# Analytics for Decision-Making

**Instructors/Creators:** Jen Schellinck, Tristan Shaeen

uOttawa

Institut de développement professionnel
Professional Development Institute

# Jen Schellinck

Bio

- CEO ['12 – now | Sysabee Inc.]
- Co-Founder ['18 – now | Data Action Lab]
- Co-Founder ['20 – now | AI Guides]
- Adjunct Professor ['09 – now | ICS, Carleton]
- Director of Modeling Methodologies ['09 – '12 | Cogniva]

Projects and Clients

- GAC; DFO; CATSA; CSPS Digital Academy, etc.

Specializations

- Unsupervised learning techniques
- Simulations

# Section 1:

## Orientation and Introduction to Concepts


Some Course Housekeeping
and Orientation

# Optional: Download Slides/Materials

https://www.data-action-lab.com/pdi_adm-may2024/

# Participant Requests and Expectations

Have something available for note taking and diagram sketching – could be old school (pen and paper) or digital

For Virtual: As much as possible, turn cameras on for ‘discussion mode’ – in particular during breakout room activities. Less important for ‘lecture mode’

We expect people will not be making personal recordings of these sessions

Be willing to participate in discussions – but totally okay if you wish to change the names and details of your stories to protect privacy.

# Course Audience


**Analysts who want to learn about decision making and how analytics fits in to this process.**

**Decision makers who want to learn about how to use analytics during decision making.**

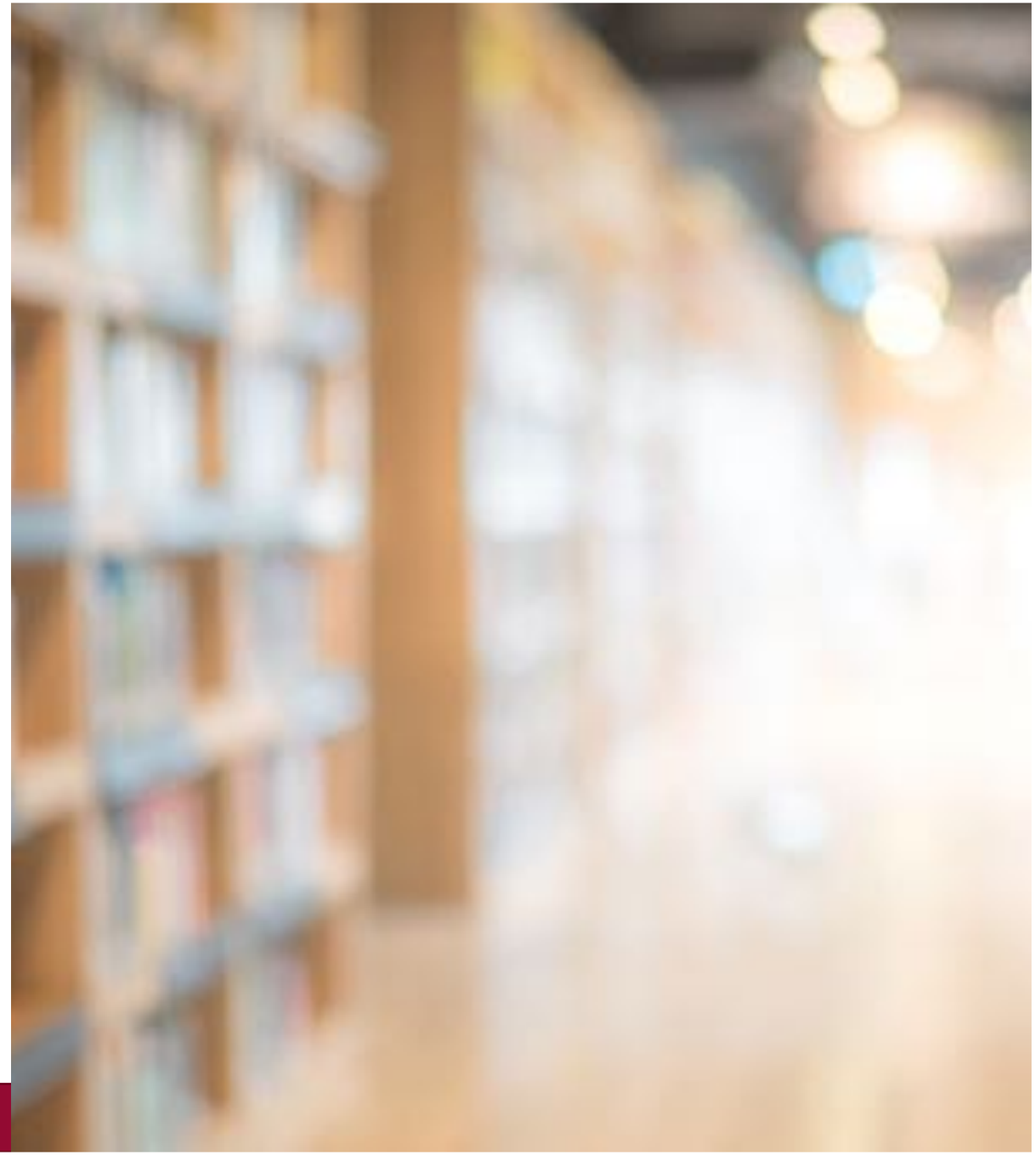
# Our Teaching Approach and Philosophy

People learn concepts by actively engaging with them.

People learn skills by practicing them.

The brain is a sponge but only with so much capacity: we try to keep lecture portions relatively short.

Empathy (understanding other roles) is an important element of practical learning.



# Introductions – Participants and Instructors

A bit about your background

Your typical roles in the decision making and analytics space

Optional: Why you are interested in this topic

# Let's Talk About Decisions in Your Own Life

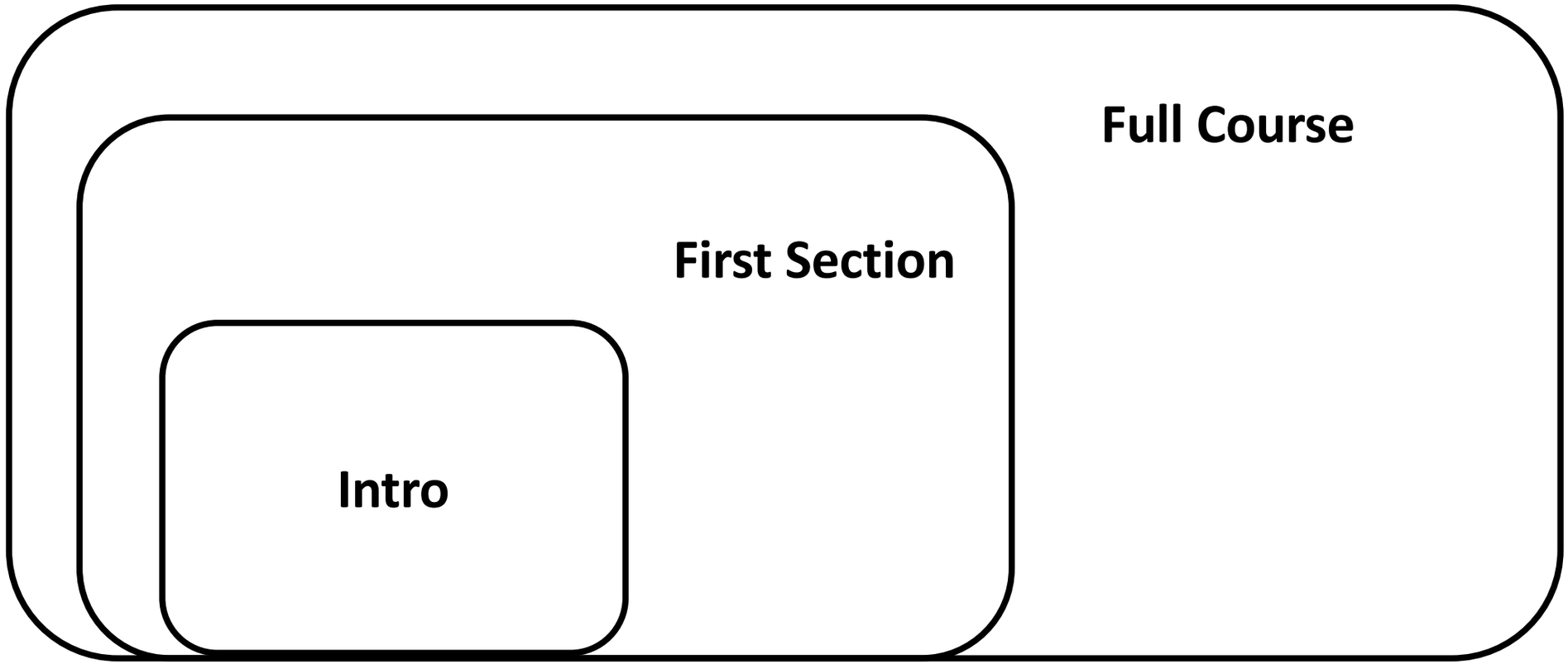
This course is space for you to think about decision making in your life – your work or personal life.

Maybe you're already an amazing decision maker - you have the know-how, you just need the labels.

First discussion:

- in your groups, take turns briefly chatting about a decision you each recently faced (could be work or personal)
- Did you make the decision from emotion or reason? Or both? Do you ever flip a coin?
- More generally, who in your life (work or personal) is a good decision maker, and why? Who is a good decision supporter?

# Course Structure: Three Passes, Increasing Depth



# Workshop Plan/Outline

## Section 1: Warming Up To Decision Making

- Housekeeping, Orientation, Introductions
- Introduction: Deciding to Decide!
- Getting into the Details of Decision-Making

## Section 2: Concepts and Data Deep-Dive

- Introducing Data
- Getting Further Into the Elements of Decision Making
- Where Does Analytics Come into Play?
- First Data Exercise (prep for Lab)

## Section 3: Human Factors in Decision Making

- Decision Making Frameworks
- Decision Making Gone Wrong
- Q&A with John Stroud

## Section 4:

- Lab – Putting it all together
- Final Reflections (if time!)

# Goals for this course

We want you to become better at decision making, as well as getting good at using analytics for decision making

We want you to understand how analytics fits into the larger context of decision making.

We want you to know when and how its appropriate to use analytics and data as part of decision making.

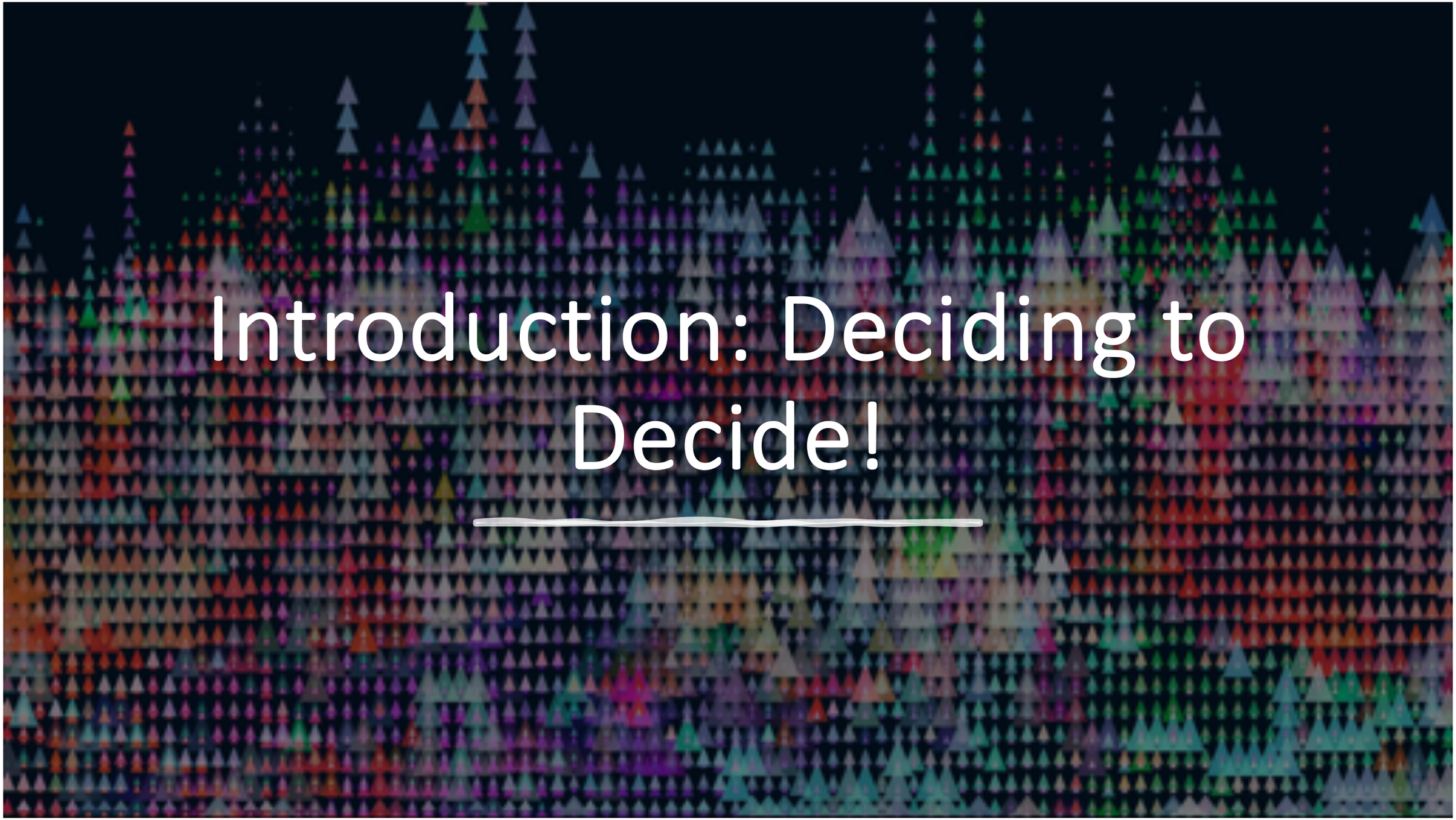
We want you to understand what it means to work with others to make decisions, and how different roles fit into that picture.

We want to help improve your level of decision theory expertise.

# Key Question(s) We Aim to Tackle

HOW DO I MAKE EVIDENCE | DATA | INFORMATION-BASED DECISION MAKING (INDIVIDUALLY OR IN A GROUP)?

WHEN SHOULD I USE EVIDENCE | DATA | INFORMATION-BASED DECISION MAKING?


Introduction: Deciding to Decide!

# Setting the Baseline: Decision Making without Thought

Flip a coin, read the tea leaves.

You still have to know **the choices**, though.

After that, this approach cuts out everything else (at least in principle).

Would asking an all-knowing oracle (or perhaps an AI) that we could totally trust be better?

Until that comes along (hint – it hasn't yet. And also – free will?) we are still in the space where we need to make decisions.

You are the owner of a struggling racing team, fighting to keep your lifelong dream alive. It's the day of the final race of the season - the Grand Prix - and your hopes are resting on today's result. You're currently teetering on the brink of bankruptcy and need a good finish today to secure the prize money that will keep your team afloat for another year.

Your ace driver, a veteran with years of experience under his belt, is aware of the team's predicament. He's loyal to the core, a true embodiment of team spirit, ready to drive his heart out for the team's survival.

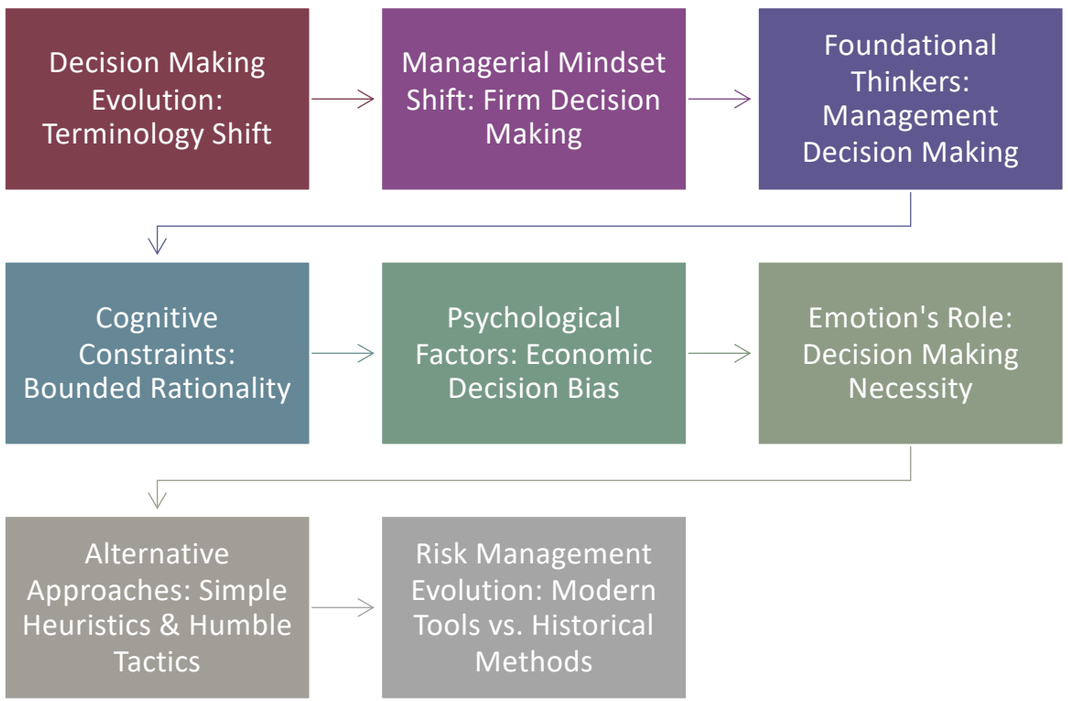
In the early hours of the race day, your chief mechanic, a grizzled figure with grease-stained overalls and hands that have repaired a thousand engines, brings an unsettling issue to your attention. The "Turbo Couplers", the crucial components that connect the engine to the turbocharger, boosting your car's speed, have never been tested under the day's projected cold weather conditions.

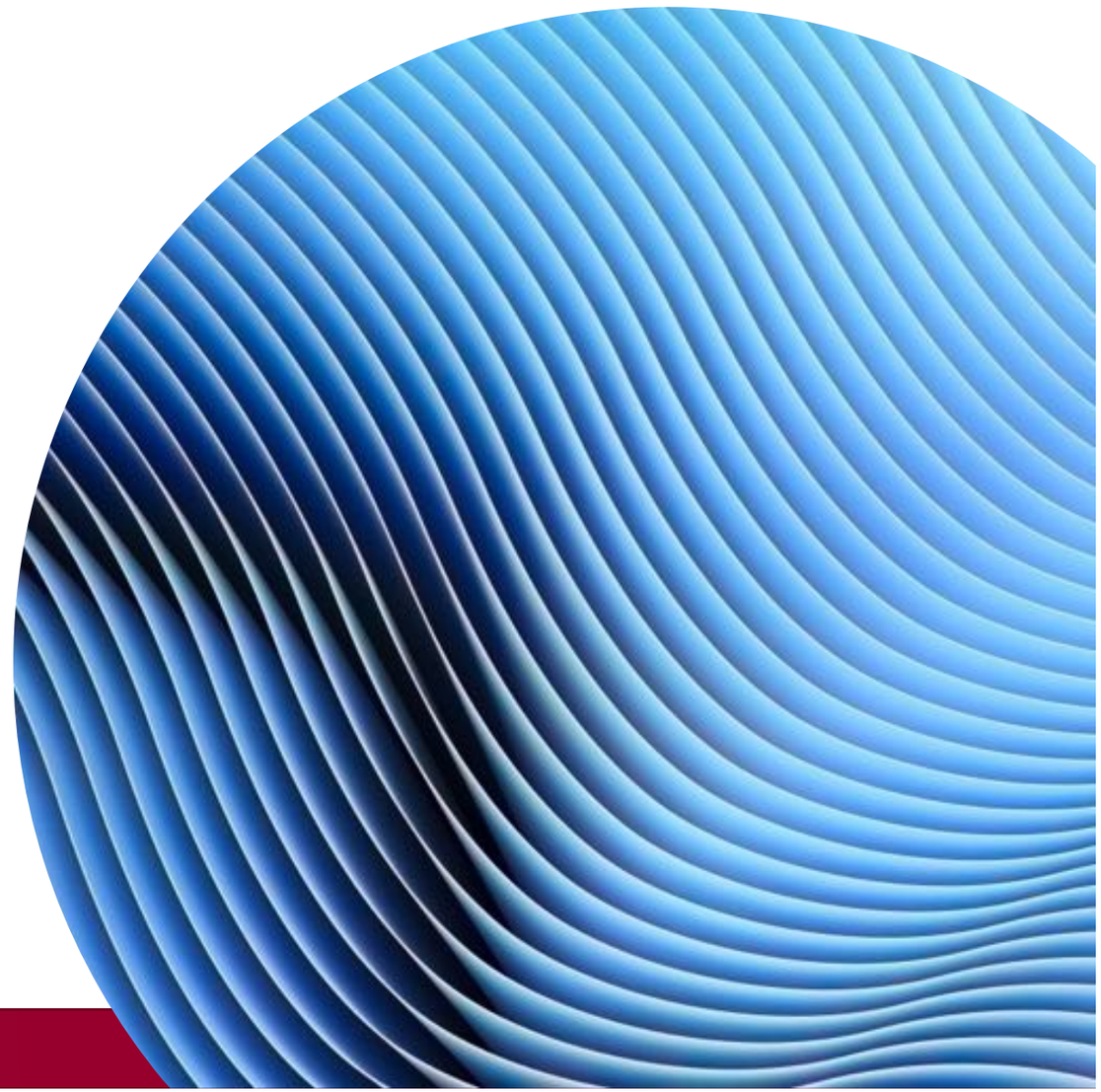
The mechanic explains that all previous races had temperatures of at least 18 degrees Celcius. But today, a cold front has brought in a bone-chilling -1 degree Celcius. The Turbo Couplers might fail under these conditions. If they do, the car will lose its turbocharged speed, making a top finish impossible, and the car might even crash.

With the weight of this information heavy on your shoulders, you share the concern with your driver. He looks at you, determination burning in his eyes, and says, "Boss, I'm ready to drive. I know the risks, but this is our shot. Let's do it." What do you do?

See: http://www.freedomsummercollegiate.org/teacher-blog/2019/6/13/classroom-update-from-searching-for-extraterrestrial-life-and-behavioral-psychology-by-marjorie-cantine-and-jonathan-tugman

# The History of Decision Making



Source: https://hbr.org/2006/01/a-brief-history-of-decision-making

# History of Evidence Based Decision Making

Rooted in the evidence-based medicine movement that arose in the 1990's (term "evidence-based medicine" first used in 1990 by Gordeon Guyatt)

The concept of evidence-based policy (or governance) in a medical context quickly followed. This was also connected to evidence-based practice more broadly.

Gained even more momentum in the 2000's. Coincided with a rise in availability of data.

The adjective "data-driven" started to be popular around this time (although, see "data journalism", Wattenberg, 1960).

# Impacts of Evidence Based Decision Making In Medicine

From: Evidence-based practice improves patient outcomes and healthcare system return on investment: Findings from a scoping review. (Connor L, Dean J, McNett M, Tydings DM, Shrout A, Gorsuch PF, Hole A, Moore L, Brown R, Melnyk BM, Gallagher-Ford L.)



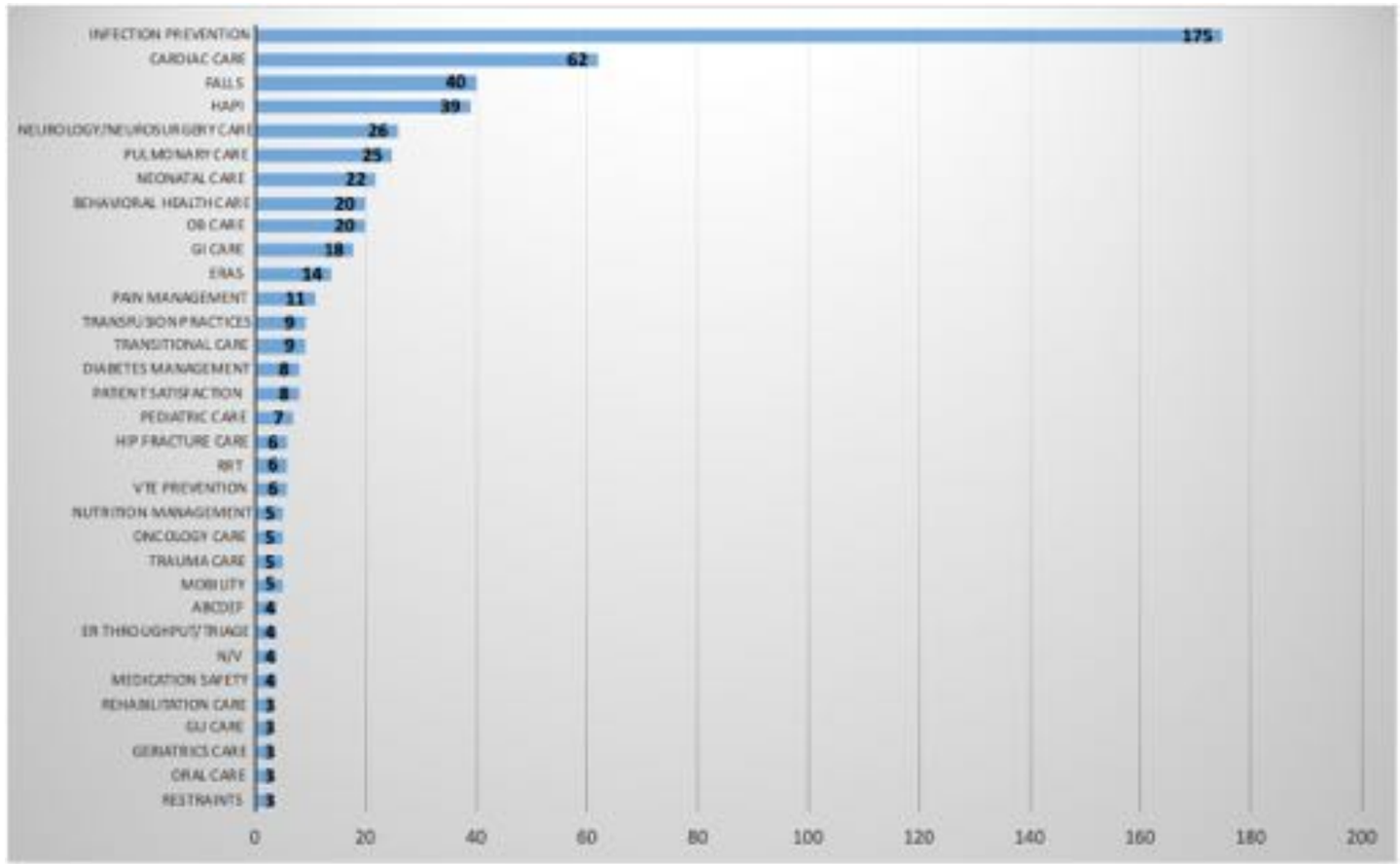
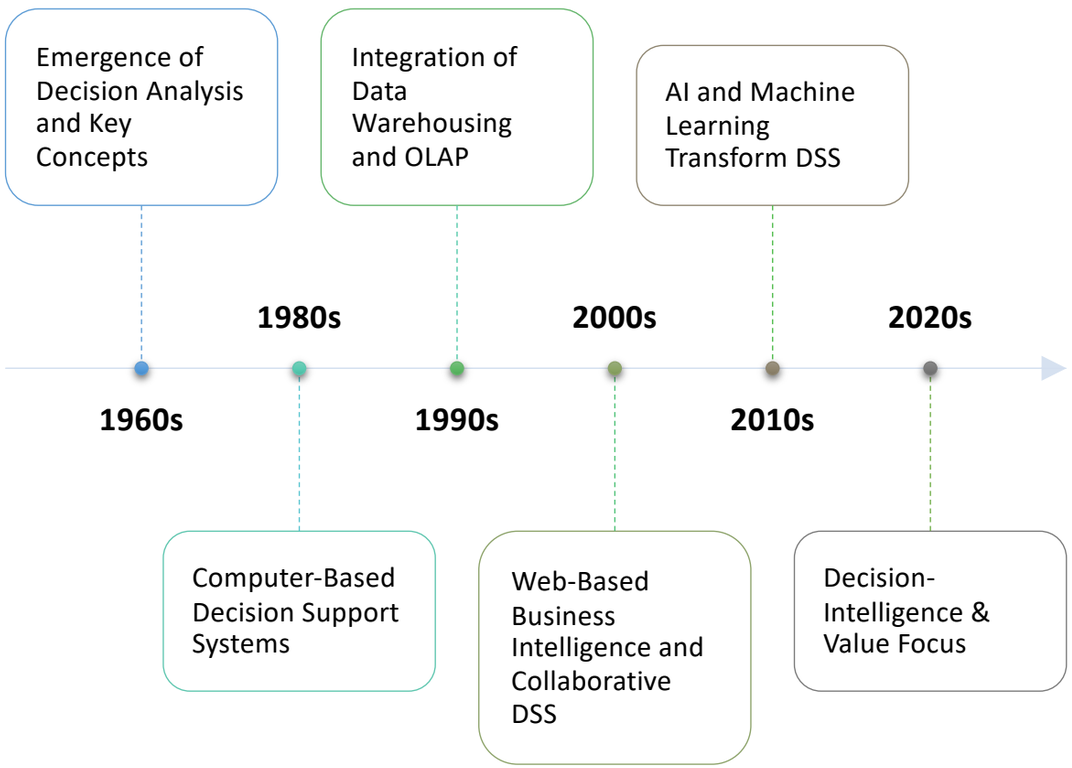
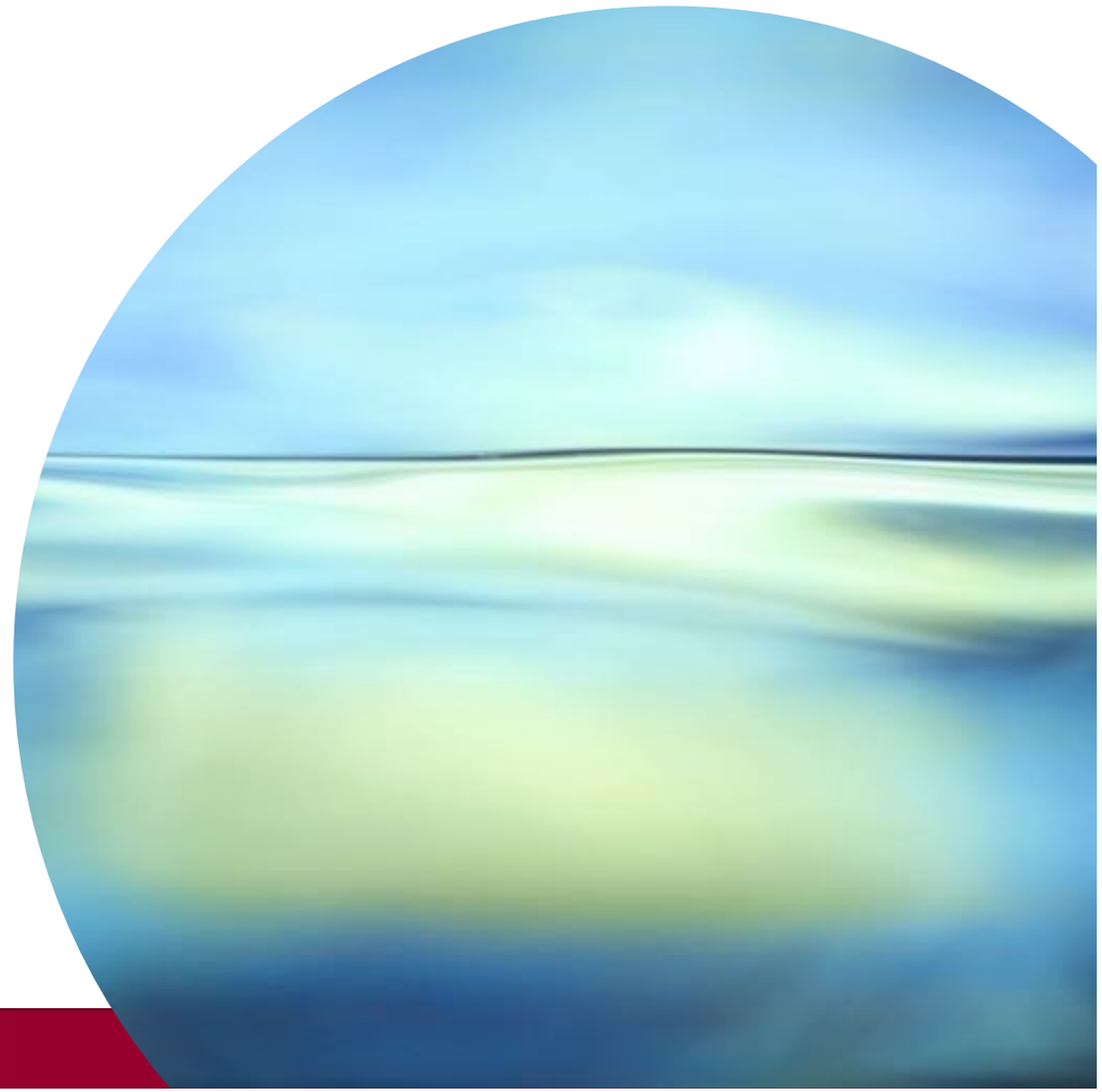



FIGURE 2 Types of EBPs implemented: EBP domains

# Decision Intelligence Timeline



Source: https://www.linkedin.com/feed/update/urn:li:activity:7067494749548498944/

# Key Players and Study Areas

Daniel Kahneman: A Nobel Prize-winning psychologist known for his work in behavioral economics and decision-making under uncertainty. His research, particularly on heuristics and biases, has greatly influenced decision theory and intelligence.

Gary Klein: A cognitive psychologist renowned for his work on naturalistic decision-making and expertise. He has written extensively on the subject and is considered a leading authority in understanding how experts make decisions in real-world settings.

Cassie Kozyrkov: Chief Decision Scientist at Google. She is a prominent advocate for decision intelligence and has contributed extensively to the development and application of decision-making frameworks in organizations.


Richard Thaler: A behavioral economist who won the Nobel Prize in Economics for his contributions to understanding irrational decision-making. His research on nudges and choice architecture has had a significant impact on decision-making theory and practice.

Sheena Iyengar: A psychologist known for her research on choice and decision-making. Her work focuses on understanding how people make choices and the implications of choice overload. She has made significant contributions to the study of decision-making in various contexts, including business and consumer behavior.

Annie Duke: A former professional poker player turned decision strategist and author. Her work focuses on the application of decision theory and cognitive psychology principles to improve decision-making in various domains, including business and personal life.

# The First "Decision Scientist": Kozyrkov

*"A lot of the training that data scientists have assumes that the decision maker knows exactly what they need and the question and problem are framed perfectly."*

Need for a "Decision Scientist" arose from Google's adoption of machine-learning.

But, the algorithm is only as good as the data it is trained on, which is full of human decisions.

Therefore, we need a principled approach to human decision making (i.e., the decision scientist!).

Otherwise, decisions may be steered by unconscious bias rather than the data itself.

Source: https://www.fastcompany.com/90203073/why-google-defined-a-new-discipline-to-help-humans-make-decisions

# Kozyrkov's Take on When Data Should Get Involved

Doesn't think data always needs to be involved in a formal sense.

Distinguishes between data inspired decision making and data driven decision making.

If you already have your preference, and there is nothing that would change your mind, there is no need to turn to the data! Make your decision and call it a day.

But, be mindful of your biases…

# Confirmation Bias

- Tendency to seek out information that confirms preexisting beliefs or hypotheses.
- Disregard or dismissal of evidence that contradicts one's beliefs.
- Interpretation and memory of information in a way that supports existing views.

# Buy it or Leave it?

Consider a situation where you are shopping with your friend and a brand new shirt catches your eye.

Do you:

- A) Look a the price before making your decision?
- B) Decide what the price would have to be to make your decision one way or the other, then look at the price.

Kozyrkov has an opinion about this scenario.

# Kozyrkov's decision making process

1

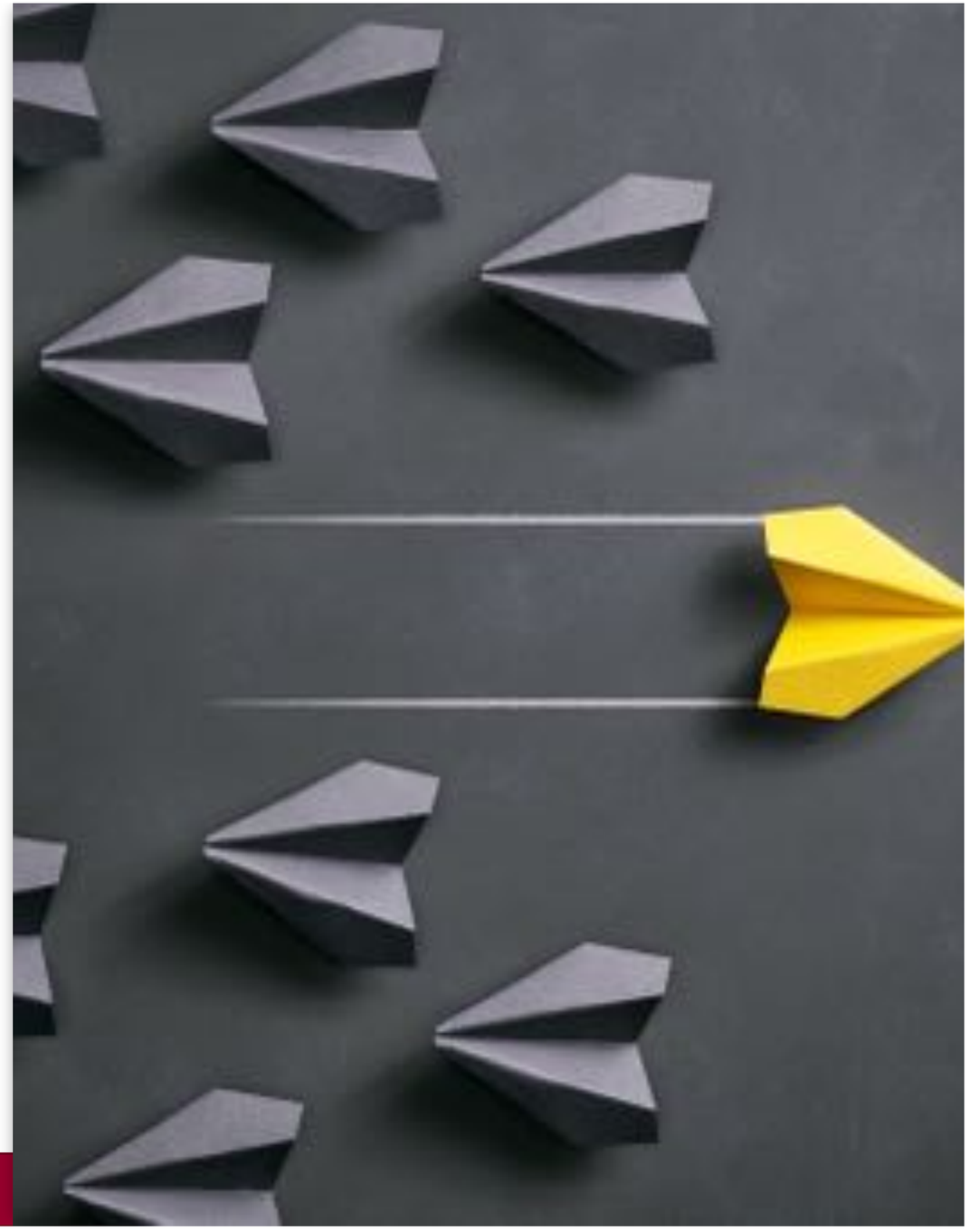
Determine how you will make the decision with no additional information (what would the default choice be?)

2

Define how you would make the decision if you had access to any information you wanted. What would it take to convince you otherwise?

3

Look at whether you can access all the data you ideally want to make the decision.



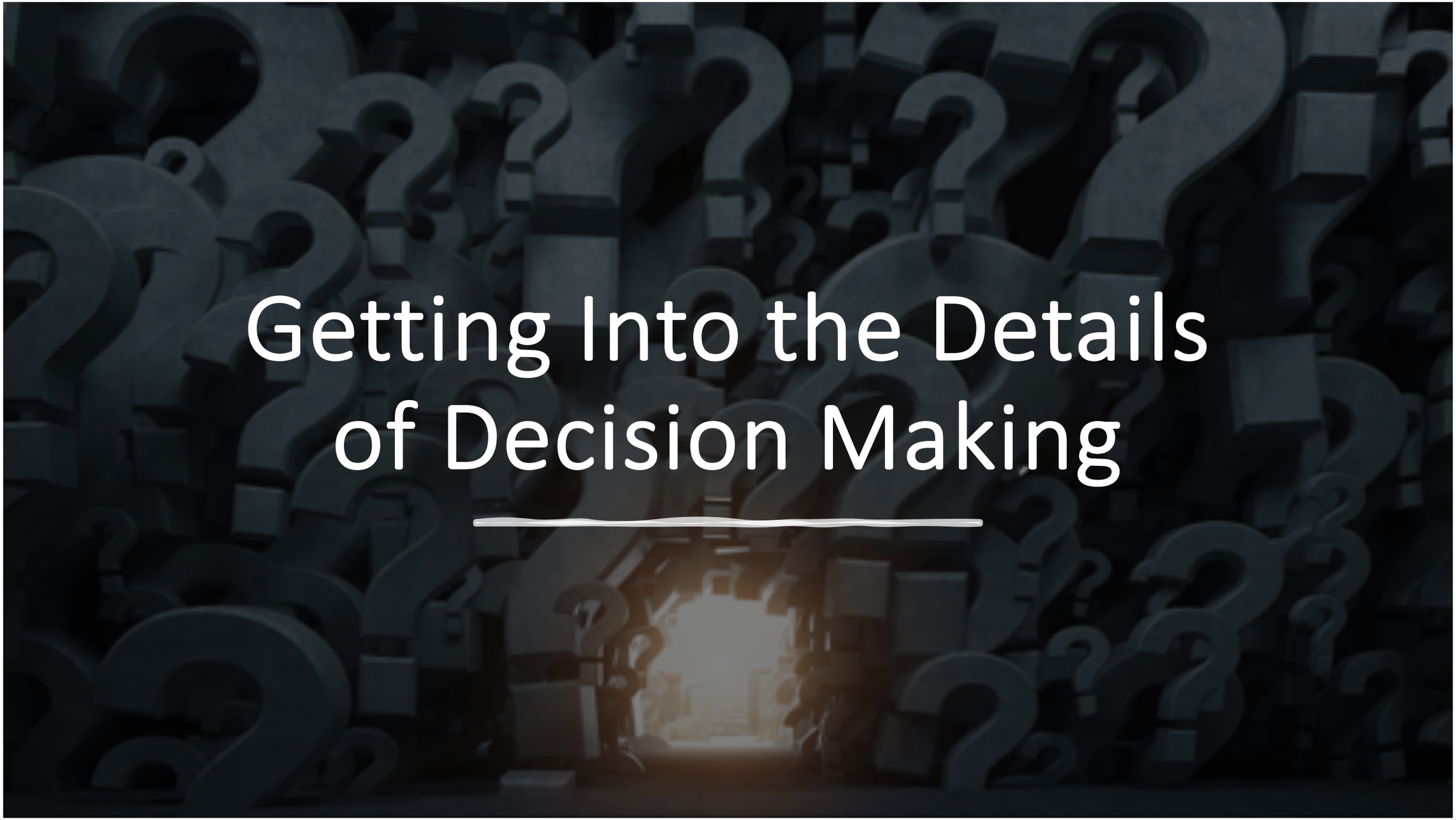
Source: https://www.fastcompany.com/90203073/why-google-defined-a-new-discipline-to-help-humans-make-decisions

# Revisiting the Race Car

Would you use Kozyrkov's process in the Race Car situation?

(3 steps – default decision, data that would change this, is this data available?)

Why or why not?



# Getting Into the Details of Decision Making

# Decision Awareness

How do you know if you need to make a decision?

How do you know when you need to support someone else in making a decision. What does that look like?

Sometimes it depends on the type of decision. Sometimes it's more obvious than others.

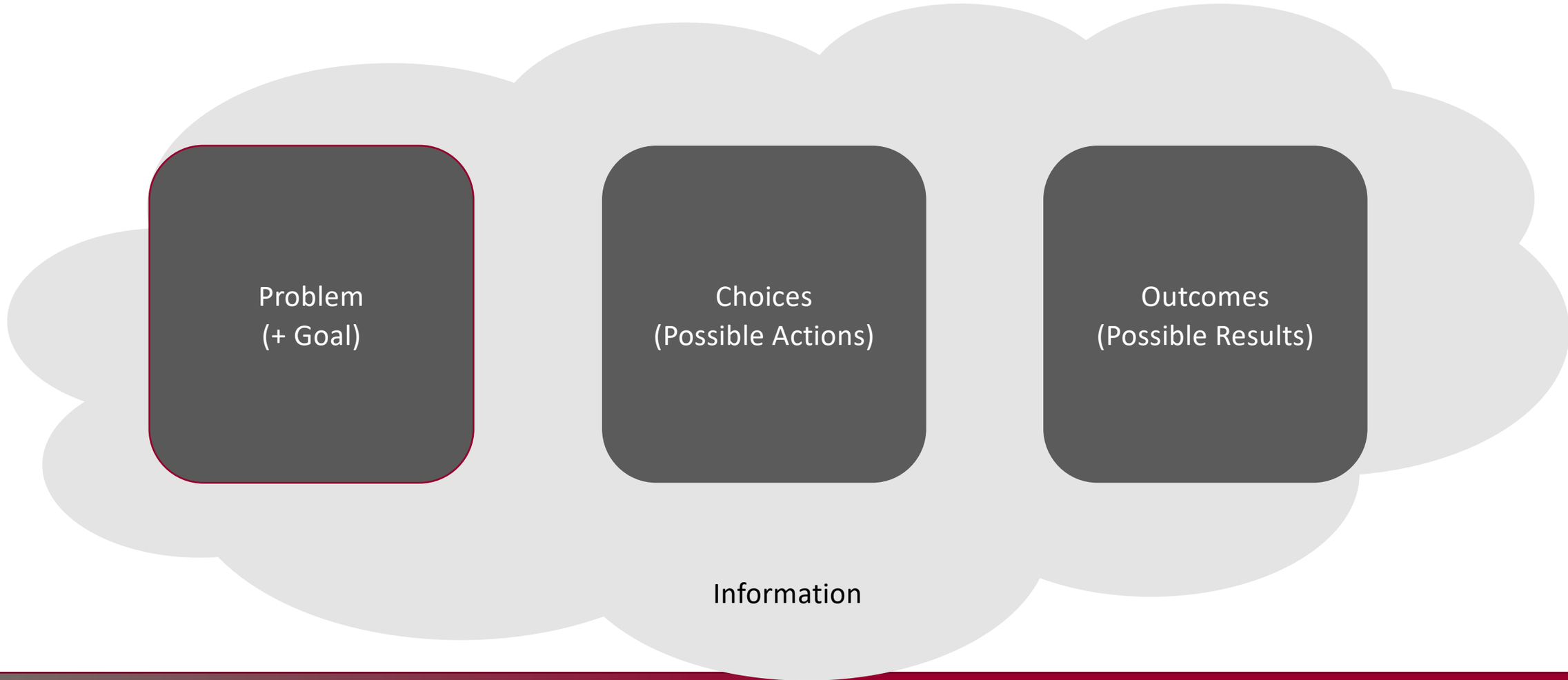
# The Bigger Picture: Three Main States

PRE-DECISION MAKING

DECISION MAKING

POST DECISION MAKING

# Sneak Preview: The Decision-Making Part



# Choice Architecture

- A choice architect shapes environments to influence decision-making.
- Choice architecture connects with nudge theory, emphasizing positive reinforcement and implicit suggestions.

- **Case Study: Organ Donation Systems and Donation Rates:**
  - Analyzed explicit consent vs. presumed consent vs. mandated choice.
  - In the Netherlands, mandated choice and presumed consent systems proved more effective than explicit consent in increasing donor registrations, suggesting the power of defaults in decision-making.

Source: https://thedecisionlab.com/reference-guide/psychology/choice-architecture

# Reducing Uncertainty

How can we feel more confident in the decision we're about to make?

# The elements/components of decision making

CHOICES/OPTIONS

FACTORS

ACTIONS

OUTCOMES/RESULTS/ CONSEQUENCES

GOALS

COSTS/BENEFITS/RISKS /PROBABILITIES

FACTS/INFORMATION/ KNOWLEDGE/BENEFIT S

# Activities Related to Decision Elements

Analysis, Reasoning

Imagining, Speculating (options and results)

Factor Generation (impacts, influences)

Evaluating the results of the decision

Detecting, mitigating biased thinking

Reducing Uncertainty

Information collecting

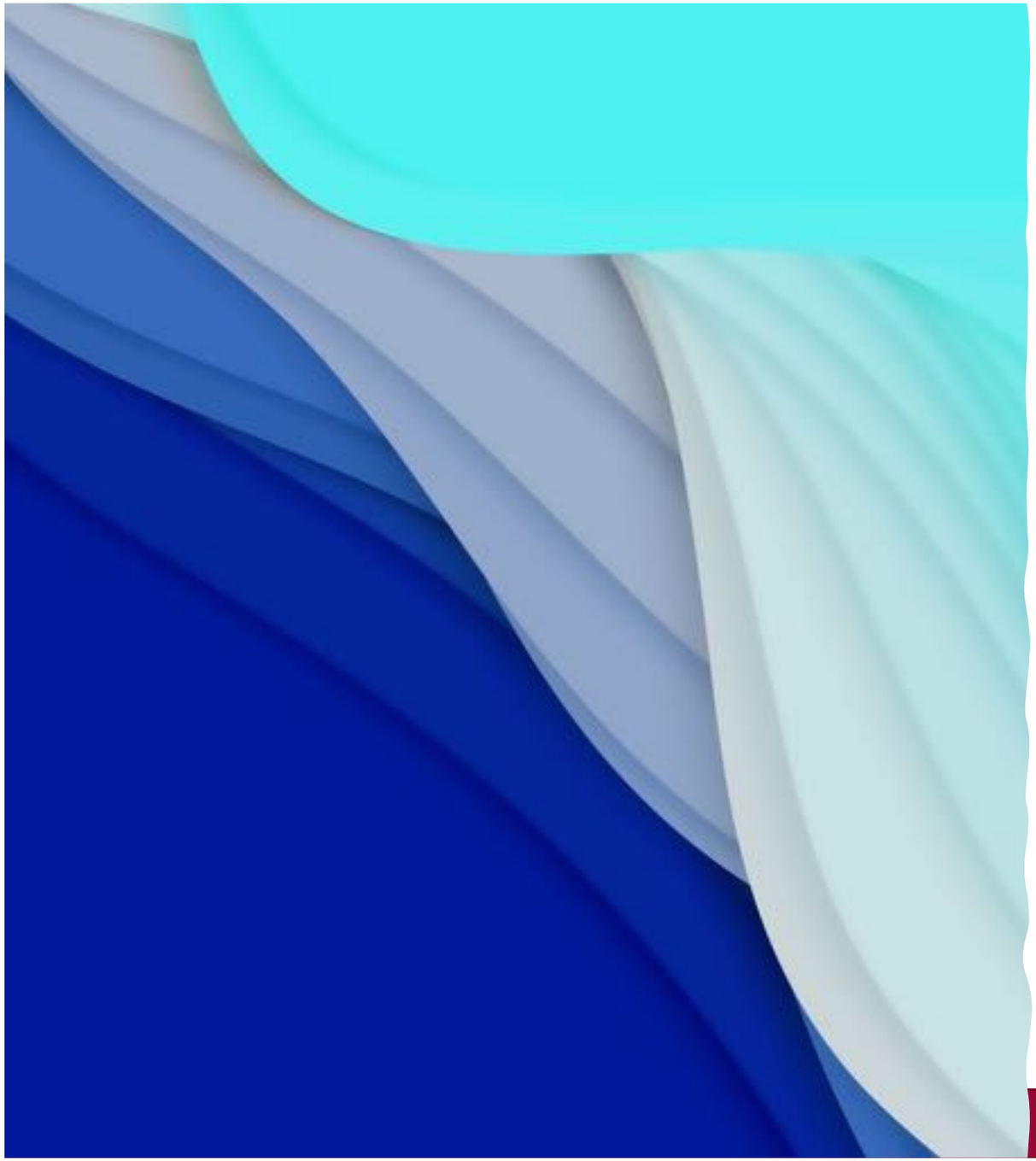
How can we become more skilled at these actions? What can improve the quality of these actions?
**How does data fit in?**

# Sneak Preview: The Mustard in the Sandwich

Our general position is that we can think of analytics as the mustard in the sandwich.

Perhaps not strictly necessary, **in every situation** but takes a sandwich from “Meh” to “Amazing”.

Increase the quality, increase the positive impact.



# Concepts and Activities

A First Pass

# Types of Decisions

Reversible decisions (“2-way door”)

Irreversible decisions (“1-way door”)

Fork in river or open water: forced choice vs generated choices

# Imagining Possible Worlds

In general all elements of decision making benefit from the imagination process.

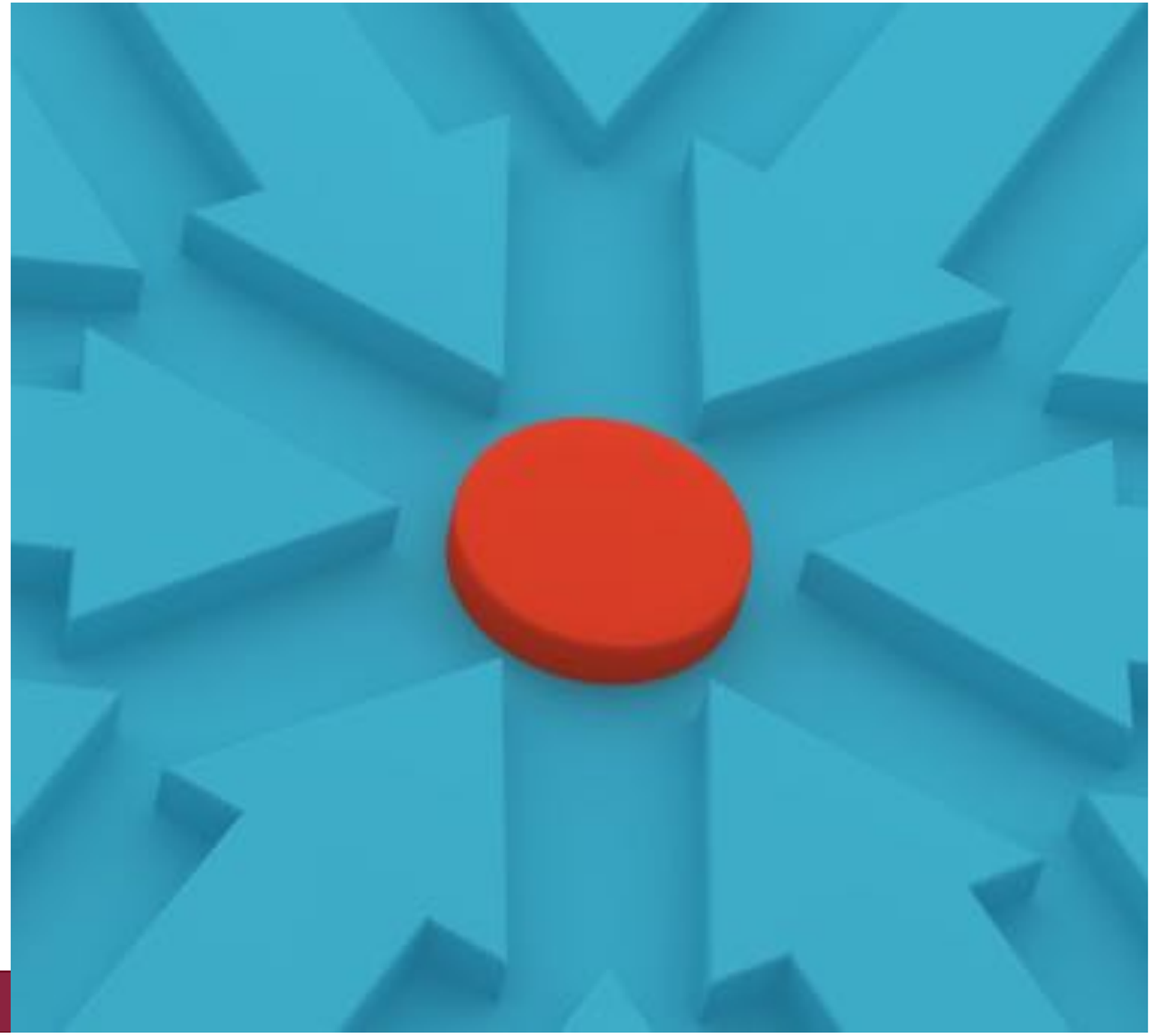
We can think of this as imagining possible worlds.

Each choice option represents a possible world.

Each set of results from a particular choice represents a possible world.

# Factor Discovery

- A fundamental element of many of the stages of decision making.
- Goes by many different names:
  - Causes
  - Effects
  - Impacts
  - Variables
  - Influences
- These determine which possible worlds might feasible exist.



# Choice Generation

By imagining possible worlds, and understanding current facts, we can generate many and creative choices.

In a given situation, are there really only two choices?

# Choice Overload!

- AKA “overchoice” or “the paradox of choice.”
- More choices sometimes bad:
  - Decrease motivation to decide
  - Decrease satisfaction with final choice
  - Increase negative emotions (e.g., regret).
- We gravitate towards more options but don’t handle the situation well: **The Jam Experiments**.

Source: https://thedecisionlab.com/reference-guide/psychology/choice-overload

# Optimization

We can ask ourselves: What is the best possible world, given trade offs and constraints?

This can sometimes be framed as an optimization problem.

How much energy can you devote to all of this?

# Introducing Three Levels of Data Supported Decision Making

ARMCHAIR

DATA | EVIDENCE INSPIRED

DATA | EVIDENCE DRIVEN

# Pre-Activity Pop Self-Quiz

What are the three main states you can be in, in the broader decision space?

What are key elements or components of decision making (according to this workshop)?

What are some associated activities?

What are the three levels of data supported decision making?

# Pre-Mortem/ Back-casting

Helps people with the imagining possible worlds

In the process, can make the implicit factors explicit

Makes it easier for people to speak up and voice concerns

# Pre-Mortem

A post-mortem is good for learning the causes of a bad outcome, with one tiny limitation: the patient is already dead.

Pre-mortem: imagine yourself at some time in the future, having **failed to achieve a goal**, and looking back at how you arrived at that destination – it is an autopsy **before** the patient dies.

Steps:

1. identify goal to achieve, or decision being considered
2. pick a timeline for achieving that goal.
3. imagine it is the day after the deadline and you are looking back from that date; give 5 reasons "within your control" and 5 reasons "outside of your control" for why things didn't work out

Example Scenario:

Pretend it is December 2025.

The AI-powered analytics platform, named "Project Insight," that your team had been developing for the past two years has, regrettably, failed.

The goal of Project Insight was ambitious: to create a single, unified analytics platform that would harness the power of AI to analyze data from various government departments and aid in decision-making processes.

Looking at everything that happened since 2023 answer the question: why did it fail?

What are the reasons in your control and outside of your control?

# Backcasting

Backcasting: imagine yourself at some point in the future, having succeeded in achieving a goal, and looking back at how you arrived at that destination.

The process is like the one for pre-mortems (directions changed, of course).

Benefits (pre-mortem/backcasting):

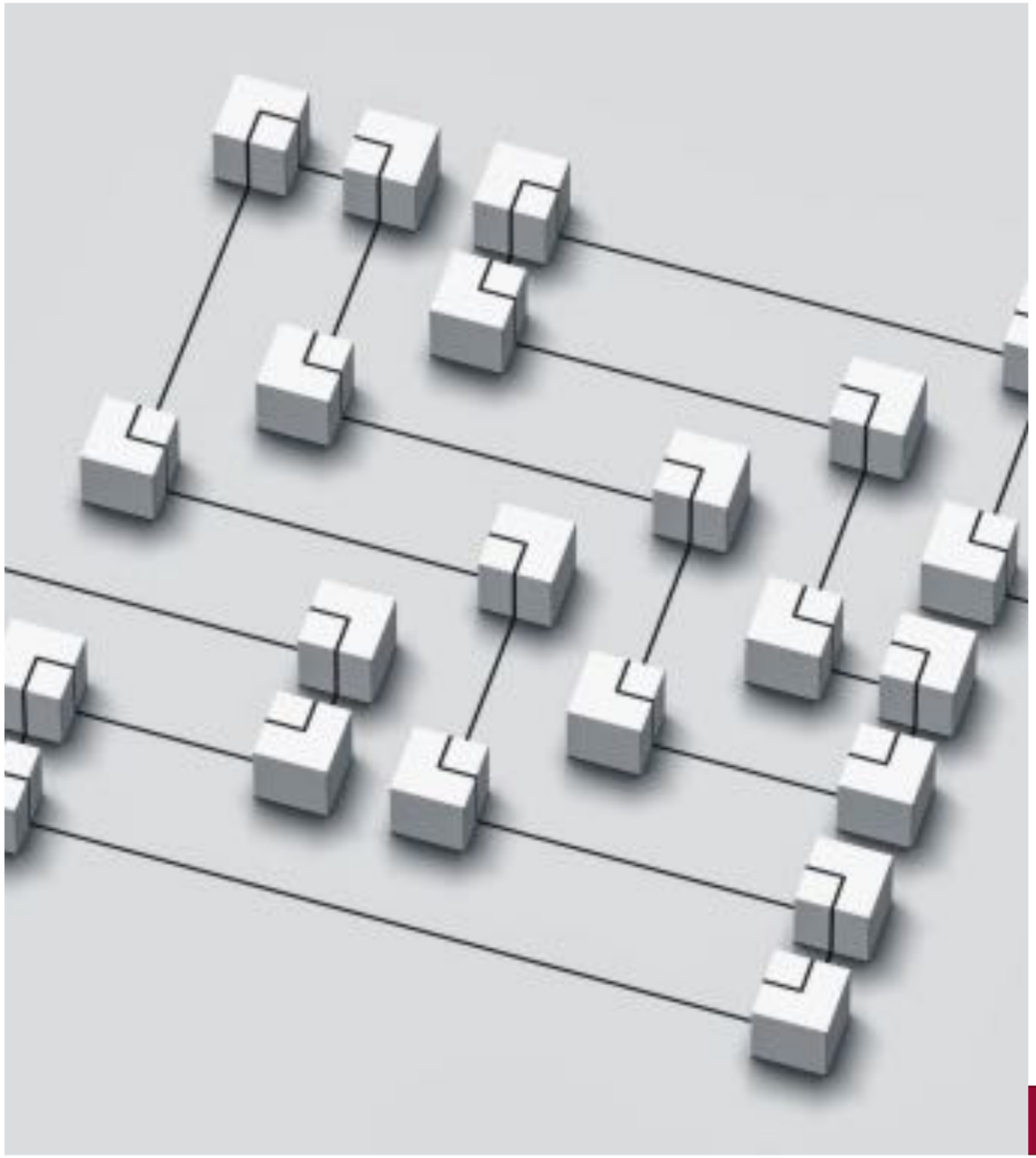
- get outside view
- wisdom of the crowd
- avoid group think
- eliminates the risk of people "not wanting to be the squeaky wheel"

# Decision Exploration Table

| | Pre-mortem | Backcasting |
|---|---|---|
| 3 reasons **within** control/skill | 1. | 1. |
| | 2. | 2. |
| | 3. | 3. |
| 3 reasons outside control/skill | 1. | 1. |
| | 2. | 2. |
| | 3. | 3. |

# Section 2: Data Plus Concepts Deep Dive


Introducing
Data



# Three Levels of Data Supported Decision Making

Recall our three categories of data driven decision making:

- Armchair decision making
- Data Inspired Decision Making
- Data Driven Decision Making

All three involve problem (or goals), choices, and outcomes

Information and data are incorporated differently for each category.

Our position: data inspired is more common than data driven AND it may also be more appropriate. But – will you agree?

# Armchair Analysis

Think about a talk show with a bunch of talking heads

Where are their opinions coming from? They seem to be relying on the “Facts” (aka beliefs, opinions) in their brains.

They could be subject matter experts. But are they?

What about bias and other thought errors (e.g. mis-remembering facts)

How common is this?

# Data Inspired Decision Making

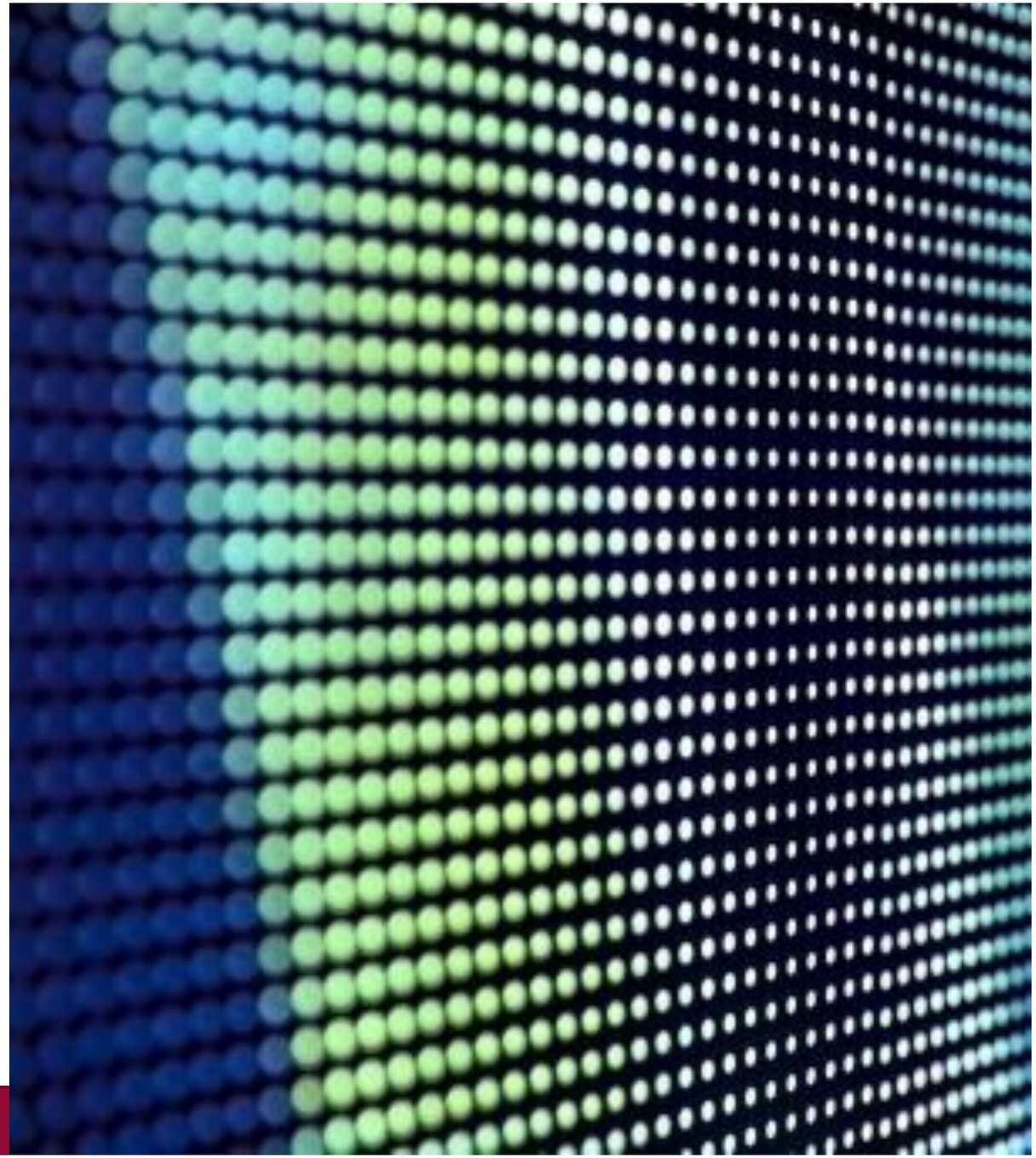
Is this what we really mean when we say "Evidence Based Decision Making"?

What is "evidence"? Is it a substance?

According to Kozyrkov: "That's where we, like whales encountering plankton, swim around in some numbers, and then reach an emotional tipping point and… decide. There are numbers near our decision somewhere, but those numbers don't drive it."

(We may be more of a fan than Kozyrkov…)

(quote from: https://kozyrkov.medium.com/data-inspired-5c78db3999b2)



# Just the Facts, Friend

A key ingredient for data inspired (evidence based) decision making is statements, or facts.

Where do facts come from? Some possibilities:

- Observations
- Data Analysis
- Reasoning over other facts (input facts into a reasoning engine, get new facts)

# Giant Grab Bag of Facts

Whenever you think of data, analytics and decision making, we want you to think about "**The Giant Grab Bag of Facts**".

In a nutshell, analytic activities add more facts, aka "Decision Making Materials" to the "Giant Grab Bag of Facts".

# Random Facts vs Useful Facts

Left to their own devices analysts and analytics techniques may produce a bunch of “random facts”.

You need relevant facts for specific decision-making situations.

More on this in the analytics section.

# Decision Making Informed by Facts

It seems pretty clear that we want our decision making to be informed by facts.

Data inspired decision making captures this idea.

We want that giant "grab bag of facts" to draw on.

Do we always need data sets and analytic activities to achieve this?

Do we need a dataset and an analytics engine in order to choose which sandwich to buy for lunch?

# Data Driven Decision Making

Process is set up, decision point is determined, data/information pours in and the decision is taken (choice made, action taken) essentially *automatically* based on this data.

At its most extreme – automated decision making? I will buy whatever sandwich my dataset tells me most other people bought.

Kozyerkov: "For a decision to be data-driven, it has to be the data — as opposed to something else entirely — that drive it. If the first thing we do is poke around in our data, our decision will be, at best, something I like to call *data-inspired*… Solution: set the goalposts in advance and resist temptation to move them later."

(quote from: https://kozyrkov.medium.com/data-inspired-5c78db3999b2)

# Analytics: Analysis Paralysis

We may need to make a decision with less than complete information. What is the risk of not deciding vs. the risk of making a less-than-perfect decision?

Analysis paralysis is caused by overthinking a situation and worrying about the outcome at the expense of decision-making. It is perfectionism, taken to an extreme.

"It doesn't matter in which direction you choose to move when under a mortar attack, just so long as you move. Decisions are never final for the simple fact that change is never absolute. Rather, change is ongoing. To stay competitive and progress at the rate of change requires adaptive decisions that can be iterated and improved upon on the fly." [Jeff Boss, Forbes]

# Getting Further into the Elements of Decision-Making

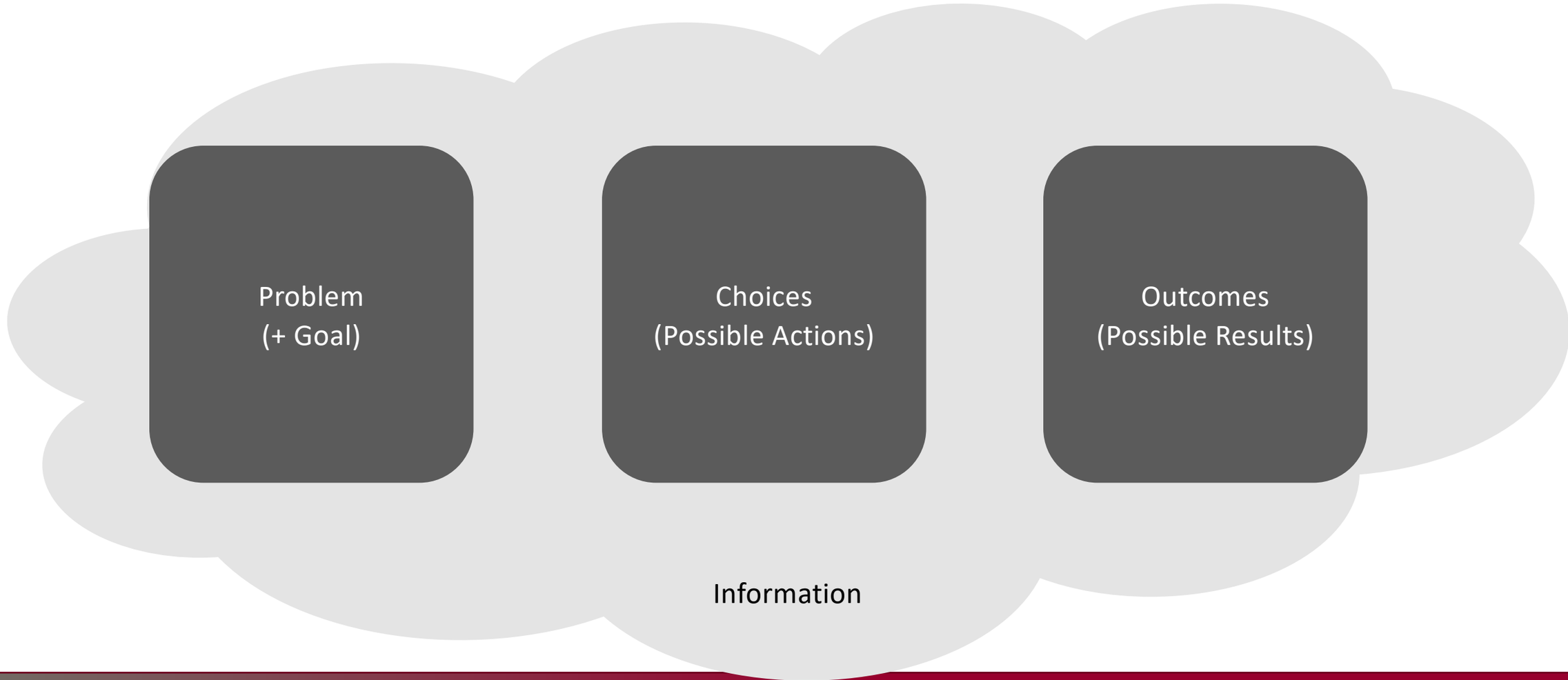
# The Bigger Picture: Decision States

PRE-DECISION MAKING

DECISION MAKING

POST DECISION MAKING

# Core Elements of Decision Making



# Where Does the Data Fit?

Data work must first **fit** somewhere into one or more of our decision making activities.

Specifically, **it must be some type of input** into one or more of the core elements/activities.

# Illustrative Case Study 1: A Hike

You're on a hike. You come to a folk in the road, with one branch to the left and one branch to the right.

# Illustrative Case Study 2: Canada Arts Funding

You must determine the 2022 arts program funding strategy for Heritage Canada.

Data available:

- Funding breakdown relative to type of events and regions (from 2016-2017)
- Survey of attendance of events across regions and event types (for 2021)

Additional information available:

- Goals and Mandate of Heritage Canada, additional departmental information

(all of this information is actually available on the GoC data portal)

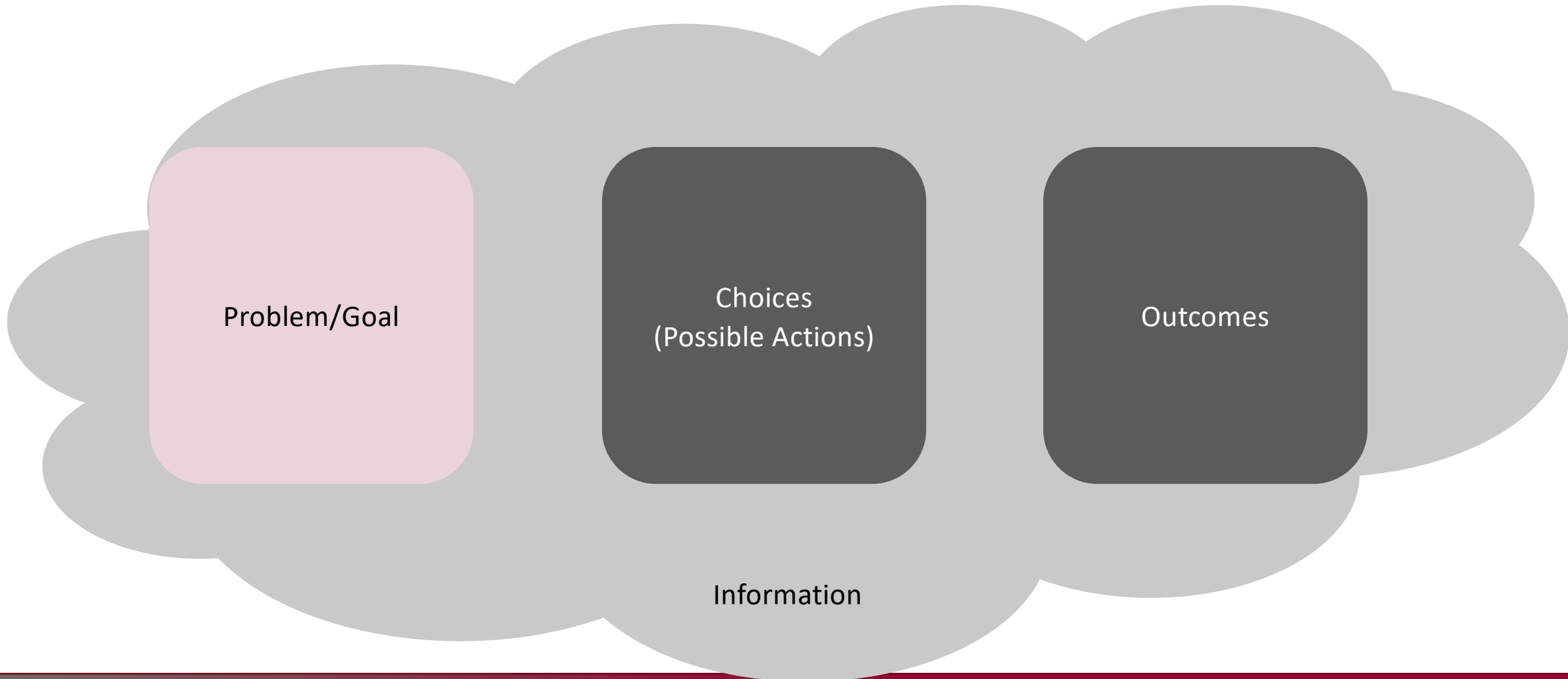
# Illustrative Case Study 3: Your Case Study!

Follow along by choosing a situation where you may need to make a decision – you could be in the pre-decision stage.

Take a moment now to write a short description of that situation for yourself

Take another moment to identify any data, evidence or information sources you have available that seem like they could be relevant – make a quick list of these sources

# Four Core Elements of Decision Making

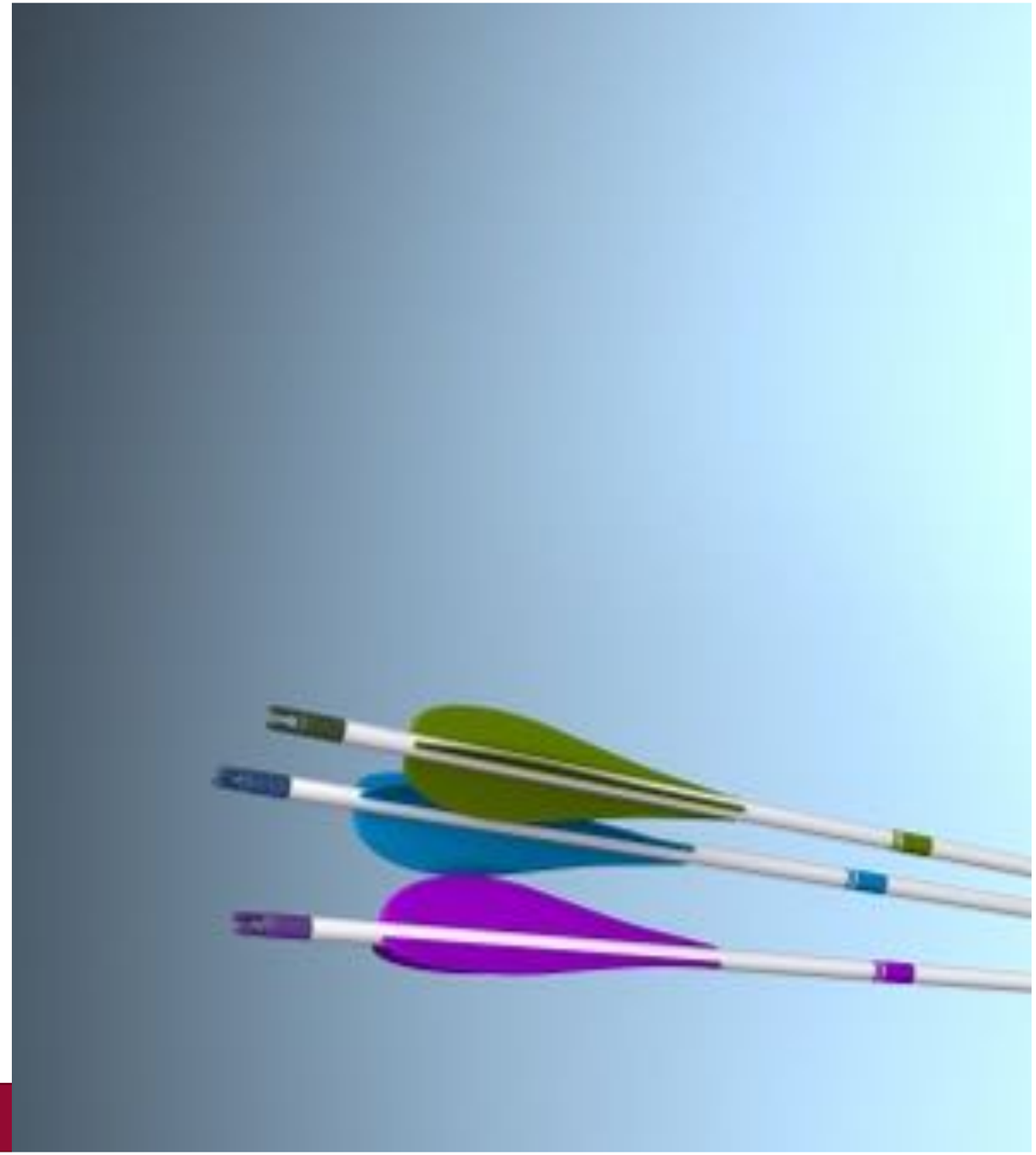


# Problem or Goal or Target

This is the element that kicks off the decision-making process proper

We find ourselves in a state that is not stable or satisfactory – we want things to be better, or at least not get worse.

We may be in a situation that simply must evolve in some direction – and we want to have agency.



# Problem or Goal: Relevant Activities

Describe: the current state. What state are you in now? What do you want to change, or stay the same?

State: the problem or goal clearly.

Note: Might be more value driven than “data driven”. Critical nonetheless.

# Situational Awareness

What exactly is my situation right now? (Do I have data to tell me?)

What factors are contributing to my situation? (Cause and effect)

What factors might cause my situation to change? (Cause and effect)

# Hiking Scenario: Problem, Goal, Target

Problem: We're walking through the woods. We don't know a lot about the trail system. Eventually it's going to get dark and cold. We're faced with a fork in the road.

Goal: We want to finish our hike by ending back at the parking lot before dark.

Situational Awareness: What time is it, how tired am I, what is the temperature?

(Do I need facts? Do I need a dataset?)

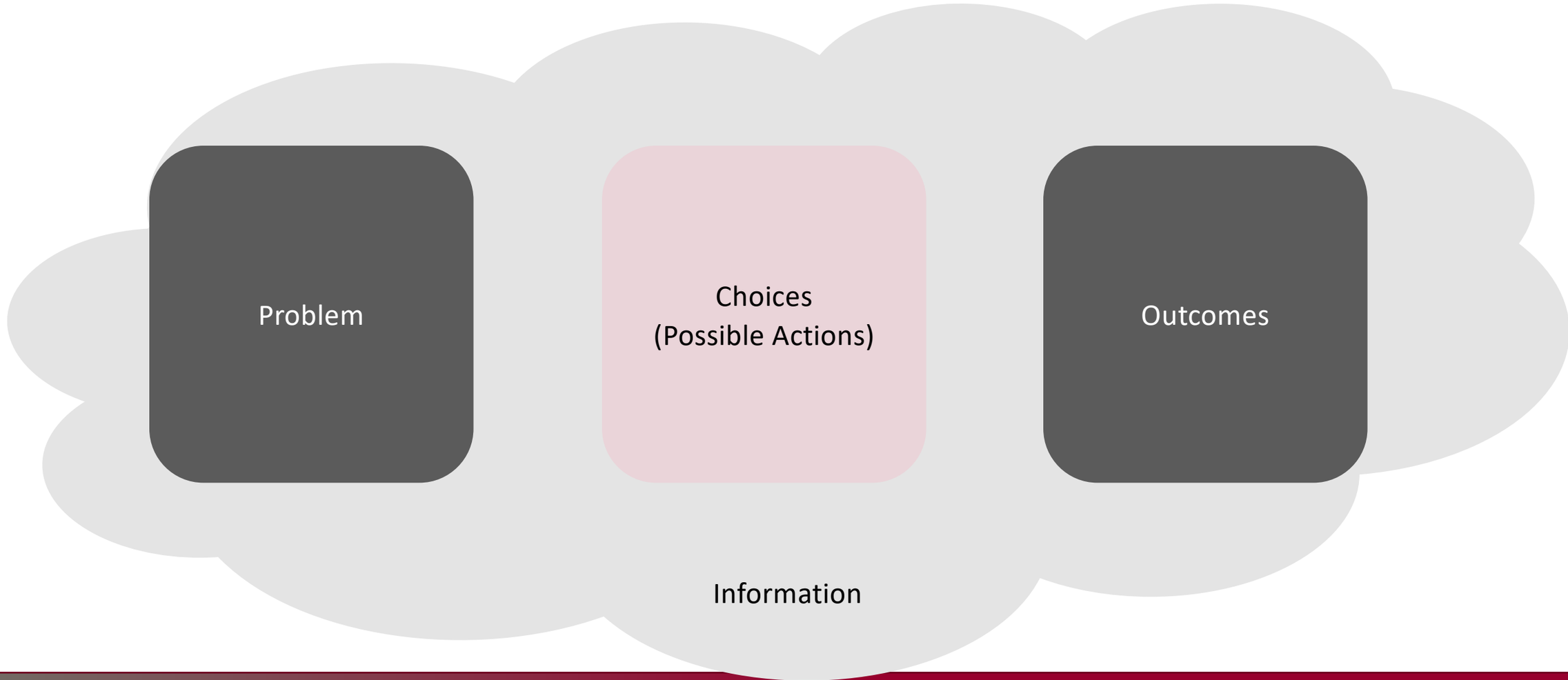
# Goal: Canada Arts Funding

In the case of the Canada Arts Funding scenario, what is the state that is not stable? What is the state that must evolve?

What is the goal that has not yet been achieved, and for which action is required?

Situational awareness considerations?

# Core Elements of Decision Making

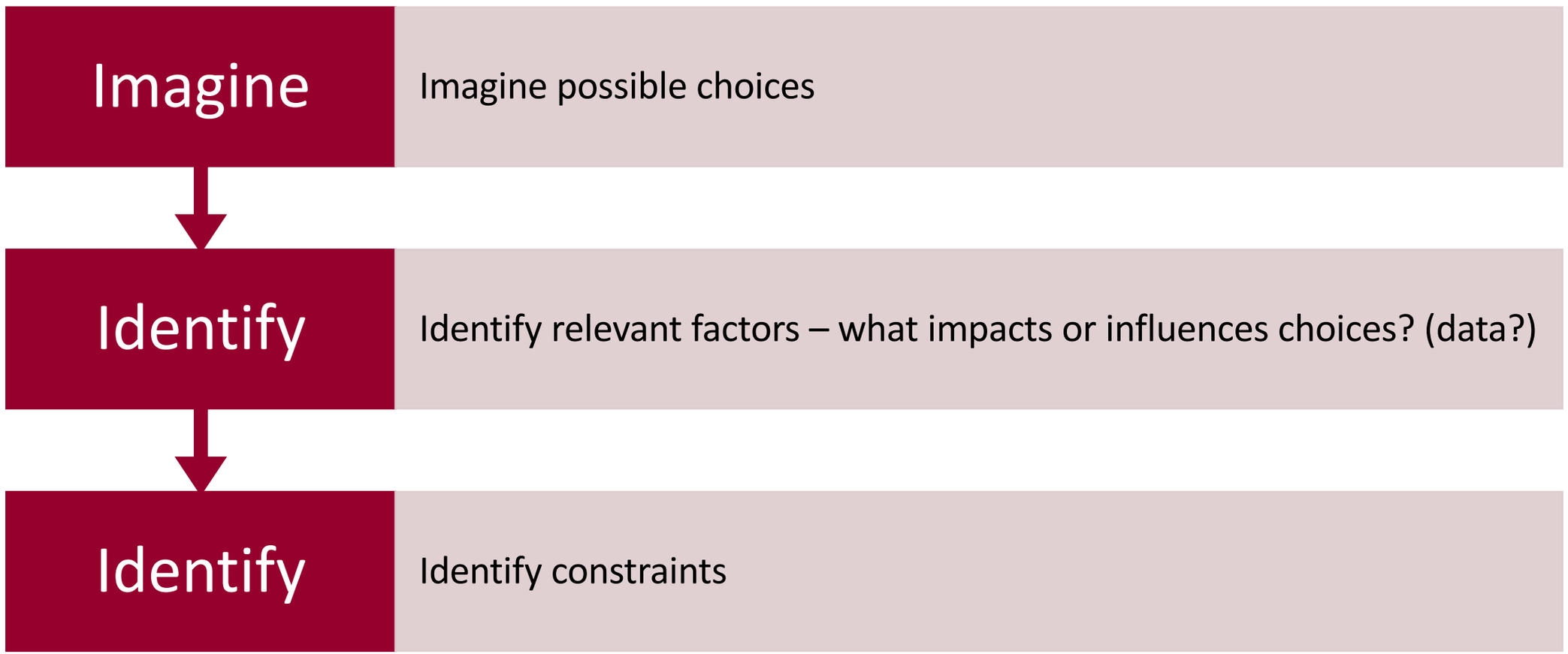


# Choices – Possible Actions

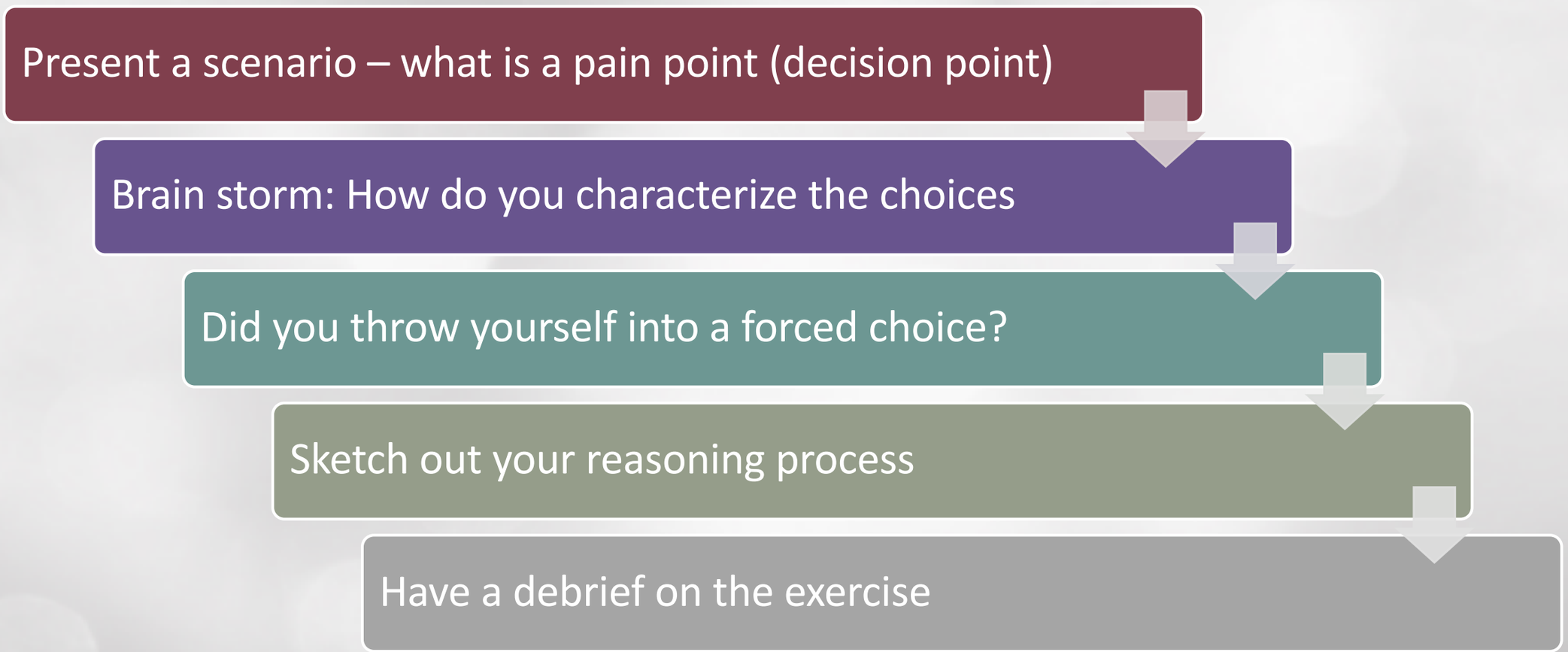
If we agree that we must, or wish to, act:

- What are possible actions?
- What are constraints on these actions?
- What are the *factors* at play? How do they make one possible course of action different from another?

# Choices: Relevant Activities



# Effects Based Planning: Factor Generation



# Hiking Scenario

Faced with a  fork in the trail, what are possible courses of action?

- Go left
- Go right

Can you think of any more?

What are common factors (or variables) across all of these? What could *influence* choices?

- Direction of movement. Anything else?

# Choices of Action: Illustrative Example

In the case of the Canadian Heritage example, choices of action will involve several elements:

- Total amount of money available
- How money is to be allotted across regions and types of artistic activity
- What type of funding programs

- Infinite choices? What are constraints?

# Factors and Questions: Canada Arts Funding

In our Canada Arts Funding case study, factors or influences could include:

- How much funding different regions have previously received
- The success of different types of programs, measure by:
  - Attendance
  - Positive Press
  - Positive impact
  - Improved opinions of the arts

Do we need a bag of facts? Do we need datasets? Do we need answers?

# Case Study 3: Your Scenario

Take a moment to consider, for your scenario:

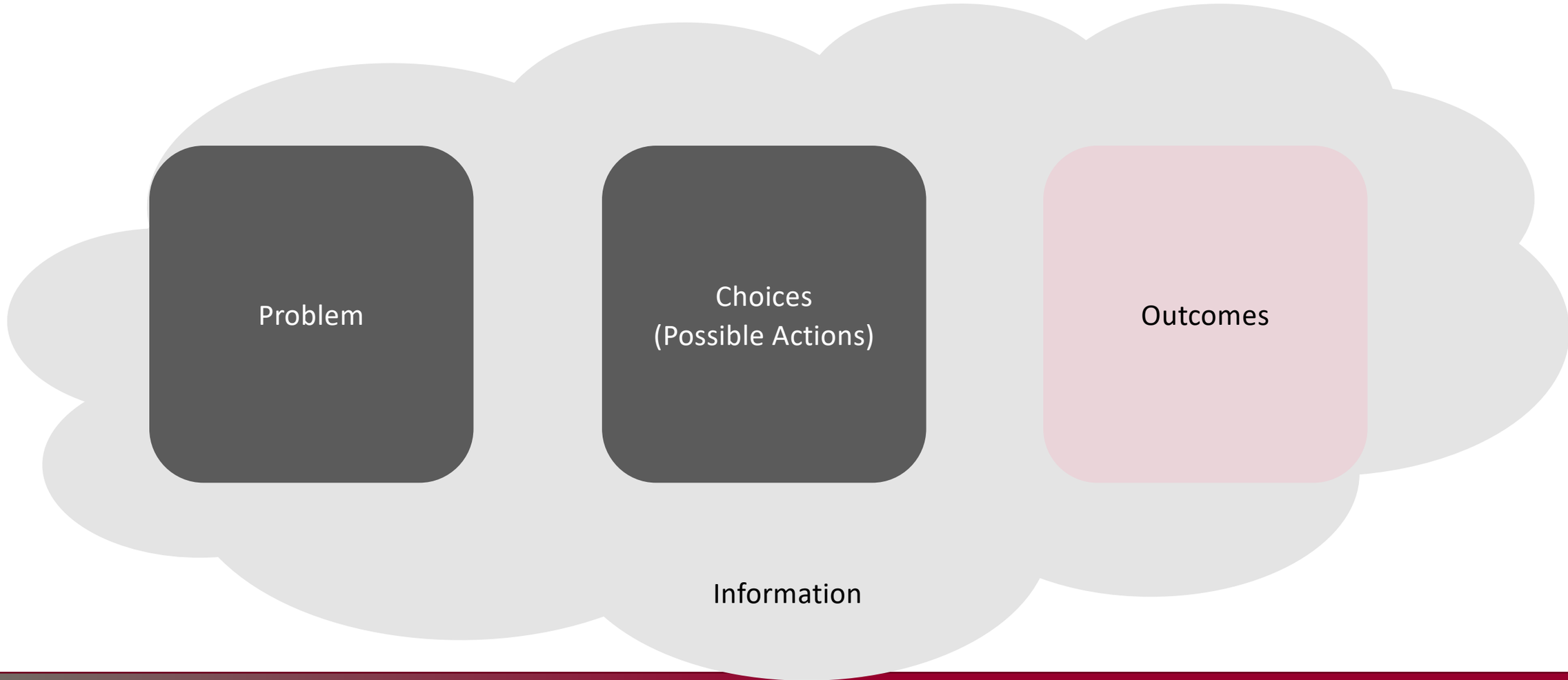
Possible choices of action

Factors that influence available choices of action

Constraints

Data that could help identify sources of influence or constraints

# Core Elements of Decision Making



# Outputs, Products or Results

In-between our choices of action and possible outcomes, we can think about the output, product or immediate result of our choice of actions.

In our simple trail example, some specific concrete results could be:

- We walk down the left fork and…
- We walk down the right fork and…

In our Canadian Heritage example, the product (output, result) is a budget.

# Outcomes, Consequences

Outcomes and consequences are broader and more contextual.

When considering outcomes, consequences or results, we need to consider possible worlds

In our straightforward example:

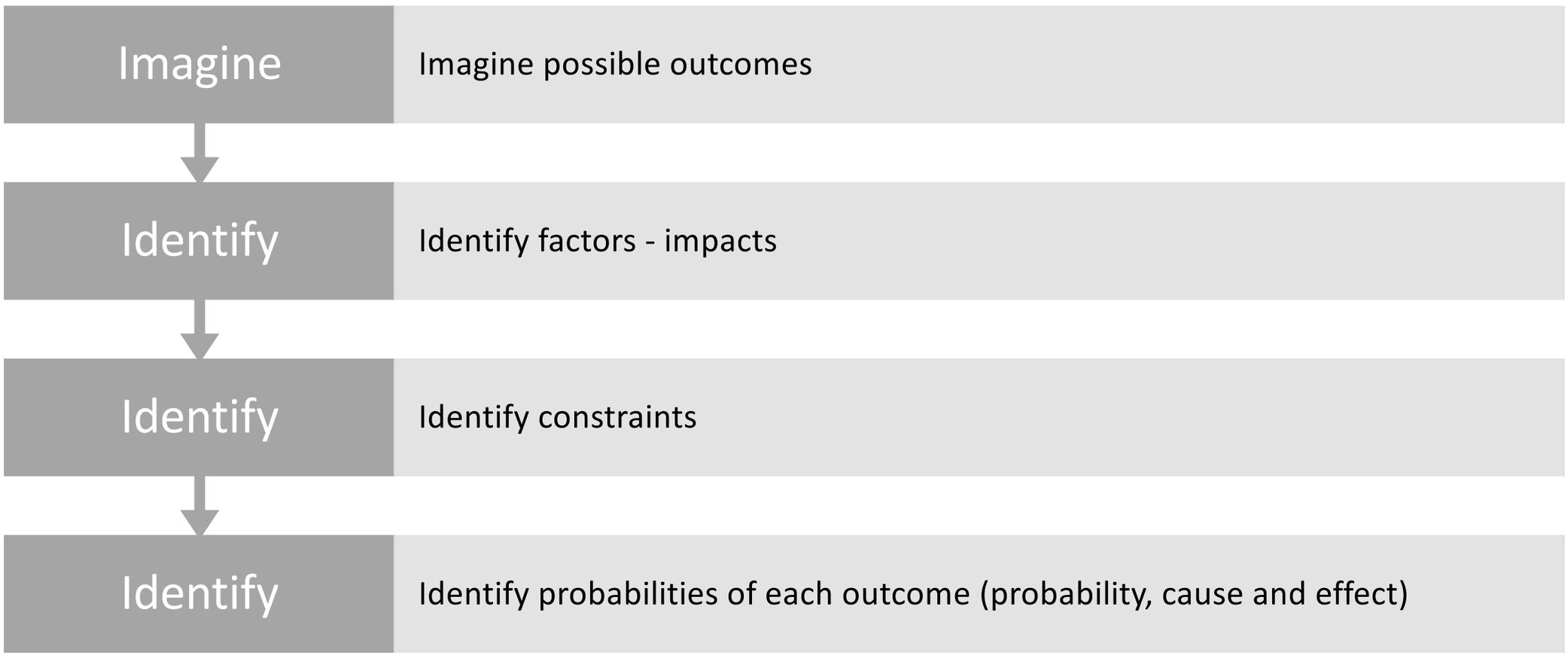
- Outcomes: We make it back to the trail head warm and happy. We make it back, but it's cold and dark. We get lost and people must try to find us. We have to stay overnight in the park!
- Consequences: We have a sense of our own agency, we feel like we know what we're doing, we have to deal with exposure, we feel afraid, we get in trouble with the park and charged for a rescue.

# Risks and Benefits, Pros and Cons

For each possible course of action and imagined outcome, we can consider pros and cons, risks and benefits

This also returns us to our consideration of factors, but in a different sense – what are the effects?

# Outcomes: Relevant Activities



# Canadian Arts Funding Scenario

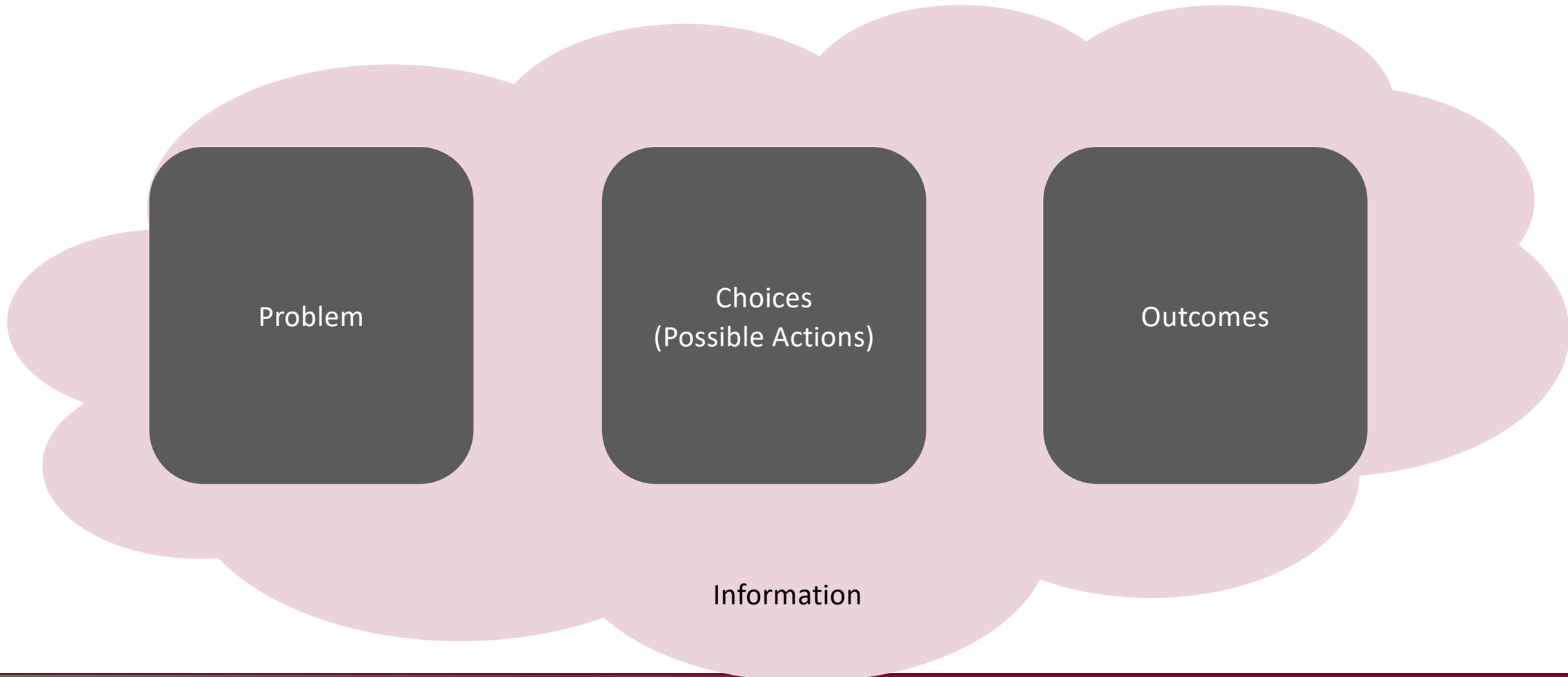
## Consequences:

- If we distribute the money well, we can have a positive impact on artists and Canadians who are participating in the art in some way (e.g. as audience)
- If we distribute the money poorly, we might have a freezing effect on arts in certain part of the country, we might contribute to a negative perspective of arts, we might cause some art forms to decline

## Risks and Benefits:

- a risk could be undermining some types of artistic endeavour, a benefit could be ensuring the enduring presence of a marginalized art form.

# Core Elements of Decision Making



# Information, Data, Knowledge

**Information**: broad term to refer to statements of all kinds (may be true or false, correct or incorrect, actual or possible)

**Data**: Structured collection of measurements

**Knowledge**: Justified True Belief – true statements, facts

# The Pervasive Role of Information

How does information (evidence, data) come into play at different points in the decision-making process?

Remember the “Grab Bag of Information”. At each point in the process, what type of information would you like to be able to pull from the bag?

# Information: Relevant Activities

| | |
|---|---|
| Identify | Identify sources of information |
| Turn | Turn this into statements |
| Identify | Identify which parts of the decision-making process would benefit from these statements |

# Information in the Hiking Scenario

Consider the simple fork in the trail situation.
What types of information are available to us?

# Information: Canada Arts Funding Example

Suppose we have at hand the following datasets:

- Environics - Canadian Heritage - Arts and Heritage Access and Availability Survey 2021
- https://open.canada.ca/data/en/dataset/d9f0cc12-8f12-4355-91d4-6ba7fcd8c6ec
- Data on funding provided in 2016-2017 and 2017-2018 by the Canada Arts Presentation Fund, Canadian Heritag
- https://open.canada.ca/data/en/dataset/92984c11-6fd4-40c4-b23c-e8832e1f4cd5)

# The Form of Information in Decision Making

What's the most useful form that information takes during decision-making? how can we transform it so it is useful.

We suggest that the statement is a fundamental form for information.

We might think of statements as the raw material for each aspect of decision making: problem/goal, choices, possible outcomes

Different analytics engines (techniques) produce different forms of statements.

# Our Position: Understanding the Form of Statements is Critical to Using Analytics for Decision Making

# In General, What Form Do Statements Take?

NOT A

EITHER A OR B but NOT BOTH

As are x

IF A THEN B

- IF A goes up, then B goes down
- When A goes up, B goes up
- It seems like A causes B
- It seems like A doesn't influence B

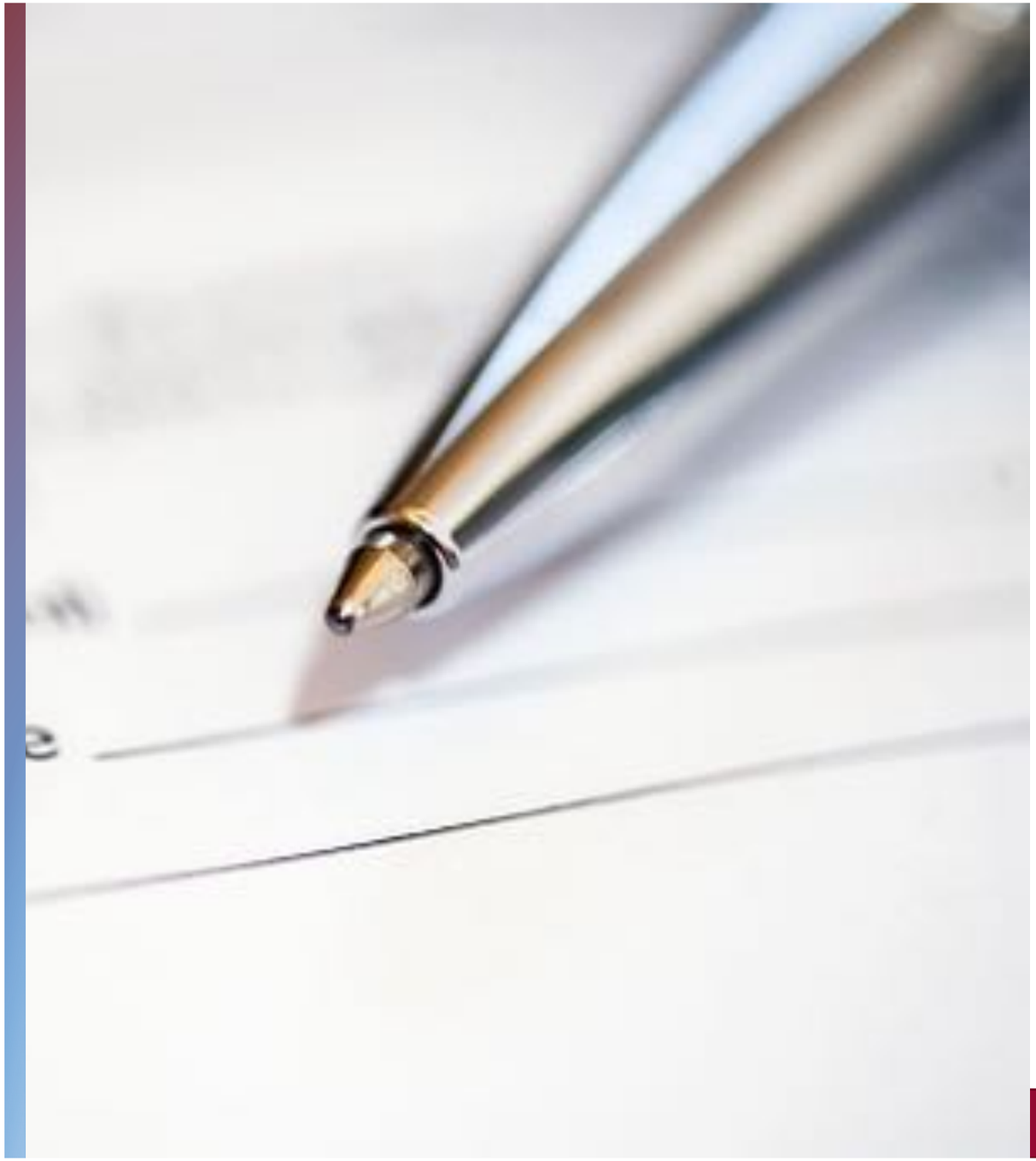
(Value Statements: A is good, B is bad – data analysts need to know…)

# Possible Statements in the Hiking Example

- A basic statement of fact:
  - I have 1 liter of water.
- IF A THEN B
  - IF it has been raining a lot this week THEN low lying trails could be washed out
  - When I walk for longer than 30 minutes, I get hungry.
  - Walking a lot causes me to be tired.
- NOT A
  - I don’t have any food.
- EITHER A OR B but NOT BOTH
  - Either I go forward or I go back.
- As are x
  - Trails are busy during the day
- Value Statements: A is good, B is bad
  - Getting back to the parking lot is good

# Possible (Made up) Statements from Canada Arts Funding Example

- Arts festivals received 30% of funding last year
- Fringe festivals did not receive funding last year.
- Most arts events in Manitoba are theater related.
- The more funding a type of event receives, the more events of that type there are the following year
- It’s better to have many different types of arts events

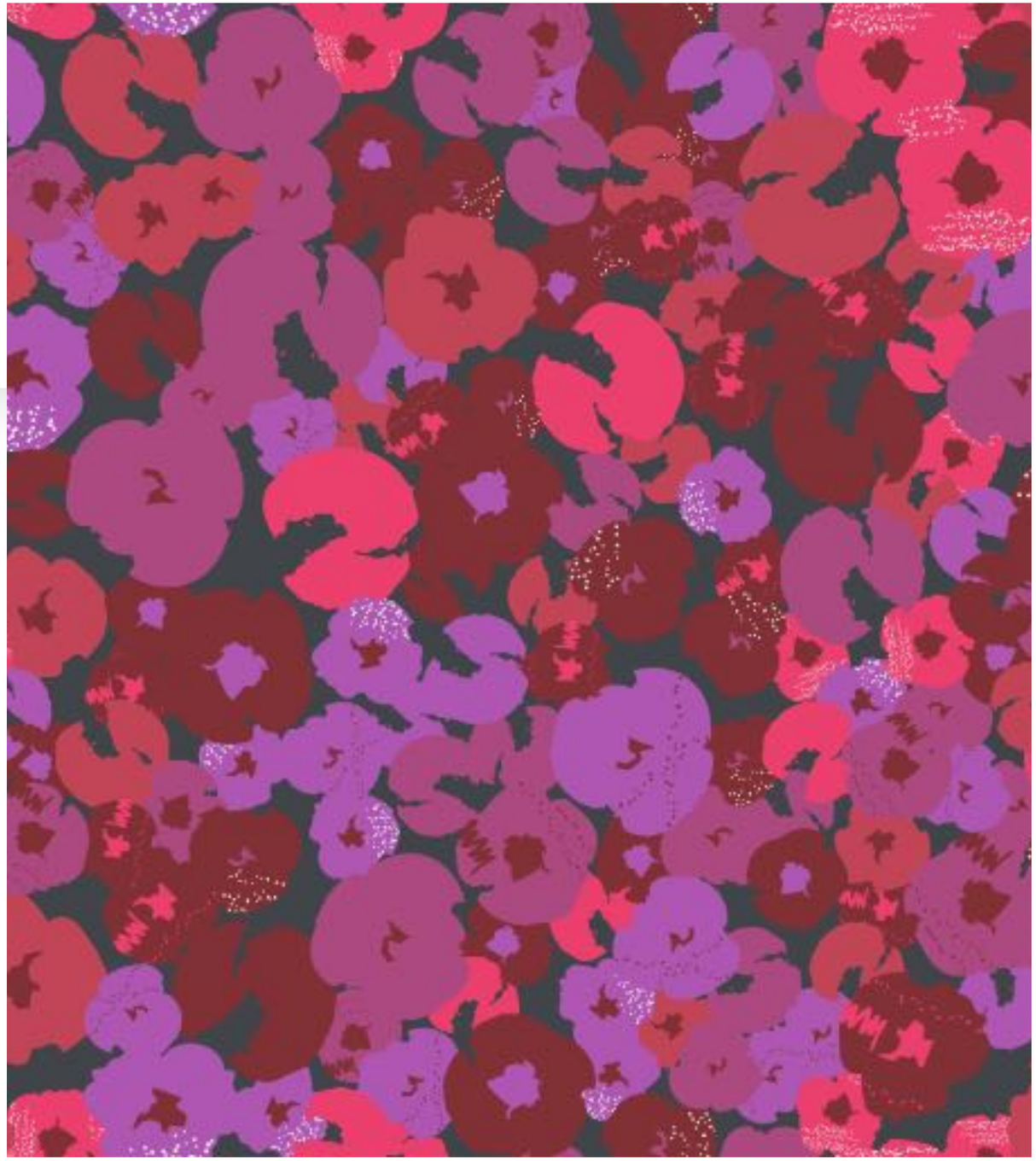


# Where can we get more useful statements?

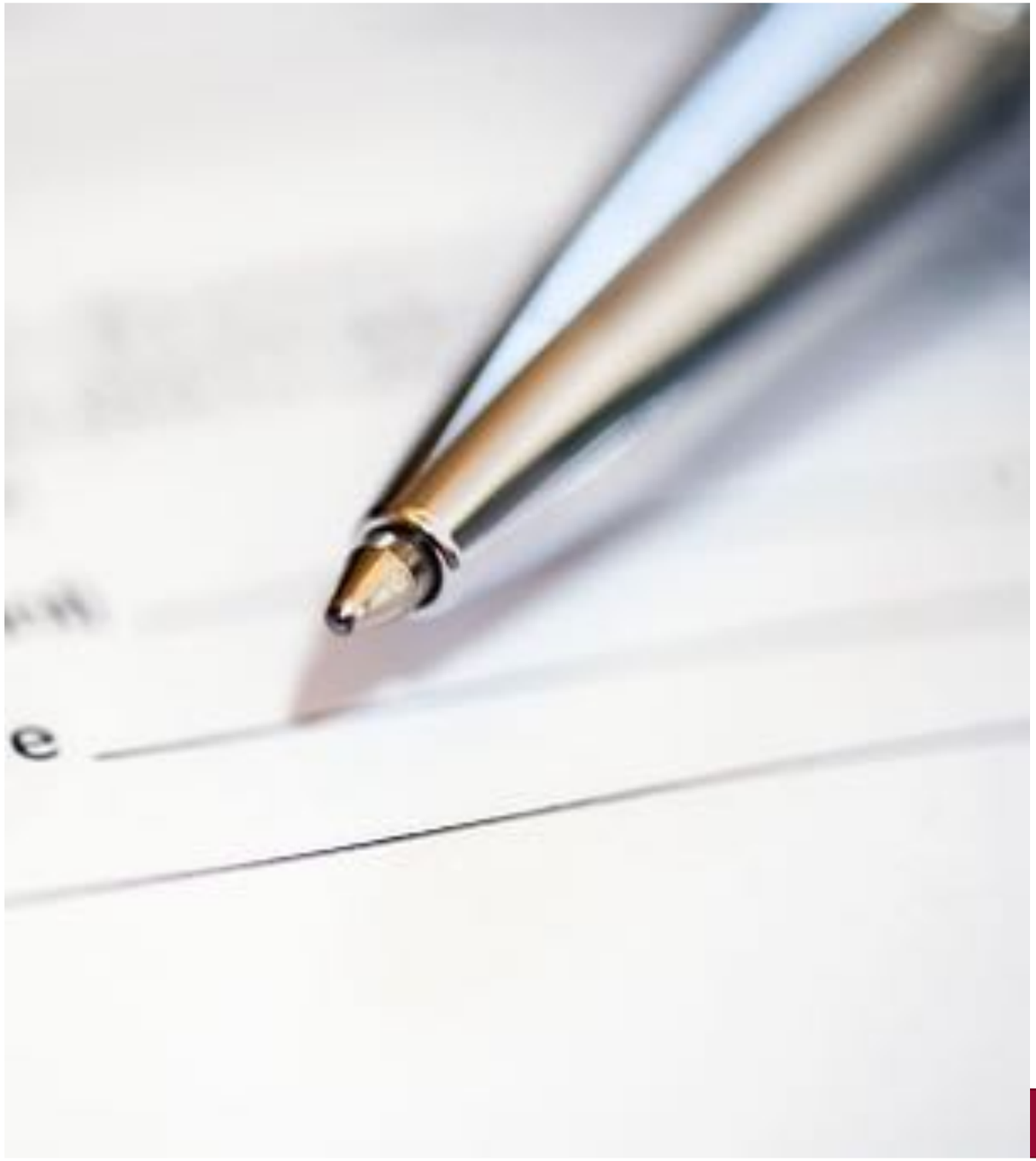
- In each of our examples, where could we get more useful statements?
- Where could we get support or validation for potentially useful statements?

# Finally Taking the Decision

- In our three scenarios (hiking, arts funding, your scenario ):
  - What would it look like to make an armchair decision?
  - What would it look like to make a data inspired decision?
  - What would it look like to make a data-driven decision?




How Analytics Come Into Play



# Can we get more useful statements from analytics?

- We believe the answer is: YES!
- Different analytics techniques provide different types of statements.
- These can act as input into different parts of the decision making process
- When you are doing analysis, you can use this perspective to ground your work.

# Mapping Analytics Techniques to the Decision Landscape

WITHIN ANALYTICS ITSELF, THERE ARE MANY (MANY) TECHNIQUES

HOW DO THESE INFORM EACH PARTS OF THE DECISION-MAKING PROCESS?

# Considering Five (Plus One) Types of Analytics

Data Visualization and Basic Analytics

Metrics

Statistics

Optimization

Classic Machine Learning

Generative AI?

# Data + Analytics Engines Generates "Concentrated" Statements

Example of a vague statement:

Government at different levels provides tons of money to arts organizations.

(Is this true? What counts as tons of money? Is there a value judgement in here?)

Made up!!! example of a specific statement: In 2022 across municipal, provincial and federal jurisdictions, Ontario arts oganizations were provided with 2.2 million dollars in funding, across all funding types. This represents 5% of funding provided to organizations within Ontario.

# The Role of Experts

- Experts can then interpret the ‘concentrated’ statements generated by data and put them into relevant context.
- They answer the question “So what?”.

# The Role of Values

**Facts generated by data can’t directly help with the value part.**

**However, facts can connect to the value part:**

A is good, If B then A, C usually leads to B

Conclusion – Let’s Act – Specifically, let’s do C!

# Analytics Engines: Statements Generators

Data + analytics can help to generate certain types of statements.

Effectively, analytic techniques use data as fuel to generate statements.

If applied ‘naively’, analytics can result in a grab bag of statements.

If applied in a more focused manner, can lead to statements relevant to a particular decision.

What are the relevant topics, factors, questions based on the decision-making situation?

# Analysis Questions

It might sometimes be easier to think of data and analytics as providing the answer to questions:

- If A then…. What happens?
- Is the current situation A or not A?
- Can both A and B happen at the same time? Or does one prevent the other?

The answer to a question is a statement, so we end up in the same place, at the end.

Curiosity gives us more fuel for good decision making.

# Considering Five (Plus One) Types of Analytics

Data Visualization and Basic Analytics

Metrics

Statistics

Optimization

Classic Machine Learning

Generative AI?

# Section 2 Exercise Preview

Following our review of analytics techniques, you will have a chance to think about how these techniques might apply to the hiking scenario.

You'll be provided with a "pocket dataset" to ground the discussion: a hiking trail reviews dataset, which we'll provide

This will be a chance to match techniques to types of statements in a concrete fashion.

# Keep Using Your Scenario!

As we go through each type of analytics technique, ask yourself – is this relevant to my scenario?

# Analytic Technique 1: Data Visualization and Basic Analytics

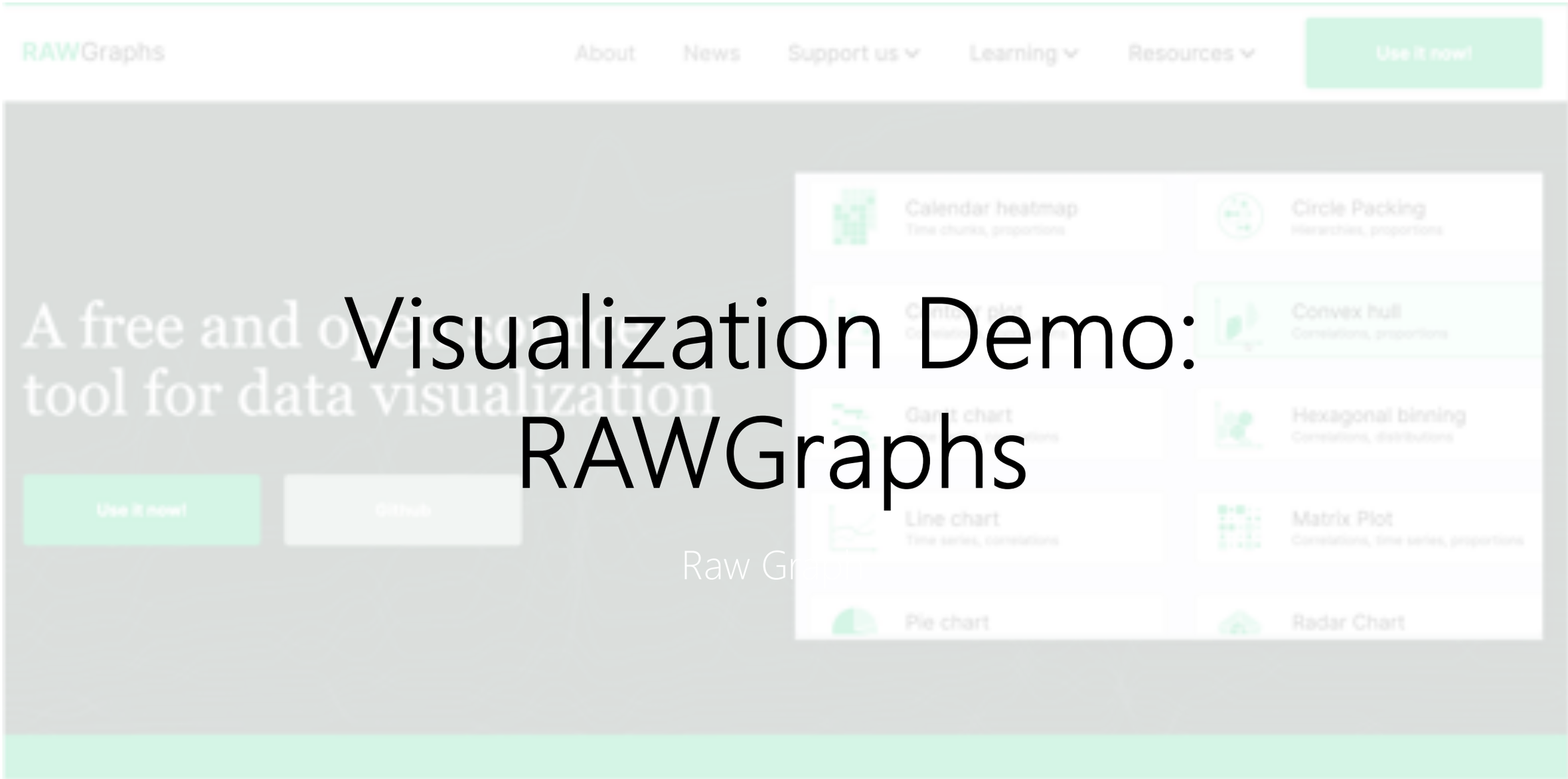
Data visualization techniques show many pieces of data at once (data are the parts, we want to see the whole picture)

What type of statements can be extracted from data visualizations? Lots!

These statements can be useful, BUT they may not be very rigorous. Jumping off point. May not be good for prediction.

Basic analytics provides useful summary numbers produced from raw data (e.g. we sold 56 books in 2012).

# Visualization Demo: RAWGraphs



# Analytic Technique 2: Metrics

Metrics are simple combinations of raw measures using math operations Intended to capture more abstract or complex concepts (mini math models)

Usually used in a business context.

Often ad hoc experimentation – if we change our organization like this, does the metric go up?

Tend to generate descriptive statements OR causal statements

# Metrics Uses

Pre-decision making: situational awareness

During decision: impact evaluators

Post decision: evaluation of decision

# Metrics Examples

Key performance indicators (KPIs) are the classic example.

Related to index in statistics (e.g. Gross National Happiness index)

For some interesting reading, best practices see “The Tyranny of Metrics” Jerry Z. Muller

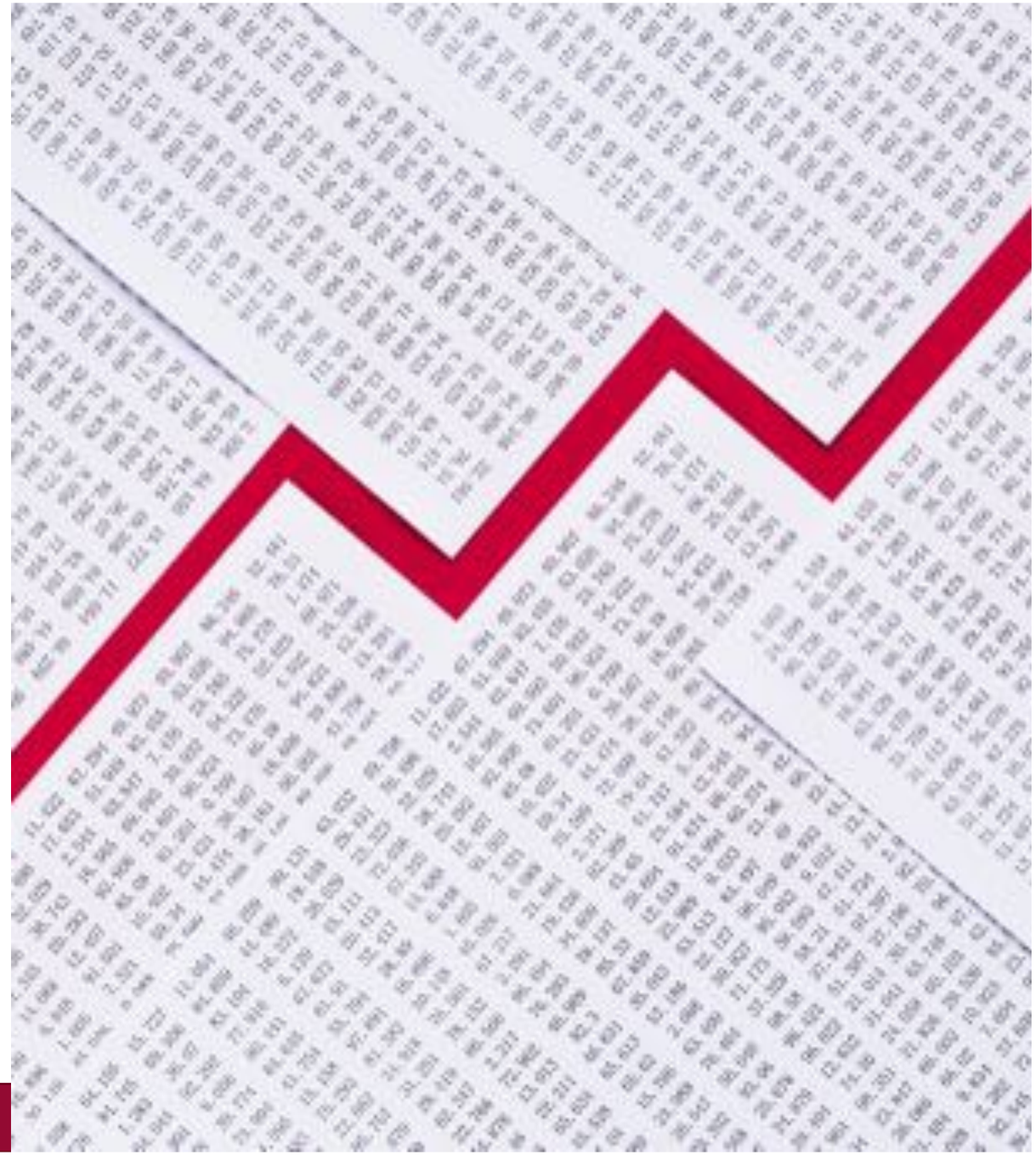
# Analytic Technique 3: Statistics

From a decision-making perspective, statistics typically provides generalized statements based on collections of very specific statements (i.e., data)

Common forms of statements are:

- When A, then typically B (e.g., When people eat sandwiches, their mood improves)
- A's often x (e.g. Vegetarians often have low cholesterol)
- As have the property x (e.g., Canadian women are 164cm tall)

How and where might these types of statements feed into the basic decision-making architecture?



# What about “Correlation not Causation!”

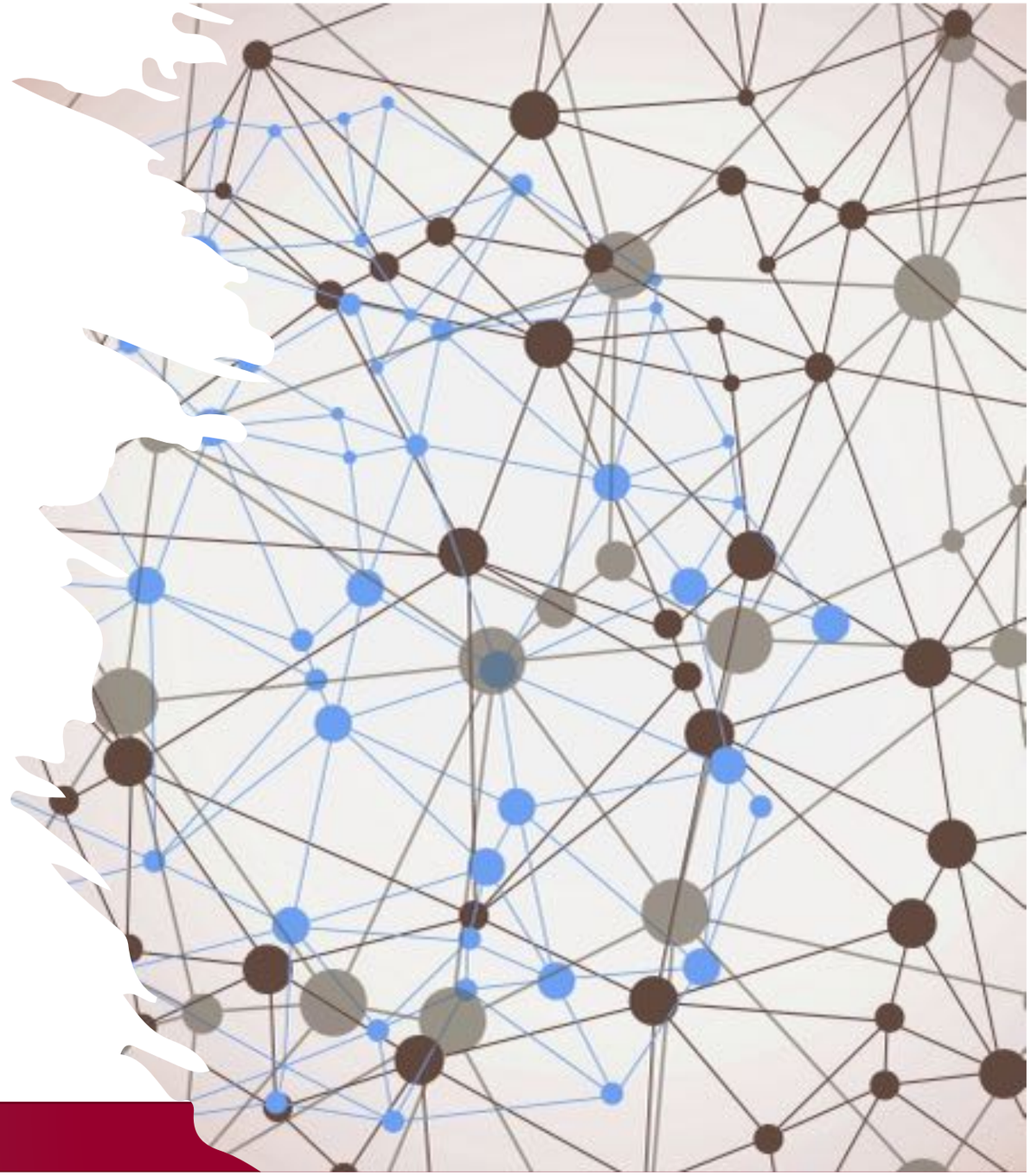
There’s a lot of upheaval going on in statistics right now!

Particularly, frequentists are “under attack” from Bayesians and causal modellers.

It’s a problem if we erroneously conclude causation from correlation, but its also a problem if we never admit that correlation is a very strong clue that there could be something causal at play.

# Statistics Demo

Statisty



# Analytic Technique 4: Optimization

Given a set of constraints and relationships, what is the best possible solution?

What is the maximum or minimum possible in a certain circumstance?

Statements of the form: "The best possible x is (approximately) y, and that happens when z"

But what counts as "the best"? Techniques aside, optimization is all about organizational values/goals and metrics that measure these.

Very relevant to imagining possible outcomes.

# Optimization: Video Explainer

Introduction to Optimization: What Is Optimization?

https://www.youtube.com/watch?v=Q2dewZweAtU

# Analytic Techniques 5: Classic Machine Learning

The most classic and common technique of classic machine learning is labelling: could be classification and categorization

Classification provides as an output a statement of the form "A is an x"

It is different from previous approaches: It often focuses on the individual. It doesn't necessarily provide statements in a more general form.

As a result, it is typically applied in what might be called "local" or "specific" decision making. "I need to decide whether or not to grant this particular individual a loan".

# Machine Learning Video Explainer

Computer Scientist Explains Machine Learning in 5 Levels of Difficulty | WIRED

https://www.youtube.com/watch?v=5q87K1WaoFI&t=12s

# Is Generative AI an Analytics Technique?

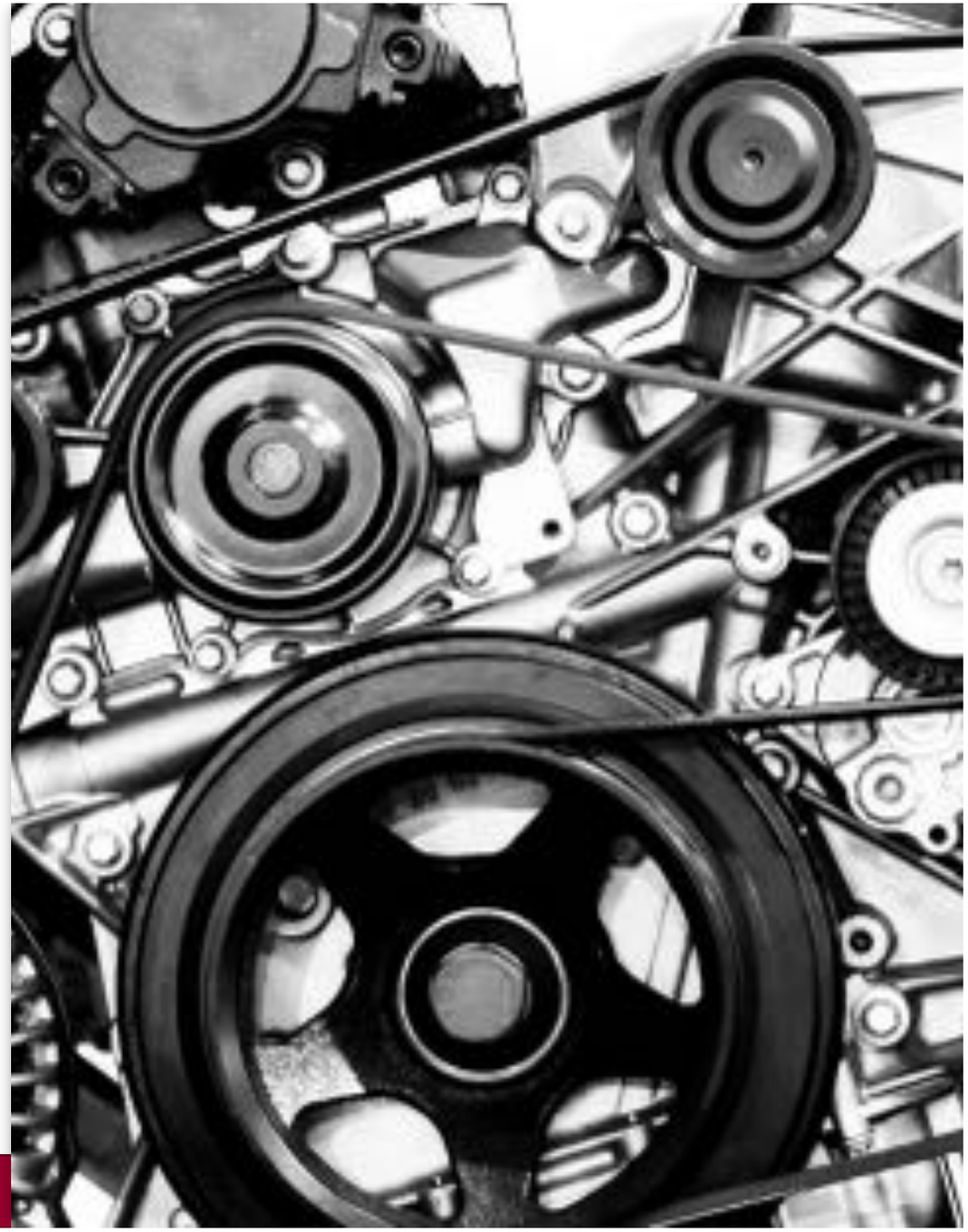
Can we use Generative AI engines (e.g. ChatGPT) for analysis? This is difficult to answer in a straightforward manner!

Traditional "plain jane" Large Language Models (the technique used to create the original GPT engine) are not good for analysis.

Right now commercial products are very black box – we can't easily evaluate their likely behaviour or quality based on how they are constructed.

Many of the front running providers of these engines may also be using them as interfaces to more classic analysis techniques

This means we may need to take a "test kitchen" approach.



# Small Group Analysis Exercise

# Exercise Part 1

In this exercise, you will work with a partner to consider what type of statements you might be able to extract from the provided "pocket data sets" – the hiking reviews dataset.

Consider which analytic technique might result in which sort of statement.

This will be exploratory – any statements you can come up with are good!

# Exercise Part 2

How could the results of your analysis and the statements you extracted influence your decision about which part of the trail to take?

# Automated Decision Making?

What does an automated decision-making system look like to do all of this?

At base, a truly automated decision-making system must be able to choose an action (e.g. loan approved or denied).

Current systems have default choices programmed in (including deciding not to decide, and passing the decision along to a person)

The assumption is that available options, along with the results and trade offs have been thought through **when designing the system**, and then baked into the system.

Would we want an automated system that could generate new choices and reason about desired and undesirable outcomes of these choices?

# Section 3:

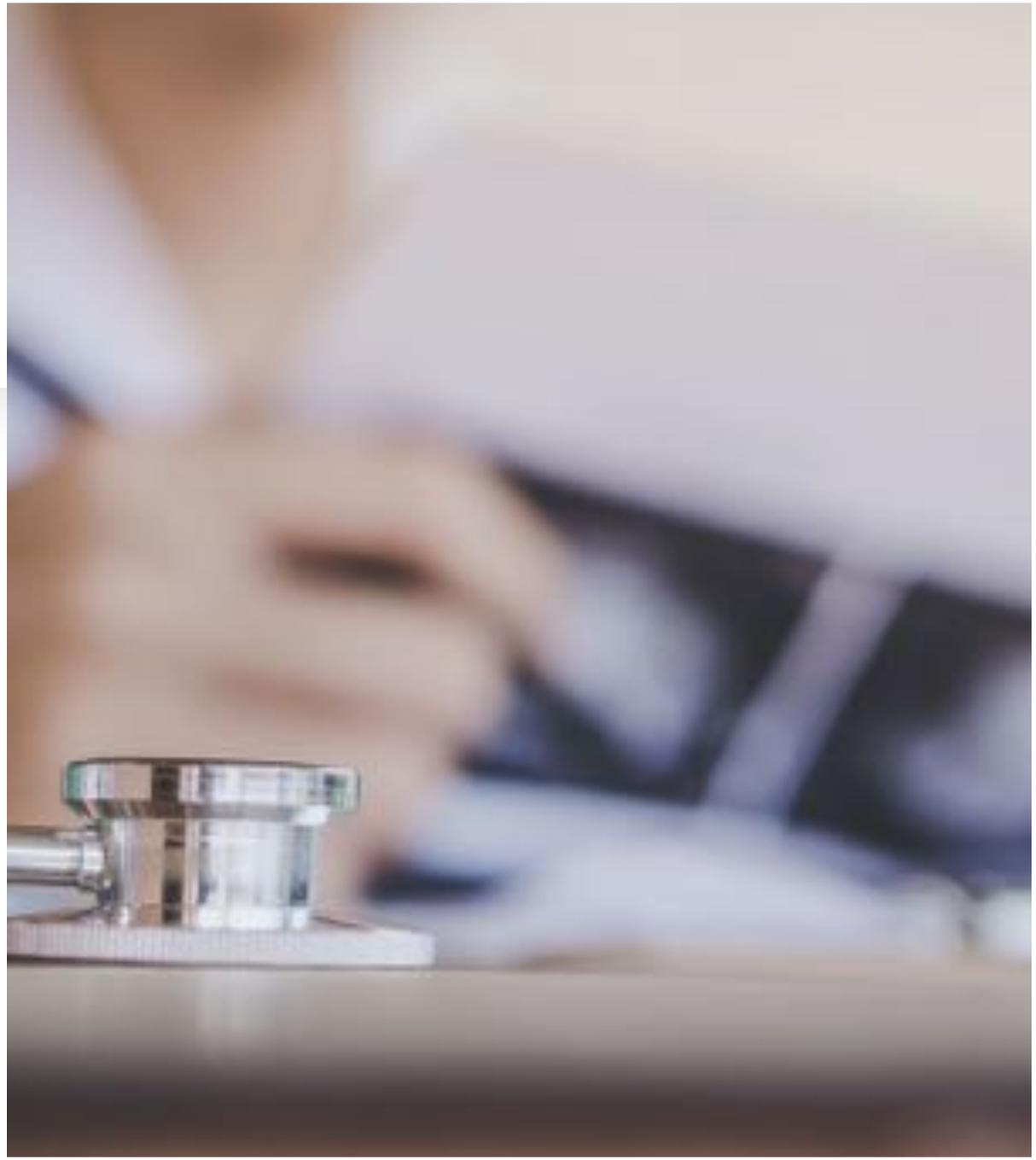
## Human Factors

# Group Decision Making with Data

# Having Responsibility Without Expertise

We often must make decisions in situations where we don’t have expertise.

An expert or experts come to us, providing facts we don’t understand, but we are the ones with the authority to make the decision - e.g., A doctor asks us to choose a treatment.



# How do we get more people involved?

How can decision making frameworks help with this?

How can the expert help with this? What is their decision support role?

How can data help with this?

# Group Decision Making Principles

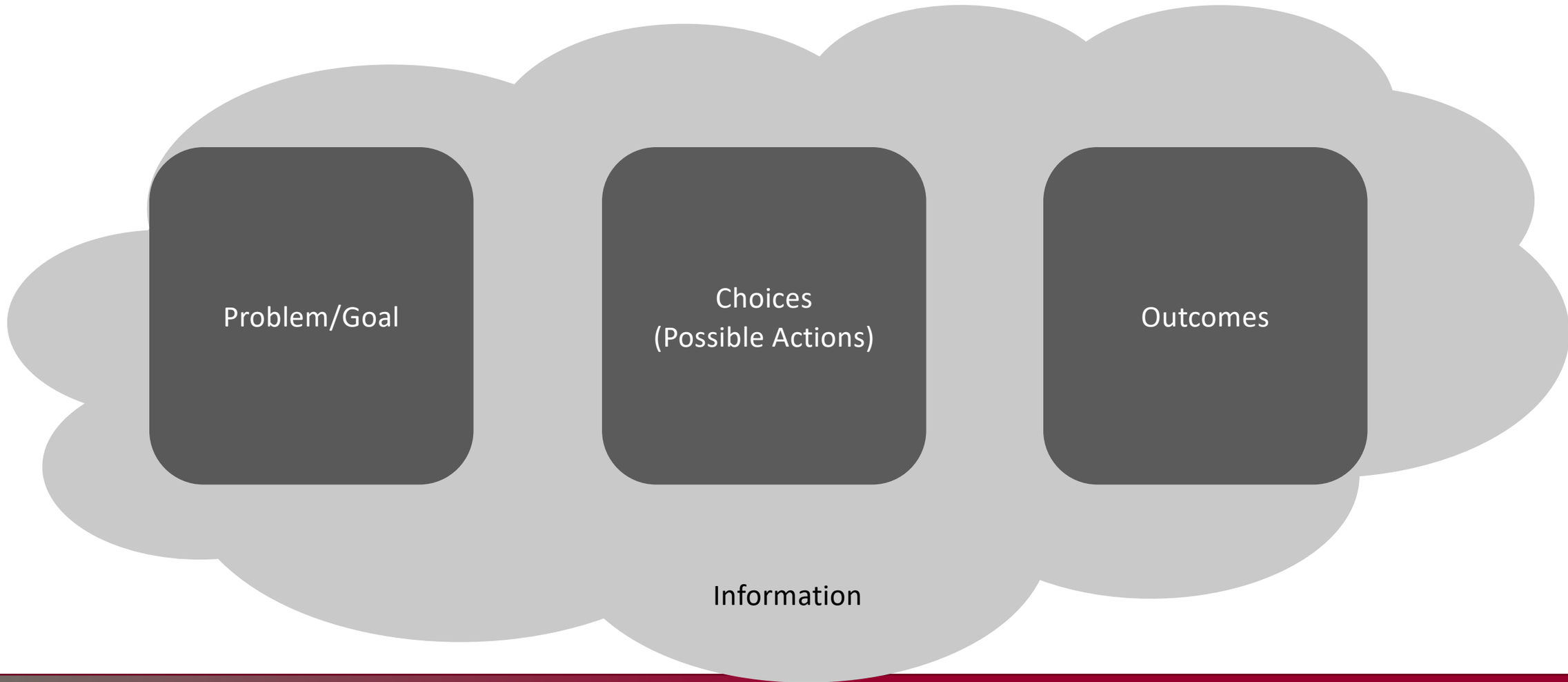
- Effective group decision-making requires clarity on meeting purposes and problem definitions.
- Encourage dissent to avoid groupthink and ensure all voices are heard.
- Leadership is crucial for guiding discussions, managing time, and summarizing decisions.
- Summarize accomplishments, make clear decisions, and delegate tasks at the end of meetings.
- By valuing diverse perspectives and fostering a proactive environment, groups can make wiser decisions collectively.

Source: https://thedecisionlab.com/insights/business/group-decision-making-how-to-be-effective-and-efficient

# Core Roles

- Problem Identifier
- Decision Maker
- Statement Provider (Decision Supporter)

# Four Core Elements of Decision Making



# Problem Identifer

Who is this in your organization?

What are they responsible for?

# Decision Maker

Who is this in your organization?

What are they responsible for?

# Decision Support (Statement Provider)

Who is this be in your organization?

What are they responsible for?

# Decision Making Frameworks

# Decision Making Frameworks

These can add rigour, consistency.

Act as a checklist – did I miss any crucial stages

Act as a guide – here are the stages to go through, here are the stages where I can add in evidence, information, data

Can help if you are in a situation where you must make a decision with little expertise or knowledge.

# Reviewing Decision Making Frameworks

## Academia:

- DECIDE : Define problem, Establish criteria, Consider alternatives, Identify best, Develop plan, Implement plan.
- GOFER: Goal clarification, Options generation, Facts-finding, Effects, Review.

Source: https://thedecisionlab.com/reference-guide/psychology/decision-making-process

## Private:

- ACE: Assess, Choose, Execute
- The 7 Steps: Identify decision, Gather info, Identify alternatives, Weigh evidence, Choose, Take action, Review.

Source: Lee, H. (2023). *The art of clear thinking: A stealth fighter pilot's timeless rules for making tough decisions*. St. Martin's Publishing Group

Source: https://www.lucidchart.com/blog/decision-making-process-steps

## Public:

- Health Canada: Issue Identification (Identify issue and context), Risk assessment (Assess risks and benefits), Risk management (identify and analyze options, select a strategy, implement the strategy and monitor and evaluate the results)

Source: https://www.canada.ca/en/health-canada/corporate/about-health-canada/reports-publications/health-products-food-branch/health-canada-decision-making-framework-identifying-assessing-managing-health-risks.html

# DECIDE

D efine the problem

E stablish the criteria

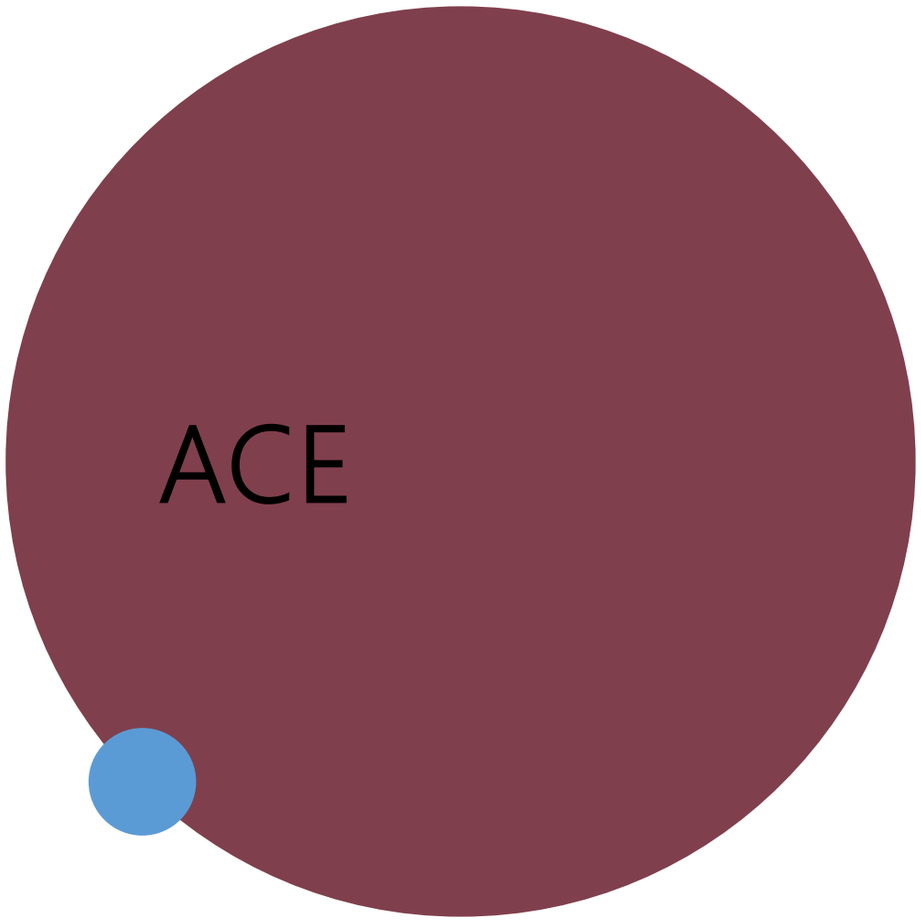
C onsider the alternatives

I dentify the best alternative

D evelop a plan and implement the plan of action

E valuate and monitor the solution and feedback

Source: https://thedecisionlab.com/reference-guide/psychology/decision-making-process

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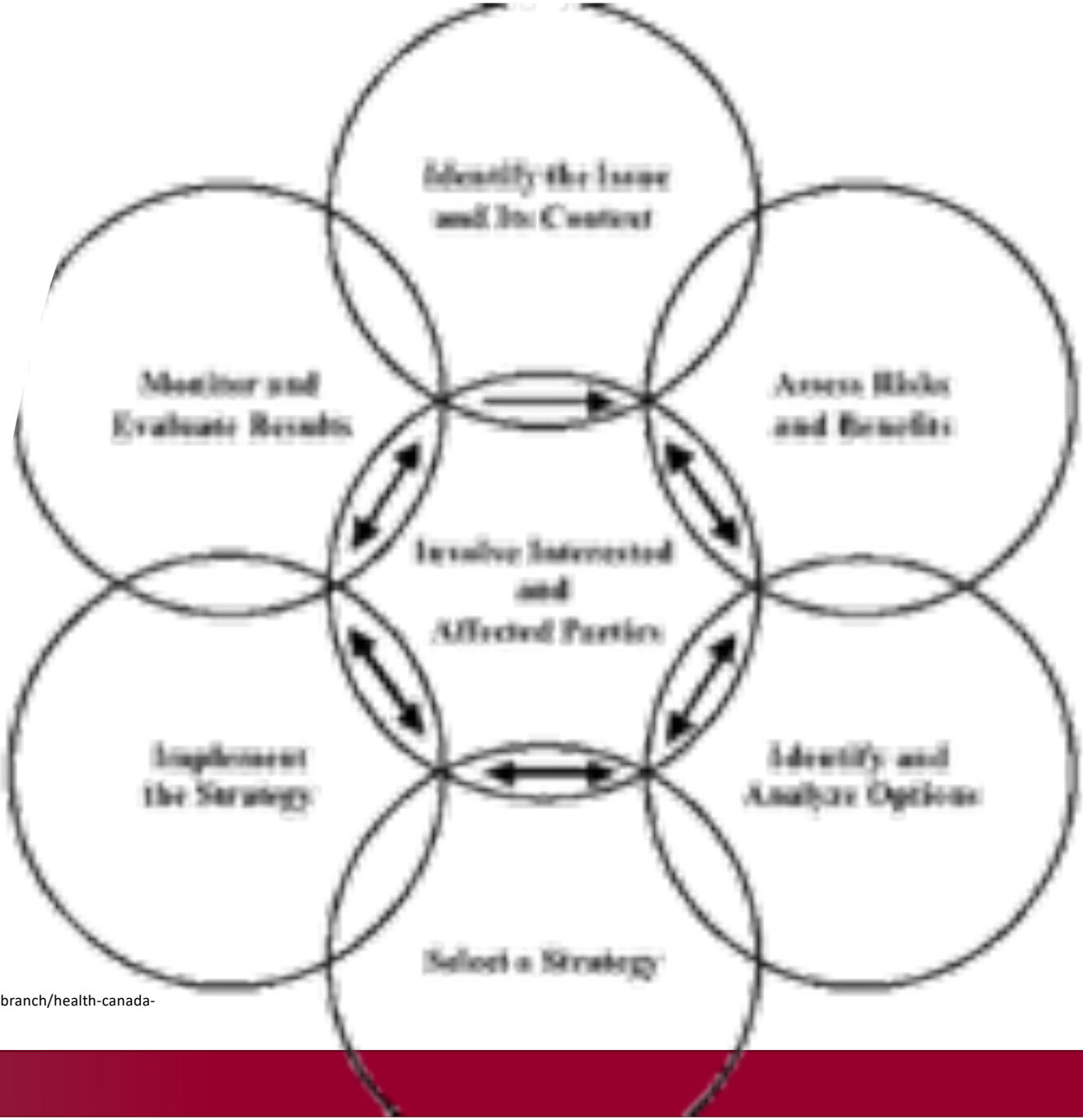
Source: Lee, H. (2023). *The art of clear thinking: A stealth fighter pilot's timeless rules for making tough decisions.* St. Martin's Publishing Group

# Health Canada




Source: https://www.canada.ca/en/health-canada/corporate/about-health-canada/reports-publications/health-products-food-branch/health-canada-decision-making-framework-identifying-assessing-managing-health-risks.html

# You Might Remember…
# "The Bigger Picture"

PRE DECISION MAKING

DECISION MAKING

POST DECISION MAKING

# Synthesizing Decision-Making Frameworks

## Pre-Decision Making

Knowledge, Culture, Goals

Recognize Problem/Decision, Values, Past Experience

## Decision Making

Develop/Recognize Options

Simulate Worlds of Consequences

Choose, Problem/Goal, Choice, Outcome

## Post-Decision Making

Outcome, Evaluate

Re-Start (if necessary)

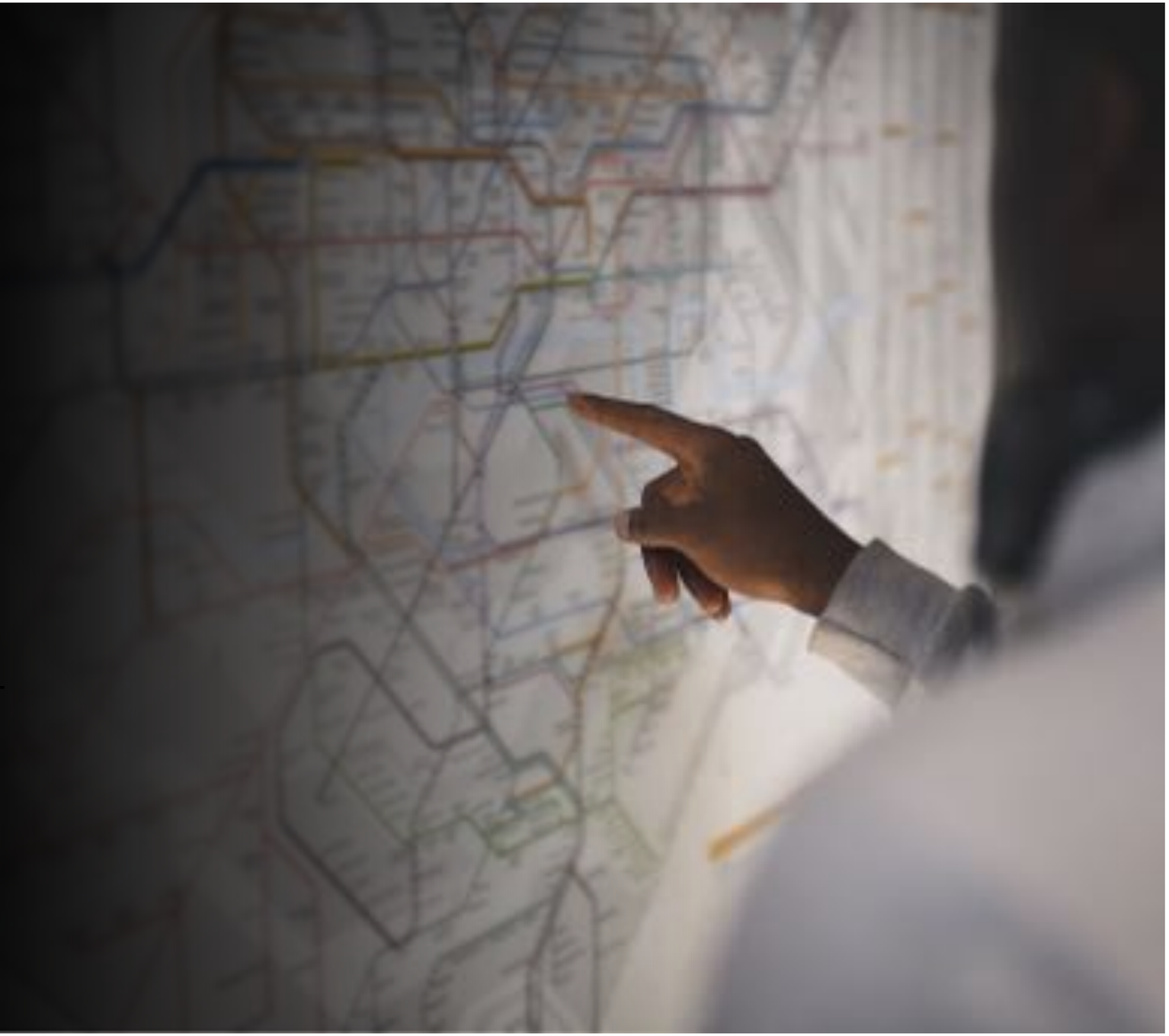
# Exercise: Analysis and Critique of Decision Making Frameworks

Each group will get a particular framework

What are the strengths and weaknesses of this framework?

How does data and analytics fit into this framework?

# Individuals and Decision Making with Data



# Decision Making Styles/Personalities

**DIRECTIVE**: DECISION-MAKERS RELY ON RATIONALITY AND PERSONAL KNOWLEDGE, DISREGARDING OTHER OPINIONS.

**CONCEPTUAL**: DECISION-MAKERS EXPLORE MULTIPLE ANGLES, BRAINSTORM ALTERNATIVES, AND SEEK CREATIVE SOLUTIONS, THOUGH THIS APPROACH MAY BE TIME-CONSUMING.

**ANALYTICAL**: DECISION-MAKERS GATHER EXTENSIVE INFORMATION FOR WELL-INFORMED AND OBJECTIVE CHOICES, SOMETIMES LIMITING INNOVATION FOR THE SAKE OF DATA-BACKED DECISIONS. CHOICES, DECISIONS ARE WELL-INFORMED AND OBJECTIVE.

**BEHAVIORAL**: GROUP-ORIENTED DECISION-MAKERS PRESENT OPTIONS FOR DISCUSSION, REQUIRING A DECISIVE LEADER TO CONCLUDE DELIBERATIONS EFFECTIVELY.

Source: https://thedecisionlab.com/reference-guide/psychology/decision-making-process

# The Human Mind as Prediction Engine

•Mind viewed as predictive system in cognitive science.

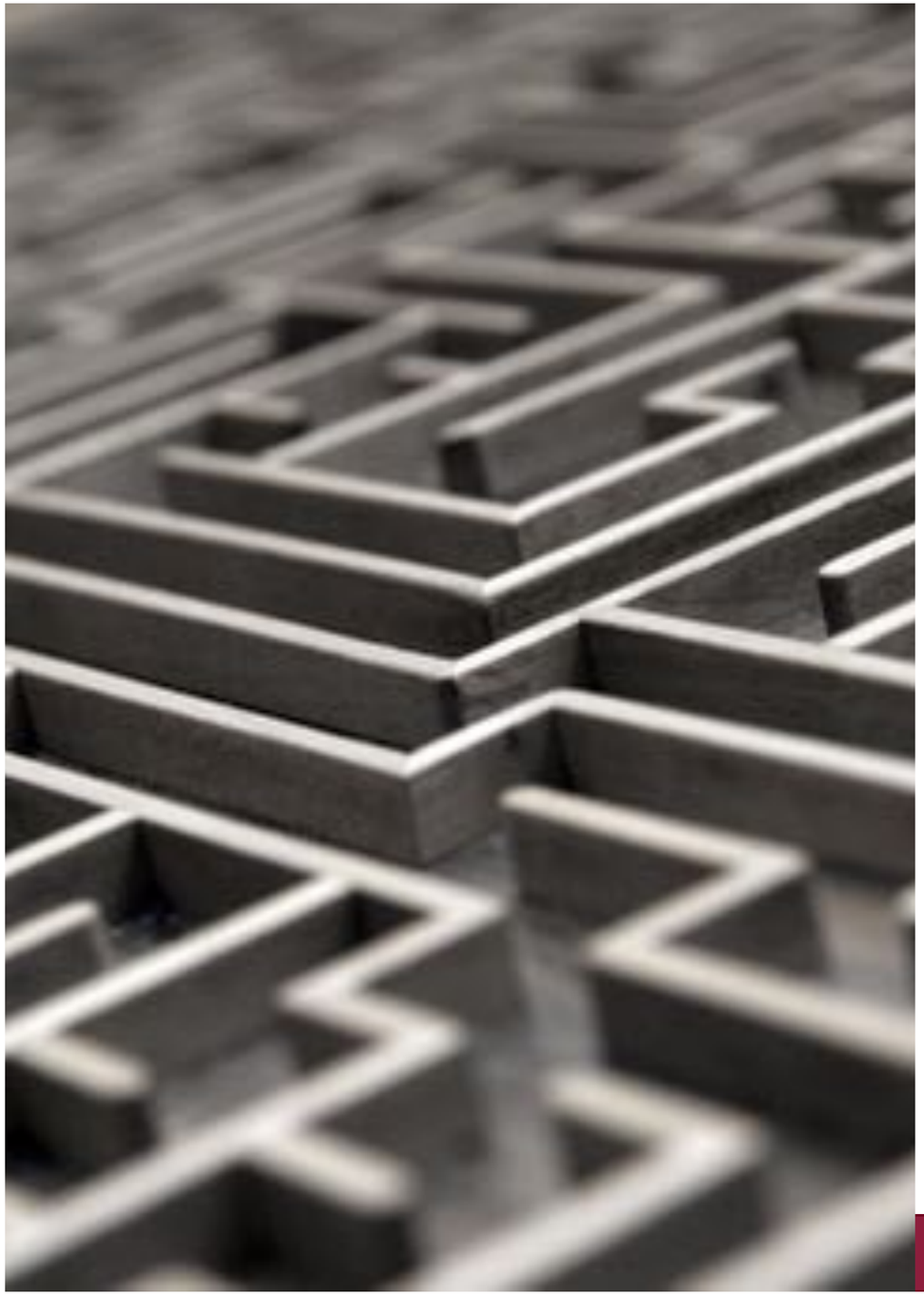
- Arguably the term prediction is too vague. We would like instead to talk about r-prediction and s-prediction.

R- prediction is deeply rooted and allows us to perceive the world to begin with.

- Generates predictions from prior knowledge and sensory input.
- Compares predictions with incoming sensory information.
- Updates internal models based on prediction errors.
- Brain aims for accurate predictions to guide behavior.

S Prediction

- If I choose A, what will world A be like?
- If I choose B, what will world B be like?
- **S prediction is what we are doing when we do decision science and every day decision making!**



# Biases / Heuristics

- Our minds rely on rules of thumb or shortcuts known scientifically as “heuristics”.
- Evolutionarily speaking, it is prohibitively expensive to invest the time and energy required to meticulously optimize action for each situation, so we have developed generalizations.
- Though they may have adaptive origins, their adaptiveness to all situations should be deeply questioned.
- Be warned! They feel very powerful. They are instinctual.

# Cognitive Biases/Properties that affect Decision Making

Anchoring Bias: Why do we compare everything to the first piece of information we received?

Action Bias: Why do we prefer doing something to doing nothing?

Bandwagon Effect: Why do we support opinions as they become more popular?

Confirmation Bias: Why do we favour our existing beliefs?

Belief Perseverance: Why do we maintain the same beliefs, even when they are proved wrong?

Bounded Rationality : Why are we satisfied by good enough?

Choice Overload: Why do we have a harder time choosing when we have more options?

Commitment Bias: Why do we favour our existing beliefs?

Decision Fatigue: Why do we make worse decisions at the end of the day?

Empathy Gap: Why do we mispredict how much our emotions influence our behaviour?

Framing Effect: Why do our decisions depend on how options are presented to us?

IKEA effect: Why do we place disproportionately high value on things we helped to create?

The Sunk Cost Fallacy: Why are we likely to continue with an investment even if it would be rational to give it up?

Zero Risk Bias: Why do we seek certainty in risky situations?

Source: https://thedecisionlab.com/biases

# Cognitive Biases Can Affect All Three Phases

PRE DECISION MAKING

DECISION MAKING

POST DECISION MAKING

# Showcasing Three Cognitive Biases

Anchoring Bias

Bandwagon Effect

Sunk Cost Fallacy

# Phase-Bias Mappings

PRE DECISION MAKING

DECISION MAKING

POST DECISION MAKING

Anchoring Bias

Bandwagon Effect

Sunk Cost Fallacy

# Anchoring Bias

PRE DECISION MAKING

Anchoring Bias

# The Anchoring Bias: What is it?

The first piece of information we receive on a topic acts as a reference point from which we interpret new information.

- If a customer first sees an item at its original price, and then subsequently sees the item at a discounted price, they will evaluate the new price as a good deal.

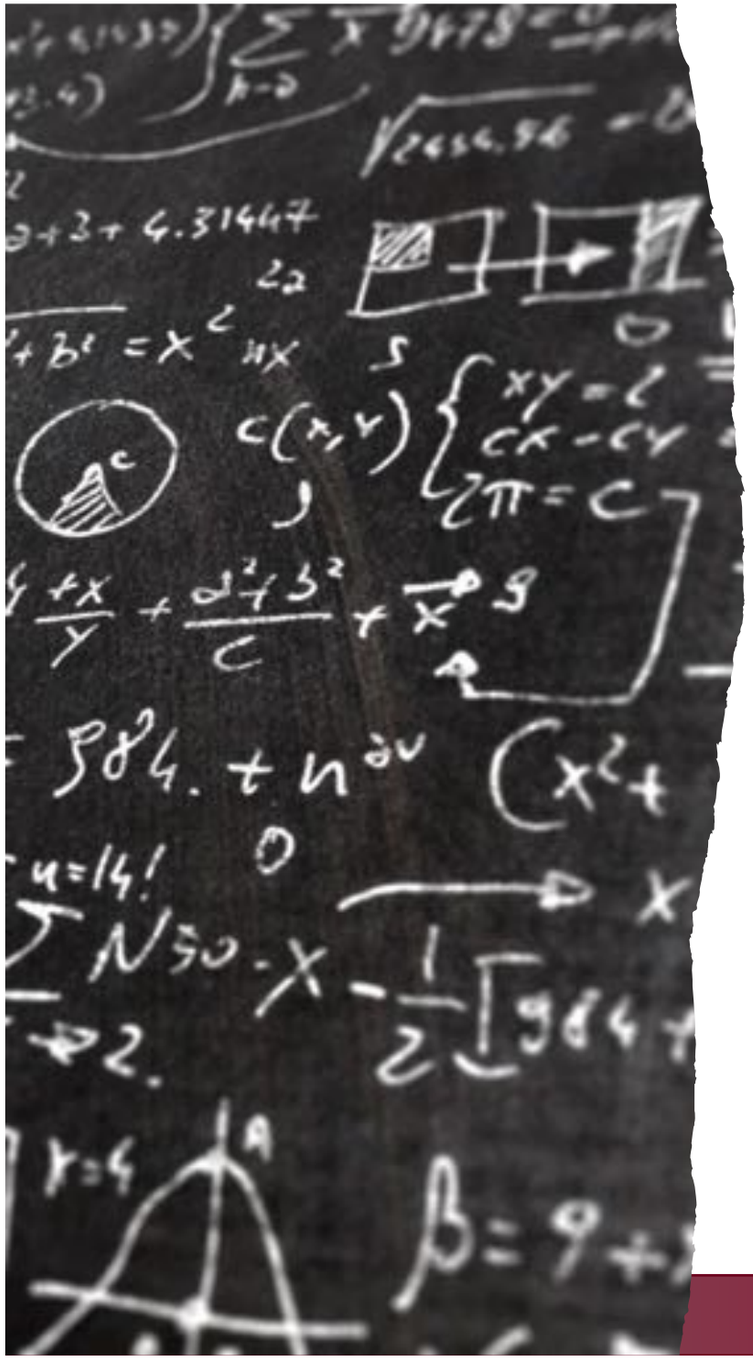
Exacerbating factors include feeling short on time and being preoccupied with other demands, and mood.

The responses we get from AI can trigger this bias!

Experiments have shown that even unrelated anchoring points, such as your social security number, can influence your purchasing judgments.

Can prevent us from adjusting our initial plan for projects when we discover that our initial time/cost estimations were inaccurate (i.e., planning fallacy).

Source: https://thedecisionlab.com/biases/anchoring-bias



# Anchoring Bias: Why Does it Happen?

Causes are still debated, but this bias is a very repeatable finding in experimental psychology (seems to depend on the context).

When we come up with anchors ourselves, the "anchor and adjust hypothesis."

- Amos Tversky and Daniel Kahneman
- Our strategy for estimating or predicting is to start with some initial value and adjust from there.
- However, the bias (and faulty decision making) comes in because our adjustments are typically trivial.
- 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 VS 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 Median Estimates = 2250 VS 512

When they are given to us: "the selective accessibility hypothesis" (priming)

- This theory relies on "priming", where exposure to a concept activates related concepts in the mind, and therefore make the original concept easy to bring to memory.
- When presented with an anchor, we test the anchor out against our model of the target, but as we do so, we activate other pieces of information that are consistent with the anchor, and our decision making is affected.
- Is the Peace Tower taller or shorter than 100m?

Source: https://thedecisionlab.com/biases/anchoring-bias

# Anchoring Bias: How Can We Mitigate its Effects?

Likely isn't possible to entirely avoid it, even spending more time thinking about your decision can further entrench an anchor point.

Instead, come up with reasons why that anchor is inappropriate. This has been shown to reduce the anchor effect in experiments where participants were anchored in their estimations of price.

Considering multiple options is always a good idea when making decisions.

Red teaming can help with this (where people are designated to play "devil's advocate" and challenge the ideas of the group).

Exercises that expose the weaknesses of alternatives can in some sense inoculate them against any hidden anchoring influence (remember that biases are unconscious!).

Source: https://thedecisionlab.com/biases/anchoring-bias

# Bandwagon Effect

DECISION MAKING

Bandwagon Effect

# Bandwagon Effect: What is it?

- Refers to our tendency to go along with the majority opinion/behaviour (“go along to get along”, “if you can’t beat’m, join’m,”, etc).
- Overrides reasoning faculties that are essential for critical thinking.
- A helpful heuristic perhaps, evolutionarily, but not always adaptive.
- The spread of AI awareness and perceived AI needs. Will AI really help you in this instance?

Source: https://thedecisionlab.com/biases/bandwagon-effect

# Bandwagon Effect: Why Does it Happen?

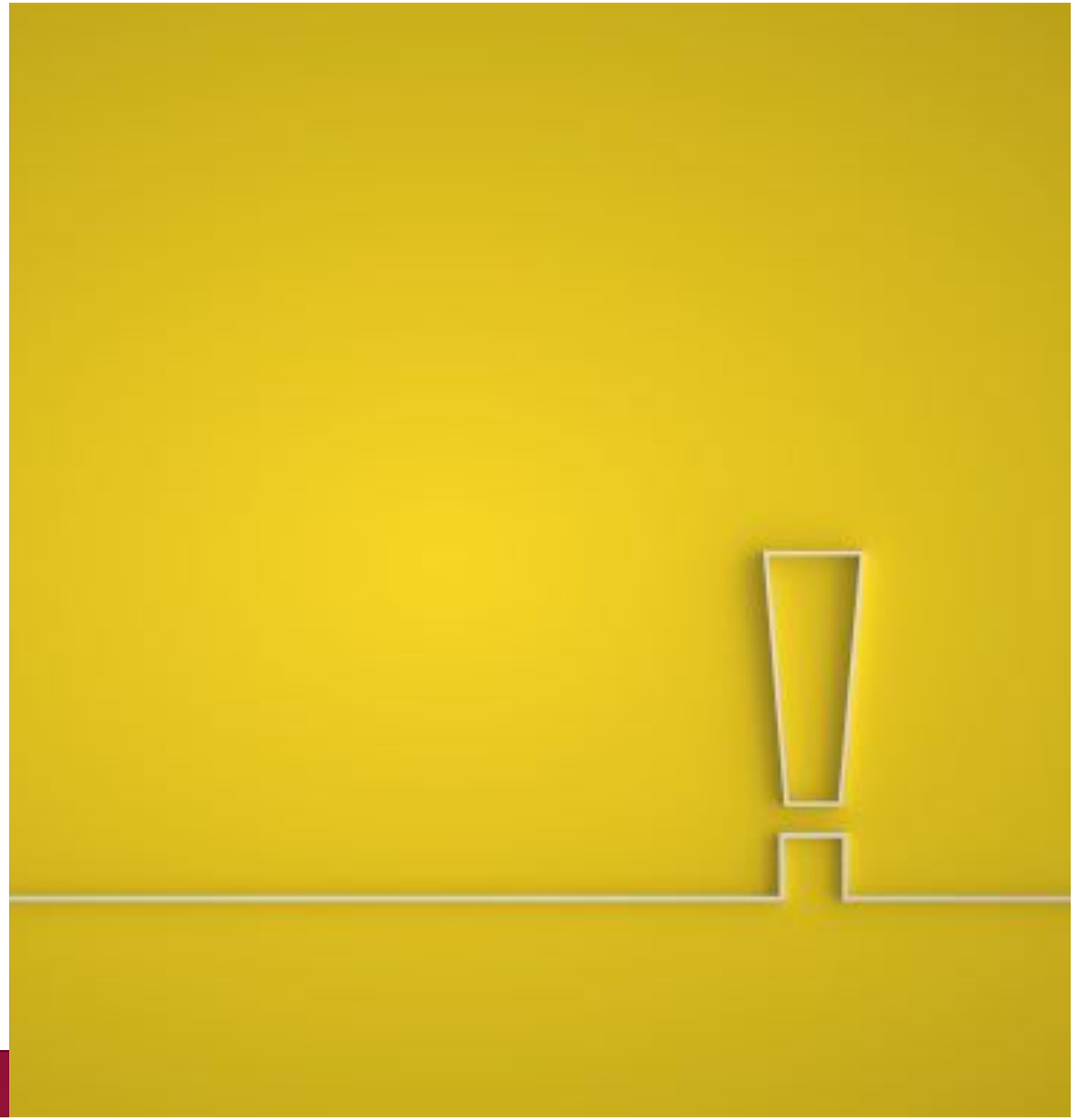
- The need to fit, sometimes called “social desirability” in psychology. “Relatedness” is need as one of the core human needs, and one of the biggest fears is social isolation. How many of us would dare to hold our positions if it meant losing our friends and family?

- “Majority rules” in more ways than one. Regardless of whether or not the majority opinion turns out to be correct, it certainly has the appearance of being right, and we are biased towards wanting to be on “winning side”.

Source: https://thedecisionlab.com/biases/bandwagon-effect

# Bandwagon Effect: How to Mitigate its Effects?

- Potentially impossible to completely escape, but…
- Take your time when making decisions – allow some time and space before you make your decision to take your stand when the information was conveyed to you in such a way where it is clear what the majority opinion is.
- Try to put yourself in an environment where social pressure is reduced.
- Think for yourself!



Source: https://thedecisionlab.com/biases/bandwagon-effect

# Sunk Cost Fallacy

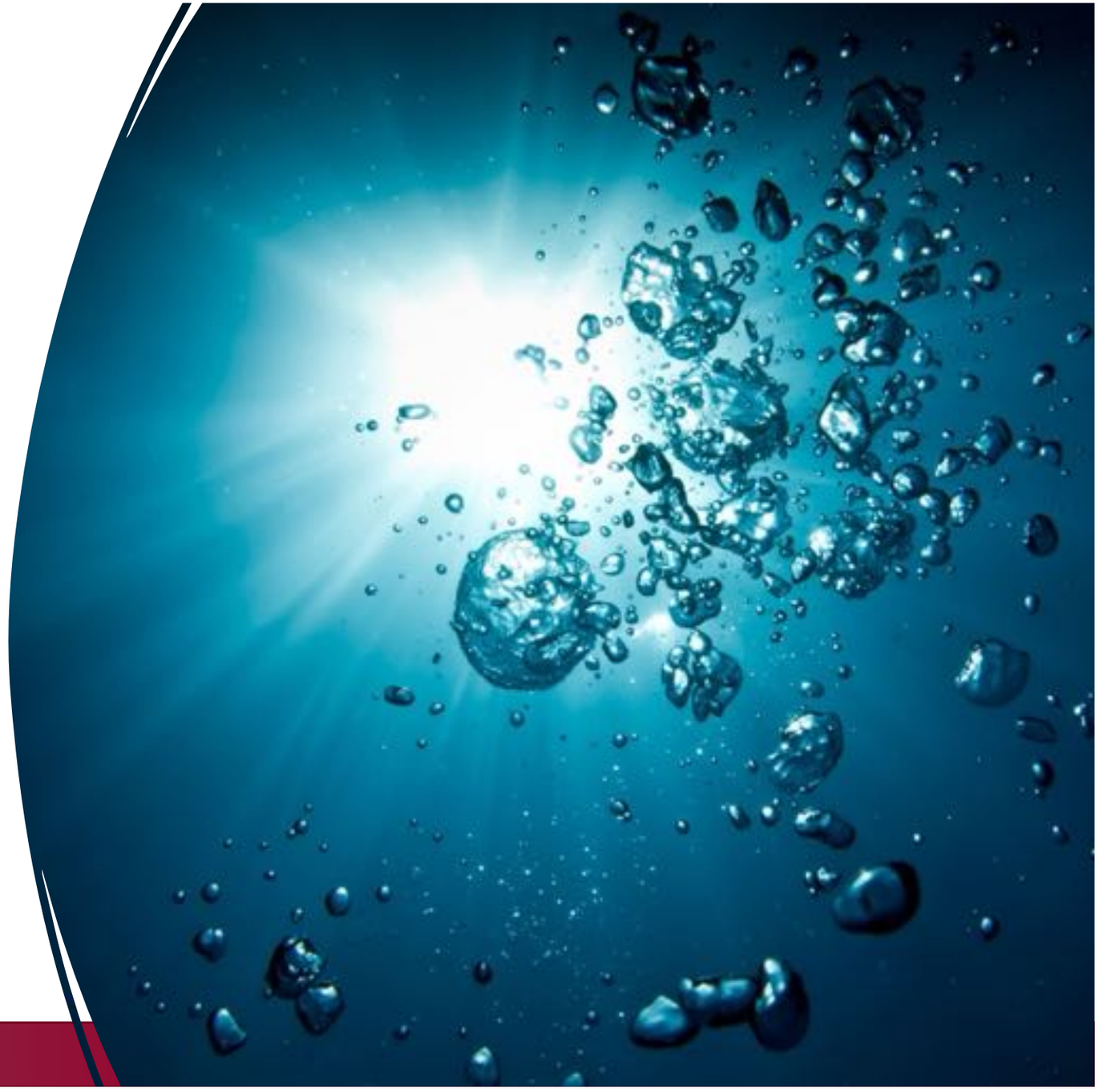
POST DECISION MAKING

Sunk Cost Fallacy

# Sunk Cost Fallacy: What is it?

- Our tendency to persist in an endeavour simply because we have already invested resources into it (e.g., time, money, energy, etc.)
- We cannot do anything about past irrecoverable costs, but we can do something about the future. In this light, we are biased away from looking rationally at current alternatives.
- The Concorde
- Can you think of any examples in your own work or life?
- Do we think AI will help or hinder?

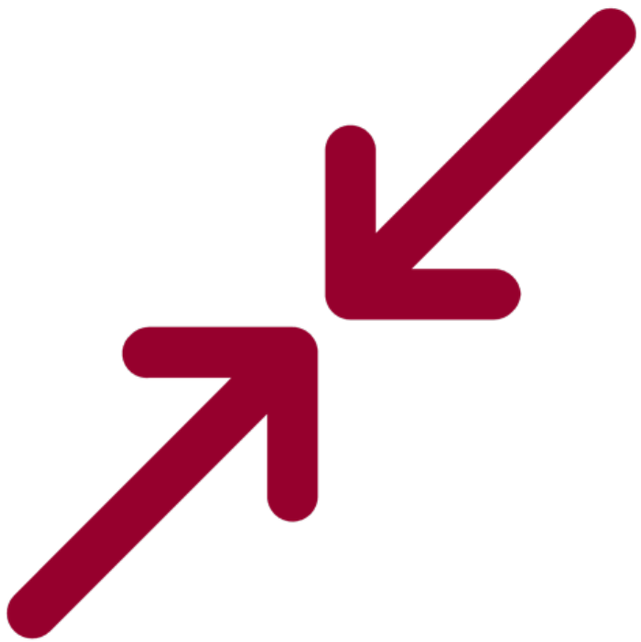
https://thedecisionlab.com/biases/the-sunk-cost-fallacy



# Sunk Cost Fallacy: Why Does it Happen?

- We are not ”purely rational” (indeed Antonio Damasio has shown that even our pure reason requires our emotional processing centers to be in tact).
- We feel negative emotion when we abandon a choice we have previously invested in (e.g., regret, remorse) and we are trying to mitigate this negative feeling.
- We are particularly loss averse (we feel losses more than gains). By switching course, we have fully accepted that loss.
- It all depends on how we frame the decision.

https://thedecisionlab.com/biases/the-sunk-cost-fallacy



# Sunk Cost Fallacy: How to Mitigate its Effects?

- Rather than fixating on irrecoverable past losses, focus on the present and the future with a fresh perspective.
- Studies have shown that when we are deterred from making decisions based off emotions, this bias is significantly reduced.
- Turn to AI / automated decision making?

https://thedecisionlab.com/biases/the-sunk-cost-fallacy

# Exercise Matching Biases to Decision Making Stages

## Pre-Decision Making

Knowledge, Culture, Goals

Recognize Problem/Decision

## Decision Making

Develop/Recognize Options

Simulate Worlds of Consequences

Choose

## Post-Decision Making

Evaluate

Re-Start (if necessary)

| | | | |
|---|---|---|---|
| **Anchoring Bias**: Why do we compare everything to the first piece of information we received? | ☐ | ☐ | ☐ |
| **Action Bias**: Why do we prefer doing something to doing nothing? | ☐ | ☐ | ☐ |
| **Bandwagon Effect**: Why do we support opinions as they become more popular? | ☐ | ☐ | ☐ |
| **Confirmation Bia**s: Why do we favour our existing beliefs? | ☐ | ☐ | ☐ |
| **Belief Perseverance**: Why do we maintain the same beliefs, even when they are proved wrong? | | | |
| **Bounded Rationality** : Why are we satisfied by good enough? | ☐ | ☐ | ☐ |
| **Choice Overload**: Why do we have a harder time choosing when we have more options? | ☐ | ☐ | ☐ |
| **Commitment Bias**: Why do we favour our existing beliefs? | ☐ | ☐ | ☐ |
| **Decision Fatigue**: Why do we make worse decisions at the end of the day? | ☐ | ☐ | ☐ |
| **Empathy Gap**: Why do we mispredict how much our emotions influence our behaviour? | | | |
| **Framing Effect**: Why do our decisions depend on how options are presented to us? | ☐ | ☐ | ☐ |
| **IKEA effect**: Why do we place disproportionately high value on things we helped to create? | | | |
| **The Sunk Cost Fallacy**: Why are we likely to continue with an investment even if it would be rational to give it up? | ☐ | ☐ | ☐ |
| **Zero Risk Bias**: Why do we seek certainty in risky situations? | ☐ | ☐ | ☐ |

# Bias and the Decision Making Process Discussion

**Taking in new statements (beliefs/facts)**

- Anchoring Bias
- Bandwagon Effect
- Base Rate Fallacy

**Handling Currently held statements**

- Confirmation Bias
- Belief Perseverance
- Commitment Bias

**Choosing/Selecting among options**

- Action Bias
- Choice Overload
- Bounded Rationality
- Decision Fatigue
- Empathy Gap
- Zero Risk Bias

**Decision Evaluation**

- IKEA Effect
- The Sunk Cost Fallacy


When Decision Making
Goes Wrong

# Case Study: Boeing's Partnership Model Decision

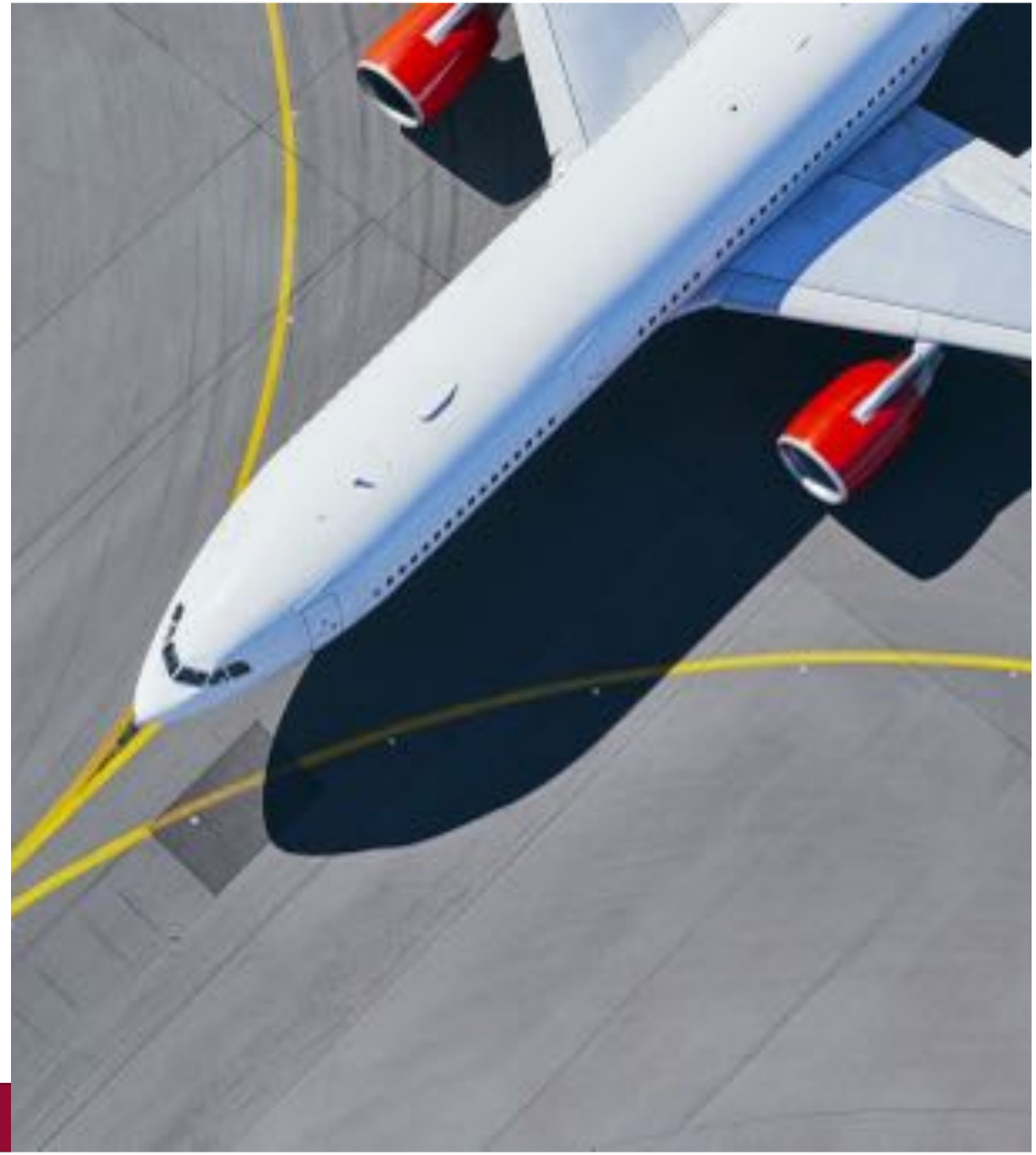
# Boeing's Partnership Model Decision

It is the early 2000s, and Boeing is in danger of losing orders to French and German government-backed Airbus, particularly the long-range A380.

In order to raise the capital and increase production scale, a new business plan is developed for the upcoming 787: sign partners who will contribute billions in advance in exchange for long-term contracts designing and building key components of the aircraft.

Subcontracting is not new to Boeing or Airbus, but major components were always made and assembled in house.

Main trade-off: quality control for increased capital for manufacturing, increased profit margins, increased shareholder return.



# Take 10 Minutes to Take Notes

Review the timeline found here: https://content.fortune.com/wp-content/uploads/2024/02/timeline_01-01.png?w=1440&q=75

# Discussion: Where Did Boeing Go Wrong?

# Decision Making Stages

## Pre-Decision State + Processes

Knowledge, Culture, Goals

Recognize Problem/Decision

## Decision State + Processes

Develop/Recognize Options

Simulate Worlds of Consequences

Choose

## Post-Decision State + Processes

Evaluate

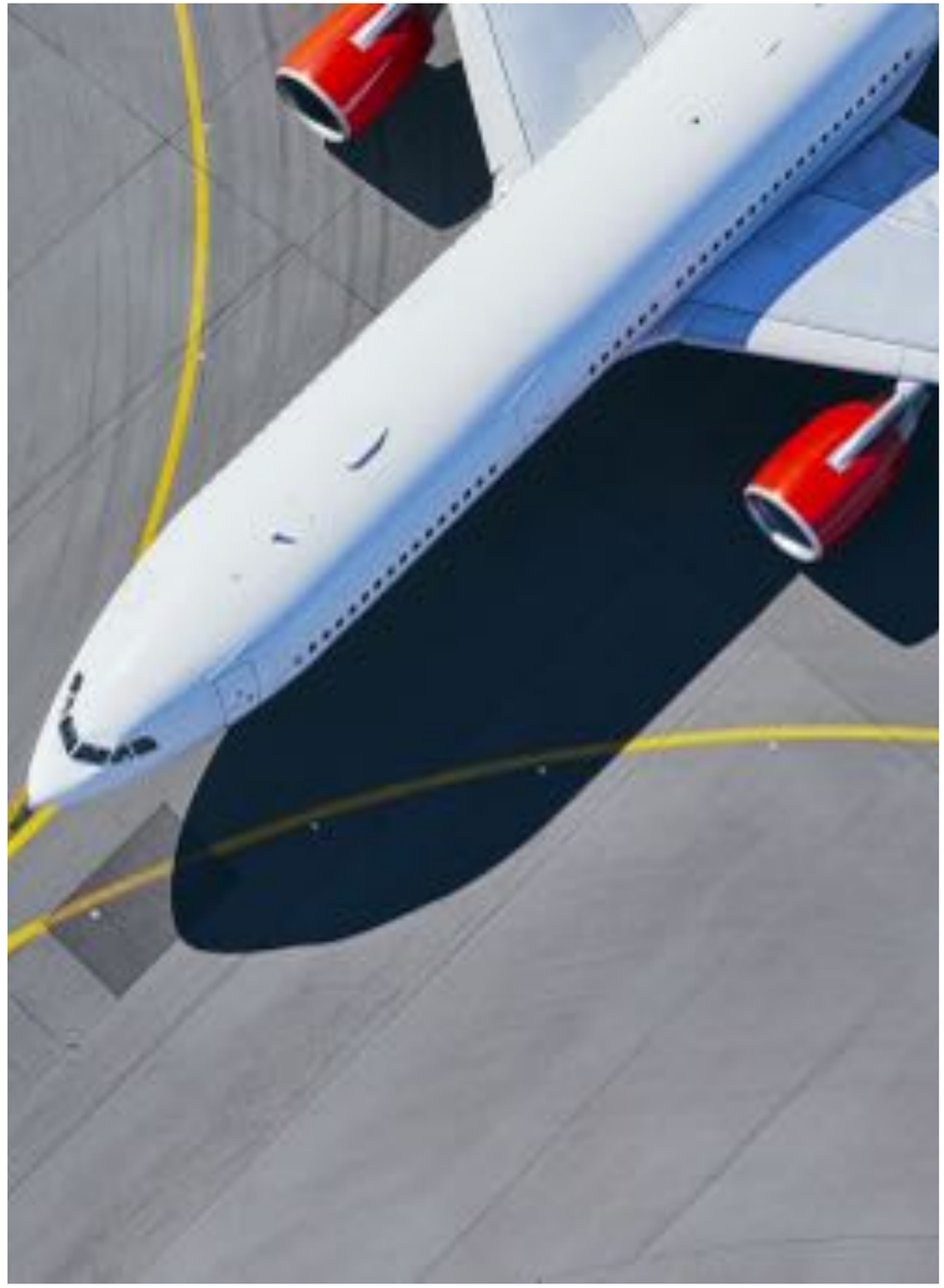
Re-Start (if necessary)

# Boeing Pre-Decision State/Processes

- What can we say about Boeing's Pre-Decision State/Processes?
    - Culture?
    - Goals?
    - Knowledge?
    - Practices?

- Are there any biases that you can see?

- Problem Identifier: "We may lose orders to Airbus and their A380. What do we do?"



# Boeing's Decision State/Processes

How did Boeing frame their decision?

What were the choices they generated?

Are there potentially any biases in play?

# Boeing's Post-Decision State/Processes

What are the outcomes of Boeing's decision to go forward with their new partnership model?

Were there any other potential metrics that might have helped evaluate the outcomes of the decision?

# What Can Go Wrong in Decision Making?

Low quality actions

Failure to carry out some actions

# Section 4: Lab

# Introduction To Lab Exercise

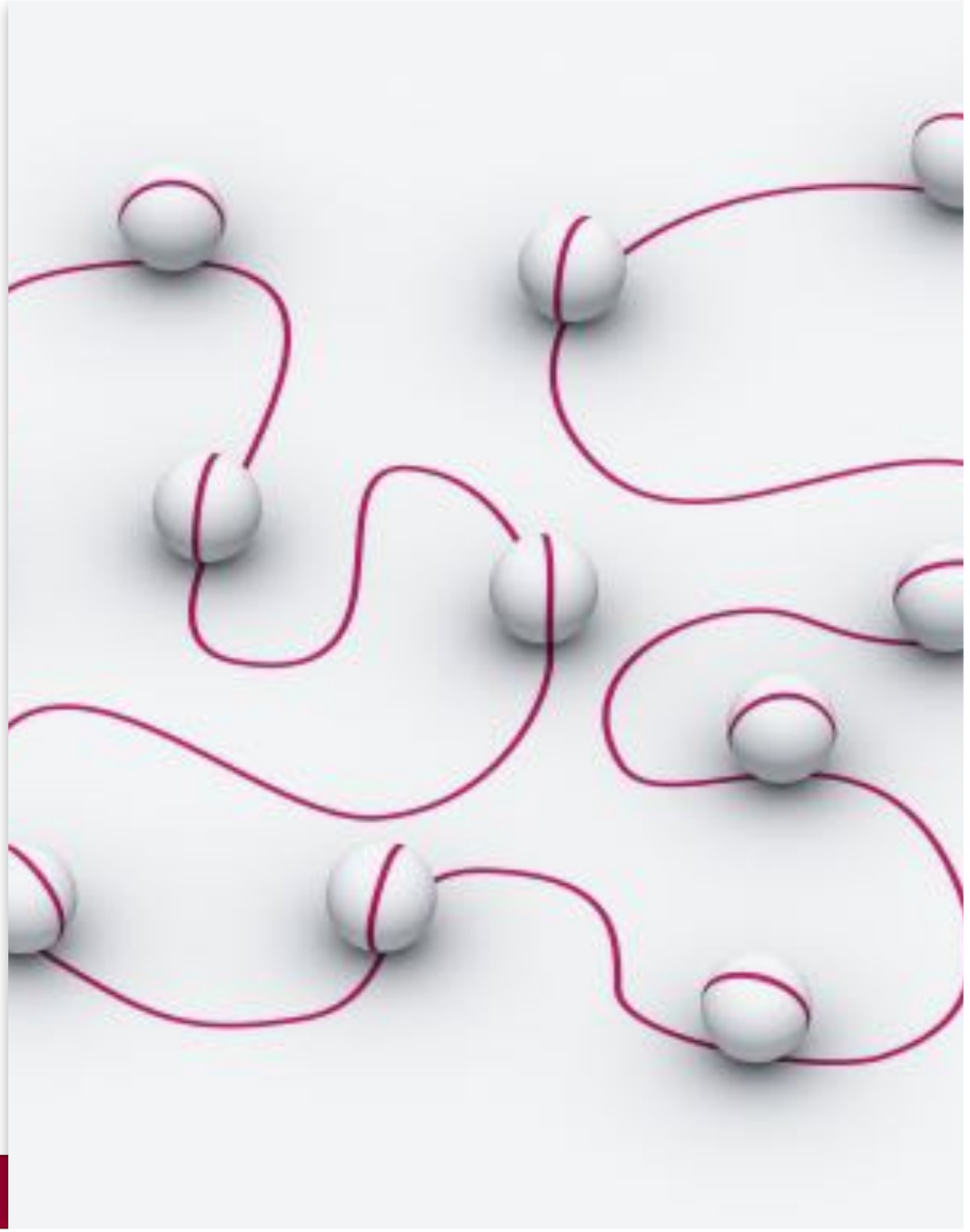
You are tasked with making a decision (see manual for details)

Work in Groups of 5-8

Within these groups, two smaller groups – the analysts/SMEs and the decision makers

At the end of the exercise, each group will make a decision

We'll follow this up with an opportunity for each group to discuss their experiences during the exercise



# Lab Structure

- Lab Part 1 – Orienting to the Data and the Decision context (~30 minutes, separate)
- Lab Part 2 – Discussing Relevant Data and Default Decisions (~20 minutes, together)
- Lab Part 3 – Data Analysis and Action Options (~30 minutes, separate)
- Lab Part 4 – Discussion of Relevant Findings and Factors (~30 minutes, together)
- Lab Part 5 – Making the Decision (~20 minutes, together)
- Lab Part 6 - Presentation of Lab Results (~30 minutes, full class)

# Lab Results Discussion

# Wrap Up

# Key Question(s) We Aimed to Tackle

How do I make evidence,data,information-based decision making?

When should I use evidence, data, information-based decision making?