

Using Case-Based Reasoning to Build Intelligent Systems

Amedeo Napoli

► **To cite this version:**

Amedeo Napoli. Using Case-Based Reasoning to Build Intelligent Systems. D. Plemenos. Third International Conference on Computer Graphics and Artificial Intelligence - ICCGAI'98, 1998, Limoges, France. AFIG – LMSI Limoges, pp.109-111, 1998. <inria-00098722>

HAL Id: inria-00098722

<https://hal.inria.fr/inria-00098722>

Submitted on 26 Sep 2006

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Using Case-Based Reasoning to Build Intelligent Systems

Amedeo Napoli
LORIA (UMR 7503)
BP 239 – 54506 Vandœuvre-lès-Nancy Cedex
Email: napoli@loria.fr

1 The Basics of Case-Based Reasoning

In this talk, we first present the basics of case-based reasoning –CBR in the following– and then we show how the CBR technology can be used for building intelligent systems.

The goal of case-based reasoning is to associate a solution $\text{Sol}(P)$ with a new or *target* problem P , by reusing the solution $\text{Sol}(P')$ of a memorized problem P' . A CBR system takes advantage of a *case base* including memorized problems –or *source* problems– with their solutions to solve a target problem.

A *case* is a pair $(P, \text{Sol}(P))$, where P denotes the problem statement and $\text{Sol}(P)$ the solution of P . The *case base* is a finite set of cases of the form $(P_k, \text{Sol}(P_k))$. A target problem P is usually considered as a “new case”, denoted by *target*, and a source problem in the case base is denoted by *source*.

The case-based reasoning cycle relies on three main operations:

- *Retrieval*: a problem *source* similar to the problem *target* is searched in the case base. The problems memorized in the case base are considered as reference cases used to solve target problems.

- *Adaptation*: given a case retrieved in the case base, say $(\text{source}, \text{Sol}(\text{source}))$, $\text{Sol}(\text{source})$ is adapted in order to be reused for solving the problem *target*.
- *Memorization*: the problem *target* and the (building) characteristics of the solution $\text{Sol}(\text{target})$ can be memorized as a new case to be reused in the future.

These three steps can be nested: for example, retrieval and adaptation are nested in the case-based system described in [13]; the learning step can take place within the retrieval and the adaptation steps as well, in order to learn retrieval and adaptation knowledge.

The implementation of knowledge-based systems relying on case-based reasoning gives rise to *case-based reasoning systems*. Given a target problem P , a CBR system exploits a case base and follows the preceding three-step cycle to solve P . The problem P can be of many types, e.g. interpretation, diagnostic, configuration, planning, etc.

2 A Bibliographical Tour

The technology of CBR has been extensively studied in the past years. Important textbooks

on the subject are [18] [10] [21] [23], and [1] about industrial CBR systems.

Important researcher groups working on CBR are based in Europe, e.g. Dublin, Kaiserslautern and Lyon. The *European Conference on Case-Based Reasoning* is organized every year since 1993 [24] [9] [6], and this conference becomes the *International Conference on Case-Based Reasoning* every two years since 1995 [22] [11].

In France, people studying CBR are members of a working group of PRC I3 (PRC IA before 1998) : see [15] for details on the research groups, and see [17] for details on the PRC I3 group.

A number of students have defended theses on many different subjects: learning in the CBR cycle [3], temporal processes and prediction [20], diagnosis and induction [2], use of CBR in optimization [8], industrial supervision [16], similarity measures [19], neural networks in CBR [14], object-based knowledge representation formalisms for building CBR systems [7] (see [5] on a related problem), case-based planning [12], ...

For terminating this short note, let us mention the publication in September 1998 of a special number on CBR of the *Revue d'intelligence artificielle*, where are addressed topics such as problem solving, knowledge representation, planning, supervision and cognitive aspects of CBR [4].

References

- [1] K.D. Althoff, E. Auriol, R. Barletta, and M. Manago. *A Review of Industrial Case-Based Reasoning Tools*. AI Perspectives Report. AI Intelligence, Oxford, UK, 1995.
- [2] E. Auriol. *Intégration d'approches symboliques pour le raisonnement à partir d'exemples*. Thèse, Université Paris-Dauphine (Paris 9), 1995.
- [3] I. Bichindaritz. *Apprentissage de concepts dans une mémoire dynamique : raisonnement à partir de cas adaptable à la tâche cognitive*. Thèse, Université René Descartes (Paris 5), 1994.
- [4] I. Bichindaritz, A. Mille, and A. Napoli, editors. *Numéro spécial de la Revue d'intelligence artificielle sur le raisonnement à partir de cas*. Hermès, Paris, 1999. (To be published in January 1999).
- [5] P. Coupey and S. Salotti. Une logique de descriptions comme cadre formel d'un système de raisonnement à partir de cas. *Revue d'intelligence artificielle*, 11(2):127–177, 1997.
- [6] B. Faltings and I. Smith, editors. *Third European Workshop on Case-Based Reasoning (EWCBR'96)*, Lausanne. Lecture Notes in Artificial Intelligence 1168. Springer, Berlin, 1996.
- [7] B. Fuchs. *Représentation des connaissances pour le raisonnement à partir de cas – Le système ROCADE*. Thèse, Université Jean Monnet, Saint-Étienne, 1997.
- [8] S. Grolimund. *Apprentissage de connaissances de contrôle pour l'optimisation combinatoire : une intégration du raisonnement à partir de cas dans la méthode tabou*. Thèse, Université Pierre et Marie Curie (Paris 6), 1997.
- [9] J.-P. Haton, M. Keane, and M. Manago, editors. *Advances in Case-Based Reasoning – Proceedings of the Second European Workshop on Case-Based Reasoning (EWCBR'94)*, Chantilly. Lec-

- ture Notes in Artificial Intelligence 984. Springer, Berlin, 1994.
- [10] J. Kolodner. *Case-Based Reasoning*. Morgan Kaufmann Publishers, Inc., San Mateo, California, 1993.
- [11] D.B. Leake and E. Plaza, editors. *Case-Based Reasoning Research and Development – Second International Conference on Case-Based Reasoning (IC-CBR'97)*, Providence, RI. Lecture Notes in Artificial Intelligence 1266. Springer, Berlin, 1997.
- [12] J. Lieber. *Raisonnement à partir de cas et classification hiérarchique – Application à la planification de synthèse en chimie organique*. Thèse d'Informatique, Université Henri Poincaré (Nancy 1), 1997.
- [13] J. Lieber and A. Napoli. Using Classification in Case-Based Planning. In W. Wahlster, editor, *European Conference on Artificial Intelligence (ECAI'96)*, Budapest, Hungary, pages 132–136. John Wiley & Sons Ltd, Chichester, 1996.
- [14] M. Malek. *Un modèle hybride de mémoire pour le raisonnement à partir de cas*. Thèse, Université Joseph Fourier, Grenoble, 1996.
- [15] H. Mignot. La recherche en raisonnement à partir de cas en France. *Bulletin de l'AFIA*, 18:18–40, Juillet 1994.
- [16] A. Mille. *Raisonnement basé sur l'expérience pour coopérer à la prise de décision*. Thèse, Université Jean Monnet, Saint Étienne, 1995.
- [17] A. Mille and A. Napoli. Aspects du raisonnement à partir de cas. In S. Pesty and P. Siegel, editors, *Actes des sixièmes journées nationales du PRC-GDR Intelligence artificielle, Grenoble*, pages 261–287, 1997.
- [18] C.K. Riesbeck and R.C. Schank. *Inside Case-Based Reasoning*. Lawrence Erlbaum Associates, Hillsdale, New Jersey, 1989.
- [19] M. Rifqi. *Mesures de comparaison, typicalité et classification d'objets flous : théorie et pratique*. Thèse, Université Pierre et Marie Curie (Paris 6), 1996.
- [20] S. Rougeguez-Loriette. *Prédiction de processus à partir de comportements observés : le système REBECAS*. Thèse, Université Pierre et Marie Curie (Paris 6), 1994.
- [21] R.C. Schank, A. Kass, and C.K. Riesbeck, editors. *Inside Case-Based Explanation*. Lawrence Erlbaum Associates, Hillsdale, New Jersey, 1994.
- [22] M. Veloso and A. Aamodt, editors. *Case-Based Reasoning. Research and Development, Proceedings of the First International Conference on Case-Based Reasoning (ICCB'95)*, Sesimbra, Portugal. Lecture Notes in Artificial Intelligence 1010. Springer, Berlin, 1995.
- [23] M. M. Veloso. *Planning and Learning by Analogical Reasoning*. Lecture Notes in Artificial Intelligence 886. Springer, Berlin, 1994.
- [24] S. Wess, K.-D. Althoff, and M.M. Richter, editors. *Topics in Case-Based Reasoning – First European Workshop (EWCBR'93)*, Kaiserslautern. Lecture Notes in Artificial Intelligence 837. Springer, Berlin, 1994.