



STEVENS
INSTITUTE *of* TECHNOLOGY
THE INNOVATION UNIVERSITY®

Stevens Institute of Technology School of Business

AI Enabled Collaboration - Opportunities and Implications in these Times of COVID

Dr. Chris Asakiewicz
Business Intelligence & Analytics Program Director
EMAIL: casakiew@stevens.edu



Stevens School of Business

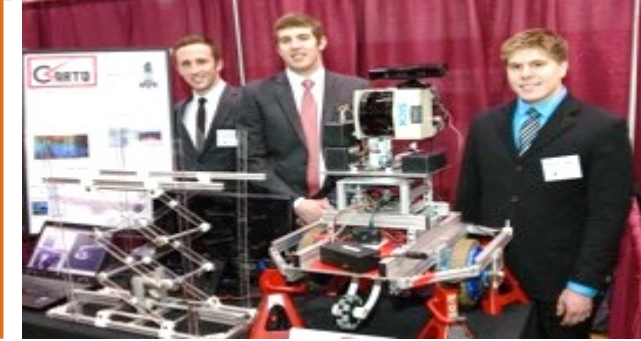
Driven by Real-World Experience



Cooperative
Education >



Project-based learning >



< Faculty-mentored
research



< Case studies drawn
from industry

Internships >



Cross-disciplinary
collaboration reflective
of real-world project
teams >

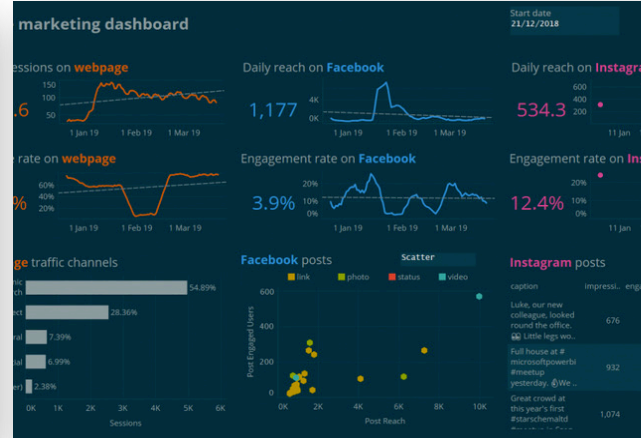


Industry Application Projects

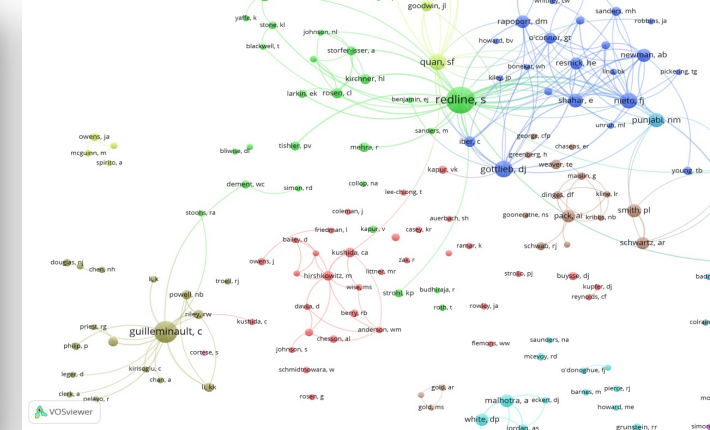
Evidence-Based Decision Making



Cognitive Computing



Marketing Analytics



Applied Analytics



Big Data Technologies



Supply Chain Analytics



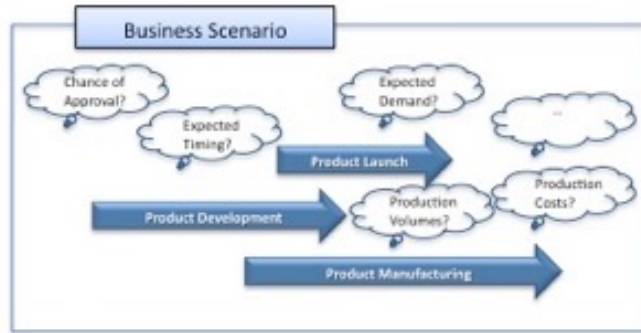
Process Analytics

Industry Application Projects

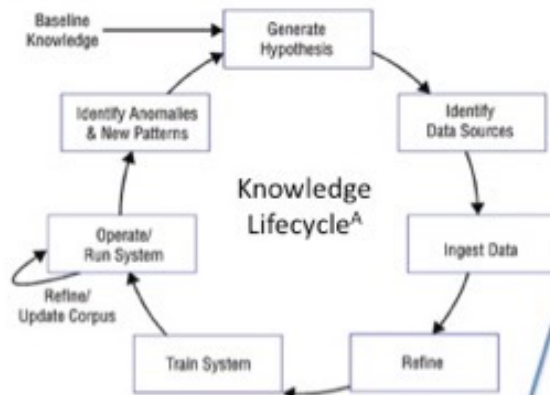
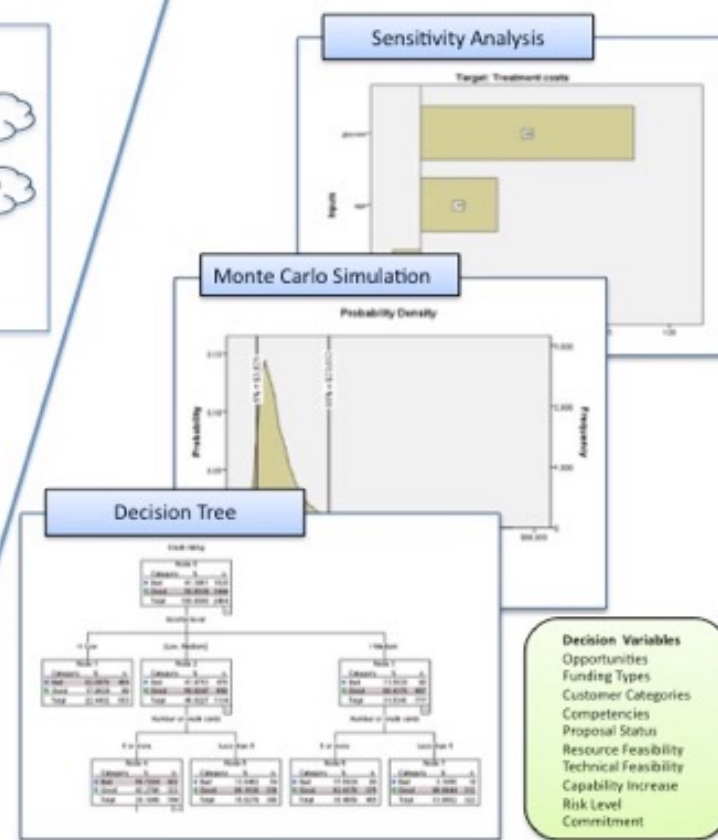
Evidence-Based Decision Making



Asking the “Right” Questions



Searching for the “Right” Answers



^A J. Hurwitz, et.al. – Cognitive Computing and Big Data Analytics – 2015 Wiley

Student Projects – 2018 – 2019

Number of Students	265
Number of Non-Industry Projects	61
Number of Industry Projects	48

Student Projects – 2019 – 2021

Number of Students	175
Number of Non-Industry Projects	47
Number of Industry Projects	34

Industry Application Projects



AI Enabled Collaboration

How can AI be a key enabler of collaborative learning?

AI systems can be used to improve collaborative learning and enhance the learning experience for students.

Group formation

AI can study large volumes of data about every student. This data can include their academic performance, attendance, and style of working. Using such data, AI can divide students into well-balanced groups that can complete different projects. Such groups may include students who have an equal level of understanding about a subject. Else, educators can customize AI systems to form groups that consist of students with different levels of academic performance. This can help students in using their own unique talents in a group. Hence, AI can allow educators to create optimal groups of students for every project. Similar tools can be used in companies to form groups for different projects.

Evaluation of collaborative abilities

AI systems can evaluate each student's degree of collaboration by studying large volumes of data about them. Such systems can generate metrics that can help educators in evaluating the degree of collaboration of each student. Based on this, educators can suggest ways to increase collaboration or correct undesirable trends in the learning processes. As a result, educators can help students in improving their collaborative abilities.

Industry Application Projects



AI Enabled Collaboration

How can AI be a key enabler of collaborative learning?

AI systems can be used to improve collaborative learning and enhance the learning experience for students.

Virtual agents

AI can be used to create virtual agents that can help students in group projects. These virtual agents can answer student queries and behave like a peer or someone who students can teach. With these applications, virtual agents can help in group projects. Such virtual agents can be quite useful in educational games and online courses. On these platforms, virtual agents can test every student's understanding of the subject matter by asking questions. Hence, AI-powered virtual agents can make the learning experience more informative and interactive.

Moderation

In group discussions and debates, monitoring the conversations of different groups can be quite difficult. AI systems can monitor conversations of many groups using recording devices. These AI programs can alert educators in case a group's conversation goes off-topic. For this, AI systems use techniques like shallow text processing and machine learning. And, with continued usage, AI systems keep getting better at moderating group debates. Hence, such systems can simplify the moderation of group debates.

Learning gaps

Industry Application Projects



AI Enabled Collaboration

How can AI be a key enabler of collaborative learning?

AI systems can be used to improve collaborative learning and enhance the learning experience for students.

Learning Gaps

Students lagging behind in a lesson or a subject is a common occurrence in schools. The reasons for such [learning gaps](#) can be an inability to grasp new concepts, difficulty to study material, or ineffective teaching methods. However, understanding the exact reason can be quite difficult.

AI systems can study large datasets to identify struggling students and complexities in the curriculum. For this, AI systems can use Natural Language Processing to analyze the content and context of study materials. Based on this analysis, educators can create personalized learning plans or assignments to bridge learning gaps.

AI-based collaborative learning will improve each student's communication and collaboration skills, which can be incredibly useful in their professional lives.

Industry Application Projects



AI Enabled Collaboration

AI Will Change the Way We Work and Collaborate

Digital tools have changed the way we work, meet, collaborate and innovate. The physical constructs we once knew — hallways, office machines and water-cooler conversations — transformed into virtual spaces, mobile devices and video calls. Connecting people digitally in a video everywhere environment fueled by cloud applications has literally torn down barriers, opened teamwork to remote participants and made collaboration fluid and seamless. We realize these benefits now and we're on the brink of exponential gain with the arrival of artificial intelligence (AI) in the workplace.

HARVARD Business Review (Collaborative Learning) at: <https://hometownhealthonline.com/wp-content/uploads/2019/02/ai2-R1804J-PDF-ENG.pdf>

By H. James Wilson and Paul R. Daugherty

A Platform for AI-Enabled Real-Time Feedback to Promote Digital Collaboration

By Beth Porter and Francesca Grippa

Machines as teammates: A research agenda on AI in team collaboration

By Isabella Seeber, et.al.

Projects

Collaborative Learning – Group Formation

This project highlights the leveraging of AI in group formation. It enables instructors to form well-balanced student groups based on specific criteria.

The dataset is manually simulated with 1 million student records, and covers 11 interpersonal skills like teamwork, empathy skills, self-control that would be collected from student questionnaires.

The system permits instructors to select the set of students to form groups with homogeneous backgrounds or heterogeneous backgrounds for different assignments.

Collaborative Learning – Group Formation

Team: Guirong Luo, Ilesh Sharda, Ruixi Wang, Xinming Yang, Xin Zhao

Instructor: Chris Asakiewicz



Introduction & Background

- The number of companies implementing AI has increased by 270% in the last four years
- AI-powered education concept has begun generating new teaching and learning approaches.
- AI system could enhance the collaborative learning experience by assisting in forming the groups, assessing collaboration capabilities, answering queries as virtual agents, monitoring the collaboration process, and identifying knowledge gaps.

Research Question

- The formation of groups is the core.
- Design a model to create well-balanced student groups for different projects.
- Equalize the academic performance of each students' groups
- Achieve a particular goal by releasing each student's potential ability and specialty

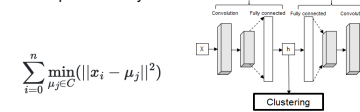
Data Simulation

- Simulate 1 million student records based on statistical facts of the U.S. population.
- Create 5 features and 11 interpersonal skills for 1 million students, including gender, race, a binary of international status variable, technical skill, reading score 11 interpersonal skills.
- Interpersonal skill score can be obtained from CareerLeader.

SKILL	YOUR SCORE	COMPARISON SCORE	DESCRIPTION
Teamwork	100	80%	A team player: cooperative, works well as part of a group.
Empathy Skills	95	90%	Can see things from other people's points of view.
Self-control	91	90%	Does not act or speak impulsively; does not easily lose composure.
Ability to Compromise	87	80%	Able to compromise when the situation calls for it.
Ability to Teach	85	80%	Clear and patient when explaining things; a good teacher.
Respect for Others	82	80%	Respectful of other people's points of view, as well as their time and privacy.
Openness to Criticism	80	80%	Accepts critical feedback without getting defensive.
Sensitivity and Tact	73	80%	Sensitive and tactful; provides an atmosphere of good feeling and mutual consideration.
Gaining Trust	71	80%	Inspires other people's trust.
Conflict with Others	64	80%	Considerate and effective in dealing with people from many different backgrounds and cultures.
Listening Skills	58	80%	Listens to other people in a way that they feel understood.

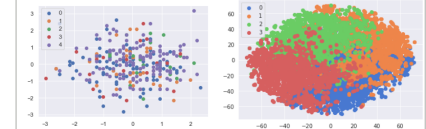
Methodology

- The classic K-Means algorithm clusters data by separating samples in N groups of equal variance, minimizing a criterion known as the inertia or within-cluster sum-of-squares.
- The autoencoder deep learning model has autoencoders to learn abstract features in an unsupervised way.



K-Means Model

- The elbow method is applied to decide the optimal number of clusters and it gives the turning point of 5 clusters.
- The visualization of the group distribution may not be strongly bind and the groups are scattered.



Autoencoder Model

- Encode with 2 conv1d hidden layers with maxpooling1d layers.
- Adam as the optimizer. MSE as the cost function to evaluate the loss.
- K-Means to predict encoded data.
- Run the autoencoder clustering algorithm and keep 11 interpersonal skills as data input.
- Save the model to predict all data and visualize 5,000 samples.

Cluster	Strength	Drawback
0	- Good at listening to others - Great at gaining trust - Tactful	- Lack of self-control and empathy - Learn to compromise
1	Empathy above average	Lower scores for all skills, indicate lack interpersonal and networking skills
2	- Good at teamwork - Outstanding on self-control	- Need to be more tactful and empathetic - Learn to work with people from different background
3	- High scores for all skills - Excellent on networking	Need to listen to others more

Business Impacts

- A reasonable, realistic and intelligent technique for professors, instructors to group students. It permits instructors to select the set of students to form groups with homogeneous backgrounds or heterogeneous, diversified for different assignments.
- The attributes of the dataset could be up-to-date as long as users input the most recent collected students' information. And the number of clusters could also be modified with needs. The succeeding visualizations section would aid in obtaining the properties of each group.
- The application may be beneficial not only limited to the formation of student groups but also to the formation of project teams in enterprises.

<http://www.stevens.edu/howe/academics/graduate/business-intelligence-analytics>

Projects

Classification of Student Performance

This project highlights the analysis of student performance which will help in developing more efficient student prediction tools, improving the quality of education and enhancing school resource management.

The objective of the project is to leverage AI & ML models to predict student performance based on the habits and lifestyles.

This project builds toward a tool which helps in identifying gaps in student performance which could be addressed in a more proactive manner.

Classification of Student Performance

Shardul Shinde, Gaurav Vanjara
Instructor: Dr. Christopher Asakiewicz



Introduction & Background

- Personalized learning occurs when e-learning systems make deliberate efforts to design educational experiences that fit the needs, goals, and interests of their learners.
- The objective of the project is to leverage AI & ML models to predict student performance based on the habits and lifestyles.
- The data focuses on the students' achievements in the secondary education level of two Portuguese schools.

Business Question

- The business question is to classify the students based on several parameters like lifestyle, and habits.
- The analysis of student performance which will help in developing more efficient student prediction tools, improving the quality of education and enhancing school resource management
- Leveraging Business Intelligence/Data Mining, with an aim to extract high-level knowledge from raw data, offer interesting automated tools that can aid the education domain.

Methodology

- **Random Forest:** Random forest, like its name implies, consists of many individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model's prediction.

Results

- The obtained results reveal that it is possible to achieve a high predictive accuracy, provided that the first and/or second school period grades are known.
- The results confirm that student achievements are highly affected by previous performances.
- An analysis after implementation of predictive models has shown that, in some cases, there are other relevant features, such as: school related (e.g., attendance, choice of school, extra educational school support), demographic (e.g., student's age, parent's job and education) and social (e.g., going out with friends, alcohol consumption) variables.

```
#final model
forest = RandomForestClassifier(n_estimators=50, min_samples_leaf=1)
f = forest.fit(X_train, y_train)
print("Random Forest Model Score", ":", f.score(X_train, y_train), ":",
      "Cross Validation Score", ":", f.score(X_test, y_test))
```

Random Forest Model Score : 0.976712328767, Cross Validation Score : 0.847133757962

- Live Demo Link:
<https://colab.research.google.com/drive/1XuvU36Xel2bh3qopk-ewjIBSmJsfqBS3?usp=sharing>

Business Impact

- The significance of our project is to offer a tool which helps in predicting student performance.
- There is a potential for an automatic on-line learning environment, by using a student prediction engine as part of a school management support system. This will allow the collection of additional features (e.g., grades from previous school years).
- To obtain a valuable feedback.

<http://www.stevens.edu/howe/academics/graduate/business-intelligence-analytics>

Projects

AI Tutor

This AI system can enhance the collaborative learning experience of students by assisting in answering queries as virtual agents, monitoring the collaboration process, and identifying a gap in knowledge.

As a chat bot AI Tutor uses a Multiple-Choice testing format to identify a gap in their science knowledge through quizzing the student personalizing their learning experience by recommending them questions.

AITutor

Team: Darpan Shah, Devanshi Mehta, Dhaval Patel, Ilesh Sharda,
Rishi Singh

Instructor: Chris Asakiewicz



STEVENS
INSTITUTE OF TECHNOLOGY
THE INNOVATION UNIVERSITY™
Business Intelligence & Analytics

Introduction & Background

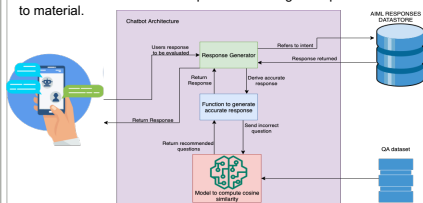
- The emergence of AI-powered education concepts has begun generating new teaching and learning approaches.
- AI system can enhance the collaborative learning experience of students by assisting in answering queries as virtual agents, monitoring the collaboration process, and **identifying a gap in knowledge**.
- AITutor is a chatbot that uses a Multiple-Choice testing format for high school students to identify a gap in their science knowledge through quizzing the student personalizing their learning experience by recommending them questions.

Research Question

- To create a cognitive application that can tailor learning and testing for students
- Identifying and addressing a gap in student's knowledge by assessing them and recommending areas of weakness.
- Measures student's confidence post personalized learning experience to gain an understanding of the success of the application.

Model Architecture and Dataset

The application has been coded using Python and to create the user interface Tkinter has been used to provide a console based design. This design choice is simple and useful and provides the user a straightforward experience. Utilizing the OpenBookQA Dataset which is found on the Allen Institute for AI data repository consists of 5000 questions and six columns with great interest in the question stem and answer key. The application uses Artificial Intelligent Markup Language (AIML) to store the intents for the application and provide accurate responses to the user by making use of tags. The application identifies a gap in the students understanding using incorrect responses to questions and recommends provides questions the student is likely to get incorrect. At the end of the quiz the AITutor recommends areas where the student can brush up their knowledge and provides links to material.



The diagram illustrates the Chatbot Architecture. It shows a flow from 'User response (AIML-enabled)' to 'Response Generator', which then interacts with 'AIML RESPONSES DATABASE'. The 'Response Generator' also receives 'Default to correct' and 'Response returned' from the database. It then sends 'Return Responses' to 'Return recommended questions', which in turn sends 'Send incorrect question' to 'Model to calculate cosine similarity'. The 'Model' then sends 'Return recommended questions' back to the 'Response Generator'.

Natural Language Processing

- The Cognitive Application access the student with five random science questions in order to identify a gap in knowledge.
- The application informs students whether the answer is correct or incorrect along with the correct answer and stores the question the student has gotten incorrect.
- Using the **bert-base-nli-mean-tokens** a pretrained model the questions stem are vectorized and stored as a numpy array.
- The pretrained model is known as sentence transformer which is able to map sentences to a 768 dense dimensional vector space.
- Chronologically the question with an incorrect responses has been used in the cosine similarity check. The top 5 questions with the highest similarity are individually returned to the user.

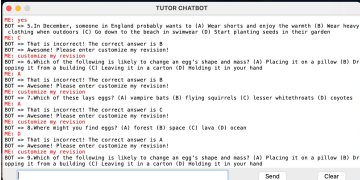
Cosine Similarity Check

- The cosine similarity check is used to retrieve a numeric distance between an a dense vectorized question that has been answered incorrectly by the user and the rest of the questions in the dataset.
- As seen in the figure below the first selected question is 'The sun is responsible for' has highest similarity with 'Q.107' 'the sun is source of...'
- Using the sklearn cosine similarity function the application computes the cosine similarity distance between an individual question and the rest of dataset along with sorting the questions by similarity value and personalizing the quiz by returning the most similar question.

Question Stem	similarity
Q The sun is responsible for	1.000000
107 The sun is source of which, first and foremost?	0.883985
3074 The sun is	0.883987
885 An example of how sunlight is a source of light...	0.885884
857 Sunlight is a heat source emitted from	0.882023
1110 A group of burrows move into a field and start...	-0.160440
383 After a long winter's hibernation, a female be...	-0.158723
744 A pack of wolves and the sheep before a gully...	-0.148893
28 A mouse is being hunted by a Great Horned Owl.	-0.146973
1480 A squirrel eats all of the acorns in a tree. T...	-0.207894

4857 rows x 2 columns

AITutor UI



The screenshot shows the AITutor UI, a chatbot interface. It displays a list of questions and answers, with the user's response and the chatbot's response. The chatbot's response includes a recommendation for a question based on the user's previous incorrect answer.

In the figure above the tutor chatbot has been able to personalize the quiz dependent on the questions the student has got wrong using pretrained sentence-transformers and cosine similarity. The AITutor is also able to extract keywords from the questions the student has gotten incorrect and return them as topics to the user along with utilizing the WikipediaAPI and returning hyperlinks that will direct the student to information about these topics. To provide the student with personal questions of their wish we have also incorporated a question generation component where the user enters a topic and a fresh new question with multiple choice answers is returned to the user.

Business Impacts

- The business impact of this application from the anticipated results will see a functional chatbot that will be used by students studying science in high school and aid these students with their revision by identifying their gap in knowledge and improve their revision sessions.
- This application should see students gain more confidence in their academics and take their revision and understanding of the science subject into their own hands.

Future Scope

In the future we plan to automate a dynamic question bank that mines data from web and forms MCQ like question generation functionality. This will improve our chatbot by creating fresh content and keeping the dataset up to date. Along with this we aim to improve our topic modelling so more precise recommendations can be returned.



Projects

FAQ Chatbot for Graduate Admissions

Students from the school and especially incoming students will have many doubts like regarding their application status, fee waiver, about the unofficial test scores, transcripts, etc...

Addressing each and every student's questions on a global basis can be a difficult task for the Office of Graduate Admissions.

This AI Chatbot is designed in such a way that it will be capable enough to answer all general questions for the Office of Graduate Admissions, on a 24 / 7 basis.

FAQ Chatbot for Office of Graduate Admissions Rajiv Mahajan, Shreeya Kokate, Sai Srivedh Chagantipati



Business Problem

We see a lot of students from the school and especially incoming students will have many doubts like regarding their application status, Fee waiver, about the unofficial test scores, transcripts, etc... Addressing each and every student all the time individually can be a difficult task sometimes. That is where an Artificial Intelligence Chatbot comes into picture. It is designed in such a way that it will be capable enough to answer all general questions, which will be of great help for the employees. Our aim is to build and deploy one for the Office of Graduate Admissions, Stevens Institute of Technology.

Business Question

1. Will the advanced technology assist the user in smooth understanding of the admission process?
2. Will we be able to achieve accuracy in addressing the exact concerns of the student without any involvement of the respective officials?
3. Till what level can we reduce the repetitive workload of the organization through automation?

Approach

Our work is divided in 3 components, namely, preparing the input dataset, Natural Language Processing (NLP) Engine and the user interface. We have used IBM Watson Assistant for this project.

Intents: They are purposes or goals that are expressed in a customer's input, such as answering a question or processing a bill payment. By recognizing the intent expressed in a customer's input, the Watson Assistant service can choose the correct dialog flow for responding to it. We have started incorporating our chatbot with a total of 44 intents. We have used existing intents with some customization and created a few of our own as per needed.

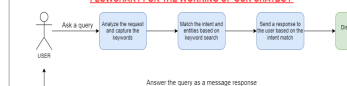
Entities: Entities are used for identifying interesting parts of the user's utterance, such as names and dates. Watson Assistant already provides system entities (for date, time, names, etc.), and lets you define entities with synonyms and fuzzy matching, as well as defining pattern-based entities. We have incorporated a few customized entities as per needed for our chatbot.

Dialog: The dialog uses the intents that are identified in the user's input, plus context from the application, to interact with the user and ultimately provide a useful response. The dialog matches intents (what users say they want to do) to responses (what the bot says back). We have built the dialog chat flow by adding nodes, child nodes in a way that the machine understands the user questions and be able to answer accurately.

COMPONENTS OF OUR CHATBOT SYSTEM



FLOWCHART FOR THE WORKING OF OUR CHATBOT



Data, Scope, Privacy Issue

We have 1 sources of data which is an External source. External Source would be the University website where we can find generic QnA sets. We have scrapped the data from Stevens Graduate Admissions using an automated bot called Axiom.

Scope: focusing on creating a chatbot to be used by students to get their queries responded to easily from the college website. The Stevens Inquiry Chatbot (SIC) has the capacity to make friendly conversations; respond to the departments like Admissions, PhD/Graduate Orientation, Open Houses, Academic department, and ISSS. To build the chatbot, IBM Watson Assistant, Topic Modeling, and Knowledge base services will be utilized.

No, currently there won't be any data privacy issues. For this course project we only aim to implement Stage1 and Stage2 is just the future scope of our problem statement.

Results

The below statistics, tells us we have a total of 87 conversations were made till now with the chatbot from 12 different users and they had 429 requests in total. From the graph below, we have achieved 92% of accuracy.



Conclusion & Future Work

- When prospective applicants or admitted students send an email inquiry to the admission department, they have to wait for some time before they can get an answer (sometimes it's days/weeks!)
- A chatbot for general inquiries would eliminate the time lag and make the chatbot more productive
- This chatbot would assist in saving the applicant precious time on general inquiries and as a result focus on more pressing and important concerns
- We can allow user login and thus solve a more detailed query which requires handling sensitive data and access to user data. This would be the phase where we might have data privacy issues which can be solved by using authentication, authorization, end-to-end encryption, etc. techniques.

<http://www.stevens.edu/school-business/masters-programs/business-intelligence-analytics>

Projects

Course & Career Recommendation Chatbot

This Chatbot is used to guide students, especially those who are new to a subject, to appropriate skill development courses; as well as, assist students to hone in on career paths based upon their technical and personal skills

The logic of chatbot is to narrow the range of course or career selection step by step adding constraints to give personalized recommendations.

Course & Career Recommendation Chatbot

Yu Hao, Chongyuan Huang, Sherri Putnam, Muyao Wang
Instructor: Dr. Christopher Asakiewicz



STEVENS
INSTITUTE OF TECHNOLOGY
THE INNOVATION UNIVERSITY
Business Intelligence & Analytics

Introduction

Resource

A Watson Assistant Chatbot is used to:

- Guide students, especially those who are new to a subject, to appropriate skill development courses
- Assist students to hone in on career paths based upon their technical and personal skills

The logic of chatbot is to narrow the range of course or career selection step by step adding constraints to give personalized recommendations. After giving a result, the chatbot will return to the previous step to ask if users want to choose other options. Once users have no more question, the chatbot will end the conversation.

IBM Watson Assistant service
IBM Watson Discovery service
Coursera course information data
Indeed career information data

Business Impact

Parameters

Students

- Students are often concerned about making the right course decisions. They want to be sure that they're choosing correctly based on their academic interests, skills, and potential careers.

Learning Institutions

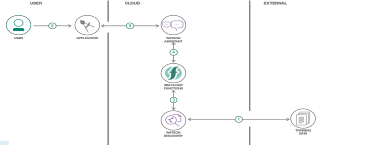
- Chatbots can guide students towards their interests. This can help universities secure course registrations and increase admissions. It also help student to pursue their career in the future.



Privacy & Ethical Issues

Architecture

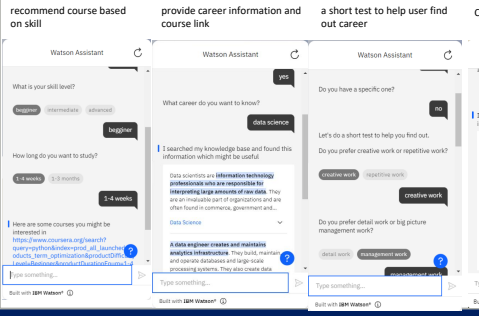
A Chatbot interface will collect users' private demographic information and analyze it – along with use, search, and registration data. Watson Knowledge Catalog's Policy Management will manage the security of private data.



Resource: <https://github.com/IBM/watson-discovery-sdu-with-assistant>

Results

Future Scope



Chatbot improvements include testing to determine users' skill levels. Addition of free text entry fields will further personalize the user experience. Students will be redirected to more web pages for relevant, detailed information.

<http://www.stevens.edu/school-business/masters-programs/business-intelligence-analytics>

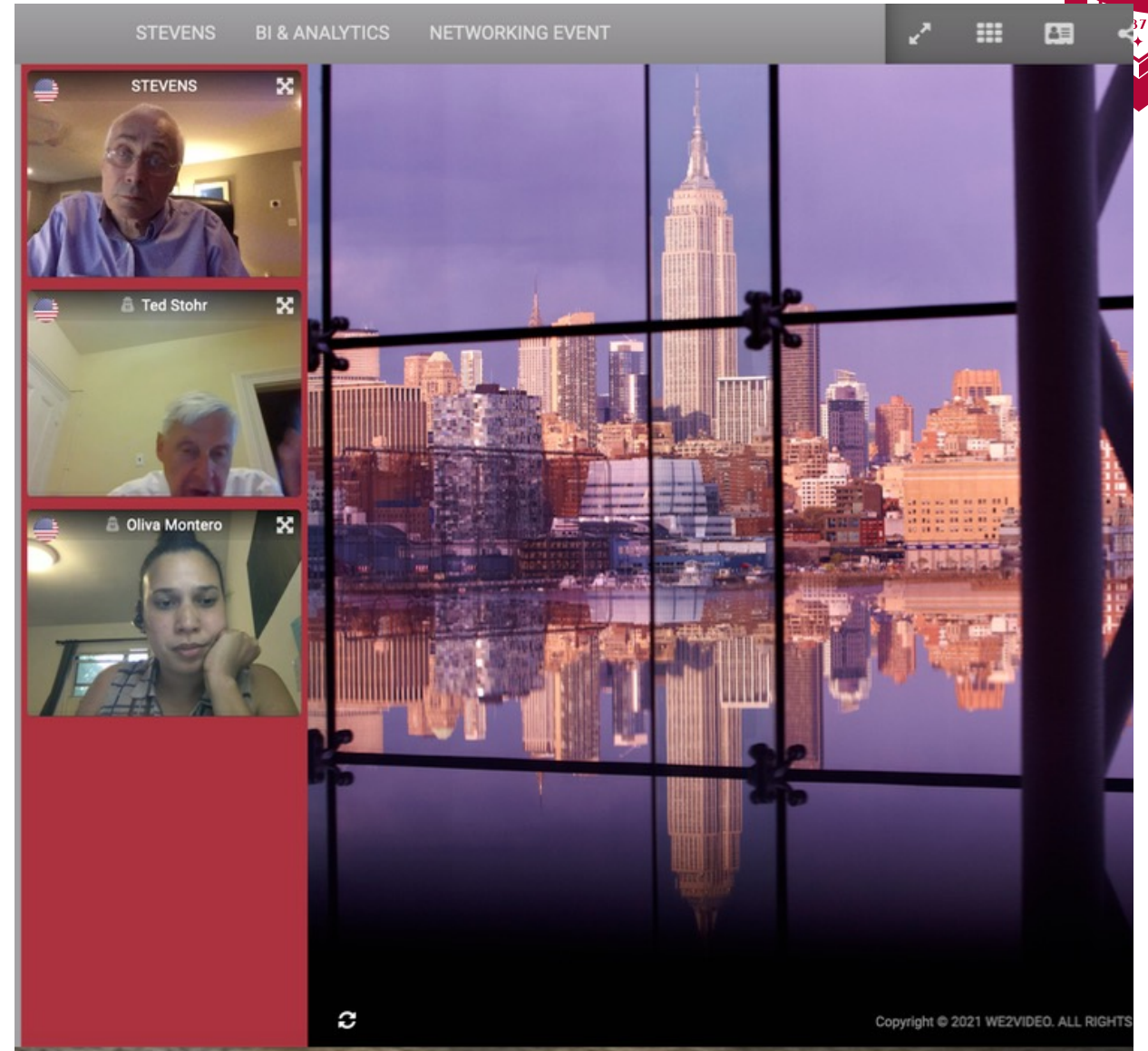
Projects

Virtual Corporate Networking Event - Pilot

The pilot involved virtual access to posters, presentations, and demos from 16 student teams, a handful of faculty, and 20 BI&A Advisory Board members.

The pilot event was conducted live on May 28th, 2021 using the virtual TCS WE2VIDEO Platform, and was available for access for 5 days after the event.

Participants could engage with students virtually over video as well as chat.



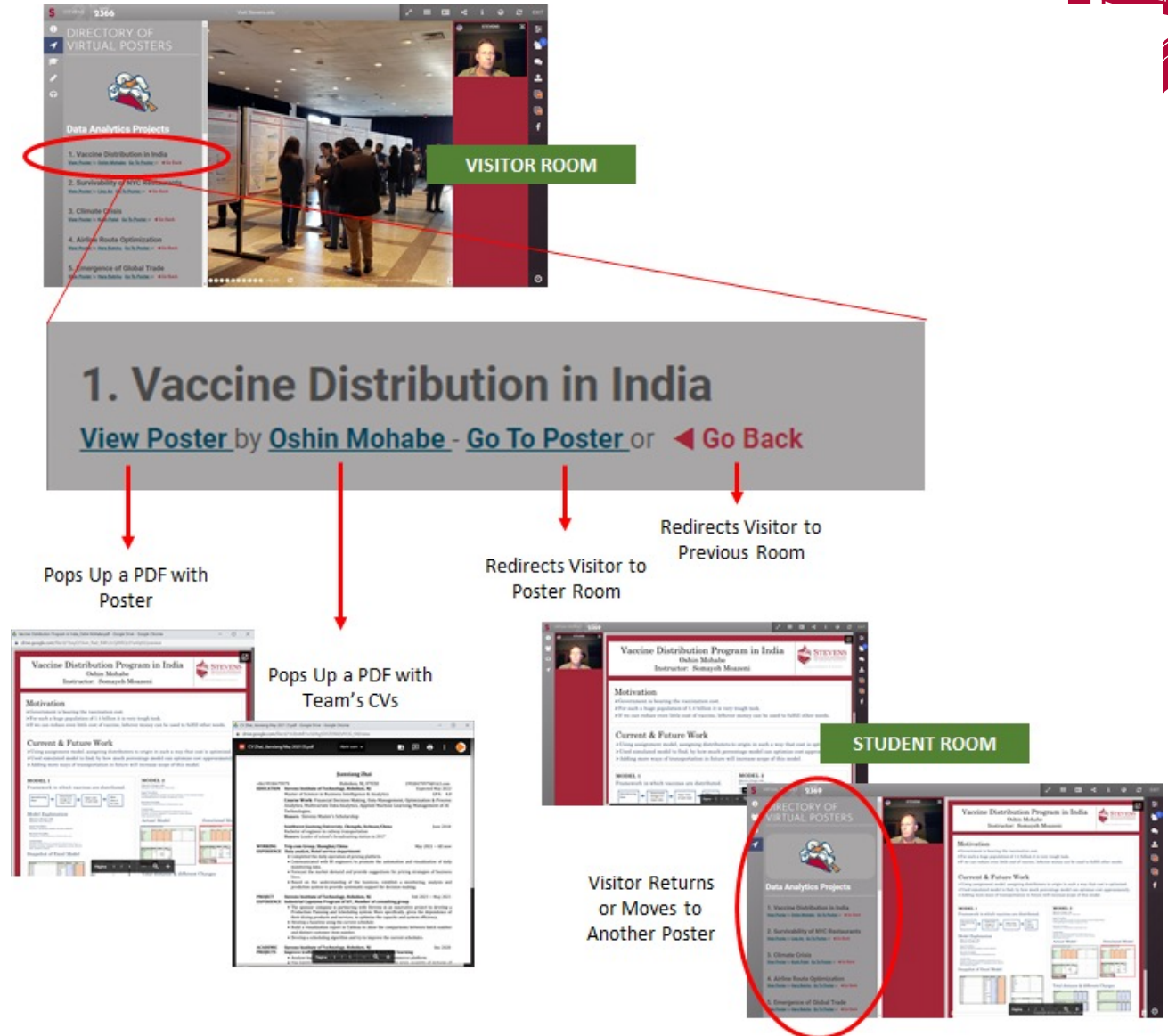
Projects

Virtual Corporate Networking Event - Pilot

As a result of the pilot, several small changes were recommended to the platform, to both enhance participant navigation as well as enrich the virtual interaction among the students presenting their work to participants, both synchronously and asynchronously.

With this new navigation format, we could scale up to 200 student poster rooms in any one event.

Allowing participants to either browse a category of posters or simply select those posters and students of specific interest to engage with questions and possible follow-up. Overall, virtual access allow for an event to be available globally.



Projects



Virtual Corporate Networking Event - Pilot

No current solution exists outside of web links to content, Zoom sessions and text based messaging (e.g., Brazen). Our last Corporate Networking event consisted of Approximately 70 data scientists and recruiters from 40 companies.

Students present and give live demos of their research projects (last semester we had over 60 posters from student teams).



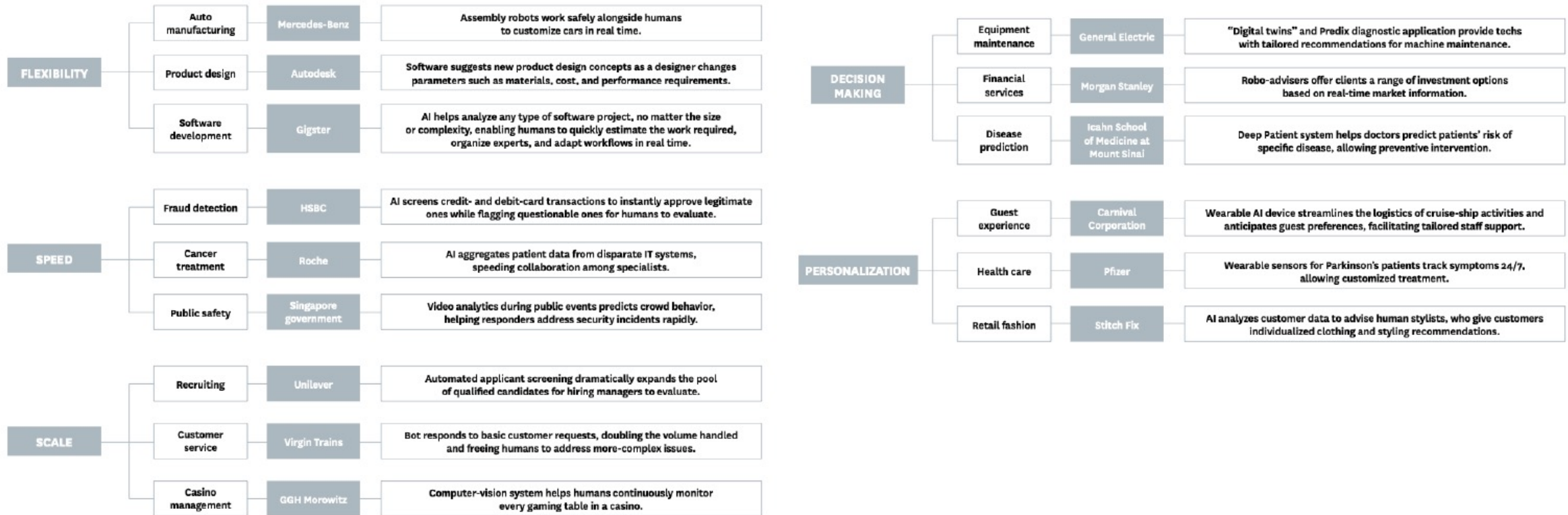
Graduate students in the Business Intelligence & Analytics, Information Systems and Financial Engineering programs at Stevens showcase research projects and business applications of concepts like analytics, data science, machine learning, and artificial intelligence.

Opportunities and Implications



Enhancing Performance

Across all kinds of Industries, Humans and AI are Collaborating to Improve Five Elements of Business Process



Wilson and Daugherty, Collaborative Intelligence: Humans and AI Joining Forces, HBR Article, 2018

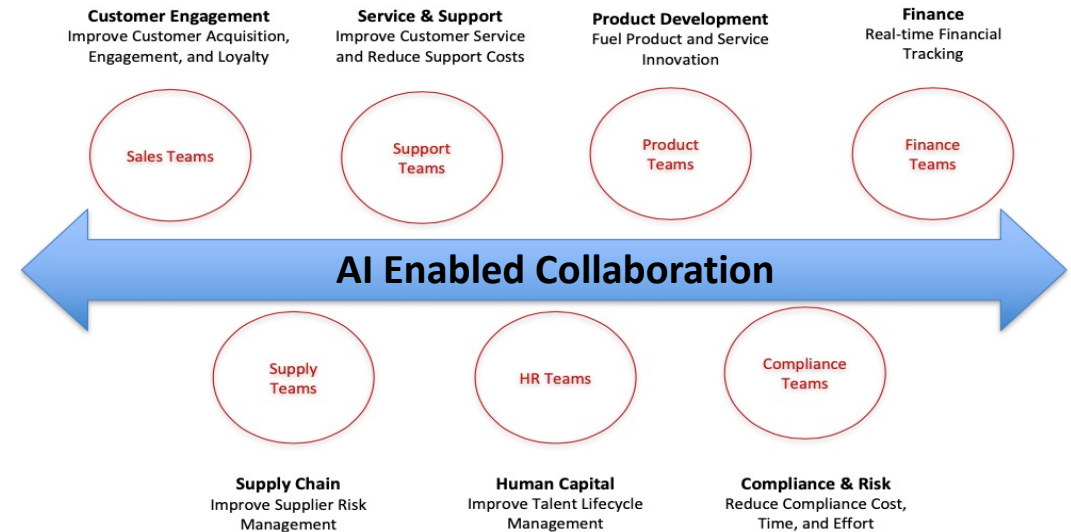
Opportunities and Implications



Augmented Intelligence and AI Enabled Collaboration



Augmented intelligence is an alternative conceptualization of artificial intelligence that focuses on AI's assistive role, emphasizing the fact that Cognitive Technology is designed to enhance human intelligence rather than replace it. Cognitive Computing and AI are enabling today's Cognitive Business Environment.

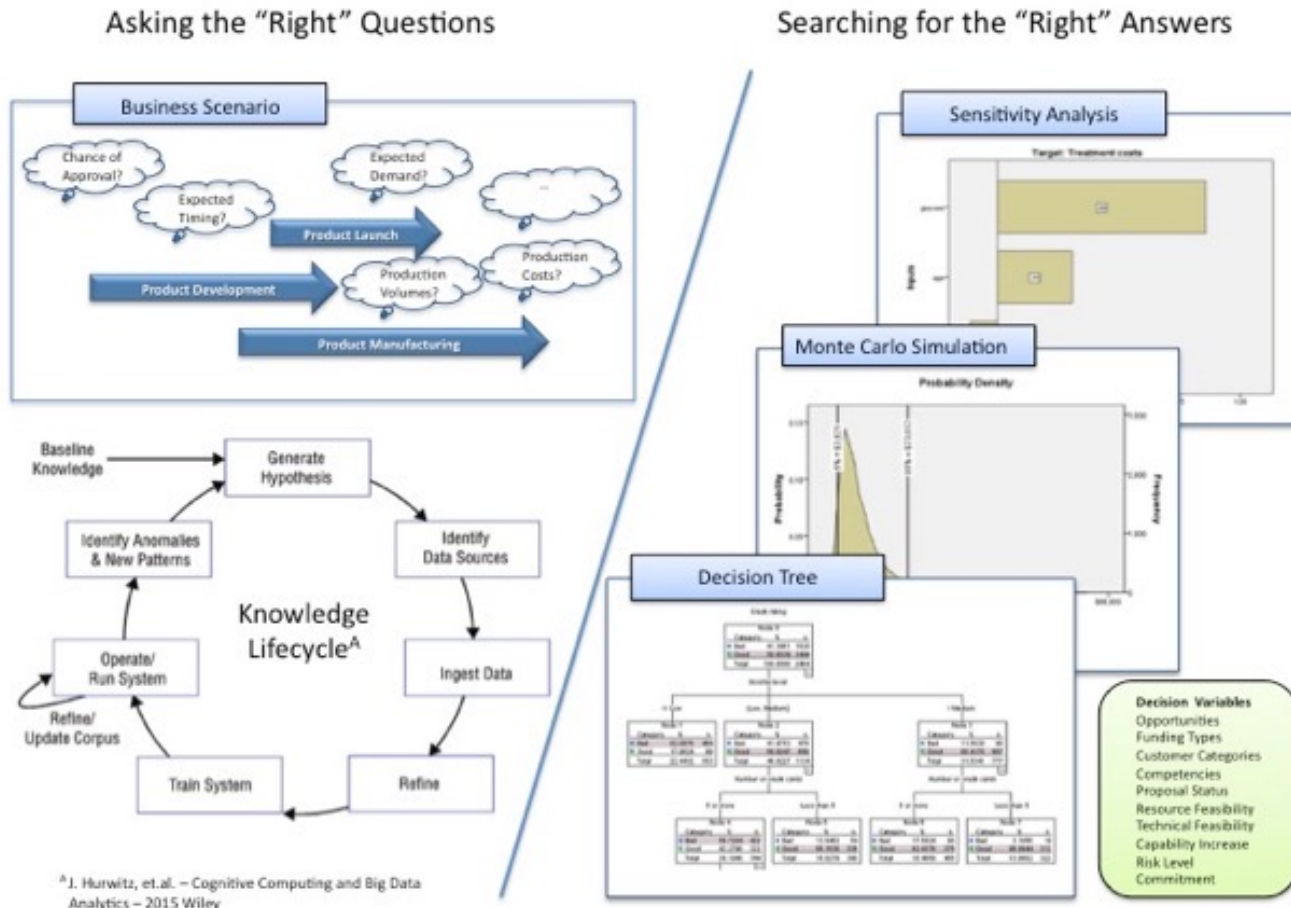


Wilson and Daugherty, Collaborative Intelligence: Humans and AI Joining Forces, HBR Article, 2018

Opportunities and Implications



Enhancing Evidence-based Decision Making



In the Pharmaceutical Industry, Humans and AI are Collaborating to enhance the Discovery, Development, and Commercialization of New Therapies.

AI is being used to augment evidence-based decision making in areas like Regulatory Review and Compliance, Study Design, Trial Monitoring, Hypothesis Testing, as well as Competitive Assessment and Portfolio Management.

Solutions take the form of AI Advisors augmenting the capabilities of humans to not only search for the "right" answers to key questions, but advise and guide humans in asking the "right" questions.

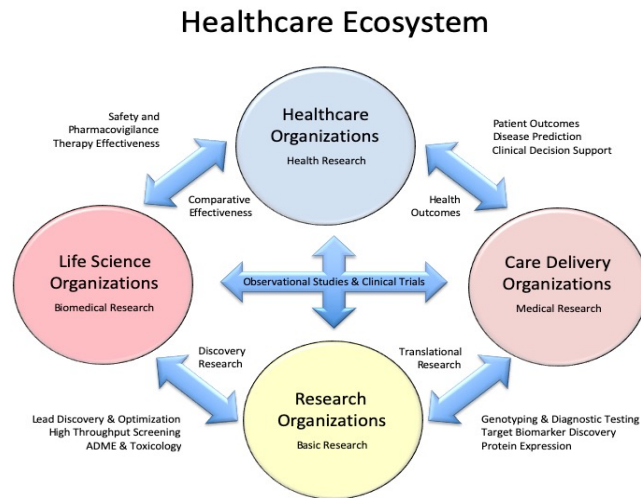
Opportunities and Implications



AI Enabled Collaboration

Implications for the pharma industry

The use of artificial intelligence (AI) has been increasing in various sectors of society, particularly the pharmaceutical industry. AI enabled collaborative Intelligence is being used in diverse sectors of the pharmaceutical industry, including drug discovery and development, drug repurposing, improving pharmaceutical productivity, and clinical trials, among others; such use reduces the human workload as well as achieving targets in a short period of time.



In today's healthcare ecosystem environment, data constitute a shared language that connects payers, hospitals, accountable care organizations, and consumers— and the consumer's voice is coming through more clearly than ever before.

Here AI-enabled collaboration can enhance the cooperation and collaboration of ecosystem partners in improving healthcare. Leveraging AI for enhanced therapy planning, better and more personalized patient care, and improved health outcomes.

Johnson, et.al., Precision Medicine, AI, and the Future of Personalized Healthcare, Clinical Translational Science, 2021

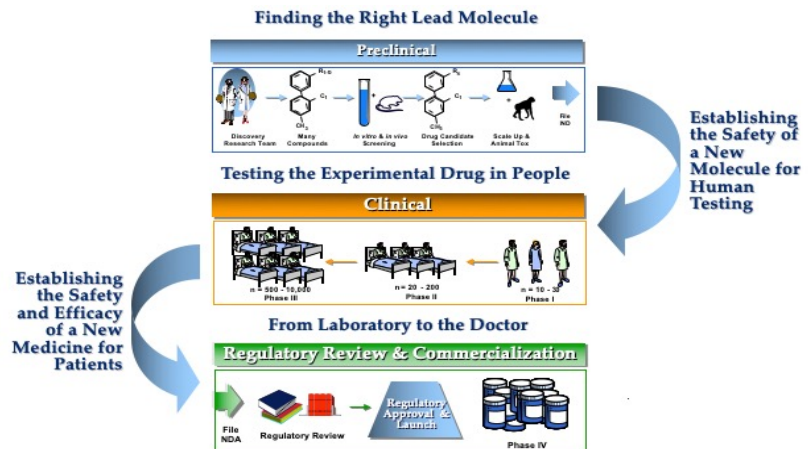
Opportunities and Implications

AI Enabled Collaboration



Implications for the pharma industry

Advances in artificial intelligence could potentially reduce the complexities and costs in drug discovery. Significant impact can be seen in leveraging AI – Human collaboration in the development of new drugs whose mechanism of impact on a disease is known and for drugs at the medium level of chemical novelty. However, AI – Human collaboration is less helpful in developing drugs when there is no existing therapy, entirely novel or those that are incremental “follow-on” drugs.



Drug Candidate Discovery and Screening focuses on the drug discovery process, from idea generation through the filing of an Investigational New Drug Application (IND).

AI – Human collaboration is enhancing the ability to leverage the massive amount of data associated with molecular modeling, high throughput screening, combinatorial chemistry, as well as robotics. AI agents are being used to leverage this data and assist in problem formulation, data collection, and model development.

Gil, Thoughtful AI: Forging New Partnerships for Data Science and Scientific Discovery, Research Gate, 2017

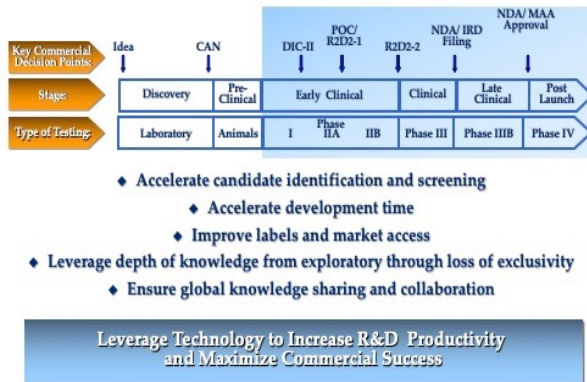
Opportunities and Implications



AI Enabled Collaboration

Implications for the pharma industry

The use of artificial intelligence (AI) has been increasing in various sectors of society, particularly the pharmaceutical industry. AI enabled collaborative Intelligence is being used in diverse sectors of the pharmaceutical industry, including drug discovery and development, drug repurposing, improving pharmaceutical productivity, and clinical trials, among others; such use reduces the human workload as well as achieving targets in a short period of time.

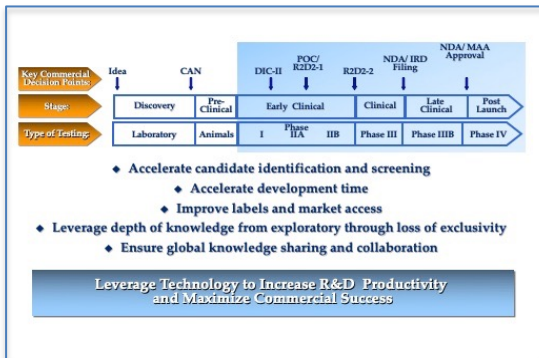
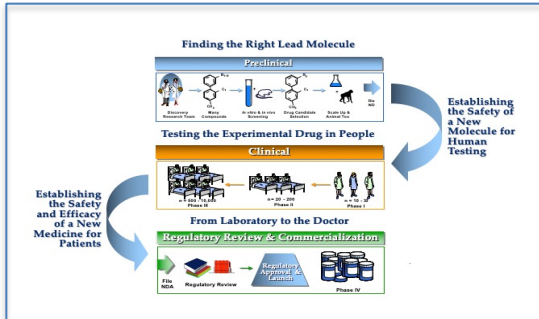
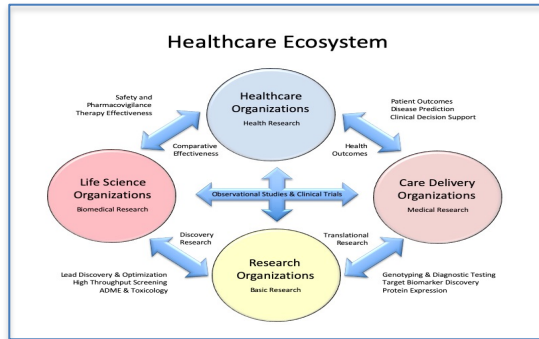


We've seen the impact of enabling technology in accelerating drug discovery and development. AI enabled collaboration offers the promise of improving labeling and market access, leveraging the depth of knowledge across all ecosystem stakeholders, and ensuring knowledge sharing and collaboration among them. The Covid-19 Open Research Dataset (CORD-19) Initiative is a great example of AI enabled search and discovery, question answering, augmented synthesis and visualization of over 1 million scholarly articles associated with Covid-19, SARS-Cov-2, and related coronaviruses.

COVID Research (CORD-19) at: https://maksimekin.github.io/COVID19-Literature-Clustering/plots/t-sne_covid-19_interactive.html

Wang et.al., CORD-19: The COVID-19 Open Research Dataset, Semantic Scholar, 2020

Opportunities and Implications



The Language of Business in Pharmaceutical and Life Sciences

INDUSTRY TRENDS AND DIRECTIONS

Dr. Chris Asakiewicz

STEVENS
INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY

Language of Business Series at: <https://sit.instructure.com/courses/47774/modules>



STEVENS
INSTITUTE *of* TECHNOLOGY
THE INNOVATION UNIVERSITY®



Christopher J. Asakiewicz, PhD.
Professor and Program Director Business Intelligence and Analytics

Director of the Stevens Alliance for Innovation and Leadership (S.A.I.L.)

Stevens Institute of Technology
School of Business
Castle Point on Hudson
Hoboken, New Jersey 07030

Email: Christopher.Asakiewicz@stevens.edu

Web: www.drchrisasakiewicz.com

Phone: (201) 216-8012

President
IT Strategy and Management Consulting, LLC
65 Millbrook Road
New Vernon, NJ 07976

Adjunct Professor
Robert Wood Johnson Medical School
University of Medicine and Dentistry of New Jersey
125 Paterson Street
New Brunswick, NJ 08901

Vice President – Retired
Pfizer, Global Business Technology
235 East 42nd Street
New York, NY, 10017

A senior management professional with strategic background in Business Technology Management, Information Technology, Consulting and Education with a 21-year history as a Vice President of Global Business Technology at Pfizer. Chris has done pioneering work in the areas of Knowledge Mining and its application within Life Sciences, most notably as a means of accelerating Translational Research. His research and teaching interests include: Cognitive Systems; Healthcare Analytics. Enterprise-level Application, Information, and Business Process Rationalization; as well as Talent, Skill, and Capability Development.

Chris' current IT strategy and management consulting engagements have been with major life sciences firms, healthcare organizations, and disease foundations, helping them in integrating major IT-enabled business processes, assessing and managing the risks associated with major change efforts, and assisting in the establishment of a biobank and collaborative environment to support rare disease research.

Over the years, his work has helped IT organizations in their effort to reduce costs, to increase productivity, and along with their business partners, to more effectively develop and deploy scalable and innovative business solutions. Before retiring from Pfizer, Chris was Vice President of Pfizer's Global Pharmaceutical Division where he led the Global Business Technology Group for Drug and Regulatory Affairs, World-wide Safety, Medical and Scientific Affairs, Clinical Data Operations, Outcomes, Clinical Development, and Product Development.