INSTITUT FÜR INFORMATIK
Lehr- und Forschungseinheit für
Programmier- und Modellierungssprachen
Oettingenstraße 67, D–80538 München

Ludwig-Maximilians-Universität München

Rent Estimates with Constraints over the Internet (System Description)

Slim Abdennadher, Thom Frühwirth, Peter Blenninger

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Rent Estimates with Constraints over the Internet
– System Description –

Thom Frühwirth[1] **Slim Abdennadher** **Peter Blenninger**

Institut für Informatik
Ludwig-Maximilians-Universität München
Oettingenstraße 67
D – 80538 München
{fruehwir,abdennad,blenning}@informatik.uni-muenchen.de

Abstract: *We present an application utilizing Constraint Handling Rules (CHRs) offering rent advice. The city government of Munich publishes a booklet called the "Mietspiegel" (MS). The MS basically contains a verbal description of an expert system. It allows to calculate the estimated fair rent of a flat. By hand, one may need a weekend to do so. With our computerized version, "The Munich Rent Advisor", the user just fills in a form and the rent is calculated immediately. We also extended the functionality and applicability of the MS so that the user need not answer all questions of the form. The key to computing with such imprecise and partial information was to use constraint technology. We rely on the internet, and more specifically the World-Wide-Web (WWW), to provide this service to a broad user–group.*

Keywords: *Constraints, Finite Domains, Internet*

1 Do you pay too much rent?

Every other year the city government of Munich publishes a booklet called the "Mietspiegel" (MS) [MS94]. It allows any citizen to calculate the estimated fair rent for his flat. The results of these calculations are typically used in civil court cases. The MS contains explanations to read, tables to lookup and rules to follow. One can say that the MS contains a verbal description of an expert system.

[1] Work was performed while at ECRC, Munich, Germany

The MS is derived from a statistical model compiled from sample data using statistical methods such as regression analysis [A*94]. Due to the underlying statistical approach, there is the problem of inherent imprecision which is ignored in the paper version of the MS.

Equipped with pencil, paper and calculator, one may need a weekend to figure out the estimated rent. Usually, the calculation is performed by hand in about half on hour by an expert from the City of Munich or from one of the renter's associations. One of these associations has produced an "improved version" of the MS which is a double-sided printed sheet of paper of about one square-meter in size [MhM94]! *With our computerized version, "The Munich Rent Advisor", we brought the calculation time down to a few minutes.*

The calculations are based on size, age and location of the flat and a series of detailed yes/no questions about the flat and the house it is in. Some of these questions are hard to answer (e.g. "Is the house looking good?" or "In the bathroom, are the tiles on all the walls more than 180cm high?"). However, to be able to calculate the rent estimate by hand, all questions must be answered. *With "The Munich Rent Advisor", one can compute the estimated rent even in the presence of partial information.* Thus, for the first time, the "Mietspiegel" can also be used to compute the price level of the rent when looking for a new flat, for which the information is not totally known to the interestet person.

2 Constraints go Internet

With high-level programming in ECL^{i}PS^e [B*94], ECRC's advanced constraint logic programming platform, the calculations described in the "Mietspiegel" were encoded in just two man weeks. ECL^{i}PS^e is a generic development system for constraint logic programs (CLP) and other extensions. It supports independent development of new constraints solvers from scratch or on top of existing ones.

We were able to make the results more reliable by taking the imprecision of the underlying statistical model into account. Furthermore, we extended the functionality and applicability of the MS by being able to deal with partial information. *The key to computing with imprecise and partial information was to use constraint technology.* Our approach was to first implement the tables, rules and formulas of the "Mietspiegel" as if everything was known. Then we added constraints on variables in case the user gives no or partial answers. Finally, we considered the formulas as constraints that refine the rent estimate by propagation using the constrained input variables. Instead of computing with actual values, the program computes with ranges (intervals) of numbers and boolean variables.

From a constraints point of view, the MS application is characterized by

- Interval constraints over non-linear equations
- Constraint database (i.e. tables involving interval constraints)
- If-then-else rules able to perform constructive disjunction

While it would have been difficult to implement the required functionality with a given, built-in black-box constraints system, it was relatively straightforward using constraint handling rules (CHRs). It sufficed to modify an existing finite domains solver written in CHRs that is part of the CHR ECL^{i}PS^e library.

Constraint handling rules (CHRs) [B*94, Fru95] are a high-level language extension to write constraint systems. Basically, CHRs are multi-headed guarded clauses. CHRs support rapid prototyping of application-oriented constraint systems by providing executable specifications and efficient implementations due to an optimizing compiler. They allow for specialization, modification and combination of constraint solvers.

CHRs have been implemented as a library of ECL^{i}PS^e [B*94] and in Common LISP, an implementation in the concurrent language OZ is currently under way. CHRs have been used to encode a wide range of constraint solvers, including new domains such as terminological and temporal reasoning. The ECL^{i}PS^e CHR library includes more than 20 constraint handlers, many of them novel or with extended functionality over existing implementations.

In our computerised version, *The Munich Rent Advisor (MRA)*, we rely on the internet, and more specifically the World-Wide-Web (WWW), to provide this service. The reason for using internet is: While every citizen is a potential user of the MRA, he will typically use this service only every year or so, when he rents a new flat, - when his rent increases or when the new version of the MS is published.

Using the internet, there is no need for the user to acquire specific software. Moreover, there is a broad user basis already now, since in Germany, the internet is not only accessible directly, but also from a number

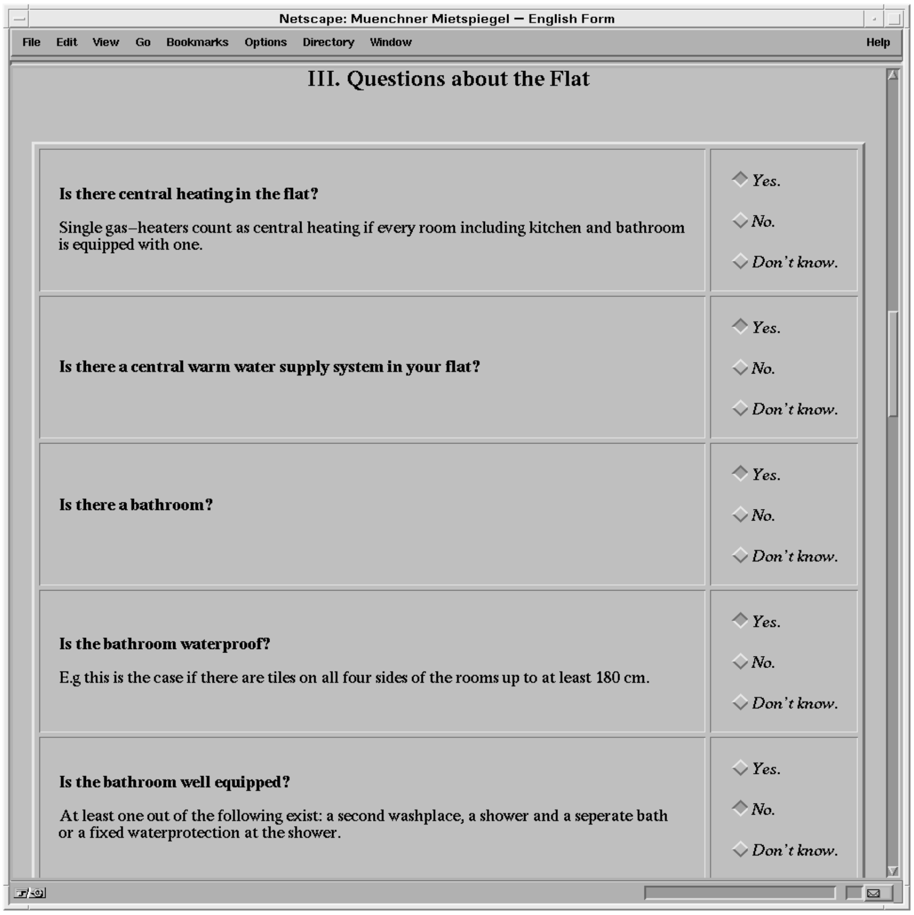

Figure 1: Fragment of the Form

of other online services. The largest is T-Online (formerly BTX/Datax-J) of Deutsche Telekom (German phone company) with about one million users in Germany.

The user of the MRA only needs to fill in what he knows and what he cares about. All answers are optional. There are just four questions requiring numeric inputs (about size and age of flat), one question choosing from a list the district, the rest are multiple choice questions, where the only possible answers are *Yes, No* or *Don't know/care* and optional detailed questions to calculate the fixed costs where numeric input can be given (figure 1).

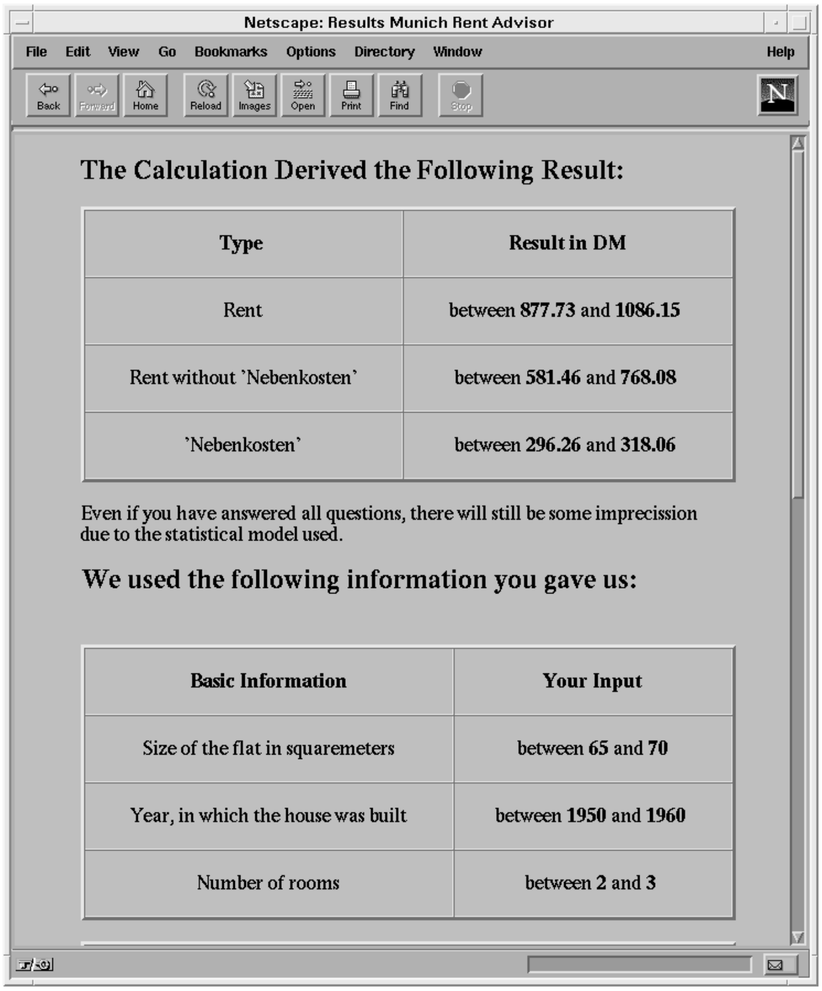

Figure 2: Result of a Sample Query

In about four man-weeks, we developed the form in the *Hyper Text Markup Language (HTML)*, Version 3.0. The WWW-front-end is the graphical user-interface and for this reason should be handable without experienced computer-knowledge. We chose not to rely on advanced developments like applets in HotJava. To process the answers from the questionaire and return its result (figure 2), we wrote a basic web-server in ECL^{i}PS^e using its C-sockets for internet communication.

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