Towards An AI Agent for Online Education

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(Joint thoughts with Yogita Bhalla and Dan Weld)
Background: Artificial Intelligence

• Sequential Decision Making under Uncertainty

• AI Applications to Crowdsourcing
  – intelligent agent to manage crowdsourced processes

• Crowdsourcing <-> Large-scale Personalized Education
  – intelligent agent to manage online education!
Use Case 3

Number of students who appeared for IITJEE 2012 ~560,000

Number of seats in 15 IITs ~9,600

Number of seats in traditional IITs ~5,400
Affluent City Students vs. Rest

• Good coaching
  – expensive; in select cities

• Average coaching
  – expensive; in more cities

• Average-income/town students
  – at a huge disadvantage
80% students are stressed out because of their entrance preparation.
90% find study material boring.
WHAT’s MISSING?
Engagement with Study Material
Strong Support Network Around Preparation
Personalizing Education to Individual Strengths
Engagement

125,000 users already
1/3rd active users

Deeply connected to Student’s Social Profiles

- Peer Study Buddies
- With a Group Leader

Study Buddy Network
Outline

• Use Case: Exam Preparation in India

• Clowder, our AI agent for crowdsourcing

• Crowdsourcing <-> Online Education
Crowdsourcing Issues

• Huge number of workers
  – personal attention impossible
• Data helps in making decisions
  – lots of it
• Machines/humans have different strengths
  – memory/micro-tasks
  – global task objectives

• AI-based agents will be a key to success!
The Clowder Agent

[Weld, Mausam, Dai’11]

- Which workflow to select? Workflow Parameters
- Which job to post? Worker Abilities/Skills
- When to submit? Task Difficulties

- A language to specify workflows
- Knowledge about different workers
- Knowledge about different tasks
Basic Binary Choice Questions

Over 50% money saving

Accuracy (%)

Clowder\textsubscript{binary}

Majority Vote

Number of ballot answers

1 3 5 7 9 11
Control for Iterative Improvement

[14]

[Dai, Mausam, Weld 10]
Submit $\alpha$ →

Initial artifact $(\alpha)$ →

Improvement needed? →

Y →

Generate improvement HIT →

Estimate quality of $\alpha'$ →

More voting? →

Y →

Generate ballot HIT →

Update quality estimates →

N →

Update quality estimates →

$\alpha \leftarrow$ better of $\alpha$ and $\alpha'$ →

N →

Submit $\alpha$ →
Control

submit $\alpha$

initial artifact ($\alpha$)

Improvement needed?

$\alpha$ ← better of $\alpha$ and $\alpha'$

Generate improvement HIT

Estimate quality of $\alpha'$

More voting?

$\alpha$, $\alpha'$$\rightarrow$ b

Generate ballot HIT

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Control

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Initial artifact ($\alpha$)

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initial artifact ($\alpha$)

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$\alpha$

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$\alpha'$

More voting?

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Update quality estimates

$\alpha \leftarrow$ better of $\alpha$ and $\alpha'$
Improvement needed?

Generate improvement HIT

Estimate quality of \( \alpha' \)

More voting?

Generate ballot HIT

Update quality estimates

\[ \alpha \leftarrow \text{better of } \alpha \text{ and } \alpha' \]

\[ \alpha \leftarrow \alpha' \]

\[ \alpha \leftarrow \alpha' \]
Writing Image Descriptions

[Dai, Mausam, Weld’11]

Average Quality

Clowder\textsubscript{iterative}  Static

40 images, same average cost
Writing Image Descriptions

[Dai, Mausam, Weld’11]

40 images, same average quality

Clowder_{iterative}  Static

28.7% more money
Outline

• Use Case: Exam Preparation in India

• Clowder, our AI agent for crowdsourcing

• Crowdsourcing <-> Online Education
Crowdsourcing <-> Online Education

• understanding worker quality/skills
  understanding student learning/strengths
• tracking task difficulty/skill needs
  assessing question difficulty
• task-routing for higher quality output
  matching student to questions for best learning
• quality-cost tradeoffs and task optimization
  learning-time optimization for students
• design and execution of workflows for a complex task
  workflows for peer-peer evaluation
• incentive mechanisms to engage the workers
  incentive mechanisms to engage the students
• worker training and educational interventions
  personalized educational interventions for students
Personalized Education

Given a student, available time & target exams

• **Jointly and Dynamically**
• **Estimate his/her**
  – prior knowledge,
  – strengths/weaknesses
  – learning speed

• **Personalize a curriculum**
  – which units to study
  – which questions in which order to answer
  – when to move to a different unit
  – when to revisit a unit
  – when to offer a manual intervention
## AI Agent for Education

### Students

- Practice
- Responses

### Instructors

- Grades
- Anomalies
- Educational Material
- Exams

### Knowledge Representation

- Student Ability/Agility
- Student Learning Rate
- Question Difficulties
- Unit Importance
- Knowledge about diff. students
- Knowledge about diff. edu-units
- Knowledge about diff. questions

### Learning Planning & Control

- How to plan and control learning processes for students.