Spectral learning for structured partially observable environments

Lucas Langer

McGill University

lucas.langer@mail.mcgill.ca

August 15, 2015

Overview

PSRs

Predictive state representations (PSRs) are for computing a probability distribution over observations in a dynamical system [Littman et al.]
Also known as Weighted Automata (motivation dependent)
PSRs compute a function on finite strings of observations sequences f(abaab...).
Defined by three parameters: $< \alpha, A_x, \beta >$
α : Weighting on states E.g $\alpha = [0.5, 0.5]$
A_x : Transition operator for symbol x

$$A_x = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 & 7 \end{bmatrix}$$

β : Normalizer on states E.g

$$M = \begin{bmatrix} 1 & 2 \end{bmatrix}$$

$f(abaaba) = \alpha * A_a * A_b * A_a * A_a * A_b * \beta$

Bullet Points

- HMMs are an example of PSRs
- $A_x = O_x * T_x$
- O_x being an observation matrix
- T_x being a transition matrix
- So why bother the general framework of PSRs?

A Learning Algorithm

- Turns out that with spectral can learn PSRs from data, but learning HMMs cannot be done.
- $< \alpha, A_x, \beta >$ v.s $< \alpha * M^{-}1, M * A_x * M^{-}1, M * \beta >$
- $A_x = O_x * T_x$
- O_x being an observation matrix
- T_x being a transition matrix
- So why bother the general framework of PSRs?

Blocks of Highlighted Text

Block 1

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Block 2

Pellentesque sed tellus purus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Vestibulum quis magna at risus dictum tempor eu vitae velit.

Block 3

Suspendisse tincidunt sagittis gravida. Curabitur condimentum, enim sed venenatis rutrum, ipsum neque consectetur orci, sed blandit justo nisi ac lacus.

Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table : Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)

Title of the publication

Journal Name 12(3), 45 – 678.

The End