Cheat Sheet GF(32)

January 16, 2021

polynomial: $X^5 + X^2 + 1 = 37$
$Z_i = \log_\alpha(1 + \alpha^i)$

i	γ_i	$-\gamma_i$	γ_i^{-1}	$\log_\alpha(\gamma_i)$	α^i	Z_i	$\phi(\gamma_i)$	$T(\gamma_i)$	$N(\gamma_i)$
0	$0 = 0$	0	DNE	DNE	1	DNE	0	0	0
1	$1 = 1$	1	1	31	2	18	1	1	1
2	$\alpha = \eta$	2	18	1	4	5	4	0	1
3	$\alpha + 1 = \eta^{18}$	3	28	18	8	29	5	1	1
4	$\alpha^2 = \eta^2$	4	9	2	16	10	16	0	1
5	$\alpha^2 + 1 = \eta^5$	5	23	5	5	2	17	1	1
6	$\alpha^2 + \alpha = \eta^{19}$	6	14	19	10	27	20	0	1
7	$\alpha^2 + \alpha + 1 = \eta^{11}$	7	12	11	20	22	21	1	1
8	$\alpha^3 = \eta^3$	8	22	3	13	20	10	1	1
9	$\alpha^3 + 1 = \eta^{29}$	9	4	29	26	16	11	0	1
10	$\alpha^3 + \alpha = \eta^6$	10	25	6	17	4	14	1	1
11	$\alpha^3 + \alpha + 1 = \eta^{27}$	11	16	27	7	19	15	0	1
12	$\alpha^3 + \alpha^2 = \eta^{20}$	12	7	20	14	23	26	1	1
13	$\alpha^3 + \alpha^2 + 1 = \eta^8$	13	15	8	28	14	27	0	1
14	$\alpha^3 + \alpha^2 + \alpha = \eta^{12}$	14	6	12	29	13	30	1	1
15	$\alpha^3 + \alpha^2 + \alpha + 1 = \eta^{23}$	15	13	23	31	24	31	0	1
16	$\alpha^4 = \eta^4$	16	11	4	27	9	13	0	1
17	$\alpha^4 + 1 = \eta^{10}$	17	24	10	19	30	12	1	1
18	$\alpha^4 + \alpha = \eta^{30}$	18	2	30	3	1	9	0	1
19	$\alpha^4 + \alpha + 1 = \eta^{17}$	19	29	17	6	11	8	1	1
20	$\alpha^4 + \alpha^2 = \eta^7$	20	30	7	12	8	29	0	1
21	$\alpha^4 + \alpha^2 + 1 = \eta^{22}$	21	26	22	24	25	28	1	1
22	$\alpha^4 + \alpha^2 + \alpha = \eta^{28}$	22	8	28	21	7	25	0	1
23	$\alpha^4 + \alpha^2 + \alpha + 1 = \eta^{26}$	23	5	26	15	12	24	1	1
24	$\alpha^4 + \alpha^3 = \eta^{21}$	24	17	21	30	15	7	1	1
25	$\alpha^4 + \alpha^3 + 1 = \eta^{25}$	25	10	25	25	21	6	0	1

i	γ_i	$-\gamma_i$	γ_i^{-1}	$\log_\alpha(\gamma_i)$	α^i	Z_i	$\phi(\gamma_i)$	$T(\gamma_i)$	$N(\gamma_i)$
26	$\alpha^4+\alpha^3+\alpha=\eta^9$	26	21	9	23	28	3	1	1
27	$\alpha^4+\alpha^3+\alpha+1=\eta^{16}$	27	31	16	11	6	2	0	1
28	$\alpha^4+\alpha^3+\alpha^2=\eta^{13}$	28	3	13	22	26	23	1	1
29	$\alpha^4+\alpha^3+\alpha^2+1=\eta^{14}$	29	19	14	9	3	22	0	1
30	$\alpha^4+\alpha^3+\alpha^2+\alpha=\eta^{24}$	30	20	24	18	17	19	1	1
31	$\alpha^4+\alpha^3+\alpha^2+\alpha+1=\eta^{15}$	31	27	15	1	DNE	18	0	1

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$2^0 = 1$
$2^1 = 2$
$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 5$
$2^6 = 10$
$2^7 = 20$
$2^8 = 13$
$2^9 = 26$
$2^{10} = 17$
$2^{11} = 7$
$2^{12} = 14$
$2^{13} = 28$
$2^{14} = 29$
$2^{15} = 31$
$2^{16} = 27$
$2^{17} = 19$
$2^{18} = 3$
$2^{19} = 6$
$2^{20} = 12$
$2^{21} = 24$
$2^{22} = 21$
$2^{23} = 15$
$2^{24} = 30$
$2^{25} = 25$
$2^{26} = 23$
$2^{27} = 11$
$2^{28} = 22$
$2^{29} = 9$

$2^{30} = 18$
$2^{31} = 1$

i	γ_i	$-\gamma_i$	γ_i^{-1}	$\log_\alpha(\gamma_i)$	α^i	Z_i	$\phi(\gamma_i)$	$T(\gamma_i)$	$N(\gamma_i)$
0	$0 = 0$	0	DNE	DNE	1	DNE	0	0	0
1	$1 = 1$	1	1	31	2	18	1	1	1
2	$\alpha = \eta$	2	18	1	4	5	4	0	1
3	$\alpha + 1 = \eta^{18}$	3	28	18	8	29	5	1	1
4	$\alpha^2 = \eta^2$	4	9	2	16	10	16	0	1
5	$\alpha^2 + 1 = \eta^5$	5	23	5	5	2	17	1	1
6	$\alpha^2 + \alpha = \eta^{19}$	6	14	19	10	27	20	0	1
7	$\alpha^2 + \alpha + 1 = \eta^{11}$	7	12	11	20	22	21	1	1
8	$\alpha^3 = \eta^3$	8	22	3	13	20	10	1	1
9	$\alpha^3 + 1 = \eta^{29}$	9	4	29	26	16	11	0	1
10	$\alpha^3 + \alpha = \eta^6$	10	25	6	17	4	14	1	1
11	$\alpha^3 + \alpha + 1 = \eta^{27}$	11	16	27	7	19	15	0	1
12	$\alpha^3 + \alpha^2 = \eta^{20}$	12	7	20	14	23	26	1	1
13	$\alpha^3 + \alpha^2 + 1 = \eta^8$	13	15	8	28	14	27	0	1
14	$\alpha^3 + \alpha^2 + \alpha = \eta^{12}$	14	6	12	29	13	30	1	1
15	$\alpha^3 + \alpha^2 + \alpha + 1 = \eta^{23}$	15	13	23	31	24	31	0	1
16	$\alpha^4 = \eta^4$	16	11	4	27	9	13	0	1
17	$\alpha^4 + 1 = \eta^{10}$	17	24	10	19	30	12	1	1
18	$\alpha^4 + \alpha = \eta^{30}$	18	2	30	3	1	9	0	1
19	$\alpha^4 + \alpha + 1 = \eta^{17}$	19	29	17	6	11	8	1	1
20	$\alpha^4 + \alpha^2 = \eta^7$	20	30	7	12	8	29	0	1
21	$\alpha^4 + \alpha^2 + 1 = \eta^{22}$	21	26	22	24	25	28	1	1
22	$\alpha^4 + \alpha^2 + \alpha = \eta^{28}$	22	8	28	21	7	25	0	1
23	$\alpha^4 + \alpha^2 + \alpha + 1 = \eta^{26}$	23	5	26	15	12	24	1	1
24	$\alpha^4 + \alpha^3 = \eta^{21}$	24	17	21	30	15	7	1	1
25	$\alpha^4 + \alpha^3 + 1 = \eta^{25}$	25	10	25	25	21	6	0	1

i	γ_i	$-\gamma_i$	γ_i^{-1}	$\log_\alpha(\gamma_i)$	α^i	Z_i	$\phi(\gamma_i)$	$T(\gamma_i)$	$N(\gamma_i)$
26	$\alpha^4 + \alpha^3 + \alpha = \eta^9$	26	21	9	23	28	3	1	1
27	$\alpha^4 + \alpha^3 + \alpha + 1 = \eta^{16}$	27	31	16	11	6	2	0	1
28	$\alpha^4 + \alpha^3 + \alpha^2 = \eta^{13}$	28	3	13	22	26	23	1	1
29	$\alpha^4 + \alpha^3 + \alpha^2 + 1 = \eta^{14}$	29	19	14	9	3	22	0	1
30	$\alpha^4 + \alpha^3 + \alpha^2 + \alpha = \eta^{24}$	30	20	24	18	17	19	1	1
31	$\alpha^4 + \alpha^3 + \alpha^2 + \alpha + 1 = \eta^{15}$	31	27	15	1	DNE	18	0	1

+	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
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