Appendix 1 Deep learning technologies

Convolutional neural network (CNN)

This is the most basic network in deep learning area which is used for feature extraction in 1D or 2D. The blocks consists of convolution and max pooling there by size reduction, shown by APL 1, APL 2, APL 3, and APL 4 (Figure S1). The bottle neck layer is shown as AP 4. Finally the dense 1 and dense 2 are used for classification and software layer for segmentation. The characteristics of CNN can be seen in (148).

Long short-term memory (LSTM)

When it comes to processing the multiple type of data points such as single (image), series of data points (video, speech, etc.), one can use LSTM-based classifier. It is superior in formulating long term dependencies in the data. Due to limitation of RNN, i.e., simple RNN associated to TensorFlow, the design of LSTM came to existence. There are four main components of LSTM architecture and it consists of (I) cell, (II) an update gate, (III) an output gate, and (IV) the forget gate, shown in Figure S2. The function of the cell is to remember the values of the random time intervals while the three gates helps in regulation of the information flow or features into and out of the cell (149). The LSMT unit has 4 fully connected dense layers stacked together. The structural configuration of LSTM is like RNN.

Recurrent neural network (RNN)

When we need temporal dynamic paradigm, there is a class of artificial neural networks where the connections between the nodes can form a directed graph or undirected graph along the sequence. Such a system exhibits a non-linear dynamics. Such systems are applicable to tasks such as un-segmented, connected handwriting recognition (150) or speech recognition (151). The problems with RNN are the complex optimization process and the vanishing gradient problem. RNN can run arbitrary programs to process arbitrary sequences of inputs. Figure S3 shows the RNN architecture with ReLU activation unit and four dense layer unit. The nodes of the dense layer's unit are 64, 32, 8, and 4, respectively. There are four nodes and a SoftMax activation units in the output layer. The DL model is trained for classification of the granular CVD risk class from the input feature. The loss function and optimizer used are namely, cross-entropy loss (CEL) and Adaptive Moment Estimation (ADAM).

Generative adversarial networks (GAN)

GANs are characterized as profound learning calculations that are utilized to create new occasions of information that match the preparation information. GAN ordinarily comprises of two parts specifically a generator that figures out how to create bogus information and a discriminator that adjusts by gaining from this misleading information. Throughout some time, GANs have acquired tremendous use since they are regularly being utilized to explain cosmic pictures and reproduce lensing the gravitational dim matter. It is likewise utilized in computer games to increment designs for 2D surfaces by reproducing them in higher goals like 4K. They are additionally utilized in making practical kid's shows character and delivering human appearances and 3D article delivering (152).

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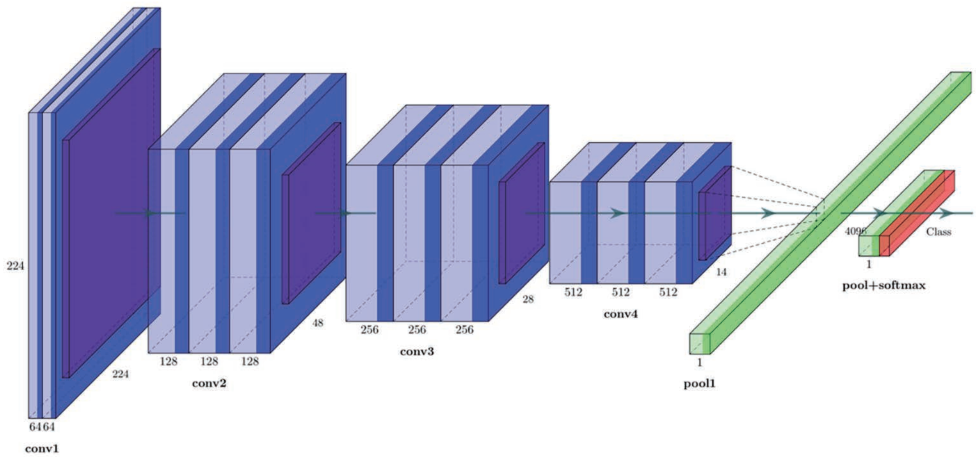

Figure S1 General structure of CNN architecture (courtesy of AtheroPoint™, Roseville, CA, USA).

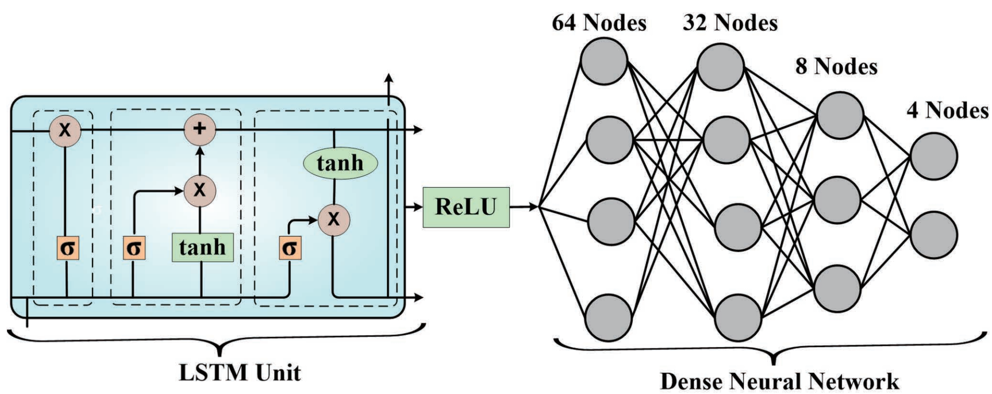

Figure S2 General structure of LSTM architecture.

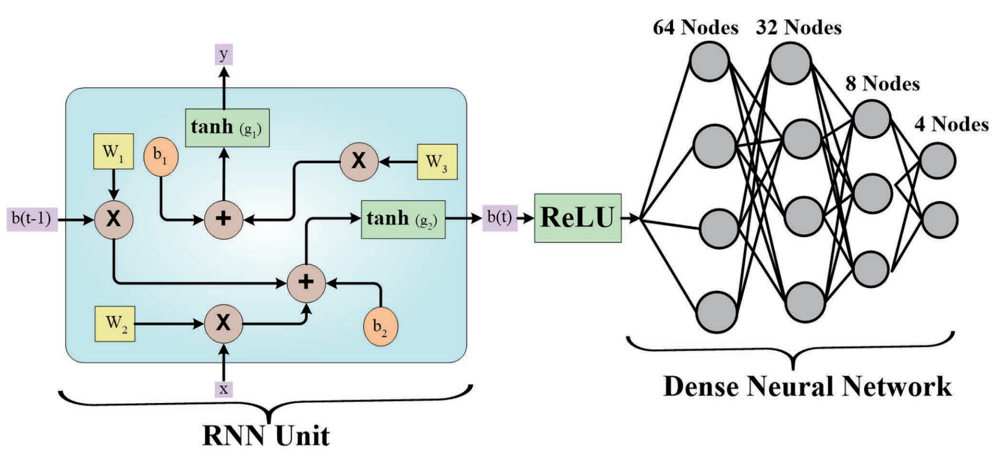

Figure S3 RNN architecture showing RNN block with dense network.

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Table S1 Ranking of all the DL-based CVD studies based on the scores from the ranking-bias score model.

Studies	Mean	Rank
Biswas *et al.* (79)	3.8	1
Jain *et al.* (103)	3.7	2
Jain *et al.* (98)	3.6	3
Biswas *et al.* (81)	3.6	4
Jain *et al.* (99)	3.4	5
Jamthikar *et al.* (13)	3.3	6
Lakadir *et al.* (82)	3.2	7
Ziegler *et al.* (88)	3.1	8
Biswas *et al.* (80)	3.1	9
Bortsova *et al.* (89)	3	10
Latha *et al.* (101)	3	11
Ganitidis *et al.* (87)	3	12
Zhou *et al.* (86)	2.9	13
Wu *et al.* (84)	2.8	14
Azzorpardi *et al.* (78)	2.7	15
Jain *et al.* (90)	2.7	16
Meshram *et al.* (83)	2.6	17
Zhou *et al.* (85)	2.5	18
Otgonbaatar *et al.* (102)	2.5	19
Savaş *et al.* (91)	2.5	20
Mohannadi *et al.* (100)	2.2	21
Park *et al.* (105)	2.2	22
Zhu *et al.* (104)	2.1	23
Sudha *et al.* (93)	1.9	24
Flores *et al.* (108)	1.8	25
Groves *et al.* (106)	1.8	26
Washim *et al.* (92)	1.8	27
Tsakanikas *et al.* (107)	1.8	28
Xiao *et al.* (97)	1.7	29
Luo *et al.* (96)	1.6	30
Koktzoglou *et al.* (95)	1.5	31
Saba *et al.* (94)	1.4	32

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Table S2 Ranking based on the weights from the radial-bias map model and radial-bias area model

Studies	Weight	Cumulative Mean	Rank
A. Radial-bias map model			
Biswas *et al.* (79)	24.65	24.65	1
Jain *et al.* (98)	24	48.65	2
Jain *et al.* (103)	23.85	72.5	3
Biswas *et al.* (81)	23.65	96.15	4
Jain *et al.* (99)	23	119.15	5
Jamthikar *et al.* (13)	22.5	141.65	6
Biswas *et al.* (80)	22.1	163.75	7
Lakadir *et al.* (82)	21.95	185.7	8
Ziegler *et al.* (88)	21.6	207.3	9
Bortsova *et al.* (89)	21.55	228.85	10
Ganitidis *et al.* (87)	21.1	249.95	11
Latha *et al.* (101)	20.85	270.8	12
Zhou *et al.* (86)	20.6	291.4	13
Azzorpardi *et al.* (78)	20.4	311.8	14
Wu *et al.* (84)	20.1	331.9	15
Jain *et al.* (90)	19.8	351.7	16
Meshram *et al.* (83)	19.35	371.05	17
Zhou *et al.* (85)	19.15	390.2	18
Otgonbaatar *et al.* (102)	18.95	409.15	19
Savaş *et al.* (91)	18.6	427.75	20
Park *et al.* (105)	17.8	445.55	21
Zhu *et al.* (104)	17.7	463.25	22
Al-Mohannadi *et al.* (100)	17.65	480.9	23
Sudha *et al.* (93)	16.4	497.3	24
Groves *et al.* (106)	16.3	513.6	25
Washim *et al.* (92)	16.3	529.9	26
Flores *et al.* (108)	16.05	545.95	27
Xiao *et al.* (97)	16	561.95	28
Tsakanikas *et al.* (107)	15.95	577.9	29
Luo *et al.* (96)	15.1	593	30
Koktzoglou *et al.* (95)	14.55	607.55	31
Saba *et al.* (94)	14.45	622	32
B. Radial-bias area model			
Biswas *et al.* (79)	24.65	24.65	1
Jain *et al.* (98)	24	48.65	2
Jain *et al.* (103)	23.85	72.5	3
Biswas *et al.* (81)	23.65	96.15	4
Jain *et al.* (99)	23	119.15	5
Jamthikar *et al.* (13)	22.5	141.65	6
Biswas *et al.* (80)	22.1	163.75	7
Lakadir *et al.* (82)	21.95	185.7	8
Ziegler *et al.* (88)	21.6	207.3	9
Bortsova *et al.* (89)	21.55	228.85	10
Ganitidis *et al.* (87)	21.1	249.95	11
Latha *et al.* (101)	20.85	270.8	12
Zhou *et al.* (86)	20.6	291.4	13
Azzorpardi *et al.* (78)	20.4	311.8	14
Wu *et al.* (84)	20.1	331.9	15
Jain *et al.* (90)	19.8	351.7	16
Meshram *et al.* (83)	19.35	371.05	17
Zhou *et al.* (85)	19.15	390.2	18
Otgonbaatar *et al.* (102)	18.95	409.15	19
Savaş *et al.* (91)	18.6	427.75	20
Park *et al.* (105)	17.8	445.55	21
Zhu *et al.* (104)	17.7	463.25	22
Mohannadi *et al.* (100)	17.65	480.9	23
Sudha *et al.* (93)	16.4	497.3	24
Groves *et al.* (106)	16.3	513.6	25
Washim *et al.* (92)	16.3	529.9	26
Flores *et al.* (108)	16.05	545.95	27
Xiao *et al.* (97)	16	561.95	28
Tsakanikas *et al.* (107)	15.95	577.9	29
Luo *et al.* (96)	15.1	593	30
Koktzoglou *et al.* (95)	14.55	607.55	31
Saba *et al.* (94)	14.45	622	32

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Table S3 Ranking based on the weights from the ROBINS-I model

Studies	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Total	Mean Value	Cumulative Mean	Rank
Jain *et al.* (98)	4.0	4.7	3.5	5.0	5.0	5.0	3.8	30.9	4.4	4.4	1
Jain *et al.* (99)	3.0	3.8	3.8	5.0	5.0	5.0	3.8	29.3	4.2	8.6	2
Biswas *et al.* (79)	5.0	4.7	3.5	1.5	5.0	3.8	5.0	28.4	4.1	12.7	3
Zhou *et al.* (86)	3.3	3.8	2.3	5.0	5.0	3.8	3.8	26.9	3.8	16.5	4
Jain *et al.* (103)	5.0	4.5	4.5	5.0	0.0	3.8	3.8	26.5	3.8	20.3	5
Biswas *et al.* (81)	3.3	4.7	4.3	1.5	5.0	3.8	3.8	26.3	3.8	24.0	6
Lakadir *et al.* (82)	4.0	4.0	4.0	4.0	5.0	1.3	3.8	26.0	3.7	27.8	7
Ziegler *et al.* (88)	3.3	3.2	4.3	5.0	0.0	5.0	5.0	25.8	3.7	31.4	8
Jamthikar *et al.* (13)	5.0	4.7	1.8	4.0	5.0	1.3	3.8	25.4	3.6	35.1	9
Ganitidis *et al.* (87)	2.7	4.7	3.8	4.0	5.0	1.3	3.8	25.1	3.6	38.7	10
Biswas *et al.* (80)	3.0	4.7	2.8	2.5	5.0	2.5	3.8	24.2	3.5	42.1	11
Meshram *et al.* (83)	5.0	4.0	1.8	4.0	5.0	1.3	2.5	23.5	3.4	45.5	12
Latha *et al.* (101)	3.3	4.2	2.5	5.0	0.0	3.8	3.8	22.5	3.2	48.7	13
Otgonbaatar *et al.* (102)	2.0	3.0	3.3	4.0	5.0	1.3	3.8	22.3	3.2	51.9	14
Bortsova *et al.* (89)	4.7	4.5	3.8	4.0	0.0	1.3	3.8	21.9	3.1	55.0	15
Azzorpardi *et al.* (78)	1.3	3.8	3.3	2.0	5.0	2.5	3.8	21.7	3.1	58.1	16
Wu *et al.* (84)	5.0	3.3	2.5	4.0	0.0	2.5	3.8	21.1	3.0	61.1	17
Zhou *et al.* (85)	3.3	2.2	2.0	5.0	0.0	2.5	3.8	18.8	2.7	63.8	18
Jain *et al.* (90)	3.0	1.5	3.8	2.0	0.0	3.8	3.8	17.8	2.5	66.3	19
Mohannadi *et al.* (100)	1.3	1.7	3.5	4.0	0.0	2.5	3.8	16.8	2.4	68.7	20
Flores *et al.* (108)	1.3	1.5	3.0	5.0	0.0	2.5	2.5	15.8	2.3	71.0	21
Koktzoglou *et al.* (95)	1.3	1.5	1.8	5.0	0.0	3.8	1.3	14.6	2.1	73.0	22
Park *et al.* (105)	1.0	2.0	2.5	4.0	0.0	1.3	3.8	14.5	2.1	75.1	23
Savaş *et al.* (91)	2.7	2.3	3.0	2.5	0.0	1.3	2.5	14.3	2.0	77.2	24
Xiao *et al.* (97)	1.3	1.0	3.8	4.0	0.0	1.3	2.5	13.8	2.0	79.1	25
Zhu *et al.* (104)	2.0	0.7	3.3	1.5	0.0	2.5	3.8	13.7	2.0	81.1	26
Sudha *et al.* (93)	2.7	2.3	1.8	3.5	0.0	0.0	2.5	12.8	1.8	82.9	27
Tsakanikas *et al.* (107)	3.0	0.7	2.3	1.5	0.0	2.5	2.5	12.4	1.8	84.7	28
Groves *et al.* (106)	2.7	0.7	3.3	2.0	0.0	1.3	2.5	12.3	1.8	86.4	29
Saba *et al.* (94)	2.0	0.7	1.8	1.5	0.0	3.8	2.5	12.2	1.7	88.2	30
Washim *et al.* (92)	1.0	1.7	3.0	0.5	0.0	1.3	3.8	11.2	1.6	89.8	31
Luo *et al.* (96)	2.7	2.3	1.8	0.5	0.0	1.3	1.3	9.8	1.4	91.2	32

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Table S4 Ranking based on the weights from the PROBAST model

Studies	Participants	Predictors	Outcomes	Analysis	SUM	Mean	Cumulative Mean	Rank
Jain *et al.* (103)	4.875	4.6	4	3.75	17	4.3	4.3	1
Jain *et al.* (98)	4.625	3.8	5	3.75	17	4.3	8.6	2
Biswas *et al.* (79)	5	3.8	3	5	17	4.2	12.8	3
Ziegler *et al.* (88)	3.625	4.4	5	3.75	17	4.2	17.0	4
Jain *et al.* (99)	3.625	4	5	3.75	16	4.1	21.1	5
Biswas *et al.* (81)	4.375	4.4	3	3.75	16	3.9	25.0	6
Latha *et al.* (101)	4.375	3	4	3.75	15	3.8	28.8	7
Bortsova *et al.* (89)	4.75	4	2	3.75	15	3.6	32.4	8
Lakadir *et al.* (82)	4.5	4.2	2	3.75	14	3.6	36.0	9
Zhou *et al.* (86)	3.625	2.8	4	3.75	14	3.5	39.5	10
Wu *et al.* (84)	4.375	3	3	3.75	14	3.5	43.1	11
Ganitidis *et al.* (87)	4.125	4	2	3.75	14	3.5	46.5	12
Biswas *et al.* (80)	4.25	3.2	2.2	3.75	13	3.4	49.9	13
Jamthikar *et al.* (13)	5	2.4	2	3.75	13	3.3	53.2	14
Jain *et al.* (90)	2.25	4	3	3.75	13	3.3	56.4	15
Azzorpardi *et al.* (78)	3	3.6	2.2	3.75	13	3.1	59.6	16
Otgonbaatar *et al.* (102)	3	3.6	2	3.75	12	3.1	62.6	17
Mohannadi *et al.* (100)	1.75	3.8	3	3.75	12	3.1	65.7	18
Meshram *et al.* (83)	4.875	2.4	2	2.5	12	2.9	68.7	19
Zhou *et al.* (85)	2.375	2.6	3	3.75	12	2.9	71.6	20
Zhu *et al.* (104)	1.25	3.6	2	3.75	11	2.7	74.2	21
Flores *et al.* (108)	1.625	3.4	3	2.5	11	2.6	76.9	22
Park *et al.* (105)	1.5	3	2	3.75	10	2.6	79.4	23
Washim *et al.* (92)	1.625	3.4	1	3.75	10	2.4	81.9	24
Xiao *et al.* (97)	1.25	4	2	2.5	10	2.4	84.3	25
Savaş *et al.* (91)	2.75	3.4	1	2.5	10	2.4	86.7	26
Koktzoglou *et al.* (95)	1.625	2.4	4	1.25	9	2.3	89.1	27
Saba *et al.* (94)	1.25	2.4	3	2.5	9	2.3	91.3	28
Tsakanikas *et al.* (107)	1.625	2.8	2	2.5	9	2.2	93.6	29
Sudha *et al.* (93)	2.75	2.4	1	2.5	9	2.2	95.7	30
Groves *et al.* (106)	1.5	3.6	1	2.5	9	2.2	97.9	31
Luo *et al.* (96)	2.75	2.4	1	1.25	7	1.9	99.7	32

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