A Statistical Framework for Deepfake Detection

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Document Markings

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Deepfakes are “believable media generated by neural networks” (Mirsky and Lee 2021)

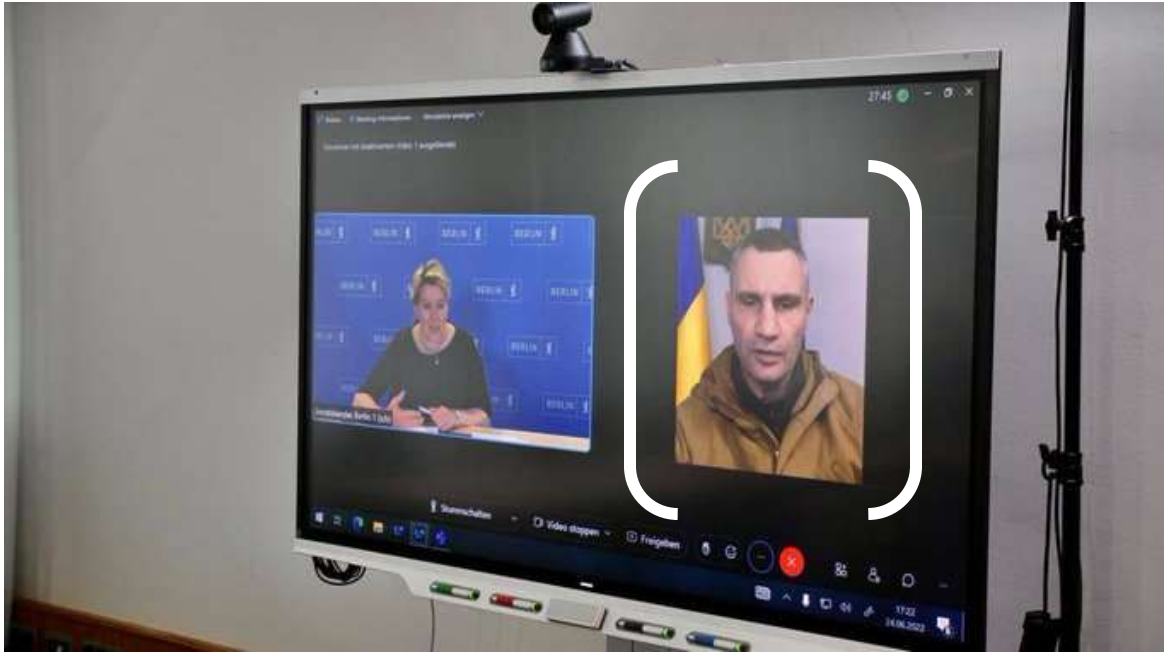


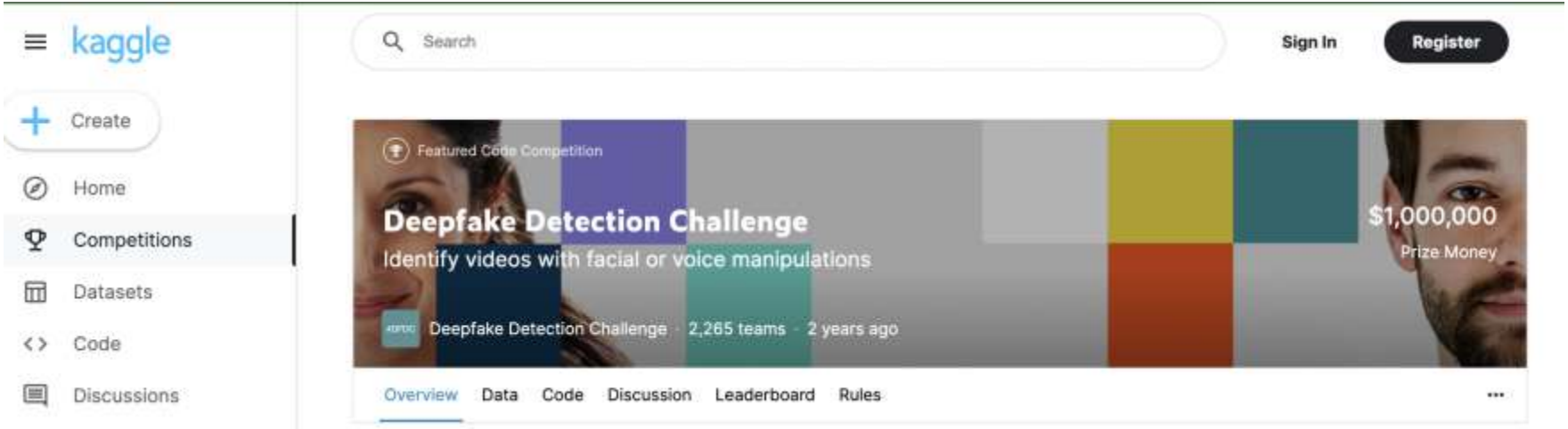
Image from DW.com. The righthand side image is an example of a deepfake used to impersonate the mayor of Kyiv. Brackets are ours.

Potential Dangers:

- Impersonation of political figures and celebrities
- Defamation of citizens
- Extension of ‘catfishing’
- >100k hours of video uploaded to web every day!

We need robust detectors!

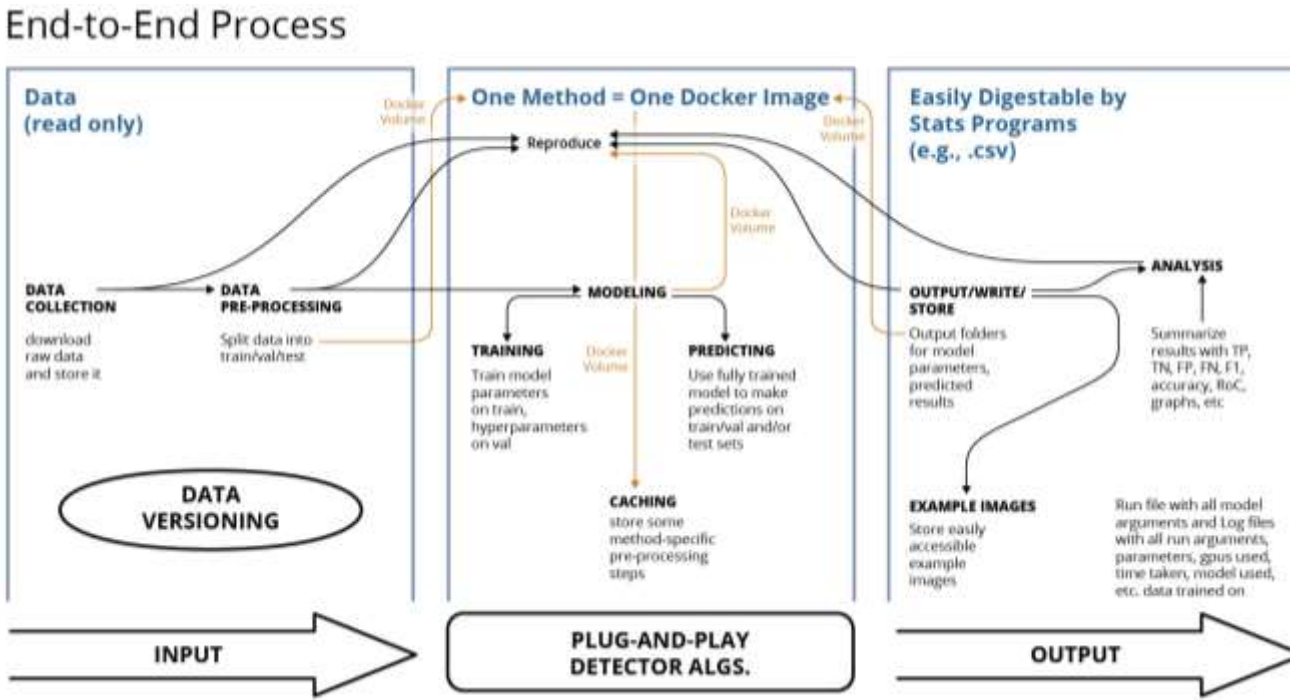
No shortage of methods, but reproducibility is difficult



Challenges:

- Data formats (storage, image vs. video, resolution, source)
- Non-generalizable code (will work only in given scenario)
- Dynamic software (tensorflow, pytorch, opencv, pillow)
- Hardware (GPUs, CPU, data storage, cost)
- Uninterpretable algorithms (usually work well on one data set but not others)

Our solution: Deepfake Detection Pipeline (DDP)



DDP is reproducible, portable, and modular

DDP's backend is SEI's Juneberry – a publicly accessible tool!

Some preliminary results: generalization is difficult

Accuracy (%) of fine-tuned ResNet

Tested on

Trained on	Data Set	Celeb DF v1	Stylegan2	Stylegan3-r	Stylegan3-t	DFDC Pt. 0
	Celeb DF v1	99.1	44.2	44.0	44.2	
	Stylegan2	24.1	98.7	48.4	52.9	
	Stylegan3-t	16.7				
	Stylegan3-r	16.9	68.0	97.2	89.0	
	DFDC Pt. 0					

Looking forward: Ensembles, Data, and GANs

Ensembles

- Time (real time pred.?)
- Accuracy and other metrics
- Feature-based

Data

- Different orgs. have different data with different levels of privacy
- Improved generated data

GANs

- Generative adversarial networks
- Can use our detectors against us
- Should we release detectors?
- How can we defend detectors?