Dynamic Answer Set Programming

François Laferrière[1], Roland Kaminski[1], Torsten Schaub[1], Pedro Cabalar[2], and Martín Diéguez[3]

[1] University of Potsdam, Germany
[2] University of Corunna, Spain
[3] ENIB, Brest, France

Answer Set Programming(ASP[1]) is highly competitive in static domains such as time tabling and workforce management, whereas it has more difficulties to handle dynamic ones, as for instance, robotic intra-logistics. The reason is that the modeling language aims at handleling static knowledge, while dynamic knowledge is only indirectly dealt with via reductions to the static case. There is thus a lack of a versatile language for modeling dynamic domains in ASP. Our ultimate goal is to conceive an extension of ASP with language constructs from dynamic and temporal logic to provide an expressive computational framework for modeling dynamic applications.

Using a restriction of the logical foundations of the temporal logic of here-and-there () and its non-monotonic counterpart of temporal equilibrium logic (TEL)[3][4] in the context of finite traces (THTf) and (TEL_f)[5], we to obtain a temporal extension of ASP that can be treated with (incremental) ASP solving technology. Indeed,TEL_fformulas can be reduced to a normal form close to logic programs, which is much simpler than the one obtained for TEL. Also, TEL_fmodels are finite and offer a one-to-one correspondence to plans. A first system, *telingo*[2], extend the ASP system clingo with a subset of TEL_f, using clingo's mutli-shot interface, and allows to modelize problem using temporal operators.

Similarly as done with and TEL, the (linear) dynamic logic of here-and-there (DHT) and its non-monotonic counterpart, dynamic equilibrium logic (DEL)[6][7] are restricted to finite traces and we refer to the resulting systems as $\mathrm{DHT}_f$and DEL_f. We extend *telingo* with dynamic operators using a translation from a $\mathrm{DEL}_f$to TEL_f. We allow the use of dynamic formulas in constraints or behind a negation in the body of rules.

References

1. Lifschitz, V. (1999, December). Answer set planning. In International Conference on Logic Programming and Nonmonotonic Reasoning (pp. 373-374). Springer, Berlin, Heidelberg.
2. Cabalar, P., Schaub, T. (2018). Dynamic and Temporal Answer Set Programming on Linear Finite Traces
3. Cabalar, P., Vega, G. P. (2007, February). Temporal equilibrium logic: a first approach. In International Conference on Computer Aided Systems Theory (pp. 241-248). Springer, Berlin, Heidelberg.
4. Aguado, F., Cabalar, P., Diéguez, M., Pérez, G., Vidal, C. (2013). Temporal equilibrium logic: a survey. Journal of Applied Non-Classical Logics, 23(1-2), 2-24.
5. Cabalar, P., Kaminski, R., Schaub, T., Schuhmann, A. (2018). Temporal answer set programming on finite traces. Theory and Practice of Logic Programming, 18(3-4), 406-420.

6. Bosser, A. G., Cabalar, P., Diéguez, M., Schaub, T. (2018, September). Introducing temporal stable models for linear dynamic logic. In Sixteenth International Conference on Principles of Knowledge Representation and Reasoning.
7. Cabalar, P., Diéguez, M., & Schaub, T. (2019, June). Towards Dynamic Answer Set Programming over Finite Traces. In International Conference on Logic Programming and Nonmonotonic Reasoning (pp. 148-162). Springer, Cham.