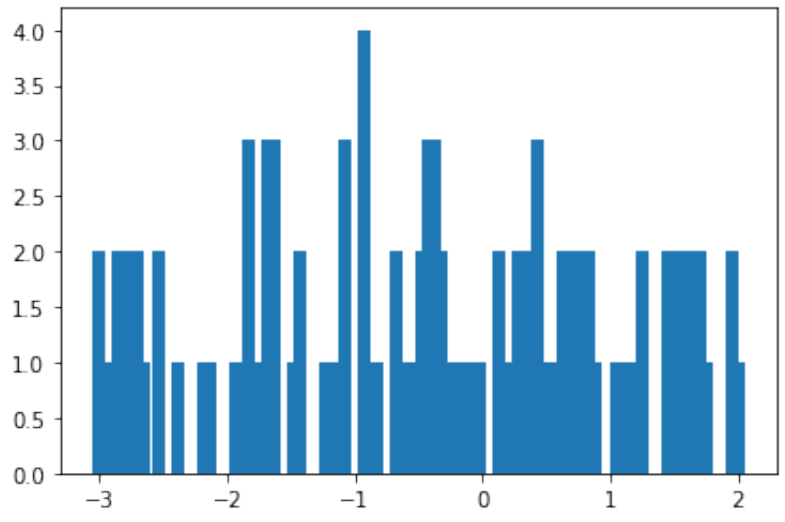
Programming on Random Number Generation

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.

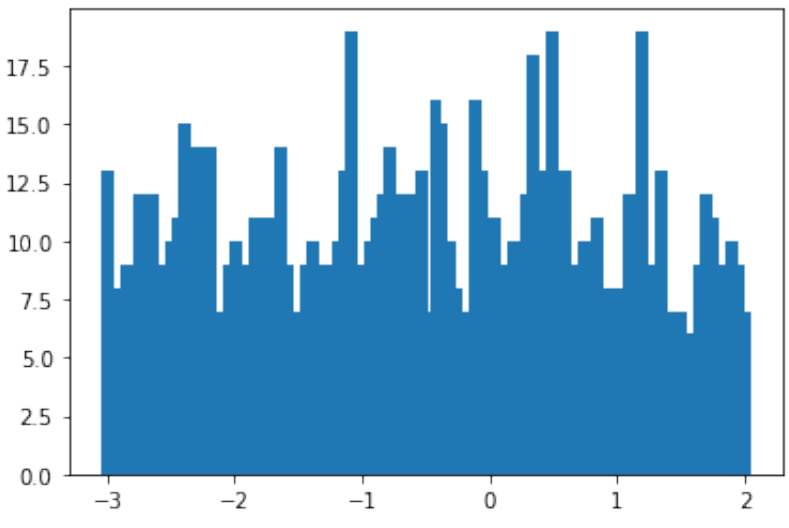
A. Uniform Distribution

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



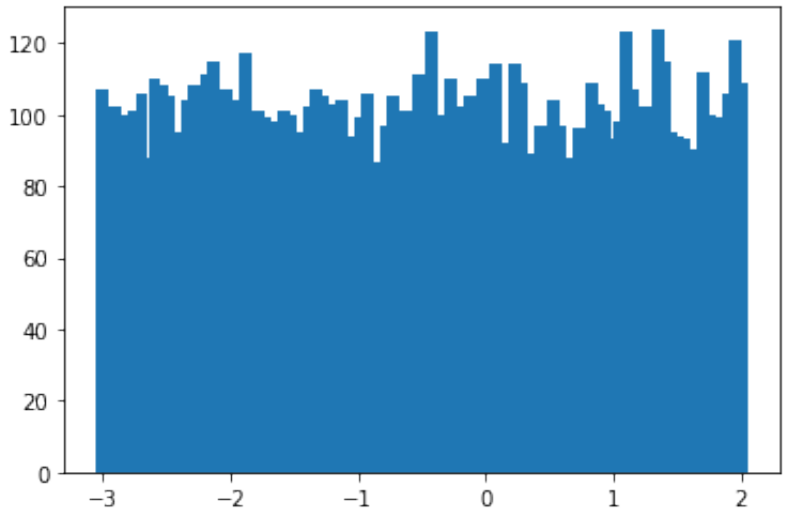
Range	1	2	3	4	5	6	7	8	9	10
-3.00 ~ -2.55	2	1	1	2	1	2	2	1	0	2
-2.50 ~ -2.05	0	0	1	0	0	0	1	1	0	0
-2.00 ~ -1.55	0	1	0	3	1	0	3	3	0	0
-1.50 ~ -1.05	1	2	0	0	0	1	1	0	3	0
-1.00 ~ -0.55	0	4	0	1	0	0	2	1	1	1
-0.50 ~ -0.05	2	3	3	2	0	1	0	1	1	1
+0.00 ~ +0.45	0	0	2	1	0	2	0	2	3	0
+0.50 ~ +0.95	1	0	2	2	1	2	2	1	0	0
+1.00 ~ +1.45	1	0	1	1	2	0	0	0	2	2
+1.50 ~ +1.95	2	2	0	2	1	0	0	0	2	1

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



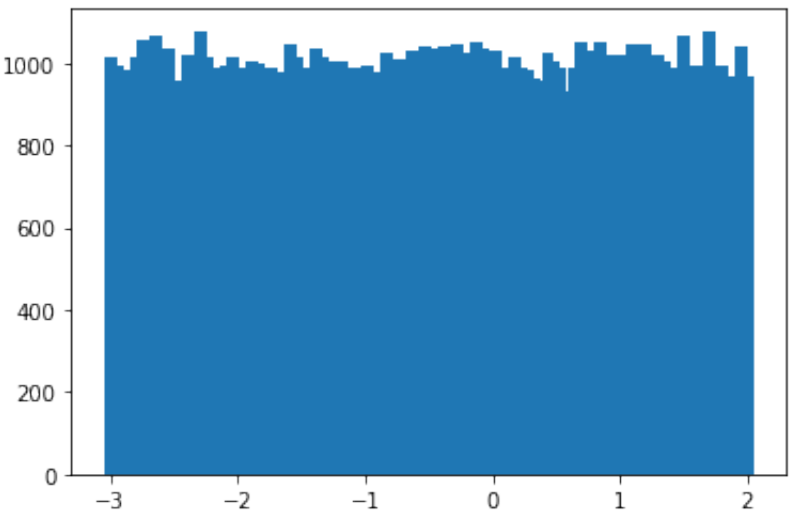
Range	1	2	3	4	5	6	7	8	9	10
-3.00 ~ -2.55	13	6	8	9	5	12	7	12	9	8
-2.50 ~ -2.05	10	11	15	9	14	14	14	7	6	9
-2.00 ~ -1.55	10	9	6	11	11	11	8	14	9	7
-1.50 ~ -1.05	2	9	10	7	9	9	10	13	19	5
-1.00 ~ -0.55	9	10	11	12	14	11	12	9	12	13
-0.50 ~ -0.05	7	16	15	10	8	5	7	16	13	11
+0.00 ~ +0.45	11	6	9	10	6	12	18	13	12	19
+0.50 ~ +0.95	12	13	9	5	10	9	11	8	5	8
+1.00 ~ +1.45	8	12	9	19	8	9	13	6	7	7
+1.50 ~ +1.95	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 ~ -2.55	107	96	102	100	91	101	106	88	110	108
-2.50 ~ -2.05	105	93	95	104	108	85	111	115	101	107
-2.00 ~ -1.55	104	98	117	97	101	99	98	85	101	100
-1.50 ~ -1.05	81	95	102	107	105	84	103	104	94	89
-1.00 ~ -0.55	99	106	83	87	97	105	87	101	98	111
-0.50 ~ -0.05	101	123	100	86	110	102	97	105	99	110
+0.00 ~ +0.45	104	114	92	88	114	109	89	83	97	93
+0.50 ~ +0.95	104	97	85	88	96	93	109	103	101	93
+1.00 ~ +1.45	98	123	107	80	102	99	124	115	95	94
+1.50 ~ +1.95	93	80	90	112	100	97	99	106	121	109

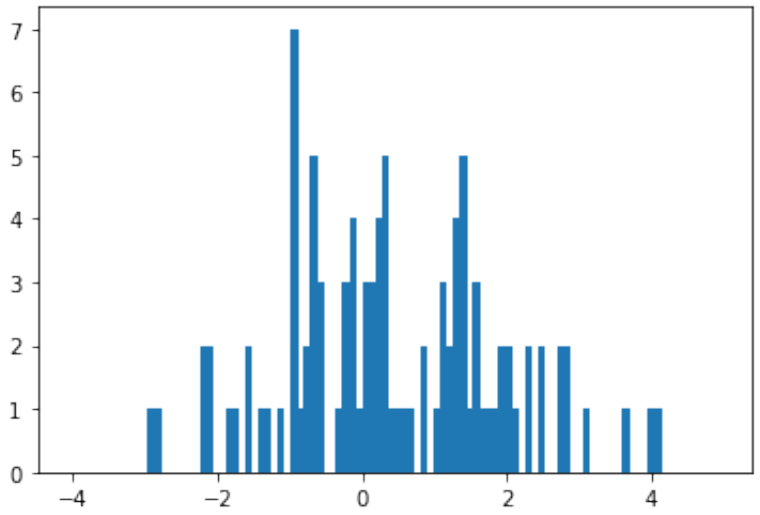
A - 4. Histogram of Uniform Distribution in [-3, 2] with 100000 samples



Range	1	2	3	4	5	6	7	8	9	10
-3.00 ~ -2.55	1012	995	983	931	1016	1055	984	1067	948	1036
-2.50 ~ -2.05	951	959	1020	999	1078	1016	989	980	994	1015
-2.00 ~ -1.55	962	990	1005	998	978	987	979	946	1043	1013
-1.50 ~ -1.05	990	977	1036	1015	988	1002	1005	986	990	933
-1.00 ~ -0.55	991	938	979	1022	1008	986	1007	1031	1011	1041
-0.50 ~ -0.05	975	1035	1039	1020	1044	1016	1022	1048	1033	1006
+0.00 ~ +0.45	1031	989	971	1013	989	985	962	958	1025	1006
+0.50 ~ +0.95	989	933	987	1051	1032	943	1053	1018	954	1018
+1.00 ~ +1.45	979	1047	999	1044	984	1019	1003	987	990	1064
+1.50 ~ +1.95	970	993	956	1076	972	992	967	943	1040	965

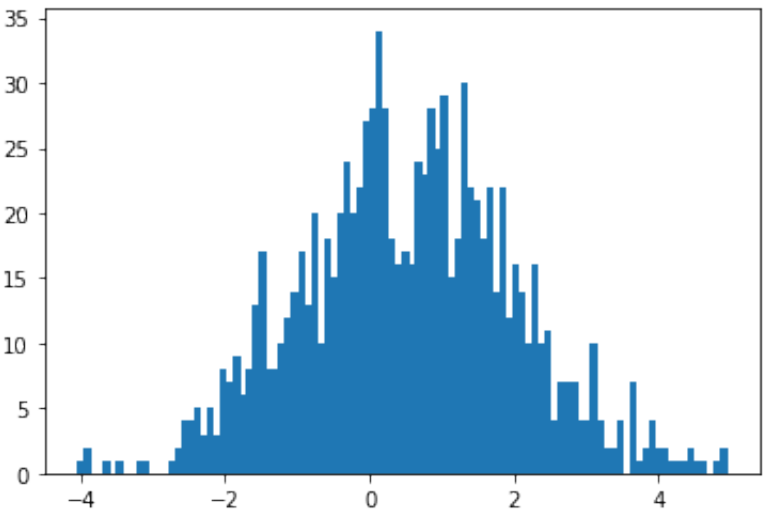
B. Gaussian Distribution

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



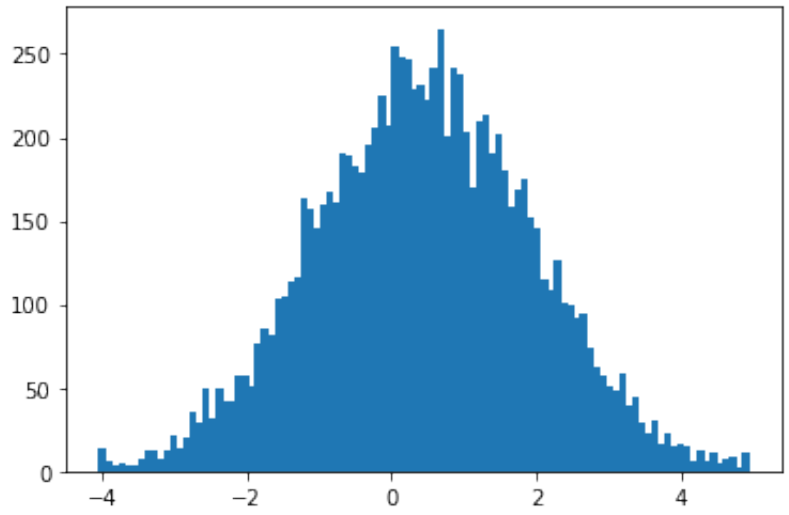
Range	1	2	3	4	5	6	7	8	9	10
-4.00 ~ -3.19	0	0	0	0	0	0	0	0	0	0
-3.10 ~ -2.29	0	0	1	1	0	0	0	0	0	0
-2.20 ~ -1.39	2	2	0	0	1	1	0	2	0	1
-1.30 ~ -0.49	1	0	1	0	7	1	2	5	3	0
-0.40 ~ +0.41	0	1	3	4	1	3	3	4	5	1
+0.50 ~ +1.31	1	1	1	0	2	0	1	3	2	4
+1.40 ~ +2.21	5	1	3	1	1	1	2	2	1	0
+2.30 ~ +3.11	2	0	2	0	0	2	2	0	0	1
+3.20 ~ +4.01	0	0	0	0	0	1	0	0	0	1
+4.10 ~ +4.91	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



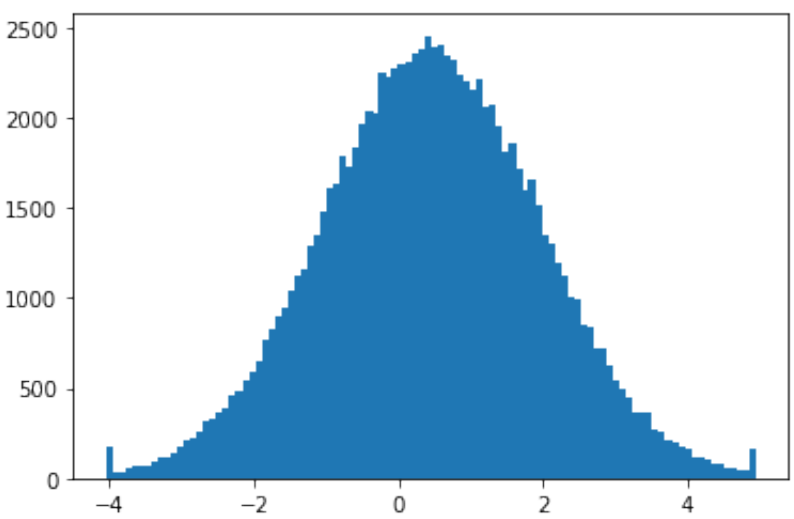
Range	1	2	3	4	5	6	7	8	9	10
-4.00 ~ -3.19	1	2	0	0	1	0	1	0	0	1
-3.10 ~ -2.29	1	0	0	0	1	2	4	4	5	3
-2.20 ~ -1.39	5	3	8	7	9	6	8	13	17	8
-1.30 ~ -0.49	8	10	12	14	17	13	20	10	18	15
-0.40 ~ +0.41	20	24	20	22	27	28	34	28	18	16
+0.50 ~ +1.31	17	16	24	23	28	25	29	15	18	30
+1.40 ~ +2.21	22	21	18	22	14	22	12	16	14	10
+2.30 ~ +3.11	16	10	11	4	7	7	7	4	4	10
+3.20 ~ +4.01	4	2	2	4	0	7	1	2	4	2
+4.10 ~ +4.91	2	1	1	1	2	1	1	0	1	2

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 ~ -3.19	14	6	3	5	3	3	7	12	13	8
-3.10 ~ -2.29	12	22	14	20	36	29	50	32	50	42
-2.20 ~ -1.39	42	57	57	51	76	86	82	103	105	114
-1.30 ~ -0.49	116	164	157	146	160	167	161	191	189	183
-0.40 ~ +0.41	179	196	206	225	207	254	248	247	229	231
+0.50 ~ +1.31	223	242	265	201	242	238	203	170	210	213
+1.40 ~ +2.21	191	202	180	159	169	175	152	145	115	108
+2.30 ~ +3.11	127	101	99	92	94	74	63	57	51	48
+3.20 ~ +4.01	58	40	44	29	23	31	16	23	15	17
+4.10 ~ +4.91	15	6	13	6	11	5	7	9	2	11

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 ~ -3.19	173	37	38	51	67	64	65	89	112	122
-3.10 ~ -2.29	136	171	210	222	261	313	331	362	394	465
-2.20 ~ -1.39	486	538	595	655	764	830	894	947	1047	1121
-1.30 ~ -0.49	1165	1289	1346	1479	1609	1630	1792	1732	1841	1966
-0.40 ~ +0.41	2037	2024	2248	2228	2275	2296	2306	2352	2376	2456
+0.50 ~ +1.31	2392	2407	2351	2320	2243	2205	2160	2214	2061	2077
+1.40 ~ +2.21	1953	1817	1859	1714	1595	1656	1517	1353	1302	1198
+2.30 ~ +3.11	1122	1007	988	846	839	727	722	630	543	498
+3.20 ~ +4.01	454	365	360	366	268	255	215	198	180	158
+4.10 ~ +4.91	119	112	102	85	76	61	53	48	44	158