

# Practical 1

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Today you will be creating and manipulating vectors, and data frames to uncover a top secret message.

## Part One: Setup

Each of the following R chunks will cause an error and/or do the desired task incorrectly. Find the mistake, and correct it to complete the intended action.

1. Create vectors containing the upper case letters, lower case letters, and some punctuation marks.

```
lower_case <- c("a", "b", "c", "d", "e", "f", "g", "h", "i", "j", "k", "l", "m", "n", "o", "p", "q", "r", "s", "t", "u", "v", "w", "x", "y", "z")
upper_case <- c("A", "B", "C", "D", "E", "F", "G", "H", "I", "J", "K", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U", "V", "W", "X", "Y", "Z")
punctuation <- c(".", ",", "!", "?", "'", "\"", "(", ")", " ", ":", ";", "-")
```

2. Make one long vector containing all the symbols.

```
my_symbols <- c(lower_case, upper_case, punctuation)
```

3. Turn the `my_symbols` vector into a data frame, with the variable name “Symbol”

```
my_symbols <- data.frame(Symbol = my_symbols)
my_symbols
```

	Symbol
1	a
2	b
3	c
4	d
5	e
6	f
7	g
8	h
9	i

10	j
11	k
12	l
13	m
14	n
15	o
16	p
17	q
18	r
19	s
20	t
21	u
22	v
23	w
24	x
25	y
26	z
27	A
28	B
29	C
30	D
31	E
32	F
33	G
34	H
35	I
36	J
37	K
38	L
39	M
40	N
41	O
42	P
43	Q
44	R
45	S
46	T
47	U
48	V
49	W
50	X
51	Y
52	Z

```

53      .
54      ,
55      !
56      ?
57      '
58      "
59      (
60      )
61
62      :
63      ;
64      -

```

4. Find the total number of symbols we have in our data frame.

```
len <- length(my_symbols$Symbol)
```

5. Create a new variable in your dataframe that assigns a number to each symbol.

```
my_symbols$Num <- 1:len
my_symbols
```

	Symbol	Num
1	a	1
2	b	2
3	c	3
4	d	4
5	e	5
6	f	6
7	g	7
8	h	8
9	i	9
10	j	10
11	k	11
12	l	12
13	m	13
14	n	14
15	o	15
16	p	16
17	q	17
18	r	18
19	s	19

20	t	20
21	u	21
22	v	22
23	w	23
24	x	24
25	y	25
26	z	26
27	A	27
28	B	28
29	C	29
30	D	30
31	E	31
32	F	32
33	G	33
34	H	34
35	I	35
36	J	36
37	K	37
38	L	38
39	M	39
40	N	40
41	O	41
42	P	42
43	Q	43
44	R	44
45	S	45
46	T	46
47	U	47
48	V	48
49	W	49
50	X	50
51	Y	51
52	Z	52
53	.	53
54	,	54
55	!	55
56	?	56
57	'	57
58	"	58
59	(	59
60	)	60
61		61
62	:	62

```
63      ; 63
64      - 64
```

## Part Two: Creating functions

Write your own function which includes the steps below.

0. Add 14 to every number (already done for you )
1. Multiply every number by 18, then subtract 257.
2. Exponentiate every number. (That is, do  $e^{\text{number}}$ .)
3. Square every number.

```
arithmetics = function(x) {
  # step 0: add 14
  x = x + 14
  # step 1: multiply by 18, subtract 257
  x = (x * 18) - 257
  # step 2: exponentiate every number
  x = exp(x)
  # step 3: square every number
  x = x^2
  # print output
  return(x)
}
```

Test your function, do you get any errors when applying it?

```
test = seq(0, 1, length.out = 5)
arithmetics(test)
```

```
[1] 4.539993e-05 3.678794e-01 2.980958e+03 2.415495e+07 1.957296e+11
```

## Part Three: Decoding the secret message

This chunk (which should NOT have errors) will load up the encoded secret message as a vector:

```
top_secret <- read.csv(
  "https://raw.githubusercontent.com/loreabad6/app-dev-gis/main/practicals/Practical1/Secret.csv",
  header = TRUE)$x
```

By altering this top secret set of numbers, you will be able to create a message. Use your function above to alter the `top_secret` object.

```
# apply your function to the top_secret object and overwrite top_secret
top_secret = arithmetics(top_secret)
```

#### Checkpoint

Headquarters has informed you that at this stage of decoding, there should be 552 numbers in the secret message that are below 17.

*Hint:* This is what is called a “relational” comparison, where you compare an object to a number and R will give you a vector of **TRUE**s and **FALSE**s based on whether the comparison is / is not met. You can then use these **TRUE**s and **FALSE**s as numbers, since **TRUE** = 1 and **FALSE** = 0 in R land. This is called a Boolean variable type.

```
sum(top_secret < 17)
```

```
[1] 552
```

4. Turn your vector of numbers into a matrix with 5 columns.

```
secret_matrix <- matrix(top_secret, ncol = 5, byrow = FALSE)
```

```
secret_matrix
```

```
      [,1] [,2] [,3] [,4] [,5]
[1,]   32  361    5  2.5 30.5
[2,]   19   25   18 30.5  7.5
[3,]   29  484   61 19.5  9.0
[4,]   22   25   23  4.0 30.5
[5,]   64  324    8  0.5 13.5
[6,]   73    1    1 19.5 10.5
[7,]   18  144   39 30.5  9.5
[8,]   31 3721   61 11.5 19.5
[9,]   41 1521   38  0.5  9.0
[10,]   34   64    1  6.0  0.5
[11,]   76   81   39  5.5  6.0
[12,]   85  196    9 30.5  4.5
[13,]   30   49   39 11.5  0.5
[14,]   43  361   21  4.5 28.0
```

[15,]	53	3721	4	19.5	29.0
[16,]	46	225	5	4.0	30.5
[17,]	87	36	61	30.5	29.5
[18,]	97	3721	115	19.5	0.5
[19,]	87	1521	118	4.0	7.0
[20,]	55	64	161	2.5	2.0
[21,]	63	81	138	4.5	30.5
[22,]	56	361	115	9.0	9.5
[23,]	50	3721	114	30.5	4.0
[24,]	109	361	107	4.0	2.5
[25,]	89	225	9	2.5	30.5
[26,]	60	324	39	0.5	19.5
[27,]	59	1521	21	2.0	9.0
[28,]	117	3721	4	9.5	4.5
[29,]	64	81	5	30.5	2.5
[30,]	61	196	61	2.0	2.0
[31,]	74	3721	35	7.5	30.5
[32,]	76	64	57	11.5	19.5
[33,]	127	25	22	7.0	7.5
[34,]	82	324	5	11.5	30.5
[35,]	75	3721	61	0.5	1.5
[36,]	94	144	7	9.0	10.5
[37,]	79	25	15	2.0	9.0
[38,]	400	361	39	27.5	19.5
[39,]	3799	361	61	30.5	9.5
[40,]	89	225	39	23.0	2.5
[41,]	307	196	15	4.0	12.5
[42,]	253	361	56	2.5	30.5
[43,]	111	3721	58	30.5	0.5
[44,]	3809	81	61	13.5	9.5
[45,]	1611	196	59	7.0	30.5
[46,]	317	3721	27	19.5	9.5
[47,]	3815	1521	12	4.5	4.0
[48,]	97	64	9	8.0	2.5
[49,]	294	25	3	0.5	30.5
[50,]	3821	3721	5	19.5	9.5
[51,]	127	361	61	4.0	8.0
[52,]	300	9	8	4.5	7.5
[53,]	122	64	1	2.5	5.5
[54,]	3244	225	4	9.5	2.5
[55,]	3831	225	61	27.0	32.0
[56,]	3476	144	14	30.5	3.0
[57,]	1339	324	15	17.5	0.5

[58,]	3837	225	61	30.5	7.0
[59,]	647	225	9	19.5	1.5
[60,]	345	169	4	4.0	12.5
[61,]	318	2916	5	4.5	30.5
[62,]	140	3721	1	7.0	1.5
[63,]	151	1	61	5.5	10.5
[64,]	452	196	23	32.0	9.0
[65,]	3851	16	8	29.0	19.5
[66,]	196	3721	1	30.5	9.5
[67,]	359	1521	39	29.5	2.5
[68,]	665	64	61	9.5	12.5
[69,]	3859	225	38	4.0	4.5
[70,]	309	441	1	2.5	7.0
[71,]	143	49	39	30.5	3.5
[72,]	340	64	9	11.5	30.5
[73,]	771	3721	39	0.5	0.5
[74,]	3869	1521	21	9.5	9.5
[75,]	319	64	4	30.5	30.5
[76,]	233	81	5	9.0	12.5
[77,]	298	361	61	0.5	7.5
[78,]	181	3721	23	19.5	10.5
[79,]	519	529	1	4.0	28.5
[80,]	3881	1	19	2.5	9.0
[81,]	1387	361	54	9.0	2.5
[82,]	3413	3721	61	30.5	30.5
[83,]	650	196	15	3.5	3.0
[84,]	193	225	18	6.0	0.5
[85,]	3891	1521	61	0.5	6.0
[86,]	208	3721	38	2.0	6.0
[87,]	175	1	15	30.5	4.5
[88,]	320	3721	14	19.5	7.0
[89,]	322	484	7	4.0	3.5
[90,]	205	25	9	2.5	30.5
[91,]	378	324	39	9.0	19.5
[92,]	3905	625	21	2.5	4.0
[93,]	190	3721	4	30.5	9.0
[94,]	813	49	5	11.5	7.5
[95,]	3911	225	61	0.5	10.5
[96,]	1713	225	5	9.5	3.5
[97,]	258	16	9	30.5	4.0
[98,]	277	3721	39	7.0	30.5
[99,]	559	225	8	7.5	19.5
[100,]	3921	256	5	30.5	4.0



[101,]	1723	256	18	7.5	2.5
[102,]	285	225	54	7.0	30.5
[103,]	375	324	61	2.5	0.5
[104,]	233	1521	2	30.5	4.5
[105,]	3346	441	21	6.0	9.0
[106,]	3576	196	39	4.5	27.5
[107,]	3935	81	61	9.5	30.5
[108,]	577	1521	39	19.5	15.0
[109,]	282	625	8	2.5	7.5
[110,]	245	3721	15	7.0	30.5
[111,]	3943	36	21	4.5	12.5
[112,]	585	225	7	7.0	7.5
[113,]	227	324	8	3.5	10.5
[114,]	309	3721	39	27.0	30.5
[115,]	246	361	61	30.5	19.5
[116,]	3953	64	39	19.5	4.0
[117,]	235	225	8	4.0	4.5
[118,]	380	529	5	4.5	7.0
[119,]	463	81	25	9.5	5.5
[120,]	681	196	61	30.5	30.5
[121,]	258	49	23	19.5	12.5
[122,]	3053	3721	5	4.5	7.5
[123,]	3967	225	18	6.5	10.5
[124,]	3612	36	5	2.5	30.5
[125,]	1475	36	61	27.0	1.5
[126,]	3973	3721	14	30.5	7.5
[127,]	423	64	9	0.5	10.5
[128,]	697	25	3	9.5	6.0
[129,]	619	324	5	30.5	2.0
[130,]	1781	3721	61	4.5	30.5
[131,]	3983	121	7	19.5	6.5
[132,]	268	196	18	30.5	0.5
[133,]	291	225	1	2.0	7.0
[134,]	3989	529	14	4.5	0.5
[135,]	319	144	4	2.0	3.5
[136,]	297	25	61	7.0	2.5
[137,]	1795	16	23	28.5	30.5
[138,]	1797	49	15	19.5	4.5
[139,]	359	25	18	30.5	19.5
[140,]	476	2916	4	9.5	28.0
[141,]	331	3721	19	7.5	30.0
[142,]	4005	1	61	10.5	30.5
[143,]	647	361	39	7.0	29.0

[144,]	513	3721	15	2.0	13.5
[145,]	459	1521	61	30.5	7.0
[146,]	317	64	19	0.5	2.0
[147,]	823	25	1	19.5	30.5
[148,]	360	324	25	30.5	11.5
[149,]	323	25	53	0.5	4.0
[150,]	624	3721	60	6.0	0.5
[151,]	327	529	42	6.0	19.5
[152,]	4025	1	18	30.5	30.5
[153,]	502	361	5	19.5	0.5
[154,]	333	3721	19	4.0	7.0
[155,]	311	196	5	2.5	30.5
[156,]	636	225	14	30.5	4.5
[157,]	4035	3721	39	9.0	3.5
[158,]	1837	225	12	4.5	7.0
[159,]	382	196	25	3.5	7.5
[160,]	345	25	61	4.0	9.0
[161,]	4043	3721	19	19.5	0.5
[162,]	333	1521	8	30.5	7.0
[163,]	351	225	5	11.5	19.5
[164,]	524	3721	61	7.5	30.5
[165,]	1851	144	2	9.0	6.0
[166,]	656	81	5	2.0	4.5
[167,]	359	361	7	30.0	19.5
[168,]	4057	1521	1	30.5	19.5
[169,]	563	25	14	29.0	6.0
[170,]	376	196	61	32.0	2.5
[171,]	4063	3721	1	1.0	30.5
[172,]	1865	1521	7	10.5	3.5
[173,]	410	225	1	19.5	4.5
[174,]	373	3721	9	30.5	9.0
[175,]	4071	64	14	17.5	6.0
[176,]	377	25	53	30.5	30.5
[177,]	355	324	61	9.5	9.5
[178,]	680	2916	58	4.0	4.0
[179,]	1879	3721	35	0.5	2.5
[180,]	424	361	61	6.0	28.5
[181,]	3171	1521	23	6.0	6.0
[182,]	4085	81	15	30.5	6.0
[183,]	1810	144	14	4.0	30.5
[184,]	393	144	4	0.5	19.5
[185,]	1891	3721	5	11.0	4.0
[186,]	4093	81	18	2.5	4.5

[187,]	543	1521	61	30.5	7.0
[188,]	401	3721	9	19.5	5.5
[189,]	4099	529	6	7.5	30.5
[190,]	741	1	61	30.5	6.5
[191,]	407	19	35	0.5	2.5
[192,]	409	61	61	9.5	30.5
[193,]	4230	7	19	5.5	3.0
[194,]	4109	15	8	30.5	7.5
[195,]	1911	15	1	19.5	9.0
[196,]	456	4	12	4.0	30.5
[197,]	395	61	12	2.5	0.5
[198,]	1917	16	61	6.5	9.5
[199,]	4119	18	6	30.5	5.5
[200,]	929	1	1	11.5	4.5
[201,]	627	3	12	4.0	7.0
[202,]	845	39	12	0.5	3.5
[203,]	550	9	61	19.5	27.5
[204,]	424	3	18	30.5	30.5
[205,]	4131	5	9	19.5	20.0
[206,]	416	61	7	4.0	7.5
[207,]	439	39	8	2.5	27.0
[208,]	4137	15	39	30.5	30.5
[209,]	454	61	61	7.0	4.5
[210,]	645	19	39	0.5	19.5
[211,]	863	1	8	6.5	28.5
[212,]	748	25	18	2.5	6.0
[213,]	4147	61	15	30.5	6.0
[214,]	1949	9	21	7.5	30.5
[215,]	494	39	7	3.0	7.0
[216,]	657	61	8	30.5	2.5
[217,]	875	15	61	19.5	11.0
[218,]	797	22	39	4.0	2.5
[219,]	439	5	8	2.5	9.0
[220,]	636	18	5	30.5	30.5
[221,]	458	60	61	1.5	2.0
[222,]	4165	61	5	7.5	7.5
[223,]	615	58	1	10.5	30.5
[224,]	529	64	18	7.0	19.5
[225,]	594	25	39	19.5	7.5
[226,]	477	5	8	9.0	30.5
[227,]	815	19	55	12.5	0.5
[228,]	4177	54	61	30.5	9.5
[229,]	474	61	34	4.5	5.5

[230,]	685	39	15	9.5	31.0
[231,]	991	8	23	27.0	30.5
[232,]	660	1	61	30.5	8.0
[233,]	3382	39	6	12.5	2.5
[234,]	4189	57	21	7.5	9.0
[235,]	1695	19	14	10.5	4.0
[236,]	4193	61	14	30.5	0.5
[237,]	1995	1	25	5.5	8.0
[238,]	540	2	61	7.0	9.5
[239,]	559	15	9	7.5	30.5
[240,]	676	21	39	11.5	17.5
[241,]	603	39	57	26.5	30.5
[242,]	4580	61	12	30.5	9.5
[243,]	3850	39	12	21.0	4.0
[244,]	4209	8	61	6.0	0.5
[245,]	3971	5	19	2.5	6.0
[246,]	528	61	5	0.5	6.0
[247,]	719	18	5	9.5	30.5
[248,]	820	9	13	2.5	9.5
[249,]	3414	7	61	27.0	2.5
[250,]	4221	8	39	30.5	2.5
[251,]	1127	39	15	19.5	30.5
[252,]	729	61	61	0.5	4.5
[253,]	947	4	3	28.5	19.5
[254,]	4229	9	15	0.5	30.5
[255,]	871	19	13	6.5	11.5
[256,]	537	39	5	27.0	9.0
[257,]	539	1	61	30.5	4.5
[258,]	3432	14	15	4.5	19.5
[259,]	4239	3	21	9.5	19.5
[260,]	1249	5	39	30.5	2.5
[261,]	666	64	61	19.5	7.0
[262,]	605	2	1	4.0	30.5
[263,]	535	21	13	4.5	10.5
[264,]	553	39	15	9.5	8.0
[265,]	4251	61	14	30.5	30.5
[266,]	596	39	7	20.0	9.5
[267,]	535	8	61	2.5	7.5
[268,]	552	5	39	11.5	6.5
[269,]	4259	14	8	30.5	2.5
[270,]	684	61	5	26.0	11.5
[271,]	567	35	61	2.5	4.0
[272,]	545	61	16	0.5	2.5

```
[273,] 870 23 5 6.0 9.0
[274,] 744 15 15 0.5 2.5
[275,] 2071 14 16 7.0 26.5
[276,] 4273 4 12 2.0 29.0
```

5. Separately from your `top_secret` numbers, create a new vector called “evens” of all the even numbers between 1 and 552. That is, “evens” should contain 2, 4, 6, 8 ..., 552.

```
evens <- seq(2, 552, by = 2)
```

```
evens
```

```
[1] 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
[19] 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
[37] 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108
[55] 110 112 114 116 118 120 122 124 126 128 130 132 134 136 138 140 142 144
[73] 146 148 150 152 154 156 158 160 162 164 166 168 170 172 174 176 178 180
[91] 182 184 186 188 190 192 194 196 198 200 202 204 206 208 210 212 214 216
[109] 218 220 222 224 226 228 230 232 234 236 238 240 242 244 246 248 250 252
[127] 254 256 258 260 262 264 266 268 270 272 274 276 278 280 282 284 286 288
[145] 290 292 294 296 298 300 302 304 306 308 310 312 314 316 318 320 322 324
[163] 326 328 330 332 334 336 338 340 342 344 346 348 350 352 354 356 358 360
[181] 362 364 366 368 370 372 374 376 378 380 382 384 386 388 390 392 394 396
[199] 398 400 402 404 406 408 410 412 414 416 418 420 422 424 426 428 430 432
[217] 434 436 438 440 442 444 446 448 450 452 454 456 458 460 462 464 466 468
[235] 470 472 474 476 478 480 482 484 486 488 490 492 494 496 498 500 502 504
[253] 506 508 510 512 514 516 518 520 522 524 526 528 530 532 534 536 538 540
[271] 542 544 546 548 550 552
```

6. Subtract the “evens” vector from the first column of your secret message matrix.

```
secret_matrix[, 1] <- secret_matrix[, 1] - evens
```

```
secret_matrix
```

```
      [,1] [,2] [,3] [,4] [,5]
[1,]    30  361    5  2.5 30.5
[2,]    15   25   18 30.5  7.5
[3,]    23  484   61 19.5  9.0
[4,]    14   25   23  4.0 30.5
[5,]    54  324    8  0.5 13.5
[6,]    61    1    1 19.5 10.5
```

[7,]	4	144	39	30.5	9.5
[8,]	15	3721	61	11.5	19.5
[9,]	23	1521	38	0.5	9.0
[10,]	14	64	1	6.0	0.5
[11,]	54	81	39	5.5	6.0
[12,]	61	196	9	30.5	4.5
[13,]	4	49	39	11.5	0.5
[14,]	15	361	21	4.5	28.0
[15,]	23	3721	4	19.5	29.0
[16,]	14	225	5	4.0	30.5
[17,]	53	36	61	30.5	29.5
[18,]	61	3721	115	19.5	0.5
[19,]	49	1521	118	4.0	7.0
[20,]	15	64	161	2.5	2.0
[21,]	21	81	138	4.5	30.5
[22,]	12	361	115	9.0	9.5
[23,]	4	3721	114	30.5	4.0
[24,]	61	361	107	4.0	2.5
[25,]	39	225	9	2.5	30.5
[26,]	8	324	39	0.5	19.5
[27,]	5	1521	21	2.0	9.0
[28,]	61	3721	4	9.5	4.5
[29,]	6	81	5	30.5	2.5
[30,]	1	196	61	2.0	2.0
[31,]	12	3721	35	7.5	30.5
[32,]	12	64	57	11.5	19.5
[33,]	61	25	22	7.0	7.5
[34,]	14	324	5	11.5	30.5
[35,]	5	3721	61	0.5	1.5
[36,]	22	144	7	9.0	10.5
[37,]	5	25	15	2.0	9.0
[38,]	324	361	39	27.5	19.5
[39,]	3721	361	61	30.5	9.5
[40,]	9	225	39	23.0	2.5
[41,]	225	196	15	4.0	12.5
[42,]	169	361	56	2.5	30.5
[43,]	25	3721	58	30.5	0.5
[44,]	3721	81	61	13.5	9.5
[45,]	1521	196	59	7.0	30.5
[46,]	225	3721	27	19.5	9.5
[47,]	3721	1521	12	4.5	4.0
[48,]	1	64	9	8.0	2.5
[49,]	196	25	3	0.5	30.5

[50,]	3721	3721	5	19.5	9.5
[51,]	25	361	61	4.0	8.0
[52,]	196	9	8	4.5	7.5
[53,]	16	64	1	2.5	5.5
[54,]	3136	225	4	9.5	2.5
[55,]	3721	225	61	27.0	32.0
[56,]	3364	144	14	30.5	3.0
[57,]	1225	324	15	17.5	0.5
[58,]	3721	225	61	30.5	7.0
[59,]	529	225	9	19.5	1.5
[60,]	225	169	4	4.0	12.5
[61,]	196	2916	5	4.5	30.5
[62,]	16	3721	1	7.0	1.5
[63,]	25	1	61	5.5	10.5
[64,]	324	196	23	32.0	9.0
[65,]	3721	16	8	29.0	19.5
[66,]	64	3721	1	30.5	9.5
[67,]	225	1521	39	29.5	2.5
[68,]	529	64	61	9.5	12.5
[69,]	3721	225	38	4.0	4.5
[70,]	169	441	1	2.5	7.0
[71,]	1	49	39	30.5	3.5
[72,]	196	64	9	11.5	30.5
[73,]	625	3721	39	0.5	0.5
[74,]	3721	1521	21	9.5	9.5
[75,]	169	64	4	30.5	30.5
[76,]	81	81	5	9.0	12.5
[77,]	144	361	61	0.5	7.5
[78,]	25	3721	23	19.5	10.5
[79,]	361	529	1	4.0	28.5
[80,]	3721	1	19	2.5	9.0
[81,]	1225	361	54	9.0	2.5
[82,]	3249	3721	61	30.5	30.5
[83,]	484	196	15	3.5	3.0
[84,]	25	225	18	6.0	0.5
[85,]	3721	1521	61	0.5	6.0
[86,]	36	3721	38	2.0	6.0
[87,]	1	1	15	30.5	4.5
[88,]	144	3721	14	19.5	7.0
[89,]	144	484	7	4.0	3.5
[90,]	25	25	9	2.5	30.5
[91,]	196	324	39	9.0	19.5
[92,]	3721	625	21	2.5	4.0

[93,]	4	3721	4	30.5	9.0
[94,]	625	49	5	11.5	7.5
[95,]	3721	225	61	0.5	10.5
[96,]	1521	225	5	9.5	3.5
[97,]	64	16	9	30.5	4.0
[98,]	81	3721	39	7.0	30.5
[99,]	361	225	8	7.5	19.5
[100,]	3721	256	5	30.5	4.0
[101,]	1521	256	18	7.5	2.5
[102,]	81	225	54	7.0	30.5
[103,]	169	324	61	2.5	0.5
[104,]	25	1521	2	30.5	4.5
[105,]	3136	441	21	6.0	9.0
[106,]	3364	196	39	4.5	27.5
[107,]	3721	81	61	9.5	30.5
[108,]	361	1521	39	19.5	15.0
[109,]	64	625	8	2.5	7.5
[110,]	25	3721	15	7.0	30.5
[111,]	3721	36	21	4.5	12.5
[112,]	361	225	7	7.0	7.5
[113,]	1	324	8	3.5	10.5
[114,]	81	3721	39	27.0	30.5
[115,]	16	361	61	30.5	19.5
[116,]	3721	64	39	19.5	4.0
[117,]	1	225	8	4.0	4.5
[118,]	144	529	5	4.5	7.0
[119,]	225	81	25	9.5	5.5
[120,]	441	196	61	30.5	30.5
[121,]	16	49	23	19.5	12.5
[122,]	2809	3721	5	4.5	7.5
[123,]	3721	225	18	6.5	10.5
[124,]	3364	36	5	2.5	30.5
[125,]	1225	36	61	27.0	1.5
[126,]	3721	3721	14	30.5	7.5
[127,]	169	64	9	0.5	10.5
[128,]	441	25	3	9.5	6.0
[129,]	361	324	5	30.5	2.0
[130,]	1521	3721	61	4.5	30.5
[131,]	3721	121	7	19.5	6.5
[132,]	4	196	18	30.5	0.5
[133,]	25	225	1	2.0	7.0
[134,]	3721	529	14	4.5	0.5
[135,]	49	144	4	2.0	3.5



[136,]	25	25	61	7.0	2.5
[137,]	1521	16	23	28.5	30.5
[138,]	1521	49	15	19.5	4.5
[139,]	81	25	18	30.5	19.5
[140,]	196	2916	4	9.5	28.0
[141,]	49	3721	19	7.5	30.0
[142,]	3721	1	61	10.5	30.5
[143,]	361	361	39	7.0	29.0
[144,]	225	3721	15	2.0	13.5
[145,]	169	1521	61	30.5	7.0
[146,]	25	64	19	0.5	2.0
[147,]	529	25	1	19.5	30.5
[148,]	64	324	25	30.5	11.5
[149,]	25	25	53	0.5	4.0
[150,]	324	3721	60	6.0	0.5
[151,]	25	529	42	6.0	19.5
[152,]	3721	1	18	30.5	30.5
[153,]	196	361	5	19.5	0.5
[154,]	25	3721	19	4.0	7.0
[155,]	1	196	5	2.5	30.5
[156,]	324	225	14	30.5	4.5
[157,]	3721	3721	39	9.0	3.5
[158,]	1521	225	12	4.5	7.0
[159,]	64	196	25	3.5	7.5
[160,]	25	25	61	4.0	9.0
[161,]	3721	3721	19	19.5	0.5
[162,]	9	1521	8	30.5	7.0
[163,]	25	225	5	11.5	19.5
[164,]	196	3721	61	7.5	30.5
[165,]	1521	144	2	9.0	6.0
[166,]	324	81	5	2.0	4.5
[167,]	25	361	7	30.0	19.5
[168,]	3721	1521	1	30.5	19.5
[169,]	225	25	14	29.0	6.0
[170,]	36	196	61	32.0	2.5
[171,]	3721	3721	1	1.0	30.5
[172,]	1521	1521	7	10.5	3.5
[173,]	64	225	1	19.5	4.5
[174,]	25	3721	9	30.5	9.0
[175,]	3721	64	14	17.5	6.0
[176,]	25	25	53	30.5	30.5
[177,]	1	324	61	9.5	9.5
[178,]	324	2916	58	4.0	4.0

[179,]	1521	3721	35	0.5	2.5
[180,]	64	361	61	6.0	28.5
[181,]	2809	1521	23	6.0	6.0
[182,]	3721	81	15	30.5	6.0
[183,]	1444	144	14	4.0	30.5
[184,]	25	144	4	0.5	19.5
[185,]	1521	3721	5	11.0	4.0
[186,]	3721	81	18	2.5	4.5
[187,]	169	1521	61	30.5	7.0
[188,]	25	3721	9	19.5	5.5
[189,]	3721	529	6	7.5	30.5
[190,]	361	1	61	30.5	6.5
[191,]	25	19	35	0.5	2.5
[192,]	25	61	61	9.5	30.5
[193,]	3844	7	19	5.5	3.0
[194,]	3721	15	8	30.5	7.5
[195,]	1521	15	1	19.5	9.0
[196,]	64	4	12	4.0	30.5
[197,]	1	61	12	2.5	0.5
[198,]	1521	16	61	6.5	9.5
[199,]	3721	18	6	30.5	5.5
[200,]	529	1	1	11.5	4.5
[201,]	225	3	12	4.0	7.0
[202,]	441	39	12	0.5	3.5
[203,]	144	9	61	19.5	27.5
[204,]	16	3	18	30.5	30.5
[205,]	3721	5	9	19.5	20.0
[206,]	4	61	7	4.0	7.5
[207,]	25	39	8	2.5	27.0
[208,]	3721	15	39	30.5	30.5
[209,]	36	61	61	7.0	4.5
[210,]	225	19	39	0.5	19.5
[211,]	441	1	8	6.5	28.5
[212,]	324	25	18	2.5	6.0
[213,]	3721	61	15	30.5	6.0
[214,]	1521	9	21	7.5	30.5
[215,]	64	39	7	3.0	7.0
[216,]	225	61	8	30.5	2.5
[217,]	441	15	61	19.5	11.0
[218,]	361	22	39	4.0	2.5
[219,]	1	5	8	2.5	9.0
[220,]	196	18	5	30.5	30.5
[221,]	16	60	61	1.5	2.0

[222,]	3721	61	5	7.5	7.5
[223,]	169	58	1	10.5	30.5
[224,]	81	64	18	7.0	19.5
[225,]	144	25	39	19.5	7.5
[226,]	25	5	8	9.0	30.5
[227,]	361	19	55	12.5	0.5
[228,]	3721	54	61	30.5	9.5
[229,]	16	61	34	4.5	5.5
[230,]	225	39	15	9.5	31.0
[231,]	529	8	23	27.0	30.5
[232,]	196	1	61	30.5	8.0
[233,]	2916	39	6	12.5	2.5
[234,]	3721	57	21	7.5	9.0
[235,]	1225	19	14	10.5	4.0
[236,]	3721	61	14	30.5	0.5
[237,]	1521	1	25	5.5	8.0
[238,]	64	2	61	7.0	9.5
[239,]	81	15	9	7.5	30.5
[240,]	196	21	39	11.5	17.5
[241,]	121	39	57	26.5	30.5
[242,]	4096	61	12	30.5	9.5
[243,]	3364	39	12	21.0	4.0
[244,]	3721	8	61	6.0	0.5
[245,]	3481	5	19	2.5	6.0
[246,]	36	61	5	0.5	6.0
[247,]	225	18	5	9.5	30.5
[248,]	324	9	13	2.5	9.5
[249,]	2916	7	61	27.0	2.5
[250,]	3721	8	39	30.5	2.5
[251,]	625	39	15	19.5	30.5
[252,]	225	61	61	0.5	4.5
[253,]	441	4	3	28.5	19.5
[254,]	3721	9	15	0.5	30.5
[255,]	361	19	13	6.5	11.5
[256,]	25	39	5	27.0	9.0
[257,]	25	1	61	30.5	4.5
[258,]	2916	14	15	4.5	19.5
[259,]	3721	3	21	9.5	19.5
[260,]	729	5	39	30.5	2.5
[261,]	144	64	61	19.5	7.0
[262,]	81	2	1	4.0	30.5
[263,]	9	21	13	4.5	10.5
[264,]	25	39	15	9.5	8.0

```
[265,] 3721 61 14 30.5 30.5
[266,] 64 39 7 20.0 9.5
[267,] 1 8 61 2.5 7.5
[268,] 16 5 39 11.5 6.5
[269,] 3721 14 8 30.5 2.5
[270,] 144 61 5 26.0 11.5
[271,] 25 35 61 2.5 4.0
[272,] 1 61 16 0.5 2.5
[273,] 324 23 5 6.0 9.0
[274,] 196 15 15 0.5 2.5
[275,] 1521 14 16 7.0 26.5
[276,] 3721 4 12 2.0 29.0
```

7. Subtract 100 from all numbers 18-24th rows of the 3rd column.

```
secret_matrix[18:24, 3] <- secret_matrix[18:24, 3] - 100
```

8. Multiply all numbers in the 4th and 5th column by 2.

```
secret_matrix[, 4] <- secret_matrix[, 4] * 2
secret_matrix[, 5] <- secret_matrix[, 5] * 2
```

9. Turn your matrix back into a vector.

```
top_secret_vector <- as.vector(secret_matrix)
top_secret_vector
```

```
[1] 30 15 23 14 54 61 4 15 23 14 54 61 4 15
[15] 23 14 53 61 49 15 21 12 4 61 39 8 5 61
[29] 6 1 12 12 61 14 5 22 5 324 3721 9 225 169
[43] 25 3721 1521 225 3721 1 196 3721 25 196 16 3136 3721 3364
[57] 1225 3721 529 225 196 16 25 324 3721 64 225 529 3721 169
[71] 1 196 625 3721 169 81 144 25 361 3721 1225 3249 484 25
[85] 3721 36 1 144 144 25 196 3721 4 625 3721 1521 64 81
[99] 361 3721 1521 81 169 25 3136 3364 3721 361 64 25 3721 361
[113] 1 81 16 3721 1 144 225 441 16 2809 3721 3364 1225 3721
[127] 169 441 361 1521 3721 4 25 3721 49 25 1521 1521 81 196
[141] 49 3721 361 225 169 25 529 64 25 324 25 3721 196 25
[155] 1 324 3721 1521 64 25 3721 9 25 196 1521 324 25 3721
[169] 225 36 3721 1521 64 25 3721 25 1 324 1521 64 2809 3721
[183] 1444 25 1521 3721 169 25 3721 361 25 25 3844 3721 1521 64
[197] 1 1521 3721 529 225 441 144 16 3721 4 25 3721 36 225
```

[211]	441	324	3721	1521	64	225	441	361	1	196	16	3721	169	81
[225]	144	25	361	3721	16	225	529	196	2916	3721	1225	3721	1521	64
[239]	81	196	121	4096	3364	3721	3481	36	225	324	2916	3721	625	225
[253]	441	3721	361	25	25	2916	3721	729	144	81	9	25	3721	64
[267]	1	16	3721	144	25	1	324	196	1521	3721	361	25	484	25
[281]	324	1	144	3721	1521	64	81	196	49	361	3721	225	36	3721
[295]	1521	64	81	361	3721	361	225	324	1521	3721	81	196	3721	64
[309]	25	324	3721	144	25	361	361	225	196	361	3721	81	196	3721
[323]	1521	64	25	3721	361	9	64	225	225	144	324	225	225	169
[337]	2916	3721	1	196	16	3721	1521	64	225	441	49	64	3721	1521
[351]	64	81	361	3721	529	1	361	3721	196	225	1521	3721	1	3721
[365]	484	25	324	625	3721	49	225	225	16	3721	225	256	256	225
[379]	324	1521	441	196	81	1521	625	3721	36	225	324	3721	361	64
[393]	225	529	81	196	49	3721	225	36	36	3721	64	25	324	3721
[407]	121	196	225	529	144	25	16	49	25	2916	3721	1	361	3721
[421]	1521	64	25	324	25	3721	529	1	361	3721	196	225	3721	225
[435]	196	25	3721	1521	225	3721	144	81	361	1521	25	196	3721	1521
[449]	225	3721	64	25	324	2916	3721	361	1521	81	144	144	3721	81
[463]	1521	3721	529	1	19	61	7	15	15	4	61	16	18	1
[477]	3	39	9	3	5	61	39	15	61	19	1	25	61	9
[491]	39	61	15	22	5	18	60	61	58	64	25	5	19	54
[505]	61	39	8	1	39	57	19	61	1	2	15	21	39	61
[519]	39	8	5	61	18	9	7	8	39	61	4	9	19	39
[533]	1	14	3	5	64	2	21	39	61	39	8	5	14	61
[547]	35	61	23	15	14	4	5	18	61	23	8	1	39	61
[561]	38	1	39	9	39	21	4	5	61	15	18	61	38	15
[575]	14	7	9	39	21	4	5	61	35	57	22	5	61	7
[589]	15	39	61	39	15	56	58	61	59	27	12	9	3	5
[603]	61	8	1	4	61	14	15	61	9	4	5	1	61	23
[617]	8	1	39	61	38	1	39	9	39	21	4	5	61	23
[631]	1	19	54	61	15	18	61	38	15	14	7	9	39	21
[645]	4	5	61	5	9	39	8	5	18	54	61	2	21	39
[659]	61	39	8	15	21	7	8	39	61	39	8	5	25	61
[673]	23	5	18	5	61	14	9	3	5	61	7	18	1	14
[687]	4	61	23	15	18	4	19	61	39	15	61	19	1	25
[701]	53	60	42	18	5	19	5	14	39	12	25	61	19	8
[715]	5	61	2	5	7	1	14	61	1	7	1	9	14	53
[729]	61	58	35	61	23	15	14	4	5	18	61	9	6	61
[743]	35	61	19	8	1	12	12	61	6	1	12	12	61	18
[757]	9	7	8	39	61	39	8	18	15	21	7	8	61	39
[771]	8	5	61	5	1	18	39	8	55	61	34	15	23	61
[785]	6	21	14	14	25	61	9	39	57	12	12	61	19	5
[799]	5	13	61	39	15	61	3	15	13	5	61	15	21	39

[813]	61	1	13	15	14	7	61	39	8	5	61	16	5	15
[827]	16	12	5	61	39	8	1	39	61	23	1	12	11	61
[841]	23	9	39	8	61	39	8	5	9	18	61	8	5	1
[855]	4	19	61	4	15	23	14	23	1	18	4	55	61	46
[869]	8	5	61	27	14	39	9	16	1	39	8	9	5	19
[883]	54	61	35	61	39	8	9	14	11	64	58	61	59	19
[897]	8	5	61	23	1	19	61	18	1	39	8	5	18	61
[911]	7	12	1	4	61	39	8	5	18	5	61	23	1	19
[925]	61	14	15	61	15	14	5	61	12	9	19	39	5	14
[939]	9	14	7	54	61	39	8	9	19	61	39	9	13	5
[953]	54	61	1	19	61	9	39	61	4	9	4	14	57	39
[967]	61	19	15	21	14	4	61	1	39	61	1	12	12	61
[981]	39	8	5	61	18	9	7	8	39	61	23	15	18	4
[995]	60	61	58	64	2	21	39	61	35	61	19	8	1	12
[1009]	12	61	8	1	22	5	61	39	15	61	1	19	11	61
[1023]	39	8	5	13	61	23	8	1	39	61	39	8	5	61
[1037]	14	1	13	5	61	15	6	61	39	8	5	61	3	15
[1051]	21	14	39	18	25	61	9	19	54	61	25	15	21	61
[1065]	11	14	15	23	53	61	42	12	5	1	19	5	54	61
[1079]	39	1	57	1	13	54	61	9	19	61	39	8	9	19
[1093]	61	40	5	23	61	52	5	1	12	1	14	4	61	15
[1107]	18	61	27	21	19	39	18	1	12	9	1	56	58	61
[1121]	59	1	14	4	61	19	8	5	61	39	18	9	5	4
[1135]	61	39	15	61	3	21	18	39	19	5	25	61	1	19
[1149]	61	19	8	5	61	19	16	15	11	5	64	6	1	14
[1163]	3	25	61	3	21	18	39	19	5	25	9	14	7	61
[1177]	1	19	61	25	15	21	57	18	5	61	6	1	12	12
[1191]	9	14	7	61	39	8	18	15	21	7	8	61	39	8
[1205]	5	61	1	9	18	55	61	30	15	61	25	15	21	61
[1219]	39	8	9	14	11	61	25	15	21	61	3	15	21	12
[1233]	4	61	13	1	14	1	7	5	61	9	39	56	60	61
[1247]	58	27	14	4	61	23	8	1	39	61	1	14	61	9
[1261]	7	14	15	18	1	14	39	61	12	9	39	39	12	5
[1275]	61	7	9	18	12	61	19	8	5	57	12	12	61	39
[1289]	8	9	14	11	61	13	5	61	6	15	18	61	1	19
[1303]	11	9	14	7	55	61	40	15	54	61	9	39	57	12
[1317]	12	61	14	5	22	5	18	61	4	15	61	39	15	61
[1331]	1	19	11	62	61	16	5	18	8	1	16	19	61	35
[1345]	61	19	8	1	12	12	61	19	5	5	61	9	39	61
[1359]	23	18	9	39	39	5	14	61	21	16	61	19	15	13
[1373]	5	23	8	5	18	5	53	58						

### Checkpoint

Headquarters has informed you that at this stage of decoding, all numbers in indices 500 and beyond are below 70.

*Hint:* Use a relational comparison similar to what you used in the last checkpoint, but here you will need to subset values from your vector! It may be helpful to think of below as *not equal* to or *smaller than* 70.

```
sum(top_secret_vector[500:length(top_secret_vector)] > 70)
```

```
[1] 0
```

10. Take the square root of all numbers in indices 38 to 465.

```
top_secret_vector[38:465] <- sqrt(top_secret_vector[38:465])
```

11. Round all numbers to the nearest whole number.

```
top_secret_vector <- round(top_secret_vector)
```

12. Replace all instances of the number 39 with 20.

```
top_secret_vector[top_secret_vector == 39] <- 20
```

### Checkpoint

Headquarters has informed you that your final message should have 507 even numbers.

*Hint:* Checking for divisibility is an interesting operation that isn't done much in R. Modulus is the operation you are interested in, where you are checking for whether the numbers are divisible by 2, with no remainder. See what you can find about modulus in R!

```
sum(top_secret_vector %% 2 == 0) # Should return 507 even numbers
```

```
[1] 507
```

```
# Should be 507!
```

## Part Four: The secret message!

Use your final vector of numbers as indices for `my_symbols` to discover the final message! The code to do so is already there for you:

```
cat(my_symbols$Symbol[top_secret_vector], sep = "")
```

Down, down, down. Would the fall never come to an end? “I wonder how many miles I’ve fallen by this time?” she said aloud. “I must be getting somewhere near the centre of the earth. Let me see: that would be four thousand miles down, I think—” (for, you see, Alice had learnt several things of this sort in her lessons in the schoolroom, and though this was not a very good opportunity for showing off her knowledge, as there was no one to listen to her, still it was good practice to say it over) “—yes, that’s about the right distance—but then I wonder what Latitude or Longitude I’ve got to?” (Alice had no idea what Latitude was, or Longitude either, but thought they were nice grand words to say.) Presently she began again. “I wonder if I shall fall right through the earth! How funny it’ll seem to come out among the people that walk with their heads downward! The Antipathies, I think—” (she was rather glad there was no one listening, this time, as it didn’t sound at all the right word) “—but I shall have to ask them what the name of the country is, you know. Please, ta’am, is this New Zealand or Australia?” (and she tried to curtsy as she spoke—fancy curtseying as you’re falling through the air! Do you think you could manage it?) “And what an ignorant little girl she’ll think me for asking! No, it’ll never do to ask: perhaps I shall see it written up somewhere.”

Google the message, if you do not recognize it, and find its title and author.

### Solution

Title: Alice’s Adventures in Wonderland and Author: Lewis Carroll

Upload the .qmd doc and the rendered html to Blackboard (don’t forget to add all your teammates names!). The first team receives an extra point each in class participation