```
/*
 * queens.cc
 *
 *  Created on: Feb 14, 2017
 *      Author: lubo
 */

#include <vector>
#include <cstdlib>
#include <iostream>

class QueensBoard {
    int size_;
    std::vector<int> board_;

public:
    QueensBoard(int size)
            : size_(size), board_(size_, -1) {
    }

    int size() const {
        return size_;
    }

    bool under_attach(int row, int col) const {
        for (int i = 0; i < col; ++i) {
            if (board_[i] == -1) {
                continue;
            }
            if (board_[i] == row) {
                return true;
            }
            if (std::abs(i - col) == std::abs(board_[i] - row)) {
                return true;
            }
        }
        return false;
    }

    bool solve(int col = 0) {
        if (col == size()) {
            return true;
        }
        std::cout << "exploring col " << col << std::endl;
        for (int row = 0; row < size(); ++row) {
            if (!under_attach(row, col)) {
                board_[col] = row;
                std::cout << "placing queen on row " << row
                        << std::endl;
                if (solve(col + 1)) {
                    return true;
                }
            }
        }
        board_[col] = -1;
        return false;
    }

    void pretty_print() const {
        std::cout << std::endl;
        for (int row = 0; row < size(); ++row) {
            for (int col = 0; col < size(); ++col) {
                std::cout << ’|’;
                if (board_[col] == row) {
                    std::cout << ’*’;
                } else {
                    std::cout << ’ ’;
                }
            }
            std::cout << ’|’ << std::endl;
        }
    }
};

int main() {

    QueensBoard qb(4);
    bool has_solution = qb.solve();
    std::cout << "has_solution=" << has_solution << std::endl;
    qb.pretty_print();

    return 0;
}

```

```
#include <iostream>
using namespace std;

void b(int, int);
void c(int, int);
void d(int, int);

void a(int i, int h) {

        if(i<=0) {
                return;
        }
        d(i-1, h);
        cout << '-' << h << ' ' << 0 << ' ' << "rlineto" << endl;
        a(i-1, h);
        cout << 0 << ' ' << '-' << h << ' ' << "rlineto" << endl;
        a(i-1, h);
        cout << h << ' ' << 0 << ' ' << "rlineto" << endl;
        b(i-1, h);

}

void b(int i, int h) {
        if(i<=0) {
                return;
        }
        c(i-1, h);
        cout << 0 << ' ' << h << ' ' << "rlineto" << endl;
        b(i-1, h);
        cout << h << ' ' << 0 << ' ' << "rlineto" << endl;
        b(i-1, h);
        cout << 0 << ' ' << '-' << h << ' ' << "rlineto" << endl;
        a(i-1, h);
}

void c(int i, int h) {
        if(i<=0) {
                return;
        }
        b(i-1, h);
        cout << h << ' ' << 0 << ' ' << "rlineto" << endl;
        c(i-1, h);
        cout << 0 << ' ' << h << ' ' << "rlineto" << endl;
        c(i-1, h);
        cout << '-' << h << ' ' << 0 << ' ' << "rlineto" << endl;
        d(i-1, h);
}

void d(int i, int h) {
        if(i<=0) {
                return;
        }
        a(i-1, h);
        cout << 0 << ' ' << '-' << h << ' ' << "rlineto" << endl;
        d(i-1, h);
        cout << '-' << h << ' ' << 0 << ' ' << "rlineto" << endl;
        d(i-1, h);
        cout << 0 << ' ' << h << ' ' << "rlineto" << endl;
        c(i-1, h);
}



int main() {
        cout << "newpath" << endl;
        int h = 512;
        int x0 = 64 + h/2;
        int y0 = 64 + h/2;
        for(int i = 1; i<6; ++i) {
          h /=2;
          x0 += h/2;
          y0 += h/2;
          cout << x0 << " " << y0 << " moveto" << endl;
          a(i, h);
          // cout << i << " setlinewidth" << endl;
          cout << "stroke" << endl;
        }
        cout << "showpage" << endl;

        return 0;
}

```

```
CXXFLAGS = -g -Wall


OBJ = queens.o
SRC = queens.cc hilbert.cc

OUT = queens


all: $(OUT)


$(OUT): $(OBJ)
	g++ $(CXXFLAGS) $(OBJ) -o $(OUT)


clean:
	rm -f *~ a.out $(OUT) *.o files.pdf


files.pdf:
	enscript -r -2 --highlight --line-numbers -o - $(SRC) Makefile | ps2pdf - files.pdf

pdf: files.pdf
```