Parameters and Memory Consumption of CNNs

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Outline

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

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Learning Goals

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

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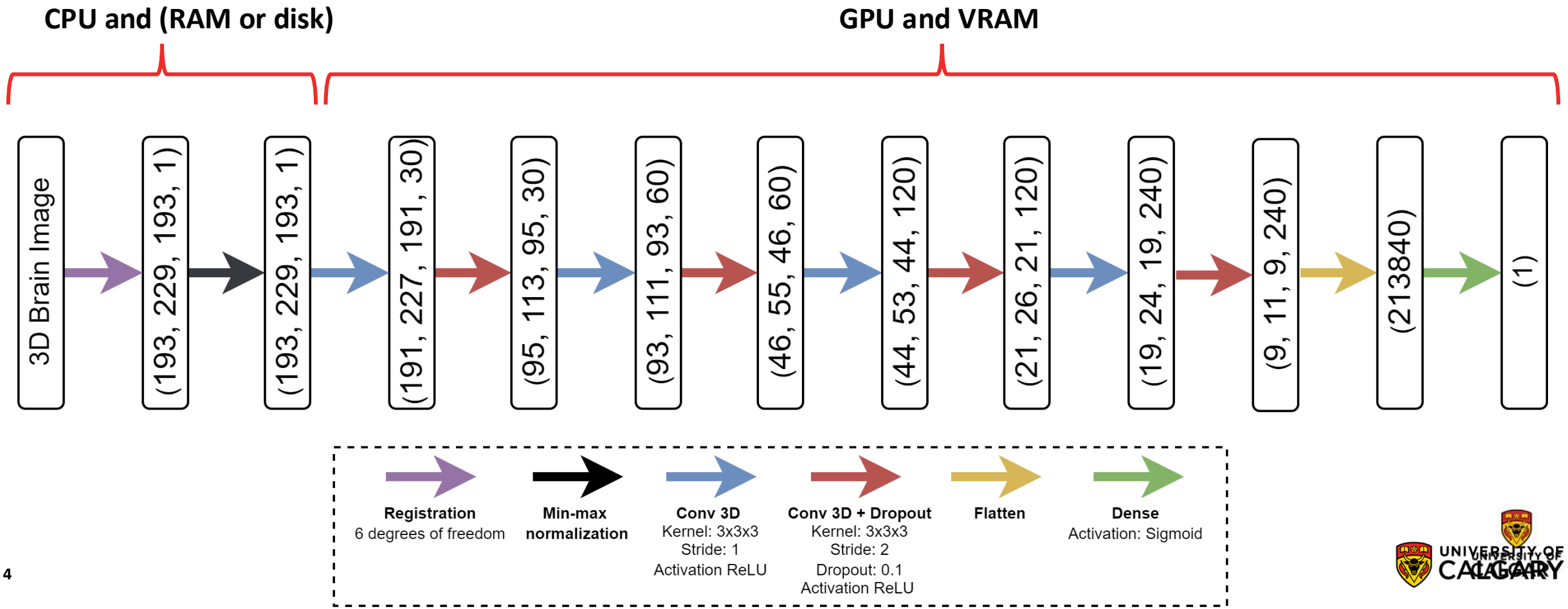
3D CNN - Network Architecture



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Number of Model Parameters

$L_1 = (27*1 +1)*30 =$ **840**

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

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

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

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

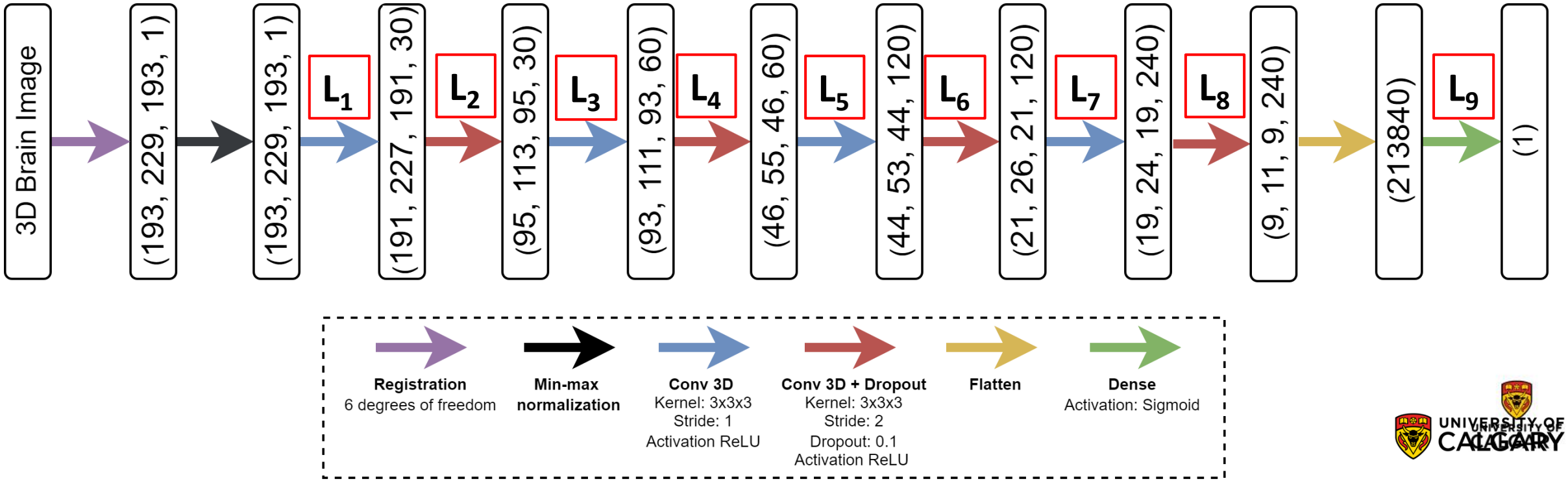
$L_6 = (27*120 +1)*120 =$ **388,920**

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

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

$L_9 = (213840 + 1)*1 =$ **213,841**

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



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GPU Memory Consumption

Params =3,301,651*4 = **13.21 MB**

Grads =3,301,651*4 = **13.21 MB**

I_1 = 193*229*193*1*4 = **34.12 MB**

I_2 = 191*227*191*30*4 = **993.74 MB**

I_3 = 95*113*95*30*4 = **122.38 MB**

I_4 = 93*111*93*60*4 = **230.4 MB**

I_5 = 46*55*46*60*4 = **51.50 MB**

I_6 = 44*53*44*120*4 = **49.25 MB**

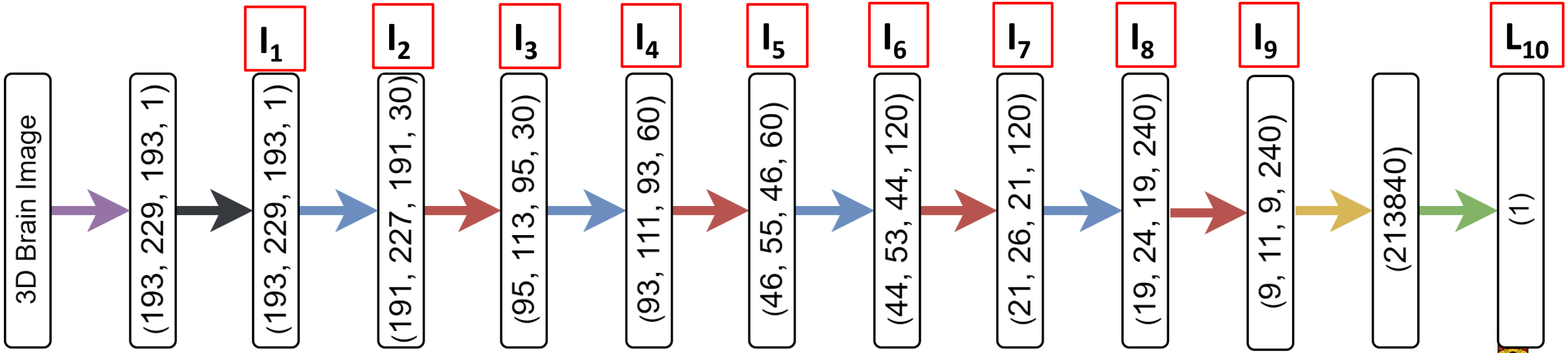
I_7 = 21*26*21*120*4 = **5.50 MB**

I_8 = 19*24*19*240*4 = **8.32 MB**

I_9 = 9*11*9*240*4 = **0.86 MB**

I_{10} = 1*4 = **4e-6 MB**

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



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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

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Thank you!

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