

表格 1

Network Architecture			Performance		
Feature Extraction	Classifier	HyperParameter	Acc&Loss	F-Beta	Num of Paras
"vgg0959" : [2,2,"M",4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(120,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 30 Batch_size = 128	Train Acc: 0.92696 Train loss: 0.07440 Test Acc: 0.96213 Test Loss: 0.03899	F-1 = 0.956953642384106 F-B = 0.9634136178014835 SEN = 0.9677689409794893 SPE = 0.9595179233621756 BAC = 0.9636434321708325 ACC = 0.9630222222222222 PPV = 0.9463774048301269 NPV = 0.975801382778127	1623
"vgg0959" : [2,"M",4,"M",8,8,"M",8,8"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(120,19) ReLU Linear(19,2)	LR = 0.0001 Epoch = 30 Batch_size = 128	Train Acc: 0.91293 Train loss: 0.09001 Test Acc: 0.95609 Test Loss: 0.04392	F-1 = 0.9510633904604585 F-B = 0.9587843463780185 SEN = 0.9640016743407284 SPE = 0.9533374536464772 BAC = 0.9586695639936027 ACC = 0.957866666666666666 PPV = 0.9384678076609617 NPV = 0.9728792179123305	3,079
"vgg0959" : [2,"M",4,"M",8,8,"M",8,8"M"] Maxpool k-size(2,1) stride(2,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(624,19) ReLU Linear(19,2)	LR = 0.0001 Epoch = 50 Batch_size = 128	Train Acc: 0.85948 Train loss: 0.14411 Test Acc: 0.94133 Test Loss: 0.06237	F-1 = 0.9319283456269757 F-B = 0.928055742108798 SEN = 0.9254918375889494 SPE = 0.9551915945611866 BAC = 0.940341716075068 ACC = 0.9425777777777777 PPV = 0.9384550084889643 NPV = 0.9455490975833588	12,655
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(5,1) stride(5,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(80,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 50 Batch_size = 256	Train Acc: 0.92728 Train loss: 0.07625 Test Acc: 0.96071 Test Loss: 0.04021	F-1 = 0.9547427154370738 F-B = 0.9620189905047476 SEN = 0.9669317706153202 SPE = 0.9567367119901112 BAC = 0.9618342413027157 ACC = 0.961066666666666666 PPV = 0.9428571428571428 NPV = 0.9751181102362205	1389
"vgg0959" : [4,4,"M",8,8,"M",16,16,16,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(160,25) ReLU Linear(25,2)	LR = 0.0001 Epoch = 50 Batch_size = 256	Train Acc: 0.93269 Train loss: 0.06896 Test Acc: 0.96231 Test Loss: 0.03799	F-1 = 0.9560530679933665 F-B = 0.9615544992077393 SEN = 0.965257429886982 SPE = 0.9601359703337453 BAC = 0.9626967001103637 ACC = 0.9623111111111111 PPV = 0.9470225872689938 NPV = 0.9739811912225705	6714
"vgg0959" : [2,2,"M",4,4,"M",8,8,8,"M"8,8,8,"M"] Maxpool k-size(5,1) stride(5,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(16,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 50 Batch_size = 256	Train Acc: 0.92260 Train loss: 0.08046 Test Acc: 0.95360 Test Loss: 0.04641	F-1 = 0.9512646514497224 F-B = 0.9613466334164589 SEN = 0.9681875261615739 SPE = 0.950247218788628 BAC = 0.959217372475101 ACC = 0.9578666666666666 PPV = 0.9349232012934519 NPV = 0.975880672802285	1,303
"vgg0959" : [2,"M",4,"M",8,8,"M",16,16,"M",16,16,"M"] Maxpool k-size(2,1) stride(2,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(624,8) ReLU Linear(8,2)	LR = 0.0001 Epoch = 30 Batch_size = 128	Train Acc: 0.91187 Train loss: 0.09205 Test Acc: 0.95911 Test Loss: 0.04280	F-1 = 0.9550259067357512 F-B = 0.9606404269513007 SEN = 0.9644202595228129 SPE = 0.9592088998763906 BAC = 0.9618145796996017 ACC = 0.9614222222222222 PPV = 0.9458128078817734 NPV = 0.9733458764502979	8110
"vgg0959" : [2,2,"M",4,4,"M",8,8,8,"M"8,8,8,"M"] Maxpool k-size(5,1) stride(5,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(16,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 40 Batch_size = 128	Train Acc: 0.92708 Train loss: 0.07374 Test Acc: 0.96018 Test Loss: 0.04052	F-1 = 0.9534835641926814 F-B = 0.9605131622792402 SEN = 0.965257429886982 SPE = 0.9561186650185414 BAC = 0.9606880474527617 ACC = 0.96 PPV = 0.9419934640522876 NPV = 0.9738747245829399	1,303
"vgg0959" : [2,2,"M",5,5,"M",10,10,10,"M"10,10,10,"M"] Maxpool k-size(5,1) stride(5,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(20,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 40 Batch_size = 128	Train Acc: 0.94030 Train loss: 0.14085 Test Acc: 0.96160 Test Loss: 0.12508	F-1 = 0.9551308683007894 F-B = 0.9594357733077372 SEN = 0.9623273336123901 SPE = 0.9610630407911002 BAC = 0.9616951872017452 ACC = 0.9616 PPV = 0.948041237113402 NPV = 0.971875	1964
"vgg0959" : [4,4,"M",8,8,"M",16,16,16,"M"16,16,16,"M"] Maxpool k-size(5,1) stride(5,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(32,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 50 Batch_size = 256	Train Acc: 0.93102 Train loss: 0.07007 Test Acc: 0.95147 Test Loss: 0.04962	F-1 = 0.9462544096285537 F-B = 0.9511096278992158 SEN = 0.9543742151527836 SPE = 0.953646477132262 BAC = 0.9540103461425229 ACC = 0.9539555555555556 PPV = 0.9382716049382716 NPV = 0.9658841940532081	4,869
"vgg0959" : [2,"M",4,"M",8,8,"M",8,8"8,M"] Maxpool k-size(2,1) stride(2,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(624,19) ReLU Dropout(0.5) Linear(19,19) ReLU Linear(19,2)	LR = 0.0001 Epoch = 50 Batch_size = 128	Train Acc: 0.88039 Train loss: 0.12354 Test Acc: 0.91093 Test Loss: 0.09584	F-1 = 0.9105308219178082 F-B = 0.898302221471408 SEN = 0.8903306822938468 SPE = 0.9517923362175525 BAC = 0.9210615092556997 ACC = 0.9256888888888888 PPV = 0.9316688567674113 NPV = 0.9216038300418911	13,035
"vgg0959" : [2,"M",4,"M",8,8,"M",16,16,"M",16,16,"M"] Maxpool k-size(2,1) stride(2,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(624,78) ReLU Dropout Linear(78,78) ReLU Linear(78,2)	LR = 0.0001 Epoch = 50 Batch_size = 128	Train Acc: 0.92769 Train loss: 0.07503 Test Acc: 0.90276 Test Loss: 0.10598	F-1 = 0.8950132335958 F-B = 0.8714541272680808 SEN = 0.856425282544998 SPE = 0.957663782447466 BAC = 0.907044532496232 ACC = 0.9146666666666666 PPV = 0.9372423270728355 NPV = 0.900348634514817	58,162
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(2,1) stride(2,1) Conv k-size(3,1) stride (1,1) padding (0,0)	AvgPool(7,7) Dropout(0.5) Linear(392,5) Linear(5,2)	LR = 0.0001 Epoch = 100 Batch_size = 256	Train Acc: 0.90894 Train loss: 0.12096 Test Acc: 0.87396 Test Loss: 0.15347	F-B = 0.796875	

表格 1

[2,"M",4,"M",8,8,"M",8,8" M"]

[2,2,"M",4,4,"M",8,8,"M",8,8,8,"M"]

Network Architecture			Performance		
Feature Extraction	Classifier	HyperParameter	Acc&Loss	F-Beta	Paras
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.0001 Epoch = 60 Batch_size = 64	Train Acc: 0.93350 Train loss: 0.07019 Test Acc: 0.94916 Test Loss: 0.05599 第二次 Train Acc: 0.92765 Train loss: 0.07310 Test Acc: 0.96124 Test Loss: 0.03930	F-1 = 0.9608892548373816 F-B = 0.9704781704781704 SEN = 0.9769778149853495 SPE = 0.9582818294190358 BAC = 0.9676298222021926 ACC = 0.9662222222222222 PPV = 0.945321992709599 NPV = 0.9825728770595691 第二次 F-1 = 0.9563598759048604 F-B = 0.9631728045325779 SEN = 0.9677689409794893 SPE = 0.9585908529048207 BAC = 0.963179896942155 ACC = 0.9624888888888888 PPV = 0.9452166802943581 NPV = 0.9757785467128027	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.00009 Epoch = 90 Batch_size = 64	Train Acc: 0.92952 Train loss: 0.07081 Test Acc: 0.96213 Test Loss: 0.03829	F-1 = 0.9562345169281585 F-B = 0.964162267921073 SEN = 0.9694432817078276 SPE = 0.9570457354758962 BAC = 0.963244508591862 ACC = 0.9623111111111111 PPV = 0.9433808553971487 NPV = 0.9769716088328075	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.000095 Epoch = 70 Batch_size = 64	Train Acc: 0.88986 Train loss: 0.11279 Test Acc: 0.95360 Test Loss: 0.04933	F-1 = 0.949145477282201 F-B = 0.951252820727121 SEN = 0.95311845960653 SPE = 0.9592088988763906 BAC = 0.9561636797414603 ACC = 0.9566222222222223 PPV = 0.9452054794520548 NPV = 0.9651741293532339	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.0001 Epoch = 70 Batch_size = 64	Train Acc: 0.82520 Train loss: 0.18902 Test Acc: 0.90613 Test Loss: 0.10630	F-1 = 0.8829787234042553 F-B = 0.8528127408168507 SEN = 0.833821682712432 SPE = 0.8595179233621756 BAC = 0.8966698030373037 ACC = 0.9061333333333333 PPV = 0.9382948657560056 NPV = 0.8866362078812108	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.0001 Epoch = 60 Batch_size = 64 input FFT	Train Acc: 0.85513 Train loss: 0.15013 Test Acc: 0.87556 Test Loss: 0.13071	F-1 = 0.8913998744507219 F-B = 0.8915118031140131 SEN = 0.8915864378401005 SPE = 0.9196538936959209 BAC = 0.9056201657680107 ACC = 0.9077333333333333 PPV = 0.891213389121339 NPV = 0.9199381761978361	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.00004 Epoch = 100 Batch_size = 64	Train Acc: 0.88169 Train loss: 0.12517 Test Acc: 0.90969 Test Loss: 0.10093	F-1 = 0.8829787234042553 F-B = 0.8847754096968667 SEN = 0.872331519464211 SPE = 0.9576637824474466 BAC = 0.9149976509558384 ACC = 0.9214222222222223 PPV = 0.9383160738406123 NPV = 0.9103995299647474	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.00001 Epoch = 60 Batch_size = 64	Train Acc: 0.83724 Train loss: 0.17867 Test Acc: 0.90044 Test Loss: 0.10282	F-1 = 0.8833228970987267 F-B = 0.8847633383508948 SEN = 0.8857262452909167 SPE = 0.911619283065513 BAC = 0.8906222222222222 ACC = 0.9006222222222222 PPV = 0.880932556203164 NPV = 0.9152963077877754	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.00001 Epoch = 80 Batch_size = 64	Train Acc: 0.87234 Train loss: 0.14103 Test Acc: 0.93884 Test Loss: 0.06657	F-1 = 0.9276595744680851 F-B = 0.918513524909859 SEN = 0.9125156969443282 SPE = 0.9595179233621756 BAC = 0.9360168101532519 ACC = 0.9395555555555555 PPV = 0.9433145824318477 NPV = 0.9369342184671092	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,23) ReLU Linear(23,2)	LR = 0.00006 Epoch = 80 Batch_size = 64	Train Acc: 0.91362 Train loss: 0.09346 Test Acc: 0.92889 Test Loss: 0.07685	F-1 = 0.9241232731137089 F-B = 0.915599730458221 SEN = 0.9100041858518209 SPE = 0.9561186650185414 BAC = 0.930614254351811 ACC = 0.9365333333333333 PPV = 0.9386873920552677 NPV = 0.9350256875188879	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,39) ReLU Linear(39,2)	LR = 0.00001 Epoch = 60 Batch_size = 64	Train Acc: 0.92692 Train loss: 0.07414 Test Acc: 0.95787 Test Loss: 0.04166	F-1 = 0.9276595744680851 F-B = 0.9180966344551816 SEN = 0.9648388447048974 SPE = 0.9558096415327565 BAC = 0.960324243118827 ACC = 0.9596444444444444 PPV = 0.9415849673202614 NPV = 0.9735599622285175	9507
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,29) ReLU Linear(29,2)	LR = 0.00006 Epoch = 60 Batch_size = 64	Train Acc: 0.92875 Train loss: 0.07382 Test Acc: 0.96302 Test Loss: 0.03785	F-1 = 0.953070084763283 F-B = 0.9644806025350016 SEN = 0.9694432817078276 SPE = 0.9595179233621756 BAC = 0.9644806025350016 ACC = 0.9637333333333333 PPV = 0.9464650592562321 NPV = 0.9770295783511642	11733 linear过渡节点数 29 优于 19 优于 9
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,19) ReLU Linear(19,2)	LR = 0.0001 Epoch = 60 Batch_size = 64 input FFT	Train Acc: 0.92057 Train loss: 0.08019 Test Acc: 0.95893 Test Loss: 0.04156	F-1 = 0.9531827515400412 F-B = 0.964110658020271 SEN = 0.9715362076182503 SPE = 0.950556242274128 BAC = 0.9610462249463316 ACC = 0.9594666666666666 PPV = 0.9355098750503829 NPV = 0.9783715012722646	8023 增加input FFT优于没有input FFT
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,29) ReLU Linear(29,2)	LR = 0.0001 Epoch = 100 Batch_size = 32	Train Acc: 0.92496 Train loss: 0.07958 Test Acc: 0.90471 Test Loss: 0.10321	F-1 = 0.9146289146289146 F-B = 0.9011750781976499 SEN = 0.892423602042696 SPE = 0.9564276885043264 BAC = 0.924425648354298 ACC = 0.9292444444444444 PPV = 0.9379674439067311 NPV = 0.923329356085919	11733
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,29) ReLU Linear(29,2)	LR = 0.0001 Epoch = 60 Batch_size = 64 input FFT	Train Acc: 0.88365 Train loss: 0.14447 Test Acc: 0.87804 Test Loss: 0.13086	F-1 = 0.8896335078534031 F-B = 0.889298274995813 SEN = 0.8890749267475931 SPE = 0.919035846724351 BAC = 0.9040553867359721 ACC = 0.9063111111111111 PPV = 0.8901927912824812 NPV = 0.9181846248842235	11733
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,19) ReLU Linear(19,2)	LR = 0.0001 Epoch = 60 Batch_size = 64	Train Acc: 0.88649 Train loss: 0.11982 Test Acc: 0.90222 Test Loss: 0.11059	F-1 = 0.953719082644629 F-B = 0.8942339926248741 SEN = 0.8932607785684387 SPE = 0.9252163164400494 BAC = 0.909238547504244 ACC = 0.9116444444444445 PPV = 0.8981481481481 NPV = 0.9215143120960295	8023 增加input FFT优于没有input FFT
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(80,5) ReLU Linear(5,2)	LR = 0.0001 Epoch = 50 Batch_size = 256	Train Acc: 0.92785 Train loss: 0.07625 Test Acc: 0.96071 Test Loss: 0.04021	F-1 = 0.9547427154370738 F-B = 0.9620189905047476 SEN = 0.9669317706153202 SPE = 0.956736719901112 BAC = 0.9618342413027157 ACC = 0.9610666666666666 PPV = 0.9428571428571428 NPV = 0.975181102362205	1389 增加padding(1,0)优于没有padding
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(3,1) stride(3,1) Conv k-size(3,1) stride (1,1) padding (1,0)	Dropout(0.5) Linear(368,9) ReLU Linear(9,2)	LR = 0.0001 Epoch = 60 Batch_size = 64	Train Acc: 0.93013 Train loss: 0.07441 Test Acc: 0.94791 Test Loss: 0.05761	F-1 = 0.953719082644629 F-B = 0.9611060214874657 SEN = 0.9660946002511511 SPE = 0.9558096415327565 BAC = 0.9609521208919538 ACC = 0.9601777777777778 PPV = 0.941656466748266 NPV = 0.9744801512287334	4313 寻找最佳的linear过渡节点数
"vgg0959" : [4,4,"M",8,8,"M",8,8,8,"M"] Maxpool k-size(5,1) stride(5,1) Conv k-size(3,1) stride (1,1) padding (1,0)	AvgPool(7,7) Dropout(0.5) Linear(368,5) ReLU<br				

[2,"M",4,"M",8,8,"M",8,8,8,"M"]

[2,"M",4,"M",8,"M",8,8,"M"]

[2,"M",4,"M",8,8,"M"]