COVID-19 Trend Forecasting Using Neural Models

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Introduction

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RESEARCH INTERESTS

Data Mining/Databases, NLP/Machine Learning/AI

RESEARCH PROJECTS (publications)

google scholar | dblp

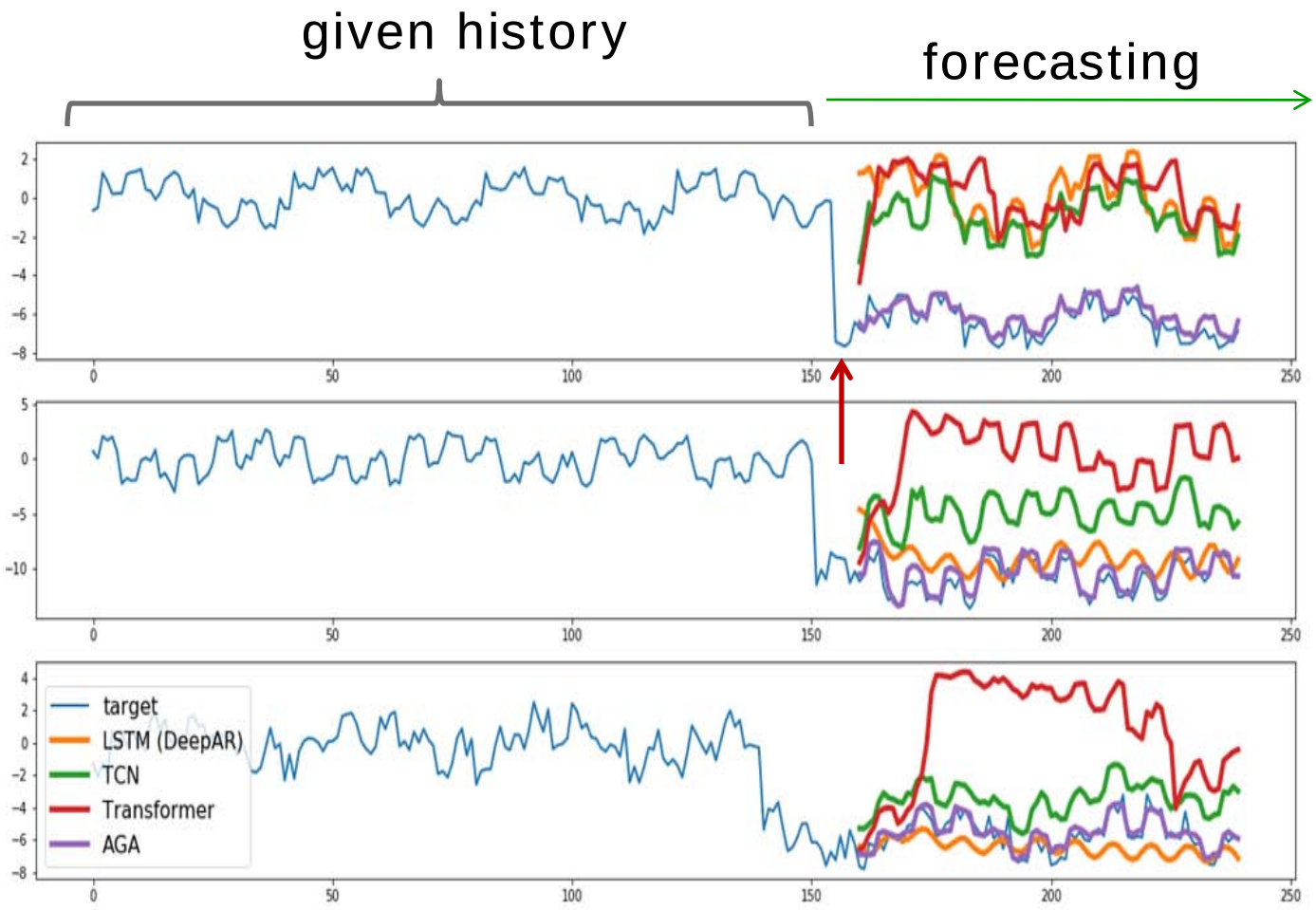
- Neural Time Series Analysis: Interventional COVID-19 Response Forecasting Using Neural Models (NSF)
- Knowledge Bases
- All kinds of Question Answering (Knowledge Graph, FAQ and Text based)
- Artificial Intelligence for Systems and IoTs
- Motif Discovery in Massive Protein Sequences (10,000 times faster than MEME)
- Knowledge Graph Query Processing and Benchmarking (NSF)
- Graph Information System (NSF)
- Network Science (ARL)
- Collaborative Networks (NSF)

Knowledge Base

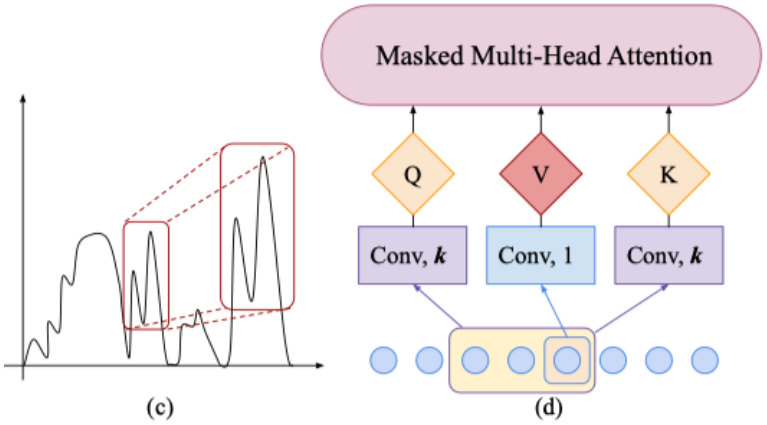
Text Analysis

Time Series

Time Series Forecasting: A Long Standing Problem



Old Issues, New Technologies



Our neural network approach, ConvTrans (NeurIPS 2019):

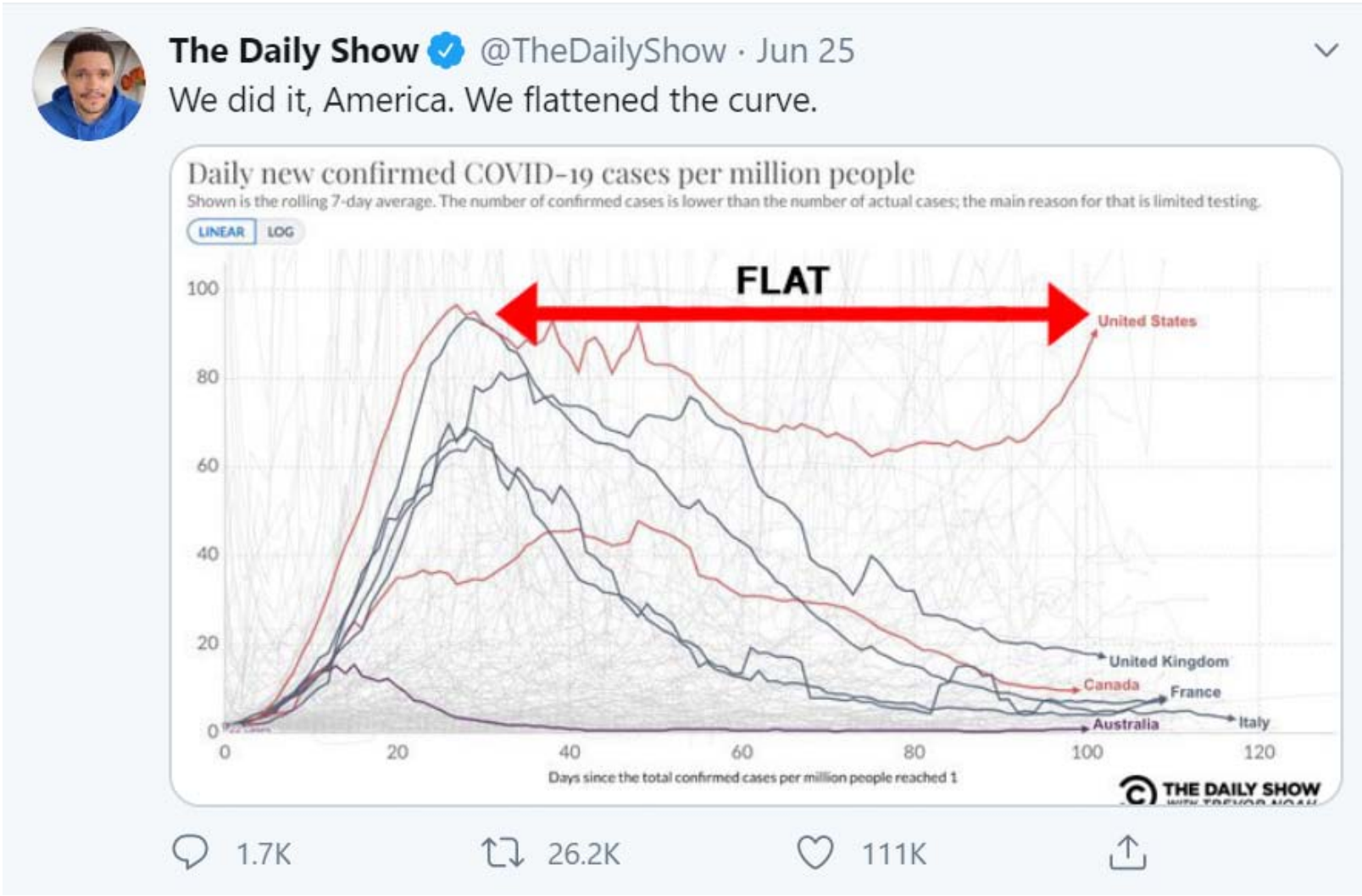
- the state-of-the-art accuracy
- a broad range of applications
- deployed in leading industries

Amazon

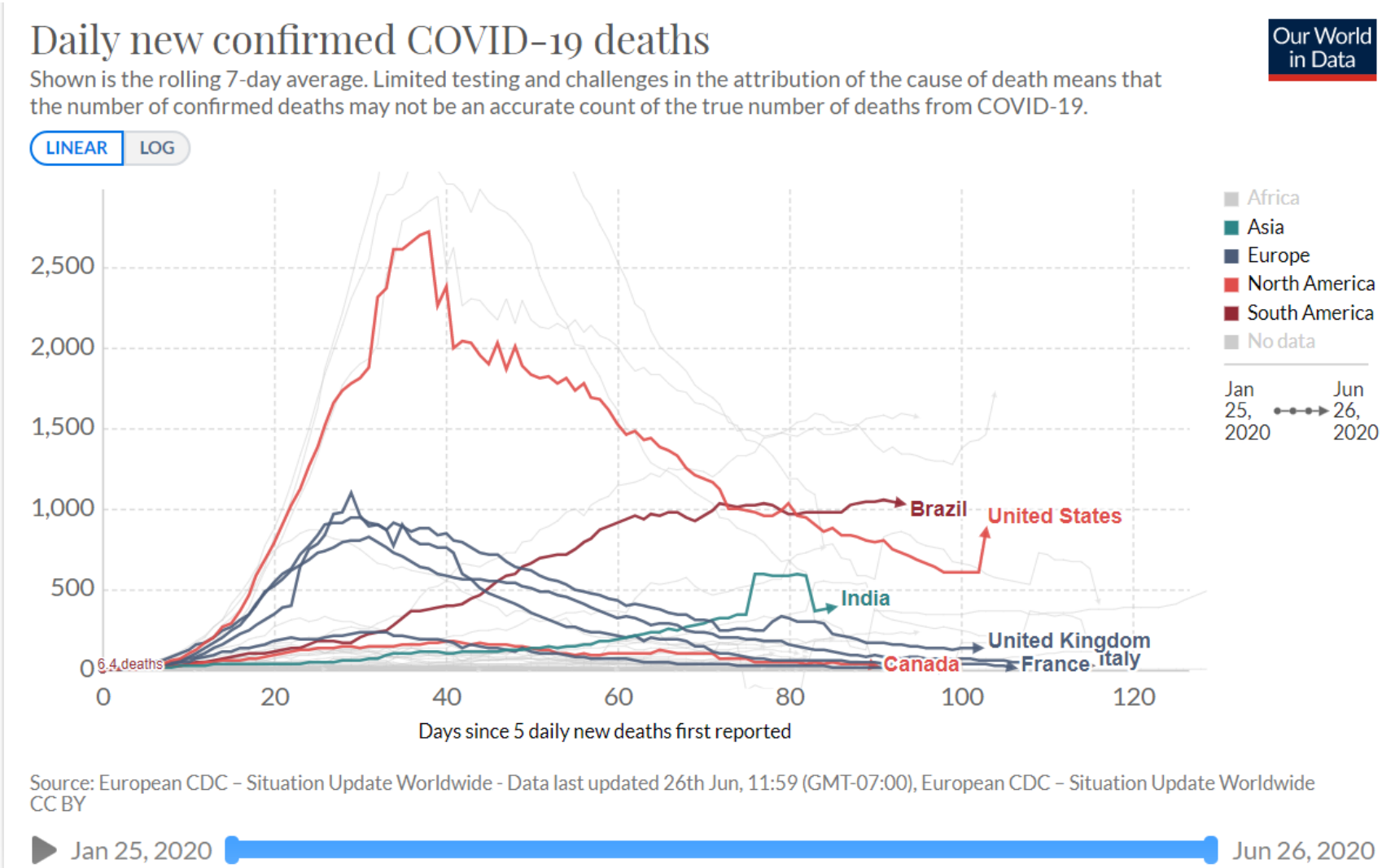
Ours

Dataset	T	τ	TRMF[45]	TCN[6]	DEEPAR[16]	MQ-RNN[42]	DEEPSSM[36]	CONVTRANS[27]
electricity	168	24	0.084/-	0.073/0.060	0.075/0.040*	0.077/0.036	0.083/0.056*	0.059/0.034
traffic	168	24	0.186/-	0.151/0.118	0.161/0.099*	0.132/0.110	0.161/0.113*	0.122/0.081
web	380	30	0.091/-	0.062/0.052	0.056/0.037	0.076/0.054	0.065/0.050	0.042/0.036
yahoo	168	24	0.039/-	0.044/0.030	0.038/0.030	0.042/**0.027**	0.041/0.042	0.041/0.031

We Flattened the Curve

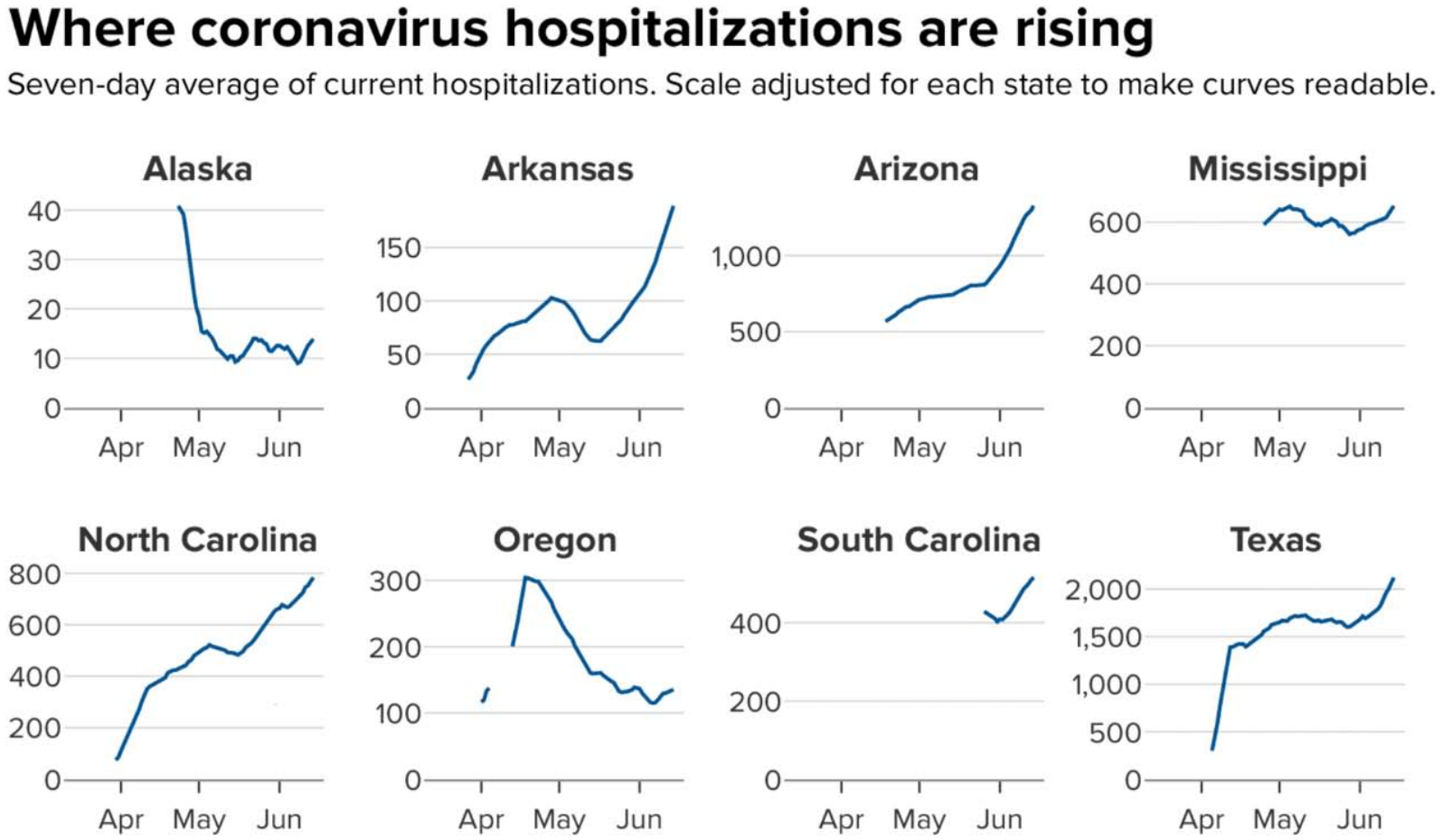


Not That Pessimistic



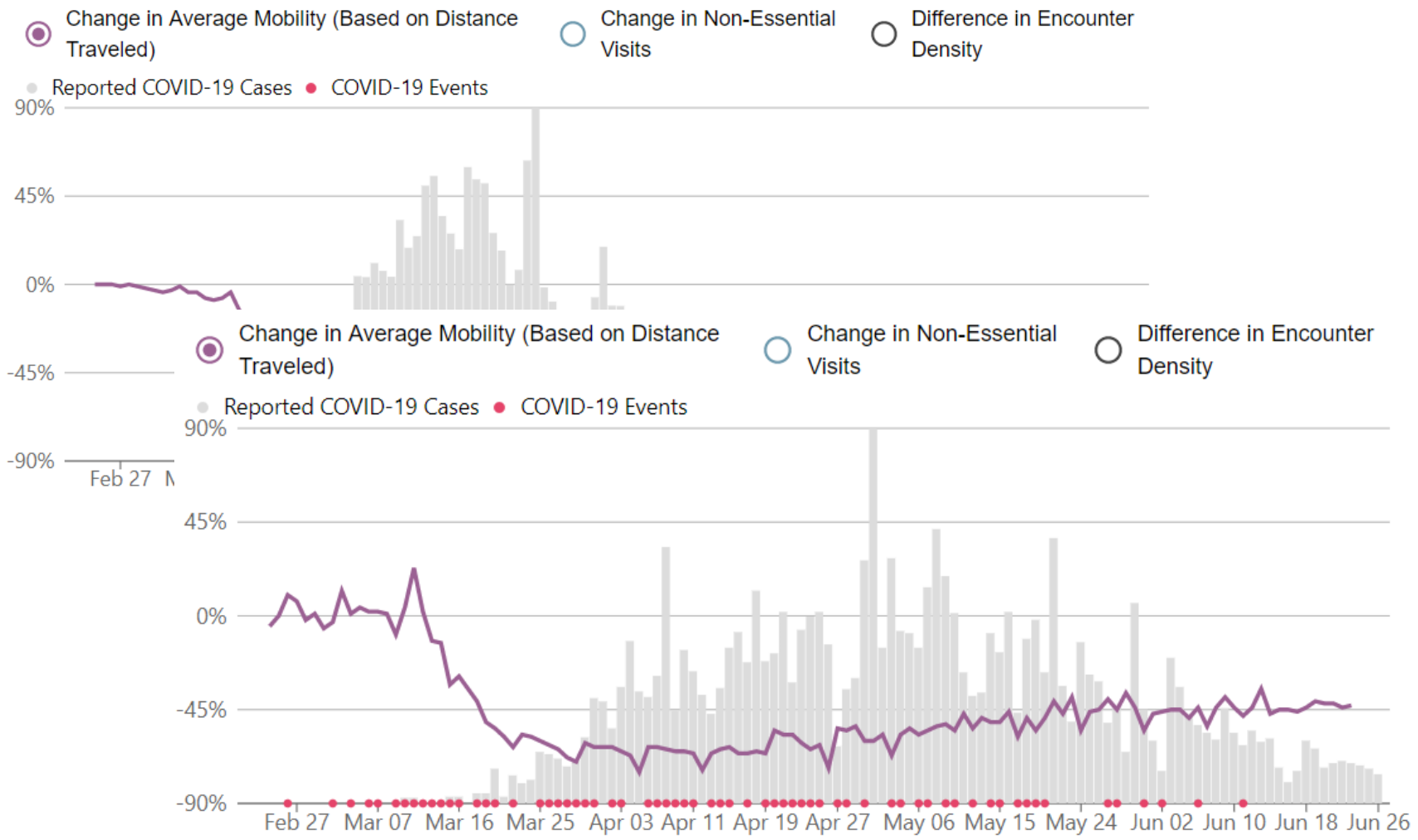
credit: https://ourworldindata.org/coronavirus

But Hospitalization Is Rising



from cnbc

Business Reopenning vs Protest

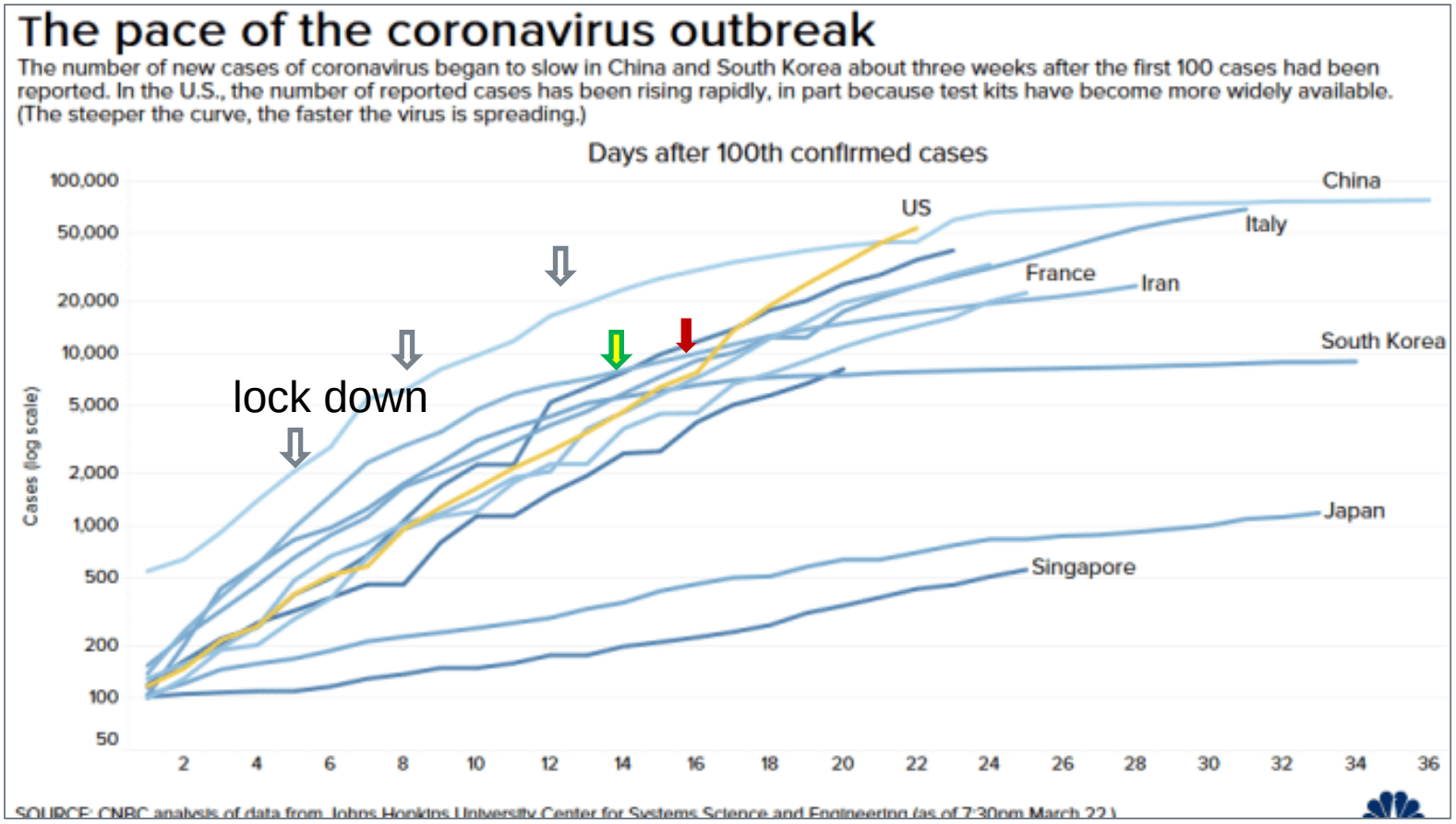


Time Square @ New York City, June 23, 3:13pm

Washington D.C.

Protesters flood streets in huge, peaceful

NSF Rapid: Interventional COVID-19 Response Forecasting

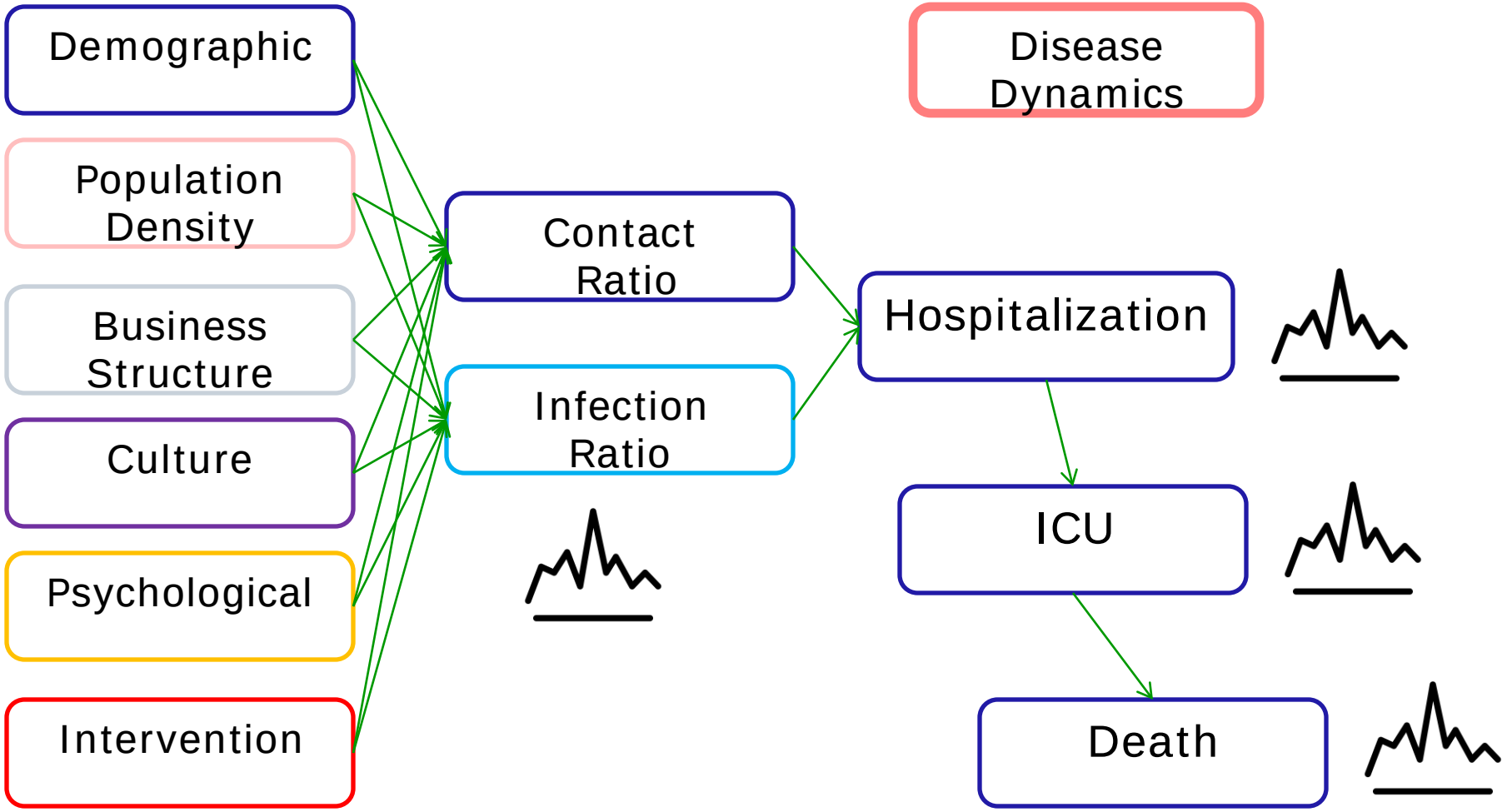


Interventional COVID-19 Response Forecasting

- Factors: Demographic, population density, business structure, cultural, psychological factors and interventional policy differ across regions.

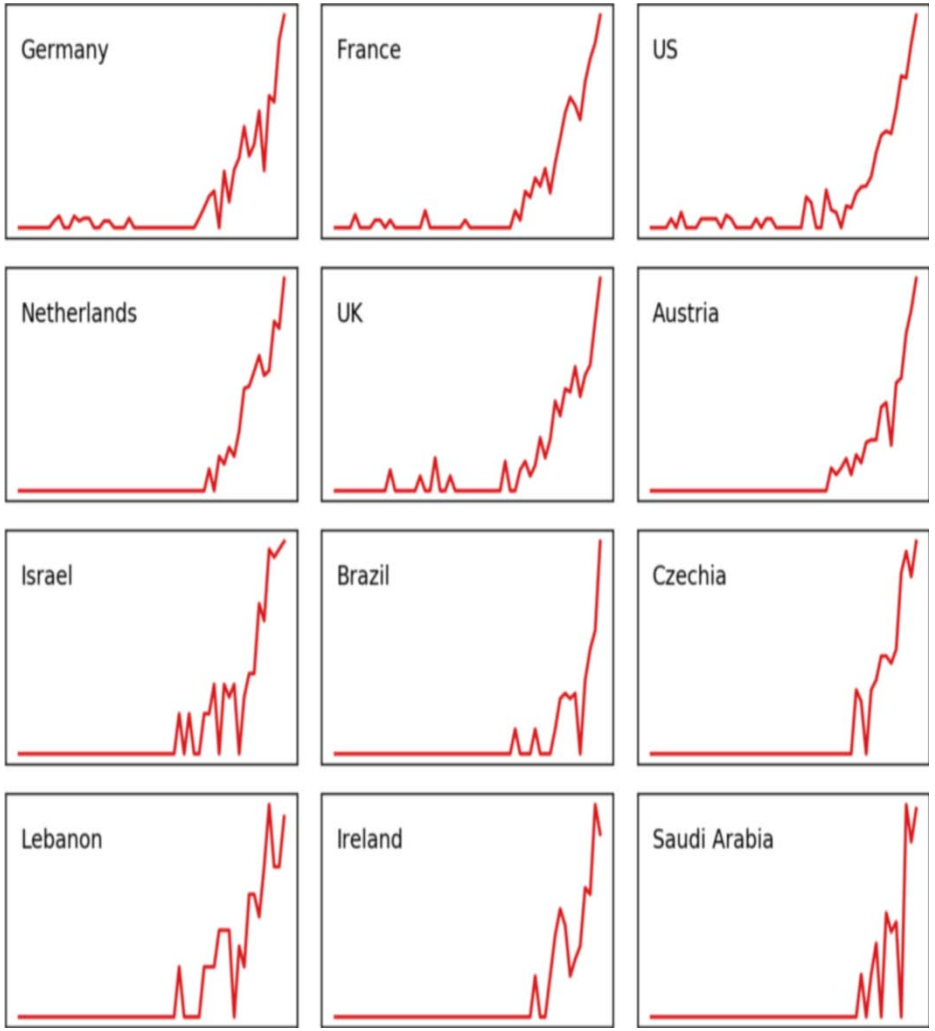
- Different from the classic epidemic models like SIR for COVID-19, we develop a new type of data-driven forecasting models based on the lately developed deep learning techniques

Factors


Demographic
Population Density
Business Structure
Culture
Psychological
Intervention
Contact Ratio
Infection Ratio
Disease Dynamics
Hospitalization
ICU
Death

COVID Forecasting

- Different regions share COVID-19 trending pattern
  - The spreading rate is determined by common factors, such as social interactions and protections
- To forecast cases in a certain region, we can refer to other regions where pandemic starts earlier



Daily new cases

Find Similar Regions

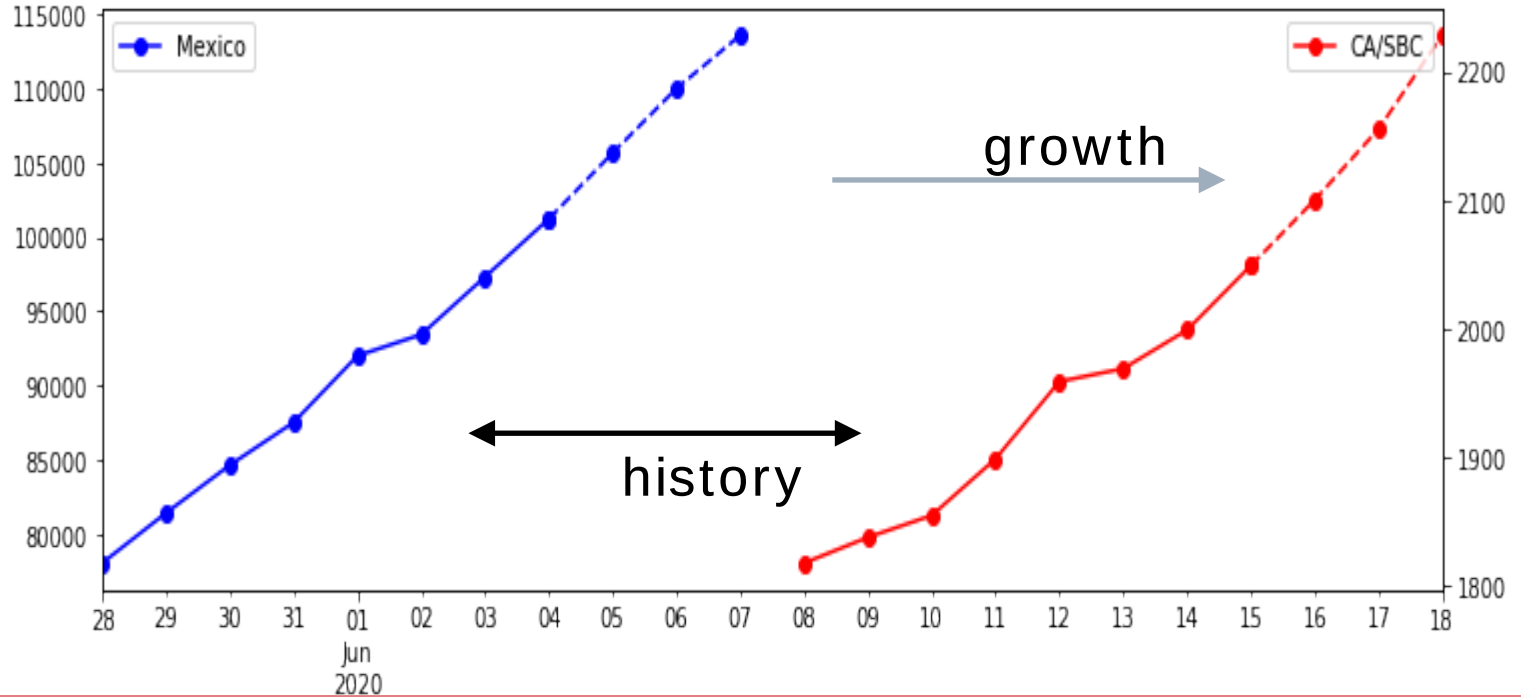
- For example, sharing similar factors : demographic, population density, business structure, social culture, psychological factors and interventional policy

OR

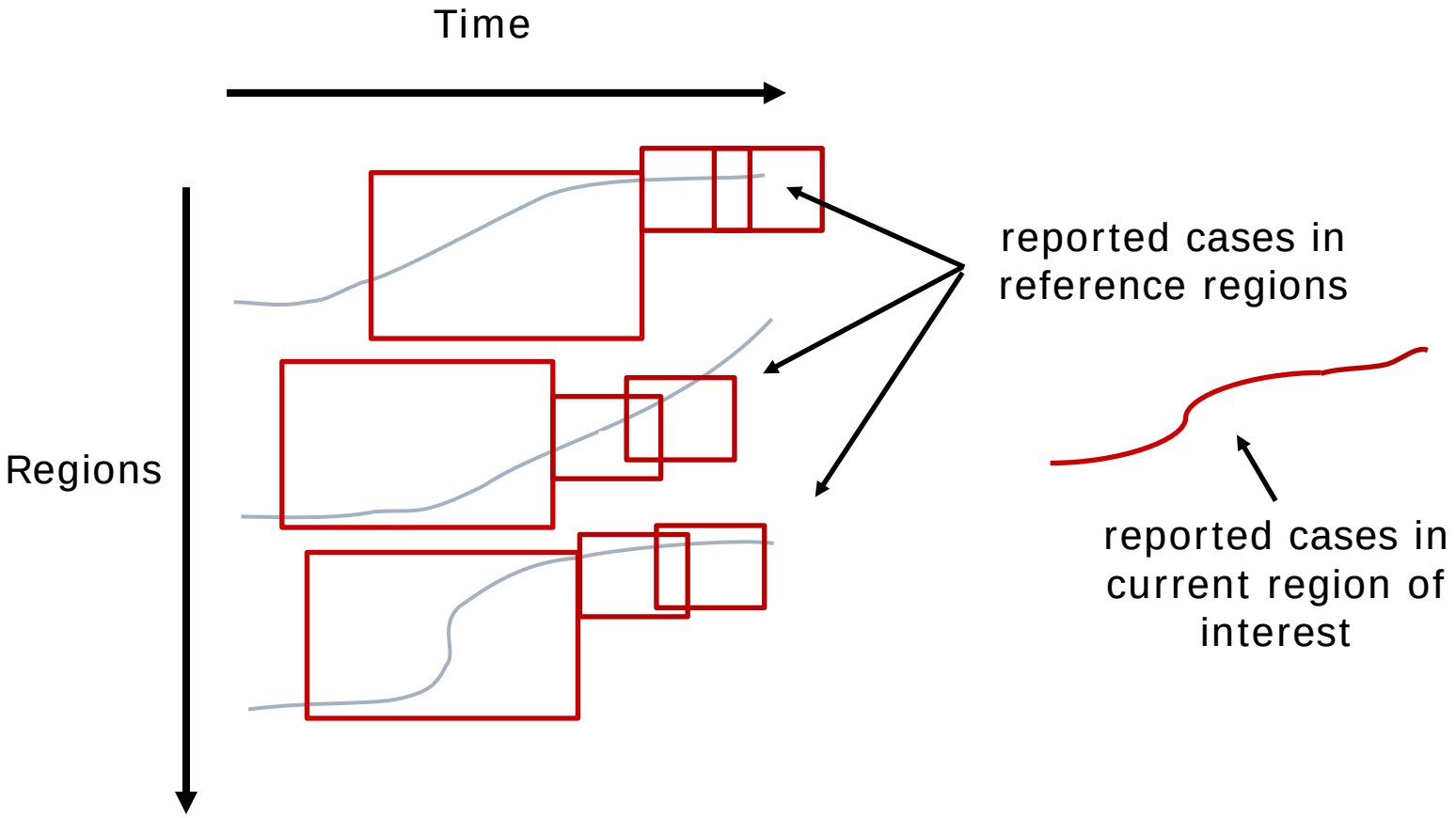
- Find regions whose trends look similar: All the aforementioned factors have been priced in!

Similar historical pattern → Similar future growth

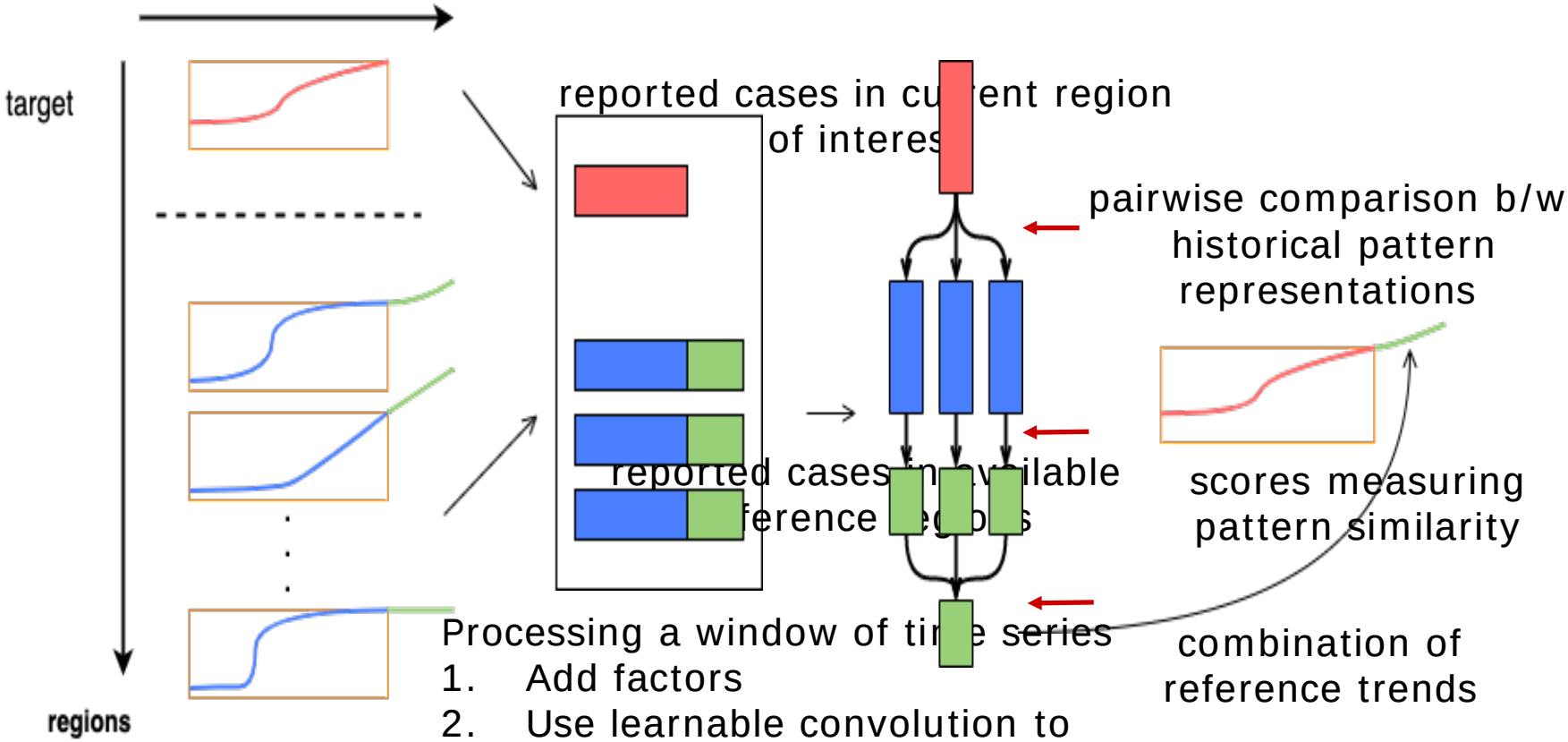
- Santa Barbara county is experiencing a new wave of COVID-19 spreading that resembles that in other regions
  - e.g. Mexico in early June



Attention Mechanism



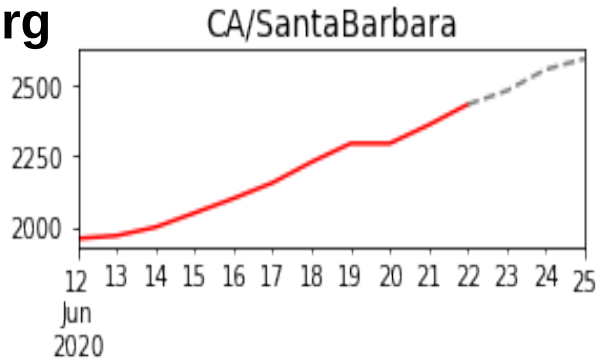
Neural Network Model

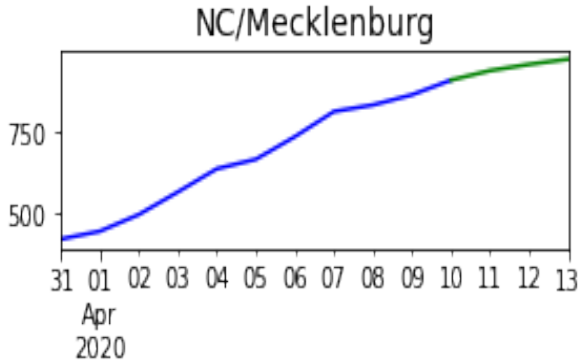


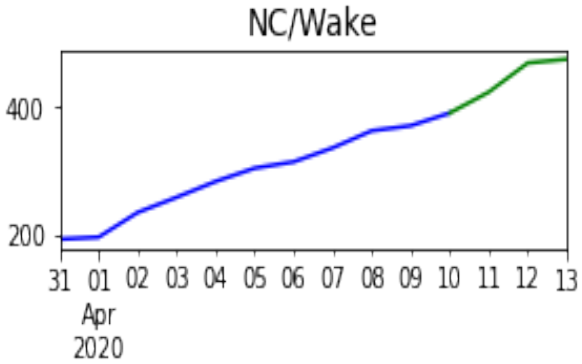
Identified References

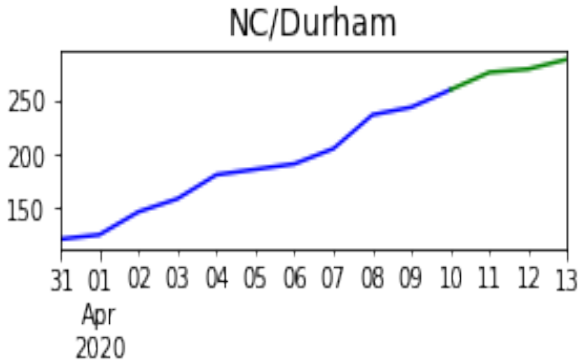
For Santa Barbara County during 06/12 ~ 06/22

- Most similar state: **North Carolina** during 03/31~04/10
- Most similar counties in NC:
  - NC/**Mecklenburg**
  - NC/**Wake**
  - NC/**Durham**

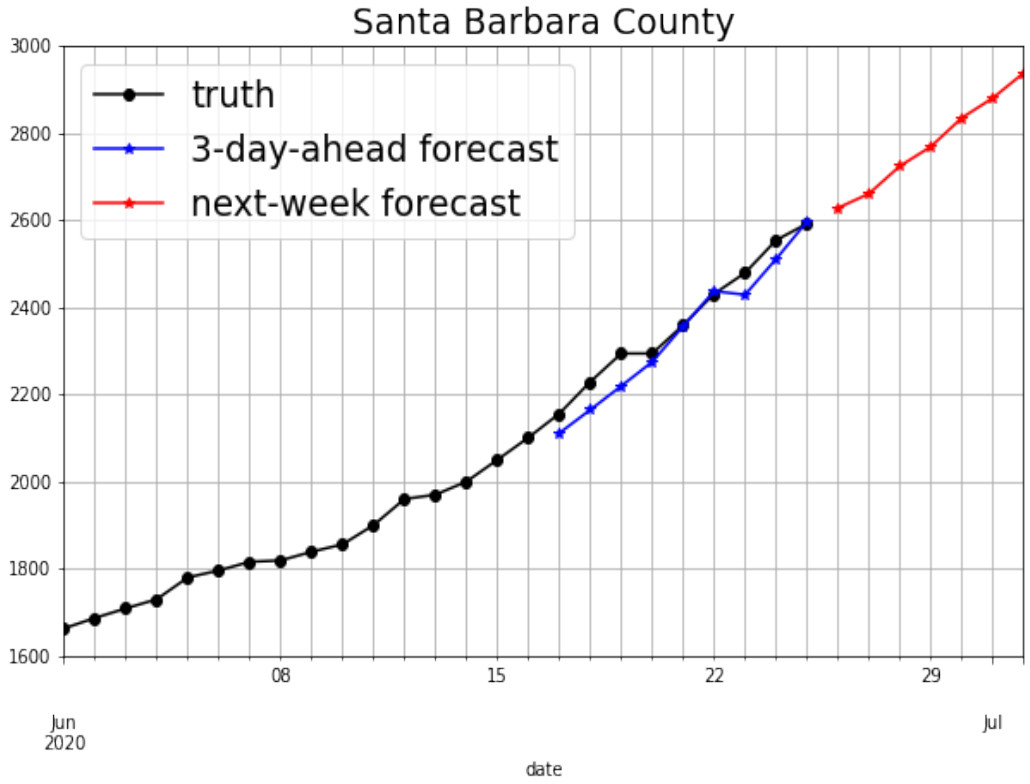








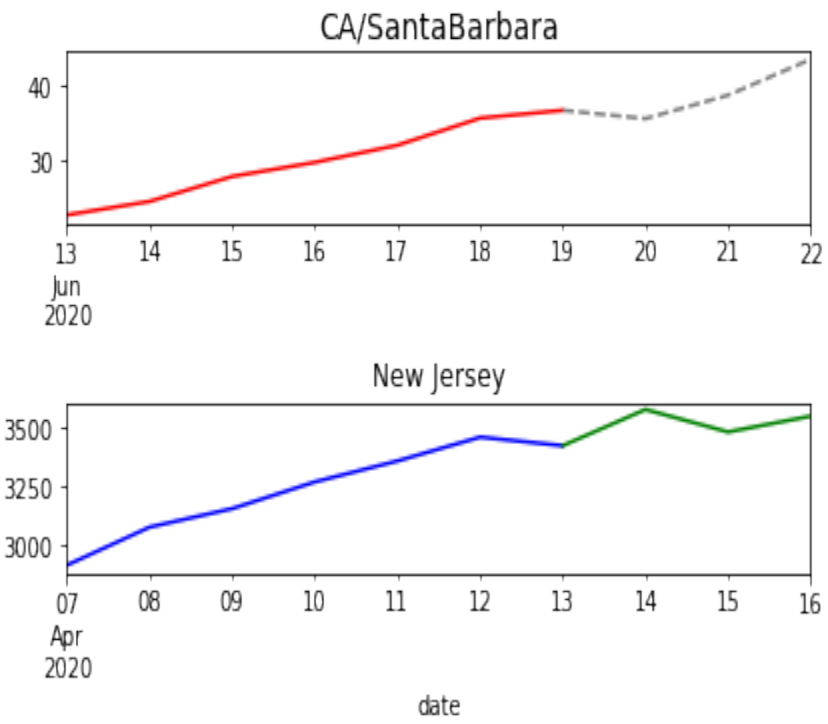
Forecasting Cases for Santa Barbara County

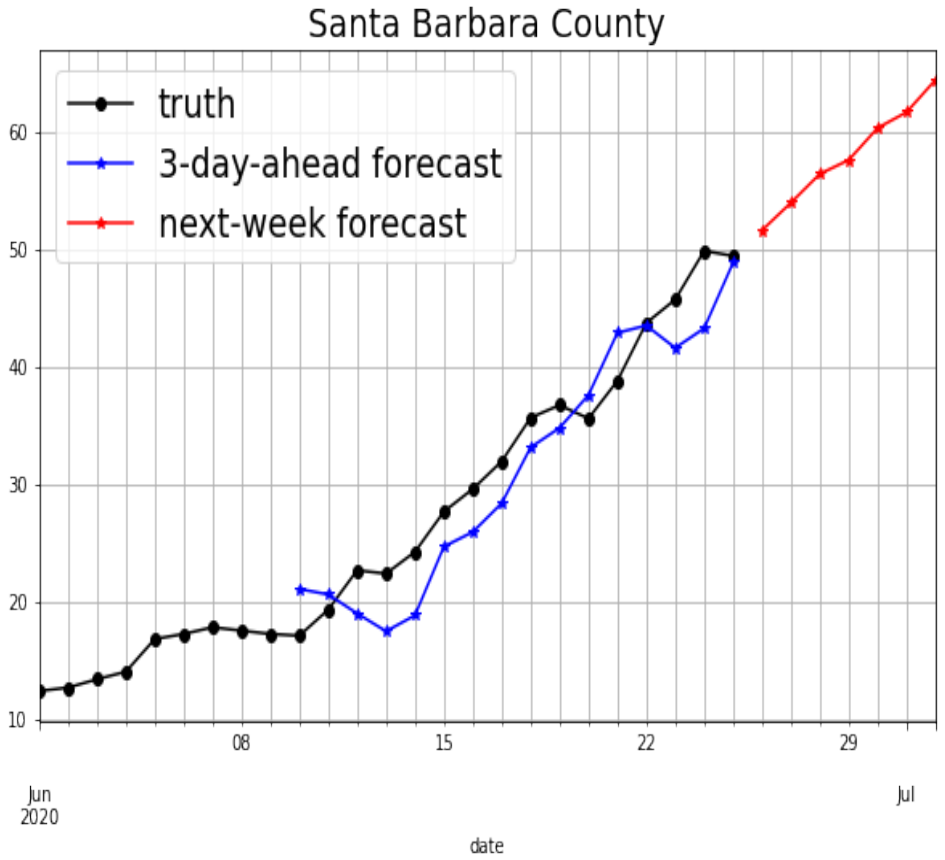


	RMSE	MAPE
RBF-SVM (autoregression)	180	0.072
SIR model	284	0.11
Attention	**75.7**	**0.030**

3-day-ahead forecast means the prediction for the date is made three days before
Next-week forecast is made on 06/26 for the next 7 days

Forecasting 14-day Moving Average of New Cases





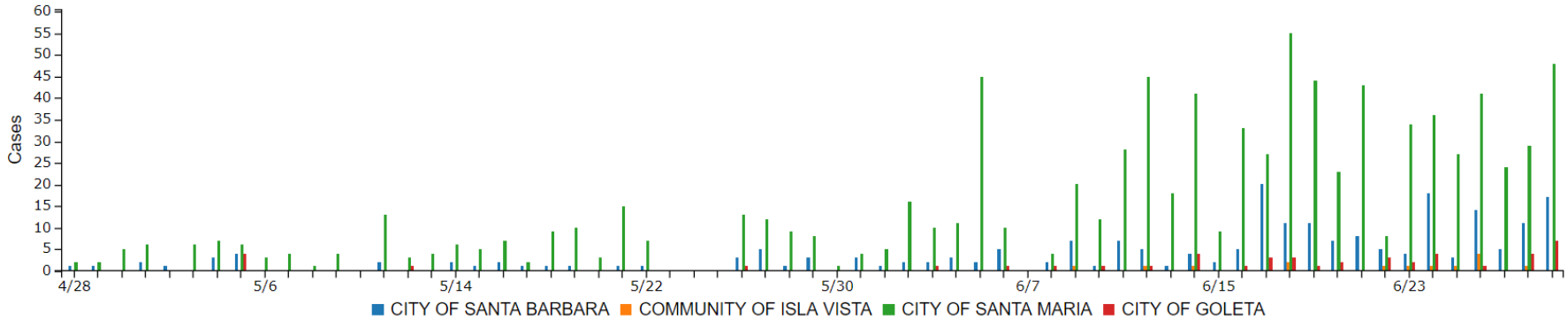
Daily Updated Trend @ Santa Barbara

COVID-19 Trend in Santa Barbara County

We create this website to track the COVID-19 status in Santa Barbara County to increase the public awareness of the virus. Our data are collected from Santa Barbara Public Heath.

Notice: as of 5/23/2020, COVID-19 Case Statistics from Santa Barbara Public Heath is updated Monday – Friday except Memorial Day Holiday.

Daily | 7-Day Average | 14-Day Average



Cases from Santa Barbara Public Heath, last updated with data at June 29 , 2020, 4:00 p.m.

http://fts.cs.ucsb.edu/covid19

7-Day Average @ Santa Barbara

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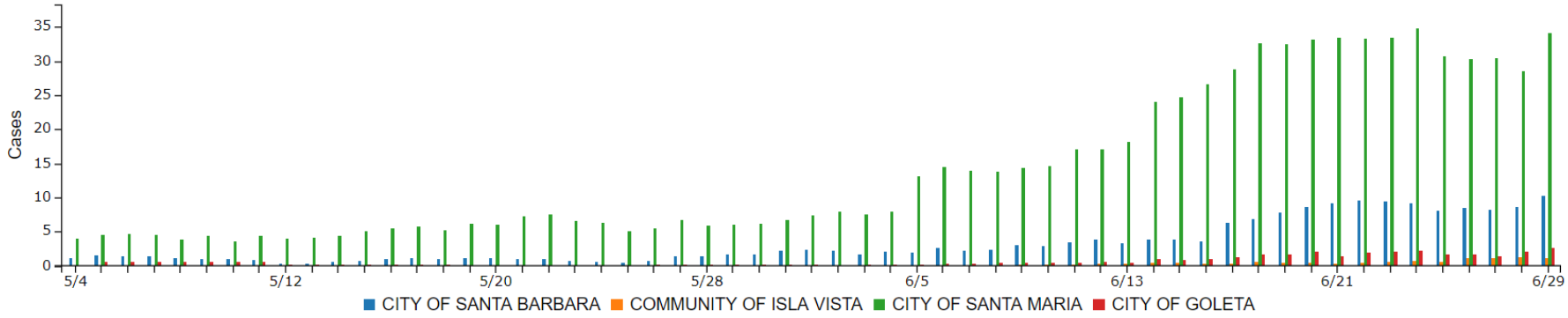

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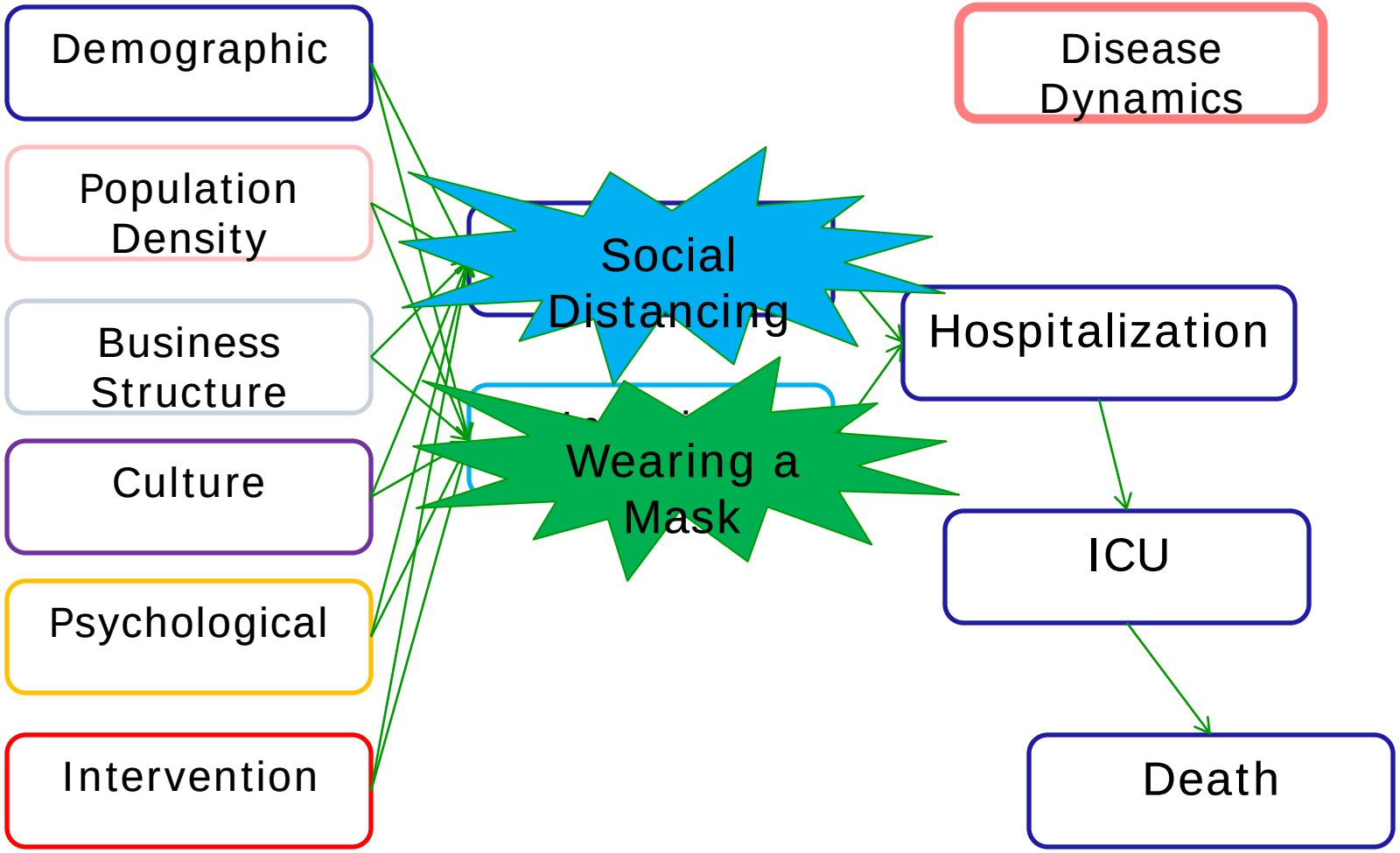
ts.cs.ucsb.edu/covid19#profile

http://fts.cs.ucsb.edu/covid19

Intervention Strategy



Q&A