

# Machine Teaching for Question Answering in Jill Watson

Karan Taneja, Harsh Sikka, Vrinda Nandan, Ashok Goel | Design and Intelligence Lab @ School of Interactive Computing



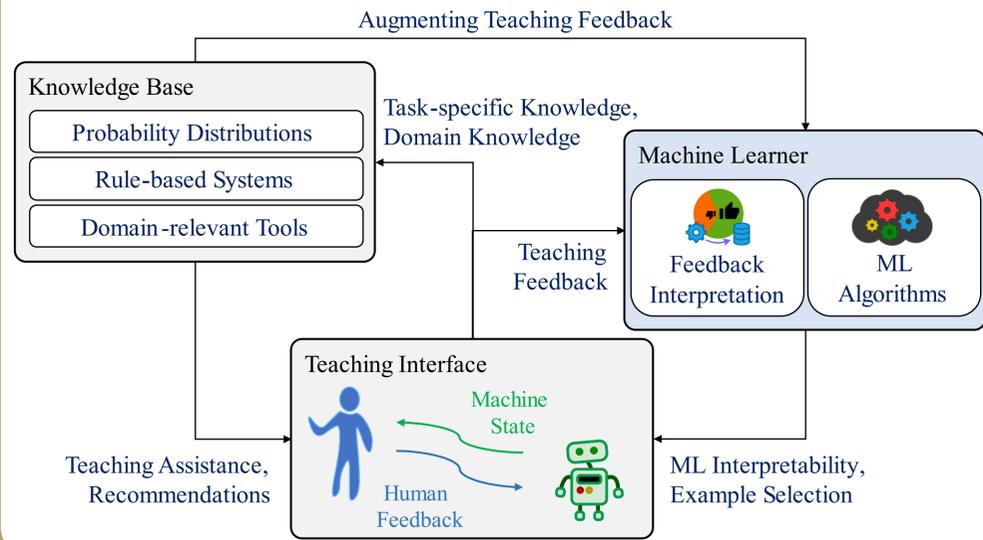
## Introduction

**Machine Teaching** is a collection of approaches explicitly aimed at solving the difficulties that lie in enabling domain experts to effectively teach machine learning systems.

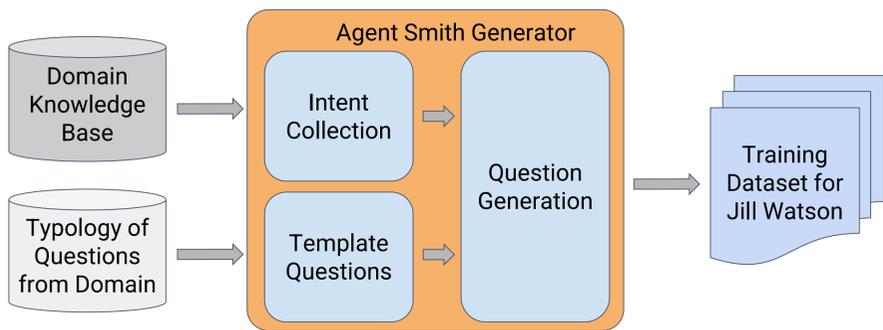
AI Systems, including agents like Jill Watson, face significant challenges in adapting to new domains.

- Cost for creating, training, and configuring Jill Watson was around 500 person hours in 2016.
- **How can we rapidly teach Jill Watson to adapt to new domains i.e. new courses?**
- **What sort of rich interfaces can be designed to facilitate Machine Teaching on the part of domain experts?**

## Interactive Knowledge-Aided Machine Teaching



## Agent Smith



Agent Smith works through operating on 2 distinct inputs:

- **The Domain Knowledge Base** holds concepts and connections that form the body of knowledge the Jill Watson Agent seeks to explain.
- A **Distilled set of Question Templates** that represent the structural form of questions asked by users about this domain.

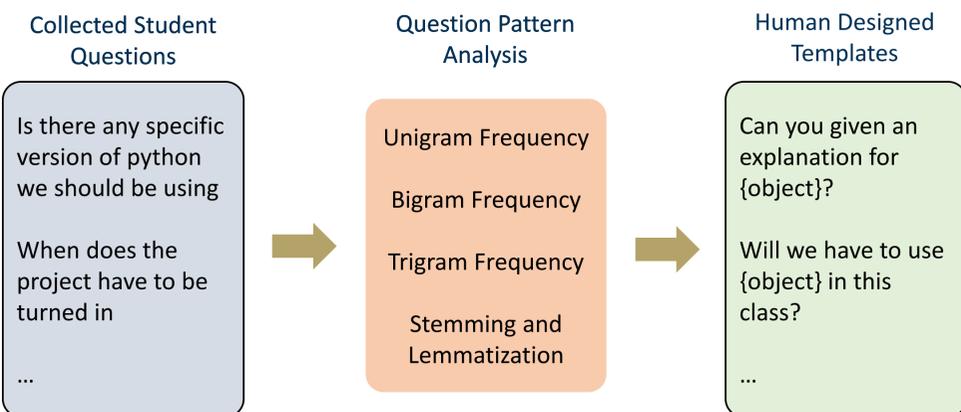
Agent Smith combines these two inputs, and creates large datasets of examples questions to rapidly train new Jill Watson Agents.

## Teaching intent classification to a machine

The interface shows the following steps:
 

- Input:** "How do I turn in an assignment?"
- Top-5 Intent Predictions (Confidence):**
  - thisweek (0.22)
  - nextweek (0.17)
  - submission (0.10)
  - weekx (0.08)
  - estimatedtime (0.05)
- Teacher provides the correct label:** "submission"
- Machine presents its estimated word importance:** A bar chart shows importance values for words: How, do, I, turn, in. The word "turn" is highlighted as inconsequential for the intent.
- Teacher aims to correct machine about its deemed words importance:** "do, I, assignment"
- Machine suggests replacements for an important word using existing knowledge:** "Which words are important for the intent?"
- Teacher is giving detailed feedback and sharing task-specific knowledge:** "turn, in"
- Machine suggests replacements for an important word using existing knowledge:** "Choose words among following that can replace 'turn' in the input: participate, qualify, turn over, give, ..."
- Teacher is giving detailed feedback and sharing task-specific knowledge:** "turn over, give"
- Machine suggests replacements for an important word using existing knowledge:** "Enter any other words that can replace 'urn' in the input."
- Teacher is giving detailed feedback and sharing task-specific knowledge:** "submit, put"
- Machine suggests replacements for an important word using existing knowledge:** "Choose words among following that can replace 'in' in the input ..."
- Teacher is giving detailed feedback and sharing task-specific knowledge:** "...continues to get replacement for word 'in' from the teacher."

## Agent Smith In Action



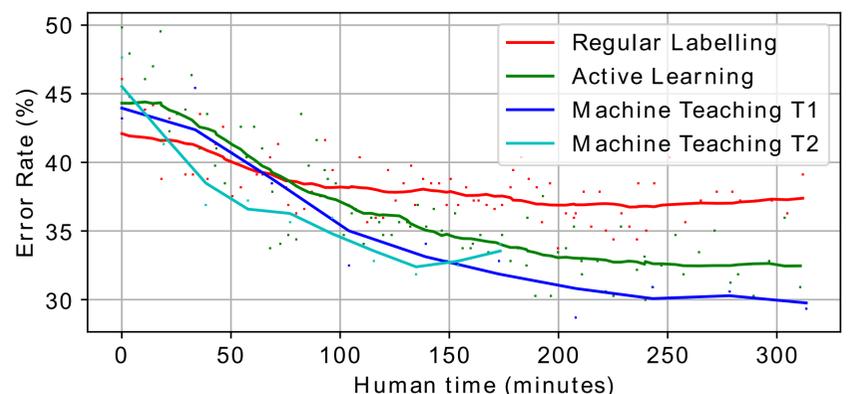
Collected Student Questions	Question Pattern Analysis
object_display_name	object_keywords
Start of Course Survey	Start of Course Survey, survey 1, ...
...	...

**Templates:**  
 What is the release date for {object}  
 When can I start on {object}  
 On what day will {object} be available  
 ...

What is the release date for Start of Course Survey.  
 When can I start on Start of Course Survey  
 On what day will Start of Course Survey be available  
 When can I start on Start of Course Survey  
 ...

importantdates  
 importantdates  
 importantdates  
 importantdates  
 importantdates

## Learning Curve



## Conclusions

- Machine teaching can leverage knowledge for jointly increasing learner performance and teaching efficiency.
- Teaching efficiency can be increased by using machine learned model and existing knowledge.
- **Future Work**
  - Extending work to different tasks and domains.
  - MT for creating intelligent educational documents such as textbooks and open educational resources like Wikipedia.

## Takeaways and Motivation for Knowledge-aided MT

- Agent Smith reduces the estimated time cost of the development of a new Jill Watson agent to ~25 person hours.
- Deployed and used in more than 20 course deployments over the past few years in the OMSCS program.
- **An opportunity:**
  - Better teaching interfaces and data augmentation approaches that allow domain experts to more easily configure a Machine Teaching system to build Q&A agents.

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