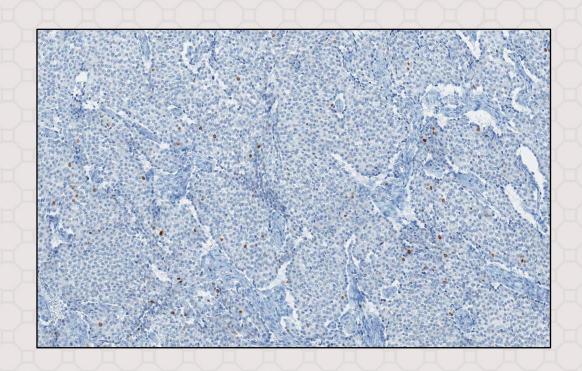
# NAML Project

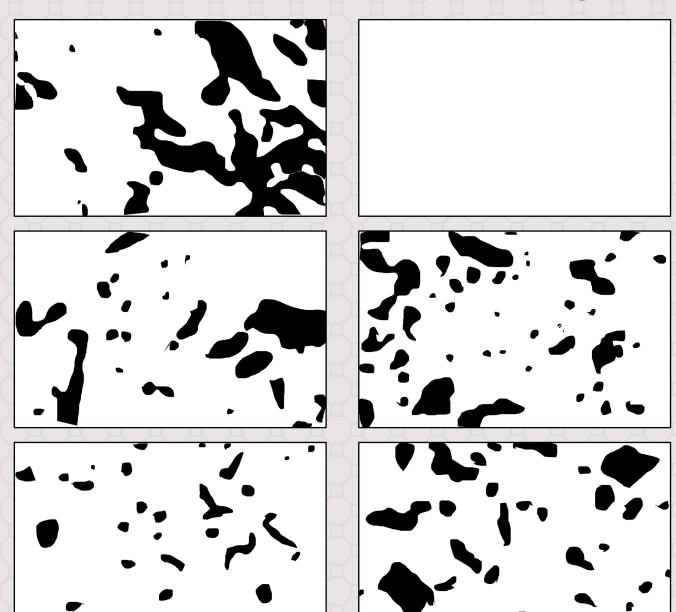
Luca Olivieri Tommaso Giordano



Dataset
Input-output

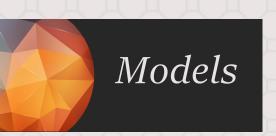






Dataset challenges

- Very unbalanced (1 to 10)
- Only testing data present



#### AlexNet

Fine-tuning

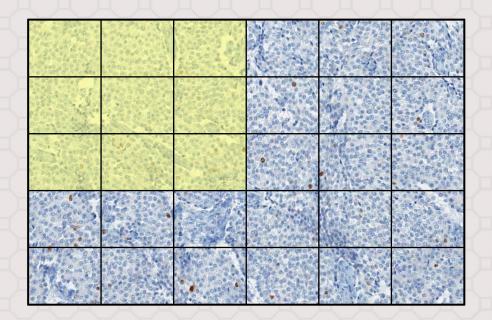
| Layer Type | Input Dimension | Output Dimension |
|------------|-----------------|------------------|
| Linear     | 4096            | 1000             |
| Linear     | 1000            | 512              |
| Linear     | 512             | 128              |
| Linear     | 128             | 32               |
| Linear     | 32              | 2                |

### **Inception V3**

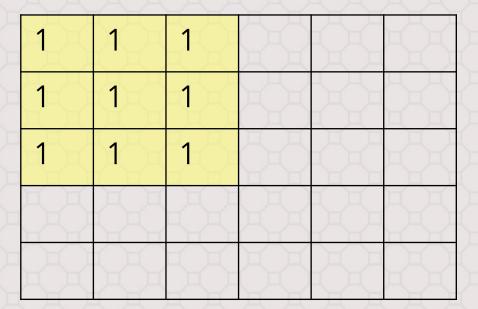
Transfer-learning

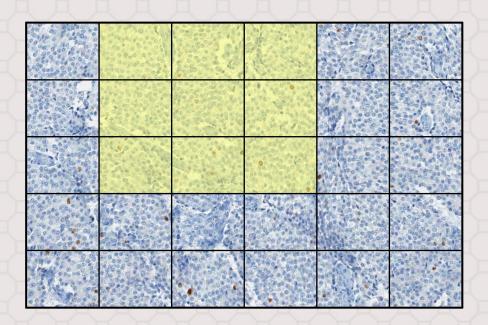
| Layer Type | Input Dimension | Output Dimension |
|------------|-----------------|------------------|
| Linear     | 2048            | 512              |
| Linear     | 512             | 128              |
| Linear     | 128             | 32               |
| Linear     | 32              | 2                |

| ID | Model   | Optimiser                                | Loss function           | Batch size | Epochs |
|----|---------|--|-------------------------|------------|--------|
| A1 | AlexNet | $Adam(lr = 10^{-4})$                     | XEn                     | 100        | 5      |
| A2 | AlexNet | AdamW(lr = $10^{-4}$ , $\lambda = 0.1$ ) | XEn                     | 100        | 5      |
| I1 | IncV3   | $Adam(lr = 5 \cdot 10^{-4})$             | $FL(\alpha=1,\gamma=2)$ | 100        | 5      |
| I2 | IncV3   | $AdamW(lr = 5 \cdot 10^{-4})$            | XEn                     | 100        | 5      |



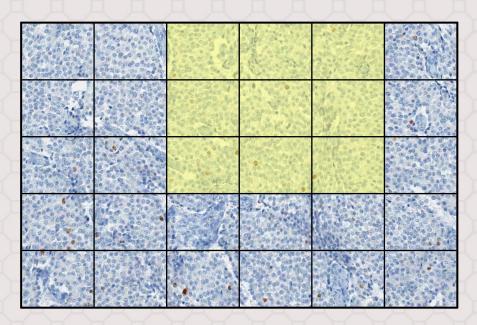
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| 7    |         |   |
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| Prod | iction: | 1 |
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| 1  | 2  | 2  | 1 |   |
|----|----|----|---|---|
| 1  | 2  | 2  | 1 |   |
| 1  | 2  | 2  |   | T |
| 55 | 85 |    |   | Ĭ |
|    | 96 | 55 |   |   |



| Prediction:  |   |
|--------------|---|
| 1 rediction. | U |

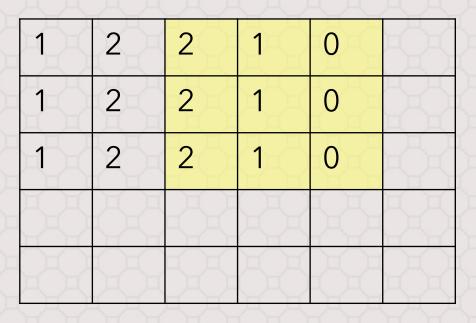
| 1  | 2  | 2  | 1  | 0  |  |
|----|----|----|----|----|--|
| 1  | 2  | 2  | 1  | 0  |  |
| 1  | 2  | 2  | 1  | 0  |  |
| 55 | 85 |    |    |    |  |
|    | 95 | 58 | 56 | 86 |  |

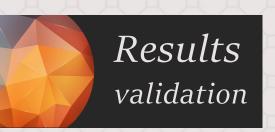
#### 30 images

- 10-fold cross validation
- 1 image reserved for testing

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Prediction: o



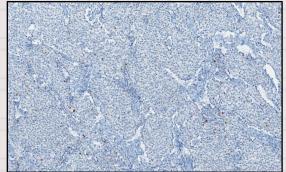


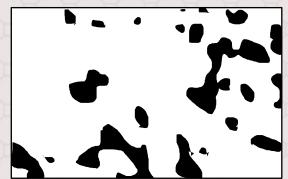
|            | <b>A</b> 1          | <b>A2</b>           | I1                  | I2                  |
|------------|---------------------|---------------------|---------------------|---------------------|
| Acc.       | $0.9125 \pm 0.0044$ | $0.9172 \pm 0.0031$ | $0.8966 \pm 0.0058$ | $0.9041 \pm 0.0048$ |
| Prec.      | $0.9100 \pm 0.0071$ | $0.8948 \pm 0.0064$ | $0.9138 \pm 0.0066$ | $0.9122 \pm 0.0069$ |
| Spec.      | $0.6084 \pm 0.0163$ | $0.5458 \pm 0.0102$ | $0.6549 \pm 0.0156$ | $0.6590 \pm 0.0106$ |
| Sens.      | $0.9552 \pm 0.0069$ | $0.9822 \pm 0.0015$ | $0.9338 \pm 0.0068$ | $0.9449 \pm 0.0042$ |
| IoU        | $0.8929 \pm 0.0063$ | $0.9019 \pm 0.0043$ | $0.8762 \pm 0.0075$ | $0.8854 \pm 0.0062$ |
| <b>F</b> 1 | $0.9414 \pm 0.0037$ | $0.9471 \pm 0.0025$ | $0.9320 \pm 0.0044$ | $0.9377 \pm 0.0036$ |

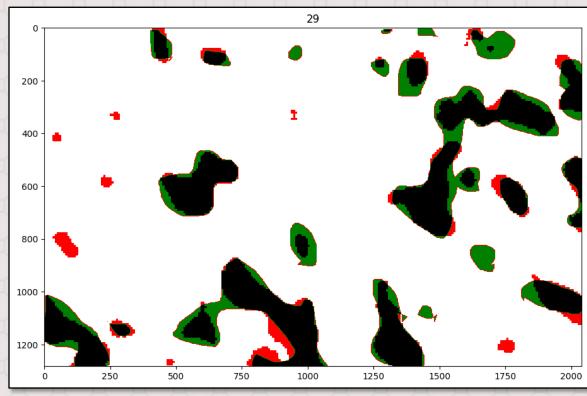
| ID | Model   | Optimiser                                | Loss function           | Batch size | Epochs |
|----|---------|--|-------------------------|------------|--------|
| A1 | AlexNet | $Adam(lr = 10^{-4})$                     | XEn                     | 100        | 5      |
| A2 | AlexNet | AdamW(lr = $10^{-4}$ , $\lambda = 0.1$ ) | XEn                     | 100        | 5      |
| I1 | IncV3   | $Adam(lr = 5 \cdot 10^{-4})$             | $FL(\alpha=1,\gamma=2)$ | 100        | 5      |
| I2 | IncV3   | $AdamW(lr = 5 \cdot 10^{-4})$            | XEn                     | 100        | 5      |



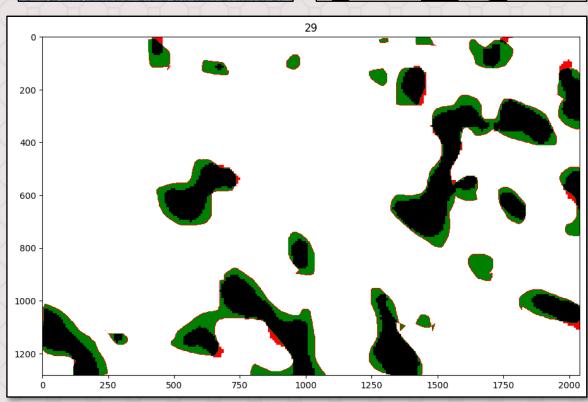
- ☐ Correct tumor
- Correct non tumor
- False positive
- False negative







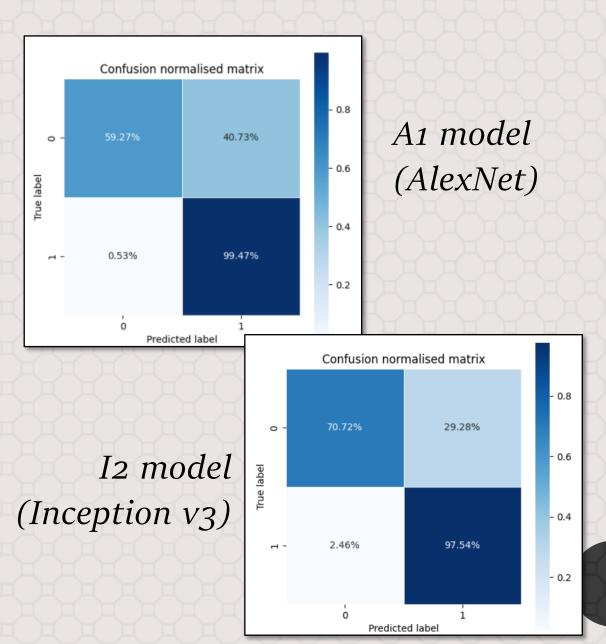
A1 model (AlexNet)



*I2 model (Inception v3)* 



| д д д ј |                              |                                    |
|---------|------------------------------|------------------------------------|
|         | AlexNet not regularized (A1) | Inception-v3<br>cross-entropy (I2) |
| Acc.    | 92,54%                       | 92,92%                             |
| Prec.   | 92,15%                       | 94,12%                             |
| Spec.   | 59.27%                       | 70,72%                             |
| Rec.    | 99,47%                       | 97,54%                             |
| loU     | 91,70%                       | 91,94%                             |
| F1      | 95,67%                       | 95,80%                             |





#### Also tried:

- Dataset oversampling
- Data augmentation
- Image equalization
- Custom class weighting

| ID | Model   | Optimiser                                | Loss function           | Batch size | Epochs |
|----|---------|--|-------------------------|------------|--------|
| A1 | AlexNet | $Adam(lr = 10^{-4})$                     | XEn                     | 100        | 5      |
| A2 | AlexNet | AdamW(lr = $10^{-4}$ , $\lambda = 0.1$ ) | XEn                     | 100        | 5      |
| I1 | IncV3   | $Adam(lr = 5 \cdot 10^{-4})$             | $FL(\alpha=1,\gamma=2)$ | 100        | 5      |
| I2 | IncV3   | $AdamW(lr = 5 \cdot 10^{-4})$            | XEn                     | 100        | 5      |

# Thank you!

Luca Olivieri Tommaso Giordano

