Department of Computer Science
UNIVERSITY OF COLORADO **BOULDER**

Ranking

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LECTURE 15

Administrivia

- How is the course going?
- What do you like?
- What don't you like?
- What should we do for an undergrad section?

Content Questions

Content Questions

Content Questions

Content Questions

Content Questions

Content Questions

Content Questions

Content Questions

Content Questions

Content Questions

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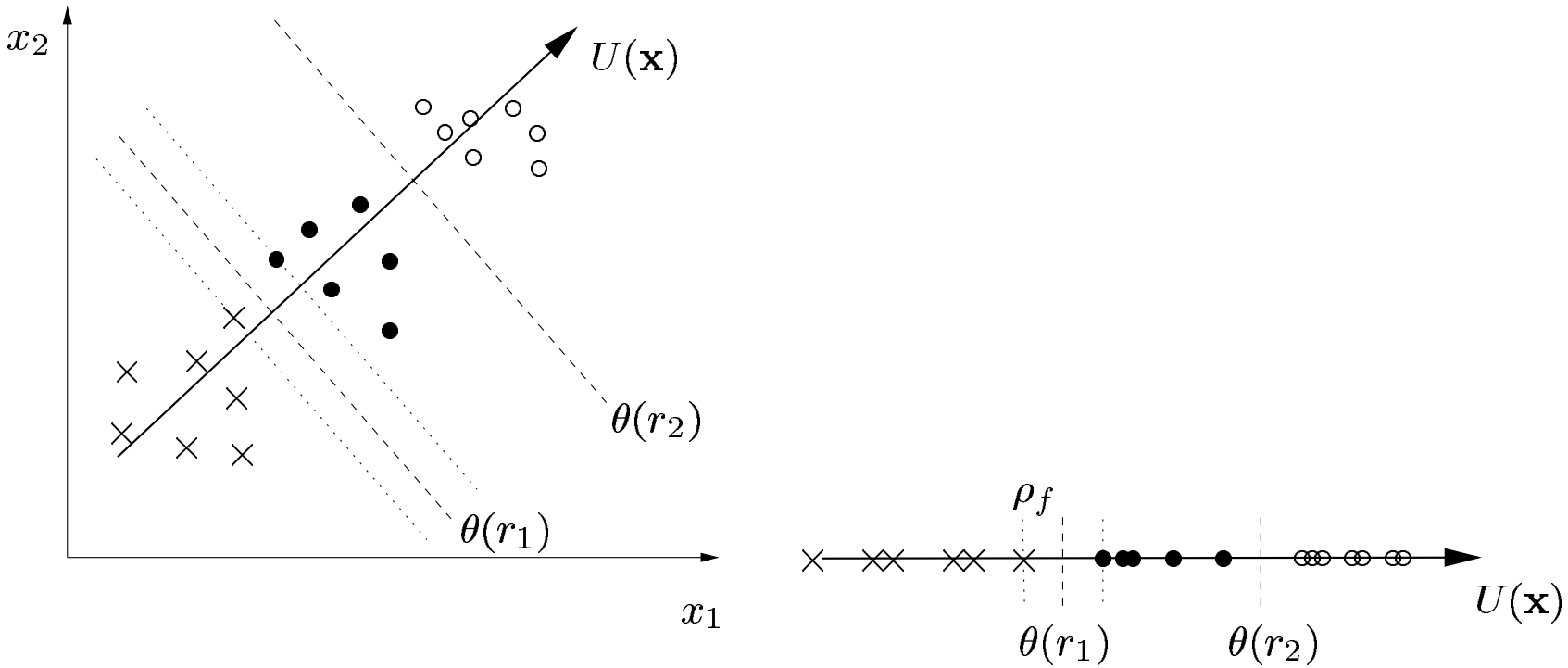
Administrivia

- Boosting Due on Friday
- Midterm Next Week: 1.5 Hours

SVM Ranking


x_2
$U(\mathbf{x})$
$\theta(r_2)$
$\theta(r_1)$
x_1
ρ_f
$U(\mathbf{x})$
$\theta(r_1)$
$\theta(r_2)$

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
2 qid:375 1:0.06 2:-0.00 3:0.7 4:0.0 5:1.0 6:0.0 7:0.0
 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

1: Year of the movie ($\mu = 1987$, var=266)

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
2 qid:375 1:0.06 2:-0.00 3:0.7 4:0.0 5:1.0 6:0.0 7:0.0
 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

2: Length of the movie ($\mu = 108$, var=569)

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
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 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

3: Rating ($\mu = 6.4$, var=1.4)

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
2 qid:375 1:0.06 2:-0.00 3:0.7 4:0.0 5:1.0 6:0.0 7:0.0
 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

4: Action (binary)

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
2 qid:375 1:0.06 2:-0.00 3:0.7 4:0.0 5:1.0 6:0.0 7:0.0
 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

5: Comedy (binary)

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
2 qid:375 1:0.06 2:-0.00 3:0.7 4:0.0 5:1.0 6:0.0 7:0.0
 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

6: Documentary (binary)

Real(-ish) Data

Sets of five movies ranked by users

```
# Big Lebowski, The
1 qid:375 1:0.04 2:0.01 3:1.1 4:0.0 5:1.0 6:0.0 7:0.0
# School of Rock, The
2 qid:375 1:0.06 2:-0.00 3:0.7 4:0.0 5:1.0 6:0.0 7:0.0
 # While You Were Sleeping
3 qid:375 1:0.03 2:-0.01 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
# Clockwise
4 qid:375 1:-0.01 2:-0.02 3:0.04 4:0.0 5:1.0 6:0.0 7:0.0
 # Enchanted April
5 qid:375 1:0.02 2:-0.02 3:0.7 4:0.0 5:0.0 6:0.0 7:1.0
```

7: Drama (binary)

Fitting an SVM

- SVM-RANK
- Five support vectors
- Weight vector

$$w = \langle 0.02, 0.03, -1.82, -2.30, -0.05, 1.73, 1.84 \rangle \quad (1)$$

Predictions

$$w = \langle 0.02, 0.03, -1.82, -2.30, -0.05, 1.73, 1.84 \rangle \quad (2)$$

```
# Paper Chase
1:-0.06 2:0.0 3:0.53 4:0.0 5:0.0 6:0.0 7:1.0
# Seconds
1:-0.08 2:-0.01 3:0.74 4:0.0 5:0.0 6:0.0 7:1.0
#Smokey and the Bandit II
1:-0.03 2:-0.02 3:-1.43 4:1.0 5:1.0 6:0.0 7:0.0
# CB4
1:0.02 2:-0.03 3:-0.73 4:0.0 5:1.0 6:0.0 7:0.0
#Sideways
1:0.06 2:0.03 3:1.09 4:0.0 5:1.0 6:0.0 7:1.0
```

- Paper Chase:

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds:

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$
- Smokey and the Bandit II:

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$
- Smokey and the Bandit II: $-0.01 \cdot -0.03 + 0.07 \cdot -0.02 + -1.95 \cdot -1.43 + -2.28 \cdot 1.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 0.00 = 0.44$

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$
- Smokey and the Bandit II: $-0.01 \cdot -0.03 + 0.07 \cdot -0.02 + -1.95 \cdot -1.43 + -2.28 \cdot 1.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 0.00 = 0.44$
- CB4:

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$
- Smokey and the Bandit II: $-0.01 \cdot -0.03 + 0.07 \cdot -0.02 + -1.95 \cdot -1.43 + -2.28 \cdot 1.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 0.00 = 0.44$
- CB4: $0.01 \cdot 0.02 + 0.07 \cdot -0.03 + -1.95 \cdot -0.73 + -2.28 \cdot 0.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 0.00 = 1.35$

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$
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- Sideways: $-0.01 \cdot 0.06 + 0.07 \cdot 0.03 + -1.95 \cdot 1.09 + -2.28 \cdot 0.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = -0.32$

- Paper Chase: $-0.01 \cdot -0.06 + 0.07 \cdot 0.00 + -1.95 \cdot 0.53 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.84$
- Seconds: $-0.01 \cdot -0.08 + 0.07 \cdot -0.01 + -1.95 \cdot 0.74 + -2.28 \cdot 0.00 + -0.07 \cdot 0.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = 0.43$
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- CB4: $0.01 \cdot 0.02 + 0.07 \cdot -0.03 + -1.95 \cdot -0.73 + -2.28 \cdot 0.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 0.00 = 1.35$
- Sideways: $-0.01 \cdot 0.06 + 0.07 \cdot 0.03 + -1.95 \cdot 1.09 + -2.28 \cdot 0.00 + -0.07 \cdot 1.00 + 1.57 \cdot 0.00 + 1.87 \cdot 1.00 = -0.32$

What's the predicted ranking?

Ranking

Predicted Rank

1. Sideways
2. Seconds
3. Smokey and the Bandit II
4. The Paper Chase
5. CB4

Ranking

Predicted Rank

1. Sideways
2. Seconds
3. Smokey and the Bandit II
4. The Paper Chase
5. CB4

True Rank

1. Sideways
2. Smokey and the Bandit II
3. Seconds
4. The Paper Chase
5. CB4

Ranking

Predicted Rank	True Rank
1. Sideways	1. Sideways
2. Seconds	2. Smokey and the Bandit II
3. Smokey and the Bandit II	3. Seconds
4. The Paper Chase	4. The Paper Chase
5. CB4	5. CB4

How many errors is this?

Ranking to Regression

- Using SVMs to predict a value
- Ranking that value
- What if we care about actual value and not just relative order?
- Regression!