NAVIGATING WHITEWATER:

PREPARING OUR STUDENTS FOR UNKNOWN CHALLENGES

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MAA Seaway
November 2, 2019

Think about a situation when you had to build on previous knowledge to solve a new problem.

What skill(s) or attitude(s) or experience(s) did you draw on?

http://1000thingstoronto.com/35-queen-st-bridge/

Embrace uncertainty

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Statistical Thinking

John Braun

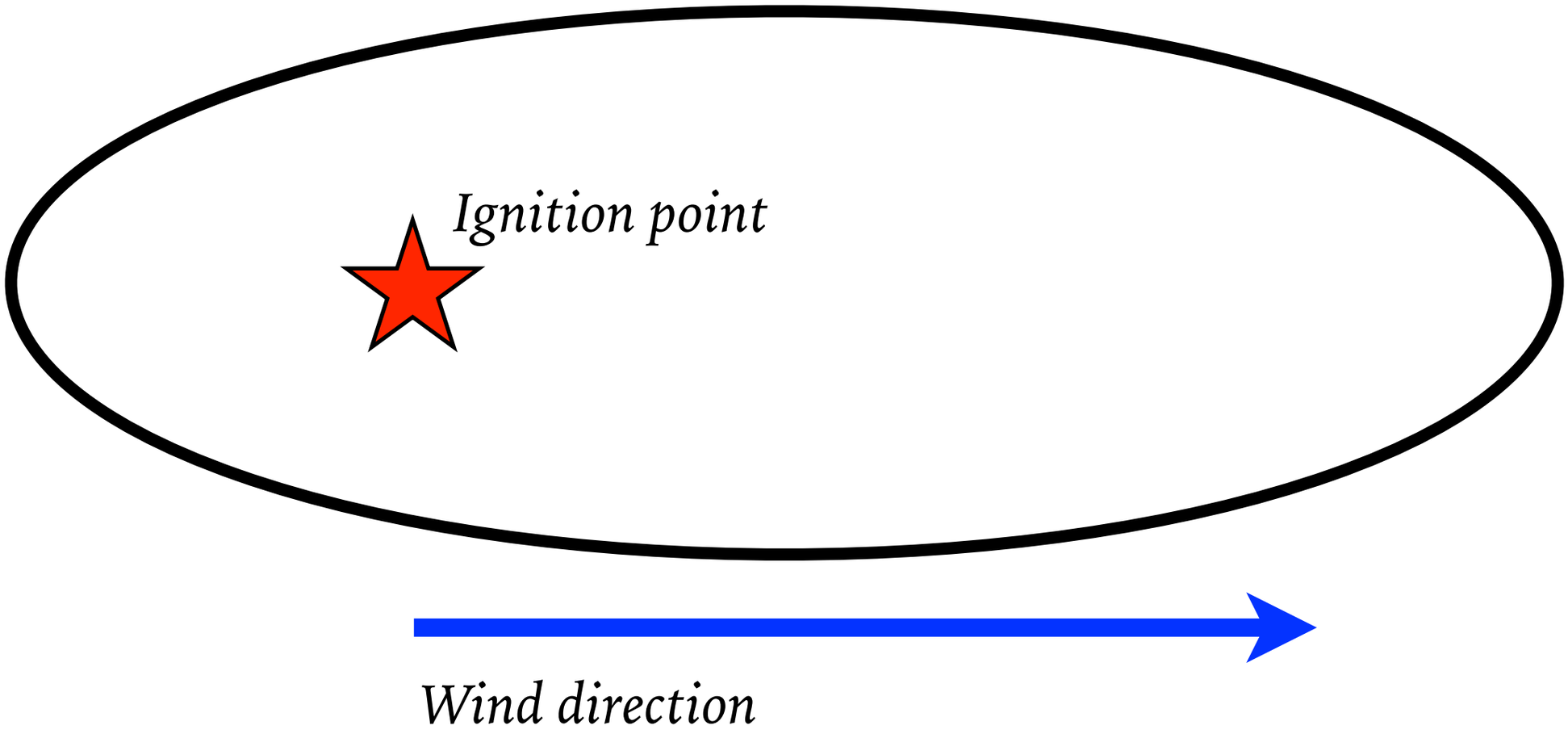
University of British Columbia

Fort McMurray, Alberta

2016

Where will the fire spread to be at a certain time?

Authorities used a model based on historical data, with inputs for weather, fuel, and topography.



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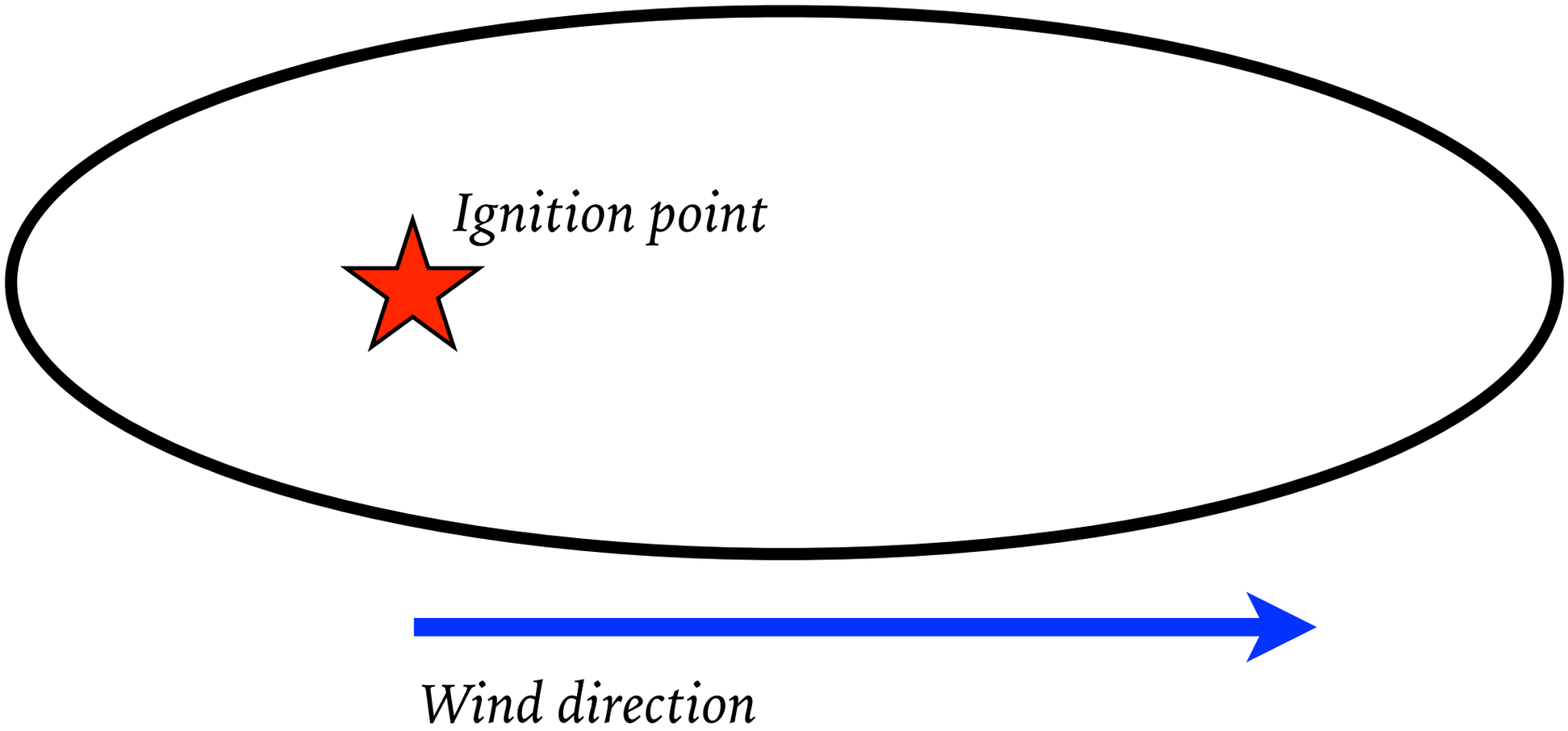

At noon, the model estimated that the fire would reach the town limits at 11pm.

Is it too early to divert resources to the evacuation?

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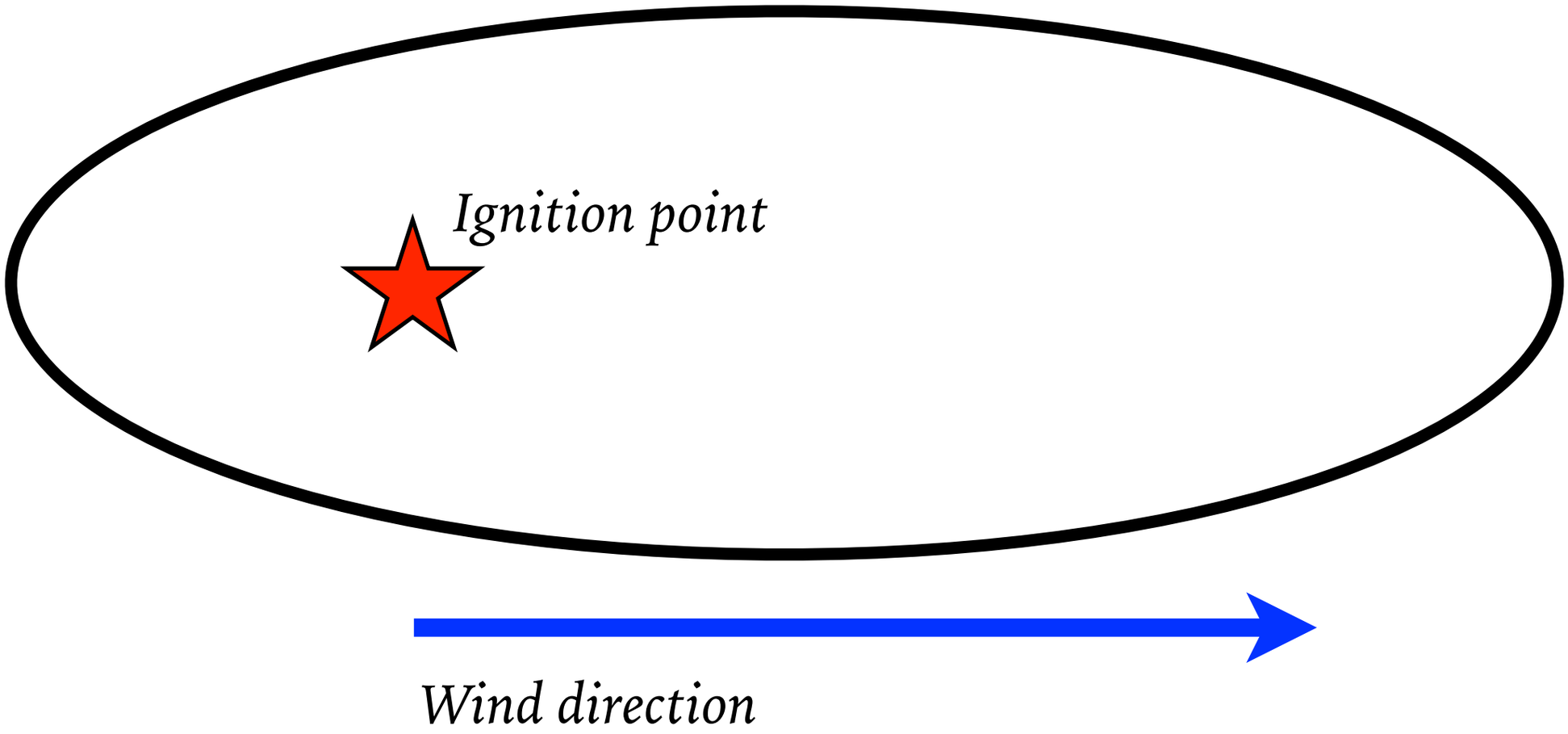

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Is it too early to divert resources to the evacuation?

The fire reached the city limits in 6.5 hours.

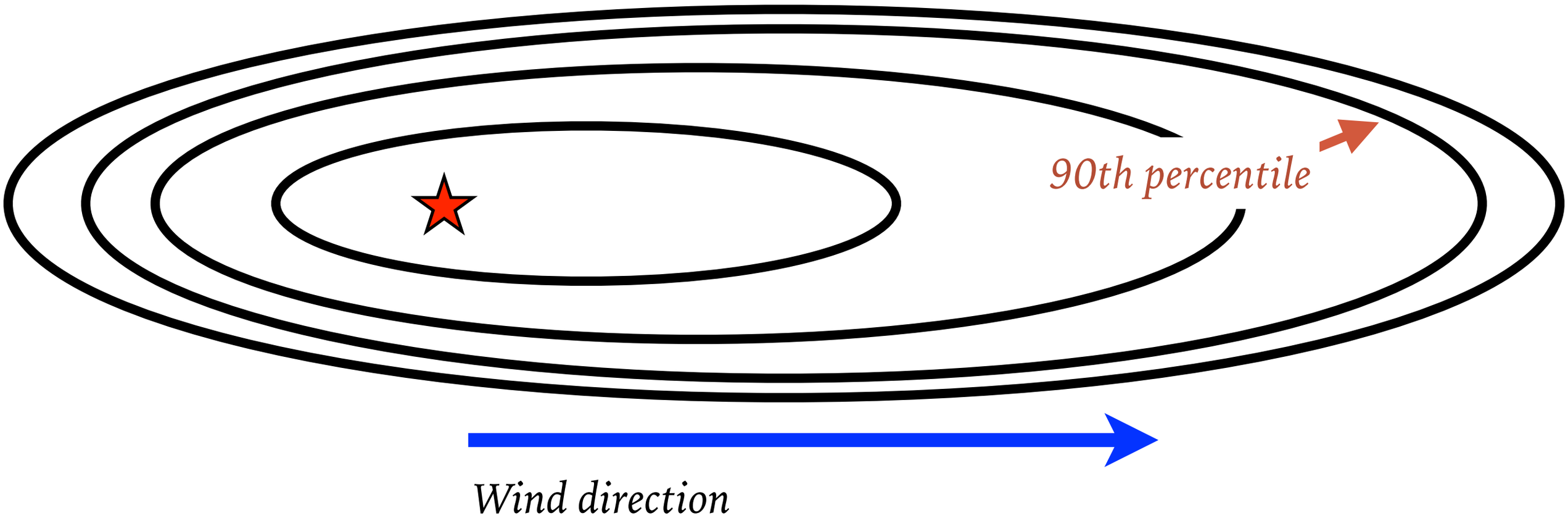
What's uncertain?

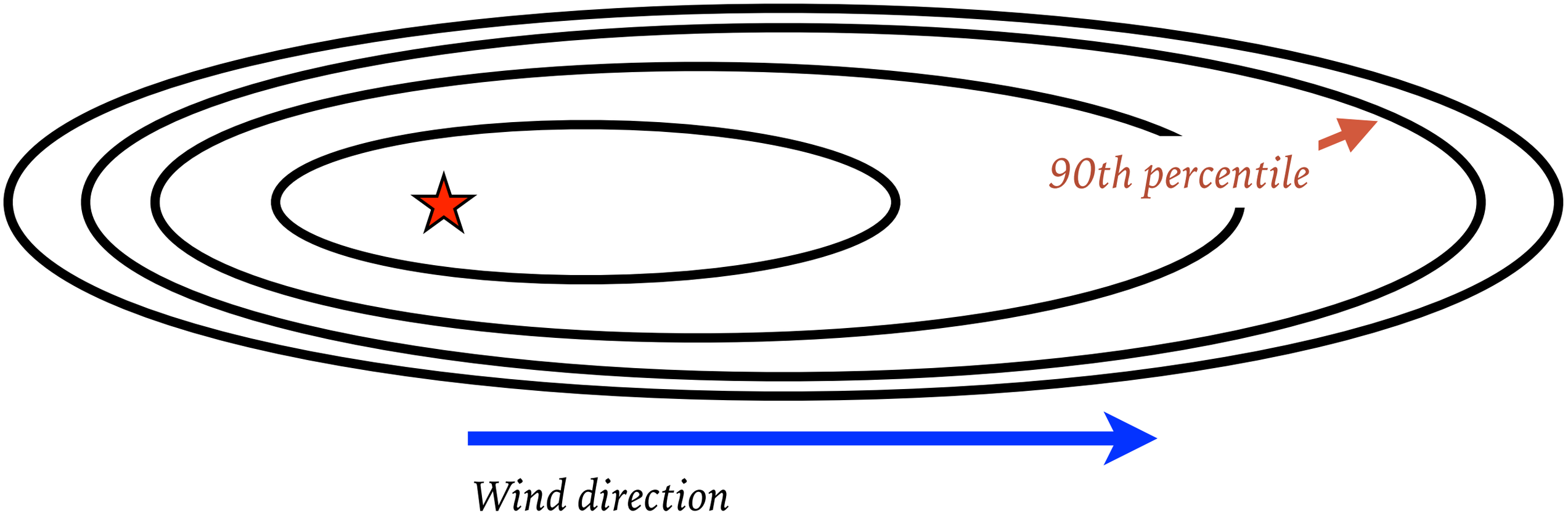
The post-mortem analysis:

Add in some statistical thinking…

- The model relied on inputs they could explain: some are observable and some not observable.

- The statistician exploited the unexplained variation in the historical data to create a probability distribution of envelopes for the fire spread.





The 90th percentile of the distribution estimated the arrival of the fire in town within 20 minutes of its actual arrival time.

Embrace uncertainty

A Necessity for Learning


Am. Eagle

"It's ok not to know

Expressing ignorance is encouraged

It's not OK not to have a willingness to learn"

Embrace uncertainty

Preparing our students for a lifetime of not knowing


Big Data

The Economist

Topics Current edition More

Regulating the internet giants

The world's most valuable resource is no longer oil, but data

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AN ADAPTIVE EXPERT

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- Able to innovate
- Continuous learner
- Seeks challenges
- Creative
- Has better developed meta-cognitive skills

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DEVELOPING ADAPTIVE EXPERTISE

- To help our students develop from routine to adaptive experts, the adaptive learning literature suggests we need to spend more time on the following educational approaches

Learning that emphasizes understanding	Opportunities to explore, discover, and struggle	Experience with lots of variations on problems

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- Not just procedural knowledge (how)
- Also conceptual knowledge (why)
- How knowledge connects

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Learning that emphasizes understanding	**Opportunities to explore, discover, and struggle**	Experience with lots of variations on problems

- Learning activities that promote building knowledge and formulating strategies
- Opportunities to struggle, confront errors and exceptions
- Need time to reflect on and articulate the process

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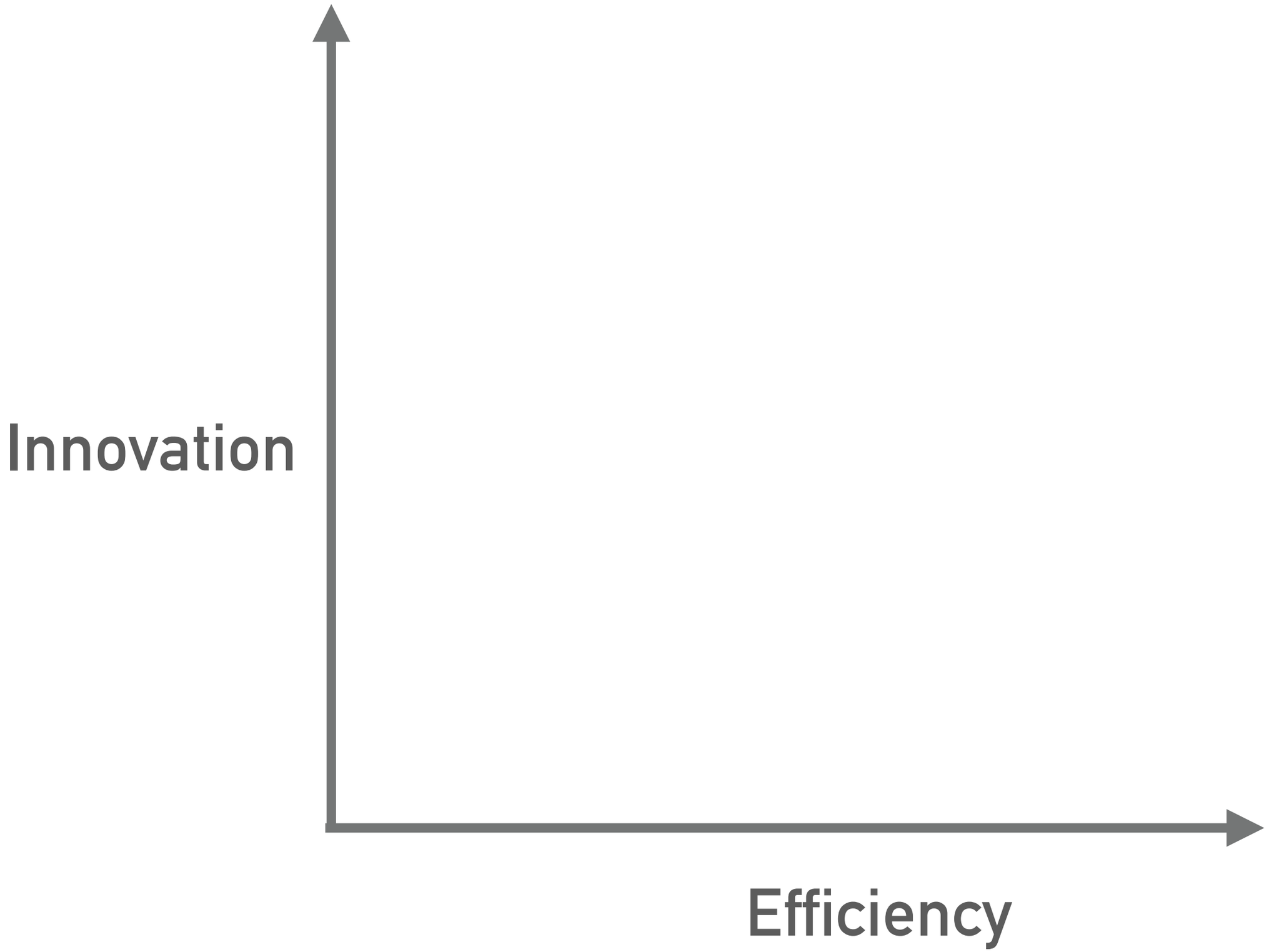
Learning that emphasizes understanding	Opportunities to explore, discover, and struggle	**Experience with lots of variations on problems**

- See concepts in multiple contexts
- Focus on differentiation
- Recognize when previously practiced procedures don't apply

A PATH TO ADAPTIVE EXPERTISE



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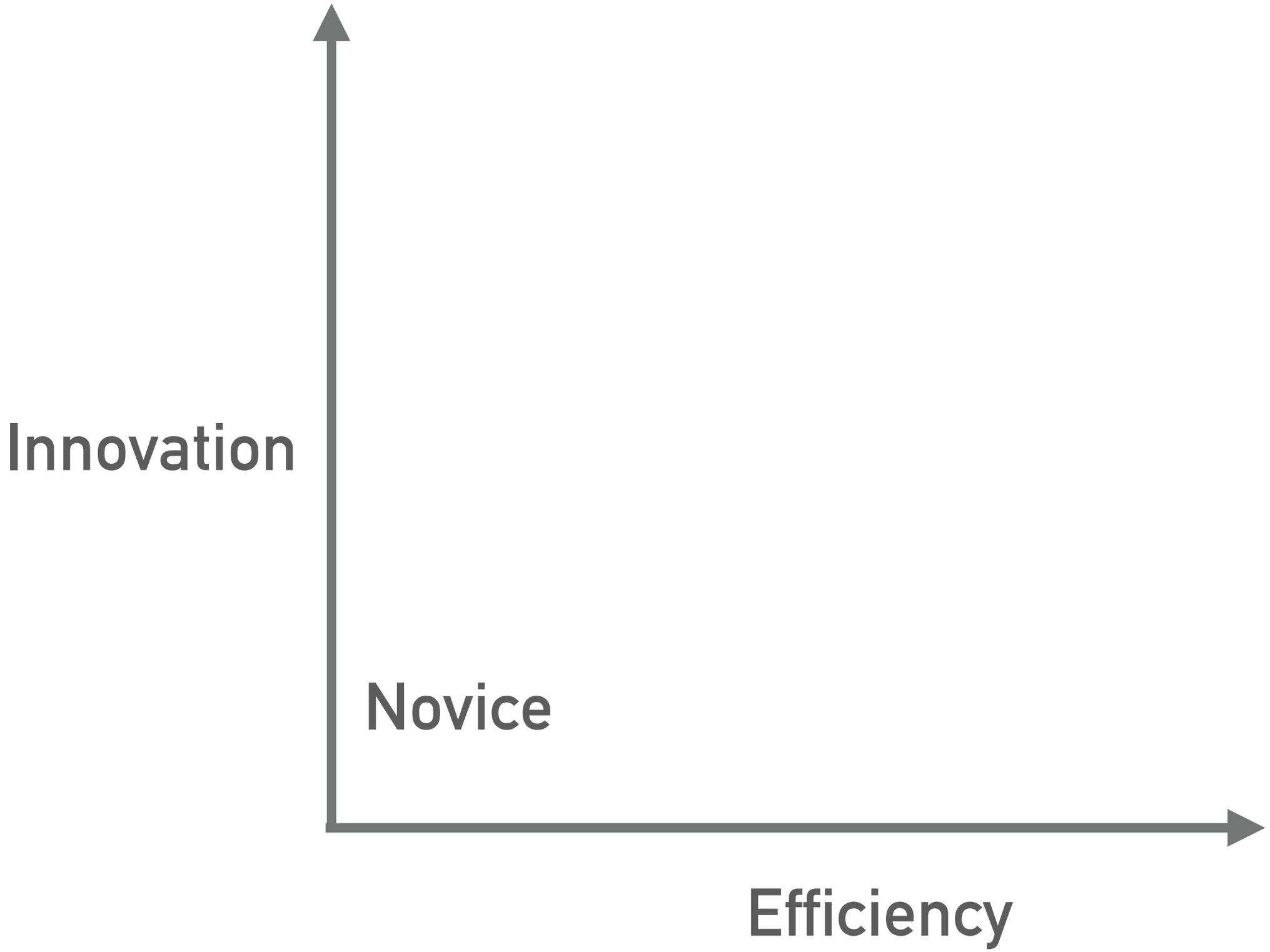

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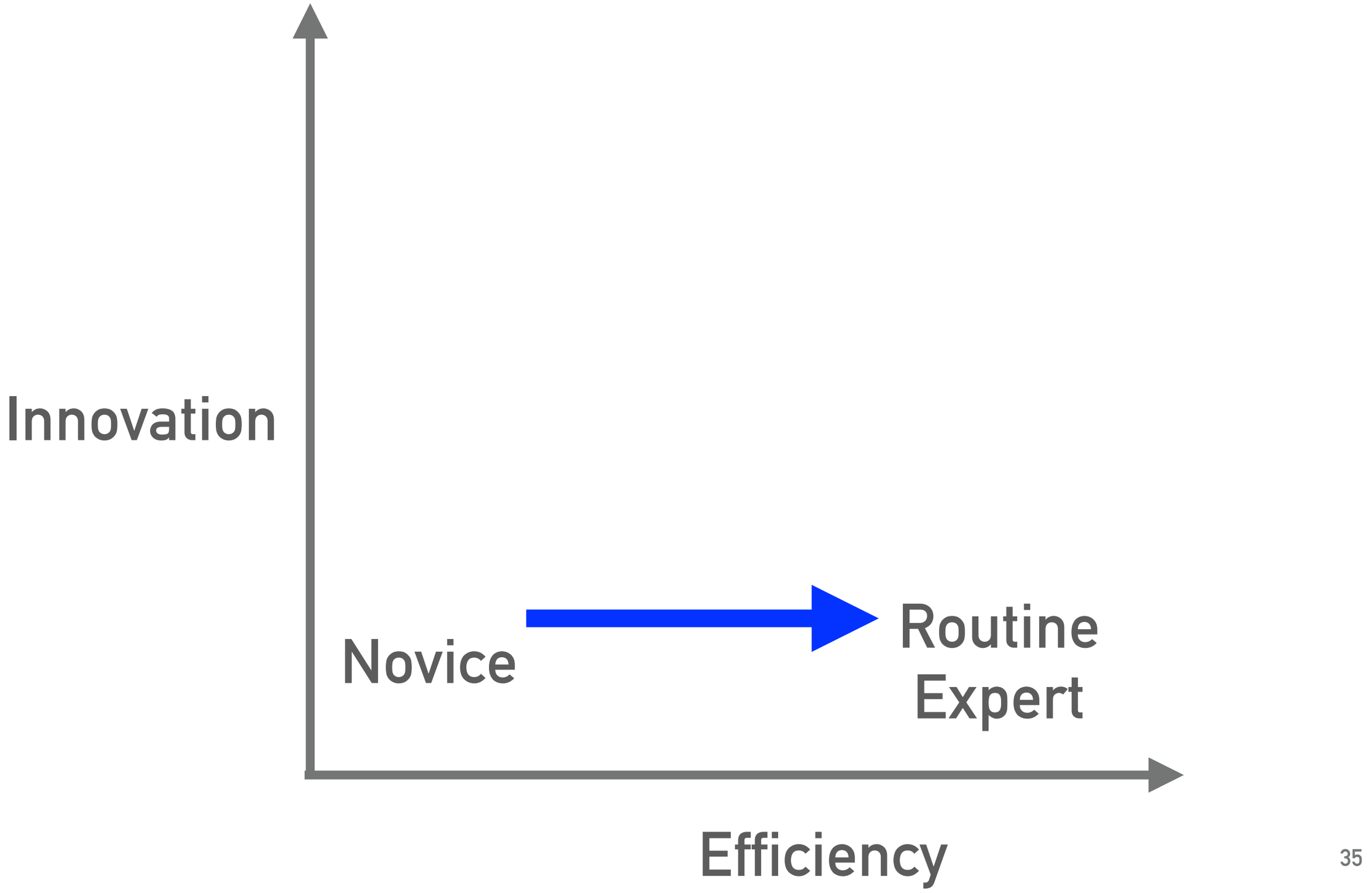

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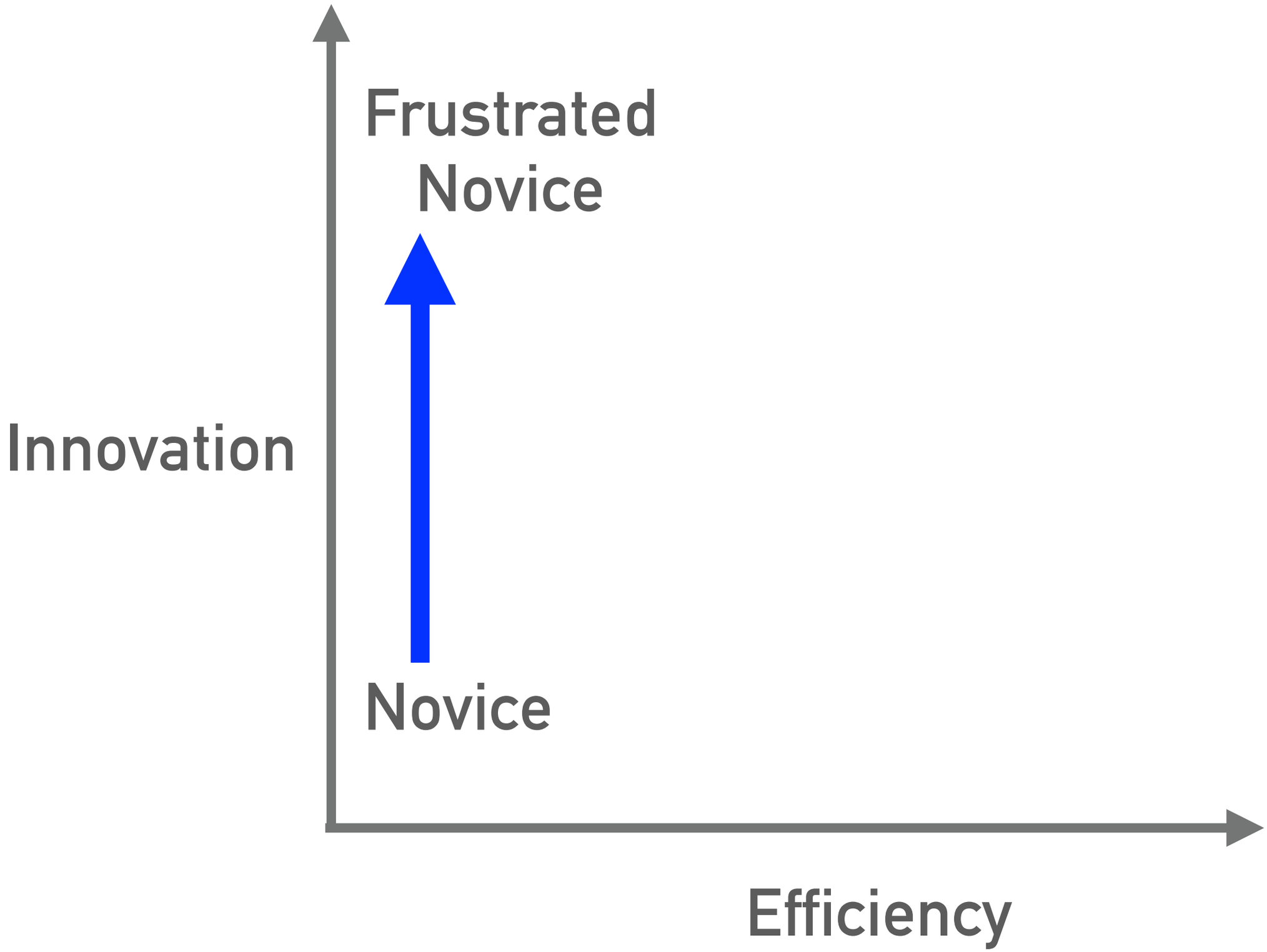

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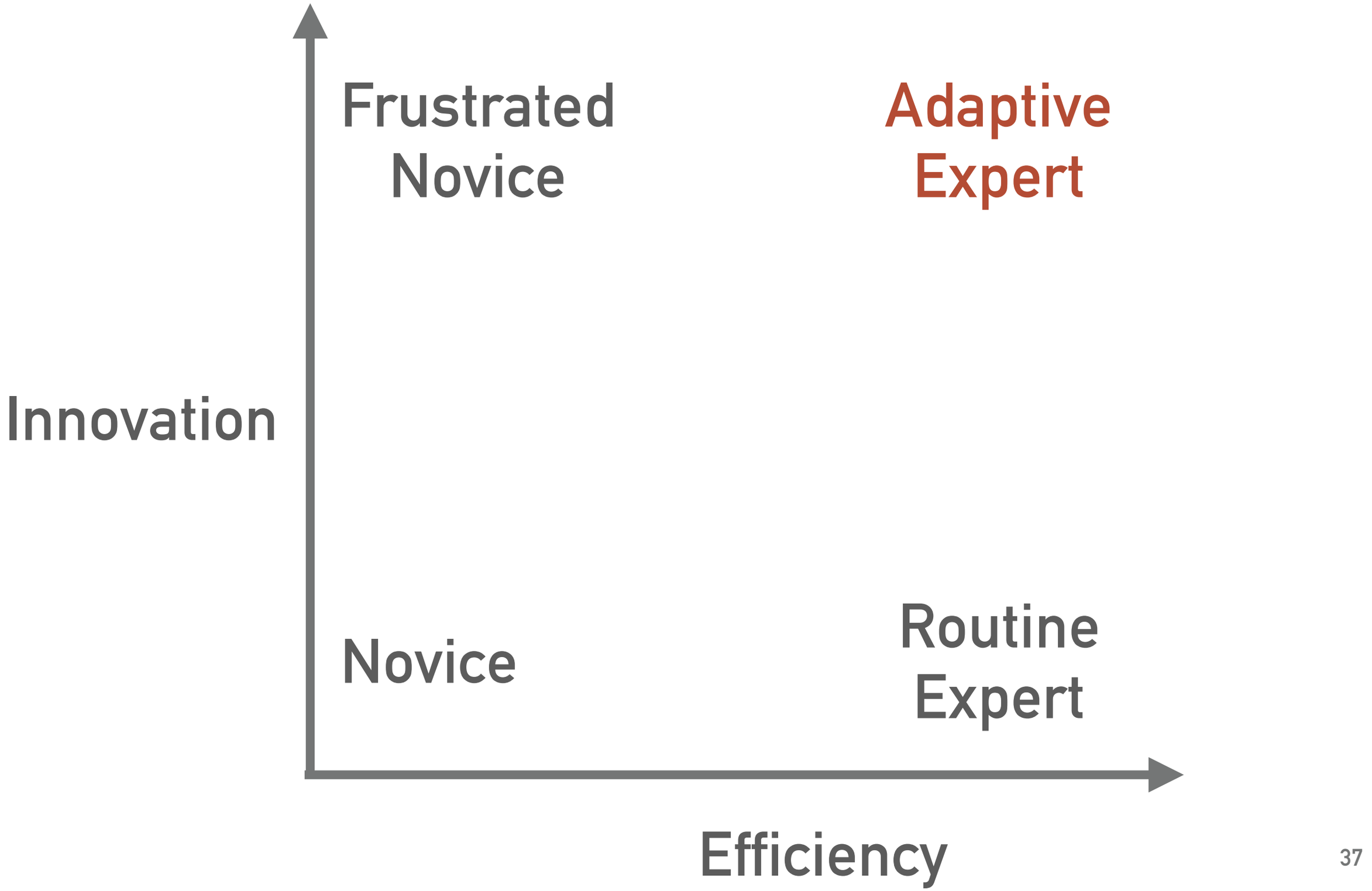

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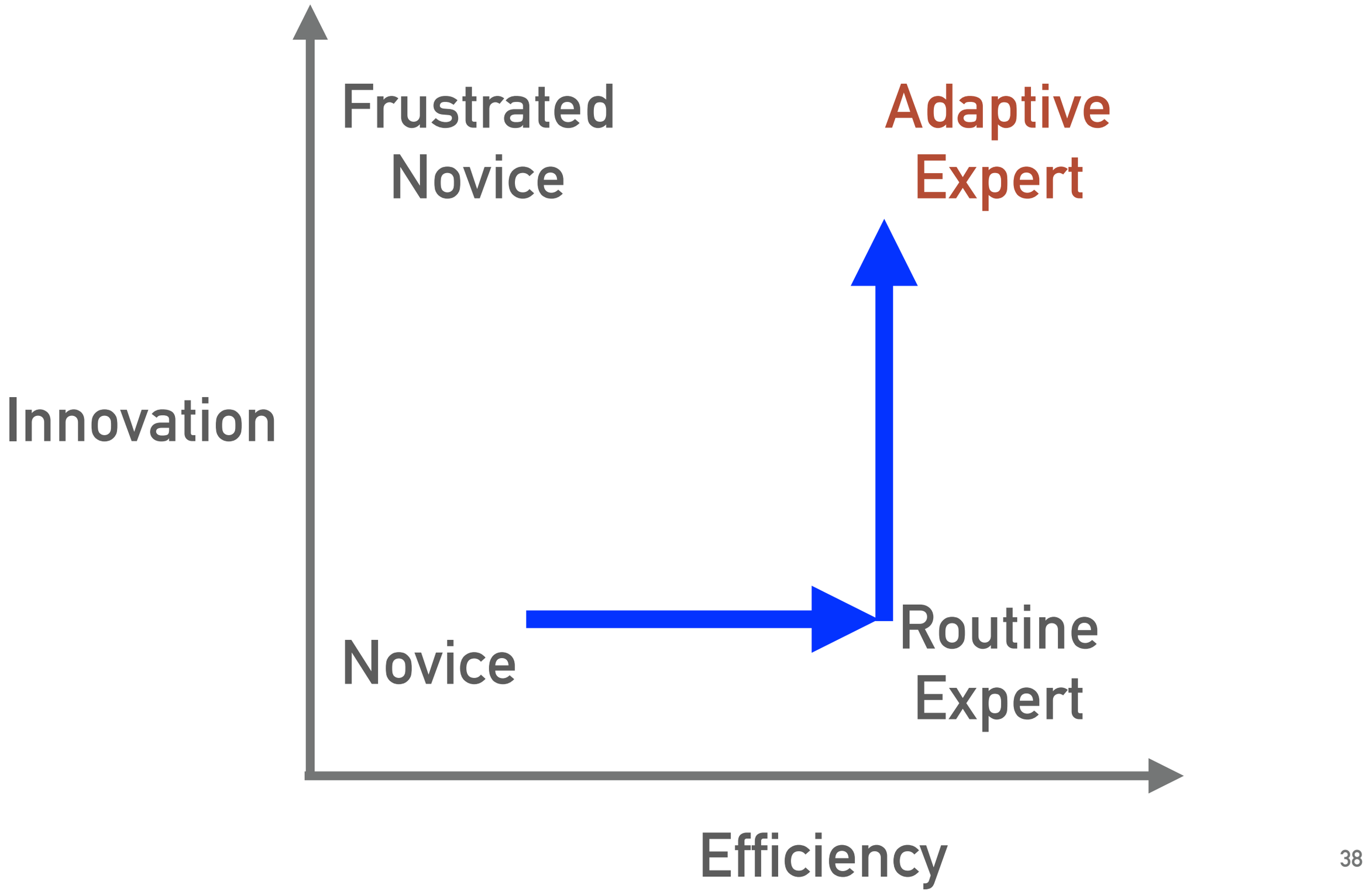

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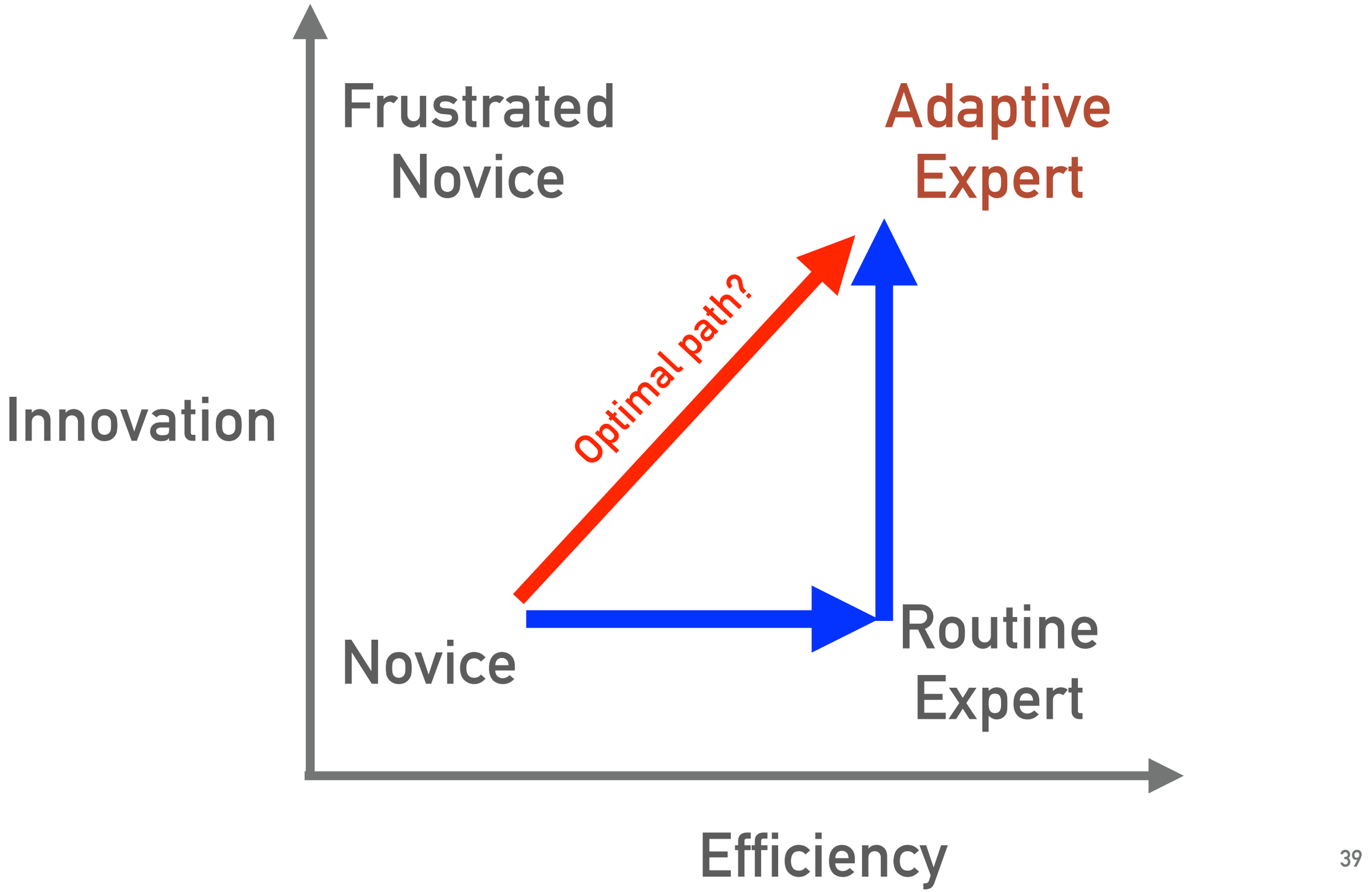


Develop efficiency and innovation starting in the first course

A course goal:

By the end of the course, we want our students to be able to do something **creative with data**, while demonstrating **appropriate statistical thinking**

and be able to **talk about it**.

THE CONTEXT

- First year course

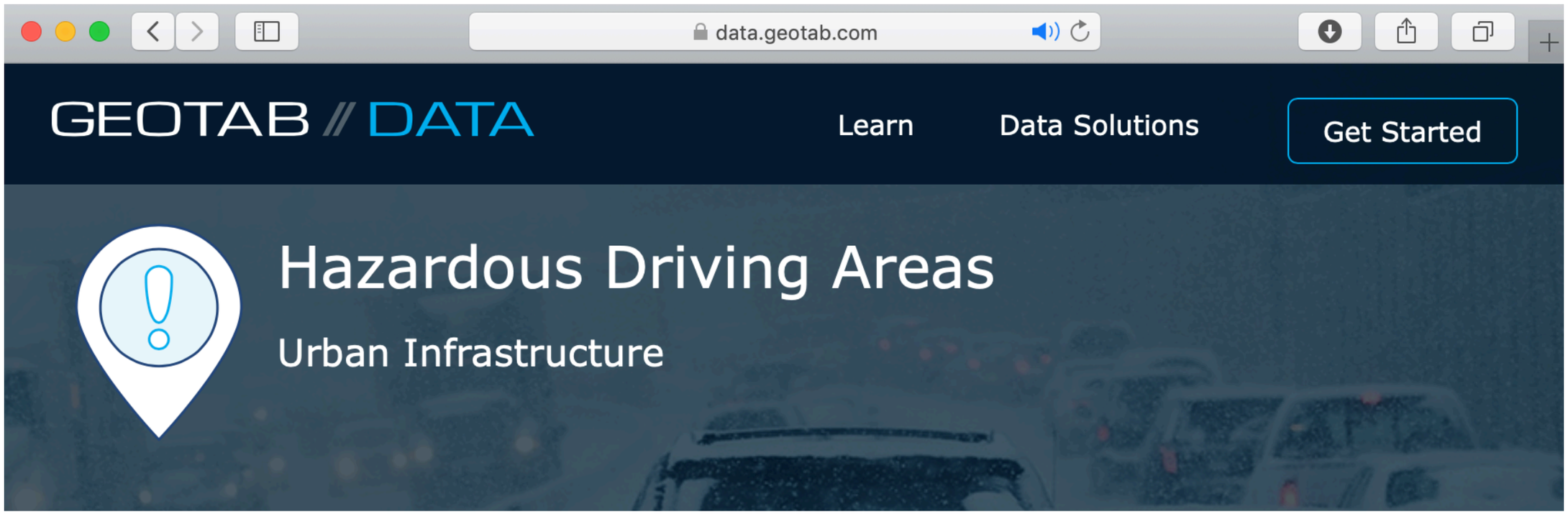
  STA130:

  Introduction to Statistical Reasoning and Data Science

~1000 students per year

sta130.utstat.utoronto.ca

FIRST YEAR COURSE: FINAL PROJECT DATA 2018



- Areas Of Idling
- Cell Coverage Dark Spots
- Hazardous Driving Areas
- Intersection Metrics
- Road Impediments
- Searching For Parking

Description

This dataset identifies hazardous areas for driving according to harsh braking and accident level events within a specific area. Each month a new set of dangerous driving areas is produced and encapsulates one year of rolling data (i.e. from the previous month back 1 year).

Associated with each area is a severity score that is based on the frequency of occurrences in the area and the severity of said occurrences.

Real-Time and Historical Incident Data for Accidents and Near-Miss Events

Around the world, over one million people die every year as a result of road traffic crashes, according to a study conducted by the World Health Organization (WHO). This number does not include the massive amount of non-fatal injuries and vehicle damage.

FIRST YEAR COURSE FINAL PROJECT 2018: HAZARDOUS DRIVING INCIDENTS

Given harsh braking, accident incidents, and an index measuring severity, location characteristics:

- What is hazardous driving?
- Where is there more hazardous driving?

Opportunity to creatively explore data, develop their own questions, in a context that is socially significant

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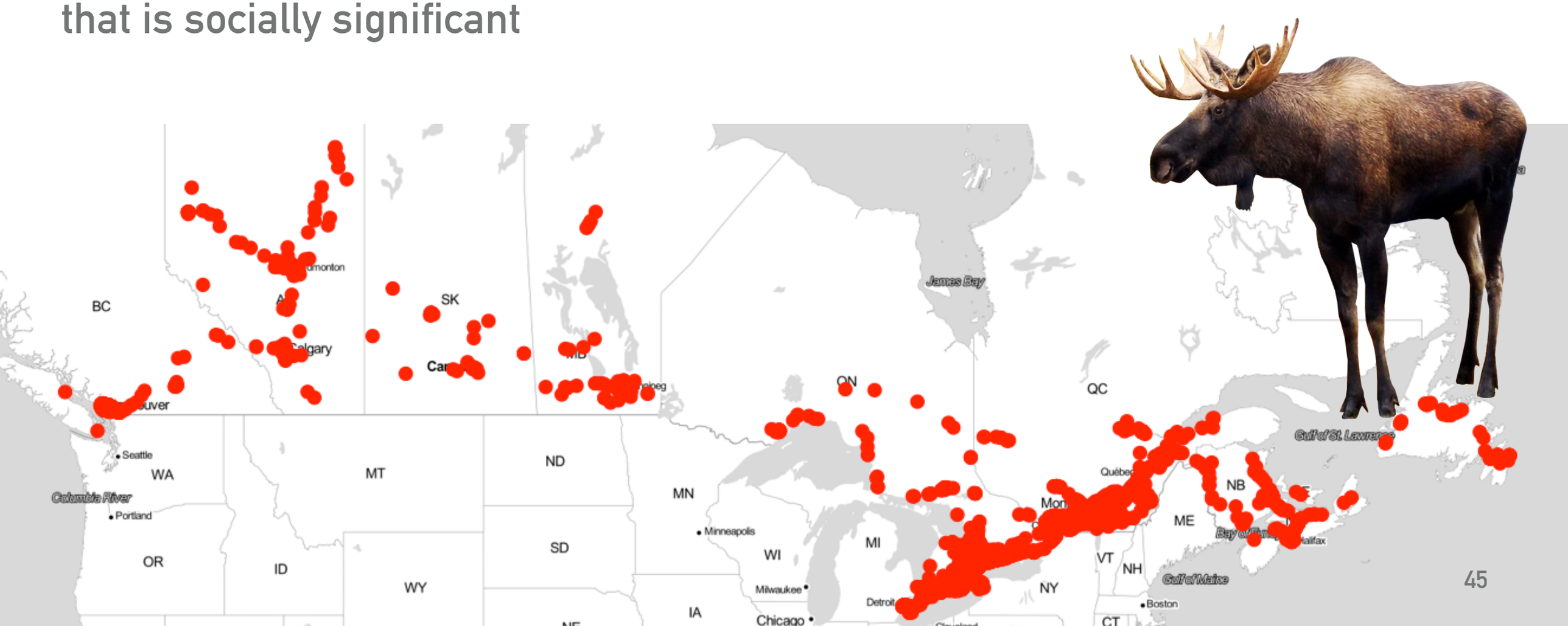

WHERE WE WANT STUDENTS TO BE AT END OF FIRST YEAR

<< Home

New Study: Be Alert to Moose Car Crash Risk

August 14, 2018

Author: Geotab, Data and Analytics Team

Like 9 Tweet G+ Share

A 2018 study by University of Toronto students using Geotab's Intelligence Data highlights the importance of being aware of hazardous driving areas, and particularly moose habitats. The risk of a moose car crash is no joke, especially considering the consequences. A collision with the animal which stands about 6 ft and weighing up to 1,500 lb could result in serious damage to a vehicle,

Headline:

"New Study: Be Alert to Moose Car Crash Risk"

A FIRST COURSE: STRUCTURE

Mondays

- Large lecture sections
- Data stories
- A new idea or method each week

- Practice problems
- One solution brought to tutorial for grading and discussion

Fridays

- Small group tutorials
- Random group assignments each week
- Oral or written communication exercise each week

Project

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ASSESSING ADAPTIVE EXPERTISE

- Why?
- What if?
- Why not?
- When does it work and when does it not?
- Given a new scenario, what questions would you ask? why? what do you hope to learn? how would knowledge affect what you would do next?
- Compare / contrast two approaches to a problem
- How confident are you?

Embrace uncertainty

What we don’t know is as important as what we do know

Miracle Cat Survives 20-Story Fall From Upper West Side Apartment Building

By Maurice DuBois July 13, 2011 at 11:45 pm **Filed Under:** Barry Myers, Gloucester, Manhattan, Maurice DuBois, miracle cat, New York City, Upper West Side

Who, What, Why: How do cats survive falls from great heights?

25 March 2012 Share

How cats can survive falling 32 stories high with limited injuries

Uma Sharma and Shira Polan Nov. 5, 2018, 9:00 AM

1987 study:

- 132 cats
- Fell from high-rise building
- Brought to a NYC emergency veterinary clinic
- 90% of treated cats survived
- Only 37% needed emergency treatment to keep them alive
- Cats who fell less than 6 stories had more serious injuries than cats who fell from higher stories

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CATS ARE AMAZING!

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These are the cats that were brought to the vet

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