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LAB REPORT
DISTRIBUTED ALGORITHMS (IN4150)
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Randomized Byzantine Agreement

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The following sections tabulate results from the various cases that we tried. The table columns correspond to process ids, red indicates malicious process and the rows correspond to the round-phase, 1N for 1st round notification phase, 1P for 1st round proposal phase and so on. The consensus reached is indicate in bold at the end of each tabulation. For malicious process, since there can be multiple broadcasts or no broadcasts in a single round, we list only the sampled values.

Case 1: 6 processors with 1 faulty

Table 1. Case 1 - **Consensus value: 1**, **Total Rounds: 41**

	1	2	3	4	5	6
1N	1	0	1	0	1	0
1P	6	7	7	4	4	1
2N	0	0	1	0	0	0
2P	5	2	0	0	0	6
3N	1	0	1	0	0	1
3P	6	5	5	4	7	0
4N		0	0	1	1	0
4P	5	8	8	1	3	8
5N	1	1	1	0	0	0
5P	1	0	7	0	0	5
6N	1	0	0	1	1	0
6P	5	8	3	5	6	2
7N	1	0	1	0	0	0
7P		2	0	5	6	0

8N	0	1	1	1	1	0
8P	1	7	3	3	8	1
9N	1	1	0	1	1	0
9P	1	6	1	3	6	9
10N	0	1	1	1	1	1
10P	0	6	5	1	5	9
11N	1	0	1	0	0	1
11P		8	5	6	4	9
12N	1	1	0	0	0	1
12P	4	6	3	1	7	3
13N	1	1	0	1	1	0
13P	1	5	1	6	0	1
14N		1	0	1	1	1
14P	0	6	1	2	5	2
15N	0	0	0	0	0	1
15P	6	0	3	0	1	0
16N	1	0	0	0	0	0
16P	5	0	4	0	0	0
17N	1	0	0	0	0	1
17P		0	7	0	5	8
18N	1	1	0	1	0	1
18P	9	1	1	0	2	9
19N		1	0	1	1	1
19P		9	1	7	9	2
20N	0	1	0	1	1	1
20P		5	4	0	3	3
21N	1	1	1	0	0	0
21P		1	9	9	2	3
22N	1	1	0	0	0	0
22P	5	9	7	1	7	0
23N	1	0	0	0	0	1
23P	0	9	5	5	7	0
24N	1	0	0	1	1	0
24P	2	1	7	0	6	5
25N	1	1	0	1	0	0
25P		0	5	3	8	9
26N	0	0	1	1	0	1
26P		5	0	7	4	8
27N	0	0	0	0	0	1
27P		0	8	0	2	0
28N	1	0	0	0	0	1
28P		3	0	9	0	0
29N	1	0	1	0	1	0
29P	7	7	6	0	4	9
30N	0	1	1	1	1	0
30P	7	5	5	9	4	0
31N	0	1	1	1	1	0
31P	3	2	4	0	5	1
32N		1	0	1	1	0
32P	6	6	7	5	1	8
33N	0	1	1	1	1	0
33P	9	8	3	4	7	1

	1	2	3	4	5	6
34N		1	0	1	0	1
34P		4	1	3	2	1
35N	0	1	1	0	1	0
35P	3	1	5	0	6	9
36N		0	0	1	0	0
36P	7	2	4	0	6	2
37N		0	1	0	0	0
37P		7	0	3	6	1
38N		1	0	0	1	0
38P		6	5	7	5	7
39N	0	0	1	1	1	1
39P	5	6	5	3	9	6
40N	0	1	0	1	1	1
40P	7	1	1	9	2	9
41N		1	1	1	1	1
41P	1	1	1	1	1	1

Case 2: 11 processors with 2 faulty

Table 2. Case 2 - **Consensus value: 1**, **Total Rounds: 12**

	1	2	3	4	5	6	7	8	9	10	11
1N	0	0	1	0	1	0	1	0	1	1	0
1P	2	2	6	4	7	7	4	8	0	2	7
2N		1	0	1	0	1	0	1	1	1	0
2P			4	0	1	2	1	8	9	7	2
3N	0		0	0	1	1	1	1	0	0	1
3P		3	0	5	7	0	9	3	2	0	7
4N			0	0	1	0	0	0	0	0	1
4P	7	6	3	9	0	6	8	2	4	3	0
5N		0	1	0	1	0	1	0	1	1	0
5P	2		2	6	6	2	9	9	1	0	2
6N	0	1	1	1	1	1	1	0	1	1	0
6P	4		6	4	0	7	9	9	1	1	5
7N	0	0	0	1	1	0	1	1	1	0	0
7P	5	7	3	3	2	9	4	5	8	7	3
8N			1	1	1	0	1	1	1	1	0
8P	4	0	1	8	0	1	1	6	2	8	1
9N	0	0	0	0	0	1	0	0	0	1	1
9P			1	9	9	6	2	5	2	9	1
10N	0	0	0	0	1	1	1	1	1	0	0
10P	8	4	6	0	5	2	5	2	9	3	1
11N	0		1	1	1	1	0	0	0	0	1
11P	1	1	6	2	9	8	8	6	7	4	0
12N			1	1	1	1	1	1	1	1	0
12P	6		1	1	1	1	1	1	1	1	1

Case 3: 40 processors with 7 faulty

Table 3. Case 3 - **Consensus value: 0**, **Total Rounds: 298**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1N	0	1	0	1	0	1	1	1	0	1	0	0	0	1	0	1	0	0	0	0	1	1	0	0	1	0	1	1	0	0	1	0	1	0	0	1	0	1	0	0
1P	5	5	2	7	8	0	0	0	5	0	0	0	2	3	7	5	0	2	1	7	1	4	1	2	1	4	5	6	1	4	2	6	1	3	6	7	7	0	7	8
2N	1	0	0	1	1	1	1	1	0	0	1	1	1	1	0	1	0	1	1	0	0	0	1	1	1	1	0	0	0	1	1	0	0	0	0	0	1	0	1	0
2P	7		9	4	4	2	3	0	6	5	8	4	3	5	4	7	0	9	0	7	2	6	5	1	3	1	7	8	3	6	3	7	8	4	5	6	1	2	2	0
3N	0	1	0	1	1	0	1	1	1	0	0	1	1	0	0	0	1	0	0	1	0	0	1	1	0	1	1	0	1	1	0	1	0	1	0	0	1	1	0	1
3P	0	7	1	4	8	6	3	4	5	3	1	0	1	5	0	2	3	5	2	7	0	5	8	1	3	7	1	5	1	2	8	5	8	9	9	7	4	1	5	4
4N	0	0	1	1	0	1	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	1	1	1	1	0	0	0	1	0	0	0	0	1	0	0
4P	5	1	5	4	5	4	3	2	8	2	6	0	6	0	9	3	1	0	3	4	3	6	9	4	2	3	7	6	7	0	1	8	1	4	3	3	5	3	4	0
5N	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0	0	1	1	0	0	0	1	0	0	1	1	1	0
5P	9	5	8	1	4	7	0	3	1	6	9	6	9	4	8	9	8	4	1	9	0	5	5	4	8	8	0	0	0	5	3	3	0	6	8	4	3	7	0	0
6N	0	0	0	1	1	1	0	0	1	1	0	1	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0	1	1	0	1	1	1	1	1	1	0	1	0	1
6P	6	6	3	7	9	9	3	0	5	3	6	1	8	7	7	3	9	6	3	9	6	1	4	8	7	9	9	3	5	1	9	7	6	7	1	1	8	4	4	3
7N	0	0	1	1	1	0	0	0	0	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	1	1	0	0
7P	8	5	9	9	7	3	3	5	3	4	1	6	6	5	3	4	4	4	2	5	7	0	3	3	9	6	9	9	4	7	1	8	4	6	2	6	3	7	9	4
8N	1	1	1	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	1	1	0	1	1	1	1	0	0	0	0	1	0	1	1	0	0	1	0	1	0	0
8P	9	6	6	3	9	5	3	9	6	0	8	0	8	5	4	0	3	7	7	4	2	8	4	3	7	0	7	5	6	2	8	2	8	3	3	3	8	4	6	9
9N	0	1	0	1	0	1	1	1	0	1	0	0	1	0	1	0	1	1	1	1	1	0	0	0	1	1	0	0	1	0	0	1	1	0	1	0	0	0	0	1
9P	1	4	4	8	9	1	0	2	0	3	7	4	3	7	1	8	0	4	7	8	1	1	9	8	0	4	5	8	3	5	0	3	8	1	6	6	2	5	6	9
10N	0	0	1	0	0	0	0	1	1	0	1	1	0	1	0	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	1	0	0	1	0
10P	8	7	9	4	0	4	9	0	4	9	1	4	9	9	8	6	5	2	5	4	9	4	0	0	4	4	2	7	9	0	5	9	7	6	4	7	4	6	8	3
11N	1	1	1	1	0	0	1	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1	1	1	0	1	0	1	1	1
11P	2	6	6	2	7	2	1	7	8	7	9	8	1	0	4	2	3	0	6	3	5	0	3	1	0	9	9	5	7	0	6	5	0	7	8	7	8	3	4	3
12N	1	0	0	0	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	1	1	1	1	0	0	0	1	0	0	0	1	0	0
12P	9	0	8	7	6	1	3	4	0	9	2	7	2	2	0	9	9	2	4	8	3	9	4	3	9	1	4	7	8	4	4	8	8	0	6	0	6	5	3	4
13N	1	0	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	1	1	1	0	1	1	0	1
13P	6	6	4	9	9	4	9	6	7	0	1	7	6	4	4	6	6	8	6	0	0	2	1	1	9	2	1	1	8	1	4	1	9	8	7	1	1	9	0	6
14N	0	0	0	1	0	1	0	1	0	1	0	1	1	0	1	1	1	0	1	0	0	0	1	1	0	1	0	0	1	1	1	1	1	0	0	0	0	1	0	1
14P	3	4	0	4	8	9	2	5	8	0	4	2	0	8	0	0	3	3	8	9	5	0	0	6	6	4	0	1	7	3	6	8	1	1	7	6	6	2	1	3
15N	1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	0	1	0	1	0	1	0	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0
15P	4	6	5	2	8	7	8	5	1	9	6	3	8	2	0	1	4	7	0	2	6	8	9	5	7	8	1	9	3	1	4	2	4	7	2	3	1	7	8	1
16N	1	0	0	0	1	1	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0	0	0	0	1	0	1	0	0	1	0	1	1	1	0	1	1	0	1	0
16P	9	6	0	0	6	1	3	3	4	2	7	6	1	8	5	7	8	6	4	7	5	1	7	4	9	6	6	5	0	7	4	3	4	1	7	1	1	8	7	4
17N	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	1	0	1	1	0	0	0	0	1	1	1	1	1
17P	0	5	1	2	4	6	2	0	0	3	6	9	1	2	7	2	4	7	0	0	0	1	6	7	3	4	0	5	7	8	7	6	9	2	7	6	1	6	1	8
18N	1	0	1	0	0	1	0	1	0	1	1	0	1	0	1	1	1	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	0	0	0	1	1
18P	4	4	0	0	9	8	7	3	6	5	4	9	1	6	4	8	1	7	2	9	6	1	3	7	9	1	1	0	3	7	8	5	1	5	4	6	5	4	9	0
19N	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0	1	1	1	0	1	1	1	1	1	0	1
19P	6	8	2	9	3	2	5	2	0	2	7	8	2	1	2	4	6	3	4	0	1	3	5	6	5	9	1	2	8	5	5	9	5	1	7	0	8	9	3	8
20N	0	0	0	1	1	0	1	1	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	1	1	1	1	0	0	1	1	0	0	0	0	1
20P	2	8	7	5	6	1	7	5	4	8	5	8	0	7	9	4	8	2	5	8	5	0	3	5	7	8	7	8	7	9	7	8	2	7	5	6	2	6	7	8
21N	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	1	1	0	1	1	1	0	1
21P	1	4	8	0	2	8	9	8	6	8	0	2	8	8	6	2	3	4	0	5	5	3	5	4	0	6	7	5	0	5	4	0	6	8	7	3	1	7	5	2
22N	1	1	0	0	0	1	1	1	0	1	1	1	1	1	0	0	1	1	1	1	0	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1	1	1	1	1
22P	6	7	1	7	8	4	2	5	8	1	4	1	2	5	0	8	8	0	1	0	3	7	5	3	7	5	9	1	5	4	3	8	9	7	2	1	1	2	7	5
23N	1	1	0	0	1	1	0	0	1	0	0	1	1	1	1	0	1	0	1	0	1	0	0	1	0	1	1	0	1	0	1	0	0	1	1	1	1	1	0	0
23P	0	2	1	7	9	9	4	7	5	2	3	9	8	3	5	0	4	8	3	2	5	8	1	4	7	0	9	4	5	8	0	9	5	2	1	3	3	3	9	7
24N	0	1	1	0	1	0	0	0	0	1	1	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	0	1	0	1	1	0	0	0	0	1	0	1	1
24P	8	7	4	2	6	3	7	8	5	4	3	9	3	9	3	8	2	4	7	6	7	0	0	8	6	4	1	9	1	9	5	2	3	6	9	2	3	2	7	5

```
25N 1110100111 1 0 1 0 1 1 1 0 1 0 1 1 0 1 0 1 1 0 1 1 0 1 1 0 0 0 1 0 0 1
25P 1998515954 1 5 5 2 8 2 1 4 7 4 8 0 4 7 2 1 5 8 7 7 2 8 3 4 7 5 0 9 4 5
26N 0011011010 1 0 1 0 0 0 0 1 0 0 0 0 1 0 0 1 1 0 0 1 0 1 0 1 1 0 1 1 1
26P 0067822249 7 5 3 4 9 5 6 4 1 6 9 2 5 5 1 8 6 4 5 7 3 9 5 8 9 8 2 2 2 3
27N 1000110010 1 1 1 1 1 1 0 1 0 1 0 1 1 1 1 0 0 1 0 0 0 1 0 0 1 1 0 1 0 1
27P 8651765236 4 1 3 8 1 0 6 4 9 5 1 6 5 3 3 0 0 6 6 0 1 3 5 2 4 8 0 2 4 5
28N 1011101011 1 1 0 1 0 1 0 0 1 1 0 0 1 1 1 1 0 0 0 1 0 0 1 1 0 1 1 0 1 0
28P 6688918051 9 6 2 6 7 1 8 4 5 0 9 7 1 6 4 4 7 7 0 8 9 3 6 5 6 8 1 7 8 8
29N 0000010001 0 1 1 1 0 1 1 1 1 1 1 0 0 1 1 0 1 0 1 1 0 0 1 1 0 0 1 0 1
29P 1447488161 5 8 9 9 0 0 1 2 5 1 5 4 2 6 6 9 2 0 4 4 1 9 6 4 0 2 5 3 0 9
30N 1010101000 0 0 0 0 0 1 1 0 0 1 0 0 1 1 1 1 0 0 0 0 1 1 1 0 1 0 1 0 0 1
30P 0519186259 4 3 9 9 3 2 3 3 4 8 6 3 7 8 3 0 0 0 8 9 9 9 3 7 7 2 4 1 2 0
31N 1100111000 0 1 1 0 1 0 0 0 1 1 1 0 0 0 1 1 0 1 0 1 1 0 0 1 1 1 0 1 1 0
31P 7722570055 4 7 6 8 9 6 3 6 3 4 1 0 7 9 0 0 5 5 9 3 9 7 5 4 7 6 9 2 4 1
32N 1001100011 1 0 1 0 1 0 0 0 0 1 0 1 0 0 0 0 1 0 0 1 0 1 0 0 1 1 0 1 0 1
32P 9368477534 7 0 5 4 8 1 0 9 0 4 8 1 4 4 5 1 1 0 5 6 0 5 6 4 8 1 0 2 2 1
33N 1001111011 1 1 0 0 0 0 1 0 0 1 1 1 0 1 0 0 1 1 0 1 0 0 0 1 0 1 1 1 1 1
33P 2 0811793 3 9 7 5 7 1 4 9 0 5 6 1 3 7 6 4 6 2 9 3 9 9 6 7 0 7 3 6 4 8 3
34N 10 1101111 0 1 1 1 1 1 1 0 0 0 0 0 0 1 0 0 1 1 0 1 1 0 1 0 0 0 1 0 1 0
34P 6599406976 7 3 1 7 4 5 4 6 9 4 2 8 3 3 2 1 6 0 1 8 5 9 1 9 8 7 9 3 0 2
35N 0011010010 1 1 0 1 1 0 0 0 1 1 1 0 1 1 0 0 1 1 1 1 0 0 1 1 1 0 1 0 0
35P 4548705509 5 4 1 9 5 1 4 7 5 8 2 9 0 3 8 8 3 2 3 1 7 8 8 5 8 6 9 8 8 4
36N 1110110011 0 1 0 0 1 0 1 1 0 1 1 0 0 0 0 1 1 1 0 1 0 0 1 1 1 0 0 1 1 0
36P 6635484721 7 8 1 8 1 5 5 2 5 3 6 5 8 9 0 4 5 5 4 1 7 6 4 0 4 6 8 9 5 1
37N 0001101010 1 1 1 0 0 0 1 1 0 0 0 1 0 0 1 1 1 1 1 0 0 1 1 0 1 0 0 1 1
37P 2385192328 8 0 1 2 4 4 9 0 1 9 1 7 2 9 7 3 0 5 9 3 0 1 5 3 4 1 8 8 6 7
38N 1100010000 1 1 0 1 1 0 1 0 0 1 0 1 1 0 0 1 0 0 0 1 1 1 1 1 0 1 1 0 1 0
38P 1066342307 8 5 4 1 0 8 5 4 1 5 4 7 0 6 4 1 5 6 5 3 9 9 1 5 2 1 6 1 0 7
39N 0001100110 1 1 1 0 0 0 0 1 0 1 1 1 1 0 1 1 1 1 0 1 0 1 0 1 1 1 0 0 0
39P 1055671225 9 6 9 2 9 6 0 6 7 2 5 8 3 6 1 8 2 4 8 1 3 7 0 7 8 3 3 6 5 3
40N 0111000011 1 1 0 1 0 1 0 1 0 1 0 1 1 1 1 1 0 0 1 1 0 0 0 0 1 1 0 0 1
40P 0412227480 6 1 6 8 1 6 6 2 7 9 9 1 9 2 8 0 4 1 8 9 2 0 3 8 8 7 8 1 0 6
41N 1111010010 1 1 1 0 0 1 1 0 0 0 0 0 1 1 0 1 0 1 0 0 0 0 1 1 0 1 0 1
41P 2456373678 9 7 8 1 9 0 4 5 6 7 2 6 6 7 7 9 4 8 7 6 9 4 2 1 0 4 0 0 1 2
42N 1010101101 1 1 1 0 0 0 1 1 0 0 1 1 0 1 0 0 0 1 0 1 0 1 0 0 0 0 0 1 1 1
42P 3668387916 8 6 2 5 6 5 5 5 1 0 7 6 9 4 2 1 8 6 6 7 9 9 3 6 2 6 7 6 8 2
43N 1011101001 0 0 1 0 1 0 0 1 0 1 1 1 0 1 1 0 0 1 0 0 0 1 0 0 0 1 1 1 1 1
43P 2184160782 1 7 7 5 1 1 2 5 5 5 0 0 0 1 2 7 6 5 5 3 4 8 5 5 0 4 6 9 0 8
44N 0101111111 1 1 1 1 1 0 1 1 1 0 1 1 1 1 0 1 1 1 0 0 1 1 1 1 1 0 1 0 1 1
44P 7130129848 4 9 7 0 4 2 2 3 8 1 6 3 4 6 4 0 0 6 9 2 6 6 3 4 9 0 7 0 7 4
45N 1010100110 1 0 1 1 1 0 1 0 0 0 1 0 1 0 1 1 0 0 0 1 1 0 0 1 0 0 0 0 1 0
45P 0261102772 7 3 3 6 2 4 4 3 6 8 1 6 1 5 9 8 2 3 1 3 1 0 1 5 5 9 4 2 7 8
46N 1011111000 0 0 1 0 1 0 1 0 0 1 0 0 0 1 0 0 0 1 0 1 0 1 0 0 1 0 0 0 1 0
46P 5080538321 8 4 2 9 3 0 1 9 7 3 4 8 8 5 3 0 5 4 2 4 0 0 2 4 7 2 5 7 7 5
47N 0010010010 0 0 1 1 0 0 1 1 1 1 1 1 0 0 1 0 0 1 0 1 0 0 1 1 1 1 0 0 1 1 1
47P 1617003576 8 0 2 9 1 2 2 1 1 7 1 7 7 5 9 2 6 6 8 8 0 7 3 0 1 3 9 7 6 8
48N 1000000010 1 0 0 1 1 1 0 0 1 1 1 0 1 1 1 0 0 1 1 1 1 1 1 0 1 1 1 1 1
48P 3378957719 3 0 9 2 3 7 3 1 9 3 2 1 2 6 2 7 8 2 0 7 8 7 8 0 7 1 5 8 1 7
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192P 1 5 4 8 0 4 4 3 3 0 0 4 4 1 2 3 7 8 3 2 7 6 4 5 1 7 5 8 5 0 3 6 1 3 0 7 4 0 4 3
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...continued upto 298 rounds

Case - More than $1/5$ faulty processes with 40 processes

When we attempted to run with more than $1/5$ faulty processes, the processes failed to reach consensus and could not make progress beyond certain number of rounds (mostly $1/n$ rounds)