

Trifest: Automated Inference for Probabilistic Systems

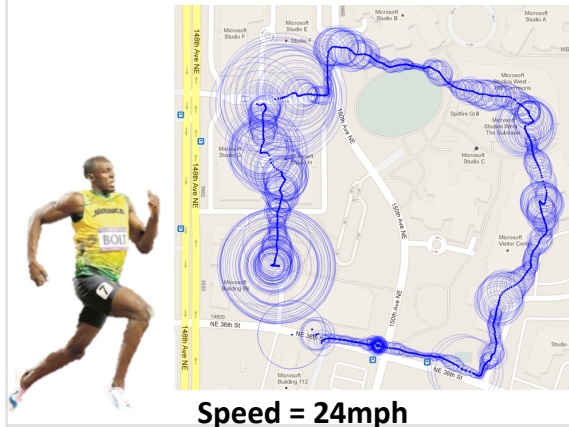
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Problem: Modern systems increasingly consume probabilistic estimates. Programming with estimates is difficult and error-prone.



```
Original Implementation:
GeoCoordinate PrevLocn = Get();
Sleep(5);
GeoCoordinate Location = Get();
double Dist =
    Distance(PrevLocn, Location);
double Speed = Dist / 5;
Print(Speed);
```

X Speed = 59mph

```
New Implementation:
Uncertain<GeoCoordinate> PrevLocn = Get();
Sleep(5);
Uncertain<GeoCoordinate> Location = Get();
Uncertain<double> Dist =
    Distance(PrevLocn, Location);
Uncertain<double> Speed = Dist / 5;
Print (Speed); // Expected value at 95 CI
```

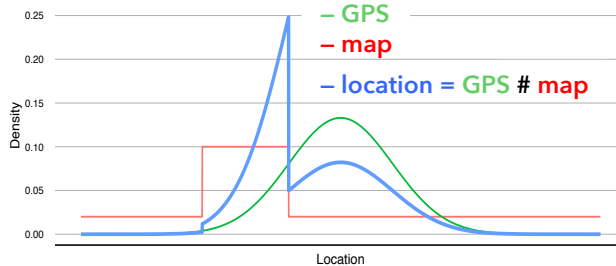


✓ Speed = 6.5mph

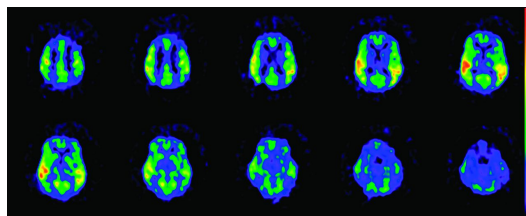
Insight: By putting estimates into context and adding domain knowledge, we can improve estimate accuracy.



Estimate: GPS location reading
Context: Car on the road

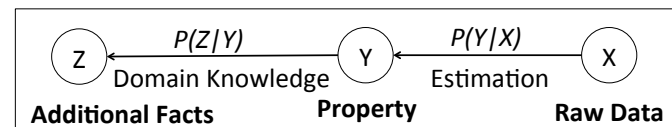


Estimate: Sleep status
Context: User profiles like age



Estimate: Alzheimer disease diagnosis
Context: User profiles and medical history

Trifest: Two program constructs and runtime support



$$P(Y|X,Z) = \frac{P(Y|X)P(Z|Y)}{P(Z|X)} \text{ (assume } P(Z|X,Y)=P(Z|Y))$$

<|: To specify domain knowledge $P(Z|Y)$

#: To compose domain knowledge and estimates

Sampling at runtime for lazy evaluation

```
if (Speed > 4)
    Alert("Keep it up!");
```

