

CLAIMS

1. A system, comprising:
 - a spatial convolution network configured to process a window of per-cycle sequencing image sets for a series of sequencing cycles of a sequencing run on a cycle-by-cycle basis by separately processing respective per-cycle sequencing image sets in the window of per-cycle sequencing image sets through respective spatial processing pipelines; and
 - a bus network, connected to the spatial convolution network, and configured to form buses between spatial convolution layers within respective sequences of spatial convolution layers of the respective spatial processing pipelines, the buses configured to cause respective per-cycle spatial feature map sets generated by two or more spatial convolution layers in a particular sequence of spatial convolution layer for a particular sequencing cycle to combine into a combined per-cycle spatial feature map set, and provide the combined per-cycle spatial feature map set as input to another spatial convolution layer in the particular sequence of spatial convolution layer.
2. The system of claim 1, wherein the two or more spatial convolution layers include a first spatial convolution layer and a third spatial convolution layer, wherein the first spatial convolution layer generates a first per-cycle spatial feature map set, wherein the first spatial convolution layer provides the first per-cycle spatial feature map set as input to a second spatial convolution layer, wherein the second spatial convolution layer processes the first per-cycle spatial feature map set and generates a second per-cycle spatial feature map set, wherein the second spatial convolution layer provides the second per-cycle spatial feature map set as input to the third spatial convolution layer, and wherein the third spatial convolution layer processes the second per-cycle spatial feature map set and generates a third per-cycle spatial feature map set.
3. The system of claim 2, wherein the buses are further configured to cause the first spatial feature map set and the third per-cycle spatial feature map set to combine into the combined per-cycle spatial feature map set.
4. The system of claim 3, wherein the another spatial convolution layer is a fourth spatial convolution layer that immediately succeeds the third spatial convolution layer in the particular sequence of spatial convolution layer, wherein the fourth spatial convolution layer processes the combined per-cycle spatial feature map set as input.
5. The system of claim 2, wherein the two or more spatial convolution layers include the first spatial convolution layer and a seventh spatial convolution layer, wherein the third spatial

convolution layer provides the third per-cycle spatial feature map set as input to a fourth spatial convolution layer, wherein the fourth spatial convolution layer processes the third per-cycle spatial feature map set and generates a fourth per-cycle spatial feature map set, wherein the fourth spatial convolution layer provides the fourth per-cycle spatial feature map set as input to a fifth spatial convolution layer, and wherein the fifth spatial convolution layer processes the fourth per-cycle spatial feature map set and generates a fifth per-cycle spatial feature map set.

6. The system of claim 5, wherein the buses are further configured to cause the first spatial feature map set and the fifth spatial feature map set to combine into the combined per-cycle spatial feature map set.

7. The system of claim 6, wherein the another spatial convolution layer is a sixth spatial convolution layer that immediately succeeds the fifth spatial convolution layer in the particular sequence of spatial convolution layer, wherein the sixth spatial convolution layer processes the combined per-cycle spatial feature map set as input.

8. The system of claim 5, wherein the two or more spatial convolution layers include the first spatial convolution layer, the third spatial convolution layer, and the fifth spatial convolution layer, and wherein the buses are further configured to cause the first per-cycle spatial feature map set, the third per-cycle spatial feature map set, and the fifth per-cycle spatial feature map set to combine into the combined per-cycle spatial feature map set.

9. The system of claim 8, wherein the another spatial convolution layer is the sixth spatial convolution layer that processes the combined per-cycle spatial feature map set as input.

10. The system of claim 1, wherein the buses are further configured to cause a per-cycle sequencing image set for the particular sequencing cycle, provided as input to the first spatial convolution layer, and the third per-cycle spatial feature map set to combine into the combined per-cycle spatial feature map set.

11. The system of claim 10, wherein the another spatial convolution layer is the fourth spatial convolution layer that processes the combined per-cycle spatial feature map set as input.

12. The system of claim 1, wherein the bus network is further configured to include dimensionality compatibility logic configured to modify spatial and depth dimensionality of an incoming per-cycle spatial feature map set that is combined with a receiving per-cycle spatial feature map set to generate the combined per-cycle spatial feature map set.

13. The system of claim 12, wherein the dimensionality compatibility logic is a dimensionality reduction operation, including convolution, pooling, or averaging.
14. The system of claim 12, wherein the bus network is further configured to include scaling logic configured to scale feature values of the incoming per-cycle spatial feature map set that is combined with the receiving per-cycle spatial feature map set to generate the combined per-cycle spatial feature map set.
15. The system of claim 1, further configured to comprise a temporal convolution network configured to process the per-cycle spatial feature map sets on a groupwise basis by convolving on respective overlapping groups of per-cycle spatial feature map sets in the per-cycle spatial feature map sets using respective temporal convolution filter banks of a first temporal convolution layer to generate respective per-group temporal feature map sets for the respective overlapping groups of per-cycle spatial feature map sets.
16. The system of claim 15, further configured to comprise the bus network, connected to the temporal convolution network, and configured to form buses between temporal convolution layers within the respective sequences of temporal convolution layers, the buses configured to cause respective per-cycle temporal feature map sets generated by two or more temporal convolution layers in a particular sequence of temporal convolution layer for a particular sequencing cycle to combine into a combined per-cycle temporal feature map set, and provide the combined per-cycle temporal feature map set as input to another temporal convolution layer in the particular sequence of temporal convolution layer.
17. An artificial intelligence-based method, including:
- processing, through a spatial convolution network, a window of per-cycle sequencing image sets for a series of sequencing cycles of a sequencing run on a cycle-by-cycle basis by separately processing respective per-cycle sequencing image sets in the window of per-cycle sequencing image sets through respective sequences of spatial convolution layers; and
 - combining respective per-cycle spatial feature map sets generated by two or more spatial convolution layers in a particular sequence of spatial convolution layer for a particular sequencing cycle into a combined per-cycle spatial feature map set, and providing the combined per-cycle spatial feature map set as input to another spatial convolution layer in the particular sequence of spatial convolution layer.
18. The artificial intelligence-based method of claim 17, wherein the two or more spatial convolution layers include a first spatial convolution layer and a third spatial convolution layer,

wherein the first spatial convolution layer generates a first per-cycle spatial feature map set, wherein the first spatial convolution layer provides the first per-cycle spatial feature map set as input to a second spatial convolution layer, wherein the second spatial convolution layer processes the first per-cycle spatial feature map set and generates a second per-cycle spatial feature map set, wherein the second spatial convolution layer provides the second per-cycle spatial feature map set as input to the third spatial convolution layer, and wherein the third spatial convolution layer processes the second per-cycle spatial feature map set and generates a third per-cycle spatial feature map set.

19. The artificial intelligence-based method of claim 18, wherein the buses are further configured to cause the first spatial feature map set and the third per-cycle spatial feature map set to combine into the combined per-cycle spatial feature map set.

20. The artificial intelligence-based method of claim 19, wherein the another spatial convolution layer is a fourth spatial convolution layer that immediately succeeds the third spatial convolution layer in the particular sequence of spatial convolution layer, wherein the fourth spatial convolution layer processes the combined per-cycle spatial feature map set as input.