



xD

<https://www.xd.gov>



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.*



BEFORE DIVING IN – INTRODUCTION TO THE xD TEAM

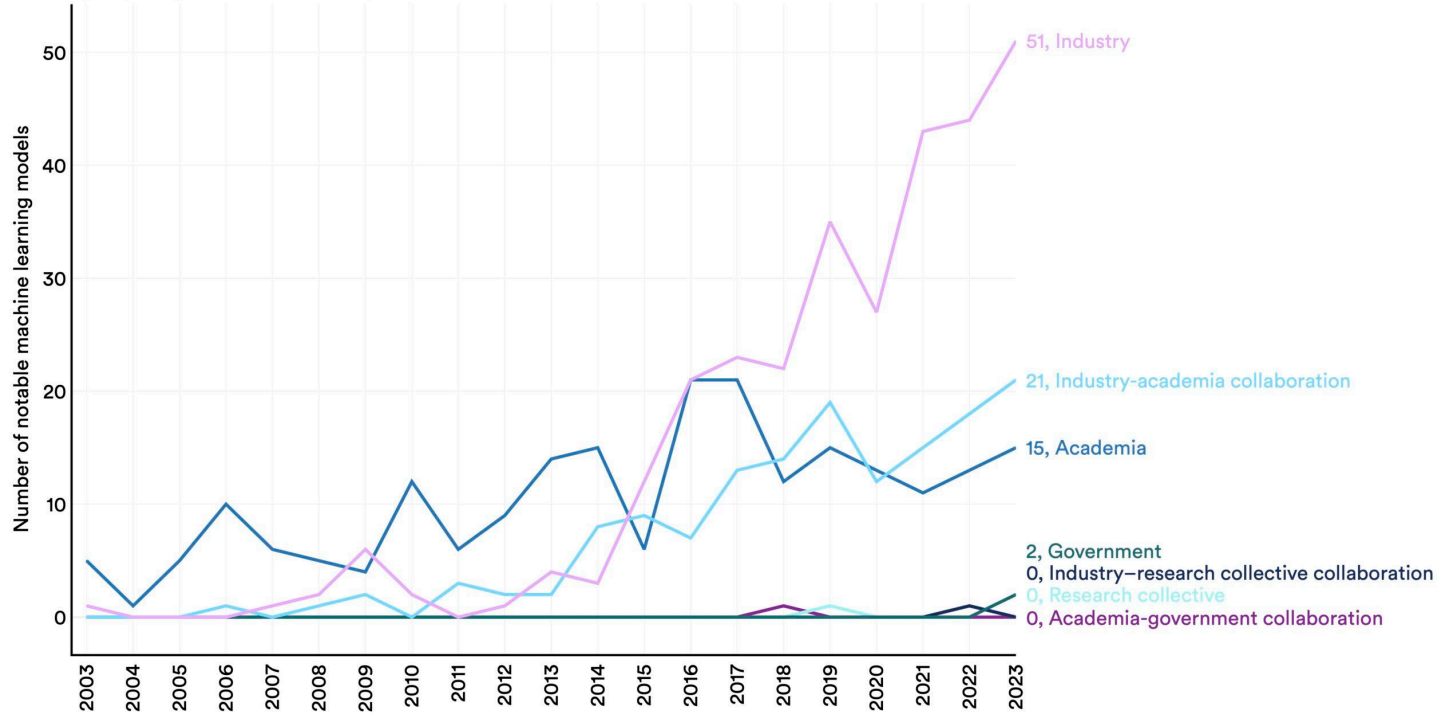
xD is an **emerging technologies group** that's advancing the delivery of data-driven services through new and transformative technologies.

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



Number of notable machine learning models by sector, 2003–23

Source: Epoch, 2023 | Chart: 2024 AI Index report

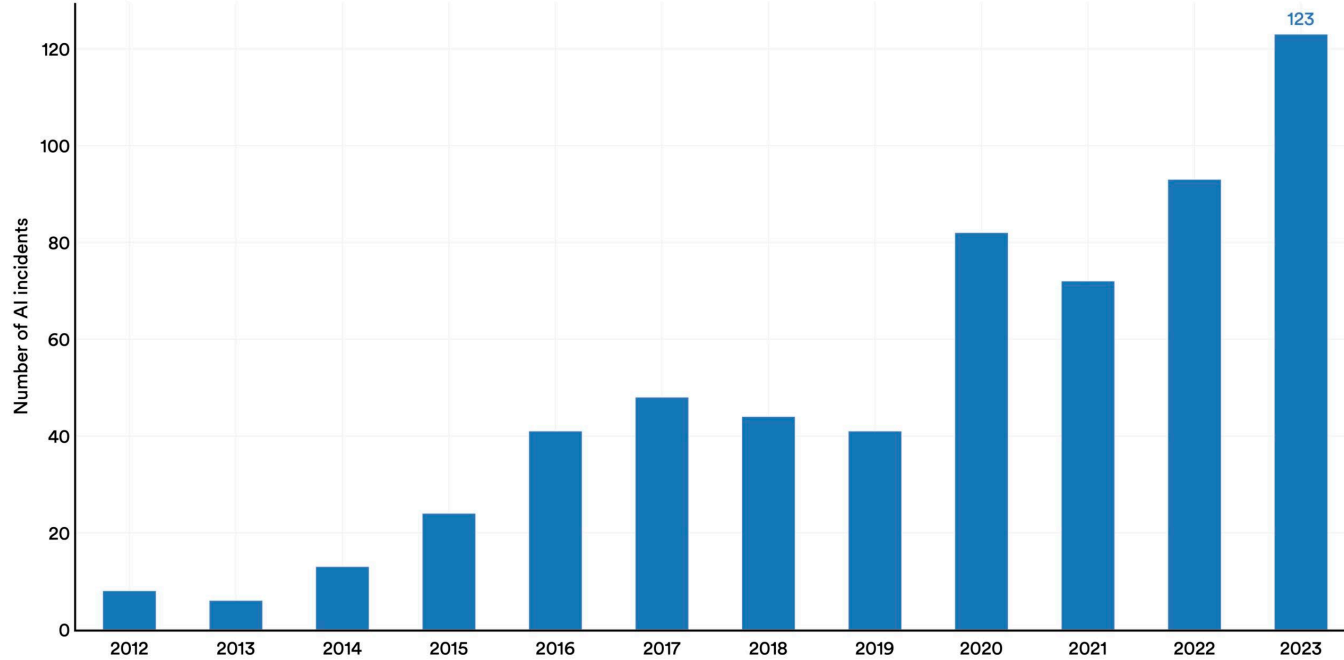


AS AI/ML ADOPTION RISES, SO DO THE NUMBER OF AI-RELATED INCIDENTS REPORTED



Number of reported AI incidents, 2012–23

Source: AI Incident Database (AIID), 2023 | Chart: 2024 AI Index report



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



Foreign TikTok Networks Political Lies

A flood of anti-Trump videos, generated by AI, has led to a web of overseas...

Aug. 8, 2024 9:00 pm ET

of bus
Eighty-five percent
"existential" threat

Published Sept. 3, 20

AI-Fakes Detected in Global South

With generative AI affecting content creation, researchers face a "detection gap," as the systems mean tools for identifying fake content in the Global South.

FORBES > BUSINESS

BREAKING

An Algorithm Told Police She Was Safe. Then Her Husband Killed Her.

Spain has become reliant on an algorithm to score how likely a domestic violence victim is to be abused again and what protection to provide — sometimes leading to fatal consequences.

By **Adam Satariano** and **Roser Toll Pifarre** Photographs by **Ana María Arévalo Gosen**
Adam Satariano and Roser Toll Pifarre interviewed more than 50 victims, families, police, government officials and other experts about Spain's gender violence program.
July 18, 2024

...researchers face a
...systems mean tools for
...ork poorly or not at all in the Global



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



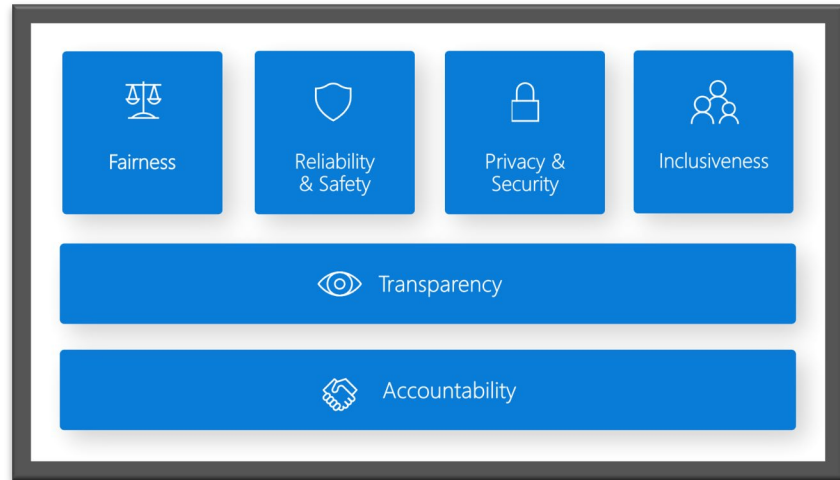
By Casey Ross  and Bob Herman  March 13, 2023



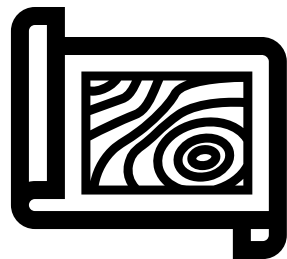
Incorporate methods for **building and evaluating AI/ML systems that account for real-world human impacts.**

With emphasis on being:

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



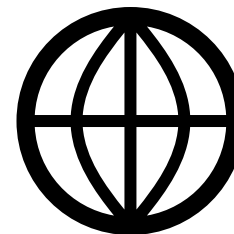
Microsoft Responsible AI Principles



Using AI to enhance
agency work and
statistical products



Governing AI projects
within the agency



Enabling responsible
AI for the public

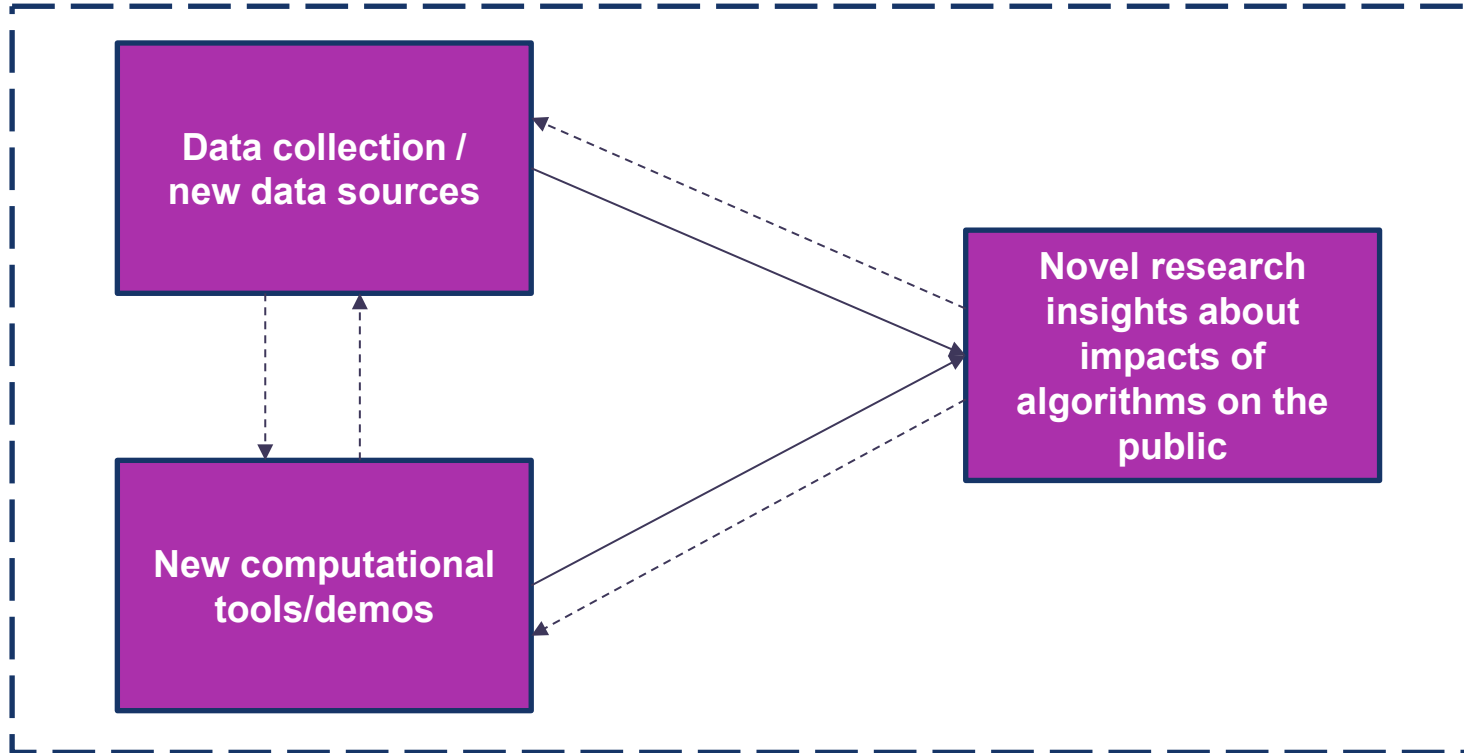
Often overlooked

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



The screenshot shows the DATA.GOV website homepage. At the top left is the DATA.GOV logo with an American flag icon. Below it is a blue banner that says "CELEBRATING 15 YEARS OF DATA.GOV". The main heading reads "The Home of the U.S. Government's Open Data". Below this is a paragraph: "Here you will find data, tools, and resources to conduct research, develop web and mobile applications, design data visualizations, and more." A large red number "288,372 DATASETS AVAILABLE" is displayed. At the bottom is a search bar with a red "Search" button.

Rich, widely
varying datasets

The infographic is titled "Annual Business Survey" in white text on a blue background. Below the title is a paragraph: "The Annual Business Survey provides annual data on business owner demographics (e.g., sex, ethnicity, race and veteran status), research and development activity for small businesses, business innovations, and technology usage." To the right of this paragraph are the abbreviations "M = Millions" and "K = Thousands". The main data is presented in four columns, each with a large number and a description: "1.0M Minority-owned businesses in the United States.", "1.1M Women-owned businesses in the United States.", "322K Hispanic-owned businesses in the United States.", and "351K Veteran-owned businesses in the United States." At the bottom left is a note: "Note: The Annual Business Survey (ABS) includes employer businesses only. The ABS is sponsored by the National Center for Science and Engineering Statistics within the National Science Foundation. This graphic is an update from the one previously released in fall 2019." Below the note is the source: "Source: 2018 Annual Business Survey, data year 2017, www.census.gov/programs-surveys/abs.html". At the bottom are the logos for the United States Census Bureau, the U.S. Department of Commerce, the NSF, and the NCSES.

Vast reach into households
and businesses



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

Luca Belli
Twitter Inc.

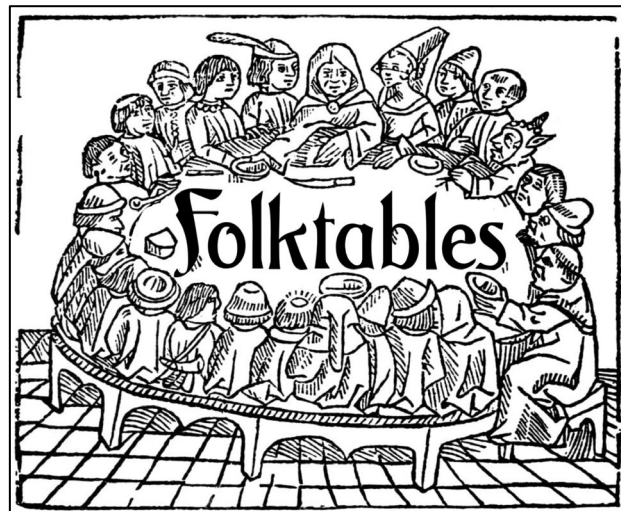
Kyra Yee
Twitter Inc.

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.**

How?



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



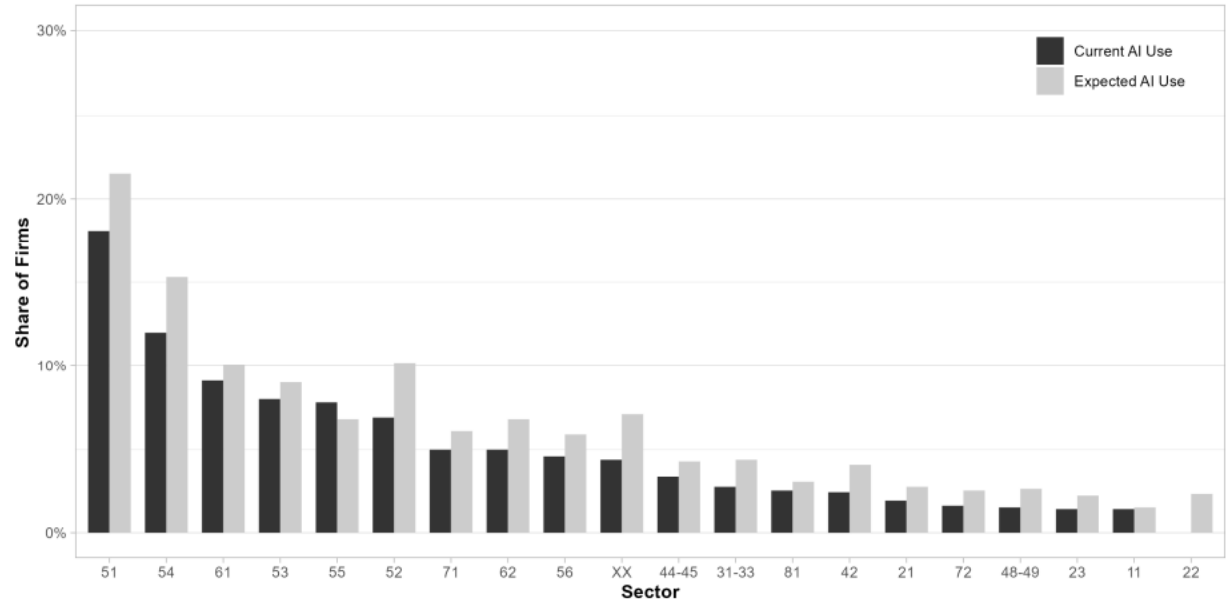
EXAMPLE – CENSUS BUSINESS TRENDS AND OUTLOOKS SURVEY

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*

Figure 2a. Current and Expected AI Use by Sector (Firm-weighted)



EXAMPLE - PRIVACY-PRESERVING MODEL AUDITING

New computational tools/demos



PARTY 1

ID
1
2
3

PARTY 2

ID	Feature
2	700
3	800
901	60000



PJC protocol

Intersection size
2

Intersection size	Feature sum
2	1500

INPUTS

OUTPUTS

EXAMPLE - PRIVACY-PRESERVING MODEL AUDITING

New computational tools/demos



PARTY 1

ID
1
2
3

PARTY 2

ID	Prediction = ground truth?
2	1
3	0
901	0



PJC protocol

Intersection size
2

Intersection size	Number of correct predictions
2	1

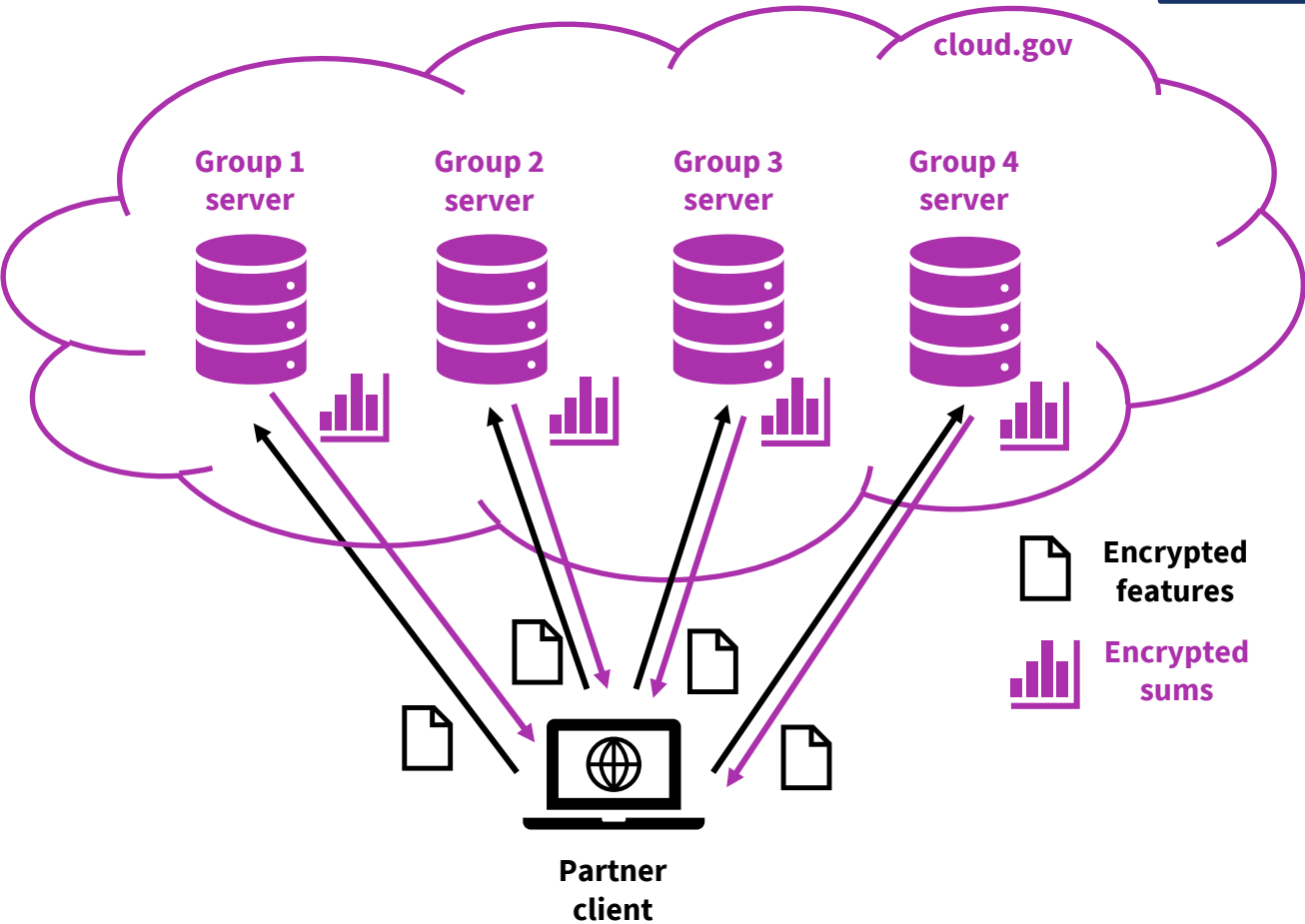
Accuracy = 1 / 2 = 50%

INPUTS

OUTPUTS

COMPUTING ACROSS DEMOGRAPHIC GROUPS

New computational tools/demos



Demo - ML model performance across demographic groups



The screenshot shows the Cloud.gov Applications dashboard. The left sidebar contains navigation options: Home, Applications, Marketplace, Services, Cloud Foundry, and Endpoints. The main content area displays a grid of six application cards, each representing a different demographic group. Each card includes the application name, state (Deployed - Online), number of instances (1 / 1), organization and space information, and the creation date.

Application Name	State	Instances	Org/Space	Created
test-lazovich-pjc-proxy-Alaska_Native	Deployed - Online	1 / 1	census-xd-pets-prototyping / dev	Aug 14, 2024, 12:58:16 PM
test-lazovich-pjc-demo-Alaska_Native	Deployed - Online	1 / 1	census-xd-pets-prototyping / dev	Aug 14, 2024, 12:57:42 PM
test-lazovich-pjc-proxy-Asian	Deployed - Online	1 / 1	census-xd-pets-prototyping / dev	Aug 14, 2024, 12:57:09 PM
test-lazovich-pjc-demo-Asian	Deployed - Online	1 / 1	census-xd-pets-prototyping / dev	Aug 14, 2024, 12:56:37 PM
test-lazovich-pjc-proxy-White	Deployed - Online	1 / 1	census-xd-pets-prototyping / dev	Aug 14, 2024, 12:56:00 PM
test-lazovich-pjc-demo-White	Deployed - Online	1 / 1	census-xd-pets-prototyping / dev	Aug 14, 2024, 12:55:27 PM

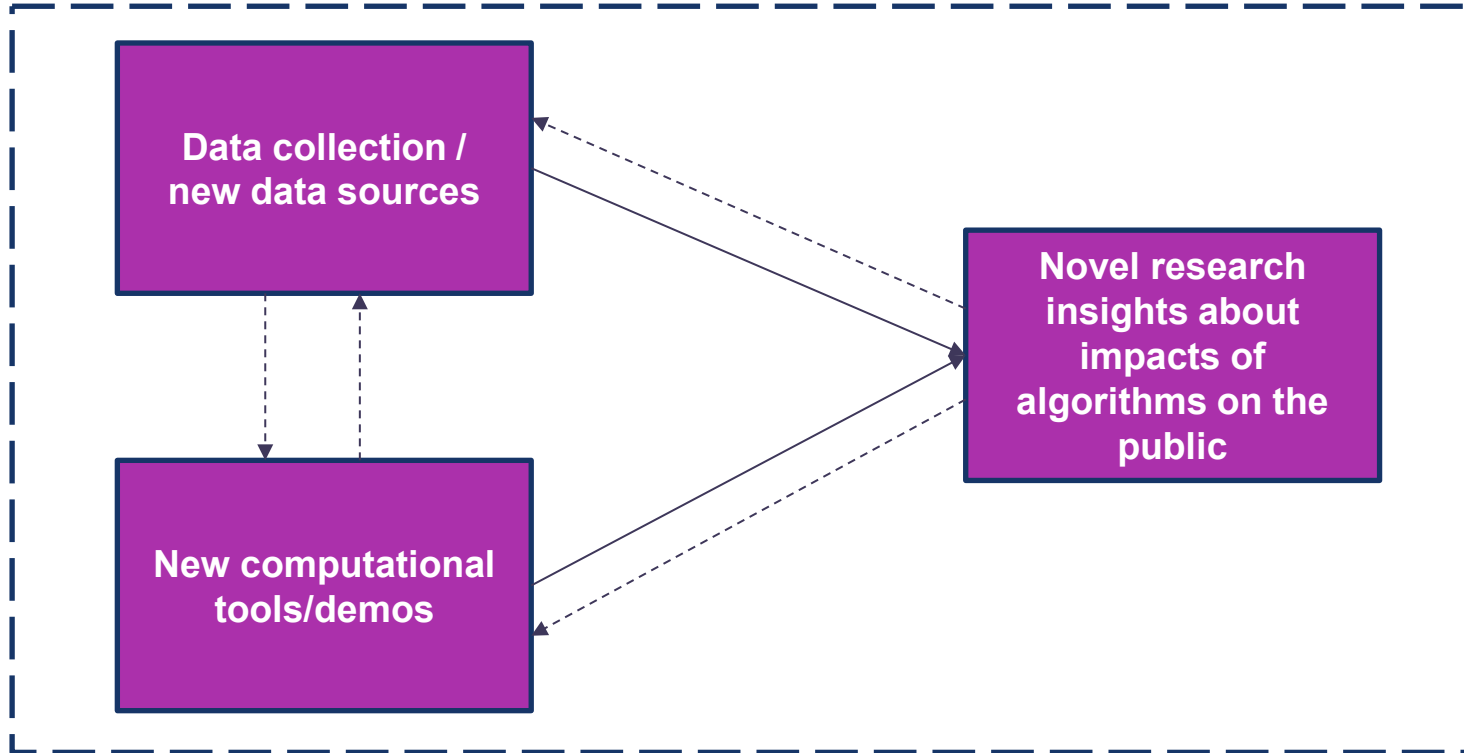
Demo - ML model performance across demographic groups



```
Private-ID -- zsh -- 126x30
~/code/Private-ID -- zsh
(workenv) lazov001@MD-K57Dw9FJKM Private-ID % ./run-demographic-client.sh
Running demographic group White
Running demographic group Asian
Running demographic group Alaska_Native

==== RESULTS ====
Group White, result: .82142857142857142857
Group Asian, result: .77205882352941176470
Group Alaska_Native, result: .80604534005037783375
```

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!



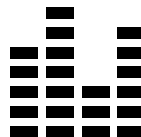


—
Backup



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



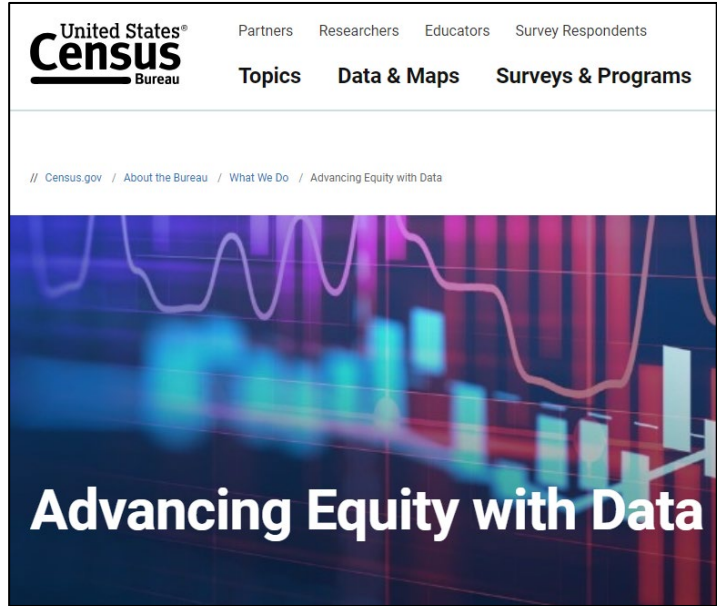
IMPORTANCE OF DEMOGRAPHIC DATA FOR FEDERAL AGENCIES

JANUARY 20, 2021

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


[BRIEFING ROOM](#)

[PRESIDENTIAL ACTIONS](#)



United States[®]
Census
Bureau

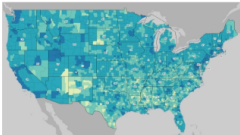
Partners Researchers Educators Survey Respondents

Topics **Data & Maps** **Surveys & Programs**

// [Census.gov](#) / [About the Bureau](#) / [What We Do](#) / [Advancing Equity with Data](#)

Advancing Equity with Data

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

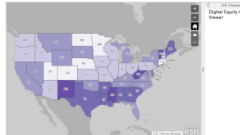
Census Business Builder (CBB)

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.





PRIVATE JOIN AND COMPUTE PROTOCOL, MORE FORMALLY

Private Intersection Sum with Cardinality

Inputs:

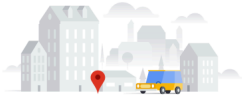
P_1 : Set $V = \{v_i\}_{i=1}^{m_1}$ P_2 : Set of pairs $W = \{(w_i, t_i)\}_{i=1}^{m_2}$

Outputs:

P_1 : $C = |\{i : w_i \in V\}|$ P_2 : $C = |\{i : w_i \in V\}|, S = \sum_{i:w_i \in V} t_i$

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

Private Join and Compute Protocol



City



Businesses / Point of Sale

Train Riders (IDs)

1
4
8
...

i 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
...	...

FIND THE INTERSECTION BETWEEN BOTH SIDES

Double-Encrypted Train Riders (IDs)

26
1
13
4
...

Total Train Riders Who Made a Purchase

2

Encrypted Purchases (\$ spent)

\$15

Total Train Riders Who Made a Purchase

2

Encrypted Purchases (\$ spent)

\$15

Total Train Riders Who Made a Purchase

2

Total Amount (\$ spent)

\$15

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



Workflow GUI Mockup



Welcome to SMPC Data Joiner!

Data Joiner allows you to securely join your data sets with US Census Bureau data sets using Secure Multi-Party Computation (SMPC). Both party's data is double-encrypted, ensuring that Personally Identifiable Information (PII) is kept secure and inaccessible from the beginning to end of the process.

Get started

How Secure Multi-Party Computation (SMPC) works:

- 1 Each party has its own data**
The US Census Bureau has several [data sets](#) you can choose to join your data set with.
- 2 Encrypting each party's data**
First, both you and the US Census Bureau both encrypt your respective data with private keys so that it's not accessible or decipherable to anyone else.
- 3 Exchanging encrypted data**
Then, each party's [encrypted data](#) is sent to the other party.
- 4 Double encrypting**
Both party's data are encrypted with their own private keys, resulting in [double-encrypted data](#).

The double-encrypted IDs can be compared but can't be decrypted by either party individually.
- 5 Finding intersections**
The US Census Bureau can send your double-encrypted data back to you in shuffled order.

SMPC Example

Click to view an example from Google that illustrates how SMPC works in practice.

[View example](#)



Data sets

These are the data sets currently offered by the US Census Bureau. Click on one to begin the SMPC join process.

⚠ Please note that if you perform a join through this process, the results will have to go through the Disclosure Review process before you can view them. This can take up to 2 weeks.

Title	Information	Join
2020-Race-Ethnicity.csv	Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute inure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.	View join
2010-Race-Ethnicity.csv	Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute inure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.	View join

Workflow GUI Mockup



The screenshot shows the SMPC Data Joiner interface with a modal dialog open. The dialog contains two success messages: "2020-Race-Ethnicity.csv server successfully called." and "YourFileNameHere.csv successfully uploaded." Below these, it prompts the user to upload data for joining with "2020-Race-Ethnicity.csv". It includes a file selection area with a "Selected file" field containing "YourFileNameHere.csv" and a "Change file" link. A "Continue" button is at the bottom.

My joins

View your joins here.

Please contact first.last@census.gov with any questions.

Awaiting disclosure review

Title	Joined with	Date uploaded
YourFileNameHere.csv	2020-Race-Ethnicity.csv	07/12/24

Ready to view

Title	Joined with	Date uploaded	Date reviewed	View results
AnotherFile.csv	2020-Race-Ethnicity.csv	06/28/24	07/07/24	View
APreviousFile.csv	2020-Race-Ethnicity.csv	05/14/24	05/21/24	View

Demo 2 - ML model performance across demographic groups



```
2018HU1278462,4
2018HU1297422,4
2018HU0707826,4
2018HU0225572,4
2018HU0393953,4
2018HU0677879,4
2018HU1244338,4
2018HU0623582,4
2018HU0873650,4
2018GQ0017689,4
```

Demographic server

CSV with unique ID and
demographic group

```
2018HU1296546,0
2018HU0797135,1
2018GQ0056212,1
2018HU1278462,1
2018HU0143803,0
2018HU1199963,1
2018HU0474613,1
2018HU1053291,1
2018HU1256208,1
2018HU0144706,1
```

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

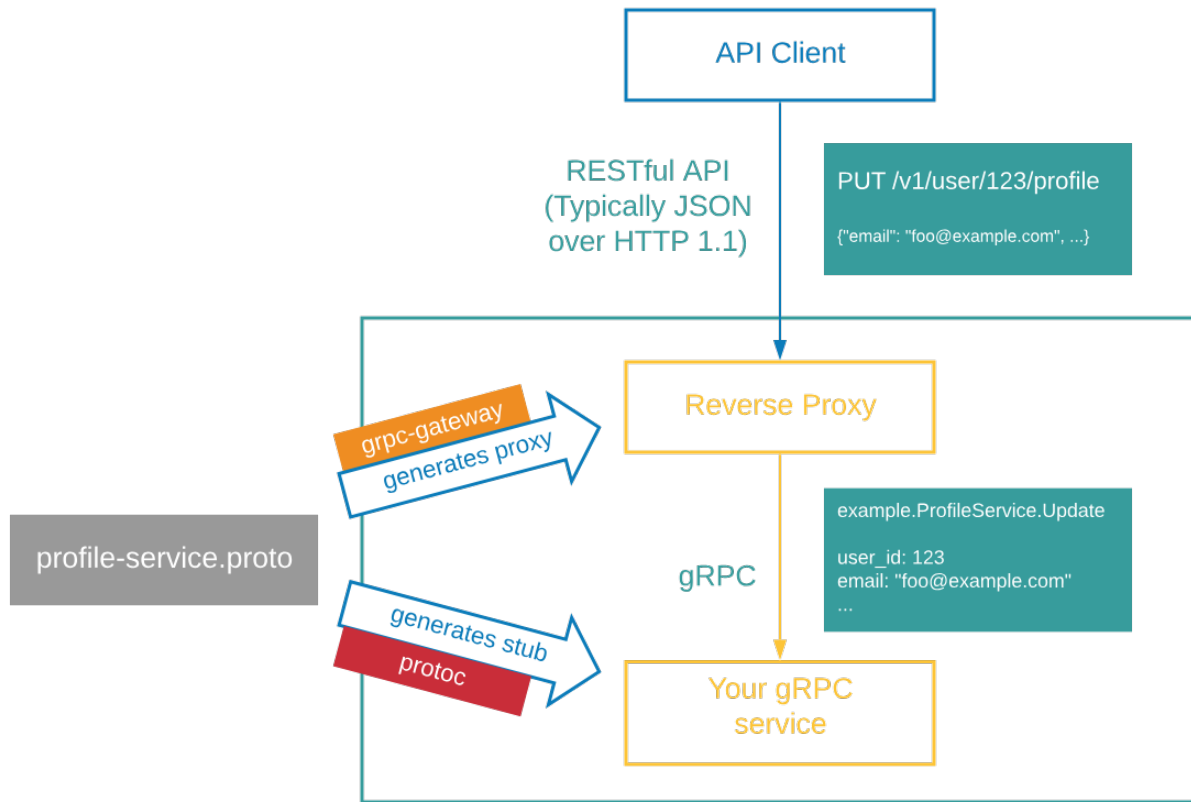
Generating a REST API proxy around gRPC communication protocol

Modifying client to call REST API and serialize JSON correctly

Internal cloud.gov networking for proxy communication with gRPC server



gRPC -> REST API - Overview





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"};  
  }  
}
```

```
func request_PJC_KeyExchange_0(ctx context.Context, marshaler runtime.Marshaler) {  
  var protoReq Init  
  var metadata runtime.ServerMetadata  
  
  if err := marshaler.NewDecoder(req.Body).Decode(&protoReq); err != nil {  
    return nil, metadata, status.Errorf(codes.InvalidArgument, "%v", err)  
  }  
  
  fmt.Println(protoReq)  
  msg, err := client.KeyExchange(ctx, &protoReq, grpc.Header(&metadata.HeaderMD))  
  return msg, metadata, err  
}
```

Generated Go proxy code

Add annotations to proto file



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

The screenshot shows the 'My joins' page of the SMPC Data Joiner application. The header includes the logo, the text 'SMPC Data Joiner xD | U.S. Census Bureau', and navigation links for HOME, DATA SETS, MY JOINS (which is active), and PROFILE. A 'Log out' button is also present. The main content area is titled 'My joins' and contains a message: 'View your joins here. Please contact first.last@census.gov with any questions.' Below this, there are two sections: 'Awaiting disclosure review' and 'Ready to view'. Each section contains a table of data joins.

SMPC Data Joiner
xD | U.S. Census Bureau

HOME DATA SETS **MY JOINS** PROFILE [Log out](#)

My joins

View your joins here.
Please contact first.last@census.gov with any questions.

Awaiting disclosure review

Title	Joined with	Date uploaded
YourFileNameHere.csv	2020-Race-Ethnicity.csv	07/12/24

Ready to view

Title	Joined with	Date uploaded	Date reviewed	View results
AnotherFile.csv	2020-Race-Ethnicity.csv	06/28/24	07/07/24	View
APreviousFile.csv	2020-Race-Ethnicity.csv	05/14/24	05/21/24	View