prime	equation	solutions
$p=2$	$x^2 \equiv n \pmod 2$	$x \equiv 1$
$p=3$	$x^2 \equiv n \pmod 3$	none
$p=5$	$x^2 \equiv n \pmod 5$	$x \equiv 1,4$
$p=7$	$x^2 \equiv n \pmod 7$	none
$p=11$	$x^2 \equiv n \pmod{11}$	$x \equiv 1,10$
$p=13$	$x^2 \equiv n \pmod{13}$	$x \equiv 2,11$

$$n = 2201$$

Factor Base

prime	equation	solutions
$p=2$	$x^2 \equiv n \pmod 2$	$x \equiv 1$
$p=3$	$x^2 \equiv n \pmod 3$	none
$p=5$	$x^2 \equiv n \pmod 5$	$x \equiv 1,4$
$p=7$	$x^2 \equiv n \pmod 7$	none
$p=11$	$x^2 \equiv n \pmod{11}$	$x \equiv 1,10$
$p=13$	$x^2 \equiv n \pmod{13}$	$x \equiv 2,11$

$$n = 2201$$

$n = 2201$ $\sqrt{n} \approx 47$

$n = 2201$ $\sqrt{n} \approx 47$

k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63

$n = 2201$ $\quad \sqrt{n} \approx 47$

k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3

k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

highlight k such that

$$k^2 \equiv n \pmod 2$$

has solutions

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

highlight k such that

$$k^2 \equiv n \pmod 2$$

has solutions

$$\Downarrow$$

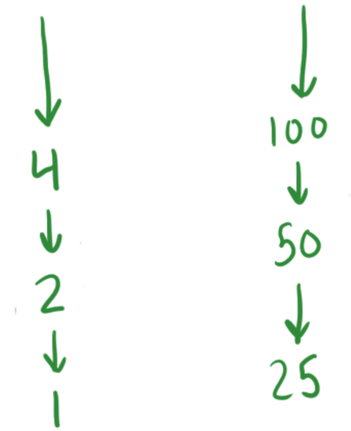
$$2 \mid k^2 - n$$

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

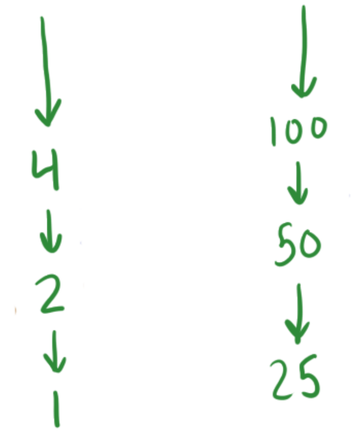
4

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768



$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768



$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

8 → 4 → 2 → 1

200 → 100 → 50 → 25

400 → 200 → 100 → 50 → 25

608 → 304 → 152 → 76 → 38 → 19

824 → 412 → 206 → 103

1048 → 524 → 262 → 131

1280 → 640 → 320 → 160 → 80 → 40 → 20 → 10 → 5

1520 → 755

1768 → 884 → 442 → 221

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

8 → 4 → 2 → 1

200 → 100 → 50 → 25

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1048 → 524 → 262 → 131

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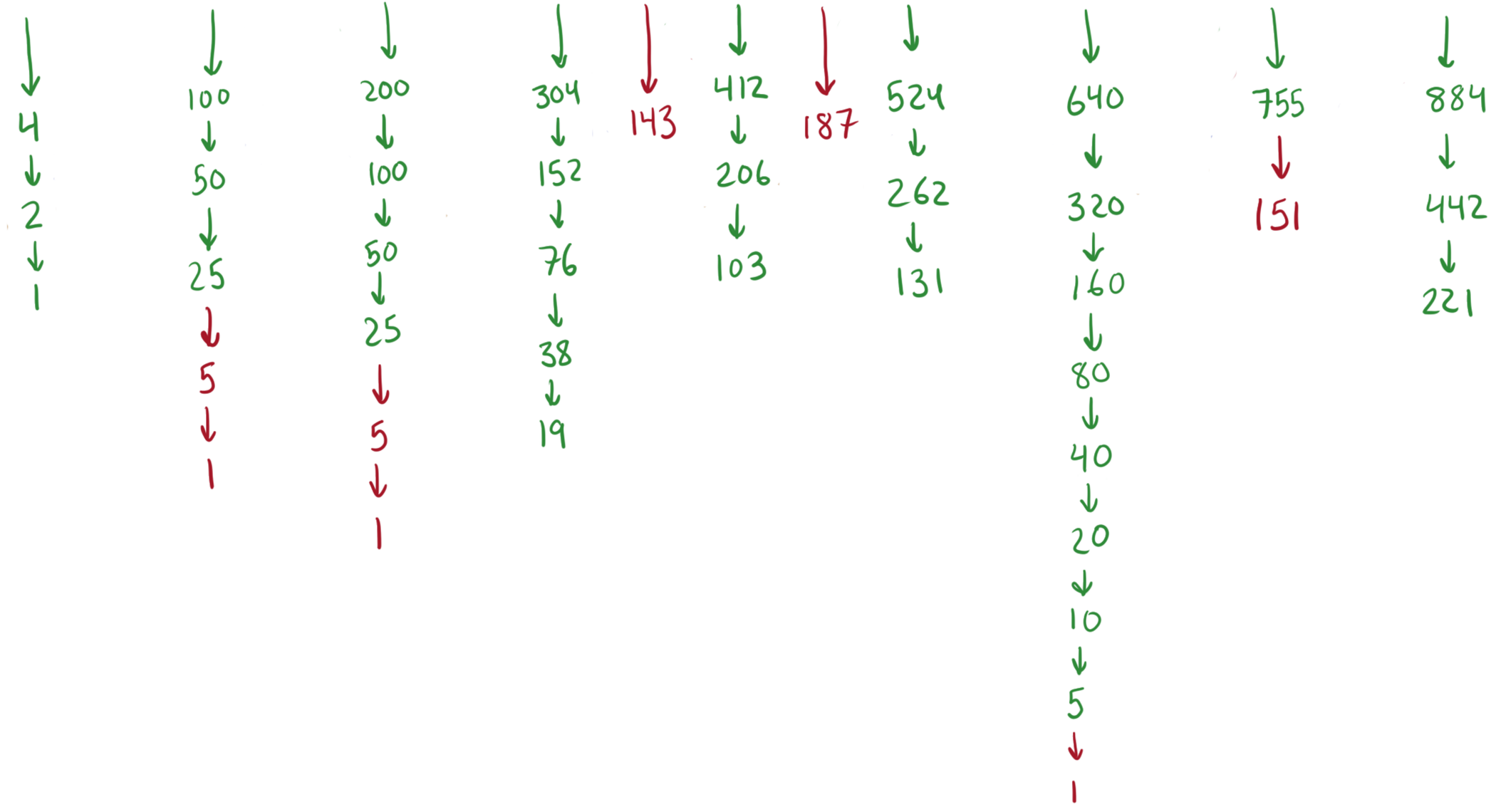
1520 → 755

1768 → 884 → 442 → 221

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768



$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

8 → 4 → 2 → 1

200 → 100 → 50 → 25 → 5 → 1

400 → 200 → 100 → 50 → 25 → 5 → 1

608 → 304 → 152 → 76 → 38 → 19

715 → 143

824 → 412 → 206 → 103

935 → 187

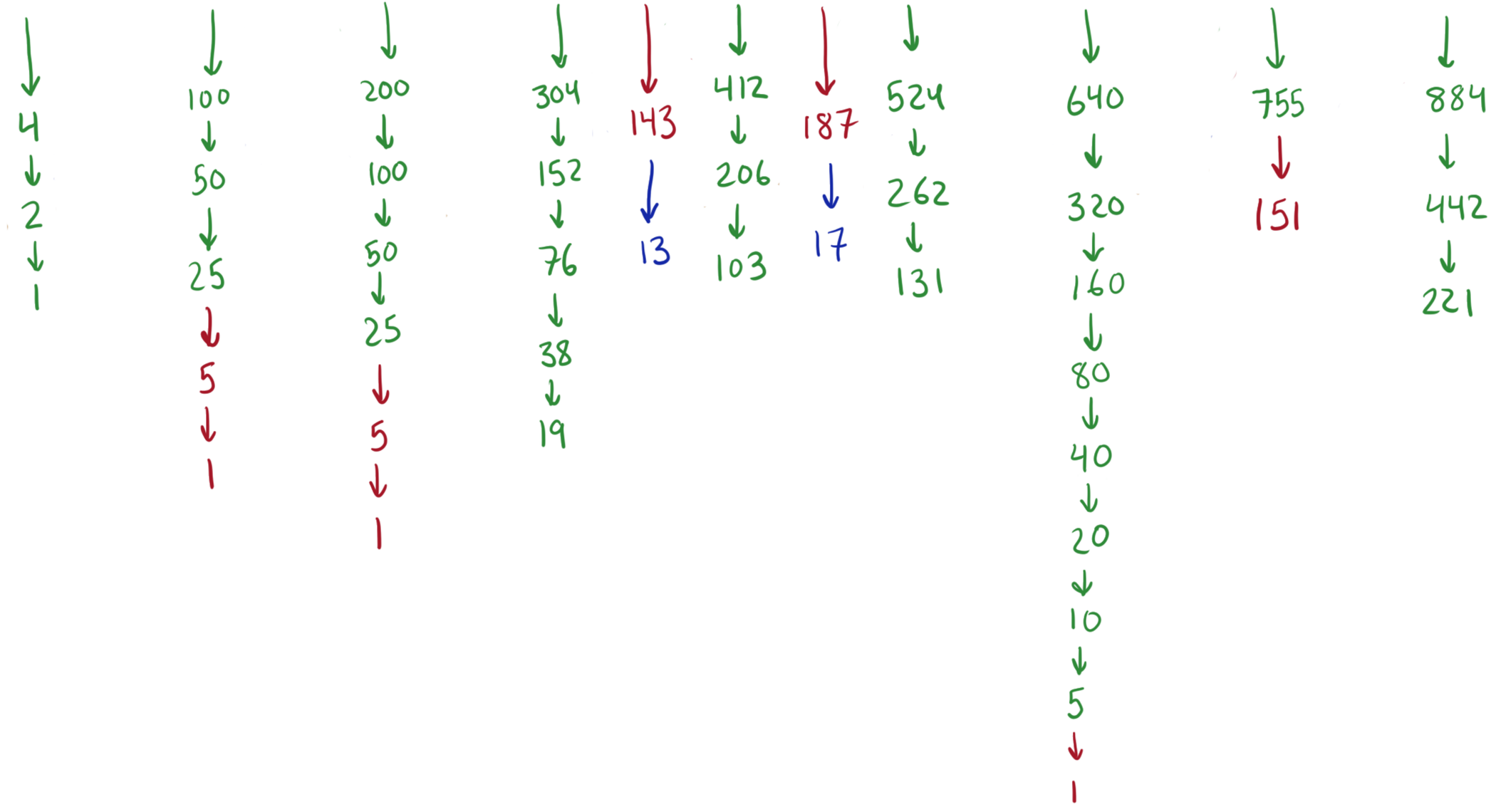
1048 → 524 → 262 → 131

1280 → 640 → 320 → 160 → 80 → 40 → 20 → 10 → 5 → 1

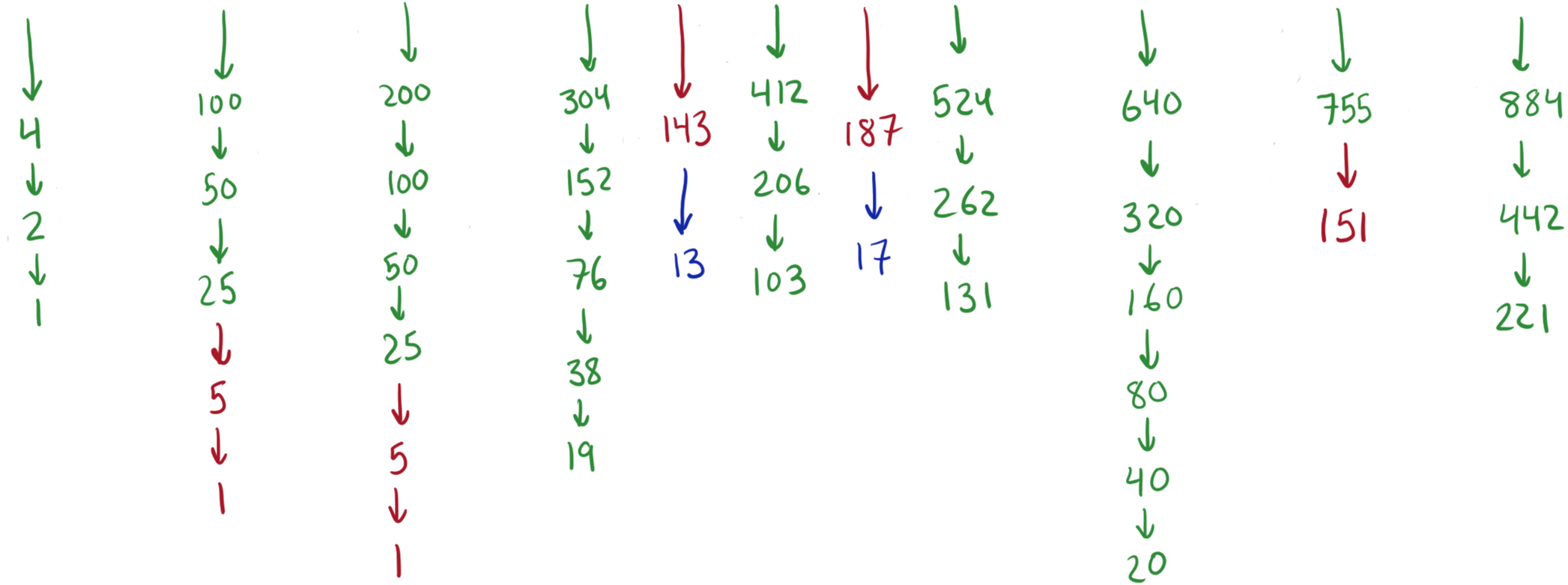
1520 → 755 → 151

1768 → 884 → 442 → 221

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768



$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768



$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
k^2-n	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

47: 8 → 4 → 2 → 1

49: 200 → 100 → 50 → 25 → 5 → 1

50: 299 → 23

51: 400 → 200 → 100 → 50 → 25 → 5 → 1

53: 608 → 304 → 152 → 76 → 38 → 19

54: 715 → 143 → 13 → 1

55: 824 → 412 → 206 → 103

56: 935 → 187 → 17

57: 1048 → 524 → 262 → 131

59: 1280 → 640 → 320 → 160 → 80 → 40 → 20 → 10 → 5 → 1

61: 1520 → 755 → 151

63: 1768 → 884 → 442 → 221 → 17

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
$k^2 - n$	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

47: 8 → 4 → 2 → 1

$47^2 \equiv 2^3$

49: 200 → 100 → 50 → 25 → 5 → 1

50: 299 → 23

51: 400 → 200 → 100 → 50 → 25 → 5 → 1

53: 608 → 304 → 152 → 76 → 38 → 19

54: 715 → 143 → 13 → 1

55: 824 → 412 → 206 → 103

56: 935 → 187 → 17

57: 1048 → 524 → 262 → 131

59: 1280 → 640 → 320 → 160 → 80 → 40 → 20 → 10 → 5 → 1

61: 1520 → 755 → 151

63: 1768 → 884 → 442 → 221 → 17

$k \bmod 2$	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
$k \bmod 5$	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3
$k \bmod 11$	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8
$k \bmod 13$	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11
k	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
$k^2 - n$	8	103	200	299	400	503	608	715	824	935	1048	1163	1280	1399	1520	1643	1768

$47^2 \equiv 2^3$

$49^2 \equiv 2^3 \cdot 5^2$

$51^2 \equiv 2^4 5^2$

$54^2 \equiv 5 \cdot 11 \cdot 13$

$59^2 \equiv 2^8 \cdot 5$