Exploiting smart phone data to identify users' activities

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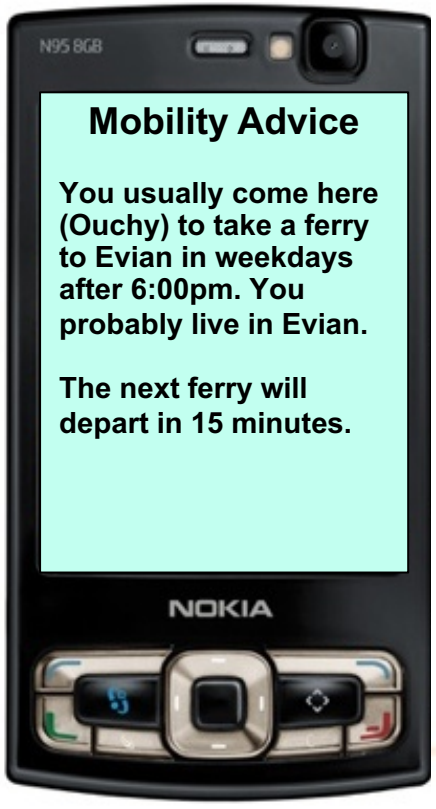
Motivations: e.g. customized service

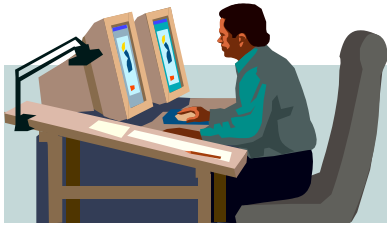
Customized services

Understanding Mobility Patterns



Mobility Patterns

Activity?



Transport?

Which Route?

How to infer them from smart phone data?

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Activity

- What the traveler does at his destination.
- Category:
  - Work
  - Shopping
  - Home
  - Social/recreation
  - Pick up/drop off
  - Change transport mode
  - Personal business

Motivations: Rich Data

Context

Motivations: Rich Data

Phone

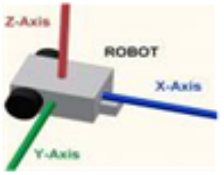
Camera

Calendar

Media Play

Call Log

System:
Profile,
Inactive time



Acceler ometer

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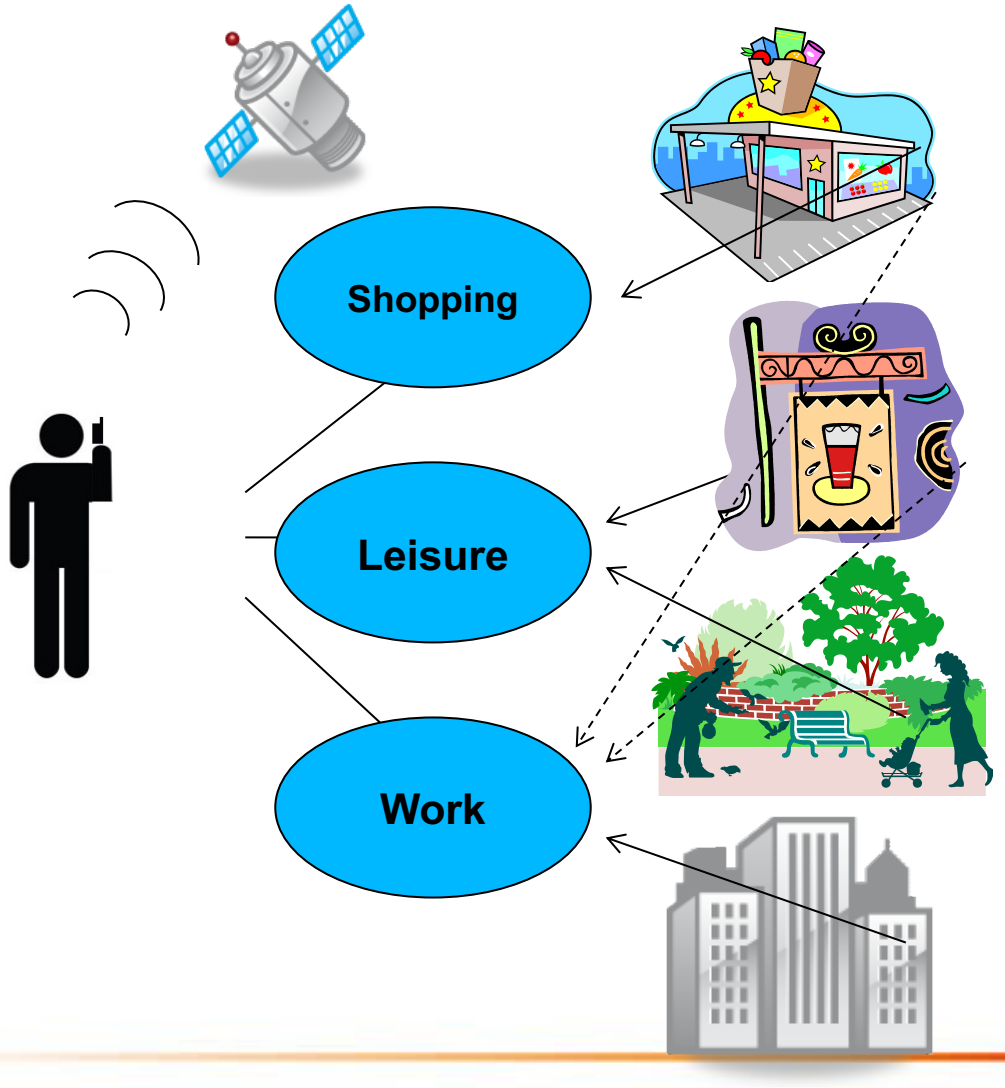
Location-based Activity Inference:

- GPS +
- Land use



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Modeling framework

- Behavioral assumptions:

1. Context ➔ Activity
2. Activity ➔ Measurements

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The likelihood model

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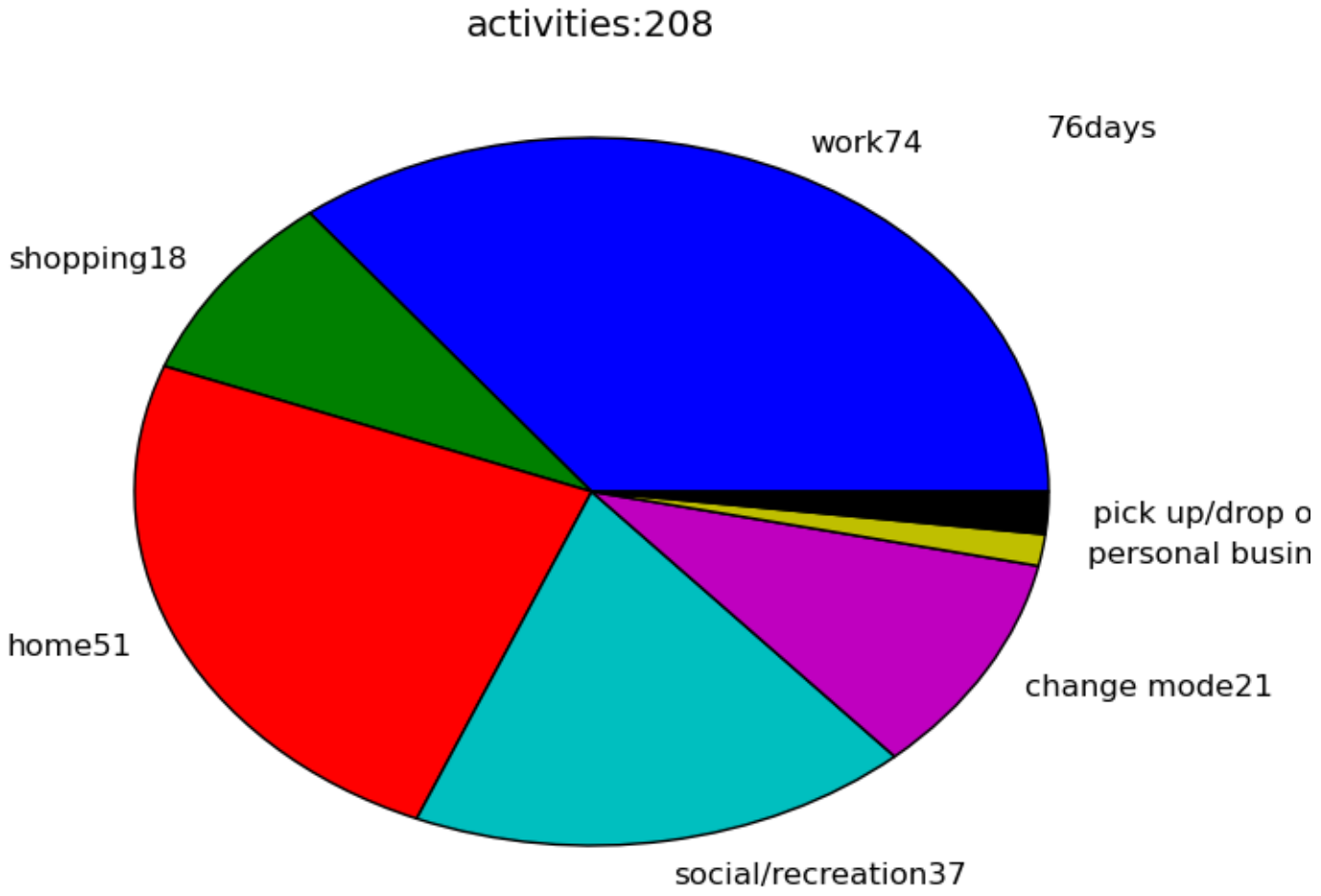
- Measurements:
  - Nearby bluetooth devices
  - Call
  - Phone interaction
  - Media
  - Media play
  - Charging
  - Calendar
  - Profile change

Collecting activity data



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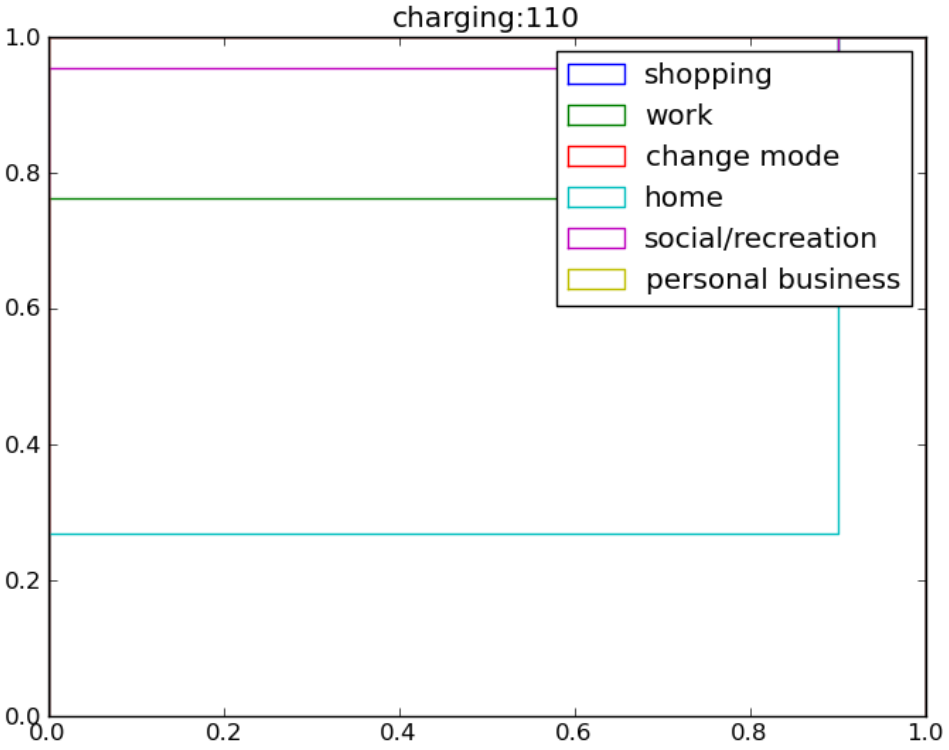

	work	social/recreatio	home	change mode	shopping	personal business
work	-0.04,0.65	-0.25,0.06	0.49,0.00	-0.28,0.05	-0.24,0.11	-0.09,0.59
social/recreati	0.25,0.06	-0.25,0.01	0.69,0.00	-0.13,0.43	-0.12,0.53	-0.05,0.84
home	-0.49,0.00	-0.69,0.00	0.59,0.00	-0.70,0.00	-0.64,0.00	-0.30,0.13
change mode	0.28,0.05	0.13,0.43	0.70,0.00	-0.23,0.02	nan,1.00	nan,1.00
shopping	0.24,0.11	0.12,0.53	0.64,0.00	nan,1.00	-0.18,0.06	nan,1.00
personal busin	0.09,0.59	0.05,0.84	0.30,0.13	nan,1.00	nan,1.00	-0.06,0.55

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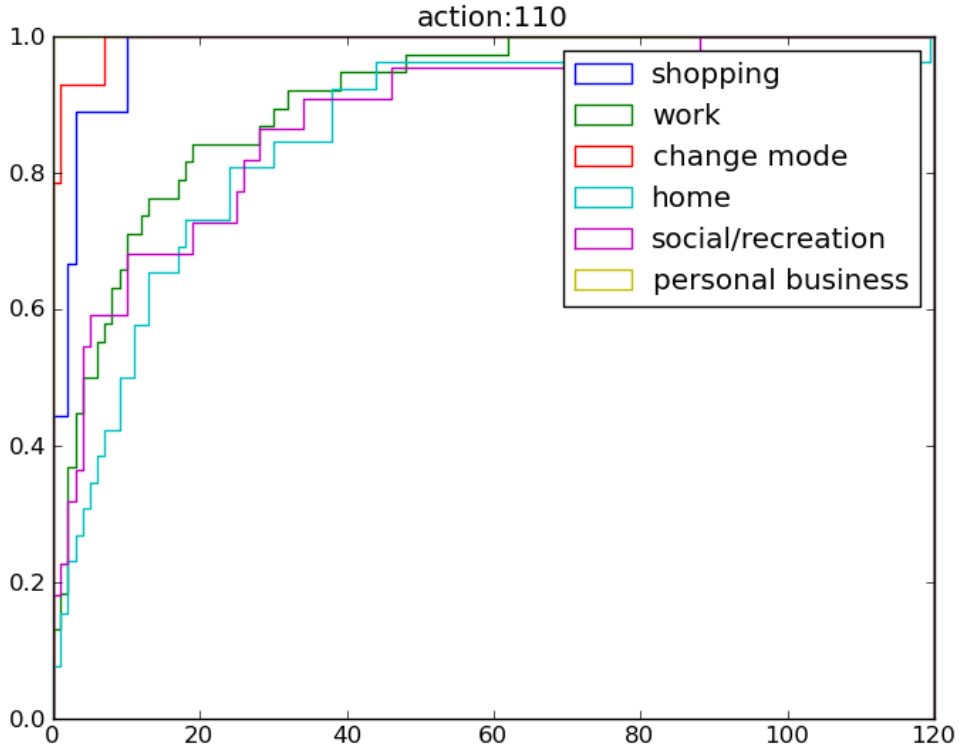

	home	social/recreati	work	personal busin	shopping	change mode
home	0.20,0.04	-0.07,0.66	-0.16,0.19	-0.14,0.49	-0.30,0.08	-0.38,0.02
social/recreati	0.07,0.66	0.09,0.34	-0.10,0.46	-0.14,0.51	-0.30,0.10	-0.38,0.02
work	0.16,0.19	0.10,0.46	-0.00,0.98	-0.12,0.46	-0.26,0.08	-0.35,0.01
personal busin	0.14,0.49	0.14,0.51	0.12,0.46	-0.06,0.54	0.23,0.53	0.09,0.74
shopping	0.30,0.08	0.30,0.10	0.26,0.08	-0.23,0.53	-0.15,0.13	-0.31,0.15
change mode	0.38,0.02	0.38,0.02	0.35,0.01	-0.09,0.74	0.31,0.15	-0.22,0.02

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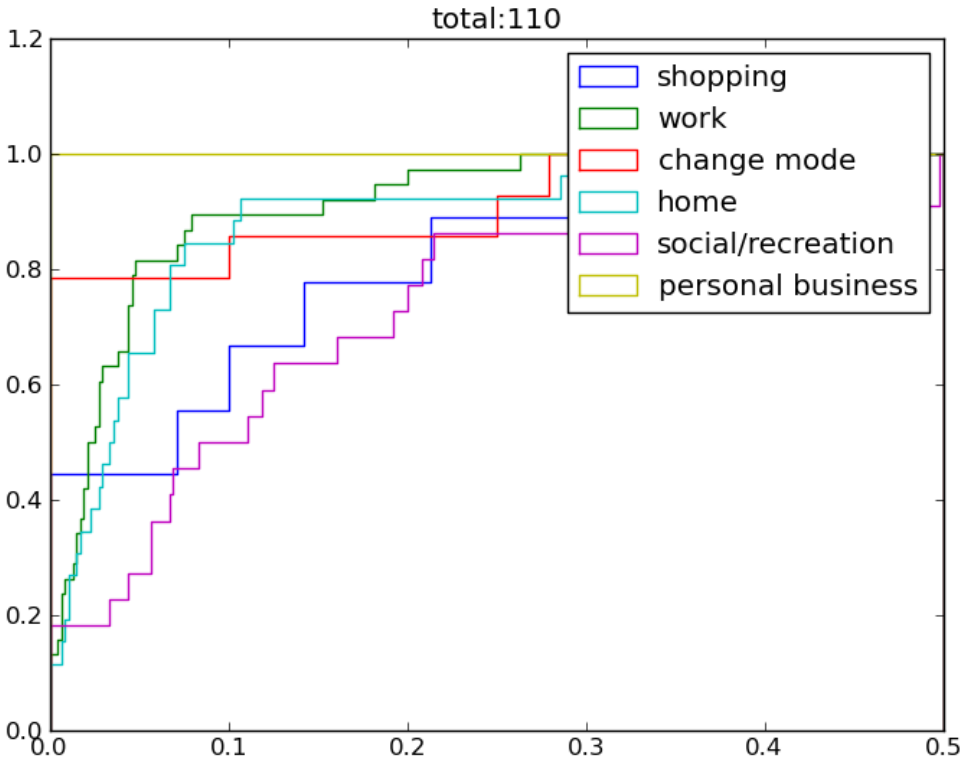

	home	social/recreati	work	personal busin	shopping	change mode
home	-0.07,0.46	0.35,0.02	-0.10,0.44	-0.14,0.47	0.17,0.32	-0.07,0.66
social/recreati	-0.35,0.02	0.35,0.00	-0.43,0.00	-0.20,0.36	-0.17,0.37	-0.35,0.04
work	0.10,0.44	0.43,0.00	-0.19,0.05	-0.12,0.46	0.26,0.08	0.00,0.98
personal busin	0.14,0.47	0.20,0.36	0.12,0.46	-0.07,0.48	0.27,0.44	0.12,0.66
shopping	-0.17,0.32	0.17,0.37	-0.26,0.08	-0.27,0.44	0.06,0.52	-0.23,0.30
change mode	0.07,0.66	0.35,0.04	-0.00,0.98	-0.12,0.66	0.23,0.30	-0.10,0.31

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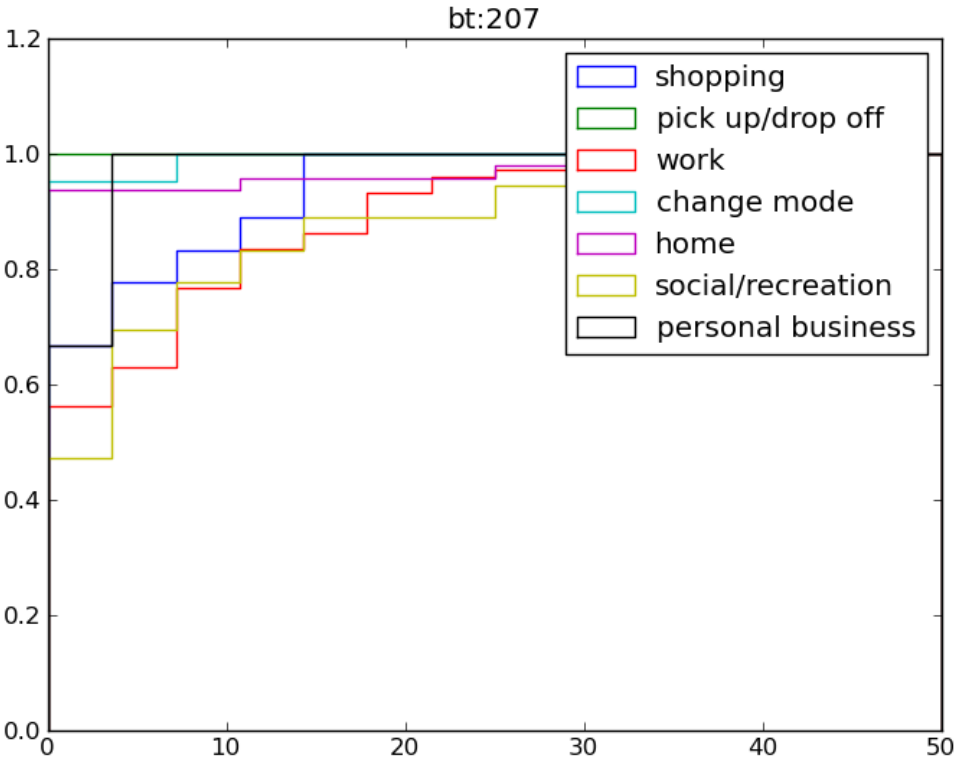

	work	social/recreati	pick up/drop off	change mode	shopping	home	personal business
work	0.08,0.23	0.05,0.60	-0.14,0.23	-0.25,0.01	-0.12,0.26	-0.07,0.44	-0.08,0.48
social/recreati	-0.05,0.60	0.10,0.16	-0.20,0.21	-0.34,0.01	-0.19,0.17	-0.10,0.34	-0.13,0.43
pick up/drop o	0.14,0.23	0.20,0.21	-0.06,0.36	0.13,0.55	0.31,0.17	0.08,0.57	0.47,0.29
change mode	0.25,0.01	0.34,0.01	-0.13,0.55	-0.14,0.05	0.40,0.01	0.14,0.25	0.25,0.23
shopping	0.12,0.26	0.19,0.17	-0.31,0.17	-0.40,0.01	-0.04,0.54	0.03,0.79	-0.11,0.62
home	0.07,0.44	0.10,0.34	-0.08,0.57	-0.14,0.25	-0.03,0.79	-0.03,0.68	-0.04,0.79
personal busin	0.08,0.48	0.13,0.43	-0.47,0.29	-0.25,0.23	0.11,0.62	0.04,0.79	-0.03,0.64

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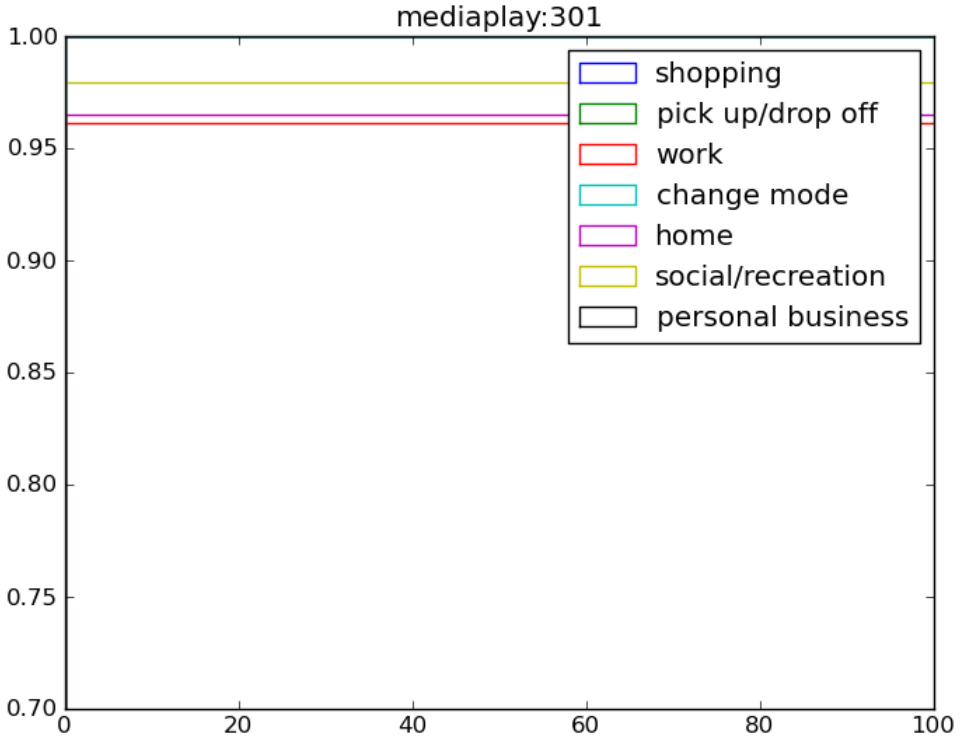

	work	social/recreati	shopping	home	change mode	pick up/drop o	personal busin
work	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00
social/recreati	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00
shopping	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00
home	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00
change mode	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00
pick up/drop o	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00
personal busin	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00	nan,1.00

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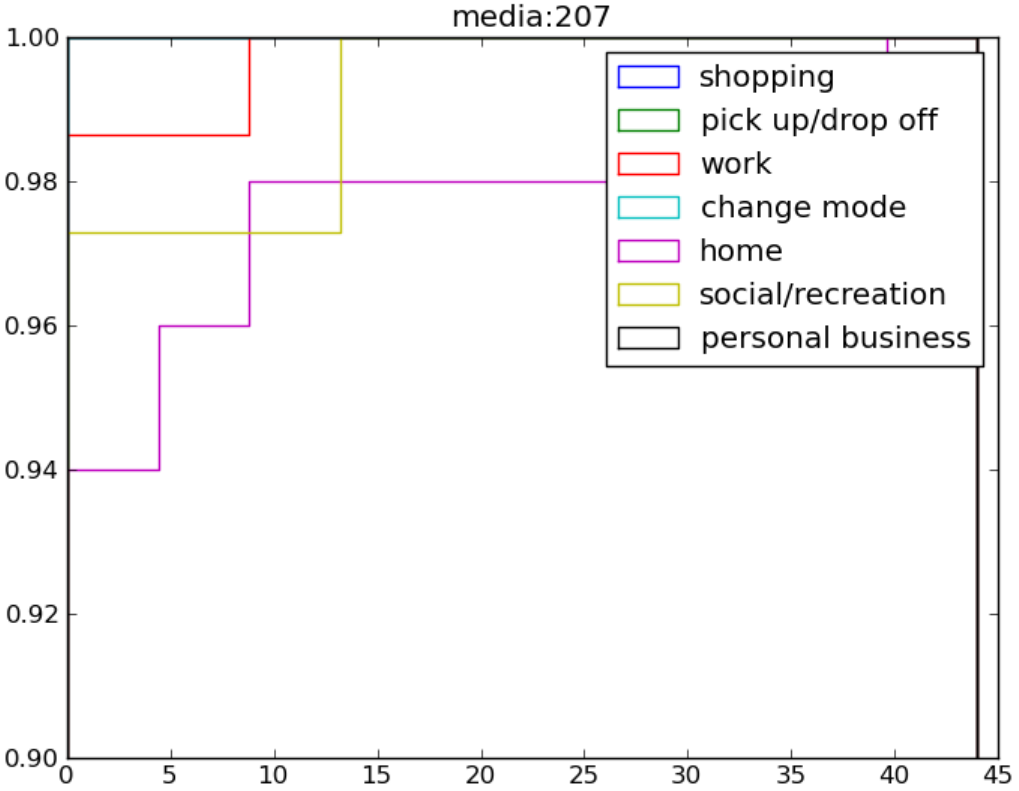

	work	social/recreati	pick up/drop o	change mode	shopping	home	personal busin
work	-0.06,0.38	0.08,0.42	-0.03,0.80	-0.06,0.56	-0.06,0.59	0.13,0.16	-0.03,0.83
social/recreati	-0.08,0.42	-0.00,0.99	-0.05,0.75	-0.10,0.46	-0.09,0.49	0.08,0.47	-0.05,0.78
pick up/drop o	0.03,0.80	0.05,0.75	-0.02,0.81	nan,1.00	nan,1.00	0.05,0.71	nan,1.00
change mode	0.06,0.56	0.10,0.46	nan,1.00	-0.04,0.56	nan,1.00	0.10,0.39	nan,1.00
shopping	0.06,0.59	0.09,0.49	nan,1.00	nan,1.00	-0.04,0.59	0.10,0.43	nan,1.00
home	-0.13,0.16	-0.08,0.47	-0.05,0.71	-0.10,0.39	-0.10,0.43	0.13,0.06	-0.05,0.75
personal busin	0.03,0.83	0.05,0.78	nan,1.00	nan,1.00	nan,1.00	0.05,0.75	-0.01,0.83

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Future works

- Collect activity data
- Specify likelihood model