



## Artificial Intelligence for Fintech, Green Finance, and ESG

Time: 2022/12/12 (Mon) 14:00-16:00 Place: Room 106, New Building, Institute of Information Science, Academia Sinica Host: Prof. Yu Tsao, TIGP (SNHCC), Academia Sinica



#### Min-Yuh Day, Ph.D,

#### **Associate Professor**

Institute of Information Management, National Taipei University

https://web.ntpu.edu.tw/~myday

2022-12-12





### Min-Yuh Day, Ph.D.



aws	academy
	acaaciii

Accredited Educator



#### Associate Professor, Information Management, NTPU Visiting Scholar, IIS, Academia Sinica Ph.D., Information Management, NTU

Director, Intelligent Financial Innovation Technology, IFIT Lab, IM, NTPU

**Director, Fintech and Green Finance Center, NTPU** 

Publications Co-Chairs, IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2013- )

Program Co-Chair, IEEE International Workshop on Empirical Methods for Recognizing Inference in TExt (IEEE EM-RITE 2012- )

Publications Chair, The IEEE International Conference on Information Reuse and Integration for Data Science (IEEE IRI 2007-)









## Outline

- Al in FinTech
  - Metaverse, Web3, DeFi, NFT
  - Financial Services Innovation and Applications
  - Technology-driven Financial Industry Development
- Green Finance and ESG
  - SDGs: Sustainable Development Goals
  - ESG: Environmental, Social, and Governance
  - CSR: Corporate Social Responsibility
- AI for Social Good (AI4SG)

NTCIR IMNTPU at the NTCIR-16 FinNum-3 Task: Data Augmentation for Financial Numclaim Classification





**∆zeois** 

Yung-Wei Teng<sup>1</sup>, Pei-Tz Chiu<sup>1</sup>, Ting-Yun Hsiao<sup>1</sup>, Mike Tian-Jian Jiang<sup>2</sup> and Min-Yuh Day<sup>1,\*</sup>

<sup>1</sup> Information Management, National Taipei University, New Taipei City, Taiwan

<sup>2</sup> Zeals Co., Ltd. Tokyo, Japan myday@gm.ntpu.edu.tw

This paper provides a detailed description of IMNTPU team at the NTCIR-16 FinNum-3 shared task in formal financial documents. We proposed the use of the XLM-RoBERTa-based model with two different approaches on data augmentation to perform the binary classification task in FinNum-3. The first run (i.e., IMNTPU-1) is our baseline through the fine-tuning of the XLM-RoBERTa without data augmentation. However, we assume that presenting different data augmentations may improve the task performance because of the imbalance in the dataset. Accordingly, we presented double redaction and translation method on data augmentation in the second (IMNTPU-2) and third (IMNTPU-3) runs, respectively. The best macro-F1 scores obtained by our team in the Chinese and English datasets are 93.18% and 89.86%, respectively. The major contribution in this study provide a new understanding toward data augmentation approach for the imbalanced dataset, which may help reduce the imbalanced situation in the Chinese and English datasets.



Information Management, National Taipei University 🗸 🖉 🗮 🗮 🗮

2022 NTCIR-16 **Best Oral Presentation Award Best Poster Presentation Award** 

NTCÍR

4







#### ∆zeals

#### IMNTPU at the NTCIR-16 FinNum-3 Task: Data Augmentation for Financial Numclaim Classification

<sup>1</sup> Information Management, National Taipei University, New Taipei City, Taiwan <sup>2</sup> Zeals Co., Ltd. Tokyo, Japan









Yung-Wei Teng<sup>1</sup> Pei-Tz Chiu<sup>1</sup> Ting-Yun Hsiao<sup>1</sup> Mike Tian-Jian Jiang<sup>2</sup> Min-Yuh Day<sup>1,\*</sup> <u>myday@gm.ntpu.edu.tw</u> NTCIR-16 Conference, June 14-17, 2022, Tokyo, Japan









#### IMNTPU Dialogue System Evaluation at the NTCIR-16 DialEval-2 Dialogue Quality and Nugget Detection

<sup>1</sup> Information Management, National Taipei University, New Taipei City, Taiwan <sup>2</sup> Zeals Co., Ltd. Tokyo, Japan



Ting-Yun Hsiao <sup>1</sup>







Hsiao<sup>1</sup> Yung-Wei Teng<sup>1</sup> Pei-Tz Chiu<sup>1</sup> Mike Tian-Jian Jiang<sup>2</sup> Min-Yuh Day<sup>1,\*</sup> <u>myday@gm.ntpu.edu.tw</u> NTCIR-16 Conference, June 14-17, 2022, Tokyo, Japan

# **Al for** Social Good (AI4SG)

Source: Nenad Tomašev, Julien Cornebise, Frank Hutter, Shakir Mohamed, Angela Picciariello, Bec Connelly, Danielle Belgrave et al. (2020) "AI for social good: unlocking the opportunity for positive impact." Nature Communications 11, no. 1: 1-6.

## Al in FinTech: Metaverse, Web3, DeFi, NFT, **Financial Services Innovation and Applications**



## FinTech

### **FinTech ABCD**



**Block Chain** 

**Cloud Computing** 

**Big Data** 

**Decentralized Finance (DeFi)** Block Chain Financial Technology

#### Block Chain & Bitcoin (BTC)

#### Smart Contract & Ethereum (ETH)

Decentralized Application (DApp)

(AI)



#### AI, ML, DL



Source: https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/deep\_learning.html

## Definition of **Artificial Intelligence** (A.I.)

#### "... the Science and engineering of making intelligent machines" (John McCarthy, 1955)

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

## "... technology that thinks and acts like humans"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

## "... intelligence exhibited by machines or software"

Source: https://digitalintelligencetoday.com/artificial-intelligence-defined-useful-list-of-popular-definitions-from-business-and-science/

#### **4 Approaches of Al**



#### 4 Approaches of Al



Al Acting Humanly: The Turing Test Approach (Alan Turing, 1950)

- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
  - Deep Learning (DL)
- Computer Vision (Image, Video)
- Natural Language Processing (NLP)
- Robotics

# FinTech

Financial Technology FinTech

"providing financial services by making use of software and modern technology"

## Financial

## Technology

## Financial

## Services

#### **FinTech: Financial Services Innovation**



#### **FinTech:**

#### **Financial Services Innovation**

**1. Payments** 2. Insurance 3. Deposits & Lending 4. Capital Raising **5. Investment Management** 6. Market Provisioning

#### 1

#### **FinTech: Payment**



### 2

#### **FinTech: Insurance**



#### FinTech: Deposits & Lending

3



#### **FinTech: Capital Raising**



#### **G** FinTech: Investment Management



#### FinTech: Market Provisioning



#### Deep learning for financial applications: Topic-Model Heatmap



RBN

#### Deep learning for financial applications: Topic-Feature Heatmap

price data -	35	3	0	16	10	7	10	22	- 35
technical indicator -	15	0	0	7	1	4	3	7	
index data -	5	1	0	0	0	0	1	1	- 30
market characteristics -	6	2	2	0	9	0	0	0	
fundamental -	2	0	0	2	3	0	0	0	- 25
market microstructure data -	8	4	3	0	0	1	0	1	
sentiment -	1	1	0	0	0	1	7	5	- 20
text -	2	7	2	1	1	0	21	36	
news -	0	1	0	0	0	0	4	22	- 15
company/personal financial data -	0	21	5	2	1	0	2	3	
macroeconomic data -	1	2	2	0	0	1	0	0	- 10
risk measuring features -	0	3	2	0	0	0	0	0	_
blockchain/cryptocurrency specific features -	0	0	0	0	0	6	0	0	- 5
human inputs -	0	0	0	0	0	0	0	2	0
	algorithmic trading -	risk assessment -	fraud detection -	portfolio management -	asset pricing andderivatives	cryptocurrency and blockchain studies	financial sentiment _ analysis	financial text mining -	 0

#### Deep learning for Financial applications: Topic-Dataset Heatmap

Stock Data -	15	2	0	11	3	0	7	20	2	3	- 35
Index/ETF Data -	35	0	0	3	3	0	9	14	0	1	
Cryptocurrency -	9	0	0	2	0	15	2	0	0	0	- 30
Forex Data -	5	0	0	1	0	0	0	0	0	2	
Commodity Data -	6	0	0	1	0	0	0	0	0	2	- 25
Options Data -	1	0	0	0	4	0	0	0	0	0	
Transaction Data -	2	3	2	0	0	0	0	1	0	0	- 20
News Text -	4	3	0	0	0	0	13	36	0	0	
Tweet/microblog -	1	0	0	0	0	1	8	10	0	1	- 15
Credit Data -	0	10	1	0	0	0	0	0	0	0	
Financial Reports -	0	6	2	3	2	0	4	3	0	3	- 10
Consumer Data -	0	8	6	0	0	0	0	1	0	1	_
Macroeconomic Data -	0	2	1	0	0	0	0	0	0	1	- 5
Other -	5	3	1	1	3	0	0	3	1	0	
	algorithmic trading -	risk assessment -	fraud detection -	oortfolio management -	asset pricing and derivatives market	cryptocurrency and blockchain studies	financial sentiment analysis	financial text mining -	theoretical or conceptual studies	other financial applications	—- 0
Metaverse Web3 DeFi NFT

### Metaverse Development from 1991 to 2021



### Web3: Decentralized Web Internet Evolution



Source: https://www.businessinsider.com/personal-finance/what-is-web3

#### **Metaverse Economy**



Source: Yang, Qinglin, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.

#### **Blockchain in the Metaverse**



Source: Gadekallu, Thippa Reddy, Thien Huynh-The, Weizheng Wang, Gokul Yenduri, Pasika Ranaweera, Quoc-Viet Pham, Daniel Benevides da Costa, and Madhusanka Liyanage (2022). "Blockchain for the Metaverse: A Review." arXiv preprint arXiv:2203.09738..

#### Blockchain

#### for Key Enabling Technologies of the Metaverse



Source: Gadekallu, Thippa Reddy, Thien Huynh-The, Weizheng Wang, Gokul Yenduri, Pasika Ranaweera, Quoc-Viet Pham, Daniel Benevides da Costa, and Madhusanka Liyanage (2022). "Blockchain for the Metaverse: A Review." arXiv preprint arXiv:2203.09738..

#### **Seven Layers of a Metaverse Platform**



### Layered Architecture of Blockchain



Source: Yang, Qinglin, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.

#### **Primary Technical Aspects in the Metaverse**

Al with ML algorithms and DL architectures is advancing the user experience in the virtual world



#### **Fusion of AI and Blockchain in Metaverse**



Source: Yang, Qinglin, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.

#### **DeAl:**

#### Synthesizing On-device AI, Edge AI, and Cloud AI



#### **Smart Virtuality-Reality Metaverse Ecosystem:** Metasynthesizing DeAl, Metaverse, Blockchain, Web3



#### The difference between AR, MR, and VR under the umbrella of XR XR VR MR AR **Extended Reality** Virtual Reality Entire experience **Mixed Reality** spectrum from fully User is completely Augmented Reality virtual to fully real immersed into a virtual Environment aware world Non-environment aware 2D/3D content is overlaid 2D/3D content is overlaid onto the physical space onto the physical space **⊳** P User

#### **Computer vision in the metaverse**

#### with scene understanding, object detection, and human action/activity recognition



#### A Blockchain-based IoT Framework

with ML to enhance security and privacy



#### **5G and beyond for Metaverse Services**

AI with ML algorithms and DL models contribute in multi-level tasks



## **A Data-Driven Digital Twin Architecture**

for intelligent healthcare systems using ML to process raw data of IoMedicalThings devices



## **Brain-Machine Interfaces (BMIs)**

for processing neural signals and responding neural stimulations



#### Al for the Metaverse

Technical Aspect	Ref	Task	AI Technique
NLP	[20]	Word and linguistic prediction for language	RNNs and LSTM networks with the attention mechanisms.
	[21]	modeling	Advanced memory network with residual connection.
Γ	[24]	modering.	Deep networks with gated connection and bi-directional structure.
	[25]	Analyzing and understand the representation of	General deep networks with CNN and LSTM architectures.
		words from characters	
	[27]	Identifying prefixes and suffixes and detecting mis-	DL framework with CNN, Bi-LSTM, and conditional random field.
		spelled words	
	[29]	Sentiment prediction and question type classifica-	Various CNNs and LSTM networks with simple structures and
		tion.	advanced-designed architectures.
	[31]	Generate short text in image captioning and long	DL framework with single RNN/LSTM and mixture LSTM-CNN
		text in virtual question answer.	models.
	[32]	Semantic labeling, context retrieval, and language	Unsupervised and reinforcement learning with common RNN/LSTM
		interpretation.	and CNN models.

#### Al for the Metaverse in the Application Aspects

#### healthcare, manufacturing, smart cities, gaming E-commerce, human resources, real estate, and DeFi



#### **Conversational AI**

#### to deliver contextual and personal experience to users





Source: Belk, Russell, Mariam Humayun, and Myriam Brouard. (2022)

"Money, possessions, and ownership in the Metaverse: NFTs, cryptocurrencies, Web3 and Wild Markets." Journal of Business Research 153: 198-205.

#### **Combination of Web3 with other Technologies**



Source: Sheridan, Dan, James Harris, Frank Wear, Jerry Cowell Jr, Easton Wong, and Abbas Yazdinejad. (2022) "Web3 Challenges and Opportunities for the Market." arXiv preprint arXiv:2209.02446.

## Decentralized Finance (DeFi) **Block Chain FinTech**

## **Decentralized Finance (DeFi)**

- A global, open alternative to the current financial system.
- Products that let you borrow, save, invest, trade, and more.
- Based on open-source technology that anyone can program with.

### Traditional Finance Centralized Finance (CeFi)

- Some people aren't granted access to set up a bank account or use financial services.
- Lack of access to financial services can prevent people from being employable.
- Financial services can block you from getting paid.
- A hidden charge of financial services is your personal data.
- Governments and centralized institutions can close down markets at will.
- Trading hours often limited to business hours of specific time zone.
- Money transfers can take days due to internal human processes.
- There's a premium to financial services because intermediary institutions need their cut.

## DeFi vs. CeFi

#### **Decentralized Finance (DeFi)**

You hold your money.

You control where your money goes and how it's spent.

Transfers of funds happen in minutes.

Transaction activity is pseudonymous.

DeFi is open to anyone.

The markets are always open.

It's built on transparency – anyone can look at a product's data and inspect how the system works.

#### Traditional Finance (Centralized Finance; CeFi)

Your money is held by companies.

You have to trust companies not to mismanage your money, like lend to risky borrowers.

Payments can take days due to manual processes.

Financial activity is tightly coupled with your identity.

You must apply to use financial services.

Markets close because employees need breaks.

Financial institutions are closed books: you can't ask to see their loan history, a record of their managed assets, and so on.

#### (DeFi)

#### **Decentralized Applications (Dapps)**

- Ethereum-powered tools and services
- Dapps are a growing movement of applications that use Ethereum to disrupt business models or invent new ones

### **The Internet of Assets**

- Ethereum isn't just for digital money.
- Anything you can own can be represented, traded and put to use as non-fungible tokens (NFTs).





Source: Matt Fortnow and QuHarrison Terry (2021), The NFT Handbook - How to Create, Sell and Buy Non-Fungible Tokens, Wiley

## **Financial Stability Challenges**

Crypto Ecosystem	<ul> <li>Operational, cyber, and governance risks</li> <li>Integrity (market and AML/CFT) (Anti–Money Laundering / Combating the Financing of Terrorism)</li> <li>Data availability / reliability</li> <li>Challenges from cross-boarder activites</li> </ul>
Stablecoins	<ul> <li>How stable are stablecoins?</li> <li>Domestic and global regulatory and supervisory approaches</li> </ul>
Macro- Financial	<ul> <li>Cryptoization, capital flows, and restrictions</li> <li>Monetary policy transmission</li> <li>Bank disintermediation</li> </ul>

Source: Parma Bains, Mohamed Diaby, Dimitris Drakopoulos, Julia Faltermeier, Federico Grinberg, Evan Papageorgiou, Dmitri Petrov, Patrick Schneider, and Nobu Sugimoto (2021), The Crypto Ecosystem and Financial Stability Challenges, International Monetary Fund, October 2021

# Financial

## Services

# Technology Innovation

#### FinTech Innovation FinTech high-level classification



Source: Paolo Sironi (2016), "FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification", Wiley.

## **Technology-driven Financial Industry** Development

#### FinBrain: when Finance meets AI 2.0



Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924


## a new generation of Al based on the novel information environment of major changes and the development of new goals.

Yunhe Pan (2016), "Heading toward artificial intelligence 2.0." Engineering 2, no. 4, 409-413.

## Technology-driven Financial Industry Development

Development stage	Driving technology	Main landscape	Inclusive finance	Relationship between technology and finance	
Fintech 1.0 (financial IT)	Computer	Credit card, ATM, and CRMS	Low	Technology as a tool	
Fintech 2.0 (Internet finance)	Mobile Internet	Marketplace lending, third-party payment, crowdfunding, and Internet insurance	Medium	Technology- driven change	
Fintech 3.0 (financial intelligence)	Al, Big Data, Cloud Computing, Blockchain	Intelligent finance	High	Deep fusion	

Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

## **Artificial Intelligence in the Financial Markets**



## Al in Managerial Blind Spots: Unknown Knowns and Unknown Unknowns

Do I know?



## **Green Finance ESG** (Environmental, Social, Governance)



## Sustainable Development Goals (SDGs)



## Sustainable Development Goals (SDGs) and 5P



**Green Finance Generic term** implying use or diversion of financial resources to deploy and support projects with long term positive impact on the environment

## Sustainable Finance Finances

deployed in support of projects that ensure just, sustainable and inclusive growth or attainment of one or more sustainable development goals

**Carbon Finance Financial instruments** based on economic value of carbon emissions which an organization cannot avoid but which it offsets by funding other compensatory projects that contribute to carbon emissions reduction

## **Climate Finance**

**Finances deployed** in support of low carbon and climate resilient projects that help in climate change mitigation and adaptation efforts, particularly in the energy and infrastructure sectors

## **ESG Investing**

**Investments** considering the broad range of environmental (e.g. climate change, pollution biodiversity loss), social (e.g. working conditions, human rights, salary or compensation structures) and governance (e.g. board composition, diversity and inclusion, taxes) characteristics of the projects or companies being invested in; ethical and business sustainability considerations are integral part of financing

## Impact Investing

Investing in projects that solve a social or environmental problem; the focus is on the positive impact rather than the means used to produce that impact

### **Dynamic Trends of Green Finance and Energy Policy**





## Environmental



Governance

# CSR: Corporate Social Responsibility

## ESG to 17 SDGs



## ESG to 17 SDGs

Environment Social Governance

1: End Poverty 2: Zero Hunger 3: Good Health and Well-Being 4: Quality Education 5: Gender Equality 6: Clean Water and Sanitation 7: Affordable and Clean Energy 8: Decent Work and Economic Growth Industry, Innovation, and Infrastructure 10: Reduced Inequalities 11: Sustainable Cities and Communities 12: Responsible Consumption and Production 13: Climate Action 14: Life Below Water 15: Life on Land 16: Peace, Justice, and Strong Institutions 17: Partnerships for the Goals



## Sustainable Productivity: Finance ESG



## Sustainable Resilient Manufacturing ESG



## **ESG Indexes**

- •MSCI ESG Index
- Dow Johns Sustainability Indices (DJSI)
- FTSE ESG Index

### **MSCI ESG Rating Framework**



1,000+ data points on ESG policies, programs, and performance; Data on 100,000 individual directors; up to 20 years of shareholder meeting results

DATA

#### EXPOSURE METRICS MANAGEMENT METRICS

How exposed is the company to each material issue? Based on over 80 business and geographic segment metrics How is the company managing each material issue? 150 policy/program metrics, 20 performance metrics; 100+ Governance Key Metrics

#### KEY ISSUE SCORES & WEIGHTS

35 Key Issues selected annually for each industry and weighted based on MSCI's materiality mapping framework.

#### ESG RATING (AAA-CCC)

Issue scores and weights combine to overall ESG rating relative to industry peers. Individual E, S, G scores also available

#### INSIGHT

Specialized ESG research team provides additional insight through:

Company reports Industry reports Thematic reports Analyst calls & webinars

#### DATA OUTPUTS



Access to selected underlying data

Ratings, scores, and weights on 680,000 securities 17 years of history

#### SOURCES

100+ specialized datasets (government, NGO, models)

Company disclosure (10-K, sustainability report, proxy report)

۵۵۵

3,400+ media sources monitored daily (global and local news sources, governments, NGOs)

#### MONITORING & QUALITY REVIEW

Systematic, ongoing daily monitoring of controversies and governance events

In-depth quality review processes at all stages of rating, including formal committee review

## **MSCI ESG Key Issue Hierarchy**

3 Pillars	10 Themes	35 ESG Key Issues				
Environment	Climate Change	Carbon Emissions	Financing Environmental Impact			
		Product Carbon Footprint	<b>Climate Change Vulnerability</b>			
	Natural Capital	Water Stress	Raw Material Sourcing			
		Biodiversity & Land Use				
	Pollution &	Toxic Emissions & Waste	Electronic Waste			
	Waste	Packaging Material & Waste				
	Environmental	Opportunities in Clean Tech	Opportunities in Renewable			
	Opportunities	Opportunities in Green Building	Energy			
Social	Human Capital	Labor Management	Human Capital Development			
		Health & Safety	Supply Chain Labor Standards			
	Product Liability	Product Safety & Quality	Privacy & Data Security			
		Chemical Safety	Responsible Investment			
		<b>Consumer Financial Protection</b>	Health & Demographic Risk			
	Stakeholder	Controversial Sourcing				
	Opposition	Community Relations				
	Social	Access to Communications	Access to Health Care			
	Opportunities	Access to Finance	Opportunities in Nutrition & Health			
Governance	Corporate	Ownership & Control	Pay			
	Governance	Board	Accounting			
	Corporate	Business Ethics				
	Behavior	Tax Transparency				

Source: https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf

### **MSCI Governance Model Structure**



Source: https://www.msci.com/documents/1296102/21901542/ESG-Ratings-Methodology-Exec-Summary.pdf

### **MSCI Hierarchy of ESG Scores**



### **FTSE Russell ESG Ratings**





## Sustainalytics ESG Risk Ratings

Sustainalytics' ESG Risk Ratings measure a company's exposure to industry-specific material ESG risks and how well a company is managing those risks.

Negligible	Low	Medium	High	Severe		
0 - 10	10 - 20	20 - 30	30 - 40	40+		

## TruValue Labs

## Truvalue ESG Ranks

- Truvalue Labs applies AI to analyze over 100,000 sources and uncover ESG risks and opportunities hidden in unstructured text.
- The ESG Ranks data service produces an overall company rank based on industry percentile leveraging the 26 ESG categories defined by the Sustainability Accounting Standards Board (SASB).
- The data feed covers 20,000+ companies with more than 13 years of history.

Laggard	Below Average	Average	Above Average	Leader		
<				$\rightarrow$		

# **Al for** Social Good (AI4SG)

Source: Nenad Tomašev, Julien Cornebise, Frank Hutter, Shakir Mohamed, Angela Picciariello, Bec Connelly, Danielle Belgrave et al. (2020) "AI for social good: unlocking the opportunity for positive impact." Nature Communications 11, no. 1: 1-6. AI for Social Good (AI4SG) AI for Sustainable Development AI4SG 10 Guidelines

- AI Technology (G1, G2, G3)
- Applications (G4, G5, G6, G7, G8)
- Data Handling (G9, G10)

## AI4SG 10 Guidelines AI Technology (G1, G2, G3)

- G1: Expectations of what is possible with AI need to be wellgrounded.
- G2: There is value in simple solutions.
- G3: Applications of AI need to be inclusive and accessible, and reviewed at every stage for ethics and human rights compliance.

## AI4SG 10 Guidelines Applications (G4, G5, G6, G7, G8)

- G4: Goals and use cases should be clear and well-defined.
- G5: Deep, long-term partnerships are required to solve large problems successfully.
- G6: Planning needs to align incentives, and factor in the limitations of both communities.
- G7: Establishing and maintaining trust is key to overcoming organisational barriers.
- G8: Options for reducing the development cost of AI solutions should be explored.

## AI4SG 10 Guidelines Data Handling (G9, G10)

- G9: Improving data readiness is key.
- G10: Data must be processed securely, with utmost respect for human rights and privacy.

## Al for Social Good (Al4SG) Domains and Techniques

	Cognitive modeling	0	0	0	0	0	1	0	0	1	
	Constraint satisfaction and optimization	2	5	31	48	20	26	9	59	173	
	Cognitive systems	1	2	2	7	2	3	1	5	20	150
	Computer vision	3	8	12	20	6	12	7	19	79	
Game playing and interactive entertainment Game theory and economic paradigms		0	1	0	1	0	0	0	0	2	
		3	5	30	6	11	31	1	16	78	120
12/20	Human-AI collaboration	1	8	11	23	9	6	6	17	69	
anb	Human computation and crowd sourcing	1	5	6	20	45	12	11	15	98	
inic	Heuristic search and optimization	1	3	11	14	8	8	6	26	69	90
[ec]	Knowledge representation and reasoning	0	0	0	5	3	2	0	1	11	
-	Multiagent systems	2	7	47	19	16	22	8	31	122	60 30
	Machine learning	12	27	65	174	53	65	36	92	460	
	Natural language processing	4	12	6	18	10	10	5	3	58	
	Planning, routing, and scheduling	9	4	48	43	14	28	31	84	210	
	Robotics	3	4	12	10	4	5	4	10	47	
	Reasoning under uncertainty	4	3	30	23	8	6	6	13	78	
	Total	40	78	225	344	155	177	90	253	1176	
	Agricolt	ental s	tion ustainab	Healthr neation P	care panipulation	ublic sa	fets an plant Tr	unsporta	tion T	otal	0
					I	Domaiı	n				

### NLP for Social Good (NLP4SG)



Source: Fernando Gonzalez, Zhijing Jin, Jad Beydoun, Bernhard Schölkopf, Tom Hope, Rada Mihalcea, and Mrinmaya Sachan (2022). "How Is NLP Addressing the 17 UN Sustainability Goals? A Challenge Set of Social Good Paper Classification and Information Extraction."
## NLP for Social Good (NLP4SG) Visualization

....

#### Good Health and Well-Being

- Quality Education
- Gender Equality
- **Clean Water and Sanitation**
- Affordable and Clean Energy
- Decent Work and Economic Growth
- Industry, Innovation and Infrastrucure

**Reduced Inequalities** 

Sustainable Cities and Communities Responsible Consumption and Production

- ....
- Life on Land
- Peace, Justice and Strong Institutions
- Partnership for the Goals

- classification
- coreference resolution
- covid 19
- event extraction
- fact checking
- fake news detection
- hate speech
- hope speech detection
- inference
- information retrieval
- machine translation.

#### named entity recognition

- natural language generation
- nlp applications
- parsing
- part of speech
- question answering
- relation extraction
  - rumor detection
  - sentiment analysis
- stance detection
- text summarization
- toxic spans detection

### annotati... attention -

automatic speech recognition models

### bert

- classifiers -
- conditional random field -
- convolutional neural network
  - deep neural network
    - domain adaption
  - ensemble methods -
  - fact checking models
    - hybrid approach -
    - language models -
  - language technology -
    - Istm -
- machine learning methods
  - ner models -
  - nip models -
  - part of speech models
- recurrent neural networks
  - roberta -
  - topic models -
  - transfer learning
    - transformers
  - word embeddings -

### Other methods

Source: Fernando Gonzalez, Zhijing Jin, Jad Beydoun, Bernhard Schölkopf, Tom Hope, Rada Mihalcea, and Mrinmaya Sachan (2022). "How Is NLP Addressing the 17 UN Sustainability Goals? A Challenge Set of Social Good Paper Classification and Information Extraction."

## Summary

- Al in FinTech
  - Metaverse, Web3, DeFi, NFT
  - Financial Services Innovation and Applications
  - Technology-driven Financial Industry Development
- Green Finance and ESG
  - SDGs: Sustainable Development Goals
  - ESG: Environmental, Social, and Governance
  - CSR: Corporate Social Responsibility
- AI for Social Good (AI4SG)

## **Acknowledgments: Research Projects**

- Applying AI technology to construct knowledge graphs of cryptocurrency anti-money laundering: a few-shot learning model
  - MOST, 110-2410-H-305-013-MY2, 2021/08/01~2023/07/31
- Deepen Corporate Sustainability: Enhance the Performance of Corporate Sustainability from AI, Financial, and Strategic Perspectives. AI for Corporate Sustainability Assessment and Cross Language Corporate Sustainability Reports Generative Mode
  - NTPU, 111-NTPU\_ORDA-F-001 , 2022/01/01~2022/12/31
- Artificial intelligence methods applied for analyzing the introduction of technological innovation: Patent text analysis and image analysis. Artificial Intelligence for FinTech

Knowledge Graph from Patent Textual Analytics

- NTPU, 111-NTPU\_ORDA-F-003, 2022/01/01~2022/12/31
- Establishment and Implement of Smart Assistive Technology for Dementia Care and Its Socio-Economic Impacts. Intelligent, individualized and precise care with smart AT and system integration
  - MOST, 111-2627-M-038-001-, 2022/08/01~2023/07/31







# Artificial Intelligence for Fintech, Green Finance, and ESG

Time: 2022/12/12 (Mon) 14:00-16:00 Place: Room 106, New Building, Institute of Information Science, Academia Sinica Host: Prof. Yu Tsao, TIGP (SNHCC), Academia Sinica



## Min-Yuh Day, Ph.D,

### **Associate Professor**

Institute of Information Management, National Taipei University

https://web.ntpu.edu.tw/~myday

2022-12-12



- Longbing Cao (2022). "Decentralized ai: Edge intelligence and smart blockchain, metaverse, web3, and desci." IEEE Intelligent Systems 37, no. 3: 6-19.
- Qinglin Yang, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.
- Russell Belk, Mariam Humayun, and Myriam Brouard (2022). "Money, possessions, and ownership in the Metaverse: NFTs, cryptocurrencies, Web3 and Wild Markets." Journal of Business Research 153: 198-205.
- Thien Huynh-The, Quoc-Viet Pham, Xuan-Qui Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022). "Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.
- Thippa Reddy Gadekallu, Thien Huynh-The, Weizheng Wang, Gokul Yenduri, Pasika Ranaweera, Quoc-Viet Pham, Daniel Benevides da Costa, and Madhusanka Liyanage (2022). "Blockchain for the Metaverse: A Review." arXiv preprint arXiv:2203.09738.
- Dan Sheridan, James Harris, Frank Wear, Jerry Cowell Jr, Easton Wong, and Abbas Yazdinejad (2022). "Web3 Challenges and Opportunities for the Market." arXiv preprint arXiv:2209.02446.
- Yves Hilpisch (2020), Artificial Intelligence in Finance: A Python-Based Guide, O'Reilly Media.
- Aurélien Géron (2019), Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly Media.
- Yves Hilpisch (2018), Python for Finance: Mastering Data-Driven Finance, 2nd Edition, O'Reilly Media.
- Paolo Sironi (2016), FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification, Wiley.
- Yuxing Yan (2017), Python for Finance: Apply powerful finance models and quantitative analysis with Python, Second Edition, Packt Publishing
- Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, Fred Ehrsam (2021), DeFi and the Future of Finance, Wiley
- Matt Fortnow and QuHarrison Terry (2021), The NFT Handbook How to Create, Sell and Buy Non-Fungible Tokens, Wiley
- Parma Bains, Mohamed Diaby, Dimitris Drakopoulos, Julia Faltermeier, Federico Grinberg, Evan Papageorgiou, Dmitri Petrov, Patrick Schneider, and Nobu Sugimoto (2021), The Crypto Ecosystem and Financial Stability Challenges, International Monetary Fund, October 2021
- Henrik Skaug Sætra (2021) "A Framework for Evaluating and Disclosing the ESG Related Impacts of AI with the SDGs." Sustainability 13, no. 15: 8503
- Nenad Tomašev, Julien Cornebise, Frank Hutter, Shakir Mohamed, Angela Picciariello, Bec Connelly, Danielle Belgrave et al. (2020) "AI for social good: unlocking the opportunity for positive impact." Nature Communications 11, no. 1: 1-6.
- Zheyuan Shi, Ryan, Claire Wang, and Fei Fang (2020). "Artificial intelligence for social good: A survey." arXiv preprint arXiv:2001.01818.
- Fernando Gonzalez, Zhijing Jin, Jad Beydoun, Bernhard Schölkopf, Tom Hope, Rada Mihalcea, and Mrinmaya Sachan (2022). "How Is NLP Addressing the 17 UN Sustainability Goals? A Challenge Set of Social Good Paper Classification and Information Extraction."
- Ramesh Sharda, Dursun Delen, and Efraim Turban (2017), "Business Intelligence, Analytics, and Data Science: A Managerial Perspective", 4th Edition, Pearson
- Frederic S. Mishkin (2015), "The Economics of Money, Banking and Financial Markets", 11th Edition, Pearson
- Susanne Chishti and Janos Barberis (2016), "The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries", Wiley.
- Paolo Sironi (2016), "FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification", Wiley.
- Brett King (2014), "Breaking Banks: The Innovators, Rogues, and Strategists Rebooting Banking", Wiley.
- Brett King (2012), "Bank 3.0: Why banking is no longer somewhere you go, but something you do", John Wiley & Sons
- Gopalakrishnan, Shanti, and Fariborz Damanpour (1997). "A review of innovation research in economics, sociology and technology management." Omega 25, no. 1: 15-28.