

Parameters and Memory Consumption of CNNs

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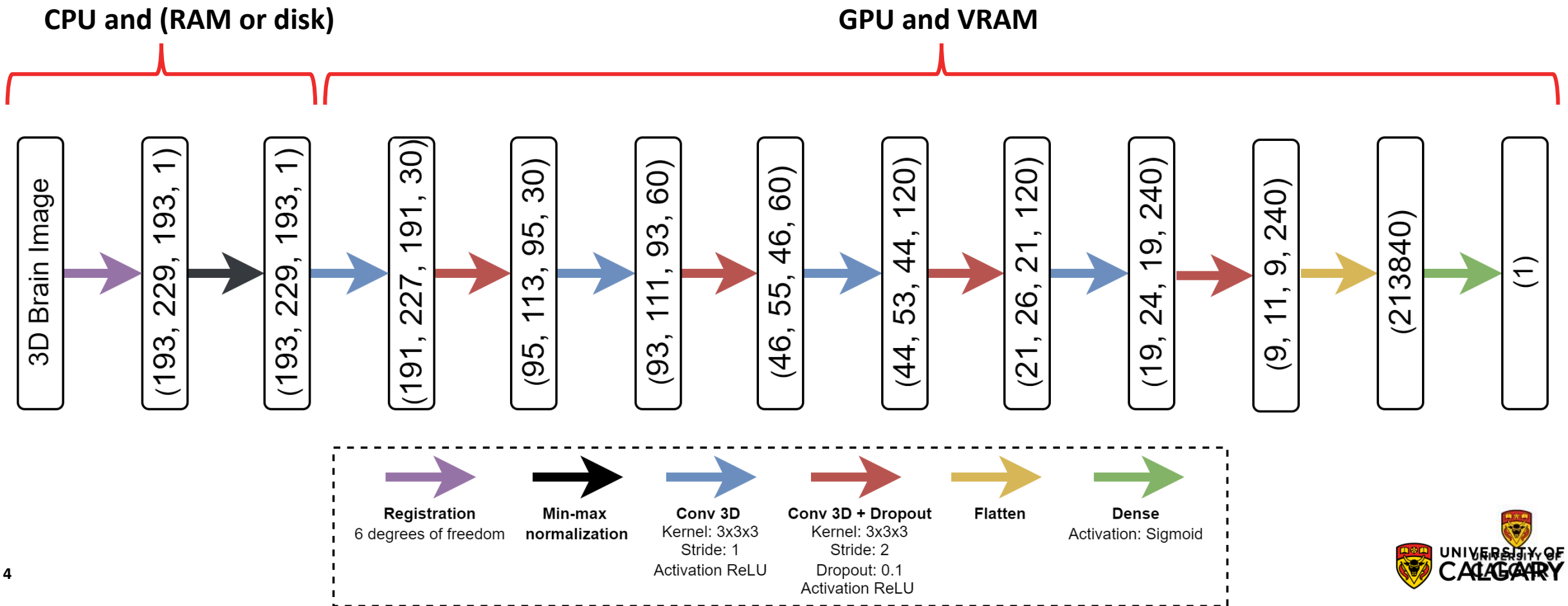
Outline

- Learning Goals
- Compute number of CNN parameters
- Compute GPU memory consumption
- Summary

Learning Goals

- Be able to compute number of parameters of a CNN
- Estimate GPU memory consumption during training/testing

3D CNN - Network Architecture



Number of Model Parameters

$$L_1 = (27 \cdot 1 + 1) \cdot 30 = 840$$

$$L_5 = (27 \cdot 60 + 1) \cdot 120 = 194,520$$

$$L_9 = (213840 + 1) \cdot 1 = 213,841$$

$$L_2 = (27 \cdot 30 + 1) \cdot 30 = 24,330$$

$$L_6 = (27 \cdot 120 + 1) \cdot 120 = 388,920$$

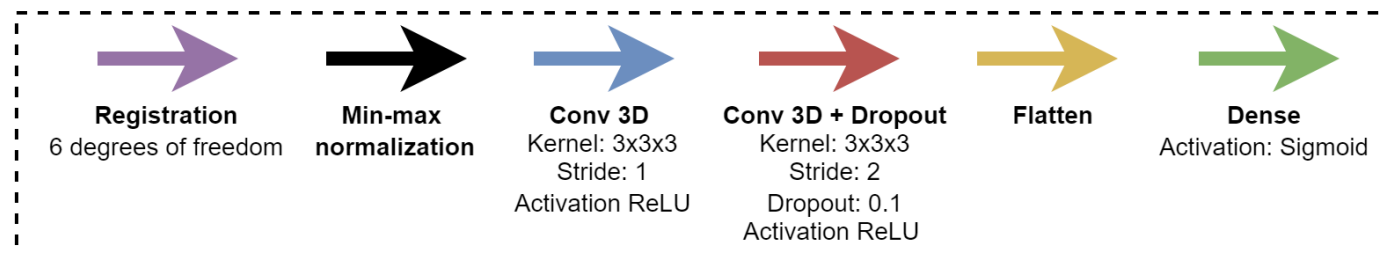
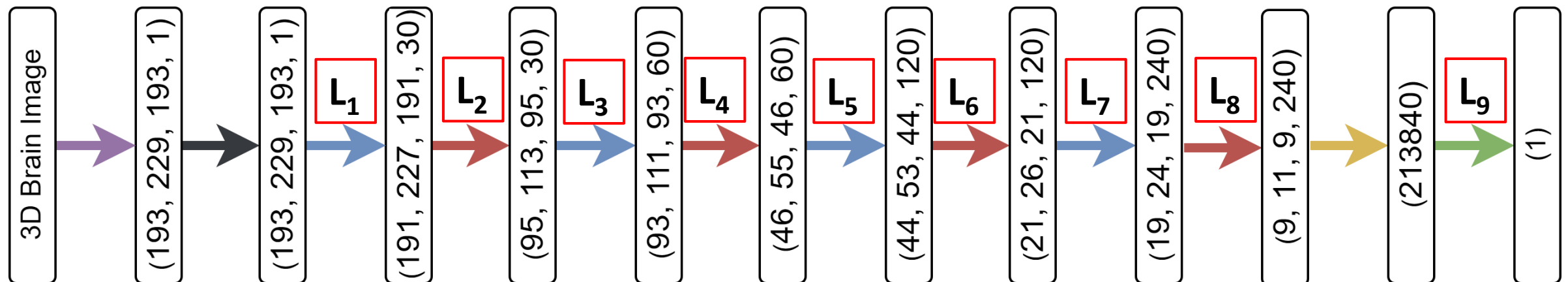
$$L_3 = (27 \cdot 30 + 1) \cdot 60 = 48,660$$

$$L_7 = (27 \cdot 120 + 1) \cdot 240 = 777,840$$

$$L_4 = (27 \cdot 60 + 1) \cdot 60 = 97,260$$

$$L_8 = (27 \cdot 240 + 1) \cdot 240 = 1,555,440$$

$$\sum_{i=1}^9 L_i = 3,301,651$$



GPU Memory Consumption

Params = $3,301,651 \times 4 = 13.21$ MB

Grads = $3,301,651 \times 4 = 13.21$ MB

$I_1 = 193 \times 229 \times 193 \times 1 \times 4 = 34.12$ MB

$I_2 = 191 \times 227 \times 191 \times 30 \times 4 = 993.74$ MB

$I_3 = 95 \times 113 \times 95 \times 30 \times 4 = 122.38$ MB

$I_4 = 93 \times 111 \times 93 \times 60 \times 4 = 230.4$ MB

$I_5 = 46 \times 55 \times 46 \times 60 \times 4 = 51.50$ MB

$I_6 = 44 \times 53 \times 44 \times 120 \times 4 = 49.25$ MB

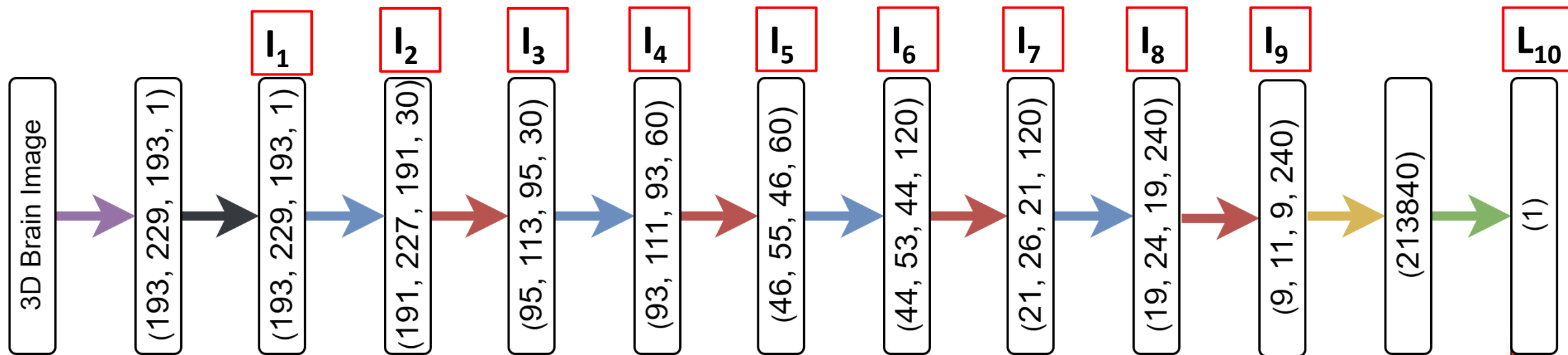
$I_7 = 21 \times 26 \times 21 \times 120 \times 4 = 5.50$ MB

$I_8 = 19 \times 24 \times 19 \times 240 \times 4 = 8.32$ MB

$I_9 = 9 \times 11 \times 9 \times 240 \times 4 = 0.86$ MB

$I_{10} = 1 \times 4 = 4e-6$ MB

$$\text{Batch mem} = \text{Params} + \text{Grads} + bs \times (I_1 + 2 \times \sum_{i=2}^{10} I_i)$$



Summary

- Understanding the number of parameters and GPU memory consumption is important:
 - It allows you to estimate if the hardware available is sufficient for training the desired model
 - It allows to identify layers with the most number of parameters and how to potentially alter them if facing problems, such as overfitting

Thank you!

