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Optimization Algorithms

Mini-batch gradient descent

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Batch vs. mini-batch gradient descent

Vectorization allows you to efficiently compute on m examples.

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Mini-batch gradient descent

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Optimization Algorithms

Understanding mini-batch gradient descent

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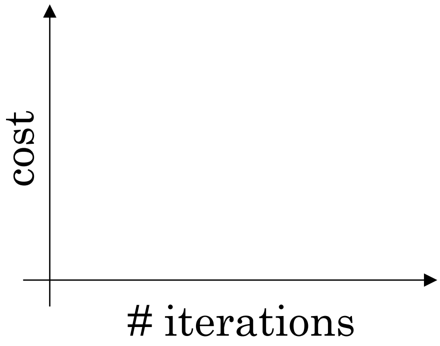
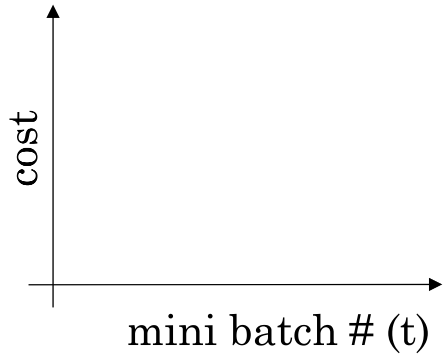
Training with mini batch gradient descent

Batch gradient descent



Mini-batch gradient descent



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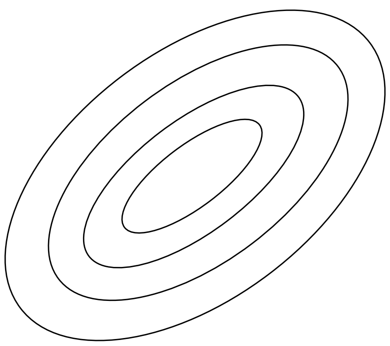
Choosing your mini-batch size



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Choosing your mini-batch size

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Optimization Algorithms

Exponentially weighted averages

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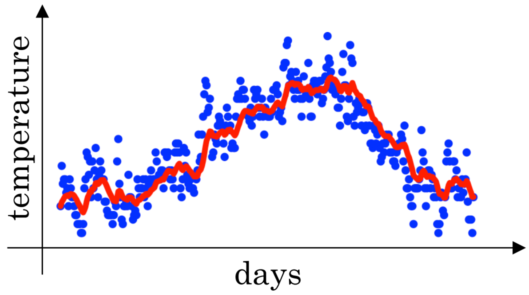
Temperature in London

$\theta_1 = 40°F$
$\theta_2 = 49°F$
$\theta_3 = 45°F$
$\vdots$
$\theta_{180} = 60°F$
$\theta_{181} = 56°F$
$\vdots$



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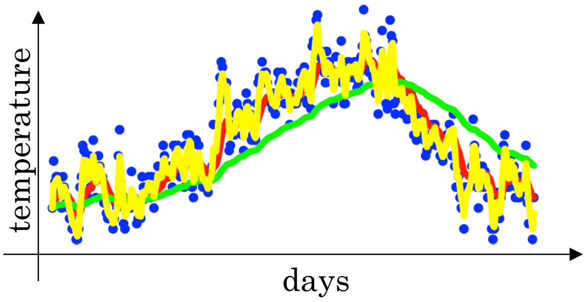
Exponentially weighted averages



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Optimization Algorithms

Understanding exponentially weighted averages

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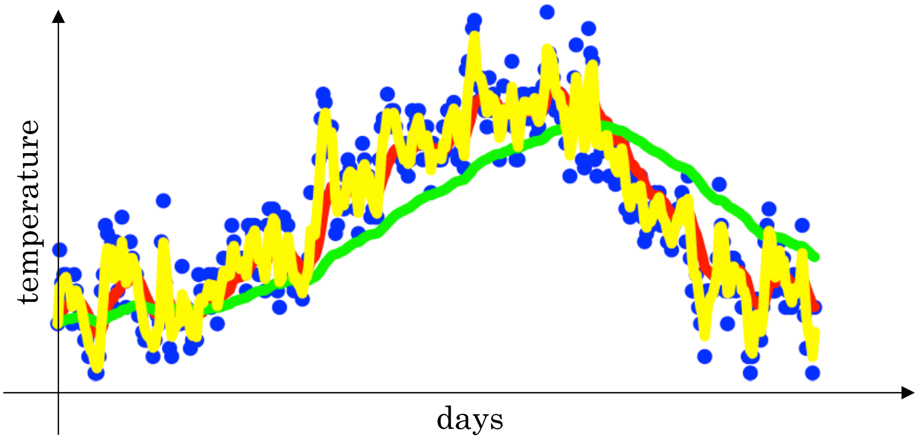
Exponentially weighted averages

$$v_t = \beta v_{t-1} + (1-\beta)\theta_t$$



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Exponentially weighted averages

$v_t = \beta v_{t-1} + (1-\beta)\theta_t$

$v_{100} = 0.9v_{99} + 0.1\theta_{100}$

$v_{99} = 0.9v_{98} + 0.1\theta_{99}$

$v_{98} = 0.9v_{97} + 0.1\theta_{98}$

…

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Implementing exponentially weighted averages

$v_0 = 0$

$v_1 = \beta v_0 + (1-\beta)\,\theta_1$

$v_2 = \beta v_1 + (1-\beta)\,\theta_2$

$v_3 = \beta v_2 + (1-\beta)\,\theta_3$

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Optimization Algorithms

Bias correction in exponentially weighted average

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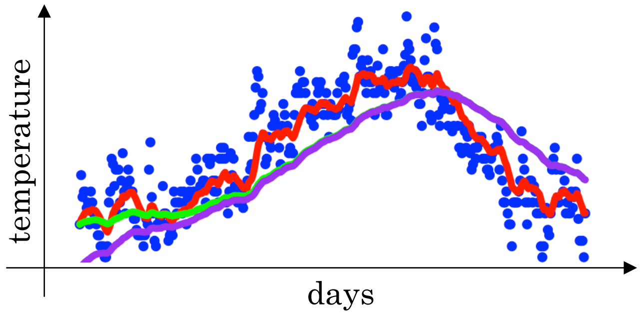
Bias correction



$$v_t = \beta v_{t-1} + (1-\beta)\theta_t$$

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Optimization Algorithms

Gradient descent with momentum

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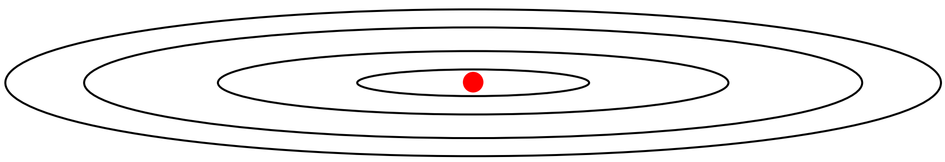
Gradient descent example



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Implementation details

On iteration t:

Compute dW, db on the current mini-batch

$v_{dW} = \beta v_{dW} + (1-\beta)dW$

$v_{db} = \beta v_{db} + (1-\beta)db$

$W = W - \alpha v_{dW}, \; b = b - \alpha v_{db}$

Hyperparameters: α, β $\beta = 0.9$

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Optimization Algorithms

RMSprop

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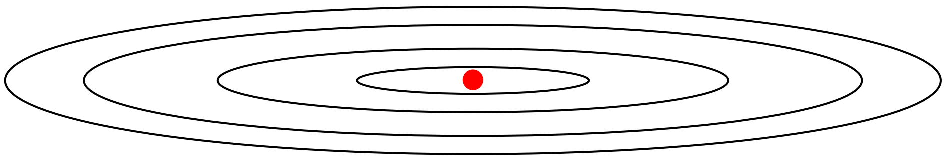
RMSprop



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Optimization Algorithms

Adam optimization algorithm

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Adam optimization algorithm

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Hyperparameters choice:

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Learning rate decay

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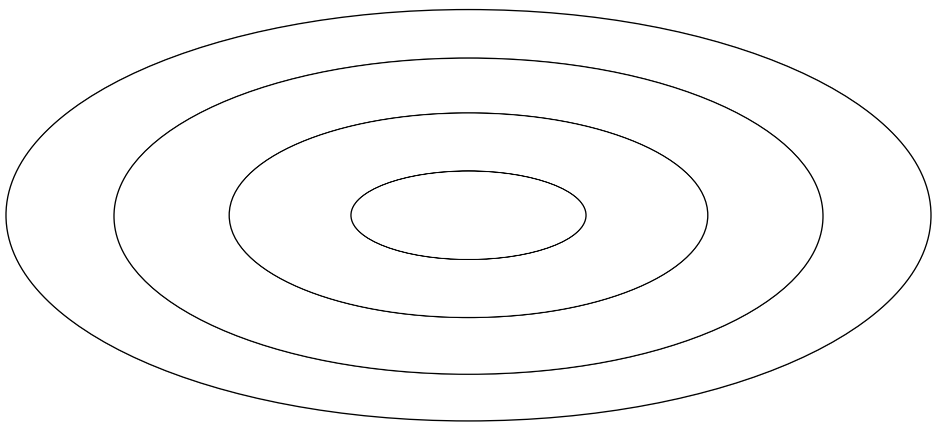
Learning rate decay



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Learning rate decay

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Other learning rate decay methods

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Optimization Algorithms

The problem of local optima

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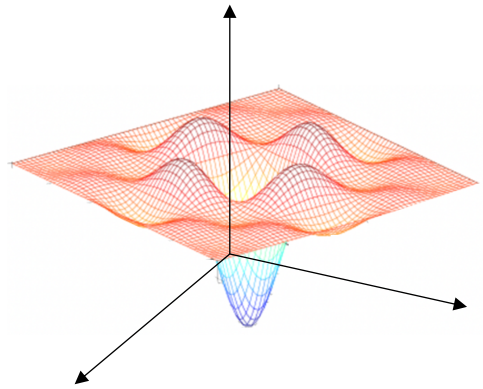
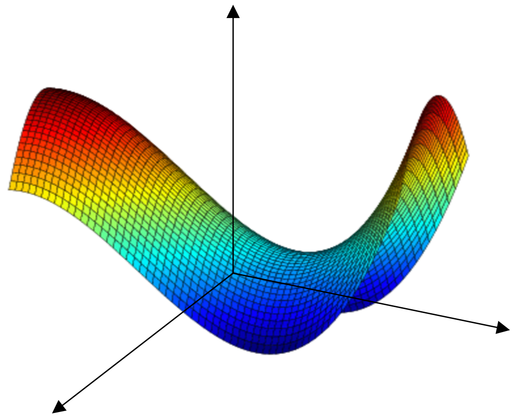
Local optima in neural networks





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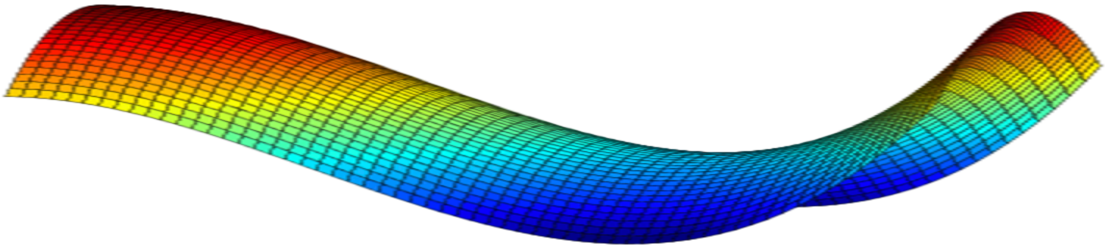
Problem of plateaus



- Unlikely to get stuck in a bad local optima
- Plateaus can make learning slow

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