

there's
something
about
bayes

**effective probabilistic
programming for the
rest of us**

JAMES
BORNHOLT

TODD
MYTKOWICZ

KATHRYN S.
MCKINLEY



PERSONS UNDER 15 YEARS MUST BE
ACCOMPANIED BY A PARENT OR ADULT GUARDIAN
SEXUAL REFERENCES, MEDIUM LEVEL COARSE LANGUAGE



Programs are doing (probabilistic) inference, even if they don't realise it.

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bool HasBeard = BeardRecognizer(Photo);  
if (HasBeard)  
    Avatar.AddBeard();
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...but the user is on a road



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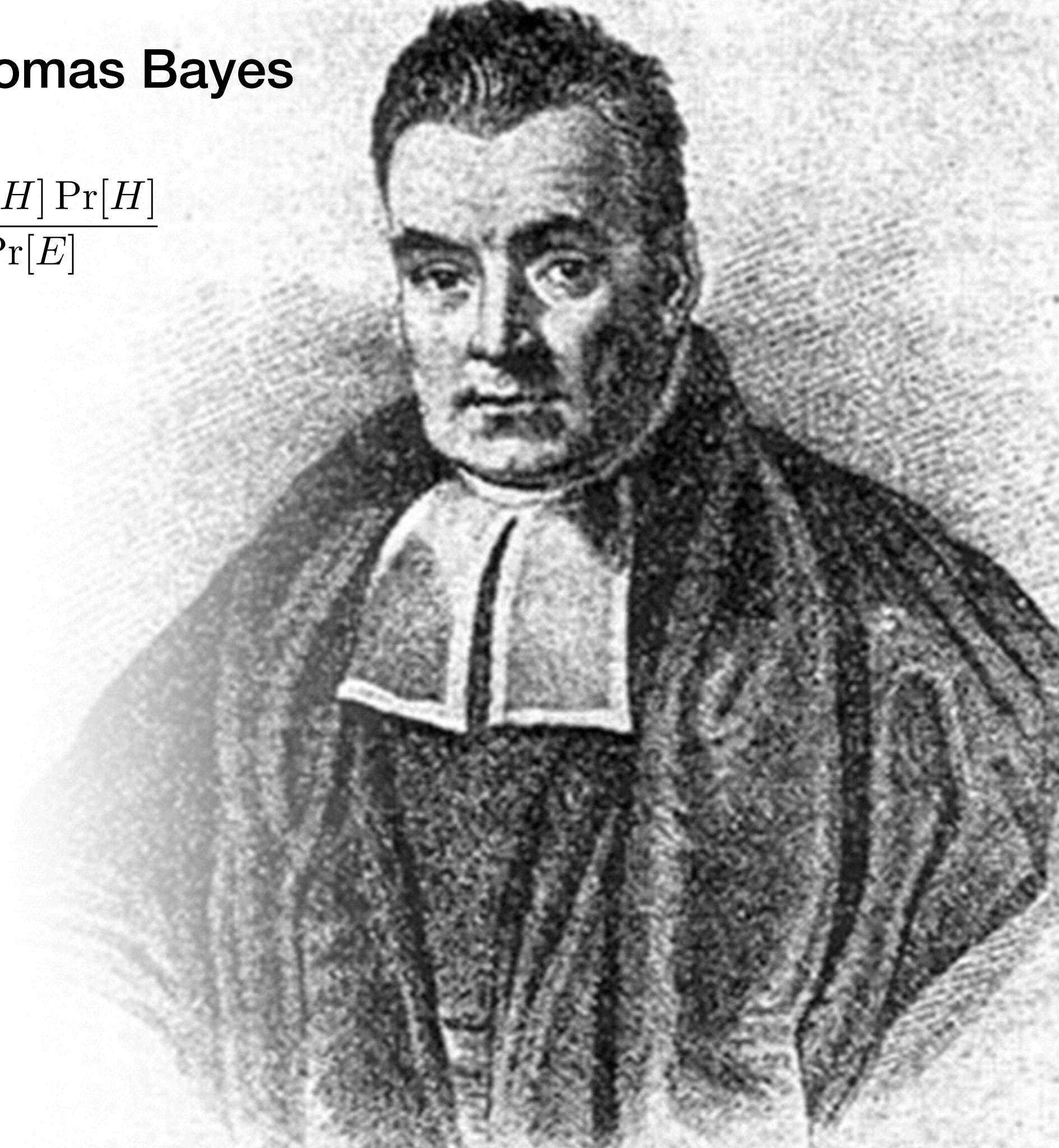


```
bool HasBeard = BeardRecognizer(Photo);  
if (HasBeard) conclusion evidence  
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```

...but the user is male

The Reverend Thomas Bayes

$$\Pr[H|E] = \frac{\Pr[E|H] \Pr[H]}{\Pr[E]}$$

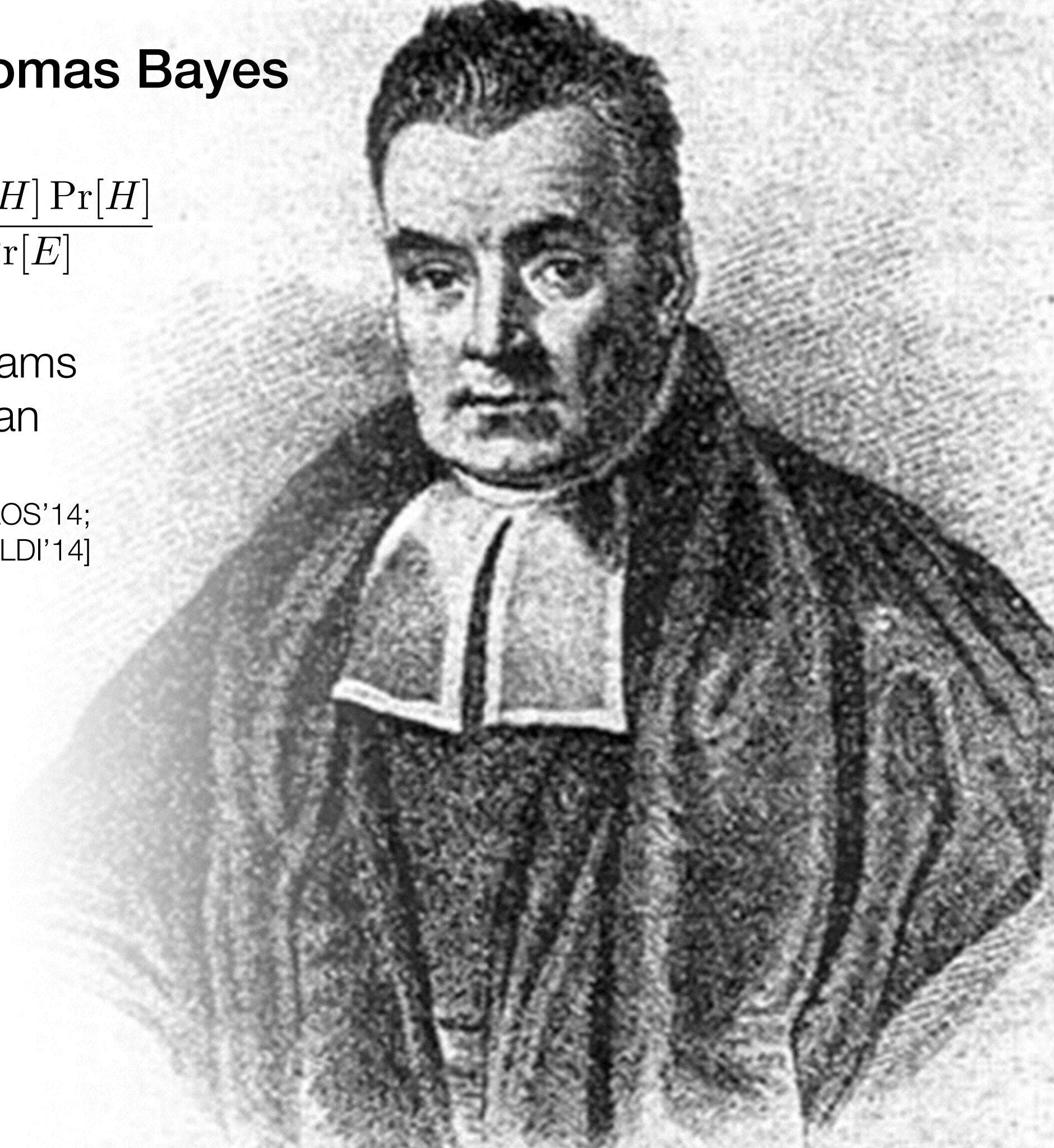


The Reverend Thomas Bayes

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These inference programs
[already have](#) a Bayesian
interpretation.

[Bornholt et al, ASPLOS'14;
Sampson et al, PLDI'14]



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U<GeoCoordinate> Loc = Bayes(GPSLoc, GPS.GetMapPrior());  
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```
U<bool> HasBeard = BeardRecognizer(Photo);  
double BeardProbability = IsMale ? 0.2 : 0.01;  
HasBeard = Bayes(HasBeard, Bernoulli(BeardProbability));  
if (HasBeard)  
    Avatar.AddBeard();
```

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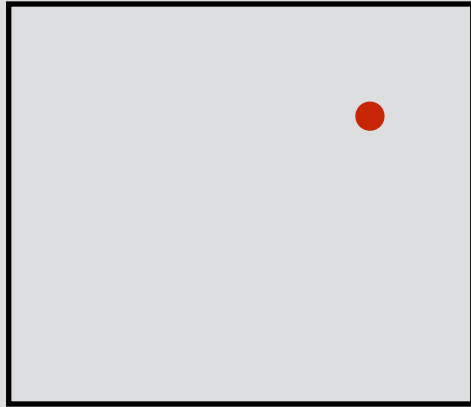


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Rejection sampling

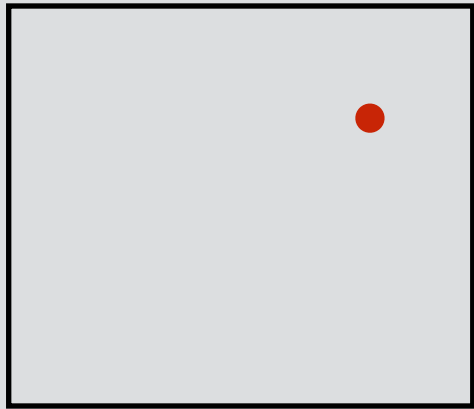
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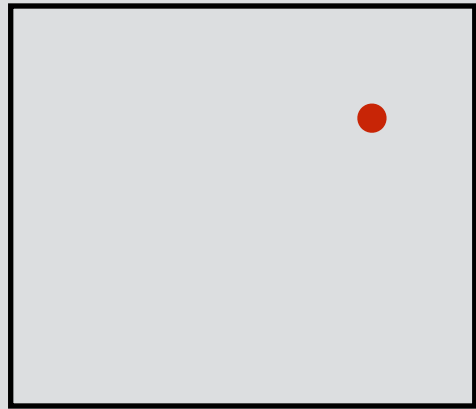
Rejection sampling



no constraints
poor performance

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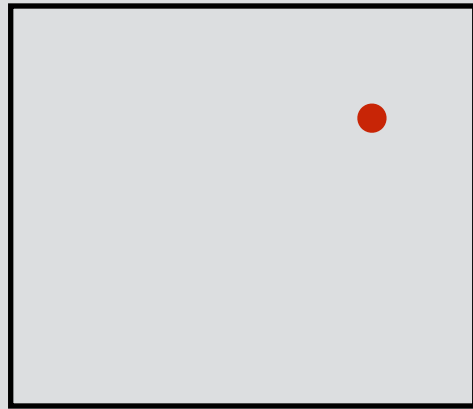


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Infer.NET

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Variable<GeoCoordinate> Location  
    = GPS.GetMapPrior();  
Variable<GeoCoordinate> GPSLoc  
    = GPS.GetLocationDist(Location);  
GPSLoc.ObservedValue = GPS.GetLocation();  
var ie = new InferenceEngine();  
var NewLocation = ie.Infer(Location);
```

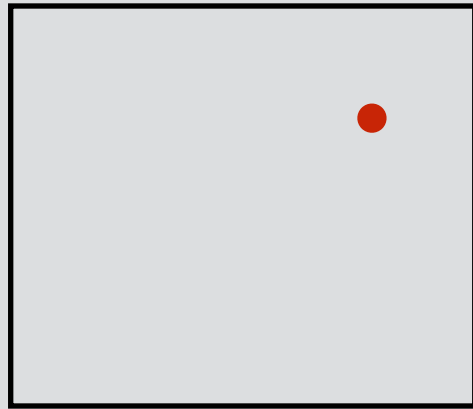


Your PC ran into a problem and needs to restart. We're just collecting some error info, and then we'll restart for you. (0% complete)

If you'd like to know more, you can search online later for this error: HAL_INITIALIZATION_FAILED

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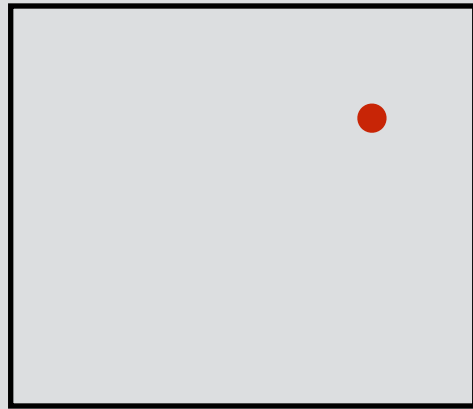
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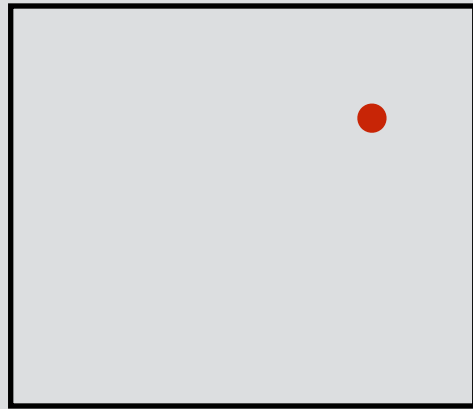
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Church


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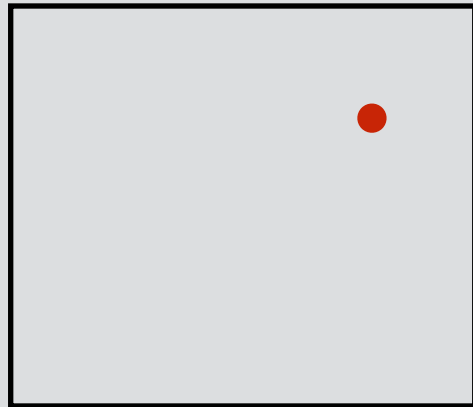
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Church

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some constraints
good performance

Church

[illegible]

Not everyone can make the same **compromises** as current probabilistic programming languages.

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Probabilistic programming is great, but please... think of the rest of us!