PyTorch

# 动量与学习率衰减

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# Tricks

- momentum

- learning rate decay

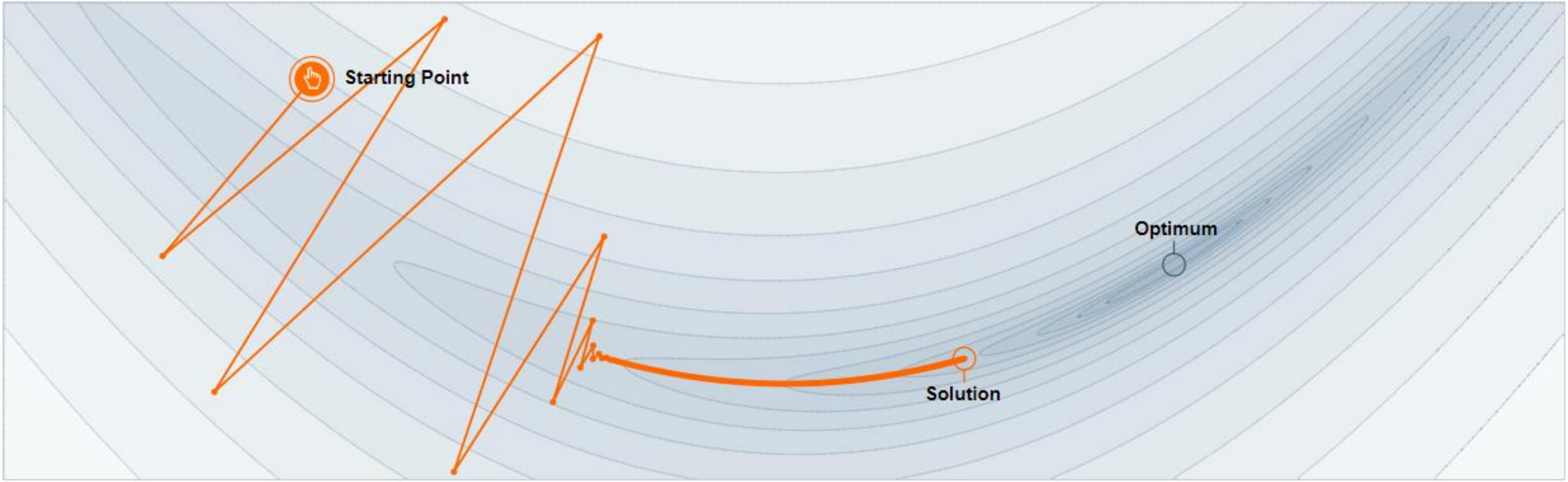
# Momentum

$$w^{k+1} = w^k - \alpha \nabla f(w^k).$$

$$z^{k+1} = \beta z^k + \nabla f(w^k)$$
$$w^{k+1} = w^k - \alpha z^{k+1}$$

https://distill.pub/2017/momentum/

# No momentum




Step-size α = 0.0038

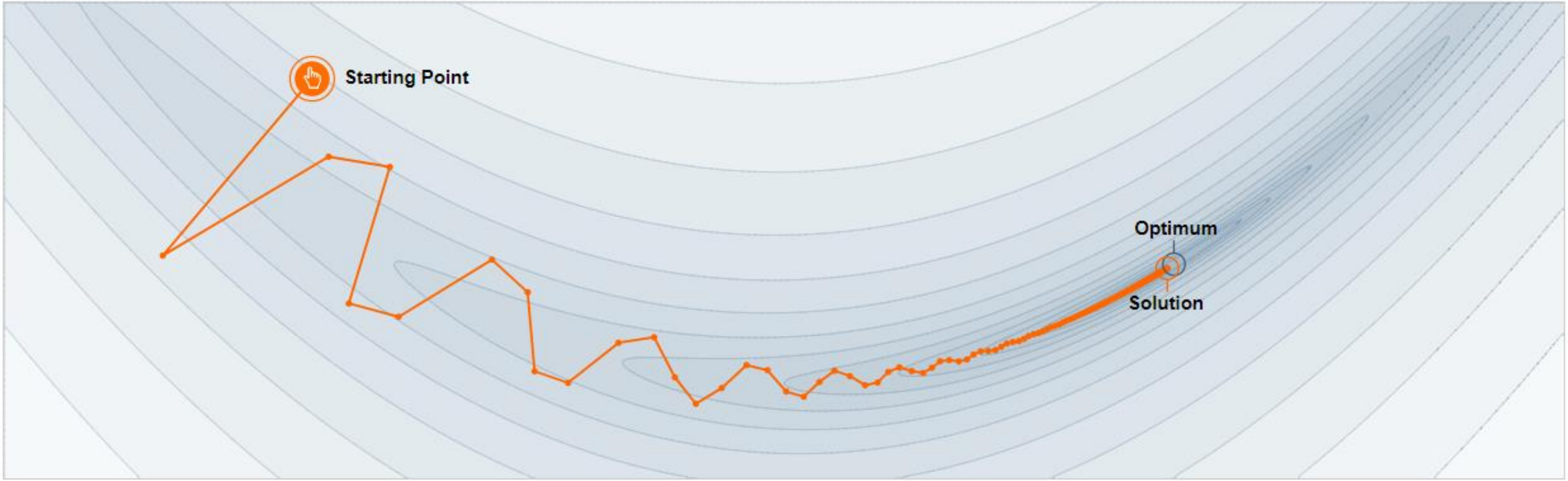
0 0.003 0.006

Momentum β = 0.0

0.00 0.500 0.990

We often think of Momentum as a means of dampening oscillations and speeding up the iterations, leading to faster convergence. But it has other interesting behavior. It allows a larger range of step-sizes to be used, and creates its own oscillations. What is going on?

# With appr. momentum





We often think of Momentum as a means of dampening oscillations and speeding up the iterations, leading to faster convergence. But it has other interesting behavior. It allows a larger range of step-sizes to be used, and creates its own oscillations. What is going on?

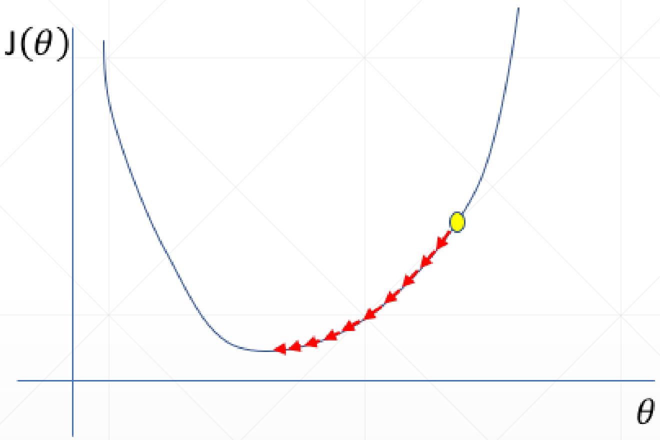
# momentum

```
optimizer = torch.optim.SGD(model.parameters(), args.lr,
                            momentum=args.momentum,
                            weight_decay=args.weight_decay)
scheduler = ReduceLROnPlateau(optimizer, 'min')

for epoch in xrange(args.start_epoch, args.epochs):
    train(train_loader, model, criterion, optimizer, epoch)
    result_avg, loss_val = validate(val_loader, model, criterion, epoch)
    scheduler.step(loss_val)
```

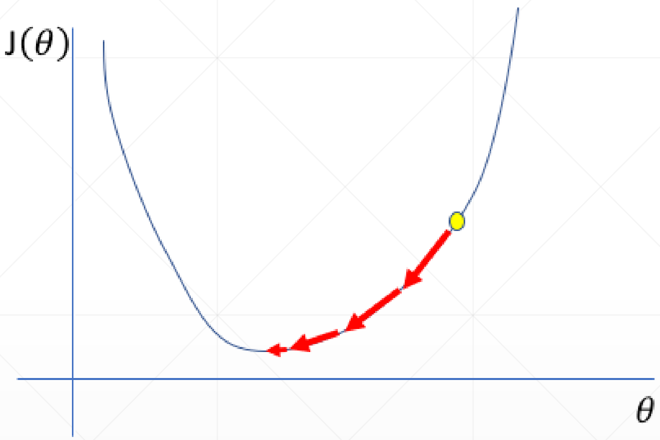
# Learning rate tunning

**Too low**



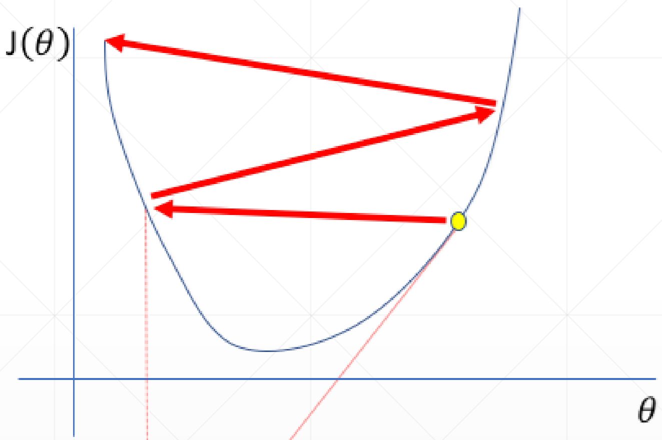

A small learning rate requires many updates before reaching the minimum point

**Just right**




The optimal learning rate swiftly reaches the minimum point

**Too high**




Too large of a learning rate causes drastic updates which lead to divergent behaviors

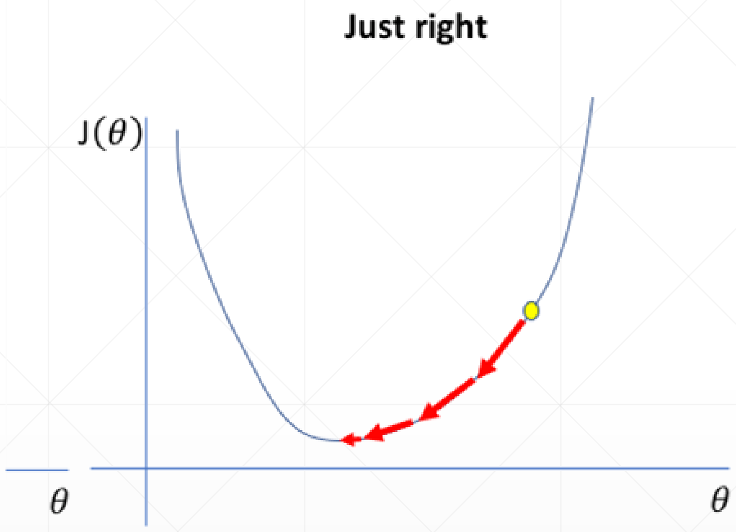
**Andrej Karpathy**
@karpathy

3e-4 is the best learning rate for Adam, hands down.

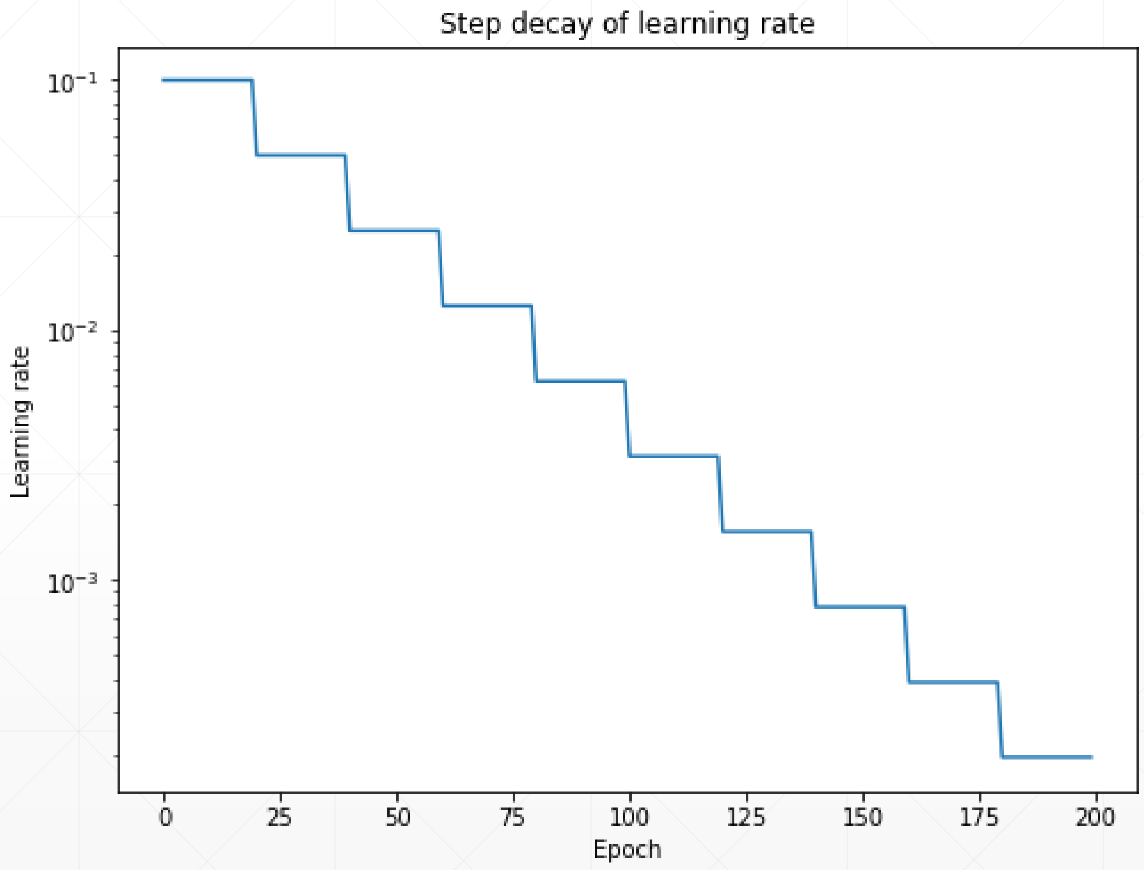
408 11:01 AM - Nov 24, 2016

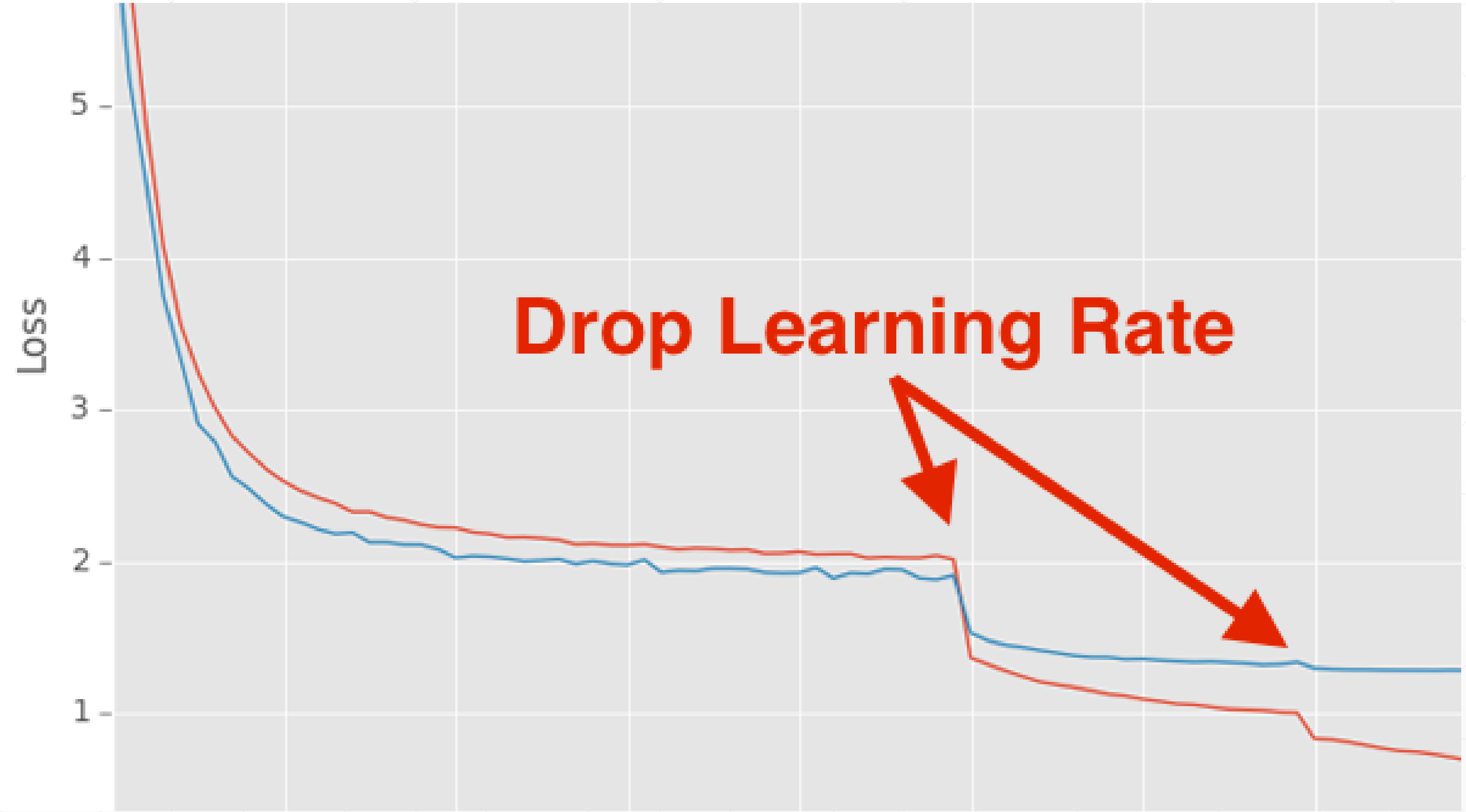
124 people are talking about this

# Learning rate decay




The optimal learning rate swiftly reaches the minimum point




Drop Learning Rate
Loss
5
4
3
2
1

# Scheme 1.

CLASS `torch.optim.lr_scheduler.ReduceLROnPlateau`(*optimizer, mode='min', factor=0.1, patience=10, verbose=False, threshold=0.0001, threshold_mode='rel', cooldown=0, min_lr=0, eps=1e-08*) [SOURCE]

```
optimizer = torch.optim.SGD(model.parameters(), args.lr,
                            momentum=args.momentum,
                            weight_decay=args.weight_decay)
scheduler = ReduceLROnPlateau(optimizer, 'min')

for epoch in xrange(args.start_epoch, args.epochs):
     train(train_loader, model, criterion, optimizer, epoch)
     result_avg, loss_val = validate(val_loader, model, criterion, epoch)
     scheduler.step(loss_val)
```

# Scheme 2.

```python
# Assuming optimizer uses lr = 0.05 for all groups
# lr = 0.05     if epoch < 30
# lr = 0.005    if 30 <= epoch < 60
# lr = 0.0005   if 60 <= epoch < 90
# ...
scheduler = StepLR(optimizer, step_size=30, gamma=0.1)
for epoch in range(100):
    scheduler.step()
    train(...)
    validate(...)
```

# 下一课时

其他Tricks

# Thank You.