Lecture 03-2: Storytelling with Data

DATA 503: Fundamentals of Data Engineering

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This lecture covers storytelling with data and introduces the project matchmaking workshop. We explore how data engineering pipelines enable compelling narratives by combining disparate data sources, then participate in a structured activity to form project teams.

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1 Storytelling with Data

Data engineering is not just about moving bytes. It is about enabling decisions.

Your pipeline exists to answer a question that matters.

1.1 Why Storytelling Matters

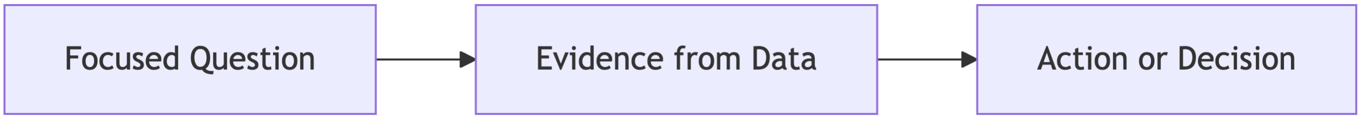
1.1.1 The Pipeline Serves the Story

Every data engineering project answers a question:

- What is happening?
- Why is it happening?
- What should we do about it?

Your pipeline is the infrastructure that makes the answer credible.

1.1.2 Three Parts of a Data Story



Without a question, you have a data dump.

Without evidence, you have an opinion.

Without an action, you have a report nobody reads.

1.1.3 Why Pipelines Enable Better Stories

Raw data from a single source tells a limited story.

Combining multiple sources creates new knowledge:

Single Source	Combined Sources
Weather data shows rainfall	Weather + traffic + accidents reveals crash risk patterns
Job postings list skills	Job postings + salary data + geography shows where to move
Restaurant inspections show violations	Inspections + reviews + demographics reveals food desert risks

1.1.4 The Data Engineering Advantage

You are not just analysts. You are infrastructure builders.

Your project will:

- Ingest data from multiple disparate sources
- Transform and normalize into a unified schema
- Enable queries that were previously impossible

This is how you create new knowledge.

1.2 Example Project Deep Dive

1.2.1 Oregon Trail Towns: Tourism and Economic Resilience

Research Question:

Which small Oregon towns along historic tourism corridors show the strongest relationship between seasonal visitor traffic and local business survival rates?

1.2.2 Why This Question Matters

Small towns depend on tourism but lack data infrastructure.

A chamber of commerce director asks:

- Should we invest in a summer festival?
- Which business types survive tourist seasons?
- How do we compare to similar towns?

No single dataset answers this. But combining three does.

1.2.3 Data Source 1: StreetLight Data (Traffic Counts)

Source: StreetLight InSight API (academic access available)

What it provides:

- Estimated vehicle and pedestrian counts by location
- Origin-destination patterns
- Day-of-week and seasonal breakdowns

Ingestion approach:

- API calls with geographic bounding boxes
- Weekly batch pulls for historical data
- Store raw JSON, parse into normalized tables

1.2.4 Data Source 2: Oregon Secretary of State Business Registry

Source: Oregon Business Registry public data export

What it provides:

- Business registration and dissolution dates
- Business type classifications
- Registered agent addresses (gives location)

Ingestion approach:

- Monthly CSV download from state portal
- Incremental loads tracking new registrations and dissolutions
- Geocode addresses to link with traffic zones

1.2.5 Data Source 3: Census Bureau ACS 5-Year Estimates

Source: Census API (data.census.gov)

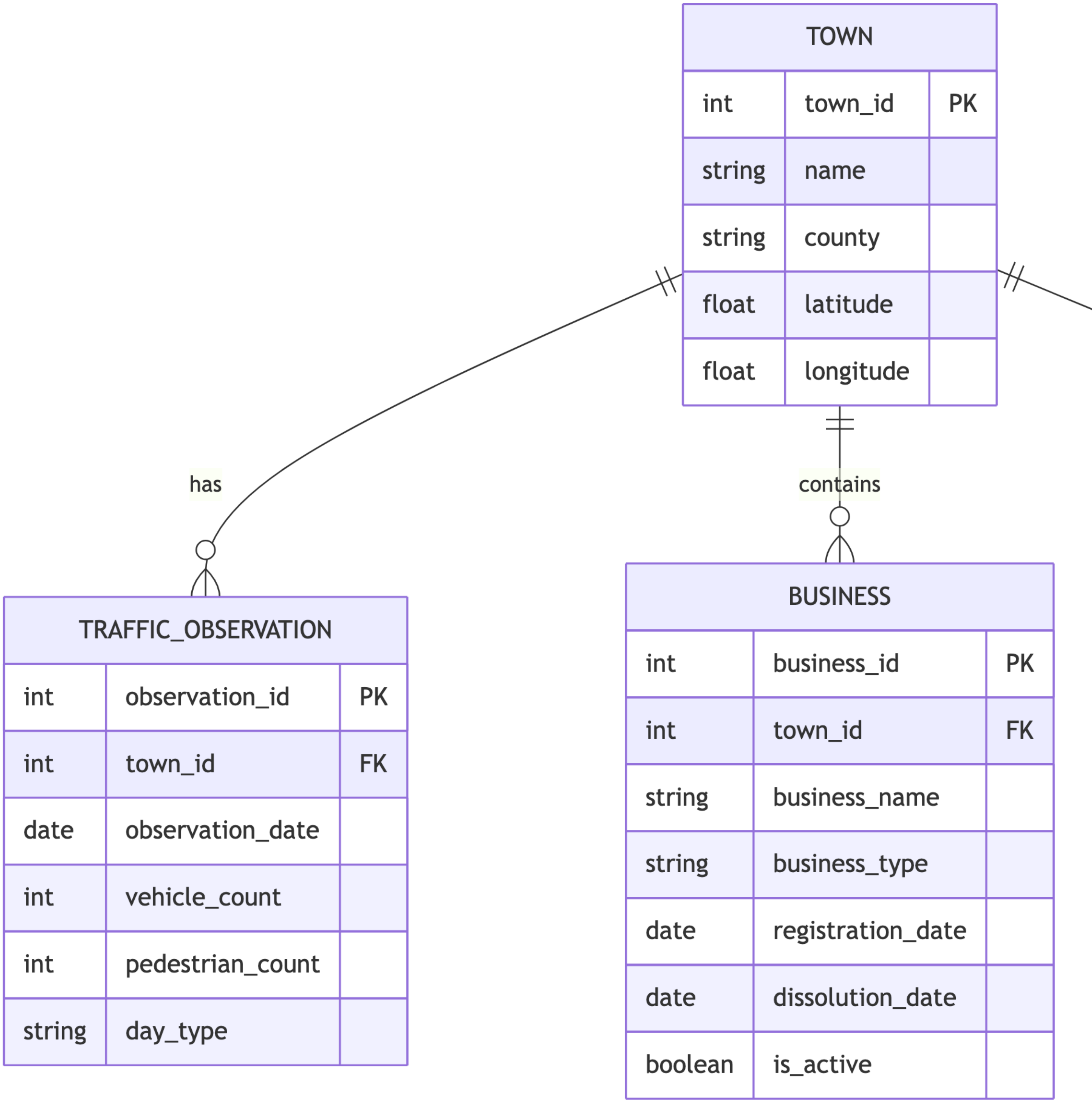
What it provides:

- Population by town
- Median household income
- Employment by industry sector

Ingestion approach:

- Annual API pull at census tract level
- Crosswalk tracts to town boundaries
- Store as slowly changing dimension

1.2.6 The Combined Schema



TOWN		
int	town_id	PK
string	name	
string	county	
float	latitude	
float	longitude	

TRAFFIC_OBSERVATION		
int	observation_id	PK
int	town_id	FK
date	observation_date	
int	vehicle_count	
int	pedestrian_count	
string	day_type	

BUSINESS		
int	business_id	PK
int	town_id	FK
string	business_name	
string	business_type	
date	registration_date	
date	dissolution_date	
boolean	is_active	

1.2.7 The Transformation Layer

Key derived metrics:

```sql
-- Seasonal traffic ratio
SELECT
    town_id,
    SUM(CASE WHEN MONTH(observation_date) IN (6,7,8)
        THEN vehicle_count ELSE 0 END) * 1.0 /
    NULLIF(SUM(CASE WHEN MONTH(observation_date) IN (1,2,12)
        THEN vehicle_count ELSE 0 END), 0)
    AS summer_winter_ratio
FROM traffic_observation
GROUP BY town_id;

-- Business survival rate by type
SELECT
    town_id,
    business_type,
    COUNT(CASE WHEN is_active THEN 1 END) * 1.0 /
    COUNT(*) AS survival_rate
FROM business
WHERE registration_date < DATE_SUB(CURRENT_DATE, INTERVAL 3 YEAR)
GROUP BY town_id, business_type;
```

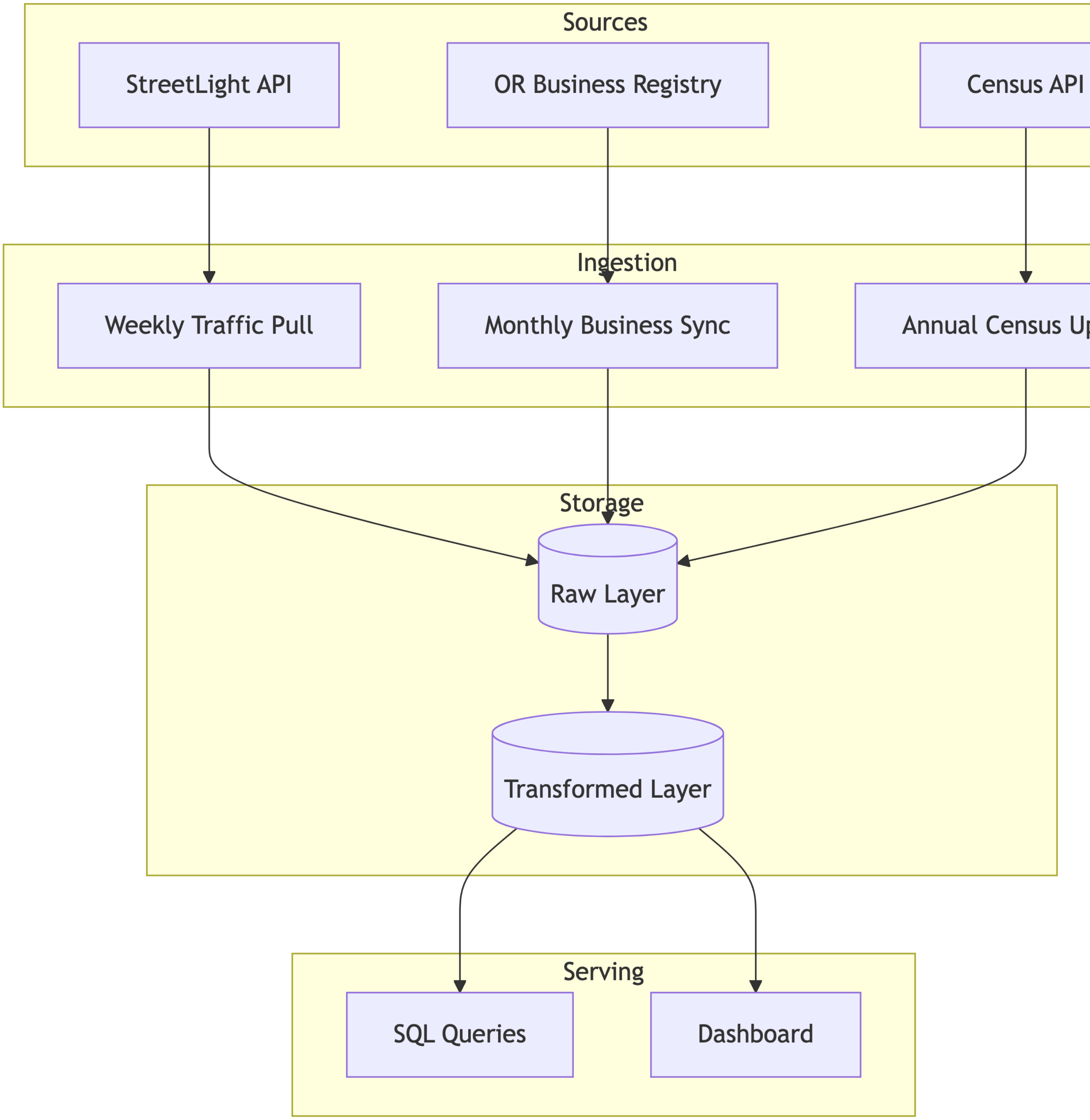
1.2.8 The Story This Pipeline Tells

With this infrastructure, you can answer:

- Towns with high summer/winter traffic ratios and high restaurant survival rates are resilient tourism economies
- Towns with high ratios but low survival rates may have infrastructure gaps
- Comparing similar-population towns reveals what works

The action: Target economic development resources to towns with potential but gaps.

1.2.9 Pipeline Architecture



1.2.10 Feasibility Checklist

Criterion	Status
Data publicly accessible or API available	Yes
Rate limits manageable	StreetLight: 1000/day, Census: 500/day
Schema stable	Business registry format unchanged since 2019
Can automate ingestion	All sources support scripted pulls
Fits 3NF model	Yes, clear entity relationships
Answers novel question	No existing dataset combines these three

1.2.11 What Makes This a Good Project

1. **Multiple disparate sources** - Three distinct data providers
2. **Non-obvious combination** - Traffic + business + demographics is novel
3. **Clear stakeholder** - Chamber of commerce, economic development offices
4. **Actionable insight** - Specific towns get specific recommendations
5. **Feasible scope** - Focus on 20-30 towns, not entire state
6. **Technical depth** - API ingestion, geocoding, time series joins

1.3 Finding Your Project Question

1.3.1 The Project Story Template

Write one sentence:

> I am investigating [**question**] by combining [**data source 1**] and [**data source 2**] so that [**stakeholder**] can [**decision**].

Example:

> I am investigating which Portland neighborhoods have the highest gap between Airbnb density and affordable housing availability by combining Inside Airbnb listings and HUD fair market rent data so that housing advocates can target policy interventions.

1.3.2 Good Questions Have These Properties

Property	Weak Example	Strong Example
Specific	“How is climate change affecting Oregon?”	“Which Oregon counties show the largest gap between summer fire risk and emergency response capacity?”
Multi-source	“What do Yelp reviews say about restaurants?”	“Do Yelp ratings correlate with health inspection scores, and does this vary by neighborhood income?”
Actionable	“What is the history of bike lanes?”	“Which Portland intersections have the highest cyclist injury rate per commuter volume?”
Feasible	“Predict stock prices”	“Which SEC filing patterns correlate with earnings surprises for Oregon-based public companies?”

1.3.3 Data Source Categories to Consider

APIs with academic/free tiers:

- Census Bureau, BLS, BEA (economic data)
- OpenWeatherMap, NOAA (weather/climate)
- Spotify, Last.fm (music/entertainment)
- GitHub, Stack Overflow (developer activity)
- Reddit, Twitter/X (social discourse)

Public data portals:

- data.oregon.gov, data.seattle.gov (government)
- Kaggle, UCI ML Repository (curated datasets)
- Inside Airbnb, Open Food Facts (domain-specific)

Scrapeable sources (with care):

- News archives, job boards, event listings
- Real estate listings, product catalogs

1.3.4 Quick Write: Draft Your Question

Take 3 minutes. Write:

1. One research question (be specific)
2. Two data sources you would combine

3. One stakeholder who would use this

You will refine this in the matchmaking activity.

1.4 Project Matchmaking Workshop

1.4.1 Workshop Goals

By the end of this hour, you will have:

- Pitched your project idea to 6 different classmates
- Heard 6 different project ideas
- Identified your top 2-3 potential teammates
- Refined your research question based on feedback

Teams of 2-3 will form based on mutual interest and complementary skills.

1.4.2 Workshop Timeline (~50 minutes)

Phase	Duration	Activity
1	5 min	Prepare your pitch card
2	36 min	Speed rounds (6 rounds x 6 min)
3	10 min	Reflection and ranking

1.4.3 Phase 1: Prepare Your Pitch Card (5 minutes)

Fill out the index card provided with:

Front of card:

- Your name
- Your research question (one sentence)
- Data Source 1 and access method
- Data Source 2 and access method

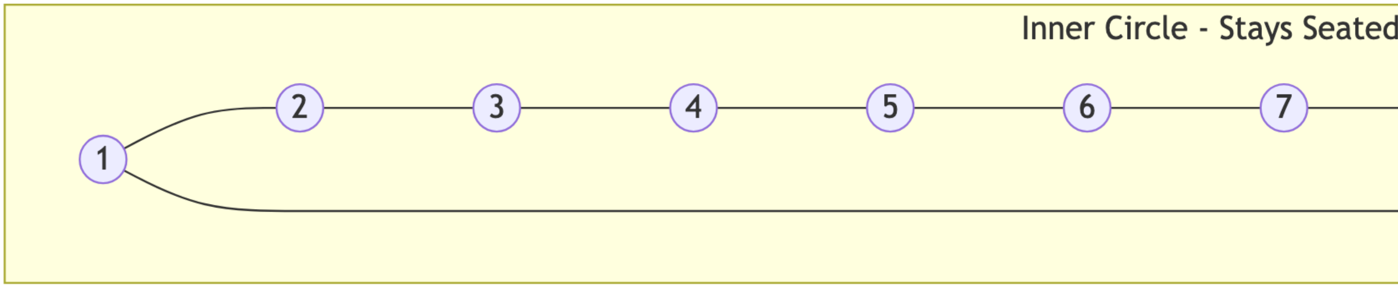
Back of card:

- One skill you bring (SQL, Python, APIs, visualization, domain knowledge)
- One thing you want to learn
- Your biggest feasibility concern

1.4.4 Phase 2: Speed Rounds Setup

Room setup: Two concentric circles facing each other

- Inner circle: 12 students (stay seated)
- Outer circle: 12 students (rotate clockwise each round)



Outer circle faces inner circle and rotates clockwise after each round.

1.4.5 Phase 2: Round Timing (6 min each)

Time	Activity
0:00-2:00	Inner circle person pitches
2:00-2:30	Outer circle asks one question
2:30-4:30	Outer circle person pitches
4:30-5:00	Inner circle asks one question
5:00-6:00	Both score and take notes, outer rotates

You will complete 6 rounds total.

1.4.6 Your Pitch Script (2 minutes)

Cover these points in order:

1. **Question** (15 sec): “I want to investigate…”
2. **Sources** (30 sec): “I would combine X from [source] with Y from [source]…”
3. **Why it matters** (30 sec): “This matters because [stakeholder] currently cannot…”
4. **Pipeline vision** (30 sec): “The pipeline would ingest…, transform by…, and serve…”
5. **What I bring** (15 sec): “I can contribute… and want to learn…”

1.4.7 Feasibility Questions to Ask

Use your 30-second question slot wisely. Good questions:

- "What is the API rate limit for your main source?"
- "How would you handle missing data in the join?"
- "What granularity does your data have: daily, weekly, per-record?"
- "Have you confirmed the data is actually accessible?"
- "What would the minimal viable dataset look like?"
- "How would you normalize this into 3NF?"

1.4.8 Scoring Your Matches

After each round, record on your score sheet:

Field	Description
Partner name	Who you talked to
Their question	Brief summary
Fit score (1-3)	3 = strong overlap, 2 = complementary, 1 = not a fit
Notes	Skills, concerns, ideas that emerged

Score 3 if:

- Your questions could combine into one richer project
- Your skills complement each other
- You are excited about their approach

1.4.9 Phase 3: Reflection and Ranking (10 minutes)

After all 6 rounds, take 10 minutes to:

1. **Review your scores** - Who were your 3s?
2. **Refine your question** - What did you learn from feedback?
3. **Rank your top 3** - Who would you most want to work with?
4. **Write a revised pitch** - One sentence, improved

Fill out the team preference form:

- First choice partner (and why)
- Second choice partner (and why)
- Third choice partner (and why)
- Revised research question

1.4.10 Phase 4: Team Formation (9 minutes)

Process:

1. Submit preference forms to instructor
2. Instructor identifies mutual first-choices (these form teams immediately)
3. Remaining students matched based on second/third preferences and skill balance
4. Teams announced before end of class

Teams of 3: Some teams will have 3 members based on mutual rankings and project scope.

1.4.11 Project Success Criteria

Your project will be evaluated on:

Criterion	What We Look For
Research question	Specific, answerable, novel
Data sources	Multiple, disparate, properly cited
Pipeline design	Ingestion, transformation, serving layers clear
Schema	Normalized (3NF preferred), documented
Implementation	Working code, reproducible
Story	Clear narrative connecting data to insight to action

1.5 Key Takeaways

1.5.1 What We Covered

1. **Data stories have three parts:** question, evidence, action
2. **Pipelines enable stories** by combining sources that don't talk to each other
3. **Good projects** are specific, multi-source, actionable, and feasible
4. **Team formation** works best with diverse skills and shared vision

1.5.2 Your Exit Ticket

Before you leave, submit:

1. Your team preference form
2. Your revised research question (one sentence)
3. One feasibility concern you need to resolve this week