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NIPS Thanks Its Sponsors
The Online Revolution: Education for Everyone

Daphne Koller
Stanford University & Coursera

NIPS 2013
Massive Open Online Course

100,000

400
Take the world's best courses, online, for free.

Join 5,271,598 Courserians.
Learn from 534 courses, from our 107 partners.
How it works »
NUMBER OF COURSES AVAILABLE
2 Oct. 2011
532 Oct. 2013

NUMBER OF PARTNER UNIVERSITIES
1 Oct. 2011
107 Oct. 2013

NUMBER OF STUDENTS
111,479 Oct. 2011
5,266,200 Oct. 2013

TOTAL COURSE ENROLLMENTS
19.1 Million

TIME SPENT WATCHING VIDEOS
48,784,829 hours
that’s 5,565 years...

NUMBER OF COURSE INSTRUCTORS
731
35 of the top 60 universities worldwide, including the #1 or #2 ranked university in 16 countries.
The Humanities, Sciences, Engineering, Business, ....
The Social Context of Mental Health and Illness
Charmaine Williams
6 weeks long

Critical Thinking in Global Challenges
Celine Caquineau, Mayank Dutia
5 weeks long

Introduction to Computer Networks
Arvind Krishnamurthy, David Wetherall, John Zahorjan
10 weeks long

Grow to Greatness: Smart Growth for Private Businesses, Part I
Edward O. Hess
5 weeks long

Computational Photography
Irfan Essa
8 weeks long

Astrobiology and the Search for Extraterrestrial Life
Charles Cockell
5 weeks long

Courses offered
- 30% Science
- 28% Arts and humanities
- 23% Information technology
- 13% Business
- 6% Mathematics

The Humanities, Sciences, Engineering, Business, ....
<table>
<thead>
<tr>
<th>Course</th>
<th>Instructor/Provider</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Signal Processing</td>
<td>Paolo Prandoni and Martin Vetterli</td>
<td>February 2013</td>
</tr>
<tr>
<td>MOS Transistors</td>
<td>Yannis Tsividis</td>
<td>February 2013</td>
</tr>
<tr>
<td>The Modern and the Postmodern</td>
<td>Michael S. Roth</td>
<td>Feb 1st 2013</td>
</tr>
<tr>
<td>Introduction to Sociology</td>
<td>Mitchell Duneier</td>
<td>February 2013</td>
</tr>
<tr>
<td>The Language of Hollywood: Storytelling, Sound, and Color</td>
<td>Scott Higgins</td>
<td>Feb 1st 2013</td>
</tr>
<tr>
<td>Analytic Combinatorics, Part I</td>
<td>Robert Sedgewick</td>
<td>February 2013</td>
</tr>
</tbody>
</table>

The Humanities, Sciences, Engineering, Business, ....
Courses offered

- 30% Science
- 28% Arts and humanities
- 23% Information technology
- 13% Business
- 6% Mathematics

Courses:
- Analytic Combinatorics, Part I
  - Robert Sedgewick
  - PRINCETON UNIVERSITY
  - February 2013
  - 5 weeks long

- Pattern-Oriented Software Architectures for Concurrent and Networked Software
  - Douglas C. Schmidt
  - UNIVERSITY OF MARYLAND, COLLEGE PARK
  - February 4th, 2013
  - 6 weeks long

- Natural Language Processing
  - Michael Collins
  - COLUMBIA UNIVERSITY
  - February 11th, 2013
  - 10 weeks long

- Linear and Discrete Optimization
  - Friedrich Eisenbrand
  - ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
  - February 18th, 2013
  - 8 weeks long

- Women and the Civil Rights Movement
  - Dr. Elsa Barkley Brown
  - UNIVERSITY OF MARYLAND, COLLEGE PARK
  - February 25th, 2013
  - 12 weeks long

The Humanities, Sciences, Engineering, Business, ....
Software Defined Networking
Dr. Nick Feamster
Feb 4th 2013
6 weeks long

Pattern-Oriented Software Architectures for Concurrent and Networked Software
Douglas C. Schmidt
Feb 4th 2013
6 weeks long

Natural Language Processing
Michael Collins
Feb 11th 2013
10 weeks long

Linear and Discrete Optimization
Friedrich Eisenbrand
Feb 18th 2013
8 weeks long

Women and the Civil Rights Movement
Dr. Elsa Barkley Brown
Feb 25th 2013
12 weeks long

Aboriginal Worldviews and Education
Jean-Paul Restoule
Feb 25th 2013
4 weeks long

The Humanities, Sciences, Engineering, Business, ....
Coursera makes studying easier for me. I could sit at home and learn like I’m at school, no distractions just me, my head phones and my books. ... I could earn certificates ... without spending a dime to get to my local school. It helps me a lot since my mom is in the hospital and financially, I cannot afford to attend school. (Amanda, Dominica)
was devastated as I had left my job and was finding out new directions in life. I wanted to go back to academics and could not find a way to do so. One of my friends recommended Coursera and it was like a new life to me. I was thrilled to see so many courses and so many ways of learning. Thanks to Coursera, I got admission into one of the premier schools in my country and I could continue my academics. (Aarti, India)
took the class on Experimental Genome Science... The course was very, very challenging, I had to do some of the coursework during lunch work ... There's a different kind of commitment needed in taking online courses. There is a stronger sense of personal integrity required or it... I got into an interview for a job I really desire, and I mentioned that I was taking the Experimental Genome Science course. Now, I have new job evaluating genomic research proposals. Funny how that works. (Jose, Philippines)
Two years ago I felt incredibly miserable. I am coming from a traditional family - so I married young and all my life I was either pregnant, breastfeeding or both.

I knew that I am talented, but all I had in life was cleaning, feeding, cleaning, feeding, working part time... I wanted very much to study like my classmates ... but it was very hard to find time. I started and left, started and left. I was deeply depressed. There was a moment ... when I tried to kill myself. But we - humans are very tenacious of life and I survived.
At that time I found Coursera. My first course called the "game theory" expelled the depression and the desire to die once and forever. I feel happy and I enjoy my life and my family much more. In the last two years I have taken about 40 courses (I am addicted) ... Coursera breathes life into me. It gave me hope. I know that when my kids will grow up (in 10-15 years) I will leave everything and go to Oxford. I dream about it...

As Charles Dickens once said: “Suffering has been stronger than all other teaching .... I have been bent and broken, but - I hope - into a better shape.”

(Anonymous)
grew a lot from answering the longer quizzes and wrestling with the complex essay grading rubrics... you are not only allowing autistic people to learn, but actually diminishing the severity of the illness itself. (Daniel Bergmann, USA)
The Student Experience
Course Begins

# users on site

Timeline

Real Course
Don't click "Continue" Yet! First, answer the below question, then click submit.

**Lecture Quiz: 1.1 (Bandage Removal)**
Which strategy of bandage removal would you choose?

- Short bursts of extreme pain (20028 Responses)
- Long periods of less intense pain (21290 Responses)

52%

Total: 41318 respondents

If you have trouble seeing the poll, click here to open it in a new window.
Base Rate Bias

Okay, so we’ve looked at these four things. Prospect theory, hyperbolic
John takes out a loan for his business at extremely high interest rates, even though there is no conceivable way that he'll make enough money from the loan to pay off the interest. Of the behavioral biases we've covered, which type could John be operating under?

The mode he's using is hyperbolic discounting.

**Explanation**

The loan has an immediate payoff. The cost of borrowing is too high, but since it can be deferred until much later, the cost appears acceptable. This is an example of hyperbolic discounting.

Correct!
A Beginner's Guide to Irrational Behavior
by Dan Ariely

Video Lectures

Don't click “Continue” Yet! First, answer the below question, then click submit.

Lecture Quiz: 1.1 (Bandage Removal)
Which strategy of bandage removal would you choose?

- Short bursts of extreme pain (20028 Responses) 48%
- Long periods of less intense pain (21290 Responses) 52%

Total: 41318 respondents

If you have trouble seeing the poll, click here to open it in a new window.

In-video quizzes
Multiple choice

Question 1

AIS – Axon Initial Segment

Match the name of the section with the number as plotted in the figure.

Computer programs

Math expressions

Question 1

What is the derivative of \( \frac{\sin(x)}{x} \) w.r.t. \( x \)?

\( (x^2 \cos(x) - \sin(x)) / x^2 \)

Your submission is equivalent to:

\( \frac{x \cos(x) - \sin(x)}{x^2} \)

Short answer (regular expression)

Who discovered the theory of general relativity?

Albert Einstein

Submit

Autograded Homeworks and Exercises
Introductory Physics I with Laboratory by Dr. Michael F. Schatz
Online Labs

Introductory Physics I with Laboratory by Dr. Michael F. Schatz
An Introduction to Interactive Programming in Python
by Joe Warren, John Greiner, Stephen Wong, Scott Rixner

Share and run code in the browser
Feedback — Quiz on miniLectures 1-10

You submitted this quiz on Sun 3 Nov 2013 12:35 PM PST (UTC -0800). You got a score of 3.60 out of 23.00. However, you will not get credit for it, since it was submitted past the deadline.

Quiz 1 treats material in Week 1, miniLectures 1 through 10.

Question 1

1. A newly synthesized drug called numb3rcaine contains an amine group, an aromatic group, a carbonyl group, and an ester linkage. Which of these moieties would be expected to form a charge-charge (or coulombic or ionic or cation-π) interaction with the receptor?

   Your Answer        Score   Explanation
   ester linkage       0.00   Ester linkages typically do not participate in charge-charge or cation-π interactions
   carbonyl group
   aromatic group
   amine group

Total 0.00 / 1.00
Your Final Project for this course is to take the concepts we have explored each week and create a resource that you can incorporate into your teaching. The project outline below has been structured to allow you to tailor the content to the context in which you teach so that it can be most useful. The goal of this final project assignment is to give you an opportunity to practice and be creative with the concepts from the class in a forum where you can share ideas and get feedback from your peers. The peer assessment process will also give you the opportunity to see the ideas that others come up with. Be creative! This is your chance to apply the course concepts to real-world situations.

Your assignment is to select an artwork that you would like to use as the starting point for an inquiry based lesson in your classroom.

Format: Please provide the following information in the order that it is presented below:

1. Subject Area
2. Intended grade level range
3. Artwork Selection (please use the "Upload an Image" button or insert a link to the image)
4. Artwork Title
5. Artist
6. Date
7. Materials
Your Final Project for this course is to take the concepts we have explored each week and create a resource that you can incorporate into your teaching. The project outline below has been structured to allow you to tailor the content to the context in which you teach so that it can be most useful. The goal of this final project assignment is to give you an opportunity to practice and be creative with the concepts from the class in a forum where you can share ideas and get feedback from your peers. The peer assessment process will also give you the opportunity to see the ideas that others come up with. Be creative! This is your chance to apply the course concepts to real-world situations.

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1. Subject Area
2. Intended grade level range
3. Artwork Selection (please use the "Upload an Image" button or insert a link to the image)
4. Artwork Title
5. Artist
6. Date
7. Materials

Evaluation/feedback on the above work:

- Does the activity relate to the artwork?
- Are the instructions/prompts clear?
- Is the activity developmentally appropriate?
Mitch Duneier
Princeton

Peer Grading
Analysis by:
Matthew Salganik & Mitch Duneier
Princeton University Sociology Dept.

Peer Grading
LaPtable
laptop table

DuoSlim
portable device holder

Neo-WD
space-efficient workdesk

Ramaswamy Venkatachalal
Gujarat, India

Aranzazu Hurtado Ruiz
Madrid, Spain

Paul Mendoza
Manila, Philippines

From Knowledge to Action
Information storage

The problem summary:
How is the information stored in our brain? As in computers we use potentials, or magnetization for example to make an array of binary code (1 or 0), what is the analogous in the brain?

Steps to reply:
- We have ways of inputting data to our brain, like a computer.
- In the brain, we have the network of cells which process data.
- The question is, how do our cells store information? Are they just storing memories, or is there a more complex mechanism involved?

Student 2
Maybe it's just that: a day ago %

Student 3
Actually it's not just that, it turns out that it's more complex. We're not really even sure how it works. The mechanisms are too complicated. a day ago %

Anonymous
Within the human brain, the neurons (which are the cells that process information) are divided into different layers. This layering helps to organize information in a hierarchical manner. 20 hours ago %

Student 4
I've already worked a lot on this before starting with this course (nonetheless I learned a lot of details in the course). One of the most interesting papers I found is that information is represented feature based http://www.cs.rochester.edu/users/faculty/dana/tanifji.pdf . I've already tried around building some small information processing algorithms based on this. If you are interested we could probably talk a bit about it. 5 minutes ago %
Synapses, Neurons and Brains Students Map

Tag yourself in our map here: http://geo.gi/maze/XaCW0

Note that we update this map every week, so new tags won’t appear immediately in this page.
2982 Coursera communities

Global Network of Learning Communities

31,293 COURSERANS  2,682 CITIES

Connecting the world to a great education and let people learn without limits.
U.S. Plans Global Network of Free Online Courses

By TAMAR LEWIN
Published: October 31, 2013 24 Comments

Coursera, a California-based venture that has enrolled five million students in its free online courses, announced on Thursday a partnership with the United States government to create “learning hubs” around the world where students can go to get Internet access to free courses supplemented by weekly in-person class discussions with local teachers or facilitators.
Global Learning Hubs, 24 Countries, 5 Continents

Baghdad, Buenos Aires, Cairo, Chennai, Hanoi, Helsinki, Juba, Kyiv, La Paz, Lima, Manila, Mountain View, Phnom Penh, Port au Prince, Port Louis, Prague, Santiago, Seoul, Shanghai, Tbilisi, Kakamega, Moscow, Mumbai, Port of Spain.
Verified Certificate record successfully made.
Self-Induced Mastery
Mastery Improves Outcomes

Do, Chen Brandman, & Koller
Mastery Improves Outcomes
For students of similar baseline performance, mastery-based score improvements on formative assessments correlate with final exam performance.
Hourly retention
High group

Hourly retention
Low group

Koller, Ng, Do & Chen

Intent & Retention
Maas, Heather, Do, Brandman, Koller, Ng

Intent & Retention

Overall

Highly Committed
Maas, Heather, Do, Brandman, Koller, Ng

Intent & Retention

Overall

Non-SigTrack
SigTrack

Highly Committed
Maas, Heather, Do, Brandman, Koller, Ng

Intent & Retention

Graph showing comparison between Non-SigTrack and SigTrack:
- Overall: SigTrack significantly higher than Non-SigTrack.
- Highly Committed: SigTrack also significantly higher than Non-SigTrack.
Maas, Heather, Do, Brandman, Koller, Ng

**Intent & Retention**

- **Overall**
  - Non-SigTrack: Low
  - SigTrack: High

- **Highly Committed**
  - Non-SigTrack: Medium
  - SigTrack: Very High
Wrong student answers

New Window into Human Learning

The 2 Sigma Problem

The 2 Sigma Problem

The 2 Sigma Problem

The 2 Sigma Problem

The 2 Sigma Problem
College is a place where a professor’s lecture notes go straight to the students’ lecture notes,

—Edwin Emery Slosson
College is a place where a professor’s lecture notes go straight to the students’ lecture notes, without passing through the brains of either.

—Edwin Emery Slosson
High-qua

The Best of Both Worlds
High-quality online content
Produced locally or adopted

The Best of Both Worlds
High-quality online content
Produced locally or adopted

- Active learning, problem solving

The Best of Both Worlds
High-quality online content
Produced locally or adopted

- Active learning, problem solving
- Personal attention to students

The Best of Both Worlds
Scott Rixner and Joe Warren, Rice:
I will never, ever, ever, teach a class any other way as far as I can tell...This is so much better - I had so much more fun teaching and the students learned so much more, I will never get up here and lecture. I just don’t see the point anymore. I can do better this way.”

Adrienne Williams, UCI:
This was more fun to teach than a traditional course...students were awake, asking questions, and much more engaged.”

Kristin Sainani, Stanford:
“As the instructor, I definitely preferred engaging in interactive discussions and exercises with the students rather than lecturing at them...my lectures used to take up nearly all the class time and I’d be rushing just to get through them.”

On-campus instruction with Coursera
Fall 2011: Traditional  Spring 2012: Blended

Comparison of ECE course, University of Wisconsin Madison

Flipped Classroom Results (not Coursera)
Where Next?
A New Frontier for Education
A New Frontier for Education
A New Frontier for Education
A New Frontier for Education
A New Frontier for Education
A New Frontier for Education

Christian Terwiesch

Increase productivity

Student Learning

High
Office hours

Large lecture hall

Old frontier

New frontier

Low

Faculty Productivity

Low
High

MOOCs
A New Frontier for Education

- **Student Learning**: High to Low
- **Faculty Productivity**: Low to High

- **Old Frontier**: Large lecture hall
- **New Frontier**: MOOCs

- **Increase Productivity**

- **Improve Learning**

Christian Terwiesch
MOOCs: The Blue Ocean Strategy*
Big breakthroughs happen when what is suddenly possible meets what is desperately necessary.

—Thomas Friedman
May 15, 2012 - New York Times
Wanted: 1,500 universities; apply here

Over the next six years, India needs to create another 1,500 universities... “the low penetration of high-quality education and the growing demand for educated workers in a fast developing service-led economy” offers huge potential to develop the education market. (James Lamont, 1/30/2009)
Over the next six years, India needs to create another 1,500 universities... “the low penetration of high-quality education and the growing demand for educated workers in a fast developing service-led economy” offers huge potential to develop the education market. (James Lamont, 1/30/2009)

... even the most prestigious public institutions, including the IITs, are struggling to fill top faculty positions and teacher student ratios are deteriorating. (Yojana Sharma, 3/2/2011)
Suddenly Possible
NIPS Thanks Its Sponsors
Optimizing Instructional Policies

Robert Lindsey, Michael Mozer, William Huggins
Department of Computer Science,
Institute of Cognitive Science

Harold Pashler
Department of Psychology

University of Colorado
Boulder

UCSD
Optimizing Instructional Policies

Robert Lindsey, Michael Mozer, William Huggins
Department of Computer Science,
Institute of Cognitive Science
University of Colorado, Boulder

Harold Pashler
Department of Psychology
University of California, San Diego
Optimizing Instructional Policies

Robert Lindsey, Michael Mozer, William Huggins
Department of Computer Science,
Institute of Cognitive Science
University of Colorado, Boulder

Harold Pashler
Department of Psychology
University of California, San Diego
An Illustrative Learning Problem

Zoubin Ghahramani
Is it better to study

Each face once
2 seconds per face

Each face twice
1 second per face

Geoffrey Hinton
Is it better to study

Each face once

2 seconds per face

Each face twice

1 second per face

Zoubin Ghahramani
Is it better to study

Each face once
2 seconds per face

Each face twice
1 second per face

Max Welling
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Each face once
2 seconds per face

Each face twice
1 second per face

Max Welling
Is it better to study

Each face once
2 seconds per face

Each face twice
1 second per face
Finding The Better Training Policy

Conduct an experiment where
- half the audience studies at 1s / face
- half at 2s / face
Finding The Better Training Policy

Conduct an experiment where
• half the audience studies at 1s / face
• half at 2s / face

Test everyone’s memory and look for a statistically reliable advantage
Finding The Best Training Policy

Continuum of potential training policies

percent recall

training policy
Finding The Best Training Policy

Continuum of potential training policies

Want to identify the optimum
Finding The Best Training Policy

Continuum of potential training policies

Want to identify the optimum

Treat the search as function optimization

Graph showing the percent recall against training policy with a peak at 1s.
A Bayesian Active Learning Approach
A Bayesian Active Learning Approach

Given data from individuals trained at various points in policy space
A Bayesian Active Learning Approach

Given data from individuals trained at various points in policy space

Approximate the performance function with Gaussian process regression
A Bayesian Active Learning Approach

Given data from individuals trained at various points in policy space

Approximate the performance function with Gaussian process regression
A Bayesian Active Learning Approach

Given data from individuals trained at various points in policy space

Approximate the performance function with Gaussian process regression
A Bayesian Active Learning Approach

Given data from individuals trained at various points in policy space

Approximate the performance function with Gaussian process regression

Select promising policy to evaluate next via upper confidence bound heuristic
A Bayesian Active Learning Approach

Given data from individuals trained at various points in policy space.

Approximate the performance function with Gaussian process regression.

Select promising policy to evaluate next via upper confidence bound heuristic.
Embellishments To Off-The-Shelf GP Regression

Draw from GP represents latent population-wide effectiveness of training policies
Embellishments To Off-The-Shelf GP Regression

Draw from GP represents latent population-wide effectiveness of training policies.

Chance-corrected beta-binomial observation model

Population effectiveness

\[ f(x) \sim \mathcal{GP}(m(x), k(x, x')) \]

Population probability correct

\[ c(x) \triangleq \frac{1}{1 + \exp(-f(x))} \]
Embellishments To Off-The-Shelf GP Regression

Draw from GP represents latent population-wide effectiveness of training policies.

Chance-corrected beta-binomial observation model

Population effectiveness
\[ f(x) \sim \mathcal{GP}(m(x), k(x, x')) \]

Population probability correct
\[ c(x) \triangleq \frac{1}{1 + \exp(-f(x))}^{-1} \]

Individual's probability correct
\[ \mu_i | c(x) \sim \text{Beta}(\alpha, \alpha/(1 - c(x))/c(x)) \]
Draw from GP represents latent population-wide effectiveness of training policies

**Chance-corrected beta-binomial observation model**

**Population effectiveness**

\[ f(x) \sim GP(m(x), k(x, x')) \]

**Population probability correct**

\[ c(x) \triangleq \frac{1 + \exp(-f(x))}{1} \]

**Individual's probability correct**

\[ \mu_i | c(x) \sim Beta(\alpha, \alpha(1 - c(x))/c(x)) \]

**Individual's exam score**

\[ s_i | \mu_i \sim Binomial(g + (1 - g)\mu_i; n) \]
Associate faces with the name of their favorite sports team

*Jets* or *Sharks*

Six training faces, 30 seconds of training

Each face shown for duration $d$ ms
(each face shown $5000/d$ times)
Experiment 1

Associate faces with the name of their favorite sports team

*Jets* or *Sharks*

Six training faces, 30 seconds of training

Each face shown for duration $d$ ms (each face shown $5000/d$ times)

Immediate test following training
Experiment 1

What is the optimal presentation duration?
Experiment 1

What is the optimal presentation duration?

250 ms per presentation  5000 ms per presentation

20 presentations / face  1 presentation / face
Experiment 1

What is the optimal presentation duration?

250 ms per presentation  
20 presentations / face

5000 ms per presentation  
1 presentation / face

More presentations are better (with diminishing returns)  
More time to process is better (with diminishing returns)
Experiment 2

Participants are told they are learning the Martian word "GLOPNOR"

The Martians can only teach through examples
Is this GLOPNOR?

No  Perhaps no  Don't know  Perhaps yes  Yes
Is this GLOPNOR?

No    Perhaps no    Don't know    Perhaps yes    Yes

Wrong! This is GLOPNOR.
Is this GLOPNOR?
Is this GLOPNOR?

No  Perhaps no  Don't know  Perhaps yes  Yes

Correct! This is not GLOPNOR.
Is this GLOPNOR?

No  Perhaps no  Don't know  Perhaps yes  Yes
“GLOPNOR” = graspability
Ease of picking up & manipulating object with one hand
(Salmon, McMullen, & Filliter, 2010)

Participants must learn the **category boundary** from exemplars
Fading

relative distance to category boundary

far

near

training trial

5  10  15  20  25
Fading

relative distance to category boundary

training trial

far

near

25
Fading

relative distance to category boundary

training trial

far
near

25
Fading

relative distance to category boundary

training trial

start far, end far

start far, end near

start near, end near
Blocking: + + + - - -

Interleaving: + - + - + -
Experiment 2

Training

- 25 trial sequence generated by chosen policy

1. Is this GLOPNOR?
2. Is this GLOPNOR?
3. Is this GLOPNOR?

...
Experiment 2

Training
• 25 trial sequence generated by chosen policy

Testing
• 24 test trials, independent of policy
• No feedback
Our Contribution

Alternative to traditional A-B testing

Allows us to efficiently search over a continuum of alternatives to discover an optimum.
Our Contribution

Alternative to traditional A-B testing

Allows us to efficiently search over a continuum of alternatives to discover an optimum.

Used to optimize instructional policies

- presentation duration
- fading
- blocking
Extensions

- Individualized policies
Extensions

- Individualized policies
- Discrete policy spaces
Extensions

- Individualized policies
- Discrete policy spaces
- Higher-dimensional policy spaces
Other Human Optimization Problems
Other Human Optimization Problems

• Maximizing charitable donations via anchoring manipulation
Other Human Optimization Problems

- Maximizing charitable donations via anchoring manipulation
- Improving discriminability for the visually impaired via image transformations

Satgunam et al. (2012)
Other Human Optimization Problems

- Maximizing charitable donations via anchoring manipulation

- Improving discriminability for the visually impaired via image transformations

- Optimizing web page design
  - e.g., color combinations
Thanks!
NIPS Thanks Its Sponsors