

# Image Super-Resolution Using Deep Convolutional Networks

## (4) implementation

Visual Computing Lab

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# Result

- Training Data 30 set  $\rightarrow$  91 set
- Gradient Descent  $\rightarrow$  Rmsprop, Adam
- Cost 0.128  $\rightarrow$  0.032

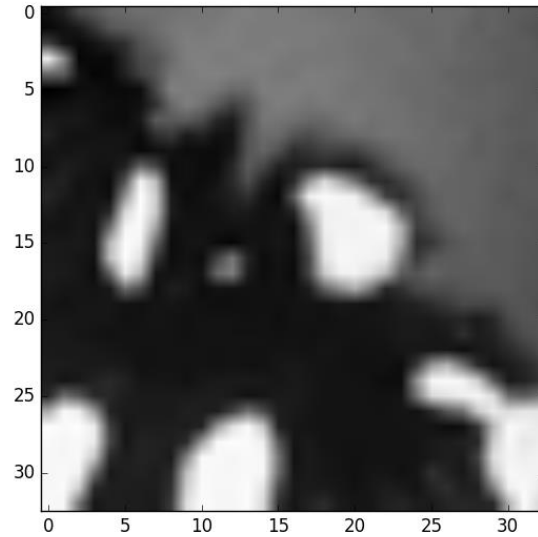
# Divide to Batch size

- Training Data 91 set → 21884 sub-Images
- Resource exhausted : OOM Error
- Batch size = 128
- [21884,33,33,1] 한번에 계산하던 것을  
→ [128,33,33,1] 분할하여 계산

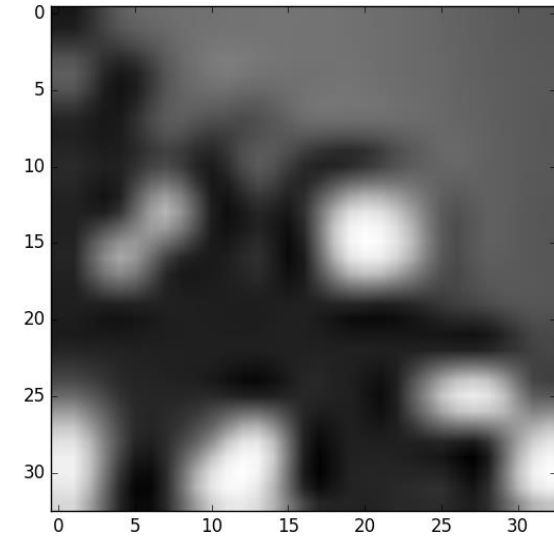
# Experiments



Divide  
33by33

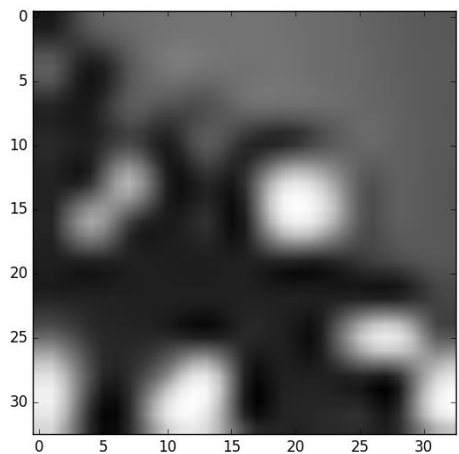


Original

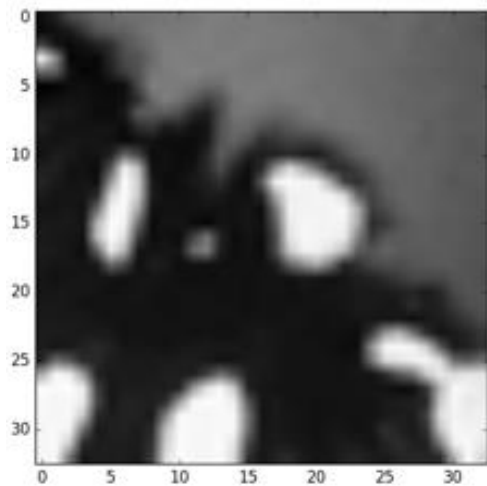


Input

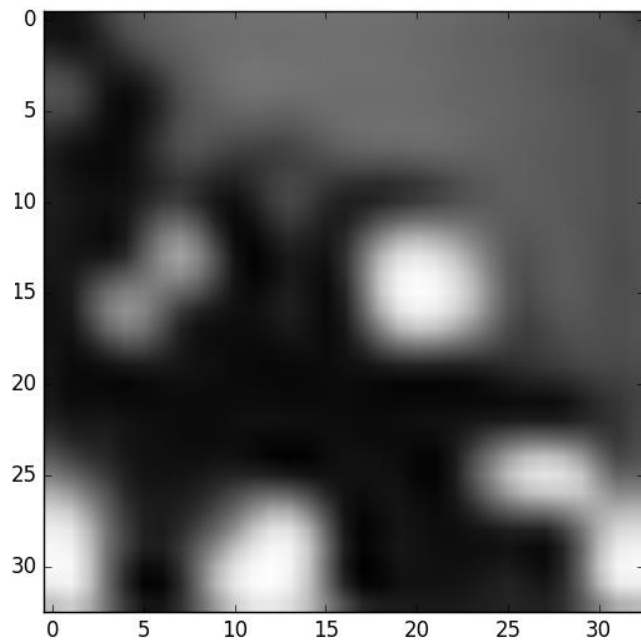
# Result - Batch 적용 후



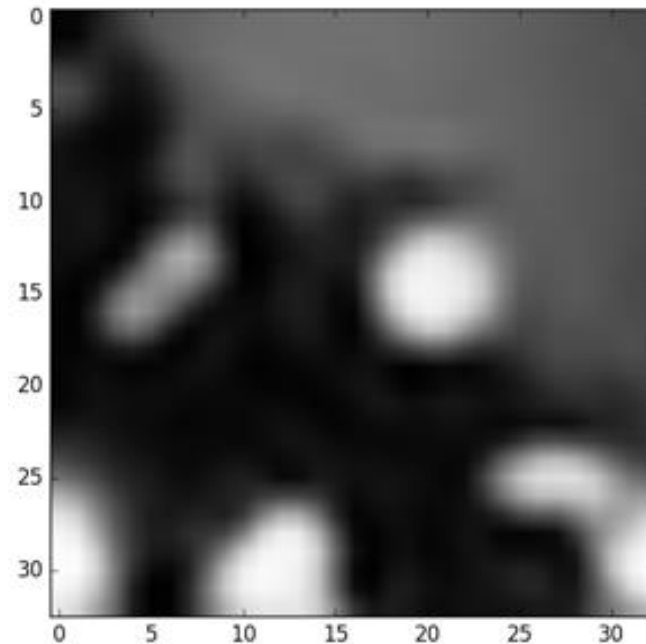
Input



Original

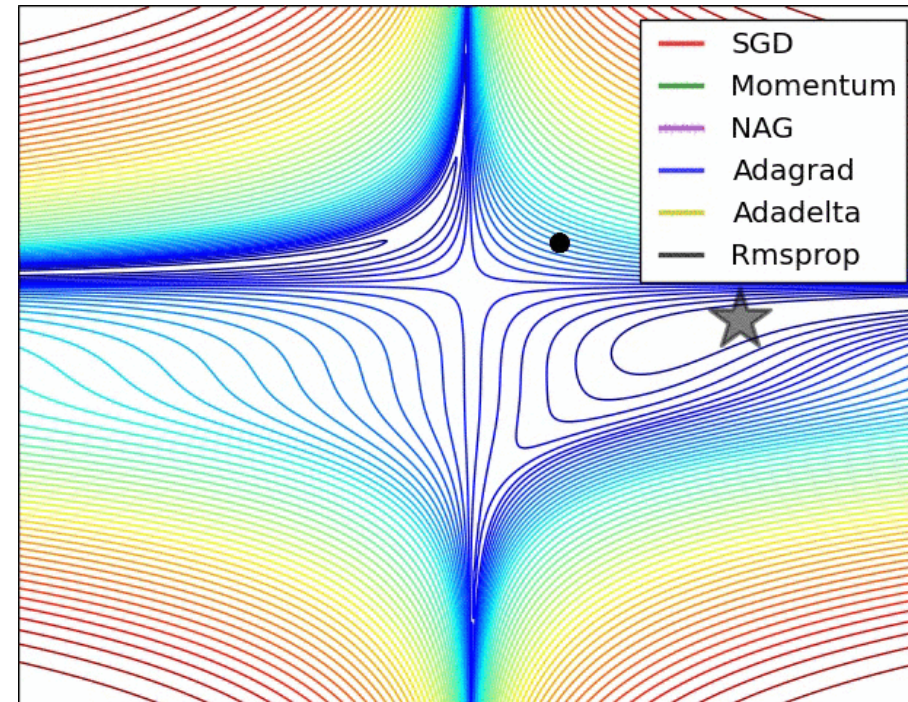
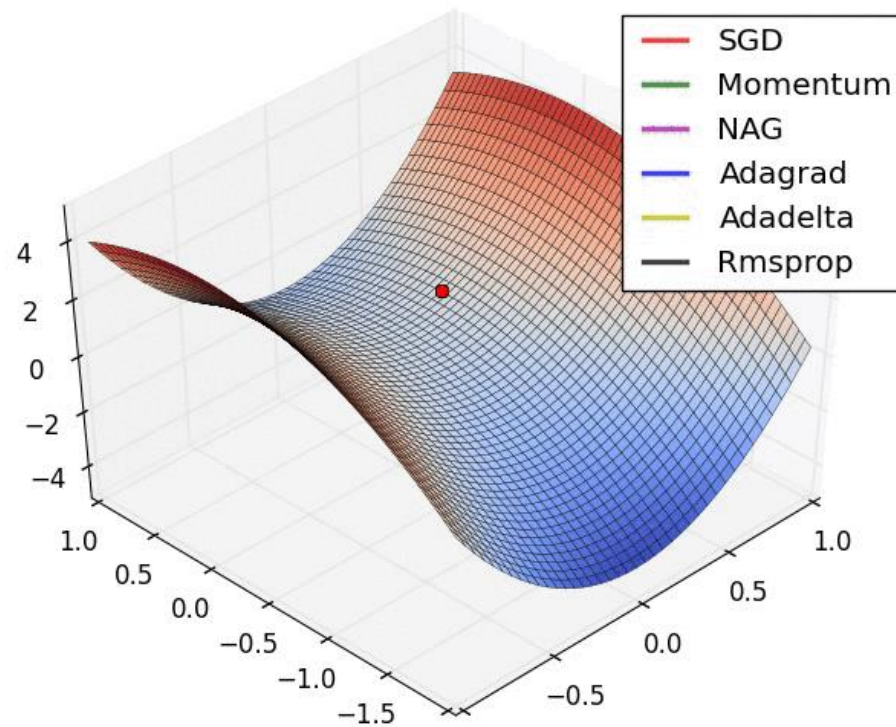


적용 전 : 0.12847



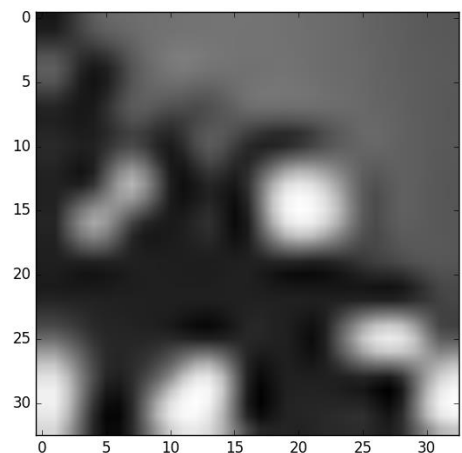
적용 후 : 0.0391

# Optimizer Algorithm

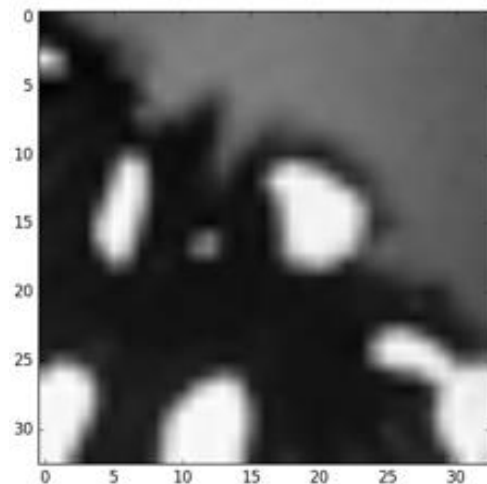


<http://cs231n.github.io/neural-networks-3/>

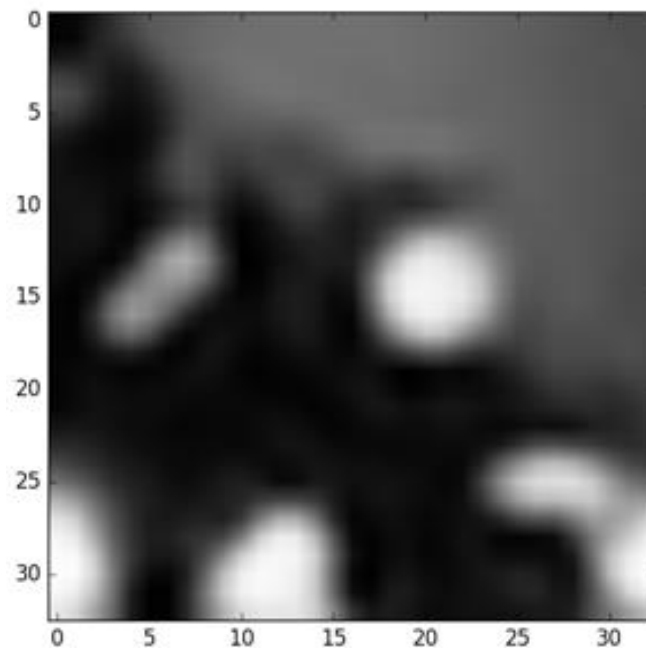
# Result - Rmsprop



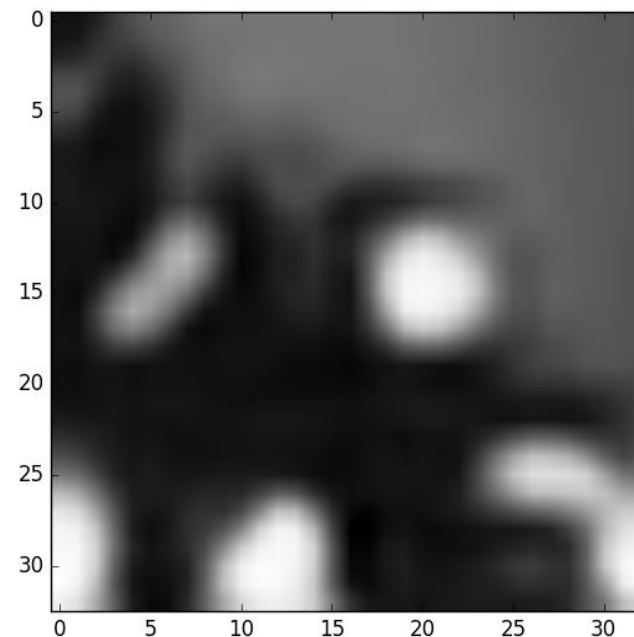
**Input**



**Original**



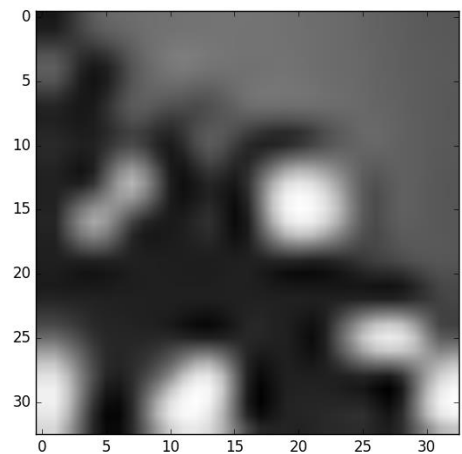
**Gradient : 0.0391**



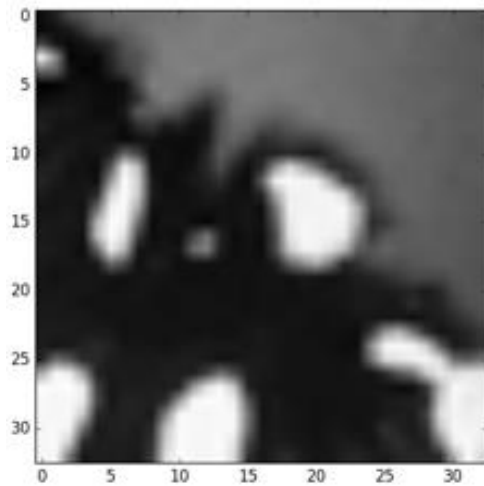
**Rmsprop : 0.0339**



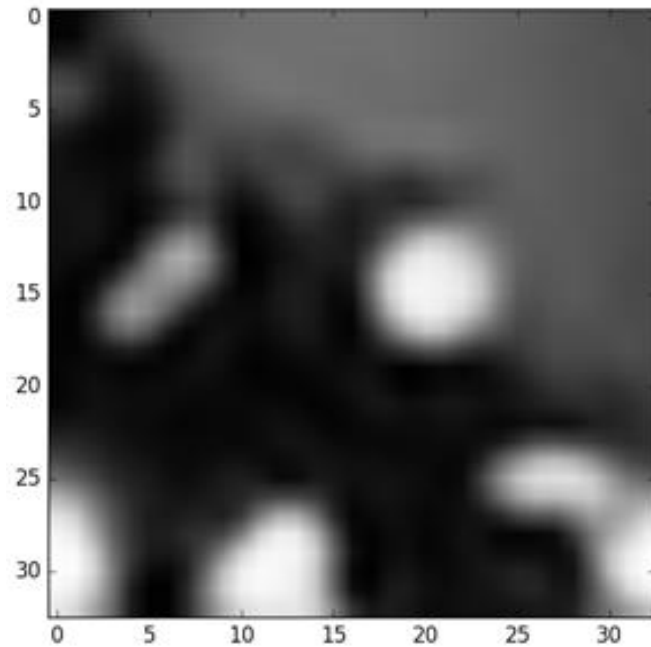
# Result - Adam



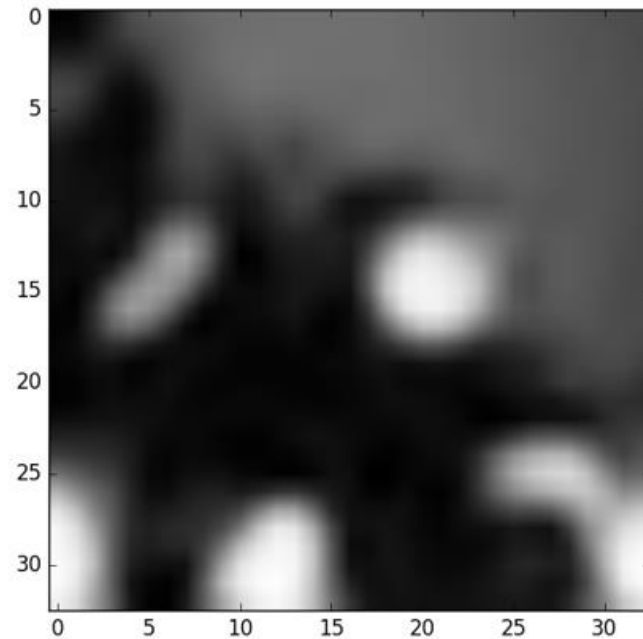
**Input**



**Original**



**Gradient : 0.0391**



**Adam : 0.03232**



# Learning rate – Adam 0.01

```
[epoch] : 1000 [cost] : 0.283321
[epoch] : 2000 [cost] : 0.221090
[epoch] : 3000 [cost] : 0.140350
[epoch] : 4000 [cost] : 0.089370
[epoch] : 5000 [cost] : 0.063210
[epoch] : 6000 [cost] : 0.049670
[epoch] : 7000 [cost] : 0.044780
[epoch] : 8000 [cost] : 0.042850
[epoch] : 9000 [cost] : 0.041910
[epoch] : 10000 [cost] : 0.041200
[epoch] : 11000 [cost] : 0.040700
[epoch] : 12000 [cost] : 0.040100
[epoch] : 13000 [cost] : 0.039500
[epoch] : 14000 [cost] : 0.039000
[epoch] : 15000 [cost] : 0.038500
[epoch] : 16000 [cost] : 0.038200
[epoch] : 17000 [cost] : 0.037900
[epoch] : 18000 [cost] : 0.037700
[epoch] : 19000 [cost] : 0.037500
[epoch] : 20000 [cost] : 0.037300
```

**Adam**

```
[epoch] : 1000 [cost] : 1.613690
[epoch] : 2000 [cost] : 0.405742
[epoch] : 3000 [cost] : 0.295106
[epoch] : 4000 [cost] : 0.265947
[epoch] : 5000 [cost] : 0.235715
[epoch] : 6000 [cost] : 0.202749
[epoch] : 7000 [cost] : 0.173553
[epoch] : 8000 [cost] : 0.152280
[epoch] : 9000 [cost] : 0.137445
[epoch] : 10000 [cost] : 0.126534
[epoch] : 11000 [cost] : 0.117988
[epoch] : 12000 [cost] : 0.110440
[epoch] : 13000 [cost] : 0.103709
[epoch] : 14000 [cost] : 0.097216
[epoch] : 15000 [cost] : 0.091349
[epoch] : 16000 [cost] : 0.086004
[epoch] : 17000 [cost] : 0.081393
[epoch] : 18000 [cost] : 0.077669
[epoch] : 19000 [cost] : 0.074642
[epoch] : 20000 [cost] : 0.072420
```

**Gradient**

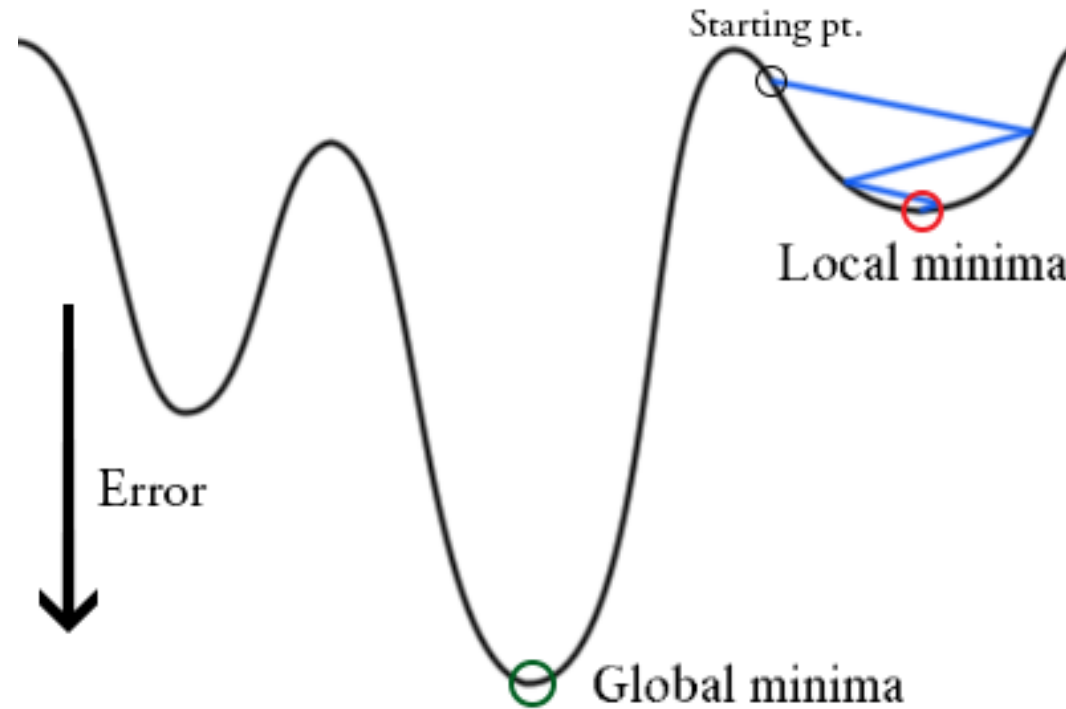
# Learning rate – Adam 0.0001

```
[epoch] : 500000 [cost] : 0.032711634398711956
[epoch] : 501000 [cost] : 0.03266732516178094
[epoch] : 502000 [cost] : 0.03267286455614821
[epoch] : 503000 [cost] : 0.03268398612819831
[epoch] : 504000 [cost] : 0.03269044305334854
[epoch] : 505000 [cost] : 0.032694216924445595
[epoch] : 506000 [cost] : 0.03267266506685273
[epoch] : 507000 [cost] : 0.032683137297520745
[epoch] : 508000 [cost] : 0.03266611190321034
[epoch] : 509000 [cost] : 0.03271997649469139
[epoch] : 510000 [cost] : 0.03268741373630131
[epoch] : 511000 [cost] : 0.032680065588861267
[epoch] : 512000 [cost] : 0.032663208283210066
[epoch] : 513000 [cost] : 0.03267008866019109
[epoch] : 514000 [cost] : 0.0326706375762382
[epoch] : 515000 [cost] : 0.032668620627373454
[epoch] : 516000 [cost] : 0.0326778079081765
[epoch] : 517000 [cost] : 0.032651806147495174
[epoch] : 518000 [cost] : 0.03268950929563931
[epoch] : 519000 [cost] : 0.032655937124646324
[epoch] : 520000 [cost] : 0.0326688040225931
```

# Learning rate – Adam 0.00001

```
[epoch] : 3000000 [cost] : 0.032371751438168915
[epoch] : 3001000 [cost] : 0.03235254728591398
[epoch] : 3002000 [cost] : 0.032389704946099836
[epoch] : 3003000 [cost] : 0.032370580141158664
[epoch] : 3004000 [cost] : 0.03235709045821911
[epoch] : 3005000 [cost] : 0.032345015277593016
[epoch] : 3006000 [cost] : 0.032374997463022526
[epoch] : 3007000 [cost] : 0.03233177144737805
[epoch] : 3008000 [cost] : 0.03235773527857793
[epoch] : 3009000 [cost] : 0.032357137951561636
[epoch] : 3010000 [cost] : 0.03234758150681634
[epoch] : 3011000 [cost] : 0.032364312314209255
[epoch] : 3012000 [cost] : 0.03236091790227767
[epoch] : 3013000 [cost] : 0.032360551393974354
[epoch] : 3014000 [cost] : 0.032369633822921004
[epoch] : 3015000 [cost] : 0.032399207264568436
[epoch] : 3016000 [cost] : 0.03237884497434339
[epoch] : 3017000 [cost] : 0.03235178863328388
[epoch] : 3018000 [cost] : 0.032328921774237906
[epoch] : 3019000 [cost] : 0.03236954886301914
[epoch] : 3020000 [cost] : 0.03232462197569582
```

# Future works



- Local Minimum 탈출하기