

# Detekcia meningeómu v CT snímkach

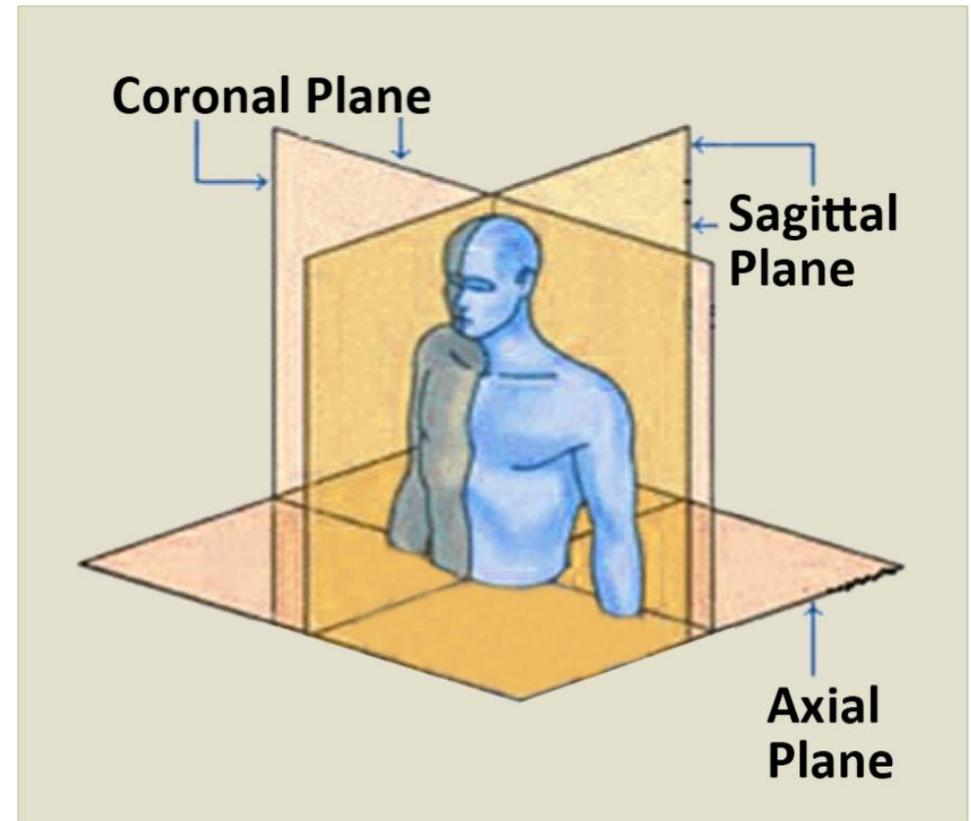
Filip Sekerka

# Detail práce

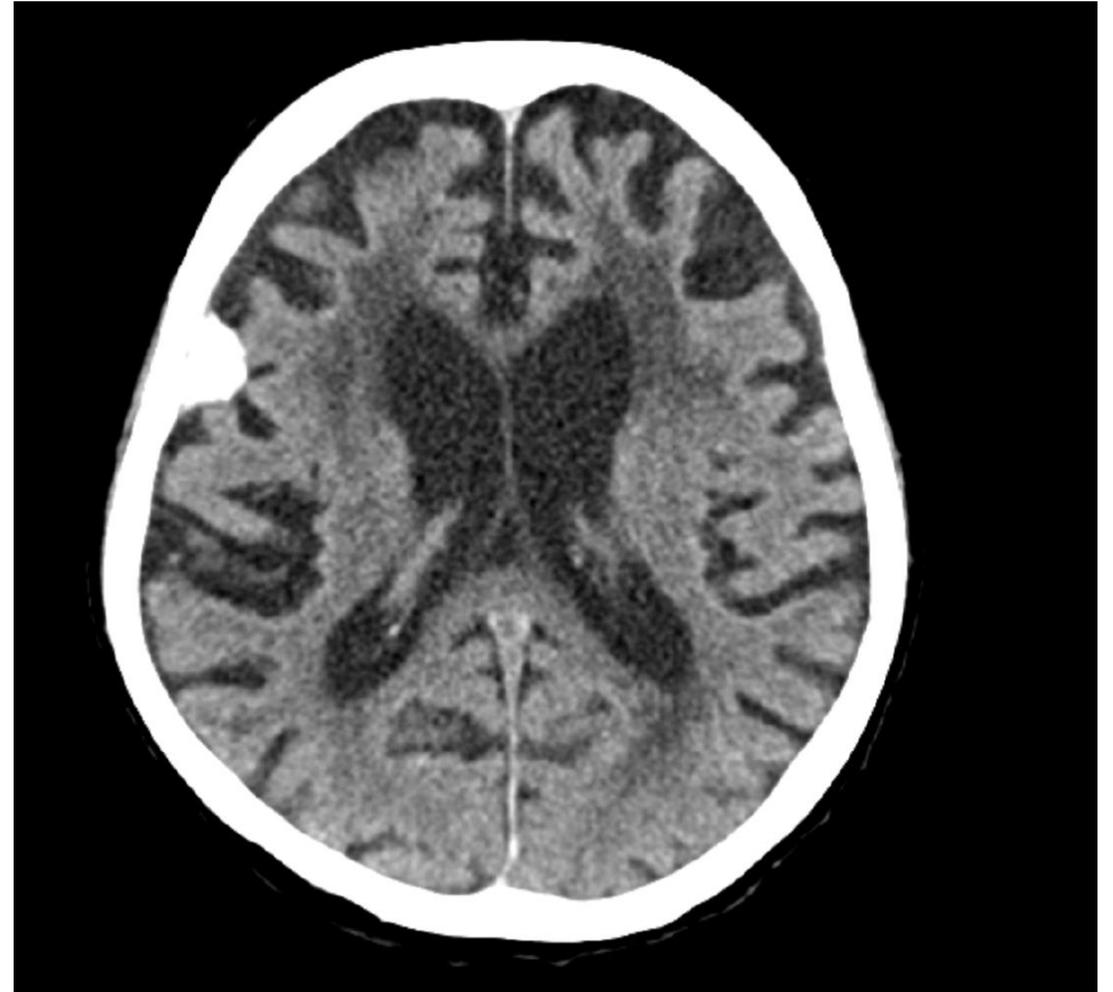
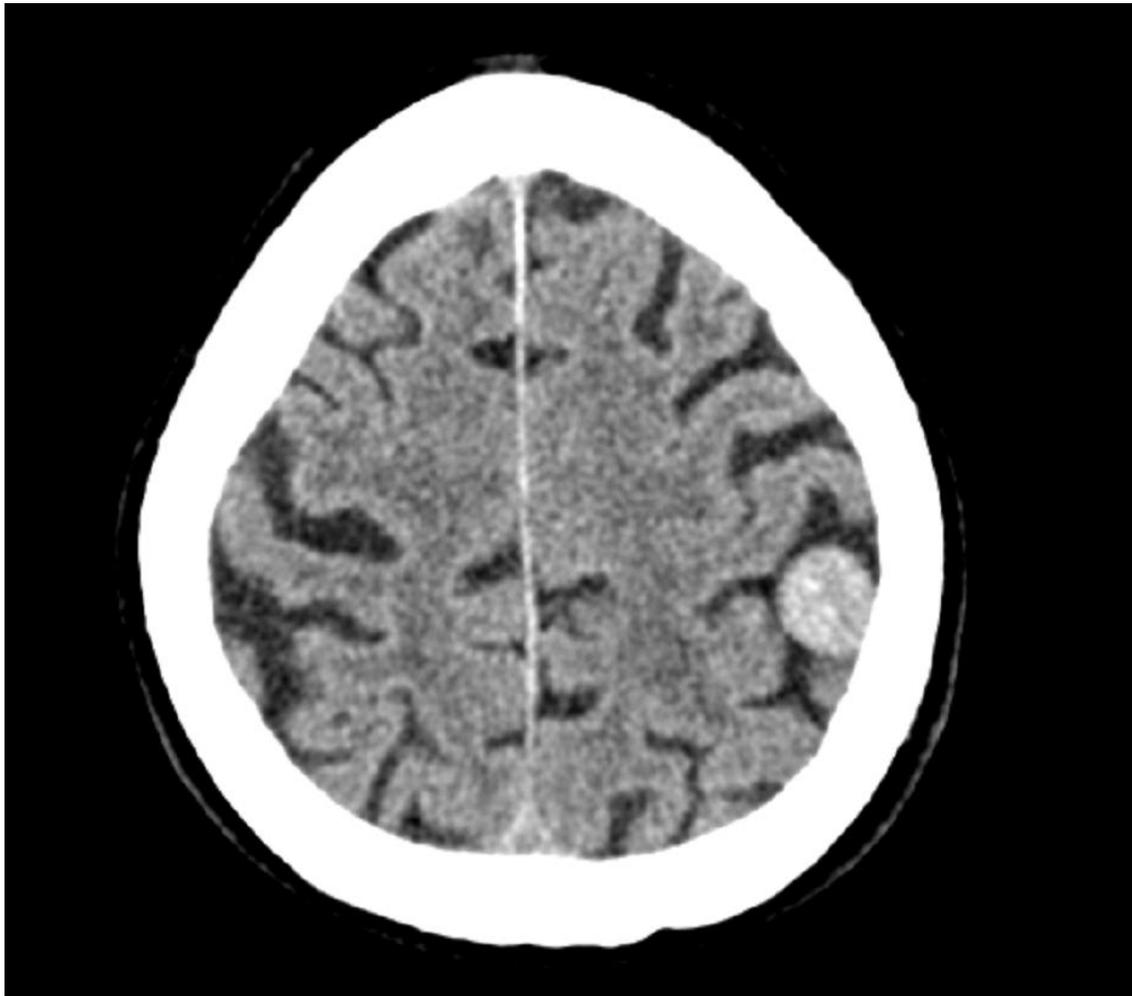
- Školiteľ: RNDr. Zuzana Černeková, PhD.
- Cieľ práce: detekcia meningeómu v CT snímkach s využitím neurónových sietí.
- Klasifikácia a určenie veľkosti meningeómu.

# CT snímky (computed tomography)

- Dáta sú z rádiologickej kliniky z Nemocnice sv. Cyrila a Metoda.
- Sken pozostáva z viacerých rezov.
- Dáta sú čiastočne anotované.
- HU (Hounsfieldova jednotka)
- Nádory nie sú homogénne.



# CT snímky (computed tomography)



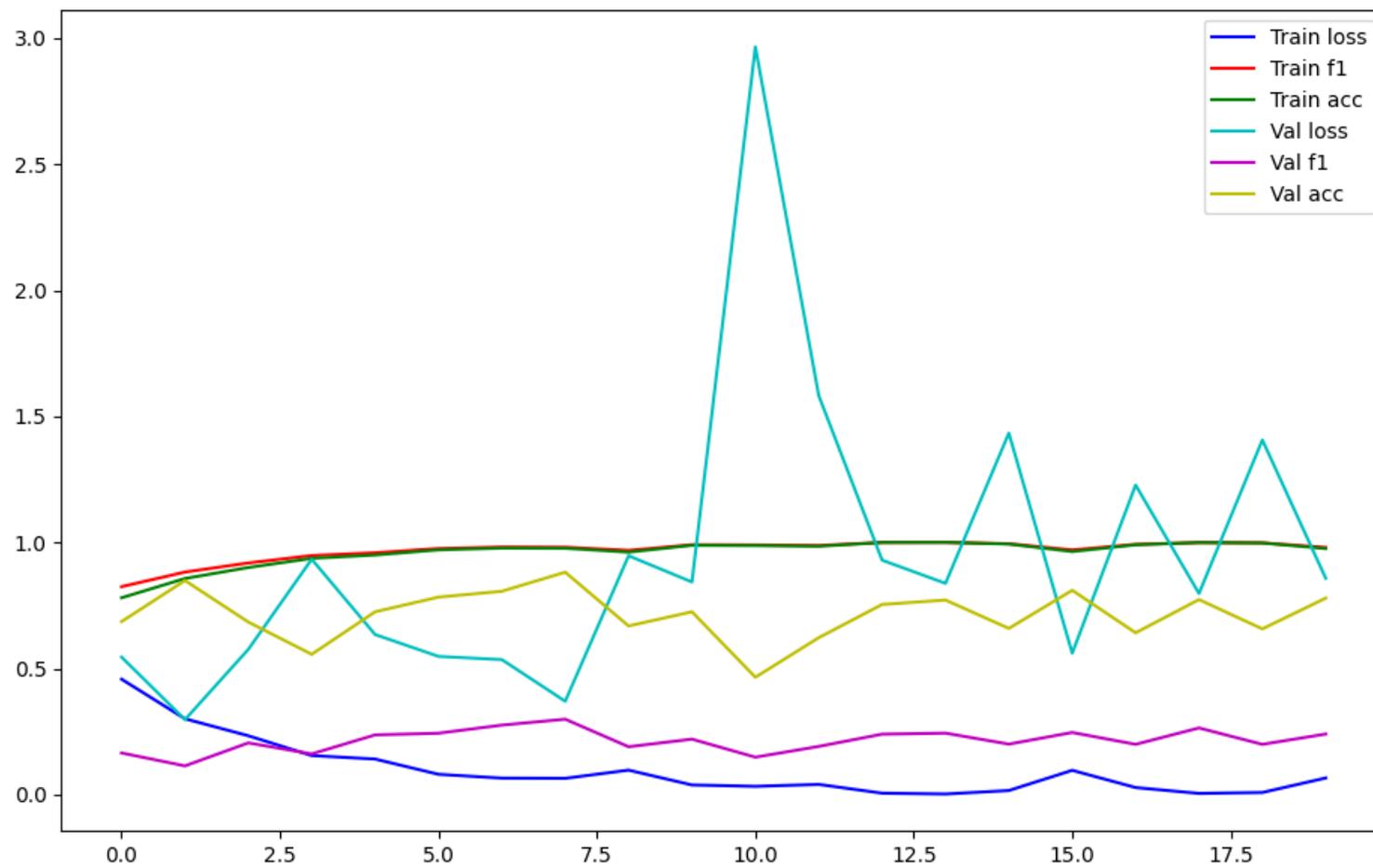
# Riešenia cez neurónové siete

- Upravené vlastné verzie VGG19 a VGG11
- Upravený ResNet predtrénovaný na ImageNet datase.
- Vlastná jednoduchá konvolučná neurónová sieť.
- 2 verzie 3D ResNetu predtrénovaný na MR/CT dátach.

# Upravená verzia VGG19

- Test accuracy: 43.9%
- Test recall: 64.5%
- Test f1 score: 28.2%

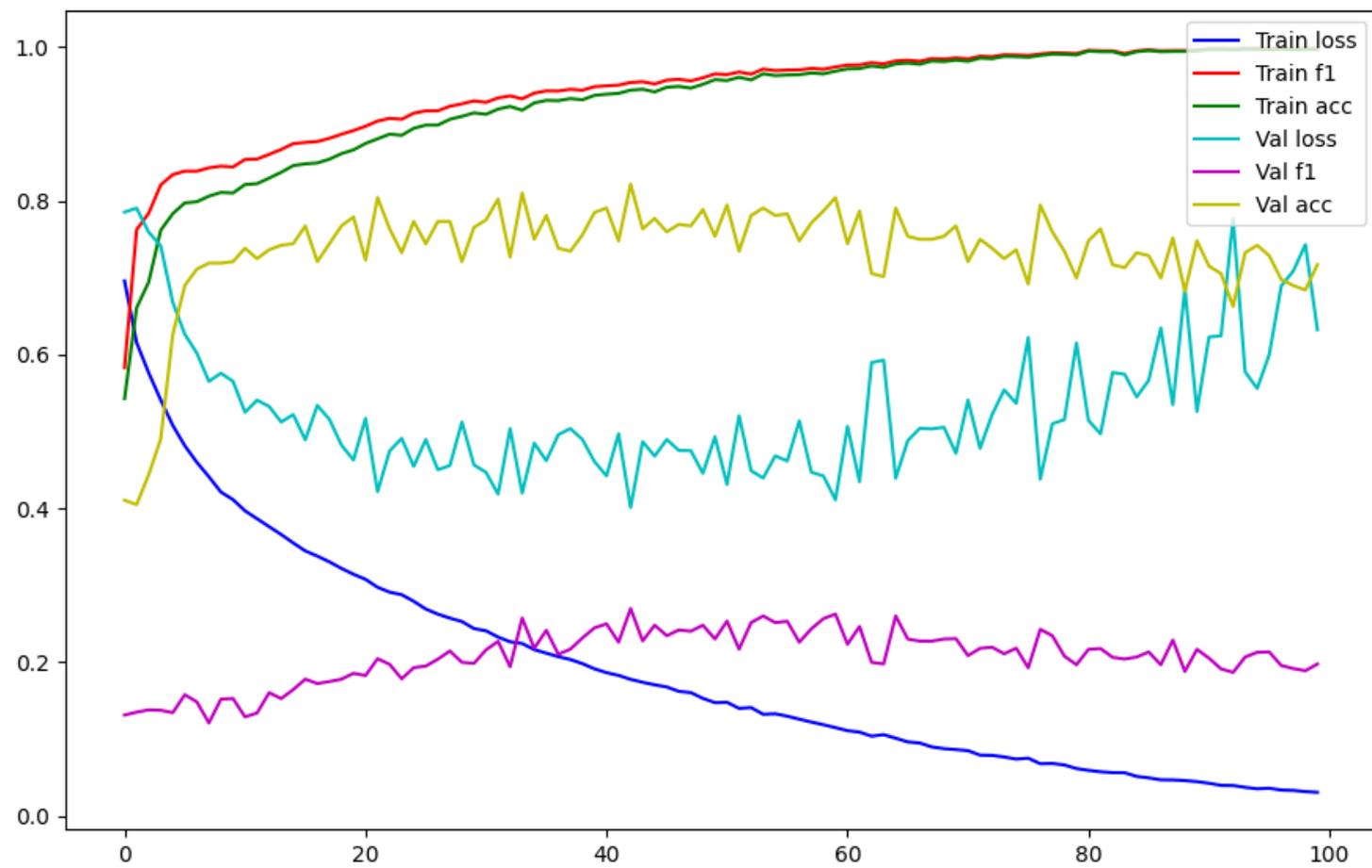
# Vlastný model



# Vlastný model

- Test accuracy: 58.4%
- Test recall: 40.9%
- Test f1 score: 7.9%

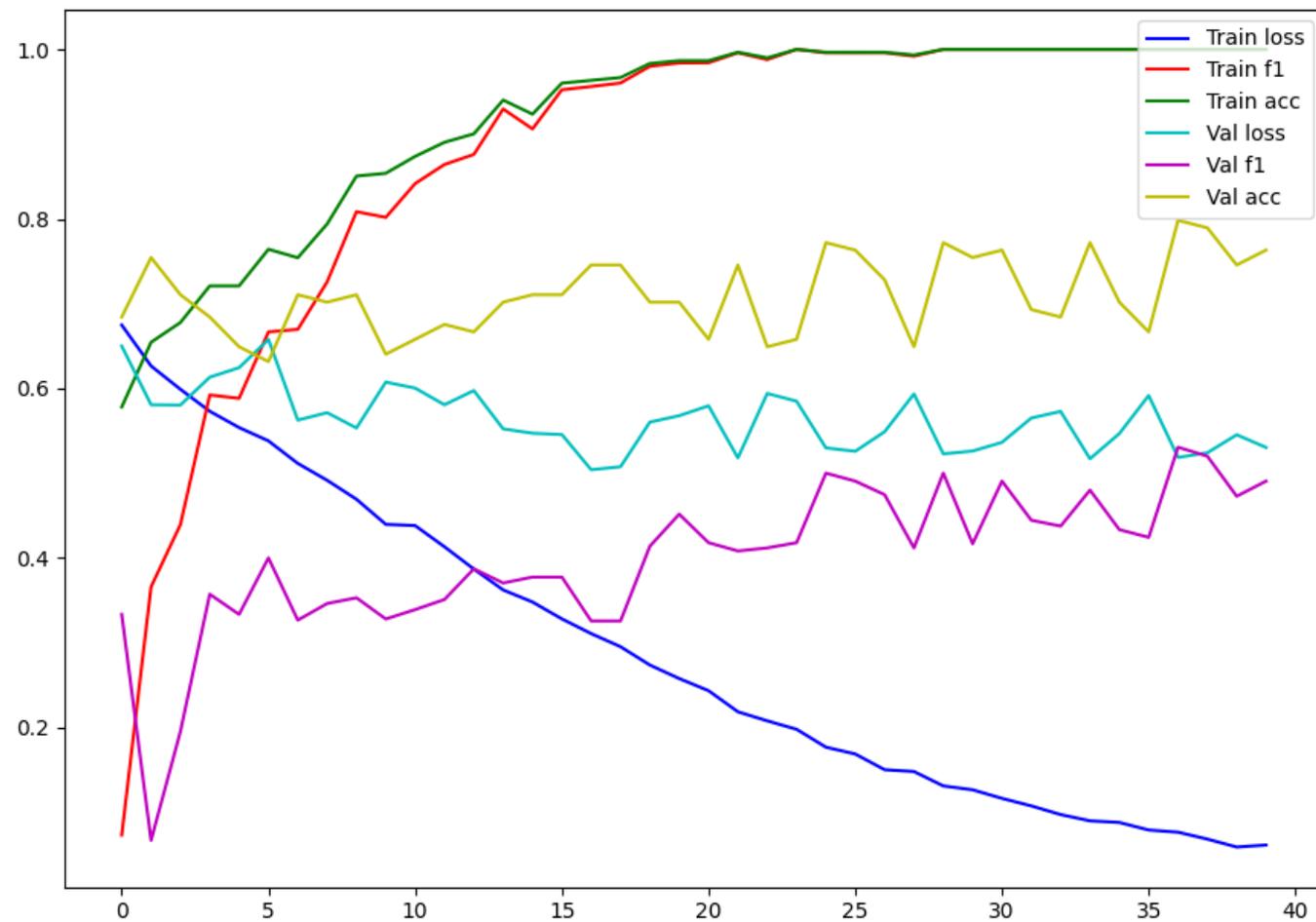
# ResNet



# ResNet

- Test accuracy: 52.4%
- Test recall: 45.4%
- Test f1 score: 7.7%

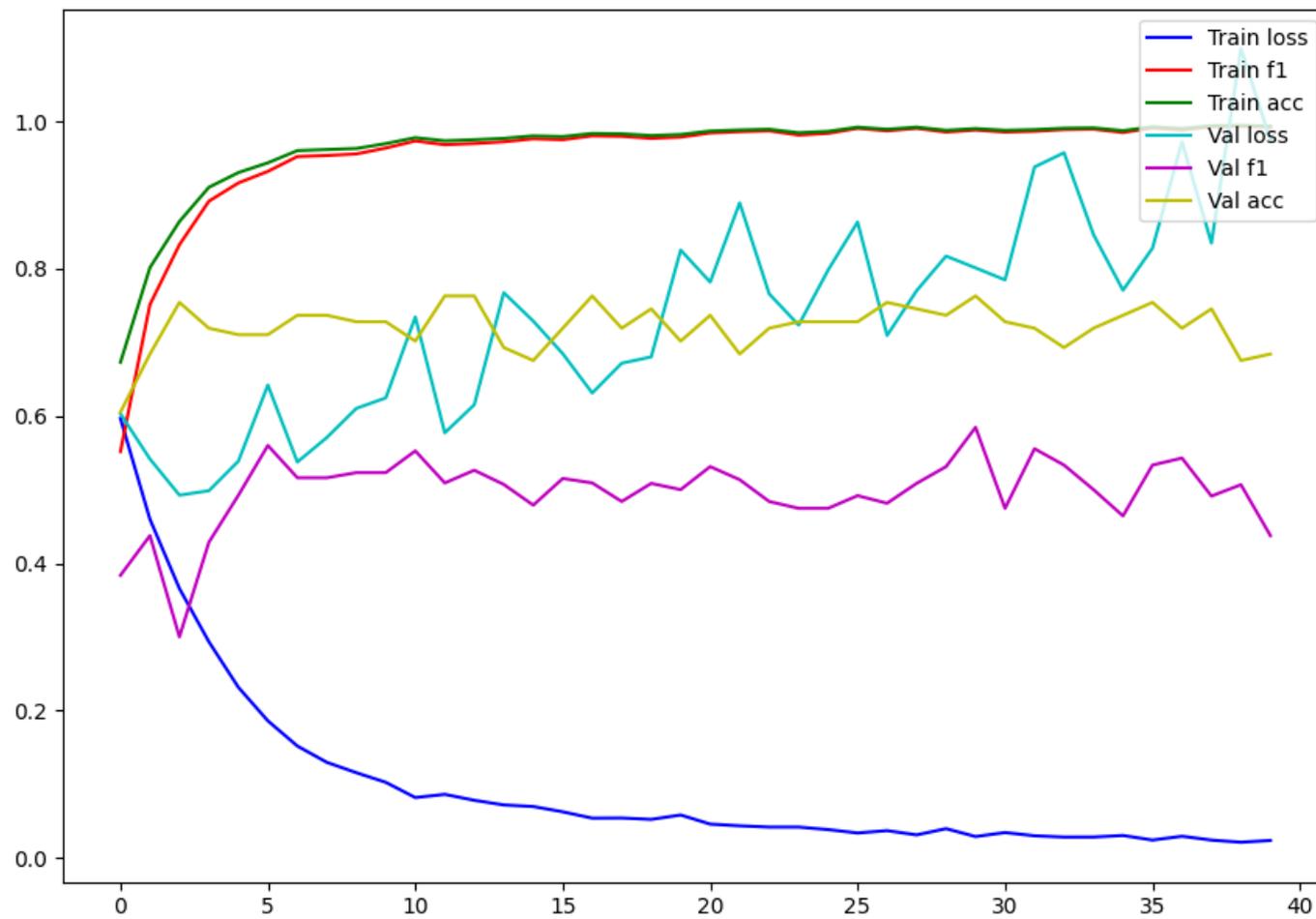
# ResNet3D - rezy veľkosti 11, bez augmentácie



# ResNet3D - rezy veľkosti 11, bez augmentácie

- Test accuracy: 72.8%
- Test recall: 27.3%
- Test f1 score: 33.33%

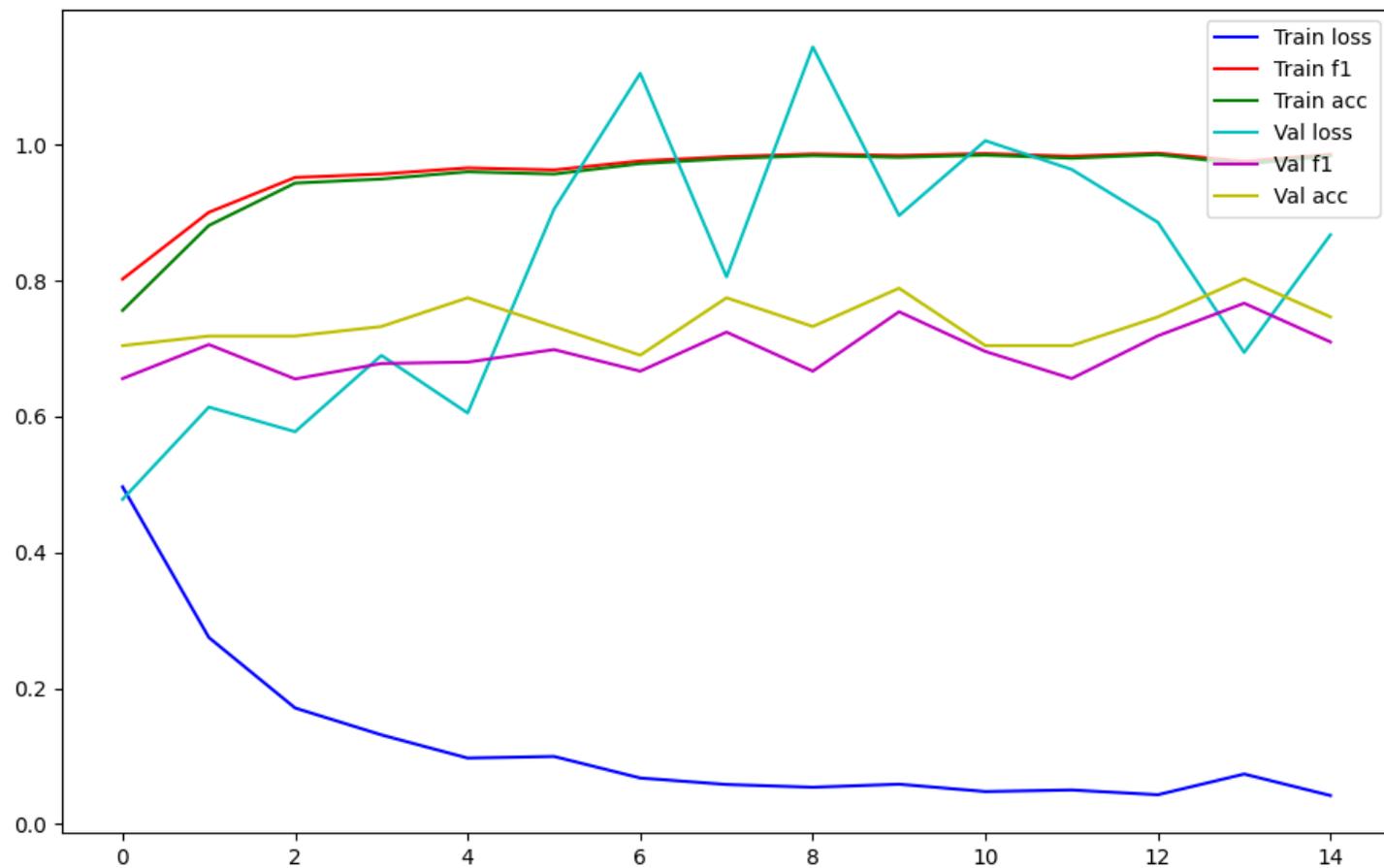
# ResNet3D - rezy veľkosti 11, s augmentáciou



# ResNet3D - rezy veľkosti 11, s augmentáciou

- Test accuracy: 69.9%
- Test recall: 36.3%
- Test f1 score: 34.04%

# ResNet3D - rezy veľkosti 21, s augmentáciou



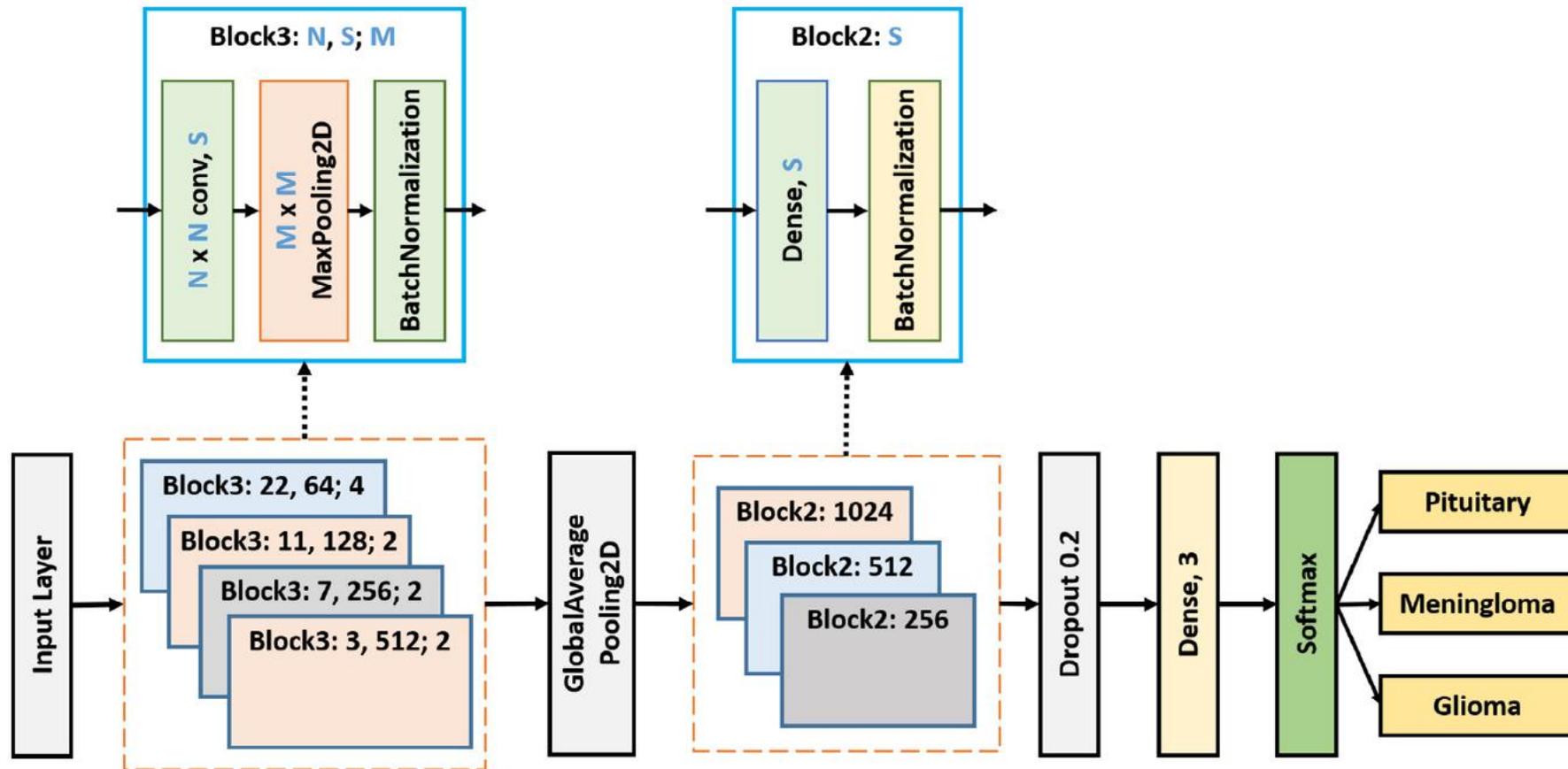
# ResNet3D - rezy veľkosti 21, s augmentáciou

- Test accuracy: 69.8%
- Test recall: 68.18%
- Test f1 score: 61%

# Článok 1

- Accurate brain tumor detection using deep convolutional neural network
- Md. Saikat Islam Khan, Anichur Rahman, Tanoy Debnath, Md. Razaul Karim, Mostofa Kamal Nasir, Shahab S. Band, Amir Mosavi, Iman Dehzangi
- Dva deep-learning modely.
- Dva dataseety - 3064 a 152 MRI snímok.
- Preučenie - transfer learning.

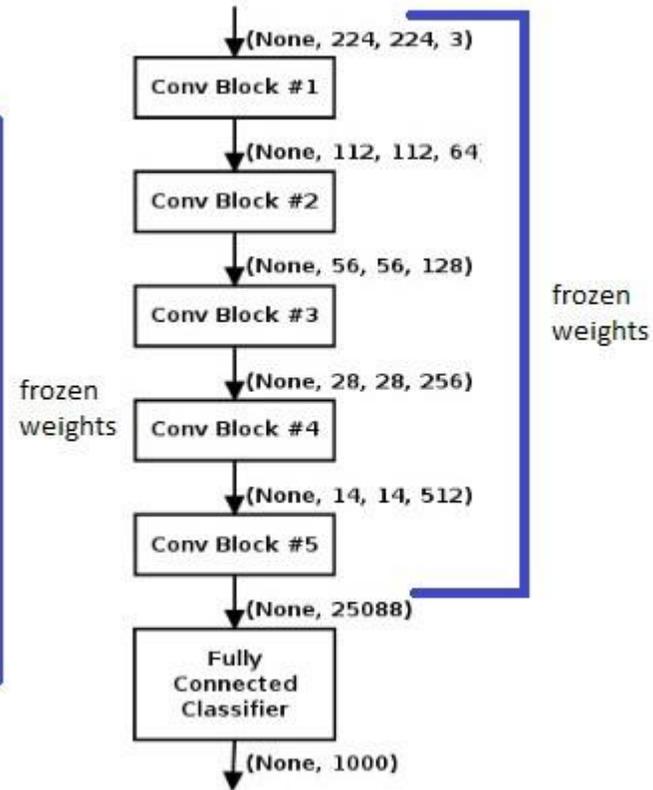
# Článok 1 - model 1



# Článok 1 - model 2

## Keras VGG-16 Model

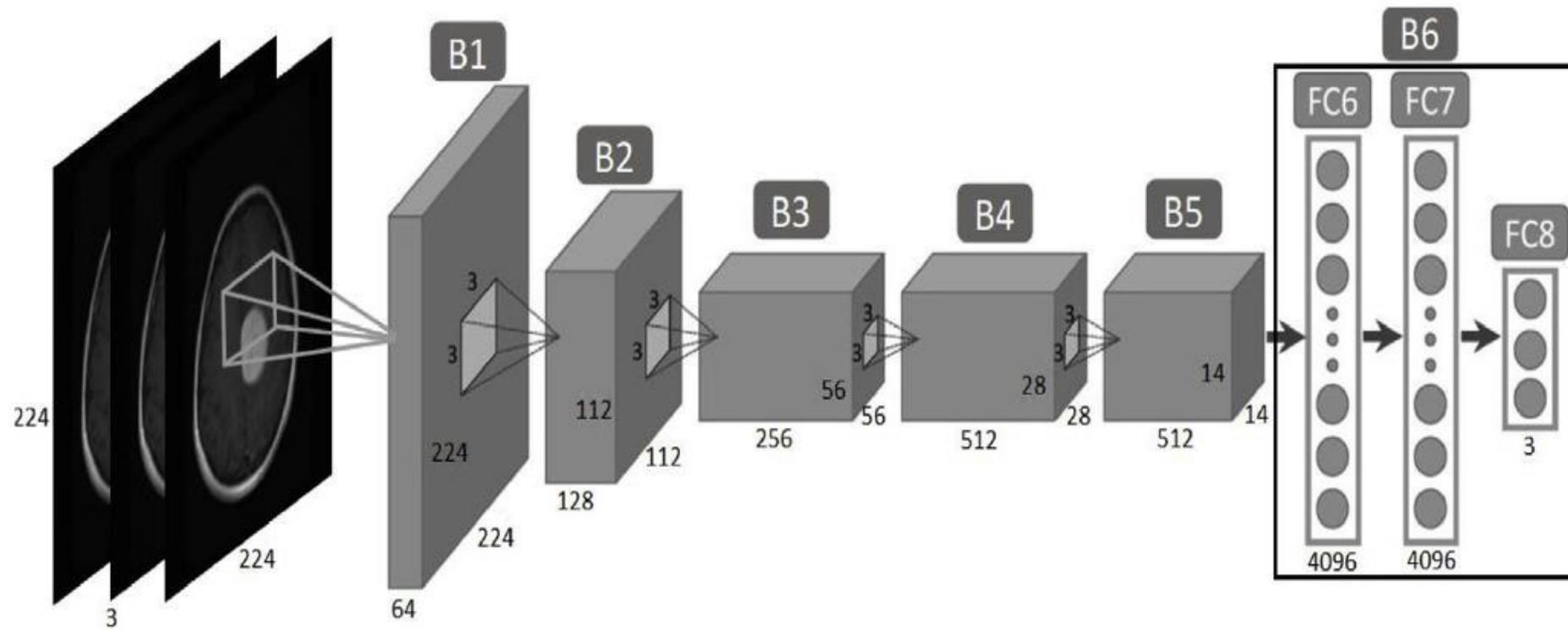
```
( 0, 'input_6',      (None, 224, 224, 3))
( 1, 'block1_conv1', (None, 224, 224, 64))
( 2, 'block1_conv2', (None, 224, 224, 64))
( 3, 'block1_pool',  (None, 112, 112, 64))
( 4, 'block2_conv1', (None, 112, 112, 128))
( 5, 'block2_conv2', (None, 112, 112, 128))
( 6, 'block2_pool',  (None, 56, 56, 128))
( 7, 'block3_conv1', (None, 56, 56, 256))
( 8, 'block3_conv2', (None, 56, 56, 256))
( 9, 'block3_conv3', (None, 56, 56, 256))
(10, 'block3_pool',  (None, 28, 28, 256))
(11, 'block4_conv1', (None, 28, 28, 512))
(12, 'block4_conv2', (None, 28, 28, 512))
(13, 'block4_conv3', (None, 28, 28, 512))
(14, 'block4_pool',  (None, 14, 14, 512))
(15, 'block5_conv1', (None, 14, 14, 512))
(16, 'block5_conv2', (None, 14, 14, 512))
(17, 'block5_conv3', (None, 14, 14, 512))
(18, 'block5_pool',  (None, 7, 7, 512))
(19, 'flatten',      (None, 25088))
(20, 'fc1',           (None, 4096))
(21, 'fc2',           (None, 4096))
(22, 'predictions', (None, 1000))
```



# Článok 2

- Brain tumor classification for MR images using transfer learning and fine-tuning
- Zar Nawab Khan Swati, Qinghua Zhao, Muhammad Kabir, Farman Ali, Zakir Alia, Saeed Ahmed, Jianfeng Lu
- Deep-learning model
- Transfer learning.
- MRI dataset, 3064 snímkov

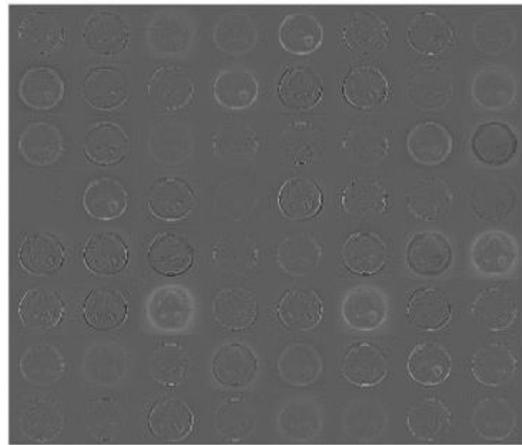
# Článok 2



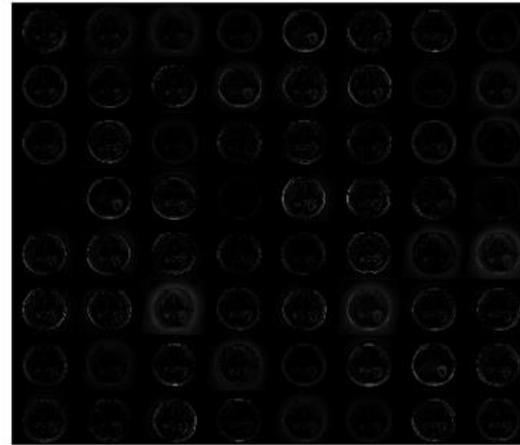
# Článok 2 - transfer learning po blokoch

	Accuracy	Precision	Recall	
Trénované bloky	FT:B1-B6	94.82	89.52	94.25
	FT:B2-B6	94.66	89.20	94.26
	FT:B3-B6	94.26	88.23	94.04
	FT:B4-B6	93.78	87.47	93.38
	FT:B5-B6	91.92	83.99	91.50
	FT:B6	86.81	76.10	84.76

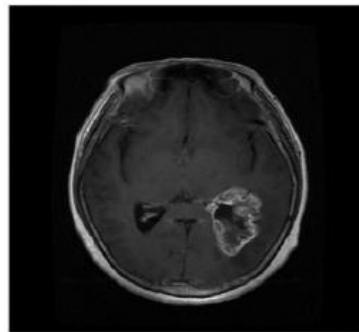
# Článok 2 - naučené príznaky blok B1



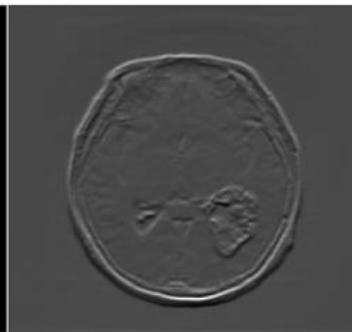
(a)



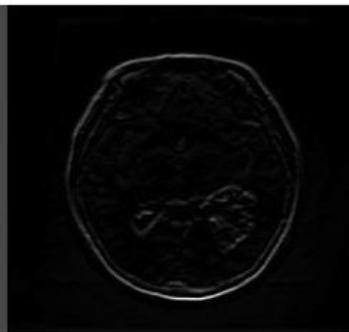
(b)



(c)

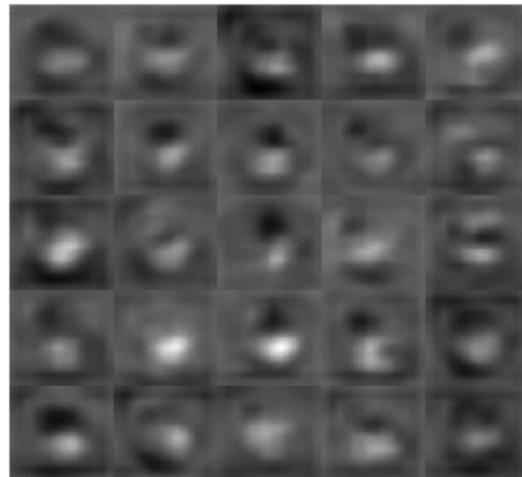


(d)

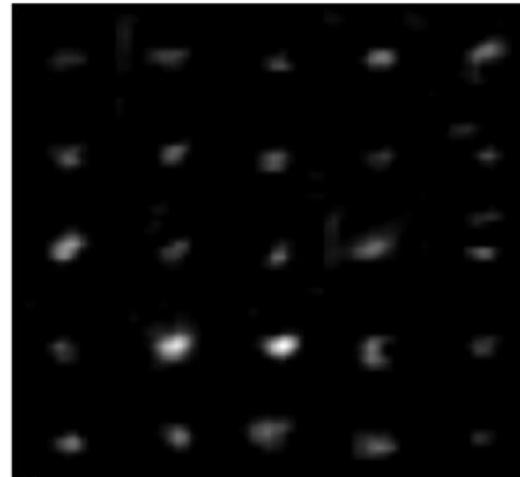


(e)

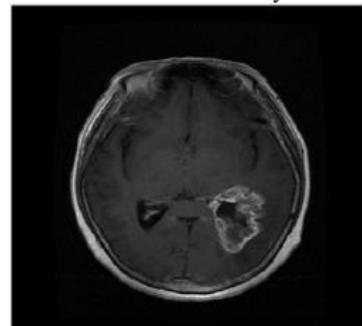
# Článok 2 - naučené príznaky blok B5



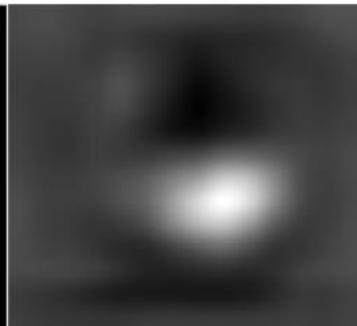
(a)



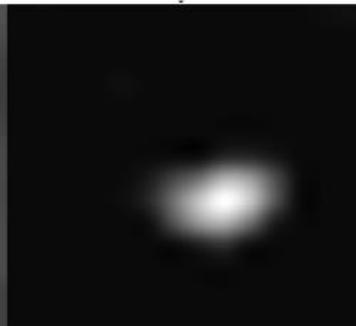
(b)



(c)



(d)



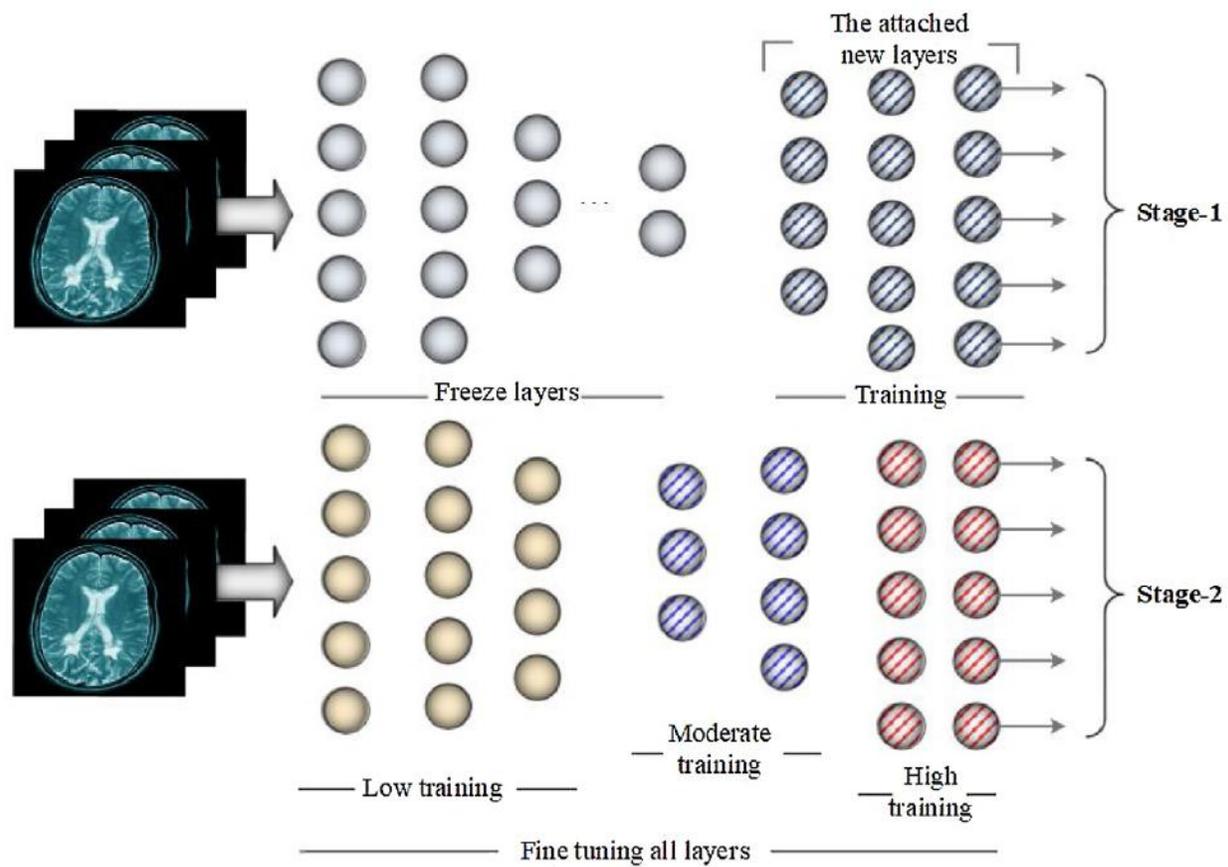
(e)

# Článok 3

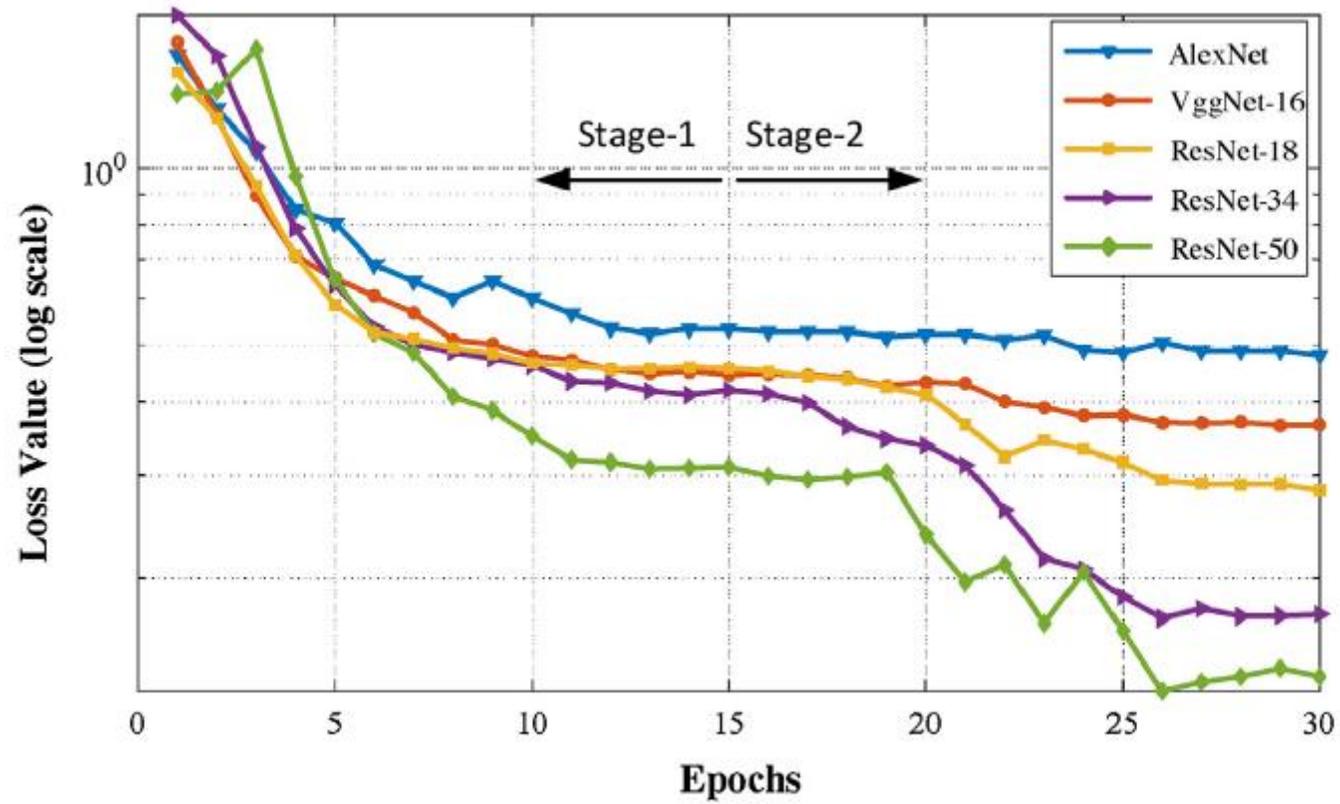
- Convolutional neural networks for multi-class brain disease detection using MRI images
- Muhammed Talo, Ozal Yildirim, Ulas Baran Baloglu, Galip Aydin, U Rajendra Acharya
- Porovnali 5 deep-learning modelov.
- MRI dataset.



# Článok 3



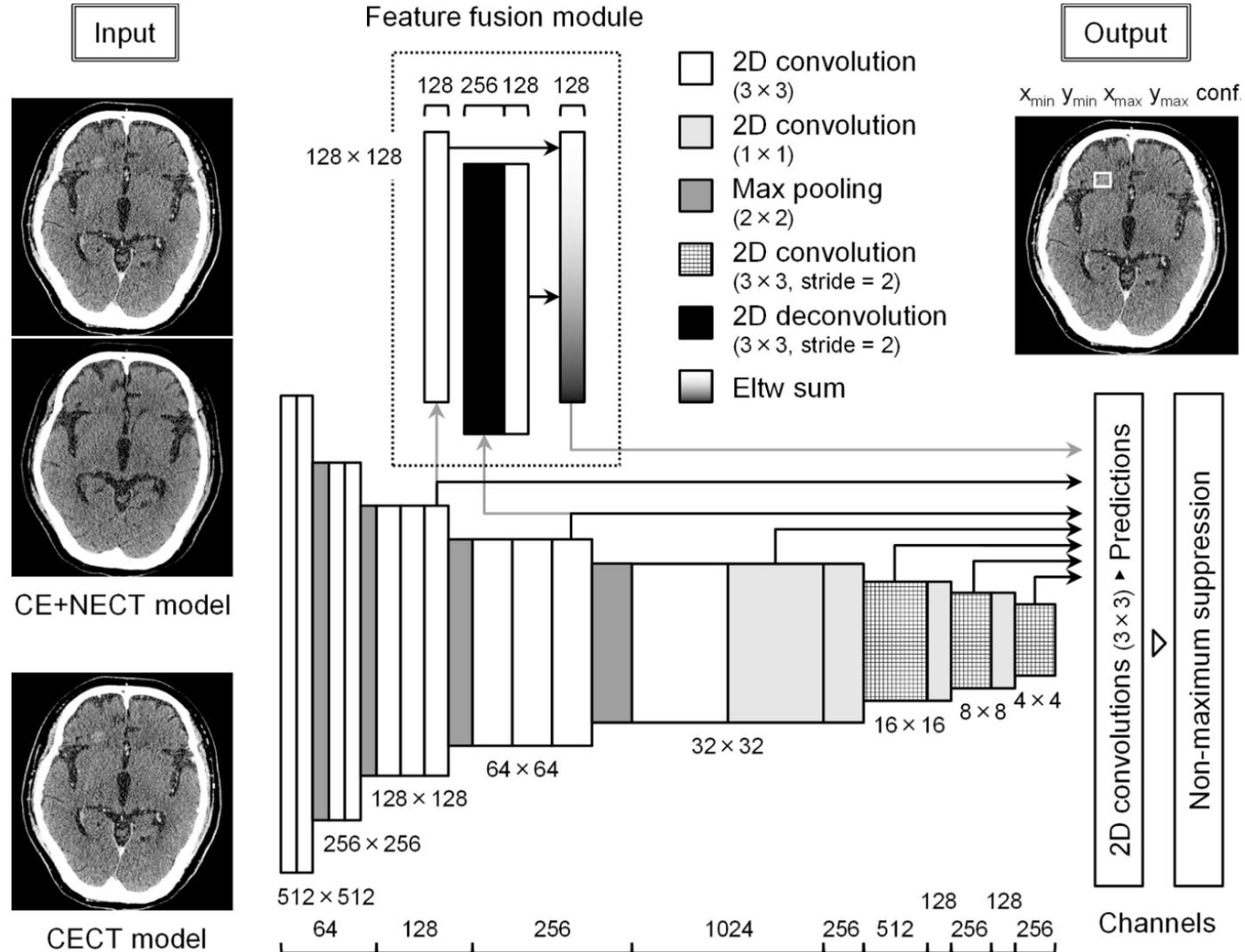
# Článok 3



# Článok 4

- Deep-learning single-shot detector for automatic detection of brain metastases with the combined use of contrast-enhanced and non-enhanced computed tomography images
- Hidemasa Takao, Shiori Amemiya, Shimpei Kato, Hiroshi Yamashita, Naoya Sakamoto, Osamu Abe
- Deep learning model.
- CT snímky, detekcia metastáz v mozgu.
- Augmentácia dát.

# Článok 4



# Článok 4

- metrika presnosť (accuracy)
- AlexNet:  $80.09 \pm 3 \%$
- Vgg-16:  $86.26 \pm 2.3 \%$
- ResNet18:  $87.47 \pm 2.5 \%$
- ResNet34:  $90.46 \pm 2.6 \%$
- ResNet50:  $95.23 \pm 0.6 \%$
- najlepšie výsledky - Resnet50
- Precision:  $96.12 \pm 2.16 \%$
- Senzitivita (recall):  $94.51 \pm 1.98\%$

# Využití knihnice

- Pydicom - práce s DICOM snímkami.
- SimpleITK - práce s DICOM snímkami.
- Pytorch - práce s neuronovými sítěmi.
- Scikit-learn - metriky na vyhodnocení výsledků.
- Numpy - práce s maticami.
- Torchio - augmentace pro 3D data.

Ďakujem za pozornosť.