KAUNO TECHNOLOGIJOS UNIVERSITETAS
INFORMATIKOS FAKULTETAS

Programavimo kalbų teorija (P175B124)

Laboratorinių darbų ataskaita

Atliko:
IFF-1/6 gr. studentas
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TURINYS

1. C++ arba Ruby (L1)

1.1. Darbo užduotis

You are to determinate X by given Y, from expression $X = \sqrt{Y}$

Input

The first line is the number of test cases, followed by a blank line.

Each test case of the input contains a positive integer Y ($1 \leq Y \leq 10^{1000}$), with no blanks or leading zeroes in it.

It is guaranteed, that for given Y, X will be always an integer.

Each test case will be separated by a single line.

Output

For each test case, your program should print X in the same format as Y was given in input.

Print a blank line between the outputs for two consecutive test cases.

Sample Input

```
1

7206604678144
```

Sample Output

```
2684512
```

1 pav. Užduoties pavyzdys iš rinkinių.

Užduotis labai paprasta, turime kintamuosius Y ir X. Turime įvedimo ir išvedimo failus, Y saugomas įvedimo faile, X išvedamas į išvedimo failą. Mes paskaičiuojame X reikšmę, pagal formulę $X = \sqrt{Y}$. Pradžioje įvedimo failo nurodome atvejų kiekį ir pačias Y reikšmes. X išvedamas su eilučių tarpais, jeigu turime daugiau nei vieną duomenų atvejį.

1.2. Programos tekstas

Program.cpp

```
//AUTHOR Lukas Kuzmickas IFF-1/6
#include <iostream>
#include <fstream>
#include <string>
#include <chrono>
#include <vector>
#include <iostream>
#include <sstream>
using namespace std;

/// <summary>
/// Input class for file input operations
/// </summary>
static class Input {
public:
    Input(const string& filename) : infile(filename) {}
    /// <summary>
    /// Method to read from string filename to an integer data type
    /// </summary>
    /// <returns>integer</returns>
    int readInt() {
        int n;
        infile >> n;
        return n;
    }

    /// <summary>
    /// Method to read a file to a string
    /// </summary>
    /// <returns>string</returns>
    string readString() {
        string s;
        infile >> s;
        return s;
    }

    /// <summary>
    /// Method to check if file isn't empty (End of file)
    /// </summary>
    /// <returns>true or false</returns>
    bool eof() {
        return infile.eof();
    }

private:
    ifstream infile;
};


/// <summary>
/// Output class for file output operations
/// </summary>
static class Output {
public:
    Output(const string& filename) : outfile(filename) {}

    /// <summary>
    /// Write function for writing output to a data file
    /// </summary>
```

```
    /// <param name="s">string to write</param>
    void write(const string& s) {
        outfile << s;
    }

    /// <summary>
    /// Write function for writing output with new line to a data file
    /// </summary>
    /// <param name="s">string value</param>
    void writeLine(const string& s) {
        outfile << s << endl;
    }
private:
    ofstream outfile;
};


/// <summary>
/// Data class for Y object
/// </summary>
class Y {
private:
    string y_str;
public:
    Y(const string& str) : y_str(str) {}
    /// <summary>
    /// Putting all Y value to a vector digit list
    /// </summary>
    /// <returns>vector value digit list</returns>
    vector<int> digits() const {
        vector<int> y_digits(y_str.size());
        for (int i = 0; i < y_str.size(); i++) {
            //ASCI code convertion/deletion
            y_digits[i] = y_str[i] - '0';
        }
        return y_digits;
    }
};

/// <summary>
/// Data class for X object
/// </summary>
class X {
public:
    X(int value) : value(value) {}
    /// <summary>
    /// Convert X value to string
    /// </summary>
    /// <returns>string</returns>
    string to_string() const {
        return std::to_string(value);
    }
private:
    int value;
};


/// <summary>
/// Class for data operations
/// </summary>
class TaskUtils {
public:
    /// <summary>
    /// Method for converting from string to double
    /// </summary>
    /// <param name="str">given string</param>
```

```
    /// <returns>double value</returns>
    static double stringToDouble(const std::string& str) {
        double result;
        std::istringstream stream(str);
        stream >> result;
        return result;
    }
    /// <summary>
    /// Method for getting root square of given value
    /// </summary>
    /// <param name="Y">Given value</param>
    /// <returns>root square</returns>
    static double squared(double Y)
    {
        return sqrt(Y);
    }
};
int main() {
    //INPUT for Y
    Input in("input_y.txt");
    //OUTPUT for X
    Output out("output_x.txt");
    using namespace std::chrono;
    //chrono objects for time calculation
    time_point<system_clock> start, end;
    start = system_clock::now();

    //number of test cases
    int t = in.readInt();
    while (!in.eof() && t > 0) {
        Y y(in.readString());
        vector<int> y_digits = y.digits();
        string y_str;
        for (int i = 0; i < y_digits.size(); i++) {
            y_str += to_string(y_digits[i]);
        }
        double Y_double = TaskUtils::stringToDouble(y_str);
        X x = TaskUtils::squared(Y_double);
        out.writeLine(x.to_string());
        if (!in.eof()) {
            out.writeLine("");
        }
        t--;
    }
    end = system_clock::now();
    duration<double> elapsed_seconds = end - start;
    cout << "Total time elapsed " << elapsed_seconds.count() << "s\n";
    return 0;
}
```

1.3. Pradiniai duomenys ir rezultatai

Pirmieji duomenys:

input_y.txt
```
2
169
81
```

output_x.txt
```
13

9
```

Antrieji duomenys:

input_y.txt
```
10
9000000
31382404
40401
324
9
25
16
4
81
64
```
output_x.txt
```
3000

5602

201

18

3

5

4

2

9

8
```

2. Scala L2 darbas

2.1. Darbo užduotis

Turime sukurti Scalatron botą, naudodami Scala programavimo kalbą, pagal pateiktus reikalavimus.

Reikalavimai programai/botui

1. Panaudoti bent kelis master boto išleidžiamus botų padėjėjų tipus
(pvz.: minos, raketos į priešus, "kamikadzės", rinkikai, masalas ir pan.)
2. Panaudoti bet kurį vieną iš kelio radimo algoritmų (DFS, BFS, A*, Greedy, Dijkstra).

2 pav. Reikalavimai botui.

2.2. Programos tekstas

```
//Lukas Kuzmickas IFF-1/6
import scala.collection.mutable.Stack
import scala.util.Random



//Pasyvus botas, resursų rinkėjas su galimybėmis dėti minas ir bombas. Naudoja DFS
algoritmą resursų rinkimui.

/** This bot builds a 'direction value map' that assigns an attractiveness score
to
  * each of the eight available 45-degree directions. Additional behaviors:
  * - aggressive missiles: approach an enemy master, then explode
  * - defensive missiles: approach an enemy slave and annihilate it
  *
  * The gatherers (mini-bots) use DFS algorithm to find shortest path to collect a
resource
  *
  * The master bot uses the following state parameters:
  *  - dontFireAggressiveMissileUntil
  *  - dontFireDefensiveMissileUntil
  *  - lastDirection
  * The mini-bots use the following state parameters:
  *  - mood = Aggressive | Defensive | Gathering | Mine | Returning | Bomb
  *  - target = remaining offset to target location
  */
object ControlFunction
{
    def forMaster(bot: Bot) = {
        val random = new Random()
        val (directionValues, nearestEnemyMaster, nearestEnemySlave,
numberOfResources, nearbyEnemies) = analyzeViewAsMaster(bot.view)
        val dontFireAggressiveMissileUntil =
bot.inputAsIntOrElse("dontFireAggressiveMissileUntil", -1)
        val dontFireDefensiveMissileUntil =
bot.inputAsIntOrElse("dontFireDefensiveMissileUntil", -1)
        val lastDirection = bot.inputAsIntOrElse("lastDirection", 0)
        // determine movement direction
        directionValues(lastDirection) += 10 // try to break ties by favoring the
last direction
        val bestDirection45 = directionValues.zipWithIndex.maxBy(_._1)._2
        val direction = XY.fromDirection45(bestDirection45)
        bot.move(direction)
```

```
        bot.set("lastDirection" -> bestDirection45)

        if(dontFireAggressiveMissileUntil < bot.time && bot.energy > 100) { // 
fire attack missile?
            nearestEnemyMaster match {
                case None =>            // no-on nearby
                case Some(relPos) =>    // a master is nearby
                    val unitDelta = relPos.signum
                    val remainder = relPos - unitDelta // we place slave nearer 
target, so subtract that from overall delta
                    bot.spawn(unitDelta, "mood" -> "Aggressive", "target" -> 
remainder)
                    bot.set("dontFireAggressiveMissileUntil" -> (bot.time + 
relPos.stepCount + 1))
            }
        }
        else
        if(dontFireDefensiveMissileUntil < bot.time && bot.energy > 100) { // fire 
defensive missile?
            nearestEnemySlave match {
                case None =>            // no-on nearby
                case Some(relPos) =>    // an enemy slave is nearby
                    if(relPos.stepCount < 8) {
                        // this one's getting too close!
                        val unitDelta = relPos.signum
                        val remainder = relPos - unitDelta // we place slave 
nearer target, so subtract that from overall delta
                        bot.spawn(unitDelta, "mood" -> "Defensive", "target" -> 
remainder)
                        bot.set("dontFireDefensiveMissileUntil" -> (bot.time + 
relPos.stepCount + 1))
                    }
            }
        }
        if(bot.time < 3900 && numberOfResources > 1){ //gatherer bot
            for(i <- 0 until numberOfResources.min(7)){
                if(bot.energy > 200){
                    val spawnLoc = XY.fromDirection45(i)
                    bot.spawn(spawnLoc, "mood" -> "Gathering")
                }
            }
        }
        else if(nearbyEnemies > 3 && bot.energy >= 300) {
            bot.spawn(XY(random.nextInt(3)-1, random.nextInt(3)-1), "mood" -> 
"Mine")
        }


        //Check if bot needs bombs
       else if (bot.energy > 500 && nearbyEnemies > 5) {
           bot.spawn(XY(random.nextInt(3)-1, random.nextInt(3)-1), "mood" -> 
"Bomb")
           bot.say("I spawned a bomb!")
        }
    }



    //Describes all moods of a mini bot
    def forSlave(bot: MiniBot) = {
        bot.inputOrElse("mood", "Idle") match {
            case "Aggressive" => reactAsAggressiveMissile(bot)
            case "Defensive" => reactAsDefensiveMissile(bot)
            case "Gathering" => reactAsGathering(bot)
            case "Returning" => reactAsReturning(bot)
            case "Bomb" => reactAsBomb(bot)
```

```
            case "Mine" => reactAsMine(bot)
            case s: String => bot.log("unknown mood: " + s)
        }
    }




    /**
      * Describes the behaviour of a bomb
      */
    def reactAsBomb(bot: MiniBot): Unit = {
        bot.explode(8)
    }


    /**
      * Describes the behaviour of a aggressive missile bot
      */
    def reactAsAggressiveMissile(bot: MiniBot) = {
        bot.view.offsetToNearest('m') match {
            case Some(delta: XY) =>
                // another master is visible at the given relative position (i.e.
position delta)
                // close enough to blow it up?
                if(delta.length <= 2) {
                    // yes -- blow it up!
                    bot.explode(4)
                } else {
                    // no -- move closer!
                    bot.move(delta.signum)
                    bot.set("rx" -> delta.x, "ry" -> delta.y)
                }
            case None =>
                // no target visible -- follow our targeting strategy
                val target = bot.inputAsXYOrElse("target", XY.Zero)
                // did we arrive at the target?
                if(target.isNonZero) {
                    // no -- keep going
                    val  unitDelta  =  target.signum  //  e.g.  CellPos(-8,6)  =>
CellPos(-1,1)
                    bot.move(unitDelta)
                    //  compute  the  remaining  delta  and  encode  it  into  a  new
'target' property
                    val remainder = target - unitDelta // e.g. = CellPos(-7,5)
                    bot.set("target" -> remainder)
                } else {
                    // yes -- but we did not detonate yet, and are not pursuing
anything?!? => switch purpose
                    bot.set("mood" -> "Gathering", "target" -> "")
                    bot.say("Gathering")
                }
        }
    }








    /**
      * Describes the behavior of a defensive missile
      */
    def reactAsDefensiveMissile(bot: MiniBot) = {
```

```
        bot.view.offsetToNearest('s') match {
            case Some(delta: XY) =>
                // another slave is visible at the given relative position (i.e.
position delta)
                // move closer!
                bot.move(delta.signum)
                bot.set("rx" -> delta.x, "ry" -> delta.y)
            case None =>
                // no target visible -- follow our targeting strategy
                val target = bot.inputAsXYOrElse("target", XY.Zero)
                // did we arrive at the target?
                if(target.isNonZero) {
                    // no -- keep going
                    val  unitDelta  =  target.signum  //  e.g.  CellPos(-8,6)  =>
CellPos(-1,1)
                    bot.move(unitDelta)
                    //  compute  the  remaining  delta  and  encode  it  into  a  new
'target' property
                    val remainder = target - unitDelta // e.g. = CellPos(-7,5)
                    bot.set("target" -> remainder)
                } else {
                    // yes -- but we did not annihilate yet, and are not pursuing
anything?!? => switch purpose
                    bot.set("mood" -> "Gathering", "target" -> "")
                    bot.say("Gathering")
                }
        }
    }



    /**
      * Describes the behaviour of a mine bot
      */
    def reactAsMine(bot: MiniBot) {
        var blewUp = false
        val targets = Array('s', 'b', 'm')
        for (t <- targets) {
            bot.view.offsetToNearest(t) match {
                case Some(delta: XY) =>
                    // close enough to blow it up?
                    if(delta.length <= 2 && !blewUp) {
                        // yes -- blow it up
                        bot.say("Boom")
                        bot.explode(4)
                        blewUp = true
                }
                case None => // do nothing
            }
        }
    }




    /**
      * Describes the behaviour of a gatherer slave bot
      */
    def reactAsGathering(bot: MiniBot) = {
        if(bot.time > 3900){
            //deposit energy to master
            bot.set("mood" -> "Returning")
        }
        else{
```

```
            val bestDirectionToFood = findDirectionToGatherDFS(bot.view) //DFS for
direction of movement
            if(bestDirectionToFood == -1){ // not path to food
                if(bot.energy < 2000){
                    bot.set("mood" -> "Returning")
                }
            }
            else{ //bot finds path to food
                val direction = XY.fromDirection45(bestDirectionToFood)
                bot.move(direction)
                bot.set("lastDirection" -> bestDirectionToFood)
            }
        }

    }




    /**
      * Defines the behaviour of a bot that's returning to master
      */
    def reactAsReturning(bot: MiniBot) = {
        // determine movement direction towards master
        val   (directionValues)   =   analyzeViewAsReturning(bot.view)   //   other
directions
        directionValues(bot.offsetToMaster.toDirection45)  +=  400  //  direction  to
master
        val bestDirection45 = directionValues.zipWithIndex.maxBy(_._1)._2
        val direction = XY.fromDirection45(bestDirection45)
        bot.move(direction)
        bot.set("lastDirection" -> bestDirection45)
    }





    /** Analyze the view, building a map of attractiveness for the 45-degree
directions and
      * recording other relevant data, such as the nearest elements of various
kinds.
      */
    def analyzeViewAsMaster(view: View) = {
        val directionValues = Array.ofDim[Double](8) // slightly confusing, but
this is a 1 dimension array of length 8 (number of directions)
        var nearestEnemyMaster: Option[XY] = None // coordinates of the nearest
enemy master ?
        var nearestEnemySlave: Option[XY] = None // coordinates of the nearest
enemy slave ?
        var nearbyEnemies = 0.0
        var numberOfResources: Int = 0
        val cells = view.cells // takes the string of cells contained in the
master's view
        val cellCount = cells.length // determines the length of the cells string
(number of cells seen by the master)
        for(i <- 0 until cellCount) { // iterates through the cells
            val cellRelPos = view.relPosFromIndex(i) // gets the relative position
of a certain cell
            if(cellRelPos.isNonZero) {
                val stepDistance = cellRelPos.stepCount // how many steps it takes
to get to a cell
                val value: Double = cells(i) match { // calculates the value of
every cell
                    case 'm' => // another master: not dangerous, but an obstacle
                        nearbyEnemies += 1
```

```
                    nearestEnemyMaster = Some(cellRelPos)
                    if(stepDistance < 2) -1000 else 0
                case 's' => // another slave: potentially dangerous?
                    nearbyEnemies += 1
                    nearestEnemySlave = Some(cellRelPos)
                    -100 / stepDistance
                case 'S' => // our own slave
                    0.0
                case 'B' => // good beast: valuable, but runs away
                    numberOfResources = numberOfResources + 1
                    if(stepDistance == 1) 600
                    else if(stepDistance == 2) 300
                    else (150 - stepDistance * 15).max(10)
                case 'P' => // good plant: less valuable, but does not run
                    numberOfResources = numberOfResources + 1
                    if(stepDistance == 1) 500
                    else if(stepDistance == 2) 300
                    else (150 - stepDistance * 10).max(10)
                case 'b' => // bad beast: dangerous, but only if very close
                    nearbyEnemies += 1
                    if(stepDistance  <  4)  -400  /  stepDistance  else  -50  /
stepDistance
                case 'p' => // bad plant: bad, but only if I step on it
                    if(stepDistance < 2) -1000 else 0
                case 'W' => // wall: harmless, just don't walk into it
                    if(stepDistance < 2) -1000 else 0
                case _ => 0.0
            }
            val direction45 = cellRelPos.toDirection45
            directionValues(direction45) += value
        }
    }
    (directionValues,          nearestEnemyMaster,          nearestEnemySlave,
numberOfResources, nearbyEnemies)
}




/**
  * Analyzes view as a bot that means to return to master
  */
def analyzeViewAsReturning(view: View) = {
    val directionValues = Array.ofDim[Double](8)
    val cells = view.cells // the view of the gatherer
    val cellCount = cells.length
    for(i <- 0 until cellCount) { // iterates through the cells
        val cellRelPos = view.relPosFromIndex(i) // gets the relative position
of a certain cell
        if(cellRelPos.isNonZero)  {  //  checks  if  the  position  is  not  center
(aka the gatherer bot)
            val stepDistance = cellRelPos.stepCount // how many steps it takes
to get to a cell
            val  value:  Double  =  cells(i)  match  {  //  calculates  the  value  of
every cell
                case 'M' => // our master, very good as we want to deposit
                    1000
                case 'm' => // different master: potentially dangerous?
                    if(stepDistance   <   2)   -1000   else   -100   +   (-100   /
stepDistance)
                case 's' => // another slave: potentially dangerous?
                    -100 + (-100 / stepDistance)
                case 'S'  =>  //  other  slave:  :  harmless,  just  don't  walk  into
it
                    if(stepDistance < 2) -1000 else 0
```

```
                    case 'B' => // good beast but we want to move towards master
so lesser priority
                        if(stepDistance == 1) 600
                        else if(stepDistance == 2) 100
                        else 0
                    case 'P' => // good plant: even less valuable to us
                        if(stepDistance == 1) 600
                        else if(stepDistance == 2) 300
                        else 0
                    case 'b' => // bad beast: dangerous, but only if very close
                        if(stepDistance  <  4)  -400  /  stepDistance  else  -50  /
stepDistance
                    case 'p' => // bad plant: bad, but only if I step on it
                        if(stepDistance < 2) -1000 else 0
                    case 'W' => // wall: harmless, just don't walk into it
                        if(stepDistance < 2) -1000 else 0
                    case _ => 0.0
                }
                val direction45 = cellRelPos.toDirection45
                directionValues(direction45) += value
            }
        }
        directionValues
    }


/**
  * Uses  the  DFS  path  finding  algorithm  to  determine  which  direction  the  bot
should move
  * to go down the path towards the closest food resource
  */
  def findDirectionToGatherDFS(view: View): Int = {
    val centerCell = view.center
    var cellStack = List(centerCell)
    var visited = Set(centerCell)
    var initialDirection = Map(centerCell -> -1) // the center cell has no initial
direction
    var pathDirection = -1 // sets the initial direction

  while (cellStack.nonEmpty && pathDirection == -1) {
    val currentCell = cellStack.head
    cellStack = cellStack.tail

    if (!visited.contains(currentCell)) {
      visited += currentCell
      val cellElement = view.cells(view.indexFromAbsPos(currentCell))
      if ("BP".contains(cellElement)) {
        val cellDirection = initialDirection(currentCell)
        pathDirection = cellDirection
      }
      else {
        val neighbors = getNeighbors(currentCell, view)
        for (neighbor <- neighbors) {
          if (!visited.contains(neighbor)) {
            cellStack = neighbor :: cellStack
            if (!initialDirection.contains(currentCell)) {
              initialDirection            +=            neighbor             ->
view.relPosFromAbsPos(neighbor).toDirection45
            }
            else {
              initialDirection += neighbor -> initialDirection(currentCell)
            }
          }
        }
      }
    }
```

```
  }

  pathDirection
}

// Help function that returns all neighbors of a cell
def getNeighbors(cell: XY, view: View): Seq[XY] = {
  val neighbors = Seq(cell + XY.Right, cell + XY.Up, cell + XY.Left, cell +
XY.Down)
  val validNeighbors = for (neighbor <- neighbors
                            if (neighbor.x >= 0 && neighbor.x < view.size &&
                              neighbor.y >= 0 && neighbor.y < view.size &&

!"msSbpW".contains(view.cells(view.indexFromAbsPos(neighbor)))))
                        yield neighbor
  validNeighbors
}


}
```

```
// -------------------------------------------------------------------------------
------------------
// Framework
// -------------------------------------------------------------------------------
------------------
class ControlFunctionFactory {
    def create = (input: String) => {
        val (opcode, params) = CommandParser(input)
        opcode match {
            case "React" =>
                val bot = new BotImpl(params)
                if( bot.generation == 0 ) {
                    ControlFunction.forMaster(bot)
                } else {
                    ControlFunction.forSlave(bot)
                }
                bot.toString
            case _ => "" // OK
        }
    }
}
// -------------------------------------------------------------------------------
------------------
trait Bot {
    // inputs
    def inputOrElse(key: String, fallback: String): String
    def inputAsIntOrElse(key: String, fallback: Int): Int
    def inputAsXYOrElse(keyPrefix: String, fallback: XY): XY
    def view: View
    def energy: Int
    def time: Int
    def generation: Int
    // outputs
    def move(delta: XY) : Bot
    def say(text: String) : Bot
    def status(text: String) : Bot
    def spawn(offset: XY, params: (String,Any)*) : Bot
    def set(params: (String,Any)*) : Bot
    def log(text: String) : Bot
}
```

```
trait MiniBot extends Bot {
    // inputs
    def offsetToMaster: XY // minibots also know the direction towards master
(used by gatherers)
    // outputs
    def explode(blastRadius: Int) : Bot // and minibots can explode
}
case class BotImpl(inputParams: Map[String, String]) extends MiniBot {
    // input
    def inputOrElse(key: String, fallback: String) = inputParams.getOrElse(key,
fallback)
    def inputAsIntOrElse(key: String, fallback: Int) =
inputParams.get(key).map(_.toInt).getOrElse(fallback)
    def inputAsXYOrElse(key: String, fallback: XY) = inputParams.get(key).map(s =>
XY(s)).getOrElse(fallback)
    val view = View(inputParams("view"))
    val energy = inputParams("energy").toInt
    val time = inputParams("time").toInt
    val generation = inputParams("generation").toInt
    def offsetToMaster = inputAsXYOrElse("master", XY.Zero)
    // output
    private var stateParams = Map.empty[String,Any]     // holds "Set()" commands
    private var commands = ""                                // holds all other
commands
    private var debugOutput = ""                             // holds all "Log()"
output
    /** Appends a new command to the command string; returns 'this' for fluent
API. */
    private def append(s: String) : Bot = { commands += (if(commands.isEmpty) s
else "|" + s); this }
    /** Renders commands and stateParams into a control function return string. */
    override def toString = {
        var result = commands
        if(!stateParams.isEmpty) {
            if(!result.isEmpty) result += "|"
            result += stateParams.map(e => e._1 + "=" +
e._2).mkString("Set(",",",")")
        }
        if(!debugOutput.isEmpty) {
            if(!result.isEmpty) result += "|"
            result += "Log(text=" + debugOutput + ")"
        }
        result
    }
    def log(text: String) = { debugOutput += text + "\n"; this }
    def move(direction: XY) = append("Move(direction=" + direction + ")")
    def say(text: String) = append("Say(text=" + text + ")")
    def status(text: String) = append("Status(text=" + text + ")")
    def explode(blastRadius: Int) = append("Explode(size=" + blastRadius + ")")
    def spawn(offset: XY, params: (String,Any)*) =
        append("Spawn(direction=" + offset +
            (if(params.isEmpty) "" else "," + params.map(e => e._1 + "=" +
e._2).mkString(",")) +
            ")")
    def set(params: (String,Any)*) = { stateParams ++= params; this }
    def set(keyPrefix: String, xy: XY) = { stateParams ++= List(keyPrefix+"x" ->
xy.x, keyPrefix+"y" -> xy.y); this }
}
// -------------------------------------------------------------------------------
-----------------
/** Utility methods for parsing strings containing a single command of the format
  * "Command(key=value,key=value,...)"
  */
object CommandParser {
    /** "Command(..)" => ("Command", Map( ("key" -> "value"), ("key" -> "value"),
..}) */
```

```
    def apply(command: String): (String, Map[String, String]) = {
        /** "key=value" => ("key","value") */
        def splitParameterIntoKeyValue(param: String): (String, String) = {
            val segments = param.split('=')
            (segments(0), if(segments.length>=2) segments(1) else "")
        }
        val segments = command.split('(')
        if( segments.length != 2 )
            throw new IllegalStateException("invalid command: " + command)
        val opcode = segments(0)
        val params = segments(1).dropRight(1).split(',')
        val keyValuePairs = params.map(splitParameterIntoKeyValue).toMap
        (opcode, keyValuePairs)
    }
}
// -----------------------------------------------------------------------------------------
-----------------
/** Utility class for managing 2D cell coordinates.
  * The coordinate (0,0) corresponds to the top-left corner of the arena on
screen.
  * The direction (1,-1) points right and up.
  */
case class XY(x: Int, y: Int) {
    override def toString = x + ":" + y
    def isNonZero = x != 0 || y != 0
    def isZero = x == 0 && y == 0
    def isNonNegative = x >= 0 && y >= 0
    def updateX(newX: Int) = XY(newX, y)
    def updateY(newY: Int) = XY(x, newY)
    def addToX(dx: Int) = XY(x + dx, y)
    def addToY(dy: Int) = XY(x, y + dy)
    def +(pos: XY) = XY(x + pos.x, y + pos.y)
    def -(pos: XY) = XY(x - pos.x, y - pos.y)
    def *(factor: Double) = XY((x * factor).intValue, (y * factor).intValue)
    def distanceTo(pos: XY): Double = (this - pos).length // Phythagorean
    def length: Double = math.sqrt(x * x + y * y) // Phythagorean
    def stepsTo(pos: XY): Int = (this - pos).stepCount // steps to reach pos: max
delta X or Y
    def stepCount: Int = x.abs.max(y.abs) // steps from (0,0) to get here: max X
or Y
    def signum = XY(x.signum, y.signum)
    def negate = XY(-x, -y)
    def negateX = XY(-x, y)
    def negateY = XY(x, -y)
    /** Returns the direction index with 'Right' being index 0, then clockwise in
45 degree steps. */
    def toDirection45: Int = {
        val unit = signum
        unit.x match {
            case -1 =>
                unit.y match {
                    case -1 =>
                        if(x < y * 3) Direction45.Left
                        else if(y < x * 3) Direction45.Up
                        else Direction45.UpLeft
                    case 0 =>
                        Direction45.Left
                    case 1 =>
                        if(-x > y * 3) Direction45.Left
                        else if(y > -x * 3) Direction45.Down
                        else Direction45.LeftDown
                }
            case 0 =>
                unit.y match {
                    case 1 => Direction45.Down
```

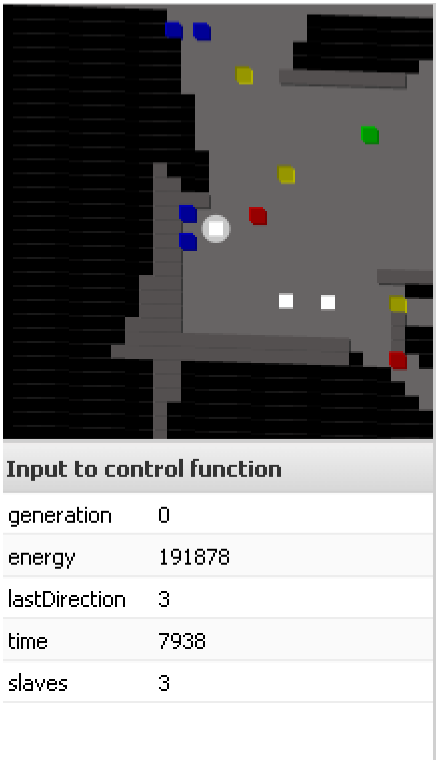
```
                    case 0 => throw new IllegalArgumentException("cannot compute
direction index for (0,0)")
                    case -1 => Direction45.Up
                }
            case 1 =>
                unit.y match {
                    case -1 =>
                        if(x > -y * 3) Direction45.Right
                        else if(-y > x * 3) Direction45.Up
                        else Direction45.RightUp
                    case 0 =>
                        Direction45.Right
                    case 1 =>
                        if(x > y * 3) Direction45.Right
                        else if(y > x * 3) Direction45.Down
                        else Direction45.DownRight
                }
        }
    }
    def rotateCounterClockwise45 = XY.fromDirection45((signum.toDirection45 + 1) %
8)
    def rotateCounterClockwise90 = XY.fromDirection45((signum.toDirection45 + 2) %
8)
    def rotateClockwise45 = XY.fromDirection45((signum.toDirection45 + 7) % 8)
    def rotateClockwise90 = XY.fromDirection45((signum.toDirection45 + 6) % 8)
    def wrap(boardSize: XY) = {
        val fixedX = if(x < 0) boardSize.x + x else if(x >= boardSize.x) x -
boardSize.x else x
        val fixedY = if(y < 0) boardSize.y + y else if(y >= boardSize.y) y -
boardSize.y else y
        if(fixedX != x || fixedY != y) XY(fixedX, fixedY) else this
    }
}
object XY {
    /** Parse an XY value from XY.toString format, e.g. "2:3". */
    def apply(s: String) : XY = { val a = s.split(':'); XY(a(0).toInt,a(1).toInt)
}
    val Zero = XY(0, 0)
    val One = XY(1, 1)
    val Right     = XY( 1,  0)
    val RightUp   = XY( 1, -1)
    val Up        = XY( 0, -1)
    val UpLeft    = XY(-1, -1)
    val Left      = XY(-1,  0)
    val LeftDown  = XY(-1,  1)
    val Down      = XY( 0,  1)
    val DownRight = XY( 1,  1)
    def fromDirection45(index: Int): XY = index match {
        case Direction45.Right => Right
        case Direction45.RightUp => RightUp
        case Direction45.Up => Up
        case Direction45.UpLeft => UpLeft
        case Direction45.Left => Left
        case Direction45.LeftDown => LeftDown
        case Direction45.Down => Down
        case Direction45.DownRight => DownRight
    }
    def fromDirection90(index: Int): XY = index match {
        case Direction90.Right => Right
        case Direction90.Up => Up
        case Direction90.Left => Left
        case Direction90.Down => Down
    }
    def apply(array: Array[Int]): XY = XY(array(0), array(1))
}
object Direction45 {
```

```
    val Right = 0
    val RightUp = 1
    val Up = 2
    val UpLeft = 3
    val Left = 4
    val LeftDown = 5
    val Down = 6
    val DownRight = 7
}
object Direction90 {
    val Right = 0
    val Up = 1
    val Left = 2
    val Down = 3
}
// -------------------------------------------------------------------------------------
------------------
case class View(cells: String) {
    val size = math.sqrt(cells.length).toInt
    val center = XY(size / 2, size / 2)
    def apply(relPos: XY) = cellAtRelPos(relPos)
    def indexFromAbsPos(absPos: XY) = absPos.x + absPos.y * size
    def absPosFromIndex(index: Int) = XY(index % size, index / size)
    def absPosFromRelPos(relPos: XY) = relPos + center
    def cellAtAbsPos(absPos: XY) = cells.charAt(indexFromAbsPos(absPos))
    def indexFromRelPos(relPos: XY) = indexFromAbsPos(absPosFromRelPos(relPos))
    def relPosFromAbsPos(absPos: XY) = absPos - center
    def relPosFromIndex(index: Int) = relPosFromAbsPos(absPosFromIndex(index))
    def cellAtRelPos(relPos: XY) = cells.charAt(indexFromRelPos(relPos))
    def offsetToNearest(c: Char) = {
        val matchingXY = cells.view.zipWithIndex.filter(_._1 == c)
        if( matchingXY.isEmpty )
            None
        else {
            val          nearest          =          matchingXY.map(p          =>
relPosFromIndex(p._2)).minBy(_.length)
            Some(nearest)
        }
    }
}
```

2.3. Pradiniai duomenys ir rezultatai

Aprašome mūsų botą ir galime paleisti jį į turnyrą prieš kitą botą.

4 pav. Mūsų boto turnyras prieš reference botą.



5 pav. Botas-rinkėjas.

3. L3 – Haskell užduotis

3.1. Darbo užduotis

All the positive numbers can be expressed as a sum of one, two or more consecutive positive integers. For example 9 can be expressed in three such ways, 2+3+4, 4+5 or 9. Given an integer less than $(9*10^{14}+1)$ or (9E14 + 1) you will have to determine in how many ways that number can be expressed as summation of consecutive numbers.

Input

The input file contains less than 1100 lines of input. Each line contains a single integer N $(0 \leq N \leq 9^{14})$. Input is terminated by end of file.

Output

For each line of input produce one line of output. This line contains an integer which tells in how many ways N can be expressed as summation of consecutive integers.

Sample Input

```
9
11
12
```

Sample Output

```
3
2
2
```

6 pav. Haskell užduotis.

3.2. Programos tekstas

main.hs

```haskell
import Control.Monad
import System.IO

main :: IO ()
main = do
  input <- readFile "input.txt"
  let numbers = map read (lines input) :: [Integer]
  let results = map countConsecutiveSums numbers
  withFile "output.txt" WriteMode $ \handle ->
    forM_ results $ hPrint handle

countConsecutiveSums :: Integer -> Int
countConsecutiveSums n = length $ filter (isConsecutiveSum n) [1..(n `div` 2 + 1)]

isConsecutiveSum :: Integer -> Integer -> Bool
isConsecutiveSum n k = 2 * n `mod` k == 0 && (m - k + 1) `mod` 2 == 0
  where m = 2 * n `div` k
```

3.3. Pradiniai duomenys ir rezultatai

Pirmieji pradiniai duomenys

input.txt
9
8
4
1
5
10
12

output.txt
3
1
1
1
2
3
2

Antrieji pradiniai duomenys

input.txt
9
8
4
22
13
14
525
231

output.txt
3
1
1
3
2
3
21
13

4. L4

4.1. Darbo užduotis

4.2. Programos tekstas

4.3. Pradiniai duomenys ir rezultatai