Programming on Random Number Generation

Sample의 개수가 적을 때에는 히스토그램상 sample의 분포가 원 분포와 다르게 생긴 경우가 있지만,
개수가 많아질 수록 sample의 분포는 원 분포에 가까워지는 것을 확인할 수 있다.
이는 컴퓨터에서 계산된 random number 가 정확하게 uniform 한 random 분포가 아니며 컴퓨터에 있는 장비만 가지고는 정확하게 random한 분포를 묘사할 수 없기 때문에 그렇다.
때문에 컴퓨터는 소수의 성질을 이용한 특정한 연산을 통해 **seed**라고하는 수로부터 시작하여 실제 random과 유사한 수열을 계속해서 얻어내는 것으로 random 한 숫자를 얻기에 정확하게 random한 숫자를 얻지 않는다.
하지만, sample의 개수가 많아지면 큰 수의 법칙(Law of Large Number)에 의해 원 분포와 비슷한 분포를 갖게 된다.

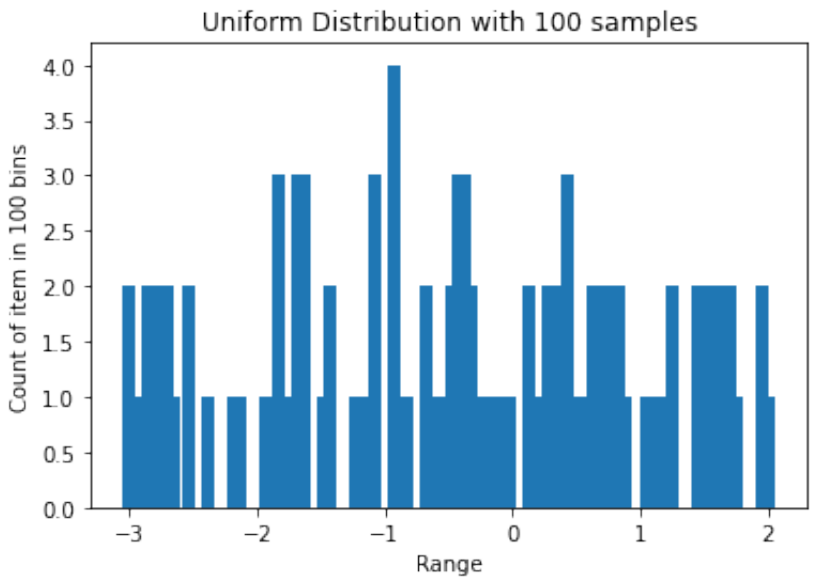
How to build and run

> Compile Environment
>
> > Mac 13.0 (22A380)
> >
> > Apple clang version 14.0.0 (clang-1400.0.29.202)

```
cd Homework #4
cd Code
./build.sh
./main
```

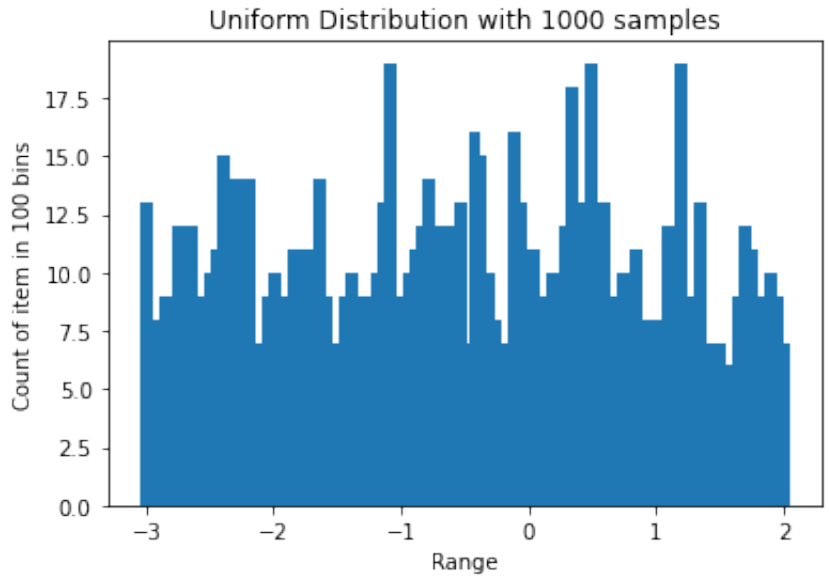
A. Uniform Distribution

A - 1. Histogram of Uniform Distribution in [-3, 2] with 100 samples



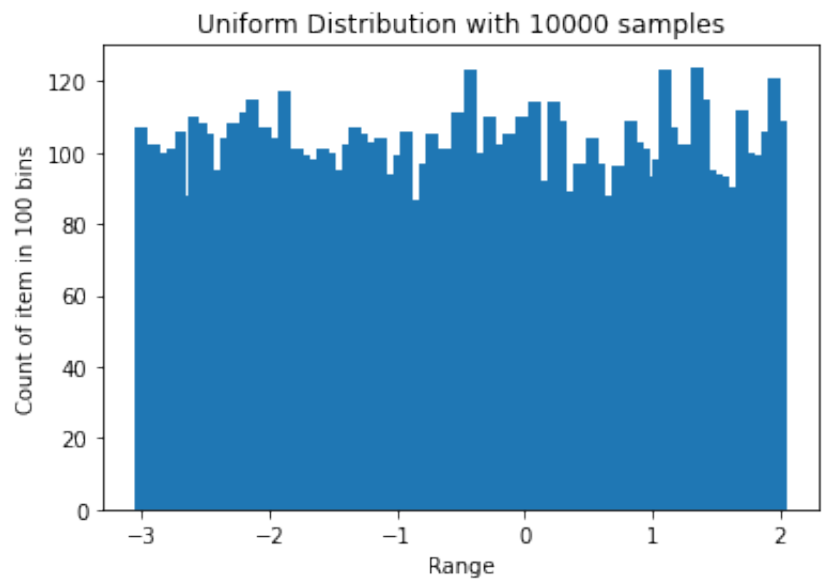
Range	1	2	3	4	5	6	7	8	9	10
[-3.00, -2.50)	2	1	1	2	1	2	2	1	0	2
[-2.50, -2.00)	0	0	1	0	0	0	1	1	0	0
[-2.00, -1.50)	0	1	0	3	1	0	3	3	0	0
[-1.50, -1.00)	1	2	0	0	0	1	1	0	3	0
[-1.00, -0.50)	0	4	0	1	0	0	2	1	1	1
[-0.50, -0.00)	2	3	3	2	0	1	0	1	1	1
[-0.00, +0.50)	0	0	2	1	0	2	0	2	3	0
[+0.50, +1.00)	1	0	2	2	1	2	2	1	0	0
[+1.00, +1.50)	1	0	1	1	2	0	0	0	2	2
[+1.50, +2.00)	2	2	0	2	1	0	0	0	2	1

A - 2. Histogram of Uniform Distribution in [-3, 2] with 1000 samples



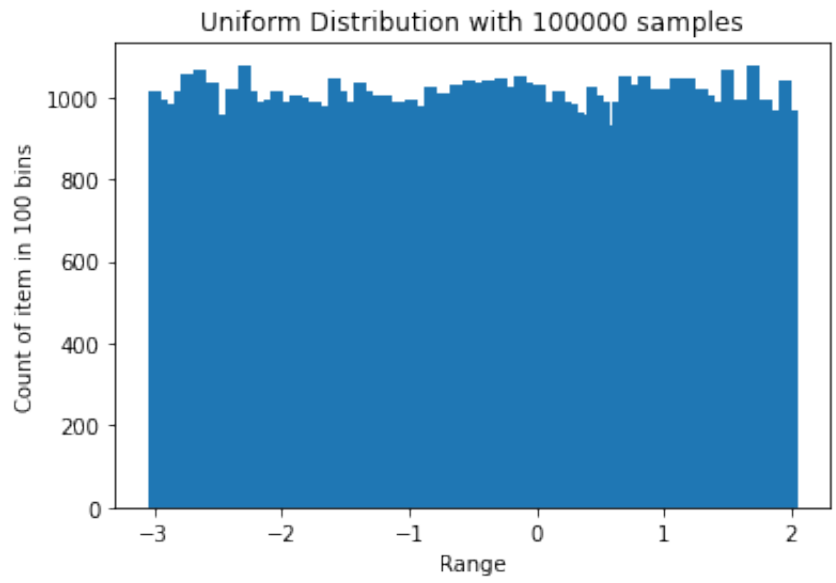
Range	1	2	3	4	5	6	7	8	9	10
[-3.00, -2.50)	13	6	8	9	5	12	7	12	9	8
[-2.50, -2.00)	10	11	15	9	14	14	14	7	6	9
[-2.00, -1.50)	10	9	6	11	11	11	8	14	9	7
[-1.50, -1.00)	2	9	10	7	9	9	10	13	19	5
[-1.00, -0.50)	9	10	11	12	14	11	12	9	12	13
[-0.50, -0.00)	7	16	15	10	8	5	7	16	13	11
[-0.00, +0.50)	11	6	9	10	6	12	18	13	12	19
[+0.50, +1.00)	12	13	9	5	10	9	11	8	5	8
[+1.00, +1.50)	8	12	9	19	8	9	13	6	7	7
[+1.50, +2.00)	6	6	9	12	11	9	9	10	9	7

A - 3. Histogram of Uniform Distribution in [-3, 2] with 10000 samples



Range	1	2	3	4	5	6	7	8	9	10
[-3.00, -2.50)	107	96	102	100	91	101	106	88	110	108
[-2.50, -2.00)	105	93	95	104	108	85	111	115	101	107
[-2.00, -1.50)	104	98	117	97	101	99	98	85	101	100
[-1.50, -1.00)	81	95	102	107	105	84	103	104	94	89
[-1.00, -0.50)	99	106	83	87	97	105	87	101	98	111
[-0.50, -0.00)	101	123	100	86	110	102	97	105	99	110
[-0.00, +0.50)	104	114	92	88	114	109	89	83	97	93
[+0.50, +1.00)	104	97	85	88	96	93	109	103	101	93
[+1.00, +1.50)	98	123	107	80	102	99	124	115	95	94
[+1.50, +2.00)	93	80	90	112	100	97	99	106	121	109

A - 4. Histogram of Uniform Distribution in [-3, 2] with 100000 samples

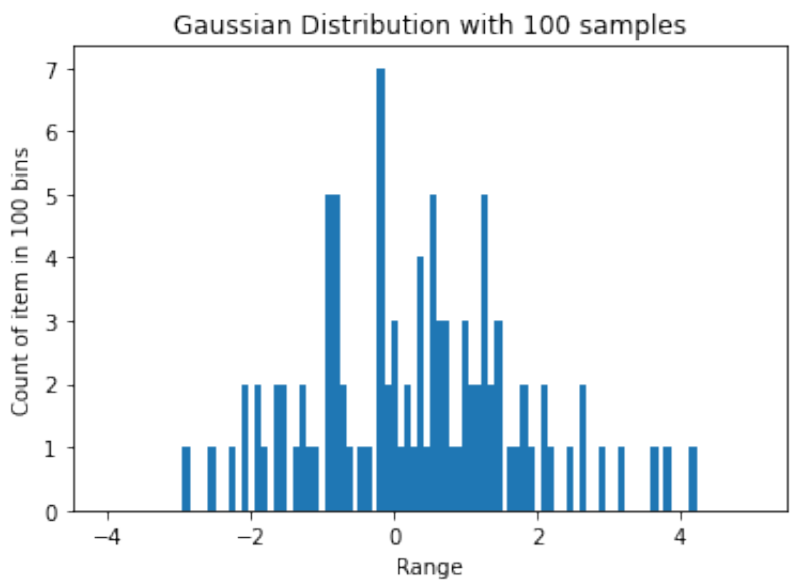


Range	1	2	3	4	5	6	7	8	9	10
[-3.00, -2.50)	1012	995	983	931	1016	1055	984	1067	948	1036
[-2.50, -2.00)	951	959	1020	999	1078	1016	989	980	994	1015
[-2.00, -1.50)	962	990	1005	998	978	987	979	946	1043	1013
[-1.50, -1.00)	990	977	1036	1015	988	1002	1005	986	990	933
[-1.00, -0.50)	991	938	979	1022	1008	986	1007	1031	1011	1041
[-0.50, -0.00)	975	1035	1039	1020	1044	1016	1022	1048	1033	1006
[-0.00, +0.50)	1031	989	971	1013	989	985	962	958	1025	1006
[+0.50, +1.00)	989	933	987	1051	1032	943	1053	1018	954	1018
[+1.00, +1.50)	979	1047	999	1044	984	1019	1003	987	990	1064
[+1.50, +2.00)	970	993	956	1076	972	992	967	943	1040	965

B. Gaussian Distribution

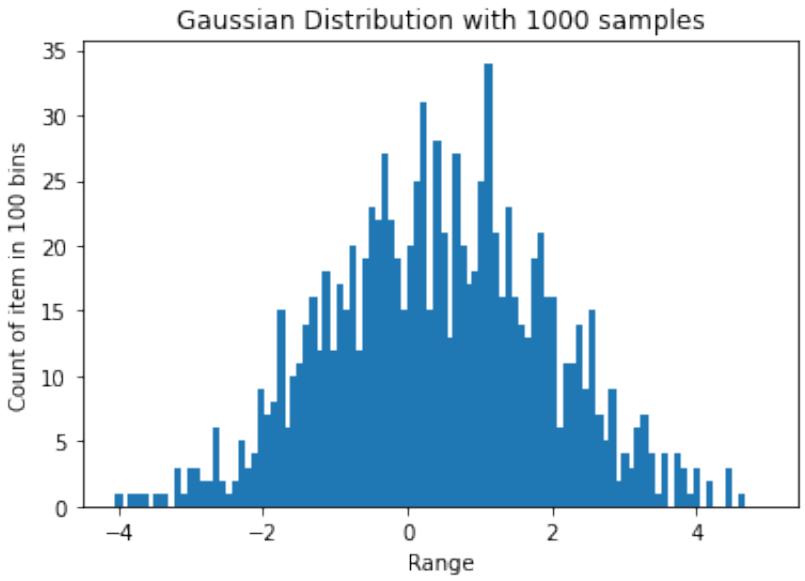
Rest of samples outside the ranges(m-6s, m+62) are ignored.

B - 1. Histogram of Gaussian Distribution with m = 0.5, standard s = 1.5 with 100 samples



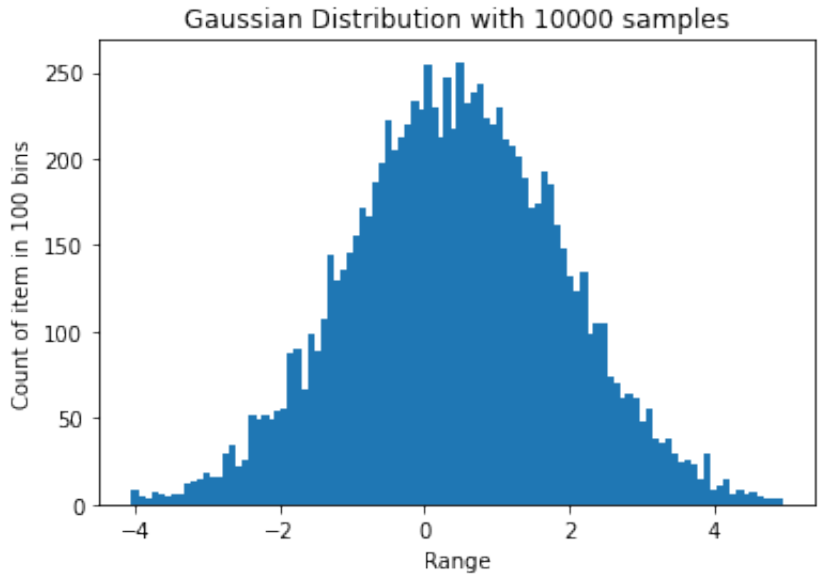
Range	1	2	3	4	5	6	7	8	9	10
[-4.00, -3.10)	0	0	0	0	0	0	0	0	0	0
[-3.10, -2.20)	0	0	1	0	0	0	1	0	0	1
[-2.20, -1.30)	0	2	0	2	1	0	2	2	0	1
[-1.30, -0.40)	2	1	1	0	5	5	2	1	0	1
[-0.40, +0.50)	1	0	7	2	3	1	2	1	4	1
[+0.50, +1.40)	5	3	3	1	1	3	2	2	5	2
[+1.40, +2.30)	3	0	1	1	2	1	0	2	1	0
[+2.30, +3.20)	0	1	0	2	0	0	1	0	0	1
[+3.20, +4.10)	0	0	0	0	1	0	1	0	0	0
[+4.10, +5.00)	1	0	0	0	0	0	0	0	0	0

B - 2. Histogram of Gaussian Distribution with m = 0.5, standard s = 1.5 with 1000 samples



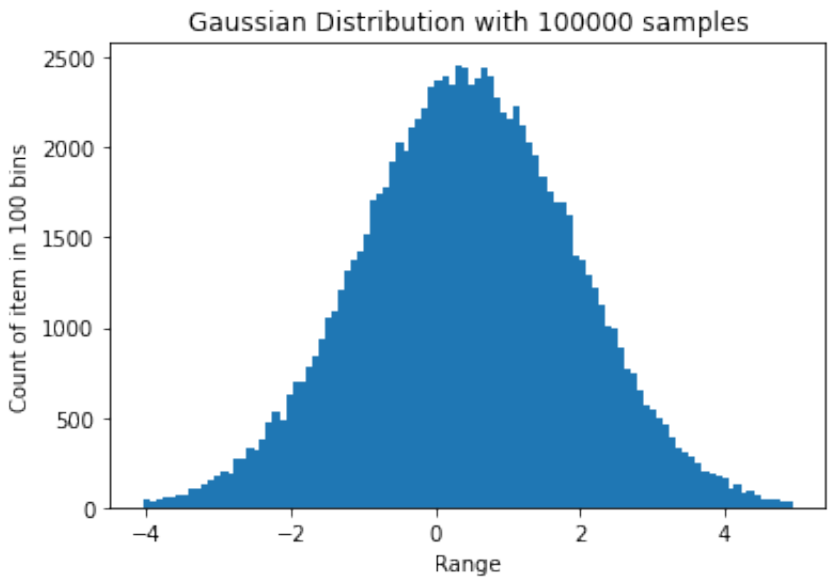
Range	1	2	3	4	5	6	7	8	9	10
[-4.00, -3.10)	1	0	1	1	1	0	1	1	0	3
[-3.10, -2.20)	1	3	3	2	2	6	2	1	2	5
[-2.20, -1.30)	3	4	9	7	8	15	6	10	11	14
[-1.30, -0.40)	16	12	18	12	17	15	20	12	19	23
[-0.40, +0.50)	22	27	22	19	15	20	25	31	15	28
[+0.50, +1.40)	21	13	27	20	17	18	25	34	21	16
[+1.40, +2.30)	23	16	14	13	19	21	16	16	6	11
[+2.30, +3.20)	11	14	9	15	7	5	9	2	4	3
[+3.20, +4.10)	6	7	4	1	4	0	4	3	1	3
[+4.10, +5.00)	0	2	0	0	3	0	1	0	0	0

B - 3. Histogram of Gaussian Distribution with m = 0.5, standard s = 1.5 with 10000 samples



Range	1	2	3	4	5	6	7	8	9	10
[-4.00, -3.10)	8	5	4	7	6	5	6	6	12	13
[-3.10, -2.20)	15	18	16	16	29	34	22	26	52	49
[-2.20, -1.30)	52	49	54	56	88	90	67	99	89	107
[-1.30, -0.40)	145	130	136	146	156	171	167	187	197	222
[-0.40, +0.50)	205	212	220	233	229	255	230	212	247	217
[+0.50, +1.40)	256	232	238	243	224	220	230	211	207	201
[+1.40, +2.30)	189	172	174	192	185	162	148	132	123	135
[+2.30, +3.20)	99	105	105	74	70	61	64	61	48	55
[+3.20, +4.10)	38	36	38	29	24	26	23	15	30	9
[+4.10, +5.00)	11	15	6	8	6	7	5	4	3	3

B - 4. Histogram of Gaussian Distribution with m = 0.5, standard s = 1.5 with 100000 samples



Range	1	2	3	4	5	6	7	8	9	10
[-4.00, -3.10)	47	31	44	53	55	72	74	102	109	124
[-3.10, -2.20)	153	177	194	188	271	272	331	324	381	476
[-2.20, -1.30)	532	485	626	701	694	785	845	934	1060	1088
[-1.30, -0.40)	1211	1315	1380	1426	1520	1709	1742	1773	1922	2023
[-0.40, +0.50)	1983	2114	2157	2215	2336	2373	2394	2347	2459	2445
[+0.50, +1.40)	2349	2388	2446	2394	2275	2194	2160	2226	2125	2030
[+1.40, +2.30)	1961	1838	1758	1695	1695	1622	1399	1377	1296	1219
[+2.30, +3.20)	1122	1012	1000	884	768	749	654	571	546	493
[+3.20, +4.10)	464	385	334	301	277	250	195	193	172	162
[+4.10, +5.00)	110	123	78	91	64	50	47	41	39	34