Problem A

Card Game

Judging instructions : Two points for each scoring line ($6 \times 2 = 12$), and three points total for the two summary lines. Total 15 points.

Input file card.in :

```
seven
jack
six
six
two
two
seven
nine
ace
queen
queen
king
jack
seven
four
ten
nine
eight
jack
ace
seven
eight
three
five
eight
six
three
three
four
ten
four
nine
five
queen
nine
five
two
jack
two
king
three
ten
ten
ace
four
five
eight
ace
king
king
queen
six
```

Output file card.out :

```
Player B scores 1 point(s).
Player A scores 1 point(s).
Player B scores 4 point(s).
Player B scores 2 point(s).
Player B scores 1 point(s).
Player B scores 3 point(s).
Player A: 1 point(s).
Player B: 11 point(s).


.
```

Problem 2

Year 2000

Judging instructions : There are 13 dates which should be changed. Deduct a point for each of these which was not converted. If other errors are made, deduct a point for each up to 2 points. These errors include converting a date which should not have been converted and garbling other text. Total 15 points.

Input file y2k.in :

```
16
Before 02/03/04, but not after December 19, 99,
there was a rehash of the 55.34.02 meeting.  A date, like November 15,
95 cannot traverse two lines, nor can it be surrounded by alphabetics
or numerics like this:  78November 01, 88, or 6801/12/03, or 02/03/04x.
January 01, 25 February 28, 99
 MMarch 20, 24 March 89,24...April 0, 00  May 99, 01 this is it
March 2A, 12  March 21, 12 March 21, 1A April 8, 8 April 08, 08
April  8,  8   May 01,01  June 30, 89, December 01/02/03
01.02.03  99.02.04  02.99.04  02.04.99
January 02, 02
January 02,
December 31, 99
02/03/04
99.11.11

hello there
```

Output file y2k.out :

```
Before 02/03/2004, but not after December 19, 1999,
there was a rehash of the 55.34.02 meeting.  A date, like November 15,
95 cannot traverse two lines, nor can it be surrounded by alphabetics
or numerics like this:  78November 01, 88, or 6801/12/03, or 02/03/04x.
January 01, 1925 February 28, 1999
 MMarch 20, 24 March 89,24...April 0, 00  May 99, 01 this is it
March 2A, 12  March 21, 2012 March 21, 1A April 8, 8 April 08, 2008
April  8,  8   May 01,01  June 30, 1989, December 01/02/2003
2001.02.03  1999.02.04  02.99.04  02.04.99
January 02, 2002
January 02,
December 31, 1999
02/03/2004
1999.11.11

hello there
```

Problem 3

Divided Fractals

Judging instructions : Parts a), b), and c) are worth 3 points each. Part d) has 6 test cases worth 1 point each. Total 15 points.

Input file frac.in :

```
6
3
2
10
5
27
5
13
43
100
139
0
1
1
1
1
1
1
3
1
3
2
1
9
1
9
4
42
81
42
81
```

(a) If the process is repeated n times ($n \geq 1$), how many holes are there in the square?

Judging instructions: There should be a brief explanation of the answer.
Give up to **3** points for a correct answer with justification.

Answer: The first iteration produces 1 hole. Every iteration after the first produces 8 holes around each of the holes produced in the previous iteration, so the second iteration produces 8(1) = 8 holes, the third produces 8(8) = 64 holes and so on.

Thus the total number of holes after n iterations is :

$1 + 8 + 64 + \ldots + 8^{n-1} = \frac{8^n - 1}{7}$. (Note that the final sum is not needed to get full marks, the series is sufficient.)

(b) After *n* iterations, what is the total filled area?

Judging instructions: The answer is worth **3** points. Some explanation should be provided.

Answer: Each iteration removes $\frac{1}{9}$ of the area, so after each iteration there is $\frac{8}{9}$ of the area filled after the previous iteration. Thus after the first iteration $\frac{8}{9}$ of the area is filled, after two iterations $\frac{8}{9}$ ($\frac{8}{9}$) of the area is filled, and so on.

The total area filled after *n* iterations is $\left(\frac{8}{9}\right)^n$ of the original area.

(c) After infinitely many iterations, what is the total filled area?

Judging instructions: The answer is worth **3** points, with or without justification.

Answer: After infinitely many iterations, **none** of the area will be filled.

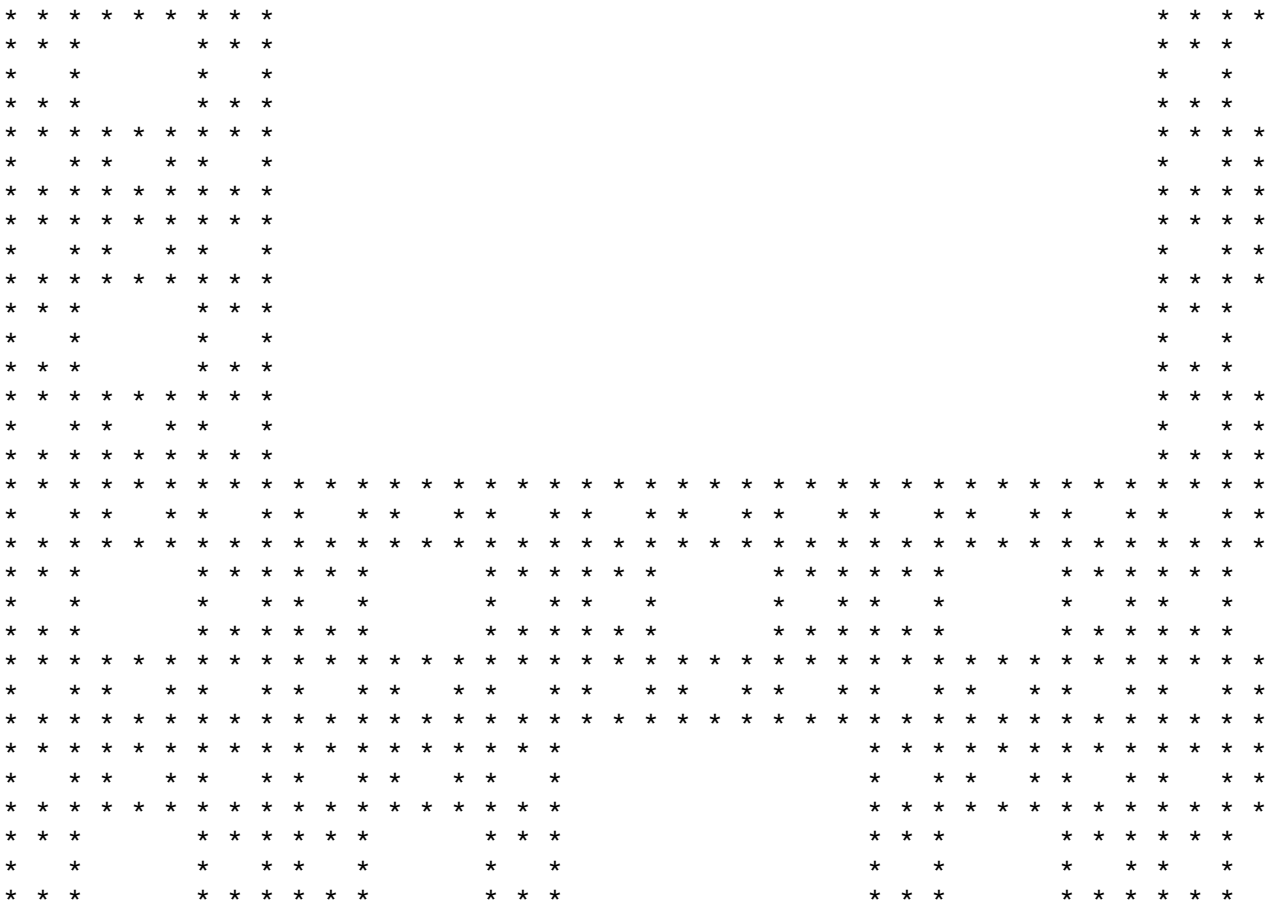
Technically, this is because : $\lim_{n\to\infty}\left(\frac{8}{9}\right)^n = 0$, but it is not necessary to state this for full credit.

(d) **Judging instructions**: There are six test cases worth **1** point each.

Output file frac.out :

```
* * * * *                     * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * *
  * *   * *   * *   * *   * *   * *   * *   *
* * * * * * * * * * * * * * * * * * * * * * *
    * * * * * * *       * * * * * * *       * * *
    *   * *   *       *   * *   *       *   *
    * * * * * * *       * * * * * * *       * * *
* * * * * * * * * * * * * * * * * * * * * * *
  * *   * *   * *   * *   * *   * *   * *   *
```

Note: only one line between this picture and the next.



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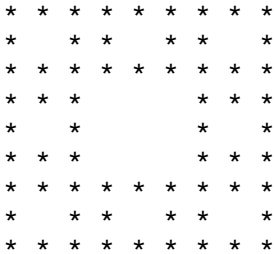
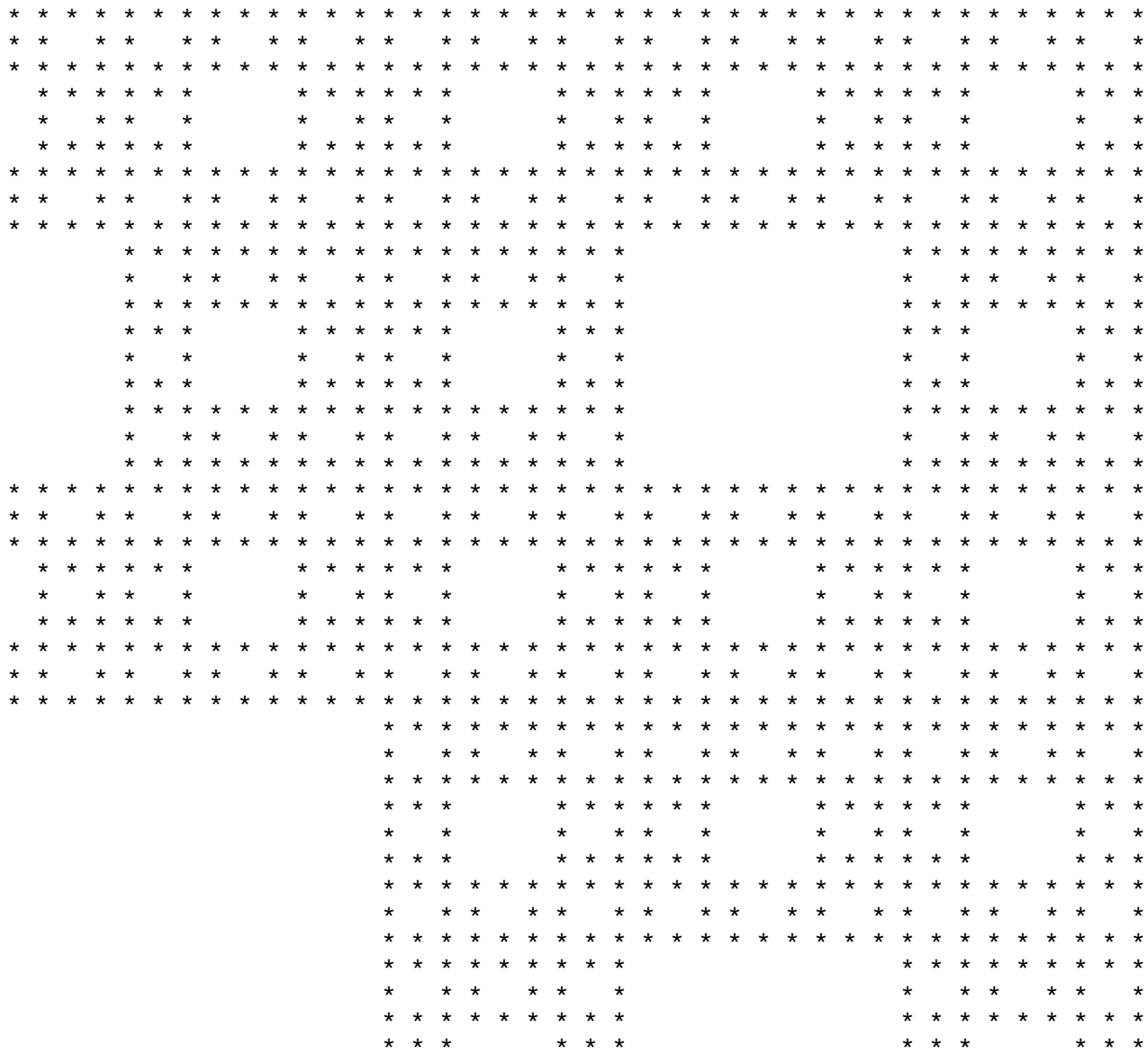


Note: only one line between this picture and the next.



Problem 4

A Knightly Pursuit

Input file knight.in : (shown in 2 columns, only a single column in the file)

```
11
99
99
33
33
33
35
3
3
1
1
2
3
99
99
96
23
99
1
10
10
8
4
10
4
99
99
60
1
1
99
```

```
99
99
1
1
99
99
99
99
1
1
89
98
99
99
20
20
21
20
99
2
1
1
1
2
99
2
1
1
3
1
99
2
1
1
2
2
```

Judging instructions: There are eleven test cases.
2 points each for the first 4 cases, and **1** for each of the other 7 cases.
Total 15 points.

Output file knight.out:

```
Win in 1 knight move(s).
Stalemate in 1 knight move(s).
Loss in 2 knight move(s).
Loss in 1 knight move(s).
Loss in 38 knight move(s).
Win in 49 knight move(s).
Stalemate in 49 knight move(s).
Stalemate in 0 knight move(s).
Stalemate in 1 knight move(s).
Win in 2 knight move(s).
Win in 3 knight move(s).
```

Problem 5

Letter Arithmetic

Judging instructions: There are four test cases. The first three are each worth **4** points each, and the last case is worth **3** points. Total 15 points.

Input file letter.in :

```
4
JTYJITJTH
TJJDHOQFF
DQQMTOTYQI
BBXXXFFCXL
BXJIULXSUQ
ULQSCLLLQI
NIJBSNIWJJJIHJXISO
XJIINIHSAWABXWNJBOX
NNHHIBWABWAAJINXOJA
YOQFUQXTTXYOQFUQXTTX
YQQUOXXUOTYQQUOXXUOT
LYTQFIYLDYLYTQFIYLDY
```

Output file letter.out :

```
579587572
755120366
1334707938

1155500756
1534265928
2689766684

289562809998791863
1988287640451029531
2277850450449821394

12807856651280785665
18872557261887255726
31680413913168041391
```