# Harmony: The Art of Reconciliation
## (Invited Talk)

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The Harmony system is a generic framework for reconciling disconnected updates to heterogeneous, replicated XML data. It can be used, for instance, to synchronize the bookmark files of several different web browsers, allowing bookmarks and bookmark folders to be added, deleted, edited, and reorganized by different users running different browser applications on disconnected machines.

A central theme of the Harmony project—and of this talk—is bringing ideas from programming languages to bear on a set of problems more commonly regarded as belonging to the purview of databases or distributed systems. In particular, a major component of the proposed work concerns developing the foundations of *bi-directional programming languages* [1], in which every program denotes a pair of functions—one for extracting a *view* of some complex data structure, and another for "putting back" an updated view into the original structure. Bi-directional programs play a crucial role in the way the system deals with heterogeneous structures, mapping between diverse concrete application data formats and common abstract formats suitable for synchronization. Similarly, the issue of *alignment* during reconciliation—that is, of determining which parts of divergent replicas are intended to represent "the same information"—can be addressed by focusing on the type structure of the data being reconciled [2].

Further information and an open-source implementation can be found on the Harmony home page: `http://www.cis.upenn.edu/~bcpierce/harmony`.

## References

1. Foster, J.N., Greenwald, M.B., Moore, J.T., Pierce, B.C., Schmitt, A.: Combinators for bi-directional tree transformations: A linguistic approach to the view update problem. In: ACM SIGPLAN–SIGACT Symposium on Principles of Programming Languages (POPL), Long Beach, California. (2005) Extended version available as University of Pennsylvania technical report MS-CIS-03-08. Earlier version presented at the *Workshop on Programming Language Technologies for XML (PLAN-X)*, 2004.
2. Foster, J.N., Greenwald, M.B., Kirkegaard, C., Pierce, B.C., Schmitt, A.: Schema-directed data synchronization. Technical Report MS-CIS-05-02, University of Pennsylvania (2005) Supercedes MS-CIS-03-42.

R. De Nicola and D. Sangiorgi (Eds.): TGC 2005, LNCS 3705, p. 1, 2005.