Assessment for Data Geeks:

Business Intelligence, Relational Databases, and Dashboard Reporting Applied to Learning Outcomes Assessment

2021 IUPUI Assessment Institute

NATIONAL
LOUIS
UNIVERSITY

Agenda Outline

- Background
- Assessment of Learning Dashboard
- Key Concepts from Business Intelligence and Relational Databases
- Applications for Learning Outcomes Assessment

National Louis University

- Pathways program begins (2015-16)
- Undergraduate College begins (2018-2019)
- In AY 2021...
  - Over 3200 students served
  - 51% entered as first-time freshmen, 49% adult/transfer
  - 57% Hispanic or Latino, 20% Black or African American
  - 76% Pell eligible or undocumented
  - 73% first generation college students

Undergraduate College Programs

Business	BA: Business Administration BA: Communications BS: Computer Science & Information Systems
Education	BA: Early Childhood Education BA: Elementary Education BA: Infant/Toddler Studies
Social & Behavioral Sciences	BA: Criminal Justice BA: Human Services BA: Psychology

My Role

- Director of Undergraduate Analytics
  - Organized under the Undergraduate College
  - Collaborate with IR, IT, provost's office, other university departments
- Representing Undergraduate College on University Assessment Council
  - Monthly committee focused on assessment
  - Facilitated by provost's office
  - Representation from Student Affairs & all colleges
- Representing a college as an analytics administrator
  - What you're giving up
  - What you're getting

Obligations to Stakeholders...

To our program chairs and faculty...

- Provide clear & bounded requirements for assessment planning
- Support & consultation during assessment planning
- Perform **all** data gathering, transformation, reporting
- Support & consultation for meaning-making of assessment data
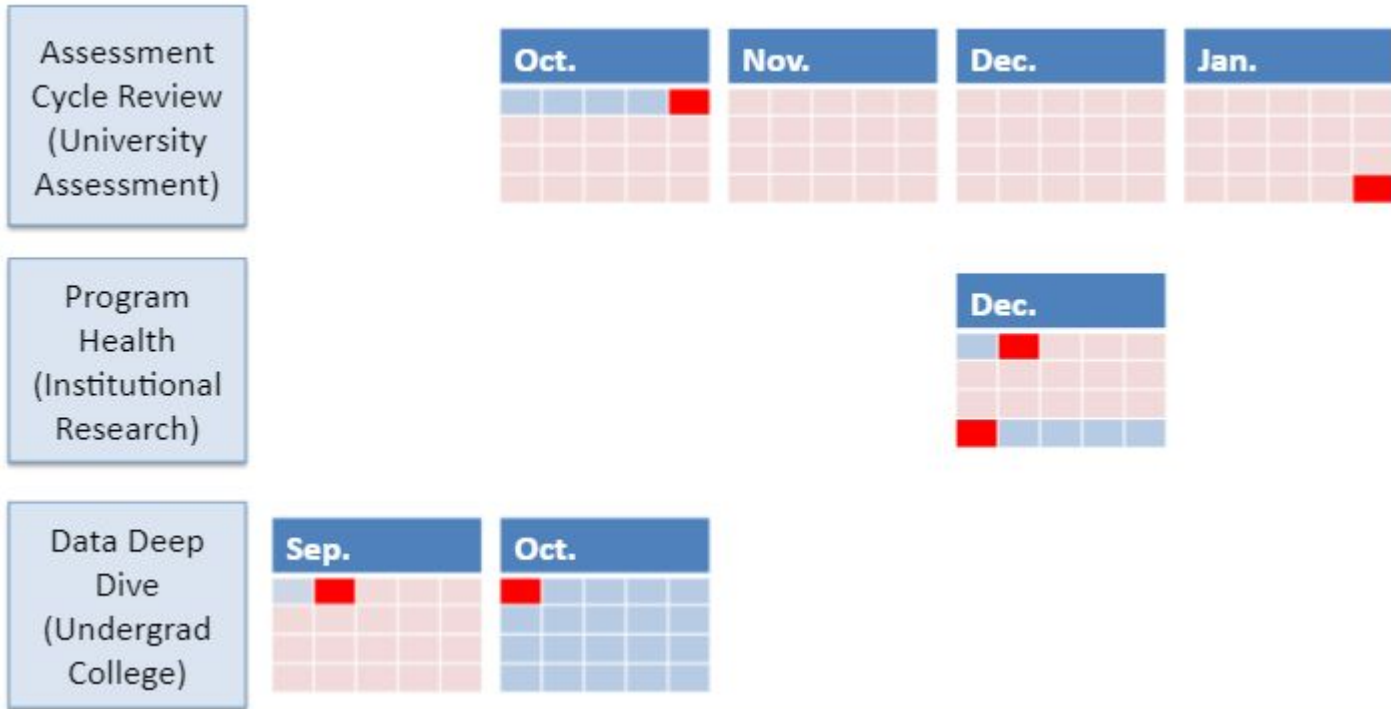
To my dean and academic leadership...

- Standard metrics across programs
- Consistent of methodology (when possible)
- Consistent visualization/reporting across programs
- Create a longitudinal dataset for future strategic analysis

Design principles

Annual Program Review

Previous process...

	Oct.	Nov.	Dec.	Jan.
Assessment Cycle Review (University Assessment)				

	Dec.
Program Health (Institutional Research)	

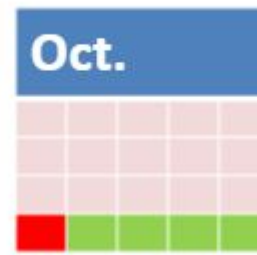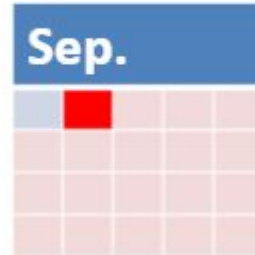|	Sep.	Oct.
Data Deep Dive (Undergrad College)		

Annual Program Review

New process as of AY 2019…

Consolidates multiple review cycles into one

Encompasses multiple dimensions of program health:

- Enrollment & Revenue
- Student Outcomes
- Assessment of Learning

Dashboard Reporting

- Annual Program Review
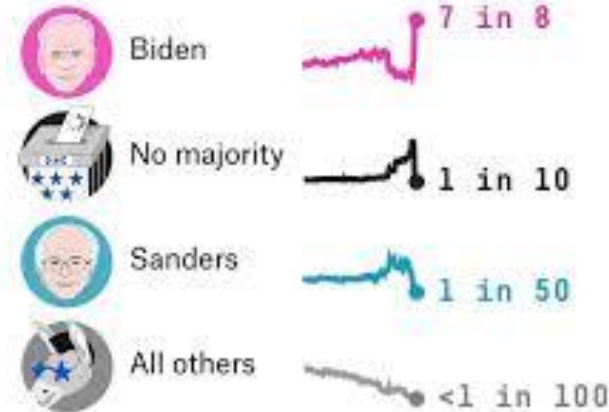- Focus on Assessment of Learning

Dashboard

- Program Review Dashboard
  - Enrollment & Revenue
  - Student Outcomes →
  - **Assessment of Learning**

The Democratic Primary Forecast

UPDATED 48 MINUTES AGO

Biden			7 in 8
No majority			1 in 10
Sanders			1 in 50
All others			<1 in 100

Assessment of Learning Dashboard

Features to view interact with assessment results...

… as a trend in Key Performance Indicators →

… as annual summary by measure →

… disaggregated by demographic →

… by program learning outcome →

… by University learning outcome →

… deep dive into individual measures →

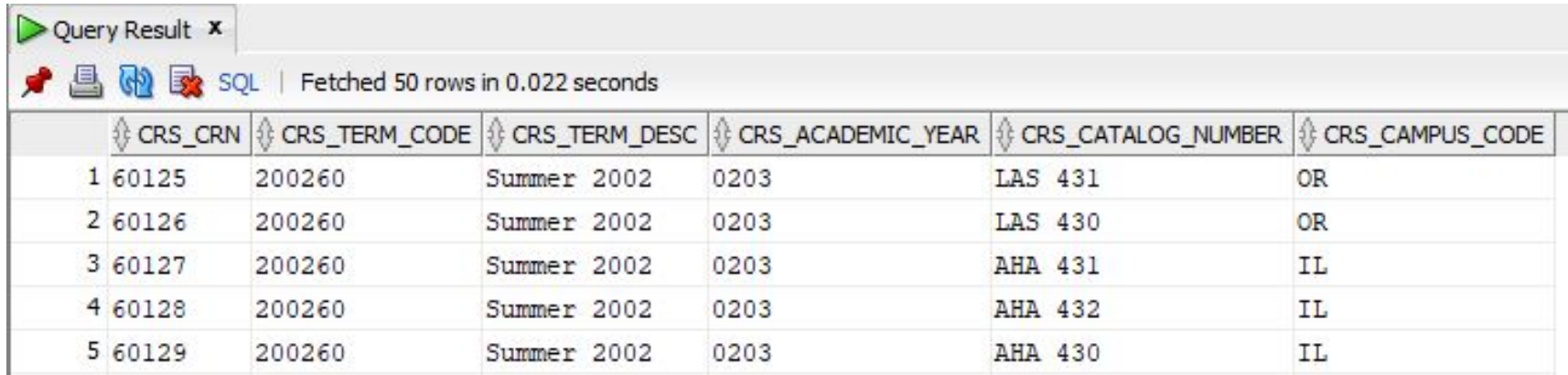# Key Concepts from Business Intelligence and Relational Databases

- Identifiers and Keys
- Entity Relationship Diagrams / Star Schema
- Facts and Dimensions

Relational Databases

- If you have ever worked with an Excel spreadsheet, you have worked with a database.
- Storage and retrieval of information structured in rows and columns

Example: *SELECT * FROM t_bi_course*

Query Result ✗

🔴 🖨 👥 📋 SQL | Fetched 50 rows in 0.022 seconds

	CRS_CRN	CRS_TERM_CODE	CRS_TERM_DESC	CRS_ACADEMIC_YEAR	CRS_CATALOG_NUMBER	CRS_CAMPUS_CODE
1	60125	200260	Summer 2002	0203	LAS 431	OR
2	60126	200260	Summer 2002	0203	LAS 430	OR
3	60127	200260	Summer 2002	0203	AHA 431	IL
4	60128	200260	Summer 2002	0203	AHA 432	IL
5	60129	200260	Summer 2002	0203	AHA 430	IL

Relational Databases

- *Relational* refers to how data is split into different tables for more efficient storage
- Can be merged or joined together when needed

Identifiers and Keys

- Well-organized databases will have a *key* for each table (or most important tables)
- Keys have two purposes:
  - *Define what a unique record is in the context of a table (primary key)*
  - Join together data from two or more tables

STUDENTS		
ID 🔑	*First*	*Last*
N0123	Nate	Flint
N1234	Mary	Allen
N2345	Nate	Flint
N0123 🚫	Joe	Levy

Identifiers and Keys

- Well-organized databases will have a *key* for each table (or most tables)
- Keys have two purposes:
  - Define what a unique record is in the context of a table (primary key)
  - *Join together data from two or more tables*

T_BI_COURSE

crs_term_code 🔑	crn_crn 🔑	crs_start_date	term_start
202190	01234	09/21/2021	?
202190	12345	09/24/2021	?
202190	23456	09/21/2021	?
202190	34567	09/22/2021	?

TERM_CODES

term_code 🔑	term_name	term_start_date
202160	Summer 2021	07/10/2021
202190	Fall 2021	09/21/2021
202210	Winter 2022	01/15/2022
202230	Spring 2022	04/21/2022

Entity Relationship Diagrams

- An ERD is a visual map that illustrates how different tables in the database are related.
- Tableau, Microsoft Power BI, and similar dashboard software have an interface where you define the ERD for your data. Modeling your data correctly is often very important to building legible charts and graphs!

T_BI_COURSE	TERM_CODES
crs_term_code 🔑	🔑 term_code
crs_crn 🔑	term_name
crs_catalog_number	term_start_date
crs_title	term_end_date
crs_campus	

* 1
n

An ERD Model

- Example from Microsoft Power BI
- Optimized for counting unique students served per AY (annualized enrollment)
- **Small fraction of the tables in the University's data lake**
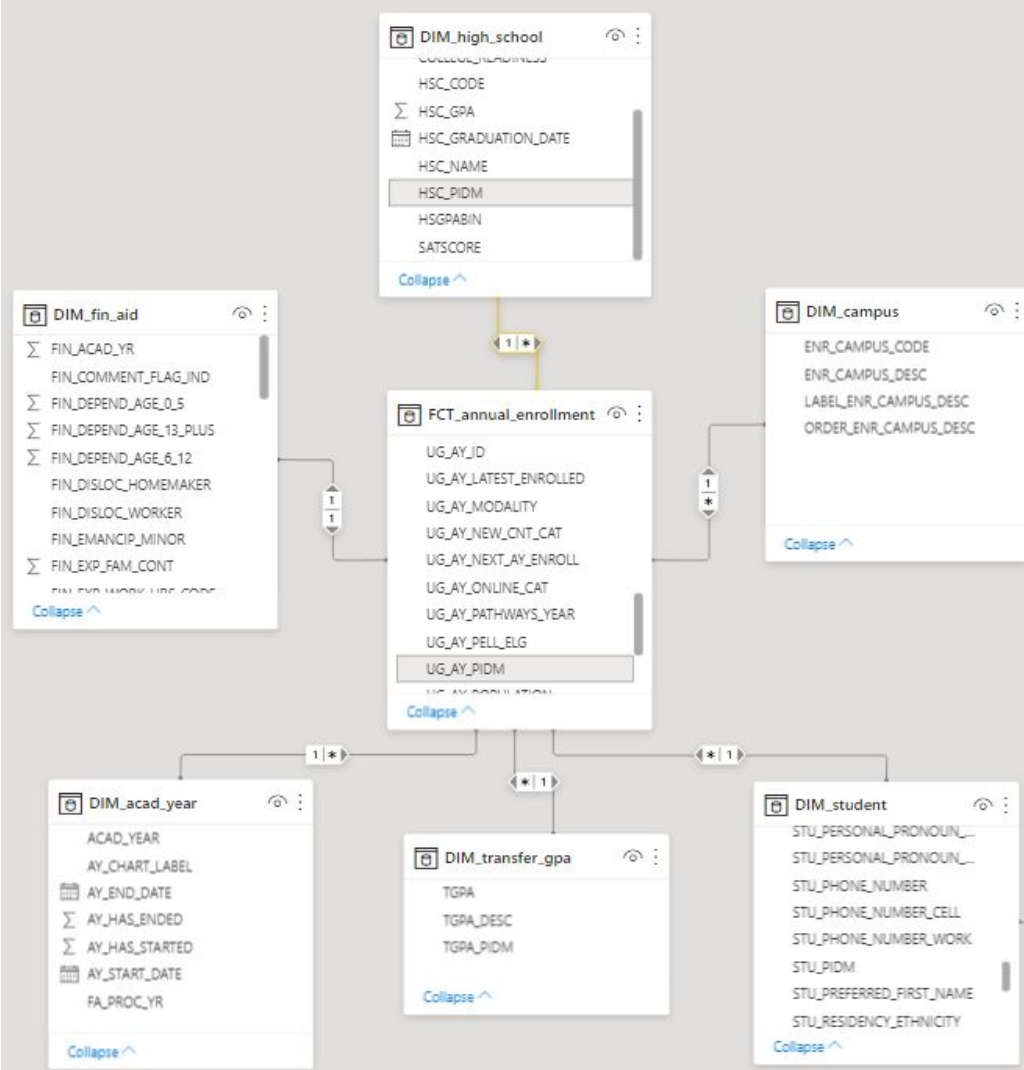
Facts and Dimensions

Dimensions

- Stable entities or "objects"
- Change more slowly (or not at all)
- The *nouns* in a data sentence

Facts

- Transactional / event data generated when two dimensions intersect
- Changes more quickly
- The *verbs* in a data sentence

A Simple Higher Ed Example...

Students (Dimension)

ID	First	Last	Gender
N012	Juan	Albion	M
N123	Jill	Bly	F
N234	Lucy	Cortes	F
...	...	...	

Registration (Fact)

CRS	SDNT	Status
1234X	N012	Actv
1234X	N234	Actv
2345Y	N012	Actv
2345Y	N123	Wthd
2345Y	N234	Actv
3456Z	N123	Actv
3456Z	N234	Actv

Courses (Dimension)

ID	Term	Code
1234X	FA21	MTH-101
2345Y	FA21	ADG-201
3456Z	SP22	MTH-101
...	...	...

Other Examples...

Customer (Dim)

Customer ID
Customer Name
Address
Phone

Product (Dim)

Product ID
Product Name
Category

Gradebook

Activity ID
Activity Name
Activity Category
Points Possible
Due Date

Roster

Student ID
...

Sales (Fct)

Invoice ID
Customer ID
Product ID
Date
Price

Grades (Fct)

Student ID
Activity ID
Submitted Date
Graded Date
Points Earned

21
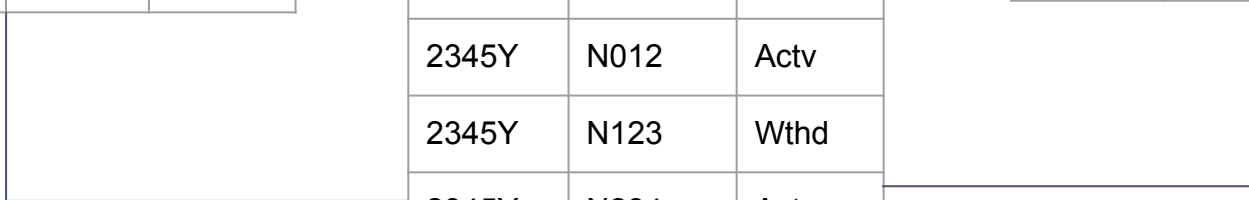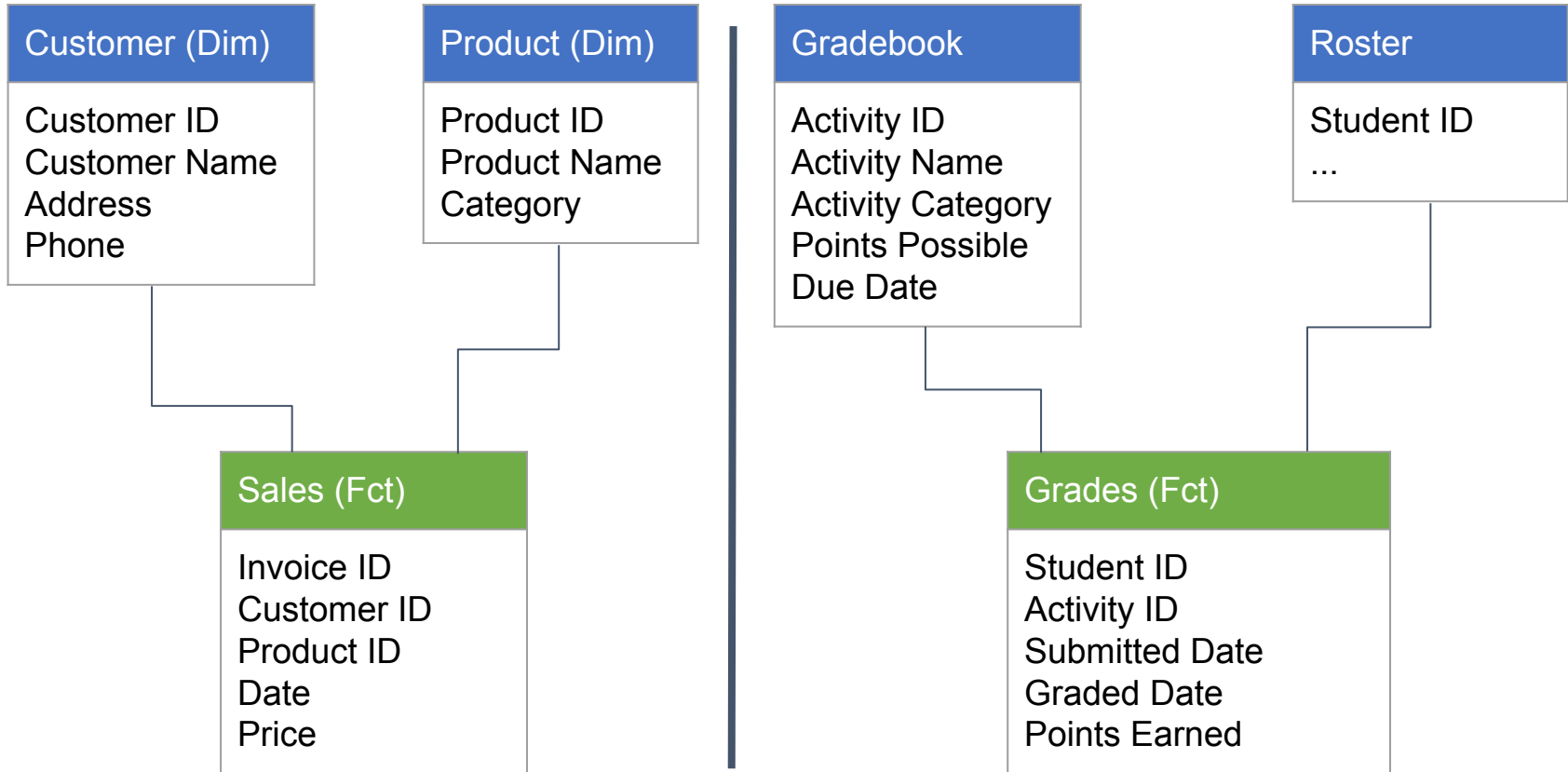
"Star Schema"

An ERD with the **Fact** at the center and the **Dimensions** arrayed around it

Star schemas are optimized for *describing* the facts *in terms of* the dimensions
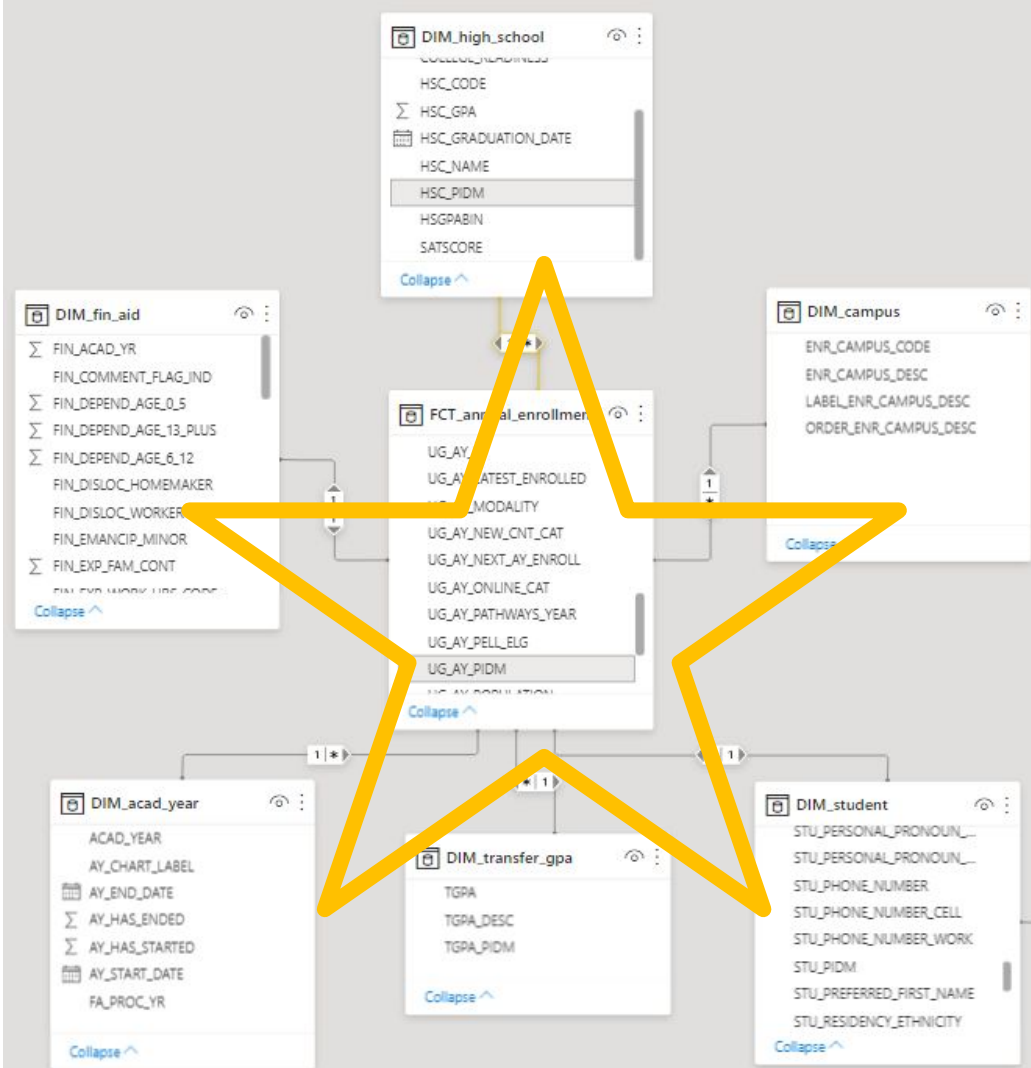
"Squid" Schema
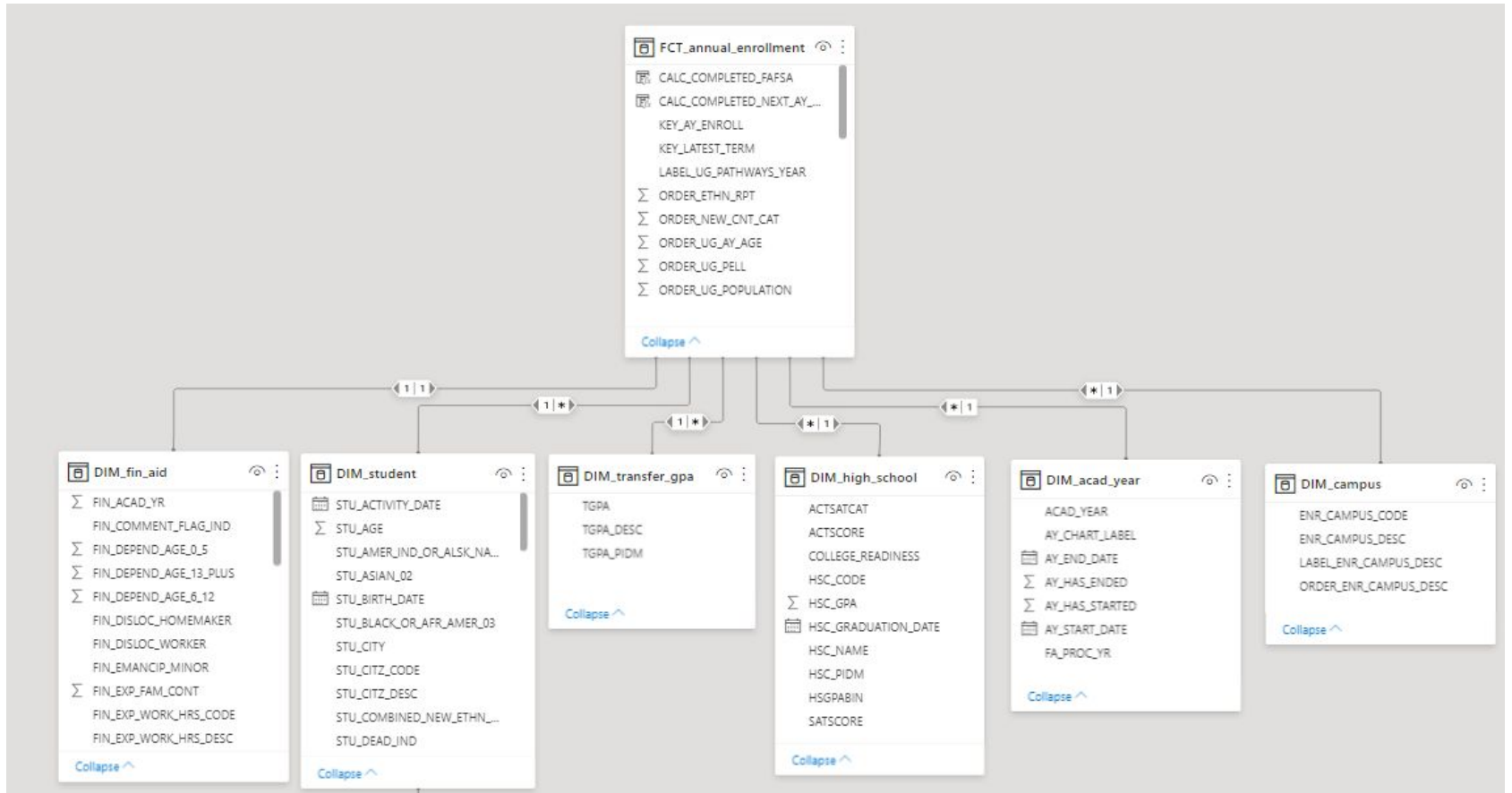
WE
DO NOT
SOW

GREYJOY

Applications for Learning Outcomes Assessment

- "The" Logic Model for Learning Outcomes Assessment
- Assessment Planning with Measurement at the Center
- Getting Your Fact (table) Straight
- "The" Entity-Relationship Model for Outcomes Assessment

"The" (an example of a) Logic Model for Learning Outcomes Assessment

Propositions / Assumptions

- We have students in an academic program.
- The academic program has a corpus: knowledge we want students to hold, skilled behaviors we want them to perform, and disciplinary values or attitudes we want them to embody. The corpus can be expressed as a list of *learning outcomes*.
- We want students to demonstrate a certain level proficiency in each of these outcomes by the time they complete the program.
- A student's performance on specific learning activities from the curriculum offers the evidence for their proficiency. Learning activities are *measures.*
- A *measure* can be relevant evidence for some learning outcomes, but not others. One learning outcomes can be evaluated distinctly from other learning outcomes.
- We can rely of the professional judgment of the program's faculty to make appropriate connections between learning outcomes and learning activities.

Assumption / Propositions

Design Parameters

- We have students in an academic program.
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Assessment Planning

Informed by the assumptions of our logic model, which are taken as design principles, the assessment planning process has three aims:

1) Define the list of program learning outcomes

2) Define the list of measures

3) Align / index the outcomes against the measures (i.e. specify which measures are relevant to which outcomes)

Assessment Planning

Align / index the outcomes against the measures

Creating a "user-friendly" worksheet:

Google Sheets example

Smartsheet example

Across all nine programs, there were…

179 measures in AY 18-19 (avg. of 20 measures per program)

165 measures in AY 19-20 (avg. 18 measures per program)

Assessment Planning

Define the list of program learning outcomes

AY20 B.A. Human Services – UGC Major Assessment Plan Worksheet – v2.2.1

File Edit View Insert Format Data Tools Add-ons Help   Last edit was on January 15

A1 | ID

	A	B	C
1	ID	Description	Program
2	PLO_01	Summarize the historical development of human services.	BA HMS
3	PLO_02	Explain the dynamics of interaction within and among human systems including individual, interpersonal, group, family, organizational, community, and societal.	BA HMS
4	PLO_03	Identify and analyze the scope of conditions that promote or inhibit human functioning.	BA HMS
5	PLO_04	Obtain, organize, evaluate, present, and utilize information while using appropriate technology.	BA HMS
6	PLO_05	Systematically analyze service needs; plan appropriate intervention strategies, services, and implementation; and evaluate outcomes.	BA HMS
7	PLO_06	Identify and apply appropriate practices for providing diret services and intervening to clients and client groups.	BA HMS
8	PLO_07	Effectively resolve conflict, establish rapport with colleagues and clients, and act in ways that reflect the values and ethics of the human services profession.	BA HMS
9	PLO_08	Explain the functioning of the administrative aspects of the services delivery system.	BA HMS
10	PLO_09	Apply and promote values and ethics intrinsic to the human services profession in practice, including self-determination, interdisciplinary team collaboration, and diversity.	BA HMS
11	PLO_10	Develop awareness of their own values, personalities, reaction patterns, interpersonal styles, and limitations.	BA HMS
12	PLO_11	Apply human services, knowledge, theory, and skills in the professional environment.	BA HMS
13			

Assessment Planning

Define the list of measures

Elements of the list are...

- Name of assessment
- Course
- Assessor
  - Faculty
  - student (self assessment)
  - cooperating teachers
  - test/exam score
- Beginning, middle, end of program
- Data system
- Success definition

Assessment Measure

Final Position Paper

Program

BA CJ

Measure ID

M_08

Course

CSJ-107

Assessor

Instructor ×

Time Point

Beginning of Program

System

D2L Rubric

Measure Performance Target

3 or higher on 4-point rubric

Assessment Planning

Align / index the outcomes against the measures

Smartsheet Plan in Grid View

Program	Measure ID	Course	PLO 01	PLO 02	PLO 03	PLO 04	PLO 05
BA CJ	M_01	CSJ-354	☐	☑	☑	☑	☐
BA CJ	M_02	CSJ-354	☐	☑	☐	☑	☐
BA CJ	M_03	CSJ-354	☑	☑	☐	☑	☐
BA CJ	M_04	CSJ-354	☐	☑	☐	☐	☐
BA CJ	M_05	CSJ-355	☑	☑	☑	☑	☐

PLO 1	MSR 1
PLO 3	MSR 1
PLO 2	MSR 2
PLO 2	MSR 3
PLO 3	MSR 3

Assessment Planning

Align / index the outcomes against the measures

PLO 1	
PLO 2	
PLO 3	

PLO 1	MSR 1
PLO 3	MSR 1
PLO 2	MSR 2
PLO 2	MSR 3
PLO 3	MSR 3
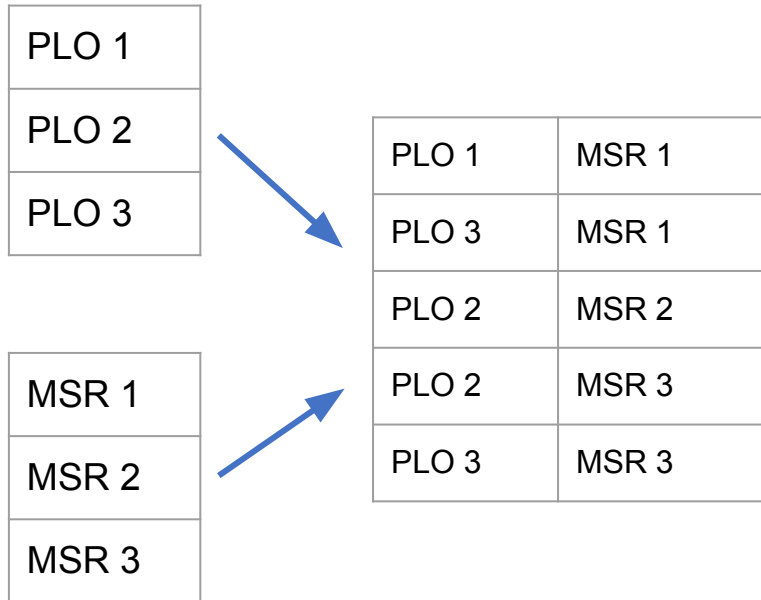
MSR 1	
MSR 2	
MSR 3	

- *Measure 1 offers evidence for PLOs 1 and 3*

- *Measure 2 offers evidence for PLO 2 only*

- *Measure 3 offers evidence for PLOs 2 and 3*

Curriculum Map

PLO 1	MSR 1	Course A
PLO 3	MSR 1	Course A
PLO 2	MSR 2	Course B
PLO 2	MSR 3	Course C
PLO 3	MSR 3	Course C

	Course A	Course B	Course C
PLO 1	X		
PLO 2		X	X
PLO 3	X		X

- *Emergent* from measures-focused plan, not a separate step
- Simple guidance for scoping plan:
  - For each PLO, one beginning, one middle, and one end of program measure. Smartsheet

Getting Your Fact (table) Straight

Student Inf. System (University Data Lake)

Course Mgt. & Other Results Systems

Measures & Alignments
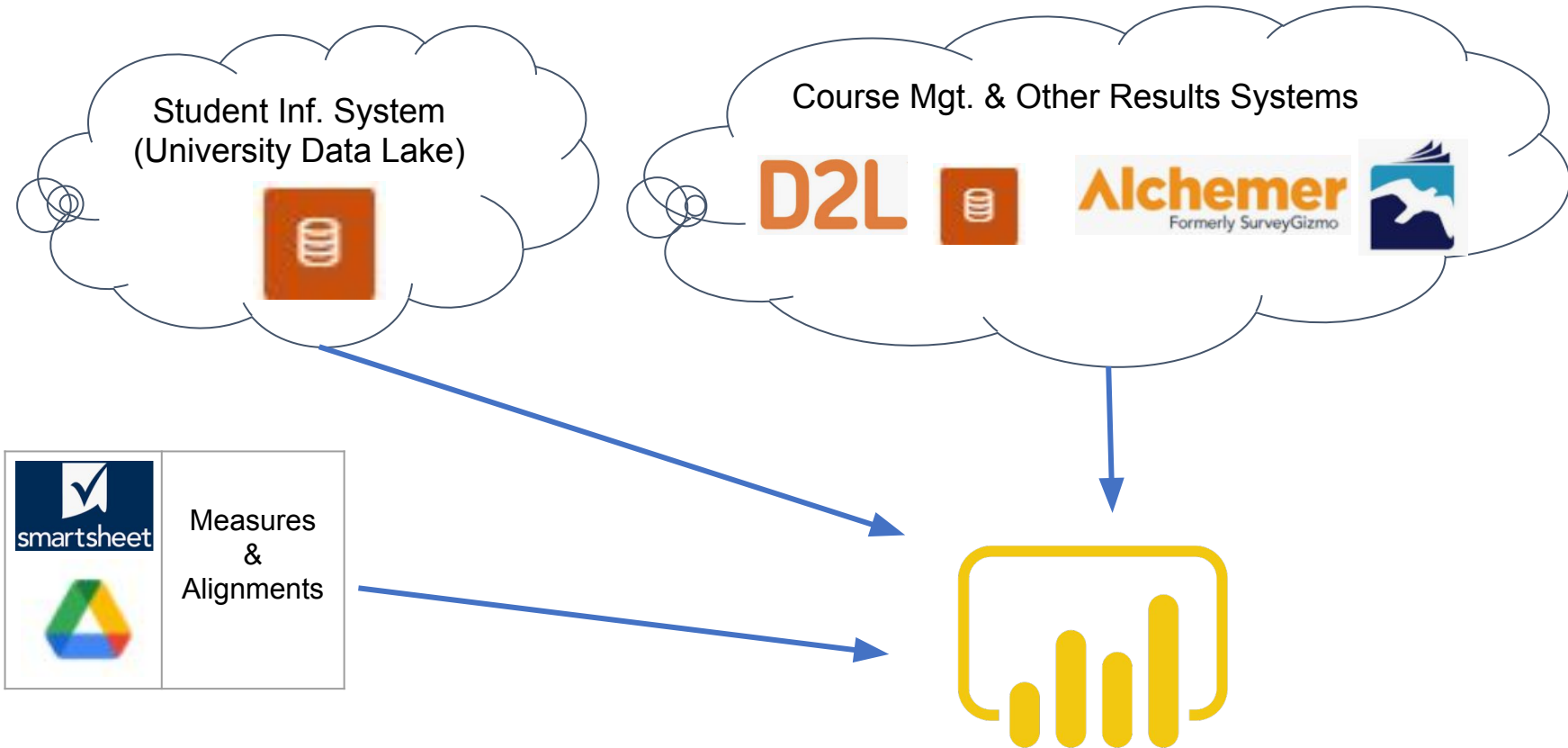
Getting your Fact (table) straight

The most important single table in "the" model is a novel data structure.

Table with… one row **per** completed course attempt by a student in the program **per** assessment measure in the course. "Expected assessments"

- Similar to registrations but with...
    - ...withdrawn students excluded
    - ...students from other programs excluded
    - ...only the most recent attempt by any single student
    - ...rows duplicated if multiple assessment measures in same course

Getting Your Fact (table) Straight

	Measures & Alignments

Join measures to class registrations where the course and program match

prg	msr	sdnt
CJ	M_01	N012
CJ	M_01	N123
CJ	M_01	N234

prg	msr	crs
CJ	M_01	CSJ-106
ELED	M_02	EDU-300
ELED	M_03	EDU-300
PSY	M_05	PSY-306

Student Inf. System (University Data Lake)

Query class registrations

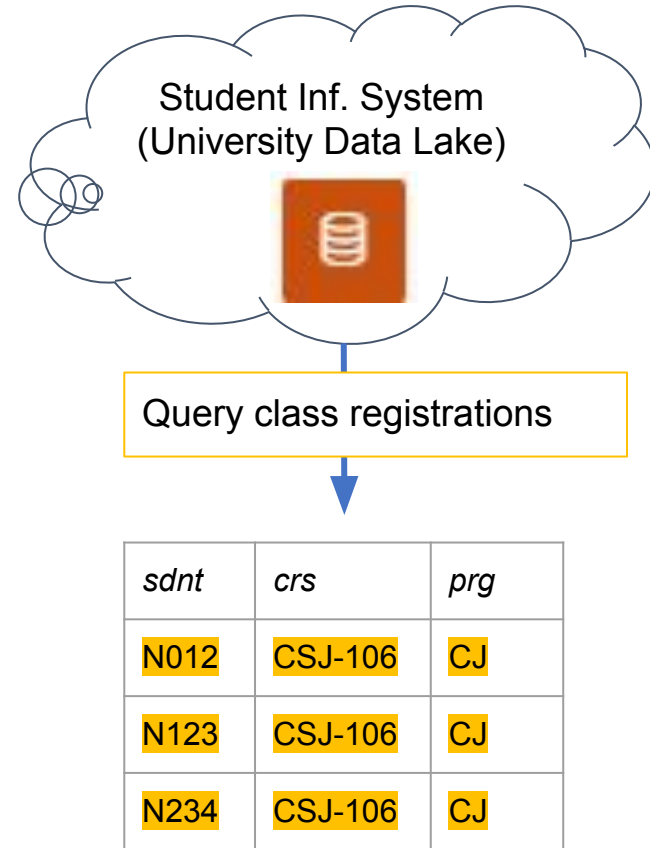| sdnt	crs	prg
N012	CSJ-106	CJ
N123	CSJ-106	CJ
N234	CSJ-106	CJ

Getting Your Fact (table) Straight

Measures & Alignments

Join measures to class registrations where the course and program match

Student Inf. System (University Data Lake)

Query class registrations

prg	msr	crs
CJ	M_01	CSJ-106
ELED	M_02	EDU-300
ELED	M_03	EDU-300
PSY	M_05	PSY-306

prg	msr	sdnt
ELED	M_02	N345
ELED	M_02	N456
CJ	M_01	N012
CJ	M_01	N123
CJ	M_01	N234

sdnt	crs	prg
N345	EDU-300	ELED
N456	EDU-300	ELED
N789	EDU-300	ECE

Getting Your Fact (table) Straight

smartsheet	Measures & Alignments

Join measures to class registrations where the course and program match

Student Inf. System (University Data Lake)

prg	msr	crs
CJ	M_01	CSJ-106
ELED	M_02	EDU-300
ELED	M_03	EDU-300
PSY	M_05	PSY-306

prg	msr	sdnt
ELED	M_03	N345
ELED	M_03	N456
ELED	M_02	N345
ELED	M_02	N456
CJ	M_01	N012
CJ	M_01	N123
CJ	M_01	N234

Query class registrations

sdnt	crs	prg
N345	EDU-300	ELED
N456	EDU-300	ELED
N789	EDU-300	ECE

Getting Your Fact (table) Straight

Measures & Alignments (smartsheet / Google Drive)

Join measures to class registrations where the course and program match

Student Inf. System (University Data Lake)

prg	msr	crs
CJ	M_01	CSJ-106
ELED	M_02	EDU-300
ELED	M_03	EDU-300
PSY	M_05	PSY-306

prg	msr	sdnt
PSY	M_05	N567
ELED	M_03	N345
ELED	M_03	N456
ELED	M_02	N345
ELED	M_02	N456
CJ	M_01	N012
CJ	M_01	N123
CJ	M_01	N234
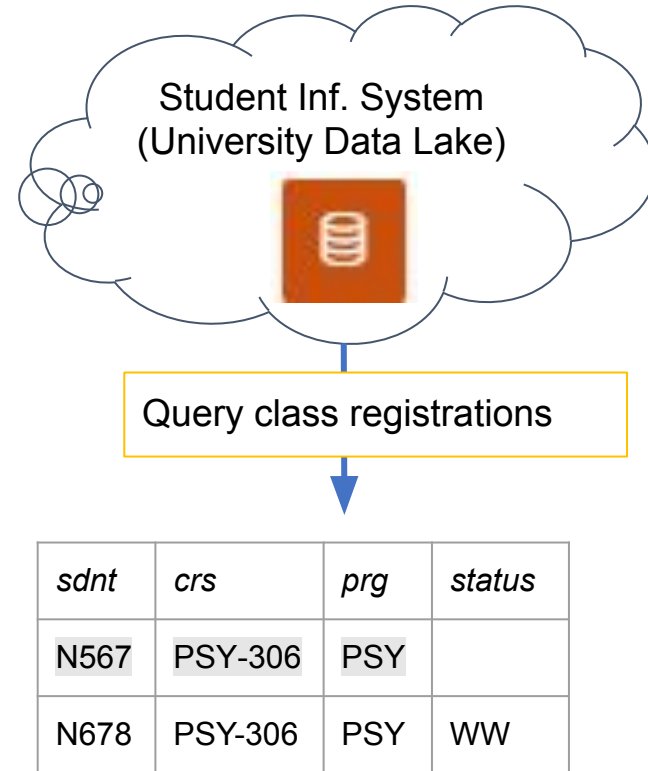
Query class registrations

sdnt	crs	prg	status
N567	PSY-306	PSY	
N678	PSY-306	PSY	WW

Getting Your Fact (table) Straight

~ 180 rows

Measures
Program Measure ID Measure Name Course Assessor Timepoint System Success Def.

~ 7000 rows (avg. ~40 students per assessment)

Assessments (Fact)
Program (student & measure) Measure ID Course Term Section CRN Student ID

Getting Your Fact (table) Straight

~ 180 rows

Measures
Program
Measure ID
Measure Name
Course
Assessor
Timepoint
System
Success Def.

~ 7000 rows (avg. ~40 students per assessment)

Assessment Measures (Fact)
Program (student & measure)
Measure ID
Course
Term
Section CRN
Student ID
Completion?
Result?
Met Success Def.?

Getting Your Fact (table) Straight

~ 180 rows

Measures
Program Measure ID Measure Name Course Assessor Timepoint System Success Def.

~ 7000 rows (avg. ~40 students per assessment)

Assessment Measures (Fact)
Program (student & measure) Measure ID Course Term Section CRN Student ID *Completion?* *Result?* *Met Success Def.?*

D2L

R

Alchemer
Formerly SurveyGizmo

Granular Results

- Table with one row per expected assessment is linked to a table with more granular fact tables from the assessment system

Rubric (Granular Fact)

prg	msr	stdnt	criteria	score
CJ	M_01	N0123	Content	4
CJ	M_01	N0123	Creativity	4
CJ	M_01	N0123	Writing Mechanics	3
CJ	M_01	N0234	Content	4
CJ	M_01	N0234	Creativity	4
CJ	M_01	N0234	Writing Mechanics	3

Assessment Measure (Fact)

prg	msr	stdnt	sys
CJ	M_01	N0123	D2L Rubric
CJ	M_01	N0234	D2L Rubric

Getting Your Fact (table) Straight

~ 180 rows

Measures

Program
Measure ID
Measure Name
Course
Assessor
Timepoint
System
Success Def.

~ 7000 rows (avg. ~40 students per assessment)

Assessment Measures (Fact)

🔑 Program (student & measure)
🔑 Measure ID
Course
🔑 Term
🔑 Section CRN
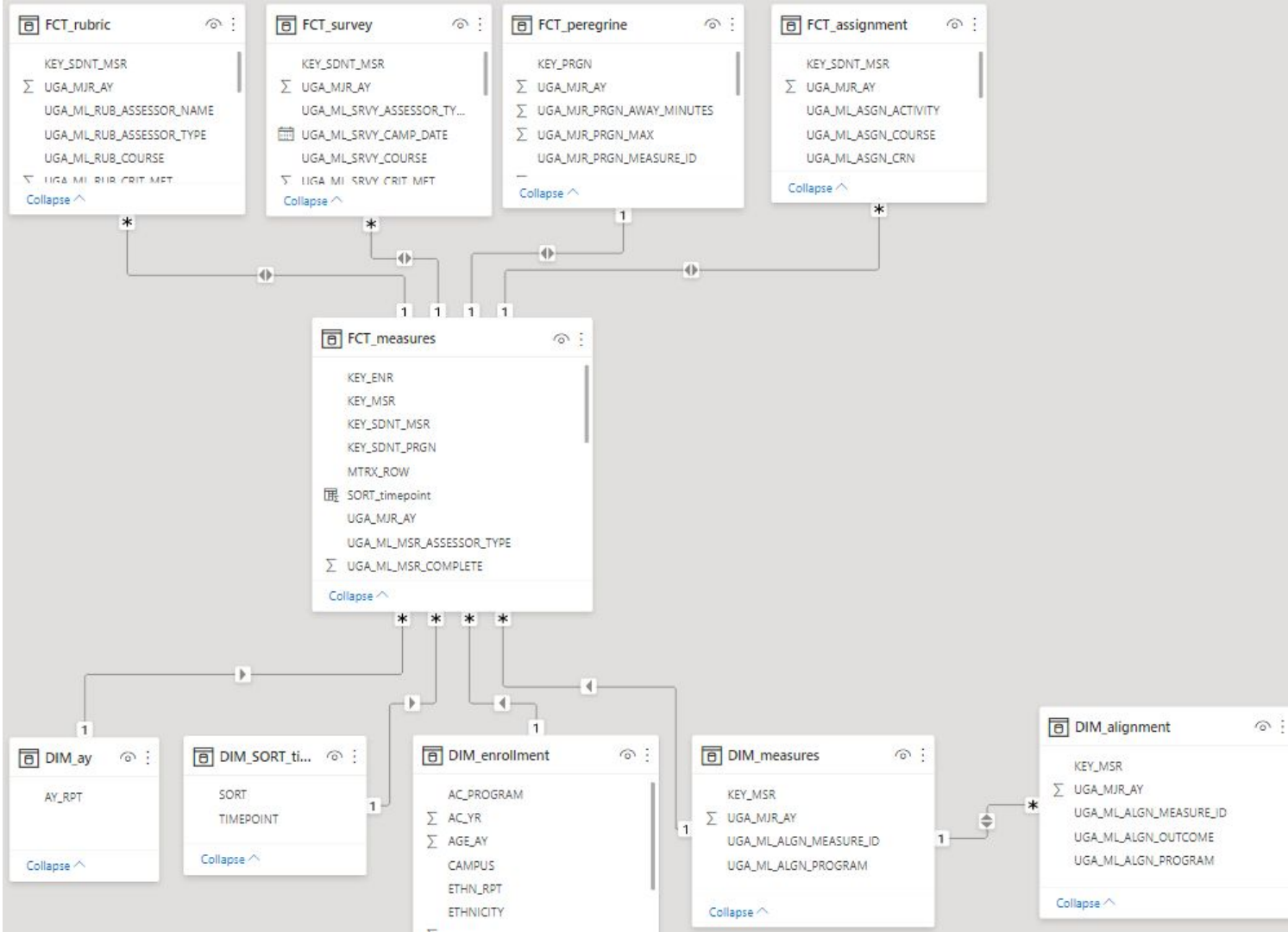🔑 Student ID
Completion
Result
Met Success Def.
...

Rubric

🔑 Program (student & measure)
🔑 Measure ID
Course
🔑 Term
🔑 Section CRN
🔑 Student ID
🔑 Criterion
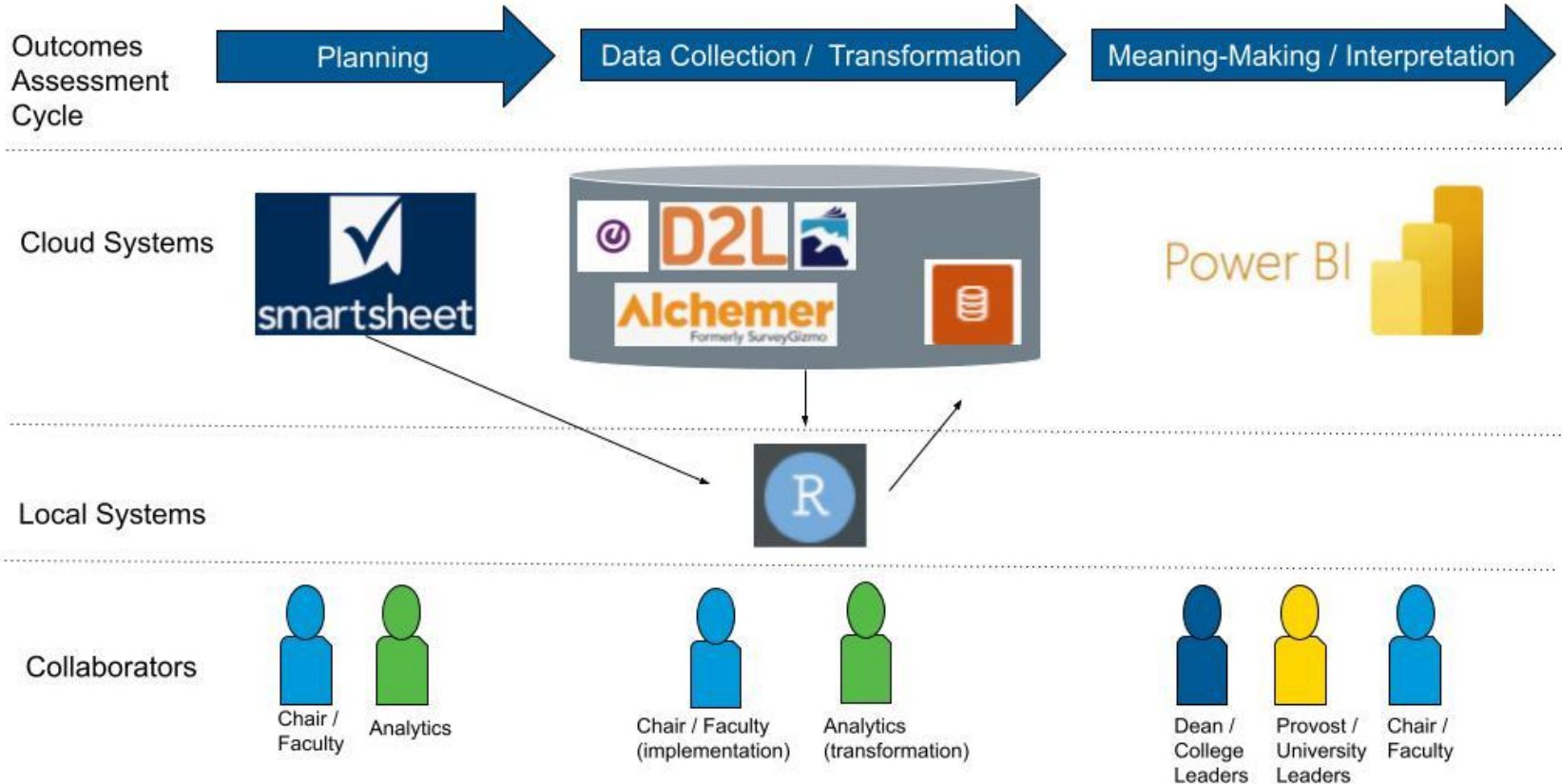*Score*
Possible Points
Date Assessed
...

"The" Model

Technology / Process Stack

Thank you!

Nate Flint

nflint1@nl.edu

Presentation Materials at: https://assessmentinstitute.iupui.edu/