Siamese Neural Network

**One-shot Learning**

Face Recognition

Siamese Neural Network

(From Wikipedia)

The most famous pair of conjoined twins was Chang and Eng Bunker (Thai: อิน-จัน, In-Chan) (1811–1874), Thai brothers born in Siam, now Thailand. They traveled with P.T. Barnum's circus for many years and were labeled as the **Siamese twins**.

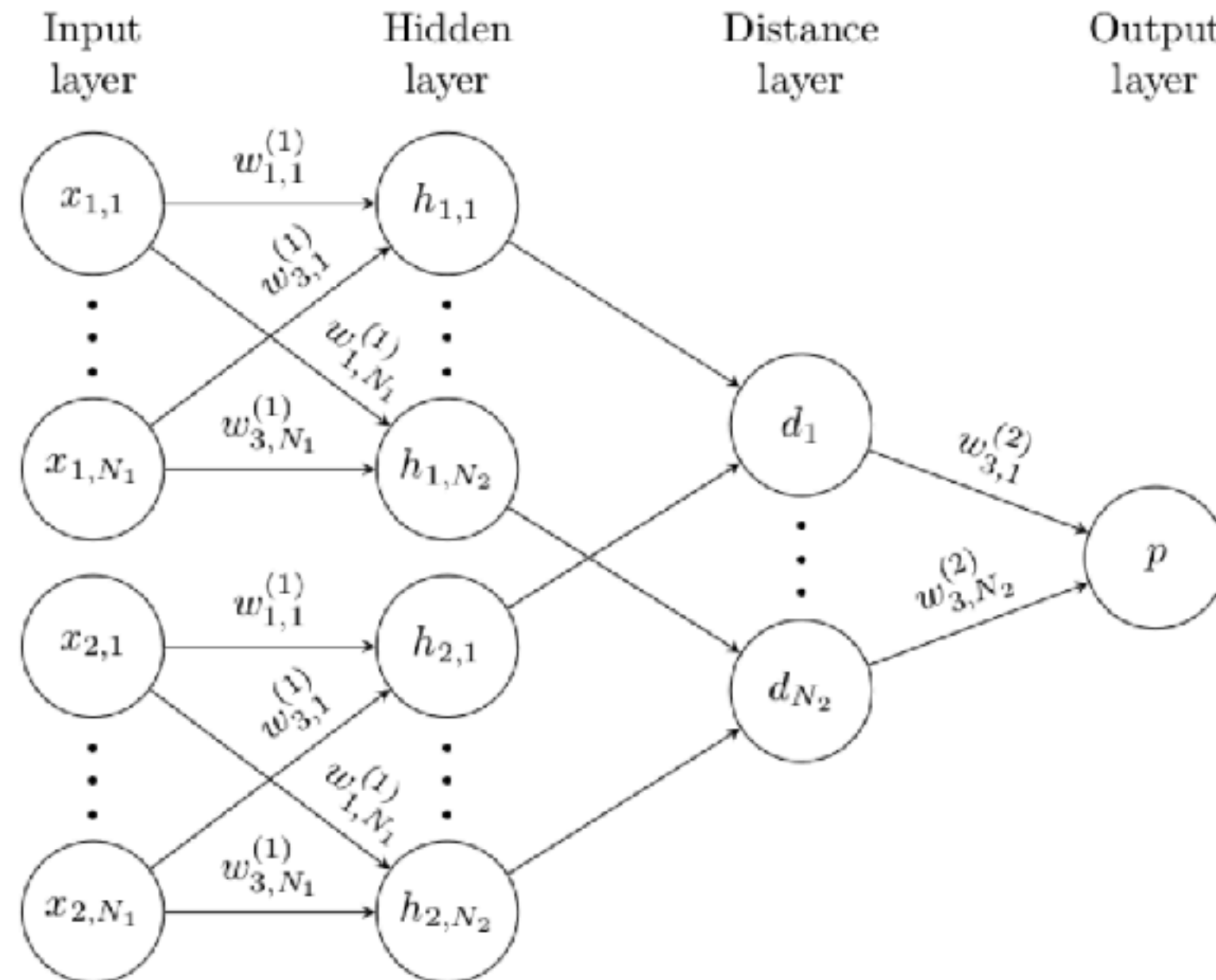The term "Siamese twins" came to be used as a synonym for conjoined twins.[7]
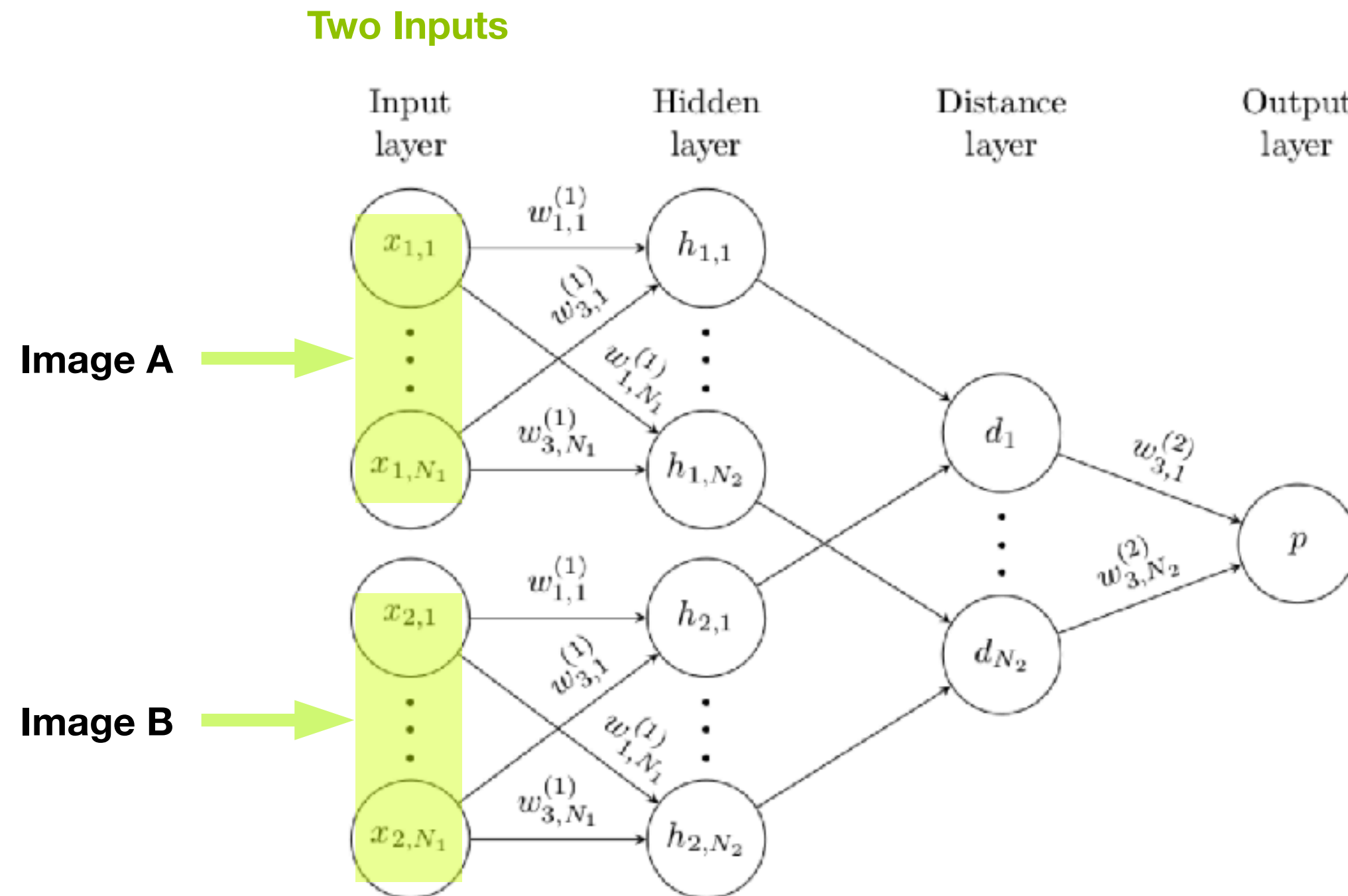
Siamese Neural Network
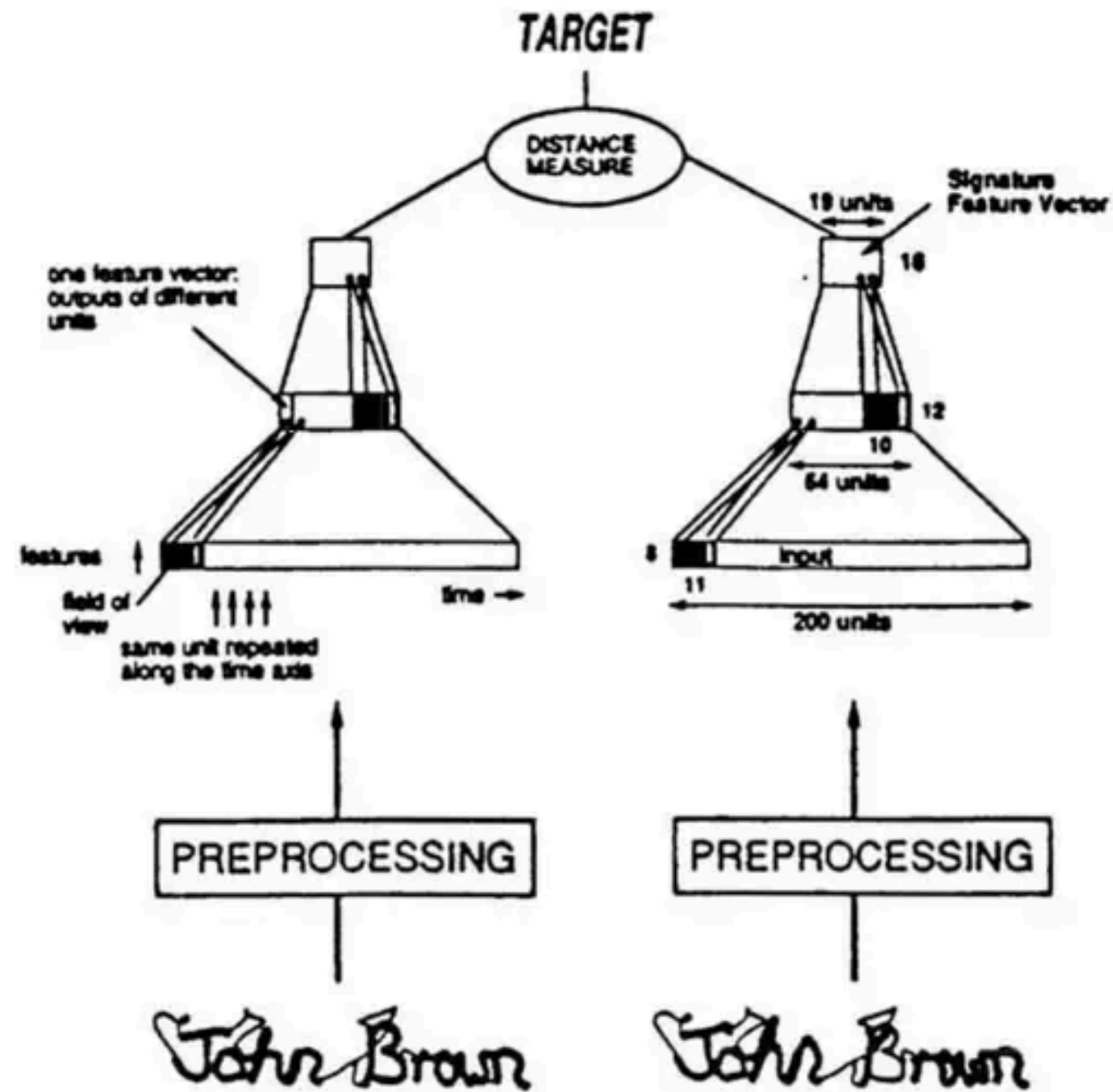
Bromley et al., 1993
Signature Verification using a "Siamese" Time Delay Neural Network

Siamese Neural Network

Siamese Neural Networks for One-shot Image Recognition (Koch et al., 2015)

Siamese Neural Network

Two Inputs

Image A →

Image B →

Siamese Neural Networks for One-shot Image Recognition (Koch et al., 2015)

Siamese Neural Network

Two Inputs

Image A

Image B

The "Twins"

Input layer   Hidden layer   Distance layer   Output layer

$x_{1,1}$ $w_{1,1}^{(1)}$ $h_{1,1}$

$w_{3,1}^{(1)}$ $w_{1,N_1}^{(1)}$

x_{1,N_1} $w_{3,N_1}^{(1)}$ h_{1,N_2}

d_1 $w_{3,1}^{(2)}$

$x_{2,1}$ $w_{1,1}^{(1)}$ $h_{2,1}$

$w_{3,1}^{(1)}$ $w_{1,N_1}^{(1)}$

d_{N_2} $w_{3,N_2}^{(2)}$ p
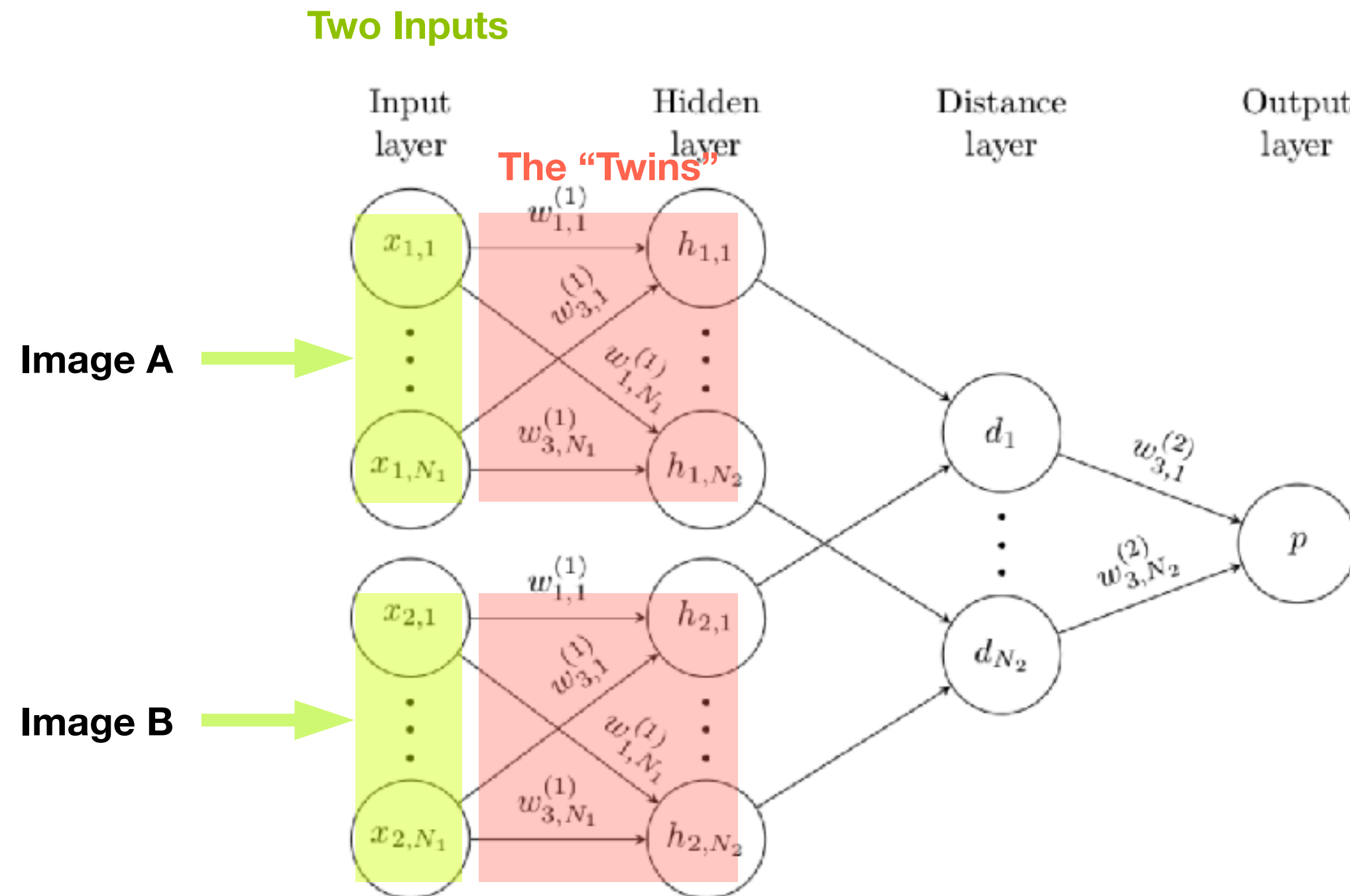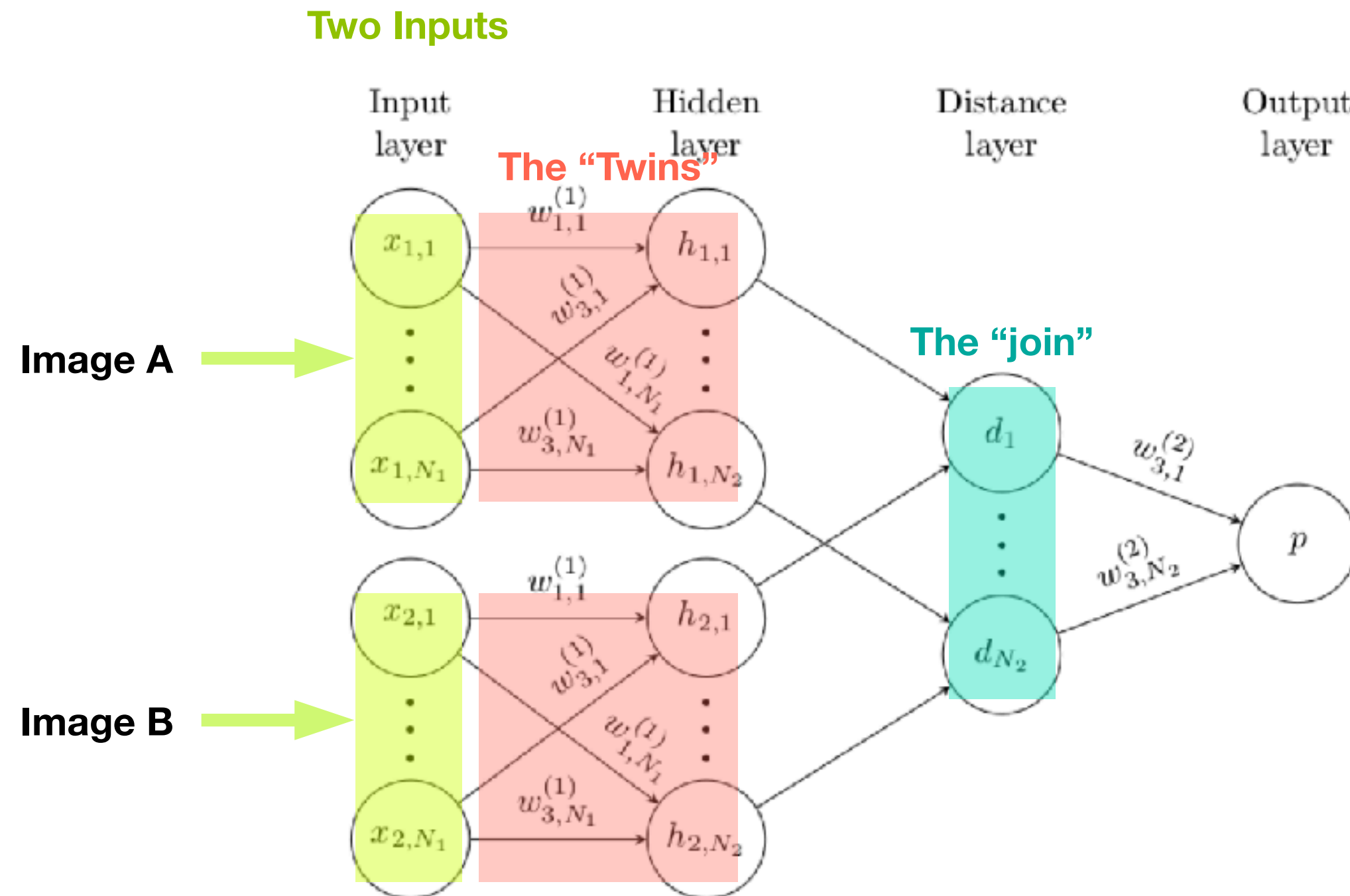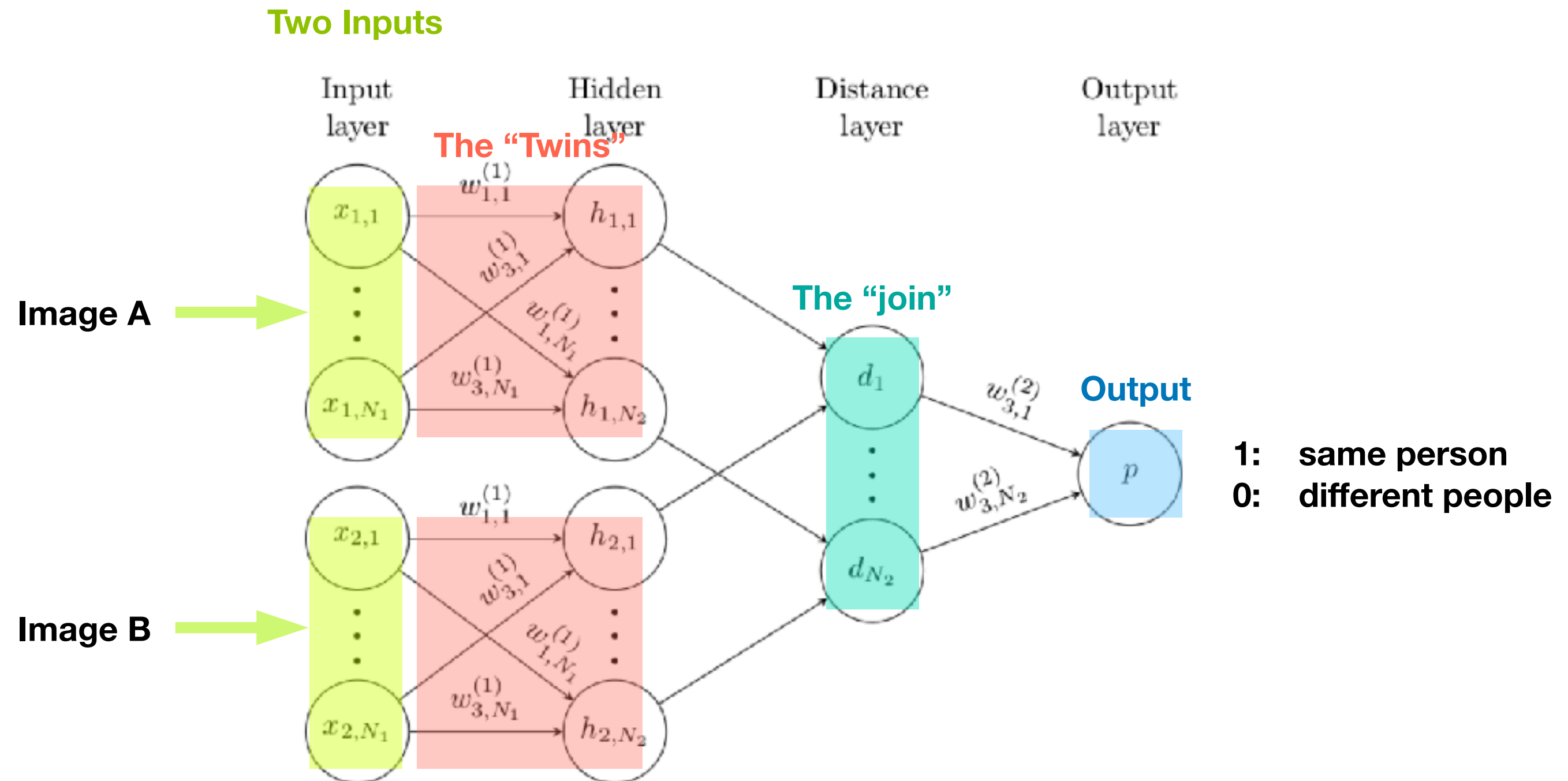
x_{2,N_1} $w_{3,N_1}^{(1)}$ h_{2,N_2}

Siamese Neural Networks for One-shot Image Recognition (Koch et al., 2015)

Siamese Neural Network

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Siamese Neural Network

Two Inputs

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Siamese Neural Network

Contrastive Loss

Triplet Loss

Anchor   Positive   Negative

Maximize Distance(A, N)
Minimize Distance(A, P)
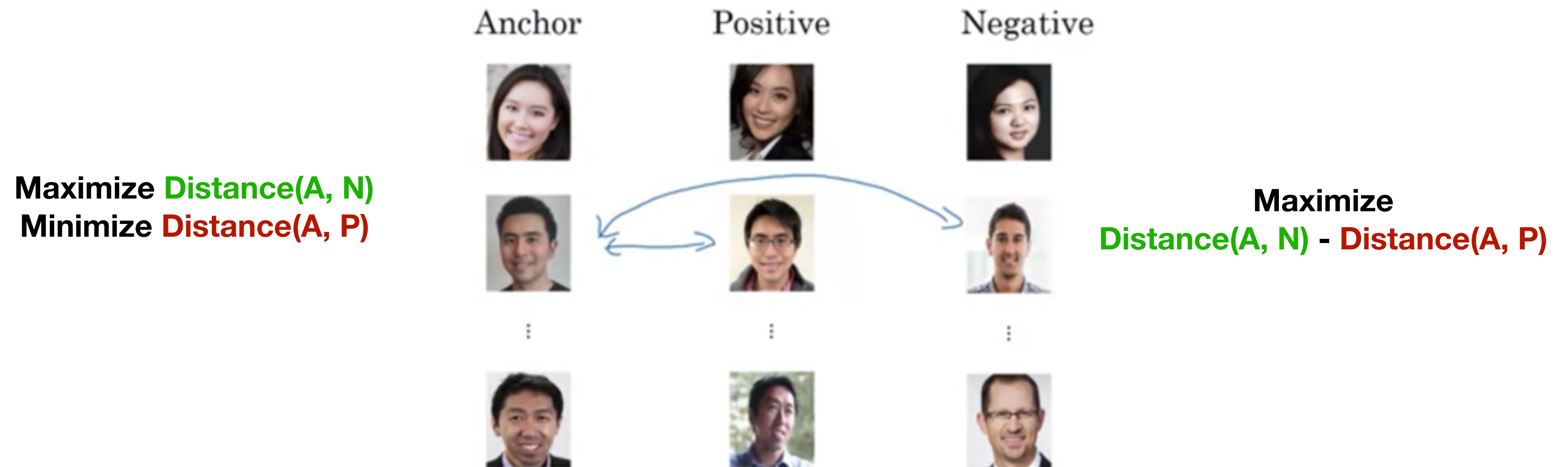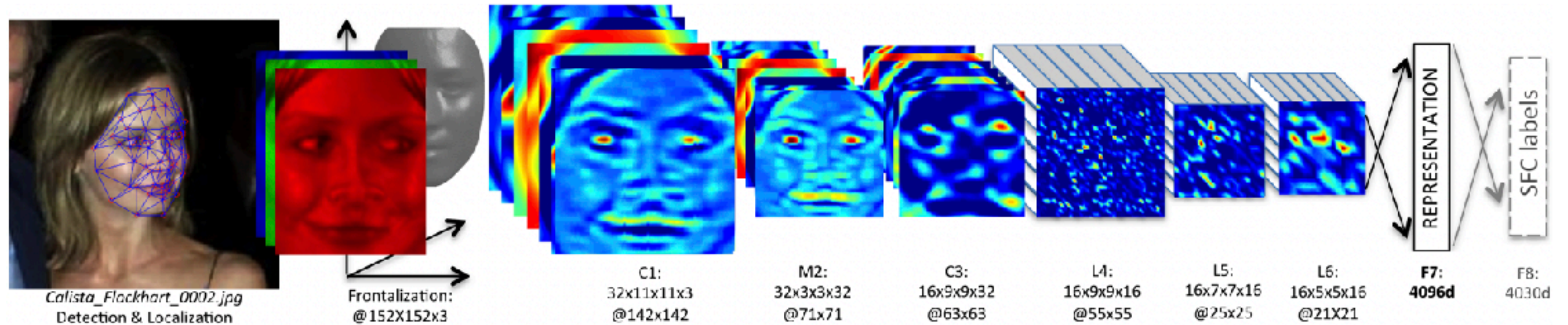
Maximize
Distance(A, N) - Distance(A, P)

Image above is borrowed from Andrew Ng Coursera video:
https://www.coursera.org/learn/convolutional-neural-networks/lecture/gjckG/one-shot-learning

Siamese Neural Network

If you were to create a simplified version of "FaceID" in iPhone X…

Step 1: train a Siamese Network on LOTS of data (triplets of faces)

Calista_Flockhart_0002.jpg Detection & Localization	Frontalization: @152X152x3	C1: 32x11x11x3 @142x142	M2: 32x3x3x32 @71x71	C3: 16x9x9x32 @63x63	L4: 16x9x9x16 @55x55	L5: 16x7x7x16 @25x25	L6: 16x5x5x16 @21X21	F7: **4096d**	F8: 4030d

Step 2: load trained parameters into a phone
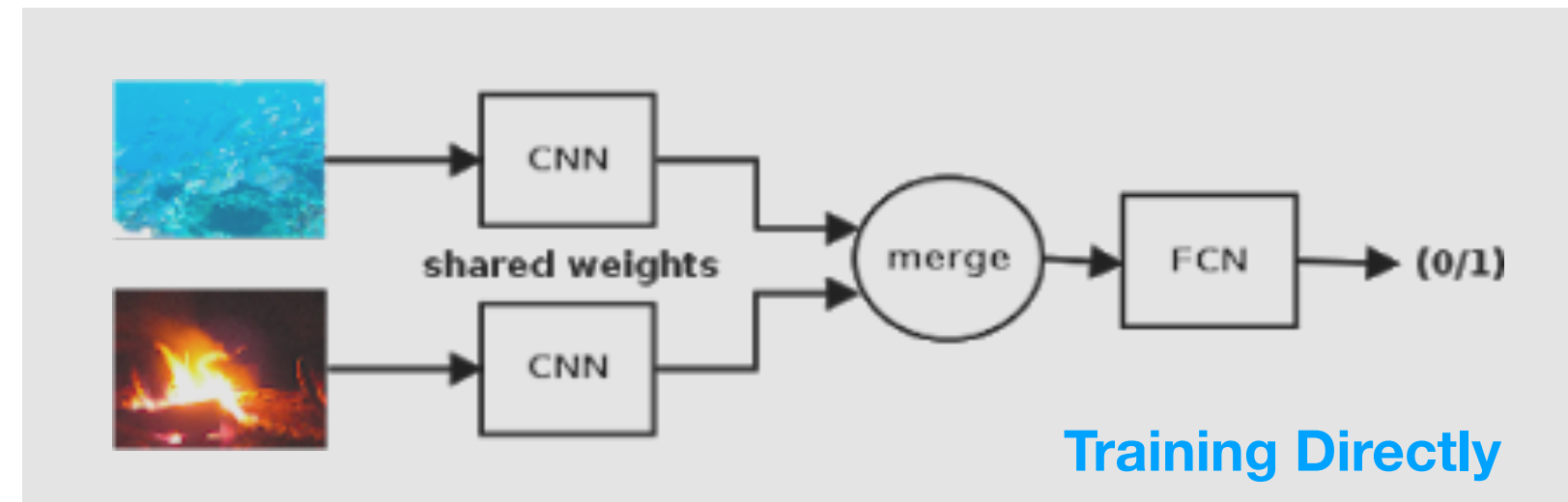

Step 3: compute your own "face vector" (one time only)

*Bonus: combine with depth field

Siamese Neural Network

Transfer Learning Example

Adapted from blogpost by Sujit Pal:
http://sujitpal.blogspot.com/2017/02/

Training Directly

Transfer Learning

- VGG-16
- VGG-19
- ResNet
- InceptionV3
- ...

Keras Applications