Discovering Latent Structure in Clinical Databases

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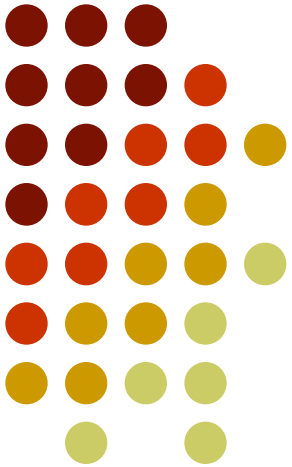
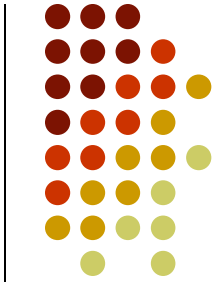


Overall Goal



Patient

PID	Gender	Birthday
P1	M	3/22/63

Drugs

PID	Date	Medication	Dose	Duration
P1	5/17/98	zololf	10mg	3 months

Diseases

PID	Date	Symptoms	Diagnosis
P1	1/1/01	palpitations	hypoglycemic
P1	2/1/03	fever, aches	influenza

Lab Tests

PID	Date	Lab Test	Result
P1	1/1/01	blood glucose	42
P1	1/9/02	blood glucose	45

Given: Patient's clinical history

Learn: To predict, at prescription time, if a patient will have an adverse reaction to a medicine

An Unforeseen Challenge

- Address the task by learning (probabilistic) rules in first-order logic

$$\text{Drug}(p, \text{Zoloft}) \wedge \text{Lab}(\text{p}, \text{BloodSugar}) \wedge \ldots \Rightarrow \text{Reaction}(p)$$

- Important regularities look this:
  - MAOIs can cause liver inflammation
  - SSRIs may increase risk of MI
- Data refers to individual drugs, regularities may talk about classes of drugs

Designed algorithm that

1) Automatically learn clusters about objects
2) Use learned clusters in rules

High-Level Algorithmic Picture

$\text{Drug}(p, \text{Zoloft}) \wedge \ldots \wedge \ldots \Rightarrow \text{Reaction}(p)$

Generalize rule to refer to learned (hierarchical) clusters of constants

$\text{Hier\_11(x)} \wedge \text{Drug}(p, \text{x}) \wedge \ldots \wedge \ldots \Rightarrow \text{Reaction}(p)$

Learn hierarchy definition by

Assign objects to hierarchy

Reuse previously learned groups

$\text{Hier\_11}(\text{Zoloft})$

$\text{Hier\_11}(\text{Paxil})$

...

$\text{Hier\_8}(\text{x}) \Rightarrow \text{Hier\_11}(\text{x})$

Empirical Evalution: Adverse Drug Reactions

- Real clinical data for three tasks
  - Task 1: MI on selective Cox-2 inhibitor
  - Task 2: Bleeding on Warfarin
  - Task 3: Angioedma on ACE inhibitors
- Improved performance on all three tasks