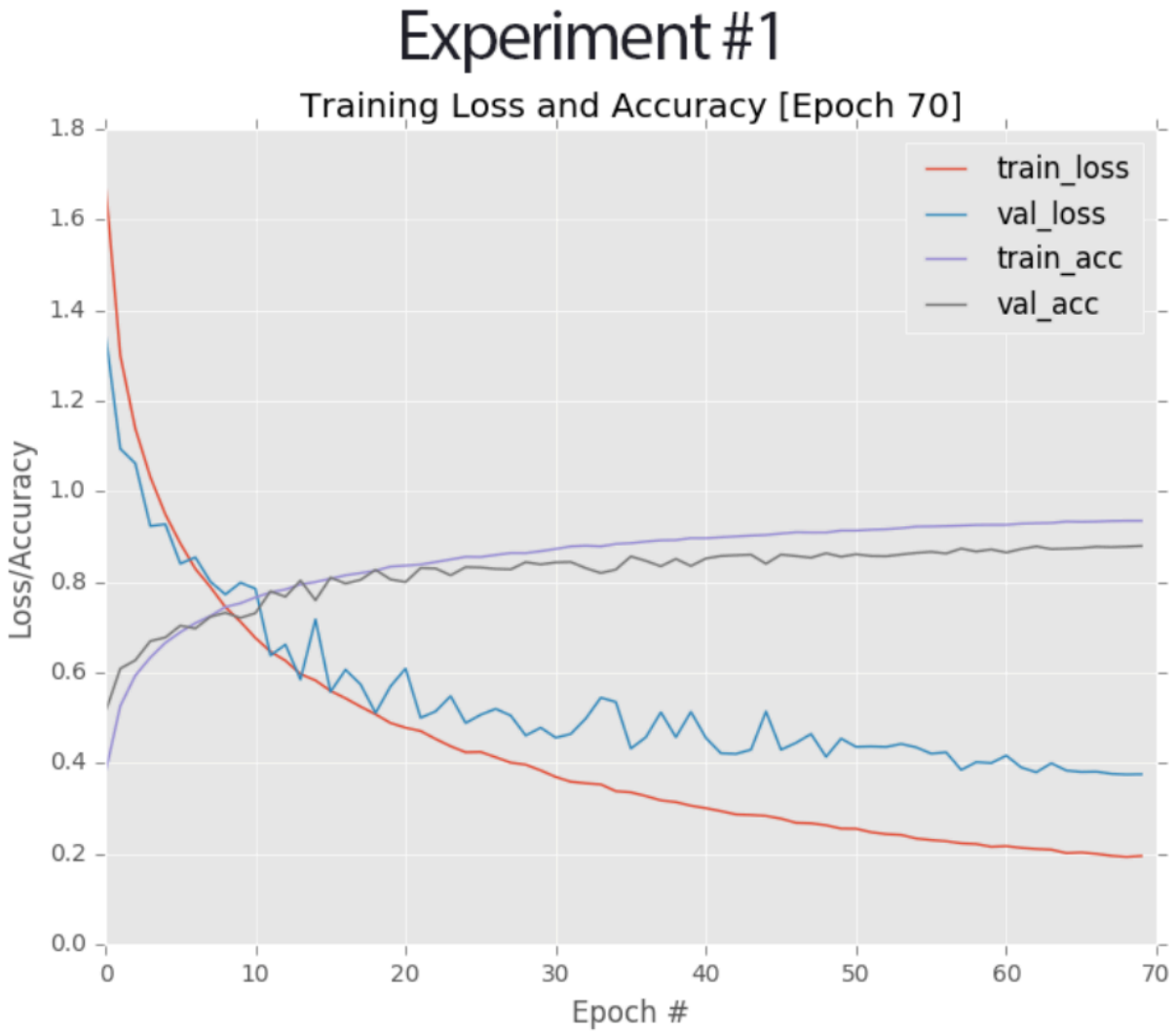
Preste atenção na curva de treinamento

- Você está aplicando alguma regularização?
- Sua taxa de aprendizado está alta?
- Sua rede é muito profunda?

MiniGoogleNet - Experimentos

- Experimento 1
  - Lr = 0.001

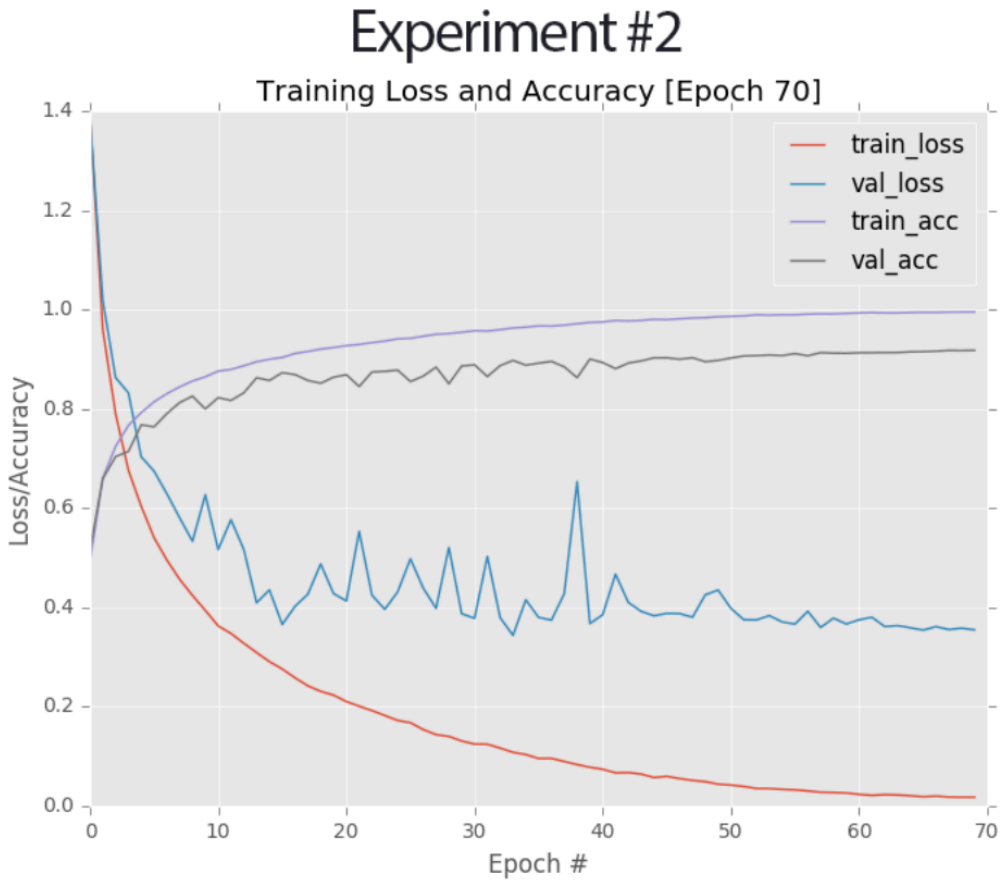
Acurácia = **87,5%**



MiniGoogleNet - Experimentos

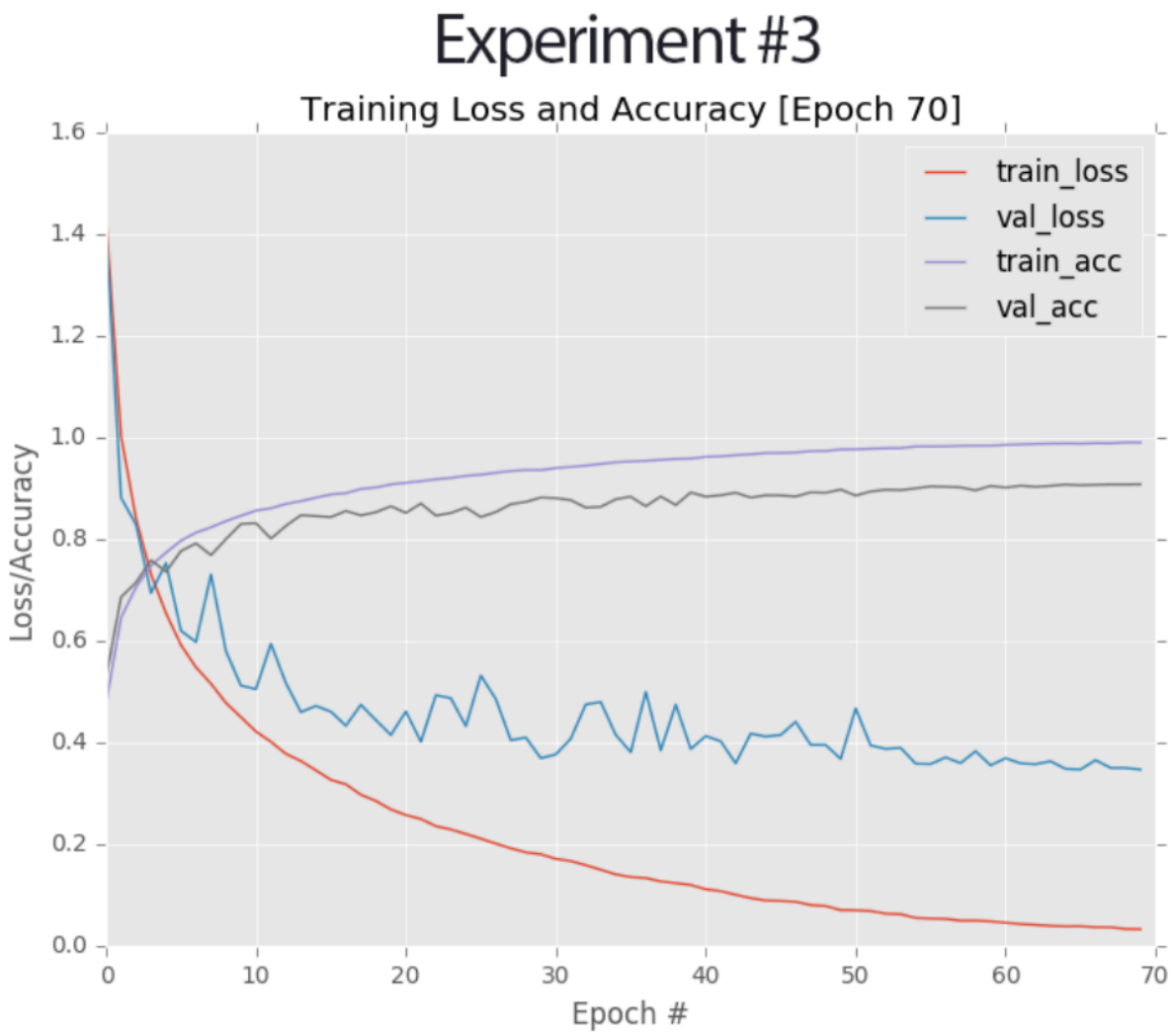
- Experimento 2
  - Lr = 0.001-> 0.01

Acurácia = **91,79%**



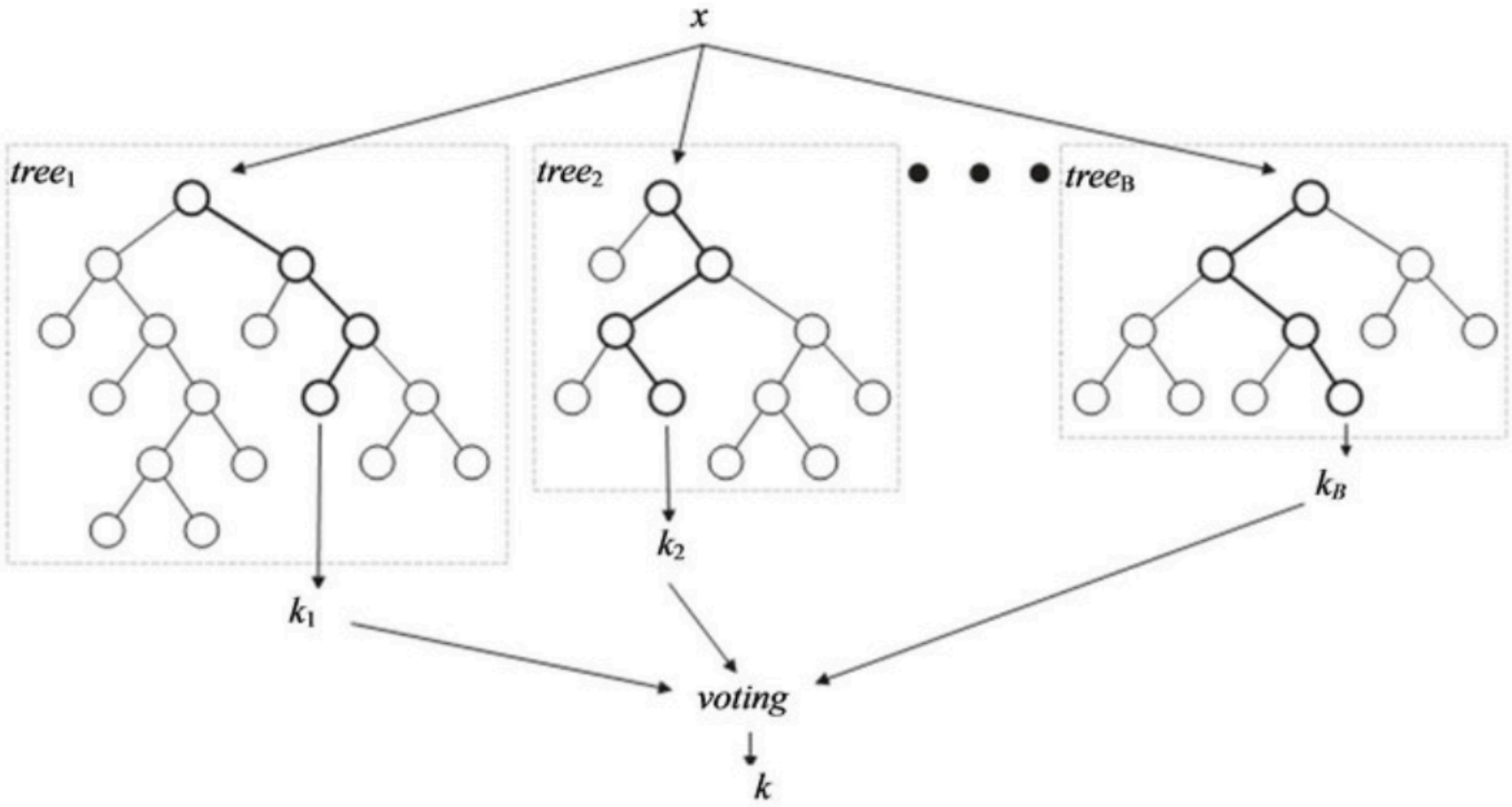
MiniGoogleNet - Experimentos

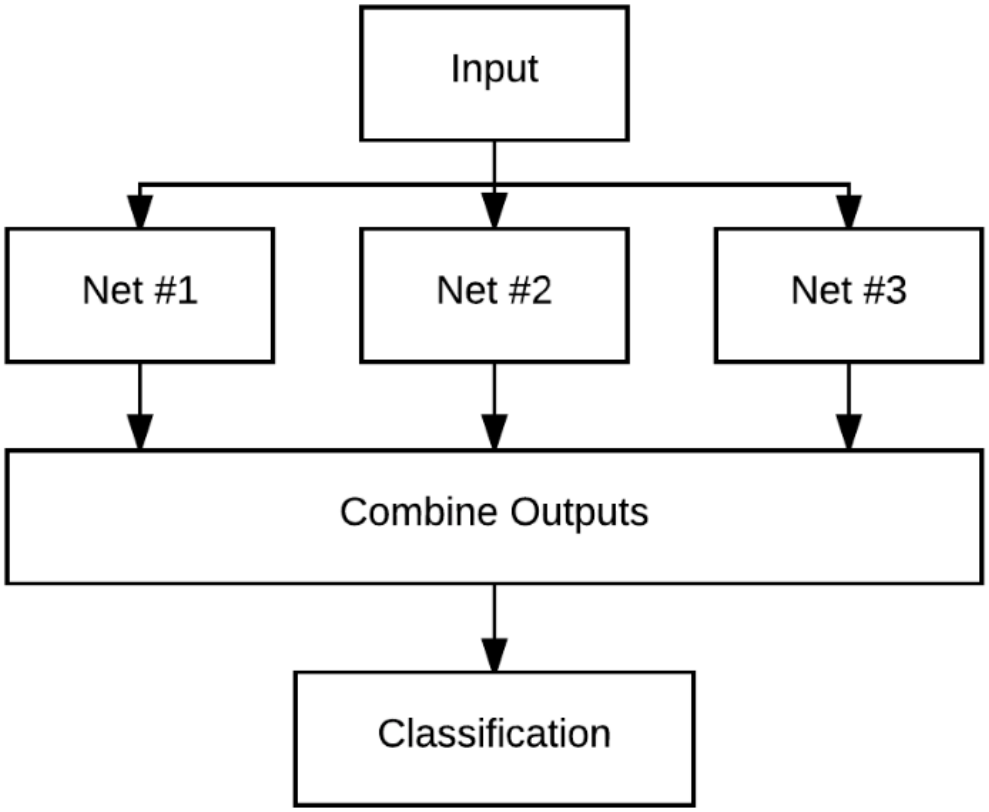
- Experimento 3
  - Lr = 0.001-> 0.01 ->0,005 Acurácia = **90,81%**



Método Ctrl+c – Resnet + cifar10

Ensembles


x
tree1
tree2
treeB
k1
k2
kB
voting
k


Input
Net #1
Net #2
Net #3
Combine Outputs
Classification


IDEAS
Think?
good
click
Inspiration
CHECK LIST:
- SEO
- 3G / 4G
cloud
SHARE