The Online Revolution: Education for Everyone

Daphne Koller & Andrew Ng
Stanford University & Coursera
Price Changes Since 1985

559% Increase

Source: Bureau of Labor Statistics
Big breakthroughs happen when what is suddenly possible meets what is desperately necessary.

—Thomas Friedman
May 15, 2012 · New York Times
400,000
18 April launch

1 million users

1.5 million users

course enrollments
registered students

1m 3m 6m YTD 1y All

From: Jun 28, 2012 To: Sep 27, 2012

Zoom
Coming from a middle class family from a small town in India. Never had the luck and guidance to reach Stanford for education. Guess what? God has sent the opportunity right across my door step! Heartfelt thanks to the great team and teachers who made this happen!

(Aakash Goswami)
I'm learning this from home because my 3 month old daughter was diagnosed with a rare immune disease and is still receiving her bone marrow transplant. [She] is doing well, but our family cannot be in public. (Ryan Murphy)

I've started a database management internship, based partly on my knowledge I gained through your course...
# users on site

**Timeline**

**Course Begins**

**Real Course**
VIDEO-BASED INSTRUCTION
ASSESSMENTS
Retrieval Practice Improves Learning

"Retrieval Practice Produces More Learning than Elaborative Studying with Concept Mapping."
In-Lecture Interaction
Multiple choice

Which of these is a reasonable definition of machine learning?

- Machine learning is the science of programming computers.
- Machine learning is the field of allowing robots to act intelligently.
- Machine learning is the field of study that gives computers the ability to learn without being explicitly programmed.
- Machine learning means from labeled data.

Short answer (regular expression)

Who discovered the theory of general relativity?

Albert Einstein

Math expressions

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

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

Your submission is equivalent to:

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

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units sold</td>
<td>20,000</td>
<td>30,000</td>
<td>35,000</td>
</tr>
<tr>
<td>Revenue</td>
<td>400,000</td>
<td>600,000</td>
<td>700,000</td>
</tr>
<tr>
<td>COGS</td>
<td>100,000</td>
<td>150,000</td>
<td>175,000</td>
</tr>
<tr>
<td>Ad spend</td>
<td>30,000</td>
<td>40,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>

### Distributor model

<table>
<thead>
<tr>
<th>8 Sales People</th>
<th>1</th>
<th>2</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 Dist. per sales person</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

## Computer programs

```java
image = new SimpleImage("puzzle-copper.png");
for (pixel: image) {
    // your code here
    pixel.setRed(0);
    pixel.setGreen(pixel.getGreen() * 10);
    pixel.setBlue(pixel.getBlue() * 10);
}
print(image);
```
In-Depth Exercises
“The Impact of Self-and Peer-Grading on Student Learning”.
Evaluation criteria & Grading rubric

Grade value 40 points

Guiding questions | 0-15 points | 16-20 points
--- | --- | ---
Did you make informal prototypes of two ideas? Points off if the prototype is too formal. (As a rough rule of thumb, a detail-oriented computer mock-up is too formal.) (max 20) | Fewer than 2 prototypes: inessential prototypes: unnecessary formality. | Two prototypes, created rapidly.

Did you test your prototype with at least 5 (3 if the activity is long) users waiting in a real line? (max 20) | Not really. | Yes. With real users who were waiting in a real line.

0-15: The testing was hasty, and done with your friends or family for the sake of convenience.

Evaluation

Did the student make informal prototypes of two ideas? Points off if the prototype is too formal. (As a rough rule of thumb, a detail-oriented computer mock-up is too formal.) (max 20)

* 0-15 points: Fewer than 2 prototypes: inessential prototypes: unnecessary formality.
* 16-20 points: Two prototypes, created rapidly.

Comments:

student1: Your prototypes were at the right level of formality.
student2: I'm glad you chose to highlight the navigation buttons and de-emphasized the less important actions.
student3: You clearly put a lot of effort, but the assignment asked for a high-level prototype, and your submission had too much detail.
student4: pretty good
student5: I was a bit confused about which parts of your 2nd prototype to focus on. The professor said a good informal prototype doesn't show details for views that don't impact the flow of the UI.

Aggregate score: 17.5
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Instructor(s)</th>
<th>Dates</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-learning and Digital Cultures</td>
<td>Jeremy Knox, Sian Bayne, Hamish Macleod, Jen Ross, Christine Sinclair</td>
<td>Jan 28th 2013</td>
<td>5 weeks</td>
</tr>
<tr>
<td>Introduction to Philosophy</td>
<td>Dave Ward, Duncan Pritchard, Michela Massimi, Sullin Lavelle, Matthew</td>
<td>Jan 28th 2013</td>
<td>7 weeks</td>
</tr>
<tr>
<td></td>
<td>Chrisman, Allan Hazlett, Alasdair Richmond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Social Context of Mental Health and Illness</td>
<td>Charmaine Williams</td>
<td>Jan 28th 2013</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Critical Thinking in Global Challenges</td>
<td>Celine Caquineau, Mayank Dutta</td>
<td>Jan 28th 2013</td>
<td>5 weeks</td>
</tr>
<tr>
<td>Introduction to Computer Networks</td>
<td>Arvind Krishnamurthy, David Wetherall, John Zaharjan</td>
<td>Jan 28th 2013</td>
<td>10 weeks</td>
</tr>
<tr>
<td>Grow to Greatness: Smart Growth for Private Businesses, Part I</td>
<td>Edward D. Hess</td>
<td>Jan 28th 2013</td>
<td>5 weeks</td>
</tr>
</tbody>
</table>

The Humanities, Sciences, Engineering, Business, ….
** font size proportional to \sqrt{\text{number of participants}}

COMMUNITY
Global Community

~7000 students on site at most times
In one of the questions, it is suggested that we "Use the unix command line utilities." How do I solve this on a non-unix OS? I have never worked with this, so I am at a complete loss what to do. Thanks in advance.

Median response time: 22 minutes

If you want the true 'Unix experience', running a virtual machine is better than using cygwin / gnuwin, imo.

Oracle VirtualBox is great, and you can find many preconfigured virtual machine image on Virtualboxes.org. Choose Ubuntu, if you are new to the linux world. That one also has Python 2.7 included, while many other distributions like Debian still have Python 2.6.

Open a terminal window by entering 'terminal' in the dashboard. You can also install 'Guake Terminal', then you can always open and close a terminal by pressing F12.

Assuming you’re using windows, you can
- install cygwin, or
- install gnuwin32, or
- run live linux in virtualbox (e.g. ubuntu live cd)
Ordering for assigning factors to cliques in \texttt{ComputInitialPotentials}. The order of assignment of factors to cliques should happen in the order the cliques are given to you at the end of the \texttt{CreateCliqueTree} function. Each factor should be assigned to the first clique that contains the variables in the factor, where ordering of the cliques is given in \texttt{C.nodes} (\texttt{C} is the argument for \texttt{ComputInitialPotential} function).

For example: in function \texttt{ComputInitialPotentials}, the argument \texttt{C} has a field \texttt{nodes}. Now let's say the contents of \texttt{C.nodes} are:

\begin{verbatim}
C.nodes[1] = [1 2]
C.nodes[2] = [2 3]
\end{verbatim}

And your factors are [1], [2], [3]. So [1] and [2] should be assigned to the 1st clique. Even though [2] can be assigned to the second clique, for the purpose of this assignment we are going to assign [2] to the first clique that contains it.

**Order of Variables in Cliques.** You should use \texttt{CliqueTree.nodes} to get the ordering for your variables and those nodes are in numerical order.

**Empty cliques.** It is possible that you may end up with cliques with no factors assigned to them. If that is the case, set the initial potential to 1 for all variable assignments for that clique.

**\texttt{CliqueTreeCalibrate (for max-sum)}** If you are having problems with this part, but your code is otherwise correct for sum-product message passing, make sure that your \texttt{FactorMaxMarginalization} works properly with logspace-potentials.

**\texttt{Clique Potentials}** If you have a clique over variables [1 2 3] with only one factor assigned to it, say [1], then you should assume that there's an initial potential over [1 2 3] with all 1s and multiply it.

This is the implementation we have and it doesn't really affect the answer because you will end up multiplying stuff about all your variables in the clique. If a variable does not appear in any factor, then it shouldn't be in any clique. However, if a variable is in a clique and just that the factors assigned to the clique don't contain the variable then there must be some other clique that contains that variable, and to which the factor is assigned. By running intersection property that variable has to be in the select set so you will get messages for it.

[Posted by (Community TA) on Mon 9 Apr 2012 2:36:28 PM PDT]

**Comments**

\begin{verbatim}
Thanks a lot! It clarified several things for me. However, when you mention empty cliques, apart from the initial potential set to 1: what variable (i mean, field .var) should we put? Zero? An empty vector []? And the cardinality? Because this has an effect on the amount of values (all ones, as you said).
\end{verbatim}
Student Study Groups

Vietnam
Nigeria Miami
Russian Austin, Texas
speaking students Minnesota
Arabic speaking students
Athens Nepal Kenya

Guatemala
A multilingual universal study group

1500 communities
1344 cities
First lectures posted

STATISTICS & ANALYTICS
Wrong student answers
Identify the forum discussion thread which is most likely to cause a student to correct misconception.

Experimental setup:

- "incorrect" submission
- "incorrect" submission
- Forum visits
- Final "correct" submission

Submission timeline

Jon Huang

New Window into Human Learning
IMPROVING
TEACHING
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

The mind is not a vessel that needs filling, but wood that needs igniting.

—Plutarch

from Ian Kidd's translation of Essays
"Improved Learning in a Large-Enrollment Physics Class."
### Question 4

**Plate Semantics.** "Let A and B be random variables inside a common plate indexed by i. Which of the following statements must be true? You may select more than one option.

<table>
<thead>
<tr>
<th>Option</th>
<th>Submissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>For each i, A(i) and B(i) have edges connecting them to the same variables outside of the plate.</td>
<td>33 / 143</td>
</tr>
<tr>
<td>For each i, A(i) and B(i) have different CPDs.</td>
<td>10 / 143</td>
</tr>
<tr>
<td>If there is an instance of A for some i, then there is no instance of B for that i.</td>
<td>0 / 155</td>
</tr>
<tr>
<td>For each i, A(i) and B(i) have the same CPDs.</td>
<td>28 / 151</td>
</tr>
<tr>
<td>There is an instance of A and an instance of B for every i.</td>
<td>291 / 301</td>
</tr>
<tr>
<td>For each i, A(i) and B(i) are not independent.</td>
<td>5 / 162</td>
</tr>
<tr>
<td>For each i, A(i) and B(i) are independent.</td>
<td>12 / 149</td>
</tr>
</tbody>
</table>

- Just-in-time teaching
- Real-world case studies
- Team problem solving
Universal Access to Education