CSCE 240: Advanced Programming Techniques

Lecture 24: Intro to AI / ML/ DL

PROF. BIPLAV SRIVASTAVA, AI INSTITUTE

4TH APRIL 2024

Carolinian Creed: "I will practice personal and academic integrity."

Credits: Some material reused with permission of Dr. Jeremy Lewis. Others used as cited with thanks.

Organization of Lecture 24

- Introduction Section
  - Recap of Lecture 23
- Main Section
  - Concept: AI as decision support tool
  - Concept: ML and DL
  - Perspective: Successful AI, AI for Society
  - Concept: AI in Software Development
  - Task: HW 6 – due next class
  - Task: Project – PA #6 starts
- Concluding Section
  - About next lecture – Lecture 25
  - Ask me anything

Introduction Section

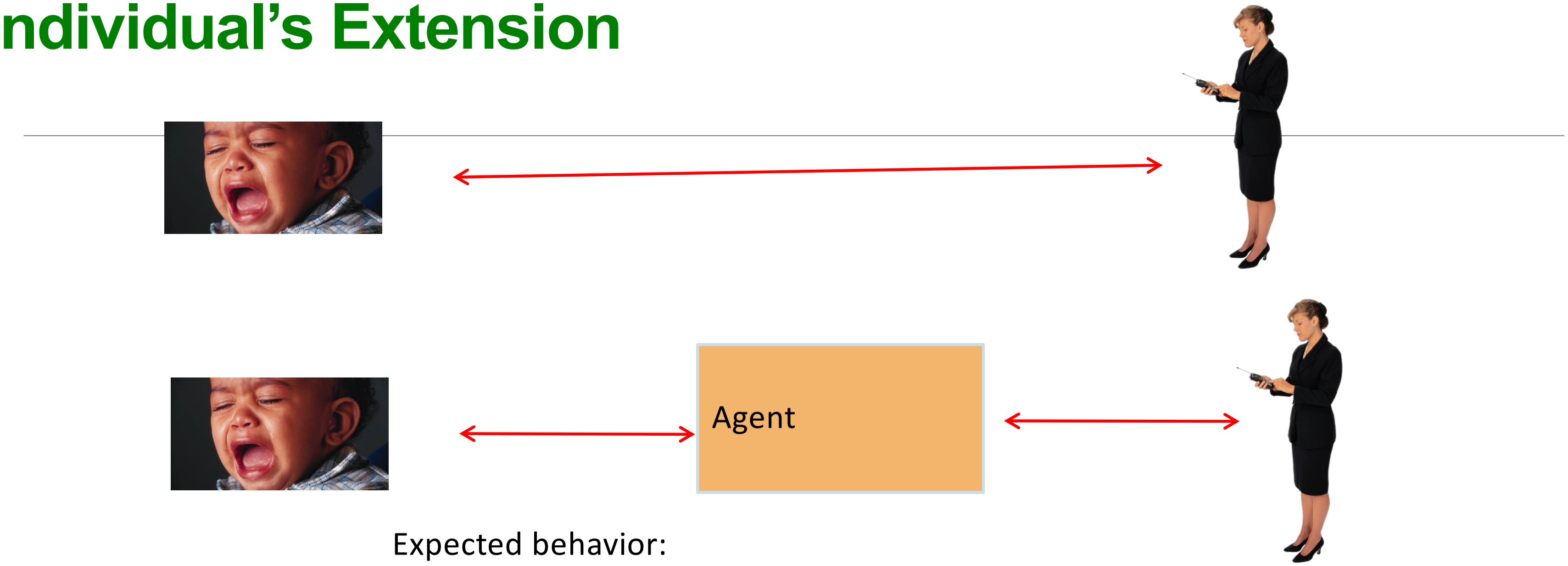
Recap of Lecture 23

- Programming practice for project assignments based on PA#4
- We discussed
  - Templates
  - Class templates
  - Functional templates
- PA#5 is due today

Main Section

Concept: AI

Example: Taking Care of a Baby
Individual’s Extension



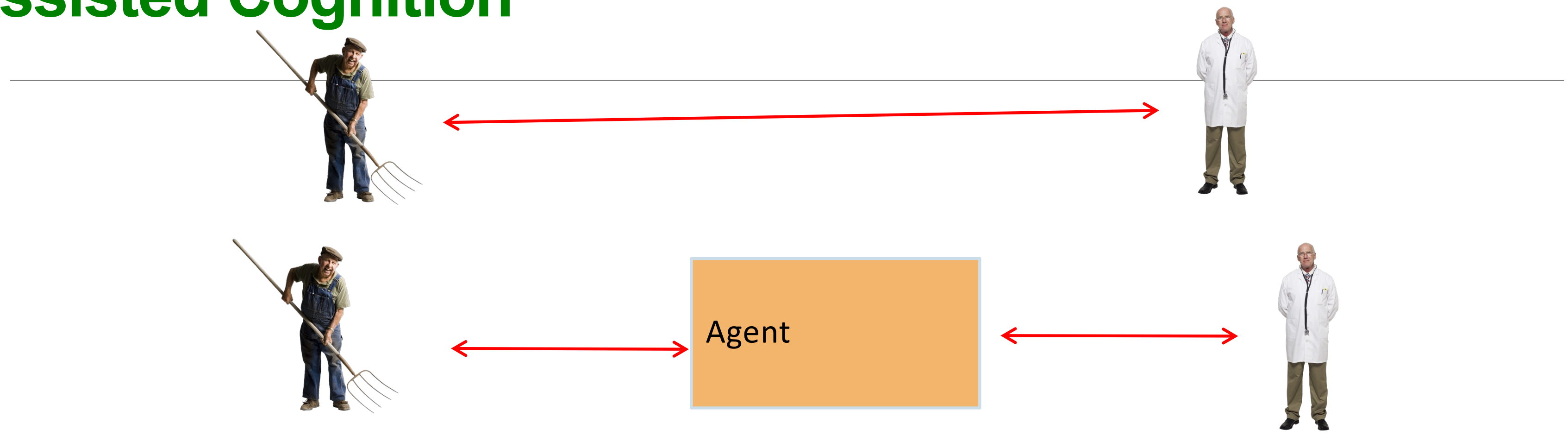
Expected behavior:

- Inform
  - Alert when crying
  - Alert when awake
  - Alert when idle
- Do
  - Raise temperature of room
  - Play music
  - …

Conditions can be

- input and **reasoned** (**e.g. rule-based methods**) OR
- **learned (from data)**

Example: Taking Care of a Senior
Assisted Cognition

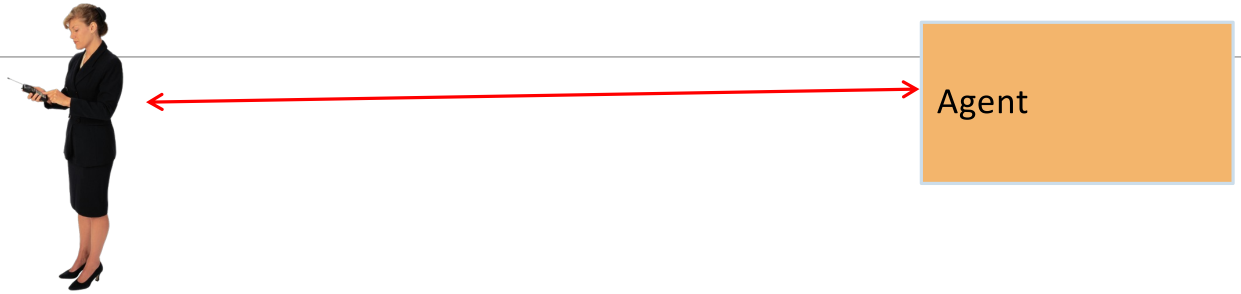


Agent

Expected behavior:

- Inform
  - Alert when idle
  - Alert when away from known locations
  - Alert when checkup/ medicines due
- Do
  - Send body parameters periodically
  - …

Example: Taking Care of Oneself
Personal Digital Assistants



Agent

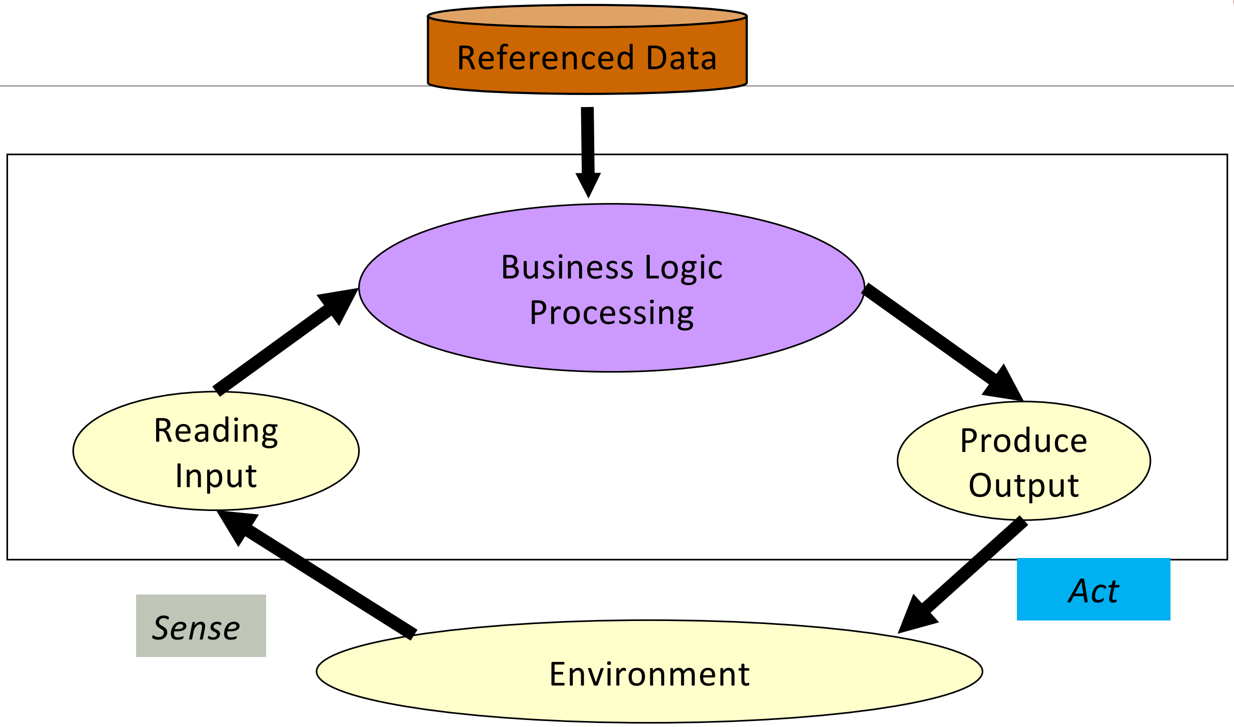
Expected behavior:

- Inform
  - When missing meetings
  - When missing social commitments
  - Reminding of priorities
  - …
- Do
  - Make all cancellations / re-bookings when schedule changes
  - Find alternatives to current decisions and give choices (e.g., traffic)
  - …

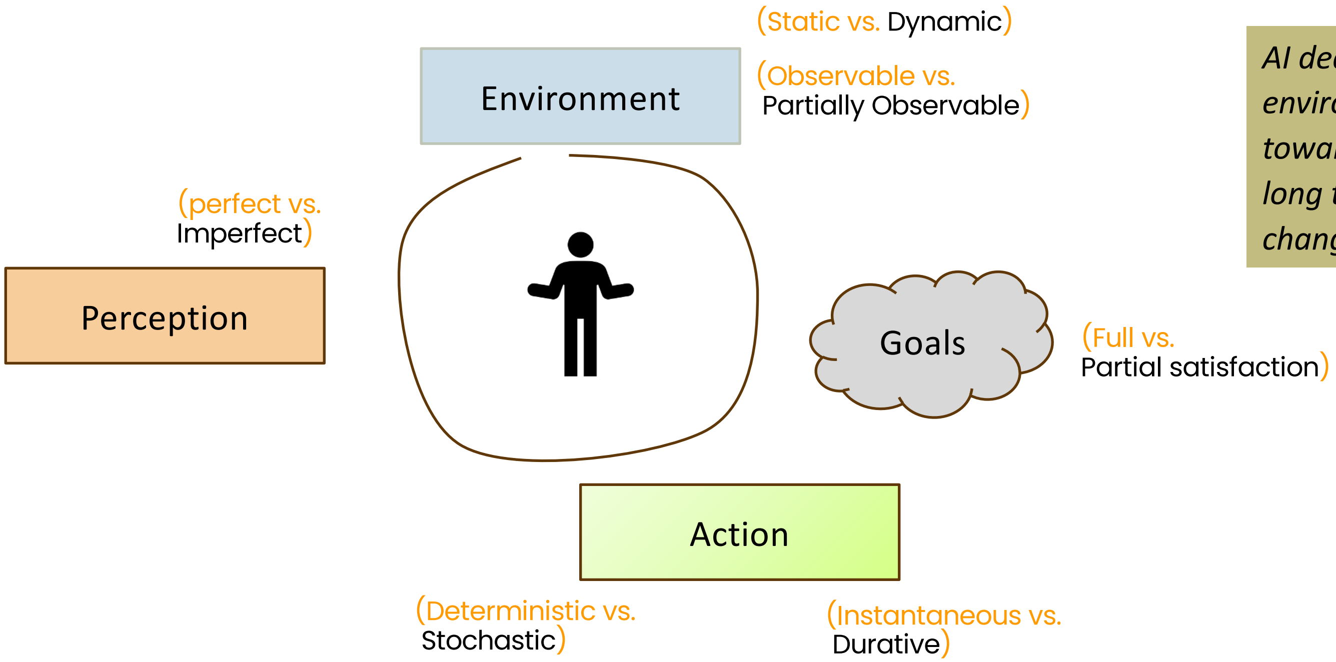
AI => Adaptive/ Intelligent

Software System

- Business Logic Moves to Declarative Data (policy)
- Software is more resilient to changes in environment



Intelligent Agent Model



Environment

(Static vs. Dynamic)

(Observable vs. Partially Observable)

(perfect vs. Imperfect)

Perception

Goals

(Full vs. Partial satisfaction)

Action

(Deterministic vs. Stochastic)

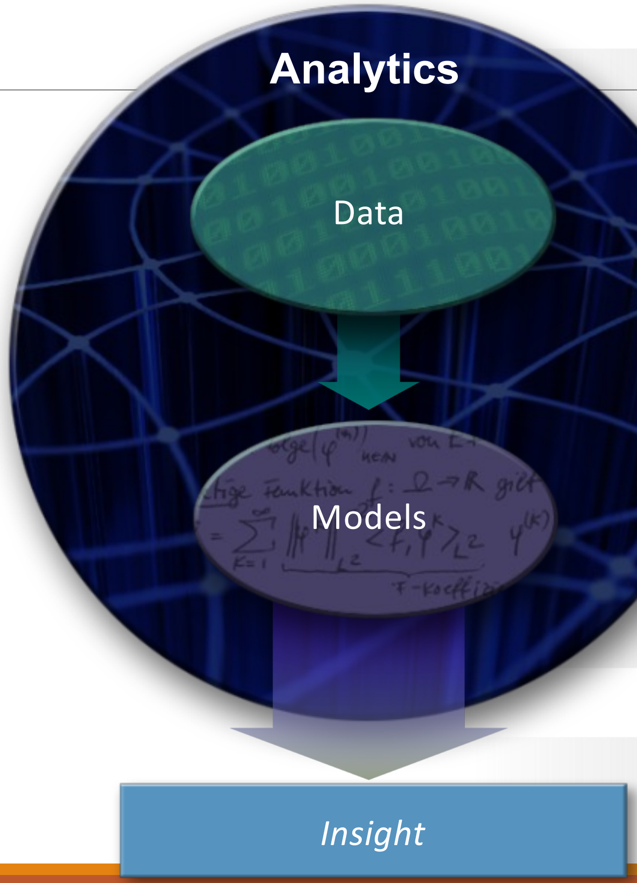
(Instantaneous vs. Durative)

AI deals with perceiving the environment and taking actions towards short- and long term goals as the world changes over time.

Concept: ML and DL

Advanced AI Techniques (Analytics) like Reasoning & Machine Learning

make use of data and models to provide insight to guide decisions

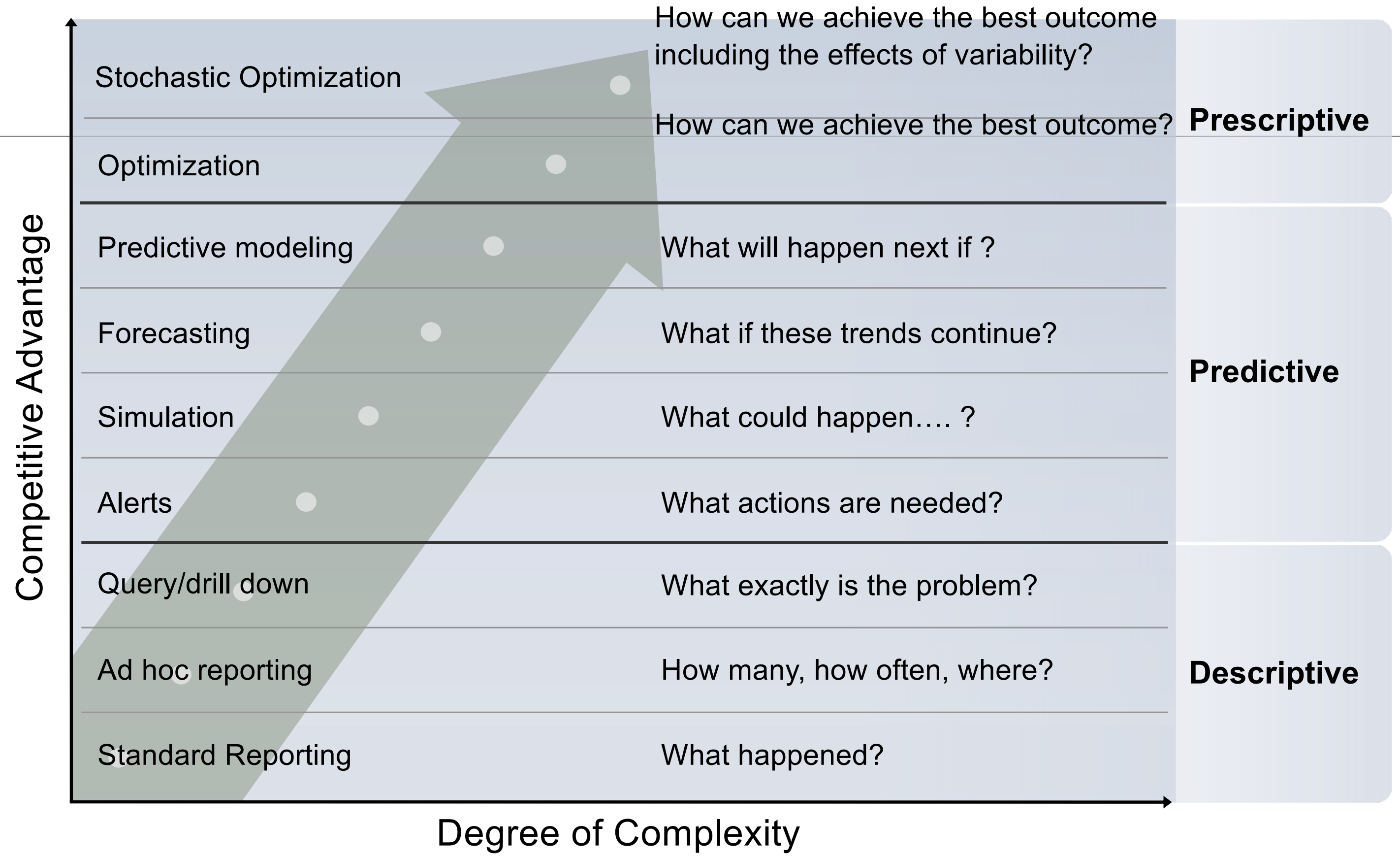


Data sources:
Business automation
Instrumentation
Sensors
Web 2.0
Expert knowledge
"real world physics"

Model:
a mathematical or algorithmic representation of reality intended to explain or predict some aspect of it

Decision executed automatically or by people

Analytics Landscape



Stochastic Optimization	How can we achieve the best outcome including the effects of variability?	Prescriptive
Optimization	How can we achieve the best outcome?	
Predictive modeling	What will happen next if ?	Predictive
Forecasting	What if these trends continue?	
Simulation	What could happen…. ?	
Alerts	What actions are needed?	
Query/drill down	What exactly is the problem?	Descriptive
Ad hoc reporting	How many, how often, where?	
Standard Reporting	What happened?	

Based on: Competing on Analytics, Davenport and Harris, 2007

Example: Adv Prog Course (CSCE 240)

Are they useful? (Descriptive)

- Answering needs an assessment about the past courses

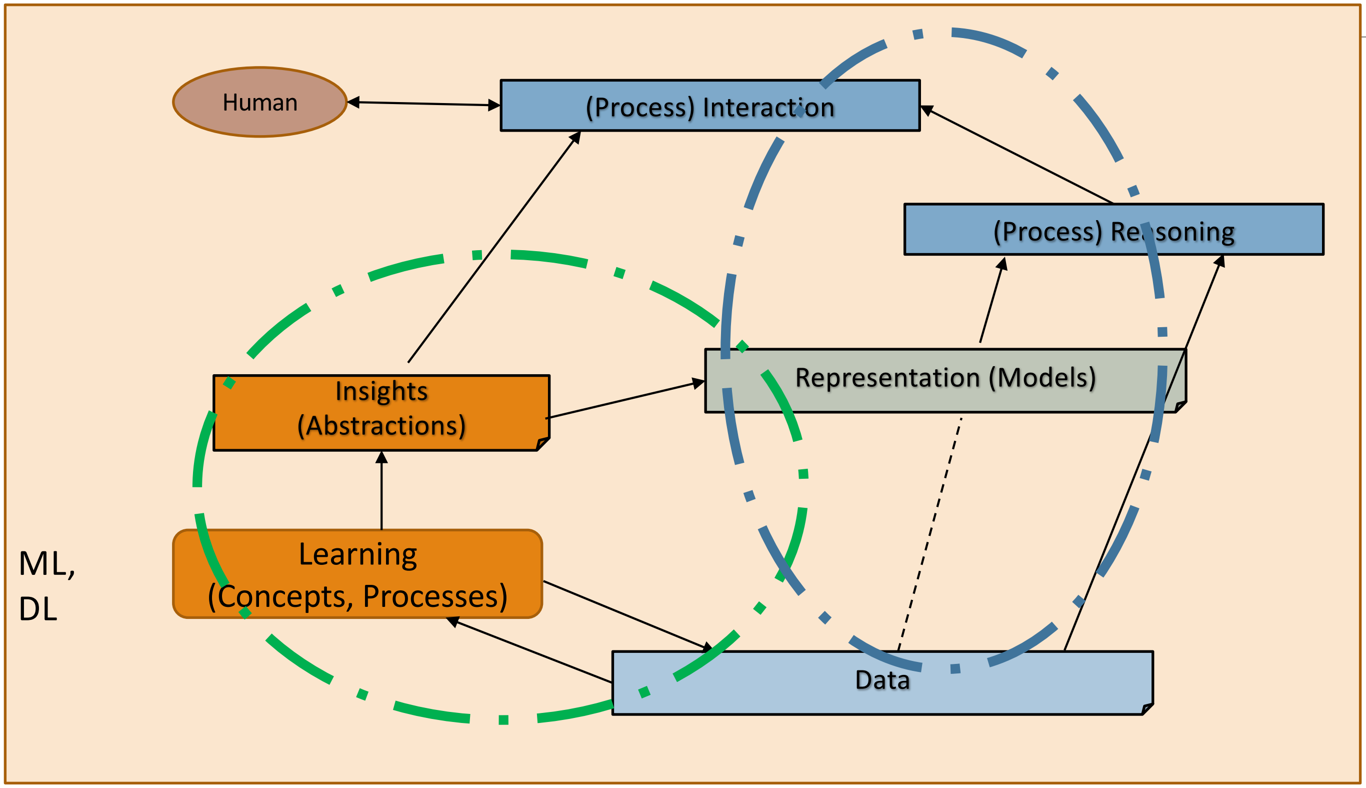
If it happens next time, how many will attend? (Predictive)

- Above + Answering needs an assessment about unknowns (e.g., future of prog. language)

Should you attend? (Prescriptive)

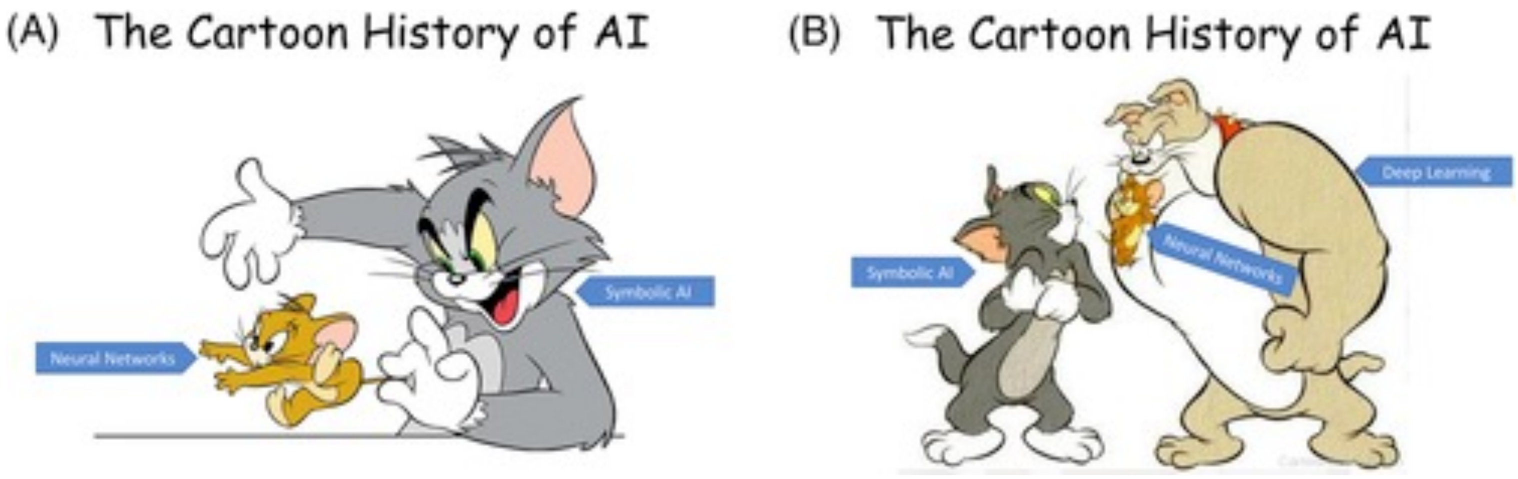
- Above + Answering needs understanding the goals and current status of the individual

Slew of AI Methods



Reasoning

AI: Symbolic, ML, DL



(A) The Cartoon History of AI

(B) The Cartoon History of AI

Image credit: https://onlinelibrary.wiley.com/doi/full/10.1002/aaai.12036

Perspective: Successful AI, AI for Society

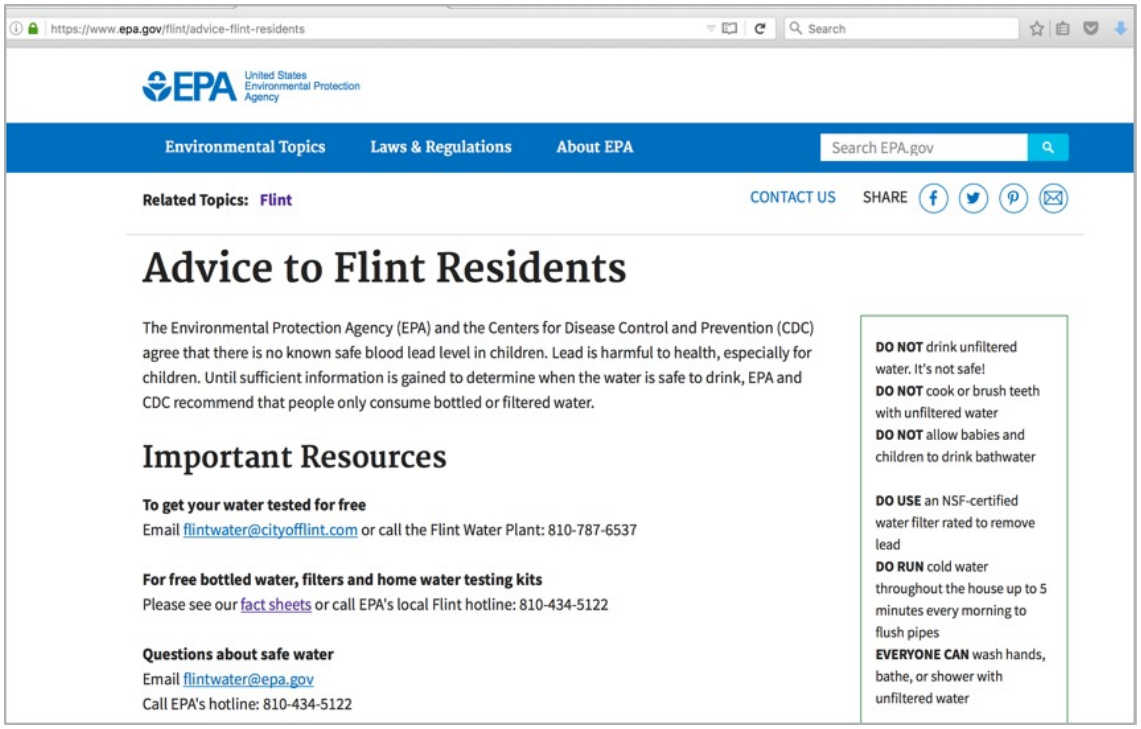
Before and After: Decision Support

Today's tools: Static, non-interactive, non-contextual, lack explanations

Future tools: Dynamic to data, interactive, contextual, explaining with data, anywhere, multi-modal, social (group dependency), societally relevant, …

Future has potential to improve people's lives, promote well-being and reduce waste

Water Information to People: Static and Post-Facto Advisories (US)


https://www.epa.gov/flint/advice-flint-residents
Search
EPA United States Environmental Protection Agency
Environmental Topics
Laws & Regulations
About EPA
Search EPA.gov
CONTACT US
SHARE

Related Topics: Flint

Advice to Flint Residents

The Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention (CDC) agree that there is no known safe blood lead level in children. Lead is harmful to health, especially for children. Until sufficient information is gained to determine when the water is safe to drink, EPA and CDC recommend that people only consume bottled or filtered water.

Important Resources

To get your water tested for free
Email flintwater@cityofflint.com or call the Flint Water Plant: 810-787-6537

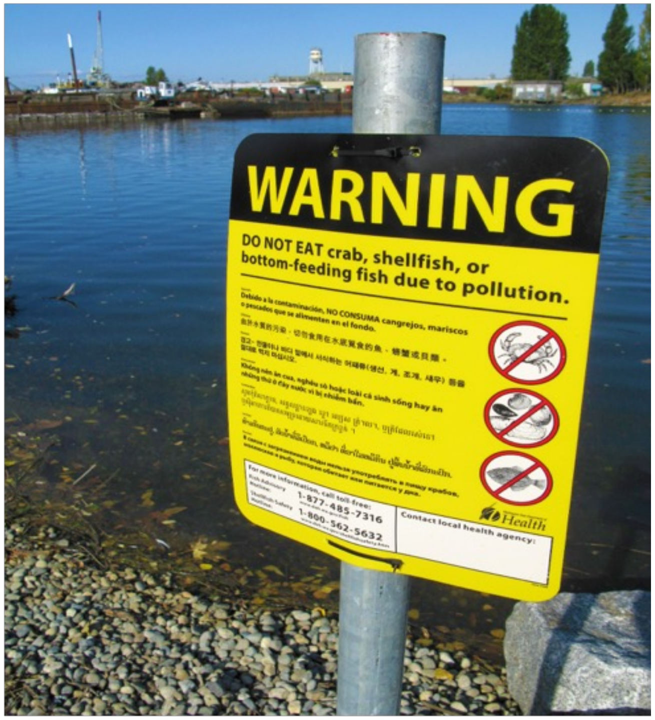
For free bottled water, filters and home water testing kits
Please see our fact sheets or call EPA's local Flint hotline: 810-434-5122

Questions about safe water
Email flintwater@epa.gov
Call EPA's hotline: 810-434-5122

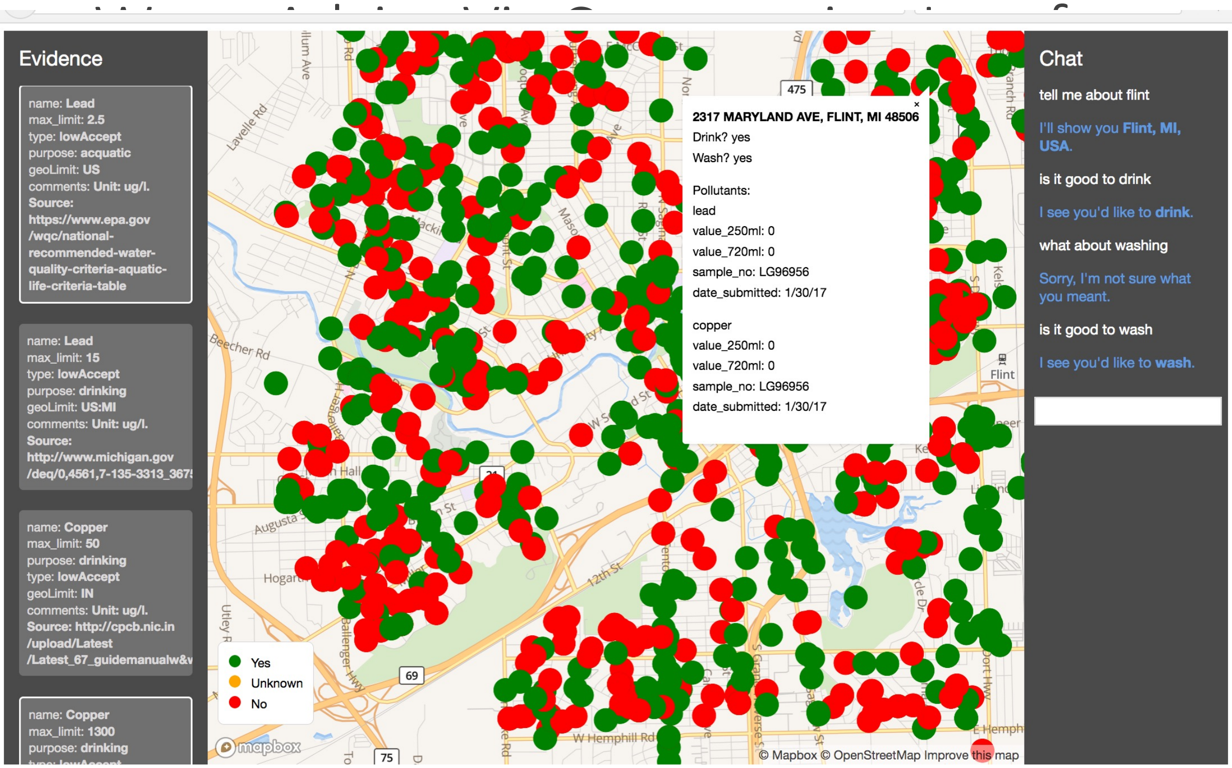
DO NOT drink unfiltered water. It's not safe!
DO NOT cook or brush teeth with unfiltered water
DO NOT allow babies and children to drink bathwater

DO USE an NSF-certified water filter rated to remove lead
DO RUN cold water throughout the house up to 5 minutes every morning to flush pipes
EVERYONE CAN wash hands, bathe, or shower with unfiltered water

Advisories to public for Flint Residents, MI, USA


WARNING
DO NOT EAT crab, shellfish, or bottom-feeding fish due to pollution.
Debido a la contaminación, NO CONSUMA cangrejos, mariscos o pescados que se alimenten en el fondo.
For more information, call toll-free:
Fish Advisory Hotline: 1-877-485-7316
Shellfish Safety Hotline: 1-800-562-5632
Contact local health agency:
Health

Physical signage at a lake in Washington, USA



Evidence

name: **Lead**
max_limit: **2.5**
type: **lowAccept**
purpose: **acquatic**
geoLimit: **US**
comments: **Unit: ug/l.**
Source:
https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

name: **Lead**
max_limit: **15**
type: **lowAccept**
purpose: **drinking**
geoLimit: **US:MI**
comments: **Unit: ug/l.**
Source:
http://www.michigan.gov/deq/0,4561,7-135-3313_367

name: **Copper**
max_limit: **50**
purpose: **drinking**
type: **lowAccept**
geoLimit: **IN**
comments: **Unit: ug/l.**
Source: http://cpcb.nic.in/upload/Latest/Latest_67_guidemanualw&v

name: **Copper**
max_limit: **1300**
purpose: **drinking**

2317 MARYLAND AVE, FLINT, MI 48506

Drink? yes

Wash? yes

Pollutants:

lead

value_250ml: 0

value_720ml: 0

sample_no: LG96956

date_submitted: 1/30/17

copper

value_250ml: 0

value_720ml: 0

sample_no: LG96956

date_submitted: 1/30/17

Chat

tell me about flint

I'll show you **Flint, MI, USA**.

is it good to drink

I see you'd like to **drink**.

what about washing

Sorry, I'm not sure what you meant.

is it good to wash

I see you'd like to **wash**.

Video: https://www.youtube.com/watch?v=z4x44sxC3zA

Paper: Jason Ellis, Biplav Srivastava, Rachel Bellamy and Andy Aaron, Water Advisor - A Data-Driven, Multi-Modal, Contextual Assistant to Help with Water Usage Decisions, AAAI 2018. [Demonstration paper].

AI-Based Decision-Support for COVID-19

- Understanding the disease
  - Disease spread and simulation models
  - Insights by visualization
- Tackling the disease
  - Tracking people’s movement
  - Fever detection via images
  - Understanding mental depression from social posts
  - Fighting fake news
- Understanding impact
  - Economic – job loss, industrial growth
  - Supply Chain
  - Risks

- Individual actions
  - *Screening/ triage tools*
- Group actions
  - *Models for how to open economy*
  - *Contact tracing*
  - *Matching producers and consumers: food, medical supplies*
- Policy actions
  - *Understanding impact of policy choices (e.g. lockdowns, travel restrictions)*
  - *Design of economic interventions*

Resource: https://github.com/biplav-s/covid19-info/wiki/AI-and-COVID-19

Discussion

Concept: AI in Software Development (Testing Focus)

AI for Code Generation

Co-Pilot: https://copilot.github.com/

"GitHub Copilot is an AI pair programmer that helps you write code faster and with less work. GitHub Copilot draws context from comments and code, and suggests individual lines and whole functions instantly. GitHub Copilot is powered by OpenAI Codex, a new AI system created by OpenAI. The GitHub Copilot technical preview is available as an extension for Visual Studio Code, Neovim, and the JetBrains suite of IDEs."

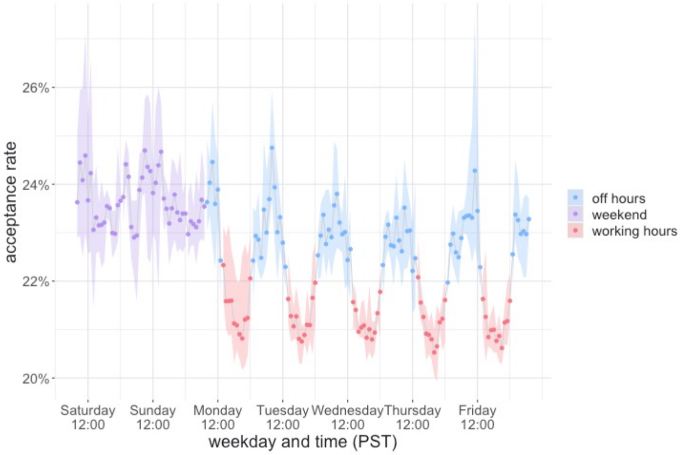
Impact of CoPilot on Productivity

Credit: Measuring GitHub Copilot's Impact on Productivity, CACM 2024

https://cacm.acm.org/research/measuring-github-copilots-impact-on-productivity/

AI pair-programming tools such as GitHub Copilot have a big impact on developer productivity. This holds for developers of all skill levels, with junior developers seeing the largest gains.

- The reported benefits of receiving AI suggestions while coding span the full range of typically investigated aspects of productivity, such as task time, product quality, cognitive load, enjoyment, and learning.
- Perceived productivity gains are reflected in objective measurements of developer activity.
- While suggestion correctness is important, the driving factor for these improvements appears to be not correctness as such, but whether the suggestions are useful as a starting point for further development.



Average acceptance rate during the week. Each point represents the average for a one-hour period, whereas the shaded ribbon shows the min-max variation during the observed four-week period.

Using github Copilot

Github Copilot - Registering

Setting up your GitHub Student Account
Create a GitHub account: If you don't already have one, create a GitHub account. GitHub account is free, so if you have not signed up yet feel free to sign up as it is a prerequisite before you can access the Student Developer Pack. https://github.com

Verify your student status on GitHub:
Go to the GitHub Student Developer Pack and verify your student status on GitHub: https://education.github.com/pack

Step 1

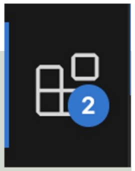
By TA: Rushil T.

Github Copilot - Setup

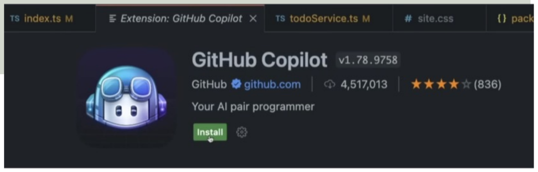
Using github Copilot

Copilot plugin is available in VS code

1. go to the plugin store by clicking on this button:



2. You will need to connect your student verified github account and reload your IDE (integrated development environment) aka VS code
3. You should see 2 plugins when you search “copilot”
    a. github copilot chat: allows you to ask programmatic questions and writes code for you
    b. github copilot: code auto-complete in your IDE
4. Go ahead and install both



GitHub Copilot v1.78.9758

GitHub github.com | 4,517,013 | ★★★★☆ (836)

Your AI pair programmer

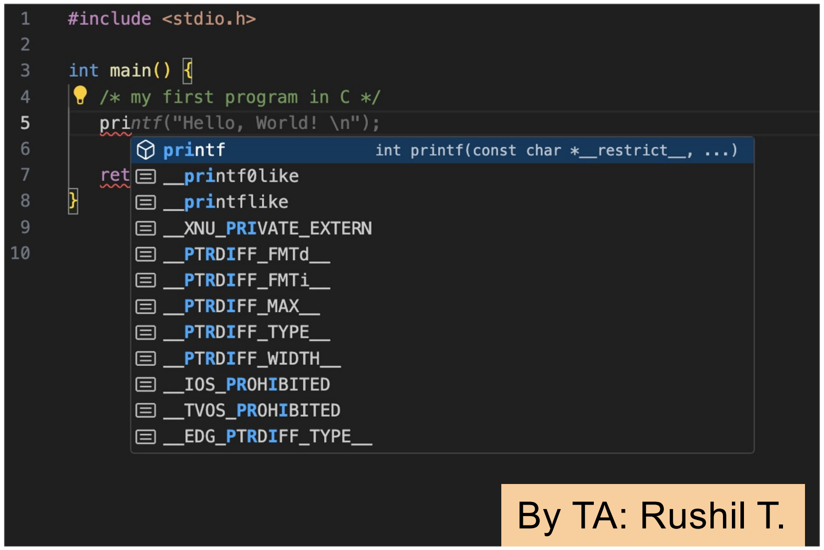
Step 2

By TA: Rushil T.

Using github Copilot

Github Copilot - Usage

Running github Copilot
The regular copilot can be used as you type code, it will give you code suggestions based upon the code that you have already written just click on tab to auto-complete:



```
#include <stdio.h>

int main() {
    /* my first program in C */
    printf("Hello, World! \n");

    ret
}
```

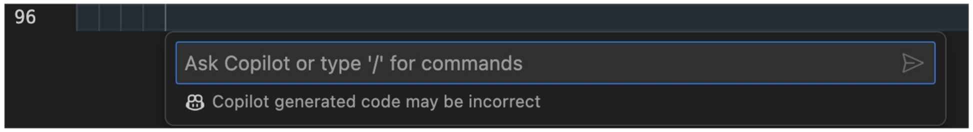
By TA: Rushil T.

Step 3 - the good parts :)

Using github Copilot

Github Copilot - Usage

Running github Copilot
You can also chat inline (while writing code) to ask Copilot to write some specific code for you:
* the command to do this is (command + K then I, or windows + K then I)



Ask Copilot or type '/' for commands

Copilot generated code may be incorrect

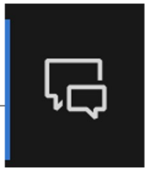
Step 3 - the good parts :)

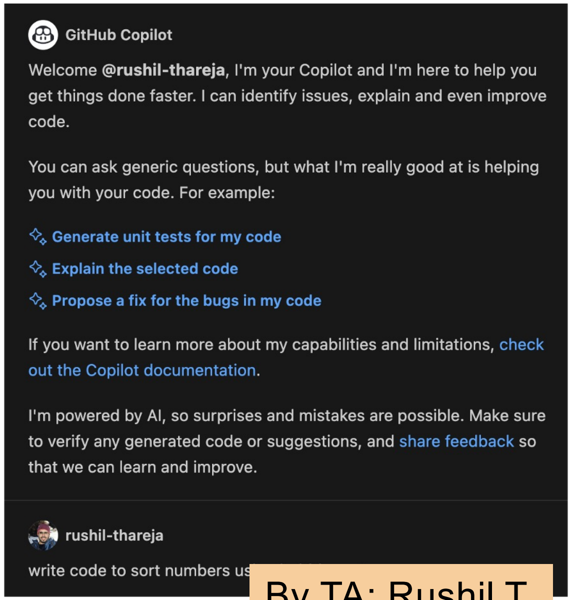
By TA: Rushil T.

Using github Copilot

Github Copilot - Usage

Running github Copilot
To use copilot chat, use the chat icon on the left of your IDE, go ahead and ask questions!





GitHub Copilot

Welcome **@rushil-thareja**, I'm your Copilot and I'm here to help you get things done faster. I can identify issues, explain and even improve code.

You can ask generic questions, but what I'm really good at is helping you with your code. For example:

- **Generate unit tests for my code**
- **Explain the selected code**
- **Propose a fix for the bugs in my code**

If you want to learn more about my capabilities and limitations, check out the Copilot documentation.

I'm powered by AI, so surprises and mistakes are possible. Make sure to verify any generated code or suggestions, and share feedback so that we can learn and improve.

rushil-thareja

write code to sort numbers us

By TA: Rushil T.

Step 3 - the good parts :)

AI *for* Testing

- AI for testing
  - Test case and data generation
  - "Value" based testing

- Sample of work
  - **Blogs**: https://www.perfecto.io/blog/ai-in-software-testing ; https://www.testingxperts.com/blog/AI-in-Software-Testing
  - **Papers**: Artificial Intelligence in Software Test Automation: A Systematic Literature Review, Anna Trudova, Michal Dolezel, Alena Buchalcevová, Published in ENASE 2020, https://www.semanticscholar.org/paper/Artificial-Intelligence-in-Software-Test-A-Review-Trudova-Dolezel/ccbe24b348194905edeca784776255007 86e55d6;
    T. M. King, J. Arbon, D. Santiago, D. Adamo, W. Chin and R. Shanmugam, "AI for Testing Today and Tomorrow: Industry Perspectives," *2019 IEEE International Conference On Artificial Intelligence Testing (AITest)*, 2019, pp. 81-88, doi: 10.1109/AITest.2019.000-3.

Testing *for* AI

- Papers
  - A. Aggarwal, S. Shaikh, S. Hans, S. Haldar, R. Ananthanarayanan and D. Saha, "Testing Framework for Black-box AI Models," *2021 IEEE/ACM 43rd International Conference on Software Engineering: Companion Proceedings (ICSE-Companion)*, 2021, pp. 81-84, doi: 10.1109/ICSE-Companion52605.2021.00041. **Video**: https://youtu.be/984UCU17YZI
  - Machine Learning Testing: Survey, Landscapes and Horizons, Jie M. Zhang, Mark Harman, Lei Ma, Yang Liu, https://arxiv.org/abs/1906.10742, 2019
  - Software Engineering for AI-Based Systems: A Survey, Silverio Martínez-Fernández, Justus Bogner, Xavier Franch, Marc Oriol, Julien Siebert, Adam Trendowicz, Anna Maria Vollmer, Stefan Wagner, https://arxiv.org/abs/2105.01984, 2021

What is AI Being Tested For?

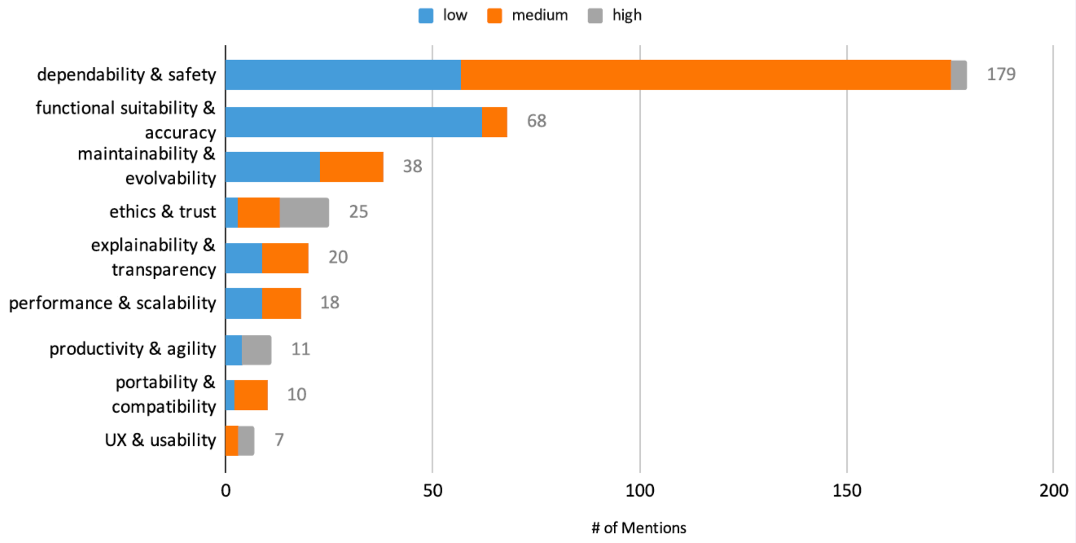


Fig. 16. Frequency of quality goals per thematic cluster and level of abstraction.

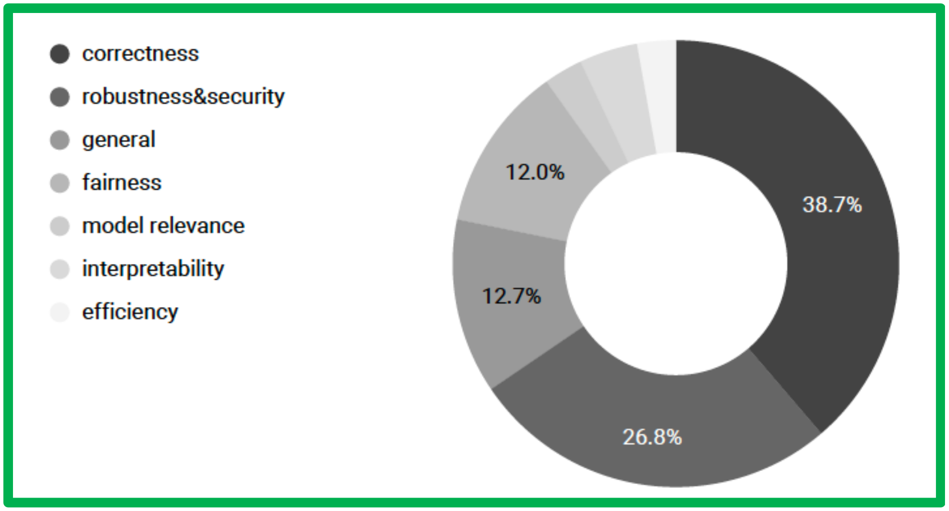


Figure Source: Software Engineering for AI-Based Systems: A Survey, Silverio Martínez-Fernández, Justus Bogner, Xavier Franch, Marc Oriol, Julien Siebert, Adam Trendowicz, Anna Maria Vollmer, Stefan Wagner, https://arxiv.org/abs/2105.01984, 2021

Figure Source: Machine Learning Testing: Survey, Landscapes and Horizons, Jie M. Zhang, Mark Harman, Lei Ma, Yang Liu, https://arxiv.org/abs/1906.10742, 2019

Concept: Problems with AI

An Unstable Collaboration

Human over AI

- Common AI tools for image, speech and text tools (translators)
- Vehicles: Cruise control, Park Assist

AI over Human

- Self parking of car*
- Automated trading*
- Cognitive biases in human decision making**

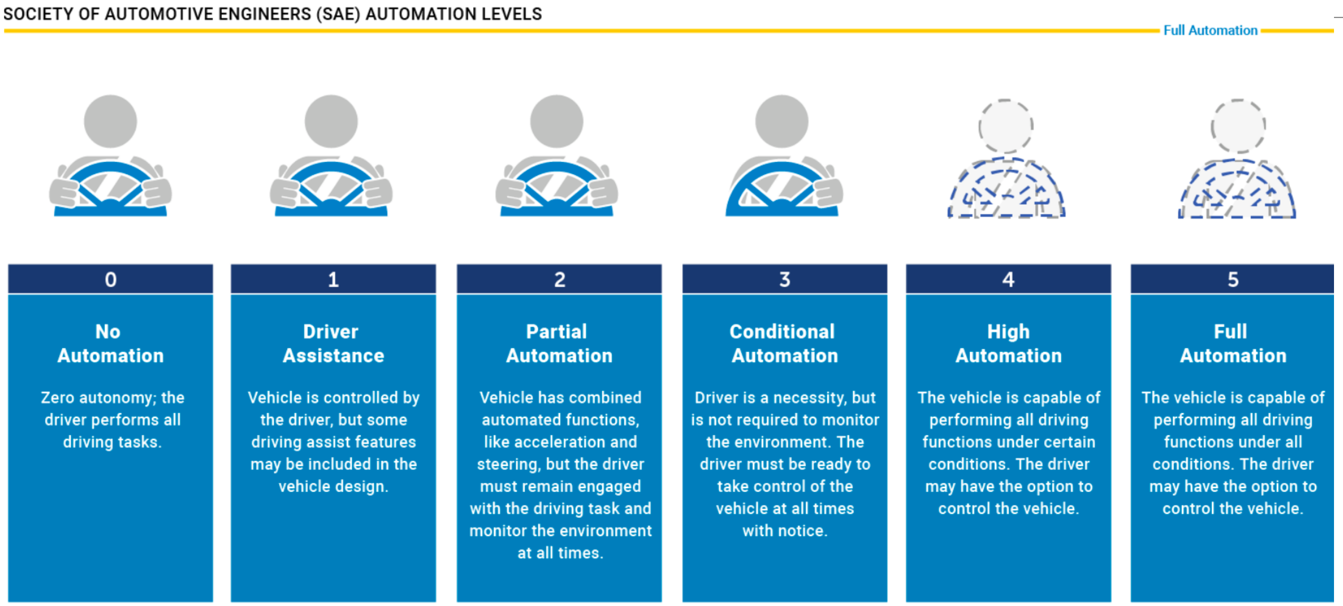
Objection: *When have humans liked control over them?*

Human and AI as equal collaborators is ambiguous

What does this mean in a practical sense ? No clear answer.

- ***Human AI Collectives**, By N. R. Jennings, L. Moreau, D. Nicholson, S. Ramchurn, S. Roberts, T. Rodden, A. Rogers, Communications of the ACM, December 2014, Vol. 57 No. 12, Pages 80-88, 10.1145/2629559, https://cacm.acm.org/magazines/2014/12/180791-human-agent-collectives/fulltext
- **** Thinking, Fast and Slow** by Daniel Kahneman, https://en.wikipedia.org/wiki/Thinking,_Fast_and_Slow

Misleading Levels of Automation for Vehicles



SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Sources:

- SAE: https://www.nhtsa.gov/technology-innovation/automated-vehicles
- * Consumer Report: https://www.consumerreports.org/autonomous-driving/levels-of-car-automation/

Questions:

- What is the problem being solved?
- Are humans ready to take over?

  Recall the case when humans were not ready to take over?
  ***Hint**: A flying vehicle with professional drivers!*

- Are you the **driver**, or are you a **passenger** in a self-driving car?*

Fear:

- Getting away with incompetence?
- Getting away with murder!

Instability of AI is Well Recorded

[Text] Su Lin Blodgett, Solon Barocas, Hal Daumé III, Hanna Wallach, Language (Technology) is Power: A Critical Survey of "Bias" in NLP, Arxiv - https://arxiv.org/abs/2005.14050, 2020 [NLP Bias]

[Image] Vegard Antun, Francesco Renna, Clarice Poon, Ben Adcock, and Anders C. Hansen, On instabilities of deep learning in image reconstruction and the potential costs of AI, https://doi.org/10.1073/pnas.1907377117, PNAS, 2020

[Audio] Allison Koenecke, Andrew Nam, Emily Lake, Joe Nudell, Minnie Quartey, Zion Mengesha, Connor Toups, John R. Rickford, Dan Jurafsky, and Sharad Goel, Racial disparities in automated speech recognition, PNAS April 7, 2020 117 (14) 7684-7689, https://doi.org/10.1073/pnas.1915768117, March 23, 2020

References for AI

Textbook

- AI – A Modern Approach (AIMA), S. Russell & P. Norvig, http://aima.cs.berkeley.edu/

Tools and demos

- Code sample in AIMA book
- Learning tools and model libraries
  - https://ai.google/tools/
  - Watson library: https://www.ibm.com/watson/products-services/
  - Exciting startups: https://www.prowler.io/
  - Interchange standards: https://onnx.ai/

Articles and Papers

- New York Time, AI Special Issues, *https://www.nytimes.com/spotlight/artificial-intelligence, April 2020*
- McKinsey, Notes from the AI Frontier modeling the impact of AI on the world economy, https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economy, 2018
- Henry A. Kautz, The third AI summer: AAAI Robert S. Engelmore Memorial, 2022, https://onlinelibrary.wiley.com/doi/full/10.1002/aaai.12036
- Biplav Srivastava, Understanding AI and Cognitive Systems – a Perspective on Its Potential and Challenges While Putting Them to Work with People, AI & Cognitive Systems, Issue 4, Vol 2- Issue 1, 2018.

Home Work 6

Due Thursday, April 9, 2024

Home Work (#6) – C++ - Understand Code Optimization

- Consider BubbleSort algorithm for sorting (shown on right)
- Processing
  1. Generate n random numbers – called S
  2. (Store and Sort as Array)
     1. Store the numbers of S in an array: allocated with size n at the start
     2. **Sort using Bubble Sort**
  3. (Store and Sort as Vector)
     1. Store the numbers of S in a vector: allocated with size 1 and size increased one by one number until n
     2. Sort using Bubble Sort
  4. Measure time difference in both cases with n = 100, 1,000, 10,000, 100,000
- Output
  1. Make a graph showing any difference in timing
  2. Check the sorted results and confirm they are same (write a validator code to check)
  3. Document which one is your validation code

Algo 3 (BubbleSort):

```
• current_array = a = Input
• For (i=0; i<N-1; i++) {
    • For (j=(i+1); j<N; j++) {
        • If(a[i] > a[j])
            • Swap(a[i], a[j])
    • }
• }
• Return current_array
```

Example invocation

```
> SortN Bubble 1000
Time for array: 1 sec
Time for vector: 2 sec
Result_checked: True
```

Home Work (#6) – C++ - Understand Code Optimization

- Consider BubbleSort algorithm for sorting (shown on right)
- Processing
  1. Generate n random numbers – called S
  2. (Store and Sort as Array)
     1. Store the numbers of S in an array: allocated with size n at the start
     2. **Sort using C++ Standard library's sort**
  3. (Store and Sort as Vector)
     1. Store the numbers of S in a vector: allocated with size 1 and size increased one by one number until n
     2. Sort using Bubble Sort
  4. Measure time difference in both cases with n = 100, 1,000, 10,000, 100,000
- Output
  1. Make a graph showing any difference in timing
  2. Check the sorted results and confirm they are same (write a validator code to check)
  3. Document which one is your validation code

See:
https://en.cppreference.com/w/cpp/algorithm/sort

Example invocation

> ***SortN Standard*** 1000
Time for array: 1 sec
Time for vector: 2 sec
Result_checked: True

Summary

- Program name: ***SortN***
  - Parameters: Bubble, Standard
- Test with: 100, 1,000, 10,000, 100,000
- Memory storage: Vector, Array
- Write a validator code to check result. Document which one is your validation code
- Draw a graph of results.

Discussion: Course Project

Course Project – Knowing About Companies

- **Project**: Develop collaborative assistants (chatbots) that offer useful information about companies
- Specifically, use the EDGAR dataset on companies at: https://www.sec.gov/edgar/searchedgar/companysearch.
  - For Apple, it is: https://www.sec.gov/edgar/browse/?CIK=320193&owner=exclude
- **Each student will choose two companies (from thousand available).**
- Programming assignment programs will: (1) extract data about two companies from 10-k, (2) process it, (3) make content available in a command-line interface, (4) handle any user query and (5) report on interaction statistics.

Core Programs Needed for Project

- Prog 1: extract data from the district **[prog1-extractor]**
- Prog 2: process it (extracted data) based on questions **[prog2processor]**
- Prog 3: make content available in a command-line interface **[prog3-ui]**
- Prog 4: handle any user query **[prog4-userintent2querymapper]**
- Prog 5: report statistics on interaction of a session, across sessions **[prog5-sessionlogger]**

Objective in Programming Assignment # 5:

Record what happens in a chat session and provide summary

- A user may interact with your chatbot for one question or twenty. How did your chatbot do?
- **Record chat your system makes with each user and report on user session as well total usage statistics (since the chatbot was created)**

Approach Suggested

- Under data folder,
  - have a sub-folder called **chat_sessions**
    - When a person starts a chat session (i.e., starts your program and until does not quit), create a file with the “ <data>_<time>.txt” as the name. Save the user’s utterance and the system’s reply there in the order they come. Close this file when the user session ends.
    - Calculate statistics: # user_utterance, #system_utterance and time duration of session
  - have a file called **chat_statistics.csv**.
    - Have a header with columns: S.No, chat_file, # user_utterance, #system_utterance and time taken
    - For each chat file in chat_sessions, there will be a row with the chat statistics you have calculated

Objective in Programming Assignment # 5:

Record what happens in a chat session and provide summary

Approach Suggested

- Under data folder,
  - have a sub-folder called **chat_sessions**
    - When a person starts a chat session (i.e., starts your program and until does not quit), create a file with the " <data>_<time>.txt" as the name. Save the user's utterance and the system's reply there in the order they come. Close this file when the user session ends.
    - Calculate statistics: # user_utterance, #system_utterance and time duration of session
  - have a file called **chat_statistics.csv**.
    - Have a header with columns: S.No, chat_file, # user_utterance, #system_utterance and time taken
    - For each chat file in chat_sessions, there will be a row with the chat statistics you have calculated

- Goal: report statistics on interaction of a session, across sessions [Name: **prog5-sessionlogger**]

- One can invoke it with arguments
  - **prog5-sessionlogger –summary**
    - **There are 12 chats to date with user asking 23 times and system respond 24 times. Total duration is 456 seconds.**
  - **prog5-sessionlogger –showchat-summary 2**
    - **Chat 2 has user asking 2 times and system respond 2 times. Total duration is 4 seconds.**
  - **prog5-sessionlogger –showchat 2**
    - **Chat 2 chat is:**

      …
  - **prog5-sessionlogger –showchat 200**
    - **ERROR: there are only 12 chat sessions. Please choose a valid number.**

Programming Assignment # 5

- Code organization
  - Create a folder in your GitHub called "**prog5-sessionlogger**"
  - Have sub-folders: src (or code), data, doc, test
  - Have data directory as shown in previous slide
    - ./data/**chat_sessions/**
    - ./data/ **chat_statistics.csv**
  - Write a 1-page report in ./doc sub-folder
  - Put a log of system interacting in ./test
  - Send a confirmation that code is done by updating Google sheet; optionally, send email to instructor and TA

- Use concepts learned in class
  - Exceptions
  - File operations
  - Dynamic memory

PA6 – Final Chatbot

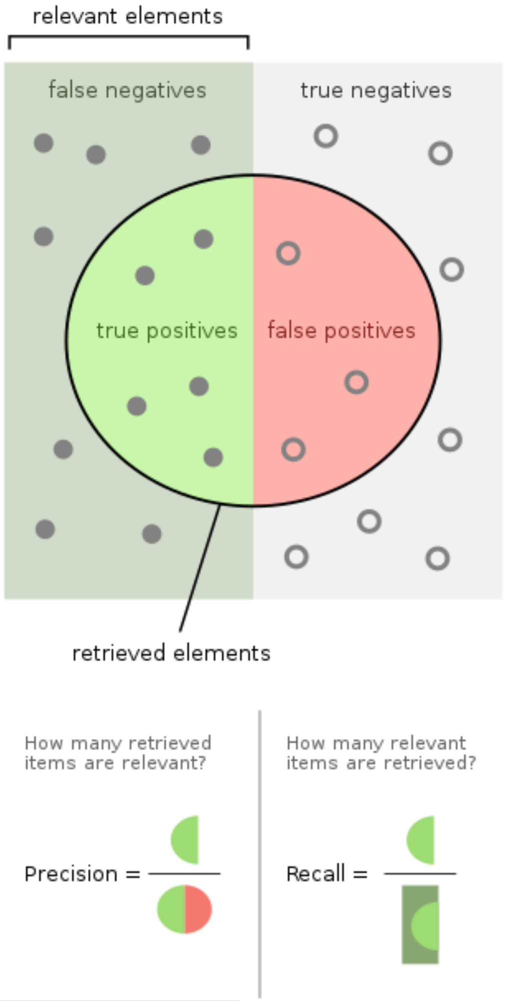
Evaluating a Chatbot's Performance Quantitatively (Information Retrieval)

- Precision:
  (# Correct answers / # answers retrieved) * 100
  // How well correctly answered

- Recall:
  (# Correct answers / # answers stored) * 100
  // How well correctly found

- Combined = F1 score =

$$F = 2 \cdot \frac{\text{precision} \cdot \text{recall}}{\text{precision} + \text{recall}}$$



Credit: https://en.wikipedia.org/wiki/Precision_and_recall

Prog 6: Assembling the Chatbot

- Have a program - **[my-chatbot]**
- User interacts with the chatbot with any utterance and the system has to answer – see right
- User can ask about statistics and query log
  - Same as PA5
  - See next slide

[#1] “Quit” or “quit” or just “q” => Program exits

[#2a]“Tell me about the CEO of IBM”, “Tell me about the the risk factors”

[#2l]“Tell me everything” => Give all information Extracted (Type-I12)

[#3] “What companies do you support for Q/A” => Give list of companies supported

[#4] “Give me your usage stats” => Give chat summary info

[#5] *<User can enter any other text and the program has to handle it>* => “I do not know this information” or
“Here is my guess - ” + <query> + <answer>. “Did I answer correctly ? “

All Queries to be Supported

[#1] “Quit” or “quit” or just “q” => Program exits

[#2a]“Tell me about the CEO of IBM”, “Tell me about the the risk factors”

[#2l]“Tell me everything” => Give all information Extracted (Type-I12)

[#3] “What companies do you support for Q/A” => Give list of companies supported

[#4] “Give me your usage stats” => Give chat summary info

[#5] *<User can enter any other text and the program has to handle it>* => “I do not know this information” or
“Here is my guess - ” + <query> + <answer>. “Did I answer correctly ? “

<u>Chatbot usable in debug mode</u>

my-chatbot –summary
=> There are 12 chats to date with user asking 23 times and system respond 24 times. Total duration is 456 seconds.

- **my-chatbot** –showchat-summary 2=> Chat 2 has user asking 2 times and system
respond 2 times. Total duration is 4 seconds.
- **my-chatbot** –showchat 2
=> Chat 2 chat is:
…
- **my-chatbot** –showchat 200
=> ERROR: there are only 12 chat sessions. Please choose a valid number.

Project – PA#6

- Code organization
  - Create a folder in your GitHub called "**my-chatbot**"
  - Have sub-folders: src (or code), data, doc, test
  - Have data directory as shown in previous slide
    - ./data/**chat_sessions/**
    - ./data/ **chat_statistics.csv**
  - Write a
    - Report in ./doc sub-folder. Credit reuse
    - Create a presentation in ./doc sub-folder
  - Put a log of system interacting in ./test
  - Send a confirmation that code is done by updating Google sheet; optionally, send email to instructor and TA

- Use concepts learned in class
  - Exceptions
  - File operations
  - PA1 to PA5 from yourself or others; credit reuse in Readme, report and presentation

<Student Name> - Project Summary

	Criteria	Information	What Needs to Change to Support Additional Company (Reuse Situation)
1	Companies and 10-k parts supported		
2	How data is extracted and stored		
3	How extracted data is processed, presented		
4	How intent is detected for user utterances		
5	How answer is given/ shown		
6	How statistics of session is calculated		
7	Performance of your chatbot	Quantitative (F1, P, R), Qualitative	
8	Anything unique?		

Sample Output

Due a Day Before Next Class
Monday, April 9, 2024

<Student Name> - Project Summary

Class Diagrams

Due Next Class

Concluding Section

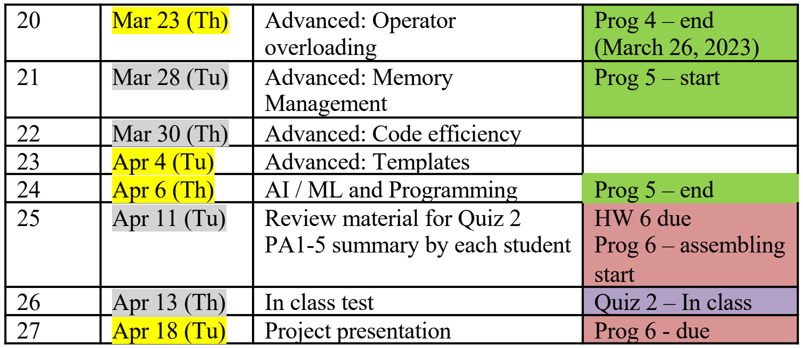
Lecture 24: Concluding Comments

- Concept: AI as decision support tool
- Concept: ML and DL
- Perspective: Successful AI, AI for Society
- Concept: AI in Software Development
- Task: HW 6 – due next class
- Task: Project – PA #6 starts

About Next Lecture – Lecture 25

Lecture 25: Review for Quiz 2

- Review of concepts – student requested
- Project summary due – PA1 to PA6



20	Mar 23 (Th)	Advanced: Operator overloading	Prog 4 – end (March 26, 2023)
21	Mar 28 (Tu)	Advanced: Memory Management	Prog 5 – start
22	Mar 30 (Th)	Advanced: Code efficiency	
23	Apr 4 (Tu)	Advanced: Templates	
24	Apr 6 (Th)	AI / ML and Programming	Prog 5 – end
25	Apr 11 (Tu)	Review material for Quiz 2 PA1-5 summary by each student	HW 6 due Prog 6 – assembling start
26	Apr 13 (Th)	In class test	Quiz 2 – In class
27	Apr 18 (Tu)	Project presentation	Prog 6 - due