Beyond the black box: Flexible programming of hierarchical modeling algorithms for *BUGS*-compatible models using *NIMBLE*

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We introduce a domain-specific language embedded in R for programming hierarchical model algorithms for models declared in the BUGS language. Various software packages allow flexible specification of hierarchical models and provide algorithms such as specific types of MCMC, particle filter (PF), Laplace approximation, or others. However, many new and old algorithms remain inaccessible for practical use without re-writing them for each model. Moreover, having different packages for different algorithms makes it difficult to combine methods or try different methods on the same problem. The new R-based NIMBLE language allows flexible programming of algorithms with access to the model structure declared by BUGS code. BUGS code is processed into model-specific C++ code, compiled, and interfaced with R. Functions in NIMBLE can use the model structure to allow automatic specialization to the details of any model. Once specialized to a model, functions can be processed into C++, compiled, and interfaced with R. With R's CRAN package system, developers will be able to distribute new algorithms written in NIMBLE. We will present examples with MCMC, PF and more.