



Ontology-driven Context Engine for the Internet of Things

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Sensing the IoT

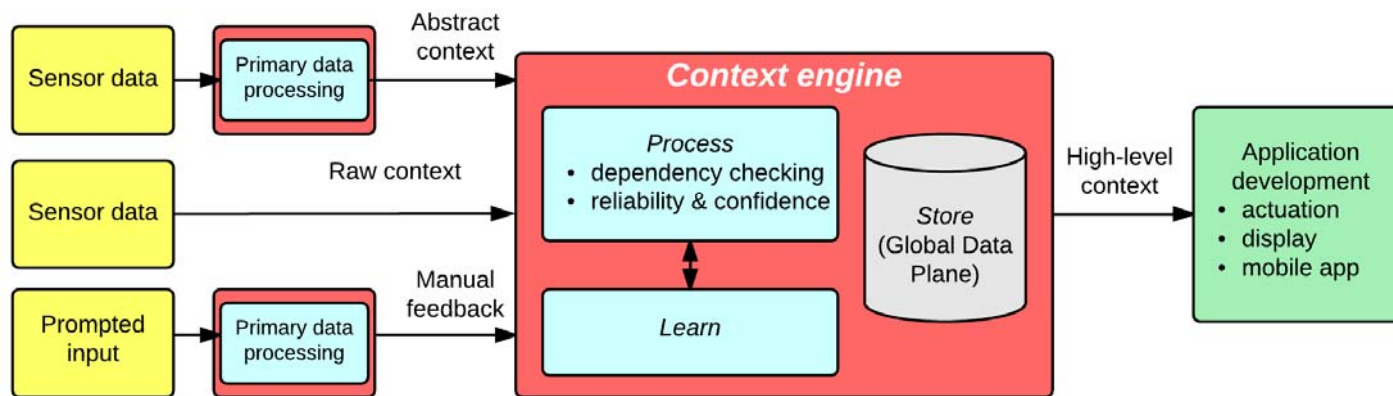


- Sensing data is *ubiquitous, dynamic, unregulated* at a *massive scale*
- Applications need to reason over well-defined knowledge
- Two main tasks
 - Transform *low-level sensor data* to *high-level context*
 - Integrate sensors and actuators



- Context ontology with the Object role model (ORM)
 - Physical/virtual entities (**objects**) have **roles** relative to to **data** – *producer* or *consumer*
- XCML: Context Modeling Language
 - **Context dimension**: minimum number of variables required by an application to perform meaningful processing

Ontology-Driven Context Engine



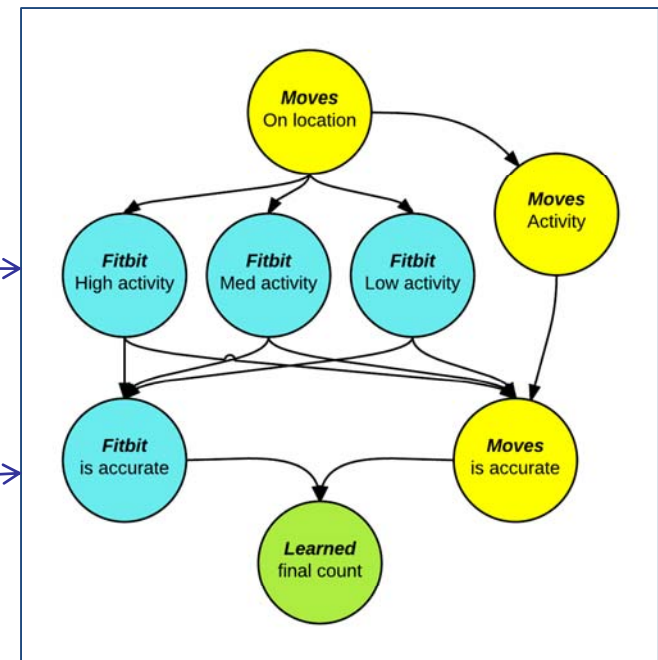
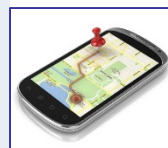
- **Process:**
 - Share context data among plug-and-play applications
 - Multiple paths to application goals
- **Store:**
 - Output to RESTful backend storage
- **Learn:**
 - Adapt to changing context dimensions
 - Optimize context scenarios
 - Negotiate missing data/sources

Sample application: step counts



- Independent hardware devices supply partially overlapping **knowledge** with different **data**
- Learn situational reliability over a Bayesian network

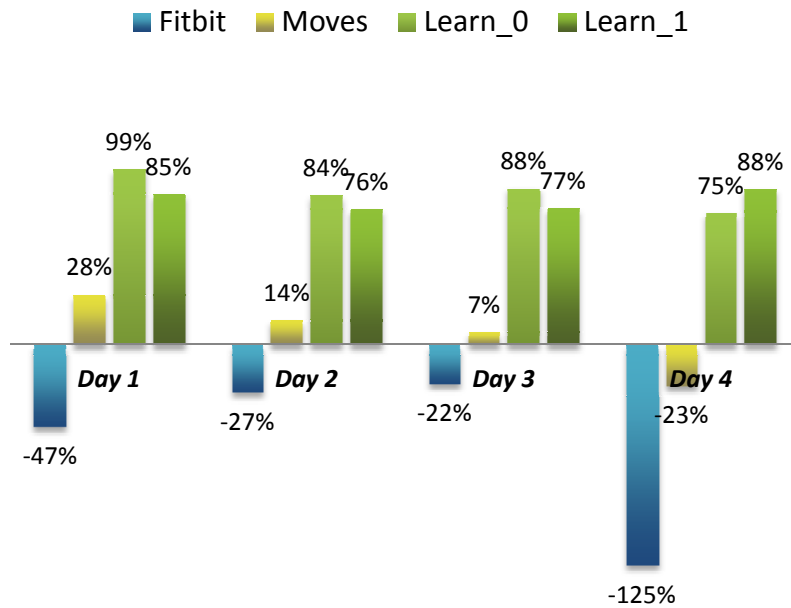
	Data	Knowledge
Fitbit	Accelerometer-based step counter	<ul style="list-style-type: none"> • Steps per minute
Moves	Smartphone-based activity and location tracker	<ul style="list-style-type: none"> • Basic activity information • GPS location • Steps per trip



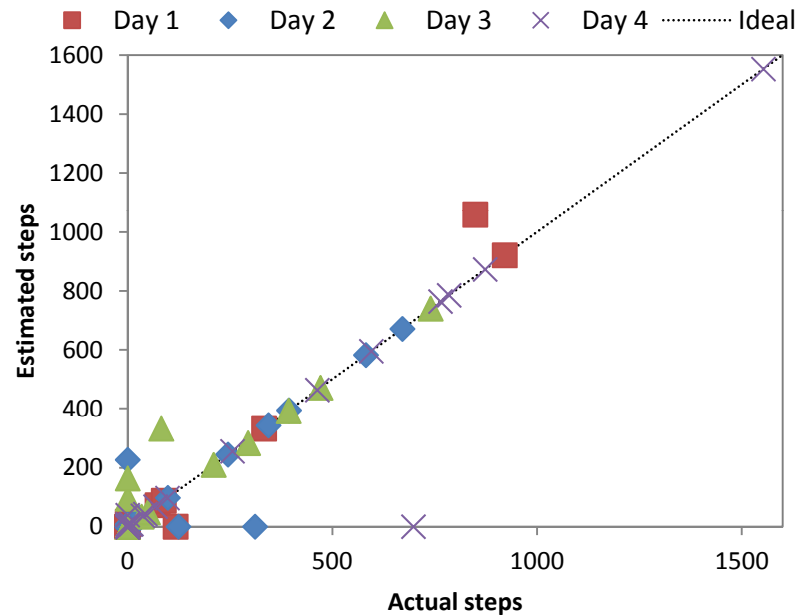
Results



Step count estimation accuracy



Actual vs Learned step count



- Device accuracy varies at runtime
 - Depends on GPS reception, sleep state, environmental noise, etc
- Learned results have 5-10x accuracy improvement over Fitbit alone, and 3-5x accuracy improvement over Moves alone