A Roadmap to developing for Stan

Stan Con

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Essential Links

Official website: `mc-stan.org`

Github repo: `https://github.com/stan-dev`

Forum: `http://discourse.mc-stan.org/`

Stan-dev wiki: `https://github.com/stan-dev/stan/wiki/`

Wiki page on *Contributing new functions*:
`https://github.com/stan-dev/stan/wiki/Contributing-New-Functions-to-Stan`

Recommended papers

The Stan Math Library: Reverse-Mode Automatic Differentiation in C++ –
https://arxiv.org/abs/1509.07164

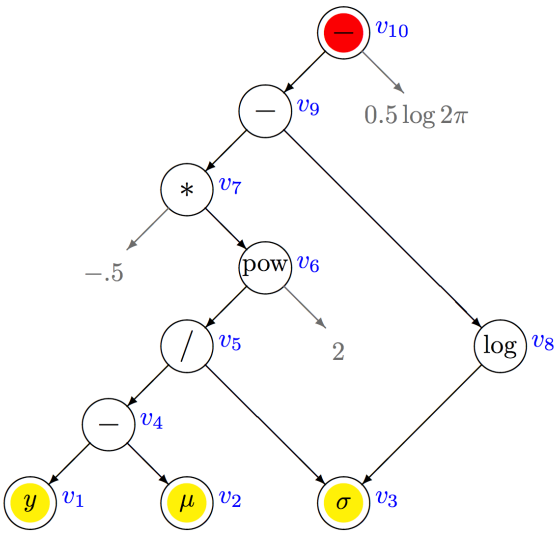
Automatic differentiation in machine learning: a survey –
https://arxiv.org/abs/1502.05767

A Conceptual Introduction to Hamiltonian Monte Carlo –
https://arxiv.org/abs/1701.02434

The No-U-Turn Sampler: Adaptively Setting Path Lengths in Hamiltonian Monte Carlo –
https://arxiv.org/abs/1111.4246

Automatic Differentiation: Example

$$\log[\text{Normal}(y|\mu,\sigma)] = -\frac{1}{2}\left(\frac{y-\mu}{\sigma}\right)^2 - \log(\sigma) - \frac{1}{2}\log(2\pi)$$



var	*fwd. eval. trace*	*fwd. der. trace*		
v_1	$y = 10$	$\dot{v}_1$	$= \dot{y}_1$	$= 1$
v_2	$\mu = 5$	$\dot{v}_2$	$= \dot{\mu}$	$= 0$
v_3	$\sigma = 2$	$\dot{v}_3$	$= \dot{\sigma}$	$= 0$
v_4	$v_1 - v_2 = 5$	$\dot{v}_4$	$= 1$	$= 1$
v_5	$v_4 / v_3 = 2.5$	$\dot{v}_5$	$= 1/v_3 \times \dot{v}_4$	$= 0.5 \times 1$
v_6	$v_5^2 = 6.25$	$\dot{v}_6$	$= 2v_5 \times \dot{v}_5$	$= 2 \times 2.5 \times 0.5$
v_7	$-0.5 \times v_6 = 3.125$	$\dot{v}_7$	$= -0.5 \times \dot{v}_6$	$= -0.5 \times 2.5$
v_8	$\log(\mu) = \log(2)$	$\dot{v}_8$	$= 1/v_3 \times \dot{v}_3$	$= 0$
v_9	$v_7 - v_8 = 3.125 - \log(2)$	$\dot{v}_9$	$= \dot{v}_7 - \dot{v}_8$	$= -1.25 - 0$
v_{10}	$v_9 - 0.5\log(2\pi) = 3.125 - \log(4\pi)$	$\dot{v}_{10}$	$= \dot{v}_7$	$= -1.25$

Reverse adjoint trace		
$\bar{v}_{10}$	$= 1$	$= 1$
$\bar{v}_9$	$= 1 \times \bar{v}_{10}$	$= 1$
$\bar{v}_8$	$= -1 \times \bar{v}_9$	$= -1 \times 1 = -1$
$\bar{v}_7$	$= 1 \times \bar{v}_9$	$= 1 \times 1 = 1$
$\bar{v}_6$	$= -0.5 \times \bar{v}_7$	$= -0.5 \times 1 = -0.5$
$\bar{v}_5$	$= 2 \times v_5 \times \bar{v}_6$	$= 2 \times 2.5 \times -0.5 = -2.5$
$\bar{v}_4$	$= 1/v_3 \bar{v}_5$	$= -1.25$
$\bar{v}_3$	$= -v_4/v_3^2 \times \bar{v}_5 + 1/v_3 \times \bar{v}_8$	$= -5/2^2 \times (-2.5) + 1/2 \times -1 = 2.625$
$\bar{v}_2$	$= -1 \times \bar{v}_4$	$= -1 \times 1.25 = -1.25$
$\bar{v}_1$	$= 1 \times \bar{v}_4$	$= 1 \times 1.25 = 1.25$