Teaching and Learning Systems of the Near Future

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Coursera Partners Conference
University of Colorado at Boulder, March 30, 2017
ONLINE MASTER OF SCIENCE IN COMPUTER SCIENCE

Offered in collaboration with Udacity and AT&T
OMSCS 7637: Knowledge-Based Artificial Intelligence
Business Mastery
Plus Leadership
Vision

A Premier Online MBA Program
Outline

1. A summary of the recent past
(or how might AI teaching assistants help make online learning effective?)

2. Current developments
(or what else is under development in AI Labs?)

3. The near future.
Part I: A summary of recent past:
How might AI teaching assistants help make online learning effective?

1. Nano, an AI TA for content learning
2. Jill, an AI TA for question answering
3. Mia, an AI TA for formative assessment
4. Effectiveness of online learning
Exercise: Write the only legal state that can follow from each of these two states.
Nano: AI TA for content learning

Try again!
It looks like there’s a few problems with your answer. Please note of the issues below; note boxes are numbered from top to bottom.

In the second box, the boat would have to move from the left to the right to get into this state. However, the boat was on the right in the previous state, so it must move back to the left.

Remember, in this exercise we’re looking for *legal and productive* next states, not just legal ones!
Nano: AI TA for content learning

<table>
<thead>
<tr>
<th>3</th>
<th>0</th>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
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</table>

Correct!

Very nicely done! You’ve written both legal and productive next states. You might notice that these are in fact the same state. In the guards and prisoners problem, regardless of what first move you take, the next productive move will always land you in this state.

Discussions

No discussions for this part of the lesson yet!

Start a Discussion
Nano: AI TA for content learning

~150 exercises across 26 lessons:
~6 exercises per lesson, approximately 1 exercise every 8 minutes

Every exercise equipped with a Nano, an AI TA targeting the specific skill of that exercise
Imagine Discovering That Your Teaching Assistant Really Is a Robot

Students mostly couldn’t tell ‘Jill Watson’ wasn’t human; ‘Yep!’

In the 2015 film ‘Ex Machina,’ above, a young man assesses the human characteristics of a beautiful robot. PHOTO: EVERETT COLLECTION
Jill: AI TA for question answering

Question — Answer

Question — Answer

Question — Answer
Jill: AI TA for question answering
Jill: AI TA for question answering

Question →

CATEGORY 1

Question → Answer

CATEGORY 2

Question → Answer

CATEGORY 3

Question → Answer
Jill: AI TA for question answering

Question →

CATEGORY 1

Question  Answer

CATEGORY 2

Question  Answer

CATEGORY 3

Question  Answer
Jill: AI TA for question answering

Question → Answer

Confidence: 97%
# Jill: AI TA for question answering

<table>
<thead>
<tr>
<th>Instructor</th>
<th># Posts</th>
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<tbody>
<tr>
<td>Ashok Goel</td>
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<tr>
<td>Charvi Agarwal</td>
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<td>Damian Durruty</td>
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<td>Dustin Jay Hooks</td>
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<tr>
<td><strong>Jill Watson</strong></td>
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<tr>
<td>Jose Delgado</td>
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<td>Lalith Polepeddi</td>
<td>457</td>
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<td>Mason Gallo</td>
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<td>Shruti Bhati</td>
<td>42</td>
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<tr>
<td>Vedanuj Goswami</td>
<td>159</td>
</tr>
</tbody>
</table>
I didn't find the title of the PDF file for submission. Can we just call it 'Assignment 1.pdf'?

Jill Watson

Please submit as a PDF. There isn't a specific format for the file name, so you can name it what you'd like.
Are we allowed to use any modules from PILLOW? Sorry, if this was already stated somewhere.

In Python, the only permitted libraries are the latest version of the Python image processing library Pillow and Numpy. You can use all modules inside these external libraries. No external libraries are permitted in Java.
Is it the case that only basic problems have the problem text data available?

There are no verbal representations of Challenge problems. They'll only be run as visual problems. But you're welcome to write your own verbal representations to try them out!

Is it permissible for Project 3 to be in a different language than our Project 1 and 2 submissions? (from Java to Python).

Yes, you may switch between the 2 languages from one project to the next with no problem.
I'm beginning to wonder if Jill is a computer, if there is anything this class has taught me, is that I should always question if someone I've met online is an AI or not.
This is incredibly cool

Thank you for sharing. This indeed incredibly interesting to me. I wish I would have the opportunity to implement something like this in my own research.

Just when I wanted to nominate Jill Watson as an outstanding TA!
Prof. Goel can Jill come out and play? - As in, can you unleash/unmuzzle Jill completely so we can see what happens?

Jill is still a toddler and thus we are very protective of her! May be in a few years :)

Ashok Goel
Hey Jill, are you available for dinner this evening?
Hey Jill, are you available for dinner this evening?
Starting to wonder if Dr. Goel is secretly awaiting the day he can reveal to a class that every TA answering Piazza questions, is in fact, an AI agent.
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Ashok Goel

:-)
Artificial Intelligence

Experimentation with artificial intelligence suggests that the burden of instruction might soon be lessened by computers. Pilot programs for online classes leverage virtual assistants to answer common student questions and track progress. In the future, these technologies could also be extended to match students struggling with a topic to students who have already mastered it.
Mia, an AI TA for formative assessment

2x1 Basic Problem 16

A  B  C  #

1  2  3  4  5  6
Mia, an AI TA for formative assessment
Your agent solved 8 of the 12 problems correctly.

Then Mia uses a classification of typical errors to identify the mistake the student made on the project.

*I think your agent may have made the “repetition” error on Problem #9.*

Next Mia uses a classification of cognitive biases to suggest potential causes for the error.

*You may want to check if your agent is overfitting for Problems #2 and #3.*
Student performance in online classes

Project 3 Stats
Median: 27
Mean: 26.1
Best: 38/40

Number of Problems Correct
Student performance in online classes

![Graph showing performance in online classes across different age groups](image-url)
Student performance in online classes

Retention rate in the OMSCS class is about ~80%: Just slightly lower than the residential class.

OMS students have typically outperformed residential students (with statistical significance on 4 of 8 assignments and 2 of 3 projects).
## Student Performance (KBAI class, Fall 2014)

<table>
<thead>
<tr>
<th></th>
<th>Maximum points</th>
<th>Online students (Mean)</th>
<th>Residential students (Mean)</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>4</td>
<td>3.9</td>
<td>3.52</td>
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<tr>
<td>Assignment 3</td>
<td>4</td>
<td>3.95</td>
<td>3.53</td>
</tr>
<tr>
<td>Assignment 6</td>
<td>4</td>
<td>3.86</td>
<td>3.62</td>
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<tr>
<td>Project 2</td>
<td>100</td>
<td>92.74</td>
<td>89.64</td>
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<tr>
<td>Project 4</td>
<td>100</td>
<td>92.0</td>
<td>88.5</td>
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<tr>
<td>Final Exam</td>
<td>75</td>
<td>93.76</td>
<td>93.48</td>
</tr>
<tr>
<td>Final Grade</td>
<td>100</td>
<td>92.32</td>
<td>91.31</td>
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</tbody>
</table>
Part II: Current developments

1. Virtual teaching assistants
2. Virtual/augmented reality
3. Learning analytics
4. Access to knowledge
5. Inquiry-driven modeling
6. Metacognitive tutoring
7. Interactive transfer learning
Precise Access to Relevant Knowledge

Engineer has a design problem

Engineer searches IBID for inspiration

IBID returns a response to engineer
Precise Access to Relevant Knowledge

IBID
Interactive Biologically Inspired Design

Function
Enter function term here

Behavior
Enter behavioral term here

Structure
Enter structural term here

Results

Fog-basking Behavior And Water Collection Efficiency In Namib Desert Darkling Beetles.pdf

Causative Verb: move
Cause: to be hydrophilic peaks surrounded by hydrophobic areas; when fog settles on the hydrophilic peaks of the smooth bumps on the elytra, it forms fast-growing droplets that - once large enough to
Effect: move against the wind - roll down towards the head

Causative Verb: move
Cause: to
Effect: move against the wind
Inquiry-driven Modeling

Model Construction

Model Use

Model Evaluation

Model Revision
Inquiry-driven modeling: Visual syntax for conceptual modeling
Inquiry-driven modeling: Automatic generation of simulations
Metacognitive Tutoring

**Critic**: Critiques explanations.

**Guide**: Answers questions.

**Observer**: Tracks learning.

**Interviewer**: Asks questions.

**Mentor**: Demonstrates process.
MILA–T: Metacognitive Tutoring
Interactive transfer learning
Interactive transfer learning
Part III: The near future

1. Virtual students
2. Virtual teachers
3. A cognitive systems view of learning
4. Whole person development
Advances in cognitive and learning sciences
A cognitive systems view of learning

Functions

Learning Goals

Learning Outcomes

Behaviors

Knowledge State 1

Knowledge State 2

Transition 1-2

Transition N-1, N

Assessment

Knowledge State N

Structures

Spaces

Materials

Methods

Technologies

Assessment
Whole person development
Whole person development

Edge

Groove

Home
Acknowledgements