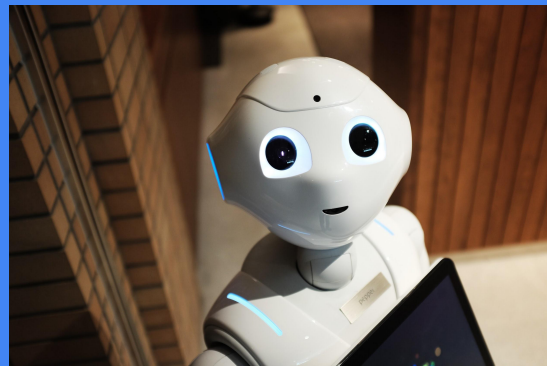


# AI Research at



Devin Conathan

Big Data Madison - 9/24/2019

# Overview

- AmFam, UW and the Amfam Data Science Institute (DSI)
- What is AI? What is Research?
- Research at AmFam
- Case study: Probabilistic Logic Bots
- From Research to Production

**Research is personal**

# What is American Family Insurance?

**American Family Insurance**, also abbreviated as **AmFam**, is an American private mutual company that focuses on property, casualty, and auto insurance, and also offers commercial insurance, life, health, and homeowners coverage as well as investment and retirement-planning products.



# American Family Insurance Data Science Institute

UNIVERSITY OF WISCONSIN-MADISON

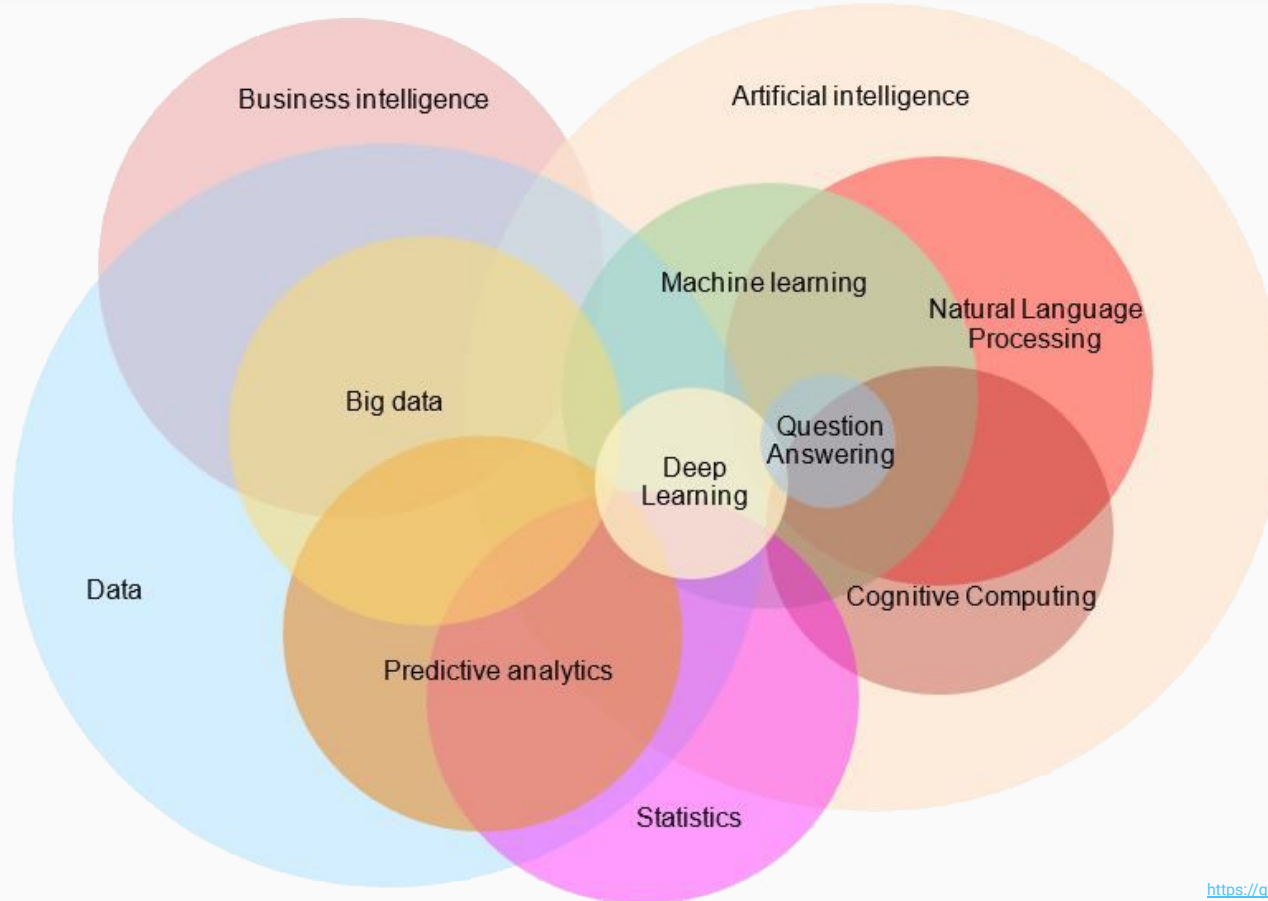
## UW-Madison expands data sciences research with \$20 million gift from American Family

### Mission

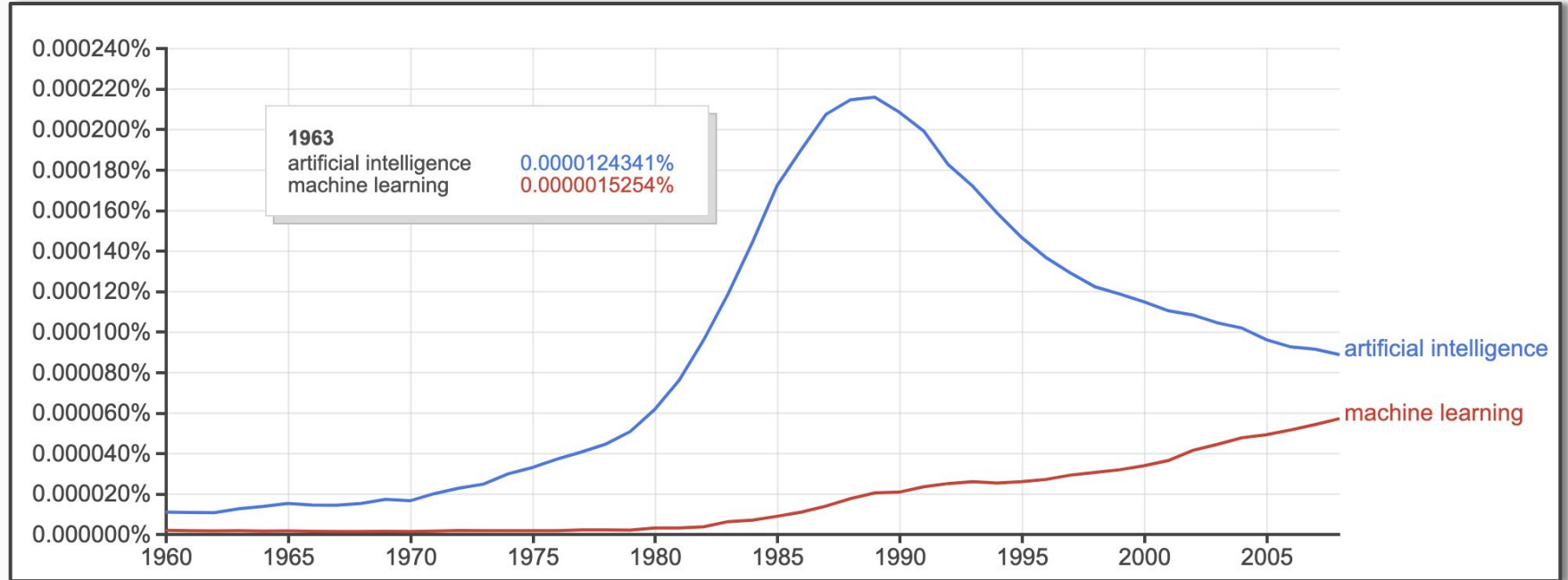
- Perform **cutting-edge** research in the fundamentals of data science
- **Translate** this research by partnering with key application areas
- **Collaborate** with researchers across divisions to advance scientific discovery

<https://datascience.wisc.edu/institute/>

# What is Artificial Intelligence (AI)?



# What is Artificial Intelligence (AI)?



# What is Research?

## Three kinds:

- *Basic research* is work undertaken to acquire new knowledge **not directed toward any particular use.**
- *Applied research* is original investigation to acquire new knowledge directed **towards a specific practical aim.**
- *Experimental development* is systematic effort directed toward **creating novel or improved products.**



# Research at AmFam

## Two Missions

Foster external research and  
academic relationships



Support the enterprise ecosystem  
with state-of-the-art techniques



**"Don't give the customer what they ask for;  
understand them, and revolutionize their world"**

# Case Study:

## Probabilistic Logic Bots

# Problem Statement

Customers and agents are burdened with evaluating complex business rules when determining eligibility for discounts and endorsements

# Typical "Data Science Story"

## Problem

A business partner presents an open-ended problem and hopes that technology can solve it

## Metrics

Problem is analyzed, metrics are developed to measure if solutions are adequate

## Theory

Theory is formulated so target metrics can be optimized

## Research

Develop proofs-of-concepts and test potential solutions

## Solution

Adequate solution is found and deployed to production

# Typical "Data Science Story"

## Problem

Customers and agents are burdened with evaluating complex business rules when determining eligibility for discounts and endorsements

## Metrics

Successfully determining eligibility by asking the least number of questions as possible

## Theory

Formulate business rule as Bayesian network and connect individual facts to business rule using mutual information

## Research

Apply theory to simulated data, develop a proof-of-concept interface to test with real data

## Solution

System for authoring and evaluating business rules is developed and put into production

# Bonus

Get a paper out of it!

## Probabilistic-Logic Bots for Efficient Evaluation of Business Rules Using Conversational Interfaces

Joseph Bockhorst,<sup>1</sup> Devin Conathan,<sup>1</sup> Glenn M Fung<sup>1</sup>

<sup>1</sup>American Family Insurance  
jbockhor@amfam.com, dconathan@amfam.com, gfung@amfam.com

### Abstract

We present an approach for designing conversational interfaces (chatbots) that users interact with to determine whether or not a business rule applies in a context possessing uncertainty (from the point of view of the chatbot) as to the value of input facts. Our approach relies on Bayesian network models that bring together a business rule's logical, deterministic aspects with its probabilistic components in a common framework. Our probabilistic-logic bots (PL-bots) evaluate business rules by iteratively prompting users to provide the values of unknown facts. The order facts are solicited is dynamic, depends on known facts, and is chosen using mutual information as a heuristic so as to minimize the number of interactions with the user. We have created a web-based content creation and editing tool that quickly enables subject matter experts to create and validate PL-bots with minimal training

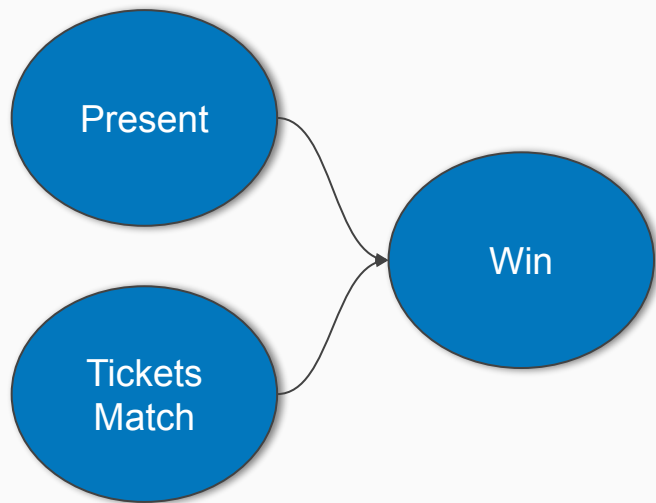
that have the potential for addressing many of these concerns (Zamora 2017; Perez and Pascual 2011). A successful intelligent virtual assistant would interact with users to understand their questions or concerns. After it has determined that the user wants to know whether a certain business rule applies, it would do so by asking the user the fewest number of questions. Furthermore, the virtual agent would be intelligent enough to allow the user to communicate in natural language.

This paper reports on efforts we have made toward creating efficient and intelligent conversational interfaces. We present an approach for creating intelligent virtual agents, which we call probabilistic-logic bots (PL-bots), that empower users to quickly evaluate complex business rules by minimizing the number of questions the bot asks of the user.



# Generating an optimal tree

- Start with some "business rule" logic
- Represent logic as a Bayesian network
- Query for facts with the must mutual information with target



$$I_{\vec{e}}(X, Y) = \sum_{x, y} \Pr(x, y | \vec{e}) \log_2 \left( \frac{\Pr(x, y | \vec{e})}{\Pr(x | \vec{e}) \Pr(y | \vec{e})} \right)$$

## A more real example

A jewelry item endorsement may be added to a homeowners policy to cover an individual jewelry item if it is stored in a lock safe that resides within the insured building.

Otherwise the endorsement is allowed if either of the following hold:

1. The item has low value and either the insured building has a burglar alarm or all gemstones are fixed to a stable body
2. The item has medium value, the insured building has a burglar alarm and all gemstones are fixed to a stable body.

## A more real example

A jewelry item endorsement may be added to a homeowners policy to cover an individual jewelry item if it is stored in a lock **safe** that resides within the insured building.

Otherwise the endorsement is allowed if either of the following hold:

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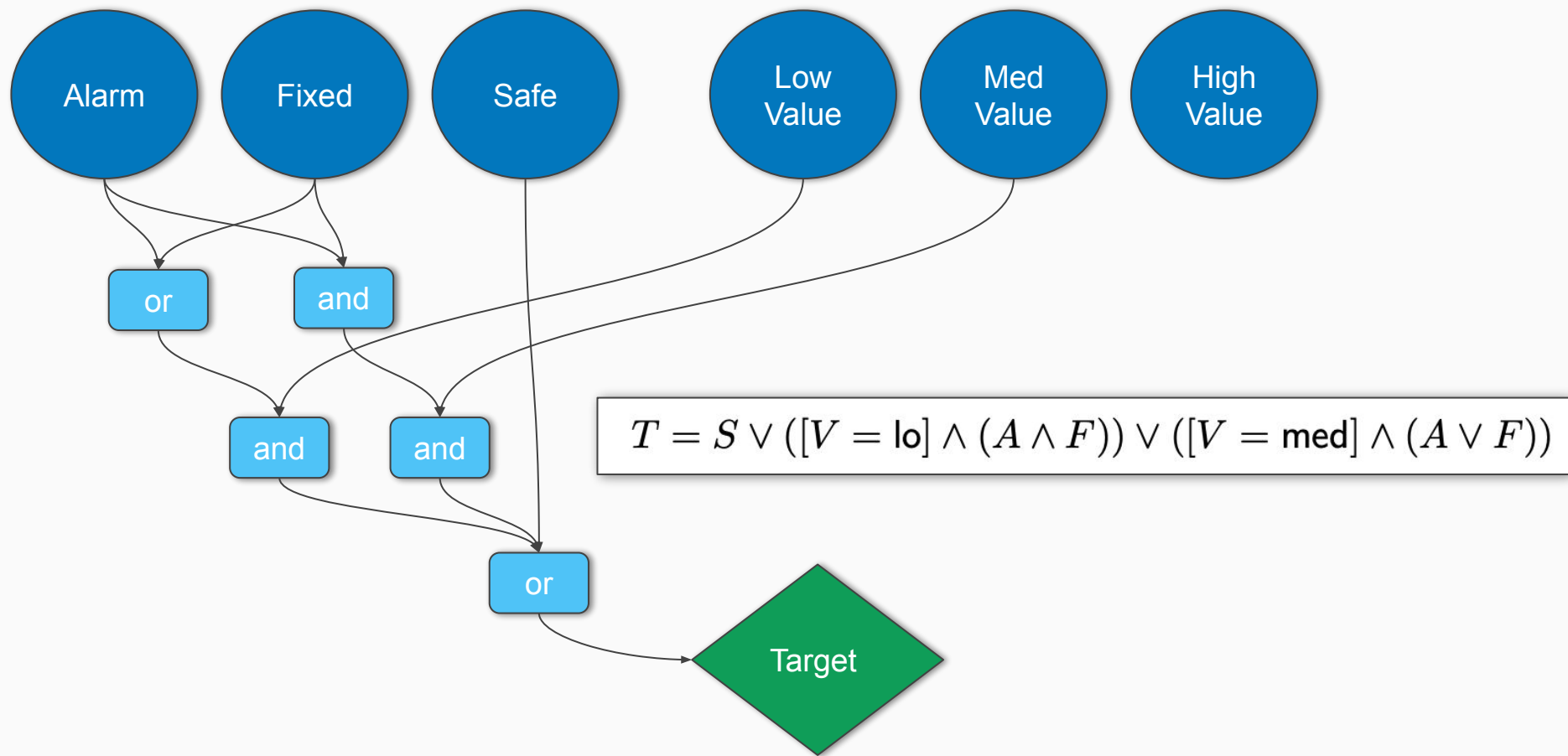
## A more real example

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## A more real example



# Research to Production

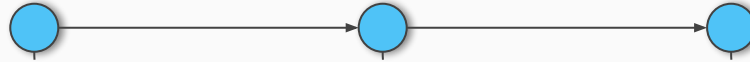
Lessons learned from the wild

# What is Production?

Anything that directly affects end-users.

# The Dream

Research



Production

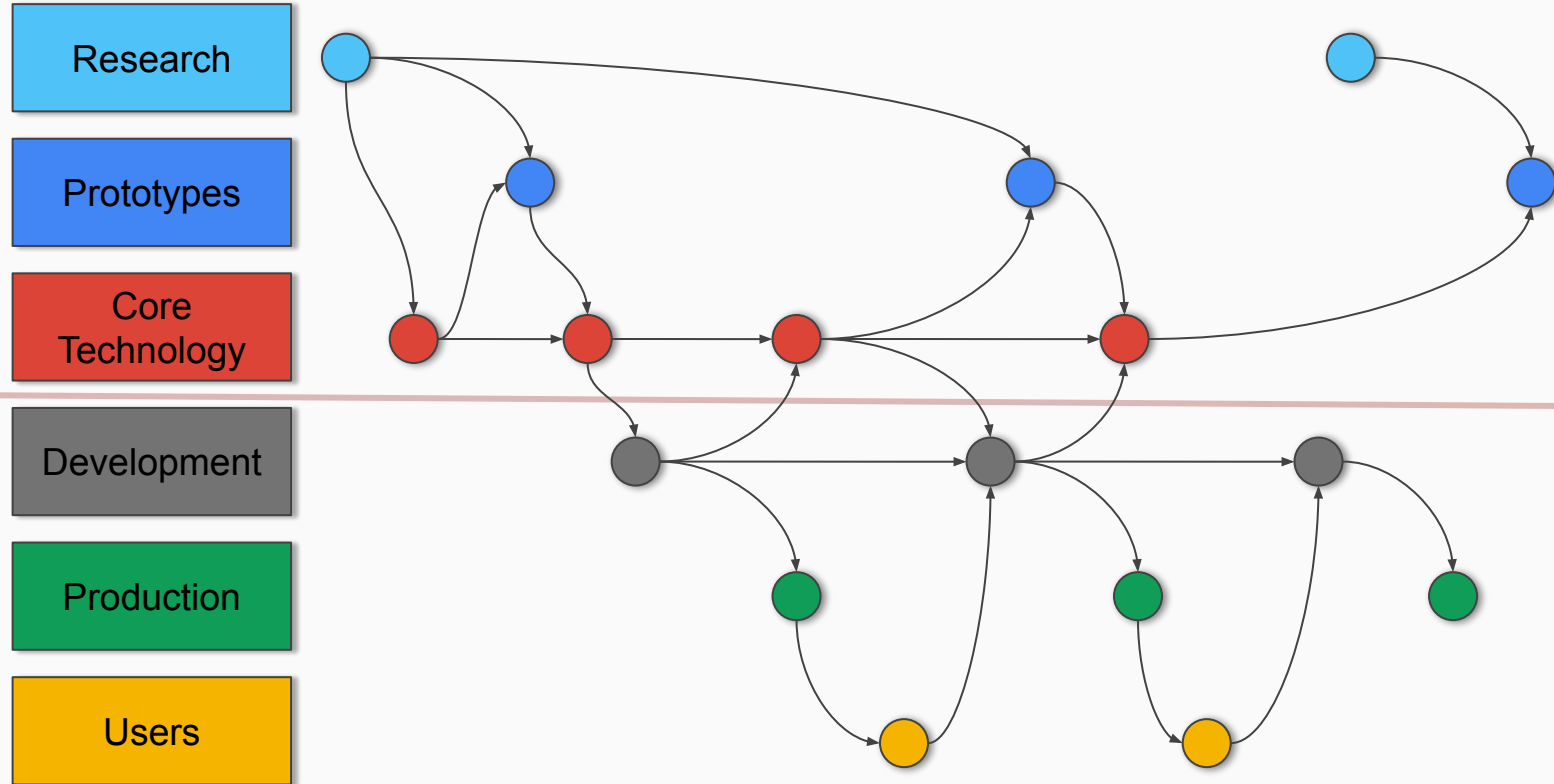






**Apply agile methodologies  
where it makes sense**

# Reality



# Learn and apply the basics of effective source control



# Use automatically created documentation whenever possible



RESPONSE SCHEMA: application/json	
query required	string (Query) the query that causes this response
documents required	Array of objects (Documents) the documents that the query returned
Array [	
answers required	Array of objects (Answers)
Array [	
span required	string (Span) the exact chosen answer span
doc_id required	string (Doc_Id)
span_start required	integer (Span_Start) the index of the character that is the start of the answer
span_end required	integer (Span_End) the index of the character that is the end of the answer
]	
doc_id required	string (Doc_Id) the unique identifier of the document. see view documentation for retrieving whole document
title required	string (Title) the title of the document

<https://www.openapi.org/>

<https://redocly.github.io/redoc/>

<https://fastapi.tiangolo.com/>

**Embrace wearing many hats,  
especially early on in the life cycle**

**Use modular design with simple interfaces,  
then optimize behind-the-scenes**

# Conclusion

**"Don't give the customer what they ask for;  
understand them, and revolutionize their world"**

- Apply agile methodologies where it makes sense
- Learn and apply the basics of effective source control
- Use automatically created documentation whenever possible
- Embrace wearing many hats, especially early on in the life cycle
- Use modular design with simple interfaces, then optimize behind-the-scenes



# Thank you!

Questions...?

<https://www.ai-ml-amfam.com/>

P.S. Want to help us put research into production?  
We're hiring!