



Building the Open Source Program Office at Goldman Sachs

2022年11月5日

Goldman Sachs Introduction

Goldman Sachs is a leading global investment banking, securities and investment management firm that provides a wide range of financial services to a substantial and diversified client base that includes corporations, financial institutions, governments and individuals.

ゴールドマン・サックスは

投資銀行業務、証券業務および投資運用業務を中心に、企業、金融機関、政府機関、個人など多岐にわたるお客様を対象に幅広い金融サービスを提供している世界有数の金融機関です。

- <https://gs.com/opensource>
- <https://github.com/goldmansachs>
- <https://developer.gs.com/>
- <https://www.goldmansachs.com/>
- <https://www.goldmansachs.com/japan/>

Our name is “Goldman Sachs”, for we are many

This may also be important later...

- I work for ゴールドマン・サックス・ジャパン・サービス株式会社
- In Japan we also have:
 - ゴールドマン・サックス証券株式会社
 - ゴールドマン・サックス・アセット・マネジメント株式会社
 - ゴールドマン・サックス・リアルティ・ジャパン有限会社
 - ゴールドマン・サックス・エナジー・ジャパン合同会社
 - ゴールドマン・サックス・ジャパン・リミテッド (Virgin Islands)
 - ゴールドマン・サックス・バンク U S A (USA)
- And outside Japan we have:
 - Goldman Sachs & Co
 - Goldman Sachs (UK) LLC
 - Goldman Sachs Ireland LLC
 - and many, many, many more

GS in Japan are regulated by
日本銀行 (BOJ) and
証券取引等監視委員会 (SESC)

Marty Pauley Introduction

Marty Pauley

- Technology Fellow
- Secrets and Encryption Services
- Dev / Ops
- 16 years working in Goldman Sachs
- “Linux, Perl, Tokyo, Geeks Welcome”
- 16 years living in Tokyo

ポーリー・マーティ

- 「テクノロジー・フェロー」
- 暗号技術サービス
- 開発者／運用者
- 16年間ゴールドマン・サックスに勤めています
- 「Linux、Perl、東京、オタクは歓迎だ」
- 16年間東京に住んでいます．．．
でも、日本語が下手です。



Thank you, Vicki Chung!

Make things possible.



Goldman Sachs Runs on Open Source

Open Source @ Goldman Sachs

- ✓ we consume (lots of) Open Source at Goldman Sachs.
- ✓ we participate in external Open Source working groups, steering committees, etc
- ✓ our engineers contribute to Open Source on behalf of GS as part of their day-to-day engineering work.
- ✓ our engineers are permitted to work on personal and passion projects for fun, or for skill development, etc.
- ✓ our engineers write public blog posts and articles about technical topics
- ✓ our engineers can speak at conferences about Open Source 😊

Some Projects of Interest to Us

Open Source @ Goldman Sachs

Projects GS Created
& Open Sourced



RELADOM



Projects GS Open Sourced &
Contributed to Foundations



Projects to Which We Contribute
(or want to)



.. Along with the tens of thousands of open source projects we use in our Software Bill of Materials

Foundations We Support

Open Source @ Goldman Sachs





The Goldman Sachs Open Source Program Office (OSPO)

Open Source @ Goldman Sachs: Goals

The Open Source Program Office was chartered in April 2021 and officially launched in August 2021.

Our goals:

1. Promote and support more Open Source code consumption and contribution by GS developers.
2. Position Open Source consumption and contribution to attract and retain talent.
3. Build and expand GS' capabilities to generate insights about Open Source activity at the firm, in the financial services industry, and within the technology ecosystem.
4. Establish GS as a leader in Open Source, capable of helping set the direction of projects, initiatives, and consortia building code and standards strategic to Goldman Sachs.
5. Increase GS's external visibility in the Open Source community and build further awareness of GS' work in open source amongst the financial services and technology industries.



What happened before 2021?

We've been doing Open Source before that.

- We used a lot of unmodified Open Source with no problems.
- We attended conferences like this one 😊
- We built software with Open Source components... but were nervous about *copyleft* licenses.
- Our staff were allowed to contribute to Open Source as personal projects... if they knew how to request approval; but the answers were not consistent.
- It was extremely difficult to contribute to Open Source as an employee on work project 😞
- We could release an entire project as Open Source, but it was expensive to do that.

Some progress before OSPO

- Communication policy to cover Social Networking Services, also covers pull/merge request and bug reporting on public Open Source channels.
- Outside Activity policy clarified within Technology/Engineering so personal unpaid Open Source contributions do not require Compliance approval.
- Produced training material about Open Source.
- Built a system, “GSOSS”, to track personal contributions on GitHub.
- Built another system to safely allow code written inside GS to be pushed to GitHub.
- Provide public cloud accounts for staff to experiment and develop outside.
- Released a large library, “GS Collections”, as Open Source
 - realised that we would not be good at managing the project so transferred it to the Eclipse Foundation



Good progress, but not enough.

Problems?

The problem with software developers...

- just want to code, so may not check the license
- if they do check the license, may not understand
 - because they are not lawyers
 - and they didn't do or remember the training

The problem with lawyers...

- they need to be paid 😊

The problem with Open Source...

- it's about copyright, not code
- common concepts in Open Source are not defined by law, such as “distribute” and “convey”

The problem with large corporations...

- if something does not have a place in the org structure, eventually it will disappear...
- because it also has a cost to be paid

Now we have OSPO

- They exist! As a real department they can collaborate with other departments, both technical and non-technical, to safeguard GS and protect Open Source.
- Improved the training.
 - Ensured that new developers took the training, and encouraged old developers to take it too.
 - Wrote simple documentation that was easy to find, including a “playbook” to Open Source a product.
 - Clearly explained the special care needed for some popular licenses.
 - Produced guidelines for personal projects
- Improved the contribution tracking tool, which now has regular releases.
- Got a budget to pay lawyers, and meet with them regularly.
- Connected with other large companies who are trying to solve the same problems.
- Help developers manage their Contributor License Agreements.
- Answering questions and providing support.

I have a story
about this



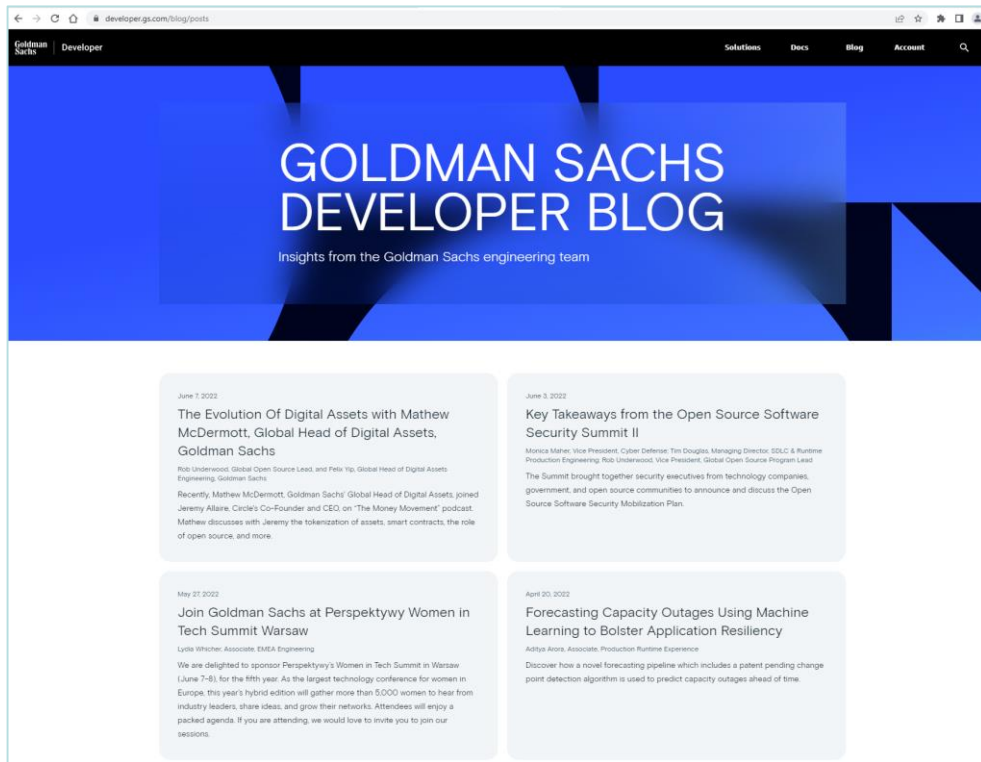
Thank you!

Make things possible.

Q&A

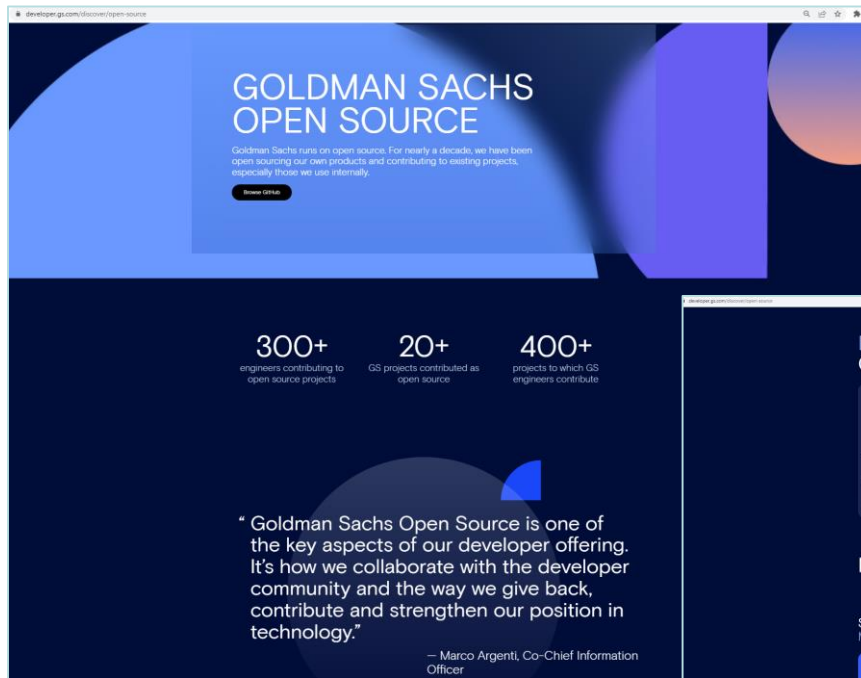
Any Questions?

Appendix



gs.com/opensource

Open Source @ Goldman Sachs



developer.gs.com/opensource

GOLDMAN SACHS OPEN SOURCE

Goldman Sachs runs on open source. For nearly a decade, we have been open sourcing our own products and contributing to existing projects, especially those we use internally.

[Browse GitHub](#)

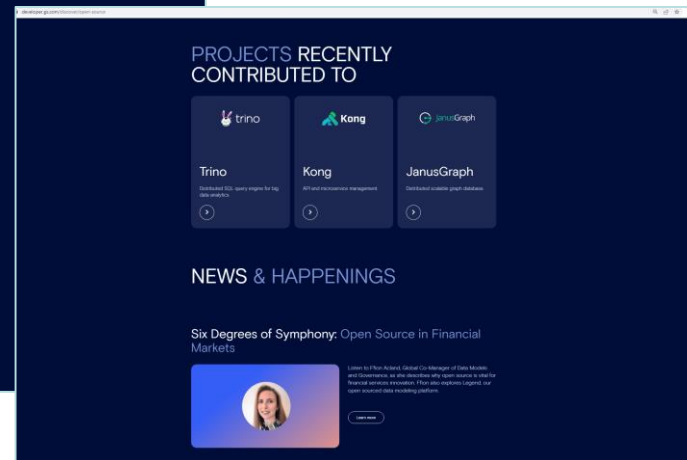
300+
engineers contributing to
open source projects

20+
GS projects contributed as
open source

400+
projects to which GS
engineers contribute

"Goldman Sachs Open Source is one of the key aspects of our developer offering. It's how we collaborate with the developer community and the way we give back, contribute and strengthen our position in technology."

— Marco Argenti, Co-Chief Information Officer



PROJECTS RECENTLY CONTRIBUTED TO


Trino
Distributed SQL query engine for big data analytics


Kong
API and microservices management


JanusGraph
Distributed scalable graph database

NEWS & HAPPENINGS

Six Degrees of Symphony: Open Source in Financial Markets

Listen to Peter Argenti, Global Co-Manager of Data Markets and Investments, as she discusses why open source is vital to financial services innovation. Then also explore LinkedIn, our open research data, building confidence.

[Learn more](#)

Twitter: @gsdeveloper

Open Source @ Goldman Sachs



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Sachs**

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Discover Goldman Sachs Financial Cloud for Data: click.gs.com/bbdn

developer.gs.com Joined September 2021



GS Quant

<https://developer.gs.com/docs/gquant>

GS Quant is a Python toolkit for quantitative finance, created on top of one of the world's most powerful risk transfer platforms. Designed to accelerate development of quantitative trading strategies and risk management solutions, crafted over 25 years of experience navigating global markets.



Designed by our quants

Created by our quants, for our quants. Our analytics tools are trusted daily by over a thousand quantitative developers at Goldman Sachs to manage our global trading business.



Comprehensive and cross-asset

Our business covers all asset classes. Our financial toolkit is designed from the ground up to be a complete solution for all markets, delivered through an intuitive interface.



Proven by markets

Leverage models and datasets which have been tested and refined through decades of experience at the center of global derivatives markets. Use what we use.

GS Quant

Jupyter Notebook In Action

Build instrument and portfolios

```
[ ]: # solving for 0 cost strike
# buy 1x atmf payer, sell 2x atmf-X payer
leg1 = IRSwapion('Pay', '30y', 'USD', notional_amount=10e6, strike='atmf', expiration_date='6m', buy_sell='Buy')
leg2 = IRSwapion('Pay', '30y', 'USD', notional_amount=20e6, strike='{}pv'.format(leg1.price()), expiration_date='6m', buy_sell='Sell')

portfolio = Portfolio((leg1, leg2))
```

Apply scenarios, price trades, and compute risk

```
[ ]: with PricingContext(market=LiveMarket(PricingLocation.NYC)):
    results = portfolio.calc((DollarPrice, IRDelta(aggregation_level=AggregationLevel.Type, currency='local')))

    carry_scenario = RollFwd('21b', realise_fwd=False)
    with carry_scenario:
        results_carry = portfolio.calc(DollarPrice)
```

Backtest strategies

```
[ ]: start_date = date(2021, 6, 1)
end_date = datetime.today().date()
call = FXOption(buy_sell=BuySell.Buy, option_type=OptionType.Call, pair='USDJPY', strike_price='ATMF', expiration_date='2y', name='2y_call')
freq = '1m'
trig_req = PeriodicTriggerRequirements(start_date=start_date, end_date=end_date, frequency=freq)
actions = AddTradeAction(call, freq)
triggers = PeriodicTrigger(trig_req, actions)
strategy = Strategy(None, triggers)

# run backtest daily
GE = GenericEngine()
backtest = GE.run_backtest(strategy, start=start_date, end=end_date, frequency='1b', show_progress=True)
```

Data analytics

```
[ ]: start_date = datetime.date(2005, 8, 26)
end_date = datetime.date.today()

fx_pairs = ['USDJPY', 'EURUSD', 'AUDUSD', 'AUDJPY', 'USDNOK', 'GBPUSD', 'USDCAD', 'NZDUSD', 'USDSEK', 'USDCHE']
fx_spot = Dataset('FXSPOT_PREMIUM').get_data(start_date, end_date, bbid=fx_pairs, location='NYC')
fx_spot = pd.pivot_table(fx_spot, values='spot', index=['date'], columns=['bbid'])
```

Legend

Overview: legend.finos.org



 [Github](#) [Docs](#)

What is

A flexible platform that offers solutions to explore, define, connect, and integrate data into your business processes. Getting access to timely, accurate, and complete data is becoming increasingly more difficult to achieve. *Why?*

- The amount, speed, and complexity of information is exploding exponentially.
- Businesses often operate within data silos limiting opportunities to collaborate, connect, and communicate efficiently.
- Data inventories are not well understood due to a lack of meaningful metrics such as usage and information flow.

The Legend platform aims to provide solutions to these challenges.

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Business

Goldman Sachs Open Sources its Data Modeling Platform through FINOS

October 19, 2020, 5:03 AM EDT

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Open Source Database Contribution Addresses Data Efficiency and Governance Challenges in the Financial Services Industry

NEW YORK, NY / ACCESSWIRE / October 19, 2020 / The Fintech Open Source Foundation ("FINOS"), together with platform vendor Goldman Sachs (GS), today announced the launch of Legend, Goldman's flagship data management and data governance platform, developed internally and used by both engineers and non-engineers alike across all divisions of the bank, the source code for five of the platform's modules have today been made available as open source within FINOS.

Today's launch comes on the heels of the completion of a six-month pilot in which other leading investment banks, such as Deutsche Bank, Morgan Stanley and RBC Capital Markets, used a shared version of Legend, hosted on FINOS infrastructure in the public cloud, to prototype interbank collaborative data modeling and standardization, in particular to build extensions to the Common Domain Model (CDM), developed by the International Swap and Derivatives Association (ISDA). This shared environment is now, starting today, generally available for industry participants to use and build models collaboratively. With the Legend code now available as open source, organizations may also launch and operate their own instances. The components open-sourced today allow any individual and organization across any industry to harness the power of Goldman Sachs' internal data platform for their own data management and governance needs as well as contribute to the open code base.

"Legend provides both engineers and non-engineers a single platform that allows everyone at Goldman Sachs to develop data-centric applications and data-driven insights," said Aste Lehtiranta, chief technology officer at Goldman Sachs. "The platform allows us to serve our clients better, automate some of the most difficult data governance challenges, as well as provide self-service tools to democratize data and analytics. We anticipate that the broad adoption of Legend will bring real, tangible value for our clients as well as greater standardization and efficiency across the entire financial services ecosystem."

"Information is the lifeblood of financial services, but it is becoming increasingly more difficult to ensure you have accurate, complete and timely information," said Nimesh Rajgopal, chief data officer and head of data engineering at Goldman Sachs. "Over the last seven years, Goldman Sachs has been developing, in the form of the Legend platform, a new way to provide fast, easy, secure access to our information for revenue generation, better client service, operational efficiency and regulatory compliance. We believe this new data platform is as powerful and important that we are making it available to our clients and the world fully open and free of charge as an open source platform through FINOS."

The Legend platform and language were together known as "Alloy" and "PURE"

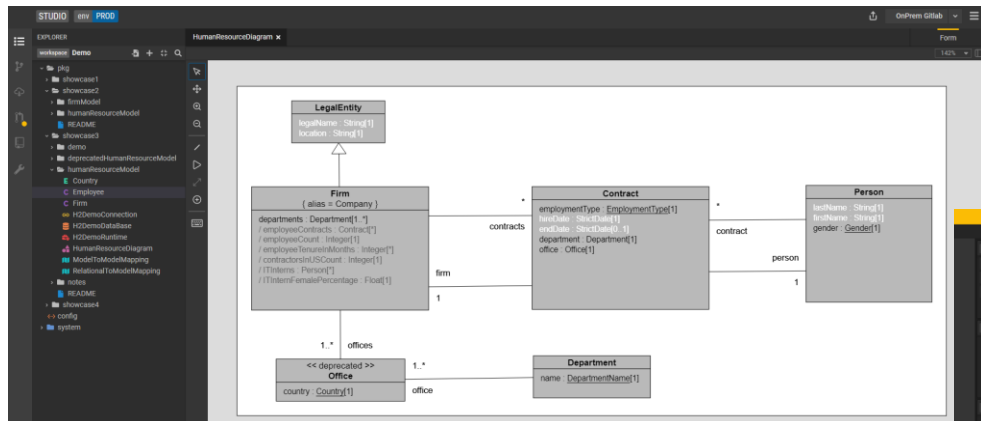


Gain a deeper understanding of the cloud security vendor landscape

[Get the White Paper](#)

Legend

Modeling Platform



The screenshot shows the Legend Modeling Platform interface. On the left, there is a tree view of the model structure. The main area displays a table with columns for Legal Name, Employee's Full Name, and Employee's Country. The table contains data for various entities, including Firm, Person, and Office. The interface also includes a search bar, a filter button, and a table view selector.

Legal Name	Employee's Full Name	Employee's Country
PMCO	Person A	USA
PMCO	Person B	UK
PMCO	Person C	USA
UNILEVER FOUNDATION	Person D	USA
UNILEVER FOUNDATION	Person E	USA
UNILEVER FOUNDATION	Person F	UK



Legend

Online Resources



- **Documentation Site:** <https://legend.finos.org/>
- **GitHub:** <https://github.com/finos/legend>
- **Getting started:** <https://legend.finos.org/docs/getting-started/getting-started-guide>
- **Contribute:** <https://legend.finos.org/docs/contribute/contribute-to-legend>
- **Working Groups:** <https://legend.finos.org/docs/contribute/contribute-to-legend#contribute-to-models>
- **Stats:** https://insights.lfx.linuxfoundation.org/projects/finos%2Flegend/dashboard;quicktime=time_filter_3Y