Official Statistics for Responsible AI

The Role of the Federal Statistical System in Enabling a More Accountable AI/ML Ecosystem

2024 FCSM Research and Policy Conference
10/24/24

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xD, U.S. Census Bureau

All statements are the speaker's personal views and do not necessarily reflect Census Bureau policy.

xD
https://www.xd.gov

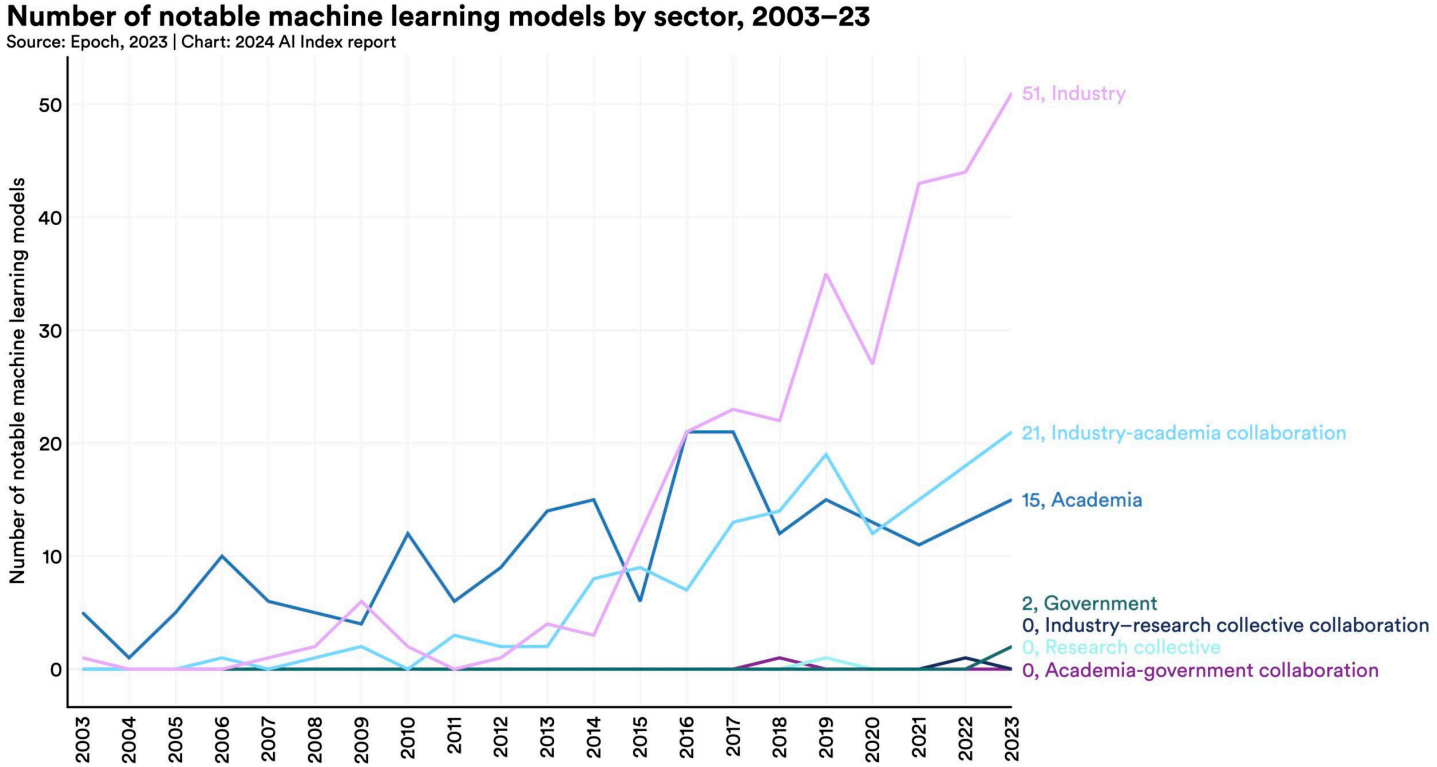
United States Census Bureau

BEFORE DIVING IN – INTRODUCTION TO THE xD TEAM

xD is an **emerging technologies group** that's advancing the delivery of data-driven services through new and transformative technologies.

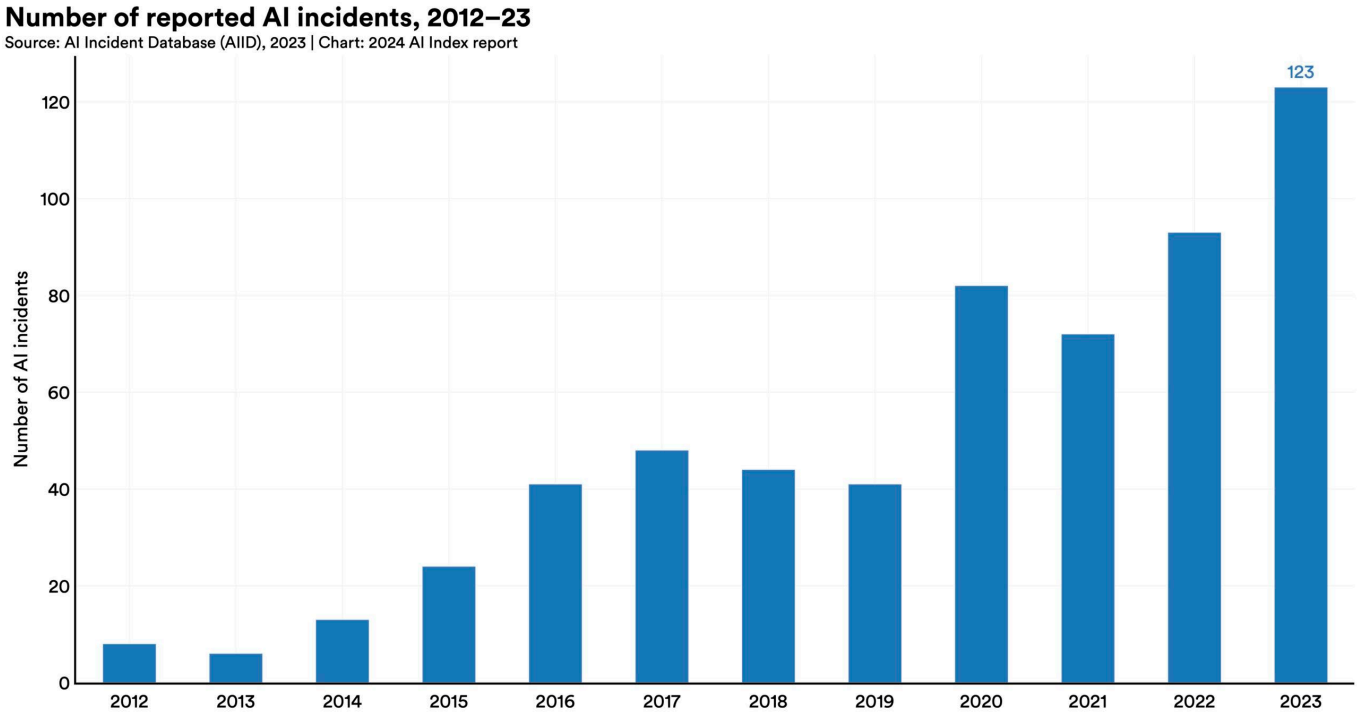
*We do this work by bringing on cohorts of **Emerging Technology Fellows** and by collaborating with others throughout the Census Bureau and beyond.*

AI/ML IS EVERYWHERE



Source: https://aiindex.stanford.edu/report/

AS AI/ML ADOPTION RISES, SO DO THE NUMBER OF AI-RELATED INCIDENTS REPORTED



Source: https://aiindex.stanford.edu/report/

WHILE AI HAS GREAT PROMISE, IT CAN ALSO HARM THE PUBLIC

WE'VE ALSO SEEN INCIDENTS WITHIN THE FEDERAL GOVERNMENT

AI

IRS's AI system to flag returns for audit may include unintended bias, report finds

Following a report identifying racial disparities in audit selection, the GAO says the tax agency hasn't conducted a "comprehensive review" of the rules and filters in its Dependent Database.

BY MATT BRACKEN • MAY 23, 2024

A STAT INVESTIGATION

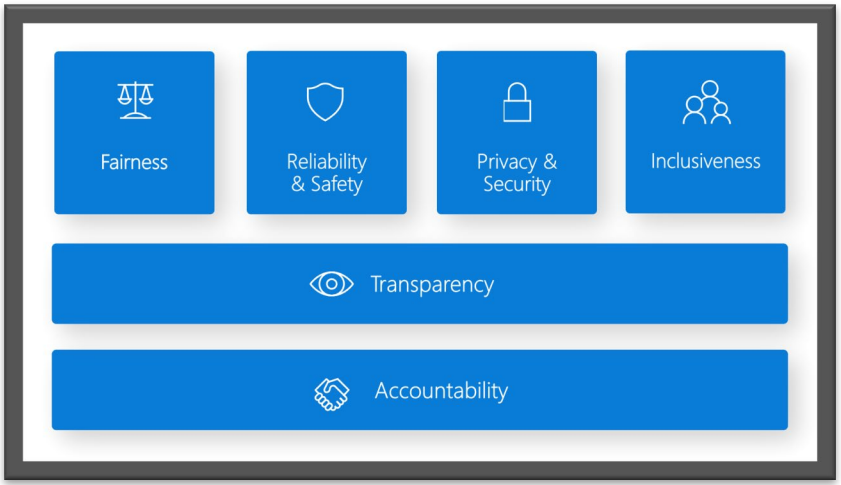
Denied by AI: How Medicare Advantage plans use algorithms to cut off care for seniors in need

By Casey Ross and Bob Herman March 13, 2023

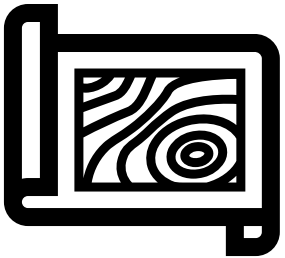
Incorporate methods for building and evaluating AI/ML systems that account for real-world human impacts.

With emphasis on being:

- ✓ Human-centric
- ✓ Transparent
- ✓ Accountable
- ✓ Privacy-preserving

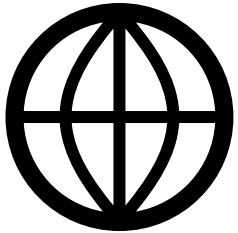


Microsoft Responsible AI Principles



Using AI to enhance agency work and statistical products

Governing AI projects within the agency



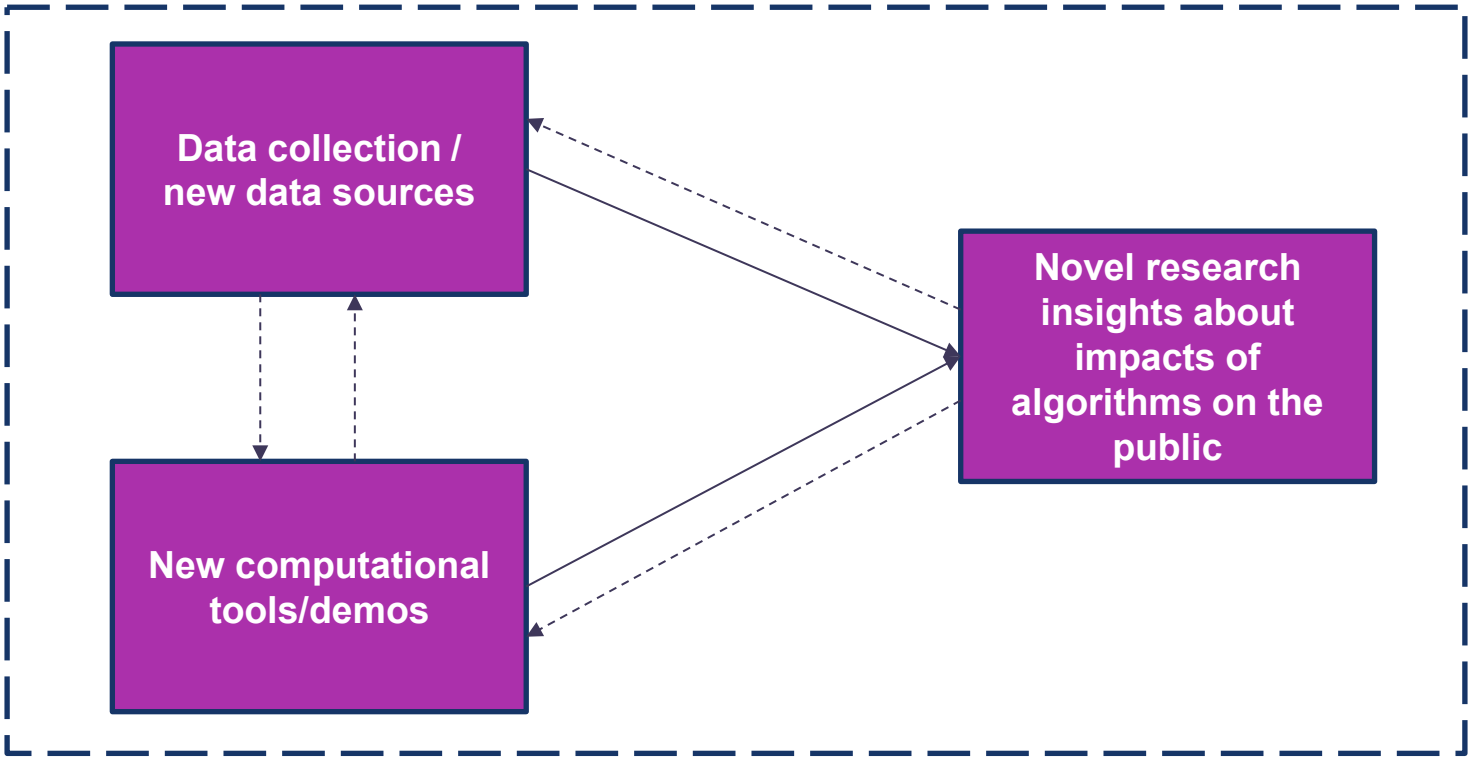
Enabling responsible AI for the public

Often overlooked

The Big Question:

How can the Federal Statistical System (FSS) help enable and promote responsible AI practices across the government and for the public?

THE VISION: A COORDINATED EFFORT ACROSS THE FSS TO ENABLE RESPONSIBLE AI

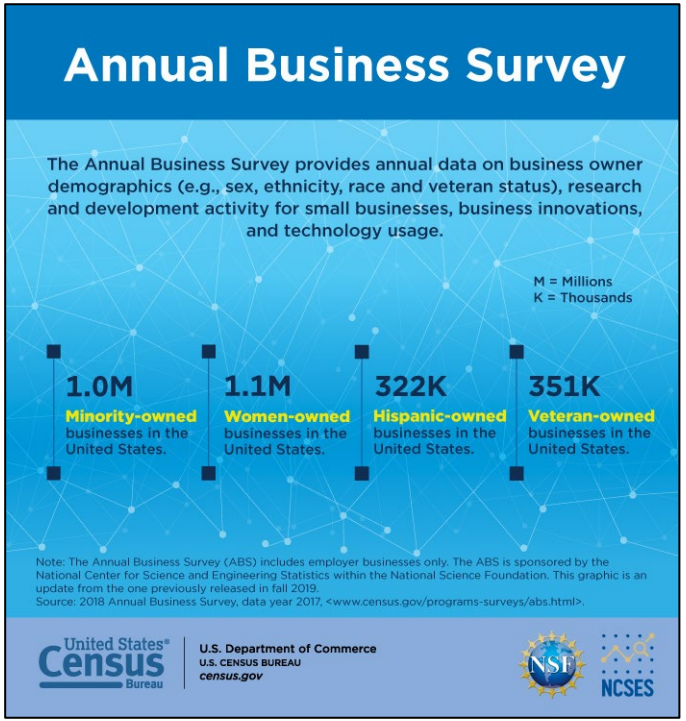


Why?

Why should the FSS use its resources to promote responsible AI?

FEDERAL STATISTICAL AGENCIES ARE UNIQUELY POSITIONED TO COLLECT DATA ON AI

Rich, widely varying datasets



Vast reach into households and businesses

RESEARCHERS ARE ALREADY USING SOME FSS DATA TO EVALUATE THEIR AI SYSTEMS

County-level Algorithmic Audit of Racial Bias in Twitter's Home Timeline

Luca Belli
Twitter Inc.

Kyra Yee
Twitter Inc.

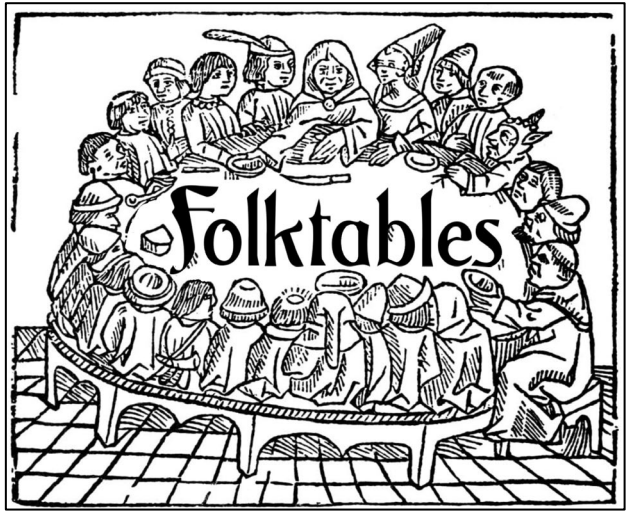
Uthaipon Tantipongpipat
Twitter Inc.

Aaron Gonzales
Twitter Inc.

Kristian Lum
Twitter Inc.

Moritz Hardt *
Max Planck Institute for Intelligent Systems, Tübingen

A central obstacle for any such audit is that Twitter does not ordinarily collect or associate racial information with its users, thus prohibiting an analysis at the level of individual authors. Working around this obstacle, we take US counties as our unit of analysis. We associate each user in the United States on the Twitter platform to a county based on available location data. The US Census Bureau provides information about the racial decomposition of the population in each county.



Folktables is a Python package that provides access to datasets derived from the US Census, facilitating the benchmarking of machine learning algorithms. The package includes a suite of pre-defined prediction tasks in domains including income, employment, health, transportation, and housing, and also includes tools for creating new prediction tasks of interest in the US Census data ecosystem. The package additionally enables systematic studies of the effect of distribution shift, as each prediction task can be instantiated on datasets spanning multiple years and all states within the US.

Source:
https://arxiv.org/abs/2211.08667; https://github.com/socialfoundations/folktables

How?

How can the FSS use its resources to measure AI impacts and build tools that promote responsible AI?

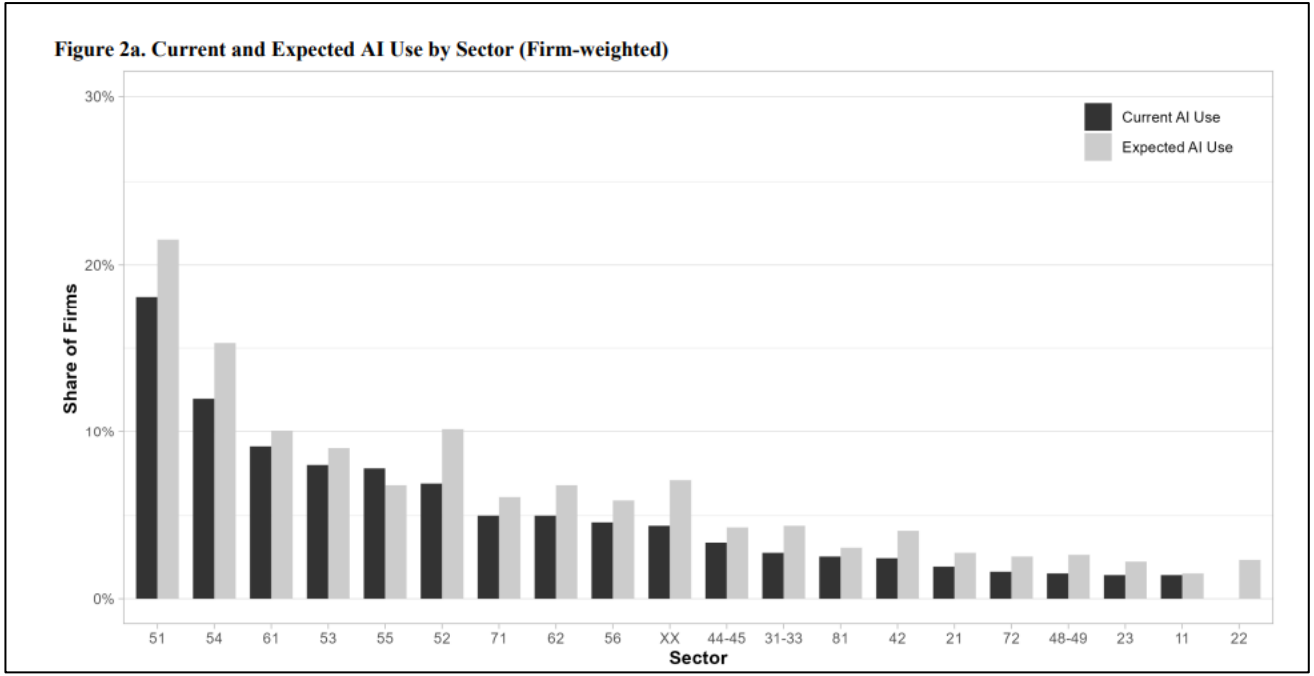
Data collection / new data sources

EXAMPLE – CENSUS BUSINESS TRENDS AND OUTLOOKS SURVEY

For Immediate Release: Thursday, March 28, 2024

Census Bureau Releases Business Trends and Outlook Survey Data With Artificial Intelligence Supplement

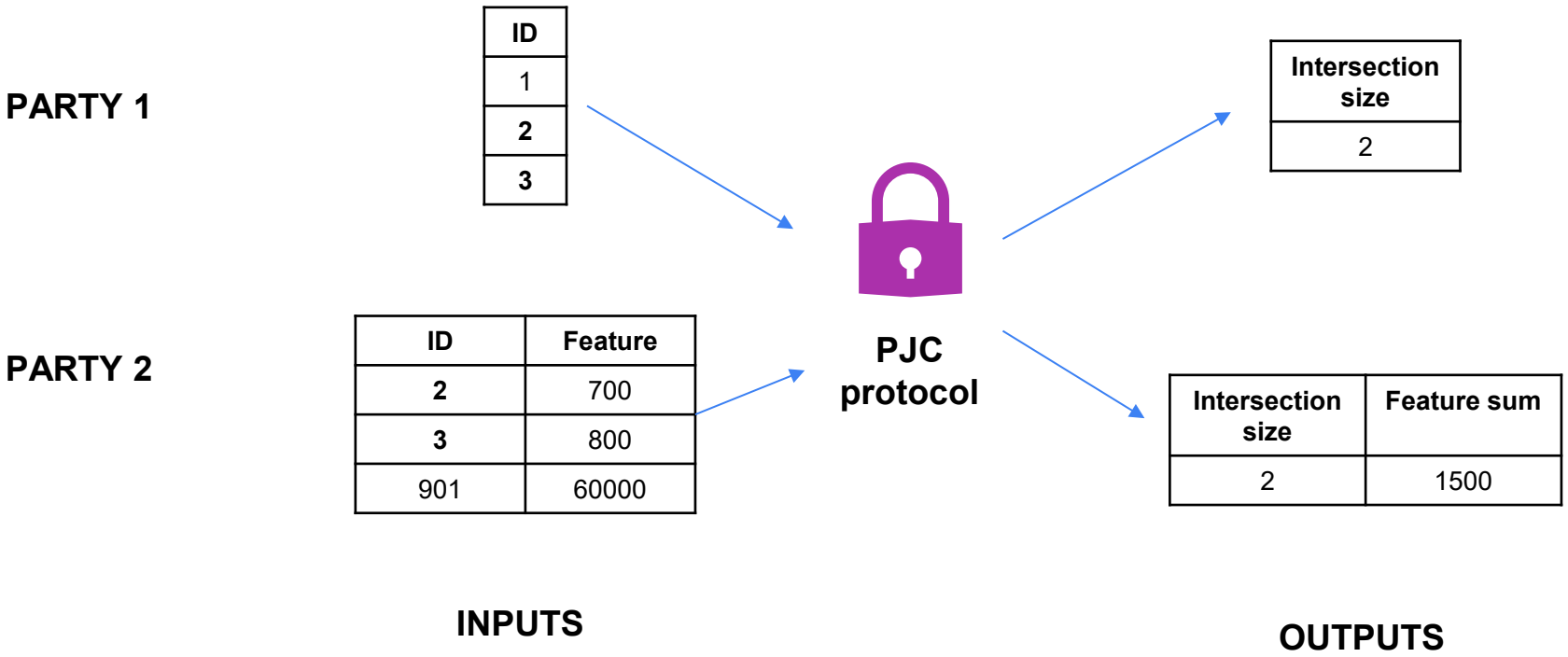
Work by Kathryn Bonney, Cory Breaux, Catherine Buffington, Emin Dinlersoz, Lucia Foster, Nathan Goldschlag, John Haltiwinger, Zachary Kroff, and Keith Savage



https://www.census.gov/hfp/btos/downloads/CES-WP-24-16.pdf https://www.census.gov/newsroom/press-releases/2024/business-trends-outlook-survey-artificial-intelligence-supplement.html

EXAMPLE – PRIVACY-PRESERVING MODEL AUDITING

New computational tools/demos



https://security.googleblog.com/2019/06/helping-organizations-do-more-without-collecting-more-data.html

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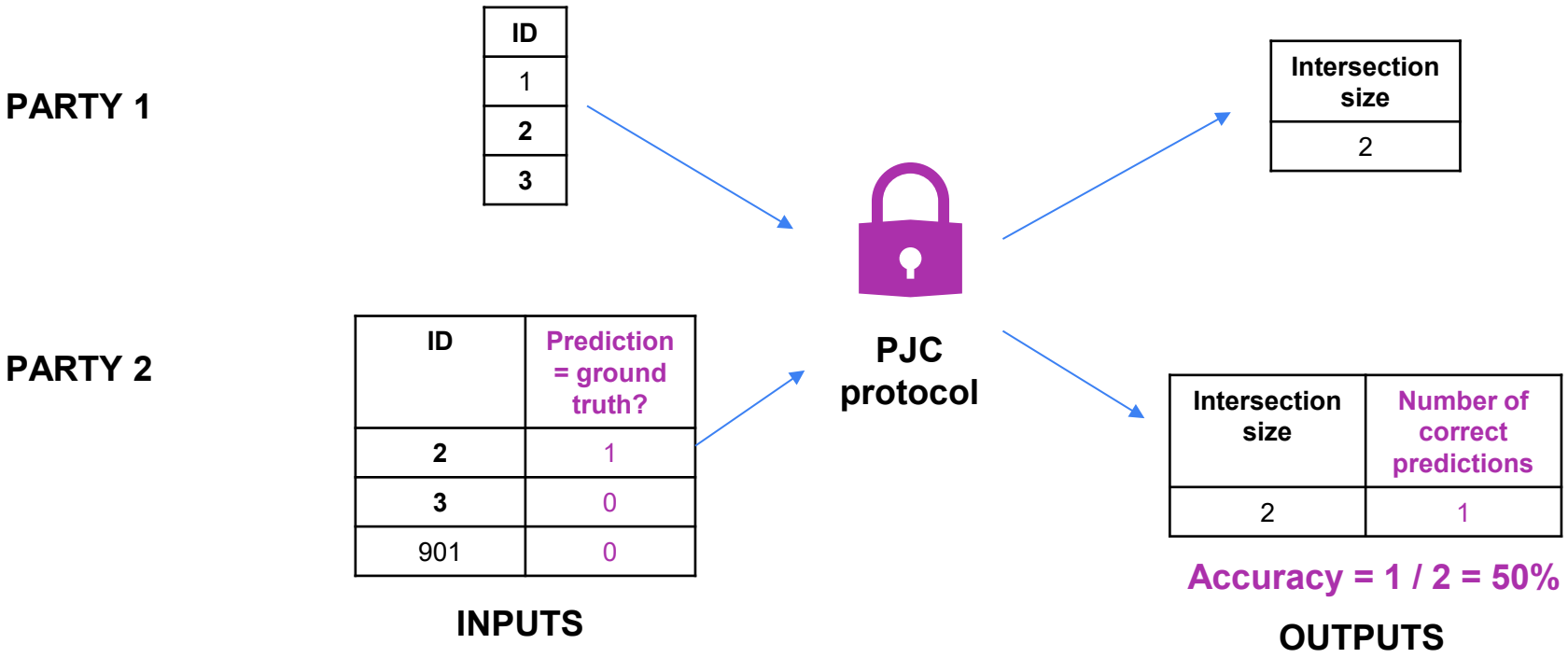
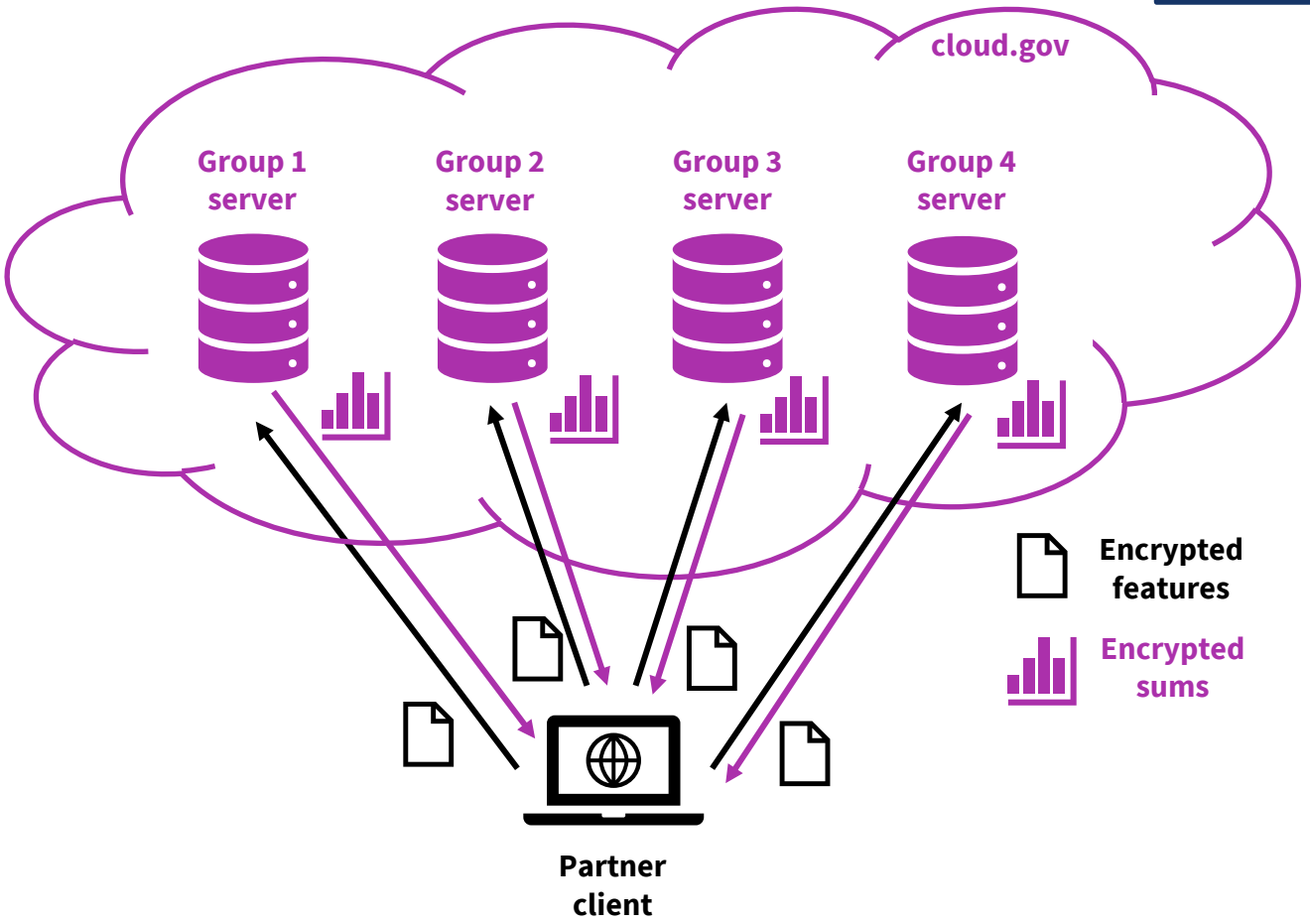
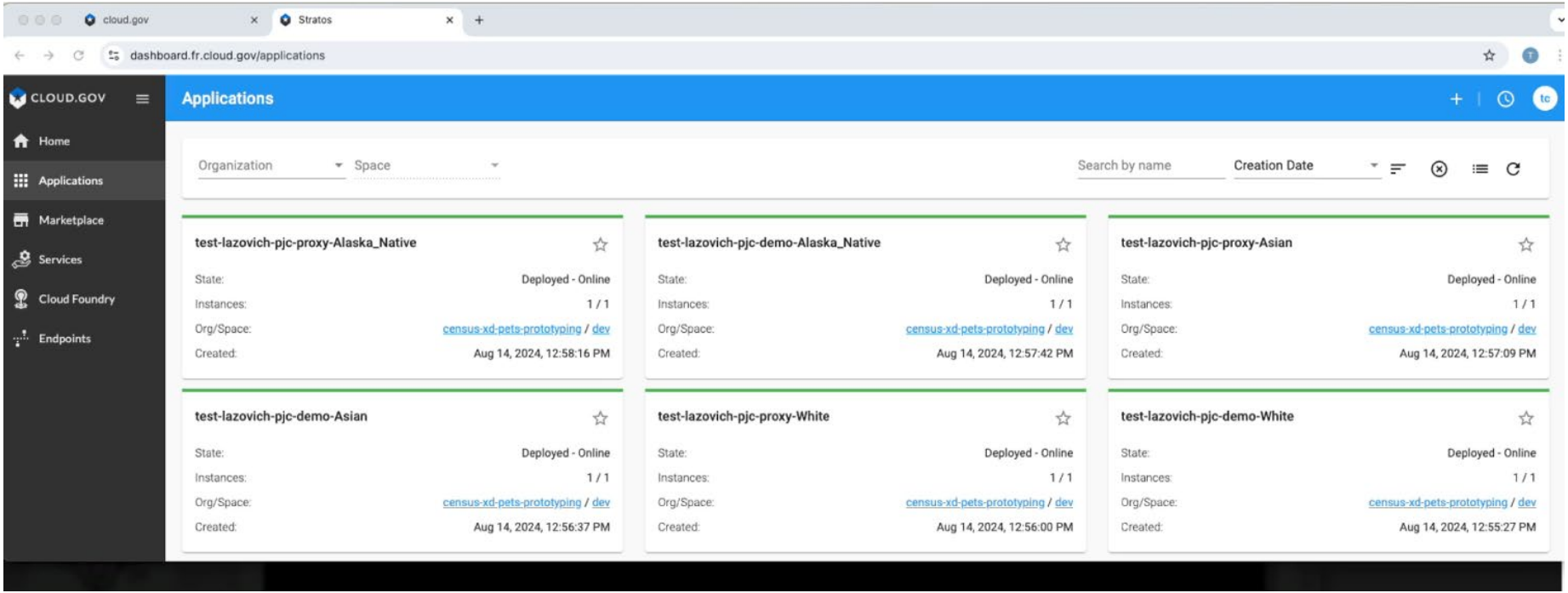


COMPUTING ACROSS DEMOGRAPHIC GROUPS

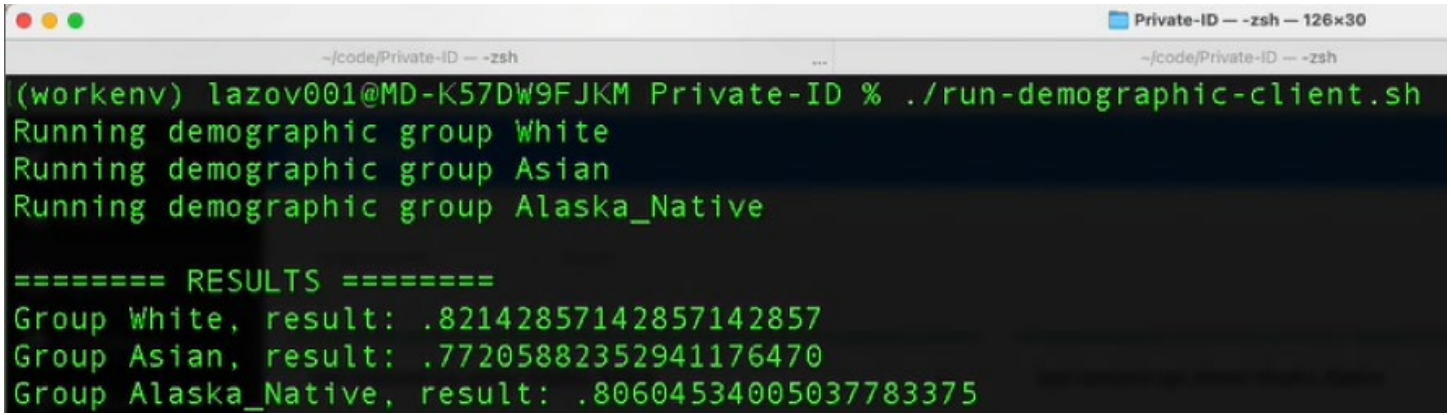
New computational tools/demos



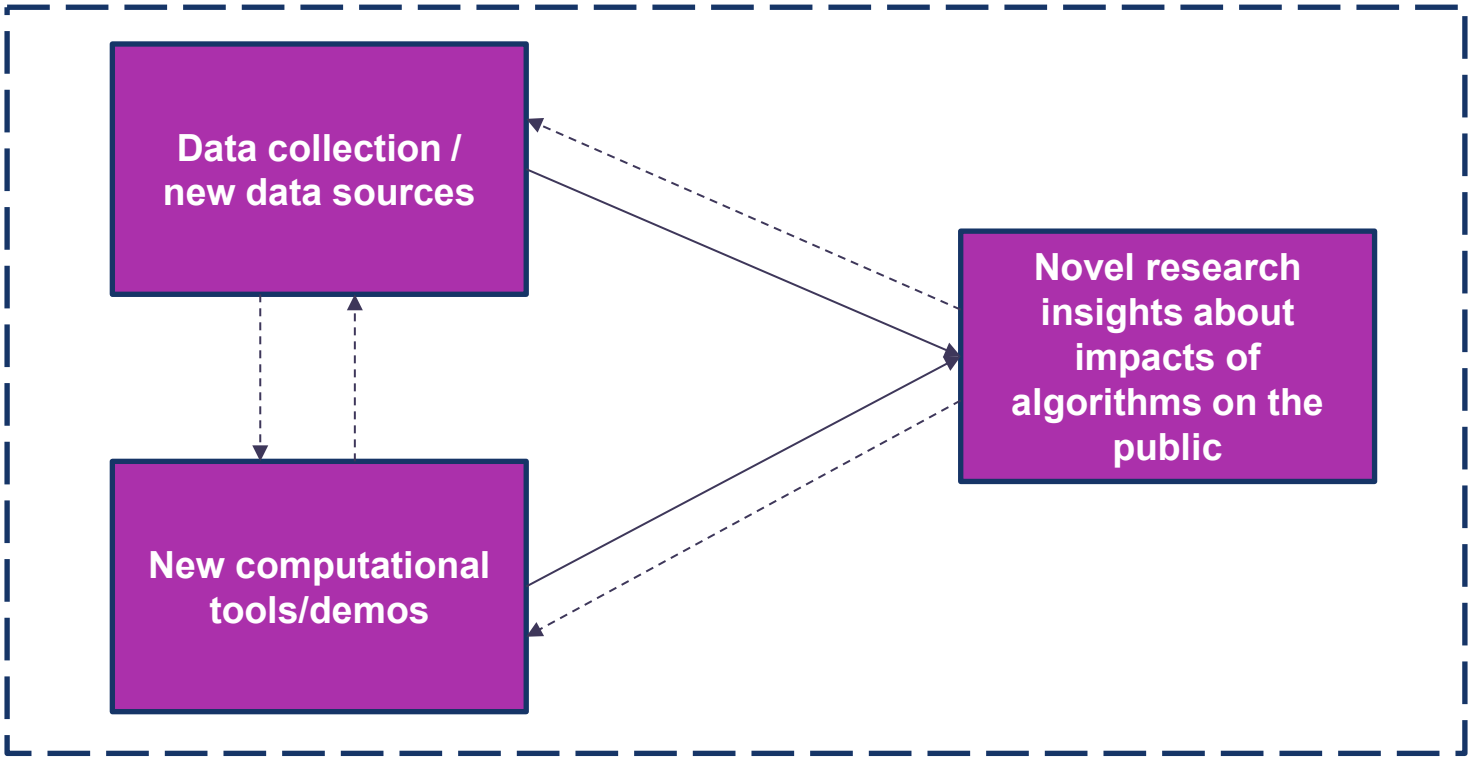
Demo – ML model performance across demographic groups



Demo – ML model performance across demographic groups



THE VISION: A COORDINATED EFFORT ACROSS THE FSS TO ENABLE RESPONSIBLE AI



Reach out if you are interested in building an RAI enablement capacity within the FSS!

inquiries@xd.gov

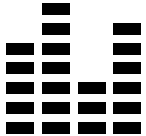
Tomo Lazovich tomo.lazovich@census.gov

Thank you for listening!

Backup

PRIVACY ENHANCING TECHNOLOGIES (PETs): THE GOAL

How can we enable analysis and gain insights without revealing private information?



Add noise: differential privacy, synthetic data generation

Encrypt: ***secure multi-party computation***, fully homomorphic encryption, zero knowledge proofs, secure enclaves

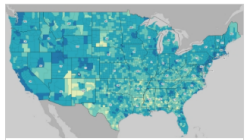
IMPORTANCE OF DEMOGRAPHIC DATA FOR FEDERAL AGENCIES

JANUARY 20, 2021

Executive Order On Advancing Racial Equity and Support for Underserved Communities Through the Federal Government

BRIEFING ROOM › PRESIDENTIAL ACTIONS

Data Tools



ACCESS BROADBAND Dashboard

The ACCESS BROADBAND Dashboard displays maps for users to assess economic conditions in areas with changes in broadband availability and adoption.

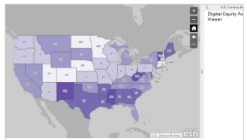
Data Tool

Census Business Builder (CBB)

Census Business Builder offers small business owners selected Census Bureau & other statistics to guide their research for opening or expanding their business.

Community Resilience Estimates (CRE) Tools

The CRE provide easily understood metrics for how socially vulnerable every neighborhood is to the impacts of disasters and other stressors.



Data Tool

Digital Equity Act Population Viewer

Interactive collection of maps that highlight various demographics and broadband internet availability and adoption by state.

United States® Census Bureau

Partners Researchers Educators Survey Respondents

Topics Data & Maps Surveys & Programs

// Census.gov / About the Bureau / What We Do / Advancing Equity with Data

PRIVATE JOIN AND COMPUTE PROTOCOL, MORE FORMALLY

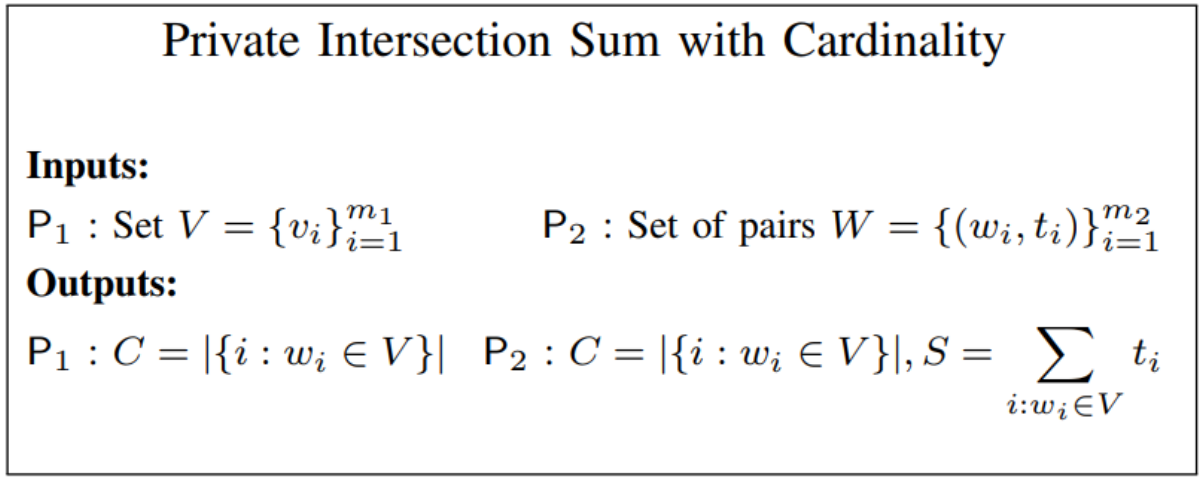


Figure 1: F_{PIS-C} : The Private Intersection-Sum with Cardinality functionality.

For details of the protocol, see Ion et al., *On Deploying Secure Computing: Private Intersection-Sum-With-Cardinality*, *https*://eprint.iacr.org/2019/723.pdf

Private Join and Compute Protocol

City

Businesses / Point of Sale

Train Riders (IDs)

1
4
8
...

Figures for illustration only

Number of riders and dollars spent are smaller than they would be in a real-world example.

Consumer Purchases (IDs, $ spent)

1	$5
4	$10
20	$5
...	...

Train Riders (IDs)

1
4
8
...

Train ID key

Encrypted Train Riders (IDs)

1
4
8
...

Encrypted Purchases (IDs, $ spent)

1	$5
4	$10
20	$5
...	...

Business ID key

Business $ key

Purchases (IDs, $ spent)

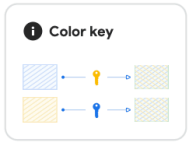
1	$5
4	$10
20	$5
...	...

Encrypted Purchases (IDs, $ spent)

1	$5
4	$10
20	$5
...	...

Encrypted Train Riders (IDs)

1
4
8
...



Double-Encrypted Purchase (IDs)

Encrypted Purchases ($ spent)

1	$5
4	$10
20	$5
...	...

Double-Encrypted Train Riders (IDs)

1
4
8
...

SHUFFLE

Double-Encrypted Purchase (IDs)

Encrypted Purchases ($ spent)

1	$5
4	$10
20	$5
...	...

Double-Encrypted Train Riders (IDs)

26
1
13
4
...

FIND THE INTERSECTION BETWEEN BOTH SIDES

Total Train Riders Who Made a Purchase

Encrypted Purchases ($ spent)

TWO TRAIN RIDERS MADE PURCHASES

2	$15

Total Train Riders Who Made a Purchase

Encrypted Purchases ($ spent)

2	$15

BUSINESS $ KEY USED TO DECRYPT

Total Train Riders Who Made a Purchase

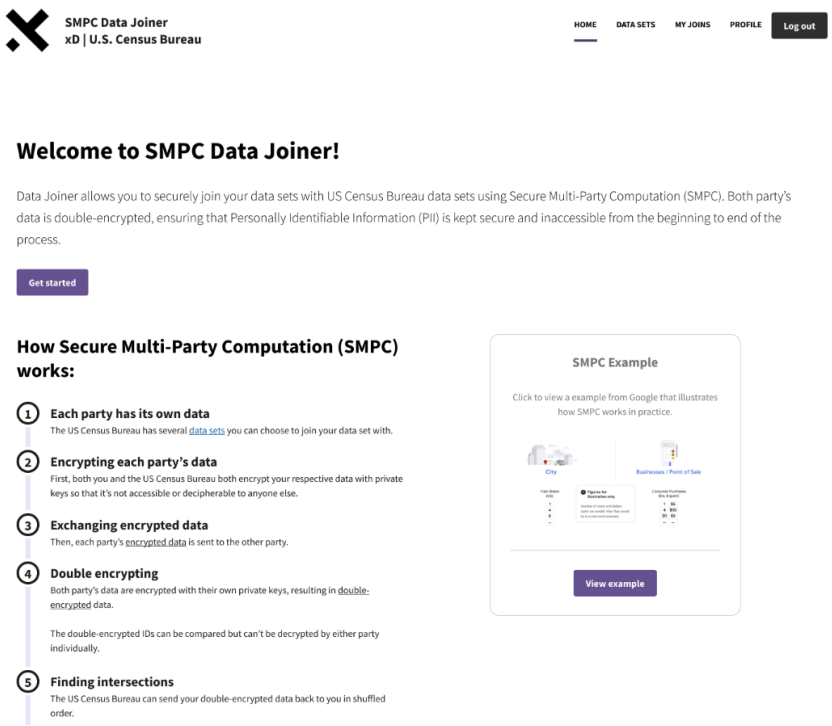
Total Amount ($ spent)

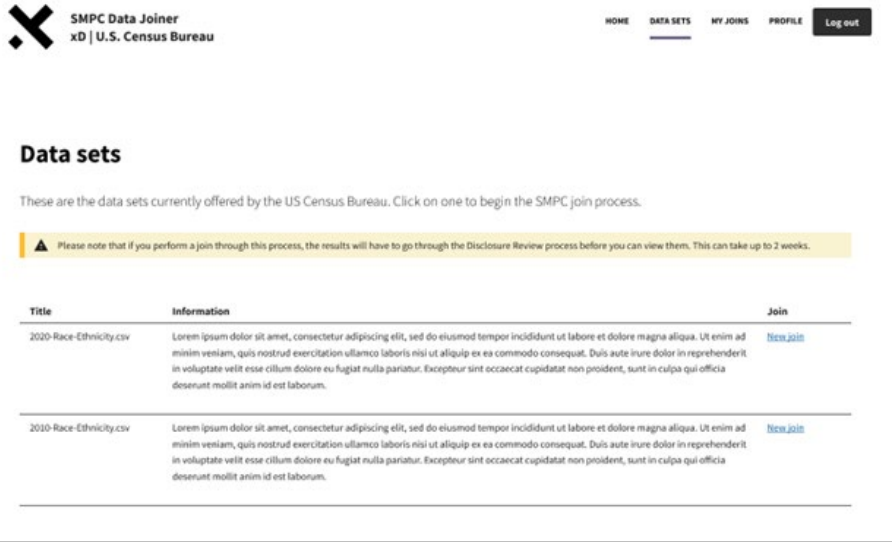
2	$15

THE CITY CAN NOW MAKE A DECISION BASED ON THE TOTAL RIDERS AND AMOUNT SPENT

https://security.googleblog.com/2019/06/helping-organizations-do-more-without-collecting-more-data.html

Workflow GUI Mockup





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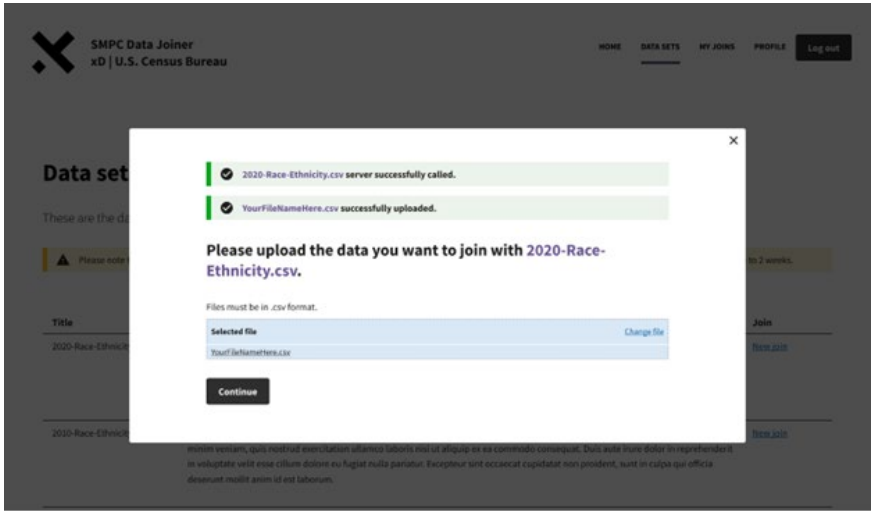
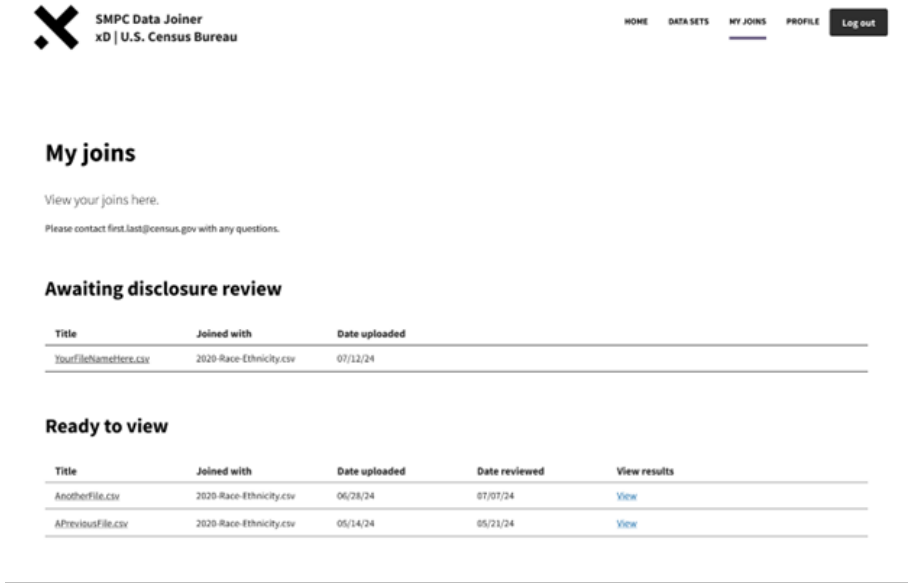
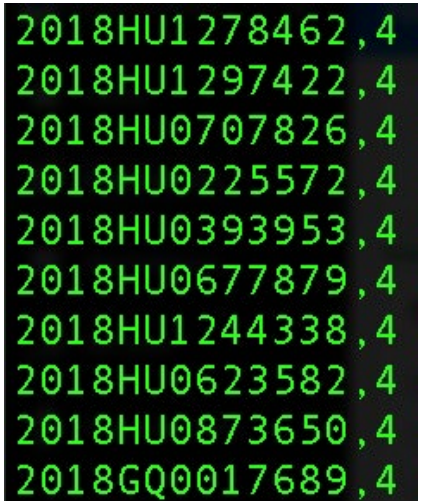


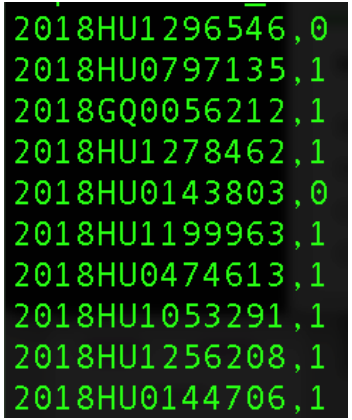


Demo 2 – ML model performance across demographic groups



Demographic server

CSV with unique ID and demographic group



Partner client

CSV with unique ID and model outcome

Demo 2 – ML model performance across demographic groups

```
#!/bin/bash
set -e

declare -a demo_groups=("White" "Asian" "Alaska_Native")

results=()

for grp in "${demo_groups[@]}"
do
    echo "Running demographic group ${grp}"
    outfile=results_$grp.log

    env RUST_LOG=info cargo run --release --bin pjc-client -- --company https://test-lazovich-pjc-proxy-$grp.app.cloud.gov \
    --input etc/example/model_results.csv --stdout --no-tls >& $outfile

    num=$(cat $outfile | awk "/Sum/" | grep -o "\w*$")
    denom=$(cat $outfile | awk "/Intersection/" | grep -o "\w*$");
    ratio=$(bc -l <<< "${num} / ${denom}")

    results+=("$ratio")
done

arraylength=${#results[@]}

echo ""
echo "======== RESULTS ========"
# use for loop to read all values and indexes
for (( i=0; i<${arraylength}; i++ ));
do
  echo "Group ${demo_groups[$i]}, result: ${results[$i]}"
done
```

Engineering workarounds to run “Private Join and Compute” on cloud.gov

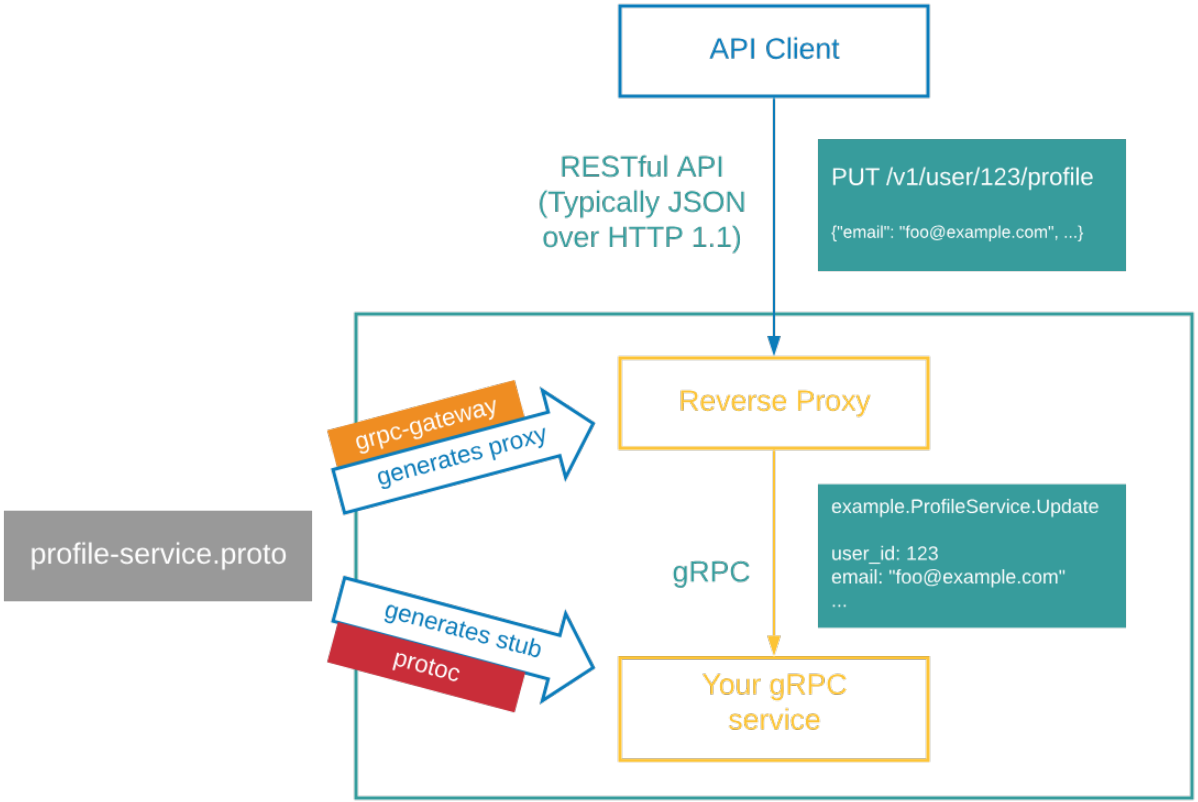
Cross-compiling Rust implementation from OS X to Linux

Generating a REST API proxy around gRPC communication protocol

Modifying client to call REST API and serialize JSON correctly

Internal cloud.gov networking for proxy communication with gRPC server

gRPC -> REST API - Overview



https://grpc-ecosystem.github.io/grpc-gateway/

gRPC -> REST API – generated code

```
service PJC {
  rpc KeyExchange(Init) returns (InitAck) {
    option (google.api.http) = {
      post: "/v1/key_exchange"
      body: "*"
    };
  }
  rpc RecvUCompanyKeys(ServiceResponse) returns (stream Payload) {
    option (google.api.http) = {post: "/v1/recv_u_company_keys"};
  }
  rpc SendECompanyKeys(stream Payload) returns (ServiceResponse) {
    option (google.api.http) = {post: "/v1/send_e_company_keys"};
  }
  rpc SendUPartnerKeys(stream Payload) returns (ServiceResponse) {
    option (google.api.http) = {post: "/v1/send_u_partner_keys"};
  }
  rpc SendUPartnerFeature(stream Payload) returns (ServiceResponse) {
    option (google.api.http) = {post: "/v1/send_u_partner_feature"};
  }

  rpc RecvStats(Commitment) returns (Stats) {
    option (google.api.http) = {post: "/v1/recv_stats"};
  }
}
```

Add annotations to proto file

```
func request_PJC_KeyExchange_0(ctx context.Context, marshaler runtim
    var protoReq Init
    var metadata runtime.ServerMetadata

    if err := marshaler.NewDecoder(req.Body).Decode(&protoReq); err
        return nil, metadata, status.Errorf(codes.InvalidArgument, "
    }

    fmt.Println(protoReq)
    msg, err := client.KeyExchange(ctx, &protoReq, grpc.Header(&meta
    return msg, metadata, err

}
```

Generated Go proxy code

Modified Rust client - example

```
169     -   let mut u_company_keys = TPayload::new();
170     -   let _ = rpc_client::recv(
171     -       ServiceResponse {
172     -           ack: Some(Ack::InitAck(init_ack.clone())),
173     -       },
174     -       "u_company_keys".to_string(),
175     -       &mut u_company_keys,
176     -       &mut client_context,
177     -   )
178     -   .await?;
        173 +
        174 +   let resp = http_client.post(
        175 +       format!("{}/v1/recv_u_company_keys", &host_pre.unwrap())
        176 +   ).send().await?.json::<KeyResponse>().await?;
        177 +
        178 +   let byte_array : Vec<ByteBuffer> = resp.result.payload.iter().map(|e| ByteBuffer{buffer: e.to_vec()}).collect();
        179 +
        180 +   let mut u_company_keys = TPayload::from(byte_array);
        181 +
        182 +   println!("{:?}", u_company_keys);
```

Convert RPC calls to REST API calls

Internal cloud.gov networking

Create internal route to gRPC server app

```
cf map-route test-lazovich-binary-pjc apps.internal --hostname test-lazovich-binary-pjc --app-protocol http2
```

Allow traffic between Go proxy app and gRPC server app

```
cf add-network-policy test-lazovich-pjc-proxy test-lazovich-binary-pjc -s dev -o census-xd-pets-prototyping --protocol tcp --port 8080
```

Future vision: Demographic Disparities as a Service