Building blocks for exact and approximate inference
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Motivation
We address the need for modular inference methods that can be reused over models and composed to build more methods. We present a collection of black-box methods implemented as probabilistic-program transformations. Modular building-blocks such as algebraic simplification can be reused to mechanically derive an efficient program from the original one. This collection creates a search space of inference strategies that combines exact and approximate techniques.

Workflow examples using Hakaru

Burglary-Alarm model
(Pearl 1988)

Model

Posterior

Simplified posterior

Dependencies among building blocks

exact inference  
gibbs sampling  
mh sampling

simplify  
condition  
density

normalize  
disintegrate

uses

uses

uses

uses

computer algebra  
expect  
total

Source of code  Average run time (ms)

Generated by disintegrator  2015 ± 4

Generated, then automatically simplified  569 ± 4

Written by hand  529 ± 10

Expressed in WebPPL  948 ± 8

Related work
We share the modularity concerns of Venture (Mansinghka et al. 2014) and WebPPL (Goodman and Stuhlmüller 2014). Šćibor et al. (2015) use a monadic probabilistic language to describe and compose sophisticated models and inference methods. We describe in detail the techniques of disintegration (Shan and Ramsey 2015) and simplification (Carette and Shan 2015).

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