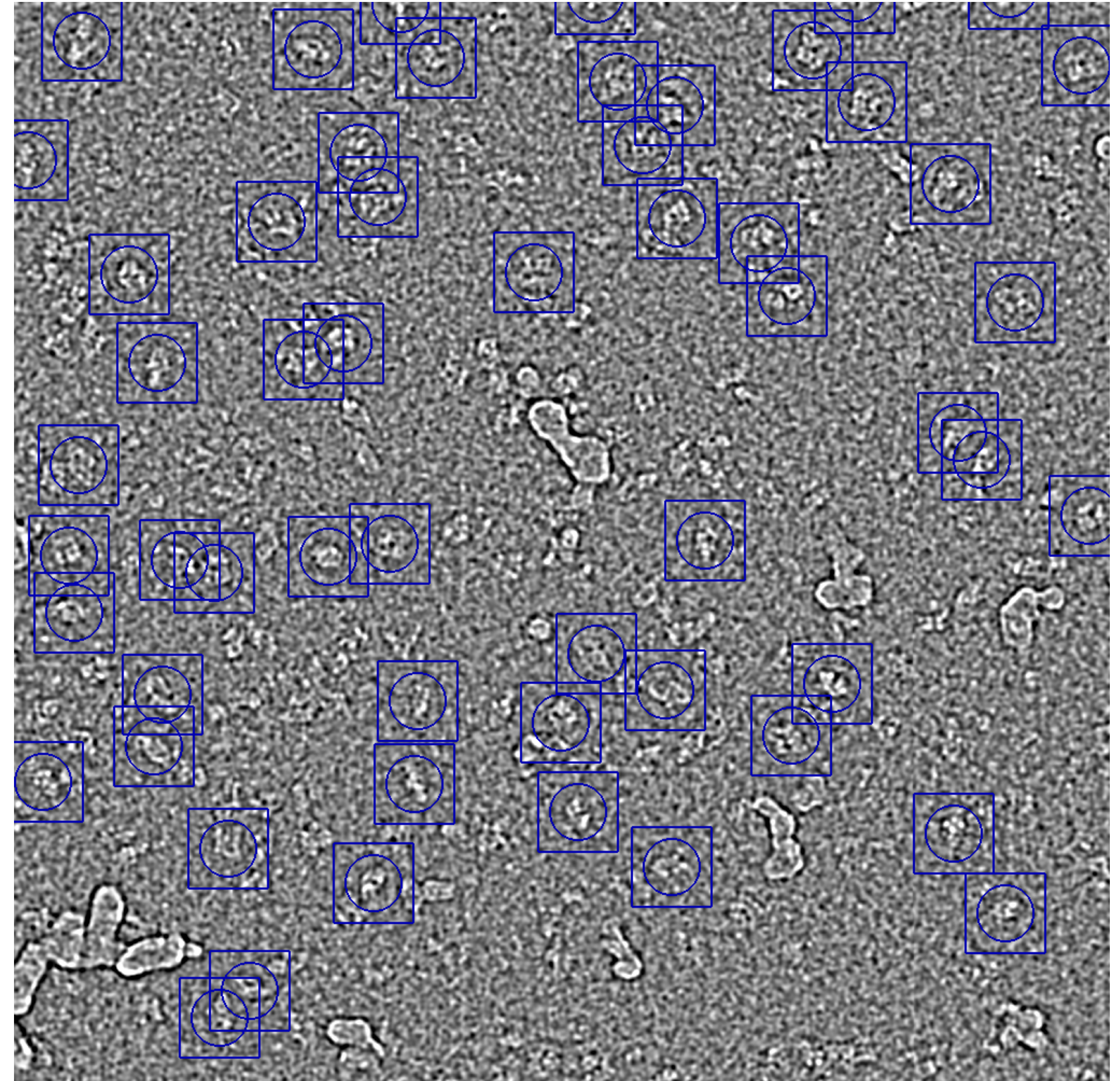
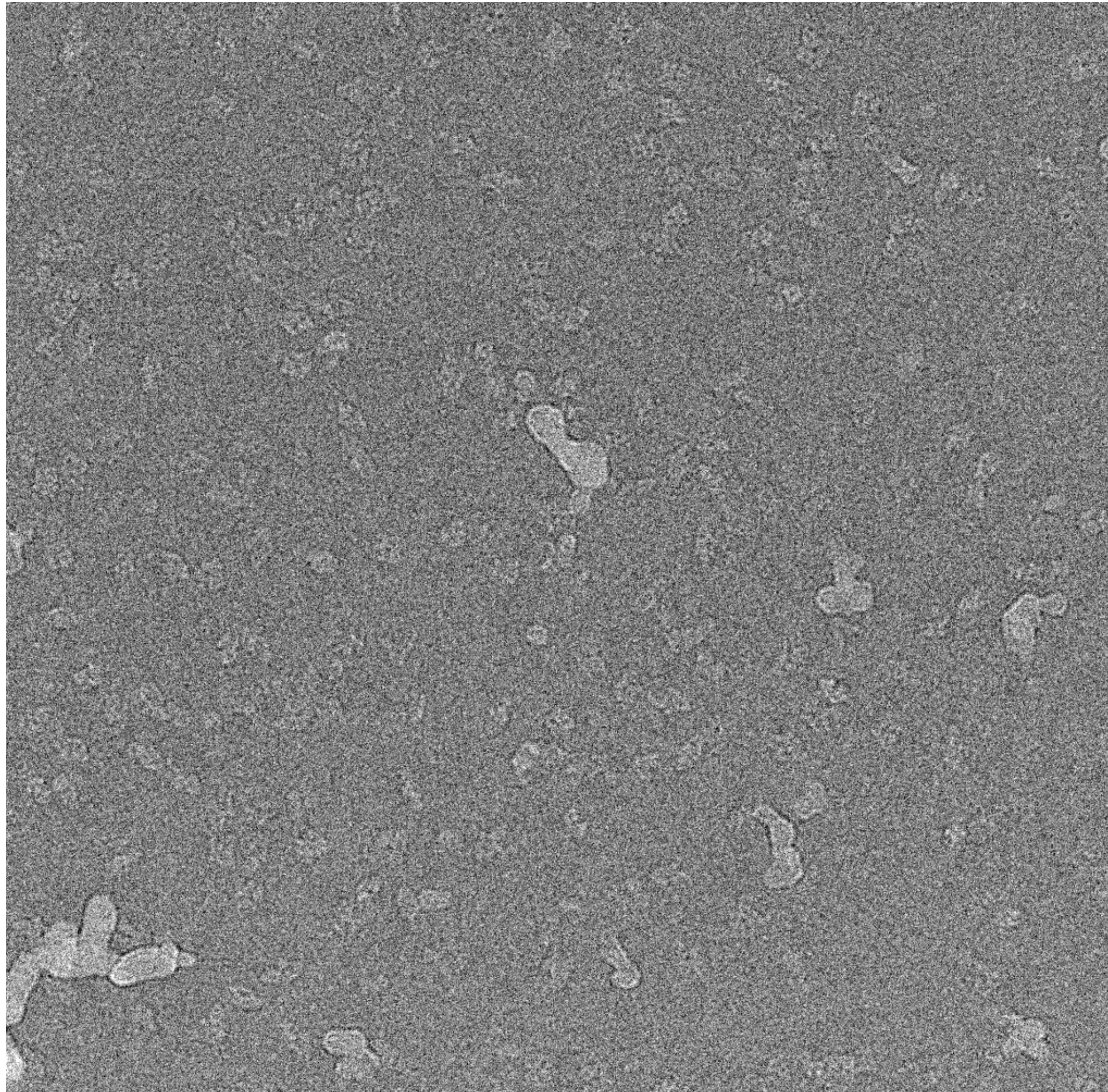


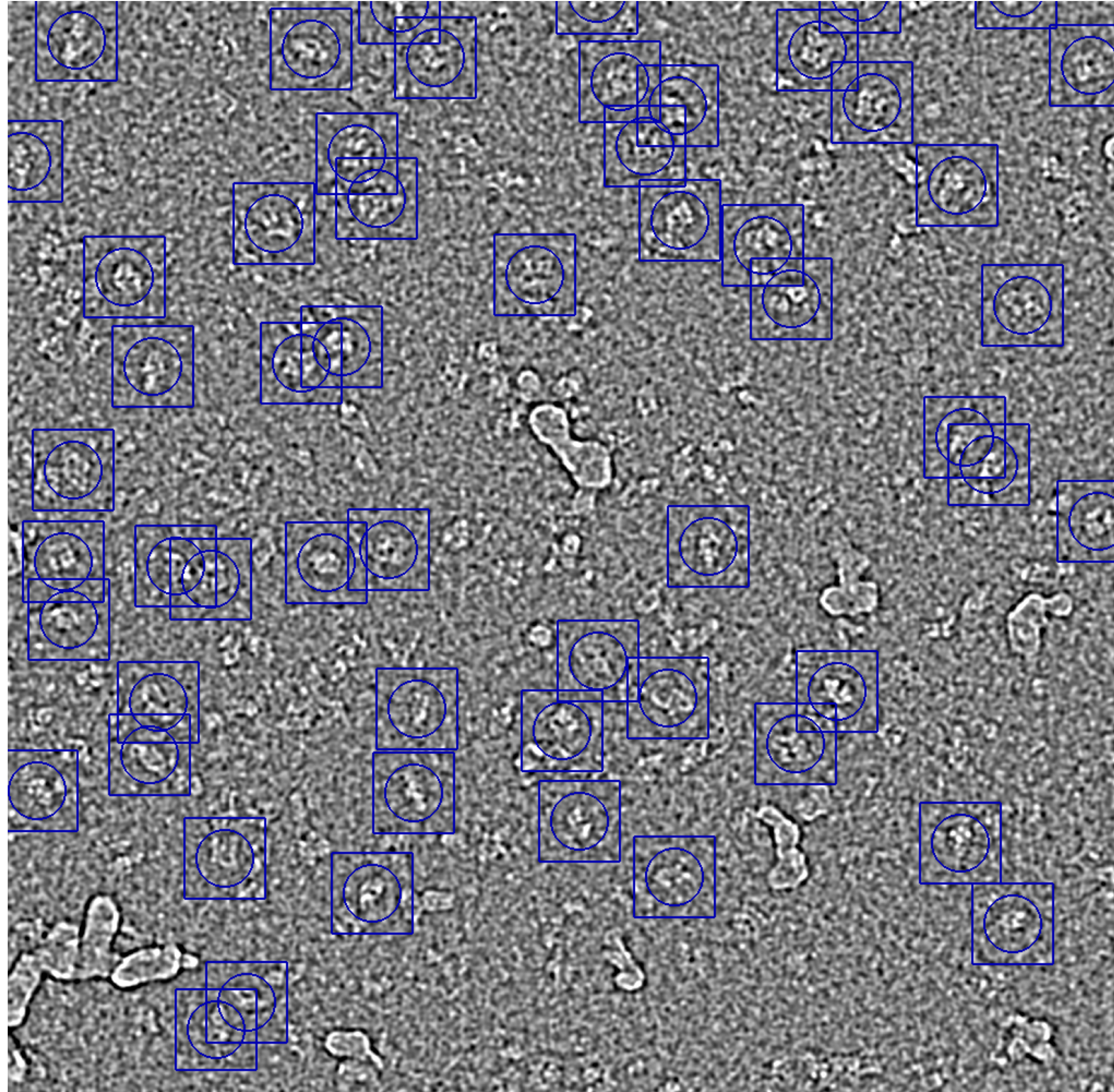
# Particle picking

Muyuan Chen  
2019-05

# From micrographs to particles

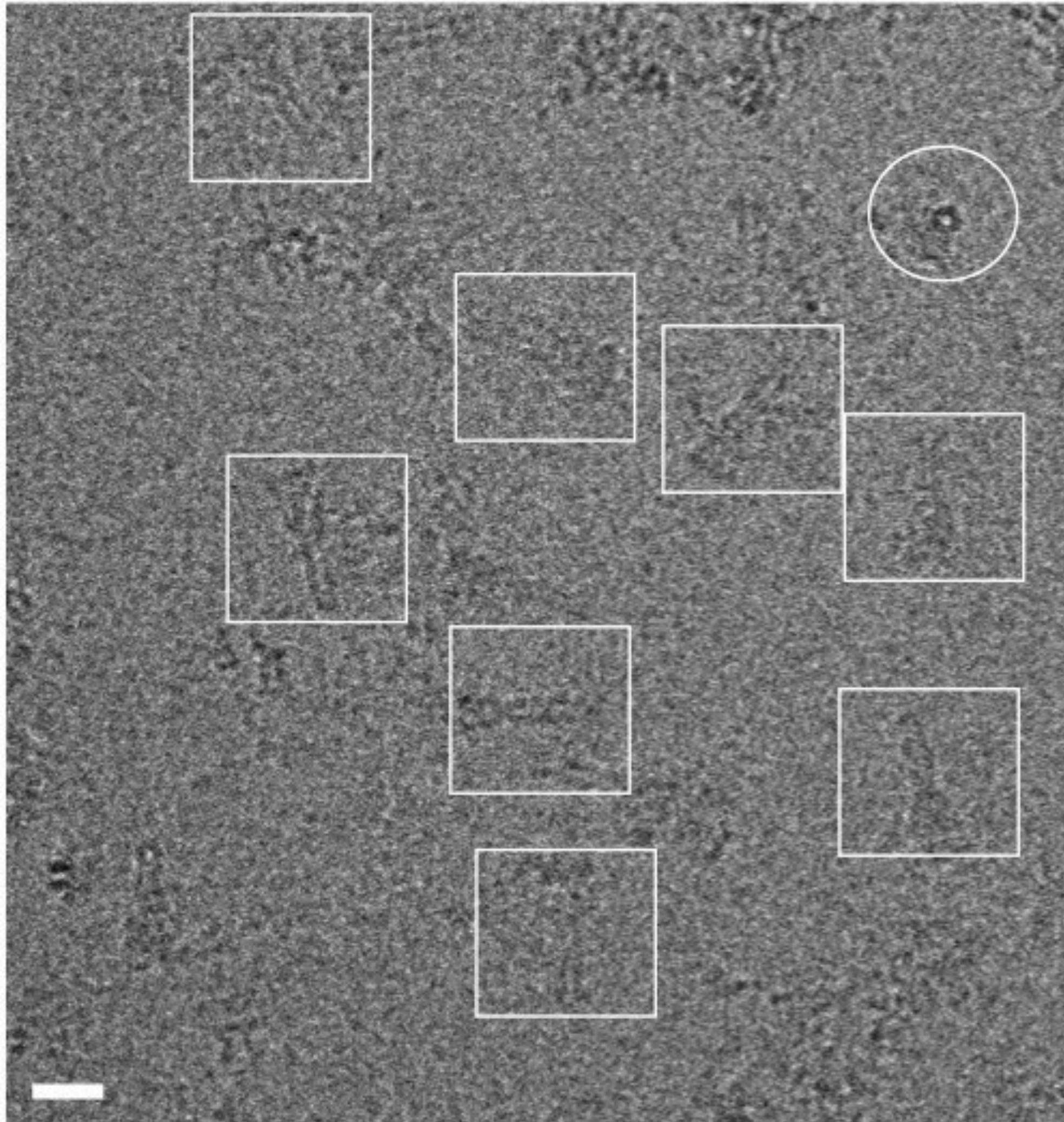


# From micrographs to particles



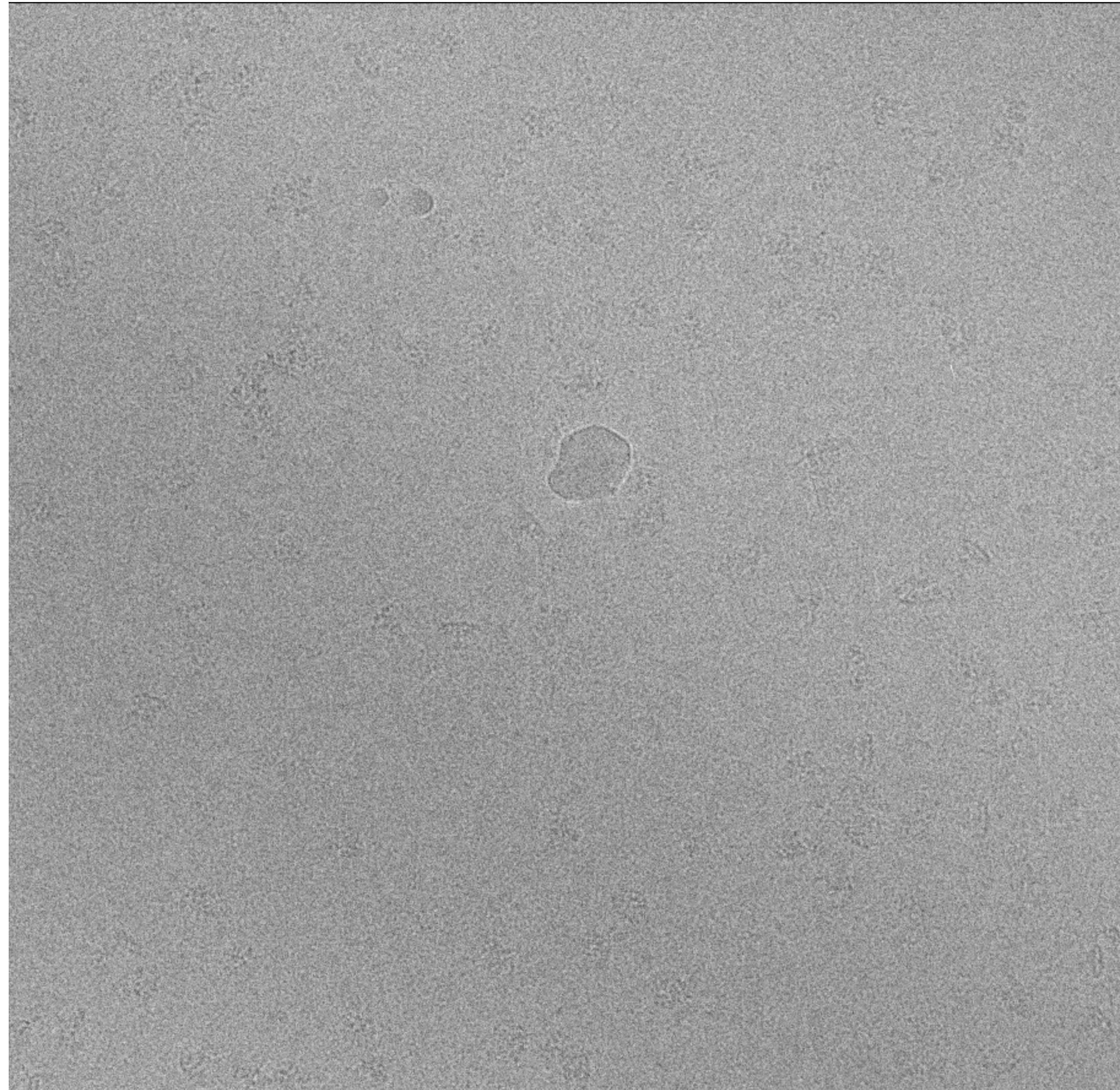
- Manual picking
  - Hand designed filter
  - Template matching
- Time consumption
  - Model bias
  - Missing views
  - Contamination

# From micrographs to particles



- Manual picking
  - Hand designed filter
  - Template matching
- 
- Time consumption
  - Model bias
  - Missing views
  - Contamination

# From micrographs to particles



- Manual picking
  - Hand designed filter
  - Template matching
- Time consumption
  - Model bias
  - Missing views
  - Contamination

# Particle picking with neural networks

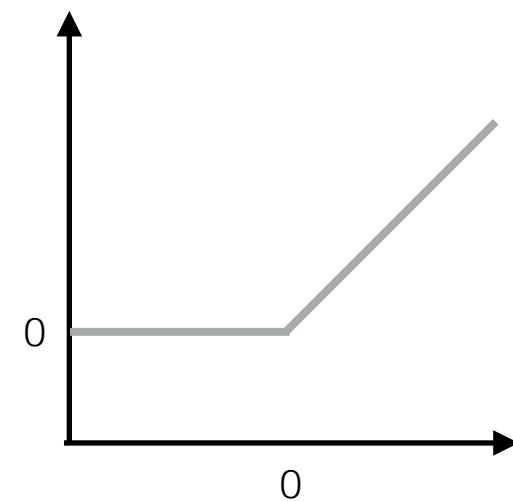
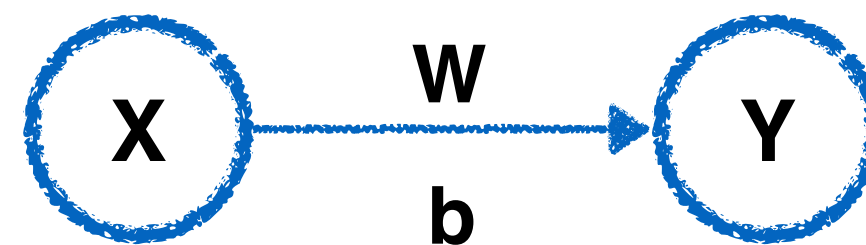
# Artificial Neural Networks

$$Y = f(WX + b)$$

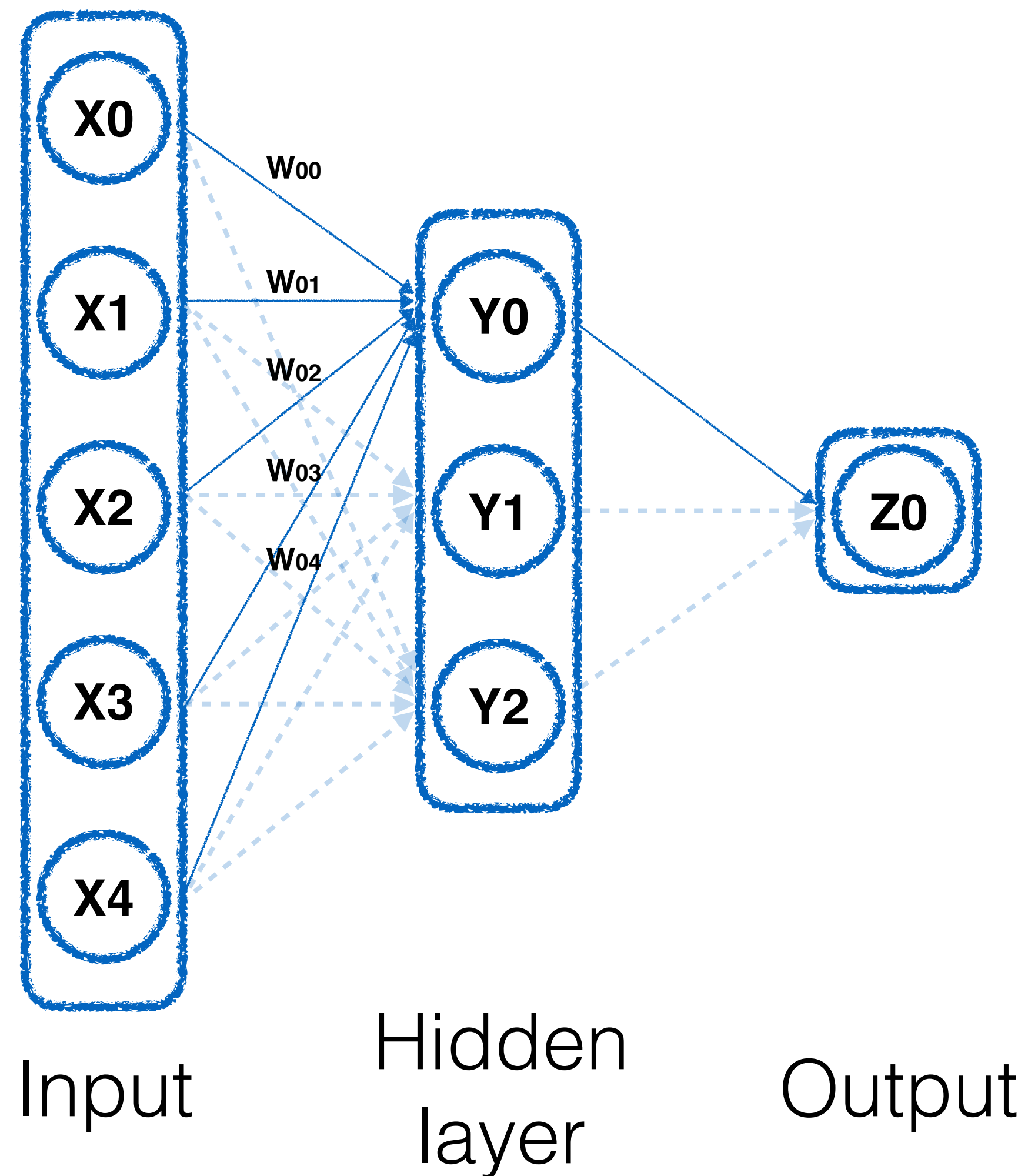
Weight

bias

Activation function



# Artificial Neural Networks



Training:  
Given know pairs of  $\mathbf{X}$  and  $\mathbf{Z}$ , adjust  $\mathbf{W}$  to make  $\mathbf{Z_0}$  close to  $\mathbf{Z}$

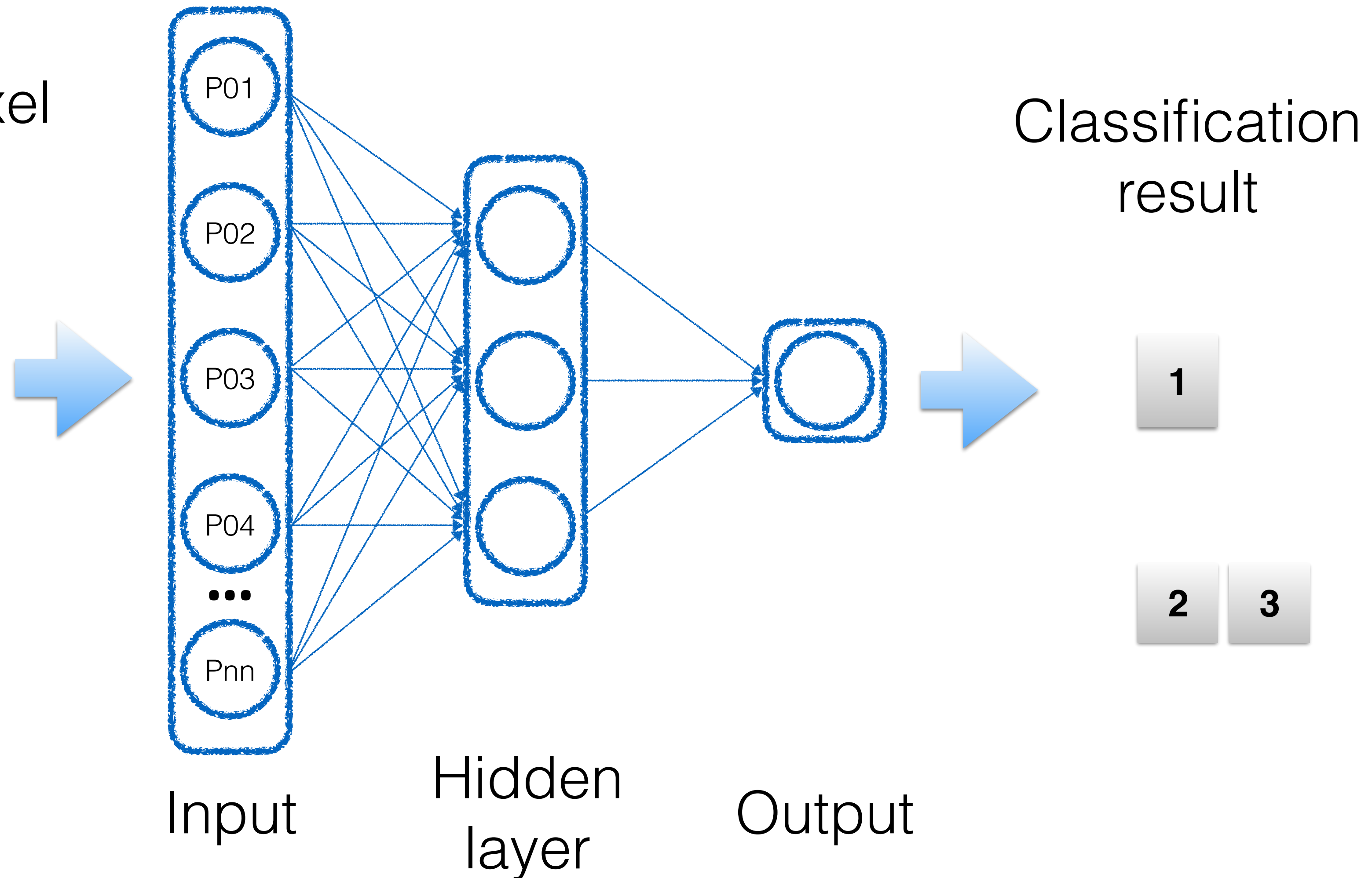


# Neural Networks in image classification

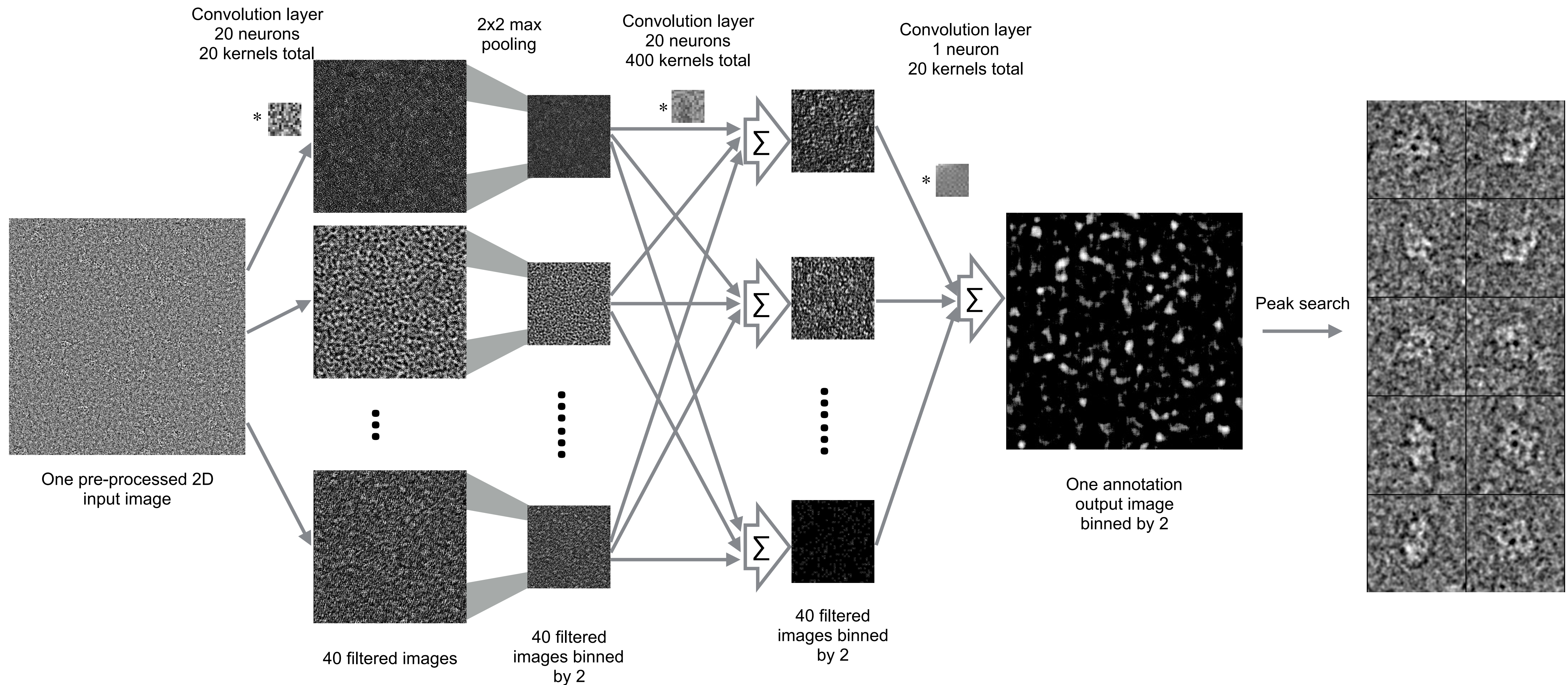
Value at each pixel of an image



0	0	0	0	0	0	0	0
0	0	0	0	0	3	3	0
0	0	0	0	1	16	11	0
0	0	0	0	9	17	3	0
0	0	0	3	18	7	0	0
0	0	1	16	13	0	0	0
0	0	8	20	4	0	0	0
0	1	16	14	0	0	0	0
0	1	15	6	0	0	0	0
0	0	1	0	0	0	0	0

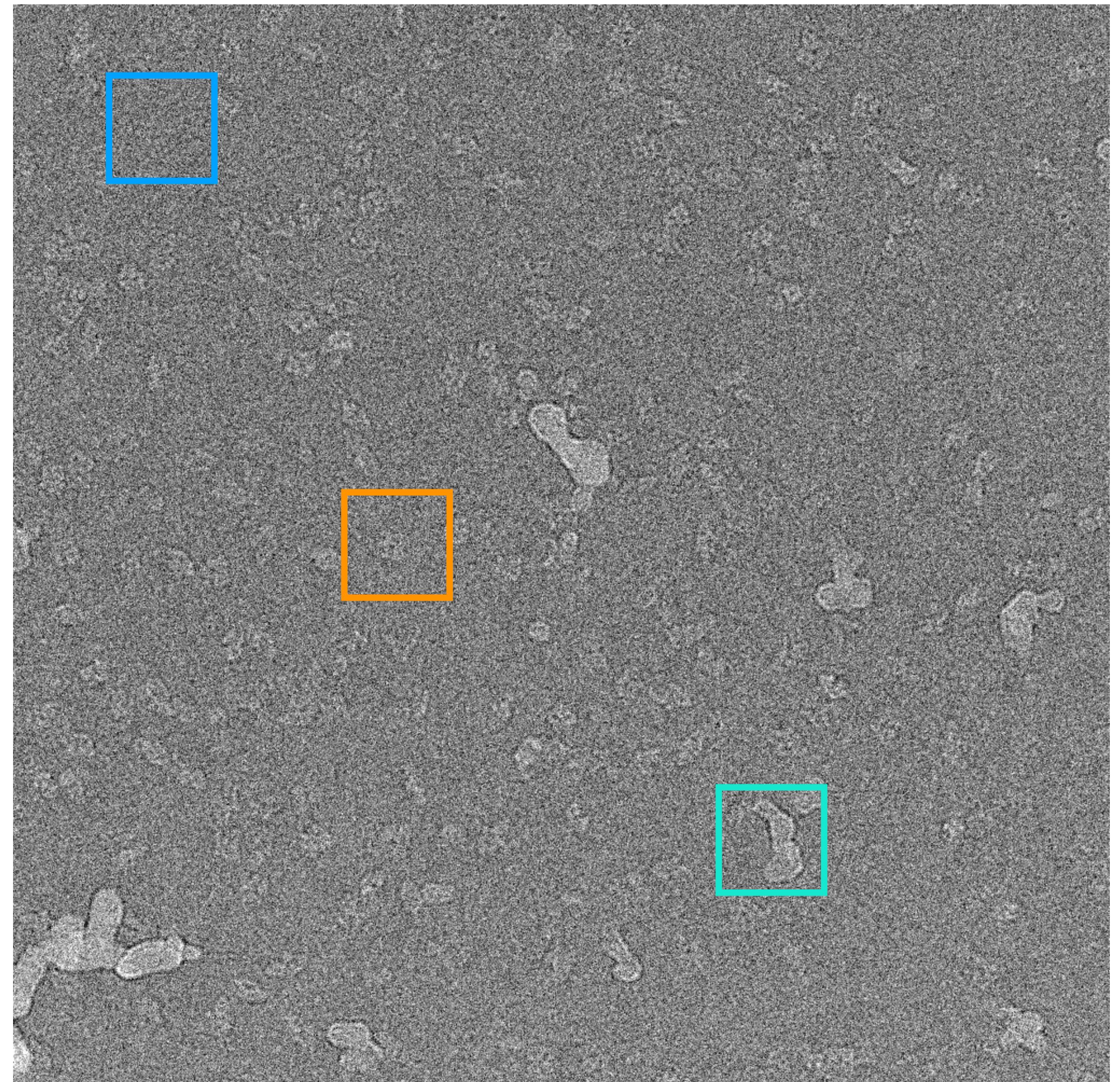


# Convolutional neural networks



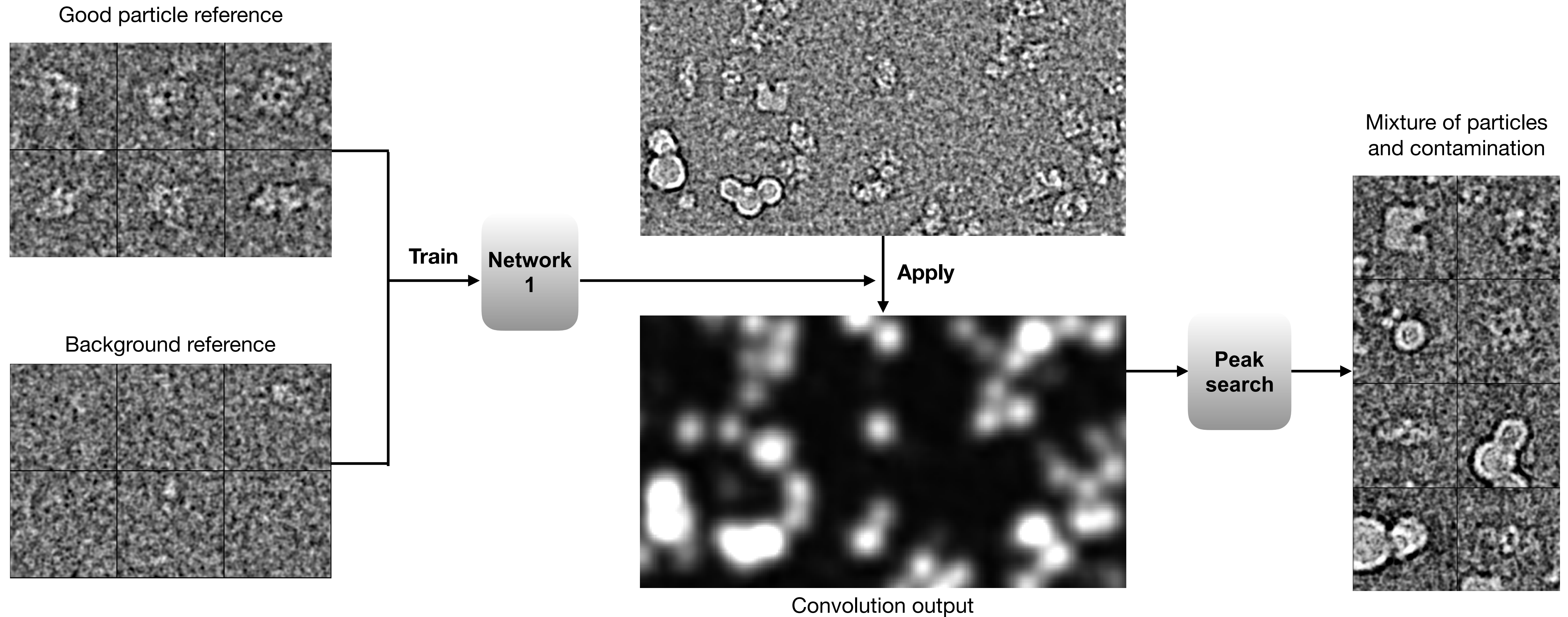
# Particle picking with neural networks

- Shallow network
  - Smaller training set requirement
  - Faster, more stable training
  - Power of shallow networks is limited
- Three types of features in micrographs
  - **particles**, **background** and **ice contamination**
- One network for a specific task



# Two-step approach

- Particles vs background noise



# Two-step approach

- Particles vs contamination

