FRIEDRICH-ALEXANDER
UNIVERSITÄT
ERLANGEN-NÜRNBERG

FACULTY OF ENGINEERING

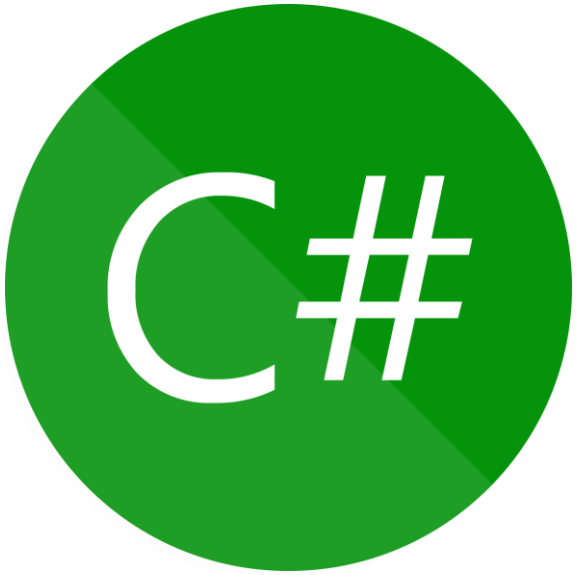
Mitobunny
-A game to annotate Mitotic Cells

Srijeet Chatterjee , Mingxuan Gu, Zhaoya Pan, Wenyu Zhang, Muhammed Umer Raja

22nd July , 2019

Lecturers
Prof. Dr.-Ing. habil. Andreas Maier, Dr. rer. biol. hum. Ludwig Ritschl,
Prof. Dr.-Ing. Joachim Hornegger

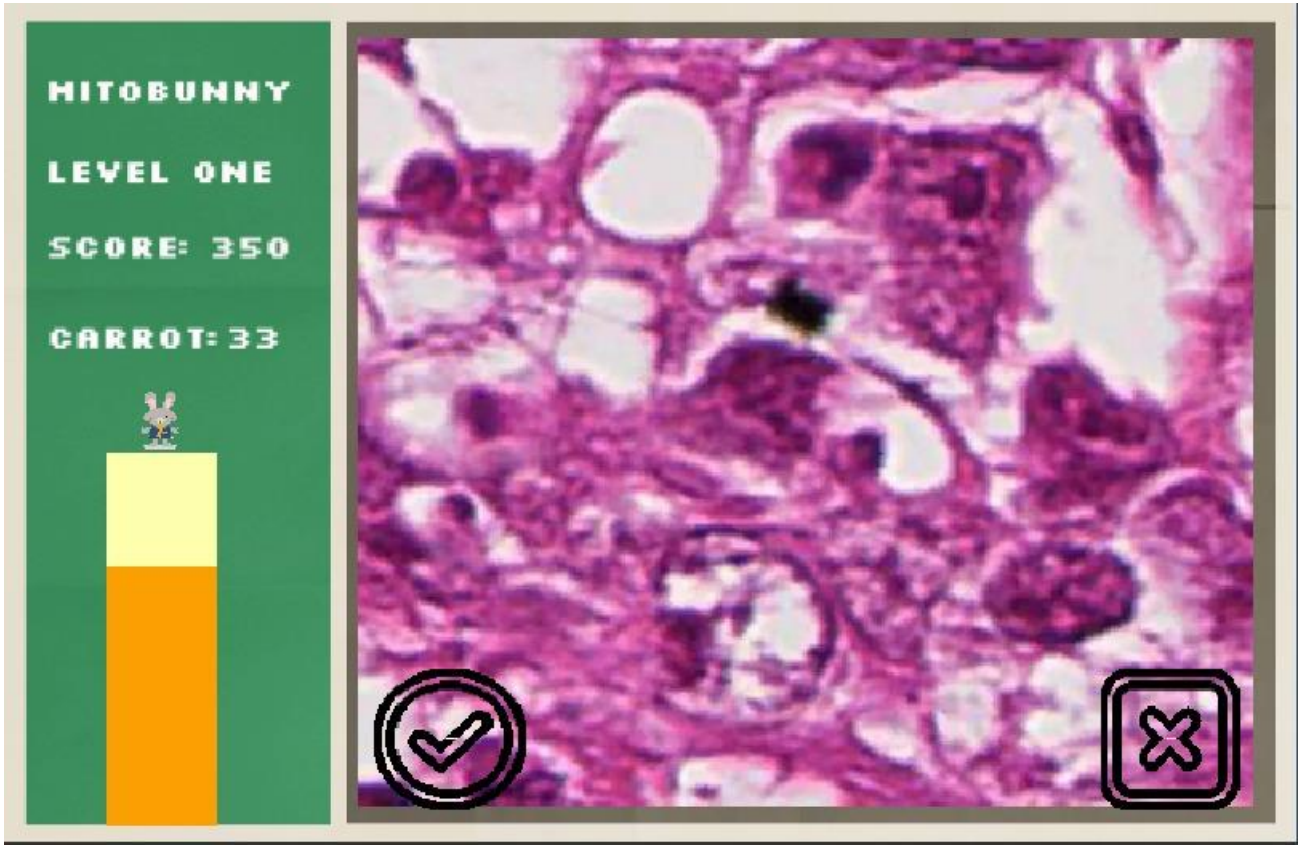
Platform



Mitobunny

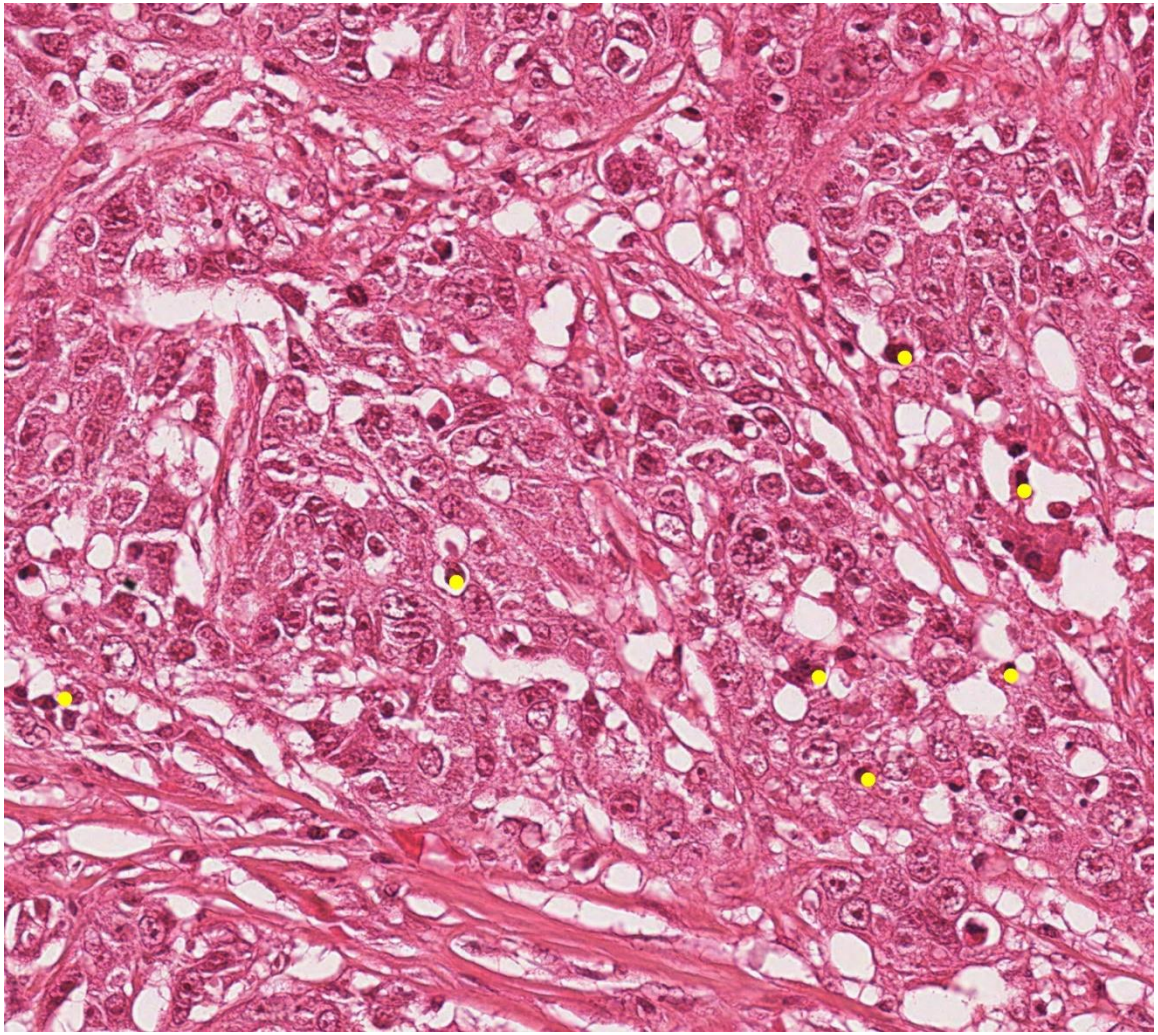

MITOBUNNY
PLAY
EXIT
REGISTRATION
EMAIL ADRESS
HIGH SCORES
Development Console
Open Log File
Clear
Close

Mitobunny

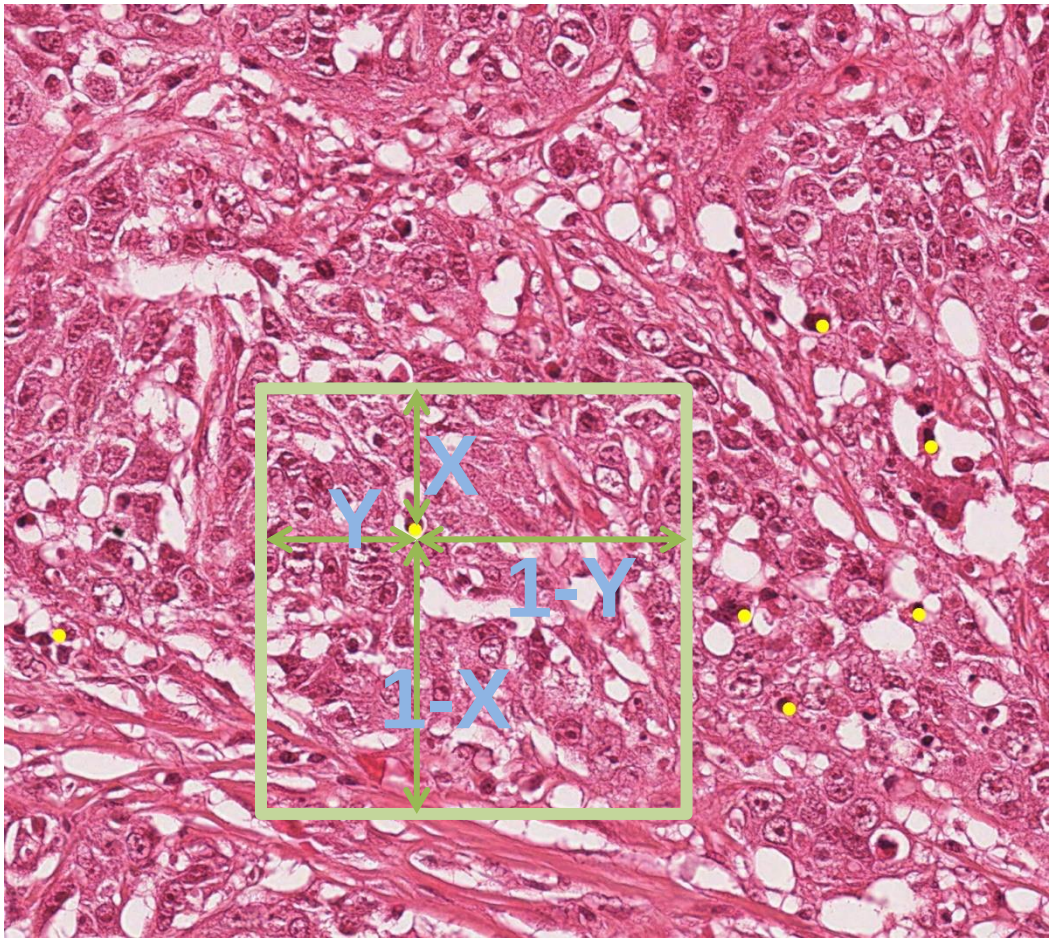



LETS
PLAY

Database(mitosis images)



Database(mitosis images)

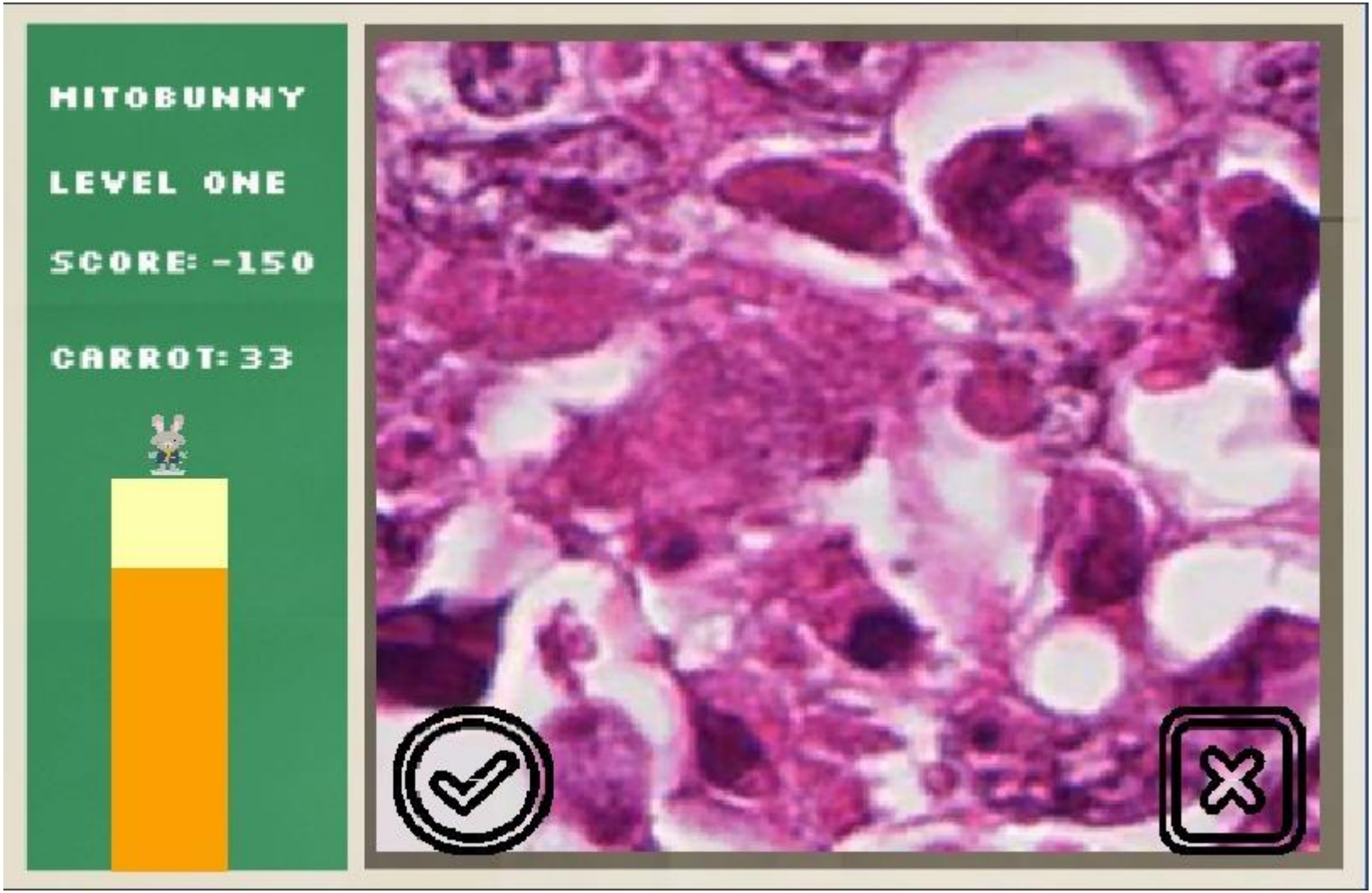


X, Y = Random(0 ,1)

Database(user information)

age	city	country	Email	familyname	firstname	institute	level	score	sex	password	carrots
22	SiChuan	China	aaaaaaa@qq.com	qqqqq	dfdfdfdf	abc	0	1200	male		33
40	cmKnL	Germany	ACrFQ.kgOeTMQlD@fau.de	NBVjW	eDRRovmz	Ger-A	0	18	female		0
40	gfphdam	Germany	AdlChFgT.R@163.com	Ey	JYTfJb	Ger-A	0	42	female		0
15	tiCqGn	Germany	AHcR.cmf@icloud.com	AOtmog	ctHbWPcJO	Ger-A	0	83	female		0
65	aGFqoNC	Germany	awWXUAYI.ecPzIimb@fau.de	TvrD	FRiahg	Ger-A	0	54	male		0
32	FDLcI	Germany	Bb.U@163.com	TBemt	iCjIkdKYJ	Ger-A	0	73	female		0
23	cVtKHKM	Germany	Bc.jR@fau.de	xpPxN	uTbREcx	Ger-B	0	31	male		0
24	ECVzfPzEd	Germany	BcMkat.yNRd@fau.de	myw	rXxJow	Ger-B	0	65	female		0
74	gCtAvG	Germany	BDjpgbrl.zCQctFmc@qq.com	jSB	yaAMOFDIJdN	Ger-B	0	85	female		0
30	olDxW	Germany	BEvKIM.SuNYUsn@163.com	Rf	EjQPpjb	Ger-B	0	77	male		0
68	DMbeHbC	Germany	bvAflH.idqiQq@163.com	EtWWmQ	IVhTfigyE	Ger-B	0	55	male		0

Scoring(L1):



Scoring(L1):

Scoring(L1):

Carrot: math.floor(max(score, 0)/100)

Leader Board:

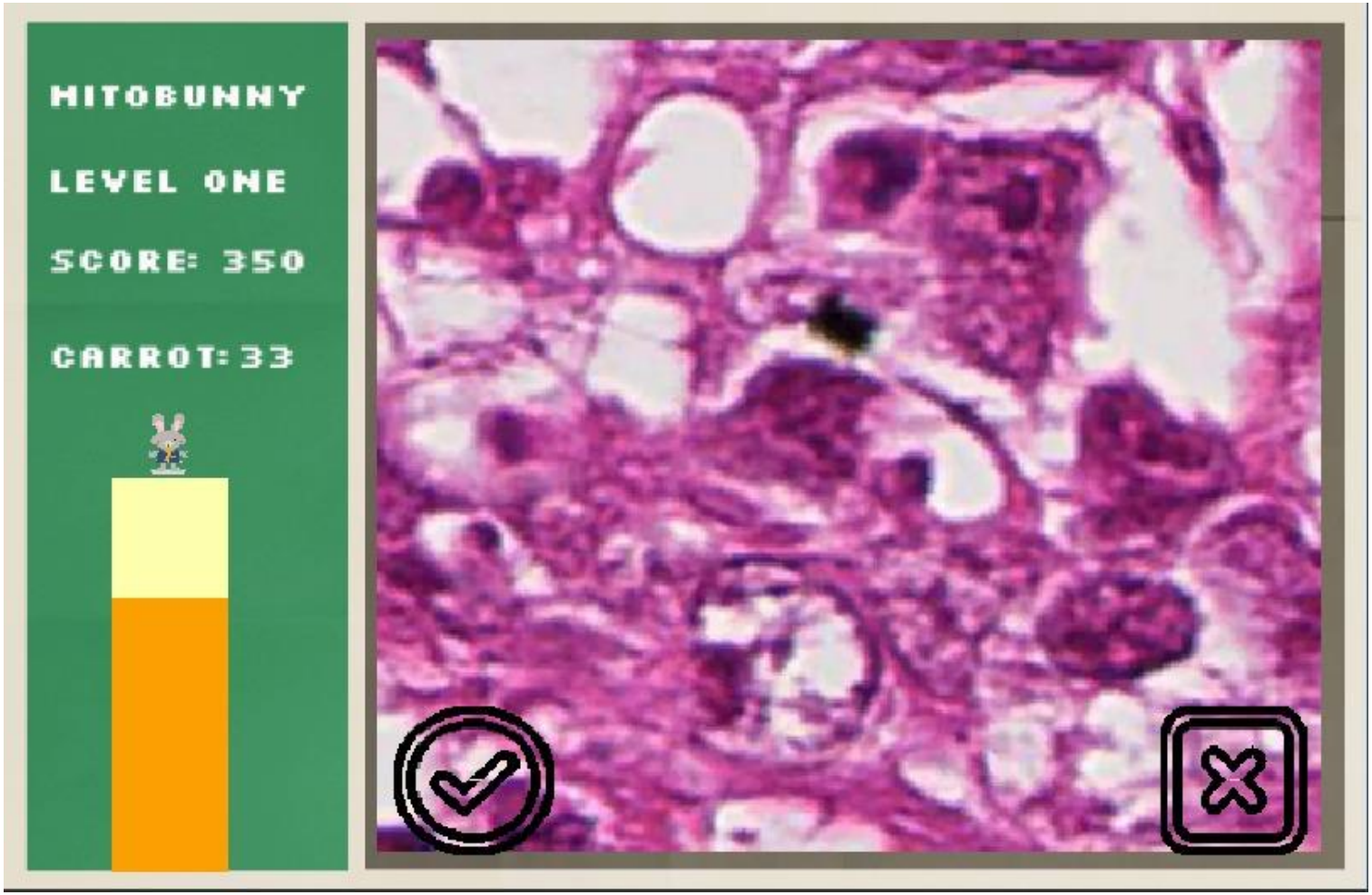
So let’s recall our Objective:

Deep Learning-based algorithms showed great performance in many fields of image procession and pattern recognition and compete with technologies such as compressive sensing and iterative optimization. The basis for the success of these algorithms is the availability of large amounts of data (big data) for training and of high computing power (typically GPUs).

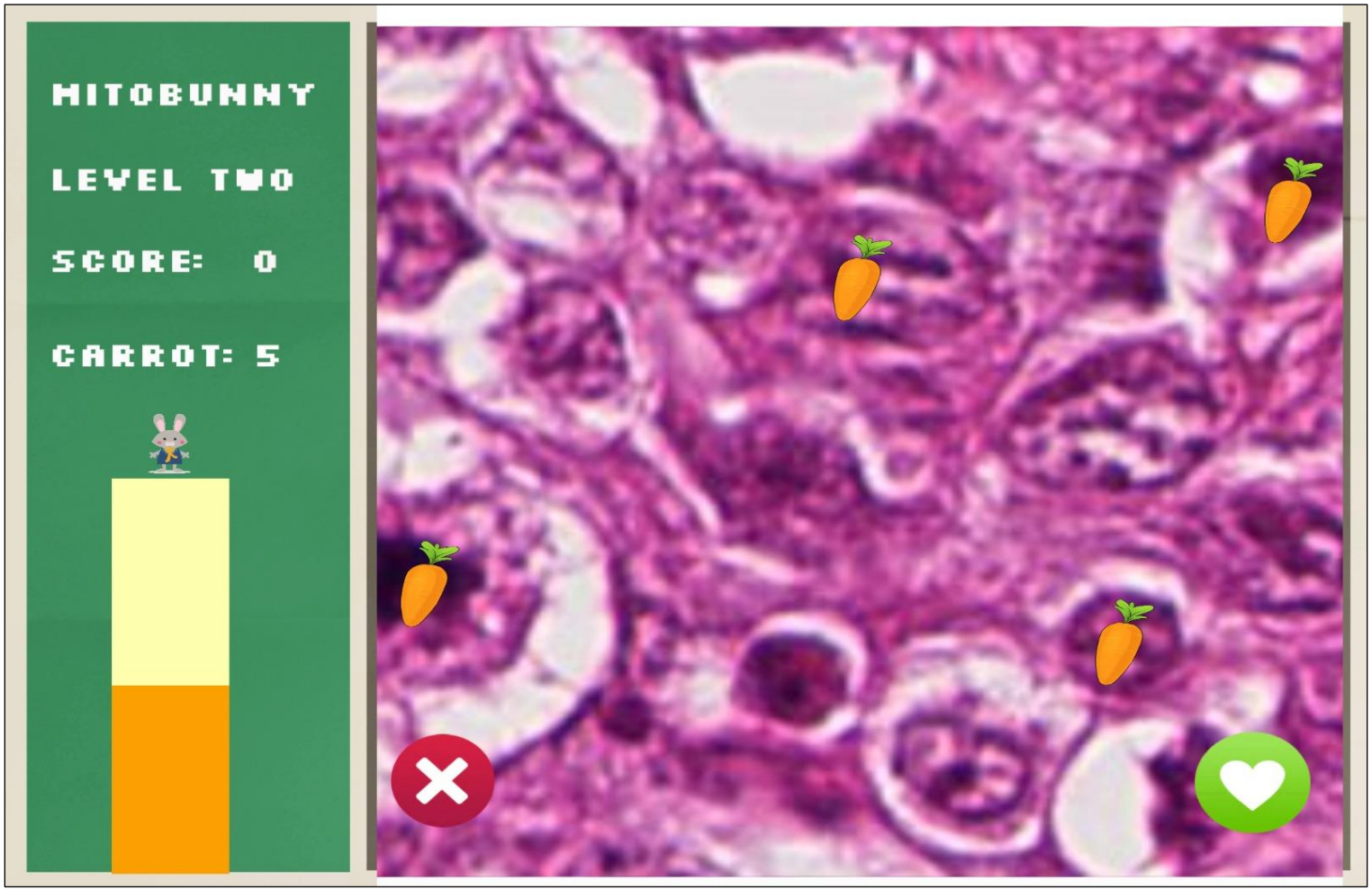
A major shortcoming is typically the number of labels that is required to train machine learning algorithms. Therefore, this project seminar will look into how to tackle this problem looking into topics of crowd-sourcing and gamification.

To arrive at good solutions also mobile game development will be a topic of interest. Aim of the seminar is to develop a prototype level for such a gamification-based crowd sourcing approach.

RECOGNITION PHASE:LEVEL-1



UNDERSTANDING PHASE: LEVEL-2



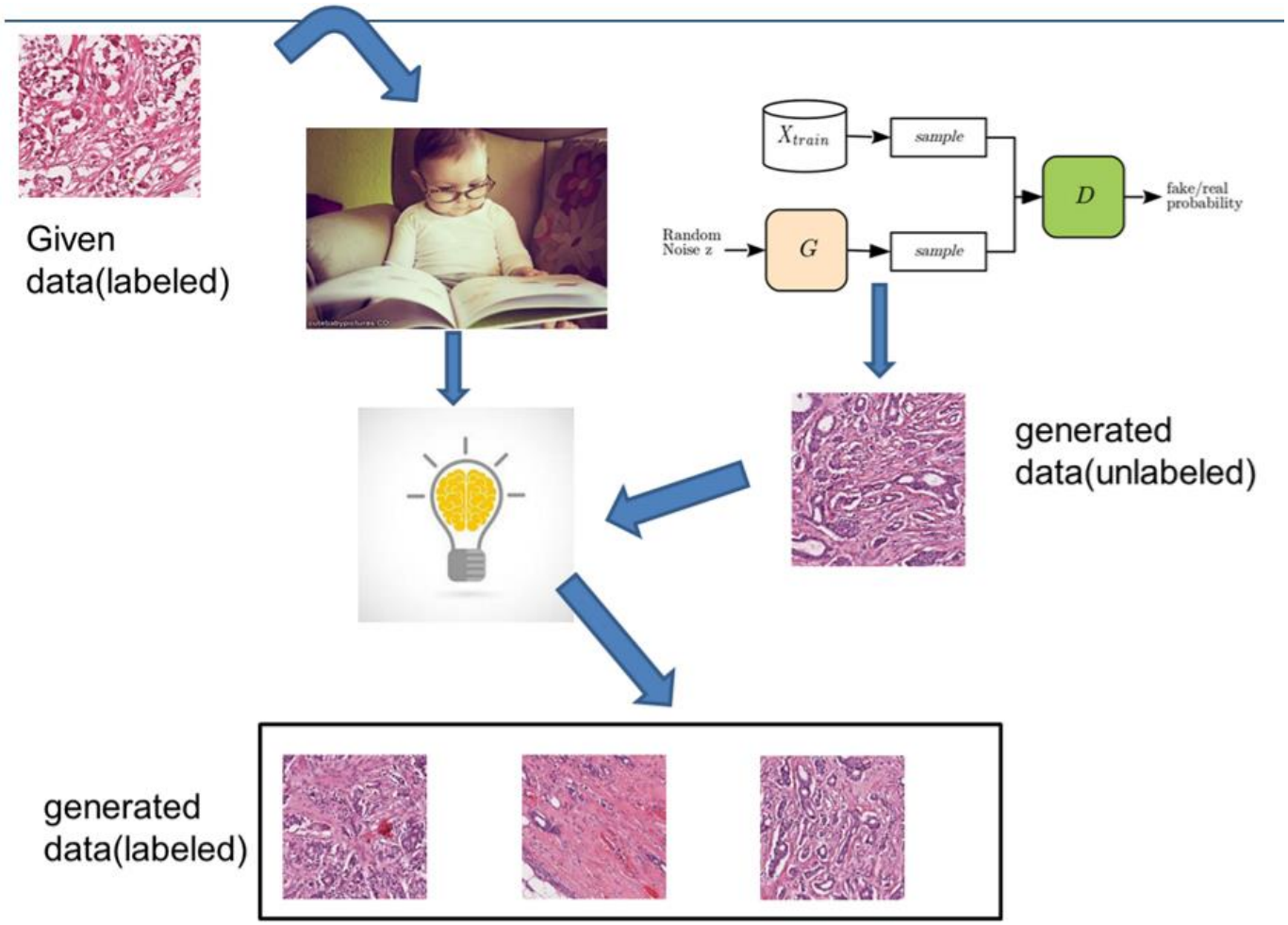
WHAT'S NEXT???

WHAT'S NEXT???

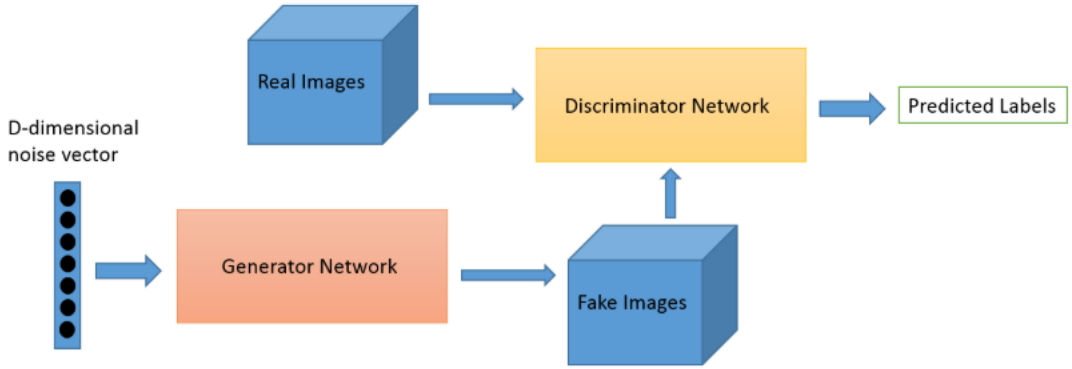
REAL GAME!!!!

LEVEL-3

Data Generation and Annotation



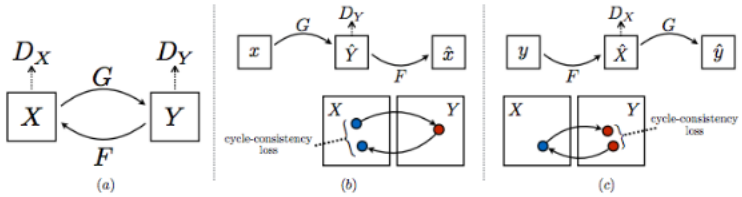
Cycle GAN



- The **Generator** model conditions on some inputs and learns to generate an image.
- The **Discriminator** model scores how 'real' images look, learning to distinguish between generated and real images. This score provides feedback to the generator on how well it is performing, like a teacher grading a student.
- Both models are trained simultaneously, and the feedback loop between the two improves the performance of each other.
- Post-training, the Generator should be able to produce original, realistic looking images.

CycleGAN: Cycle Consistency

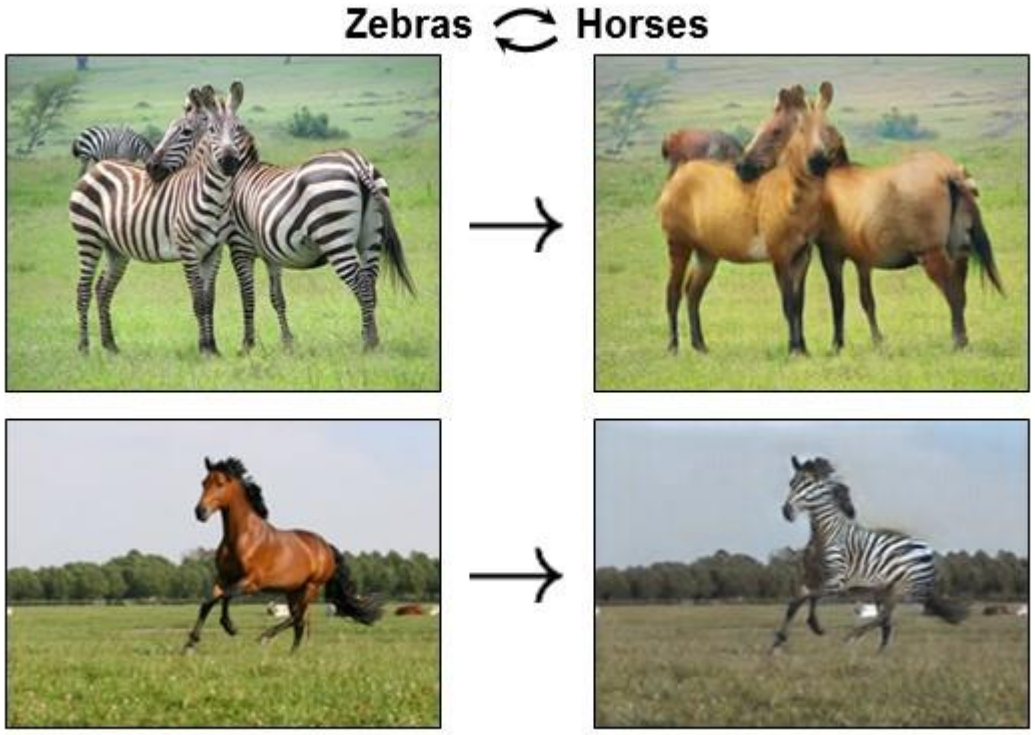
To learn to translate images of one type to another, CycleGAN uses an intuition called **cycle consistency**, using two generators and two discriminators. Given image domains **X** and **Y**, we have:



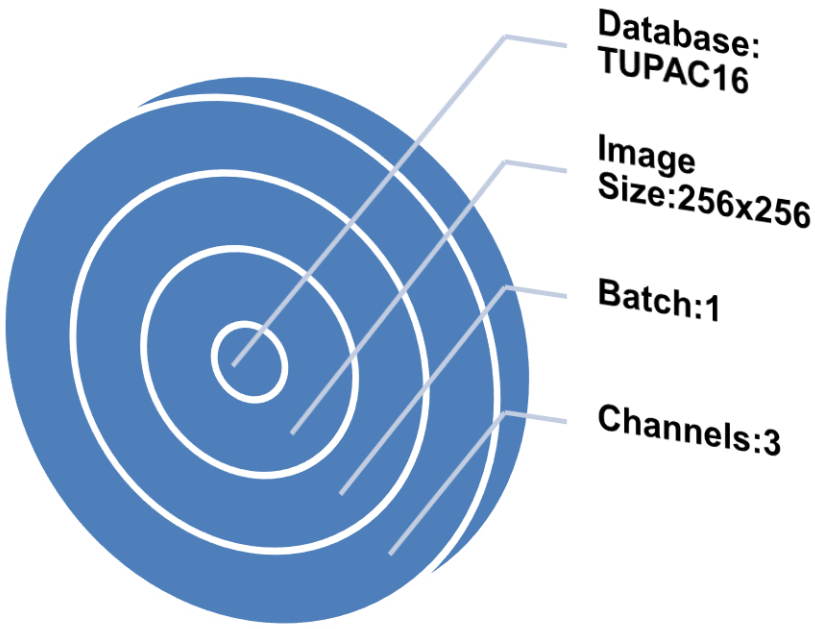
- Generator $G : X \rightarrow Y$: translates images from X to Y (e.g. horse to zebra)
- Generator $F : Y \rightarrow X$: translates images from Y to X (e.g. zebra to horse)
- Discriminator D_X: scores how real an image of X looks (e.g. does this image look like a horse?)
- Discriminator D_Y: scores how real an image of Y looks (e.g. does this image look like a zebra?)

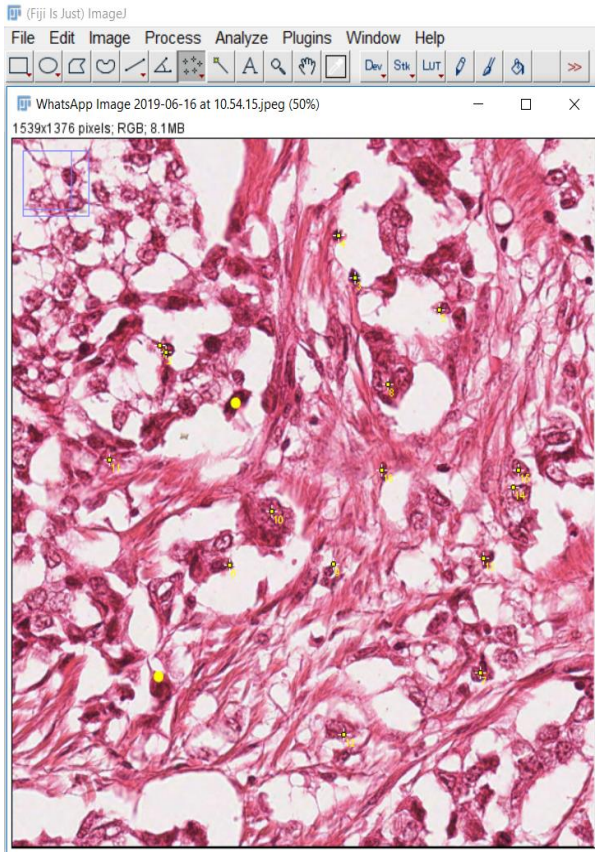
The intuition of cycle consistency is that, if you are able to train these pair of GANs to translate from $X \rightarrow Y \rightarrow X$, i.e. generate images while assuring cycle consistency, that $x \rightarrow G(x) \rightarrow F(G(x)) \approx x$, then you would have learned the image translation task sufficiently well.

Expectation



Reality


Database:
TUPAC16
Image
Size:256x256
Batch:1
Channels:3


(Fiji Is Just) ImageJ
File Edit Image Process Analyze Plugins Window Help
WhatsApp Image 2019-06-16 at 10.54.15.jpeg (50%)
1539x1376 pixels; RGB; 8.1MB

Res-net Discriminator Patch-Discriminator

Padding
Conv2d→Relu
Padding
Conv2d→Relu

Conv2d→Relu
Conv2d→Relu
Conv2d→Relu
Conv2d

Crop
Conv2d→Relu
Conv2d→Relu
Conv2d→Relu
Conv2d

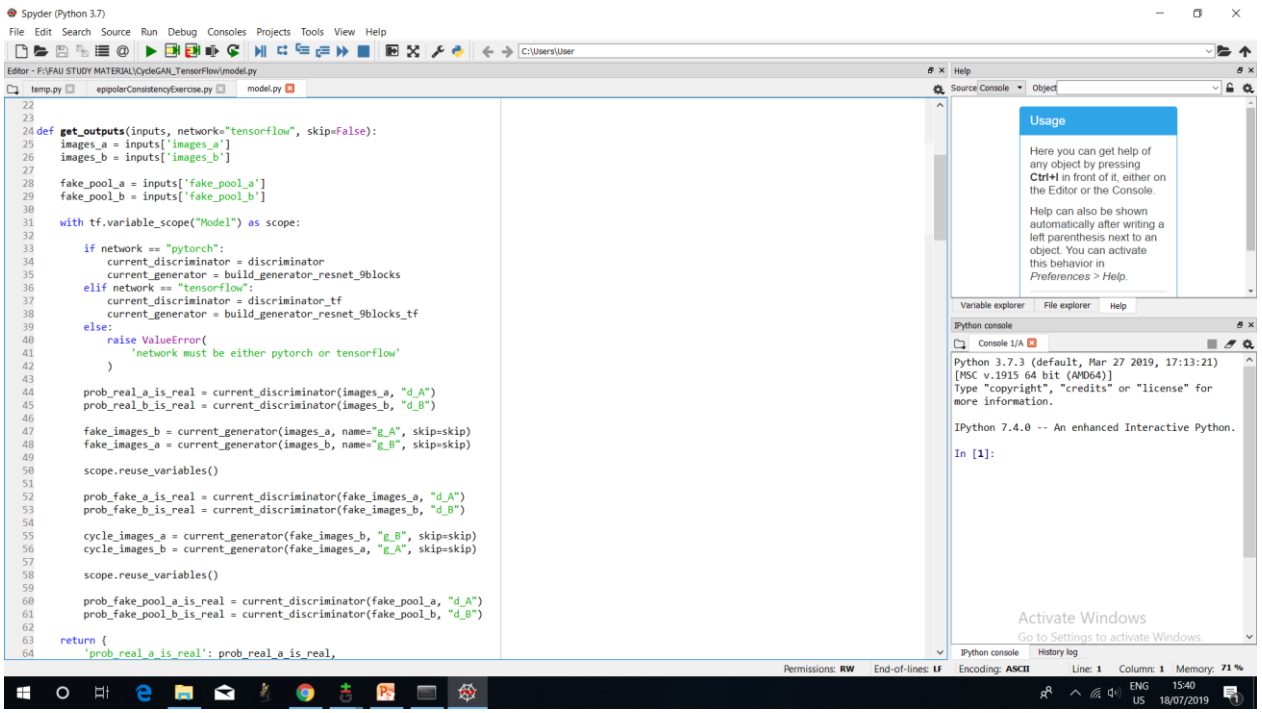
Generator

Padding
Conv2d→Relu
Conv2d→Relu

Res-net Layer
Res-net Layer
Res-net Layer
Res-net Layer
Res-net Layer
Res-net Layer

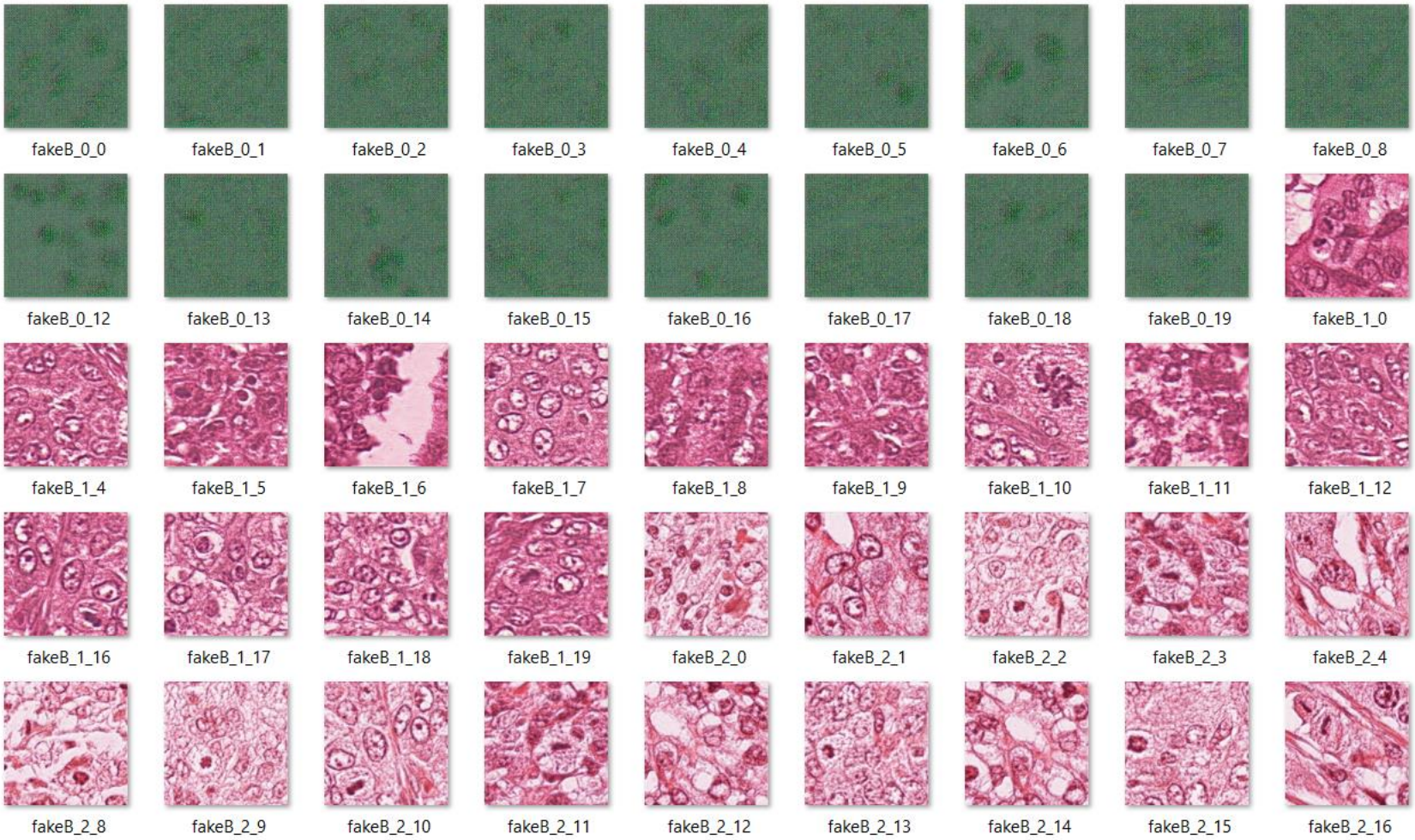
Decon→Relu
Deconv→Relu

Conv2d→tanH

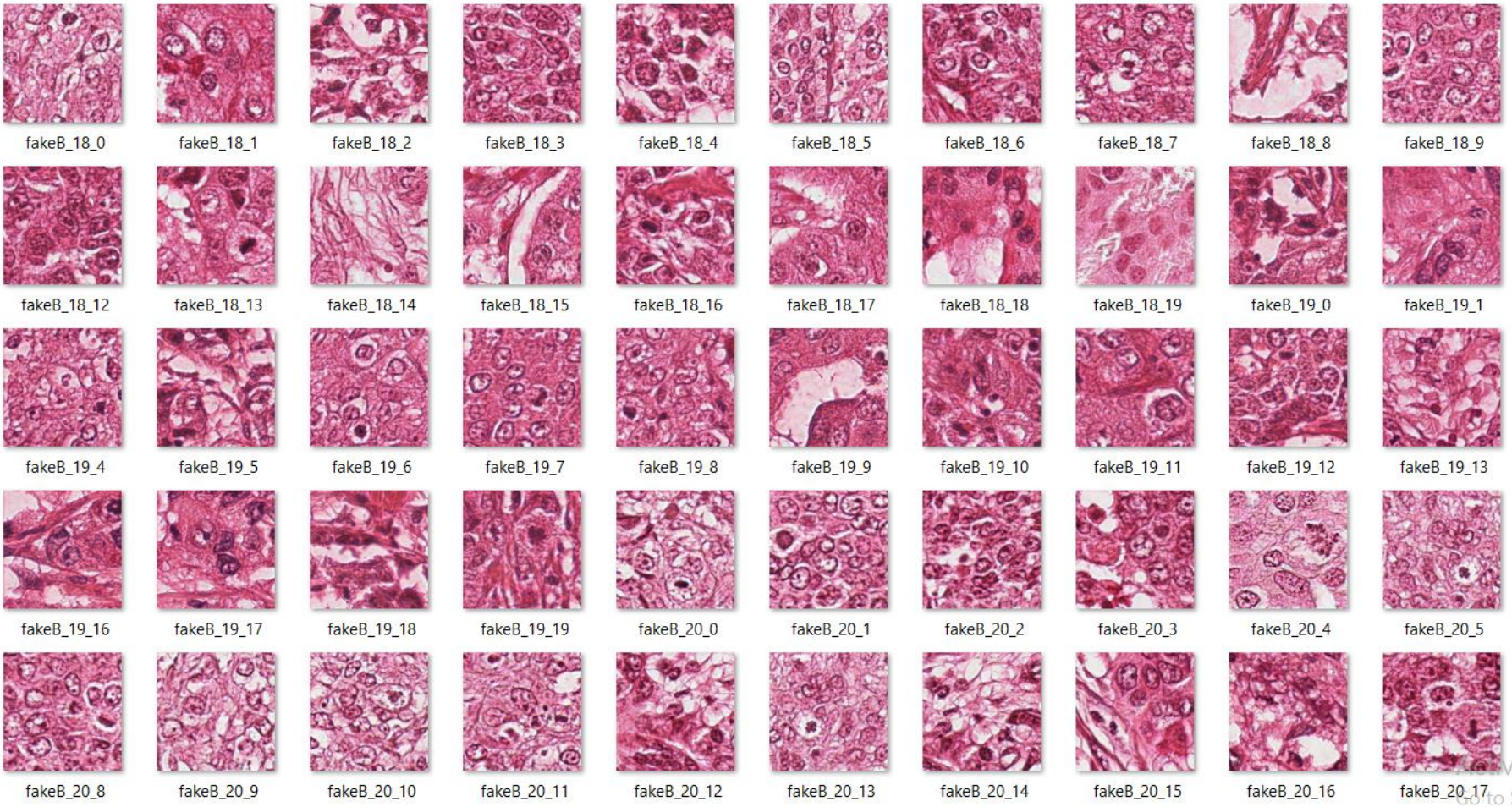


https://github.com/leehomyc/cyclegan-1

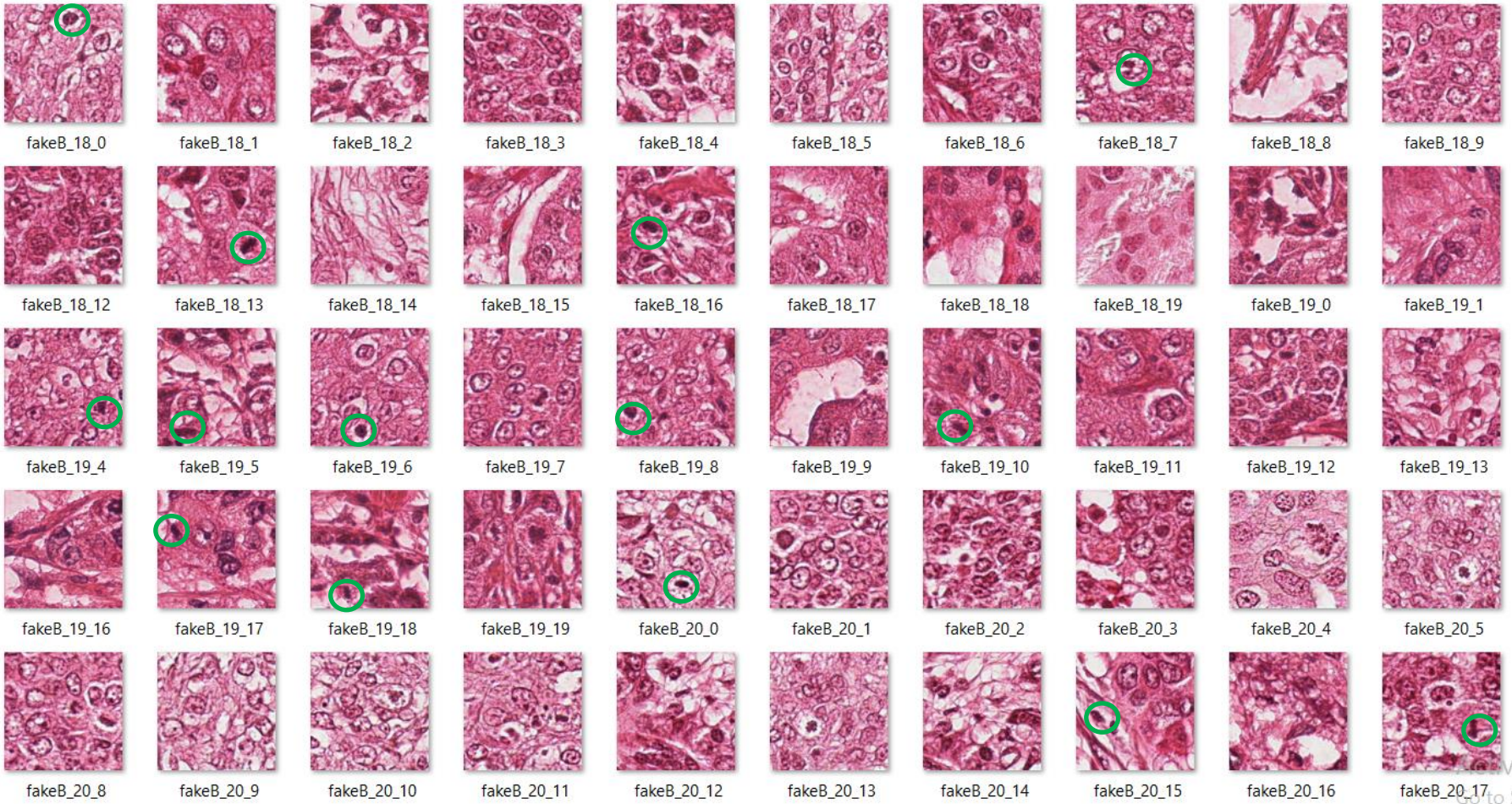
Our Trial for Artificial Mitotic Images



Does the Magic Happen?



Does the Magic Happen?



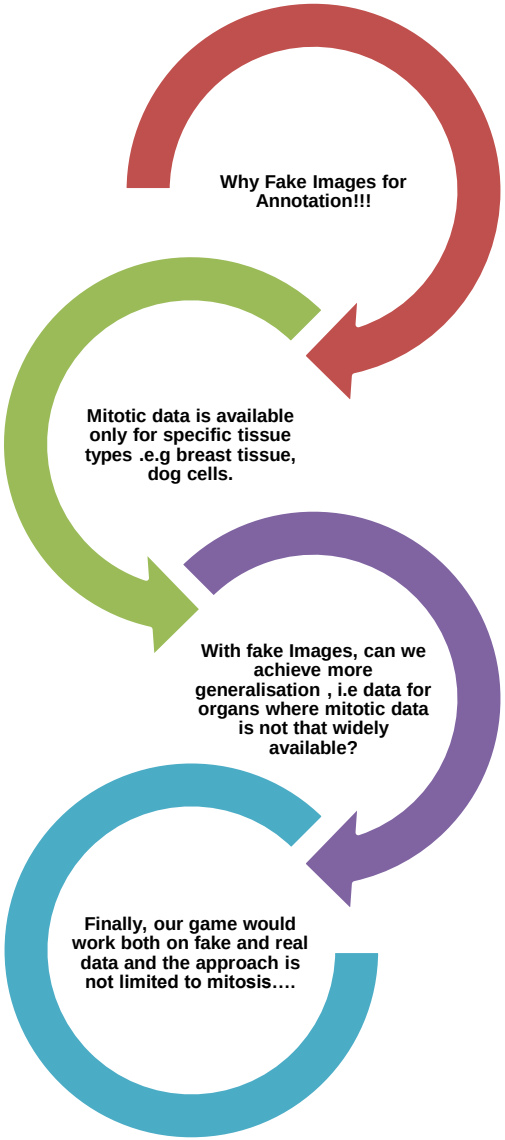
Experts Feedback in an Interview

Dipl.-Ing. Marc Aubreville

Researcher in the Computer Vision (CV) group at the Pattern Recognition Lab of the Friedrich-Alexander-Universität Erlangen-Nürnberg

Christian Marzahl M. Sc.

Researcher in the Computer Vision (CV) group at the Pattern Recognition Lab of the Friedrich-Alexander-Universität Erlangen-Nürnberg


Why Fake Images for Annotation!!!
Mitotic data is available only for specific tissue types .e.g breast tissue, dog cells.
With fake Images, can we achieve more generalisation , i.e data for organs where mitotic data is not that widely available?
Finally, our game would work both on fake and real data and the approach is not limited to mitosis….

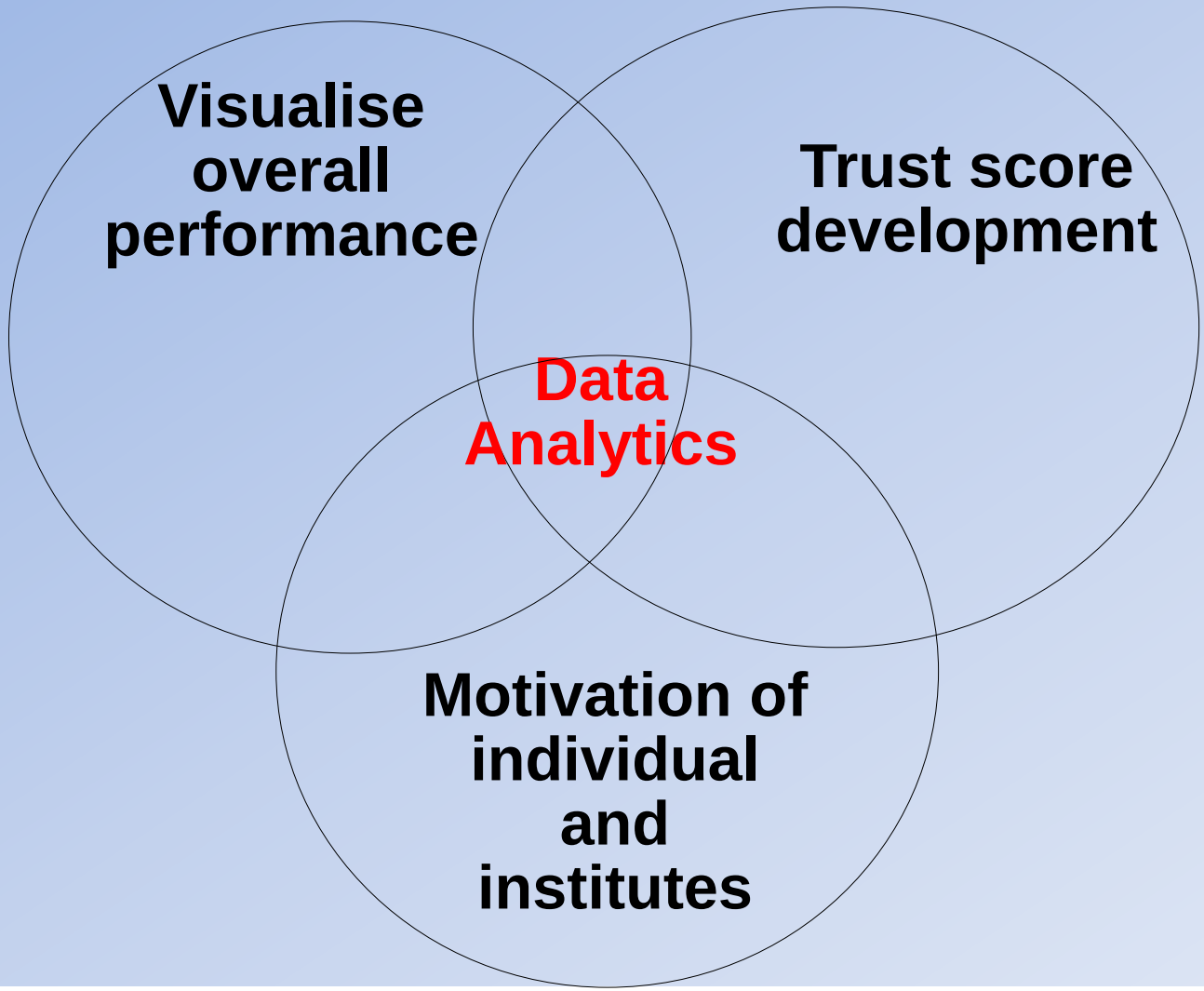
Problems:

User labels might vary for same images.

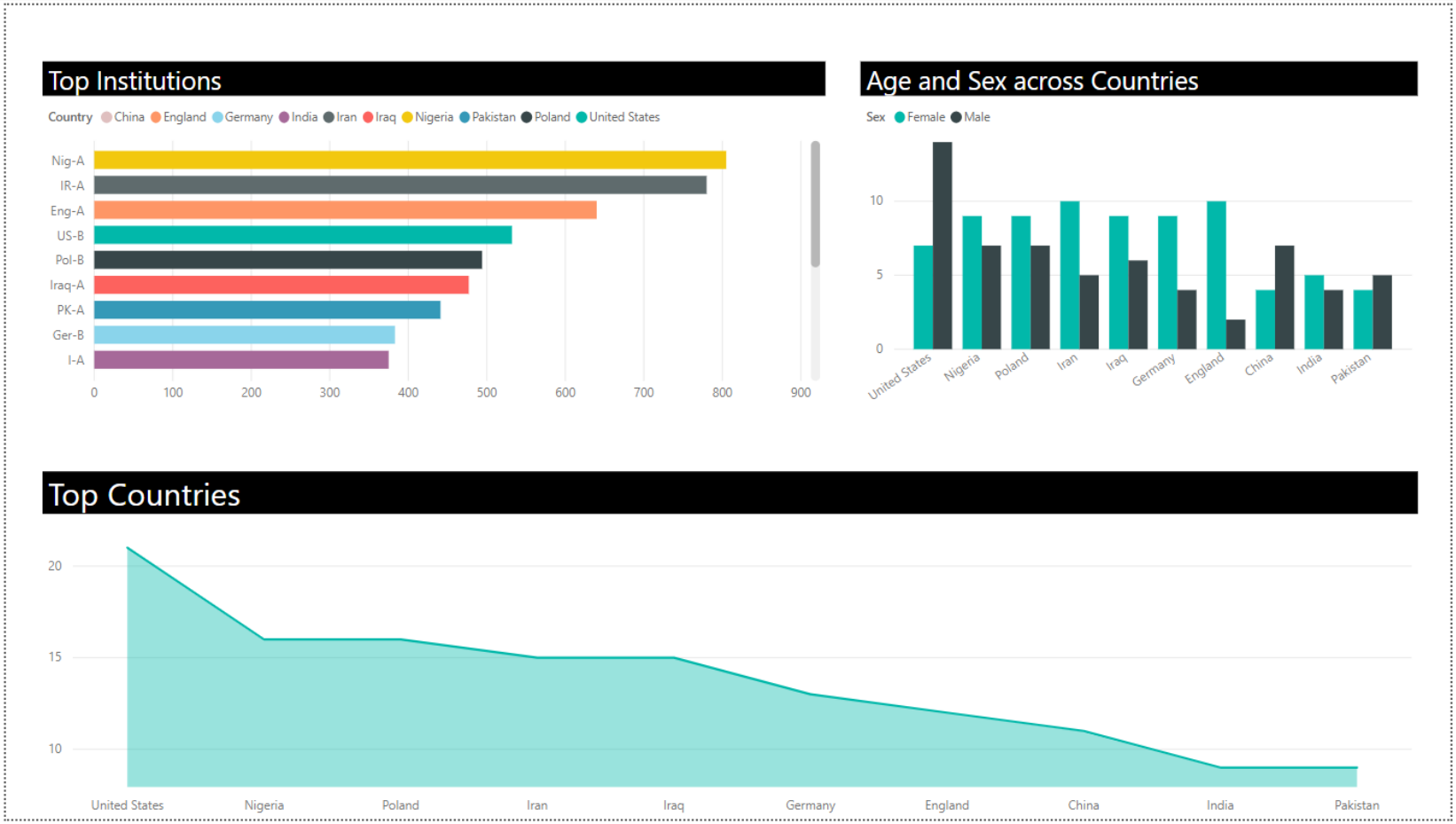
How can we trust the labels!!!

Solution:

We need a trust score model.


Visualise overall performance
Trust score development
Data Analytics
Motivation of individual and institutes

Key Performance Indicators Dashboard



Leader Board- Key Performance Indicators

Analytical Leader Board

AxhQsw FirstName	Nig-A Institution	72 Score	tYbFg.KgSXgLR@fau.de Email
bPhehJSjGSJ FirstName	Nig-A Institution	78 Score	uPNvSR.G@163.com Email
bqSsag FirstName	Nig-A Institution	27 Score	tvO.nGVp@fau.de Email
FnNjwmg FirstName	Nig-A Institution	83 Score	Wa.YnGkUyQh@fau.de Email
IhrmuhYKjgACu FirstName	Nig-A Institution	68 Score	tgcWFj.m@gmail.com Email
IVAxEc FirstName	Nig-A Institution	75 Score	Tw.v@163.com Email
nkBQBOL FirstName	Nig-A Institution	13 Score	U.xXmpQPnI@icloud.com Email
PfWbLTjsGwi FirstName	Nig-A Institution	57 Score	VrSYmgzY.QfL@gmail.com Email
qlwqXcpdFGMeK FirstName	Nig-A Institution	67 Score	TNJ.lav@fau.de Email
TUYtLB FirstName	Nig-A Institution	2 Score	vaoLrt.Ls@gmail.com Email
uezsjjlxDt FirstName	Nig-A Institution	84 Score	uEXRPa.iblLcL@icloud.com Email

Accomplishments

- Design of game level system
- Fully-built database
- Tutorial and level 1 of the game
- Part of level 2 game control
- Fake images generated by cycleGAN

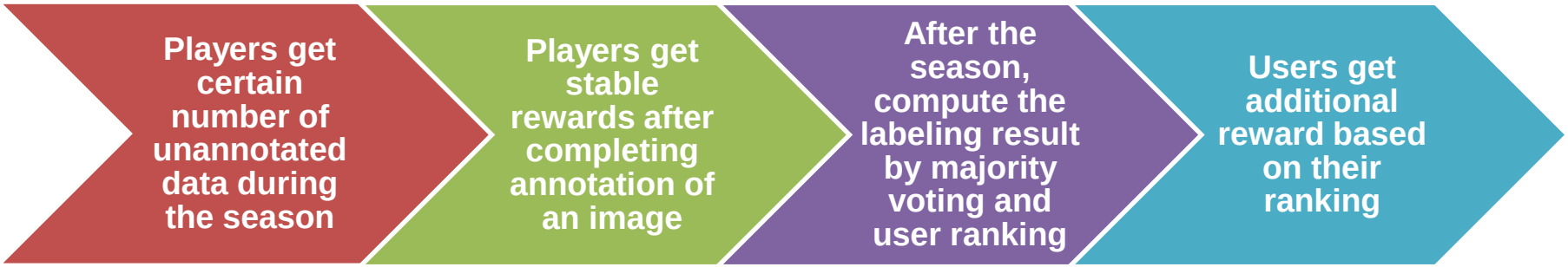
Future Work

- Implementation of level 2 and level 3 game
  - Introduce hint option
  - Scoring and rewards for level 2

$$\#\ of\ carrots = foundation\ reward \times \left(1 + \frac{right\ clicks}{total\ clicks}\right)$$

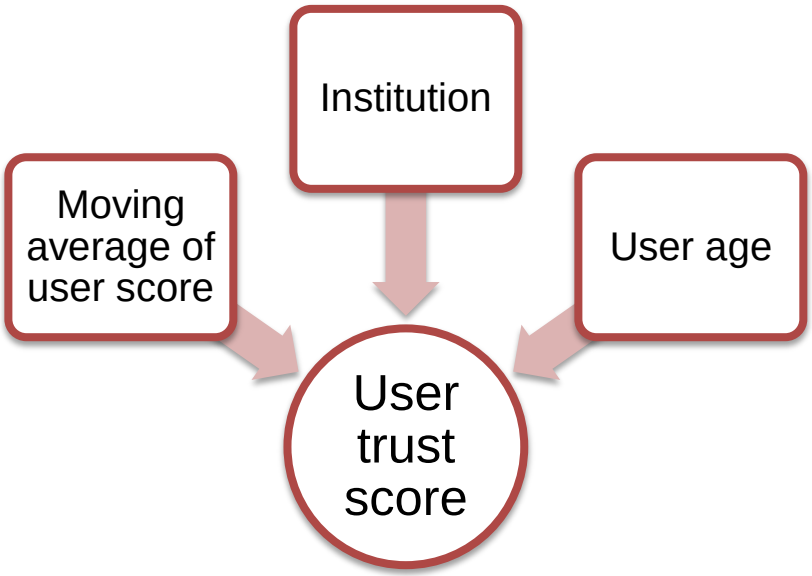
Future Work

- Implementation of level 2 and level 3 game
  - Introduce hint option
  - Scoring and rewards for level 2
  - League mechanism for level 3



Future Work

- Crowdsourcing in the backend
  - Compute individual trust score according to user performance



Future Work

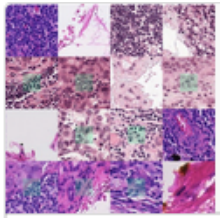
- Crowdsourcing in the backend
  - Compute individual trust score according to user performance
  - Aggregation
    - Maximum weighted crowd votes (ωCV)
    - maximum weighted crowd trust scores (ωCT)

$$\omega CV = \frac{\omega_A V_A + \omega_B V_B + \omega_C V_C + \omega_D V_D}{V_A + V_B + V_C + V_D}$$

$$\omega CT = \frac{\omega_A T_A + \omega_B T_B + \omega_C T_C + \omega_D T_D}{T_A + T_B + T_C + T_D}$$

Future Work

- Extend to other fields
  - Similar approach for labeling can easily extend to other tasks



PatchCamelyon

PatchCamelyon is a new and challenging image classification dataset of 327.680 color images (96 x 96px) extracted from histopathology images of the CAMELYON16 challenge. The goal is to detect breast cancer metastasis in lymph nodes.

GLEASON2019

Gleason2019

MICCAI 2019 Automatic Prostate Gleason Grading Challenge: This challenge aims at the automatic Gleason grading of prostate cancer from H&E-stained histopathology images. This task is of critical importance because Gleason score is a strong prognostic ...

CuRIOUS

curious2019

MICCAI Challenge 2019 for Correction of Brainshift with Intra-Operative Ultrasound. Taks 1: Register pre-operative MRI to iUS before tumor resection;Taks 2: Register iUS after tumor resection to iUS before tumor resection

Contribution Table

Umer	• Swipeable view(GUI) • Swiping functionality • Click function to locate mitosis
Wenyu Zhang	• Scene design • UI design • Registration control • Background music • Trust Score Model
Srijeet	• CycleGAN implementation • Database(JSON file to CSV) • UI design • Analytics Dashboard for Trust Score, Motivation
Mingxuan Gu	• Database connection • Leaderboard scene(control) • Registration scene(control) • Image preprocessing • User data storage
Zhaoya Pan	• Image preprocessing • Scoring system design • Scoring and rewards implementation • Load images to view