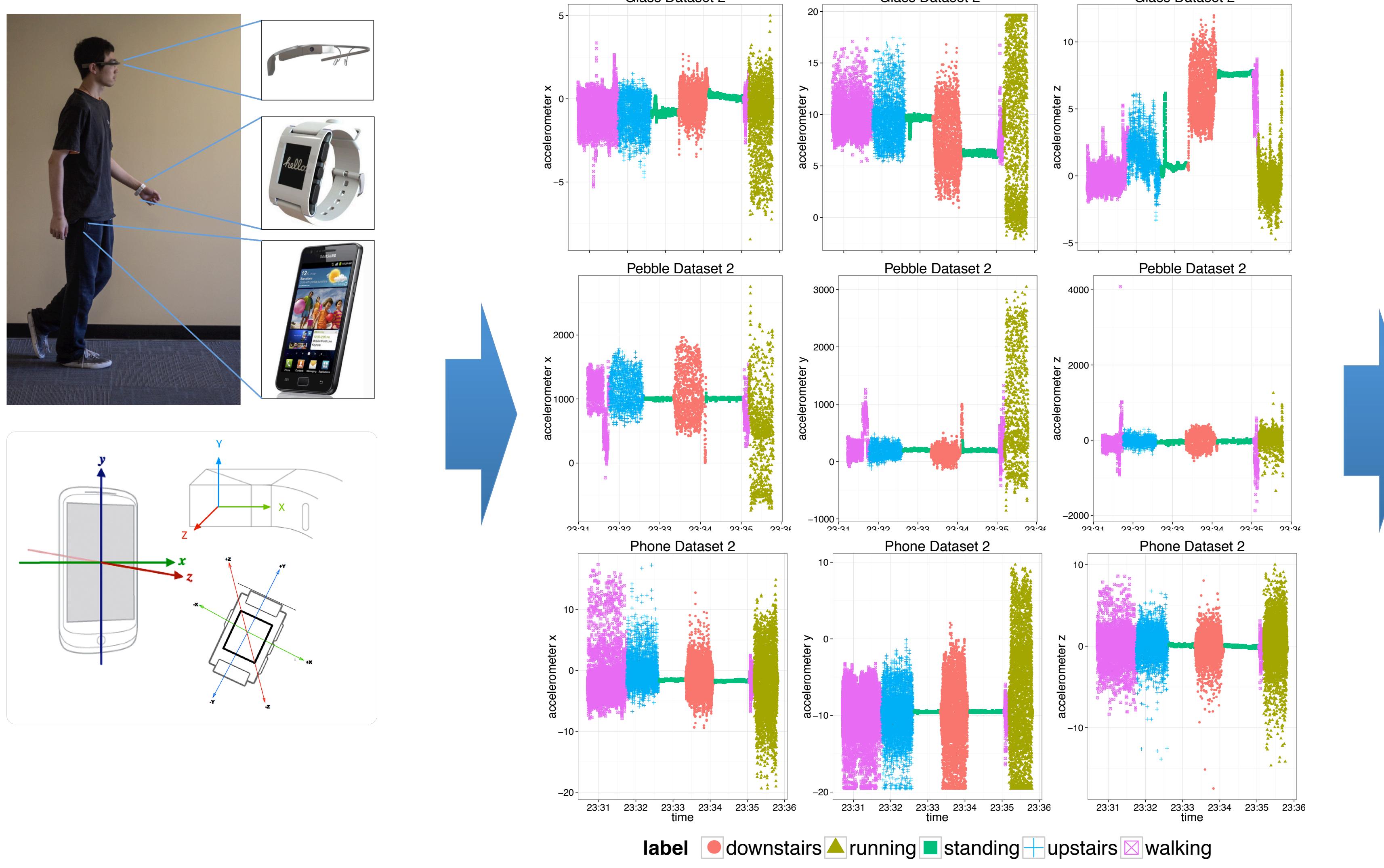


Which Device Knows Your Activity Better, Google Glass, Mobile Phones or Pebble Smartwatch?

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Extracted Features:

Time Domain	$\bar{x}, \bar{y}, \bar{z}, var(x), var(y), var(z)$
	$cov(x,y), cov(y,z), cov(z,x)$
Frequency Domain	$\sqrt{x^2 + y^2 + z^2}$
	$x_{t+1} - x_t, y_{t+1} - y_t, z_{t+1} - z_t$
	$\sum_j w_j^2 / N, -\sum_i p_i \log(p_i)$

Feature exploratory analysis:	
$\bar{x}, \bar{y}, \bar{z} y$	multivariate Gaussian
$var(x), var(y), var(z) y$	multivariate Gaussian
$cov(x,y), cov(y,z), cov(z,x) y$	multivariate Gaussian
$\sqrt{x^2 + y^2 + z^2} y$	Gamma
$x_{t+1} - x_t, y_{t+1} - y_t, z_{t+1} - z_t y$	multivariate Gaussian
$\sum_j w_j^2 / N y$	Exponential
$-\sum_i p_i \log(p_i) y$	Gamma

Data

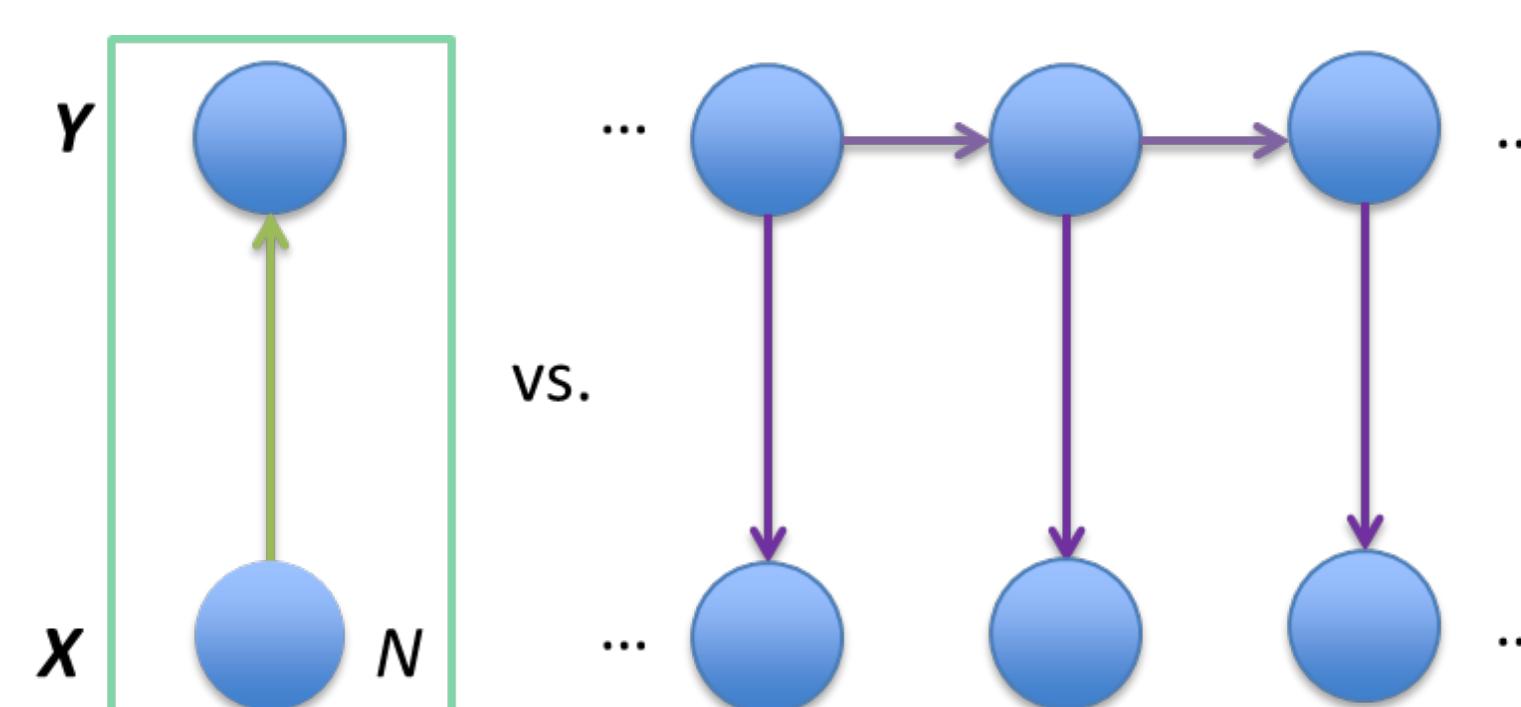
Learning

We compare two learning methods:

Multinomial Regression vs. Hidden Markov Model

Key Difference:

transitional information and conditional distribution



Glass with MLR Overall accuracy: 0.747					
Cross Error	Standing	Walking	Downstairs	Upstairs	Running
standing	0.625	0.032	0.020	0.057	0.000
Walking	0.125	0.727	0.188	0.057	0.107
Downstairs	0.250	0.727	0.188	0.057	0.107
Upstairs	0.000	0.041	0.114	0.878	0.053
Running	0.000	0.000	0.026	0.000	0.767

Glass with HMM Overall accuracy: 0.334					
Cross Error	Standing	Walking	Downstairs	Upstairs	Running
standing	0.400	0.057	0.006	0.029	0.000
Walking	0.066	0.692	0.240	0.067	0.155
Downstairs	0.133	0.211	0.629	0.022	0.017
Upstairs	0.400	0.033	0.110	0.880	0.068
Running	0.000	0.005	0.013	0.000	0.759

Pebble with MLR Overall accuracy: 0.667					
Cross Error	Standing	Walking	Downstairs	Upstairs	Running
standing	0.166	0.065	0.000	0.013	0.000
Walking	0.166	0.631	0.274	0.083	0.242
Downstairs	0.000	0.163	0.709	0.111	0.060
Upstairs	0.166	0.131	0.000	0.763	0.090
Running	0.500	0.008	0.016	0.027	0.606

Pebble with HMM Overall accuracy: 0.624					
Cross Error	Standing	Walking	Downstairs	Upstairs	Running
standing	0.500	0.063	0.000	0.019	0.000
Walking	0.000	0.618	0.370	0.182	0.080
Downstairs	0.500	0.218	0.555	0.183	0.000
Upstairs	0.000	0.081	0.074	0.596	0.000
Running	0.000	0.018	0.000	0.019	0.920

Phone with Logistic Regression Overall accuracy: 0.334					
Cross Error	Standing	Walking	Downstairs	Upstairs	Running
standing	0.593	0.125	0.071	0.017	0.000
Walking	0.196	0.125	0.313	0.366	0.318
Downstairs	0.125	0.000	0.306	0.241	0.181
Upstairs	0.129	0.125	0.282	0.294	0.272
Running	0.062	0.625	0.026	0.080	0.227

Phone with HMM Overall accuracy: 0.359					
Cross Error	Standing	Walking	Downstairs	Upstairs	Running
standing	1.000	0.014	0.064	0.006	0.000
Walking	0.000	0.542	0.303	0.635	0.158
Downstairs	0.000	0.136	0.335	0.155	0.123
Upstairs	0.000	0.188	0.271	0.162	0.341
Running	0.000	0.117	0.026	0.040	0.376