DQN 실험 결과 및 개선

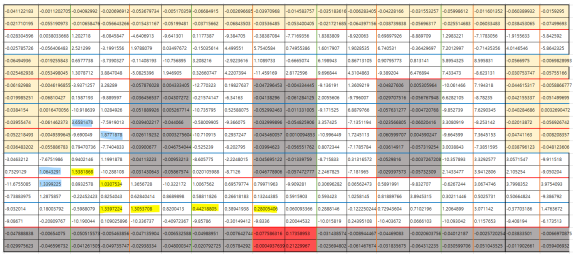
💡 **q_map이란?**

=> 각 방향으로 갔을 때 얻을 수 있는 보상의 기댓값을 나타낸 것.. 가치함수를 바탕으로 학습하여 agent가 어느방향으로 갈 지 판단하기 위해 필요한 것

1. Goal buffer를 사용하지 않았을 때

▼ image

```
episode: 6035 ε: 0.100 steps:   7 state_cur: [46] time: 17:14 score: 43 memory:10000 reward: -10.0
episode: 6036 ε: 0.100 steps:   9 state_cur: [28] time: 17:14 score: 44 memory:10000 reward: +10.0
episode: 6037 ε: 0.100 steps:  11 state_cur: [28] time: 17:14 score: 45 memory:10000 reward: +10.0
episode: 6038 ε: 0.100 steps:  13 state_cur: [28] time: 17:14 score: 46 memory:10000 reward: +10.0
episode: 6039 ε: 0.100 steps:  11 state_cur: [28] time: 17:14 score: 46 memory:10000 reward: +10.0
episode: 6040 ε: 0.100 steps:   9 state_cur: [28] time: 17:14 score: 47 memory:10000 reward: +10.0
episode: 6041 ε: 0.100 steps:   9 state_cur: [28] time: 17:14 score: 48 memory:10000 reward: +10.0
episode: 6042 ε: 0.100 steps:   6 state_cur: [55] time: 17:14 score: 48 memory:10000 reward: -10.0
episode: 6043 ε: 0.100 steps:   9 state_cur: [28] time: 17:14 score: 49 memory:10000 reward: +10.0
episode: 6044 ε: 0.100 steps:   9 state_cur: [28] time: 17:14 score: 49 memory:10000 reward: +10.0
episode: 6045 ε: 0.100 steps:  11 state_cur: [28] time: 17:14 score: 50 memory:10000 reward: +10.0
episode: 6046 ε: 0.100 steps:  11 state_cur: [28] time: 17:14 score: 51 memory:10000 reward: +10.0
progress = 60 %  --> 6046/10000 Early Stopping
```



```
episode: 3810 ε: 0.100 steps:  13 state_cur: [28] time: 10:59 score: 10 memory:10000 reward: +10.0
episode: 3811 ε: 0.100 steps:  15 state_cur: [28] time: 10:59 score: 11 memory:10000 reward: +10.0
episode: 3812 ε: 0.100 steps:  13 state_cur: [28] time: 10:59 score: 12 memory:10000 reward: +10.0
episode: 3813 ε: 0.100 steps:  13 state_cur: [28] time: 10:59 score: 13 memory:10000 reward: +10.0
episode: 3814 ε: 0.100 steps:  13 state_cur: [28] time: 10:59 score: 14 memory:10000 reward: +10.0
episode: 3815 ε: 0.100 steps:  21 state_cur: [28] time: 10:59 score: 15 memory:10000 reward: +10.0
episode: 3816 ε: 0.100 steps:  15 state_cur: [28] time: 10:59 score: 16 memory:10000 reward: +10.0
episode: 3817 ε: 0.100 steps:  13 state_cur: [28] time: 10:59 score: 17 memory:10000 reward: +10.0
episode: 3818 ε: 0.100 steps:  13 state_cur: [28] time: 10:59 score: 17 memory:10000 reward: +10.0
progress = 38 %  --> 3818/10000 Early Stopping

Process finished with exit code 0
```

```
Grid
10,10,10,10,10,11,10,10,10
0,0,0,0,0,0,0,0,0
10,0,0,0,0,0,0,0,10
11,2,88,0,88,0,88,0,10
10,2,88,0,88,0,88,0,10
10,2,88,0,88,0,88,0,10
2,2,88,0,88,0,88,0,0
2,2,2,2,2,0,0,0,0
0,2,2,0,2,0,0,0,0
88,88,88,88,2,88,88,88,88
```

▼ 실패 개수(2개)

```
episode: 9990 ε: 0.100 steps:   8 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9991 ε: 0.100 steps:  76 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9992 ε: 0.100 steps:   1 state_cur: [76] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9993 ε: 0.100 steps:  30 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9994 ε: 0.100 steps:  44 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9995 ε: 0.100 steps:   6 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9996 ε: 0.100 steps:  49 state_cur: [78] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9997 ε: 0.100 steps:  30 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9998 ε: 0.100 steps:  30 state_cur: [79] time: 29:08 score:  0 memory:10000 reward: -10.0
episode: 9999 ε: 0.100 steps:  13 state_cur: [78] time: 29:08 score:  0 memory:10000 reward: -10.0

Process finished with exit code 0
```

goal에 도착해서 reward를 받았음에도 goal 방향으로 안가고 자꾸 오른쪽으로 감

▼ 실패 q-map 이상(2개)

```
episode: 7419 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 53 memory:10000 reward: +10.0
episode: 7420 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 53 memory:10000 reward: +10.0
episode: 7421 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 54 memory:10000 reward: +10.0
episode: 7422 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 54 memory:10000 reward: +10.0
episode: 7423 ε: 0.100 steps:  11 state_cur: [28] time: 21:12 score: 54 memory:10000 reward: +10.0
episode: 7424 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 54 memory:10000 reward: +10.0
episode: 7425 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 54 memory:10000 reward: +10.0
episode: 7426 ε: 0.100 steps:   9 state_cur: [28] time: 21:12 score: 55 memory:10000 reward: +10.0
episode: 7427 ε: 0.100 steps:  11 state_cur: [28] time: 21:12 score: 55 memory:10000 reward: +10.0
progress = 74 %  --> 7427/10000 Early Stopping

Process finished with exit code 0
```

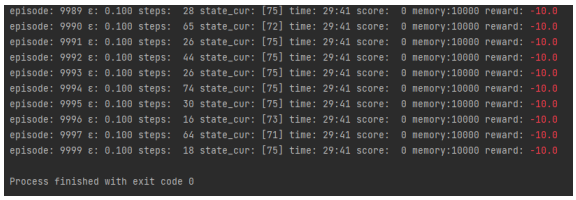
0.044675544	-0.04038578	0.04175342	-0.03361458	0.028530007	-0.043383658	0.041448407	-0.05267224	0.05453293	-0.055114135	0.04849866	-0.041882418	0.035126317	-0.04616822	0.038956042	-0.04457505	0.054767944	-0.03748402
-0.013603225	0.030150527	-0.025893394	0.045988377	-0.006553537	0.019429961	-0.012208528	0.041282784	0.008069769	0.051531736	-0.018011307	0.061116163	-0.0022392112	0.039586376	-0.015847813	0.031034164	-0.018225336	0.022305476
0.03315753	-0.05530064	-4.083427	-8.036278	4.118027	-9.552272	4.936105	-10.032276	6.9318833	-10.156726	8.332282	-10.623337	3.7035995	-9.890874	5.173639	-9.662425	1.1470393	1.7623323
-0.012301708	0.049255054	8.979383	-0.471648	6.9500628	4.7704005	3.873516	8.418195	6.335466	3.452863	6.0599256	4.587063	4.5137606	2.5961883	5.554081	2.5532985	-8.350349	-9.727273
0.054201644	-0.03836731	-10.026377	1.7453812	8.700297	5.0593224	5.730404	6.843357	4.7855167	7.966285	6.1379943	5.0989265	7.79734	6.022887	4.623058	2.8019447	0.025257168	-0.051758297
-0.00857549	0.040155552	9.420588	-0.04084803	-11.65222	5.1917863	5.8641615	6.8279424	-9.812029	6.750633	2.8839765	3.9203105	-11.056437	5.3466773	-0.43195218	-10.298264	0.008199268	0.031484872
0.019592328	-0.04500004	9.855497	7.716961	0.03811591	-0.032336246	-9.688745	3.9413948	0.031730037	-0.06221639	-9.148507	7.2597246	0.008813838	-0.050448716	-9.409555	5.820391	0.0050614337	-0.032318268
0.0032381695	0.04265699	2.8712716	-2.2677734	-0.00978707	0.04520899	2.4021685	-10.20533	-0.0005714563	0.035143368	5.476855	-7.9248557	-0.007186033	0.04302817	2.2011468	-10.34148	-5.3105123e-05	0.03375555
0.024837637	-0.044667944	-9.228025	9.278302	0.03433925	-0.052152254	-8.1550255	6.271508	0.031657573	-0.054573875	-8.90208	4.837229	0.026963867	-0.05643258	-9.382701	1.1154976	0.039679874	-0.054951794
-0.016369306	0.05259085	-2.8115175	-6.4327626	-0.0052814535	0.022852158	2.3770394	-9.890639	-0.0031527074	0.035141896	3.3607514	-10.0137205	-0.003636634	0.021595422	0.13971022	-9.059177	-0.0035414188	0.025638618
0.0123111205	-0.04726227	-8.593669	7.869638	0.026642162	-0.05773676	-9.017389	3.4496753	0.050235655	-0.059913263	-10.071808	5.2949867	0.031938747	-0.043863457	-8.955089	3.431524	0.030710226	-0.03038097
-0.013534731	0.020990042	4.26833	-9.1849575	-0.0004092771	0.048208453	2.4507103	-10.329053	0.0005938285	0.026338873	4.1737885	-8.731851	-0.010826105	0.03896097	2.5329418	-8.840784	7.19589e-05	0.03346216
-6.857568	-9.379766	1.4762886	5.6708183	0.04160534	-0.058905385	-9.715838	3.0660615	0.03275257	-0.059334792	-9.121213	2.3370135	0.03229994	-0.052132677	-10.571248	1.5703776	-0.12972221	-9.829041
2.8046215	5.0902376	3.5282907	-8.262706	-0.013907077	0.034653563	4.15816	-9.385549	-0.008526484	0.029966751	1.0840043	-8.255722	-0.011557504	0.041984513	1.6636155	1.419629	0.5861345	-9.754564
-10.434548	3.6195407	2.3453887	5.008675	3.984672	-9.52929	0.7418354	2.5736964	4.359216	-10.623193	1.0235403	0.48830283	0.68644726	-10.101716	0.55478823	0.47603416	1.3288122	1.8364809
5.227014	3.9043872	2.1301796	-1.656723	4.212926	2.8237047	0.12435313	0.41249546	0.5692387	1.246877	0.6990368	1.0737816	2.0911849	2.3235226	1.3959328	1.3696197	0.9856587	-10.463315
-9.633999	1.684475	4.8466334	3.9272394	2.358599	1.4035729	4.3076587	4.568877	0.8608542	0.7969384	0.5350219	2.0284243	0.40124997	0.9920681	1.7578143	1.9670305	0.4856246	1.358709
-10.035372	2.6009555	-10.542903	4.1999173	-9.444563	1.3639971	-10.031107	0.41440472	-9.850423	0.78240085	-10.07257	1.4838428	-10.214282	1.4020039	-10.530537	1.8031181	-10.48684	-10.591158
0.03288747	-0.041722037	0.05323508	-0.04195177	0.039615504	-0.061643723	0.06037293	-0.058196187	-0.20317172	0.6837867	0.018227123	-0.060400683	0.030985715	-0.055873297	0.037644237	-0.048796322	0.026826032	-0.061169334
-0.0134305535	0.040971555	-0.005813383	0.057241175	-0.008240993	0.030489936	-0.024917576	0.047286447	-0.90181184	0.72293746	-0.022095237	0.011558024	-0.026539188	0.033577606	0.004512137	0.04453788	0.0026434415	0.047096442

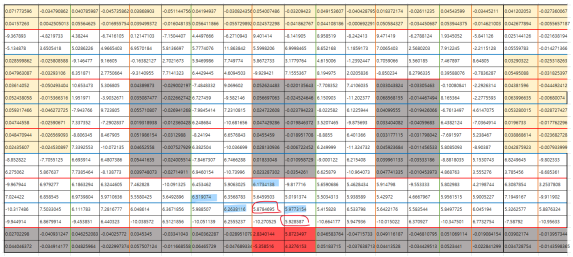
기존에 사용하던 방법으로 학습을 진행했을 때 goal에 70%로 도착해 조기종료가 되었음에도 q-map이 제대로 안나오는 경우가 10번 중 2번 있었다.

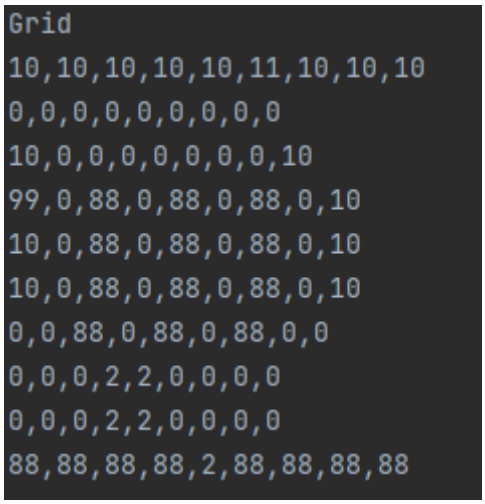
최단 경로가 9 임에도 11로 종료되어 마지막에 나온 q-map이 최단거리가 아닌 경우도 10번 중 4번 있었다.

2. target network 초기화

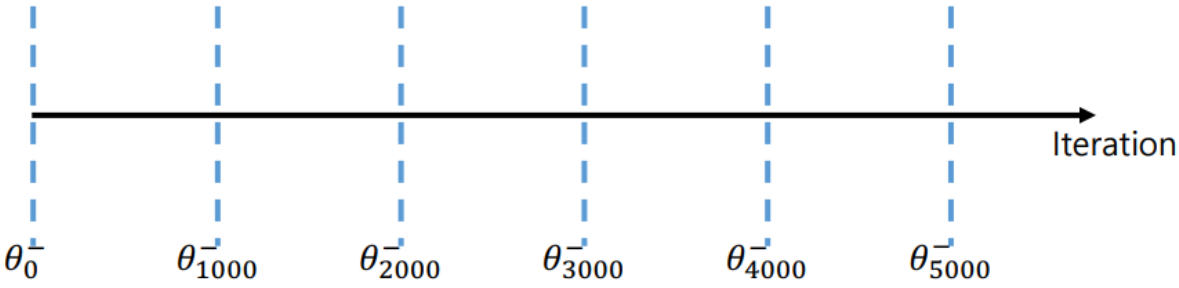
train 네트워크(=update network)를 학습할 때마다 target network를 train 네트워크로 초기화 했을 때 target 값이 자꾸 바뀌어 제대로된 학습을 진행하지 못했습니다.







target이 계속 바뀌어서 step을 멀리 밟지 못한다.



target 네트워크를 일정 episode마다 초기화해주는 방법을 통해 이 문제를 해결했고 100~900까지 테스트해본 결과 500 episode마다 업데이트 해주는 것이 제일 성능이 좋았습니다 .

3. goal 버퍼 사용

기존의 랜덤하게 샘플링 방법은 goal 로 들어가는 데이터가 샘플링이 되지않아 학습속도가 느리고 의미없는 데이터를 많이 학습하여 학습이 제대로 이루어지지않는 경우가 있었습니다.

```
# ksy 20%반영 -> 25%
goal_sampling = int(sampling / 4)
if len(self.__goal_buffer) > 0:
    if len(self.__goal_buffer) > goal_sampling:
        goalbatch = random.sample(self.__goal_buffer, goal_sampling)
    else:
        goalbatch = list(self.__goal_buffer)

if len(goalbatch) > 0:
    minibatch = random.sample(self.__replay_buffer, sampling - len(goalbatch))
    minibatch = minibatch + goalbatch
else:
    minibatch = random.sample(self.__replay_buffer, sampling)
```

goal 버퍼를 따로 만들어 학습할 때 (goal로 들어가는 데이터 + 샘플링 데이터)로 학습한 결과 10번 테스트한 것중 1번을 제외하고 평균 episode 7000 정도에 조기종료했고 최종 q-map도 잘 나왔다.

goal 데이터로만 학습하는 것보다 샘플링 데이터를 섞어주는 것이 더 좋은 성능을 보였다.

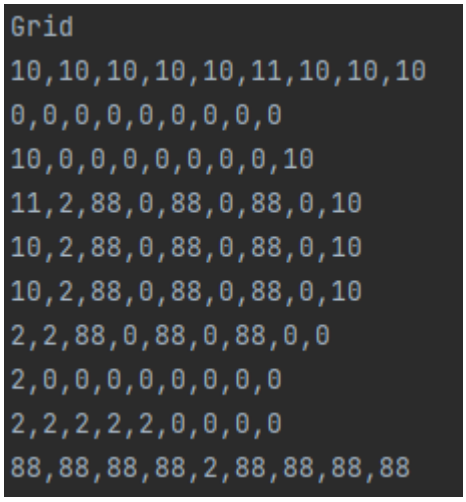
goal 데이터만 사용하면 기존의 q-network가 가진 **Correlation** 문제를 해결하지 못하는 것으로 보임.

문제점

▼ image

```
episode: 4413 ε: 0.100 steps:  15 state_cur: [28] all_steps: 83349 time: 12:07 score: 38 memory:10000 reward: +150.0
episode: 4414 ε: 0.100 steps:  11 state_cur: [28] all_steps: 83360 time: 12:08 score: 39 memory:10000 reward: +150.0
episode: 4415 ε: 0.100 steps:  15 state_cur: [28] all_steps: 83375 time: 12:08 score: 40 memory:10000 reward: +150.0
episode: 4416 ε: 0.100 steps:  13 state_cur: [28] all_steps: 83388 time: 12:08 score: 41 memory:10000 reward: +150.0
episode: 4417 ε: 0.100 steps:  15 state_cur: [28] all_steps: 83403 time: 12:08 score: 42 memory:10000 reward: +150.0
episode: 4418 ε: 0.100 steps:  11 state_cur: [28] all_steps: 83414 time: 12:08 score: 43 memory:10000 reward: +150.0
episode: 4419 ε: 0.100 steps:  11 state_cur: [28] all_steps: 83425 time: 12:08 score: 43 memory:10000 reward: +150.0
episode: 4420 ε: 0.100 steps:  11 state_cur: [28] all_steps: 83436 time: 12:08 score: 44 memory:10000 reward: +150.0
progress = 44 %  --> 4420/10000 Early Stopping

Process finished with exit code 0
```



-0.2473889	0.5878572	-0.1718118	0.5972686	-0.25143892	0.645792	-0.35927343	0.7055502	-0.3386294	0.701625	-0.32093525	0.6088719	-0.32700735	0.5686799	-0.285765	0.60056925	-0.20059359	0.64830357
-0.124564506	-0.2028528	-0.09606858	-0.23641115	-0.13938227	-0.28765938	-0.09586877	-0.3221788	-0.1784575	-0.24008924	-0.09230142	-0.2224371	-0.11925353	-0.31353584	-0.1399423	-0.23191783	-0.16539149	-0.2418842
13.9755335	-95.79291	21.461718	-103.88494	-0.22313043	-62.958084	12.01349	-101.27118	16.325247	-101.759476	7.263352	-93.72817	8.696232	-82.575485	10.905174	-84.605286	10.810156	-100.70357
18.07641	24.385368	15.918595	29.28204	6.2556505	8.5586	16.504421	29.278183	9.525335	27.806738	26.562532	28.954842	56.144127	14.638397	48.975643	24.027843	2.3609865	12.827578
-0.2721488	0.6147004	-115.601746	35.210068	12.2816305	5.974453	-19.156551	-6.007237	22.210808	19.047987	37.9417	-6.0270963	47.36741	16.728518	68.75802	32.556923	-0.32959306	0.5693771
-0.16231923	-0.16105503	-4.7466497	-45.29772	-90.87451	20.347275	3.2183366	41.3367	-69.50841	37.454586	10.096941	45.02338	-72.98039	28.555363	-3.2526991	-75.03459	-0.19797796	-0.24046418
-0.2881182	0.5485849	147.30394	-50.575527	-0.23267783	0.6327717	-104.88033	21.099552	-0.30611566	0.6221279	-47.092075	60.55494	-0.22385393	0.4967631	-97.507416	58.216446	-0.32118458	0.5708907
-0.1469117	-0.19162232	8.607803	64.52641	-0.10571553	-0.29072413	1.1234684	-70.66753	-0.11255999	-0.33187434	13.162766	-83.81691	-0.16099744	-0.20262712	8.839823	-94.938194	-0.051856276	-0.21502595
-0.29016632	0.64379907	-28.973242	128.8085	-0.33753324	0.5738443	-88.77383	11.884001	-0.18123326	0.613845	-102.79353	27.16368	-0.34295157	0.6326435	-120.89048	25.219528	-0.24382097	0.6572108
-0.1132907	-0.31496358	-25.135576	-39.763664	-0.15602034	-0.2759093	-2.675142	-84.84964	-0.07875834	-0.21397111	5.790535	-76.28093	-0.15375619	-0.30381745	2.8600354	-37.70178	-0.11183336	-0.18813764
-0.28752568	0.6373791	-106.20159	38.071445	-0.3297759	0.65830535	-98.28887	15.0936775	-0.3167851	0.6395739	-82.9954	19.795115	-0.21520156	0.58722186	-87.133446	9.378679	-0.082473114	0.5858929
-0.111509904	-0.29793707	7.871302	-91.16181	-0.1919755	-0.22607268	-1.3562152	-71.37271	-0.17756078	-0.15678982	5.1068573	-90.652794	-0.12268769	-0.17792922	-1.66988	-71.7897	-0.08940843	-0.29080436
-76.25648	-58.970818	9.3019285	19.670109	-0.24824017	0.65508616	-79.70718	12.039303	-0.251911	0.66437507	-95.574295	21.248825	-0.3073617	0.68721724	-109.021706	0.77279925	-0.69100684	-79.386215
2.858119	16.310036	8.173183	-94.51579	-0.16116638	-0.19680752	3.3600075	-84.366844	-0.07162302	-0.29112723	8.306572	-92.57197	-0.1596622	-0.3590595	7.8855195	6.839245	32.99828	-17.808983
-102.52744	6.142514	5.522835	5.3911805	-2.3931632	-89.07437	4.236037	2.5601764	8.961399	-106.4994	4.8415527	-7.5729437	24.908094	-103.941444	-5.72899	40.182957	15.325282	-0.22740233
3.8298514	-0.502198	3.542073	4.04315	3.0397155	16.114279	1.0926585	3.0822866	3.9628997	27.061127	2.478307	22.899431	7.3886914	36.916935	-7.591771	10.402594	9.3316	-89.70458
-64.09393	3.1309857	20.889694	5.312881	23.202827	4.749989	18.223444	3.6686845	17.40622	2.605297	4.00788	15.7105	16.701681	18.764019	36.441395	-2.482955	25.168362	23.494535
-76.37362	-0.028770685	-95.84708	8.714478	-99.15136	7.346711	-101.390976	11.623903	-101.3766	10.858876	-102.78494	7.981905	-100.01811	19.79296	-93.71337	4.2945185	-53.926212	-72.58015
-0.15604773	0.54851335	-0.31968704	0.675596	-0.2221682	0.682511	-0.20208773	0.57392377	3.0752583	2.6022365	-0.30745086	0.6397861	-0.3411168	0.6392216	-0.24701779	0.6627938	-0.27336085	0.5504874
-0.14339979	-0.23758732	-0.17455323	-0.23451398	-0.19147426	-0.16703323	-0.19471805	-0.2637072	0.65726006	-0.40027934	-0.07964119	-0.29105717	-0.15405828	-0.28129062	-0.0958648	-0.23485062	-0.16778584	-0.21588399

▼ 안좋은 goal 데이터

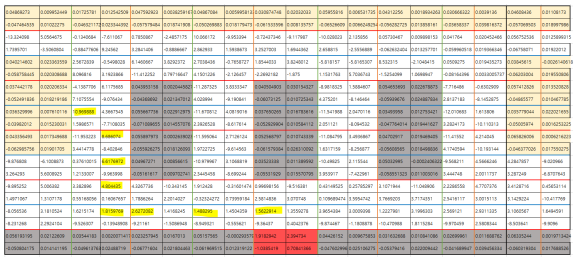
```
idx_epi : 999
time,action,p_cur,p_new,state_cur,state_new,reward,done,result_step
220530_161441,U,"(9, 4)","(8, 4)",85,76,-0.01,False,ID_GENERAL_MOVE
220530_161441,R,"(9, 4)","(8, 5)",76,77,-0.01,False,ID_GENERAL_MOVE
220530_161441,R,"(9, 4)","(8, 6)",77,78,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(7, 6)",78,69,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(7, 5)",69,68,-0.01,False,ID_GENERAL_MOVE
220530_161441,D,"(9, 4)","(8, 5)",68,77,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(8, 4)",77,76,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(8, 3)",76,75,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(8, 2)",75,74,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(8, 1)",74,73,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(8, 0)",73,72,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(7, 0)",72,63,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(6, 0)",63,54,-0.01,False,ID_GENERAL_MOVE
220530_161441,D,"(9, 4)","(7, 0)",54,63,-0.01,False,ID_GENERAL_MOVE
220530_161441,D,"(9, 4)","(8, 0)",63,72,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(7, 0)",72,63,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(6, 0)",63,54,-0.01,False,ID_GENERAL_MOVE
220530_161441,R,"(9, 4)","(6, 1)",54,55,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(5, 1)",55,46,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(4, 1)",46,37,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(3, 1)",37,28,-0.01,False,ID_GENERAL_MOVE
220530_161441,D,"(9, 4)","(4, 1)",28,37,-0.01,False,ID_GENERAL_MOVE
220530_161441,U,"(9, 4)","(3, 1)",37,28,-0.01,False,ID_GENERAL_MOVE
220530_161441,L,"(9, 4)","(3, 0)",28,27,150,True,ID_GOAL
```

goal로 들어간 데이터가 최적화된 경로가 아닐 경우 위와 같은 문제가 발생했다.

해결

위 문제를 해결하기위해 매번 goal 버퍼에 저장할 때 step을 비교해 최소 step을 갱신하고 최소 step인 데이터만 goal 버퍼에 저장해서 최적화된 경로를 학습한 결과 평균 종료 episode가 3000~4000 사이로 감소했고 q-map도 최적 경로로 잘 출력되었다.

```
while len(self.__temp_buffer) > 0 and cnt_step <= self.__goal_min_step:
    self.__goal_buffer.clear()
    self.__goal_buffer.append(self.__temp_buffer.pop())
    self.__goal_min_step = cnt_step
```



```
Grid
10,10,10,10,10,10,10,10,10,10
0,0,0,0,0,0,0,0,0,0
10,0,0,0,0,0,0,0,0,10
10,0,88,0,88,0,88,0,0,10
11,2,88,0,88,0,88,0,0,10
10,2,88,0,88,0,88,0,0,10
0,2,88,0,88,0,88,0,0,0
0,2,0,0,0,0,0,0,0,0
0,2,2,2,2,0,0,0,0,0
88,88,88,88,2,88,88,88,88,88
```

▼ 조기종료

- 기존 방법

```
def __check_early_stopping(self, early_stopping, idx_epi, buf_result):
    if early_stopping:
        if idx_epi == 0:
            early_stopping.clear()
        if not self.dqn_update.loss == 0:
            flg = idx_epi
            if buf_result == ID_GOAL:
                flg = True
            # if early_stopping.check_stopping(round(float(self.dqn_update.loss), 5)):
            if early_stopping.check_stopping(flg):
                return False
    return True
```

0	1	2	TRUE	4	5	TRUE	TRUE	TRUE	TRUE

마지막에 들어오는 값과 리스트 안에 들어 있는 값을 비교한다. 성공은 TRUE로 실패는 episode를 저장한다. Ratio 비율을 넘으면 종료한다

기존 방법은 최적경로로 가지 않았음에도 종료가 되어서 최종으로 나온 q-map이 최적경로가 아닌 경우가 있었다.

- 수정된 방법

```python
def __check_early_stopping(self, early_stopping, idx_epi, buf_result, cnt_step):
    if early_stopping:
        if idx_epi == 0:
            early_stopping.clear()
        if not self.dqn_update.loss == 0:
            flg = False  # ksy2
            if buf_result == ID_GOAL:
                flg = cnt_step
            # if early_stopping.check_stopping(round(float(self.dqn_update.loss), 5)):
            if early_stopping.check_stopping(flg, self.__goal_min_step):  # ksy2
                return False
    return True
```

FALSE	FALSE	FALSE	11	9	9	9	FALSE	27	9

비교하는 방법은 이전과 동일하나 수정된 코드에서는 성공했을 때 TRUE가 아닌 step으로 저장한다. 즉 최소 스텝으로 goal로 도착한 비율이 ratio를 넘길 때 종료된다.

4. 학습된 가중치를 사용해 학습한 결과

▼ S

▼ A → S

▼ TEST

- 1차(epi: 2522)

-0.060327142	0.014549633	-0.044647742	0.027777737	-0.061572395	0.029118622	-0.06738813	0.013440766	-0.050319918	0.022030137	-0.041909598	0.03227253	-0.042165954	0.017372003	-0.07385779	0.009887395	-0.03699349	0.03783504
0.017812641	-0.002134658	0.006136396	-0.002925756	0.006426121	-0.016055062	0.017760247	-0.011711253	0.008504461	-0.012978068	0.004000742	0.00450745	0.003445694	0.001920422	0.01434617	-0.013328948	-0.011995252	-0.011162501
-0.1391203	3.8032598	2.6036172	-9.081114	-0.3691044	-8.616746	1.2386063	-8.197274	-2.981697	-11.226908	-7.037259	-10.104853	-6.308073	-10.897735	-6.157545	-9.899125	-0.038414247	0.018445129
-11.958183	3.1567345	4.3377357	3.8186433	3.8807344	2.4059777	5.0432253	1.6749445	3.7293937	0.85704625	0.2496827	-0.11072123	0.014547359	1.4713609	-0.74995494	2.2381387	0.009263151	-0.017021963
-0.049241457	0.023512118	-9.412394	3.2264009	6.1042776	3.3047626	2.2622962	-1.4338933	-6.3888545	-12.713601	-5.5970993	-10.071871	3.6179307	8.699817	-3.763843	-10.1949215	-0.060920343	0.03193387
0.0070837657	-0.017019216	3.7990978	3.4614468	-9.391181	4.8335123	-1.4202807	1.5667598	-0.20085458	3.553582	0.10839691	2.5173252	-0.72081244	-3.9807878	1.4554342	2.415555	-0.0064076395	-0.030558215
-0.048697755	0.025256582	-9.539562	4.5132527	-0.041531794	0.029201595	1.3708652	8.6748085	-0.06766242	0.023920935	-0.06621853	0.025158305	-0.05531533	0.0361806	-0.058705978	0.018176774	-0.054034613	0.02270381
0.0020421536	-0.017470822	0.46489123	-8.321507	0.0015261635	-0.011370107	0.8624229	-0.89560497	6.6339715e-05	-0.003708839	-0.005013448	-0.022229422	-0.002338127	-0.02649703	0.0024024728	-0.013140894	0.005849241	-0.011557018
-0.056490965	0.017189369	-7.758734	4.0619273	-0.059714556	0.03572836	0.44208783	-3.2553291	-0.056830183	0.013274718	-0.05571082	0.042413034	-0.06598884	0.007165202	-0.048385657	0.025258414	-0.054990664	0.0026439074
-0.0009622546	0.0013498444	0.75721365	-8.474896	0.010276606	-0.015940802	12.076235	-1.9557524	0.0009255648	-0.001028675	-0.011059129	-0.026108796	0.013561632	-0.007247724	0.0021570507	0.002394849	-0.0055097416	-0.004501234
-9.864453	-8.708153	-9.6906395	1.0532335	-0.050268788	0.020733217	-7.0029707	4.393278	-0.05737584	0.042136703	-0.06555544	0.013752588	-0.05814398	0.032098323	-0.046234578	0.020596249	-0.04835912	0.015055949
0.7121361	1.4452372	0.8065724	-9.1664505	0.0021592204	0.004231849	0.5580535	-8.798004	0.0068387277	-0.01422613	-0.001414837	0.003596597	-0.006882481	-0.017624803	0.010025544	-0.00821423	0.02094889	-0.005977976
-10.280621	-8.844377	1.6116711	1.2179251	-0.047364213	0.019676056	-8.30854	1.286792	-0.06371208	0.023915796	-7.0403957	0.9127008	-0.054297496	0.011812054	-0.06494815	0.015597635	-0.04154304	0.0318499
0.67403185	0.9353306	2.2021275	-9.516961	0.017847676	-0.006226048	4.121171	-9.490076	0.007788476	-0.01674704	4.8552246	-11.40075	0.020854294	-0.006320364	-0.000746987	-0.003526614	0.0014848169	0.0059052
-10.272174	1.4165071	0.4291979	0.82577574	2.9684248	-8.416152	-0.59944725	0.76184845	5.5784636	-8.358547	6.7777014	1.6233377	-5.3125634	-9.005378	-4.2469783	-0.56923145	-0.057306908	0.021857802
1.3175253	1.7670403	0.7515429	1.147827	4.140004	4.895215	5.8116527	6.2815433	8.105359	5.1013155	7.0386605	3.4734817	3.5429947	8.438141	0.33974037	0.19201575	0.010324077	-0.004170242
-10.158082	0.65779424	2.2711945	1.4549283	1.4948026	1.028592	3.9781463	4.136479	5.20001	4.9080787	8.507139	3.401974	0.88476443	4.996887	0.8617971	-0.45655674	-0.046246454	0.020641793
-10.225823	0.8009026	-10.522309	3.9946356	-10.256277	5.497595	-9.91148	8.1756	-10.117156	6.386235	-1.8328208	-1.0943472	-10.732088	-0.4890469	-10.997745	-1.0064635	0.020861559	-0.015388291
-0.054033246	0.022673894	-0.057331264	0.011959867	-0.043302447	0.03543318	-0.069465704	0.008297138	-0.042546805	0.019137308	-0.06941166	0.009567571	-0.064011075	0.027668657	-0.056805465	0.032966666	-0.059027098	0.010526591
-0.0039065396	-0.024585903	0.0034715453	-0.019879047	0.0039642896	-0.007662353	-0.004369461	-0.013929645	0.009775897	-0.021201726	-0.004448359	-0.020248057	0.005143151	-0.016742297	0.0030410448	-0.019568527	0.015462585	-0.011904463

- 2차(epi: 1947)

-0.07084809	0.014676966	-0.05458703	0.025098288	-0.07445577	0.0327488	-0.07480423	0.023526955	-0.059577357	0.024636362	-0.06405641	0.029584177	-0.062298115	0.020535082	-0.07882605	0.011501024	-0.048731726	0.03287428
0.032091383	-0.021794662	0.017851615	-0.01644891	0.028101936	-0.031208035	0.031802338	-0.029411935	0.014607725	-0.033956487	0.014715649	-0.017676124	0.012980572	-0.021080066	0.028971545	-0.036237013	0.000931931	-0.017042408
0.07607514	-9.000628	2.8095372	-10.339285	3.4010684	-9.950251	-0.39677978	-11.819496	-3.9600964	-14.29924	-0.42271376	-13.162242	-3.1191845	-12.022849	-1.623891	-12.9885025	-0.046227753	-9.296254
-7.9477377	3.6391377	2.1934512	3.0500176	3.635619	4.0532565	4.21581	1.2236769	-0.1519941	-0.83352065	-1.1075261	4.5437818	-1.3232605	-0.3494956	-1.2088943	5.0586987	1.7716267	4.262644
-0.06959302	0.02257258	-9.393487	3.145977	4.4032364	3.088663	4.210968	5.989501	2.8017015	-5.8179507	-1.2829928	-12.592075	9.91786	3.6642363	-0.9765307	-8.955157	-0.07218383	0.027021596
0.021951398	-0.041739788	2.1663084	3.9963906	-9.094511	5.014815	4.5854435	6.5895414	-10.508322	6.409159	-0.3057117	3.5889742	-8.9106045	2.4413178	0.5285923	2.6832373	0.006324354	-0.053767533
-0.063827164	0.021659076	-9.98037	3.2921786	-0.05761035	0.029204926	-10.706388	4.353141	-0.07476306	0.019958409	-6.152683	8.069763	-0.07742288	0.030154416	-0.057675514	0.015931696	-0.06604842	0.02710104
0.013193003	-0.030291194	2.539575	-9.455138	0.0050928174	-0.023391878	5.3835845	-9.488689	0.010914704	-0.026294652	0.8936303	-1.7381054	0.012085468	-0.0398279	0.00811803	-0.03595661	0.011710135	-0.031751752
-0.0585681	0.009525459	-10.039958	2.1295657	-0.064358756	0.036540106	-10.7404995	5.1109414	-0.068517245	0.0135973	-0.067601	0.043095615	-0.07148075	0.013406376	-0.062033627	0.027043637	-0.06780263	0.009689301
0.007948496	-0.014661266	5 2.4324691	-9.549963	0.023506138	-0.034139432	8.234782	-7.000198	0.01272407	-0.01696162	0.009970269	-0.036181662	0.024689725	-0.026082348	0.0068464167	-0.015890727	0.010034102	-0.02249067
-9.444452	-10.514174	-9.815595	2.55022	-0.061509658	0.010125788	-10.485863	5.8655825	-0.07107406	0.041535947	-0.07273947	0.004677386	5 -0.059454482	0.022154184	-0.06533993	0.019508477	-0.057868645	0.011790109
2.6512196	2.5386379	2.1256123	-10.105306	0.008345702	-0.015522201	4.4831324	-10.254465	0.014054652	-0.035814572	0.013226842	-0.015814357	0.008587171	-0.04524	0.015734479	-0.03400721	0.031591825	-0.023910968
-9.2750225	-10.602939	2.5045304	2.9604237	-0.060152404	0.019400444	-10.585974	6.3541446	-0.071404316	0.020003168	-8.672205	0.31536227	-0.06743437	0.008999744	-0.069885515	0.013043798	-0.058748007	0.021873573
2.0906007	2.41788	3.1900578	-10.259868	0.022949643	-0.03449571	4.5237927	-9.923558	0.021326024	-0.02773321	4.924846	-13.526248	0.024522021	-0.028686792	0.009542094	-0.029449802	0.0077074165	-0.008975682
-9.482363	2.9995942	2.8597765	2.4646091	3.4275508	-10.092316	2.804813	6.3818917	4.1616445	-10.402309	5.9468327	4.5140953	6.138464	-7.547499	1.5711036	2.4109497	4.185557	0.66939664
2.9925303	3.0432625	2.9668179	3.4010642	3.549475	4.9452972	5.647062	7.053787	8.140079	5.4207435	5.662098	4.207403	7.5118446	1.3143514	-0.8390141	1.1973375	-0.71830386	-0.36439535
-10.201778	1.9750457	3.354454	3.0487158	2.686111	2.499809	4.060949	4.6757956	4.7605424	6.4404984	8.376043	5.4646583	7.3714023	4.9323235	3.263041	0.6788862	1.2312491	9.510898
-10.085059	3.4775028	-9.661556	3.2009072	-9.691834	5.3396544	-9.916636	8.787401	10.534102	5.771825	-8.705713	6.417359	-7.0622234	0.76793003	-12.070361	6.9342833	-0.70956415	-2.3757415
-0.06898152	0.018060502	-0.06654927	0.009367339	-0.061344698	0.035861455	-0.07963065	-0.00074103	-0.04536435	0.020546231	-0.08587286	0.008598762	-0.06599975	0.020859115	-0.071688496	0.04050054	-0.06890522	0.013061775
0.008518428	-0.034210023	0.011852882	-0.033486083	0.01473796	-0.024967866	0.0063820807	-0.03081217	0.01858403	-0.032765117	0.010193262	-0.03280228	0.020674873	-0.028729795	0.023106486	-0.028583698	0.023579992	-0.026893292

- 3차(epi: 2022)

-0.070735	0.012045937	-0.046610888	0.02632954	-0.06634888	0.023177052	-0.071344756	0.016338399	-0.056255385	0.028840993	-0.06317666	0.02578959	-0.06573013	0.0080396	-0.07670763	0.013570473	-0.048044782	0.037117857
0.024013752	-0.02412394	0.007993238	-0.014627885	0.015969126	-0.025865903	0.01846926	-0.028095922	0.0027355286	-0.03531827	0.001646341	-0.011412492	-0.002269541	-0.020786619	0.016168308	-0.033566926	-0.0042327726	-0.006250152
-2.0168133	-8.350099	2.9143605	-10.3227825	3.1568313	-9.738103	2.5717661	-9.601189	2.88725	-9.554735	2.650386	-10.495723	-0.7852917	-9.67174	-1.2030524	-10.125473	-2.01803	-9.523314
-8.1840925	3.1182578	4.0704937	2.2380083	3.9050155	2.4266727	4.618743	3.999885	4.3385253	5.277527	4.6312027	2.5647228	5.2943945	2.564602	1.4979507	4.452963	2.0192885	-7.173191
-0.06632765	0.023641601	-9.949554	2.11513	2.7634752	3.0459185	3.4284825	2.5109606	4.453894	3.632814	4.79603	2.1770458	5.04264	3.1016715	-2.1641304	-1.5568728	-0.07103796	0.030050784
0.0039944095	-0.030403808	2.641399	3.6134927	-9.859247	4.701961	3.6470268	4.107502	-9.911984	6.3583617	2.3728724	7.047163	-9.912599	1.7538623	-0.42203033	-9.900012	-0.003053063	-0.045936257
-0.0590922	0.022490688	-9.704803	3.1094763	-0.043603573	0.029481713	-10.006834	4.004619	-0.07768375	0.027101886	-1.9827509	10.241071	-0.07379221	0.03569187	-14.742462	1.3082402	-0.06364542	0.023924261
0.0004788329	-0.01942107	2.1037917	-10.3348	-0.0007337052	-0.022207906	4.4829097	-10.631044	0.0020291149	-0.01698904	0.13274495	-3.1374896	0.009286648	-0.030248482	-0.16465043	-2.442325	0.003854509	-0.03153948
-0.054357927	0.012670659	-10.0164	2.9752195	-0.063464575	0.037127957	-9.730797	3.7748713	-0.065068714	0.013336755	-0.062341176	0.04144023	-0.07119131	0.004650673	-0.80745864	0.7674477	-0.06815539	0.009137617
-0.0030370736	-0.019479424	2.1109216	-10.277439	0.0120539	-0.03321053	2.5681124	-8.988909	0.00160044	-0.015229476	-0.002455290	-0.03310796	0.013763185	-0.022397675	0.8713919	-7.9315133	-0.0022076603	-0.020816963
-10.233196	-10.160836	-10.014976	1.8586497	-0.05720962	0.008724163	-9.385143	4.430864	-0.06774862	0.039602853	-1.1777376	-1.7108785	-0.059759885	0.022783788	-0.0682469	0.01423832	-0.057740346	0.013023078
1.6029623	1.4051529	1.9644783	-10.4644785	-0.0048765065	-0.008371123	2.8982196	-8.957143	-0.0003354174	-0.035886195	9.831242	-1.7259346	-0.028697653	-0.04463704	0.0026356487	-0.028408086	0.02517532	-0.026129326
-9.509659	-10.104373	1.8088738	1.9387943	-0.053325847	0.026143625	-9.236429	3.5023174	-0.06980836	0.017366393	-8.889756	1.2692119	-0.070058525	0.012173014	-0.0713103	0.0136189265	-0.0590126	0.022419097
2.4452548	0.8269102	4.7296762	-9.696225	0.010581535	-0.022876358	5.6571813	-12.20451	0.014551225	-0.03275665	5.749181	-10.977738	0.009840549	-0.024121545	-0.010633931	-0.027562024	-0.0006695331	-0.014738172
-9.821274	1.2050924	3.4119506	1.7666912	4.122348	-10.2074	5.1927123	2.3244905	5.468488	-9.657266	7.5262613	2.5377607	5.0136724	-8.335354	1.4127916	2.0510812	1.2680931	3.0545762
4.593892	4.6034822	4.965243	4.6869183	5.1064477	5.5559845	6.816075	5.3564305	8.032889	5.120642	7.709729	5.483601	5.3662933	1.6593664	-0.56338865	0.7921718	0.23214757	-6.212211
-9.793585	1.7849553	4.476185	5.168983	4.8655725	5.1980515	5.58688	6.049304	6.1438284	6.3288865	9.162333	6.045323	7.8055105	4.3555274	6.0026135	1.6967217	-1.9348252	3.269394
-9.131519	4.665441	-10.1077	4.4257565	-10.476021	7.1337237	-10.368723	8.340413	8.790084	6.88197	-8.7042	5.164897	-6.3589168	3.8849502	-9.888345	1.4195571	0.15262933	-2.9160347
-0.068018824	0.01756957	-0.060465507	0.009402863	-0.060289808	0.03403904	-0.07667239	0.007340882	-0.042981893	0.028060399	-0.07914039	0.004169786	-0.06381814	0.022446658	-0.069688804	0.038950097	-0.066699155	0.009350441
-0.0001105967	-0.02872936	0.003781094	-0.032398053	0.003845597	-0.02194445	-0.0050235493	-0.02402045	0.008092885	-0.044051215	-0.000348960	-0.023881158	0.015516412	-0.029172972	0.004829515	-0.031227846	0.01476474	-0.020681873

▼ B → S

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- 1차(epi: 3110)

-0.067145355	0.0013159383	-0.04249277	0.0283315	-0.073324755	0.009855116	-0.07774717	0.004845285	-0.04450801	0.019188592	-0.053355504	0.015707426	-0.05908335	-0.010310065	-0.081922516	-0.0068597617	-0.050410837	0.021733986
0.013073867	-0.024718344	0.010452434	-0.019484391	0.0101838475	-0.029118005	0.013489572	-0.025195684	0.006144338	-0.031490304	0.00793169	-0.009611273	-0.01557985	-0.013986781	0.01750318	-0.032786865	-0.0033635797	-0.012997915
-9.707219	-10.019879	1.8408318	-9.863552	2.5401719	-8.939289	4.257778	-9.5725565	2.6014986	-10.159049	4.014369	-9.042109	2.565882	-9.559353	7.123521	-8.515747	-4.3425035	-3.092342
-10.1168995	3.2006276	1.124315	3.5094528	2.61896	3.6827762	1.9736335	4.585099	1.786484	2.656769	3.226599	4.8336787	1.4456024	1.8755368	2.630315	3.649246	2.0234928	-11.703715
-0.061191354	0.010844897	-10.124046	2.2138207	1.6199985	2.4918928	4.5585823	2.4077084	6.2059584	4.1527205	2.6350327	1.9250569	5.8901577	3.5491161	2.962009	6.1595592	-0.06341265	0.008795563
0.0048251115	-0.03395949	2.2311885	2.9339643	-9.922102	4.3654633	2.085978	1.682296	-9.670134	6.3208437	1.4576218	5.4999275	-8.227027	0.6558896	2.3032327	-8.235916	-0.0025563203	-0.0383004
-0.06038379	0.010203	-10.427614	2.2695467	-0.037359376	0.025059491	-9.919612	1.8425658	-0.07862774	0.002053579	-10.772094	2.4269106	-0.072693706	0.014340453	-13.385192	0.11756828	-0.06515393	0.01293491
-0.000306439	-0.022590829	2.6141696	-8.768871	0.0038940045	-0.021813944	3.2810059	-8.874846	-0.006111811	-0.012853395	4.558492	-5.8620996	0.0012738574	-0.028483205	0.11115023	-6.4131837	-0.00021920045	-0.031610403
-10.876969	-9.80662	-10.869354	1.9168612	-0.0644901	0.019808635	-9.260835	1.9224793	-0.060214005	-0.009158933	-10.06533	3.8197744	-0.0648857	-0.004787679	-11.056434	-14.48108	-0.068983205	-0.007954113
-9.447622	1.720459	2.7775877	-8.833996	0.012691211	-0.03744666	3.1558754	-8.878068	-0.003772187	-0.012607952	5.1595516	-6.9759674	0.0029262537	-0.023863738	-9.126104	1.4914756	-0.010658232	-0.014711977
-11.724147	-11.900525	-9.931072	0.91470027	-0.0538961	-0.004562022	-8.775262	2.1455138	-0.06352796	0.031325497	-9.581589	2.3305418	-0.06413899	0.015307309	-0.07217413	-0.0036152885	-0.05652747	0.0011514081
-3.1089263	2.0003757	3.2514243	-8.513361	-0.012102815	-0.009382777	4.7035084	-10.750168	0.005922586	-0.035581313	2.3071828	-8.283501	-0.0124169765	-0.039081633	-0.0063396636	-0.018173143	0.022498727	-0.031484384
-10.803336	-9.609722	2.12714	2.4445622	-0.049309578	0.020711156	-10.527376	1.9830263	-0.0737029	0.009129369	-7.5920467	4.195645	-0.053182453	0.0011058771	-0.076711416	-0.0043902947	-0.047153458	0.012216374
2.993279	1.912552	3.5423815	-8.235673	0.0073595103	-0.020781433	4.83743	-10.640101	0.012741749	-0.03643811	5.801732	-8.92869	0.0070322366	-0.016692817	-0.012587539	-0.020148112	-0.006622213	-0.007725868
-9.347759	2.3628557	2.2498112	3.459956	2.5735044	-8.6007805	5.9213114	4.886048	4.7369266	-9.090173	7.151706	5.358407	5.626136	-8.353485	5.306319	8.89304	2.156004	3.9897
2.6102896	4.646602	4.5099773	2.8408916	4.4955006	4.8822093	7.269472	5.985084	7.4723434	4.658672	4.9968243	4.3830023	2.584188	0.60071045	4.2654033	0.011469684	2.0556414	-4.8040195
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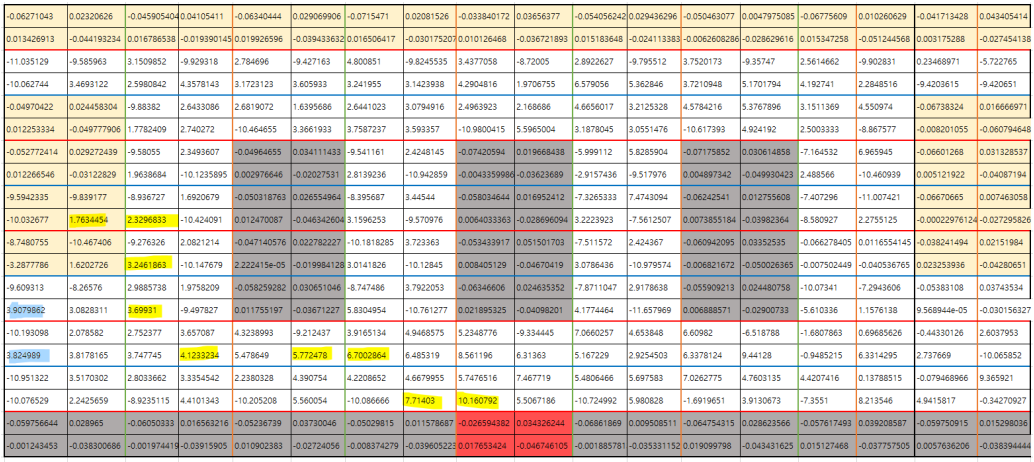
-9.676147	4.568549	-9.778479	3.9281719	-8.7026825	5.8065186	-10.04073	7.0763326	9.740368	3.5452802	-7.8727145	4.491772	-5.7175336	6.208668	-8.122521	5.4770856	4.192937	0.8724266
-0.061148826	0.006651989	-0.06471873	0.0011048592	-0.050432876	0.022227732	-0.066653095	-0.007751611	-0.026119174	0.023491567	-0.08397237	-0.007628816	-0.06897425	0.01304536	-0.06468637	0.019354222	-0.07614861	-0.007755255
-0.003217701	-0.0227459	-0.003156437	-0.0266114	0.0035401853	-0.02426795	-0.010680829	-0.022373943	0.013614558	-0.03561161	-0.005264829	-0.022144997	0.009976909	-0.02886115	0.008808813	-0.028466288	0.0032682437	-0.028162537

- 2차(epi: 2516)

-0.067355275	0.029275125	-0.04144161	0.051939663	-0.06701325	0.03375266	-0.0723265	0.024972867	-0.03750037	0.03947314	-0.04966079	0.03810429	-0.05009751	0.015096538	-0.07759634	0.013316661	-0.041524656	0.04662856
0.013606429	-0.034191165	0.01874772	-0.017943382	0.02029326	-0.034400903	0.012695542	-0.022892317	0.0136057995	-0.03548667	0.01841367	-0.02031899	-0.009354246	-0.025790717	0.021138417	-0.043824524	0.0117029715	-0.021689687
-9.485677	-9.383007	1.2183709	-9.830316	1.3509727	-9.849632	1.4302328	-10.388743	1.6618462	-9.080453	4.7070103	-7.5555696	2.2764935	-9.307412	1.9409999	-9.084552	-4.7444916	-4.23492
-11.262901	2.0829582	3.443713	2.18857	0.8185477	2.1947832	0.88123727	3.1108963	3.0730195	2.3129063	5.0086737	2.371677	1.6548747	3.7849808	2.977493	-0.76165	-5.8667154	-9.465437
-0.050289802	0.03262022	-10.630769	1.9698954	2.9169483	2.0585916	3.0318215	3.0782354	3.589078	3.6644318	3.4146302	3.4981763	6.1156545	5.606881	3.1490834	4.2449527	-0.06591304	0.026064835
0.012534963	-0.038344417	1.9715961	3.204251	-9.772935	4.0287285	3.974436	3.635547	-10.904962	4.5353155	3.5679488	3.609257	-9.029561	4.385863	2.8566892	-9.15007	0.0026582312	-0.060432017
-0.05158946	0.03508367	-10.489792	2.5378282	-0.049109943	0.032034937	-7.6138277	3.3088982	-0.08122919	0.019490957	-11.746913	2.5006766	-0.06704528	0.033280484	-13.499969	0.9525845	-0.0655423	0.04431206
0.013253806	-0.027036019	1.7164658	-10.10941	0.011599178	-0.018042559	1.779924	-10.7324505	-0.0027633356	-0.023987217	-0.6889765	-11.789264	0.008443104	-0.043658216	-0.7236057	-10.158574	0.009809858	-0.03653625
-9.988474	-9.988885	-9.428358	1.8612962	-0.05393811	0.04209536	-8.319944	2.1236305	-0.0621463	0.019618755	-9.141531	4.8243012	-0.064931735	0.016668536	-9.817238	-9.707238	-0.06551196	0.0129177505
-10.071546	1.8214761	2.259756	-10.190666	0.020271916	-0.041305907	2.229695	-10.394451	0.004589854	-0.02773072	4.6781287	-9.865774	0.005839218	4 -0.030915754	-9.783557	1.4316247	-0.004193627	-0.024847366
-10.515105	-11.111913	-9.687944	1.4496179	-0.049546707	0.032002807	-10.287655	2.096045	-0.059028853	0.059044912	-7.4472	1.2141337	-0.06349919	0.042488243	-0.0676814	0.01557623	-0.045311224	0.024701562
-3.6400359	1.169677	2.9030213	-10.045539	0.0016855047	-0.016778335	5.6817913	-9.668862	0.011477638	-0.040054005	3.945219	-10.839539	-0.006824406	-0.045911346	-0.008451355	-0.034972537	0.03181424	-0.035972577
-11.074211	-10.392061	3.2625246	2.7010615	-0.05914899	0.039108276	-9.388348	2.7019002	-0.0642466	0.030862225	-9.413859	1.9223804	-0.057397384	0.028471896	-10.480068	-7.340956	-0.0531214	0.035105355
3.9786596	2.568374	3.6884274	-9.673646	0.007764756	-0.029075166	4.8428993	-10.380243	0.02449995	-0.040063307	3.3889434	-11.456921	0.017188242	-0.021355463	-7.484888	0.78625536	-0.0053152903	-0.017114986
-10.63037	2.1022	3.3322082	3.0610993	3.8037374	-9.370302	3.2588286	3.9729514	6.2358074	-9.90157	5.478345	1.1513783	7.1330953	-6.3278637	0.086444974	1.3319161	-1.0609405	3.1281085
3.5621302	3.636897	3.2230153	3.7108264	4.3472514	5.5575097	7.6821313	7.1413155	8.294034	7.0243015	8.19374	2.8570104	3.5733435	6.7453327	-2.2385764	6.1934195	2.1596742	-10.525707
-8.813693	3.0143821	3.9222894	3.8442392	4.706462	3.3946698	4.8385344	5.174607	6.7162046	7.150632	8.030999	6.3469567	7.886398	4.9684	6.042229	1.9080805	1.6186117	7.6449513
-9.858616	3.3746085	-10.001311	4.61319	-9.974774	7.078984	-10.233499	6.1800165	9.933995	8.220861	-10.328662	6.4761415	-3.9091303	3.9565246	-6.6825094	6.515818	3.6785598	0.08276793
-0.057553504	0.037383385	-0.06690806	0.024906907	-0.04641452	0.05044265	-0.056261804	0.025846481	-0.03194728	0.040802296	-0.06849542	0.021019343	-0.06506047	0.03674673	-0.056594558	0.038910206	-0.06566476	0.016937423
-0.0028236806	-0.03666418	-0.00169329	-0.030521372	0.013611824	-0.027465416	-0.0028222804	-0.038245533	0.021189645	-0.047120754	0.0021100265	-0.037164904	0.012667385	-0.039054513	0.017549815	-0.02955032	0.01084517	-0.033330757

- 3차(epi: 2361)



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-0.052772414	0.029272439	-9.58055	2.3493607	-0.04964655	0.034111433	-9.541161	2.4248145	-0.07420594	0.019668438	-5.999112	5.8285904	-0.07175852	0.030614858	-7.164532	6.965945	-0.06601268	0.031328537
0.012266546	-0.03122829	1.9638684	-10.1235895	0.002976646	-0.02027531	2.8139236	-10.942859	-0.0043359986	-0.03623689	-2.9157436	-9.517976	0.004897342	-0.049930423	2.488566	-10.460939	0.005121922	-0.04087194
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-10.032677	1.7634454	2.3296833	-10.424091	0.012470087	-0.046342604	3.1596253	-9.570976	0.0064033363	-0.028696094	3.2223923	-7.5612507	0.007385518	4 -0.03982364	-8.580927	2.2755125	-0.0002297612	-0.027295826
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-3.2877786	1.6202726	3.2461863	-10.147679	2.222415e-05	-0.019984128	3.0141826	-10.12845	0.008405129	-0.04670419	3.0786436	-10.979574	-0.006821672	-0.050026365	-0.007502449	-0.040536765	0.023253936	-0.04280651
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3.9079862	3.0828311	3.69931	-9.497827	0.011755197	-0.03671227	5.8304954	-10.761277	0.021895325	-0.04098201	4.1774464	-11.657969	0.006888571	-0.02900733	-5.610336	1.1576138	9.568944e-05	-0.030156327
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3.824989	3.8178165	3.747745	4.1233234	5.478649	5.772478	6.7002864	6.485319	8.561196	6.31363	5.167229	2.9254503	6.3378124	9.44128	-0.9485215	6.3314295	2.737669	-10.065852
-10.951322	3.5170302	2.8033662	3.3354542	2.2380328	4.390754	4.2208652	4.6679955	5.7476516	7.467719	5.4806466	5.697583	7.0262775	4.7603135	4.4207416	0.13788515	-0.079468966	9.365921
-10.076529	2.2425659	-8.9235115	4.4101343	-10.205208	5.560054	-10.086666	7.71403	10.160792	5.5067186	-10.724992	5.980828	-1.6919651	3.9130673	-7.3551	8.213546	4.9415817	-0.34270927
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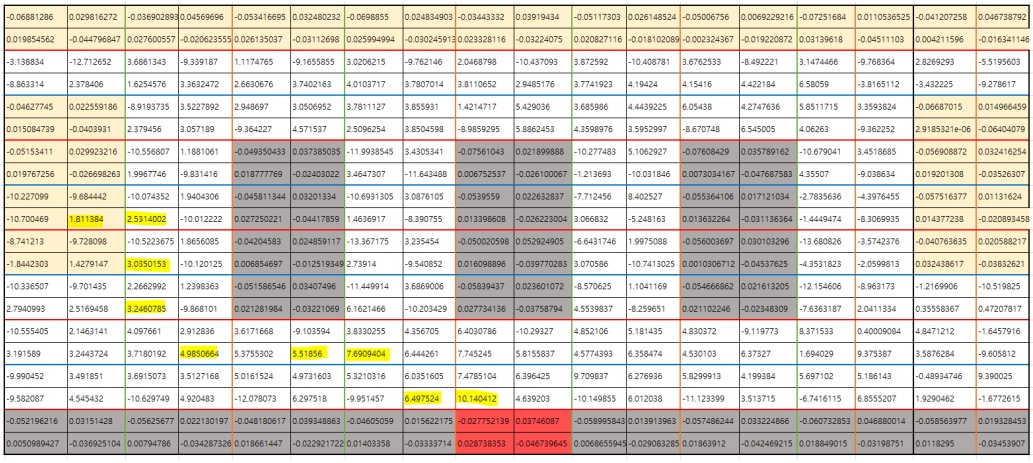
- 4차(epi: 2810)



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2.7940993	2.5169458	3.2460785	-9.868101	0.021281984	-0.03221069	6.1621466	-10.203429	0.027734136	-0.03758794	4.5539837	-8.259651	0.021102246	-0.02348309	-7.6363187	2.0411334	0.35558367	0.47207817
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3.191589	3.2443724	3.7180192	4.9850664	5.3755302	5.51856	7.6909404	6.444261	7.745245	5.8155837	4.5774393	6.358474	4.530103	6.37327	1.694029	9.375387	3.5876284	-9.605812
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- 5차(epi: 2867)

-0.06790286	0.03785191	-0.040031422	0.048719283	-0.065778434	0.03955899	-0.0711137	0.030676743	-0.043760687	0.04590879	-0.054858107	0.037305627	-0.051928148	0.018817274	-0.08165526	0.015671074	-0.046188306	0.05335393
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-10.772909	2.4749887	3.012685	2.7186263	3.416339	4.431846	2.8428125	3.9519475	3.5949988	3.819153	4.602401	3.2468069	3.1901138	3.9640539	3.1705146	0.6937312	-4.059919	-8.552922
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▼ 결론

기존에 학습했던 A → S로 가는 q-map이 2차 학습까지 남아있었으나 3차 학습에서 사라졌다.

▼ A

▼ S → A

▼ TEST

- 1차(epi: 2052)

0.05807693	-0.001800573	0.05062159	-0.005216345	0.02688203	0.011590421	0.046649568	0.007321138	0.048895117	-0.004683429	0.03220471	0.008266726	0.045371473	0.0040016766	0.054119583	-0.012343239	0.04944288	0.023826394
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-4.335371	-9.366942	-4.136647	0.5837093	0.040425584	0.0010306358	-6.6448927	-3.356661	-1.7077775	1.0842205	7.917059	-1.4348501	4.8330374	-10.061203	4.4572225	-8.120426	0.044470623	0.011462334
-1.1547534	-2.8219764	0.08136659	2.6367958	0.014670823	-0.038792413	-0.31758112	-2.465414	-1.1376712	1.109452	-1.3696288	-0.6818811	-0.37319344	-0.9564227	-1.3753155	-2.8963795	-0.018789722	-0.04529345
0.055794153	-0.005229513	-10.002027	-1.526043	3.8677783	0.041055664	-11.633376	1.6124252	3.6983917	-6.4774494	1.2810271	-2.8251703	1.2307805	3.0468028	-8.129963	1.5643526	0.038340293	0.00463592
-0.011946514	-0.02173438	0.2945191	0.11917636	-1.0299813	1.0159545	-0.94346356	6.131336	-0.7075354	5.6808167	-0.3448562	4.4552855	-10.368867	-1.4838614	-1.4421313	1.8778133	-0.00072655914	-0.026829377
0.045369085	-0.00288274	0.053421427	0.0044827475	0.028057283	0.012769553	-11.012691	3.6542625	0.041942727	0.0082472265	-6.863311	3.7718258	0.03607912	-0.009584432	-8.7526	1.0541797	0.034834884	0.005534431
0.0015913565	-0.018495785	0.002804597	-0.037083417	0.016179275	-0.02190382	2.935171	1.9180566	-0.002874531	-0.026147552	0.76109856	-3.463946	0.007781923	-0.026609883	4.949219	-8.737877	-0.0048239883	-0.02704375
0.03879848	0.019147174	1.405904	-1.0485235	0.03855523	0.006371443	-8.563506	0.26573128	0.04409509	0.0039343964	-5.244801	2.5605423	0.035402875	0.011294606	-7.5150094	0.19679135	0.06336076	0.007875506
0.0141997	-0.033033147	6.037094	-2.3348897	-0.007075087	-0.024026148	1.150068	-5.275425	-0.013032355	-0.021582335	-0.12761778	-8.894237	-0.00829375	-0.023631107	-1.3438882	-8.973109	-0.027031181	-0.029227167
0.021347392	-0.0017763075	9.930548	2.0256004	0.030494237	0.004526842	-8.7997465	2.111753	0.037503406	0.002068821	-9.672575	0.9539288	0.04526798	-0.0015471079	-9.667547	6.3300824	0.057702415	0.009417773
0.008634145	-0.016724158	0.5646818	-9.712404	0.006259796	-0.024496585	-0.38371933	-6.7706265	0.011664889	-0.012337618	0.7234888	-3.923676	-0.011172224	-0.016872678	3.5903258	-4.333091	0.001931627	-0.037466645
-8.606993	8.920186	8.899704	5.245031	0.0496143	0.017937424	-6.372694	0.90695935	0.033321604	0.005234294	-8.143991	-0.12433457	0.05624076	0.010100159	-9.862979	2.1884587	4.638806	-8.36465
6.3578677	6.6239014	-0.43672475	-11.284216	-0.008375078	-0.038081817	0.99048007	-8.872091	0.01720698	-0.028831055	0.11682275	-7.2756047	0.012386021	-0.03278055	1.2132627	2.3521953	4.128715	-9.827279
-11.426656	8.263478	5.092229	7.5497093	1.0196182	-9.650094	2.2517996	-0.25035644	1.3870549	-9.339776	1.092217	1.0107067	0.8935725	-9.254855	4.812119	4.3197656	2.029335	2.3042774
0.78558505	2.1950216	1.3080223	2.924825	0.8369875	0.68892795	0.47092202	0.84082884	0.6992683	0.4916435	0.95655805	4.468657	0.8143224	1.7058021	5.256752	3.085553	1.4137837	-10.010117
-10.089447	5.4231124	1.2936754	1.0131072	2.3127415	2.1088736	0.69976604	1.1874475	0.52588934	0.9214995	0.18583679	0.7157853	0.9734179	4.605439	0.50033945	1.7780033	4.870592	3.8633165
-10.750721	2.476605	-10.309705	2.4878356	-10.136413	0.33209294	-10.56317	0.5572728	-10.542552	0.85152245	-10.571666	1.2171423	-10.294524	5.186062	-10.157032	1.7404807	-8.209067	-9.302083
0.047136154	-0.002604878	0.053112607	0.0009177525	0.056316104	0.01043384	0.0611598	0.0026292705	-4.7274766	0.6249134	0.062796876	0.0047356687	0.06082682	0.0074325344	0.048341062	0.022668246	0.05056151	-0.0043662954
-0.007392925	-0.028497688	-0.006917572	-0.050098486	-0.012711301	-0.040175684	0.011468669	-0.033234436	-0.98263395	1.4321493	-0.008091897	-0.03169921	-0.012809563	-0.038979147	0.01993895	-0.027652914	-0.010780538	-0.030567735

- 2차(epi: 1910)

0.06379308	0.022178138	0.05369444	0.007530975	0.019862413	0.020210098	0.040109344	0.027288511	0.051466443	0.018132271	0.026570775	0.023326952	0.05328347	0.019884134	0.055358816	0.003181424	0.04422066	0.03955681
0.023822555	-0.03636901	0.01680815	-0.03407609	0.01413754	-0.021132657	0.004469129	-0.028588556	0.005156264	-0.02317098	0.024258258	-0.027557217	0.016774751	-0.027784338	0.012052182	-0.03578376	0.006918154	-0.03738551
0.7647658	-8.190341	-4.53151	-0.09347847	7.7084446	-1.4815981	0.7357108	-9.2413435	-0.004095971	-9.41095	4.764407	-4.2727337	3.5118132	-9.171776	0.88740814	-7.4659996	0.037730113	0.029652542
-3.123181	-2.8717523	0.000603059	0.5006592	0.03883711	0.630495 67	1.3518564	-0.94340336	-1.7342447	4.9031744	2.878956	3.1697855	1.095703	3.4765613	-3.1502259	-4.3277526	-0.014190055	-0.038835447
0.057986706	0.012143895	-7.488173	-0.21530153	-11.118295	2.9969096	-8.454578	-0.3301846	3.933153	-7.780406	6.8100553	4.077801	1.3080478	4.306853	2.4920163	-7.4354916	0.04749584	0.017430289
-0.010292246	-0.019200802	-0.5622826	-2.4290216	-1.4277139	-1.7640086	0.0745784	6.6929846	-1.4647645	6.792782	2.6493485	2.3310947	-10.501723	0.26657015	-0.27812225	2.59152	0.004504753	-0.029993076
0.042648435	0.0083054	-0.13987571	1.7941276	0.02420967	0.018530238	-11.752678	2.2463465	0.03611578	0.025779784	-10.294939	4.2884216	0.037818648	0.003730009	-10.075032	1.7312269	0.034036737	0.022199165
0.00914619	-0.017804915	1.5928882	1.0266697	0.014124257	-0.023639843	0.6813623	-7.769429	0.007153501	-0.021560494	1.6504784	-9.674064	0.008261199	-0.018232077	2.7222378	-7.0634623	0.004120809	-0.028677614
0.028895024	0.035319787	-1.2102686	-0.9787977	0.024591677	0.018474624	-8.071321	2.185347	0.051244915	0.025503598	-10.956727	4.3509793	0.0262065	0.023198156	-10.314547	4.7988634	0.054226417	0.02523909
0.022303062	-0.032101072	8.039096	-8.080356	-0.005102466	-0.01928453	-0.14604947	-9.680157	-0.012210699	-0.012903724	1.6252334	-10.13894	-0.004762075	-0.028834175	2.1166005	-10.684075	-0.010915135	-0.025309429
0.0296762	0.015779382	10.292144	6.3751464	0.031886853	0.012445372	-11.382231	1.586611	0.034511674	0.010561664	-8.881669	1.8755413	0.03829522	0.014598335	-9.591913	2.505116	0.04599251	0.01858279
0.014006755	-0.020516064	4.7084427	-9.271406	0.018806428	-0.024395365	2.0574863	-10.873271	0.011651376	-0.017310258	1.926851	-9.848059	0.003970362	-0.007472479	7.0965748	-10.833553	-0.001165327	-0.040248428
-10.848892	9.812132	8.515396	7.4552336	0.04517084	0.035552863	-9.925964	2.272933	0.038239047	0.023059951	-10.416389	1.6500854	0.045471717	0.021498501	-10.279328	3.1038933	4.118542	-9.686721
6.0111356	6.0288568	4.7274647	-10.75599	-0.002980087	-0.034265656	3.1763012	-11.044292	0.027373604	-0.03006065	2.2317476	-10.367218	0.02150819	-0.02504255	3.7430449	3.212499	3.179727	-10.109696
-10.696268	7.9966893	5.4213963	5.8042226	5.2154446	-9.793361	3.9499848	2.5756009	4.2998343	-10.254039	3.860977	1.8903111	2.1476355	-10.195044	3.3757129	3.758212	2.8929152	2.464464
4.6552052	4.6174836	4.1506467	4.163214	4.0464826	3.9431226	3.3644917	3.9432492	0.7797987	1.8933103	2.2617607	3.4261265	0.68026644	3.42373	2.9907262	3.429978	3.2396977	-10.182443
-8.442896	5.325746	4.1379066	5.0907655	3.7481868	3.7105272	4.3333344	4.1677227	3.5190759	4.0484247	1.118956	2.0688515	2.398788	3.1943133	2.0196586	3.0724533	1.9818999	3.784201
-10.170765	4.619869	-9.083588	4.613837	-8.955159	3.5662262	-10.486655	1.1804588	-9.635038	2.4990702	-10.306814	1.9958982	-9.405003	2.6925285	-8.726645	2.8319726	-8.870591	-9.645151
0.038660962	0.011705583	0.04972606	0.024259822	0.059867956	0.03303438	0.045956053	0.008849598	-2.5296602	0.84707355	0.055364013	0.024122495	0.048703577	0.03173826	0.035678122	0.03333883	0.04589428	0.015574404
0.010241713	-0.020236392	0.001596220	-0.045167327	-0.006405353	-0.030053442	0.018760493	-0.033104174	-1.4548674	0.87492424	-0.004093181	-0.022129543	0.002258588	-0.03226232	0.021404736	-0.022119574	0.000719378	-0.025082689

- 3차(epi: 1799)

0.06681673	0.012755056	0.062121082	0.002984517	0.024888521	0.015485785	0.050940726	0.023165755	0.053796407	0.001998292	0.033716753	0.016368385	0.058227547	0.010712918	0.060043436	0.000514071	0.0504481	0.032812763
0.027380422	-0.041261505	0.01216303	-0.044297706	0.014548341	-0.026440877	-0.003221563	-0.027537664	0.001670566	-0.03058601	0.013091767	-0.027650371	0.00823987	-0.035754874	0.006204686	-0.03379956	0.004354691	-0.040770415
0.104201406	-7.9665203	-3.3974977	0.40776518	6.5051017	-2.0058215	-1.5168465	-9.491218	2.6262677	-12.256218	-5.022647	-2.3572915	4.4768815	-9.878211	4.509928	-8.970654	0.04222226	0.027838683
-1.3966714	-3.5328488	0.4998763	-0.45551336	1.0456707	0.3496994	7.41328	-0.17858551	2.9889264	1.0644192	1.808566	9.8997555	-2.0839517	3.6255744	4.949201	-3.6008172	-0.018098088	-0.046043266
0.06659113	0.0071576126	-6.6688833	0.36396307	-8.682284	4.6349354	-9.603908	1.5074801	4.4162226	-7.6043634	3.838654	8.95468	0.259737	4.8309436	0.08591655	-8.028546	0.055602215	0.01720468
-0.019507617	-0.022383932	0.8246381	-1.9692281	-1.7250569	-0.24474598	2.525321	4.7198296	-7.332766	2.9384713	5.918946	4.438067	-7.7193317	1.7041457	8.255839	2.4239779	0.0030561336	-0.04148296
0.05250675	0.0029181596	-2.1453433	1.2824011	0.030613038	0.02173171	-10.558655	6.2377706	0.04688612	0.021124506	-9.40149	2.2998497	0.04005727	-7.4810B4e-05	-9.371737	1.6447449	0.046185147	0.014617429
0.0029064007	-0.024004329	2.391386	1.7183409	0.006939869	-0.029449286	3.0496037	-5.4682627	-0.005132515	-0.02825775	0.805146	-8.109552	0.010470642	-0.022993315	2.4183958	-4.9435315	-0.0030047896	-0.04166038
0.03491842	0.035747442	-0.33728257	-0.71356124	0.02581309	0.017547948	-7.8448462	2.388901	0.05281424	0.015028045	-8.577239	3.8078475	0.034566026	0.016282655	-9.060023	3.6307242	0.059537295	0.015703095
0.021452744	-0.032587174	7.9107623	-8.105491	-0.007810949	-0.017185729	2.4829657	-8.830618	-0.013874647	-0.016908517	3.6245928	-8.883614	-0.000764369	-0.035954066	2.026881	-9.935558	-0.022945005	-0.033474877
0.02649642	0.017114347	10.860162	5.1514974	0.036886904	0.009892051	-8.970822	2.9914951	0.03884921	0.011603263	-9.181766	2.6750238	0.04303404	0.008897692	-9.220728	4.5150294	0.052586854	0.011157004
0.0068734065	-0.029949963	5.231424	-9.014958	0.020630023	-0.025664857	2.2428668	-10.377183	0.012090864	-0.022472175	5.0304275	-7.369097	-0.009634056	-0.016529089	3.7358558	-9.656669	-0.0029617932	-0.04872125
-10.099092	9.952223	8.761504	8.356292	0.05267194	0.02689148	-9.511507	1.4287974	0.038365114	0.013830523	-9.778583	5.5982184	0.05334599	0.019903677	-10.437199	3.009588	3.268248	-10.41933
7.1027536	6.579717	6.933721	-9.155181	-0.005223765	-0.037924767	4.0225983	-9.427854	0.019510517	-0.037150696	3.6525793	-7.3688664	0.012443453	-0.031046322	1.6283419	1.9012542	1.8366393	-9.326732
-9.968554	7.81927	5.990097	6.1008043	5.9913216	-10.486716	5.550681	1.5417603	3.5982757	-9.8555155	2.7257	1.9334947	2.9969795	-9.92295	2.4098206	2.8792799	2.8298628	1.9176457
6.612117	5.968445	5.5598097	4.9331317	2.3826706	2.998135	2.4346616	2.1287782	2.4694955	2.3298948	1.7504749	2.6027415	1.6319828	2.0850184	2.0029151	1.4334608	2.1038263	-10.110577
-10.385299	6.790937	4.122623	6.058745	4.6578717	5.5321164	2.6092646	3.7439494	1.8965284	2.8681176	1.8604198	2.8813636	0.5307862	3.0857363	1.8838211	2.5254266	2.4100416	3.2078254
-8.923651	4.224845	-10.177114	3.128723	-9.961663	2.806976	-9.836481	2.84122	-10.238627	2.0425158	-9.9878025	2.3904347	-11.48162	1.9950655	-9.830384	1.808971	-8.795505	-9.078863
0.050486308	0.009221159	0.045460533	0.016762987	0.058954384	0.030912966	0.05987681	0.011129383	-2.4464133	2.5679111	0.053892232	0.016358115	0.055115405	0.024273388	0.035381775	0.031787567	0.052542537	0.014501573
0.008537775	-0.029392723	-0.001165601	-0.046087008	-0.005152739	-0.040104587	0.012556102	-0.042309597	-1.3826565	1.1536578	-0.010534061	-0.03107303	-0.004694034	-0.038008854	0.018049445	-0.023461454	-0.004829723	-0.034136117

- 4차(epi: 1584)

0.06977816	0.030660715	0.062574886	0.011674306	0.036276795	0.031213049	0.059625417	0.03747861	0.06251657	0.018643921	0.04152119	0.022426702	0.055396486	0.015564592	0.054283984	0.007780248	0.0625714	0.04466111
0.044404667	-0.044944823	0.021516904	-0.04693618	0.021541623	-0.036373578	0.011375237	-0.031896155	0.01950037	-0.028056255	0.026769493	-0.023862796	0.024778882	-0.034188356	0.016420446	-0.037264336	0.021626087	-0.04969132
-1.6967356	-6.8352866	-2.8616226	1.0789297	1.1040525	2.1372676	-2.60061	-9.600109	3.179599	-10.070055	0.7460902	-9.614175	5.1144586	-9.188055	5.0130405	-10.5864315	0.048559476	0.036618732
-2.7765656	-2.673783	0.4794964	-1.0227416	-0.3738147	-1.935685	3.2406232	-0.36904377	-0.14075097	0.7942033	2.127502	0.17023706	-2.1346445	3.6743453	-1.3778346	-3.2613392	-0.006077414	-0.040368084
0.07414662	0.011317395	-10.338554	-1.1034206	-5.8830147	-1.4825919	-2.0525653	1.366692	0.41803938	-2.2320237	2.8069038	3.5800133	-2.3432388	6.8258204	-3.869607	-2.2239258	0.062418316	0.023311054
-0.007789201	-0.024388682	3.3496297	1.125101	-10.77786	3.4752862	2.3801618	2.8950386	-12.339336	2.2307036	1.1440983	5.2252564	-3.2754064	-0.26441392	3.5301394	-7.7857256	0.014572988	-0.04401135
0.06286487	0.010606125	-6.9833446	4.66547	0.040806204	0.030856283	-10.57746	6.6139207	0.060835708	0.023881909	-11.873764	6.711895	0.04590283	0.012547175	-9.565312	7.0430155	0.053154774	0.025644394
0.019596195	-0.02624098	7.045439	-9.42431	0.016246028	-0.040126607	5.313531	-5.9654846	0.015313181	-0.020134661	3.850506	-8.46805	0.014261395	-0.017740816	4.67462	-4.2867346	0.0074624564	-0.04548006
0.03503432	0.041034438	-9.939116	5.1207967	0.028678112	0.01675644	-11.684484	5.346647	0.059418812	0.024632858	-9.705851	4.9536633	0.050248124	0.022155495	-9.673991	4.824704	0.06982375	0.032209765
0.024469817	-0.035116263	8.336433	-9.14777	0.001686482	-0.023286223	3.1029215	-7.8325615	-0.001259136	-0.019366333	2.9467092	-9.517128	0.003965324	-0.035032306	3.486691	-10.291938	-0.005326269	-0.036449004
0.03588989	0.025664115	10.726652	5.025652	0.04257082	0.01761319	-11.457409	4.4644027	0.04888614	0.01385277	-9.384738	5.314813	0.056715444	0.015140021	-10.273562	3.0582802	0.052925956	0.014284444
0.005956611	-0.037142865	7.836221	-10.147009	0.031557195	-0.026755407	1.6933717	-9.939347	0.021611152	-0.025291	2.335088	-10.688074	0.001381692	-0.019417994	4.7214026	-9.640401	0.011133672	-0.048669312
-9.96703	10.298266	9.031208	7.264477	0.05948212	0.03435701	-9.765287	3.0812237	0.038137905	0.026574695	-8.848273	3.4609158	0.051145796	0.025443595	-11.359705	4.3238072	3.3165977	-10.532277
7.5172863	8.204992	4.7479463	-10.280651	0.004093257	-0.047488082	2.7728493	-9.892905	0.036044735	-0.045116313	2.3176715	-11.053551	0.028453369	-0.042230383	4.129132	2.2464728	1.9860889	-9.752467
-10.994109	7.4893684	8.515732	7.808305	4.7882347	-10.544446	4.355516	2.017981	3.180786	-9.865302	2.1929786	2.2375271	3.0737422	-10.114139	2.2926564	3.4626079	3.2051463	1.2217293
4.6158323	5.021265	5.6835904	3.198141	3.2618203	4.592348	3.1499133	2.5730653	2.4033513	3.0518653	2.0160613	4.2486267	1.3710864	2.988109	2.1398017	2.0933442	1.8302568	-8.337445
-10.437756	7.9275055	5.2579837	6.187679	5.936708	4.993565	3.6497867	3.6899967	3.2990282	2.9738975	2.6660678	3.612717	1.9273659	3.1562686	2.7948747	4.6413727	1.584768	1.7870431
-10.072378	4.9087873	-10.336459	3.5844	-9.516795	3.2479475	-10.327552	2.4525642	-9.9929905	1.6871806	-9.905446	2.1031144	-10.254535	1.8953518	-10.696976	2.8404608	-10.02361	-10.745418
0.056313	0.014711358	0.05300339	0.028317539	0.06443975	0.026636016	0.06643429	0.008277997	-2.9259367	2.6542022	0.059033293	0.015964972	0.06934415	0.03992307	0.04231999	0.027885718	0.06475384	0.020753374
0.028921835	-0.032800335	0.0138803	-0.052968644	0.010976244	-0.03937971	0.0216136	-0.037612656	-3.546038	1.0117699	-0.005075529	-0.029767968	-0.001145844	-0.048500963	0.025228998	-0.03181015	0.011273191	-0.03987812

- 5차(epi: 1545)

0.060206752	0.0268343	0.055275463	0.013243012	0.032098502	0.028590264	0.051060658	0.032707714	0.054069284	0.023575863	0.0367678	0.027919104	0.04953826	0.024510926	0.0524597	0.010598019	0.056315873	0.051819652
0.043272916	-0.05154128	0.031655665	-0.0619729	0.017880658	-0.0395895	0.014614328	-0.033739578	0.021442799	-0.034723125	0.026971836	-0.03176889	0.020387668	-0.046640255	0.023756322	-0.04417046	0.0181625	-0.05767264
-0.62893397	-8.998188	-3.2285159	0.5888045	0.7302191	1.8175046	-2.2074206	-11.085667	2.0597048	-10.781615	3.869861	-10.16906	6.2271814	-10.021708	4.4564686	-9.610356	0.040423717	0.039154142
-2.7467442	-4.2119174	1.2409775	-2.0188196	-1.4742252	-0.19176842	3.6943195	0.39818764	0.4175115	1.2305634	2.278385	7.0839977	3.3963027	6.374749	-0.5789584	-3.8766882	-0.0034835767	-0.05018641
0.07092796	0.01732306	-9.561186	-1.4823624	-2.728796	-3.0041785	-0.40164715	1.3041823	1.3399005	-1.6152896	2.7372987	5.477613	-0.1116586	5.893708	-3.164432	-2.626455	0.057730503	0.025342194
0.00075341976	-0.024459891	4.7380795	-1.9854026	-7.7153544	5.3460445	3.0391407	2.524494	-11.031563	3.689273	-0.2228387	5.438777	-6.091981	1.7609857	1.6152787	-6.9632926	0.026904348	-0.046998348
0.054273512	0.013461816	-7.758932	3.914202	0.037512567	0.02809351	-9.517826	2.667967	0.052026812	0.03186644	-9.696738	4.5797763	0.03766099	0.010723915	-9.121812	3.0416133	0.04736277	0.026226385
0.023275465	-0.029231712	2.1825516	-8.283031	0.021559887	-0.04864756	2.9515321	-8.73068	0.028904447	-0.025860166	0.72348684	-9.663909	0.020445745	-0.02454542	4.341187	-10.089824	0.017129755	-0.048863914
0.028663497	0.04532683	-8.970776	7.5762205	0.024088494	0.019785102	-10.331119	4.7764144	0.057443853	0.029303394	-9.644568	3.5731156	0.04315506	0.02915304	-9.861166	5.4350863	0.05936689	0.029569536
0.030389579	-0.04016606	5.1127405	-9.829288	0.0026598014	-0.024652872	3.2295413	-11.104728	-0.0059421244	-0.02307009	0.42107582	-10.567351	0.009969872	-0.03913156	3.9650397	-13.008251	0.0001107309	-0.037348203
0.03101116	0.023489423	10.528685	7.3399215	0.037628934	0.017760644	-10.110269	3.7115493	0.041795827	0.016766686	-9.50932	3.5847564	0.0510684	0.015126874	-10.188595	2.1601522	0.049137015	0.019660488
0.023962662	-0.045172736	5.2354593	-10.181169	0.038726963	-0.030731287	1.7480876	-11.038988	0.0220698	-0.029413853	3.3384748	-11.039386	0.010333685	-0.01860107	3.0122278	-12.492653	0.015399586	-0.052979328
-9.977927	9.909822	8.836204	8.134008	0.051360793	0.03449463	-9.717918	2.6746933	0.02942185	0.030116191	-9.116493	2.431893	0.050686587	0.032000218	-10.077886	2.6443744	2.4755535	-9.761193
6.6170034	7.4935527	5.3652816	-10.16577	0.010664391	-0.047685787	4.160164	-11.042408	0.039967105	-0.052810315	2.3565562	-11.322181	0.030887399	-0.04040529	1.987173	1.9511894	1.8375854	-10.63686
-10.767756	7.6643424	6.182422	6.649813	5.9434047	-9.640755	4.839915	2.6354723	4.2343683	-10.059208	2.1695776	2.561964	2.969325	-9.966549	2.8581622	2.9828446	2.7462888	2.4417598
5.6868277	4.6277213	5.082881	5.386735	3.5274901	4.4341025	3.0632467	2.3383605	2.1357822	2.6981966	2.6617134	3.2180269	3.0229263	2.90081	2.6680658	2.7998588	1.4569104	-10.188418
-10.585293	6.128895	4.622871	5.813289	4.532522	5.169426	4.1246133	4.4943957	3.349158	2.2925484	2.730016	2.5064793	1.8872044	2.8621497	2.3149352	2.2885067	2.4950583	2.8652282
-7.4858828	5.344444	-9.708648	4.298706	-9.827778	3.5121772	-10.175616	3.3324733	-9.7648115	2.2005997	-9.842568	2.3671153	-9.762017	2.6180708	-10.498829	2.270226	-10.258764	-10.125353
0.050867036	0.019318918	0.052461497	0.032314442	0.055649143	0.03290486	0.05566383	0.011942642	-0.3305076	2.9590156	0.052138265	0.019257076	0.06021689	0.039088745	0.035611235	0.03395601	0.05781887	0.015876193
0.034042448	-0.03672804	0.010869643	-0.055789422	0.010218511	-0.047999527	0.025561292	-0.039877206	-0.54157513	0.29824036	0.002792982	-0.03164134	0.012039572	-0.048028085	0.027430195	-0.030940956	0.011974665	-0.039920226

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- 1차(epi: 2266)

0.04869273	0.009952449	0.01725781	0.012542509	0.047592923	0.003825916	0.04867084	0.005995813	0.030874748	0.02032033	0.05955816	0.006531735	0.04312256	0.0018934263	0.030666322	0.0039136	0.04608436	0.01108173
-0.047464535	0.01022275	-0.046321172	0.023344392	-0.057579484	0.018741908	-0.050269883	0.018179473	-0.061533596	0.008135757	-0.06526609	0.006624925	-0.056282725	0.013858161	-0.03658337	0.039816372	-0.057069503	0.018997986
-13.324098	5.0564675	-0.1340684	-7.611067	0.7850867	-2.4857175	10.066172	-9.953394	-0.72437346	-9.117987	-10.028023	2.135856	0.05730467	0.009898153	0.041764	0.020452466	0.056752536	0.012589931
1.7395701	-3.5060804	-0.88477606	9.24562	3.2841406	-0.8886667	2.862933	1.5938673	3.2527003	1.6944362	2.658815	-2.5556889	-0.062632404	0.013257701	-0.059960518	0.019366346	-0.06758071	0.01922012
0.040214602	0.023363559	2.5672839	-0.5498028	6.1460667	3.8292372	2.7038436	-0.7658727	1.8544033	3.8248012	-5.818157	-5.8165307	8.532315	-2.1048415	0.0509275	0.019435273	0.03845615	-0.002614061
-0.058758445	0.020308688	8.096816	3.1923866	-11.412252	0.79716647	4.1501226	-2.126457	-2.2692182	-1.875	1.1531763	5.7036743	-1.5254099	1.0698947	-0.08164396	0.0033005737	-0.06203004	0.019550806
0.037442178	0.020206334	-4.1387706	6.1175685	0.043953158	0.002044582	-11.287325	3.8333347	0.040504903	0.030154327	-8.9818325	1.5884607	0.054653693	0.022678873	-7.716486	-0.6302909	0.057412826	0.013520828
-0.052491836	0.018219186	7.1075554	-9.076434	-0.04368692	0.021347012	4.028994	-9.190841	-0.06073125	0.010725343	4.375201	-8.146464	-0.05939676	0.024887834	2.8137183	-8.1452875	-0.04865577	0.010467785
0.036329996	0.007610116	10.969888	4.3667545	0.055667736	0.022912975	-11.670812	4.0819016	0.037650265	0.016783616	-11.541988	2.0470116	0.03493958	0.012753421	-12.010683	1.613806	0.035779044	0.022021655
-0.03982012	0.015230031	1.5986571	-7.7108035	-0.071089655	0.014557076	2.3926528	-8.617614	-0.052929904	0.010584112	2.051121	-8.094532	-0.047764014	0.019441627	3.2824173	-10.110313	-0.05005974	0.0016253225
0.043356493	0.017349688	-11.953223	8.686074	0.055897973	0.000263902	-11.595064	2.7126124	0.052568797	0.010743339	-11.084795	3.4936867	0.04702917	0.019469405	-11.41552	4.214045	0.065826006	0.0006216223
-0.062985756	0.01901705	3.4414778	-8.402846	-0.055926275	0.018126093	1.9722725	-9.614563	-0.061579384	0.026310092	1.6317159	-8.256877	-0.05608565	0.018498836	4.1740594	-10.193144	-0.046377026	0.017550275
-9.876808	-6.1008873	0.37610015	6.6176972	0.04967271	0.00856615	-10.979967	3.1068819	0.03523338	0.011389592	-10.49825	2.115544	0.05032995	-0.0002406322	-9.568211	4.5666246	4.2847857	-9.020966
3.264293	5.6008925	1.2133007	-9.963998	-0.05161617	0.009702741	2.3445458	-8.699244	-0.05531929	0.015570795	3.953917	-7.422961	-0.058551323	0.011003016	3.444748	2.0011737	3.287249	-6.8707643
-9.895252	5.006382	3.382896	4.804435	4.3267736	-10.343145	1.912428	-0.31601474	0.99698156	-9.516381	0.43149525	0.25785297	3.1071944	-11.048906	2.2286558	4.7707376	3.4128716	4.45653114
1.4971067	1.3107178	0.55168056	0.16067657	1.7886264	2.2014027	-0.32324272	0.73959184	2.5814836	3.070748	0.10968947	3.5954742	3.7669203	3.7174351	2.5416117	3.0015113	3.1429224	-10.417769
-8.056536	3.1810524	1.6215174	1.8159769	2.6272082	1.4168245	1.488295	1.4504359	1.5622914	1.3559278	3.9654384	3.0009398	1.2227981	3.1996303	2.569121	2.9311335	3.1060567	1.6494591
-8.231268	2.2924104	-9.526307	-0.13948908	-9.21161	-1.5086948	-8.949321	-0.555621	-9.36437	0.4042376	-9.874467	-1.1808878	-10.470988	1.8115284	-9.970459	2.5808344	-8.503641	-9.9096
0.056193195	0.02122609	0.03544183	0.0020071417	0.023257945	0.0167013	0.05157565	-0.000293575	1.9182942	2.394734	0.04426152	0.009675853	0.031632688	0.010841086	0.02699961	0.011688762	0.06335244	0.0019713424
-0.050804175	0.014141195	-0.049613763	0.02488719	-0.06771604	0.021804463	-0.061969515	0.012319122	-1.0385419	0.70841366	-0.047602996	0.025106275	-0.05379416	0.022009442	-0.041689947	0.039456334	-0.060319304	0.017688526

- 2차(epi: 3219)

0.04437171	-0.0018303213	0.019757781	-0.003135829	0.037531666	-0.005982453	0.03799198	0.005070396	0.02216307	0.010986245	0.049677543	0.00437802	0.036443163	-0.006889511	0.027521357	-0.013056674	0.037867483	0.0024526883
-0.035252847	0.00015086343	-0.031848386	0.010351863	-0.049283333	0.009184602	-0.034001973	0.005420125	-0.044240847	0.0040673274	-0.052667335	0.0017029181	-0.048696287	0.011679172	-0.025958873	0.029540299	-0.044724703	0.0076214196
-8.0965185	5.832242	-2.6312556	-0.13869765	3.0720856	-9.301395	2.3802655	-11.1525	-0.42541587	-6.729903	-0.85543495	-7.7888455	2.423482	-5.441859	11.194752	-1.5390605	0.038820617	0.0023308364
0.39612675	-3.752449	5.973244	-2.8981392	3.9101806	1.5345412	3.4642322	2.619021	4.625461	0.078625396	3.9725072	1.5448433	3.7114418	1.4399956	-0.8913816	4.429247	-0.053469684	0.018722614
0.029847901	0.00747503	0.039685577	4.1786256	3.5079312	3.3410044	3.2862878	0.25654498	2.706567	0.21400447	2.0810168	5.540468	3.5849812	-0.20582913	3.074822	-0.56754357	0.039907902	-0.0058385767
-0.039995648	0.018444298	4.801531	3.1488204	-10.116466	4.3072762	5.696241	2.8720465	-13.261586	5.129509	2.941667	2.6291916	-8.690706	4.790168	-4.101946	1.5608311	-0.04748982	0.019459441
0.029189868	0.01141506	-6.7001991	5.9383345	0.027325356	-0.002213389	-10.188015	5.332421	0.03168783	0.016485771	-10.322522	4.6712294	0.034616254	0.010387289	-10.683359	3.2450593	0.045513842	0.0042312425
-0.024695186	0.017541546	12.387398	-9.024102	-0.033912014	0.0004950664	2.785358	-9.371038	-0.038642757	0.012557351	2.5955875	-9.804905	-0.03701742	0.019897584	2.7911642	-9.884255	-0.028663797	0.0071614045
0.035206854	-0.008470513	10.191939	2.8043025	0.048196346	0.016911337	-9.280503	3.1000352	0.023798348	-0.006214555	-9.807406	3.9614894	0.02419919	-0.007687599	-10.258886	3.5088122	0.032473654	0.014662413
-0.029417941	0.004498081	4.915749	-7.4159346	-0.05193871	0.012609429	2.344902	-10.001775	-0.033694487	-0.002713407	0.35215014	-8.697837	-0.039998062	0.014354246	1.8558173	-10.307389	-0.031026643	0.001754069
-4.7491446	-4.1630425	-8.1195545	8.220544	0.04545729	-0.004420078	-10.577604	2.8940737	0.041049138	0.001504268	-11.149206	2.5852394	0.048114266	0.011783486	-10.028619	3.8762932	0.048499797	-0.0030837874
2.33593	2.4324076	7.082212	-10.044685	-0.04782883	0.014643983	3.022936	-9.227991	-0.046535037	0.019588927	2.6135437	-8.352242	-0.037248176	0.019275708	2.237285	-8.177003	-0.026479816	0.010567792
-7.000362	-5.426469	2.4855123	5.457123	0.0432814	0.00420661	-9.668162	3.2441502	0.029296463	0.01037447	-10.310131	2.9428627	0.033190925	-0.009041859	-9.058661	2.9335868	-0.15624823	-6.61718
3.747218	3.5426605	2.3653219	-7.4010844	-0.03165676	0.003047381	3.5484684	-8.793016	-0.037908457	0.012483531	1.9956118	-6.907795	-0.057545993	0.017081905	1.7902352	3.9905286	3.011354	-6.571586
-8.193576	2.604874	3.3610835	4.511536	3.1986058	-9.193108	2.6516542	3.5035994	2.0601861	-8.882807	2.8235655	1.9527442	2.03073	-10.376262	2.1345527	1.7210132	1.9452741	2.4802911
3.814348	3.1424627	3.2483253	4.0302844	3.9053698	1.8108579	2.3620856	2.7275677	2.038585	1.9991231	1.7664063	2.0978923	2.3068862	1.618876	2.47584	2.727838	1.9459484	-9.090627
-8.65086	3.9815974	3.6218026	3.8193316	3.244007	2.6621597	3.1837537	2.3326468	2.5096614	2.3669872	2.4161577	1.8438792	2.1190228	1.5117128	1.2954654	2.4276206	-0.42426997	4.5922093
-9.716002	4.7062593	-10.969218	2.9009905	-11.535874	2.9937782	-10.1361265	2.3769553	-10.155841	1.9812156	-9.9880085	2.3459864	-10.443931	2.9596176	-10.791019	1.9678271	-8.41193	-6.9190187
0.04107207	-0.0016499624	0.03570972	-0.005222183	0.023492828	0.01237763	0.039808974	-0.008090192	0.5763113	1.947866	0.035460606	-0.004069400	0.030609472	-0.006288518	0.023159143	0.0013017554	0.04804248	-0.0042518307
-0.033333246	0.011800152	-0.032262795	0.019358298	-0.048087522	0.01761869	-0.05228908	0.017337525	0.13684079	0.52023476	-0.036383767	0.015098851	-0.038164254	0.013798288	-0.027978444	0.025168762	-0.045195047	0.011244693

- 3차(epi: 1591)

0.055347424	0.012214558	0.026235765	0.008113872	0.045979414	0.009687181	0.053648327	0.0229257	0.038845003	0.030163394	0.062427226	0.027552817	0.04926843	0.01081209	0.030489385	-0.003097180	0.05505794	0.026583917
-0.045075852	-0.009871379	-0.036249813	0.003977307	-0.052247934	0.005319701	-0.04458838	-0.003452562	-0.051983643	-0.002629216	-0.055076197	-0.008823629	-0.051723104	0.007259819	-0.03275993	0.024075795	-0.052957807	-0.0009010352
-8.102569	2.656311	3.0929174	-1.9274871	1.4732525	-9.964881	5.2676306	-10.563943	0.9978585	-6.7285314	-1.5550219	-10.733928	5.7500315	-2.9879239	11.613978	-0.028098673	0.06003406	0.030467136
-1.7820721	-3.216987	3.8349915	3.6720407	4.6680818	3.500421	2.7531645	4.1216955	4.57356	1.4947137	6.1519246	3.111448	2.1467705	-0.3350556	0.7526517	3.579843	-0.06507557	0.0021153407
0.043241214	0.026913064	-9.951225	4.516669	3.0471609	4.625547	6.6537585	2.583159	9.12746	1.8439649	-2.943704	1.0990982	6.152043	0.42516628	5.181932	0.23404142	0.05498338	0.0077263257
-0.04619466	0.0102379685	6.0136886	4.480509	-10.806598	4.473068	2.6030989	0.83502483	-10.638635	4.301866	3.082509	3.9382322	-7.047617	3.0728128	-2.9585075	1.2107588	-0.04994065	0.012641434
0.050004866	0.030560466	-10.335381	3.9370549	0.041918147	0.010931102	-11.217704	3.537211	0.044909745	0.03937504	-10.583489	3.6565275	0.05356228	0.032640997	-11.115492	1.2532928	0.06140631	0.027190138
-0.03457117	0.010099804	8.000621	-9.936562	-0.040006183	-0.007775070	1.7720106	-8.747596	-0.047736317	-0.002570754	0.6916049	-7.9972405	-0.04334647	0.011922735	2.4627576	-8.943835	-0.033603728	-0.0029293841
0.0444384	0.00907168	9.94139	5.929263	0.06307045	0.03766805	-8.6969	2.367397	0.032691617	0.012448581	-10.460284	2.3363137	0.032119624	0.008281881	-9.965116	2.4092696	0.04425157	0.030975368
-0.029101875	0.0008385269	6.0376205	-9.911062	-0.056621227	0.001530999	1.3247149	-9.667517	-0.04388748	-0.00822123	0.47004414	-7.3591447	-0.04241803	0.010282063	1.1415997	-9.000814	-0.04032151	-0.008452788
-10.017501	-9.919521	-10.08891	7.784383	0.05858616	0.012566718	-9.947902	2.4194183	0.055747014	0.021429766	-11.441741	1.120669	0.058190424	0.028160147	-11.106105	2.712299	0.06506369	0.01641438
3.5034978	6.0117235	4.2779856	-10.016391	-0.04749942	0.010417112	1.8241613	-8.824918	-0.051366523	0.011437613	5 1.3326575	-7.672369	-0.04583326	0.007328012	5 1.2553345	-7.5987883	-0.036397982	0.004015446
-10.03265	-9.99819	3.7767577	5.9559903	0.057457656	0.02037944	-11.53118	1.746849	0.042806756	0.025170062	-10.875563	1.997218	0.05170984	0.020223541	-11.656417	0.5011524	0.46582758	-7.696648
2.2664921	4.4063954	3.7133398	-9.999535	-0.037073534	0.002206591	4 2.7183545	-7.4760637	-0.044783875	0.009992323	0.8225595	-6.591906	-0.06252017	0.004565121	2.2465045	4.910615	3.0405364	-5.3580136
-10.130841	3.4317005	2.4532459	4.2491765	3.5758722	-9.851439	1.1470999	2.524938	2.6700115	-8.08503	4.0647154	2.718441	3.0434132	-10.361853	1.1942563	0.7097518	2.8475947	3.0457034
3.120525	3.5017257	3.0272248	2.6093109	2.548187	3.5593681	2.8600311	5.3359027	2.1340983	-0.27503455	1.9721977	1.4339421	3.006629	1.5212392	3.1198149	2.2301762	1.5259546	-9.377682
-9.839093	2.3870995	3.0277154	5.4182086	3.1624825	3.257845	4.7144775	4.058549	4.402637	4.17011	4.143958	3.425017	4.328212	4.0532312	2.669433	3.4489627	3.187444	5.8040376
-10.255093	2.9927292	-9.651034	2.8260152	-10.18548	2.500862	-9.947511	1.6520363	-10.109638	1.1353539	-9.623959	1.1760492	-10.267695	1.6799171	-10.332098	0.81843305	-10.288108	-7.7298017
0.058144026	0.020947687	0.04105382	0.010509063	0.034768768	0.025903972	0.059460368	0.011050153	1.1243695	2.6474118	0.042492766	0.013794111	0.038011402	0.015327781	0.031551406	0.015216402	0.06901621	0.012703758
-0.040436603	-0.0022427803	-0.03742627	0.01303852	-0.05926701	0.009232168	-0.0559017	0.011833627	0.058538307	-0.1439814	-0.041996513	0.010013379	-0.048579972	0.0055315765	-0.033265457	0.021160722	-0.052748684	-0.0040066144

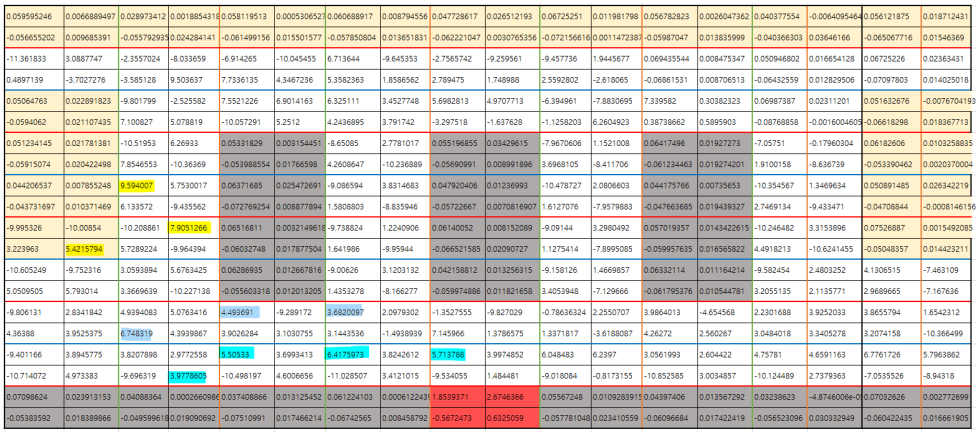
- 4차(epi: 2210)

0.04480867	-0.008925953	0.021385917	-0.011950123	0.03834425	-0.001658697	0.03878954	-0.001690422	0.025054557	0.003811954	3 0.049694743	0.005208125	0.031159481	-0.015717177	0.028136753	-0.020406818	0.0368486	0.0002489075
-0.029205665	0.008894319	-0.022890786	0.004904099	-0.047177646	0.009080311	-0.027545284	0.008374582	-0.04395885	-0.002405962	-0.051036365	0.005856896	-0.041253112	0.0057554	-0.018256573	0.024269458	-0.045440767	0.010089696
-7.276922	2.0869598	2.6510537	-0.6706251	2.657617	-9.247297	3.7155988	-8.218204	1.3209071	-4.801495	-1.4244287	-7.318881	4.67165	-4.0439343	2.1998814	-2.4184384	0.0438982	0.006672692
-0.28666353	-4.6186557	4.181685	2.741311	3.8020015	4.220487	1.420111	5.1919475	3.9899714	2.4321203	5.77027	-0.12259418	1.5122513	3.3514183	-0.3060173	1.1021523	-0.05071142	0.009096326
0.03030655	0.0044999113	-3.5427847	4.975165	2.5674489	3.7501752	3.4649613	1.1623795	3.8046708	1.9531322	1.6117282	2.826674	2.73711	0.9631021	-7.3080173	-0.847014	0.047518864	-0.016311424
-0.036050163	0.0156073645	8.718769	1.2519844	-11.516687	1.676708	4.295425	3.1959465	-11.567732	-0.2585686	1.9643067	5.9323235	-9.43164	0.5064287	2.9574215	-8.822138	-0.041277397	0.021242363
0.030809011	0.0041874372	-7.5100956	4.5340185	0.034355883	-0.006350490	-9.517072	2.2728975	0.03425065	0.022758583	-9.064602	3.4490063	0.03967729	0.012178579	-8.298434	1.0677108	0.048856553	0.008849372
-0.016121756	0.014381585	6.977438	-6.639275	-0.03310913	-0.000832355	2.3420992	-9.309254	-0.034058332	0.005667766	3.2964773	-11.908985	-0.035045747	0.01551474	0.5686987	-10.134204	-0.022650046	0.011531946
0.03044236	-0.0070802295	8.416379	6.8686934	0.046355043	0.016960727	-8.913757	1.9121175	0.028830172	-0.010309118	-9.384567	2.6518312	0.022458864	-0.013994069	-9.387953	2.2615387	0.03354847	0.010500696
-0.025164444	0.010095593	3.7552116	-5.614432	-0.05050833	0.012664029	1.2146031	-11.215537	-0.036217395	0.003714587	8 1.311805	-10.523472	-0.032804273	0.010900415	5 3.3349056	-12.165924	-0.03187024	-0.0007240783
-6.821311	-7.5783086	-7.8401756	7.6526704	0.046919033	-0.005574074	-8.23038	-0.66252196	0.04754331	0.001544463	3 -10.599015	1.9044615	0.04928397	0.006355548	3 -8.966402	1.3878164	0.052971464	-0.0072942018
4.005473	3.023106	3.958244	-8.431277	-0.04402588	0.019164912	1.4816821	-9.449234	-0.042758673	0.018646147	2.6742873	-9.326681	-0.03662704	0.017428268	2.67839	-10.513436	-0.029111715	0.014904404
-8.101301	-9.871217	3.7253208	5.002764	0.0421025	-0.000379441	-8.786401	0.99545944	0.028157268	0.012245263	-8.82353	0.34869695	0.03985503	-0.004327717	-9.426963	2.2879348	1.5185171	-9.857394
4.636064	1.9875056	2.792542	-10.328874	-0.03526338	0.014671441	2.479538	-10.213357	-0.03659771	0.01692906	2.5875943	-9.956132	-0.050496157	0.012392557	2.697355	-0.33866215	1.3178098	-6.15562
-9.249694	3.6539114	2.493666	4.282719	3.7026103	-9.398487	2.4900494	2.27593	2.4592478	-9.653678	3.350078	1.4721045	2.4701688	-10.004855	2.457355	2.4867659	2.4464722	1.8267081
2.775187	1.8892634	2.2345104	2.6868742	2.5778084	2.4600344	1.9592873	2.3405476	2.0334504	1.5020092	2.665691	2.6859884	2.43776	2.8891752	2.0292795	2.3123682	2.1679666	-10.333633
-8.244481	2.1270127	1.7399365	3.266947	2.6331317	2.6177027	2.1347938	2.5856133	2.0695643	1.9474641	1.9368964	2.1864479	2.2127368	2.6187842	1.7612864	2.4273744	2.043265	2.7951698
-6.8465676	0.81800157	-9.182623	0.90875536	-10.823247	1.4334372	-10.132179	1.8080044	-9.848799	1.9912192	-10.069757	2.0798116	-10.336762	3.0338495	-10.196737	2.5279322	-9.467621	-9.291574
0.042646226	-0.010651751	0.035123147	-0.012040292	0.028871728	0.004355731	4 0.040834364	-0.01401228	0.5011892	1.9847968	0.03225574	-0.006893616	0.02505306	-0.012958186	0.028169366	-0.000172676	0.05245225	-0.008358796
-0.026697509	0.017423265	-0.033828236	0.018733395	-0.050491128	0.02526991	-0.043490916	0.012775774	-1.5032322	1.0862689	-0.038360704	0.021675646	-0.031829804	0.022350358	-0.018946381	0.02545876	-0.033069227	0.006847156

▼ A → B

▼ TEST

- 1차(epi: 1254)

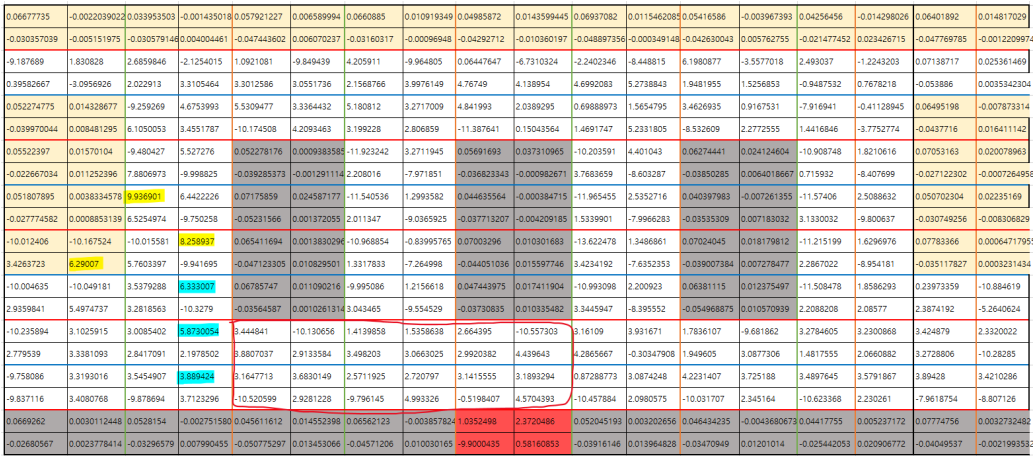


A → B를 갈 때 위로 바로 가지 않도록 예외처리

```
# 예외처리 : 시작지점과 Goal Item이 붙어있는 경우 장애물로 처리
if reward == self.env.REWARD.GOAL and cnt_step == 0:
    reward = self.env.REWARD.OBSTACLE
```

결과적으로 바로 위로 가지않고 goal에 도착한다.

- 2차(epi: 1610)



A → B를 학습하며 기존에 가지고 있던 S → B 데이터가 일부 지워짐

▼ 가설

기존의 가중치를 사용해서 학습을 하면 어느 지점에서 출발하더라도 같은 경로로 이동하는 q-map이 만들어질 것이다.

▼ 결론

1. 학습된 가중치를 사용해도 또 다른 경로를 찾는 경우가 존재한다.
    a. 탐험으로 인해 noise가 생기지만 전체적인 q-map이 다양한 경로를 통해 goal로 가는 것을 학습한다
2. 기존에 학습된 가중치 값을 일부 가지고 있어서 새로운 경로 + 기존 경로가 q-map에 나타난다.
3. 학습된 가중치를 사용해 학습하는 것이 훈련 시간을 단축 시키는데 유의미한 영향을 준다.
4. 학습된 가중치를 사용해 학습을 할수록 goal로 향하는 q-value값이 reward를 잘 받아온다. 다양한 경로를 통해 goal로 도착하는 q-map이 생성된다.
5. 학습을 반복할수록 noise가 발생한다. 이로 인해 기존에 가지고 있던 q-map이 일부 소실된다.
6. 여러번 반복 학습하는 것이 오히려 더 않좋은 성능을 보인다.