

Welcome to FinTech!

FinTech
Lesson 1.1



WELCOME



Class Objectives

By the end of today's class, you will:



Get to know the instructional team as well as each other.



Become familiar with the course format and requirements for certification.



Review the course topics and agenda.



Be able to explain what FinTech is.



Review the completion and submission guidelines for the Unit 1 homework assignment.

Defining FinTech

What exactly *is* FinTech?





FinTech is the combination of finance and technology. More specifically, it describes a **financial services industry** that has been disrupted by **technological innovation** that competes with traditional **financial methods** and **improves activities and inefficiencies** in finance.

What Is FinTech?

The broader FinTech category can be segmented into four variants.

Origin	Technology	Infrastructure providers seeking to help financial institutions digitize and modernize their technology stacks. Examples: FNZ, Marqeta, Onfido	Large technology ecosystems using financial services to strengthen relationships with users. Examples: Apple, Ant Financial, Tencent
	Financial Services	New entrants, start-ups, and attackers seeking to enter financial services using new technologies. Examples: SoFi, TransferWise, LendingClub	Incumbent financial institutions making significant investments in technology to lift their game. Examples: Wells Fargo, Ping An
	Scale		Low (small scale) High (large scale)

What Is FinTech?

Rapid advancements emphasize FinTech's importance and creates jobs.

1

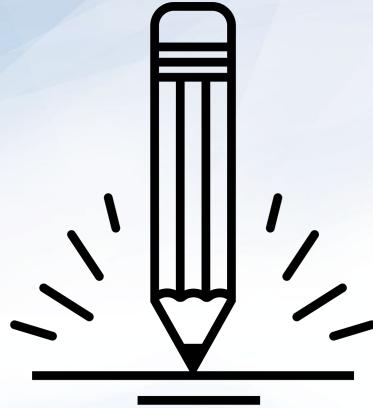
Why is FinTech so important?

- Rapid advancements have bolstered smaller companies' ability to innovate.
- Larger, traditional firms have been forced to compete and upgrade their tech.
- This has created high demand and a need for skilled technical workers.

2

What types of FinTech careers exist?

- FinTech careers are the implementation of technology within the financial domain.
- As such, careers are largely similar to any in the IT industry.
- Possibilities include:
 - General data analyst
 - Data/software engineer
 - Data Scientist



Activity: FinTech and Me

In this activity, you will reflect on what FinTech means to you.

(Instructions sent via Slack.)

Suggested Time:
5 Minutes





Time's Up! Let's Review.

Course Overview

Curriculum Overview

Intro to FinTech

First, you'll learn about the fundamental priorities of investment banks, traders, insurance agencies, and other players in the financial industry. You will also learn about the command line and GitHub to prepare for future programming assignments.

Python and Financial Programming

Next, you'll learn Python programming, focusing in depth on the core libraries relevant to finance work. You will use APIs like Quandl to add live financial data feeds to your software projects. You'll also use a variety of analytic tools to extract insights and create reports.

Curriculum Overview

Algorithms, Statistics, and Machine Learning

You will learn a variety of core algorithms, models, and forecasting tools, including Monte Carlo simulations, risk-data aggregation, portfolio theory, and regression. You'll draw on this background as you apply machine learning concepts to financial challenges.

Advanced Topics: Big Data and Blockchain

The course will end with deep coverage of the big data and blockchain toolchains. You will use Python to complete challenges that involve building and using these toolchains for financial and regulatory benefit.

Curriculum Breakdown by Week

Unit 1: Intro to FinTech

- 1. Intro to FinTech and Finance

Units 2–7: Python for Finance Deep Dive

- 2. Python Basics
- 3. Python and Pandas + Review Day
- 4. Pandas + Review Day
- 5. APIs
- 6. Data Visualization
- 7. SQL

Units 8–9: Project Work

- 8. Project 1
- 9. Project 1 (continued)

Units 10–15: Applied Machine Learning

- 10. Time Series Analysis
- 11. Classification
- 12. Natural Language Processing
- 13. AWS and Cloud ML
- 14. Deep Learning and Robo Advisors
- 15. Algorithmic Trading

Units 16–17: Project Work

- 16. Project 2
- 17. Project 2 (continued)

Units 18–22: Blockchain Deep Dive

- 18. Intro to Blockchain
- 19. Interacting with Blockchains in Python
- 20. Intro to Solidity & Smart Contracts
- 21. Advanced Solidity & Smart Contracts
- 22. Blockchain Application Development

Units 23–24: Project Work

- 23. Project 3
- 24. Project 3 (continued)

Core Program Modules

Python

Applied ML and AI

Blockchain / Cryptocurrency

Curriculum at a Glance

Week 1: You will be introduced to the world of FinTech and discuss the current financial landscape.

Weeks 2–7: You will learn the basics of Python and how to use additional libraries and tools such as Pandas, APIs, Plotly, and SQL databases, in the context of financial analysis.

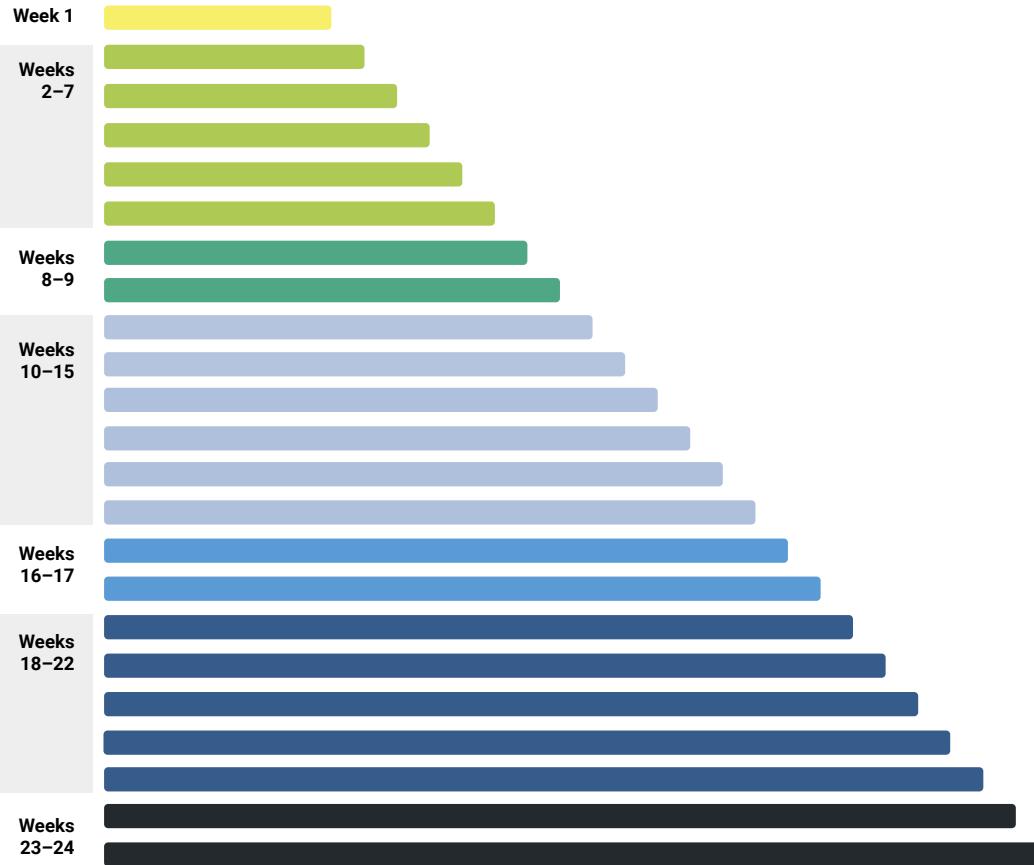
Weeks 8–9: You are tasked with your first project.

Weeks 10–15: Companies are becoming more data-driven in their decision making. Through machine learning, you will learn how to interpret and create financial models and automate the execution of such models. Topics include algorithmic trading, robo-advisory, time series analysis, risk management, and Cloud ML technologies.

Weeks 16–17: You are tasked with your second project.

Weeks 18–22: With its benefits of security, speed, and decentralized peer-to-peer validation, blockchain technology has already become more efficient than traditional finance in the context of transactions and third-party validation. You will learn blockchain fundamentals, smart contracts using Solidity, and how to develop blockchain applications on the popular Ethereum blockchain network.

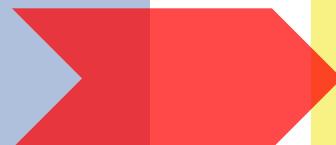
Weeks 23–24: You are tasked with your final project.



Hard Skills + Core Knowledge = *Real Jobs*

Skills/Technologies Covered

- Time Series Analysis
- Financial Ratios / Analysis
- Python Programming
- API Interactions
- Pandas
- NumPy / SciPy
- Pyfin
- Quant DSL
- SQL
- Monte Carlo Simulations
- Forecasting
- Modern Portfolio Theory
- Machine Learning
- Big Data
- Blockchain / Cryptocurrency



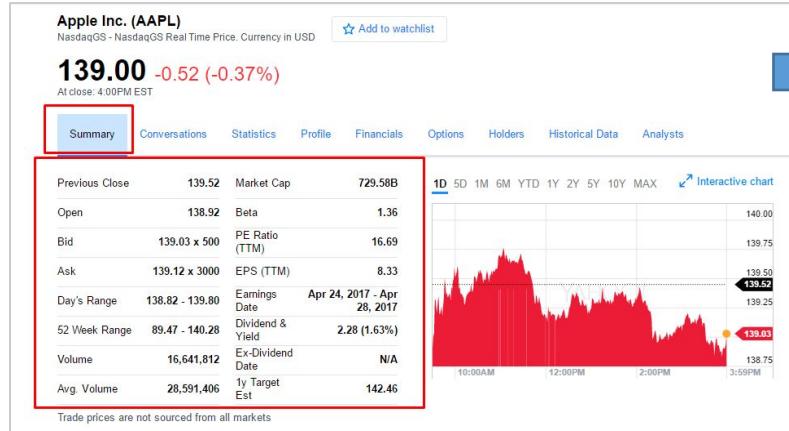
Relevant Jobs

- Business Analyst
- Financial Analyst
- Data Analyst
- Data Scientist
- Quantitative Trader
- Systems Business Analyst
- FinTech Regulatory Associate
- Software Developer
- Financial Manager
- Business Intelligence Analyst
- Cryptocurrency Expert
- Blockchain Developer

Sample Homework Assignments

Sample Assignment: Risky Business (APIs and Statistics)

You will learn to create *live* applications that draw stock data using the **financial APIs** to power Jupyter notebooks to analyze stock movement.



```
Run the Monte Carlo Simulation and Save it to DataFrame
In [8]: # Set number of simulations, trading days, and last closing price of AAPL from DataFrame
num_simulations = 1000
num_trading_days = 1000
df = pd.read_csv('AAPL.csv')
df['close'] = df['close'].tail(1)
# Initialise empty DataFrame to hold simulated price for each simulation
simulated_prices_df = pd.DataFrame()
# Run a simulation of predicting stock price for the next trading year, '1000' times
for i in range(num_simulations):
    # Initialise the simulated prices list with the last closing price of AAPL
    simulated_aapl_prices = [df['close'].values[-1]]
    # Simulate the previous day's return
    for j in range(num_trading_days):
        # Calculate the simulated price using the last price within the list
        simulated_aapl_prices.append(simulated_aapl_prices[-1] * (1 + np.random.normal(avg_daily_return, std_daily_return)))
    # Append the simulated price to the list
    simulated_aapl_prices.append(simulated_price)
# Append a simulated prices of each simulation to DataFrame
simulated_prices_df = pd.concat([simulated_prices_df, simulated_aapl_prices], axis=1)
# Print head of DataFrame
simulated_prices_df.head()
```

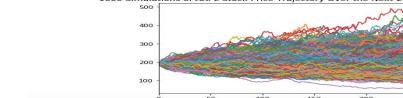
Out[8]:

	Simulation 0	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5	Simulation 6	Simulation 7	Simulation 8	Simulation 9	Simulation 10
0	190.150000	190.150000	190.150000	190.150000	190.150000	190.150000	190.150000	190.150000	190.150000	190.150000	190.150000
1	187.730611	184.203071	185.679694	189.393759	190.756362	188.733006	189.190426	186.253537	187.867401	185.006025	
2	186.724160	181.641180	182.017148	191.574346	195.208695	185.305713	189.701186	186.281182	187.183012	180.391162	
3	187.627603	183.654146	176.159603	191.549876	197.771148	182.422006	194.462152	185.288733	189.254590	180.61319	
4	186.838262	185.471081	175.401099	195.167248	199.563162	176.913988	194.359576	185.502599	194.739626	177.84529	

5 rows x 1000 columns

```
Plot the Multiple Simulations of Stock Price Trajectory for AAPL over the Next Year (252 Trading Days)
In [9]: # Use the 'plot' function to plot the trajectory of AAPL stock based on a 252 trading day simulation
plot_title = f'{(n+1)} Simulations of AAPL Stock Price Trajectory Over the Next 252 Trading Days'
simulated_prices_df.plot(legend=None, title=plot_title)
<matplotlib.axes._subplots.AxesSubplot at 0x1190e4d8>
```

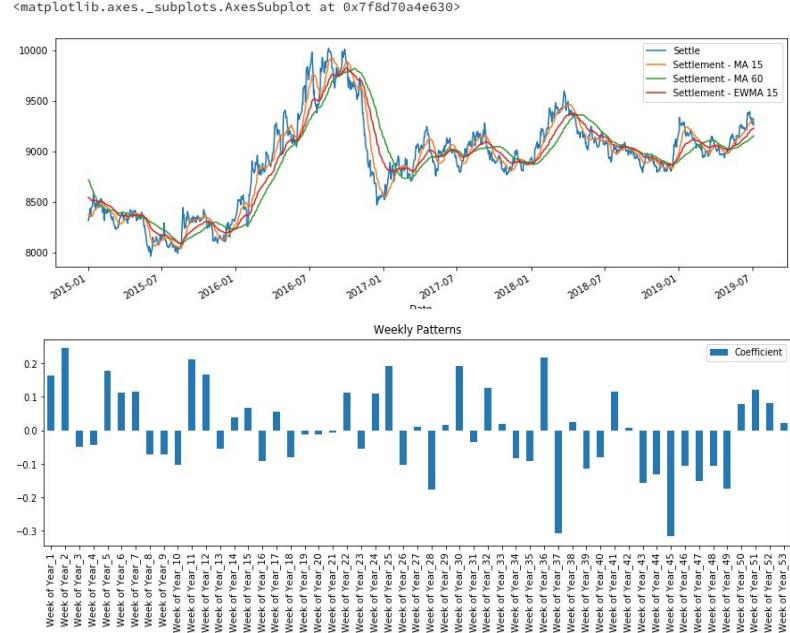
1000 Simulations of AAPL Stock Price Trajectory Over the Next 252 Trading Days



Sample Assignment: Stock Forecasting (Python & Time Series Analysis)

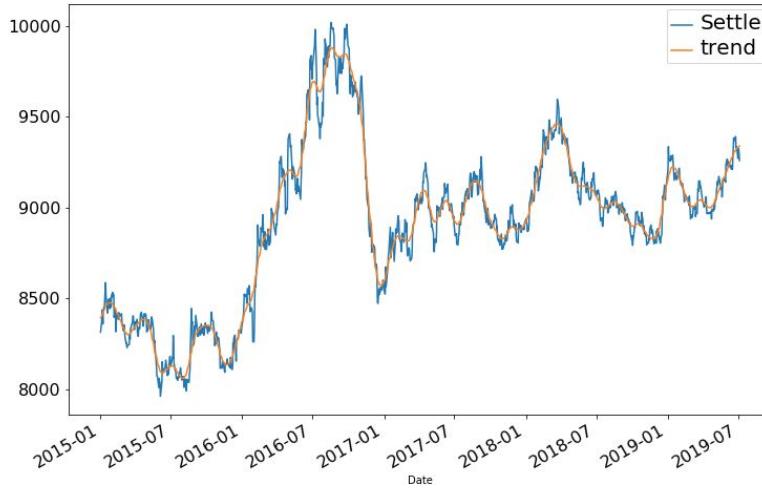
You will learn to create **predictive models** for stock prices using time series analysis and disparate variables.

Return Forecasting: MA/EWMA Smoothing of Futures Prices



Return Forecasting: Decomposition Using a Hodrick-Prescott Filter

Using a Hodrick-Prescott Filter, decompose the Settle price into a trend and noise.



Sample Assignment: Crypto Sentiment (Machine Learning)

Throughout the course, you will learn the basics behind the most common **machine learning techniques** (linear regression, logistic regression, KNN, k-means clustering, etc.) and how to apply these algorithms to classic challenges in the financial services sector, e.g., applying natural language processing to analyze sentiment scores for cryptocurrency news.

	Compound	Negative	Neutral	Positive	text
0	0.0516	0.900	0.036	0.064	Cryptocurrency exchange Binance has resumed tr...
1	0.3818	0.943	0.000	0.057	Bitcoin is now trading at around \$8,130, up a ...
2	-0.2263	0.888	0.065	0.047	Binance has vowed to raise the quality of its ...
3	0.3612	0.937	0.000	0.063	A new payment network called Flexa is launchin...
4	-0.6486	0.897	0.103	0.000	If you thought that the theft of 7,000 bitcoin...

Bitcoin NER

Cryptocurrency exchange **Binance PERSON** has resumed trading activity. Users can now cancel open orders, deposit crypto assets into their **Binance GPE** account, and of course buy and sell cryptocurrencies. You can't withdraw crypto assets to an external wallet just yet, but ... [+1191 chars]Bitcoin is now trading at **around \$8,130 MONEY**, up a whopping **60.84 percent PERCENT** over **the past month DATE**, with the price surging **\$ 3,086.14 MONEY** over the period.

The cryptocurrency's meteoric rise is reminiscent of its rocketing growth in **the latter half of 2017 DATE**, when prices reac... [+4311 chars]Binance has vowed to raise the quality of its security in the aftermath of a hack that saw thieves make off with over **\$40 million MONEY** in **Bitcoin GPE** from the exchange.

The company — which is widely believed to operate the world's largest crypto exchange based on ... [+2269 chars]A new payment network called **Flexa ORG** is launching **today DATE** that'll let you spend cryptocurrencies in physical stores. The technology currently supports bitcoin, ether, bitcoin cash, and the gemini dollar, and it'll work at retailers including **GameStop ORG**, **Nordstrom NORP**, ... [+1743 chars]If you thought that the theft of **7,000 CARDINAL** bitcoins from one of the world's biggest crypto exchanges would stop **Bitcoin GPE**'s price in its tracks, you were wrong.

On **Thursday DATE**, the price of **Bitcoin GPE** went above **\$ 6,000 MONEY** for the **first ORDINAL** time since **November last year DATE**. At th... [+1729 chars]Quadratic.io, a startup founded by some of the folks behind the once-secretive bitcoin mining operation 21E6, has raised **\$15 million MONEY** in a Series A round that will fund the development of a supercomputer designed for autonomous systems.

The round was led by ... [+3424 chars]A **Europol PERSON**-led police operation has arrested **three CARDINAL** people who allegedly ran the Wall Street Market, supposedly the world's **second ORDINAL**-largest "dark web" marketplace. Authorities also seized the site's servers and **more than €550,000 MONEY** (**around \$615,000 MONEY**)

Tips

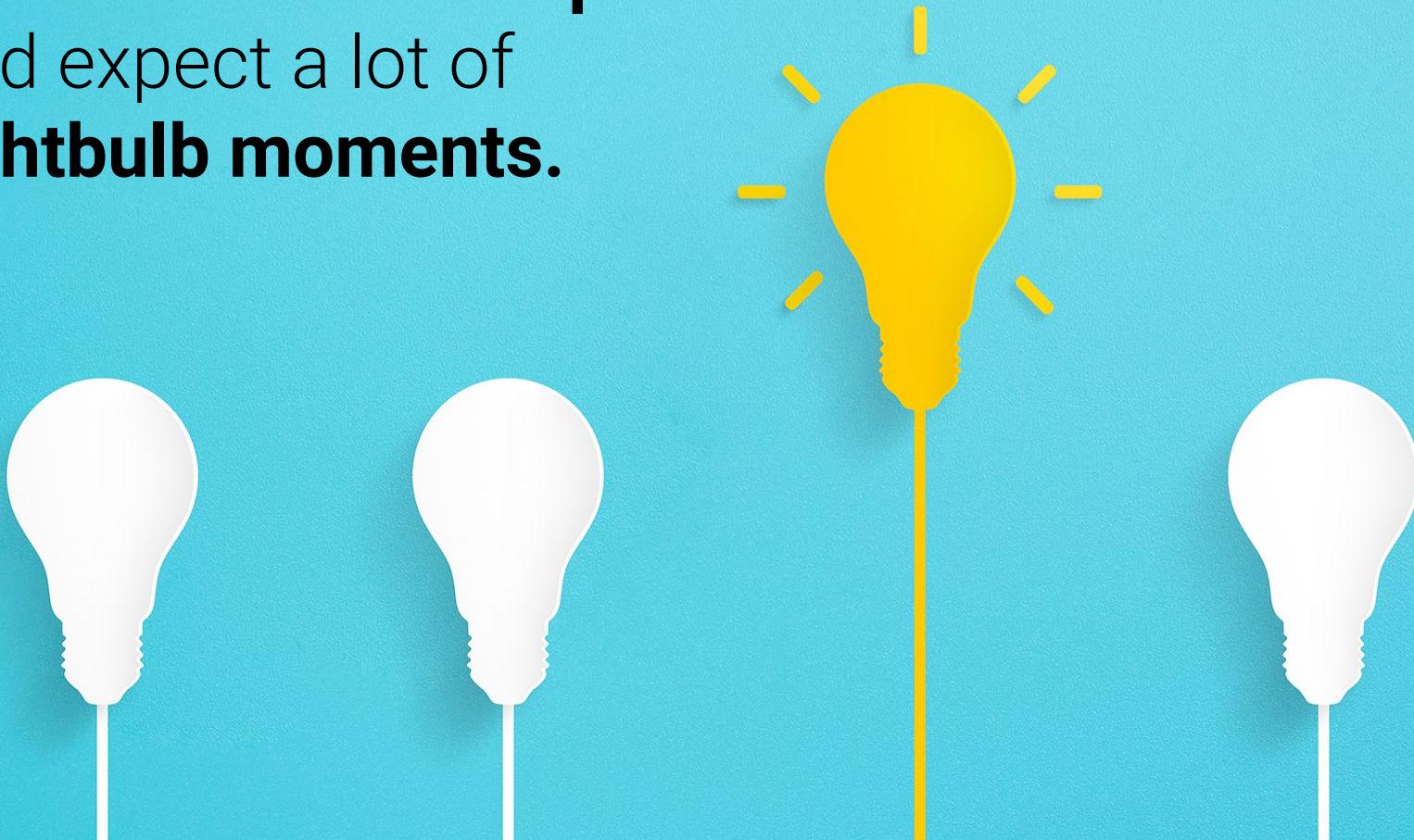
A close-up photograph of a baby with light blue eyes and a wide-open mouth, wearing a bright pink zip-up jacket. The baby's hands are pressed against a dark, water-dappled surface, likely a window. The background is dark and textured.

Embrace your
inner toddler.

Brace yourself for **doubt**,
challenge, and **confusion**.



Relish the **novice experience**
and expect a lot of
lightbulb moments.



Form a **community** with your classmates.

You and your classmates are in this process together. Use each other for help!

You all bring value to the table.
Don't be afraid to speak up!



There is no shortcut.

You've got to **put in the hours!**





Celebrate
your successes!



Break



Countdown timer

15:00

(with alarm)



**What was the
finance world like
in 1999?**



Activity: Rip Van Winkle

Rip Van Winkle is the story of a man who fell asleep right before the events of the American Revolution. He woke up 20 years later to find the world completely changed.

In this thought experiment, you will imagine what it would be like if Rip Van Winkle was a financial analyst who fell asleep in 1999 and woke up 20 years later.

Suggested Time:
10 Minutes



Activity Instructions: Rip Van Winkle

Apply the Rip Van Winkle story to FinTech by imagining if a financial analyst fell asleep in the year 1999 and woke up today. What would he or she find most surprising about the current finance world?



Define areas of finance that have been deeply affected by technology.



Name specific companies, products, or innovations that would be surprising to a financial analyst from 1999.

Suggested Time: 10 Minutes



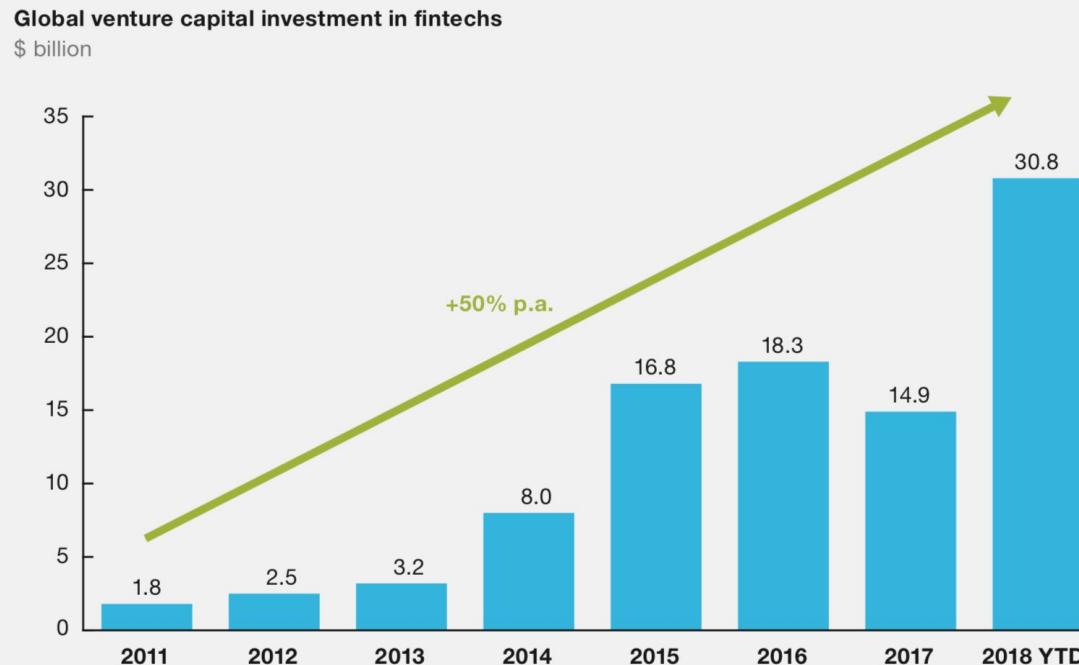


Time's Up! Let's Review.

The Rise of FinTech

Global FinTech Investment Growth

FinTech investment has shown dramatic growth in recent years.



Source: CB Insights; McKinsey analysis

FinTech Canadian Startups Market Map

Since 2015, startups are disrupting in different sectors of the FinTech realm.





Why is FinTech such a **hot** field of study these days?

The Driving Forces of FinTech

FinTech is driven by the same trends that dominate software and consumer technology.

Driving Technologies

Artificial Intelligence

Machine Learning

Big Data

Blockchain

Cryptocurrency

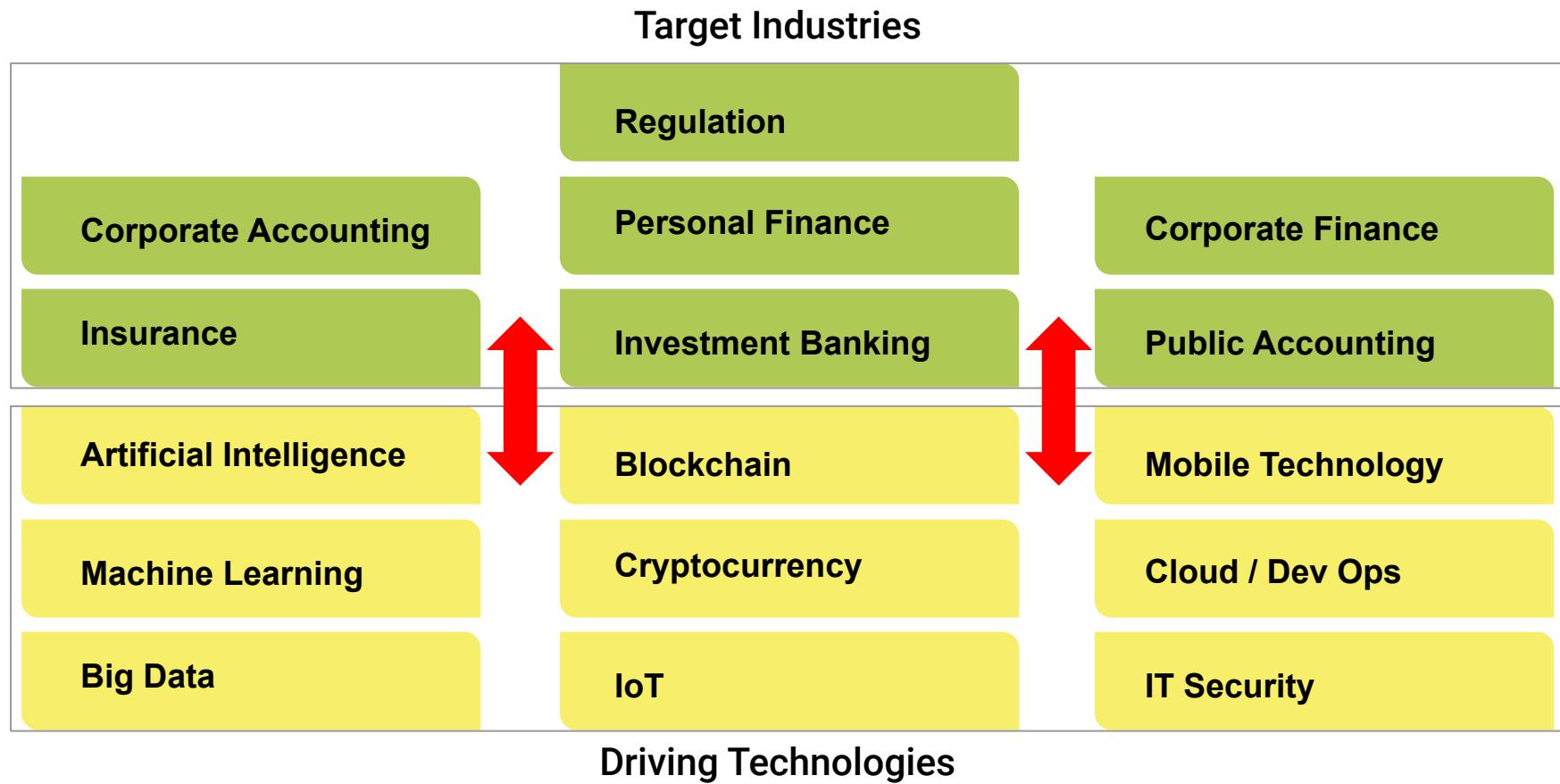
IoT

Mobile Technology

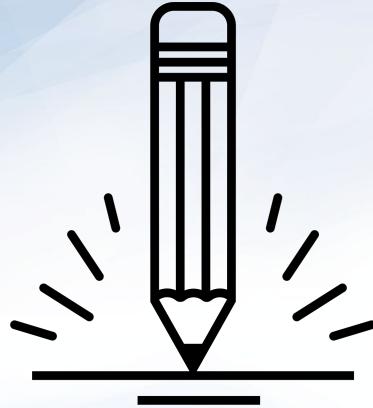
Cloud / Dev Ops

IT Security

The Driving Forces of FinTech



FinTech Thought Experiments



Activity: Alpacalypse Now

In this activity, you will work in groups to define and articulate the challenges faced by the Altruistic Alpacas charity. You will then pitch a solution to Altruistic Alpacas based on your group's brainstorm.

Suggested Time:
15 Minutes



Activity: Alpacalypse Now

The Client:

Altruistic Alpacas is a charitable organization based in Vulcan, Alberta.

Its mission is to provide alpacas to impoverished areas of the world by empowering people to donate them directly to farmers.

Alpacas provide fiber (wool/yarn), milk, and leather, and are a phenomenal way to provide relief to areas of the world that need it.

In the past few months, Altruistic Alpacas has generated a lot of buzz, and donations have started to pour in.



Activity: Alpacalypse Now

The Situation:

Altruistic Alpacas has a great mission and lots of buzz, but no plan to execute.

While they received a lot of initial donations, they had no clear system for sending alpacas to the correct locations. Donations are being returned to their office in Vulcan! Alpacas are literally piling up in the office, spitting on the interns, and eating all the donuts!

Additionally, donors have no way of knowing if their alpaca was actually delivered. Recipients have no clear global marketplace to sell alpaca wool, and Altruistic Alpacas has not established a system for monitoring the impact of its work.

Altruistic Alpacas is on the brink of collapse!



Activity: Alpacalypse Now

Your Mission:

Altruistic Alpacas has asked your group to analyze their key problem areas and offer potential solutions to their problems.

In your groups, you will:

- Discuss the five key problems facing Altruistic Alpacas (on next slide).
- Brainstorm potential solutions.
- Give a quick pitch of your analysis and solutions to Altruistic Alpacas (aka, the rest of the class).

Activity: Alpacalypse Now

The Need: Altruistic Alpacas is looking to solve **FIVE** key problems that currently jeopardize their organization.

1. Where should the alpacas be sent in order to do the most good?
2. How does the charity purchase alpacas with donation money? What would be different if it purchased the animals near the local economies?
3. How can the charity ensure that the alpacas arrived at the correct destinations?
4. Where can the recipients of alpacas sell alpaca wool?
5. Did the alpaca donations actually have a positive impact?

With your group, analyze these five key areas and identify the technical and financial challenges associated with each problem. Be ready to pitch potential solutions to Altruistic Alpacas!



Time's Up! Let's Review.



Review Alpacalypse Now

Analyze the Need

(Where should we send the alpacas?)

Step 1: Identify Data Sources

Websites like IMF Data (International Monetary Fund Data) provide economic data and indicators that cover banking, business, consumer price indexes, employment, population, GDP, and more.

The screenshot shows the IMF's data access portal. At the top, the IMF logo and "INTERNATIONAL MONETARY FUND" are displayed, along with "SIGN IN OR REGISTER" buttons. Below the header, a navigation bar includes links for IMF.ORG, ELIBRARY, BOOKSTORE, MCM DATA, DATASETS, DATA TOPICS, and HELP. A search bar with a "GO" button is also present. The main content area features a banner for the "Regional Economic Outlook: Sub-Saharan Africa (AFR REO)" report, dated October 2019. To the right, a sidebar titled "Featured Data" lists various publications: World Economic Outlook, International Financial Statistics, Global Financial Stability Report, Fiscal Monitor, and Regional Outlooks. A "Data Release Calendar" section is shown at the bottom right. The central content area is divided into sections: "Data by Country/Economy" (with a "Country" button), "Popular Datasets" (listing Balance of Payments and International Investment Position, Coordinated Direct Investment Survey, etc.), "Data by Indicator" (listing Key Indicators in Predefined Data Tables, International Financial Statistics, Exchange Rates incl. Effective Fx. Rates), and "Work with IMF Data" (listing Bulk Download or Application Programming Interface (API) for all published IMF Data by Dataset).

Step 1: Identify Data Sources

World Bank Open Data
Free and open access to global development data

Search data e.g. GDP, population, Indonesia

Browse by [Country](#) or [Indicator](#)

MOST RECENT

World's population will continue to grow and will reach nearly 10 billion by 2050 ↗
E. Suzuki, Jul 08, 2019

Harnessing the power of data so no child is left behind ↗
O. Fiala, Jul 08, 2019

New country classifications by income level: 2019-2020 ↗
World Bank Data Team, Jul 01, 2019

Chart: 47 million people are connected to a mini grid ↗
View all news ↗ View all blogs ↗

WHAT YOU CAN LEARN WITH OPEN DATA

Poverty headcount ratio at \$1.90 a day (2011 PPP) (% of population)

Data from World Bank

Extreme Poverty

The proportion of the world's population living in extreme poverty has dropped significantly

THE NEW
World Development Indicators

World Development Indicators ↗

Oct 29, 2018



Lots of Data!

Step 2: Build a Data Retrieval Plan

We could retrieve this data by brute force, but it would be:



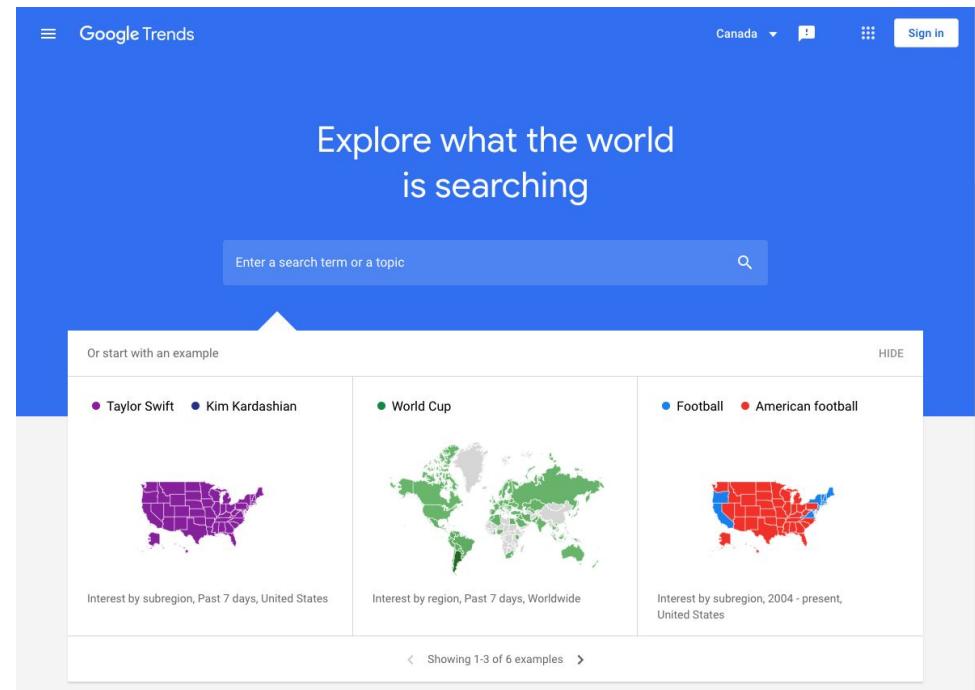
Extremely time consuming



Skewed by our city familiarity

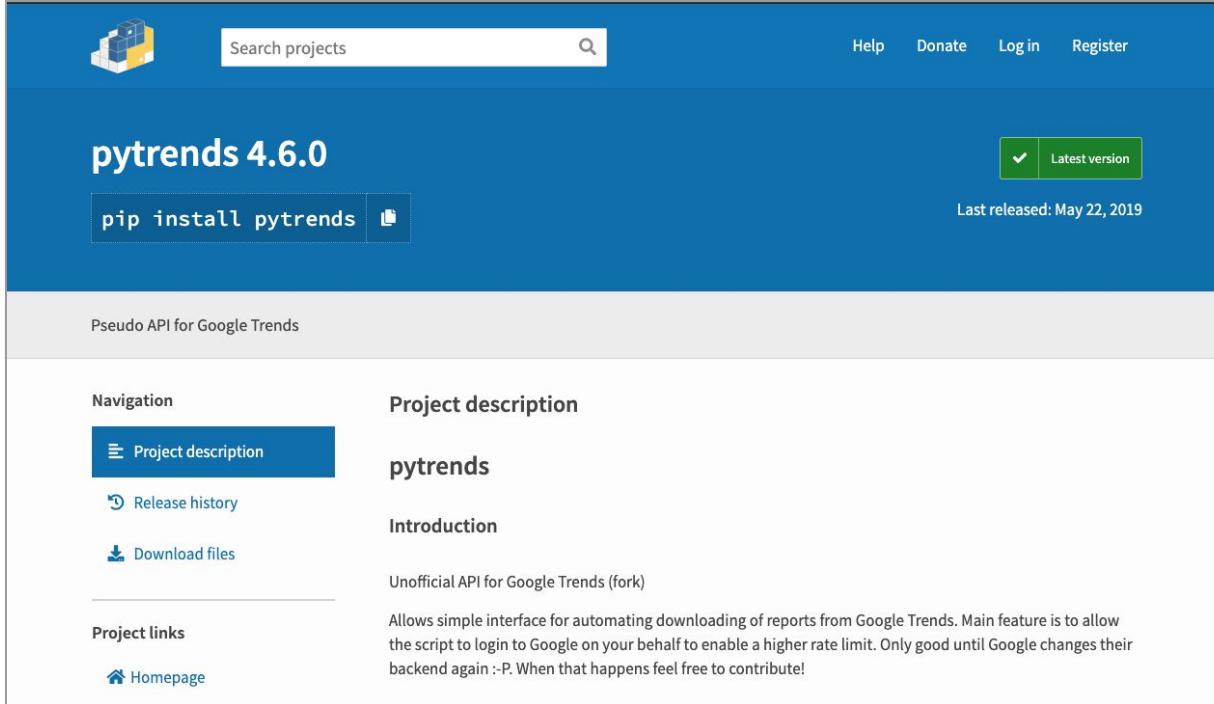


Labor intensive



Step 2: Build a Data Retrieval Plan

Thankfully, we can take advantage of the pytrends API to programmatically run our queries. (#ThankGoodnessForProgramming)



The screenshot shows the PyPI project page for 'pytrends' version 4.6.0. The top navigation bar includes a search bar, 'Help', 'Donate', 'Log in', and 'Register' links. A prominent green button labeled 'Latest version' with a checkmark is visible. Below the header, the project name 'pytrends 4.6.0' is displayed, along with a 'pip install pytrends' command and a download link. A message indicates the last release was on May 22, 2019. The main content area is titled 'Pseudo API for Google Trends'. On the left, a sidebar lists 'Navigation' items: 'Project description' (which is currently selected), 'Release history', 'Download files', and 'Homepage'. The 'Project description' section contains the project title 'pytrends', a brief introduction, and a note about it being an 'Unofficial API for Google Trends (fork)'. It also mentions that the script allows logging into Google on behalf of the user to increase the rate limit.

pytrends 4.6.0

pip install pytrends

Last released: May 22, 2019

Pseudo API for Google Trends

Navigation

Project description

pytrends

Introduction

Unofficial API for Google Trends (fork)

Allows simple interface for automating downloading of reports from Google Trends. Main feature is to allow the script to login to Google on your behalf to enable a higher rate limit. Only good until Google changes their backend again :-P. When that happens feel free to contribute!

Project links

Homepage

Step 3: Retrieve the Data with Python

```
In [3]: # Create payload and capture API tokens. Only needed for interest_over_time(), interest_by_region() & related_queries()
()
pytrends.build_payload(kw_list=['alpaca'])
```

```
In [4]: # Interest Over Time
interest_over_time_df = pytrends.interest_over_time()
interest_over_time_df.head()
```

Out[4]:

	alpaca	isPartial
date		
2014-07-13	50	False
2014-07-20	53	False
2014-07-27	49	False
2014-08-03	52	False
2014-08-10	52	False



This funky code will search Google trends for “alpacas” and return the data...

Step 4: Assemble and Clean the Data

```
In [7]: # Interest by Region  
interest_by_region_df = pytrends.interest_by_region(resolution='COUNTRY', inc_low_vol=True, inc_geo_code=False)  
print(interest_by_region_df.head())
```

```
alpaca  
geoName  
Afghanistan      0  
Albania          4  
Algeria          1  
American Samoa   0  
Andorra          0
```

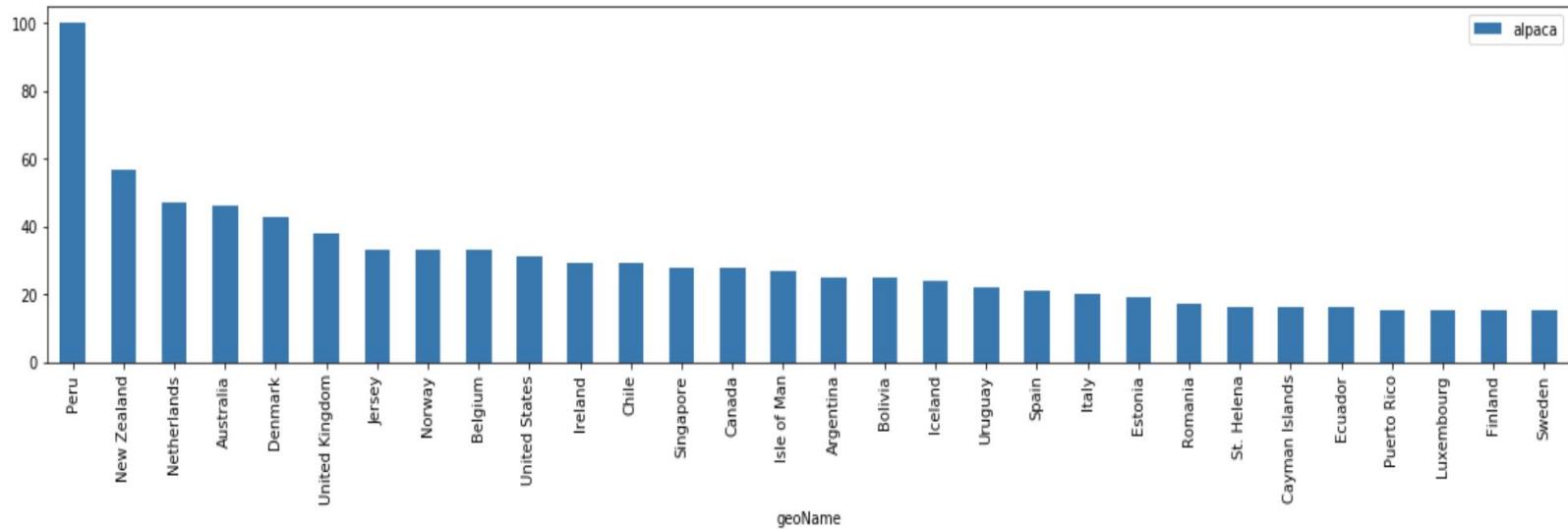


...which we can clean up, and then group results by country...

Step 5: Analyze for Trends

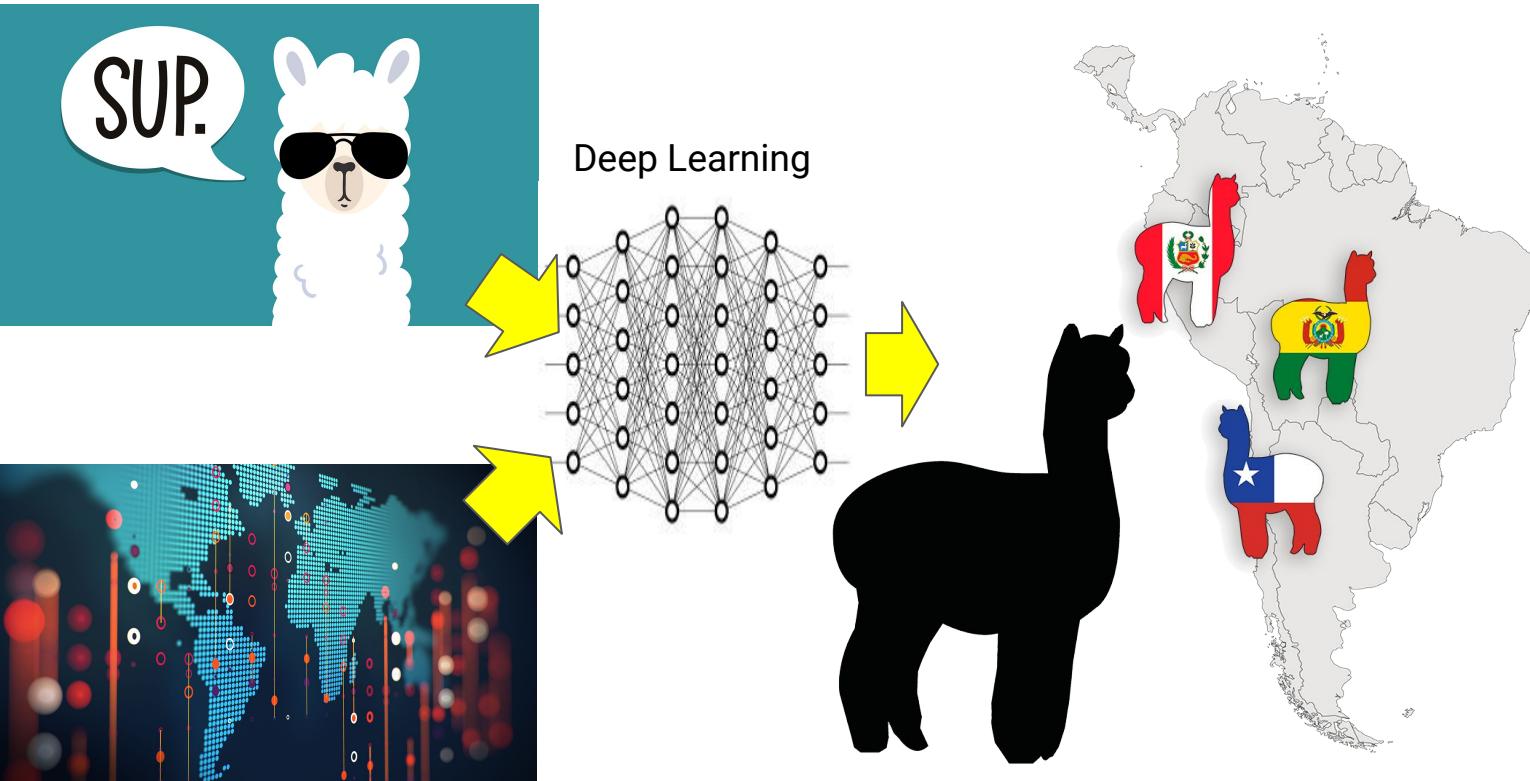
```
In [20]: interest_by_region_df.sort_values(by='alpaca', ascending=False)[0:30].plot(kind='bar', figsize=(20, 4), sort_columns=True)
```

```
Out[20]: <matplotlib.axes._subplots.AxesSubplot at 0x122a21240>
```



Finally, we can visualize the trends to see that Peru is the best location based on search trends. Obviously, there are other factors to consider, but we are rolling with this for now!

Bonus: Apply Machine Learning!



We could also apply machine learning to convert economic factors into probable locations.

More Money, More Problems

(How do we purchase animals with donation money?)

Cross-Border and Localized Payments

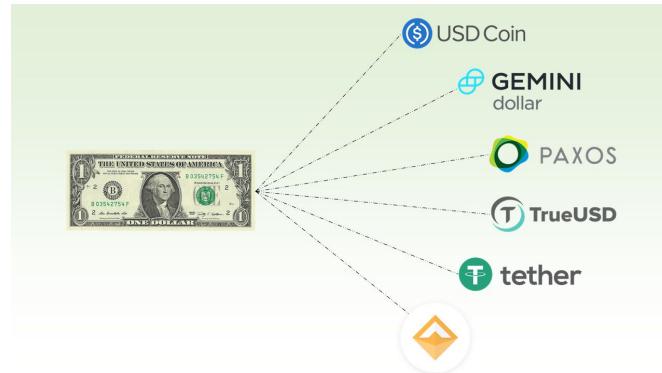
How do we move money easily in places where banking infrastructure is not stable?



Cryptocurrencies have provided a way to easily move value between borders. This is valuable in environments where the financial infrastructure is either unstable or nonexistent.



Stablecoins have provided a way to use blockchain technology without volatility.

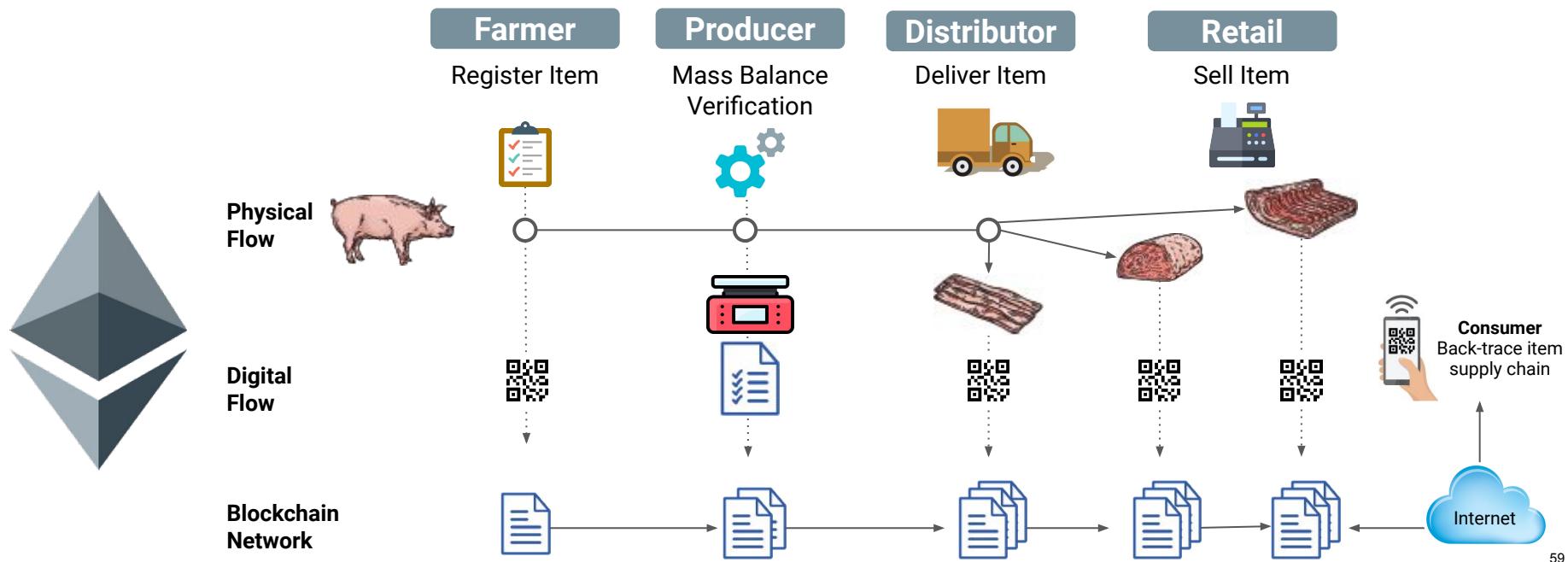


Alpaca Your Bags

(Did the animal arrive at the destination?)

Blockchain Logistics

We can address accountability, governance, transparency, and efficiency with cutting-edge Deri technology.
By targeting the supply chain and leveraging blockchain technology, we can trace the impact of the strategy from the initial donation to the event itself.



Wool You Buy This?

(How does the recipient sell the alpacas' wool?)

Mobile and Online Merchants

Using DeFi technologies, anyone, anywhere, can become their own merchant and be their own bank.



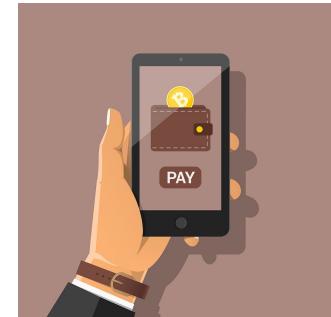
By creating an online marketplace, wool harvests can be sold cross-border and locally without any intermediaries.



Anyone can become their own merchant with just a cell phone.



This enables new economic activity and encourages market growth.



Shear Scale of Impact

(Did the donation actually help?)

Analyzing Socioeconomic Impact

We can use similar techniques to examine the effectiveness of the charity.

Analyze Wool Sales in the Region



Analyze Economic Indicators



Tracking Transactions

By leveraging DeFi technologies, you can examine blockchain data and analyze the transaction flow.



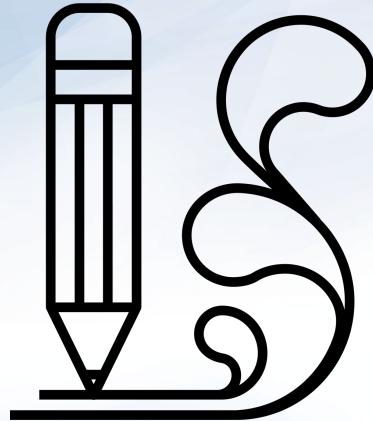
You can analyze volume and transaction flow in the region with the wool purchases from the online and peer-to-peer markets.



Proof can be embedded into the transaction.



Transactions			
Tx	0x840bcc... 54 secs ago	From 0xf3630c948c8bc62... To 0x68b0db0337d421...	0 Eth
Tx	0xa5ccb87c15... 54 secs ago	From 0xde253c56e3f4fba... To 0x4bcba674eec03d...	0 Eth
Tx	0x3c838d2f67... 54 secs ago	From 0x1d7e1445cd9a30... To 0xe22160dad38907...	0.15 Eth
Tx	0xefdcb0fef1d... 54 secs ago	From 0x761c4412ff0864e... To 0x4dd672e77c7958...	0 Eth
Tx	0xb514a72c51... 54 secs ago	From 0x0e95f8f8ecbd770... To 0x8fdcc30eda7e94f...	0 Eth
Tx	0x96a08f02d6... 54 secs ago	From 0x0e95f8f8ecbd770... To 0x8fdcc30eda7e94f...	0 Eth
View All Transactions			



Homework: FinTech Case Study

In this homework assignment, you will develop a case study for a particular FinTech company or technology.

(Instructions sent via Slack.)

Due Date:
August 31st



Questions?

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End*