# CSE199 Data, AI, and Society Extra Material

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(Includes some other past CSE199 material too.)

CSE199, Fall 2025

# Recitations Do Meet In Week 1

- Although the UB "default" is for recitations of courses not to meet in week 1, we will do so—for important organization and setup reasons. (I've done this in CSE250 and CSE305.)
- Know in hUB when and where your recitation is.
- Do not be late (grace window only 5 minutes).
- A pertinent question to ponder: A "hockey line" is an efficient way to make everyone on Team A shake the hand of everyone on Team B exactly once.
  - It works fine even if teams A and B have different sizes.

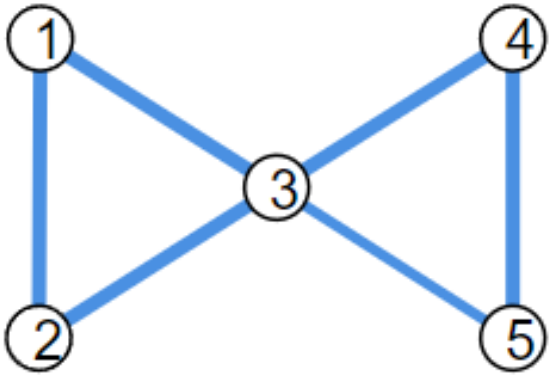
  Without breaking into teams, *can one devise an efficient way for each of N people to shake everyone else's hand?*

# Detailed Graph Game Example

Imagine hunting a polar bear on ice floes in Arctic fog. When fog lifts:

- If hunter and bear are on adjacent floes, hunter shoots bear: $\rightarrow +\mathbf{1}$.
- If the bear is 2 or more floe-jumps away, the hunter misses: $\rightarrow \mathbf{0}$.
- If they find themselves on the same floe, $\rightarrow$ **?**.

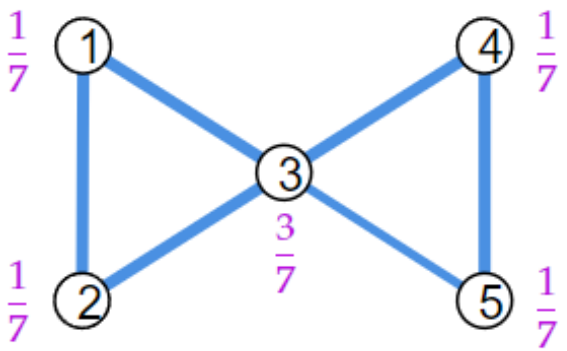
The network of adjacent floes can be represented as both a discrete graph and a matrix. Here is a picture of the game when five floes are arranged in a "bowtie" pattern:




| *You \ Bear* | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | ? | 1 | 1 | 0 | 0 |
| 2 | 1 | ? | 1 | 0 | 0 |
| 3 | 1 | 1 | ? | 1 | 1 |
| 4 | 0 | 0 | 1 | ? | 1 |
| 5 | 0 | 0 | 1 | 1 | ? |

# Bowtie Graph Game—Continued

If **? = 0** then the hunter achieves **expected value** $v = \frac{4}{7}$ by adopting the randomized strategy shown.




| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | **0** | 1 | 1 | 0 | 0 |
| 2 | 1 | **0** | 1 | 0 | 0 |
| 3 | 1 | 1 | **0** | 1 | 1 |
| 4 | 0 | 0 | 1 | **0** | 1 |
| 5 | 0 | 0 | 1 | 1 | **0** |

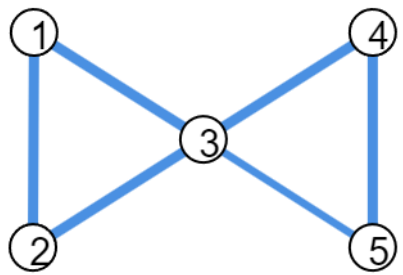
The "same" strategy by the bear assures losing no worse than $v = \frac{4}{7}$.

- Note that *both* choose the central floe (3) less than half the time.
- If **? = +1** then the hunter **dominates** by always choosing (3).
- If **?** is negative the bear sometimes wins. What negative value makes the game *fair*—that is, both have expected value 0?
- Weird answer: $3 - \frac{16}{7-\sqrt{17}} = -2.56155...$
- If **? = -1** then $v = \frac{1}{3}$ and both hunter and bear play (3) one-third of the time—same frequency as in a **random walk** of the graph.

# Two-Matrix Games: Not Zero-Sum

Change the same-floe case to be: bear knocks the gun away but raids the hunter's lunch for **+3** value rather than kill em. Meanwhile the hunter videos the bear, for **+0.5** value. And in the two-floes-away case, let's penalize both of them **-0.5**, for missing and being inadvisably close. Now we need a separate **payoff matrix** for each:

| $H$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 0.5 | 1 | 1 | −0.5 | −0.5 |
| 2 | 1 | 0.5 | 1 | −0.5 | −0.5 |
| 3 | 1 | 1 | 0.5 | 1 | 1 |
| 4 | −0.5 | −0.5 | 1 | 0.5 | 1 |
| 5 | −0.5 | −0.5 | 1 | 1 | 0.5 |




| $B$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 3 | −1 | −1 | −0.5 | −0.5 |
| 2 | −1 | 3 | −1 | −0.5 | −0.5 |
| 3 | −1 | −1 | 3 | −1 | −1 |
| 4 | −0.5 | −0.5 | −1 | 3 | −1 |
| 5 | −0.5 | −0.5 | −1 | −1 | 3 |

- If $H$ and $B$ agree on same floe, *both win*. No longer zero-sum!
- But $H$ could gain by switching to an adjacent floe and shooting...
- Analysis becomes complicated! Semi-solved by **John Nash** in 1950.
- You will play a simpler(?) example game in recitations.

# Multi-Player and Solitaire Games

- Games with $N > 2$ players are more complex, but many features of 2-player games apply.
- Nash Equilibrium: $N$ strategies such that no player can improve by emself.
- Nash proved such an equilibrium always exists, but *finding* one is not known to be in **P**—and whether more than one equilibrium exists is **NP-complete**.
- A Nash equilibrium need not be optimal for all players. (Call it a "GNash equilibrium.")
- If all others' strategies are fixed (whether optimal or equilibrium or not, and whether you know the strategies or not), then the game becomes **solitaire** for you. Like playing the house at blackjack.
- **Internet Search** is a solitaire game where the payoff to you is the *non-quantified* usefulness of the found pages to you.

# Three Functions With Data—All Handled By SQL

1. Data Definition/Creation
2. Data Manipulation (read-only access included in this heading)
3. Data Control.

The **Structured Query Language** (SQL) handles all three.

- Donald Chamberlain, Raymond Boyce, IBM, early 1970s.
- Originally **S**tructured **E**nglish **QUE**ry **L**anguage, but "SEQUEL" trademark was taken. Still often pronounced that way.
- **Oracle Corp.** both extended and "front-ended" SQL.

Largely embodies Edgar F. Codd's **Relational Model** (RM).

Relational not positional. *Declarative* in that users are responsible only for data and queries, not algorithms or code. RM governs how database is built. Queries are built from logic and numerical predicates.

# Some SQL Commands

`CREATE`. Note that it creates a structure before you input data.

```
CREATE TABLE Games (
    gid             VARCHAR(128)        PRIMARY KEY,
    white_name      VARCHAR(50)         not null,
    black_name      VARCHAR(50)         not null,
    result          VARCHAR(7)          not null,
    white_rating    INTEGER
    black_rating    INTEGER
);
```

Here `TABLE` is a built-in SQL type, or rather template for the user-defined type `Games`. To kill it and all data you give both names:

```
DROP TABLE Games;
```

`TRUNCATE TABLE Games;` would destroy the entries but not the definition.

# Inserting, Updating, and Removing Data

```
INSERT INTO Games (white_name, black_name, result)
   VALUES ('DeCastellvi', 'Vinoles', '1-0');

UPDATE Games SET gid = generate_game_id();
```

SQL allows user-defined functions, here to generate the game ID.

Since players didn't have ratings back in 1475, those fields can be left with a default `null` value. We could define a default of 0 but shouldn't—it would throw off `AVG` calculations. The `gid` field had a default which must be immediately changed, else the next insert will violate the `PRIMARY KEY` uniqueness constraint.

`DELETE FROM Games WHERE gid =` followed by the unique key removes just that game.

Can build by generating commands from data in XML/JSON/etc...

# Selection and Logic in SQL

Suppose I want just the games where the lower-rated player won. A user-defined predicate `underdog_wins()` could have body:

```
(white_rating < black_rating AND result = '1-0')
   OR (white_rating > black_rating AND result = '0-1')
```

As with a *method* in OOP, the table object is implicit. Then

```
SELECT * FROM Games WHERE underdog_wins() = 1;
```

temporarily makes a table from just those games where the underdog won. In place of  we could have listed just some fields to return.

User-defined functions can return whole tables. Tables can be `JOIN`ed together (in various ways) on common field(s).

(Yes, basic SQL needs that '`= 1`')

# Converting Data to SQL Entry (simplified)

```
<NFLTeams>
<Team code="ARI" teamName="Cardinals" region="Arizona"
      pop="4438000" lastPlayoffWin="2015"/>
<Team code="ATL" teamName="Falcons" region="Atlanta"
      pop="6462000" lastPlayoffWin="2016"/>
...
</NFLTeams>
```

```
CREATE TABLE NFLTeams (
   _code VARCHAR(50),
   _teamName VARCHAR(50),
   _region VARCHAR(50),
   _pop INT,
   _lastPlayoffWin INT
);
```

```
INSERT INTO NFLTeams VALUES ('ARI', 'Cardinals', 'Arizona', 4438000, 2015);
INSERT INTO NFLTeams VALUES ('ATL', 'Falcons', 'Atlanta', 6462000, 2016);
...
```

# SQL Permissions

- The SQL standard finally includes a whole Data Control Language (DCL).
- Maintains a list of user IDs.
- Mostly done by two commands, `GRANT` and `REVOKE`.
- Rather than read-write-execute (`rwx`) permissions, it grants or withdraws allowed SQL commands. E.g.:
- `GRANT UPDATE ON Games TO garry_kasparov;`
- `REVOKE EXECUTE ON Games FROM PUBLIC;`
- Permissions can also be system-wide.
- Permissions can be grouped into *role* specifiers.
- Can build a management system on top of the SQL DCL.
- Permissions can be granted to not just people!
- Your "Al-Go-Rith-Ms" carry lots of SQL commands to submit...
- When "everything is data," those commands are data...and data is commands...

# So Is This Data Heaven?

- **Structure**, **Extensibility**, and sheer computing power have built a brave new world.
- "Power Corrupts" is a **theorem** in CS.
- Microsoft Technet article on SQL serving:

> "Security is an exercise in creating enough barriers to the system such that the effort involved to attack a system exceeds the benefit derived from the data."

- It does *not* say, "Security is an exercise in making systems secure."
- Speedy execution cuts corners on safety.
- SQL by itself has several vulnerabilities.
- **Injection:** Trick a system into executing SQL privilege commands embedded in data.
- Show XKCD comic https://xkcd.com/327/

# Other Potential Weaknesses

- Although SQL polices its own user-defined functions, it allows functions written in other languages.
- These can possibly import "unsafe code."
- Might exploit details/weaknesses in how the SQL system was implemented.
- Even within SQL, what happens if you give 100 chars to a VARCHAR(50)?
- Implementations "should" either (a) refuse or (b) truncate your string, but (a) can block a whole upload and (b) may cause constraint violations.
- For speed and simplicity too, systems might (c) take your whole string and overflow into another memory region.
- Such "buffer overflows" have bit from the 1988 Internet Worm to 2017's Cloudflare bug.
- I wrote a joint article on the latter.
- More about security in other weeks of this course...

# Other Ways to Game a Database

- Even if a database is completely sound, the combination of incautious programming and unseen defaults can leave loopholes.
- Suppose no one under 12 can ride a roller coaster, so they wrote:

```
SELECT * FROM Riders WHERE NOT(age < 12);
```

- And suppose Bart Simpson can upload or finagle his record not to have an `age` field.
- Even if default is `null` or something producing a non-number "`nan`" value, the `age < 12` comparison may fail "gracefully."
- Then `NOT(age < 12)` will *succeed*—and Bart gets to ride!
- Yes, `...WHERE age >= 12` would have averted the problem.
- Database can be vulnerable in-between restoring constraints after upload.
- Point is: we can't escape attention to low-level details.

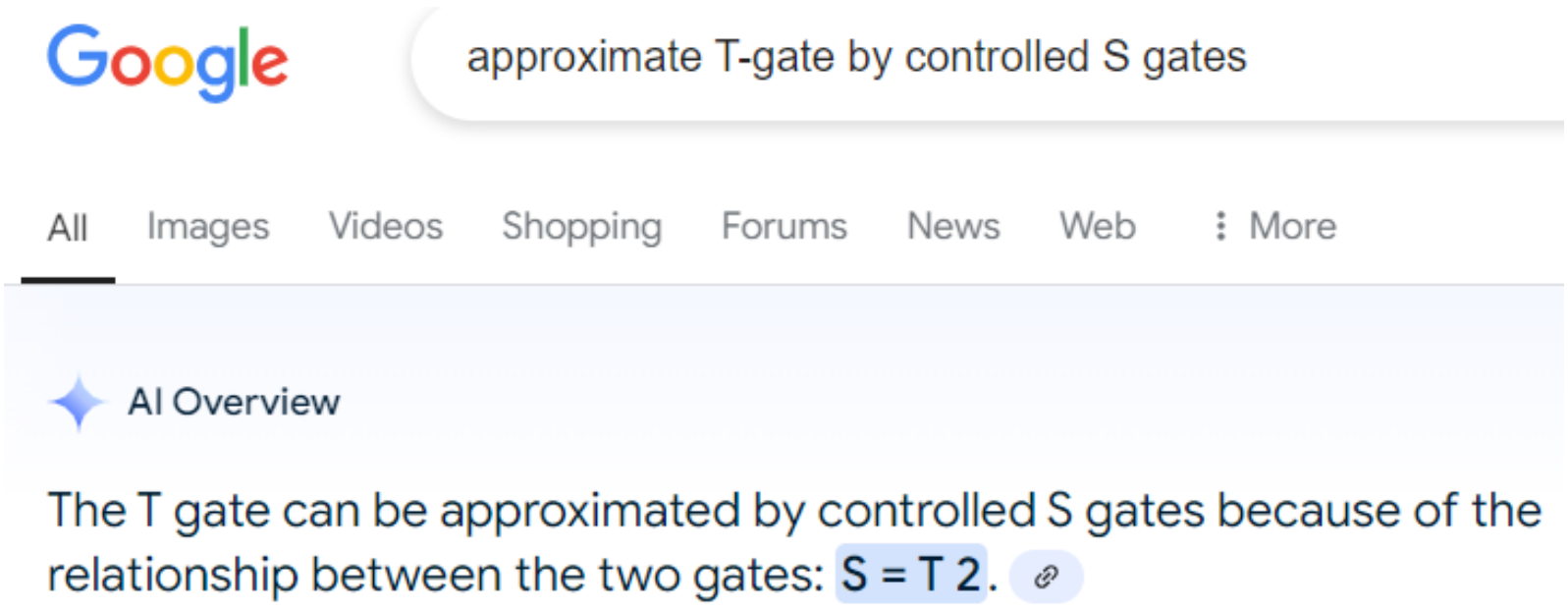
# Some Notorious Inferences and Model Decisions

- **Target**ing ads at a pregnant teen: article.
- Amazon often recommends to me the book *Quantum Algorithms Via Linear Algebra*. Problem is—I co-wrote it. Nice to hear...
- Bond and CDO (Collateralized Debt Obligation) ratings before the 2008 crash.
- Book *Weapons of Math Destruction*, by Cathy O'Neill. Thesis: Mathematical models fossilize biases in data from remote history and skewed prior sources.
- Book Everybody Lies: Big Data, New Data, and What the Internet Can Tell Us About Who We Really Are, by Seth Stephens-Davidowitz. Thesis: Formal survey responses are inconsistent with opinions from the same populations mined on social media. Review.
- Insofar as we are the training data for the Internet, the latter has baked in tangible amounts of racism and sexism.

# How AI Transforms Search

- Google and several other search engines now present an "AI Overview."
- As "overview" suggests, it summarizes the area of your query and gives wider context.
- But maybe gets away from the PageRank idea of finding related pages that a lot of people have vouched for by linking to them. Article.
- OTOH, AI promises to goive a direct answer to a query, more than merely suggest pages that may answer it.
- But OTOOH, it was fine to bring up lots of "How To..." videos and pages, which by virtue of being linked to and/or upvoted in other recorded manners, reflected bankable user opinions.
- Who will vouch for AIs in a preserved manner?
- Meanwhile, the current AI mode of "Finding What Fits In" rather than "Finding What Is True" bites now.

# AI Overview Mistakes




Exactly as dumb as saying "A 45-degree angle can be approximated by 90-degree angles because of the relationship $90 = 45 \times 2$."
OpenAI o1 on a richer query responded with something false:

To approximate the T-gate using Hadamard and controlled-S gates, you can follow these steps:

1. **Decompose the T-gate**: You can express the T-gate in terms of Hadamard and S gates by manipulating its phase characteristics.

# Chae Et Al. Web Mining and Racism Study

Found 30% higher rate of jokes with the N-word etc. online after Obama's 2008 election. Found correlation to higher Black mortality. Criticism. Can extend this along some of the general issues on the HW:

1. *Domain bias*: Web posters might not represent health care centers.
2. *Flawed Proxy*: Jokes might not represent *application* of racism *in health care*. Using % vote for Obama to control for geography (as mentioned by Critic) may also be a flawed proxy.
3. *Skewed distribution*: The level of racism needed to argue differences in health care may not be indicated by "slightly"(?) racist jokes.
4. *Misclassified responses*: Critic mentions Richard Pryor jokes.
5. *Confounding*: Local mortality and economic conditions $X$ impact both $M$ and $Y$ here. Critic notes that when $X$ is controlled for, the claimed effect drops from **8.2%** to **3.6%**.

# Chess Model Example

How I deal with these issues in my chess work.

You must cite Web pages used for your HW and presentations.