

#AI4SWE



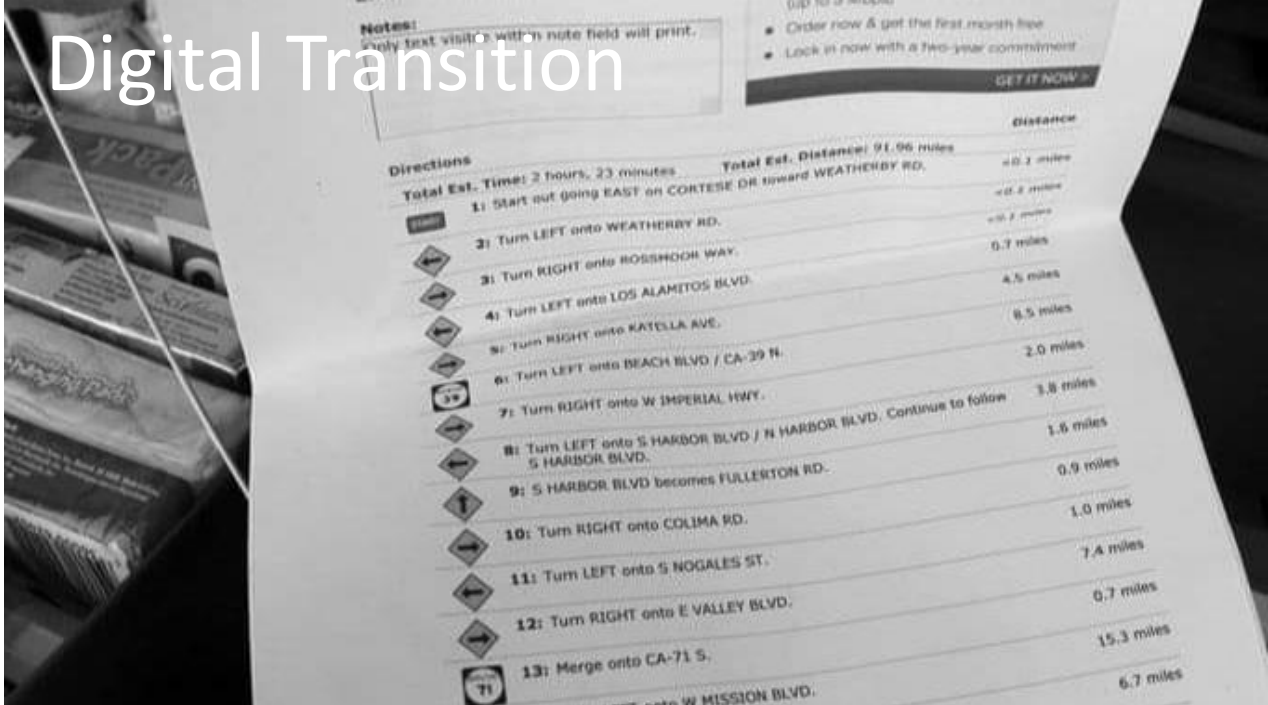
# AI Powered Software Engineering

Unlocking Innovation

# The Early Days



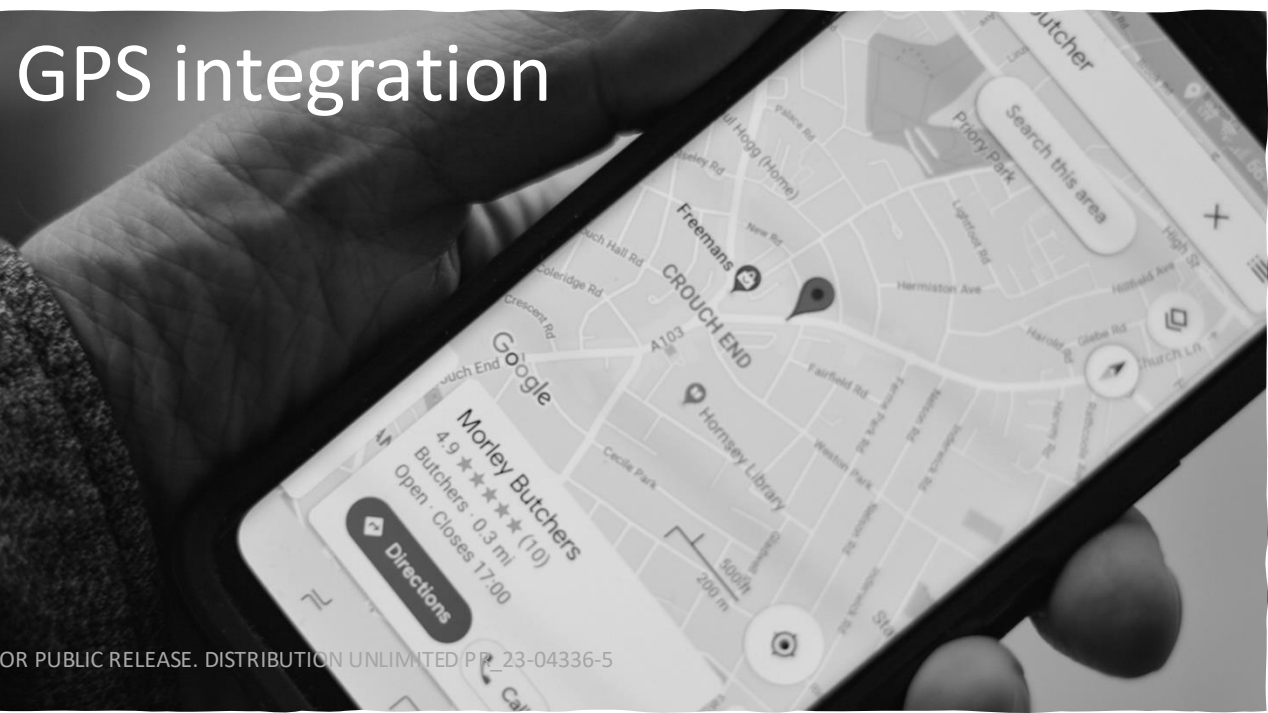
# Digital Transition



# Special GPS Units



# GPS integration



# Proliferation



# AI & Software Engineering

Digital Transition: This is where we are today.



# Who Am I? Tracy "Trac" Bannon

/trās/

Metrics  
Value Stream Design  
#OpenSource  
#DevOps  
Continuous Testing  
#StraightTalkforGovt  
Agility  
#DevSecOps  
Continuous Improvement  
#CloudNative  
CALMS  
#TDM  
CI/CD  
Building Digital Workforce  
Modernization  
#RealTechnologists  
Digital Transformation  
Community  
Low Code/No Code  
DoJo  
CyberSecurity  
Current State Baseline  
Secure by Design  
Minimum CD  
#DesignPatterns  
Modern Software Practices  
#SomethingToNoodleOn  
Evolutionary Architecture  
AI-Assisted SDLC  
Value Stream Mapping



Software architect | researcher | engineer

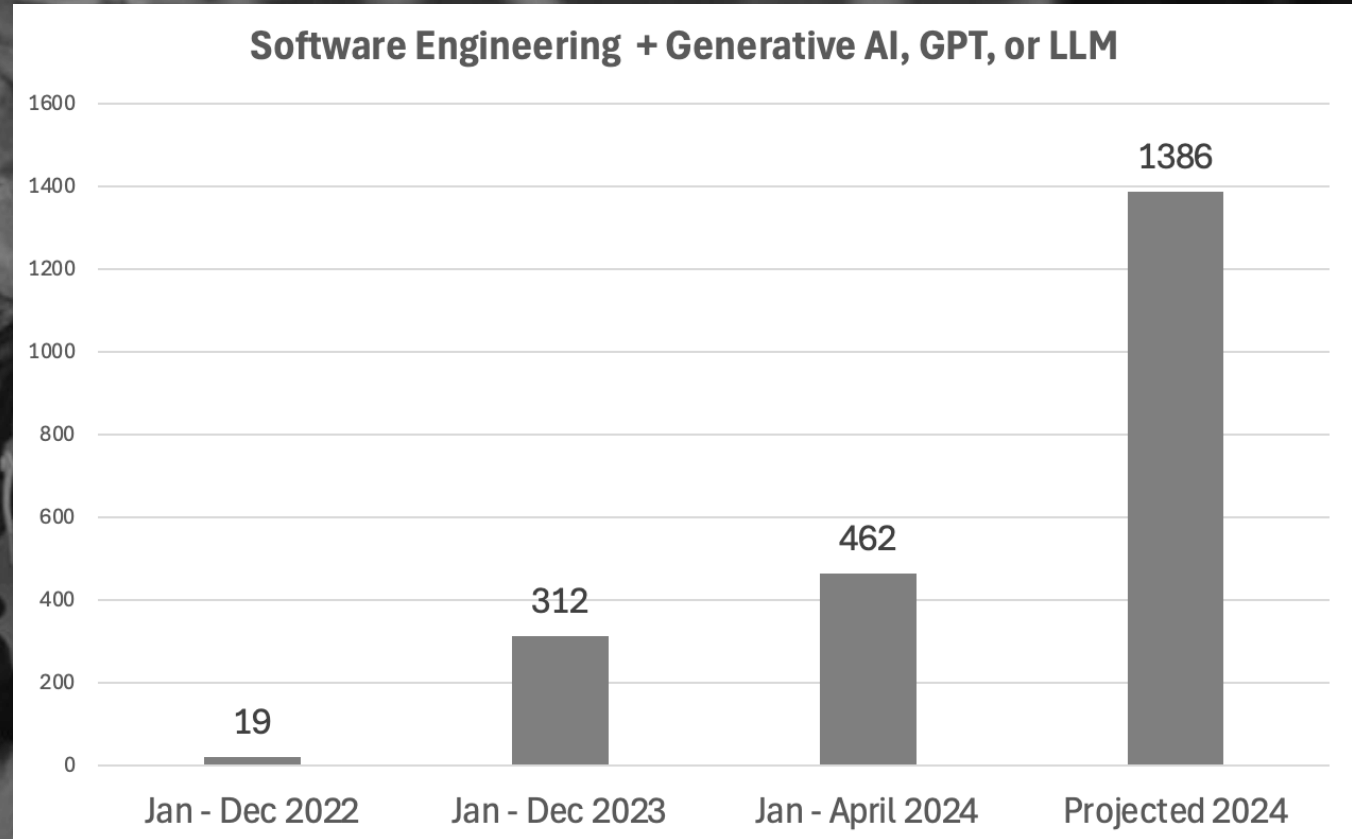
# ArchAI Tecture Research Collaborative

- Focusing on human/machine teaming and trust
- Diverse thought leaders
- Merging scholars and industry
- Data at scale
- Not-for-profit



# Quick Retrospective

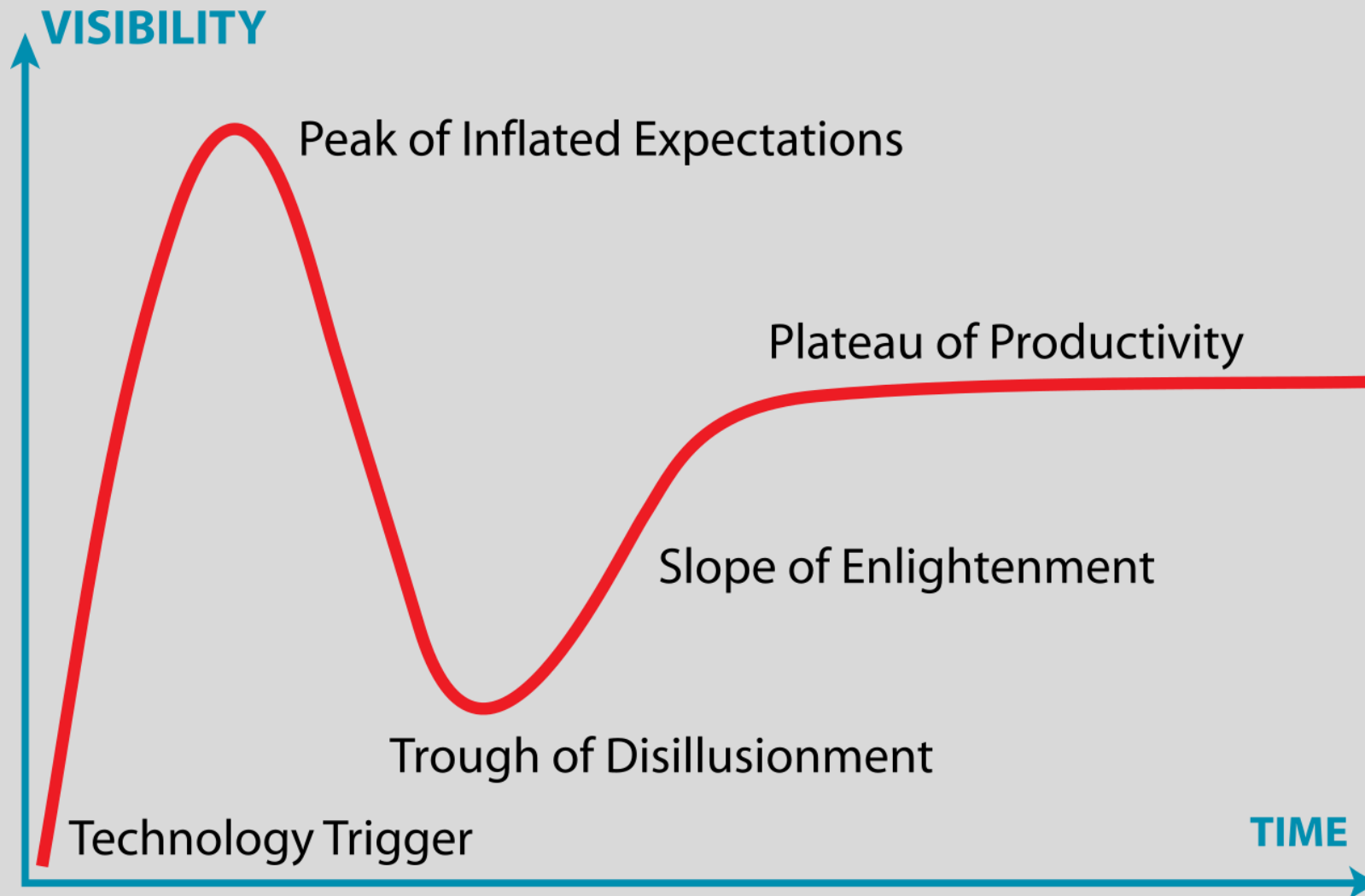
- January 2023 - ChatGPT users hits 100M
- Chronic FOMO
- 2024 - Publishing surges
- Peer-reviewed research lags



Don't get  
swept away  
by the hype



# AI in SwEngineering... where are we now?





EXPECTATIONS



2 - 5 years to reach productivity plateau

As of August 2024

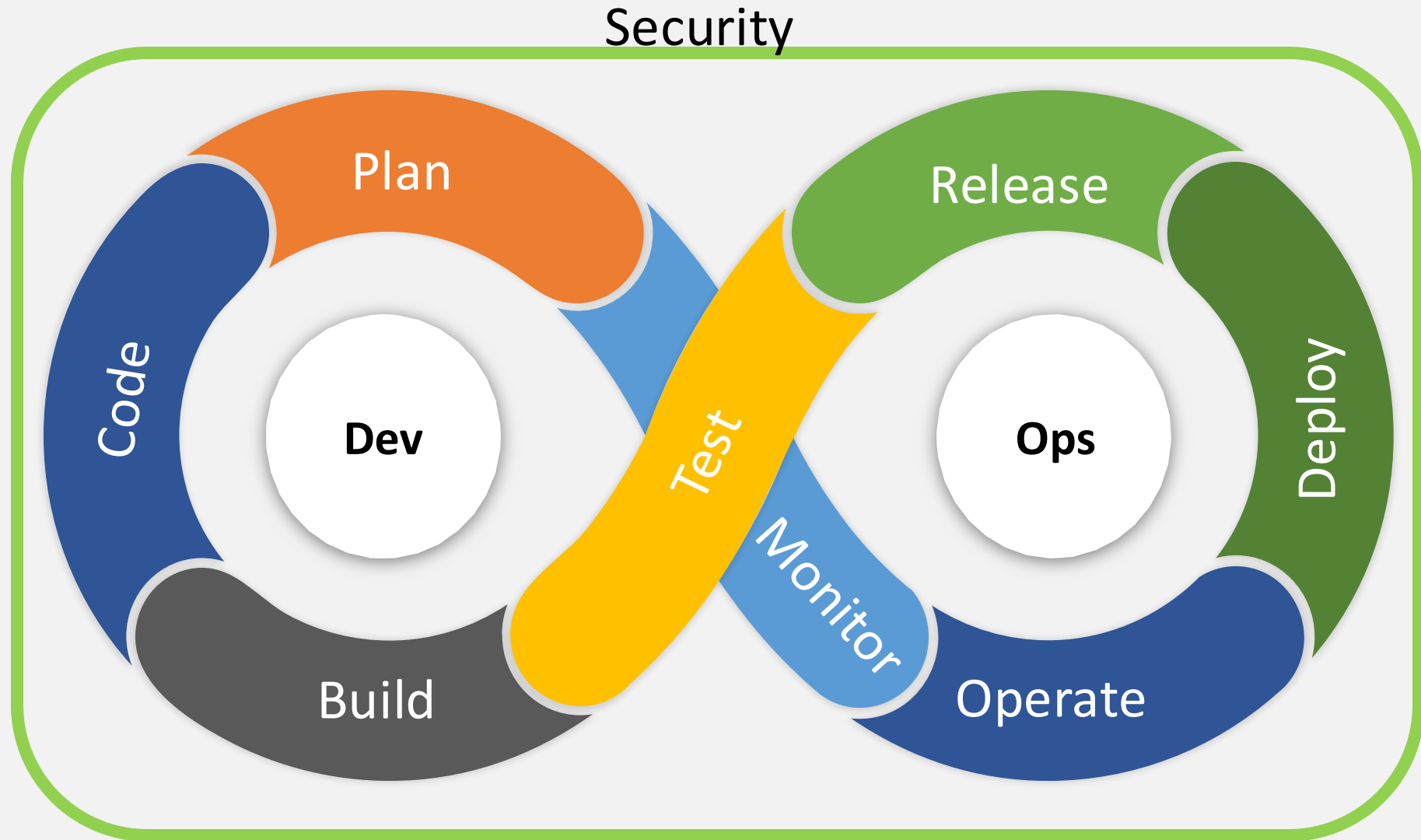
TIME

Innovation Trigger      Peak of Inflated Expectations      Trough of Disillusionment      Slope of Enlightenment      Plateau of Productivity

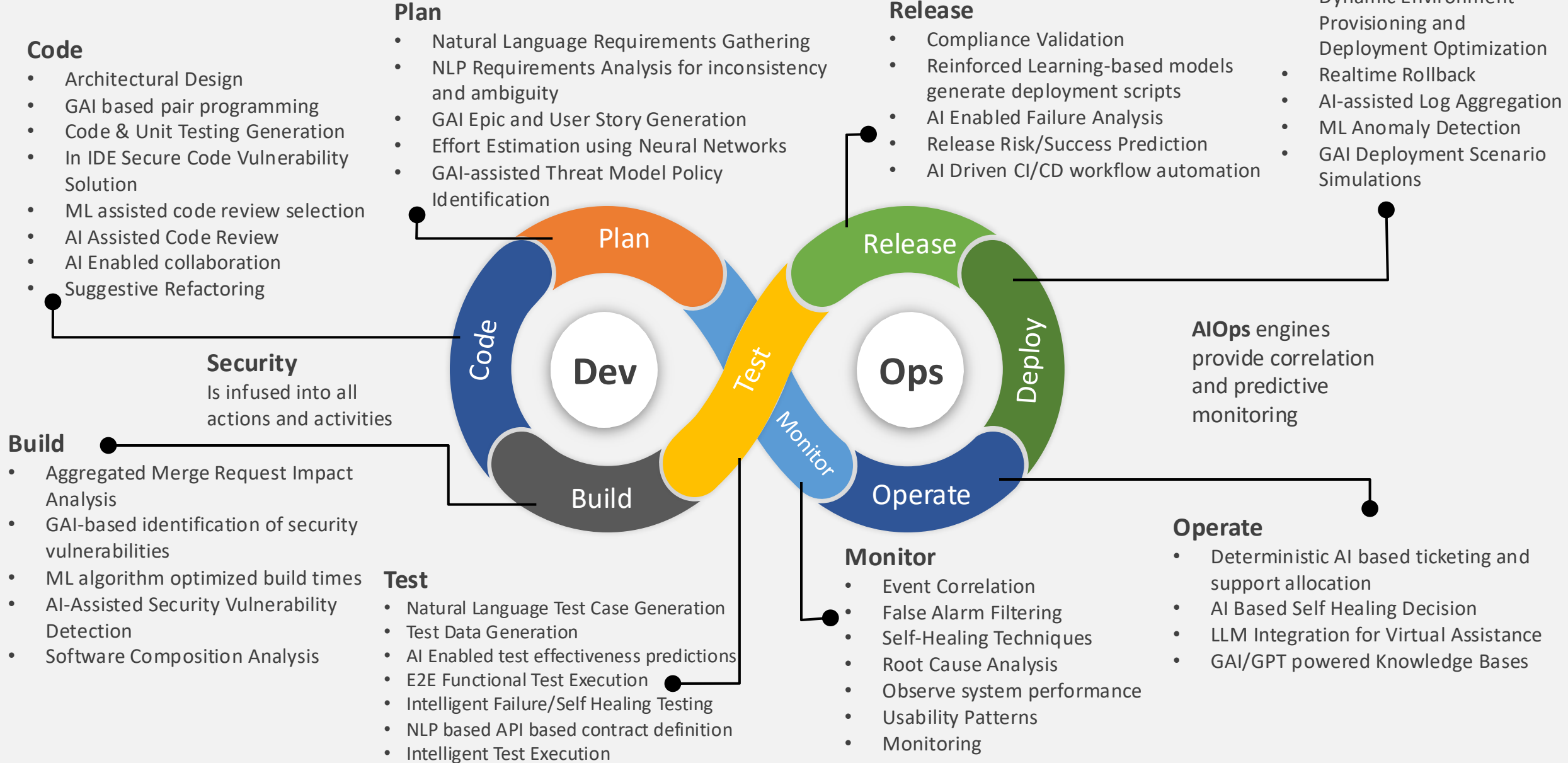
Plateau will be reached by: ○ 0 yrs   ● 2-5 yrs   ● 5-10 yrs   ▲ >10 yrs   ● Checklets before plateau

Model Interpretability Face recognition  
Convolutional Neural Networks (CNNs)  
**Search engines** Transfer Learning Explainable AI (XAI)  
Reinforcement Learning  
Computer Vision **Neural Networks** Deep Learning  
Deep Learning Bayesian Networks Speech to text  
Evolutionary Algorithms  
AI Governance Edge AI Semantic Analysis Probabilistic Reasoning  
Machine Learning **Autonomy** Federated Learning  
Swarm Intelligence **Generative AI** Connectionist AI  
Ensemble Learning Heuristic Search  
Agents Supervised Learning  
Unsupervised Learning Adversarial Machine Learning **Edge AI**  
Federated Learning  
**Recurrent Neural Networks (RNNs)**  
Pattern Recognition **Feature Engineering**  
**AI Ethics** Knowledge Representation **Transfer Learning**  
Retrieval-Augmented Generation (RAG) Natural Language Processing (NLP) **WordItOut**

# Where can AI be used with DevSecOps?



# Infusing AI across the DevSecOps Continuum



# GAI Usage Patterns

## Content Generation

Complex auto-complete as well as new content creation is typically leveraged for generating test cases, code, documentation, and deployment scripts.

## Automated Reasoning

Analyzing patterns, suggesting alternatives about code quality, identifying security vulnerabilities, optimizing deployment strategies, and ensuring compliance with standards.





Treat GAI like a  
young  
apprentice...

Always pay  
close  
attention!!

Does  
Generative AI  
contradict  
DevSecOps  
principles?





# Where are people using GAI today?

- Searching for answers
- Documentation
- Requirements Analysis
- Debugging
- Code Completion
- Test Case Augmentation

# Unveiling the Human Side of GAI in Software Engineering

Practice-wide survey to get to ground truth

**Human-Machine  
Collaboration**

**Trust Optimization**

**Skill Evolution &  
Team  
Communication**

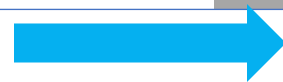
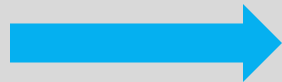
**Personal Impact &  
Future Outlook**

Take the Survey



# Most challenging, time consuming, or painful tasks^

Challenge	%
Collaborating with cross-functional teams	50%
Managing technical debt	
Continuous integration/continuous deployment (CI/CD) pipeline setup	
Documentation (code, systems, APIs, etc.)	
Maintaining legacy code	
Maintaining security compliance	
[ ... ]	
Code reviews	
Writing New Code	3%



Take the Survey



**40+ different challenges have been identified so far!**

*^This data will be more insightful when correlated with role and experience*

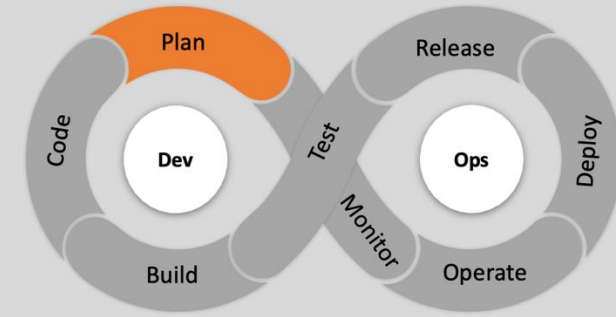




**Are we addressing the pain points?**

AI-Augmented

# ^ Requirements Analysis



## Use Case:

- Requirements generation via text analysis
- Analyze user transcripts
- Include crowdsourced survey

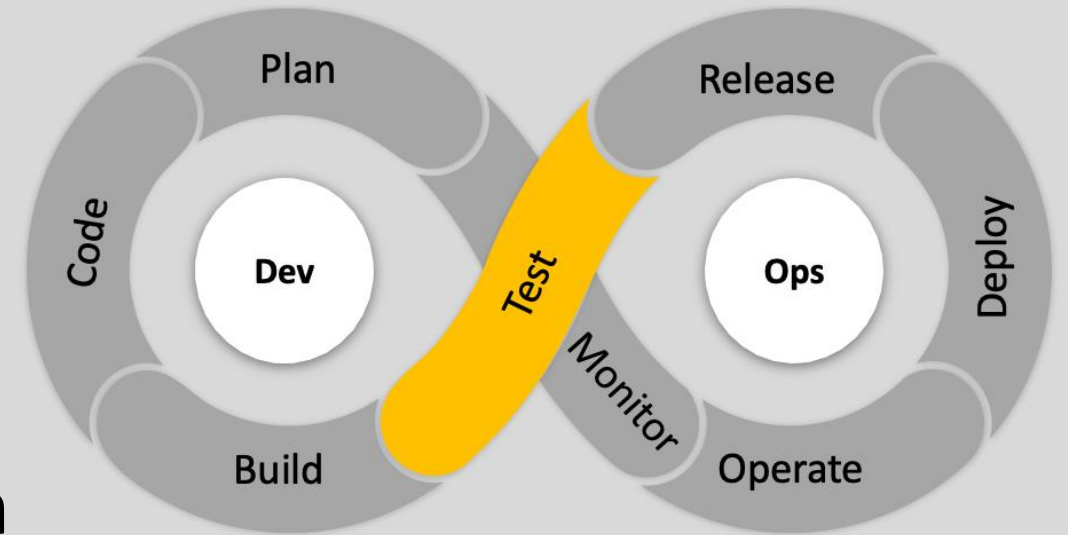
## Considerations:

- Version control GPT prompts ++
- Diverse Datasets
- QA = rigorous testing + humans in the loop

AI-Augmented

# ^ Testing Use Cases

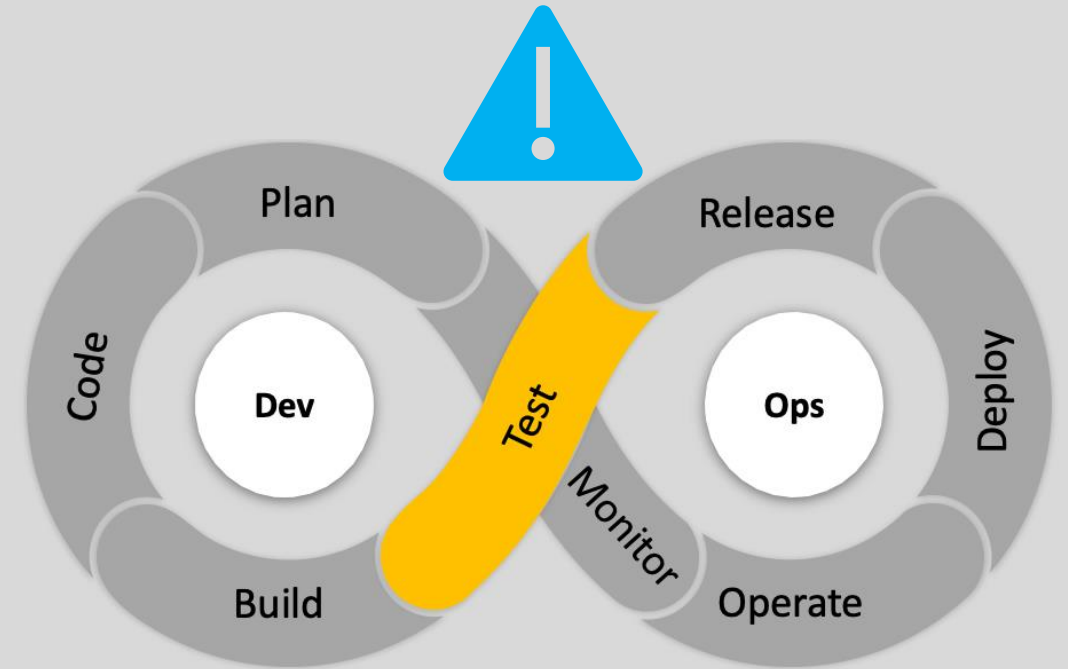
- Increase test coverage
- Brainstorming
- Synthetic Test Data Augmentation



AI-Augmented

# ^ Testing Considerations

- Data Privacy & Integrity
- Beware of Irrelevant Tests
- Transparency and Explainability



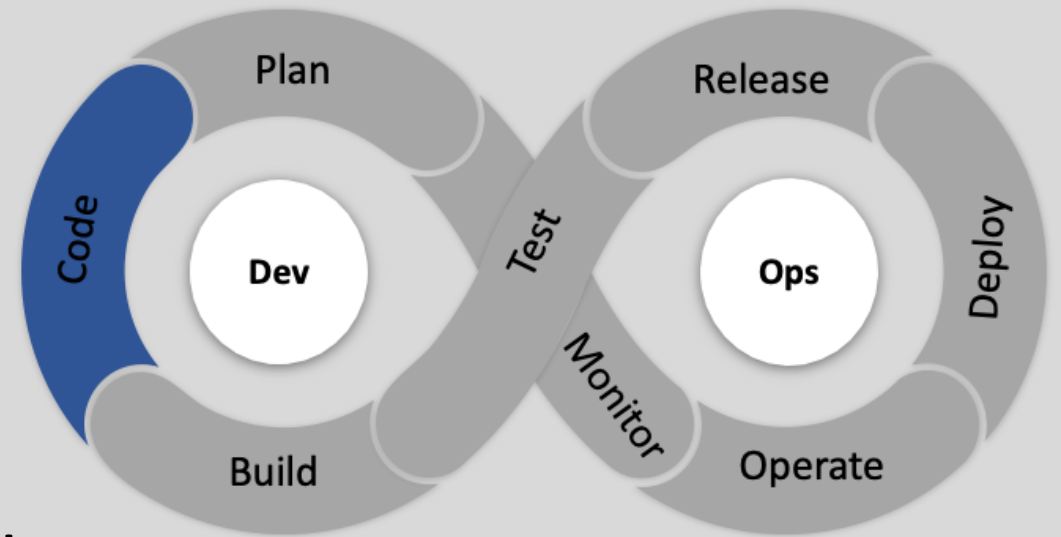
The elephant in the  
corner....



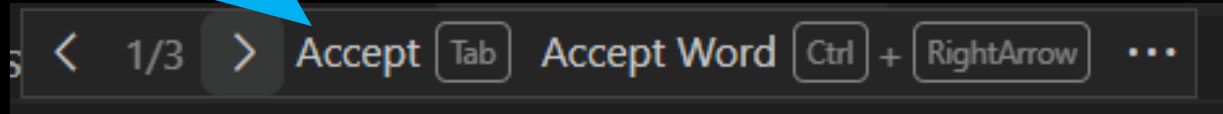


# AI-Augmented ^ Coding

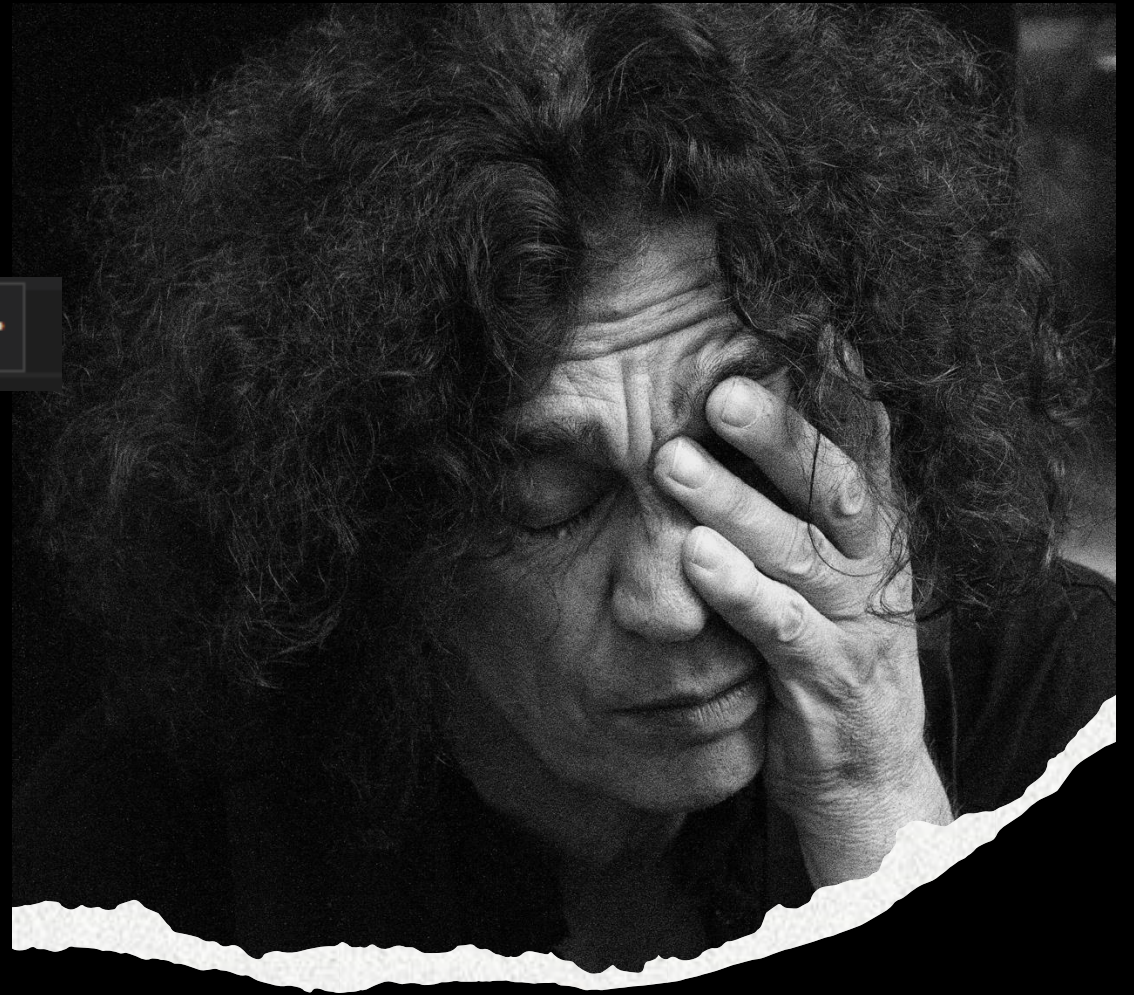
- Code Completion over Code Generation
- Great for explaining existing code
- Generally, well-structured and well-formatted



# In IDE Help



```
def max_sum_slice(xs):  
    """Return the maximum sum of a slice of xs."""  
    max_sum = 0  
    for i in range(len(xs)):  
        for j in range(i, len(xs)):  
            this_sum = 0  
            for k in range(i, j + 1):  
                this_sum += xs[k]  
            if this_sum > max_sum:  
                max_sum = this_sum  
    return max_sum
```



AI-Augmented

## ^ Coding Considerations

- Unequal productivity gains
- Code Churn
- Less Secure Code
- QA = rigorous testing + humans in the loop



GAI can be  
unreliable.

Pay close  
attention!





# Don't generate code and tests

- Lack of Independent Verification
- Bias and Blind Spots
- Overfitting





Is your organization prepared?





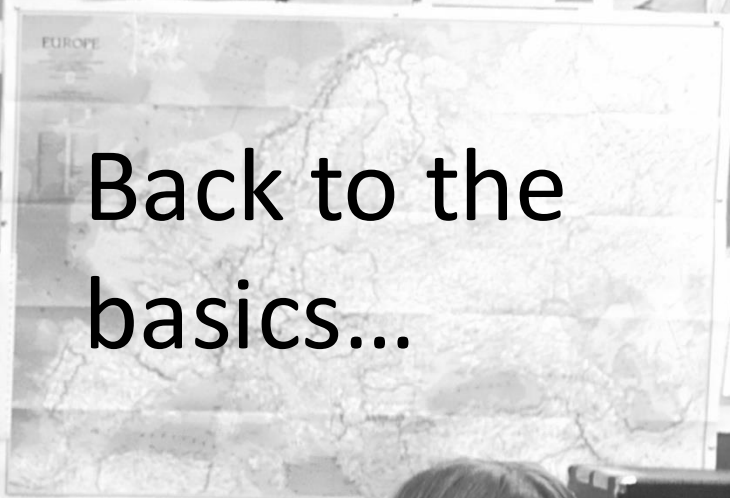
## Fix your SDLC first

- Address existing issues
- GAI can magnify existing problems



*"If Someone in Your Family  
Has Cancer"*  
*Definition*  
*Feelings*  
*Treatment*

- Who?
- What?
- When?
- Where?
- Why?
- How?



**Back to the  
basics...**



“Do the  
Minimum”



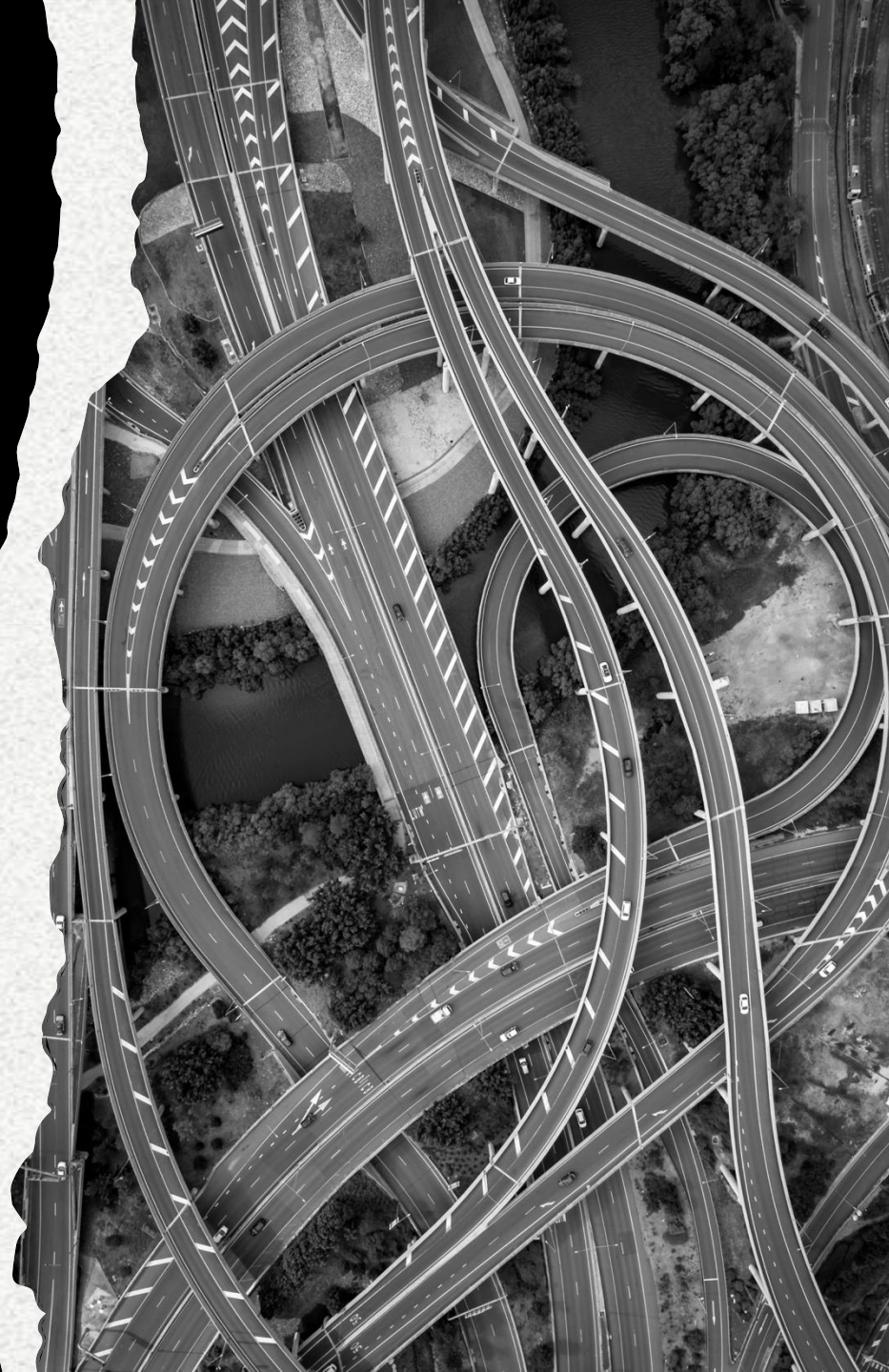


Gotchas to  
avoid



# Adaptation to New Workflows

- Measurements and metrics will waiver
- Training is a must
- Humans resist change







# What about productivity?

- Perceived productivity
- Team productivity \*not\*  
Individual productivity





# The Importance of Context

- AI requires a massive corpus of data
- If you subscribe to a service, you must provide context
- Are you okay with sharing?



Keep Humans in the Loop!

# Leading practices for today's AI-augmented SDLC

- Keep humans in the loop
- Everything in source control including prompts
- Secure your vulnerabilities
- Don't provide your private info/IP into public AI engines

# The Big Picture

Adding AI to the Enterprise

- AI Strategy
- Governance and Managing Risk
- Ask Questions of AI Suppliers





Choose when and where to start







*AI-Augmented*

Designing Today's <sup>^</sup> Software Engineering Tool Chain



Looking Ahead

# The Evolving Role of Digital Platforms

- Making it hard for humans to make mistakes
- Codify leading practices
- "Pro Code"
- The jumping off point for GAI-augmentation and future agentic capability

# What does the SDLC look like over the next few years?

## Code

- Architectural Design
- GAI based pair programming
- Code & Unit Testing Generation
- In IDE Secure Code Vulnerability Solution
- ML assisted code review selection
- AI Assisted Code Review
- AI Enabled collaboration
- Suggestive Refactoring

## Plan

- Natural Language Requirements Gathering
- NLP Requirements Analysis for inconsistency and ambiguity
- GAI Epic and User Story Generation
- Effort Estimation using Neural Networks
- GAI-assisted Threat Model Policy Identification

## Release

- Compliance Validation
- Reinforced Learning-based models generate deployment scripts
- AI Enabled Failure Analysis
- Release Risk/Success Prediction
- AI Driven CI/CD workflow automation

- Dynamic Environment Provisioning and Deployment Optimization
- Realtime Rollback
- AI-assisted Log Aggregation
- ML Anomaly Detection
- GAI Deployment Scenario Simulations

More data silos, slower flow, more quality issues...?

## Build

- Aggregated Merge Request Analysis
- GAI-based identification of security vulnerabilities
- ML algorithm optimized build times
- AI-Assisted Security Vulnerability Detection
- Software Composition Analysis

## Test

- Natural Language Test Case Generation
- Test Data Generation
- AI Enabled test effectiveness predictions
- E2E Functional Test Execution
- Intelligent Failure/Self Healing Testing
- NLP based API based contract definition
- Intelligent Test Execution

## Monitor

- Event Correlation
- False Alarm Filtering
- Self-Healing Techniques
- Root Cause Analysis
- Observe system performance
- Usability Patterns
- Monitoring

## Operate

- Deterministic AI based ticketing and support allocation
- AI Based Self Healing Decision
- LLM Integration for Virtual Assistance
- GAI/GPT powered Knowledge Bases



Jensen Huang  
CEO@ NVIDIA

But what about  
this...

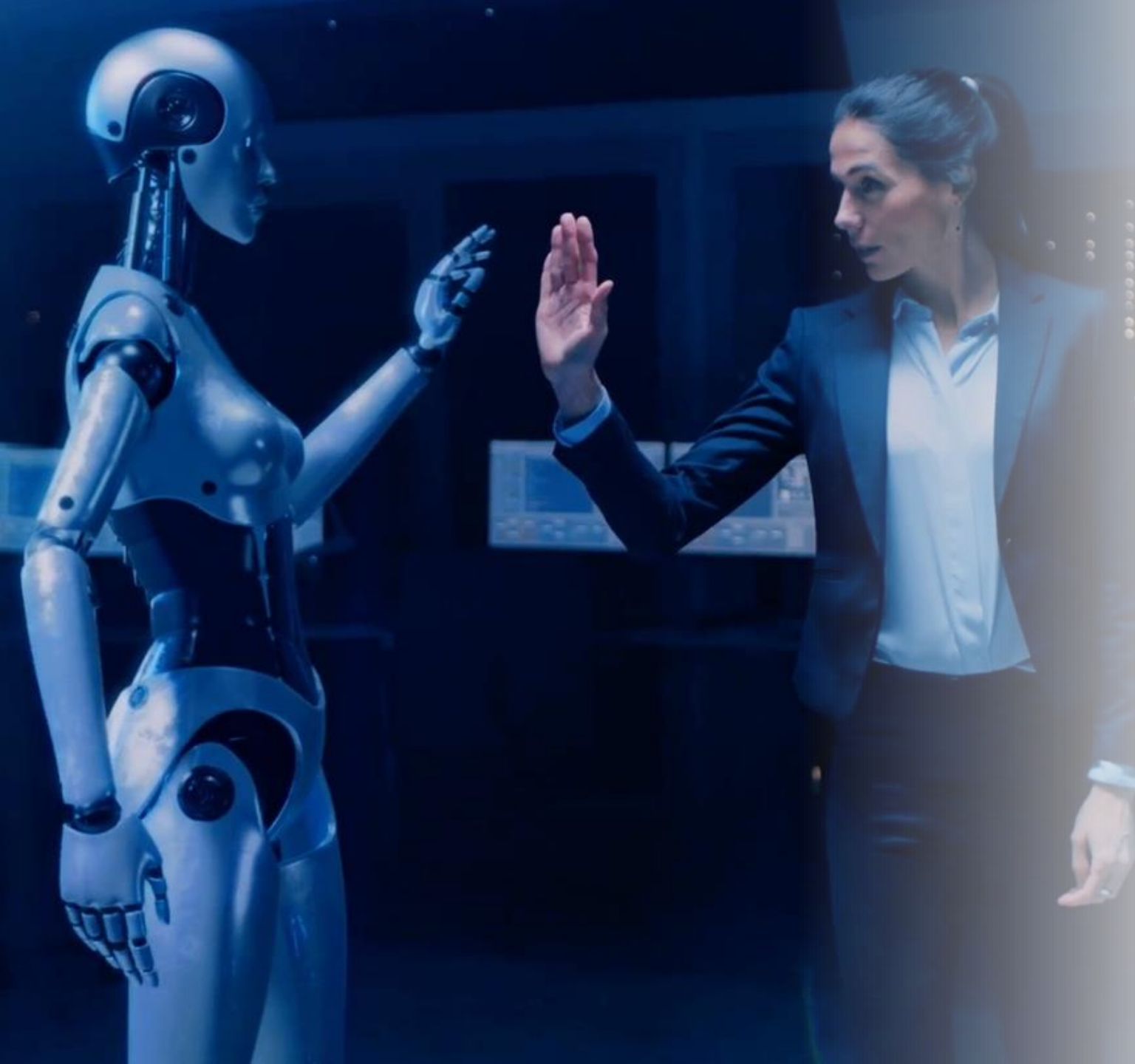
Is the future of  
coding dead?

When will AI-  
engineers join the  
team?



Scott Wu  
CEO@ Cognition AI





# AI/Human Teaming

Who will we  
optimize for?  
Humans? AI  
Agents?

# We can't put the genie back in the bottle

- Prompt engineering as a discipline
- Ethics of prompts
- Who owns the generated outcomes
- Human-Machine teaming
- Software team performance
- Trust and reliability in software outcomes





# Call to Action – Your Next Steps

- Make Cybersecurity as your highest priority
- Enable research and discovery for GAI usage
- Establish on reasonable guardrails
- Ask your GAI providers about
  - model quality
  - security
  - roadmap



# What I need from you...

- How do you think the SDLC will change?
- How is your organization preparing?
- What are you personally focusing on?
- Share your organization's story and lessons learned
- Share out new use cases and new tools



What matters are the humans.





[tbannon@mitre.org](mailto:tbannon@mitre.org) | alt: [Trac@tracybannon.tech](mailto:Trac@tracybannon.tech)



<https://www.linkedin.com/in/tracylbannon>



@TracyBannon



<https://tracybannon.tech>



**MITRE**

Disclaimer: The views, opinions and/or findings contained in this report are those of The MITRE Corporation and should not be construed as an official government position, policy, or decision, unless designated by other documentation.

# References

Academic Research, Industry Reports, Market Analysis

**Given the extensive bibliography, the content has been moved to a separate file for readability and ease of use.**



# Image Attributions

Slide 2 –

Paper map photo by Jakob Owens on [Unsplash](#)

<https://thevspotblog.com/2012/09/basic-emergency-supplies-for-car.html>

GPS Unit photo by Brock Wegner on [Unsplash](#)

iPhone photo by henry perks on [Unsplash](#) → Validate

Slide 3 – Car GPS photo by henry perks on [Unsplash](#)

Slide 4- <https://thevspotblog.com/2012/09/basic-emergency-supplies-for-car.html>

Slide 7 – crowd surf photo by Karsten Winegeart on [Unsplash](#)

Slide 8 – Twister photo by Nikolas Noonan on [Unsplash](#)

Slide 9-[https://en.wikipedia.org/wiki/Gartner\\_hype\\_cycle#/media/File:Gartner\\_Hype\\_Cycle.svg](https://en.wikipedia.org/wiki/Gartner_hype_cycle#/media/File:Gartner_Hype_Cycle.svg)

Slide 10 – 2024 Hype <UPDATE>

Slide 12 - DevOps Infinity Loop Inspired by SlideEgg

Slide 12 - DevOps Infinity Loop Inspired by SlideEgg

Slide 15 - Apprentice photo by Vance Osterhout on [Unsplash](#)

Slide 16 – One way sign photo by Brendan Church on [Unsplash](#)

Slide 17 –dipping Toes photo by Christopher Sardegna on [Unsplash](#)

Slide 18 – Team room photo by Arlington Research on [Unsplash](#)

Slide 24 – Elephant photo by Joaquín Rivero on [Unsplash](#)

Slide 26 – fatigue photo by brut carniollus on [Unsplash](#)

Slide 28 – Apprentice photo by Vance Osterhout on [Unsplash](#)

Slide 29 – Mirror Mirror photo by Milada Vigerova on [Unsplash](#)

Slide 31 – Beaver???

Slide 32- photo by National Cancer Institute on [Unsplash](#)

Slide 33 – Minimum CD.org

- Slide 34 – Uh Oh photo by Ben White on [Unsplash](#)
- Slide 35 – Highway Interchange photo by John Lockwood on [Unsplash](#)
- Slide 36 – Crewing photo by Peter Pryharski on [Unsplash](#)
- Slide 37 – library emil-widlund-xrbbXIXAWY0 on [Unsplash](#)
- Slide 38 – Apprentice photo by Vance Osterhout on [Unsplash](#)
- Slide 39 – Checklist photo by Glenn Carstens-Peters on [Unsplash](#)
- Slide 41 – two paths diverge photo by Vladislav Babienko on [Unsplash](#)
- Slide 42 - photo by Emmanuel Boldo on [Unsplash](#) ( tailor)
- Slide 42 - photo by Anthony Sebbo on [Unsplash](#) (off the rack)
- Slide 44 - Slide 16 - *DevOps Infinity Loop Inspired by SlideEgg*
- Slide 46 – Jensen Huang Image credit: Bloomberg via Getty Images
- Slide 46 – Scott Wu - Cognition AI
- Slide 47 – Generated with Getty’s permission
- Slide 48 – Horse’s end photo by Belinda Fewings on [Unsplash](#)
- Slide 49 – Runner photo by Nicolas Hoizey on [Unsplash](#)
- Slide 50 – Puzzle photo by Sigmund on [Unsplash](#)
- Slide 51– Apprentice photo by Vance Osterhout on [Unsplash](#)