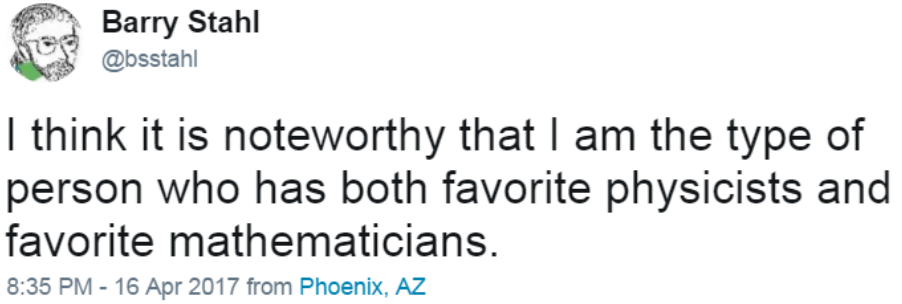
Building AI Solutions
that can reason “why”

BARRY S. STAHL - @BSSTAHL

About Me



Favorite Physicists	Favorite Mathematicians
Harold “Hal” Stahl	Ada Lovelace
Carl Sagan	Alan Turing
Neil Degrasse Tyson	Johannes Kepler
Nikola Tesla	René Descartes
Marie Curie	Isaac Newton
Richard Feynman	Leonardo Fibonacci
Albert Einstein	George Boole

Other notables: Niels Bohr, Galileo Galilei, Michael Faraday, Blaise Pascal, Johann Gauss, Grace Hopper, Stephen Hawking, Marvin Minsky, Daphne Koller, Benoit Mandelbrot, George Dantzig

About Me

https://meetup.com/azgivecamp/

What do I mean by “Artificial Intelligence”?

A Computational System that behaves rationally

1)Makes decisions
2)Attempts to make the best decision
  a)Best available understanding (model)
  b)Best available information (data)
3)May act on those decisions (automation)

Types of AI Models

Logic
- Reducible to conditionals
  - *Object Oriented (everything we've ever done before)*
  - *Rules Engine*

Completely Knowable

Probabilistic/Learning
- Results in a prediction of best solution often derived from earlier data
  - *Neural/Bayesian Networks*
  - *Genetic Algorithms*

Search/Optimization
- Based on reducing and searching the *Solution Space*
  - *Dynamic Programming*
  - *Linear Programming*

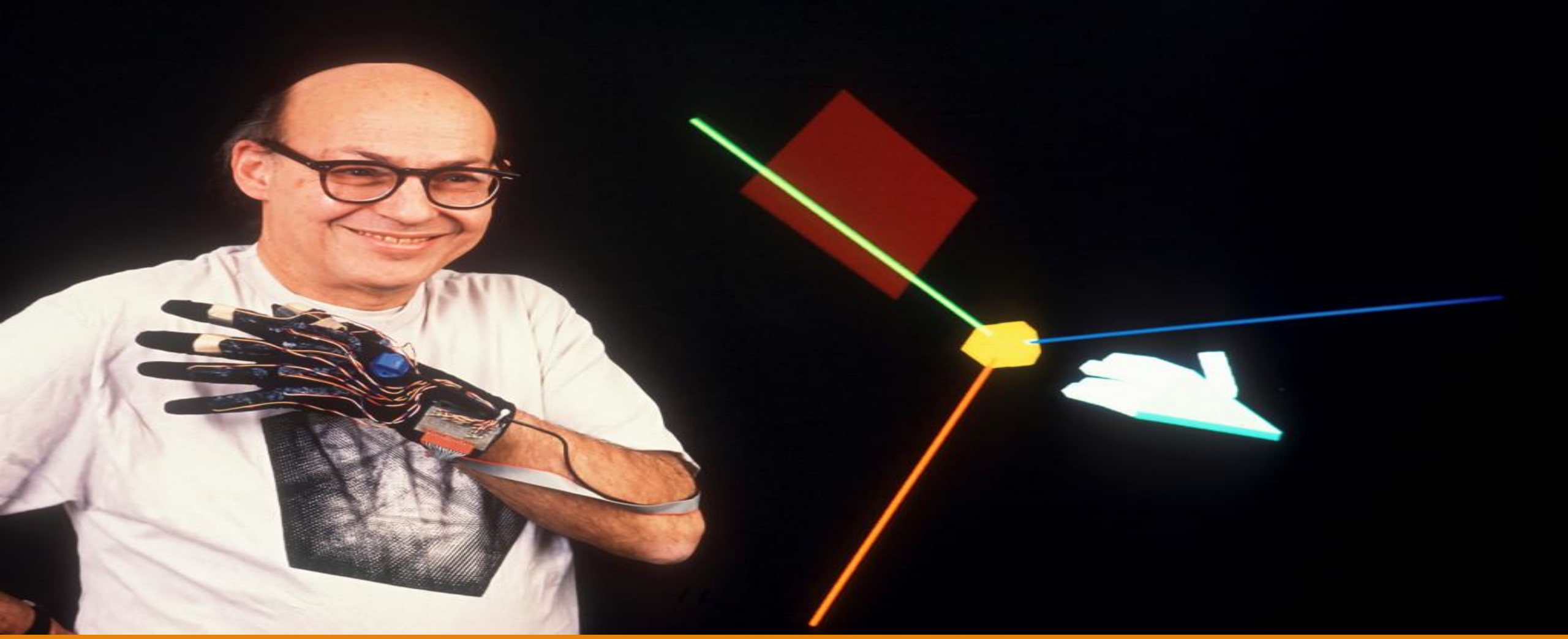
Conference Scheduling

18 Sessions
- 12 Presenters
- 1 Session is dependent on previous (102 must follow 101)

4 Timeslots
- 9:30 am
- 11:00 am
- 1:00 pm
- 2:30 pm

5 Rooms
- 1 room is only available in the AM

**** Schedule is very loosely based on SoCalCodeCamp San Diego 2017***



Demo: Conference Scheduler

Photo: Marvin Minsky – Founder of MIT's Artificial Intelligence Laboratory

What is wrong with this schedule?

Room 127	Room 126	Room 110	Room 107	Room 106
Accidental DevOps: CI (33)	Native Mobile Dev Wi (27)	Bitcoin 101 (24)	What is Ionic (34)	Redux: Introduction (28)
Everything about Cloud (41)	Timey-Wimey Stuff (14)	ML: Intro to Image (31)	Blockchain 101 (25)	Everyone is a Public Speaker (12)
Mobile for Nerdz (43)	React: Getting Started (29)		Devs Survey of AI (30)	.NET Standard 2.0 (45)
Funny Mobile Develop (42)	Rapid REST Dev w/Nod (26)		.NET Core Awesome (44)	ChatBots: Intro to using (32)

What is wrong with this schedule?

Room 127	Room 126	Room 110	Room 107	Room 106
Accidental DevOps: CI (Hattan)	Native Mobile Dev Wi (Justin)	Bitcoin 101 (Ryan)	What is Ionic (Chris)	Redux: Introduction (Max)
Everything about Cloud (ScottGu)	Timey-Wimey Stuff (Wendy)	ML: Intro to Image (Justine)	Blockchain 101 (Ryan)	Everyone is a Public Speaker (Justin)
Mobile for Nerdz (ScottHa)	React: Getting Started (Max)		Devs Survey of AI (Barry)	.NET Standard 2.0 (Damian)
Funny Mobile Develop (ScottHa)	Rapid REST Dev w/Nod (Justin)		.NET Core Awesome (Damian)	ChatBots: Intro to using (Justine)

Prefers the last 2 sessions of the day

Goals

1. Satisfy all “hard” requirements
2. Satisfy as many requests (“soft constraints”) as we can
3. Prioritize the requests made soonest

Solution 1 – Remove Constraints

Make all constraints “hard” as in our 2nd example

- While the solution fails
  - Remove one constraint at a time
    - Start with the least important (latest request)
  - Rerun the solution
  - If it still fails, restore the constraint
  - Try again

Solution 2 – Add Constraints

Start with the requests “soft” as in our 3rd example

- While the solution is feasible
  - Make one request at a time into a “hard” constraint
    - Start with the most important (earliest request)
  - Rerun the solution
  - If the problem is no longer feasible
    - Record the state of the model
    - Remove the constraint
  - Continue processing all constraints

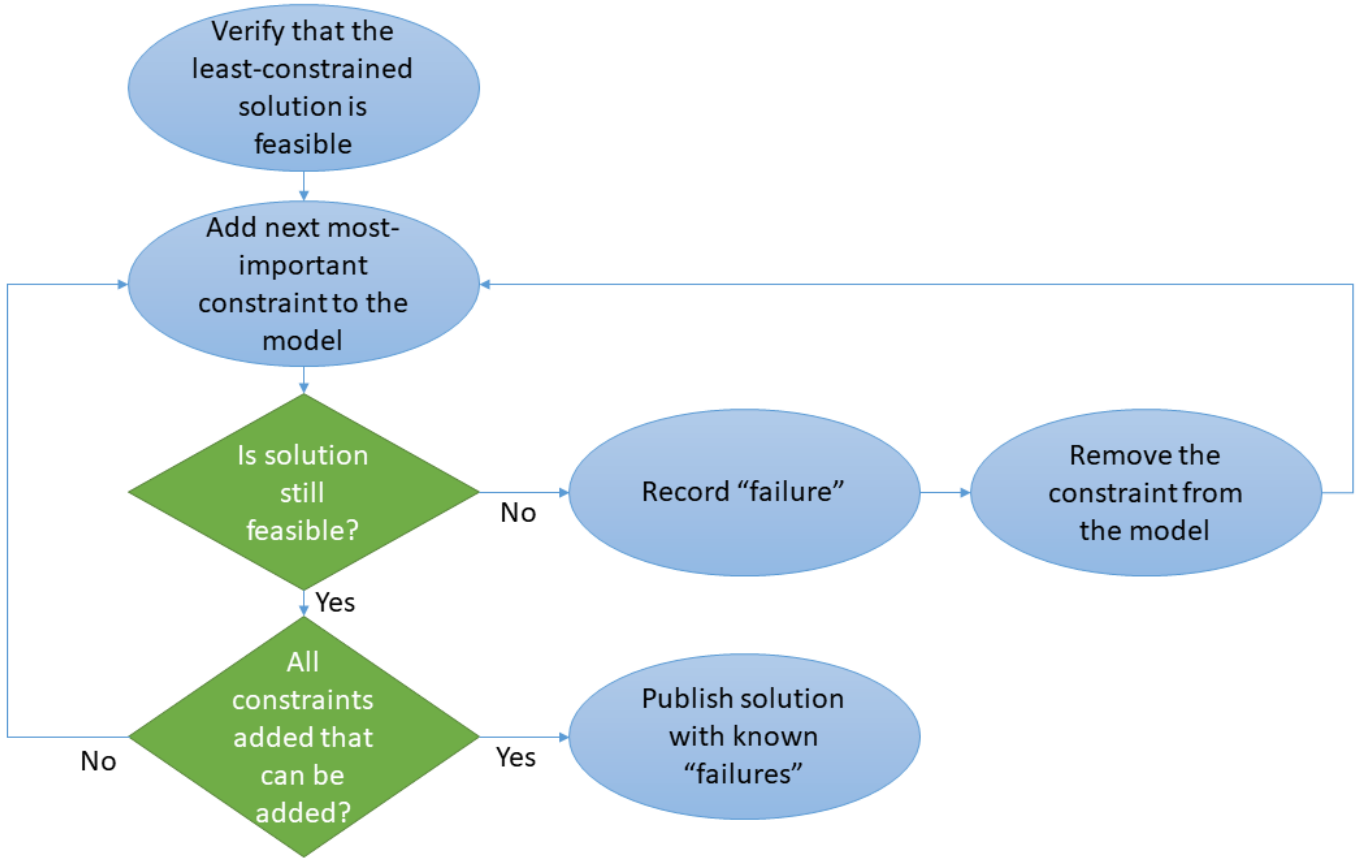
Hybrid AI Example

Photo: Michael Faraday, discovered the principles of electromagnetic induction

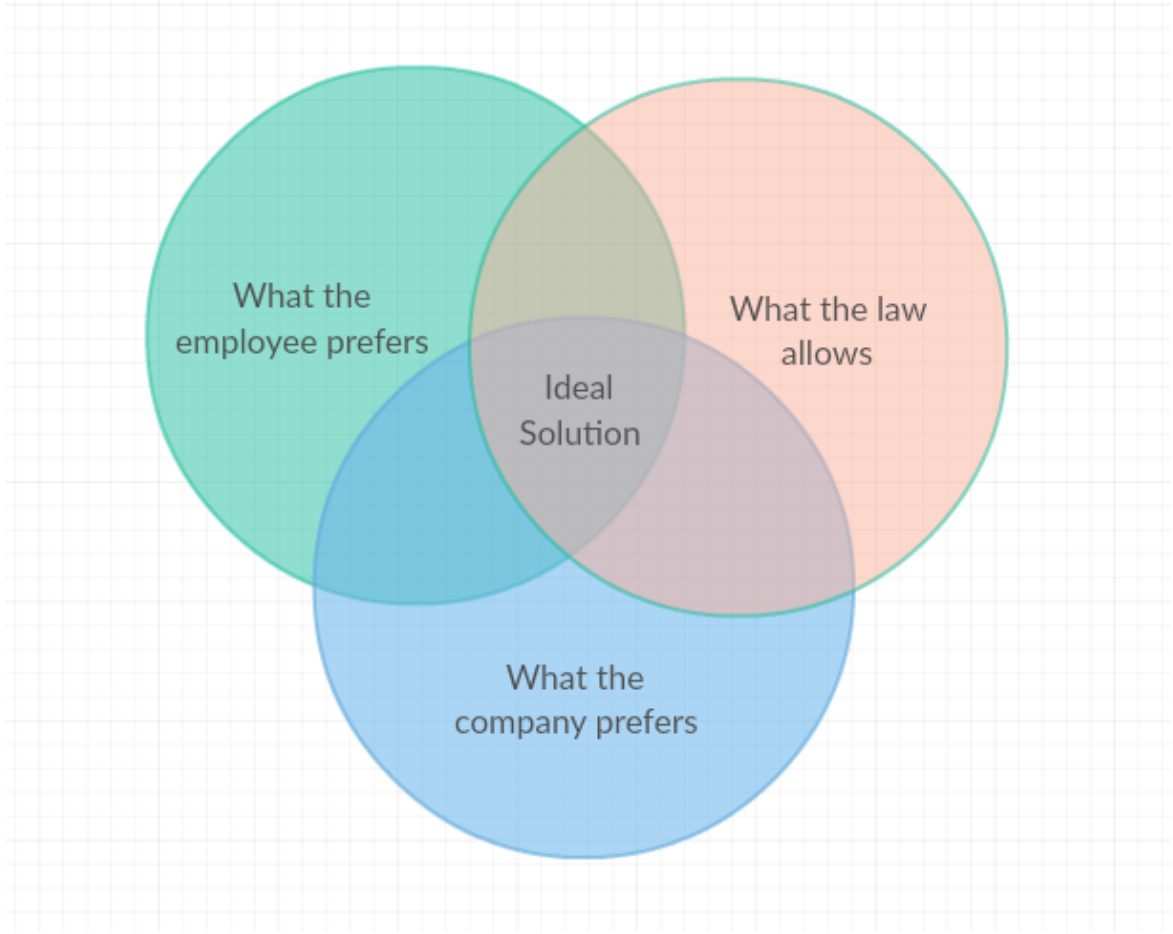
Putting the Puzzle Together

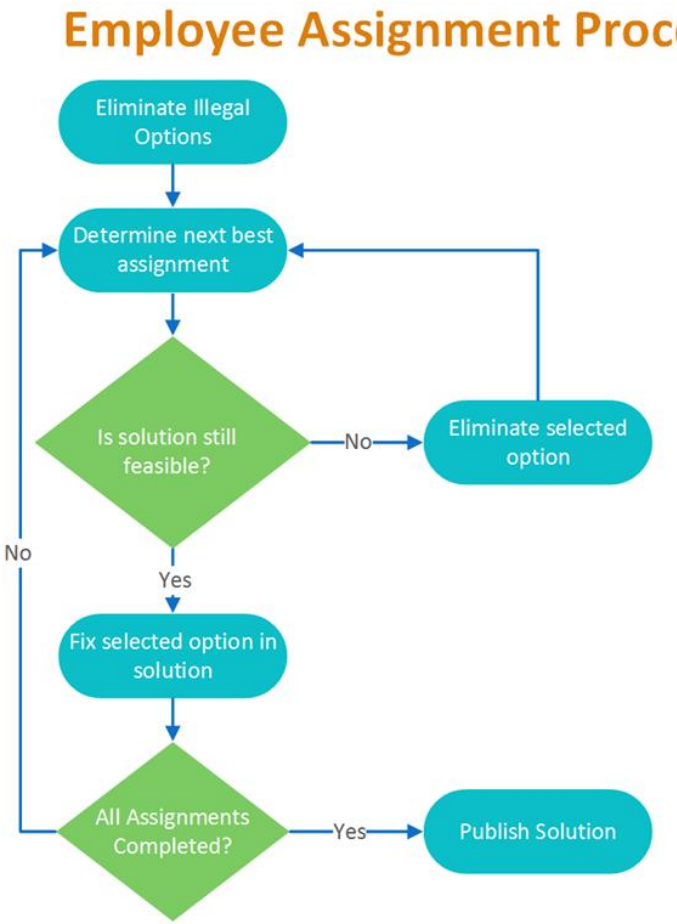
Room 127	Room 126	Room 110	Room 107	Room 106
Everyone is a Public Speaker (Justin)	Bitcoin 101 (Ryan)	ML: Intro to Image (Justine) Doesn't like 1st Session of AM & PM	Timey-Wimey Stuff (Wendy)	What is Ionic (Chris)
Blockchain 101 (Ryan)	Everything about Cloud (ScottGu)	Accidental DevOps: CI (Hattan)	Native Mobile Dev Wi (Justin)	ChatBots: Intro to using (Justine)
Mobile for Nerdz (ScottHa)	Rapid REST Dev w/Nod (Justin)		.NET Standard 2.0 (Damian)	React: Getting Started (Max)
Devs Survey of AI (Barry)	Redux: Introduction (Max)		Funny Mobile Develop (ScottHa)	.NET Core Awesome (Damian)

The Hybrid Process



Another Example





Hybrid Models

- Optimization/Logical Hybrids
  - i.e. Conference Scheduler
- Probabilistic/Logical Hybrids
  - Perhaps most are hybrids
  - i.e. Fraud Detection
- Probabilistic/Optimization/Logical Hybrids
  - i.e. Conference Scheduling w/ attendance prediction

Summary

- Artificial Intelligence is about making automated decisions
- AI Techniques are often “black-box”
- Hybrid AI mixes multiple AI techniques
  - i.e. Logical/Optimization Hybrid
    - Start with just the “hard” constraints
    - Add the Soft-Constraints iteratively & in order
    - Capture significant events to explain discrepancies

Resources

Me

- Twitter: @bsstahl
- Email: barry@bsstahl.com

Code

- https://github.com/bsstahl/AIDemos
- https://github.com/bsstahl/ConferenceScheduler

Articles

- http://www.cognitiveinheritance.com/post/Scalable-Decision-Making.aspx
- http://www.cognitiveinheritance.com/post/AI-That-Can-Explain-Why.aspx
- http://www.cognitiveinheritance.com/post/An-Example-of-a-Hybrid-AI-Implementation.aspx

Tools

- https://developers.google.com/optimization/