vLUME paper + Deep Learning
... and why you may care

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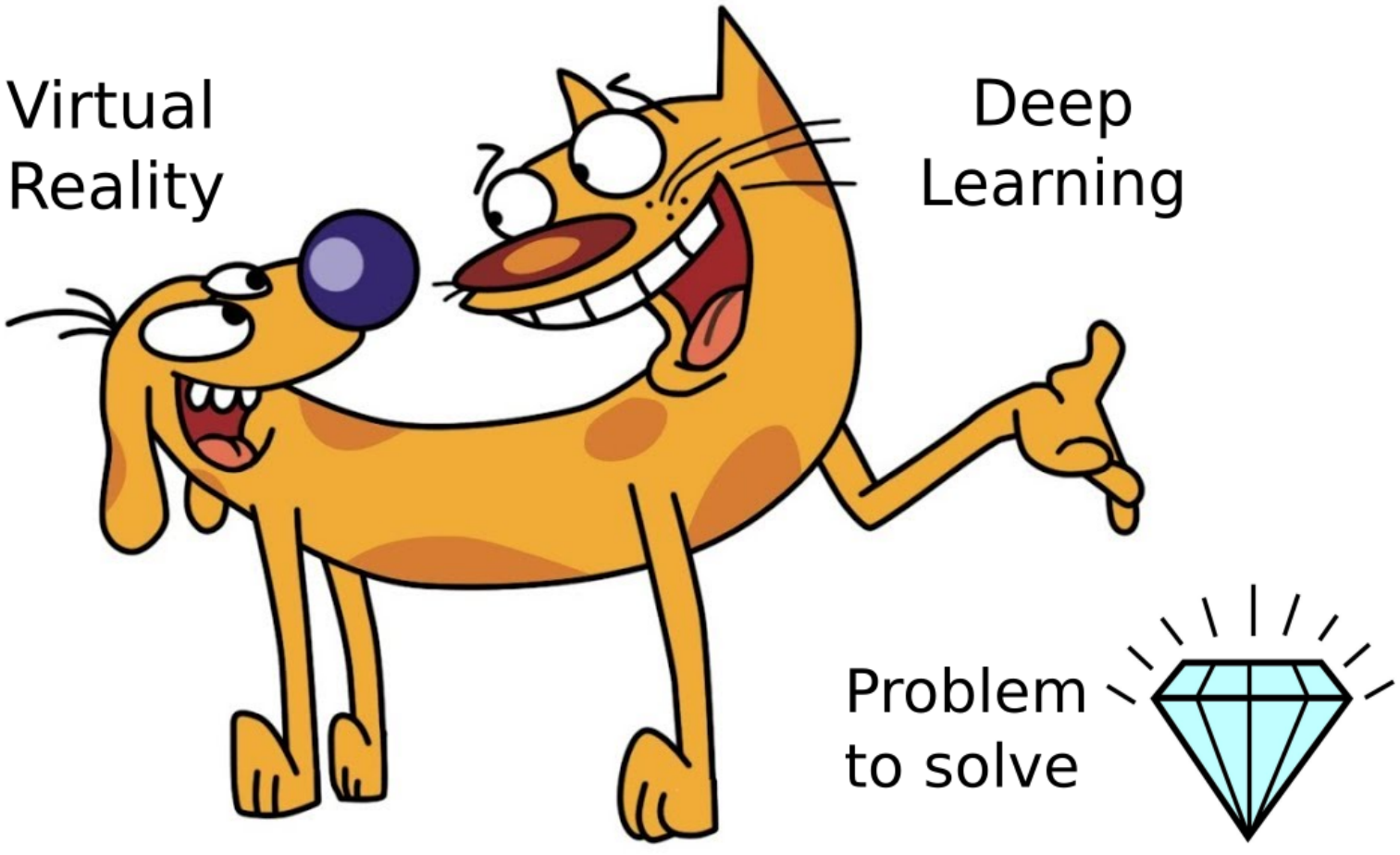
ViRe / IJC

14/12/2020


Virtual
Reality
Deep
Learning
Problem
to solve

nature methods

BRIEF COMMUNICATION

https://doi.org/10.1038/s41592-020-0962-1

*v*LUME: 3D virtual reality for single-molecule localization microscopy

by Daniel Esteban-Ferrer *et al.*

Definition

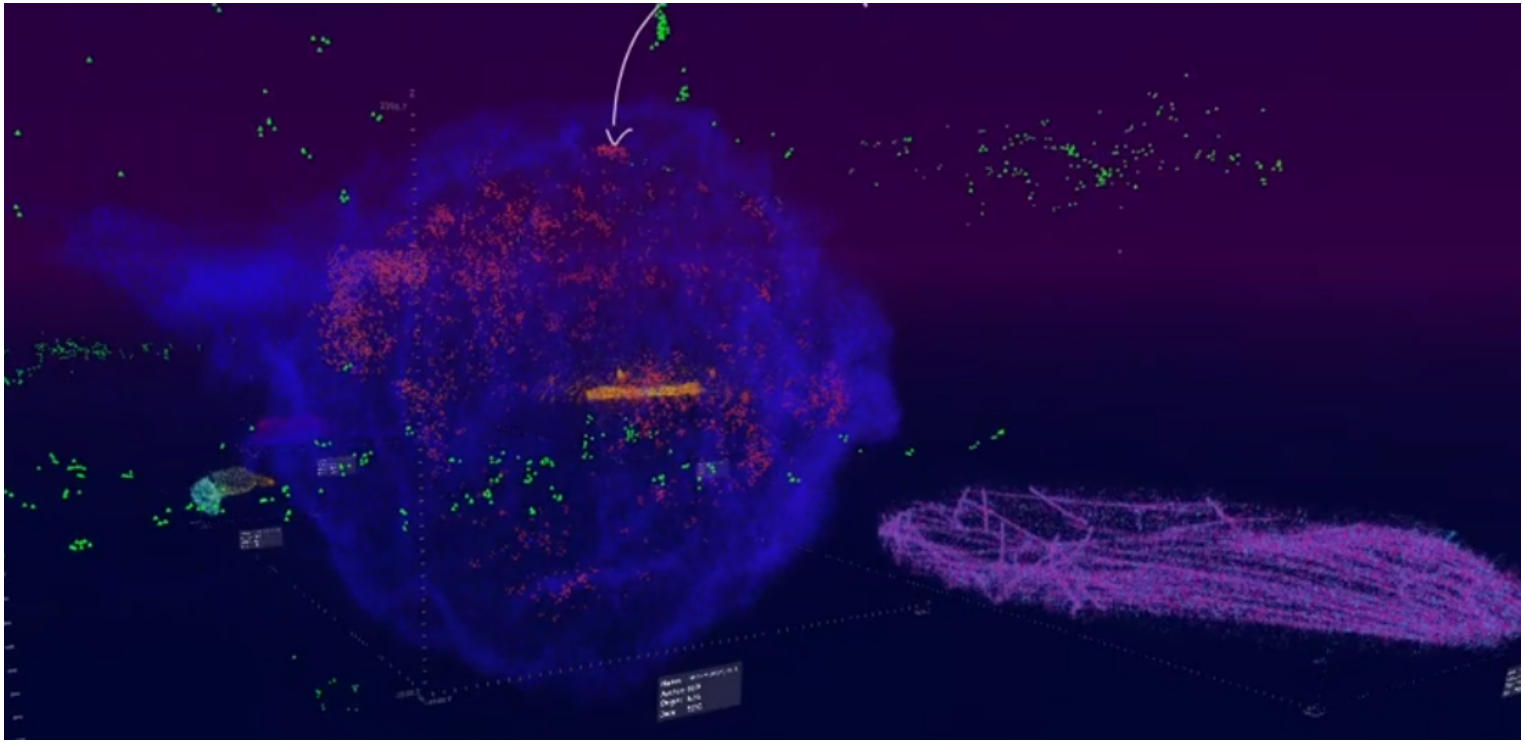
Virtual reality (VR)

the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment.

But why?

Human spatial perception is fundamentally 3D.

Demo



vLUME's key features

1. Data exploration and comparison
2. 3D regions of interest extraction (ROI); annotation, segmentation
3. Custom analysis of user-defined subregions
4. Export of video files for presentations / publications

Conclusions

Pros:

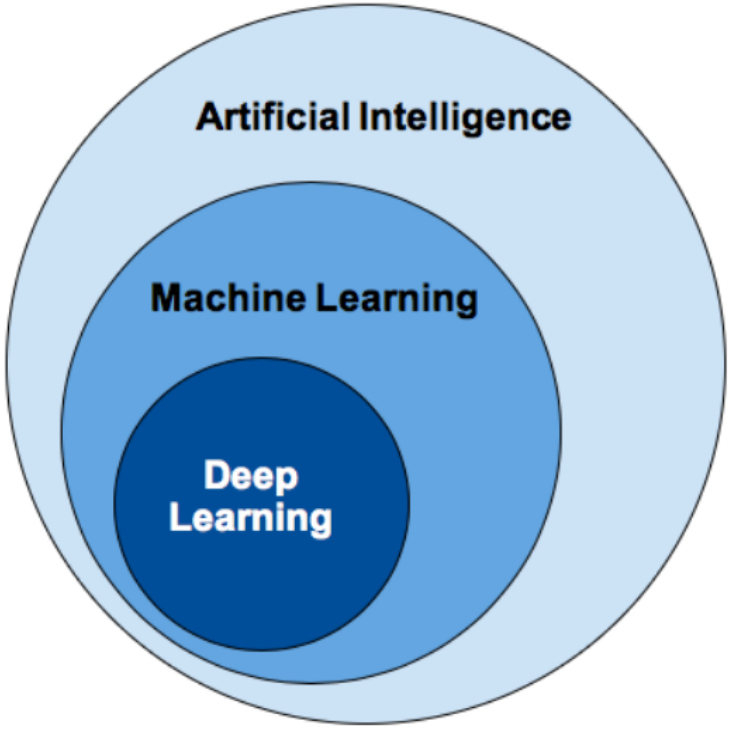
- Daniel have gotten experience of standard Unity engine utilization for VR tasks and became familiar with pitfalls to avoid

Cons:

- No source code available!

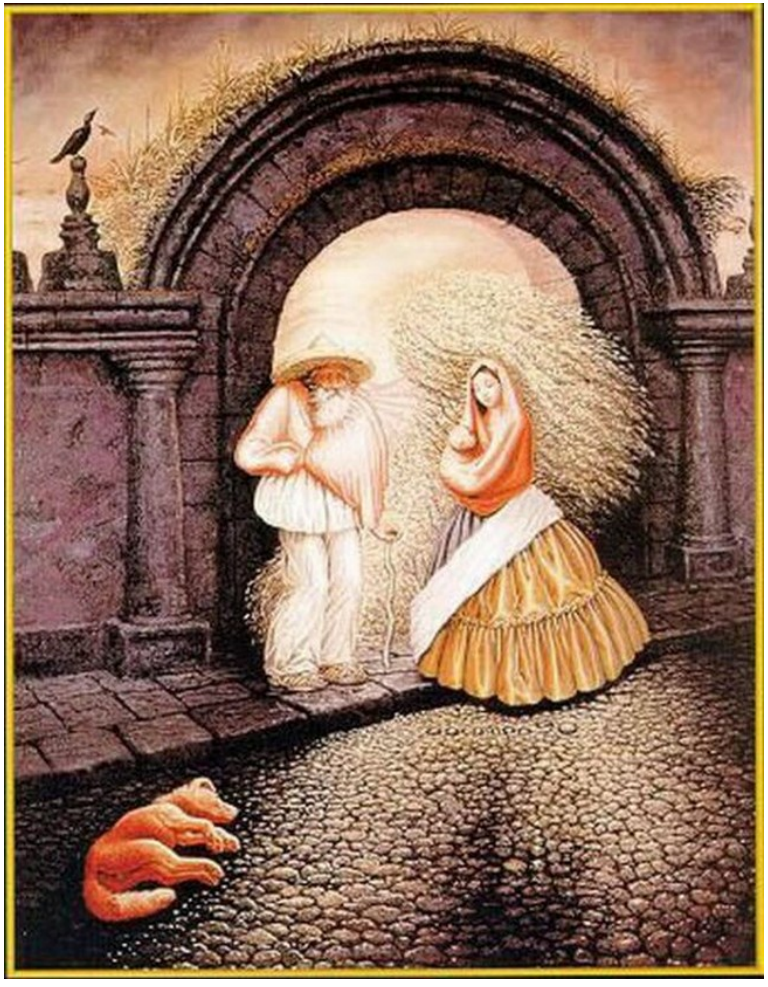
The first step was done! We start from the scratch now and have more options to adjust the future system to your needs!

What is Deep Learning?



- AI - mimics human behaviour;
- ML - use statistical methods to improve machines performance with experience;
- DL - use neural networks; *creates features on its own*.

Why Deep Learning if Random Forest works fine for us?



There are different approaches:

- Linear Models (Logistic regression, SVM);
- **Tree Based Methods (i. e. Random Forest);**
- **Deep Learning (Neural Networks);**
- kNN.

All of them has benefits and drawbacks, more suitable for different tasks and data (no free lunch theorem).

Computer vision: images are numbers

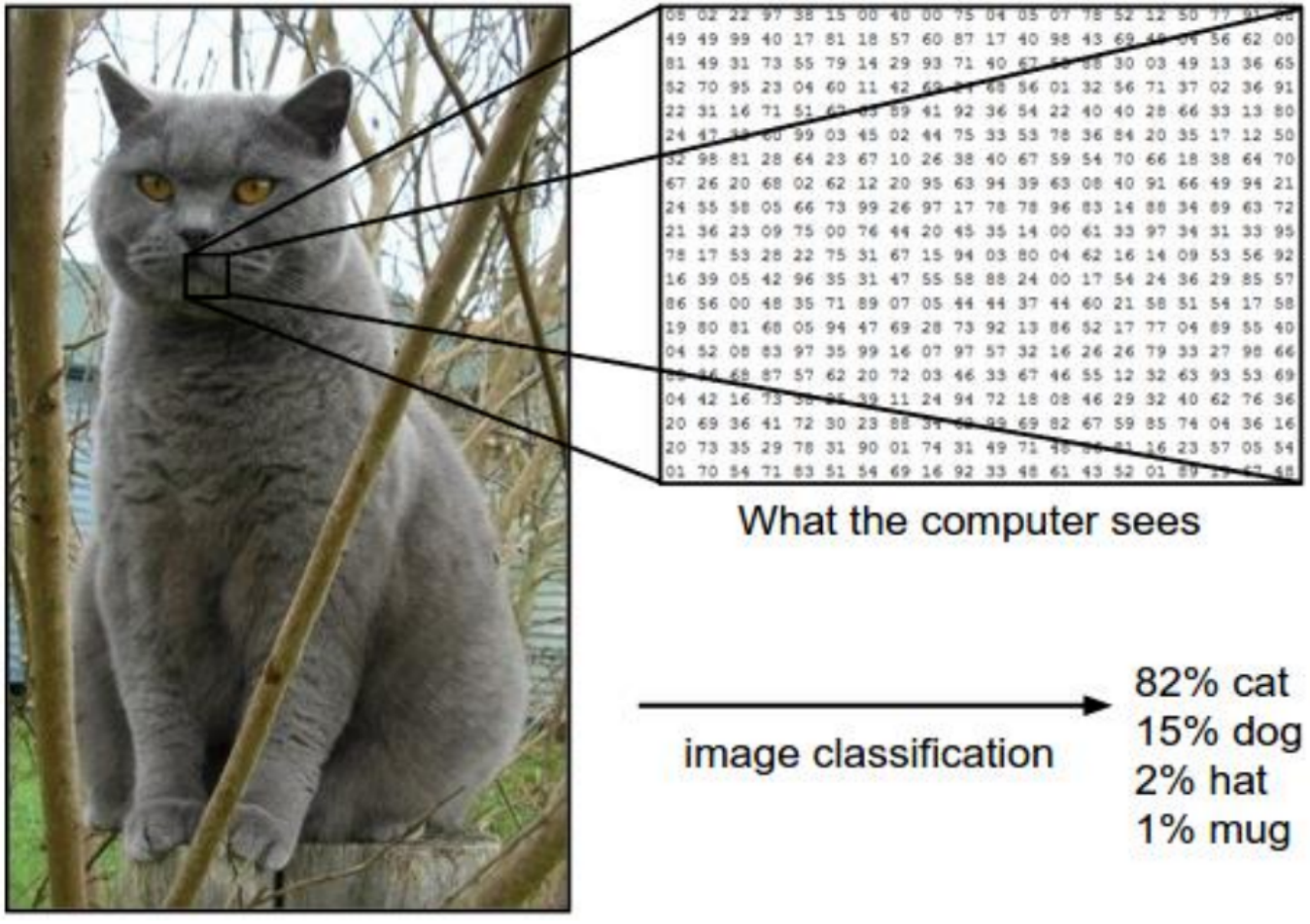
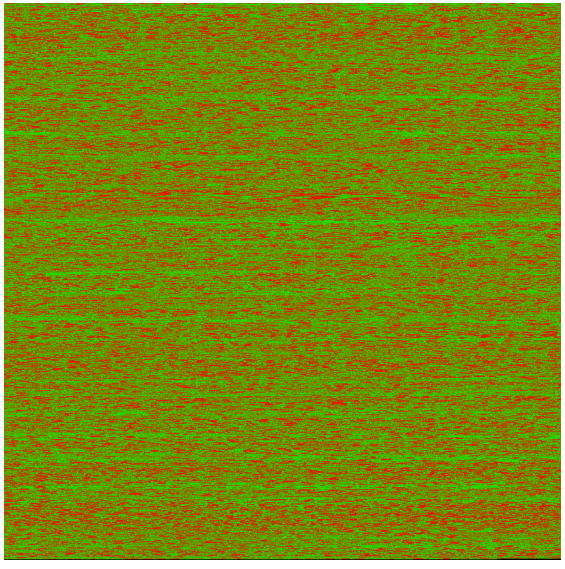


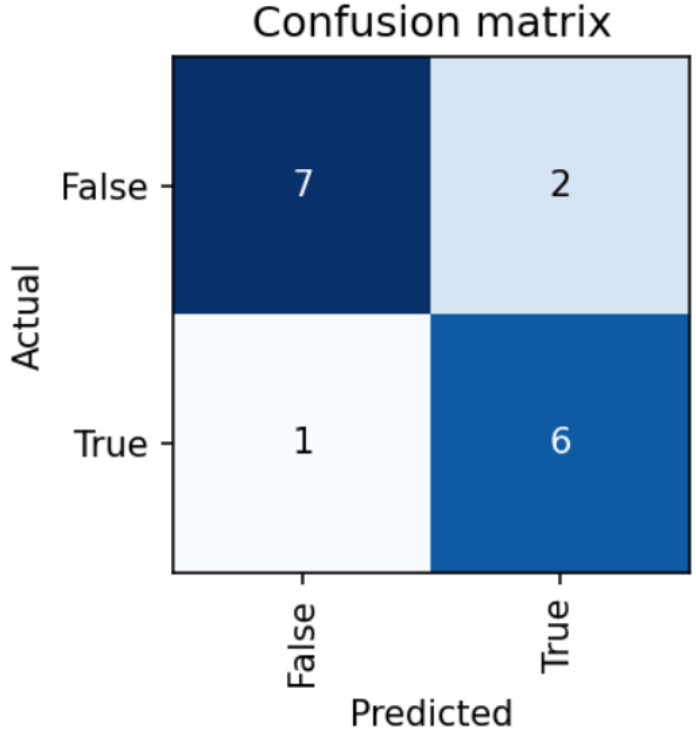
Figure: MIT 6.S094

IJC: Methilation data classifier

Step 1:
Convert interrogated cpg for patient:
[0.92, 0.77, 0.81, ..., 0.09, 0.62] to
the image:

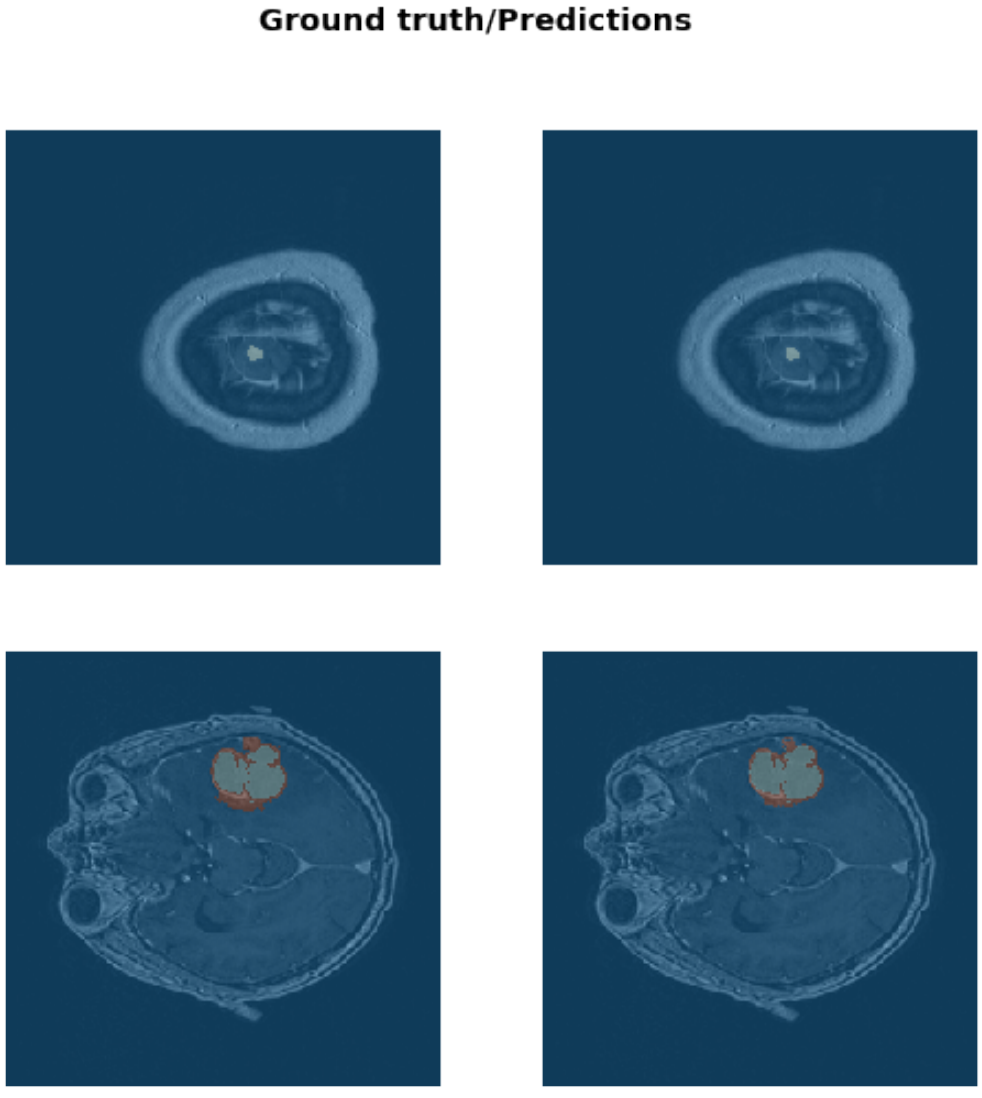


Step 2:
Build image classifier, results:



Resume: preliminary result provided by neural networks perform as classical ML approaches (and provide higher accuracy than in the paper).

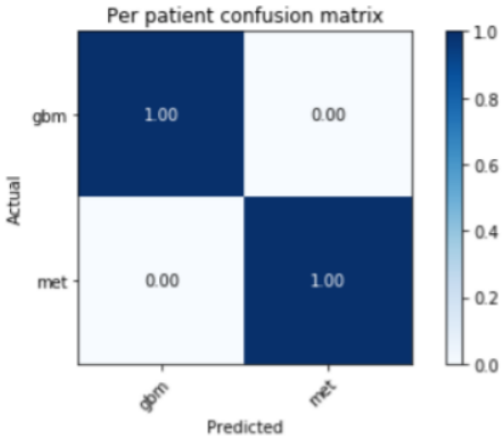
MoLAB: MRI segmentation



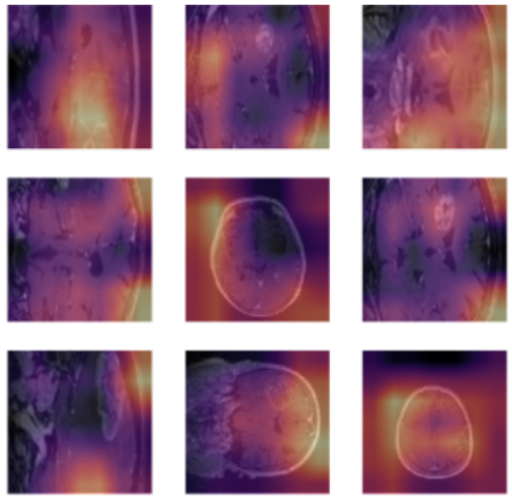
Data quality and quantity defines quality of results. Labelled data is required.

Type	# of MRIs
Meningioma	276
HGG	528
Metastasis	264
Total	**1068**

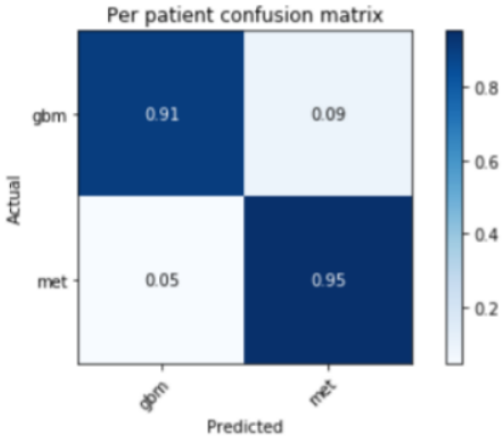
MoLAB: MRI classification & interpretability



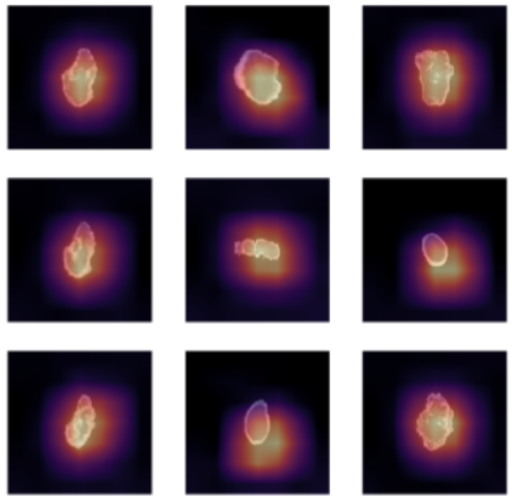
(a) Confusion matrix corresponding to CID



(b) Heatmaps corresponding to CID



(c) Confusion matrix corresponding to SID



(d) Heatmaps corresponding to SID

Figure: Qualification of DL-engineer is more important than data.

Deep Learning applications

Deep Learning solved protein folding problem.

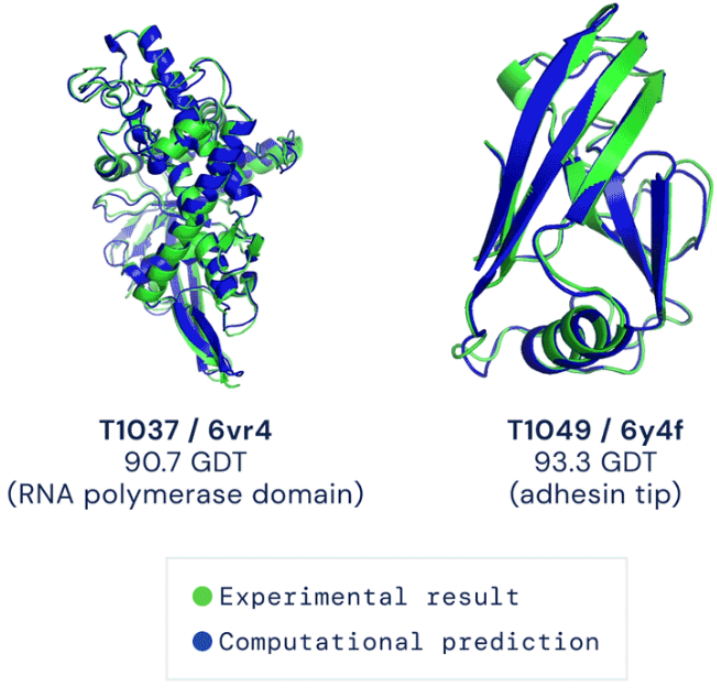


Figure: DeepMind blog post

Synthetic MRI generation.

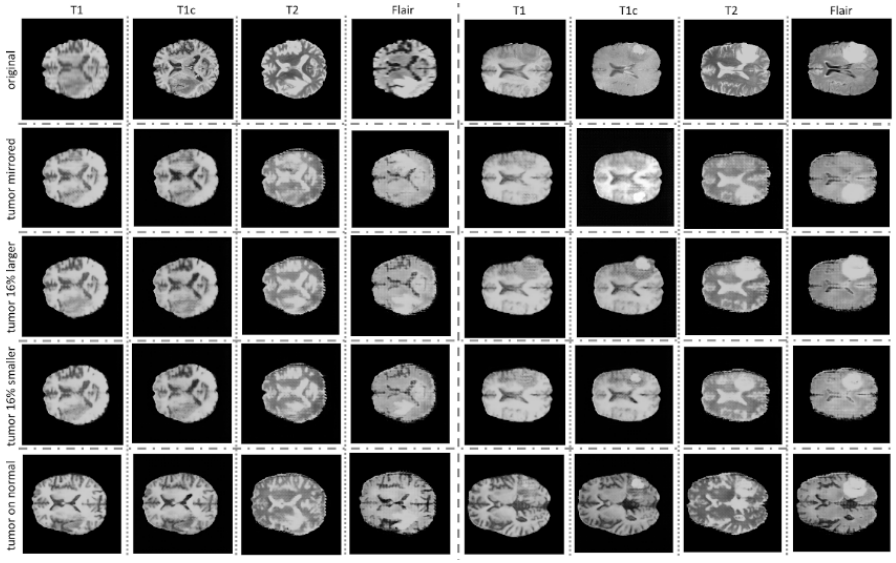


Figure: NVidia blog post

Deep Learning applications

A GPT-3 bot posted comments on Reddit for a week and no one noticed

Under the username /u/thegentlemetre, the bot was interacting with people on /r/AskReddit, a popular forum for general chat with 30 million users.

Figure: Blog post

GPT-3 model: paper

Navier–Stokes equations - important hydrodynamics model.

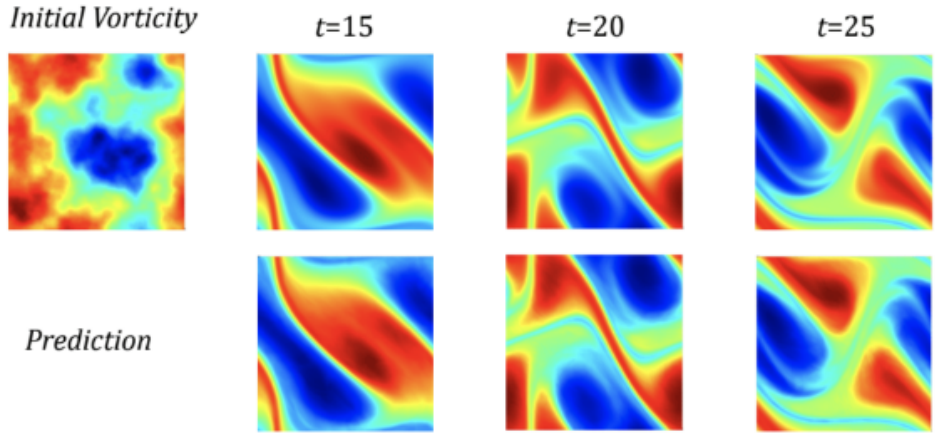
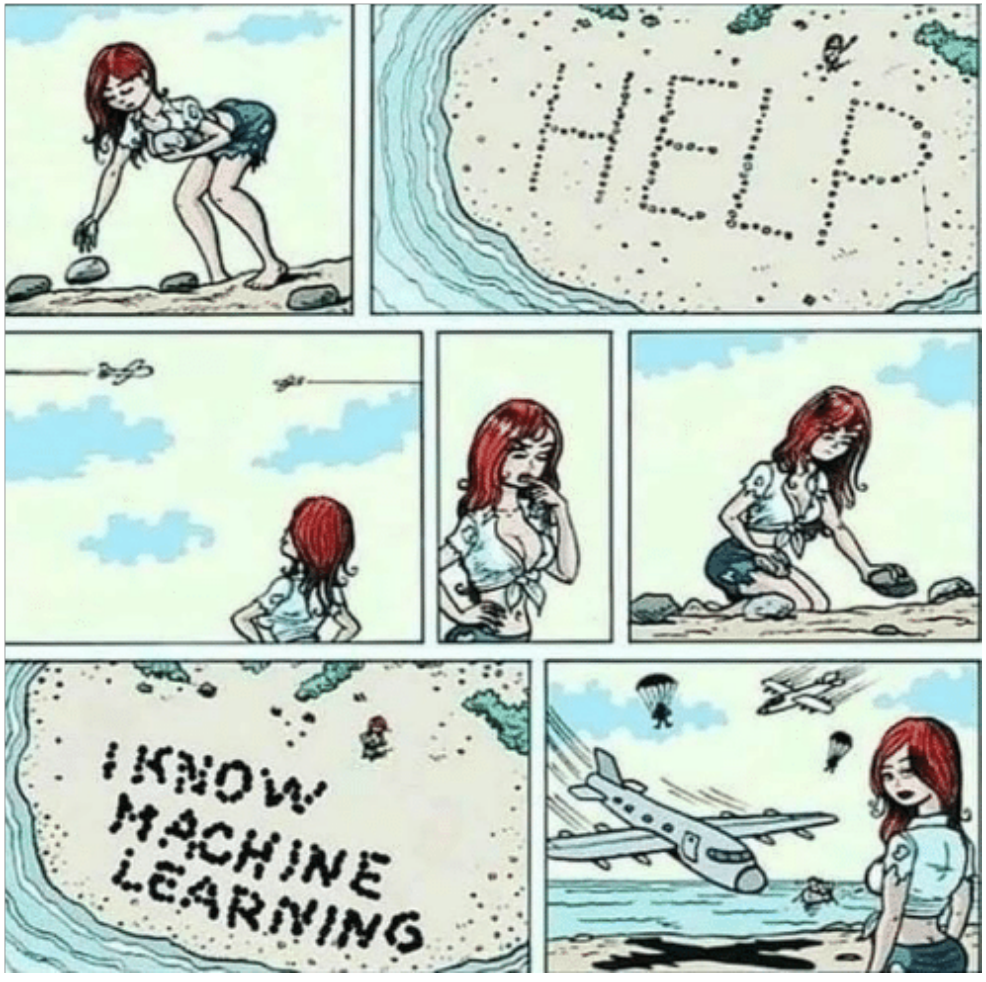


Figure: Navier-Stokes equation solver 10^3 speed-up

Conclusions



- Deep Learning is valuable addition to IJC's tools-set ("AGATA" project?);
- Classical ML is still "the thing";
- I am happy to share my DL knowledge and expertise

Discussion

- Most of AI starups fail not because they have bad ML-models... but because they solve not relevant problems.
- What problems in your everyday work may be solved with the help of VR or DL or their combination?

Thank you for your attention!