• Assignment 4 graded
• Assignment 5 follow-up
  • https://www.umass.edu/peoplefinder/
• Source control follow-up
• Midterm posted
Student developer packs

Github: https://education.github.com/pack

Bitbucket: https://bitbucket.org/product/education
Midterm

Due: Friday, November 9 at 5:00pm
Instructions posted on Piazza
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Course tasks

1. AIHC in the media
2. ML Understanding
3. Personal health technology
4. Medical decision making
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Course tasks
1. AIHC in the media
2. ML Understanding
3. Personal health technology
4. Medical decision making

UMass tasks
1. Academic advising
2. Meet your professors
3. Time management skills
4. Building good study habits
Dimensionality Reduction
Today

Dimensionality Reduction
  Principal Components Analysis
  Autoencoders
  Word embeddings
PCA
Principal Components Analysis

- Transformation of data to align with important directions
- Reduce dimensionality by dropping least important directions
- Start with most important direction, add features until you hit a threshold

https://towardsdatascience.com/a-one-stop-shop-for-principal-component-analysis-5582fb7e0a9c
PCA Algorithm

1. Start with your data matrix $X$
2. Zero-mean and (maybe) normalize the columns: $X \rightarrow Z$
3. Decompose $Z^\top Z$ into $PDP^{-1}$
   - $P$: matrix of eigenvectors
   - $D$: diagonal matrix of eigenvalues
4. sort $P$ based on the eigenvalues in $D$: $P \rightarrow P^*$
5. $Z^* = ZP^*$
   - $Z^*$ columns of $Z^*$ are independent of each other
6. Keep the desired number of features from $Z^*$

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Choosing Components

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Autoencoders
Autoencoders

\[
\begin{align*}
    z &= \sigma(We + b) \\
    x' &= \sigma(Wd z + b)
\end{align*}
\]

\[
L(x, x') = \sum (x - x')^2
\]

Autoencoders

\[ z = \sigma(W_e x + b_e) \]
\[ x' = \sigma(W_d z + b_d) \]
\[ L(x, x') = \sum (x - x')^2 \]

Denoising Autoencoders

\[ z = \sigma(W_e \tilde{x} + b_e) \]

\[ x' = \sigma(W_d z + b_d) \]

\[ L(x, x') = \sum (x - x')^2 \]

http://www.opendeep.org/v0.0.5/docs/tutorial-your-first-model
Sparse Autoencoders

Word Embeddings
Before Word Embeddings: Bag of Words

D1: “Patient has a fever, otherwise not sick”
D2: “Patient very sick, not a fever though”

<table>
<thead>
<tr>
<th></th>
<th>patient</th>
<th>fever</th>
<th>very</th>
<th>sick</th>
<th>not</th>
<th>otherwise</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>D2</td>
<td>1</td>
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Word Embeddings: Word2Vec

Activity: Dimensionality Reduction
Student Features

- Major
- Dorm/Residence
- Favorite TV show
- Age
- Hobby
- Favorite course at UMass
- Number of siblings
- Programming language
- Home state/region
- Best dining hall meal