

# **BLOOD CELL CLASSIFICATION USING DEEP LEARNING**

BY

LIAW MUN KIN

A REPORT

SUBMITTED TO

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(Kampar Campus)

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**FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY**

**UNIVERSITI TUNKU ABDUL RAHMAN**

Date: 8/9/2022

**SUBMISSION OF FINAL YEAR PROJECT/DISSERTATION/THESIS**

It is hereby certified that **LIAW MUN KIN** (ID No: **18ACB04710**) has completed this final year project entitled **“BLOOD CELL CLASSIFICATION USING DEEP LEARNING”** under the supervision of **DR. TAN JOI SAN** (Supervisor) from the Department of **COMPUTER SCIENCE**, Faculty of **INFORMATION AND COMMUNICATION TECHNOLOGY**, and **DR MOGANA A/P VADIVELOO** (Moderator) from the Department of **COMPUTER SCIENCE**, Faculty of **INFORMATION AND COMMUNICATION TECHNOLOGY**.

I understand that University will upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,




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(LIAW MUN KIN)

**F GENCTCVKQP 'QH'QTK KPCNKV[ "**

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## **ACKNOWLEDGEMENTS**

I would like to express thanks and appreciation to my supervisor, Dr. Tan Joi San and my moderator, Dr. Mogana a/p Vadiveloo who have given me a golden opportunity to venture into the deep learning research-based project. It is my first step to establish a career in deep learning. Besides that, they have given me a lot of guidance to complete this project. A million thanks to them for their patience and guidance.

To my beloved parents and friends, for their patience, unconditional support, and love, and for standing by my side during hard times. I am sincerely grateful for having them as my pillar of strength and endurance throughout my degree course.

## ABSTRACT

Throughout the years, hematology, which is the study of blood and its disorders, has played a big part in the health sector of Malaysia. Various diseases which could not be diagnosed physically could be overcome through analyzing blood samples of patients with the help of a microscope. However, the process was time-consuming and tedious as huge amounts of blood samples were needed to be manually checked by experts to achieve results which might not be clearly accurate due to human errors. The advancement of Artificial Intelligence (AI) has introduced complex methods such as deep learning that would automate the classification of blood cells in a fast and accurate manner

Thus, the study of White Blood Cells (WBCs) classification using deep learning techniques is proposed in this research. The sole objective of the continuation of this project II is to define an efficient WBC classification model from scratch. The motivation was gotten from the literature review section where various researchers developed their own methods manually through experimenting such as ensemble methods, learning algorithms, combined methodologies, etc. Therefore, two ResNet models, ResNet-18 and ResNet-50 were built from scratch as the building blocks were studied and coded into the whole architecture which will run through several experiments of different configurations (batch size, learning rate, pooling layer, number of classes and number of dense layers). The learning rate was fine-tuned using the Tuner library from Keras to find the optimal value that generates a well-established model. As a result, the finalized model which consists of batch size of 16, learning rate of 0.0009, global pooling layer, 4 number of classes dropped to 3 number of classes and 3 dense layers achieved a testing accuracy of approximately 63% and validation accuracy of 99%.

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VKNG'RCI G'	K
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CEMPQY NGFI GO GP VU''	X'
CDUVTCEV''	XK
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NKV'QH'HK WTGU'	Z'
NKV'QH'VCDNGU''	ZKK
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40'Qxgtxkgy "	7'
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4040'Uwr r qtv'Xgevqt"O cej kpg"*UXO +"	7'
4040'Ct vhekcniP gwtcniP gy qtm"*CPP +"	;
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EJ CRVGT'5<'TGUGCTEJ 'O QF GN'CPF 'FGUH P "	49'
50'F guki p"Ur gekhecvqpu"	49'
	xkk'

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<b>CRRGPFKZ'C"</b>	<b>C/3</b>
CØ"Y ggm{ 'Tgr qtv	C/3
CØ"RQUVGT	C/35
<b>RNCI KCTKUO 'EJ GEMTGUNV</b>	<b>D/3</b>
<b>EJ GEMNKUV'HQT'HJ R4"</b>	<b>E/3</b>







## NKUV'QH'CDDTGXKCVKQP U'

<i>RBC</i>	Tgf 'Dmqf 'Egm'
<i>WBC</i>	Y j kg'Dmqf 'Egm'
<i>DL</i>	F ggr 'Ngctpkpi "
<i>AI</i>	Ct wlekn'Kvgnki gpeg"
<i>CNN</i>	Eqpxqmwkqpcn'P gwtcn'P gwy qtni'
<i>NN</i>	P gwtcn'P gwy qtni'
<i>EmNN</i>	Go qvqpcn'P gwtcn'P gwy qtni'
<i>EmBP</i>	Go qvqpcn'Dceni'Rtqr ci cvkqp"
<i>ANN</i>	Ct wlekn'P gwtcn'P gwy qtni'
<i>GA</i>	I gpgve'Cni qtkj o "
<i>DT-CWT</i>	F wcn/Vtgg'Eqo r ngz 'Y cxgrgv'Vtcpuhtqto "
<i>MLP</i>	O wnk/Nc{ gt'Rgtegr vqpp"
<i>PCA</i>	Rtkpekr ng'Eqo r qpgrv'Cpcn{ uku"
<i>nprtool</i>	P gwtcn'P gwy qtni'Rcwgtp'Tgeqi pkkqp'Vqqn'
<i>MATLAB</i>	O cvtz'Nkdtct{ "
<i>DeCA</i>	F ggr 'Eqpxqmwkqpcn'Cevkxcvqpp"
<i>PCA</i>	Rtkpekr ng'Eqo r qpgrv'Cpcn{ uku"
<i>ReLU</i>	Cevkxcvqpp'Tgevhgf 'Nkgct'Wpkv'
<i>HSV</i>	J wg.'Ucwtcvqpp'cpf 'Xcmwg"
<i>RNN</i>	Tgewtukxg'P gwtcn'P gwy qtni'
<i>LSTM</i>	Nqpi 'Uj qtvVgto 'O go qt{ "
<i>DCLNN</i>	F qwdng'Eqpxqmwkqpp'Nc{ gt'P gwtcn'P gwy qtni'
<i>R-CNN</i>	Tgi kqpcn'Dcugf 'Eqpxqmwkqpcn'P gwtcn'P gwy qtni'
<i>RNN</i>	Tepf qo k gf 'P gwtcn'P gwy qtni'
<i>SSD</i>	Ukpi ng'Uj qv'O wnkqz'F gvevqt "
<i>YOLO V3</i>	[ qw'Qpn{ 'Nqqm'Qpeg'Xgtukqp'5"
<i>YOLO</i>	[ qw'Qpn{ 'Nqqm'Qpeg"
<i>SESSA</i>	Ucrr 'Uy cto 'Cni qtkj o "
<i>TWO-DCNN</i>	Vy q/o qf wrg'Y gki j vgf 'Qr vko k gf 'F ghqto cdng'Eqpxqmwkqpcn' P gwtcn'P gwy qtni'
<i>IOU</i>	Kvgtugevqpp'Qxgt'Wpkqp"

"

<i>KNN</i>	M/P gct guv'P gki j dqwt "
<i>BCCD</i>	Dmqf 'Egm'Eqwpłpi 'F cvcugv'
<i>RVFL</i>	Tcpf qo 'Xgevqt 'Hwpevłqpcn'Nłpni'
<i>SNN</i>	Uej o kf v'P gwtci'P gy qtm'
<i>ELM</i>	Gzvtgo g'Ngctplpi 'O cej łpg'
<i>lr</i>	Ngctplpi 'Tcvg'
<i>FC</i>	Hwłł 'Eqppgevgf "

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Ej cr vgt '3<Kpvt qf wevkqp"

### Ej cr vgt '3<Kpvt qf wevkqp"

#### 308'Rt qdigo 'Ucvgo gpv'epf 'O qvkc vkap"

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" Vj g'cf cr v'v'kap'qh'CKuwej "cu'ko ci g'r tqeguukpi "cpf "f ggr "ngctpkpi "o gvj qf u'y kn'dgpghk'vj g" o gf lecn'h'grf "cu'vko g'equwo kpi ."cpf "gttqt'r tqpg'vcumi'y qwf "dg'cwqo cvgf "d{"o cej kpgu'vq" tgf weg'qxgtcm'vko g'cpf "ghhtv'pggf gf "{ gv'qdv'ckpki "tgo ctndn{ 'i qaf 'tguwmu'kp'c'uj qtv'r g'kqf 0 Vj wu."vj g'f grkxgt{"qh'fcu'v'tguwmu'o c{"ucxg'vj g'rh'g'qh'r cvk'p'w'qt'gxgp"o c'pnkpf "htqo "c'f gcf n{ " f kugcug 0Hqt "kpuv'peg."c"xceekpg'eqwf "dg'tqmgf "qw'kp'uj qtv'r g'kqf "qh'vko g'dghqt'g'vj g'qwtci g" qh'vj g'f kugcug'dgi kpu'vq'vcng'c'vqm'qp"j wo cp'rx'gu'0"

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**30'Rt qlgev'Qdl gev'xgu'**

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Kpuvcf "qh'j cxkpi "vj g'cpcn\ uku'cpf "ercuukh\ kpi "dg'f qpg'o cpwcm\ ."vj g'r tqegu'eqwf "dg" cwqo cvgf "d{ "j cxkpi "o cej kpgu"cu"cnrgtpcv'xgu"ht"o" vej "eqpxgplgpv"cr r tqcej "cu" ko r ngo gpwcvkqp" qh' FN" gpcdrnu" vj gug" o cej kpgu" vq" qr gtcvg" cwqo cvkcm\ " y kj qw' cuukcpeg'f wg'vq'vj gkt'ugr'rgctplkpi "ecr cdkrkkgu0Vj wu."vj ku'y km'hqy gt'vj g'y qtmqcf "qh" gzr gtvu"cu'y gm'cu'r tqxkf kpi "vj go "y kj "o qtg'vko g'vq"ectt { "qw'qvj gt"ko r qtvcv'vcum0 Vj g'ugr'f ghkpgf "TguP gv'o qf gn'kugr'h'r tqxkf gu'dgwt"eqpvqn'qxt'vj g"o qf gn'u'ugwlpki u" y j lej "ckf u'lp'dwdf kpi "o qtg'tguklkgpv'o qf gn'htqo"ercuukhlecvkqp0"

**40 Vq'f gvt o kpg'cp'ghhlekpv'o qf gihqt 'Y DE'f kgcugu'ercuukhlecvkqp'vj tqwi j " j { r gtr ctco gvt 'wplkpi "'**

TguP gv72'cpf "TguP gv3: "o qf gn'y qwf "dg'dwkn"htqo "uetcvej "cpf "gxcnvcvgf "hqt'Rj cug'3" vcklplkpi "cpf "Rj cug'4"vcklplkpi "y qwf "uqrgn\ "hqewu"qp"TguP gv72"y j gtg"j { r gtr ctco gvt " hkg/wplkpi "qh'vj g'rgctplkpi 'tcvg'y qwf "dg'f qpg'vq'cej kxg'vj g"o quv'ghhlekpv'o qf gr0Vj g" o qf gn'kugr'h'y qwf "cev'cu'vj g'hqwpf cvkqp"o qf gn'y j gtg'ercuukhlecvkqp"qh'Y DE'f kgcugu" y qwf "dg'f qpg0"

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Dcej gnt'qh'Ego r wgt'Uekpeg'\*J qpqtu+  
Hcewv\ "qh'kphqto cvkqp'cpf 'Eqo o wplecvkqp'Vgej pqmi { '\*Mco r ct'Eco r wu+: 'WVCT "



**30'Dceni tqwpf 'Kphqto cvkqp"**

J wo cpu'ctg'o cf g'w' "qh'c'tki kf "utvewtg'qh'xctkqwu'eqo r qpgpvu'eqpukvki "qh'vj g'dtckp." j gctv."gve0'y j lej "ctg"kpvtgeqppgevgf "d{ "xgkpu"cpf "pgtxgu0'Vj g"xgkpu'r r{ "c"dkl "tqng"kp"vj g" ektewrcvkqp"u{uvgo "f wg"vq"vj g"r tgupeg"qh'c"dqf { "hmkf "ecmgf "dmqf 0'Dmqf "ku'f ghkpgf "cu"c" ektewrcvki "hmkf"o cf g'o quw{ "qh'r nuo c'y j lej "eqpvkpu'vj tgg'f kpkpevV{ r gu'qh'egmu'pco gn{ "tgf " dmqf "egm"\*TDE+."y j kg"dmqf "egm"\*Y DE+"cpf "r rrvrgwu0'Gcej "qh'vj gug"egmu"j cxg"vj gk"qy p" hvpvkpu"y j lej "ctg"j ki j n{ "ko r qtvcpv"kp"o ckpvckpki "vj g"ucvg"qh'qr vko cn'j wo cp"j gcnj 0'Hqt" kpuvpeg."tgf "dmqf "egm"vcpur qt v{ qz { i gp"vq"qvj gt "dqf { "r ctu."y j kg"dmqf "egm"hi j v'qhh" kphgevkpu'cpf "r rrvrgwu'y j lej "ckf "kp"dmqf "emvki "r tqegu0'

Vj tqwi j qw' vj g' f gecf gu." o gf lecn' uwf kgu" gur gekm{ " qp" j go cvqmi { " j cu" i ckpgf " y kf g" cvgpvkp0'Vj g'tgcuqp'ku'dgecvug'egtckp'uki pu'qh'wr eqo kpi 'f kugcugu'eqwrf "dg'f kci pqugf "vj tqwi j " vj g"cpn{ uku'qh'f kpkpev'dmqf "uco r ngu"uwej "cu"r gtr j gtrn'dmqf "uo gctu."o letqueqr ke"dmqf " ko ci gu."cpf "uq"qp0J qy gxgt."r tkqt"vq'r gthqto kpi "vj ku."vj g'emvukhckvkqp'qh'dmqf "egm"o wuv'dg" ecttkgf " qw' hktuv" vq" f khtgtpvcvg" TDE." Y DE." cpf " r rrvrgwu" hqt" ecvgi qt lecn' cpcn{ uku0' Vj g" r tqegf vt g'tgs wkt gu'j go cvqmi kuu'y j gt g'dmqf "egm'eqwv'cpf "o qtr j qmi lecn'cpcn{ uku'y qwrf "dg" f qpg'o cpwcm{ "qt"vukpi "vj g'r qy gt "qh'ctvkhckvkqp'kpvgnki gpeg"\*CK0'

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F ggr 'Ngctpkpi '\*FN+ku'c'v{ r g'qh'CKhvpvkqp'vj cv'ku'ecr cdng'qh'ko kcvki 'j wo cp'ecr cdkkkgu" vj tqwi j "ugr/ngctpkpi "cpf "cpcn{ uku'qh'hgcwv'gu'vj tqwi j "tcy "f cvc0'Vq"kmwv'cvg'vj g'kf gc"qh'FN." ko ci kpg'c'ej kf "ngctpkpi "vq'tgeqi pk'g'c'ecv0'Vj g'ej kf "y qwrf "dg'cy ctg'qh'cm'vj g'hgcwv'gu'r tgupev' kp" vj g'ecv'cpf "dwnf u" c" i gpgtcn'eqpegr v'ctqwpf "k'cu"vj g'ej kf "eqpvkpwgu"vq"tgeqi pk'g'ecw" ur qpvcpgqwu{ " y kj qw" cp{ " j gr 0' J gpeg." vj ku" cr r tqcej " uj qy u" i tgcv' r qvvpkcn' kp" vj g" emvukhckvkqp'qh'dmqf "egm" f wg'vq'ku'tqdwpvguu'cpf "ghhckgpe{ 0Gzco r ngu'qh'FN"o gyj qf u'ctg" EqpxqmwkqpcnP gwtcnP gyj qtmu'\*EP P +.'Ct vkhckvkqp' gwtcnP gyj qtmu'\*CP P +.'cwqgpeqf gtu."cpf " o cp{ "o qtg0'

Ej cr vgt "3" kptqf wekqp "

**308 Tgr qt v Qti cpl c v kqp "**

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"

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## EJ CRVGT'4<Nkgtcwtg'Tgxky "

### 408'Qxgtxky "

Ko ci g"Encuukhlecvkqp"ku"vj g"ecvgi qtkk cvkqp"cpf "ncdgnkpi "qh"ko ci gu"kpqv"fkvkvpev' encuugu'dcugf "qp"ur gekhe"ej ctcevgtkvkeu'cpf "twngu0K'eqwrf "dg"encuukhkf "kpqv"vy q"v{r gu" y j kej "ctg"uwr gtxkugf "cpf "wpuwr gtxkugf 0'Kp"vj ku"ecug."vj g"encuukhlecvkqp"y qwrf "dg"qp" v{r gu"qh'dmqf "egm"cpf "vj gkt"uwd/v{r gu"\*Tgf "Dmqf "Egm"\*TDE+."Y j kg"Dmqf "Egm" \*Y DE+."cpf "r rvgvru+0"

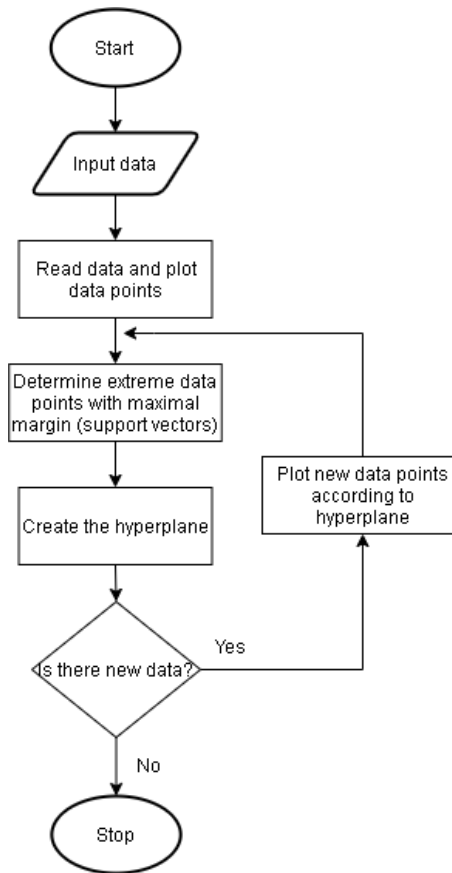
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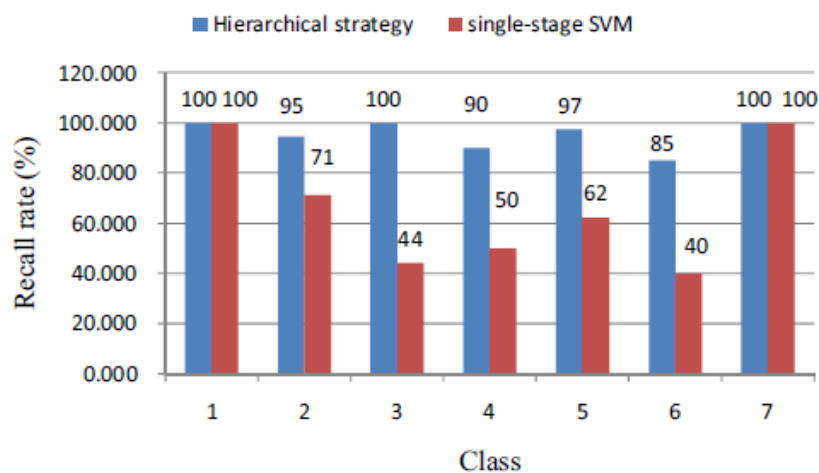
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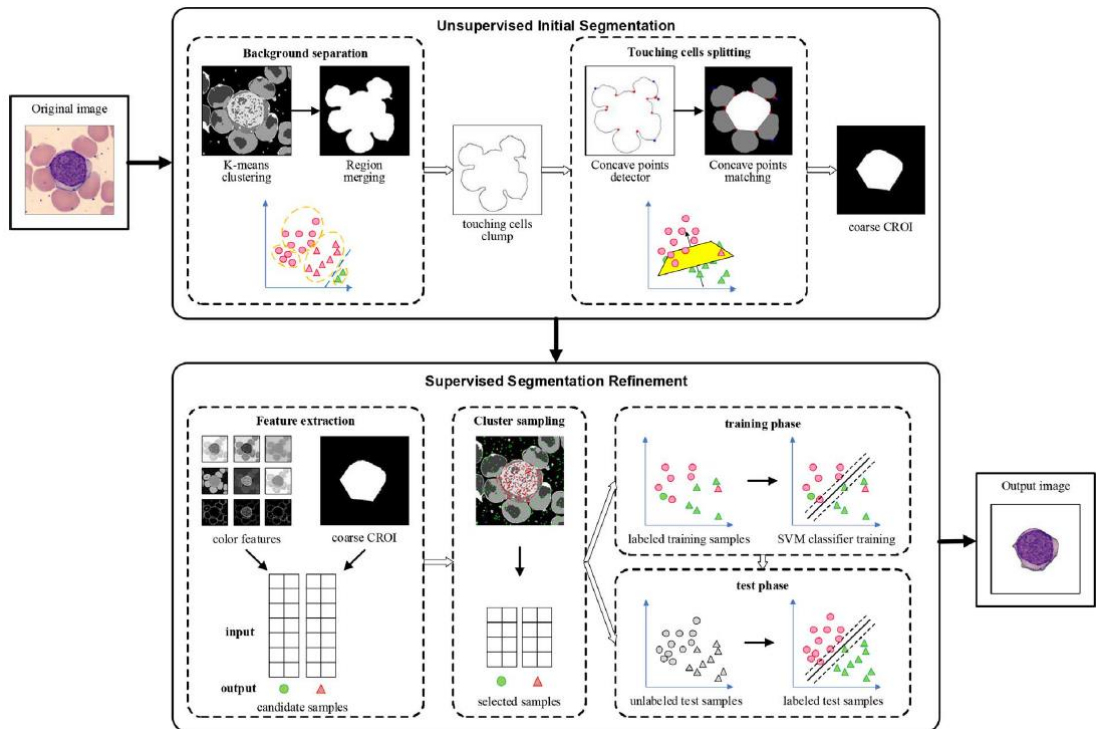
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**Vj g'bf xcpwi gu'qhUXO <'**

- Utqpi 'i gpgtckl cvkqp'cdkklv{ '\*r tngxgpv'qxgthkvlpi +0
- J cpf ngu'pqp/nkpgct'f cvc'ghkckpvn{ 0
- Y qtmu'tgrcvkgn{ 'y gml'y kj 'j ki j 'f ko gpukqpcn'f cvc"cpf 'y kf g'pwo dgt'qh'hgcwv'gu0

**Vj g'f kcf xcpwi gu'qhUXO <'**

- Tgrkgu'j gcvkkl{ "qp"r tgf ghkpgf 'hgcwv'gu'cpf 'ugi o gpvcv'qp'hqt'i qqf 'encuuhckvqp0
- Y qwf "pqv'y qtm'cu'y gml'h'vguvki 'f cvc"j cu'uki pkkkcpv'f khgtgpeg'y kj "tcklpi f cvc0
- Tgs wktgu'vqpi "tcklpi 'r gtlqf u'kh'tcklpi 'ugv'ku'rti g0

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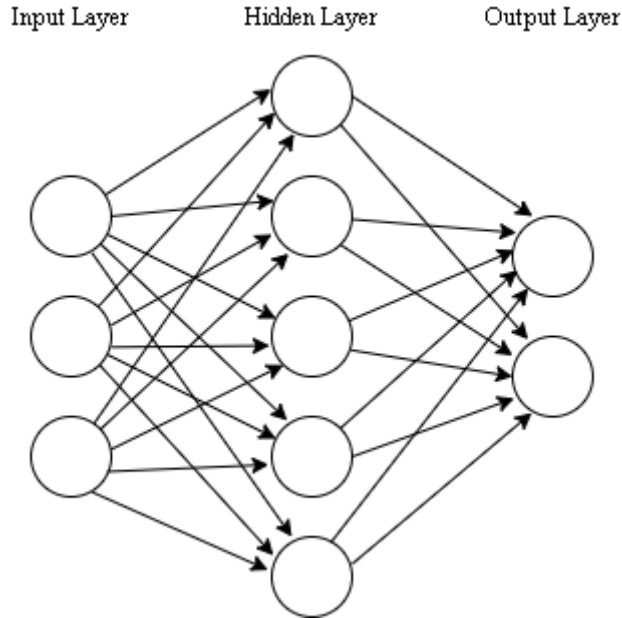
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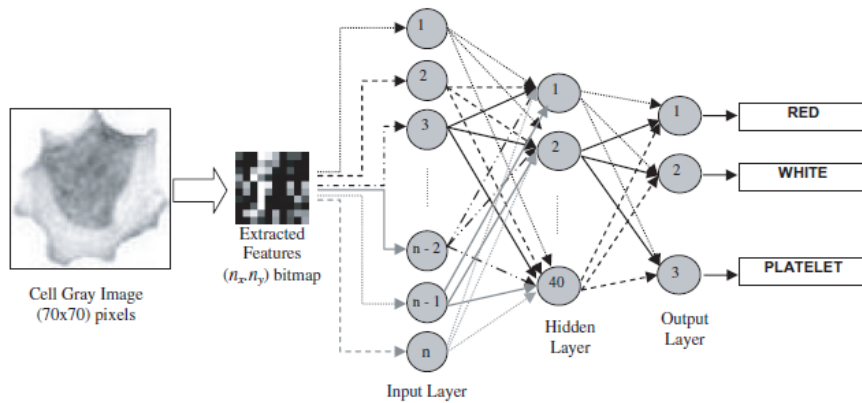
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3'y kj "ugi o gpv'uk g"\*7z7+'wukpi '3; 8'pgwtqpu'cpf "P P "4'y kj "ugi o gpv'uk g"\*9z9+'wukpi "  
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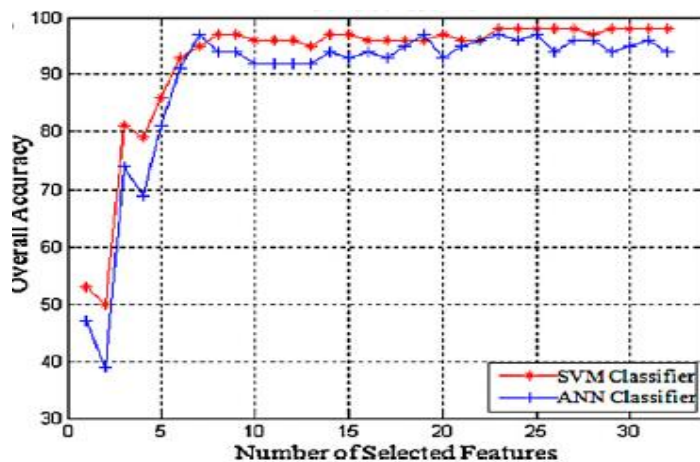


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tcvg'kpetgcuqf "htqo "87' " \*hqt"pqto cn'cr r tqcej "+vq"; 7' 'O' cplm'gv'cn0]45\_"uj qy gf "c"  
uko kct'cr r tqcej 'lp'eqwv'kpi 'cpf 'ercuukhckvkqp'qh'Y DEu'wukpi 'CPP'OE gmlugi o gpwvkqp"  
cpf 'pwengwu'ugi o gpwvkqp'd{ 'Qww'o gj qf "ctg'r'gthqto gf "ceeqtf kpi n( "dghqg'gzvtecvkpi "  
o qtr j qmi kcn'hcwgtgu'\*pwengwu'ctgc.'geegpv'lek{ . 'o clqt 'czku.'gve0'htq'kf gpwvkvkqp'qh"  
Y DE "rcvgt'P gwtcn'P gwy qtni'Rcwgt'p'Tgeqi pkkqp"vqqrn\*'pr tvqqrn'ku'wugf "vq'ercuukh{ "y j g"  
Y DEu'lpvq'vj tgg'qwr wu'Vj g'qxgtcm'ceewtce{ "ku'; : 0 ' '0Dqvj "cwj qtu"j cxg"gpi ci gf "  
vj gk'y qtni'wukpi 'O'CVNCD'uqhy ctg0'

¥ grgdk'cpf "Dwtnc{ "¥ ¾grk"]46\_"go r j cuk gf "qp'yj g'i gpgtcvkqp'qh'c"EX"cr r rckvkqp"  
vj cv'y qwr 'ckf 'f qevtu'lp'dmqf 'egmlercuukhckvkqp.'eqwv'kpi 'cpf 'cdpqto crkkgu'f gvevkqp0'  
K'hqewugu'qp'vj g'cpcn(uku'qh'r gtr j gtcn'dmqf 'egm'\*TDEu'cpf "Y DEu'+vq'ercuukh{ 'lpvq'8"  
v{r gu'dghqg'htv'j gt"ercuukhckvkqp'ku'f qpg'ht'f gvevkqp'qh'cdpqto crkkgu'wukpi "CPP'0'  
Vj g'CPP "wkk gf "eqvckpu"7"EP P u'eqppgevgf "y j gtg'r qqrkpi "cpf "mecn'tgur qpug"  
pqto crk vkqp"rc {gtu'ctg" kpenf gf "lp" dgy ggp" vj go 0' k'vgtugevkqp" qxgt" Wpkqp" twrg"  
vj tguj qrf "ku'cr r rkgf "ht'vj g'f gvto kpcvkqp'qh'f khtg'gpv'egm'v{r gu'Vj g'qweqo g'qh'vj ku"  
cr r tqcej "uj qy gf "r tqo kulpi "tguwu'y kj "qxgtcm'r tgekukqp'qh'20" y j gp'eqo r ctgf "y kj "  
vj g'tguwu'qh'j go cvqmi { "gZR gtvu'0Hqt'vj g'cdpqto crk{ "f gvevkqp'r j cug.'rdgrgf "ko ci gu"  
qh'gt{ vj tqe{ vq'htqo "f khtg'gpv'gZR gtvu'ctg" wugf "ht"v'gukpi "cpf "vtcklpi "f cvc'htq"CPP'0'  
Vj g'tguwu'ctg"eqpenf gf "cu"j cxkpi "20; "lp'ceewtce{ "y j lej "ku'f wg'vq'vj g'f khtg'kpi "qh"  
rdgrgf "uco r ngu'dgy ggp"xctkqwu'gZR gtvu'0"

J gi f g'gv'cn0]47\_"o gpvkqpgf "qp'yj g'eqo r ctukqp'qh'vtcf kkkpcn'ko ci g'r tqeguukpi "  
o gj qf u" \*ugi o gpwvkqp." hcwgtg' gzvtecvkqp" cpf "ercuukhckvkqp+" y kj " f ggr " ngctplpi "  
cr r tqcej gu'Vj g'PP'ercuukhgt'ku'tgr tgugpv'gf "cu'vj g'vtcf kkkpcn'o gj qf "crqpi "y kj 'EP P "  
cpf "cwqgpeqf gtu'ht'f ggr "ngctplpi "cr r tqcej gu'Vj g'o ckp"i qcn'qh'ercuukhckvkqp'ku'qp"  
Y DEu'wudv{r gu'cpf 'cdpqto crkkgu'htqo "gzvtecvgf 'hcwgtgu'0PP'cej kxgu'c'i tgc'v'qxgtcm'  
ceewtce{ "qh'; ; 0 ' "y kj "7/hqrf "etqu'xcrk vkqp"cpf "k'qwr gthqto u'UXO "cpf "gpugo drg"  
ercuukhgtu'j cxkpi "; 40' "cpf "; 90' "ceewtce{ 'tgur gev'xgn( 0EP P'htqo "uetevej "cnuq" { kgrf "  
uko kct'ceewtce{ "tcvg"y kj "PP "dw'EP P "uj qy u"vj g'ecr cdkkkgu'qh'ugr/ngctplpi "qp"  
f cvcugw"y kj qw"j cxkpi "vq"ko r ngo gpv'vtcf kkkpcn'o gj qf u"y j lej "kpenf g"r j cugu"qh"  
ugi o gpwvkqp" cpf " hcwgtg' gzvtecvkqp" vj cv' j ki j n( " chgeu"ercuukhckvkqp" tguwu'0'PP "  
eqwv'gtdc'rcpegu'vj ku'd{ 'j cxkpi "m'y gt'tguqwtg'tgs wktgo gpw'cpf "pwo dgt'qh'ko ci gu'htq"

Dcej grqt'qh'Eqo r wgt'Uekpeg'\*J qpqtu+ "  
Hcewn( 'qh'khtqo cvkqp'cpf 'Eqo o wplevkqp'Vgej pqmi { '\*Mco r ct'Eco r wu+: "WVCT "

Ej cr vgt "4<Nkgtcwtg'Tgxkgy "

vclpki 0' Uq." k' eqpenf gu" y cv" vcf kqpcn' cr r tqcej gu" eqwf " { krf " uko krt " tguwu" eqo r ctgf "v'f ggr "ngctpki "cr r tqcej gu"y kj "y' g'dgpgku'qh'uko r rgt "ko r ngo gpvcqp"cpf " rguu'eqo r wcvkpcn'tguqtegu0'

**Vj g'cf xcpwi gu'qh'CPP<'**

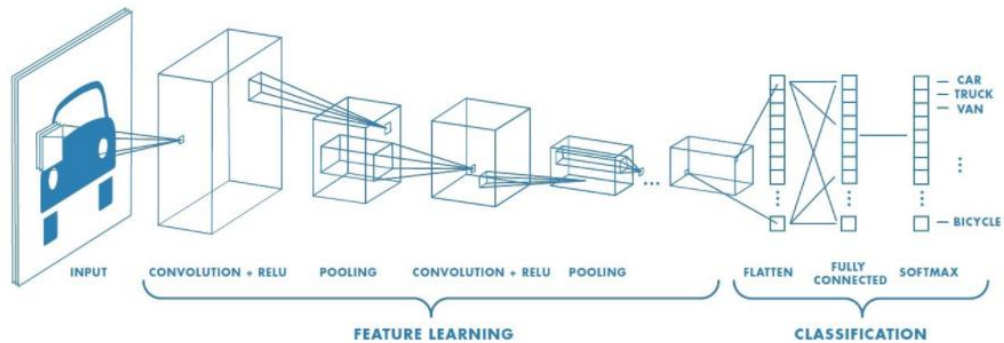
- Kphqto cvkqp'ku'hgr v'y kj kp'y' g'gpvtg'pgy qtm'f qgu'pqv'r tngxgpveqo r rdekvpku'lh yj g'g'ku'cdugpeg'kp'f cvc+
- Cdrq'v'q'r gthqto "vcunlr ctcmgm' { "o wnk'vcunlpi +
- Cdrk'v'q'y qtm'w'pf gt "y' g'eqpugs wpgegu'qh'kpuwhh'ekgpv'f cvc

**Vj g'f kcf xcpwi gu'qh'CPP<'**

- J ki j "j ctf y ctg" f gr gpf gpeg" f wg" v" y' g'tgs wktgo gpv'qh'r ctcmgri'r tqeguulpi "d { r tqeguqtu0
- Wpegtckpv' 'kp'h'p'ekvpki "y qtm'qh'CPP / F qgu'pqv'i kxg'kpuki j u'qp'j qy "cpf "y j { "y' g'lu'w'kqp'ku'eqo r wgf "h'ng yj ku0
- P q" h'zgf "ctej kgewtg"kp"CPP "pggf u"o qtg"tkcn'cpf "gttqt"v"i gv'cr r tqr tkcvg utwewtg+

**4015'Eqpxqrvkqpcn'P gwtcn'P gy qtm'EP P +'**

Eqpxqrvkqpcn'P gwtcn'P gy qtm'EP P +'cnuq"mpqy p"cu'EqpxP gv'ku'qpg'qh'y' g'f ggr " ngctpki "cni qtkj o u'y cv'ku'j gexk' { wnk' gf "h'q't'ercuwh'ekcvkqp"cpf "eqo r wgt "xkukqp"EX+" tgrv'gf "vcum0' K'ku" k'p'v'qf wgf "f wg" v" y' g'kp'ur k'cvkqp"qh'y' g'k' "eqppg'v'xk' { "r cwgtpu" dgwy ggp'pgwtqpu'y cv'o ko leu'y' g'qti cpk' cvkqp'qh'y' g'xkuw'neq'tv'gz0'Vj g'o ckp'i qcn'ku'v" tgf w'g" k'p'w'ko ci gu'k'p'v'q" c" uko r rgt "h'qto "y' cv'k'ku" tgrv'x'gn' { "gcu' { "v" r tqeguul" y j k'g" o c'k'p'v'k'p'ki "xkcn'h'gcwtgu"j48\_0Hki wtg'40'uj qy u'c'uko r rgt'ctej kgewtg'qh'EP P 0'



Hki wtg'409'"Uko r rgt'ctej kgewtg'qh'EP P "j48\_ "

"

" E P P "ku"o cf g"wr "qh"vj tgg"f kxkpev"rc {gtu"y j lej "ctg"eqpxqmwkqpcn"rc {gt."r qqrkpi "rc {gt."cpf "hwn{ "eqppgevgf "rc {gt0Gcej "qh"vj gug"rc {gtu"j cxg"vj gk "qy p"ur gekhle"tqrg0Hqt "vj g"eqpxqmwkqpcn"rc {gt."ku"qdlgevkg"ku"vq"gz vtcev'hgcwt gu"htqo "vj g"lo ci gu0Vj g"rc {gt "r gthqto u"cf qv"r tqf wev'dgvy ggp"vy q"o cvtkegu."vj g"lpr w"ko ci g"o cvtkz"cpf "vj g"ngtprn"qt "hkngt"o cvtkz "\*"wucm{ "c"5z5"o cvtkz+"vq"eqo r wvg"vj g"eqpxqmwgf "hgcwtg"o cvtkz0Vj g" r tqeguulpxqmg"vj g"ngtprn"vcxgtukpi "cmipi "vj g"r qtvkqp"qh"vj g"ko ci g"o cvtkz "ceeqt f kpi "vq"vj g"vukf g"rgpi vj "\*"urkf kpi "uk g+"wpkn"vj g"gpvtg"ko ci g"ku"vcxgtugf 0O qxkpi "qp"vq"vj g" r qqrkpi "rc {gt."k'ku'tgur qpukdng'hqt"vj g'tgf wevkqp"qh"ur cvkn"uk g"qh"vj g"eqpxqmgf "hgcwtg" o cvtkz0Vj ku"j gr u"lp"lqy gt kpi "vj g"eqo r wevkqpcnr qy gt "tgs vktgf "hqt"r tqeguulpi "cu"y gm{ cu"gz vtcev kpi "f qo kpcpv'hgcwt gu"htqo "vj g"lo ci g0K'eqpuku"qh"vy q"cr r tqcej gu"y j lej " ctg"o cz"r qqrkpi "\*"cnkpi "o czko wo "xcnwg+"cpf "cxgtci g"r qqrkpi "\*"cnkpi "cxgtci g"qh"cm{ xcnwgu+"htqo "vj g"eqpxqmwgf "o cvtkz0Chgt"vj cv."vj g"lpcn"qwr w"y kn'dg"hcwgp kpi "qww" kpvq" c" eqnw p" xgevq" hqt" vj g" ko r ngo gpvcvkp" d{ " vj g" hwn{ " eqppgevgf " rc {gt" hqt" encuukhlecvkp0Vj g'hqmny kpi "cwj qtu"o ckpn{ 'hqwugu'qp'encuukh{ kpi "Y DEu"uwdv{ r gu'cpf " TDEu"uwdv{ r gu0'

" \ j cq'gv'cn0]3\_cff tguugf "vj g"kuwg"qh"vcf kxkpcn'o gjv qf u'etgcvkpi "c"j ki j n{ "ghhgevkg" u{ ugo "hqt"Y DEu"encuukhlecvkp"htqo "r gtr j gtrn' dmqf "ko ci gu" wulpi "UXO "cu"r tg/ encuukhgt."E P P "cu"c'hgcwtg"gz vtcevq"cpf "tcpf qo "hqt guu"ht "dgwgt'encuukhlecvkp0'Chgt" r tg/r tqeguulpi "vj g"lo ci gu"ht"vj gk "hgcwt gu."vj g"UXO "encuukhgt"ku" wugf "vq" encuukh{ " Y DEu"lqv"vj tgg'encuugu"y j lej "ctg"qgukpqr j kn'dcuqr j kn'cpf "qy gtu0Vj gp."E P P "y kj "7" eqpxqmwkqpcn"rc {gtu"cpf "4"r qqrkpi "rc {gtu"ku"wkkl gf "hqt"gz vtcev kpi "hgcwt gu"lp"j ki j "hgxgr" dghqtg" wulpi "tcpf qo "hqt guv"vq" encuukh{ "vj go "lqv"qvj gt"Y DEu"uwej "cu"pgwtqr j kn" o qpqe{ vg." cpf " n{ o r j qe{ vg0 Vj ku" cr r tqcej " y cu" eqo r ctgf " y kj " r tgxkqu" y qtm{ o gpvkp gf "y j lej "ctg"Ug{ gf "o gjv qf "]42\_cpf"j kgtctej kcrn'UXO "];\_0Vj g'encuukhlecvkp" ceewtce{ 'ku'uki pkhlecprn{ 'dgwgt'cpf 'hcwgt'eqo r wevkqp"ko g'eqo r ctgf "vq"dqy 'vcf kxkpcn' o gjv qf u"\*; 40 ' "eqo r ctgf "vq"980 ' "cpf "980' "tgur gevkg n{ +0Vj g"tgcuqp"ku"dgecwug" vj g"o kzgf "f cvdcug" wugf "d{ "vj g"cwj qt"r tqxgf "vj cv"vj g"r tgxkqu"o gjv qf u"fq"pqv"eqr g" y gm{y kj "k0K'eqpenw gu"vj cv'E P P "f qgu"y gm{y kj "vj g"r tgugpeg"qh"rci g"fcv"cpf " o kzwg"qh'encuukhgtu"eqwf "qwr gthqto "lpf kxkf wcn'encuukhgtu0'

" Uj cj kp" gv'cn0]5\_"lpxguki cvgf "vj tgg"f lhtg gpv" cr r tqcej gu"ht"qr vko k kpi "Y DEu" kf gpvkhlecvkp"u{ ugo "y j lej "ctg" F ggr "Eqpxqmwkqpcn'cevxcvkp" \*F gEC+."c" vcpuhgt" rgtcpkpi "o gjv qf "vq"r tqeguulko kgf "f cvcugu."hkg/wpgf "pgy qtm{cr r tqcej "cpf "vj g"htuv" r tg/vtkp gf "E P P "pgy qtm"Y DEuP gv."hqt"Y DEu"encuukhlecvkp0'"Hktuwn{ ."hqt" F gEC"

Ej cr vgt "4<Nkgtcwtg'Tgxkgy "

cr r tqcej . "k'eqpuku'qh'6'uvg r u<r tg/r tqegu kpi " \*t guk kpi "ko ci gu+ "hgcwtg'u'gz vtcev kq p." hgcwtg'u' ugrgevkq p" \*ej k' us wctgf " qt" Rtkpek r en' Eqo r qpgpv' Cpcn{uku" \*REC+:" cpf " encuukhlecvkq p" \*UXO +0Hqt 'hkg/wpkpi . 'y q'r tg/vtkp gf 'pgy qtmu' y j lej 'ctg' CrgzP gv'cpf " NGP gv'7'ctg'hkgf /wpgf 0Ncuw{ . 'y g'Y DEuP gv'ctej kgewtg'r tqr qugf 'eqpuku'qh'5'o clkp" eqpxqmwkqpcn'rc {gtu. 'y q'r qqrkpi "rc {gtu. 'hqw'cevkvkq p'tgevkkgf "hkgct'wkv" \*TgNW+:" vy q' hwn{ 'eqppgevgf "rc {gtu'cpf "c'uqhw cz " \*encuukhlecvkq p+rc {gt0"Vj tgg'f kvkpevf cvcugv" cu'y gmi'cu' y j g'eqo dlpckvq p'qh' y j g' y j tgg'f cvcugv" \*F cvcugv CNN+ctg'wkkk gf "hqt'vguv kpi " cpf "vckpki 0k" y j g'htu'cr r tqcej . "CrgzP gv'cej kxgu' y j g' j ki j guv'ceewtce { "qh'9; 0' " eqo r ctgf "v'QxgthgcvP gv'cpf "XI I P gv' \*9808' "cpf '9406' +0O gcpy j kg. "qp' y j g'ugeqpf " gzr gtko gpv." hkg/wpgf " CrgzP gv' ueqtf " ; 304' " k" ceewtce { " y j lej " r tqxgu" hgcwtg" ugrgevkq p" eqwrf " dqquv' ceewtce { " tcvu0' Qp" y j g" r tqr qugf " Y DEuP gv' u{ vgo . " y j g" encuukhlecvkq p" ceewtce { "xctkgu'ceeqtf kpi "v'f cvcugv" \*y j g'uo cmgt' y j g'f cvcugv. 'y j g'ny gt" y j g'ceewtce { +0J qy gxgt. 'Y DEuP gv'qwr gthqto u'dqj 'tcf kkpccnu{ vgo u'cpf 'hkg/wpgf " CrgzP gv'0'Vj g'r gthqto cpeg'qh'Y DEuP gv' hwt y j g' "ko r tqxgu' y j g' "hgcwtg'ugrgevkq p" \*ej k/ us wctgf "o gj qf + "Hqo " ; 506' "vq"; 608' eqo r ctgf "v' CrgzP gv' y j lej "ku' y j g' eqo r rvg" qrr qukg" \*f tqr "v'9704' "Hqo '9908' "chgt' hgcwtg'ugrgevkq p-0'

" Z w'gv'crl'49\_f gxgrgr gf "c" TDE "dcugf "f ggr "EP P "hqt' y j g' encuukhlecvkq p'qh'c" TDE " f kuqtf gt "ecmgf "ulemg" egm'f kugcugu' Ulemg" egm'f kugcugu" ecwugu" TDE "v' j cxg" ktgi wrct" uj cr gu' y j lej "chgeu' y j g' vcpur qt'v'qh'qz { i gp' y j g' v' y qwf "dtkpi "i tgevtkumu'v' y j g' r vkgpv'0' Hqw' ugr u'ctg' i qpg' y j tqwi j "hqt' y j g' TDE "f ggr "EP P "vckpki " y j lej "ctg' j kgtcej kecn" TDE" r cvj " gzvtcev kq p." uk g/kpxctkcpv' TDE" r cvej " pqto cik vckq p." TDE" r cwgt p" encuukhlecvkq p'cpf "cwqo cvgf "TDE 'uj cr g' hcevt "ecrwr vckq p0'Qp' y j g' encuukhlecvkq p' r j cug." c'f ggr "EP P " y kj "32"rc {gtu'eqpuku'kpi "qh'5'eqpxqmwkqpcn'rc {gtu. "5"r qqrkpi "rc {gtu. "4" f tqr qw'rc {gtu'cpf "c' hwn{ "eqppgevgf "rc {gt'ku'cf qr vgf 0" C "f cvcugv'qh'656'o ketqueqr { " ko ci gu'qh": "f hhtgpv'ulemg" egm'f kugcugu'ku'wugf "cmipi " y kj "7"m/hqrf "etquu'xcirk vckq p" cpf "y j g'ceewtcekgu' i qwgp'ctg"; 303' "hqt' encuukh{ kpi "7"v{ r gu'qh' TDE "cpf " : ; 08; ' "hqt" encuukh{ kpi " : " v{ r gu'qh' TDE0' k" cf f kq p." y j g' encuukhlecvkq p" qh' f gqz { i gpcvgf "dmqf " eqo r ctkpi "v'qz { i gpcvgf "dmqf "ku'vugvf "cpf "k'eqwrf "cej kxg' j ki j "tgecm" \*; 50' +dw" o vej "ny gt" r tgekukq p" \*82' +f wg'v' y j g' j ki j "uko krctkkgu'qh'dqj "egm'00 cecy kg'gv'crl' ]4: \_r tqr qugf "c" Y DE "encuukhlecvkq p'cr r tqcej "wukpi "c'pgy "ugi o gpvckq p"o gj qf "wukpi " J wg." Ucwtkvq p" cpf " Xcnwg" \*J UX+ " eqo r qpgpv" y kj " dmq" cpcn{uku" cu" y gmi' cu" kpeqr qtcvki "y j tgg'r tgtckp gf 'EP P u'pco gn{ 'T guP gv'323. 'I qqi NgP gv'cpf 'CrgzP gv'hqt" eqo r ctkuq p0'Uko krct'v' ]5\_f gf wekqpu. 'CrgzP gv'ku'o vej "o qtg'lwrgtkqt'eqo r ctgf "v' y j g" qj gt' y q'EP P "o qf gnu"

" Nkpi 'gv'cr0]4\_ 'kvtqf wegf 'cp'kppqxcvkg'cr r tqcej 'qh'eqo dlpkpi 'Tgewtukxg'P gwtcrn' P gvy qtni' \*TPP +'y kj 'EP P '\*Zegr vkp'o qf gni'vj cv'y qwf 'f ggr gp'vj g'wv'pf gtucv'p'kpi 'qh' ko ci g'eqv'gpw'y j kg'cko kpi 'hqt'o qtg'ceewtcvg'tguwmu0'Vj g'TPP 'v{r g'wkkk gf 'j gtg' ecmgf "dkf kgevkpcn'Nqpi "Uj qtV'Vgto "O go qt { '\*NUVO +'y j gtg'k'ecp'hkgt'wughwn' kphqto cvkqp'ceeqtf kpi 'v'vj g'eni qtkj o au'twgu0'Qp'vj g'qvj gt'j cpf 0'Vj g'EP P'o qf gni' eqpukmu'qh'c'r tg/vtckpgf 'EP P'rc {gt '\*tgvkxg'y gli j vr ctco gvgtu'htqo 'ko ci gP gv'f cvcugv' r tg/vtckp'kpi 'hqt'kpkckrk cvkqp+'eqpxqmwkpcn'cpf "r qqkpi 'rc {gtu."TPP "rc {gt."o gti g' rc {gt '\*eqo dlp'g'hcwtgu'gz vtcev'f'htqo 'dqj 'EP P'cpf 'TPP +'cpf 'hwn' 'eqppgevgf 'rc {gt '\*Uqho cz-0Vj g'o qf gni'v'gugf 'cm'pi 'y kj 'qvj gt'uko krc'cr r tqcej gu'v'q'ercuukh' 'egm'k'p'v'q' 6"v{r gu' \*gqul'pqr j kn' n' o r j qe {vg."o qpqe {vg."cpf "pgwtqr j kn'0'Vj g'r tqr qugf "o gj qf " ueqtf' "vj g'j ki j guv'ceewtce { "qh"; 20; ' "co qpi "cm'o qf gni'cu'k'ecp'gh'gevkxgn' "rgctp" utwewtcr'ej ctcev'gt'ku'eu'qh'dmqf 'egm'ko ci gu'0J qy gxt. 'vj g'f qy puf'g'qh'vj ku'cr r tqcej " ku'vj g'un'y "eqo r wcvkpcn'ko g' \*cnkpi "50 "ugeqpf u'hqt'c'ukpi ng'egm'ercuukh'ecvkp+'cpf " vj g'v'gukpi "y cu'o ckpn' "qp'ukpi ng'egm'ko ci gu'tcvj gt'vj cp'qxgt'ncr r kpi "qp'gu'0'Vcdng'40B" uj qy u'vj g'eqo r ct'kuq'p'tguwmu'qh'gcej 'o qf gr0'

Vcdng'403"Eqo r ct'kuq'p'qh'ercuukh'ecvkp'tguwmu'qh'f'ku'k'p'ev'o qf gni' \*EP P'cpf 'EP P / TPP +' ]4\_ "

Model	Sub-Models	Four-classification accuracy
CNN	Inception V3	84.08
	ResNet50	87.62
	Xception	88.70
CNN-RNN	Inception V3-LSTM	87.45
	ResNet50-LSTM	89.38
	<b>Xception-LSTM</b>	<b>90.79</b>
	Xception-ResNet50-LSTM	88.58

" Vky ct'kgv'cr0]4; \_'go r j cuk gf 'qp'Y DE'ercuukh'ecvkp'wukpi 'f qwdng'eqpxqmwkqp'rc {gt' pgwtcrn'pgvy qtni' \*F ENP P +'y j kej "ku' o qtg' gh'hekgpv' cpf " vko g'ucxkpi "eqo r ctgf "v'q' v'cf k'k'k'pcn'o gjv qf u'0'Vj g'F ENP P'ctej kgewtg'eqpv'kpu'y q'eqpxqmwkpcn'rc {gtu'cpf " qp'g'r qqkpi 'rc {gt'y kj 'ko r ngo gpw'hqty ctf 'r cuu'cpf 'dceny ctf 'r tqr ci cvkqp'cni qtkj o u'0 C' f cvcugv' qh' 35.222" r kewtgu' qh' 7" f ku'k'p'ev' ecvgi qtkgu' qh' Y DEu' ctg' v'cngp' k'p'v'q' eqpuk'gtcvkqp'v'v'ckp'cpf 'v'guv'vj g'F ENP P'cm'pi 'y kj 'vy q'qvj gt'ercuukh'gtu'UXO'cpf " P c'xg'Dc {gu'cu'eqo r gv'k'qtu'0Cu'c'tguwmu'F ENP P'qwr gthqto u'vj g'qvj gt'vy q'ercuukh'gtu' y kj "c'HB'ueqtf'qh'20 5'y j kej "ku'cm quv'v'kr ng'v'q'vj cv'qh'UXO'cpf "Dc {gu'HB'ueqtf'gu'0 Qvj gt'vj cp'vj cv'vj g'eqo r ct'kuq'p'qh'o cz'r qqkpi "cpf "cxgtci g'r qqkpi "ku'hqewugf "qp'0'

Ej cr vgt "4<Nkgtcwtg'Tgxkgy "

Cxgtci g'r qqrkpi "{lgrf u"dgwgt"r gthqto cpeg"cv'uqo g'r qkpwu"\*rtgekukqp"cpf "tgecm'qh"c" egtvckp"v{r g'qh'egm'dw'o cz'r qqrkpi "qwr gthqto u'k'lp"i gpgtcr0J gi f g"gv'cr0]47\_"cnuq" vqwej gf "qp'yj g'eqo r ctluqp"qh'tcf kkpncrko ci g'r tqeguukpi 'o gyj qf u'y kj "f ggr 'hgctpkpi " cr r tqcej gu'hqt"Y DEu'ercuukh'ecv'kq"y j lej 'y cu'o gpv'kqpgf 'lp'yj g'CPP "ugev'kq"405-0C" hwm' v'ckpgf " hqo " uetcej " EPP" cpf " c" v'cpuhgt" hgctpkpi " o gyj qf " \*CrgzP gv" ku" ko r ngo gpv'f 0K'xguk' cv'kq"qp'yj g'lo r cev'qh'xct {kpi 'pwo dgt'qh'rc {gtu'y cu'eqpuk'gtgf " kp'yj g'hwm'v'ckpgf "EPP 0Vcdmg"404'uj qy u'yj g'ctej kgewtg'qh'yj g'hwm'v'ckpgf "EPP 0

Vcdmg"404"Ctej kgewtg'f gvcku"qh'hwm'v'ckpgf "EPP "]47\_"

Layer	Details
Layer 1	Convolution layer [11,11], 96, stride (4,4), padding (0,0) ReLU
Layer 2	Max pooling layer (3, stride 2) Convolution layer [5,5], 256, stride (1,1), padding (2,2) ReLU
Layer 3	Max pooling layer (3, stride 2) Convolution layer [3,3], 384, stride (1,1), padding (1,1) ReLU
Layer 4	Max pooling layer (3, stride 2) Convolution layer [3,3], 384, stride (1,1), padding (1,1) ReLU
Layer 5	Convolution layer [3,3], 256, stride (1,1), padding (1,1) ReLU
Layer 6	Max pooling layer (3, stride 2)
Layer 7	Fully connected layer (500)
Layer 8	Fully connected layer (256)
	Fully connected layer (6)

" Ceeqtf kpi "v'yj g'tguwuu."yj g'hwm'v'ckpkpi "EPP "cej kxgf "; ; ' "ceewtce{"y kj "hqwt" eqpxqmwkqpcnr{gtu'cpf "y q'hwm' 'eqppgevg'rc {gtu'8'rc {gtgf 'pgwy qtm'co qpi 'cm'qy gt" pwo dgt'qh'rc {gtu'0K'cnuq'r gthqto gf "dgwgt'yj cp'CrgzP gv."j cxkpi "qpn{ "; 7' "ceewtce{0K' eqpenmf gu'yj cv'ej cpi kpi "qh'hkngt'uk' g'qt'ko ci g'uk' g'cpf "cxckrdkkr{ "qh'f cvcugu"j ki j n{ " chgevePP 0ur' gthqto cpeg0Y cpi "cpf 'Ecq"]52\_'cf f tguugf 'yj g'kuwg'qh'EP P "qp'uctekf " cpf 'ko dcrpeg'qh'f cvcugu'd{ 'f cv'cwi o gpv'kq"cpf "tguco r r kpi "o gyj qf 0Ukpeg'EP P "ku" chgeve'd{ "cxckrdkkr{ "qh'f cvcugu."f cvcugu"yj cv'rcem'tguqtegu"y km'qxgt'k'v'yj g'EP P " o qf gn'yj wu"fi tcf g"ku'ercuukh{ kpi "cdkkr{ 0Vq"tguqrxg"yj ku."c"pgy "f cv'cwi o gpv'kq" o gyj qf "qh'ugi o gpv'kpi 'hgwnqe{ vgu'htqo "yj gk'qt'ki kpcr'lwttqwpf kpi u'kp'v'f k'htg'gpv'ht'co gu" qh'lwttqwpf kpi u'eqwf "i wlf g'yj g'EP P "hqt'dgwgt'hgcwtg'eqpegpvc'kq"0Dgukf gu'yj cv.'yj g" cwj qt"cnuq"ko r ngo gpw"ct'guco r r kpi "o gyj qf "v"i gpgtcvg"o qtg"uco r ngu'd{ "cr r n{ kpi " tqv'kq."hkr r kpi "xgt'v'ecm{ "cpf "j qtk' qpvcm{ ."cpf "cf f kpi "pqkug'v'cf f tgu'yj g'ko dcrpeg" co qwp'qh'f cv' "hqt"egt'v'ckp"egm'v{r gu'0C"EP P "o qf gn'yj kj "8"eqpxqmwkqpcnr{gtu."5" r qqrkpi "rc {gtu."5" hwm' 'eqppgevg'rc {gtu'cpf "c'Uqho cz'rc {gt'ku'k'p'v'qf wegf 0Vj ku"o qf gn'



Ej cr vgt "4<Nkgtcwtg'Tgxkgy "

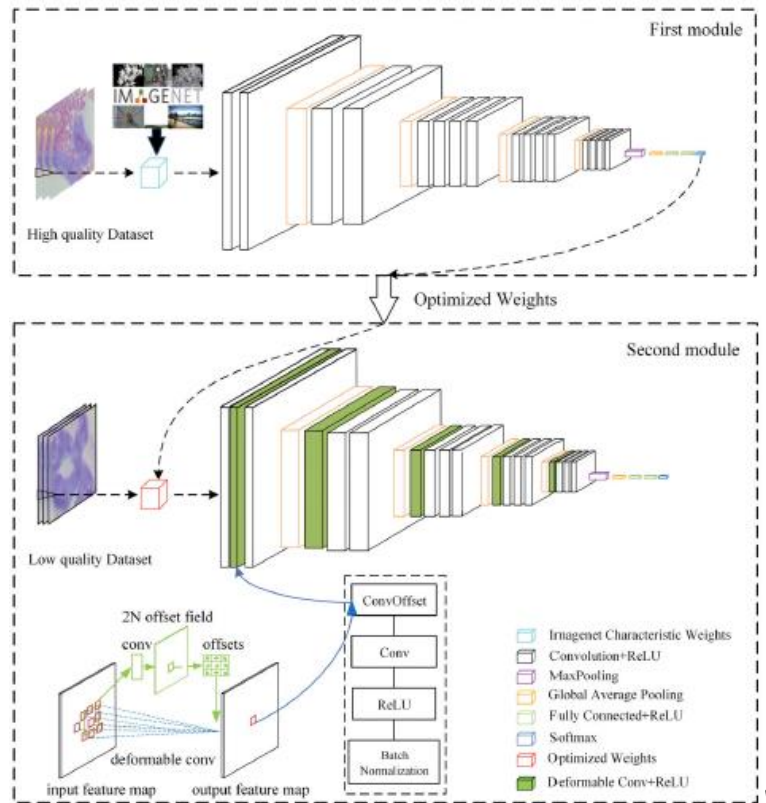
ku'eqo r ctgf 'y kj "qj gt 'hpg/wpgf 'b qf gnu'\*XI I /38. 'T guP gv.'O qdkgP gv'X3. 'Kpegr vqpp " X5+0Kpegr vqpp"X5"qdvkpu'vj g'j ki j guv'ceewtce{ "co qpi 'vj g'hpg/wpgf 'b qf gnu'\*; 60B+"dw' y cu" dgcvgp" d{ " 'vj g' r tqr qugf "EPP " d{ " c" 50' " i cr " \*; 908' +0' Vj g' cdugpeg" qh' f cvc" cwi o gpvcvqpp" cpf "tguco r rkp i "o gj qf "qp"vj g' f cvcugv"\*qpn{ "4522" ko ci gu'eqo r ctgf "vq" 49; 22+"my gtu'vj g'ceewtce{ "htqo "; 908" "vq"; 60' 0"

Mwaw' gv' cr0' ]6\_ "go r j cuk gf "qp"vj g"tqdwvpguu"qh"EP P /dcugf "u{ ugo "d{ "j cxkpi " Tgi kqpcn'Dcugf "EP P "\*"T/EP P +"cpf "vcpuhgt"ngctpkpi "o gj qf u'cu"vj gkt "cr r tqcej "hqt" Y DEu'ercuukhlec vqpp0'Vj g'cwj qt "gzs rkp u'qp"vj g'ctej kgewtg"qh'f khgt gpv'f gvgevqtu"\*T/ EP P . 'Hcuvt/EP P . 'hcuvt "T/EP P . 'Ukpi ng'Uj qv'O wnkqz "F gvgevqt "UUF +"cpf "[ qwQpn{ " Nqqm'Qpeg"Xgtukap"5"\*[ QNQ"X5+"y kj "hcuvt "T/EP P "dglpi "vj g'o quv'ceewtcevg0'Vj g' ghhev' qh' f kvkpev'EP P "ctej kgewtgu" cpf "vcpuhgt" ngctpkpi "ku'cnuq" ecttkgf "qw' y kj " Tgupgv'72" EP P " cpf "ctej kgewtgu" vckpgf " y kj " vcpuhgt" ngctpkpi " { kgrf gf " j ki j guv' r gthqto cpeg0'K'eqpenw gu'vj cv'vj g'uwg gkqtkv{ "qh'EP P "kp"qxgteqo kpi "vj g'ej cmgpi g'qh' qxgtm r r kpi "qt"my "xkukdkkx{ "qh'egm"lp"ko ci gu'y j kej "y qwf "j kpf gt"j ki j "ceewtcekgu0' Hwtvj gto qtg. "Ucj mgn'gv' cr0' ]53\_ "r tqr qugf "c"j { dtkf "cr r tqcej "d{ "eqo dlpkpi "EP P "hqt" hgcwtg"gzvcevqpp"y kj "Ucr "Uy cto "Cni qtkj o "\*"UGUUC +"hqt" hgcwtg"qr vko k cvkqp"qp" Y DEu'ercuukhlec vqpp0'XI I P gv'ctej kgewtg"ku'wkk gf "hqt"dglpi "tgenqpgf "cu"vj g'dguv' r tg/vckpgf "hgcwtg"gzvcevqt" cpf "UGUUC"ku'tgur qpukdrg"vq"hnkt "vj g'tgngxcpv'hgcwtgu" htqo "vj g'gzvcevqtu"qwr w"\*pettqy kpi "47M'hgcwtgu"vq"3M+0'Vj ku'b gj qf "cej kxgu'i tgecv' ceewtce{ "tvcgu"\*; 80B3' "cpf ": 505' "hqt"vy q'f cvcugw'tgur gevkgxgn{ +"y j gp'eqo r ctgf "y kj " r tgxkqu'cwj qtu'cr r tqcej gu'cu'y gm'cu'j cxkpi "my gt'eqo r wcvkqpcn'vko g'cpf "tguqwtg" eqpuwo r vqpp" f wg"vq"vj g'f getgo gpv'qh'hgcwtgu'vj cv'UGUUC"r tqf wegu0'

Tgegpw{ . "[ cq"gv' cr0' ]54\_ "r tqr qugf "c" f wcn'o qf wrg"y gli j v'qr vko k gf "f ghqto cdrg" EP P "\*"VY Q/F EP P +"vq" kpetgcug"vj g"tqdwvpguu"qh"Y DE "ercuukhlec vqpp0'Vj g'r tqeguu" uctw" y kj " 'vj g' r tgupeg" qh' y q" o qf wrgu" y j gtg" ko ci g' ej ctcevgtkuke" y gli j vu" qh' Ko ci gP gv'ku'wugf "vq"kpkkckk{ g'vj g'y gli j w'qh'vj g'htuv'o qf wrg" cpf "c"j ki j /s wcrkv{ "Y DE" f cvcugv'ku'kpr wwgf "vq"vckp'k0P gzv'vj g'qwr w'qh'qr vko k gf "y gli j v'htqo "vj g'htuv'o qf wrg" ku'vcpuhgttgf "vq"vj g'ugeqpf "o qf wrg"y j gtg"kv'y qwf "dg"ercuukh{ kpi "my /s wcrkv{ "Y DE" f cvc'ugv0'F ghqto cdrg"eqpxqnwvqpcn'hc{ gtu'kpvtf wegf "d{ "vj g'cwj qt"j gr u'kp'tgvtkxkpi " o qtg" f gvckrgf "hgcwtgu"htqo "my "s wcrkv{ "f cvc"ugv"\*my "tguqnwvqpp" cpf "pqku{ +0'Vj g' qr vko k gf "y gli j vu'ckf "lp"vj g'hcu'veqpxgti ppeg'ur ggf u0'Vj ku'cr r tqcej "ku'eqo r ctgf "y kj " qj gt"o cej kpg"ngctpkpi "o gj qf u"\*XI I 3; . "XI I 38. "Kpegr vqpp/X5. "T guP gv'72. "UXO . " O NR. "F gekukpp"Vtgg" cpf "T cpf qo "Hqtguw"qp"vy q'f khgt gpv'f cvcugw"\*my "s wcrkv{ "cpf " DEEF "f cvcugw+0'Vj g'tguwmu'uki plh{ "vj cv'VY Q/F EP P "vq"dg'uwg gkqtkv'kp"dqj "f cvcugw"

Ej cr vgt "4<Nkgtcwtg'Tgxlgj "

gur gekm{ 'hqt'mqy 's wrkv{ 'f cvcugv0Hki vtg'40 'f guetkdgu'yj g'qxgtcm'tej kgewt'g'qh'yj ku' cr r tqcej 0"



Hki vtg'40: "P gy qtniCtej kgewt'g'qh'Vy q/F E P P "]54\_ "

\ j w'gv'cr0]7\_r tqr qugf "ugxgp"o qf gnu'hqt "cwqo cvk"ercuukhccvqp"qh'dmqf "egmu" y j kej " ctg" DECTGP gv \*CrgzP gv/TP P u/Gp+." DET7TGP gv \*TguP gv/72/TP P u/Gp+." DEO X4TGP gv\*O qdkgP gvX4/TP P u/Gp+." DETTP gv\*TguP gv3: /TXHN+." DETGP gv \*Tgupgv3: /GNO +." DETUP gv\*Tgupgv3: /UP P +." cpf 'DEP gv0Vj g'dguv'r tqr qugf "o qf gn" DEP gv."wkrk gf "TguP gv3: "cu'ku'dcendlpgg"cpf "hwt yj gt"ko r tqxgf "ku"r gthqto cpeg"d{" tgr rckpi "ku'rcu'hqwt"rc{ gtu'y kj "yj tgg'tcpf qo k gf 'pgwtcrhpgy qtm' \*TP P u'y j kej "ctg" Tcpf qo " Xgevqt" Hxpevqpcn' Nkpm' \*TXHN+." Uej o kf v' P gwtcn' P gy qtm' \*UP P +." cpf " Gzvtgo g'Ngctpki "Ocej kpg" \*GNO +0Vj gug"TP P u'y qwf "r tgxgpv'qxgthkwpki "kuwgu"cpf " uj qtvgp'tckpki "ko g'ulpeg'yj g'pwo dgt"qh'r ctco gvtu'kpxqmgf "ctg'f'cvkccm{ 'mqy gtgf 0' Vj g"o qf gn'cej kxgf "; 80: ' " ceewtce{ ."o cnkpi "k' dgwt "yj cp" qyj gt" ucvg/qh'yj g/ctv' o gyj qf u'htqo "r tgxkqu'cwj qtu0'

**Vj g'cf xcpwci gu'qhEPP<'**

- Ecr cdki kgu'lp'ngctpki "cpf "gzvtcevpki "hgcwt'gu'cwqo cvkccm{ 0'
- Hckn{ 'j ki j "ceewtce{ 'tcvgu'lp'ko ci g'tgeqi pkqp"qt "hgcwt'g'f'gvgevt'u{ ugo u0'

Ej cr vgt "4<Nkgtcwtg'Tgxkgy "

- Kpugpukxg'vq'r qqt'ko ci g's wcrk{ '\*ny 'tguqnwkqp.'pqkug.'gve+' "

**Vj g'f kcf xcpvcj gu'qhEPP<**

- Tgs vkt gu'c'j vi g'co qwpv'qh'f cvcug'vq'r gthqto 'y gmi\*j ki j gt'eqo r ngzkv{.'j ki j gt' co qwpv'qh'f cvc-0'
- J ki j 'eqo r wcvkqpcn'equv'cpf 'tgs vkt go gpw'ht'vtckpki 'cpf 'vgukpi 0'
- Kpcdkk{ 'vq'tgvckp'vj g'nqpi /vgo 'f gr gpf gpe{ 'tgrcvkquj kr 'dgy ggp'ng{ 'hgcwt gu' qh'ko ci g' "

**40'Uwo o ct{ "**

" Vj tgg" cr r tqcej gu'j cxg" dggp" kpxguki cvgf " \*UXO ." CPP " cpf " EPP + " cnpqi " y kj " tgxkgy kpi " r tgxkqu" y qtmu" y j lej " eco g" wr " y kj " f khtgpv' vgej pls wgu" hqt" dgwgt" ercuukhcvkqp'tguwmu0Vcdng'40'uj qy u'vj g'qxgtxkgy 'qh'vj g'gzkukpi 'cr r tqcej gu'vj cvj cxg" dggp'tgxkgy gf "d{ 'v{r g'qh'ercuukhcvkqp'o gvj qf 'cpf 'kp'ej tqpqmji kecn'qtf gt0' "

Chgt'cpcn| kpi 'hwtvj gt'kvq'vj g'tgugctej gtu0r cr gtu.'f khtgpv'xctkcpw'qh'EPP 'y gtg' wkrk{ gf 'hqt'vj g'ercuukhcvkqp'r wtr qugu0O clqtkv{ 'qh'vj go 'kpenmf g'vj g'uwf { 'qh'vtcpubgt " ngctpkpi . 'd{ 'wukpi "vj g'r tg/vtckpgf 'o qf gni'uwej "cu'TguP gv.'XI I 'pgv.'Kpgr vkqp.'gve0'cu' hgcwtg'gzvtcevqtu'\*ftgg| kpi 'cm'rc { gtu'gzegr v'Hwm{ 'Eqppgevgf '\*HE+'rc { gt-0'Kp'cf f kkp." vj gug'o qf gni'y gtg'o qf kkgf "o cpwcm{ 'd{ "j cxkpi "cf f kkp'pcn'eqphki vtcvkapu"\*gpugo dng" o gvj qf u."ur gekn'cni qtkj o u."f cvc'cwi o gpvcvqp"vgej pls wgu."gve0'vq'hwtvj gt'ko r tqxg" vj gkt'tqdwupguu0Vj gtghqtg."kp'vj ku'r tq|gev."vj g'o qkxcvqp"ku'vq'tg/ko r ngo gpv'TguP gv' o qf gni'htqo 'uetcvej ."o ckpn{ 'TguP gv'3: 'cpf 'TguP gv'72'f wg'vj gkt'r gthqto cpegu'uj qy p" kp" tgegvp' r cr gtu" ]7\_" cpf " ]6\_0' D{ "j cxkpi " hwni' eqpvtni' qxgt" vj g' o qf gni' dwkm." vj g' r gthqto cpeg'eqwrf 'dg'kpg/wpgf "ceeqt f kpi n{ 0' "

Vcdrg"405""Uwo o ct { "qh'r tgxkqwu'encuukhccvkap'o gj qf u"

Cwj qt "¶ gct+"	O gj qf "I'Vej pks wg'Wugf "	Uj qtv'F guetkr vkap"
404B"Uwr r qtv'Xgevqt "O cej kpg"UXO +"		
Wuj k lo c"gv'cr0*4227+]8_"	J kgtctej kcrn' vtgg" dcugf " UXO " o wmkercuu"	<ul style="list-style-type: none"> <li>• Wkrk gf "UXO "encuukhccvkap"qxgt "P c'xg"De { gu'encuukhccvkap" hqt "dgwgt " tgeqi pkkap"</li> <li>• F khtgpv'o wmkercuu"UXO "cni qtkj o u"y gtg"lpxguki cvgf ."cpf " j kgtctej kcrn'vtgg"dcugf "UXO "j cu'vj g"dguv't guwmu"</li> </ul>
Uktqk "gv'cr0*4229+]9_"cpf "" Quqy unk'gv'cr0*422; +]: _"	I gpgvle"Cri qtkj o "y kj "UXO "	<ul style="list-style-type: none"> <li>• Wugf "I gpgvle" Cri qtkj o " hqt " ugrgevkqp" qh" dguv' hgcwtgu" cpf " tcpngf "vj go "ceeqt f lpi nf "</li> <li>• Vj g"o gj qf "j gr gf "vq"ko r tqxg"UXO au'r gthqto cpeg"dw"j ki j " eqo r wcvkqpcr'vko g'hqt"tcklpi "ku'pggf gf "</li> </ul>
Vck'gv'cr0*4233+]"; _"	J kgtctej kcrn'UXO "xu'ulpi ng/uuci g" UXO "	<ul style="list-style-type: none"> <li>• Ugr ctcvkap" qh' hgcwtgu" uwej " cu" ctgc." e { vqr ncu au" eqmgt." ektewrctkv{."gve0'ceeqt f lpi nf "vq"tckl "UXO "</li> <li>• Eqo r ctgf "vq"ulpi ng'ercuu"UXO "tcklpgf "y kj "qpnf "qpg'ercuu"qh' hgcwtg+."j kgtctej kcrn'UXO "{ kgrf "hct "dgwgt "t guwmu"</li> </ul>
J cdkd  cf gj "gv'cr0*4235+]32_"	F wcn/Vtgg" Eqo r ngz " Y cxgrgv' Vtcpuqto "y kj "UXO "	<ul style="list-style-type: none"> <li>• F wcn/Vtgg"Eqo r ngz "Y cxgrgv'Vtcpuqto "F V/EY V+y cu'wugf " crupi ukf g"UXO "y j lej "j gr gf "kpetgcug"ceewtce { "cpf "tgrkcdkiv{ "</li> </ul>
Y cpi "gv'cr0*4238+]33_"	Ur gevten'cpf "ur cvken'cpcn{ uku"y kj " UXO "	<ul style="list-style-type: none"> <li>• Eqo dlpcvkap" qh' ur cvken' cpf " ur gevten' hgcwtgu" vq" tckl "UXO " ftcuuecm{ "ko r tqxgf "UXO au'ceewtce { "</li> <li>• J qy gxgt."vj g"o gj qf "y cu'hqewugf "qp"ulpi ng'dmqf "egmu'tcvj gt " vj cp"o wmkercuu"ng'qpgu"</li> </ul>
Crk{ w'gv'cr0*423: +]34_"	UXO "xu'FN"	<ul style="list-style-type: none"> <li>• Eqpenf gf " vj cv' UXO " y qtmu" dgwgt" vj cp" FN" y j gp" uo cmi" f cvcugvu"y gtg"wugf 0FN'tgs wktgf "rti g'f cvcugu"vj cv'y qwf "dg" j ctf "vq"ces wktg0'</li> </ul>

		<ul style="list-style-type: none"> <li>UXO 'j gcxkq 'f gr gpf gf "qp'r tgf ghpqf 'hgcwtgu'htq'i qqf 'tguwmu'</li> </ul>
\ j gpi "gv'cr0*423: +]35_"	Ugrh'uw r gtxkugf " r gctplpi " y kj " UXO "	<ul style="list-style-type: none"> <li>Go r j cuk gf " y cv'uw r gtxkugf " cr r tqcej " uwej " cu" UXO " y qwf " f gi tcf g'lp'r gthqto cpeg'kh'uco r ngu'j cxg'uki p'hecpv'xctk'vqpu"</li> <li>Rtqr qugf "c"ugr'uw r gtxkugf " cr r tqcej " hqt" UXO " y cv'ko r tqxgf " ercuuk'hecv'qp"tcvgu"</li> </ul>
F kxkpc"gv'cr0*4242+]36_"	Ko ci g'r tqeguulpi "vgej pls wgu'y kj " UXO "	<ul style="list-style-type: none"> <li>Cr r rkgf " xctkqwu" ko ci g" r tqeguulpi " vgej pls wgu" hqt" r tgr tqeguulpi "qh'f cv"dghqtg"UXO "tcklpi "</li> <li>Rtqf wegf "qwu'cpf lpi 'tguwmu'dw'htv j gt'ko r tqxgo gpw'pggf gf " ukpeg'k'y cu'ecttkgf "qw'lp'c"eqputckp'gf "vgu'kpi "gpxk'qpo gpv"</li> </ul>
Mkqp"gv'cr0*4242+]37_"	O wnk'uci g'UXO "	<ul style="list-style-type: none"> <li>Clo gf "vq'tgf weg'qxgthk'vpi 'tguwmu'd'{"ecvgi qtk lpi 'y g'f cvcugv' kvq'y q'ecvgi qtk'gu."ogcu{/vq/ercuukh{ö"cpf "öj ctf/vq/ercuukh{ö"</li> <li>Vj g" öj ctf/vq/ercuukh{ö" uwdugv" y qwf " r cuu" y tqwi j " cpqj gt" UXO "hqt"tcklpi "</li> </ul>
4040'Ct'k'hecr'P gwtcr'P gvy qtm'CPP +"		
Vj ggte/Wo r qp"" *4228+]38_"	Hw   {"E/o gcpu"cpf "o cvj go cv'ecr' o qtr j qm' {"y kj "PP"	<ul style="list-style-type: none"> <li>Hw   {" E/o gcpu" cpf " o cvj " o qtr j qm' {" y cu" cr r rkgf " hqt" ugi o gpv'kpi "y g'egm'lpv'f'k'ht'gpv'r ctw'eqo r ctgf "vq"o cpwcm' " ugi o gpv'gf "d' {"gzr gtw"</li> <li>PP "ercuuk'hecv'qp" y cu' ecttkgf " qw' qp" dqj " cwqo cvgf " cpf " o cpwcm' ugi o gpv'gf "ko ci gu'Vj g'tguwmu'uj qy "y cv'cwqo cvgf " ugi o gpv'kpi "eqwf "o ko ke'y cv'qh'o cpwcm' " ugi o gpv'gf "</li> </ul>
Vj ggte/Wo r qp"cpf "Fj qo r qpi uc" *4229+]39_"	O qtr j qm' kcr' i tcpwqo gvt'ku" y kj "PP"	<ul style="list-style-type: none"> <li>Hqewugf "qp" gz'v'cv'kpi "hgcwtgu'htqo " y g' p'wergwu" vq" j cpf ng" r tqdng u'qh'ugi o gpv'kpi "qxgtm'r r lpi "egmu"</li> <li>PP " r gthqto gf " y gm' y j gp" lp" eqo r ct'ku'qp" y kj " Dc{gu' ercuuk'hecv'qp"</li> </ul>

Mj kuj o cp"*422; +]3; _"	I mdcnr cwgtp"cxgtci kpi "y kj "P P "	<ul style="list-style-type: none"> <li>• Wkrk gf "i mdcnr cwgtp"cxgtci kpi "hqt hgcwtg'gzvcevkqp"cpf "P P " hqt "ercuukhcevkqp"</li> <li>• Vy q "f kwpv"PP u"y gtg"fguki pgf ."cpf "k'f khtu"ceeqtf kpi "vq" pwo dgt"qh'kpr wtr { gt0Dqy {" kgrf gf "uko krt'tguwmu'dwPP "y kj " uo cmgt "kpr wtr { gtu'y cu'dgwgt "kp"vgo u'qh'uj qt vgt "twp"ko g"</li> </ul>
Mj kuj o cp"*422; +]3; _"	Go qvkpcn' P gwtcn' P gvy qtni' *Go P P +"	<ul style="list-style-type: none"> <li>• Kpeqr qtcvgt "go qvkpcn'dcem'r tqrci cvkqp"ngctpkpi "cni qtkj o " kpv"PP "vq"uko wrcvgo qvkpcn'f gekukqp"o cnkpi o"kp"j wo cpu"</li> <li>• Go P P "qwr gthqto gf "pqto cni'PP u'dw'tgs vktgf "o qtg"vckpkpi " vko g"cu'gzvc"go qvkpcn'y gli j v'ugvu'y gtg"cf f gf "</li> </ul>
Tgl cvqhkj k'cpf "Uqncpkcp/\ cf gj " *4233+]42_"	I tco /Uej o kf v'o gj qf "cpf "upcng" cni qtkj o "y kj "P P "	<ul style="list-style-type: none"> <li>• Wugf "I tco /Uej o kf v'o gj qf "hqt"pwengwu"ugi o gpvcvkqp" cpf "upcng"eni qtkj o "hqt"e{ vqr ruo "ugi o gpvcvkqp"</li> <li>• F vtkpi "ercuukhcevkqp."PP "y cu'eqo r ctgf "y kj "UXO "dw'hckrgf " vq"qwr gthqto "UXO "f vg"vq"xct { kpi "pwo dgt"qh'hgcwtgu"wugf "</li> </ul>
Xgnwej co {"gv'cr0"*4234+]43_"	Dcem'Rtqr ci cvkqp"PP "	<ul style="list-style-type: none"> <li>• Ercuukhcevkqp"qh'cdpqto cni'cpf "pqto cni'dmqf "egmu'wukpi "dcem' r tqrci cvkqp"PP "uko krt"vq"Go P P "d{ "Mj kuj o cp"]9_+"</li> <li>• Wugf " ucvkkecn' cpf " o qo gpv' kpxctkpv' cpcn'uku" vq" hkf " uki pkhcepv'hgcwtgu"</li> </ul>
P c  rdkrgm'gv'cr0"*4236+]44_"	Rtlpekr ng'eqo r qpgpv'cpcn' uku'y kj " P P "	<ul style="list-style-type: none"> <li>• Rtlpekr ng'eqo r qpgpv'cpcn' uku'y cu"wugf "hqt"gzvcevkqp"qh'xkcn' hgcwtgu'y j lej "dqquvgf "PP "ercuukhcevkqp'tcvgu"</li> </ul>
O cplm'gv'cr0"*4238+]45_"	PP "y kj "P gwtcn'P gvy qtni'Rcwgtp" Tgeqi pkkqp"vqni"pr tvqni"	<ul style="list-style-type: none"> <li>• Uko krt" vq" P c  rdkrgm' gv' cr0' ]36_" o gj qf ." o qtr j qmji kecn' hgcwtgu'y gtg'gzvcevgf "dghqg"ercuukhcevkqp"y kj "pr tvqni"</li> </ul>
¥ grgdk'cpf "Dwtnc {"¥ 3/4grk"*423: +" ]46_"	Cr r necvkqp"qh'Ego r wgt "Xkukqp" y kj "CPP "	<ul style="list-style-type: none"> <li>• Ercuukhcevkqp." eqvvpki " cpf " f gvevkqp" qh' cdpqto cnkku" kp" drqqf "egmu'wukpi "CPP "</li> </ul>
J gi fg'gv'cr0"*423; +]47_"	Vtcf kkkpcn' ko ci g" r tqeguulpi " o gj qf u'xu'FN"	<ul style="list-style-type: none"> <li>• Vtcf kkkpcn' ko ci g" r tqeguulpi " o gj qf u" *UXO." PP "+" y gtg" eqo r ctgf "y kj "FN"o gj qf u"</li> </ul>

		<ul style="list-style-type: none"> <li>EPP "ercuukhgt" j cf "i tgcv'r gthqto cpeg" cpf "dgpghkwgf "k" ugrh/ rgtcplpi "ecr cdkkku'y j gp" eqo r ctgf "y kj " P P 0J qy gxgt. " P P " tgs wktgf " rny gt" pwo dgt" qh' vclpki " ko ci gu" cpf " tguqwtg" tgs wktgo gpw"</li> </ul>
4045'Eqpxqmwkqpcn'P gwtcn'P gvy qtm*EPP +"		
\ j cq'gv'cn0*4238+'j3_ "	UXO ." EPP " cpf " Tcpf qo " Hqtguv' cr r tqcej "	<ul style="list-style-type: none"> <li>Wkrk gf "UXO "cu" c" r tg/ercuukhgt. " EPP "cu" c" hgcwtg" gz vcevqt " cpf " Tcpf qo " Hqtguv' hqt " dgwgt "ercuukhgt" vclpki "</li> <li>Kp " eqo r ctluqp " y kj " r t g x k q w a " c w j q t u o " o g y q f u . " y j g " ercuukhgt vclpki " t g u w n u ' y g t g ' u k i p h e c p w i " d g w g t ' c u ' E P P ' f k ' y g m i ' y k j " r t g u g p e g " q h ' m t i g " f e w " c p f " o k z w t g " q h ' e r c u u k h g t u " q w r g t h q t o g f " u k p i n g " e r c u u k h g t u "</li> </ul>
Uj cj k'gv'cn0*4239+'j5_ "	Qr vko k'cvkqp " qh' Y DE " EPP " ercuukhgt vclpki " o qf gni "	<ul style="list-style-type: none"> <li>Wugf " y j t g g " f k u k p e v ' e r r t q c e j g u " h q t " q r v k o k ' c v k q p " y j k e j " y g t g " F g g r " E q p x q m w k q p c n ' C e v k c v k q p . " v c p u h g t " r g c t p l p i " c p f " r t g / v t c l p g f " E P P . " Y D E u P g v "</li> </ul>
Zw'gv'cn0*4239+'j49_ "	F g g r " E P P " h q t " u k e m g " e g m i ' ercuukhgt vclpki "	<ul style="list-style-type: none"> <li>Rtqr qugf "c" TDE "dcugf "f g g r " E P P " y j c v ' e r c u u k h g t f " c d p q t o c n i ' c p f " p q t o c n i T D E " c u ' y g n i ' c u ' f g q z { i g p c v g f " q t " q z { i g p c v g f " e g m i "</li> </ul>
O c e c y k r g ' g v ' c n 0 * 4 2 3 : + ' j 4 : _ "	J U X " y k j " d n q d " c p c n { u k u ' c p f " r t g / v t c l p g f " E P P u "	<ul style="list-style-type: none"> <li>E c t t k g f " q w " J w g . " U c w t c v k q p " c p f " X c n w g " * J U X - " u g i o g p v c k q p " o g y q f " y k j " d n q d " c p c n { u k u ' c m p i u k f g " r t g / v t c l p g f " E P P u " * T g u P g v 3 2 3 . " I q q i N g P g v ' c p f " C r g z P g v + "</li> <li>E q p e n w f g f " y j c v ' C r g z P g v ' q w r g t h q t o u ' y j g ' q y j g t ' y q ' E P P u "</li> </ul>
Nkpi "gv'cn0*423: +'j4_ "	T P P " y k j " E P P " * Z e g r v k q p / N U V O + "	<ul style="list-style-type: none"> <li>E q o d k p c v k q p " q h ' T P P " y k j " E P P " * Z e g r v k q p / N U V O " o q f g n i ' v q " { k r f " d g w g t " e r c u u k h g t v c l p k i " t g u w n u "</li> </ul>
Vky ct'k'gv'cn0*423: +'j4; _ "	F q w d r g " E q p x q m w k q p " N c { g t " p g w t c n ' p g y q t m * F E N P P + "	<ul style="list-style-type: none"> <li>G o r j c u k f g f " F E N P P " h q t " o q t g " g h e k e p v ' c p f " h c u v g t " e r c u u k h g t v c l p k i " t g u w n u "</li> <li>Q w r g t h q t o g f " U X O " c p f " P c ' x g ' D c { g u ' e r c u u k h g t u "</li> </ul>

J gi f g'gv'cr0*423; +]47_"	Vtcf kkpqcn' ko ci g" r tqeguulpi "	<ul style="list-style-type: none"> <li>• C" hwni' vclpfg " EPP " hqo " uetvej " y cu' eqo r ctgf " y kj " r tg/ vclpfg " o qf gn " CrgZP gv "</li> <li>• Eqpenmf gf " vj cv' vj g" ej cpi g" kp" hkngt " uk g" cpf " cxckrdkklv { " qh' f cvcugw' j ki j n { " chgevgf " EPP au' r gthqto cpeg "</li> </ul>
Y cpi "cpf " Ecq" *423; +]52_"	F cxc" cwi o gpvcvkqp" cpf " tguco r rkp i " o gj qf u' hqt " EPP "	<ul style="list-style-type: none"> <li>• Cf f tguugf " vj g" kuug" qh' uetckv { " cpf " ko dncpeg" kp" f cvcugw' vj tqwi j " cwi o gpvcvkqp" cpf " tguco r rkp i " qh' f cxc "</li> <li>• Vj g" cdugpeg" qh' f cxc" cwi o gpvcvkqp" cpf " tguco r rkp i " nqy gtgf " ercuukhcvvkqp " ceewtce { "</li> </ul>
Mwvw'gv'cr0*4242+ ]6_"	Tgi kqpcn' dcugf " EPP " *T/EPP + " cpf " vcpuhgt " ngctpkpi " o gj qf u "	<ul style="list-style-type: none"> <li>• Ghgevg' qh' f kvlkpev' EPP " ctej kgewt gu' cpf " vcpuhgt " ngctpkpi " y cu' f kuewugf " cpf " eqpenmf gf " vj cv' T guP gv/2 " qdvcvkpfg " vj g" j ki j guv' r gthqto cpeg "</li> </ul>
Ucj nri'gv'cr0*4242+ ]53_"	EPP " y kj " Ucr " Uy cto " Cni qt kj o " *UGUUC + "	<ul style="list-style-type: none"> <li>• Eqo dlvckqp " qh' EPP " hqt " hgcwtg " gz vtevkqp " y kj " Ucr " Uy cto " Cni qt kj o " *UGUUC + " hqt " hgcwtg " qr vko k cvkqp "</li> <li>• Nqy gt " eqo r wcvkqpcn' vko g" f wg" vq " ngu " dw" xkcn' hgcwt gu " qr vko k gf " vj tqwi j " UGUUC "</li> </ul>
[ cq'gv'cr0*4243+ ]54_"	F wcn' o qf wg" y gli j v' qr vko k gf " f ghqto cdng " EPP "	<ul style="list-style-type: none"> <li>• Kvtqf wegf " f ghqto cdng " eqpxqnwvkqpcn' r { gtu " y j lej " j gr gf " kp " t gtlkxkpi " f gvckrgf " hgcwt gu' hqo " nqy " s wcrkv { " f cxc " ugw "</li> <li>• Cej kxgf " uw r gkqt " tguwmu " y j gp " eqo r ctgf " y kj " qvj gt " o qf gnu "</li> </ul>
\ j w'gv'cr0*4244+ ]7_"	Ugxgp " xctkcvkqpu " qh' f ggr " ngctpkpi " o qf gnu "	<ul style="list-style-type: none"> <li>• Ugxgp " o qf gnu " y gt g' t q r qugf " y j gt g " T guP gv/3: " y cu' wugf " cu' vj g " dcemlqpg " y kj " DEP gv " *T guP gv/3: " y kj " ruv' hqwt " r { gtu " tgr rcegf " d { " TXHN. " UP P " cpf " GNO + " ej qugp " cu' vj g " dguv' o qf gn "</li> </ul>



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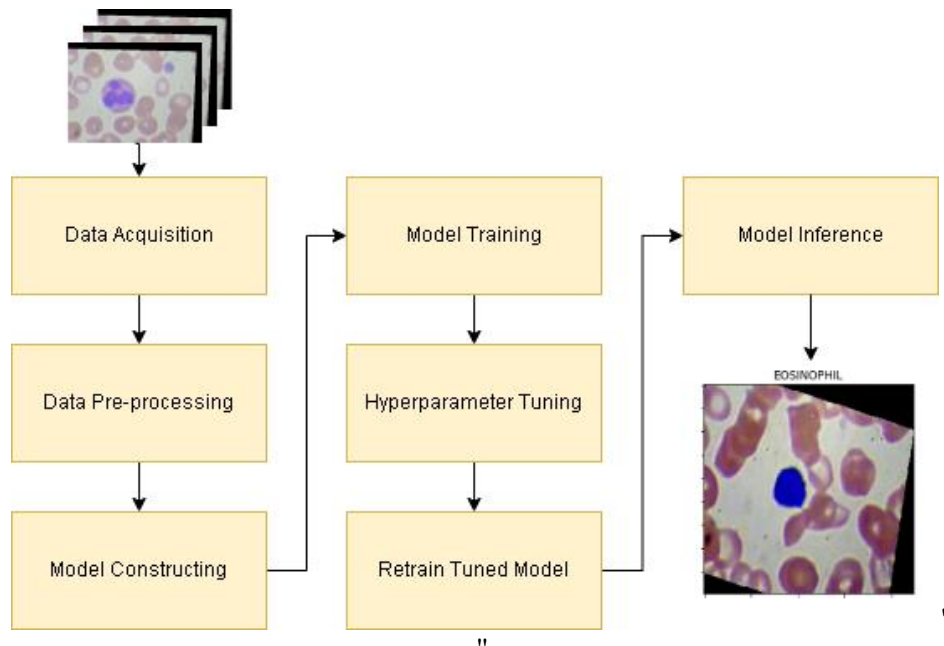
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Vj g'tgugctej 'ku'ectt'kgf'q'w'kp'ugs'w'gp'v'cm'{'cu'uj'qy'p'kp'y'g'h'm'y'f'kci'tco'kp'Hki'wt'g'508''

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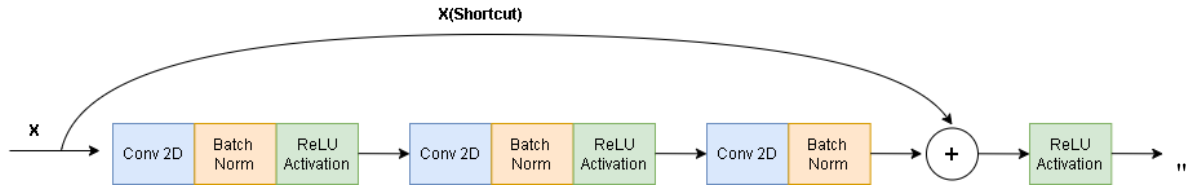
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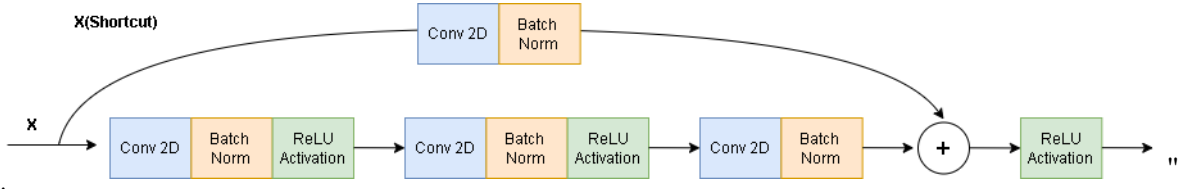
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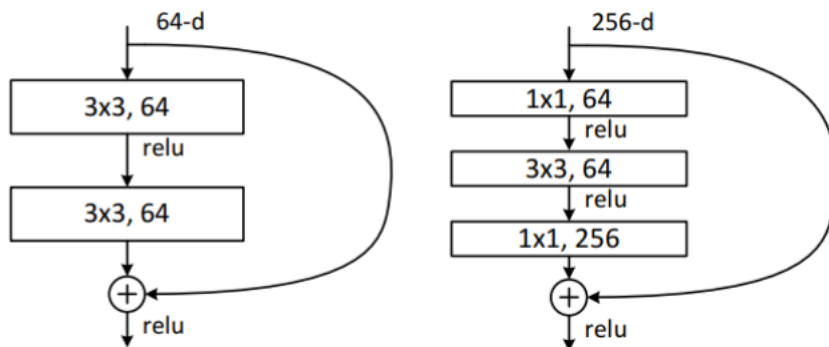


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Hki wtg "505" Eqpxqnvkqpcn'dmqem'u'ctej kgewtg"

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Hki wtg "506" T guP gv56" d'wkr kpi "dmqem'\*qp"vj g'ng'w'cpf "T guP gv72" dqwrpggeni" d'wkr kpi "dmqem' \*qp"vj g't'ki j v'56\_"

"  
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Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

Y kj " vj g" dqwrgpgem' dmqem" eqo r wcvkqpcn' vko g" y qwf " dg" tgf wegf " cu" vj g" pwo dgt" qh" r ctco gvgtu" cpf " o cvtkz " o wvkr necvkapu" ctg" f tcvkecm{ " mgy gtgf O'Y kj " vj ku" eqpegr v'kp" o kpf . " f ggr gt 'pgwy qtmi'eqwf 'dg'dvkn' \*y kj 'nguu'r ctco gvgtu+'v' uqrxg' eqo r ngz 'cumu0Hqt 'vj ku'tgugctej . " vj g'dcug" T guP gv'o qf gnku'dvkn' ceeqtf kpi "v' vj g'ctej kgewtg'i vkf gnkgu'dghqtg'f ghkpi " vj g'Hwm{ " Eqppgevgf " \*HE +rc{ gtu. " cuuki plpi " r tg/vtckpgf " K ci gP gv'y gli j u'cpf " eqo r kpi " vj g" o qf gn'y kj " ku'qr vko k gt. " hqu'hvpevkap" cpf " o gtleu'v' o qpkqt0Vj g' eqo r ngv" T guP gv/72" o qf gnku'f kvewugf " r vgt 'kp" vj ku'ej cr vgt0'

" Vj g" o qf gn'ku" vj gp" wugf " hqt " vckkpi " r j cug" vj tqwi j " c" ugv' pwo dgt " qh" gr qej u" y j gtg" vj g" ceewtce{ " cpf " mqu" ctg" eqo r wgf " cmipi ukf g" ecmdcemi " hvpevkap. " y j lej " ku" cp" qdlgev' kp" vj g" Mgtcu" rldtct{ " vj cv" ckl u" kp" i gpgtckpi " cevkapu" f vckpi " vckkpi " r gtkqf u'0' Hw vj gt" kphqto cvkap" cdqww" ecmdcemi" y kn' dg" f kvewugf " kp" vj g" ej cr vgtu" dgmjy 0' Chgt" uveeguuhwm{ " vckkpi " vj g" o qf gn" kphgtgpeg" y kn' dg" f qpg" v' i gv' vj g" vgu" ceewtce{ " cpf " uc'vku' uvej " cu" xcrlf cvkap" mqu. " vckkpi " mqu. " gv0y kn' dg" cpcn{ ugf " v' gxcnvcg" o qf gn' r gthqto cpeg" cpf " hpf " hwt vj gt" ko r tqxgo gpw' d{ " wvckpi " vj g" j { r gtr ctco gvgtu' ceeqtf kpi n{ 0'

"

"

Ej cr vgt "5<T gugctej "O qf gn'cpf "F guki p"

**5004'Vqqn'Wkk gf "**

Vcdng'503"dgny "uj qy u'vj g'j ctf y ctg'wkk gf "hqt"vj g'eqwtug"qh'vj ku'tgugctej 0'  
"

Vcdng'503"J ctf y ctg'wugf "kp"vj ku'r tqlgev'

J R'Rcxkkqp"37"Ncr vqr "	
Qr gtcvki "U{ ugo "	Y kpf qy u'32"86/dk'
I tcr j ke'Ectf "	P xkf kc'I gHqteg'O Z372"6I D"
ERW'	KpvgiEqtg'k'B "308I J   "
O go qt { "TCO +"	340'I D"
Uqtci g"	3"VD"J FF "

"  
"

Uqhy ctg'wkk gf "hqt"vj ku'r tqlgev'ctg'hwgf "dgny <"

**• I qqi ng'Ftlkg'**

I qqi ng'Ftlkg'"ku" c' "hkg"uqtci g"cpf "u{pej tqpk cvkqp"ugt xleg"f gxgnr gf "d{ "I qqi ng'0Vj g" f cvugv'y cu'wr mcf gf "vq"vj g'emwf "r rlvqto "hqt"dcemw "cpf "vq"dg'wugf "d{ "I qqi ng'Eqrnd" hqt"f cvc"mcf kpi "cpf "r tqeguokpi "r wtr qugu0"

"

**• I qqi ng'Eqrndqtcvqt { "**

I qqi ng'Eqrndqtcvqt { "qt"Eqrnd" hqt"uj qtv."y cu" wugf "vq"gzgewg"R{ vj qp"eqf gu" hqt"vj g" r tqlgev'cu"kv"ku" c" "htgg" Lw { vgt"pqvgdqnm' gpxkqpo gpv' twppkpi "gpvktgnf "qp"emwf 0'K' uwr r qtvu'o cp{ "r qr wxt"o cej kpg"ngctpkpi "rkdctkgu"vj cv'eqwf "dg"mcf gf "kpuvcpw{ "kpq" vj g'pqvgdqnm'0'K'cnq"r tqxkf gu"htgg"j ki j /gpf "I RWu"ceegu"y j kej "y cu'wkk gf "hqt"vj ku" r tqlgev0'

"

**• Uqhy ctg'Nkdtctlgv'**

**○ Vgputhny "**

Vgputhny "ku" c"R{ vj qp"dcugf "qr gp/uqwtg"rkdctct { "vj cv'ur gekrk gu"qp"o cej kpg" ngctpkpi "cpf "f ggr "ngctpkpi "f gxgnr o gpv0'K'v'lejt "rkdctct { "qh"vqqn'cpf "tguqwtegu" ckf "kp"dwkf kpi "f ggr "ngctpkpi "o qf gn'cpf "pwo gtlecnleqo r wcvkpu0'

**○ Mgtcu'**

Mgtcu"ku" c"R{ vj qp"dcugf "f ggr "ngctpkpi "CRK'f guki pgf "uqrgn{ "hqt"vj g"uo qqvj " ko r ngo gpvkvqp"qh"pgwtcn'pgvy qtmu"y j kej "j gr u"uwr r qtv'cu"cp"kpvtgceg" hqt" Vgputhny "htco gy qtn0'

"

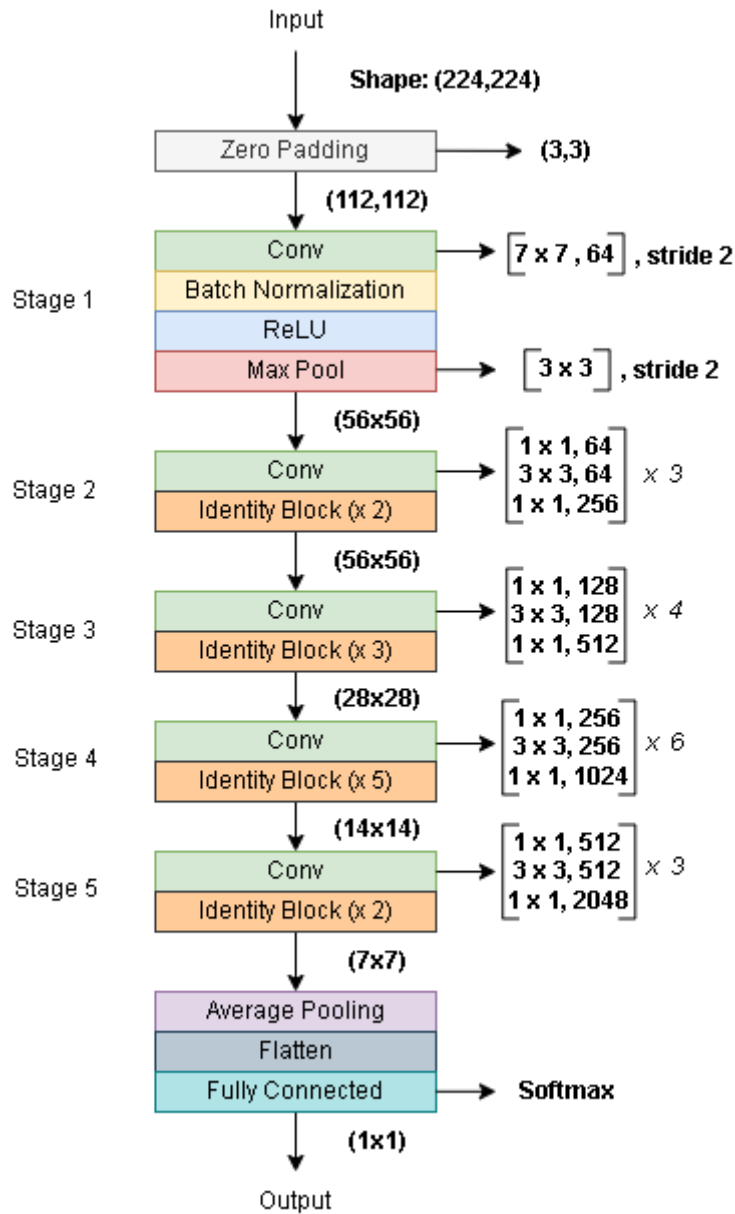
"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

504'U{ wgo 'O qf gi'

5048'kpkcnT guP gv72'O qf gn'ctej kgewt g''

Hki wtg"507'dgmy "uj qy u'y g"qxgtcm'ctej kgewt g'f kci tco "qh'TguP gv72'o qf gn' "



Hki wtg"507'T guP gv72'o qf gn'ctej kgewt cn'f kci tco "

T ghgttkpi "q'y g'hki wtg'cdqyg. 'y g'o qf gn'u'ctej kgewt g'eqpuku'qh'y g'kpr w.'Uci g'3'q'7'qh' eqo dlpvc'qpu'qh'nc {gtu'y kj "o ckn' "eqpxq'w'k'p'cn'nc {gtu'cpf "d'ce'j "p'qto c'rk' c'k'q'p'nc {gtu'cpf " gpf kpi 'y kj 'y g'hwn' "eqppgevgf 'rc {gt' hqt'q'wr w'0Vj g'ctej kgewt g'y knidg'f'kuewuugf 'y qtqwi j n'0 Hktum' . 'y g'o qf gn'vcngu'k'p'cp'kpr w'uj cr g'qh"\*446.446+'y j kej "f gh'p'gu'y g'y kf y'j 'cpf "j gki j v'qh' y' g'lo ci g'y kj "5"eqm't"ej c'ppgnu"\*Tgf. "I tggp. "cpf "D'rwg. "TI D'hqt"uj qt v'0C'uk' g'qh"\*5.5+'| gtq" r cf f kpi 'ku'cr r rkgf "q'y g'kpr w'v'q'o c'k'p'c'k'p'y' g'ur c'k'cn'f ko gpuk'qpu'qh'y g'lo ci g'cu'h'k'gtu'k'p'y' g'

Ej cr vgt "5<T gugctej "O qf gn'cpf "F guki p"

eqpxqmwkqpcn'rc {gtu'y km'uj t'kpm'ij g'ur cv'kcn't guqmwkqp. "o cnkpi 'k'j ctf gt "vq" f kxg'f ggr gt "kp'vq" 'y g' pgwy qtm'cu'ij g'ko ci g'uj t'kpm'f tcv'kcm' +0"

" Cv'uci g'3"qh'eqpxqmwkqpcn'dmjem" c"eqpxqmwkqp"dmjem'y kj "h'kngt" uk' g'qh'86"cpf "uj cr g'qh' \*90+y kj "utkf g'4"ku'r r'ceg'f "vq" i' gp'gt'cv'g'ij g'hgcwtg'o cr "ij cv'eqpenmf gu'ij g'f g'vge'v'f "hgcwtg'u'qh' ij g'kpr w'ko ci g'0Vj g'utkf g.'qt"j qy "hct" f' qgu'ij g'h'kngt" 't'cpuxgtug'ij tqwi j "ij g'ko ci g.'ku'qh'xcnwg" 4"y j lej "kp"tgwtp"uj t'kpm'ij g'kpr w'uk' g'd{ "j crh"htqo "446.446+"vq"\*334.334+0'O qxkpi "qp." Tge'v'k'gf "N'kpgct" Cev'kxcv'kqp" Hw'p'ev'kqp" \*T g'NW+"ku"ej qugp"cu'ij g'cev'kxcv'kqp"hw'p'ev'kqp"cu'f ggr " pgwy qtm'eqpxgti g'y gm'htq" i' tcf k'gp'v'f g'ue'gp'v'cpf "ku'o qtg"eqo r w'cv'kqpcn/h'k'gp'f n' ("wukpi "ij ku' cev'kxcv'kqp"0'O cz"r qqrkpi "qh'uk' g"5"d{ "5"cpf "utkf g'qh'xcnwg"4"ku"wk'k'gf "vq"ht'ij gt"tg'f weg" eqo r w'cv'kqpcn'eqv'd{ "t'gu'q'k'kpi "ij g'f ko g'puk'qpu"qh'hgcwtg'o cr u."ij wu"m'y g'kpi "pwo dgt"qh' r ctco g'vgtu'pggf g'f "vq"hgctp'd{ "ij g'o qf g'0Vj g'qwr w'uk' g'cv'ij g'gp'f "ku't'gf weg'f "htqo "334.334+" vq"\*78.78+y j lej "ku'j cr'xgf 0"

Hqt "ij g'uge'qpf "uci g."qpg'dq'w'g'p'gem'k'eqpxqmwkqpcn'dmjem'cpf "y q'dq'w'g'p'gem'k'f g'p'v'k' ("dmjem" ctg'wug'f "y kj "gcej" j' cxkpi "c"ugv'qh'ij tgg'h'kngtu'y kj "uk' gu'86z86z478."t'gur gev'k'gn' 0Vj gt'ghqtg." ij g'uge'qpf "uci g'cf f u'w'r 'kp'j' cxkpi "; "rc {gtu'uk'peg'ij tgg'dmjem"\*qpg'eqpx'dmjem'cpf "y q'kf g'p'v'k' (" dmjem'o w'kr n' "y kj "c"ugv'qh'ij tgg'h'kngtu"\*5'xcnwg'u+0Uko k'ctn'f .htqo "uci g'5"vq"7."eqpxqmwkqpcn' cpf "kf g'p'v'k' ("dmjem"ctg"ko r ngo g'p'v'f "y kj "f'ku'k'p'ev'h'kngt" uk' gu'cpf "pwo dgt"qh'kf g'p'v'k' ("dmjem"0' Tgcej kpi "ij g'gp'f "qh'ij g'o qf gn"cxgtci g'r qqrkpi "qh'uk' g"\*4.4+"cpf "h'rcwgp"qh'ij g'x'gev'qt"vq" c"3/ F ko g'puk'qpcn"\*3F +x'gev'qt"ctg"cr r n'gf "d'ghqtg"hg'gf kpi "k'vq"ij g'HE"rc {gt."cnuq"mpqy p"cu" c" f'gpug" rc {gt'ht' h'kpcn'ercu'k'h'k'ev'kqp"kp'vq"6" f'k'ht'g'p'v'ercu'gu'qh"Y DE0

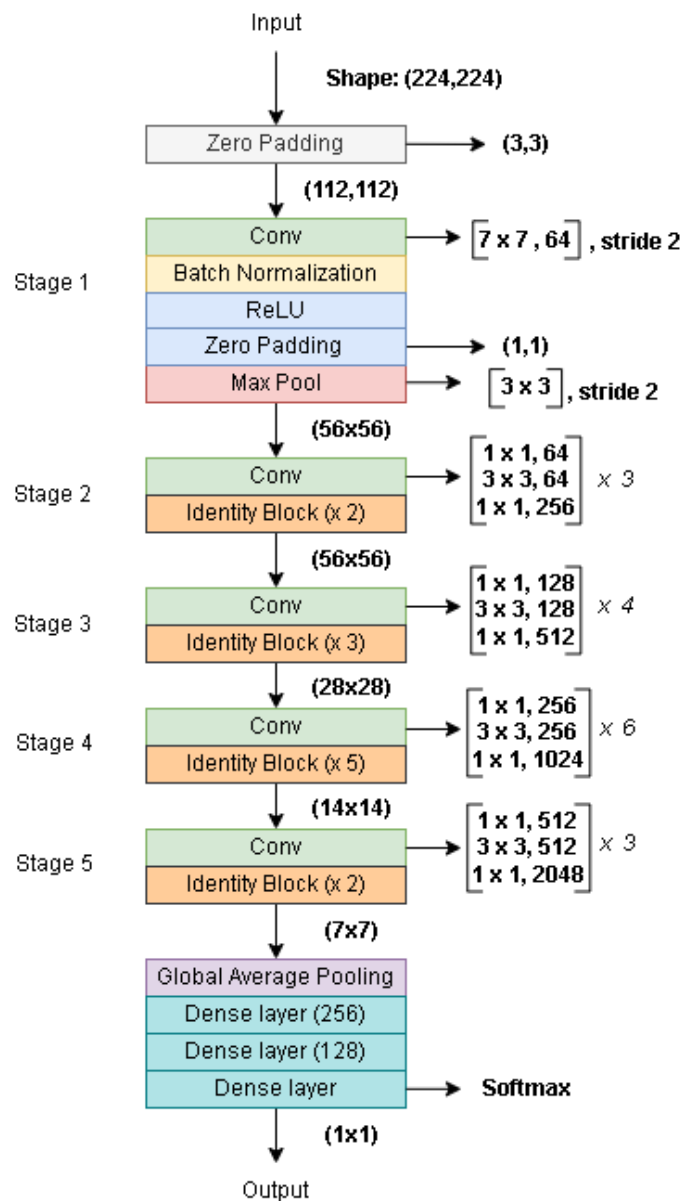
" "

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

### 504'O qf kkgf "T guP gv/72'O qf gn'

Hki wtg"508"dgmy "uj qy u'vj g"o qf kkgf "T guP gv/72"o qf gn'ht"vj ku'tgugctej "r tqlgex0

"



Hki wtg"508"O qf kkgf "T guP gv/72"o qf gn'ctej kgewtg" f kci tco "

Vj g"o qf kkgf "T guP gv/o qf gn'ku"uko kct"kp"vgtu u"qh"vj g"j kf f gp"rc {gtu'dw" f kkgtu"kp"vj g" emcuuklec vqp"rc {gt"y j gtg"i mdcn'cxgtci g'r qqrkpi 'ku'wugf 'kpugcf 'qh'cxgtci g'r qqrkpi 'cpf 'hrcwgp" rc {gtu0'Vj ku"ku"dgecwug"vj g" hrcwgp"rc {gt"y kni'r tqf weg" c"rc ti gt" f gpug"rc {gt"y j lej "ku"o qtg" eqo r wcvkqpcmf 'gZR gpukxg"cpf 'hrcf u"v'qxgthkwpki 0Vj ku'uegpctkq'y qwr' dg'dgpg hkekn'ht"rc ti g" f cvcugv0J qy gxgt."vj ku'ugwkpki 'ku'pqv'uwkcdrg"ht"vj g'ewttgpv"Y DE" f cvcugv'y j lej "ku"uo cmgt"kp" uk g0I mdcn'cxgtci g'r qqrkpi "qp"vj g"qy gt"j cpf ."ckf u"lp"o kki cvkpi "qxgthkwpki "kuuwgu"d' "tgf weg" pwo dgt"qh'r ctco gvgtu'pggf gf 'ht'v'ckpki 0Dgukf gu"vj cv'4'cf f kkgpcrif gpug"rc {gt u'qh'htk gu'478" cpf '34: "ctg"cwcej gf "dghqtg"vj g"rcu'Uqho cz"rc {gt0Vj g'lqd"qh'f gpug"rc {gtu'ku'v'cev'cu'hgcwtg"

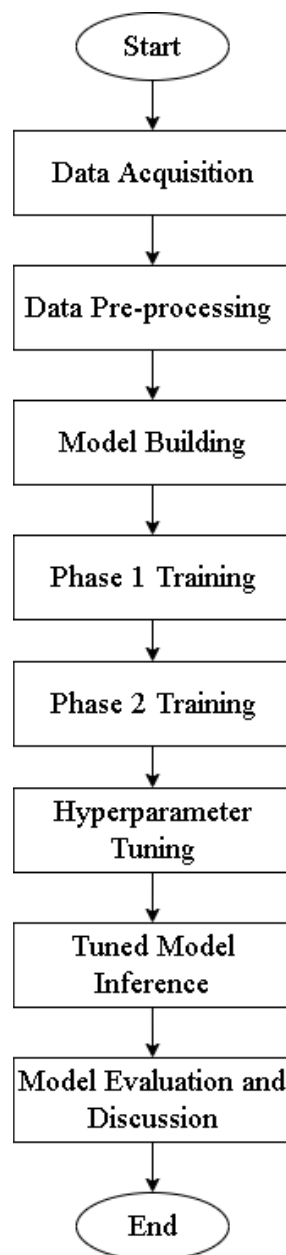
Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

ugrgevqtu'cpf 'encuukh' { 'ceeqt f kpi n' { 'q' 'y' g'pwo dgt 'qh' 'qwr w'encuugu0D { 'j' c'kpi 'o' qtg' 'y' cp' 'c' 'ukpi' rg' f gpug' 'rc' { gt. 'y' g'encuukh' 'ec' 'v' 'q' 'r' qy gt 'qh' 'y' g' 'o' qf gn' 'k' 'petgcugu' 'y' wu' 'i' k' 'kpi' "dgwgt' 'r' gthqto cpeg0' Ncum' { 'y' g' 'rc' { gt' 'y' gli' j' v' 'k' 'k' 'r' 'k' 'gtu' 'h' 'q' 't' 'g' 'cej' 'rc' { gt' 'y' j' lej' "d' { 'f' g' h' c' w' 'y' cu' 'w' 'ukpi' "i' m' 't' 'q' 'v' 'a' 'w' 'k' 'h' 'q' 'to' " ku' 't' 'gr' 'r' 'ceg' "y' kj' "j' g' 'aw' 'p' 'h' 'q' 't' 'o' " 'k' 'p' 'u' 'g' 'c' 'f' " 'cu' 'y' ku' 'h' 'q' 'to' " 'q' 'h' 'k' 'k' 'r' 'k' 'c' 'v' 'k' 'p' " 'ku' 'o' qtg' 'u' 'w' 'k' 'c' 'd' 'r' 'g' 'v' 'q' 'y' c' 't' 'f' 'u' TgNW' 'c' 'e' 'k' 'c' 'v' 'k' 'p' 'u' ]57\_0' 'V' j' g' 't' 'g' 'u' 'w' 'n' 'q' 'h' 'y' ku' 'o' qf gn' 'y' cu' 'e' 'q' 'o' r' w' 'g' 'f' . 'c' 'p' 'f' " 'h' 'w' 't' 'y' g' 't' 'c' 'p' 'c' 'n' { 'u' 'k' 'y' cu' 'f' 'q' 'p' 'g' " k' 'p' 'y' g' 'w' 'r' 'e' 'q' 'o' k' 'p' 'i' " 'e' 'j' 'c' 'r' 'v' 'g' 't' 'u' '0' "

### 56'U' wgo 'F guki p'

Hki wtg "50'dgmty "uj qy u' 'y' g' 'q' 'x' 'g' 't' 'x' 'k' 'y' " 'h' 'm' 'y' 'e' 'j' 'c' 't' 'v' 'q' 'h' 'y' g' 'r' 't' 'q' 'r' 'q' 'u' 'g' 'f' " 't' 'g' 'u' 'g' 'c' 't' 'e' 'j' '0' "

"



Hki wtg "509'Qxgtxkgy "hmy ej ctv'qh'r' tqr qugf 't'gugctej "



Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

### 508 'F cwc 'Rt g/r t qeguulpi "

Kpungcf "qh' wulpi "vj g"rtg/fghkpgf"rtg/r t qeguulpi "kp" Mgtcu."c" ugrh/fghkpgf "hwpevkqp" y cu" etgcvgf "vq"pqto crk g'vj g'r kzgn'xcnwgul"kp"vj g"ko ci g"vq"ctpci g"dgy ggp"/3"cpf "3"cu"vj g"o qf gn' hcxqtu'vj ku'tcpi g'0Hki wtg'50 "uj qy u'vj g'fghkpgf "hwpevkqp" hqt"rtg/r t qeguulpi "vj g"lpr w0

"

```
# Normalizing the pixel values between -1 and 1
def preprocess_input(x):
    x /= 127.5
    x -= 1.
    return x
```

Hki wtg'50: "Rt g/r t qeguulpi "hwpevkqp"

Vj ku"hwpevkqp" y cu"cr r rkgf "kp"vj g"ko ci g"fcw"i gpgtcvqtu'y j gtg"vy q"ko ci g"i gpgtcvqtu'y gtg" fghkpgf."vtckpai gp"cpf "vguai gp."wugf "vq"rqcf "vj g"ko ci g"fcw"htqo "vj g"fkun'ghkpgvq(0'C" xcrlf cvkqaur rk'qh'204'y cu"cr r rkgf "vq"lr rk'vj g'fcvugvlpvq": 2' "vtckpai "fcw"cpf "42' "xcrlf cvkqp" f cwc'0Hki wtg'50 "uj qy u'vj g'i gpgtcvqtu'y kj "vj g'ugr/h/fghkpgf "hwpevkqp'0

"

```
train_gen = ImageDataGenerator(
    preprocessing_function = preprocess_input,
    validation_split=0.2
)

test_gen = ImageDataGenerator(
    preprocessing_function = preprocess_input
)
```

Hki wtg'50; "ko ci g'fcw"i gpgtcvqtu."vtckpai gp"cpf "vguai gp"

Cngtpevxgn'."hqt"ko ci gu"lpxqrkpi "ko ci gP gv."vj g"rtg/r t qeguulpi "hwpevkqp."vgpuqthmy 0' ngtcu'cr r rncvqpuf gupgv/20' tgr t qeguulpr w\*+." y cu" wugf 0' Vcdrg" 504" dgrny " uj qy u" vj g" f guetk vqp"qh'vj g'r t g/r t qeguulpi "hwpevkqp"r tqxkf gf "kp"vj g'Mgtcu'kdtct { 0'

"

Vcdrg'504'Rt g/r t qeguulpi "hwpevkqp"cpf "ku"hwpevkqp"f guetk vqp"

Rt g/r t qeguulpi "hwpevkqp"	F guetk vqp"qh'hwpevkqp"
vgpuqthmy (ngtcu'cr r rncvqpuf gupgv' tgr t qeguulpr w*+)	Vj g" ko ci gu" ctg" eqpxgtvgf " htqo " TI D"vq"DI T'0Gcej "eqrqt"ej cppgn' ku' gtq/egpvtgf 'y kj 'tgur gev'vq'vj g" ko ci gP gv'fcvugv'y kj qw'uecrkpi 0'

"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

Vj g"ko ci gu'y gtg"vj gp"mcf gf "kpv"vj g"u{ uvo "gpxkqpo gpv"y kj "vj g"i gpgtcvqtu"f ghkpgf " \*I qqi ng"Eqrd+"wulpi "vj g"mry altqo af kgevqt { \*+"hwpevkp0Vj g"xctkcdrgu"uwej "cu"ko ci g"ukl g." uggf "cpf "dcvej "ukl g"y gtg"f ghkpgf "dghqtgj cpf "kpuvcf "qhlj ctf "eqf gf "kpv"hwpevkp"y kj "tgr gevkg" xcnwgu0Hki wtg"5032"uj qy u"vj g"rtg/f ghkpgf "xctkcdrg"xcnwgu"ht"ko ci g"ukl g."uggf ."cpf "dcvej "ukl g" y j kg"Hki wtg"5033"uj qy u"vj g"eqf kpi "v"mcf "tckp."xcrkf cvkqp."cpf "vgu"f cv"y kj "cf f kklqpcn" ugwkpi u"uwej "cu"ko ci g"f ko gpukqpu."dcvej "ukl g."uj whng."gve0"

"

```
IMAGE_SIZE = 224
SEED = 42 # ensure shuffle is always the same pattern
batch_size = 32
```

"

Hki wtg"5032"Rt g/f ghkpgf "xctkcdrg"xcnwgu"

"

```
# Flow image data
train_img = train_gen.flow_from_directory(
    directory = train_dir,
    target_size = (IMAGE_SIZE, IMAGE_SIZE),
    color_mode = 'rgb',
    class_mode = 'categorical',
    batch_size = batch_size,
    shuffle = True,
    seed = SEED,
    subset = 'training'
)

val_img = train_gen.flow_from_directory(
    directory = train_dir,
    target_size = (IMAGE_SIZE, IMAGE_SIZE),
    color_mode = 'rgb',
    class_mode = 'categorical',
    batch_size = batch_size,
    shuffle = True,
    seed = SEED,
    subset = 'validation'
)

test_img = test_gen.flow_from_directory(
    directory = test_dir,
    target_size = (IMAGE_SIZE, IMAGE_SIZE),
    color_mode = 'rgb',
    class_mode = 'categorical',
    batch_size = batch_size,
    shuffle = False,
    seed = SEED
)
```

"

"

Hki wtg"5033"Nqcf kpi "tckp."xcrkf cvkqp."cpf "vgu"ko ci gu"kp"vj g"i qqi ng"Eqrd"gpv"y kj "tgr gevkg" gpxkqpo gpv"

"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

C "vcti gv'ukl g"qh"\*446.446+"y cu'ugv'vq"t gukl g"vj g"ko ci g"vq"vj g'ukl g"qh"446"\*y kf vj +"z"446" \*j gki j v"cu"vj g"TuP gv'o qf gnu'tgs vkt go gp'0Vj g'eqm't "o qf g'y cu'TI D'y j lej "uxcpf u'hqt" Tgf ." I tggp'cpf "Dnwg0Ercuu'o qf g'ku'ugv'vq"ecv'gi qtlec'n'cu'vj g'hkpcn'qwr w'qh'vj g'ercuuk'lec'v'kp'eqp'v'kpu" 6"v'r gu'qh"Y DEu0Vj g'uj whng'y cu'ugv'vq"Vt wg'hqt"vj g'v'ckp'kpi "cpf "xcrkf cv'kq"v'q"i gpgtc'v'g'f cv" uco r'ngu'y j lej "ctg'f'kuk'pex'0Vj g'uggf "y cu'ugv'vq"64"v'q'g'puwt'g'vj cv'vj g'uj whng'ugs w'peg'ku'cny c{u" o clp'v'kpgf "vj g'uco g'hqt"gxgt { 'twp'0Vj g'v'guv'ko ci gu'y gtg'pqv'uj whngf "v'q"cxqkf "o guk'kpi "wr "vj g" rcdgn'kpi "qh'vj g'ko ci gu'kug'it0"

### 504'O qf gn'Dwkl kpi "

Cu'o gp'v'kpgf "kp"vj g'r'rgxk'qwu"ej cr vgtu"kp"vj ku'tgr'qt v."vj g"TuP gv'o qf gn'y cu'dwkn"htqo " uet'cej "tc'vj gt"vj cp'r'rg'ncf gf "wukpi "vj g'Mgt'cu'ikdctct {0TuP gv'72"cpf "TuP gv'3: "o qf gnu'y gtg" dwkn'kp"vj ku'r'j cug'0Dghqt'lvct'v'kpi "v'q'dwkl"vj g'y j qrg'ctej k'gewt'g."vj g'y q'b clp'd'm'em'u."kf gp'v'k{ " d'm'em'icpf "eqpxq'nw'k'pcn'd'm'em'y gtg'p'ggf gf 0Hki wt'g'504"cpf "Hki wt'g'505"uj qy u'vj g'eqf kpi "hqt" vj g'kf gp'v'k{ "d'm'em'icpf "eqpxq'nw'k'pcn'd'm'em'qh"TuP gv'3: ."t'gur'ge'v'k'gn'0"

```
def identity_block_v0(X, f, filters, stage, block):  
  
    conv_name_base = 'res' + str(stage) + block + '_branch'  
    bn_name_base = 'bn' + str(stage) + block + '_branch'  
    F1, F2 = filters  
  
    X_shortcut = X  
  
    # Layer 1  
    X = Conv2D(filters=F1, kernel_size=(3, 3), padding='same', name=conv_name_base + '2a', kernel_initializer=he_uniform)(X)  
    X = BatchNormalization(axis=3, name=bn_name_base + '2a')(X)  
    X = Activation('relu')(X)  
  
    # Layer 2  
    X = Conv2D(filters=F2, kernel_size=(3, 3), padding='same', name=conv_name_base + '2b', kernel_initializer=he_uniform)(X)  
    X = BatchNormalization(axis=3, name=bn_name_base + '2b')(X)  
  
    # Skip connection  
    X = Add()([X, X_shortcut])  
    X = Activation('relu')(X)  
  
    return X
```

Hki wt'g'5034"K gp'v'k{ "d'm'em'hw'p'v'kq"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

```
def convolutional_block_v0(X, filters, stage, block):
    conv_name_base = 'res' + str(stage) + block + '_branch'
    bn_name_base = 'bn' + str(stage) + block + '_branch'
    F1, F2, F3 = filters

    X_shortcut = X

    # Layer 1
    X = Conv2D(filters=F1, kernel_size=(3, 3), strides=(2, 2), padding='same', name=conv_name_base + '2a', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2a')(X)
    X = Activation('relu')(X)

    # Layer 2
    X = Conv2D(filters=F2, kernel_size=(3, 3), padding='same', name=conv_name_base + '2b', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2b')(X)

    # Processing Residue with Conv(1,1)
    X_shortcut = Conv2D(filters=F3, kernel_size=(1, 1), strides=(2, 2), name=conv_name_base + '1', kernel_initializer=he_uniform)(X_shortcut)

    # Add Residue
    X = Add()([X, X_shortcut])
    X = Activation('relu')(X)

    return X
```

Hki wtg "5035"Eqpxqmwkqpcn'dmjem'hpevkqp"

Hqt "T guP gv/3: ." vj g' kf gpvk{ " dmjem' eqpukuu" qh' vy q" eqpxqmwkqpcn' rc {gtu' cpf "c" unkr " eqppgevkqp" y j gtg' gcej "rc {gt' y cu' i kxgp" c" pco g" ceeqtf kpi "vq" ku' uci g' cpf "dmjem' v{ r g0'Hqt " kpuvpeg. " vj g' hktuv' eqpxqmwkqpcn' dmjem' j cu' vj g' pco g' qh' tgu4cadtpej 4c0' Vj ku' i kxgu' gcu{ " kf gpv' hkecvkqp" qh' gcej "rc {gt' kp' vj g' o qf gr0'Hqt " vj g' eqpxqmwkqpcn' dmjem' kv' eqpukuu" qh' cuuq' vy q" eqpxqmwkqpcn' rc {gtu' cpf "c" unkr "eqppgevkqp. " dw' vj g' unkr "eqppgevkqp" j cu' c' eqpxqmwkqpcn' dmjem' \*t' gukf vg+ vj cv' y kn' idg' cf f gf "vqi g' vj gt' y kj " vj g' qww' w' Z " \*Z " - "Z auj qt veww' 0"

Kp' eqo r ctkuqp. "T guP gv/72" wkk' gf "c" f khtg' gpv' ugv' qh' kf gpvk{ " cpf " eqpxqmwkqpcn' dmjem' hpevkqp" y j kej " j cu' dqwpggen' ctej kgewtg' cu' o gpvkpgf "kp' vj g' r tgxkqu' ej cr vgt' 0' kpuvgcf "qh' j cxkpi "vy q" eqpxqmwkqpcn' rc {gtu' \*5z5" uk' g' vq' "5z5" uk' g+ "kv' eqpvkpu' vj tgg' eqpxqmwkqpcn' rc {gtu' \*3z3" uk' g' vq' "5z5" uk' g' vq' "3z3" uk' g- 0' Hki wtg' "5036" cpf "Hki wtg' "5037" uj qy u' vj g' eqf kpi "hqt" vj g' g' t' gur ge' vkg' dmjem' 0"

```
# for Resnet-50 and above (has bottleneck-architecture)
def identity_block(X, f, filters, stage, block):
    conv_name_base = 'res' + str(stage) + block + '_branch'
    bn_name_base = 'bn' + str(stage) + block + '_branch'
    F1, F2, F3 = filters

    X_shortcut = X

    X = Conv2D(filters=F1, kernel_size=(1, 1), strides=(1, 1), name=conv_name_base + '2a', kernel_initializer=he_uniform)(X) # padding='valid'
    X = BatchNormalization(axis=3, name=bn_name_base + '2a')(X) # momentum=0.99
    X = Activation('relu')(X)

    X = Conv2D(filters=F2, kernel_size=(f, f), strides=(1, 1), padding='same', name=conv_name_base + '2b', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2b')(X)
    X = Activation('relu')(X)

    X = Conv2D(filters=F3, kernel_size=(1, 1), strides=(1, 1), name=conv_name_base + '2c', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2c')(X)

    # Skip connection
    X = Add()([X, X_shortcut])
    X = Activation('relu')(X)

    return X
```

Hki wtg "5036"Kf gpvk{ "dmjem'hpevkqp" \*y kj "dqwpggen' ctej kgewtg' "

Ej cr vgt"5<Tgugctej "O qf gn'cpf "F guki p"

```
def convolutional_block(X, f, filters, stage, block, s=2):
    conv_name_base = 'res' + str(stage) + block + '_branch'
    bn_name_base = 'bn' + str(stage) + block + '_branch'

    F1, F2, F3 = filters

    X_shortcut = X

    X = Conv2D(filters=F1, kernel_size=(1, 1), strides=(s, s), name=conv_name_base + '2a', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2a')(X)
    X = Activation('relu')(X)

    X = Conv2D(filters=F2, kernel_size=(f, f), strides=(1, 1), padding='same', name=conv_name_base + '2b', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2b')(X)
    X = Activation('relu')(X)

    X = Conv2D(filters=F3, kernel_size=(1, 1), strides=(1, 1), name=conv_name_base + '2c', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name=bn_name_base + '2c')(X)

    X_shortcut = Conv2D(filters=F3, kernel_size=(1, 1), strides=(s, s), name=conv_name_base + '1', kernel_initializer=he_uniform)(X_shortcut)
    X_shortcut = BatchNormalization(axis=3, name=bn_name_base + '1')(X_shortcut)

    X = Add()(X, X_shortcut)
    X = Activation('relu')(X)

    return X
```

Hki wtg"5037"Eqpxqmwkqpcn'ldmqem'hwpevkqp"\*y kj "dqwrgpgem'ctej kgewtg"

Hqt"vj g'y gli j v'lpkkrk'k' cvkqp."vj g'ngt'pgm'lpkkrk'k' gt'y cu"eqf gf'y kj "vj g'j' ga'wpkhqto "kpuvgcf " qh"vj g'f'ghcwn'"i nqtqva'wpkhqto +"cu"k'y cu'o gpvkqpgf "vj cv'k'y qtmu"dgwgt"y kj "TgNW"kp"vj g' r t'g'x'k'wu"ej cr vgt'O'Y kj "vj g'ug"dwkrf'kpi "dmqem."vj g'TguP gv3: "cpf "TguP gv72"hwpevkqpu"y gtg" o cf g"vq"dwkrf "vj g'gpvktg"o qf gr'Hki wtg"5038"cpf "Hki wtg"5039"uj qy u"vj g'eqo r ngvg"eqf g"hq"t" eqputwekpi "vj g'o qf gr'

```
def ResNet18(input_shape=(224,224,3)):
    X_input = Input(input_shape)

    X = ZeroPadding2D((3, 3))(X_input)

    X = Conv2D(64, (7, 7), strides=(2, 2), name='conv1', kernel_initializer=he_uniform)(X)
    X = BatchNormalization(axis=3, name='bn_conv1')(X)
    X = Activation('relu')(X)
    X = MaxPooling2D((3, 3), strides=(2, 2))(X)

    # Conv2_x
    X = identity_block_v0(X, 3, [64, 64], stage=2, block='a')
    X = identity_block_v0(X, 3, [64, 64], stage=2, block='b')

    # Conv3_x
    X = convolutional_block_v0(X, filters=[128, 128, 128], stage=3, block='a')
    X = identity_block_v0(X, 3, [128, 128], stage=3, block='b')

    # Conv4_x
    X = convolutional_block_v0(X, filters=[256, 256, 256], stage=4, block='a')
    X = identity_block_v0(X, 3, [256, 256], stage=4, block='b')

    # Conv5_x
    X = convolutional_block_v0(X, filters=[512, 512, 512], stage=5, block='a')
    X = identity_block_v0(X, 3, [512, 512], stage=5, block='b')

    X = AveragePooling2D(pool_size=(2, 2), padding='same')(X)
    # X = GlobalAveragePooling2D()(X)

    model = Model(inputs=X_input, outputs=X, name='ResNet18')

    return model
```

Hki wtg"5038"TuP gv3: "o qf gn'eqputwekqp"eqf g"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

```
def ResNet50(input_shape=(224, 224, 3)):  
    X_input = Input(input_shape)  
    X = ZeroPadding2D((3, 3))(X_input)  
    X = Conv2D(64, (7, 7), strides=(2, 2), name='conv1', kernel_initializer=he_uniform)(X)  
    X = BatchNormalization(axis=3, name='bn_conv1')(X)  
    X = Activation('relu')(X)  
    X = ZeroPadding2D(padding=(1, 1))(X)  
    X = MaxPooling2D((3, 3), strides=(2, 2))(X)  
    X = convolutional_block(X, f=3, filters=[64, 64, 256], stage=2, block='a', s=1)  
    X = identity_block(X, 3, [64, 64, 256], stage=2, block='b')  
    X = identity_block(X, 3, [64, 64, 256], stage=2, block='c')  
    X = convolutional_block(X, f=3, filters=[128, 128, 512], stage=3, block='a', s=2)  
    X = identity_block(X, 3, [128, 128, 512], stage=3, block='b')  
    X = identity_block(X, 3, [128, 128, 512], stage=3, block='c')  
    X = identity_block(X, 3, [128, 128, 512], stage=3, block='d')  
    X = convolutional_block(X, f=3, filters=[256, 256, 1024], stage=4, block='a', s=2)  
    X = identity_block(X, 3, [256, 256, 1024], stage=4, block='b')  
    X = identity_block(X, 3, [256, 256, 1024], stage=4, block='c')  
    X = identity_block(X, 3, [256, 256, 1024], stage=4, block='d')  
    X = identity_block(X, 3, [256, 256, 1024], stage=4, block='e')  
    X = identity_block(X, 3, [256, 256, 1024], stage=4, block='f')  
    X = convolutional_block(X, f=3, filters=[512, 512, 2048], stage=5, block='a', s=2)  
    X = identity_block(X, 3, [512, 512, 2048], stage=5, block='b')  
    X = identity_block(X, 3, [512, 512, 2048], stage=5, block='c')  
    X = AveragePooling2D(pool_size=(2, 2), padding='same')(X)  
    # X = GlobalAveragePooling2D()(X)  
    model = Model(inputs=X_input, outputs=X, name='ResNet50')  
    return model
```

Hki wtg "5039" T guP gv72 "o qf gn'eqput we vqp "eqf g"

Hkpcm{ 'vj g'encuukhccvqp'rc { gtu'y gtg'cf f gf 'vq'vj g'gpf 'qh'vj g'o qf gn'ugr ctcvgn{ 0Vj gug'rc { gtu' y gtg'wugf 'vq'cu'hgcwtg'ugrgevqtu'hqt 'vj g'o qf gn'cpf 'encuukh{ 'vj go 'kpq'6'encuugu'cv'vj g'gpf 'w'pf gt' vj g'uqho cz'cev'xcv'qp0Vj g'o qf gn'y cu'vj gp'eqo r krgf 'y kj 'vj g'Cf co "qr vko k gt '\*y kj 'f g'hcw'w' n'gctpkpi 'tcvg'qh'2023+'mquu'h'wpev'qp'qh'ecv'gi qt'kecn'et'quu'gpvtqr { '.cpf 'o g'v'keu'qp'':ceewtce { 0' cwt'kdw'g0P wo dgt "qh'gr qej u'hqt "vt'ckl'pki "y cu'cnuq'eqp'hi wtgf "hqt "vj g'r tgr ctcv'qp'qh'vt'ckl'pki " r j cug0Hki wtg "503: 'uj qy u'vj g'eqf g'hqt 'cr r gpf kpi 'vj g'encuukhccvqp'rc { gtu0'

```
# Adding the classification layer  
head_Model = base_model.output  
  
# glorot_uniform is Xavier initialization / he_normal optimized for ReLU  
# head_Model = Dense(256, activation='relu', name='fc1', kernel_initializer=he_uniform)(head_Model)  
head_Model = Dense(128, activation='relu', name='fc2', kernel_initializer=he_uniform)(head_Model)  
head_Model = Dense(3, activation='softmax', name='fc3', kernel_initializer=he_uniform)(head_Model)  
  
# Sigmoid used for binary classification  
# head_Model = Dense(1, activation='sigmoid', name='fc3', kernel_initializer=glorot_uniform(seed=0))(head_Model)  
  
model = tf.keras.Model(inputs=base_model.input, outputs=head_Model)  
  
model.summary()
```

Hki wtg "503: 'Cf f kpi 'encuukhccvqp'rc { gtu'eqf g"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

Hki wtg "508; "uj qy u'vj g"o qf gn'eqo r krcvkqp "hqt "vtcklpi "r j cug0

"

```

[ ] opt = Adam(learning_rate=0.001) # default learning rate is 0.001 (1e-3)
    loss = 'categorical_crossentropy'
    epochs = 50

[ ] model.compile(
    optimizer= opt,
    loss= loss,
    metrics=['accuracy']
)

```

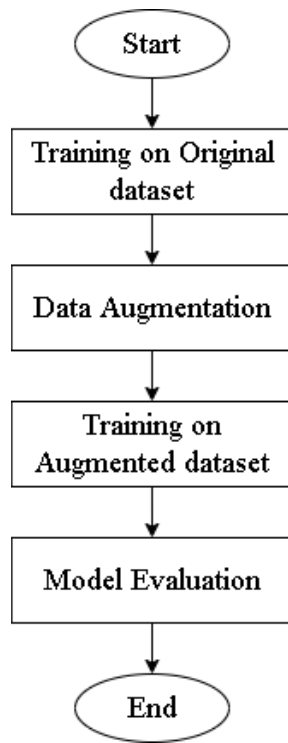
"

Hki wtg "503; "O qf gn'eqo r kipi "eqf g"

### 505'Rj cug'3'Vtcklpi "

Hki wtg "5042"uj qy u'vj g"qxgtxkgy "r tqeguu"qp"vj g"r j cug'3"vtcklpi 0'

"



"

Hki wtg "5042"Qxgtxkgy "r tqeguu"qh'Rj cug'3"vtcklpi "

"

Vj g'htuv'r j cug'lpqxqkxf "vj g"vtcklpi "qh'dqj "T guP gv/3: "cpf "T guP gv/72"o qf gnu'y j kej "j cxg" pq"o qf krcvkqp"qp"vj g"f cvcugv"cpf "vj g"o qf gnu"ctej kgewtg0Vj ku'y cu'f qpg"vq"cuuguu"y j kej " o qf gn'hku"y gm'y kj "vj g"f cvcugv"kuqih"dghqtg"hgewlpi "qp"qpg"ctej kgewtg"hwnt "hqt"hwvj gt" wplpi 0Vj g"qxgtcm'o qf gnu"vtcklpi "ku'uwo o ctkt gf "cu'uj qy p'kp"Vcdng"505"dgmy 0'

"

"

Ej cr vgt "5<Tgugctej "O qf gn'c'p'f "F guki p"

Vcdrg "505" Qxgtxlgv "qh'Rj cug"3"v'c'k'p'i "

O qf gn'Xgtukap"	Vtcklpi "Ugw'kpi u"	Gr qej u"	Ugr u'r gt "gr qej "T'Xcrkf c'v'k'p' u'gr u"
C0 Vtcklpi "qp"Qtki kpcn'f c'v'c'ugv"			
TguP gv3: "	Qr vko k gt<Cf co "		
TguP gv72"	*rgctplki 'tcvg<3g/5+" Dcvej "uk g<54"	42"	46; "T84"
D0 Vtcklpi "qp"Cwi o gpv'gf "f c'v'c'ugv"			
TguP gv3: "	Qr vko k gt<Cf co "		
TguP gv72"	*rgctplki 'tcvg<3g/5+" Dcvej "uk g<54"	42"	46; "T84"

Vj g'f c'v'c'ug'v'cwi o gpv'c'k'p'y cu'f q'p'g'v'q'i g'p'g't'c'v'g'o q't'g'f k'x'g't'ug'd'c'v'ej gu'q'h'f c'v'v'q'y'j g'v'c'k'p'i " r j cug'cu'c'o q't'g't'q'd'w'u'o q'f gn'eq'w'f "dg"i g'p'g't'c'k'k' gf "k'h'f q'p'g'u'q'0'H'k'i wtg"5043"d'g'm'y "uj qy u'y'j g" ej cpi gu'o cf g'v'q'y'j g'ko ci g'i g'p'g't'c'v'q't'u'y j g'g'c'p'c'f'f k'k'q'p'c'n'x'c'k'f c'v'k'p'i g'p'g't'c'v'q't'k'u'et'g'c'v'g'f'0"

```
# Create generators
train_gen = ImageDataGenerator(
    preprocessing_function = tf.keras.applications.resnet50.preprocess_input,
    rotation_range=20,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    vertical_flip=True,
    fill_mode='nearest',
    validation_split=0.2
)

val_gen = ImageDataGenerator(
    preprocessing_function = tf.keras.applications.resnet50.preprocess_input,
    validation_split=0.2
)

test_gen = ImageDataGenerator(
    preprocessing_function = tf.keras.applications.resnet50.preprocess_input
)
```

Hki wtg"5043"Ej cpi gu'o cf g'v'q'c'r r n'f "f'c'v'c'wi o gpv'c'k'p"

D{ "j c'x'k'p'i "y'j k'u"eqf g."g'cej "k'g't'c'v'k'p" q'h" d'c'v'ej gu" h'q't" v'c'k'p'i "y k'n' t'c'p'f'q'o n'f "c'r r n'f "y'j g" v'c'p'u'h'q't'o c'v'k'p' u'g'v'k'p'i u'r t'q'x'k'f'g'f "k'p"y'j g'v'c'k'p'i"i g'p'g't'c'v'q't"v'q'r t'q'f'w'eg"o q't'g'f k'x'g't'ug"ko ci gu'c'p'f " c'x'q'k'f' u'f'w'r n'c'v'k'p'q'h'u'ko k'w'c't'd'c'v'ej gu'k'p'y'j g'x'c'k'f'c'v'k'p' u'g'0'D'g'u'k'f' gu'y'j c'v' u'g'x'g't'c'n'f'c'm'd'c'e'm'y' g't'g" y' t'k'v'g'p'h'q't"y'j g'v'c'k'p'i "v'q"i g'v'k'p'u'k'i j w'h'q'o "y'j g'v'c'k'p'i "cu'y' g'm'cu'c'f'f k'k'q'p'c'n'c'v'k'p'u"v'q"dg" j c'p'f' r'g'f "f'v'k'p'i "eqo r w'c'v'k'p'0'H'k'u'w'f'."c"V'ko g'J k'u'q't' { \*+}y cu'f'g'h'k'p'g'f "v'q"eqo r w'g"y'j g"q'x'g't'c'm' v'c'k'p'i "v'ko g'h'q't'y'j g'o q'f'g'r'0'H'k'i wtg"5044"uj qy u'y'j g'h'w'p'v'k'p'eq'f'g'h'q't"V'ko g'J k'u'q't' { \*+0



Ej cr vgt "5<Tgugctej "O qf gr'cpf "F guki p"

```
# Define functions to record computation time for each epoch during training
class TimeHistory(tf.keras.callbacks.Callback):
    def on_train_begin(self, logs={}):
        self.times = []

    def on_epoch_begin(self, batch, logs={}):
        self.epoch_time_start = time.time()

    def on_epoch_end(self, batch, logs={}):
        self.times.append(time.time() - self.epoch_time_start)
```

Hki wtg "5044" Vlo gJ kuvqt { \*+'hwpevkqp"eqf g"

Ugeqpf n{ . 'y g'gctn{ 'uxqr r kpi 'hwpevkqp'y cu'f ghkpgf "vq'r t'g'x'g'p'v'q'x'g't'h'k'k'p'i 'd { 'o q'p'k'q't'k'p'i 'y' g' x'c'r'k'f' c'v'k'q'p' "n'q'u'u'0'V'j' g' r' c'v'k'g'p'e'g' "n'g'x'g'n' 'k'u' u'g'v' 'c'v'7" g'r' q'ej' u' . 'y' j' k'ej' "o' g'c'p'u' 'k'h' 'c'h'g't'7" g'r' q'ej' u' . 'y' g' x'c'r'k'f' c'v'k'q'p' "n'q'u'u' t'g'o' c'k'p'u' w'p'ej' c'p'i' g'f' "q't' p'q'v' n'y' g't'g'f' . 'y' g' v't'c'k'p'k'p'i 'y' k'n' 'd'g' 'j' c'n'g'f' . "c'p'f' "y' g' d'g'u'v' y' g'k'i' j' w' q'h' 'y' g' g'r' q'ej' u' y' k'n' 'd'g' 'u'c'x'g'f' 0'N'c'u'u' n{ . 'y' g' 'o' q'f' g'r' 'e'j' g'e'n'r' q'k'p'v' 'h'w'p'e'v'k'q'p' 'y' c'u' 'e'c'm'g'f' 'v'q' 'u'c'x'g' 'y' j' g' d'g'u'v' y' g'k'i' j' w' c'ee'q't'f' k'p'i 'v'q' 'y' g' x'c'r'k'f' c'v'k'q'p' c'ee'w't'c'e' { 'c'h'g't' v't'c'k'p'k'p'i 0' Hki wtg "5045" u'j' q'y' u' 'y' g' f' g'h'k'p'k'k'q'p' q'h' 'y' g' g'c't'n{ 'uxqr r kpi 'c'p'f' 'o' q'f' g'r' 'e'j' g'e'n'r' q'k'p'v' 'e'c'm'd'c'e'n'l' 'h'w'p'e'v'k'q'p' u' c'm'p'i' u'k'f' g' Hki wtg "5046" y' j' k'ej' 'u'j' q'y' u' 'y' g' 'b' q'f' g'r' v't'c'k'p'k'p'i 'e'q'f' g' 'c'p'f' 'k'u' 'g'z'c'o' r' n'g' v't'c'k'p'k'p'i 'n'q'i' 0'V'j' g' 'n'q'u'u' 'c'p'f' c'ee'w't'c'e' { 'x'c'n'g'u' y' g't'g' 'w'u'g'f' 'v'q' 'r' n'q'v' i' t'c'r' j' u' 'h'q't' 'g'x'c'n'w'c'v'k'q'p' 'c'p'f' 'y' j' g' 'o' q'f' g'r' 'y' c'u' 'c'n'u'q' 'w'u'g'f' 'v'q' 'f' q' 'r' t'g'f' k'e'v'k'q'p' u' q'p' 'v'g'u'v' u'g'v' 'c'p'f' 'x'c'r'k'f' c'v'k'q'p' u'g'v' 'h'q't' 'k'u' c'ee'w't'c'e' { 0'V'j' g' u'g' 't'g'u'w'u' 'y' q'w'f' 'd'g' 'h'w'v'j' g't' 'f' k'u'e'w'u'g'f' 'l'p' 'E'j' c'r' v'g't' '6'0

```
# for Early Stopping to prevent overfitting / determine optimum number of epochs
early_stop = EarlyStopping(
    monitor='val_loss',
    patience=5, # if 5 consecutive epochs show no improvement, then stop
    restore_best_weights=True,
    verbose=1
)

cp_path = '/content/drive/MyDrive/Blood_Cell_Images/dataset2-master/dataset2-master/Checkpoints'

# save the weights of the best model as checkpoint
checkpoint = ModelCheckpoint(
    filepath=cp_path,
    save_weights_only=True,
    monitor='val_accuracy',
    mode='max',
    save_best_only=True
)
```

Hki wtg "5045" Gctn{ 'uxqr r kpi 'c'p'f' "O qf gr'ej' g'e'n'r' q'k'p'v' 'e'c'm'd'c'e'n'l' 'h'w'p'e'v'k'q'p' u'

```
history = model.fit(
    train_img,
    validation_data = val_img,
    steps_per_epoch = steps,
    validation_steps = val_steps,
    epochs = epochs,
    callbacks=[
        checkpoint,
        early_stop,
        # lr_reduce,
        time_clb
    ]
)

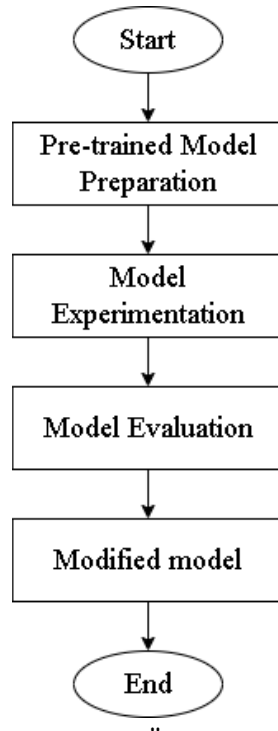
Epoch 1/5
373/373 [=====] - 1498s 4s/step - loss: 0.8451 - accuracy: 0.5945 - val_loss: 0.5972 - val_accuracy: 0.7708
```

Hki wtg "5046" O qf gr'v't'c'k'p'k'p'i 'e'q'f' g' 'c'p'f' 'k'u' v't'c'k'p'k'p'i 'n'q'i' "

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

### 506'Rj cug'4'Vtcklpi "

Hki wtg'5047"uj qy u'yj g'qxgtcm'r tqeguu'hqt"r j cug'4"vtcklpi "qh'yj ku'tgugctej 0"



Hki wtg'5047"Qxgtcm'r tqeguu'hqt"r j cug'4"vtcklpi "

Hqt"r j cug'4"qh'vtcklpi . 'yj g'T guP gv'72"o qf gn'y cu'hqewugf "uqgn' "cpf "gZR gtko gpvcvkp'y cu" f qpg"qp"yj g'j { r gtr ctco gvgtu"qh'yj g'o qf gn'v'eqpenw' g'cp"qr vko cno qf gn'y tqwi j "gxcwcvkq"qh" yj g'tguwu0Vj g'f cv'cwi o gpvcvkp'kp'Rj cug'3'y cu'tgo ckpgf 'kp'yj ku'r j cug'0"

Hktu'cpf "hqtgo quv"vtcpuhg'tgctlpi "y cu'cr r rkgf "v'yj g'o qf gn'cu'k'y cu'uggp'y cv'k'ckf u'kp" ko r tqxkpi " yj g" o qf gnu' r gthqto cpeg" qp" ugxgtcn' r cr gtu" uwej " cu" ]6\_" ]7\_" cpf " ]4: \_0' Chgt" eqputwvklpi "yj g'o qf gn'cpf "cr r gpf kpi "yj g'f gpug'rc { gtu. "yj g'o qf gn'ku'mqcf gf "y kj "yj g'vtckpgf " y gki j w"qp"yj g'K ci gP gv'y j kej "ku'kp'c"j 7"hg'hqto cv'0Vj g'o qf gn'y cu'yj gp"ugv'-Hcnig'ht'cm' vtckpcdng'rc { gtu'gzegr v'yj g'HE"rc { gtu'0Vj ku'o gy qf "qh'htgg| kpi "ku'i gpgtcrk gf "cu'o cnpki "yj g" o qf gn'cu'c'hgcwtg'gzvtcevqt0Gcej "rc { gt'y cu'r tlv'gf "qww'v'ej genlkh'yj g'eqphki wcvkq'y cu'f qpg" tki j 0Hki wtg'5048"dgmy "uj qy u'yj g'eqf kpi "f qpg"v'cej kxg'yj ku'eqphki wcvkq'cpf "Hki wtg'5049" uj qy u'yj g"vtckpcdng'lv'cg'qh'gcej "rc { gt'0"

```

# load the pre-trained ImageNet weights
base_model.load_weights("/content/drive/MyDrive/resnet50_weights_tf_dim_ordering_tf_kernels_notop.h5")

for layer in base_model.layers:
    layer.trainable = False

for layer in model.layers:
    print(layer, layer.trainable)
  
```

Hki wtg'5048"Eqf kpi "hqt'hqcf kpi "r tg/vtckpgf "y gki j w'cpf "htgg| kpi "o qf gn'rc { gtu"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

```

<keras.layers.convolutional.Conv2D object at 0x7f341b713f10> False
<keras.layers.normalization.batch_normalization.BatchNormalization object at 0x7f341b7138d0> False
<keras.layers.core.activation.Activation object at 0x7f341b6a9110> False
<keras.layers.convolutional.Conv2D object at 0x7f341b6a9690> False
<keras.layers.normalization.batch_normalization.BatchNormalization object at 0x7f341b726c50> False
<keras.layers.merge.Add object at 0x7f341b6bd290> False
<keras.layers.core.activation.Activation object at 0x7f341b6bd7d0> False
<keras.layers.pooling.GlobalAveragePooling2D object at 0x7f341b7f7110> False
<keras.layers.core.dense.Dense object at 0x7f341b766a10> True
<keras.layers.core.dense.Dense object at 0x7f341b7667d0> True
<keras.layers.core.dense.Dense object at 0x7f341b6bdb10> True

```

Hki wtg "5049"Eqf g'tguwm'upkr r gv'hqt'ej genkpi "-atckpcdnq'uvcwu'qh'gcej 'rc { gt"

Vq'hw'vj gt'ko r tqxg'vj g'o qf gnu'r gthqto cpeg."gZR gtko gpw'f qp'vj g'r ctco gygt" ugwkpi u'uwej "cu'r qqrkpi 'rc { gtu.'f gpug'rc { gtu.'hgctpkpi 'tcvg.'cpf 'dcvej 'uk' g'cu'y gm'cu'o k'pqt'f cvc" ugv'o qf k'hecvkqp'u'Vcdrg'506"dgngy 'uwo o ctk' gu'vj g'gZR gtko gpw'f qp'vj g'o qf gn'vq'hkpf 'vj g" o quv'qr vko cn'ugwkpi u'vq'ko r tqxg'o qf gn'r gthqto cpeg0"

Vcdrg'506"Qxgtxkgy "qh'Rj cug'4"gzr gtko gpw"

O qf gn' Xgtukqp"	Eqo r ctkuqp'Cur gewu"	Gr qej u"	Uygr u" r gt" gr qej " I" Xcrkf cvkqp'uuyr u"
C0 Eqo r ctkuqp'qh'I mdcn'Cxgtci g'Rqqrkpi "cpf "Cxgtci g'Rqqrkpi 'y kj "Hrcwgp'rc { gtu"			
3"	Wukpi "I mdcn'Cxgtci g'Rqqrkpi "	7"	46; "184"
4"	Wukpi "Cxgtci g'Rqqrkpi "- "Hrcwgp"		
D0 O qf k'hecvkqp'qp'F cvc'ugv"			
3"	Tgo clk'6"Y DE 'ercuugu"	7"	46; "184"
4"	F tqr r gf "P gwtqr j kn'ercuu"		
E0 Eqo r ctkuqp'kp'vgtu u'qh'pwo dgt "qh'f gpug'rc { gtu'y kj "f k'htgpv'pwo dgt "qh'pgwtqpu"			
3"	3'f gpug'rc { gt "*uqho cz+"	7"	3: 8"168"
4"	4'f gpug'rc { gtu"*34: "- "uqho cz+"		
5"	5'f gpug'rc { gtu"*478"- "34: "- "uqho cz+"		
6"	6'f gpug'rc { gtu"*734"- "478"- "34: "- "uqho cz+"		
F0 Eqo r ctkuqp'kp'vgtu u'qh'dcvej 'uk' g"			
3"	Uk' g'qh': "	7"	968"13: 8"
4"	Uk' g'qh'38"		595"1", 5"

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

5"	Uk g'qh'54"		3: 8"1'68"
6"	Uk g'qh'86"		; 5"1'45"
G0 Ego r ctkuqp "kp"vgtu u'qh'ngctpkpi "tcvg"*it+"xcnwgU"			
3"	it"? "2023"	7"	595"1"; 5"
4"	it"? "2023"		595"1"; 5"
5"	it"? "20223"		595"1"; 5"

"

Gcej "qh" yj gug" gZr gtko gpw" uj qy p" kp" yj g" wcdng" 506" cdqXg" y gtg" gxcnwcvgf " ceeqtf kpi " vq" o qf gnu" ceewtce{ " cpf " nquu" dghqtg" f gekf kpi " qp" yj g" dguv" ugwkpi " vq" wug" hqt" yj g" eqpewttgpv" gZr gtko gpw" hqtqo " C" vq" G0Vq" eqpenwf g. " yj g" o qf kkgf " o qf gn'ly knj cxg" yj g" qxgtcm' dguv" ugwkpi u" ceeqtf kpi n" hqtqo " yj g" tguwmu" qh" yj g" gZr gtko gpw" cpf " r cuugf " vq" yj g" pgzv" r j cug" hqt" j { r gtr ctco gvgt " wplkpi 0"

### 507'J { r gtr ctco gvgt "Vwplkpi "

Hki wtg"504: "dgmY "uj qy u'yj g"J { r gtdcpf "wpgt "kpkckk cvkqp" hqt "hkg/wplkpi "uci g0"

"

```
tuner = kt.Hyperband(
    model_builder,
    objective='val_loss',
    max_epochs = 10)
```

"

Hki wtg"504: "F ghkpkqp"qhj { r gtr ctco gvgt "wpgt"

Wkkk kpi " yj g" Mgtcu" ndtct { a" J { r gtdcpf " wpgt. " j { r gtr ctco gvgt " wplkpi " y cu" f qpg0' Vj g" hwpevkqp" y cu' ej qugp" dgecwug" k' cmY gf " yj g" wug" qh' gctn' " uqr r kpi " f wtkpi " ugctej kpi " qh' qr vko cn' j { r gtr ctco gvgt " xcnwg" vq" ur ggf " w' yj g' b' qf gnu" eqpxgti gpeg" cpf " r tXgpn' qxgt hkwkpi " kuuwgu0Vj g" o qpkqtgf " xcnwg" ku' xcnk cvkqp" nquu" qh' yj g" o qf gn' cu" c" o qtg" tqdwu" o qf gn' y qwf " j cxg" c" nY gt" nquu" tcvg0' Hki wtg"504: "dgmY " f guetldgf " o qf gmdwkrf gt " hwpevkqp" y j lej " kpkckk vgu" yj g" o qf kkgf " TguP gv' b' qf gn' hqtqo " Rj cug" 4" vckpkpi " cpf " yj g' ngctpkpi " tcvg" ugctej " ur ceg' hqt" yj g" wpgt " vq" vtcxgtug" cpf " hkp " yj g" qr vko cn' xcnwg0"

Ej cr vgt"5<Tgugctej "O qf gn'cpf "F guki p"

```
kt_hp = kt.HyperParameters()

def model_builder(kt_hp):

    base_model = ResNet50(input_shape)

    head_Model = base_model.output

    head_Model= Dense(256, activation='relu', name='fc1',kernel_initializer=he_uniform)(head_Model)
    head_Model= Dense(128, activation='relu', name='fc2', kernel_initializer=he_uniform)(head_Model)
    head_Model = Dense(3, activation='softmax', name='fc3', kernel_initializer=he_uniform)(head_Model)

    model = tf.keras.Model(inputs=base_model.input, outputs=head_Model)

    base_model.load_weights("/content/drive/MyDrive/resnet50_weights_tf_dim_ordering_tf_kernels_notop.h5")

    for layer in base_model.layers:
        layer.trainable = False

    kt_lr = kt_hp.Float(name='steps', min_value= 0.0001, max_value = 0.001, step = 0.00005)

    model.compile(optimizer=Adam(learning_rate=kt_lr),
                  loss=loss,
                  metrics=['accuracy'])

    return model
```

Hki wtg"504; "o qf gndwkrf gt "hwpevkqp"eqf g"

Vj g"ngctpkpi "tcvg"y cu"ugv"vq"tcxgtug"dgy ggp"20223"cpf "2023"y kj "c"uogr "qh"202227" f wtkpi "gcej "ugctej "kgtcvkqp0"Y kj "gxgt { vj kpi "hwn{ "r tgr ctgf ."vj g"wpgt0ugctej "hwpevkqp"y cu" ecmgf "hqt"vj g"ugctej kpi "r tqegu"vq"uvctv'cpf "vj g"dguv'j {r gtr ctco gygtu."y j kej "kp"vj ku"ecug."vj g" dguv'ngctpkpi "tcvg."y cu"uqtf "cpf "wugf "vq"dwkrf "vj g"j {r gtwpgf "o qf gn'hqt "hpcn'gxcnvcvkqp"qp" vj g"f cv"ug0Hki wtg"5052"uj qy u"vj g"wpgt0ugctej "kpkckk' cvkqp"y kj "gctn{ "uqr r kpi "cpf "tckpkpi " mji "qh'vj g'ugctej 0"

```
tuner.search(train_img,
             validation_data = val_img,
             steps_per_epoch = steps,
             validation_steps = val_steps,
             epochs = epochs,
             callbacks=[
                 early_stop
             ])

best_hp=tuner.get_best_hyperparameters()[0]

Trial 18 Complete [00h 09m 27s]
val_loss: 0.16042473912239075

Best val_loss So Far: 0.16042473912239075
Total elapsed time: 01h 55m 11s

Search: Running Trial #19

Value          |Best Value So Far |Hyperparameter
0.0008         |0.00075           |steps
4              |10                |tuner/epochs
0              |4                 |tuner/initial_epoch
1              |2                 |tuner/bracket
0              |2                 |tuner/round
```

Hki wtg"5052"Vwpgt0ugctej "eqf kpi "cpf "ku"tckpkpi "mji "

Ej cr vgt "5<Tgugctej "O qf gn'cpf "F guki p"

**50'ko r rgo gpvcvqp 'Kuuwu'cpf 'Ej cmgpi gu'**

Vj gtg'y gtg'ugxgtcnej cmgpi gu'hceg f'f wtkpi "vj g'ko r rgo gpvcvqp"qh'vj ku'r tqlgew'0

"

- **Nlo ksf 'j ctf y ctg'tguqwtegu'cpf 'wpuwcdig'er rdecvqp'r gt hqto cpeg"**

Vj g'tckpki "qh'f ggr "rgctpki "o qf gnu'kp"vj ku'r tqlgew'tgs wktgf "c'j ki j "f gf kecvgf "I RW"vq" tgf weg'vj g'tckpki "cpf "r tgf kevqp"vko g'pggf gf 0J qy gxgt. "vj g'ugrh/qy pgf "j ctf y ctg'f kf " pqv'o gg'vj g'tgs wktgo gpwu'qh'qr vko wo 'tguqwtegu'pggf gf "hqt"tckpki 0T wppki "qp"ERW" o go qt { "hqt"tckpki "j cf "rgpi vj gpgf "vj g'vko g'pggf gf "hqt"eqo r rgvqp"y j lej "f grc { gf "vj g" r tqlgewu" y qtnhny 0' Vj wu. "I qqi rg" Eqrdau" emwf " f gf kecvgf " I RW" y cu" wktgf " vq" qxgteqo g'vj ku'kuuwg0Vj g'j ki j /gpf "I RW"tqo "I qqi rg"Eqrd"j cf "ku'vko kecvgf"qh'wuci g." y j gtg"qpn { "34"j qwtu'qh'eqo r wcvqpcn'vko g"qp" I RW"r gt "I qqi rg"ceeqwpv"ku"cmny gf 0' Vj ku" y cu" tguqrgf " d { " j cxkpi " o wktgf " I qqi rg" ceeqwpv" kpuwcegu" hqt " r ctcngn" eqo r wcvqpcn' J qy gxgt. " vj ku" tckgf " vj g" kuuwg" qh" r gthqto cpeg" cu" utqpi " kvgtpgv" eqppgecvqp"ku'xkcn'vq" wktgf g'vj gug" I RW"ugtxlegu"y kj qw'kvgttwr vqpu0'k'cf f kvqp. "vj g" r gthqto cpeg"qh" I qqi rg"Eqrd"ku's wguvqpcdrg"cu"vj g"ugtxleg"twpu"uo qqj n' "uqo gvko gu" dw'uqo gvko gu"ku'hrwgtu"vq" c"r qkv"y j gtg"kv"i gw"uwem'cv'egtckp"qr gtcvqpu"cpf "vj g" cuuki pgf "I RW"ku'i kxgp"cv'tcpf qo "uq"vj g"qr vko cni" RW"o ki j v'p'qv'dg'kp'wug'cm'vj g'vko g0

"

- **Wpegtckpv' 'qp'vj g'f cvcugv' r gpgtckvqp"**

Vj g'f cvcugv'y cu"ces wktgf "htqo "c"r wdike"tgr qukqt { "cpf "vj g'f cvcugv'ku'gh'eqpvckpu"632" qtki kpcn' ko ci gu" dghqtg" r tg/cwi o gpvcvqp" qh' vj g" ko ci gu" kvq" c" rcti gt " f cvcugv' qh" cr r tqzko cvgn { " 34.722" ko ci gu' Vj ku" tguqrgf " vj g" uo cm' f cvcugv' r tqdrgo ." dw" vj g" cwi o gpvcvqp"r tqeguu'qh'vj g'f cvcugv'y cu"pqv'f guetkdgf 0'Vj ku'y qwf "ecwug"wpegtckpv' " cu"vj g" cwi o gpvcvqp"r tqeguu"o ki j v'j cxg"chgevgf "vj g"ceewtce { "qh'ercuuk'kecvqpcn'0'k'vj g" f cvc" cwi o gpvcvqp"ugwki u'y gtg'npqy p. "hwtvj gt"cpn { uku'y qwf "dg" f qpg0"

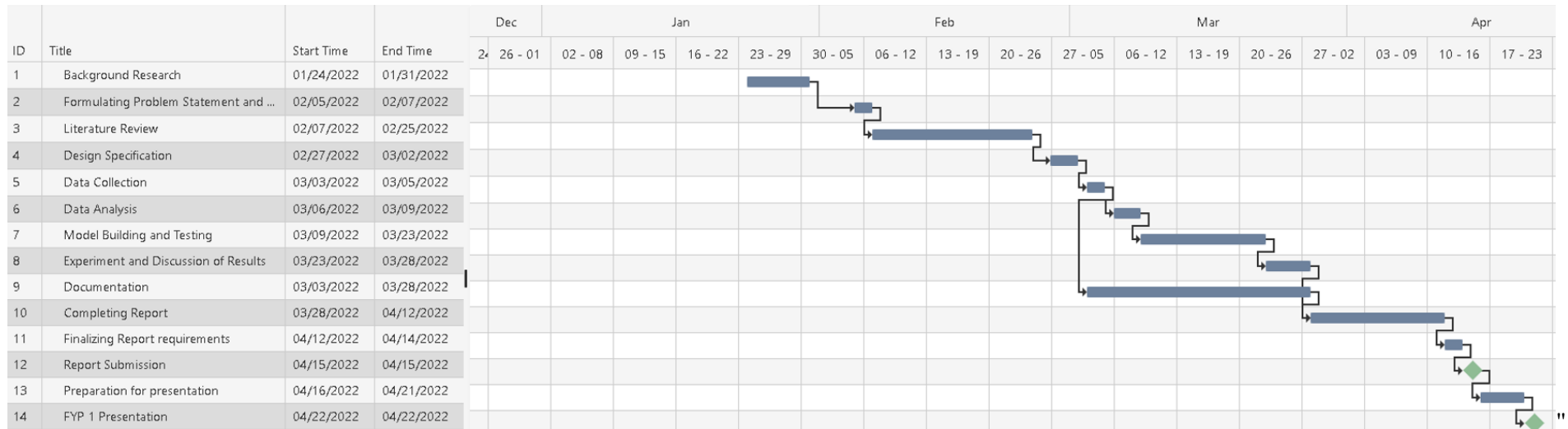
"

Ej cr vgt "5<T gugctej 'O qf gr'cpf 'F guki p"

### 50'Vlo grlpq"

" Hki wtg"5053"cpf "Hki wtg"5054"dgmjy "uj qy gf "I cpw'ej ctv"qh'y g"Rtqlgev"ku"cpf "Rtqlgev"ku"vlo grlpq"tgur gevkgm(. "uvtvpi "Itqo "dcem tqwpf " tgugetej "q"fcw"ugrgevqp."fcw"cpnf uku."o qf gr'dwrf lpi "cpf "vgu"lpi ."gzr gtko gpv"lpi ."fqewo gpv"vqp"vj gp"lpcmf "vj g"eqo r ngv"qp"qh'y g'tgr qt'v'cpf " ku'r tgu'pvcv"qp0Vj g'f wcv"qp"qh'y g'r tq'gev"Ky cu"34'y ggm'uvtvpi "Itqo "gpf "qh'Lcpwct { "4244"v'j g'o kf f rg"qh'Cr tki"4244"cpf "uko krcnf "Rtqlgev"ku ku'ur cpgpf "cetquu"34'y ggm"itqo "o kf f rg"qh'Lwpq"v'j g'ugeqpf "y ggm'qh'Ugr vgo dgt"42440Rtqlgev"ku"vlo g'y cu'o clpn "wugf "qp"vj g'wpf gtuv'cpf lpi " vj g'T guP gv'o qf gr'u'ctej kgevwtg'v'q'uvtv'dwrf lpi "k'itqo "uetvej "cpf "gzr gtko gpv"vqp"qp"lpcmf"v'ugv"lpi u'v'q'cej kxg"o'c'o qtg'tqdwu'b'o qf gr'o "

"



Hki wtg"5053"Qxgtcm'r tqegu"vlo grlpq"qh'r tqr qugf "Rtqlgev"K

"

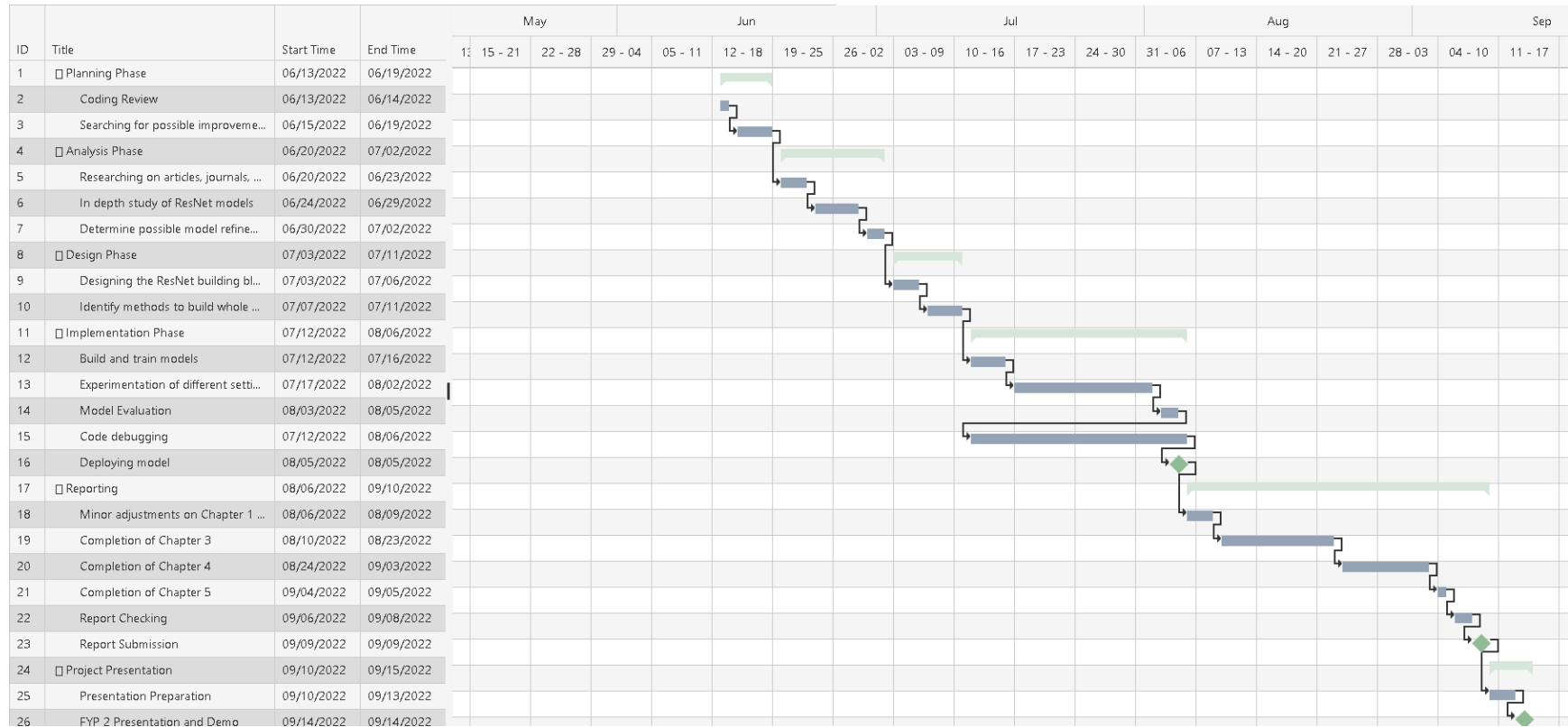
"

"

Dcej grqt "qh'Eqo r wgt "Uelqpeg"\*f qpqtu+"  
 Hcewm "qh'Eqo r wgt "Uelqpeg"\*f qpqtu+" { "Mco r ct" Eco r wgt "WCT"

Ej cr vgt "5<T gugctej 'O qf gn'cpf 'F guki p"

"



"

Hki wt g'5054'Qxgtcm'r tqegu'u'k'o grkpg'qh'r tqr qugf 'Rtqlgev'KK

"

"

Dcej gntt "qh'Ego r wgt 'Uelgpeg'\*f qpqtu+"  
 Hcewm "qh'k'p'qto cvk'p'cpf 'Eqo o wplecvk'p'Vgej pqm'i { '\*Mco r ct'Eco r wu:'WCT"



Ej cr vgt "5<Tgugctej "O qf gr'cpf "F guki p"

**508'Uwo o ct{ "**

" Hqt "vj ku'ej cr vgt. "vj g'tgugctej au'o qf gr'cpf "f guki p"y cu'f kuewuugf "f ggr n' "uuctv'kpi "htqo "vj g" i gpgtcr'lo gyj qf qm'ki kgu'cpf "hmy "qh'vj g'tgugctej 0Vj g"b qf gr'ctej kgewtg'ku'w'pf gtuvqqf "vj tqwi j " vj g'xkuwcnk' cvk'qpu'cpf "hwtvj gt'k'puki j v'ctg'r tqxkf gf 'tgi ctf kpi "vj g'dw'kf kpi "dm'em'u'qh'vj g'TguP gv' o qf gr'0Vj g"u{ uvgo "f guki p"y cu'f qewo gpv'gf "kp" f gvckl'uuctv'kpi "htqo "vj g" f cv' r tg/r tqeguukpi "vq" r j cugu"qh'vtck'kpi "cpf "r ctco gvg't"wp'kpi "dghqtg"gp'f kpi "vr "y kyj "vj g" h'kpcrk' gf "o qf gr'y j lej "ku" v'g'v'gf "hqt "ku" ceewtce { 0'Dgukf gu"vj cv"vj g"j ctf y ctgluqhw ctg"wk'k' gf "kp"vj ku'r tq'lgv'cu"y gr'cu" vj g'tgugctej au'vko gr'k'p'g"ku'uj qy p"vq"r tqxkf g"o qtg" f gr vj "tgi ctf kpi "vj g"y j q'rg"eqwtug"qh'vj g" t'gugctej "cpf "ku'qr gtcv'k'qpu'0'

"

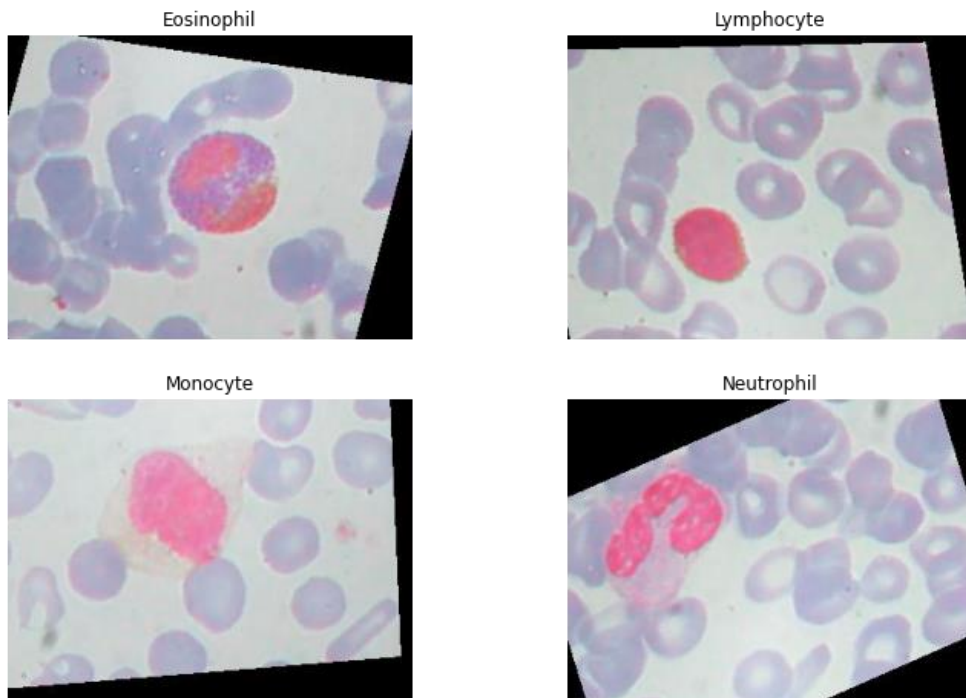
"

Ej cr vgt '6<Gzr gt ko gpv'T guwmu'cpf 'F kœwukqp"

## Ej cr vgt '6<Gzr gt ko gpv'T guwmu'cpf 'F kœwukqp"

### 60'F c v'Gzr r p c k q p"

Vj g"o letqueqr le"ko ci gu"qh"Y DE u"y gtg" qdvc k p g f " y t q w i j " q p " c " r w d n k e " t g r q u k s q t { . " M c i i n g 0 e q o " h t q o " y j g " r w d n k u j g t . " R c w d ' O q q p g { " ] 5 8 \_ 0 ' V j g " f c v c u g v ' e q p v c k p u " y q " h q r f g t u . " f c v c u g v / o c u v g t " c p f " f c v c u g v 4 / o c u v g t 0 ' F c v c u g v / o c u v g t " e q p v c k p u " 6 3 2 " q t k i k p c n ' k o c i g u " q h " d m q f " e g m u ' y k j " k u ' h c d g n u ' y j k g ' f c v c u g v 4 / o c u v g t " e q p v c k p u " y j g " 3 4 7 2 2 " k o c i g u " q h " d m q f " e g m u ' f k k f g f " k p v q ' 6 ' f k u k p e v " Y D E " u w d v { r g u " \* G q u k p q r j k n " N { o r j q e { v g . " O q p q e { v g . " c p f " P g w t q r j k n 0 ' G c e j " u w d v { r g " j c f " c " d c r p e g f " f k u k d w k q p " q h " c r r t q z k o c v g n { " 5 2 2 2 " k o c i g u " k p " I R G I " h q t o c v 0 ' H k i w t g " 6 0 8 " u j q y u " y j g " g z c o r n g ' k o c i g u " q h " g c e j " Y D E " u w d v { r g 0 "



Hki wtg'603""Y DE' uwdv{r gu'cpf 'yj gk't gur gev k x g'ko ci gu']58\_"

Nqqn k p i " c v " y j g " k o c i g u " q p " H k i w t g " 6 0 8 " c d q x g . " g c e j " q h " y j g " Y D E u " u w d v { r g " j c x g " y j g k " q y p " e j c t c e v g t k u k e u " c p f " e q w f " d g " f k u k p i w k u j g f " c u " h q m y g f < "

- N { o r j q e { v g u < " y j g " e g m i m q m u " i k n g " c " r g t h g e v n { " i k n g " c " t q w p f " r w t r n g " e q m t g f " r q v c v q 0 "
- O q p q e { v g u < " y j g " e g m i m q m u " t q w p f k u j " y k j " y j g " r w t r n g " e q p v g p v " k p j c d k k p i " k p " y j g " e g m i d w " p q v y j g " y j q n g " e g m i e q o r n g v n { 0 ' V j g " r w t r n g " e q p v g p v k u " c n y c { u " k p " c " e q p v k p w q w u " r k g e g 0 "
- P g w t q r j k n < " y j g " e g m i k u " c n u q " t q w p f k u j " y k j " r w t r n g " e q p v g p v u c { k p i " k p " y j g " e g m 0 J q y g x g t . " y j g " r w t r n g " e q p v g p v k p " y j g " e g m i j c u " o w n k r n g " i n q d u " y j c v " o c { " d g " f k u l q k p v g f " q t " i k p n g f 0 "
- G q u k p q r j k n < " y j g " e g m u " e j c t c e v g t k u k e u " c t g " c r k n g " v q " P g w t q r j k n 0 "

"

Ej cr vgt "6<Gzr gtlo gpv'T guvnu'cpf 'F kuewukqp"

**60'O qf gnRgt hqto cpeg'F ghpklqp"**

Vj g'hqmny kpi "gs wvku"dgny "y qwf "dg"vulpi "vj gug"xcnwg"vq"fgtkxg"vj gk "t guvnu"y j lej " ctg"Vtwg'Rqukxg"\*VR+."Hcnug'Rqukxg"\*HR+."Hcnug'P gi cvkxg"\*HP +."cpf "Vtwg'P gi cvkxg"\*VP +0Gcej " qh'vj gug"xcnwg"j cxg"vj gk"qy p"ur gekn'hwpevku"0VP "uki p'kku"dmqf "egm"eqttgevf "encuukhgf "cu" pqv'ku"cewcn'egm"v{r g'0VR"uki p'kku"dmqf "egm"eqttgevf "encuukhgf "cu"ku"cewcn'egm"v{r g'0HR" uki p'kku"dmqf "egm"hcngn{ "encuukhgf "cu"qvj gt"egm"v{r gu"kpugcf "qh"ku"cewcn'egm"v{r g'0HP " uki p'kku"dmqf "egm"hcngn{ "encuukhgf "cu"pqv'ku"cewcn'egm"v{r g'y j gp"v'ku"ur r qugf "v"dg0" "

30 Ceewtce{ "

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \quad (1)$$

Vq"gxcnwg"c"o qf gnu'r gthqto cpeg."vj g"ceewtce{"xcnwg"y gtg"eqpukf gtgf"]49\_0" Hqt"kpucpeg."xcnk cvkqp"ceewtce{."vgu"ceewtce{"cpf "vcklpi "ceewtce{"y gtg"f gekf kpi " hcevqu'ht'ugrevkpi "vj g'dgu'v'o qf gn'0Vj g'pwo dgt"qh"eqttgevf "encuukhgf "r tgf le'vku"qxgt" vj g'vqcn'pwo dgt"qh'r tgf le'vku"y qwf "dg"vj g"xcnwg"qh"ceewtce{0" "

40 Eqphwukqp"O cvtkz "

Vcdrg"603'Eqphwukqp"O cvtkz"vcdrg"

Predicted label

	Negative	Positive
Negative	TN	FP
Positive	FN	TP

Dcugf "qp"]4; \_."vj g"eqphwukqp"o cvtkz"y qwf "dg"i gpgtcvgf "vq"fgvgt'o kpg"vj g"hw"t" xcnwg"\*VP ."HR."HP ."VR+"cu"uj qy p"kp"Vcdrg"5040"vulpi "eqphwukqp"o cvtkz."kuki j vu"qp" j qy "y gm'gej "kpf kxf wcn'encu"y cu"encuukhgf "d{"vj g"o qf gn'y qwf "dg"npqy p0" "

50 Rtgekukqp."T gecm'cpf "HB"Ueqtg"

$$Precision = \frac{TP}{TP + FP} \quad (2)$$

$$Recall = \frac{TP}{TP + FN} \quad (3)$$

$$F1\ Score = \frac{2(Precision \times Recall)}{(Precision + Recall)} \quad (4)$$

Ej cr vgt'6<Gzr gtko gpv'T guwmu'cpf 'F kuewukqp"

"  
 Dcugf "qp"gs wcvkqpu"\*4+:"\*5+"cpf "\*6+"tqo "]4; \_'Rtgekukqp"mqm'cv'y g'ceewtce{ "qh'y g'r qukkxg'r tgf levkpu0Qp'y g'qy gt'j cpf ."tgecm'ku'y g'tcvkq"  
 qh'r qukkxg'uco r ngu'y cv'y gtg'eqtgvev' f gygevgf 0Ncuw' . 'y g'HB'ueqtg'ku'y g'eqo dlpcvq'qh'r tgekukqp"cpf 'tgecm'd{ 'vckpi 'y g'o gcp'qh'dqy 'ueqtgu0

**605'Rj cug'3'Vtcklpi 'T guwmu'cpf 'Cpcn'uku'**

F wtkpi 'y ku'r j cug'qh'tcklpi . 'y q'T guP gv'o qf gnu'y gtg'dwku'o ckn' 'T guP gv3: "cpf 'T guP gv72"o qf gn'itqo 'uetcvej "cpf 'vtckpgf "qp'y g'f cvc'ugv"  
 y kj qw'cp{ 'b qf hlecwqpu'lp'vgtu u'qh'b qf gn'ctej kgewtg'qt'cp{ 'qy gt'ugwki u0Vcdrg'60'dgm'y 'uj qy u'y g'qxgtcm't guwmu'lp'vgtu u'qh'ko g'eqo r wgf "  
 kp"o kpwgu."vgu'ceewtce{ . 'xcrkf cvkqp"ceewtce{ "cpf 'i tcr j u'ht'iquu'cpf "ceewtce{ "ht'dgwtg'xkuwck' cvkqp'qh'y g'tcklpi 0Vj g'j ki j rki j vgf 'r ctv'uj qy u'  
 y g'qr vko cno qf gn'lp'vgtu u'qh'ko g'cpf 'r gthqto cpeg0'

Vcdrg'604'Rj cug'3'vtcklpi 't guwmu'qp'qtki kpcn'f cvcugv'

Rj cug'3'Vtcklpi 'T guwmu'Qtki kpcn'xu'Cwi o gpvgf 'f cvcugv'				
C0 Vgukpi "qp'qtki kpcn'f cvcugv'				
O qf gn'	Eqo r wcvkqpcn' vko g'''	Vguv' Ceewtce{ "	Xcrkf cvkqp" Ceewtce{ "	I ter j u"
T guP gv3: "	79075"o kpwgu"	20 : 36"	20 855"	<p>Nquu'lp'vgtu u'qh'gr qej u"*Vtckl'cpf 'Xcrkf cvkqp'iquu+"</p>

Dcej gnt'qh'Eqo r wgt 'Uelgpeg'\*f qpqwtu+ "  
 Hcewv' "qh'k'p'htu cvkqp"cpf 'Eqo o wplecvkqp'Vgej pqm' { '\*Mco r ct'Eco r wu: "WCT "

Ej cr vgt "6<Gzr gtko gpvT guwmu"cpf "F kuewukqp"

				<p>Ceewtce{ 'lp'vgt o u'qh'gr qej u'*Vtckp'cpf 'Xcrkf cvkqp'ceewtce { '+'</p> <p>variable — accuracy — val_accuracy</p>
				<p>Nquu'lp'vgt o u'qh'gr qej u'*Vtckp'cpf 'Xcrkf cvkqp'rquu+ "</p> <p>variable — loss — val_loss</p>
T guP gv'72"	930 4'o kpwgu"	20 846"	20 895"	<p>Ceewtce{ 'lp'vgt o u'qh'gr qej u'*Vtckp'cpf 'Xcrkf cvkqp'ceewtce { '+'</p> <p>variable — accuracy — val_accuracy</p>

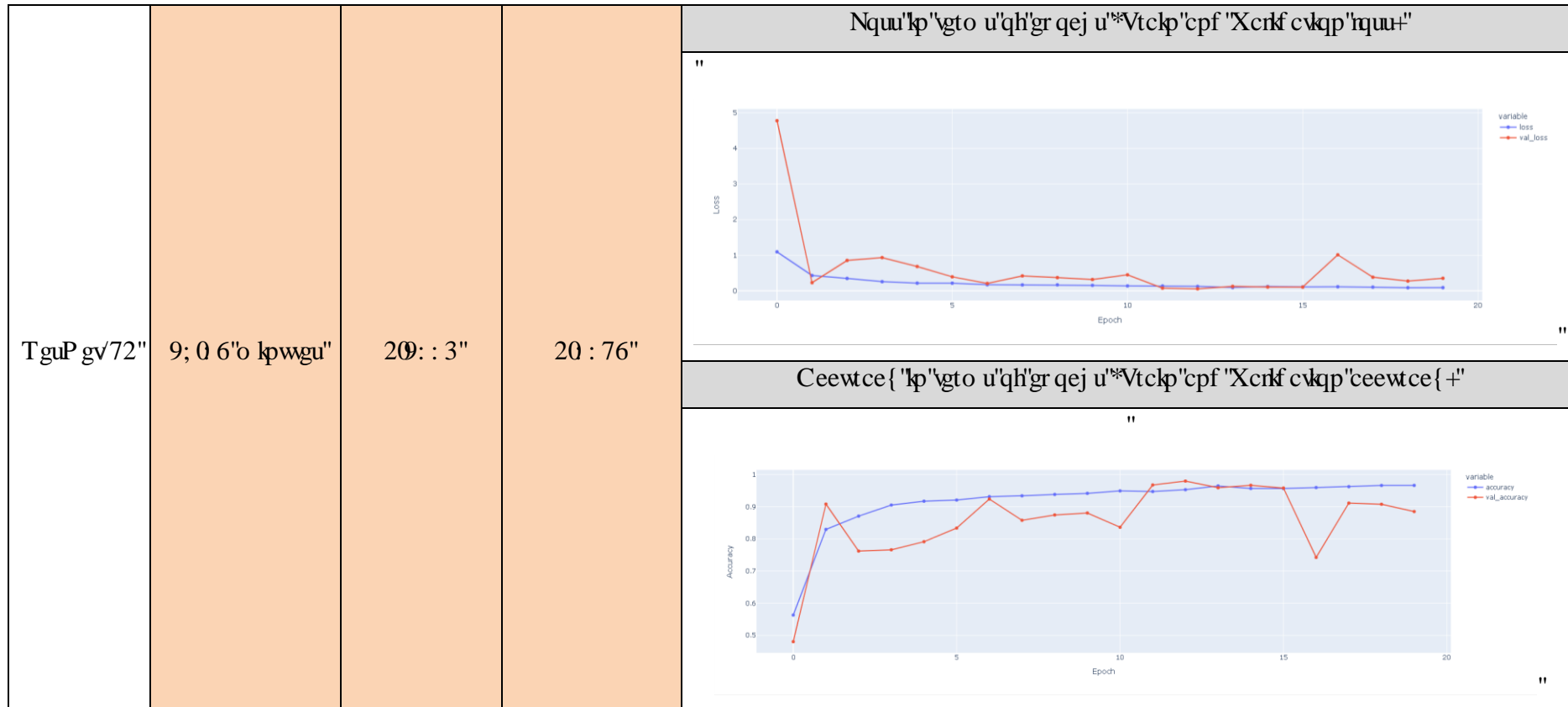
"

Dcej gntt'qh'Ego r wgt 'Uelgpeg'\*f qpqtu+ "  
 Hcewv'qh'lp'vgt o cvkqp'cpf 'Eqo o wplecvkqp'Vgej pqmri { '\*Mco r ct'Eco r wu: "WCT "

Ej cr vgt "6<"Gzr gtko gpvT guwmu"cpf "F kuewukqp"

D0 Vgukpi "qp"cwí o gpwgf "f cxcugv"				
O qf gni'	Eqo r wcvkqpcni' vko g'''	Vguv' Ceewtce{ "	Xcrkf cvkqp" Ceewtce{ "	I tcr j u"
TguP gv3: "	364043"o kpwgu"	20 843"	20 955"	Nquu'kp"vgtó u"qh'gr qej u"*Vtckp"cpf "Xcrkf cvkqp"mquu+"
				Ceewtce{ "kp"vgtó u"qh'gr qej u"*Vtckp"cpf "Xcrkf cvkqp"ceewtce{ "+"

Dcej gnt "qh'Eqo r wgt "Uelgpeg"\*f qpqtu+"  
 Hcewv "qh'kp"vgtó cvkqp"cpf "Eqo o wplecvkqp"Vgej pqmí { "Mco r ct" Eco r wu: "WCT"



Dcugf "qp'yj g'vcdrg"60"cdqyg."dqy "o qf gnu'vopf "v'qxgthk'xgt { "uqpp"cu'yj g'vcklpi "uvtu'y j gtg'yj g'vcklpi "mquu"cpf "xcrkf cvkqp"mquu'f tcvkcmf " ulpmi'vq'c'xcnwg"cr r tqzko cvgn { | gtq0Vj g'ur kngu'yj cv'qeewt 'lp'yj g'xcrkf cvkqp"mquu'utgpi vj gpu'yj ku'uvvgo gp'cu'yj g'o qf gn'oo go qtk gf o'yj g'vcklpi " f cv'cpf "eqwf 'pqv'encukh { 'y gml'y j gp'yj g'xcrkf cvkqp'ugv'hvej gu'c'pgy "dcvej 'qh'f cv'ht'xcrkf cvkqp'yj wu'yj g'kpuki pkkcpv { 'j ki j 'mquu'xcnwgu0T guP gv/ 3: "i gpgtck gf "y gml'y kj "c'uo cmgt "f cvcug'cu'k'vngu"o wej "uj qtvgt "vko g'yj cp "T guP gv/72"ht'vcklpi "y kj "j ki j gt "ceewtce { "xcnwgu"\*tgi ctf nguu'qh' qxgthk'kpi "kuwgu+0Qp'yj g'qyj gt'j cpf . "T guP gv/72"hwgf "y gml'y kj "rti gt "f cvcugu'cu'r tqxgp "htqo "yj g'vcklpi "qp'cwi o gpv'f "f cv' y j gtg'k'cej kxgxf "

Ej cr vgt'6<Gzr gtko gpv'T guwmu'cpf 'F kuewukqp"

"  
j ki j gt'ceewtce{ "xcnwgu'kp" c"r gtkqf "qh'cp"j qwt "y j gp"eqo r ctgf "vq" T guP gv3: "y j lej "vqnmf qwdng"vj g'vko g'pggf gf "hqt"vcklpi "eqo r rgvkqp"cpf "{ gv' qxgthkvgf "o qtg"lp"eqo r ctluqp"vq" T guP gv72"y j gtg"ur kngu"lp"xcnkf cvkqp"mqu"cpf "ceewtce{ "y gtg"o qtg"qhgpo'Vj wu."o qxlpi "qp"vq"Rj cug"4."vj g' T guP gv72"y cu'ej qugp'f wg'vq'ku'ceewtce{ "lp"r tgf kvkpi "rcti gt'f cvcugw"\*y kj "pq"ugxgtg"qxgthkvpki "kuuwgu'kp"eqo r ctluqp"vq" T guP gv3: "+cpf "ny gt" eqo r wcvkqpcn'vko g'pggf gf 0'

**606'Rj cug'4'Vtcklpi 'T guwmu'cpf 'Cpcn' ul'**

Chgt"eqpenf lpi "vj cv' T guP gv72"y cu'ej qugp" hqt "hwtvj gt"vcklpi ."vj ku'r j cug'hqewugf "qp"vj g'gzr gtko gpvcn'xcnwgu'hqt"vj g'o qf gn'y j gtg"vcklpi " y cu'f qpg'y kj "f kvlpev'ugvki u'vq" hpf "vj g'qr vko cn'qr vqp" hqt "lo r tqxkpi "vj g'o qf gnu'ceewtce{ 0'Vj g'o qf gn'y cu'hqcf gf "y kj "r tg/vcklpgf "ko ci gP gv' y gli j wu'dghqtg"geej "gzr gtko gpv'cu'vcpuhgt"ngctplki "o qf gnu'vqpf "vq"y qtn'dgwtg"y kj qw'hwtvj gt"gzr rcpvki"cu"vj g'o qf gn'y cu'gzr qugf "vq" c" wplxgtucm{ "rcti g'f cvcugv'uq'ku'o qtg'tqdwu0"

**606B'Cpcn' ul'lp'vgt o u'qh'Rqqrki 'Nc{ gt "**

Vcdrg'605'dgny "uj qy u'vj g'qxgtcm't guwmu'hqt'wulpi "I nqden'Cxgtci g'Rqqrki "rc{ gt'lp"eqo r ctluqp"vq'wulpi "Cxgtci g'Rqqrki "rc{ gt'y kj "hrcwgp"rc{ gt" hqt"vj g'tgf wcvkqp"qh'f ko gpukapu'hqo "vj g'hgcwtg"o cr "i gpgtcvqf "d{ "vj g'rcu'v'eqpxqmwkqpcn'rc{ gt'qh'vj g'o qf gn0'

"

Vcdrg'605'T guwmu'vcdrg'qh'wulpi "f kvlpev'r qqrki "rc{ gt u"

Rj cug'4'Vtcklpi 'T guwmu'<Rqqrki "rc{ gt"cur gev"				
30 Wulpi 'Cxgtci g'Rqqrki "rc{ gt'y kj "Hrcwgp"rc{ gt"				
O qf gn'	Eqo r wcvkqpcn' vko g'*7" gr qej u+"	Ceewtce{ "	Xcrkf cvkqp" Ceewtce{ "	Vtcklpi "Nqi "

Dcej gnt'qh'Eqo r wgt 'Uelqpeg'\*f qpqtu+"  
Hcewv{ "qh'f hqto cvkqp"cpf 'Eqo o wplecvkqp"Vgej pqm{ { '\*Mco r ct'Eco r wu: "WCT"



Ej cr vgt "6<Gzr gtko gpvT guwmu"cpf "F kuewukqp"

Rtg/ vtckpgf " TguP gv 72"	34806" o kpwgu"	206: 84"	207439"	<pre>Epoch 1/100 249/249 [=====] - 7122s 29s/step - loss: 1.7941 - accuracy: 0.3075 - val_loss: 1.3141 - val_accuracy: 0.3821 - Epoch 2/100 249/249 [=====] - 120s 481ms/step - loss: 1.3016 - accuracy: 0.3967 - val_loss: 1.2420 - val_accuracy: 0.4259 Epoch 3/100 249/249 [=====] - 120s 480ms/step - loss: 1.2208 - accuracy: 0.4497 - val_loss: 1.1323 - val_accuracy: 0.4914 Epoch 4/100 249/249 [=====] - 120s 482ms/step - loss: 1.1628 - accuracy: 0.4677 - val_loss: 1.0821 - val_accuracy: 0.5141 Epoch 5/100 249/249 [=====] - 122s 488ms/step - loss: 1.1133 - accuracy: 0.4862 - val_loss: 1.0471 - val_accuracy: 0.5217</pre>
40 Wukpi "I mdcn'Rqqrkpi "rc{ gt"				
Rtg/ vtckpgf " TguP gv 72"	6; 07" o kpwgu"	209; 7; "	204; 5"	<pre>Epoch 1/30 249/249 [=====] - 2507s 10s/step - loss: 1.0306 - accuracy: 0.5617 - val_loss: 0.7606 - val_accuracy: 0.6830 Epoch 2/30 249/249 [=====] - 118s 475ms/step - loss: 0.7479 - accuracy: 0.7009 - val_loss: 0.6867 - val_accuracy: 0.7147 Epoch 3/30 249/249 [=====] - 118s 472ms/step - loss: 0.6261 - accuracy: 0.7492 - val_loss: 0.5697 - val_accuracy: 0.7692 Epoch 4/30 249/249 [=====] - 117s 470ms/step - loss: 0.5617 - accuracy: 0.7794 - val_loss: 0.4836 - val_accuracy: 0.8059 Epoch 5/30 249/249 [=====] - 114s 460ms/step - loss: 0.5180 - accuracy: 0.7959 - val_loss: 0.5949 - val_accuracy: 0.7293</pre>

"

Cu'uggp"qp"vj g'tguwv'vcdng'cdqyg."vj g'i mdcnr qqrkpi "rc{gtu}" cf "c'rci g'r gthqto cpeg'i cr "kp'vgtu u'qh'vko g'cpf "ceewtce{ "kp'eqo r ctkuqp'y kj "vj g" wuci g'qh'Cxgtci g'Rqqrkpi "y kj "Hrcwgp"rc{gtu}Vj ku"eqwf "dg"f wg"vq"vj g'vej pls wgu"wugf "d{ "dqj "ugwvpi u'y j gtg"Hrcwgp"rc{gt "us wgg| gu"c"hgcvwg" o cr "kpv"cu'kpi ng'hqpi "uk'g'xgevqt'y j kej "y cu'pqv'f guk'cdng'cu'vj g'pwo dgt'qh'r ctco gvgtu'i gpgtcvqf "y cu'j ki j gt'kp'eqo r ctkuqp'v'wukpi "i mdcnr qqrkpi " rc{gt "49"o krikp"xu"45"o krikp+0I mdcnr qqrkpi "gcugf "vj ku'd{ "j cxkpi "hqy gt"eqo r wcvkqpcn'vko g'cu'pwo dgt'qh'r ctco gvgtu'y gtg'tgo ckpgf "hqy gt"cpf " vj g'o qf gni' gpgtcrk' gf "dgvgt"cpf "pqv'dwtf gpgf "k'vq"gzeguuk'g"co qwpv'qh'r ctco gvgtu'y j kej "y cu'pqv'cr r rkecdng'hqt"vj ku'f cvcugv'kp"vj ku'ecugO'

"

**6060'Cpcrf uk'lp'vgt o u'qhf cvcugv'O qf hkecvkqp"**

Vcdng"606"dgmy "uj qy u'vj g"qxgtcm'tguwmu"ht"ftqr r kpi "vj g'pgwtqr j ku'ercuu"cpf "pqv'f tqr r kpi "vj g'ercuu"ht"vtckkpi 0Vj g'f tqr r kpi "qh'vj g'ercuu" qeewt'gf "ukpeg'pgwtqr j ku'f k' "pqv'rc{ "cp{ "uki p'kecpeg'hqt"fgucugu'ercuu'hkecvkqp"cu'o gpv'kpgf "kp"j7\_0"

"

"

Dcej gnt'qh'Eqo r wgt "Uelgpeg"\*j qpqtu+"  
Hcewv' "qh'k'qto cvkq"cpf "Eqo o wplecvkq"Vgej pqmi { "Mc o r ct" Eco r wu: "WCT"

Ej cr vgt "6<Gzr gtko gpv'T guwmu'cpf 'F kuewukqp"

Vcdrg'606'T guwmu'vcdrg'qh'f tqr r kpi 'pgwtqr j ku'emuu"

Rj cug'4"Vtcklpi 'T guwmu'P wo dgt'qh'emuu'cur gev"

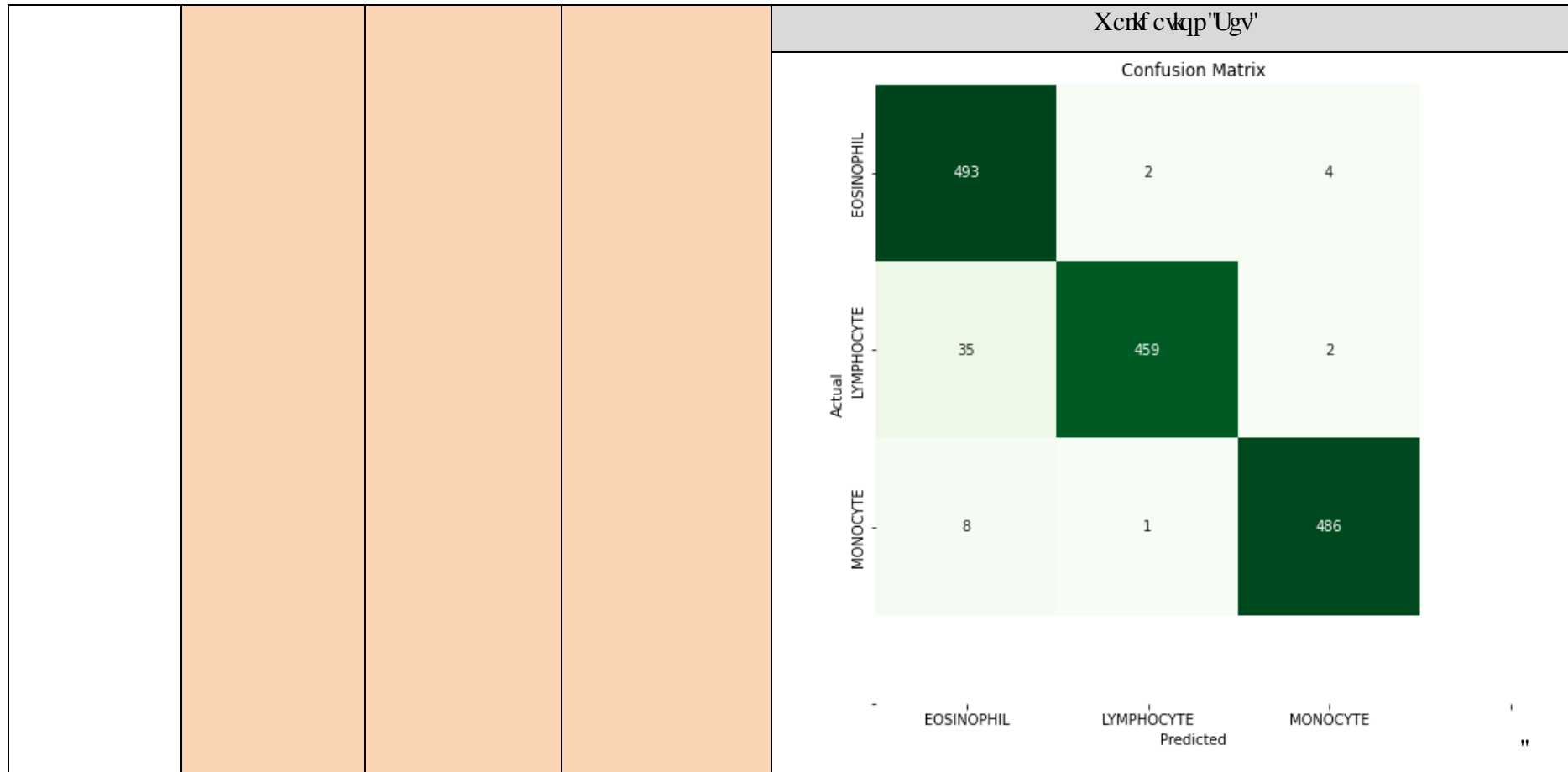
30 Qtki kpcnf cvcugv\*6'emuu+""

O qf gni'	Eqo r wcvkqpcn' vko g'''	Vguv'Ceewtce{ "	Xcrkf cvkqp" Ceewtce{ "	Eqphwukqp'O cvtkz "																					
Rtg/vtckpgf " T guP gv72"	6; 079'o kpwgu"	207; 45"	20 : 9; "	Vguv'Ugv'																					
				<p>Confusion Matrix</p> <table border="1"> <thead> <tr> <th>Actual \ Predicted</th> <th>EOSINOPHIL</th> <th>LYMPHOCYTE</th> <th>MONOCYTE</th> <th>NEUTROPHIL</th> </tr> </thead> <tbody> <tr> <th>EOSINOPHIL</th> <td>335</td> <td>11</td> <td>50</td> <td>227</td> </tr> <tr> <th>LYMPHOCYTE</th> <td>65</td> <td>324</td> <td>42</td> <td>189</td> </tr> <tr> <th>MONOCYTE</th> <td>65</td> <td>1</td> <td>276</td> <td>278</td> </tr> <tr> <th>NEUTROPHIL</th> <td>55</td> <td>7</td> <td>24</td> <td>538</td> </tr> </tbody> </table>	Actual \ Predicted	EOSINOPHIL	LYMPHOCYTE	MONOCYTE	NEUTROPHIL	EOSINOPHIL	335	11	50	227	LYMPHOCYTE	65	324	42	189	MONOCYTE	65	1	276	278	NEUTROPHIL
Actual \ Predicted	EOSINOPHIL	LYMPHOCYTE	MONOCYTE	NEUTROPHIL																					
EOSINOPHIL	335	11	50	227																					
LYMPHOCYTE	65	324	42	189																					
MONOCYTE	65	1	276	278																					
NEUTROPHIL	55	7	24	538																					

Dcej gnt'qh'Eqo r wgt 'Uelgpeg'\*f qpqtu+  
 Hcewv'qh'kpi to cvkqp'cpf 'Eqo o wplecvkqp'Vgej pqm { '\*Mc o r ct'Eco r wu: "WCT"

				Xcrkf cvkqp'Ugv'			
				Confusion Matrix			
Actual	EOSINOPHIL	367	1	12	119		
	LYMPHOCYTE	7	442	19	28		
	MONOCYTE	0	0	493	2		
	NEUTROPHIL	18	1	16	464		
						Predicted	
						EOSINOPHIL	
						LYMPHOCYTE	
						MONOCYTE	
						NEUTROPHIL	
						"	"
						"	"
						"	"
						"	"
						"	"

40 F tqr r kpi "yj g'P gwtqr j kn'ercu'5'ercuugu+"																		
Rtg/vtckpgf " TguP gv72"	54085"o kpwgu"	2085; 5"	20 873"	Vgub'Ugv"														
				<p style="text-align: center;">" "</p> <p style="text-align: center;">Confusion Matrix</p> <table border="1"> <tr> <td rowspan="3">Actual</td> <td>EOSINOPHIL</td> <td>553</td> <td>32</td> <td>38</td> </tr> <tr> <td>LYMPHOCYTE</td> <td>186</td> <td>362</td> <td>72</td> </tr> <tr> <td>MONOCYTE</td> <td>340</td> <td>4</td> <td>276</td> </tr> <tr> <td></td> <td>Predicted</td> <td>EOSINOPHIL</td> <td>LYMPHOCYTE</td> <td>MONOCYTE</td> </tr> </table>	Actual	EOSINOPHIL	553	32	38	LYMPHOCYTE	186	362	72	MONOCYTE	340	4	276	
Actual	EOSINOPHIL	553	32	38														
	LYMPHOCYTE	186	362	72														
	MONOCYTE	340	4	276														
	Predicted	EOSINOPHIL	LYMPHOCYTE	MONOCYTE														



Cpcn{ | kpi 'vj qtqwi j n{ .d{ 'ftqr r kpi 'vj g'pgwtqr j ku'ercuu.'vj g'eqo r wcvkqpcn'vko g'y cu'tgf wegf . 'cpf 'r gthqto cpeg'qh'vj g'o qf grlpetgcugf 'cu'vj g' pggf 'vq'ercuukh' 'cpqvj gt'ercuu'y cu'tgo qxgf . 'o gcplki 'vj gtg'y cu'nguugt'f cvc'vq'dg'vtclpgf 'qp'y j lej 'gzr rclpgf 'vj g'rqy gt'eqo r wcvkqpcn'vko g'0Vj g' r gthqto cpeg'dqqvuf 'f wg'vq'vj g'tgo qxcn'qh'pgwtqr j ku'cu'vj g'ercuu'y cu'r tqf vekpi 'j ki j 'hcng'r qukkxgu'y j gtg'vj g'5'qvj gt'ercuugu'y gtg'o kvcngp'cu' pggwtqr j ku'0Vj ku'ugwvpi 'y cu'ngr v'cu'vj g'pggf 'qh'ercuukh'ecvkqp'ht'pgwtqr j ku'y gtg'lttgrxcpv'cpf 'ku'cdugpeg'j cf 'r tqxkf gf 'dgpgh'ekn'qweqo gu0

Ej cr vgt'6<"Gzr gtko gpv'T guwmu'cpf 'F kuewukqp"

**6065'Cpcnf ul'lp'vgt o u'qhf gpug'Nc{ gt u'**

Vcdrg'607'dgmy 'uj qy u'yj g'qxgtcmko r ngo gpvki 'xctkqwu'pwo dgt'qhf gpug'rc{gtu'y j gtg'yj g'gcej 'kpetgo gpvcnf cf 'j ki j gt'pwo dgt'qhf'pgwtqpu'r tgu'gpv'  
 uctv'kpi 'htqo 'qpg'uqho cz'rc{gt'vq'j cxkpi 'o qtg'f gpug'rc{gtu'y kj 'pgwtqpu'qh'34: 'vq'7340

"  
"

**Vcdrg'607'T guwmu'vcdrg'qhf'wukpi 'f kulkpev'r qqrkpi 'rc{gtu"**

Rj cug'4"Vtckl'kpi 'T guwmu'F gpug'rc{gtu"cur gev'				
30 Wukpi 'uqho cz'f gpug'rc{gt'qpn'				
O qf gn'	Eqo r wcvkqpcn' vko g'7" gr qej u'	Ceewtce{ "	Xcrkf cvkqp" Ceewtce{ "	Vtckl'kpi 'Nqi "
Rtg/ vtckl'kpgf " T gu'P gv'72"	6606'o k'pwgu"	20 465"	20 9; 3"	" <pre>Epoch 1/5 186/186 [=====] - 2311s 12s/step - loss: 0.9195 - accuracy: 0.5603 - val_loss: 0.6781 - val_accuracy: 0.7120 Epoch 2/5 186/186 [=====] - 88s 473ms/step - loss: 0.6524 - accuracy: 0.7193 - val_loss: 0.5435 - val_accuracy: 0.7928 Epoch 3/5 186/186 [=====] - 89s 476ms/step - loss: 0.5736 - accuracy: 0.7695 - val_loss: 0.5772 - val_accuracy: 0.7418 Epoch 4/5 186/186 [=====] - 87s 470ms/step - loss: 0.5162 - accuracy: 0.7945 - val_loss: 0.4132 - val_accuracy: 0.8601 Epoch 5/5 186/186 [=====] - 89s 480ms/step - loss: 0.4542 - accuracy: 0.8243 - val_loss: 0.3779 - val_accuracy: 0.8791</pre>
40 Wukpi 'f gpug'rc{gt'34: +'- 'uqho cz'				
Rtg/ vtckl'kpgf " T gu'P gv'72"	54085'o k'pwgu"	20 782"	20 986"	" <pre>Epoch 1/50 186/186 [=====] - 1458s 8s/step - loss: 0.8399 - accuracy: 0.6216 - val_loss: 0.5692 - val_accuracy: 0.7643 Epoch 2/50 186/186 [=====] - 91s 491ms/step - loss: 0.5490 - accuracy: 0.7776 - val_loss: 0.4089 - val_accuracy: 0.8478 Epoch 3/50 186/186 [=====] - 90s 486ms/step - loss: 0.4661 - accuracy: 0.8125 - val_loss: 0.4663 - val_accuracy: 0.8071 Epoch 4/50 186/186 [=====] - 91s 488ms/step - loss: 0.4057 - accuracy: 0.8381 - val_loss: 0.4182 - val_accuracy: 0.8247 Epoch 5/50 186/186 [=====] - 91s 489ms/step - loss: 0.3775 - accuracy: 0.8560 - val_loss: 0.2914 - val_accuracy: 0.8764</pre>

Dcej gnt'qhf'Eqo r wgt 'Uelgpeg'7' q'pqtu+'  
 Hcewv'qhf'kpi'htqo cvkqp'cpf 'Eqo o wplecvkqp'vgej pqm' { 'Mco r ct'Eco r wu:'WCT"

Ej cr vgt "6<Gzr gtko gpvT guwmu"cpf "F kuewukqp"

50 Wukpi "f gpug'rc { gt"*478+ "- "f gpug'rc { gt"*34: + "- "uqho cz "				
Rtg/vtckpgf "	4; 6; "	20 7; 9"	20 4: 2"	<pre>Epoch 1/5 186/186 [=====] - 1415s 8s/step - loss: 0.8213 - accuracy: 0.6279 - val_loss: 0.5908 - val_accuracy: 0.7500 Epoch 2/5 186/186 [=====] - 86s 464ms/step - loss: 0.5639 - accuracy: 0.7630 - val_loss: 0.3953 - val_accuracy: 0.8471 Epoch 3/5 186/186 [=====] - 87s 467ms/step - loss: 0.4405 - accuracy: 0.8214 - val_loss: 0.2657 - val_accuracy: 0.9090 Epoch 4/5 186/186 [=====] - 88s 472ms/step - loss: 0.3857 - accuracy: 0.8484 - val_loss: 0.2298 - val_accuracy: 0.9212 Epoch 5/5 186/186 [=====] - 87s 469ms/step - loss: 0.3580 - accuracy: 0.8597 - val_loss: 0.1966 - val_accuracy: 0.9280 "</pre>
60 Wukpi "f gpug'rc { gt"*734+ "- "f gpug'rc { gt"*478+ "- "f gpug'rc { gt"*34: + "- "uqho cz "				
Rtg/vtckpgf "	5; 0 5"	20 692"	20 992"	<pre>Epoch 1/5 186/186 [=====] - 2049s 11s/step - loss: 0.8643 - accuracy: 0.5977 - val_loss: 0.8544 - val_accuracy: 0.5803 Epoch 2/5 186/186 [=====] - 86s 462ms/step - loss: 0.5726 - accuracy: 0.7562 - val_loss: 0.4666 - val_accuracy: 0.8050 Epoch 3/5 186/186 [=====] - 87s 466ms/step - loss: 0.4764 - accuracy: 0.7968 - val_loss: 0.2709 - val_accuracy: 0.9049 Epoch 4/5 186/186 [=====] - 87s 467ms/step - loss: 0.3714 - accuracy: 0.8491 - val_loss: 0.2638 - val_accuracy: 0.9015 Epoch 5/5 186/186 [=====] - 88s 471ms/step - loss: 0.3668 - accuracy: 0.8470 - val_loss: 0.2808 - val_accuracy: 0.8770 "</pre>

"

Vj g'pwo dgt "qh'f gpug'rc { gt'u'lp'yj g'o qf gn'ch'gew'yj g'qxgtcm'ercu'k'lec'v'kp'ucv'g'qh'yj g'o qf gr'0Vj g'cf f k'k'apcn'f gpug'rc { gt'u'cf f gf 'lp'v'yj g'o qf gr' ceu'cu'hcw'g'ug'ge'v'qtu'ht'qo 'yj g'hcw'g'o cr u'i g'p'gt'c'v'g'f 'ht'qo "eqpxq'w'k'p'c'n'rc { gt'u'0H'qt'yj ku'g'zr g'tko gpv'yj g't'guwmu'v'cd'ng'uki p'k'kg'f 'yj cv'w'ukpi "f gpug'rc { gt'u'qh'p'gw'q'pu'478"y kj "f gpug'rc { gt'qh'34: "cu'y gm'cu'rcu'v'f gpug'rc { gt'y kj "uqho cz "ce'v'x'c'v'kp"j cf "ugt'x'gf 'yj g'd'gu'v'lp"v'gto u'qh'ce'ewt'ce { "cpf "xc'rf'c'v'kp'ce'ewt'ce { "lp'l'w'v'cr r tqzko cv'gn' "52"o kp'w'gu'y j kej "ku'yj g'm'y g'u'v'ko g'qh'cm'ug'w'kpi u'0'

Ej cr vgt "6<Gzr gtlk gpvT guwmu'cpf 'F kuewukqp"

**606'Cpcn' uk'lp'vgt o u'qh'Dcvej 'Uk' g'**

Vcdrg"608'dgmy "uj qy u'v'j g'wug'qh'f k'k'p'ev'dcvej 'uk' gu'hqt'gzr gtlk gpw'v'k'p'y j lej 't'cpi gf 'ht'qo " v'j g'uo cm'g'u'v'uk' g'qh': "v'q'86."i tcf wcm' { 'k'p'et'g'cug'k'p'v'j g'k'p'et'go gpv'q'h'p"- 'p0"

Vcdrg"608'T guwmu'vcdrg'qh'wuk'pi 'f k'k'ht'gpv'dcvej 'uk' gu"

Rj cug"4"Vtckl'p' <Dcvej 'uk' g'cur gev"			
Dcvej 'Uk' g'"	Eqo r wcv'k'p'cn'Vlo g'"	Vg'u'Ceewtce{ "	Nquu'"
: "	49082"o k'p'w'gu"	2088; ; "	205482"
38"	53046"o k'p'w'gu"	208; 3; "	20589: "
54"	66062"o k'p'w'gu"	208996"	206764"
86"	940; 'o k'p'w'gu"	208792"	20638; "

"

Ceeqtf k'pi 'v'j g't'guwmu'vcdrg'cdq'x'g.'v'j g'uo cm'gt'dcvej 'uk' gu't'guw'ng'f 'k'p'ig'u'ng't'eqo r wcv'k'p'cn' v'k'o g'hqt'v'ck'p'k'pi 'cu'v'j g'p'wo dgt'q'h'uv'gr u'r gt'gr qej u'y cu'k'p'et'g'cug'f 'd'w'g'cej 'uv'gr 't'gs w'k'gf 'm'y gt" dcvej 'uk' g0Hqt'k'p'uc'peg.'dcvej 'uk' g'qh': 'y k'n'j c'x'g'968'uv'gr u'r gt'gr qej 'd'w'g'cej 'uv'gr 'r cu'ug'f 'q'p'n' { " : 'u'co r ng'u'0k'p'v'gt o u'qh'ceewtce{ . 'dcvej 'uk' g'qh'38'ueq't'gf 'v'j g'j k'j g'uv'co q'pi 'c'm'q'v'j gt'dcvej 'uk' gu" y j lej "o cf g'k'ug'go gf "r'k'ng"v'j g'qr v'k'o c'n'ej q'leg" g'x'gp" k'i'v'j g'eqo r wcv'k'p'cn'v'k'o g'y cu'ur'ki j v'q' j k'j gt'v'j cp'dcvej 'uk' g'qh': 0"

**607'Cpcn' uk'lp'vgt o u'qh'Ngct'p'k'pi 'T'cv'g'**

Vcdrg"609'dgmy "uj qy u'v'j g'gzr gtlk gpv"qp"j c'x'k'pi "x'ct'k'q'wu"ngct'p'k'pi "t'cv'g'u'qh"2023."2023"cpf " 20223'hqt'v'j g'C'f co "qr v'k'o k' gt0"

Vcdrg"609"Vcdrg't'guwmu'hqt'f k'k'p'ev'ngct'p'k'pi 't'cv'g'

Rj cug"4"Vtckl'p' <Ngct'p'k'pi 't'cv'g'cur gev"			
Ngct'p'k'pi 'T'cv'g'"	Eqo r wcv'k'p'cn'Vlo g'"	Vg'u'Ceewtce{ "	X'c'rk'f'c'v'k'p'Ceewtce{ "
2023"	'92082"o k'p'w'gu"	208: 55"	20 2; 6"
20223"	'8; 07"o k'p'w'gu"	208; 78"	20 ; : 9"
20223"	53047"o k'p'w'gu"	208; 3; "	20 329"

"

V'j g'ngct'p'k'pi "t'cv'g"ku'f g'h'p'gf "cu'v'j g'o g'cu'w'g'q'h'j qy "s'w'k'cm' { "v'j g'o qf g'n'i g'u'cf cr v'gf "v'q" c" egt'v'k'p"cu'm'i k'x'gp'0'Cu'uj qy p'cdq'x'g.'v'j g'qr v'k'o c'n'ngct'p'k'pi "t'cv'g'hqt"v'j g'o qf g'n'ku'd'g'y g'gp"v'j g' t'cpi g'qh'2023"cpf "20223"cu'v'j g'v'g'u'v'ceewtce{ "d'g'y g'gp"v'j g'ug'v'y q't'gi k'p'u'y gt'g't'q'w'i j n' "c'r'k'ng'0"



Ej cr vgt "6<Gzr gtlk gpvT guvnu"cpf "F kxwukqp"

Vj gthgtg."y ku'y cu"wugf "cu"t'ghgtgpeg"htq"vj g"j { r gtr ctco gvt "wplkpi ."vq" f ghkg"vj g"qr vko cni  
rgctpkpi "tcvg"qh'vj g'o qf grd

**60'J { r gtr ctco gvt 'Vwplkpi 'T guvnu'**

Vj g"j { r gtr ctco gvt "hqwugf "htq" hkg/wplkpi "y cu"vj g"rgctpkpi "tcvg"qh'vj g'o qf grdCu'o gpvkqpgf "  
k'vj g'r t gxlkwu"ej cr vgt."y g"qr vko wo "rgctpkpi "tcvg"y cu"dgw ggp"vj g"t cpi g"qh"2023"vq"202230"  
Vj wu."y g"wpgt"y cu"l pklkrl gf ."cpf "y g"t guvnu"y gtg"eqo r wgf "cu"uj qy p"dgmy "k' hki wtg"6040"  
"

```
Trial 27 Complete [00h 17m 08s]
val_loss: 0.11093910783529282

Best val_loss So Far: 0.11093910783529282
Total elapsed time: 03h 12m 32s

print(best_hp.values)
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Hki wtg"604"Dguvrgctpkpi "tcvg"xcnwg"chgt"t wppkpi "wpgt"

Vj g"j { r gtr ctco gvt "ugctej kpi "vqnm'tqwi j n' "5"j qwtu"cpf "eqpenmf gf "y kj "y g"rgctpkpi "tcvg"  
qh"2022; "htq"32"gr qej u0Vj ku'xcnwg"y cu"wkrl gf "vq"t g/l pklkrl g"y g'o qf grlvq"etgcvg"vj g'hkpcrl gf "  
o qf grlhtq"gxcnwvklp0

**60'Hkpcrl gf 'O qf grT guvnu'cpf 'F kxwukqp'**

Vcdrg"60 "dgmy "uwo o ctk gu"vj g"eqphki wcvklpu"y j lej "y cu"wugf "htq"vj g"eqpust wvklpi "y g'hkpcrl"  
o qf grly j lej "y km'dg"wugf "htq"vclpkpi "cpf "gxcnwvklp"vq"ceeguu"ku"ecr cdkrlkglu0"

Vcdrg"60: "Uwo o ctk gf "eqphki wcvklpu"htq" hpcrl'o qf grl"

O qf grEqphki wcvklpu"	Ugrgevlqp"TEqphki wcvklpu"
Rj cug"3"Vtclpkpi "	
O qf grV{r g"	T guP gv72"o qf grl"
F cvc"Cwi o gpvcvklp"	[ gu."y kj "hqmly kpi "cwi o gpvcvklp"vgej pls wgu< ""tqvcvklpatcpi g?42." ""y kf vj auj kvatcpi g?204." ""j gki j vauj kvatcpi g?204." ""uj gctatcpi g?204." ""l qgo atcpi g?204." ""j qtk qpvcmahrk ?Vtwg." ""xgt vkcmahrk ?Vtwg."

Ej cr vgt "6<Gzr gtlo gpvT guwmu'cpf 'F kuewukqp"

	""hkm o qf g? )pgct guv)"
Rj cug"4"Vtclpki "	
Vtcpuht'Ngctpki "	[ gu.'d{ 'mqf kpi 'r tg/vtclpgf 'K ci gP gv'y gli j u0'
Rqqrkpi 'rc{gt"	I mqdenCxgtci g'Rqqrkpi 'rc{gt0'
F cwcug'0 qf hlecckqp"	F tqr r gf 'P gwtqr j ku'encuu0'
F gpug'rc{gtu"	Vj tgg'f gpug'rc{gtu< <ul style="list-style-type: none"> <li>• F gpug'rc{gt '*pgwtqpu&lt;478+"</li> <li>• F gpug'rc{gt '*pgwtqpu&lt;34: +"</li> <li>• F gpug'rc{gt '*Cevkckqp&lt;Uqlho cz+"</li> </ul>
Devej 'uk g"	38"
Ngctpki 'tcv"	Dgy ggp"2023"cpf "20223"
J {r gtr ctco gvt"Vwplki "	
Vwpgf'Ngctpki 'Tcv"	; g/6"*2022; +"

"

Wulpi "vj g'ugwplki u'lp"vj g'vcdrg"cdqxs."vj g'o qf gr'y cu'tg/eqputwewf "cpf "tg/kpkckrk gf "hqt" vj g'vtclpki 'rj cug'hqt"vj g'hpcn'gxcnckqp0C"vqen'qh"52"gr qej u'y cu'tclpgf "qp"vj g'o qf gr'cpf " vj g'tguwmu'y gt'g'tgeqtf gf "cu'uj qy p'lp"vj g'vcdrg'60 "dgrny 0"

"

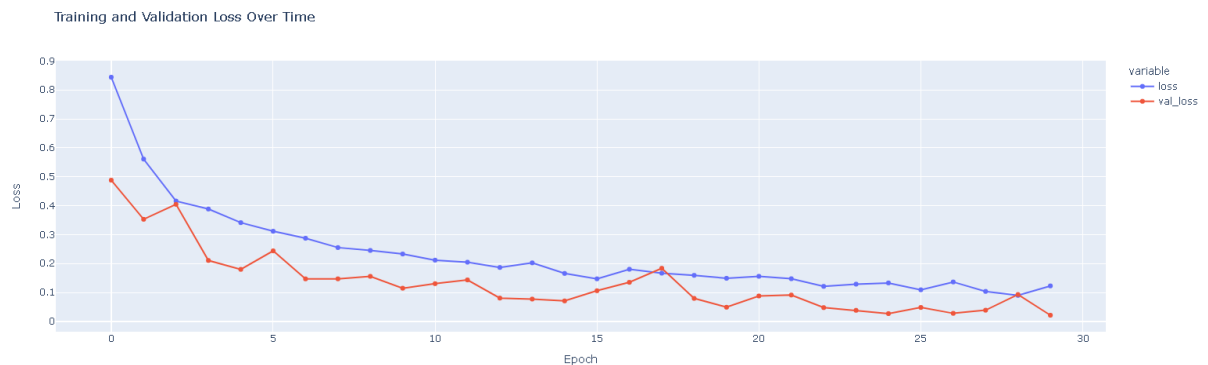
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Hpcrk gf "T guP gv72" O qf gr'	Gr qej u"	Eqo r wcvkpcn'vlo g" *lp'o kpwgu"	Vgukpi " Ceewtce{ "	Xcrkf cvkqp" Ceewtce{ "
	52"	3256: "	208599"	20 ; 68"

"

Hki wtg'605'cpf 'Hki wtg'606"dgrny 'uj qy u'vj g'hquu'i tcr j 'cpf "ceewtce{ 'i tcr j . 'tgr gevkgn(0"

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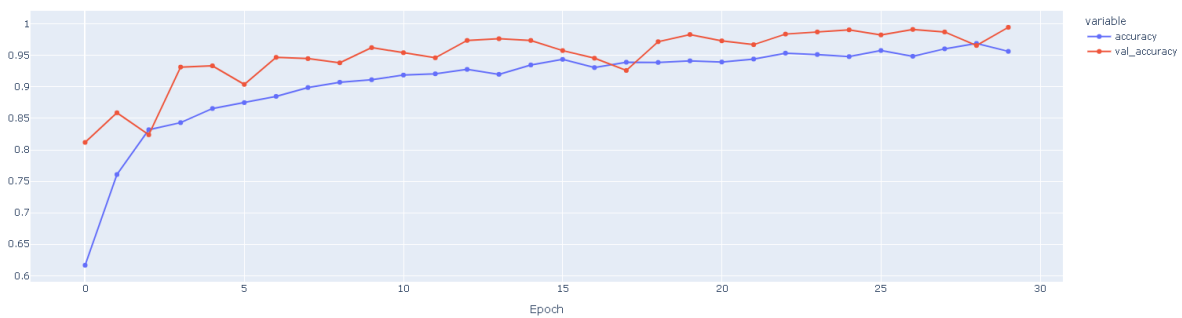
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"

"

Ej cr vgt "6<Gzr gtlb gpvT guvnu"cpf "F kuewukqp"

Training and Validation Accuracy Over Time

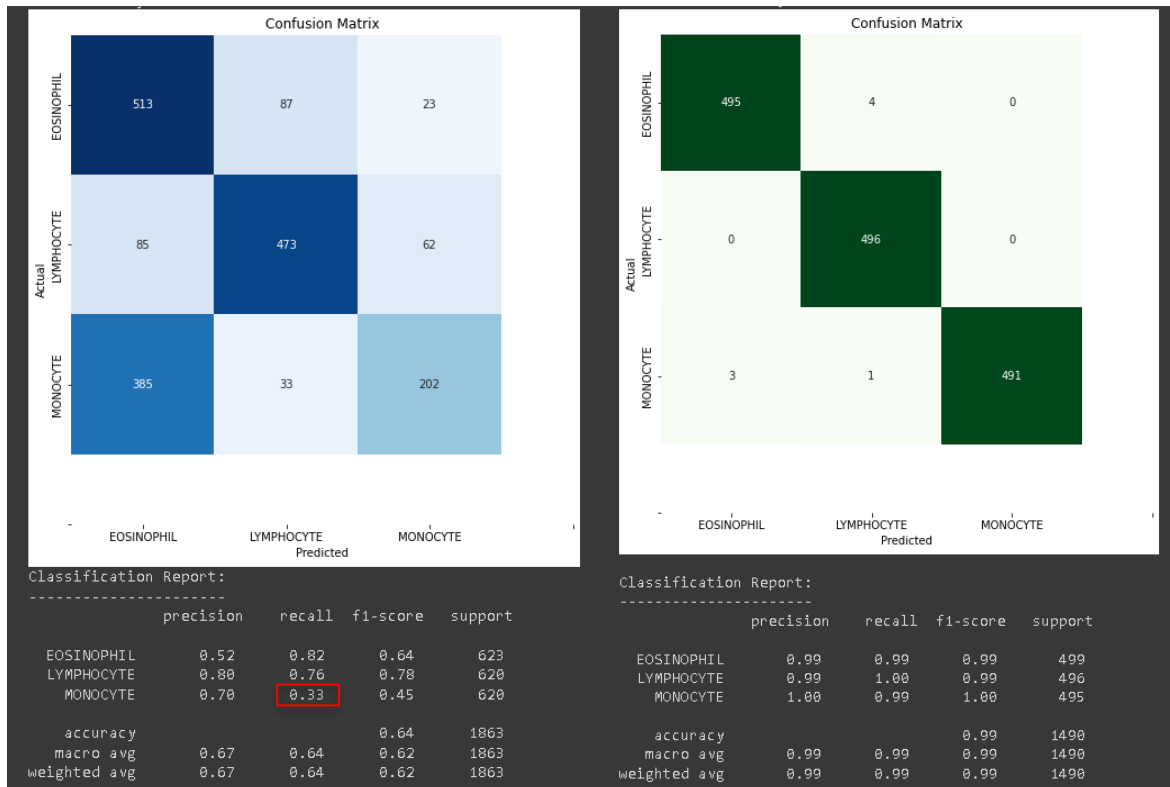


Hki wtg"606"Vtcklpi "ceewtce{"cpf"xcrkf cvkqp"ceewtce{"i tcr j "

"

Htqo "vj g'tguvnu"cdqyg.k'ecp'dg'eqpenwf gf "vj cv'j g'ugngv'gf 'ugv'kpi u'dtqwi j v'ko r tqxgo gpwu" vq"vj g"o qf gn'lp"vgtu u'qh'ceewtce{"tcvgu"y kj "85" "hqt"vgu'ceewtce{"cpf"; ; " "hqt"xcrkf cvkqp" ceewtce{0'Cu"o gpv'kpgf "lp"Rtqlgev"K"vj g'wpegtcvkpv{ "lp"vgu'ugv'i gpgtcvkqp"ecwugf "vj g"ftqr "lp" vguv' ceewtce{" gxgp" chgt" cf lwv'kpi "vj g"o qf gn' vq" gpj cpeg" ku" r gthqto cpeg0'J qy gxgt." vj g" xcrkf cvkqp" ceewtce{"kpetgcugf "ftcuk'ecm{"y gm"cpf "vj g"i tcr j u"cdqyg"fk"pqv'uki plh{"cp{" qxgthv'kpi "kuwgu"cpf "vj g"vtcklpi "y cu"fqpg"y gm'dw"hgmd'ceni'qp"eqo r wcv'kpcn'v'ko g"y j kej " y cu'hpi vj gpgf 0'Hki wtg"607"dgmy "uj qy u'vj g"eqphwukqp"o cvtz"cpf "ercuk'kecvkqp"tgr qt v'hqt"vgu' ugv'cpf "xcrkf cvkqp"ugv0'

"



"

Hki wtg"607"Eqphwukqp"o cvtz"cpf "ercuk'kecvkqp"tgr qt v'qh'hpcnk gf "o qf gn"

8; "

Dcej gmt"qh'Eqo r wgt "Uelkpeg"\*J qpqtu+" Hcewv("qh'kphqto cvkqp"cpf "Eqo o wplecvkqp"Vgej pqmji {"\*Mco r ct'Eco r wu+: "WVCT"

Ej cr vgt "6<Gzr gtko gpvT guvnu'cpf 'F kuewukqp"

" Cu'uggp'kp'yj g'eqphwukqp'o cvtkz. 'kp'yj g'vuv'ugv.'o quv'qh'yj g'o qpqe { vgu'y gtg'o ku/emcuukhgf " cu"Gqulqqr j ku'y j lej "tguvngf "kp" c"mry "tgecm'xcnwg"qh"2050'Vj g"xcnkf cvkqp"ugv'qp"vj g"qyj gt" j cpf ."emcuukhgf "yj g'fcv'ugv'y kj "gcug'cu'cmh3/ueqtgu'y gtg"20 ; "cpf "cdqyg0"

### 60'Uwo o ct{ "

" Vj ku'ej cr vgt "gzr rckp'gf "qp"yj g'fcvugv'u'qtki kp"cpf "ku'f gvcku.'tguvnu'eqo r wvgf "Htqo "Rj cug" 3"cpf "4"qh'vckp'kpi "cmipi ulk g"ku'f kuewukqp"y j lej "gpf gf "wr "y kj "yj g'eqphki vckv'qp"qh"yj g' hpcrk' gf "o qf gr'ht'gxcnw'cvkqp"chgt'j { r gtr ctco gvg't'wv'kpi "y cu'f qpg'y j lej "Hqewugf "qp'wv'kpi " yj g'rgctp'kpi 'tcvg'qh'yj g'o qf gr'F vckp' "Rj cug"3"qh'vckp'kpi . 'k'ku'uggp'vj cvT guP gv'o qf gr'u'3: "cpf " 72"ctg'qxgth'k'kpi "qp"yj g'qtki kpcn'f cvcug'v'cpf "cwi o gpvgf "f cvcugv."dw'T guP gv'72"uw'ht'gf "rguu' ugxgtg" gh'geu'Vj gtg'htg. "yj g'o qf gr'ecttkgf "qp"kv'q"r j cug"4"qh' vckp'kpi . "y j lej "kpxqngf " cr r'ncv'kqp"qh'vcp'uhgt'rgctp'kpi "ncf'kpi "r tg/vckp'gf "y gki j wu"dg'htg"ectt { kpi "qwu'c"ugt'ku"qh' f k'k'p'ev'ugv'kpi u"y j lej "eqpukngf "qh'r qqr'kpi "nc { gtu."f tqr r kpi "c"emcu'htqo "yj g'fcvugv."f gpug" nc { gtu."dcej "uk' gu'cpf "rgctp'kpi 'tcv'gu'OT gi ct'f kpi "qp"yj g'rgctp'kpi 'tcvg. 'k'ku'uggp'vj cv'ku'qr vko cn' xcnw'g'k'gf "dgw ggp"2023"cpf "202230'Vj wu.'hwt'v'gt'j { r gtr ctco gvg't'wv'kpi 'ku'vct'vgf "cpf "gpf gf " wr "y kj "yj g'dgu'v'xcnw'g"qh"2022; 0'Vj g'hpcrk' gf "o qf gr'ku'et'gcv'gf "vuk'kpi "yj g'dgu'v'ugv'kpi u'htqo " gcej "gzr gtko gpv'cpf "k'cej k'x'gf "c"v'guk'kpi "ceewtce { "qh"8509' "cpf "xcnkf cvkqp"ceewtce { "qh" ; ; 068' "y j lej "ku'c'uki p'k'k'epv'ko r tqxgo gpv'0"

**Ej cr vgt '7<Eqpenukqp'cpf 'Hwwt'g'Y qtm'**

Dmqf "egm'kf gpwkecvkqp"j cu'cny c { u'dggp'f qp'g"d { "gzi gt'u"o cpwcm { d { "ur gpf kpi "ko g"qp" vj g"o letqueqr g"cpf "f qewo gpv'kpi "vj g"tguwmu"chgt "r tqr gt "lwukhkecvkqpu0'Vj g"r tqegu"ku"ko g/ eqpuwo kpi "cu"vj gtg"ctg"o krikpu"qh'egm"vq"dg"kpur gev'f "cpf "j wo cpu"ctg"pqv'r gthgev."j gpeg" o kucngu"qp'rcdgm'kpi "vj gug'egm'y qwf "j cr r gp0'Vq'tguqk'g'vj ku'kuuwg."cp'cwqo cvgf "dmqf "egm' encuukhkecvkqp'wukpi "f ggr "rgctpkpi "y cu'r tqr qugf 0'

Vj g'uqr'g'hwu'k'p'vj g'ugeqpf "r ctv'qh'vj ku'tgugctej "y cu'ko r ngo gpv'kpi "T guP gv'o qf gn'ltqo " uetcej "cpf "w'pf gtuxcpf kpi "ku'ctej kgewt'g'cpf "r gthqto cpeg'ecr cdkk'kgu'dghqt'g'lwo r kpi "kp'v'vj g" f ggr gt "r j cug'qh'v'ckpkpi "c'ukpi ng"t guP gv'o qf gn'y j lej "y cu't guP gv'720Uko kctn' . "v"Rtqlgev'K" v'cpuhgt'rgctpkpi "y cu'cr r r'kgf "v"vj g"t guP gv'o qf gn'vj tqwi j "vj g"cr r r'kecvkqp"qh'y gli j w'v'ckp'gf " qp" K ci gP g'0' O qxkpi " qp" ltqo " j gtg. " vj g" o qf gn' y cu' twp" vj tqwi j " ugxtcn' tqwpf u" qh' gzi gt'ko gpw'kqp"kp'xqk'kpi "vj g"ej cpi g"qh" wug"kp"r qqkpi "rc { gtu. "f gpug"rc { gtu. "dcvej "uk' gu. " rgctpkpi "tcvgu'cu'y gm'cu'f tqr r kpi "c"Y DE "encu'f wg'v'ku'kt'gr'xcpeg'kp'f kugcugu'encuukhkecvkqp0' Gcej "ecv'j qt { au' dgu'ugw'kpi "y cu'tgeqtf gf "cpf "vcngp"kp"eqpuk'gtcvkqp"ht' "eqp'ut'wv'kpi "vj g" h'p'ck'gf "b' qf gr0' { r gtr ctco gvt'w'kpi "y cu'cr r r'kgf "qp'vj g'rgctpkpi "tcvg'cu'vj g'tcpi g'y cu'hw'pf " vq"dg'dgy ggp"2023"cpf "20223"cpf "vj ku'k'phqto cvkqp"y cu'hw'f "kp'v'vj g'w'p'gt'y kj "c"ugctej "uvgr " eqw'v'v'q'v'cxgtug'dgy ggp"vj g'tcpi g"v'eqo r wg'vj g'qr v'ko cn'rgctpkpi "tcvg'xcnw'0'Vq"eqpen'f g. " vj g'h'p'ck'gf "b' qf gr'w'k'gf "c'rgctpkpi "tcvg'qh'2022; . "dcvej "uk' g'qh'38. "vj tgg'f gpug'rc { gtu. "i m'cdn' cxgtci g'r qqkpi "rc { gt"cpf "f tqr r gf "pgwt'qr j ku'encu'v'q'cej k'x'g"c"v'g'kpi "ceewtce { "qh'8509' " cpf "x'ck'f cvkqp"ceewtce { "qh'; ; 068' 0'

Nqan'kpi "cv"vj g'hwwt'g'y qtmu'qh'vj g'tgugctej . "vj g"t guP gv'o qf gn'y qwf "dg"v'ckp'gf "cpf " gxcn'w'cv'f "qp" f h'gt'gp'v'f cvcugw"cu"vj ku'f cvcug'v'w'k'gf "j cu"uqo g"wp'egt'v'k'p'v' { "qp"vj g'v'g'u'ug'v' i gp'gt'cvkqp" y j lej "tguw'ngf "kp" w'p'ergt' ceewtce { "tguwmu'0' Cngt'p'cv'k'x'gn' . "vj g" o qf gn'eqwf "dg" ko r tqxgf "kp"v'gto u"qh'r gthqto cpeg"vj tqwi j "q'vj gt "f ggr "rgctpkpi "o g'vj qf u'uwej "cu"gpugo drg" encuuk'kgtu. "f gekuk'qp"cri qt'k'j o u. "gve'0C"b' qtg't'q'dw'u'v'cpf "h'ki j vy gli j v'bo qf gn'vj cv'ecp'cej k'x'g'j ki j " ceewtce { "y kj "cp { "v'g'u'f'c'v'c"cpf "m'qy gt "v'ck'p'kpi "r g'k'q'f u"ku"c" f g'uk'gf "i qcn'v'q"eqo r r'g'v'g"kp"vj g" hwwt'g'0"

TGHGTGPEGU'

]3\_ L0\ j cq.'O 0\ j cpi .\ 0\ j qw.'LOEj w.'cpf 'HOEcq.'öC wqo ckle'f gvevkap'cpf 'ercuukhcevkqp qh'igwne{ vgu'wukpi 'eqpxqnwkqpcn'pgwtcn'pgvy qtm.ö'O gf 0Dkqf0Gpi 0Ego r w0'xqr077. pq0: .'r r 034: 963523.'42390

]4\_ I 0Nkpi .'J 0J qpi .'Y 0Z kg.'cpf 'N0\ j gpi .'öEgo dlpkpi 'eqpxqnwkqpcn'pgwtcn'pgvy qtm y kj 'tgewtukxg'pgwtcn'pgvy qtm'ht' 'dmqf "egm'ko ci g'ercuukhcevkqp.ö"KGGG"Ceegu.'xqr0 8.'r r 0583: : 6583; 9.'423: 0

]5\_ C0K0Uj cj kp.'I 0I wq.'M00 0Co kp.'cpf 'C0C0Uj ctcy k'öY j kg'dmqf "egm'kf gpv'khecvkap u{ ugo "dcugf "qp"eqpxqnwkqpcn'f ggr "pgwtcn'ngctpkpi "pgvy qtm.ö"Ego r w0' O gj qf u Rtqi tco u'Dkqo gf 0'xqr038: . 'r r 08; ö: 2.'423; 0

]6\_ J 0Mwww.'G0C xek'cpf 'H0' | { wt.v.'öY j kg'dmqf "egm'f gvevkap'cpf 'ercuukhcevkqp'dcugf qp" tgi kqpcn' eqpxqnwkqpcn' P gwtcn' P gy qtm.ö" O gf kecn' J { r qj gugu." 26/P qx/423; 0 ]Qprkpg\_0 Cxckrcdrg< j w r u<ly y 0uekgpegf ktgeveqo luekgpegktvenglr kklU2528; : 993; 5328: 20' ]Ceeguugf < 28/Cr t/4244\_0

]7\_ \ 0\ j w.'U0Nw.'U0J 0Y cpi .'I00 0I »ttk. 'cpf '[ 0F 0\ j cpi .'öDEP gv<C"pqxgn'pgvy qtm ht' 'dmqf "egm'ercuukhcevkqp.ö" H'qp'vgtu"lp"Egm'cpf "F gxgrqr o gpv'cn'Dkqmi { ."xqr0; . 42440

]8\_ F 0'O 0'Wuj k ko c."C0'E0'Nqtgpc."cpf "C0'E0'R0'N0'H0'f g"Ectxcnj q."öUw r qtv'xgevqt o cej kpgu'cr r rkgf "v'y j kg'dmqf "egm'tgeqi pklqp.ö"lp'Hkny "KpvtpcvqpcnEqphgtgpeg'qp J { dtkf "Kpvgmki gpv'U{ ugo u'\*J KU027+.'42270

]9\_ T0'Uktqle.'U0'Quqy unk"V0'O ctnky le|. "cpf "M0'Uky gm"öUw r qtv'xgevqt"o cej kpg"cpf i gpgve"cn qtkj o "ht'glt'lekp'v'dmqf "egm'tgeqi pklqp.ö"lp"4229"KGGG"Kpustwo gpvcvkap ( 'O gcuwtgo gpv'Vgej pqmi { 'Eqphgtgpeg'KO VE'4229.'4229.'r r 03680

] : \_ U0'Quqy unk"V0'O ctnky le|. "cpf "M0'Uky gm"öCr r rkecvkap"qh'uw r qtv'xgevqt o cej kpg"cpf "i gpgve"cn qtkj o "ht'"ko r tqxgf "dmqf "egm'tgeqi pklqp.ö"KGGG"Vtcpu0 Kpustwo 0O gcu0'xqr07: . 'pq09.'r r 0437; 6438: . '422; 0

] ; \_ Y 0N0Vck'T00 0J w'J 0E0Y 0J ukq.'T00 0Ej gp.'cpf 'L0L0R0'Vuck'öDmqf "egm'ko ci g ercuukhcevkqp'dcugf "qp"j kgtctej kecn'UXO .ö"lp"4233"KGGG"Kpvtpcvqpcn'U{ o r qukw "qp O wko gf kc.'42330

]32\_ O 0J cdld| cf gj .'COMt| { cm'cpf 'V0H'xggu.'öEgo r ctcv'xg'uwf { "qh'lj cr g.'kp'v'pukv' { 'cpf vgz'wtg' hgcwt'gu' cpf " uw r qtv' xgevqt" o cej kpg"ht" y j kg" dmqf "egm' ercuukhcevkqp.ö Ruw0gf w0' ]Qprkpg\_0 Cxckrcdrg<

Dcej gnt'qh'Ego r wgt'Uekpeg'\*J qpqwtu+  
Hcewv' { 'qh'kphqto cvkqp'cpf 'Ego o wplecvkap'Vgej pqmi { '\*Mco r ct'Eco r wu+.'WVCT''

j wr <1ekguggtz0u0f uw0f wxkgy f qe lf qy pmqcf Af qk? 3200089: 0 825( tgr ?tgr 3( v r g?  
r f h0]Ceeguugf <28/Cr t/4244\_0

]33\_ S 0Y cpi . 'NOEj cpi . 'O 0\ j qw'S 0Nk'J 0Nkw.'cpf 'HOI wq.'0C'ur gevten'cpf 'o qtr j qmji ke  
o gjv qf 'hqt'y j kg'dmqf 'egm'ercuukhlec vkp.ö'Qr v0Ncugt'Vgej pqr0'xqr0: 6.'r r 0366636: .  
42380

]34\_ J 0C0Ck{ w.'T0Uwf ko cp.'O 0C0Cdf w{Te| cm'cpf 'O 0C0Cdf 'Y ej cd.'0T gf 'dmqf 'egm  
ercuukhlec vkp<F ggr 'rgctpkpi 'ctej kgewtg'xgtuwu'ur r qt v'xgevqt'o cej kpg.ö'kp"423: "4pf  
kpgtvcvkpcn'Eqphgtgpeg"qp"DkqUki pcn'Cpcn{ uku.'Rtqeguulpi "cpf "U{ ugo u"\*EDCRU+  
423: .'r r 036463690

]35\_ Z0\ j gpi .[ 0Y cpi .I 0Y cpi . 'cpf 'L0Nkw.'0Hcu'cpf 'tqdwu'ugi o gpvcvkp'qh'y j kg'dmqf  
egm'ko ci gu'd{ "ugrh'ur gtxkugf 'rgctpkpi .ö'O letqp.'xqr0329.'r r 077693.'423: 0

]36\_ R0F 0E0F kxkpc.'L0R0V0Hgrlegu.'E0E0J qt vkpgr'KX.'L0E0Hewuq.'H0N0Xcrkpgv.'cpf 'L0  
T0Dcnlkp.'0Encuukhlec vkp'qh'tgf 'dmqf 'egm'o qtr j qmji { "wukpi "ko ci g'r tqeguulpi "cpf  
ur r qt v'xgevqt'o cej kpg.ö'kp'Rtqeggf lpi u'qh'vj g"4242"32vj "kpgtvcvkpcn'Eqphgtgpeg"qp"  
Dkqo gf lecn'Gpi kpggtkpi "cpf "Vgej pqrmi { ."42420

]37\_ J 0'V0Mkpg.'P 0J 0'Rj wqpi . "J 0'V0Nw{ gp.'P 0'O 0'F we."cpf "F 0'V0Nwqpi . "0Ngwme{ vg  
\*Y j kg" Dmqf " Egm" Ercuukhlec vkp" y kj " c" O wnk'uci g" Uwr r qt v' Xgevqt" O cej kpgö  
Co gtlecp'Lqwtpcn'qh'Dkqo gf lecn'Uekpgeu0'xqr034."pq06.'r r 0438/446.'42420

]38\_ P 0'Vj ggte/Wo r qp."0Y j kg'dmqf 'egm'ugi o gpvcvkp'cpf "ercuukhlec vkp"kp"o letqueqr ke  
dpgg" o cttqy " ko ci gu.ö" kp" Hw| { " U{ ugo u" cpf " Mpqy rfi g" F kueqxt { ." Dgtrkp.  
J glf gndgti <Ur tkpi gt'Dgtrkp"J glf gndgti . "4227.'r r 09: 969; 80

]39\_ P 0'Vj ggte/Wo r qp" cpf "U0'F j qo r qpi uc."0O qtr j qmji lecn'i tcpwqo gwle"hgwtgu"qh  
pwengwu"kp"cwqo cve"dpgg"o cttqy "y j kg'dmqf 'egm'ercuukhlec vkp.ö"KGG"Vtcpu0'kph0  
Vgej pqr0'Dkqo gf 0'xqr033."pq05.'r r 0575657; . "42290

]3: \_ C0Mj cuj o cp."0Dmqf 'egm'kf gpvkhlec vkp'wukpi "c'ulo r r'pgwtcn'pgy qtmö"K0L0P gwtcn  
U{ u0'xqr03: . "pq07.'r r 0675667: . "422: 0

]3; \_ C0Mj cuj o cp."0Dmqf 'egm'kf gpvkhlec vkp'wukpi "go qvkpcn'pgwtcn'pgy qtm.ö"Ru0gf w0  
]Qprkpg\_0 Cxckrdrg<

j wr u<1ekguggtz0u0f uw0f wxkgy f qe lf qy pmqcf Af qk? 3200074: 08436( tgr ?tgr 3( v r g?  
?r f h0]Ceeguugf <28/Cr t/4244\_0

]42\_ U0J 0'Tgl cvqhi j k'cpf "J 0'Uqncpkp/\ cf gj ."0Cwqo cve"tgeqi pkvkp'qh'hkxg"v r gu"qh  
y j kg'dmqf 'egm'kp'r gtr j gten'dmqf .ö'Ego r w0O gf 0'K0 ci lpi "I tcr j 0'xqr057."pq06.  
r r 05556565.'42330

- J43\_ O 0Xgrwej co {.'MORgtwo cn"cpf "VORqpwj co {.'õHgcwtg"gzvtcevqpp"cpf "ercuukhlecwqpp qh'dmqf "egmu"wulpi "ctvkhlecn'pgwtcn'pgwy qtmö"Co 0L0Crr r0Uek0"xqr0; . 'pq07.'r r 08376 83; . '42340
- J44\_ UOP c| rklrgm'F 0Mctceqt."V0Gtecp."O 0J 0Uc| rk"Q0Mcrpft gt."cpf "[ 0Gi g."õCwqo cve ugi o gpwvqpp."eqwvqpi ."uk g"fgvgt o kpcvqpp"cpf "ercuukhlecwqpp"qh'y j kg"dmqf "egmu.ö O gcuwtgo gpv\*Nqpf 0:"xqr077.'r r 07: 687.'42360
- J45\_ U00 cplm'N00 0Uclpk"cpf "P 0Xcf gtc."õEqwvqpi "cpf "ercuukhlecwqpp"qh'y j kg"dmqf "egm wulpi "Ct vkhlecn'P gwtcn'P gy qtm\*"CP P +.ö"kp"4238"KGG"3uv"Kpvtgpcvqppcn'Eqphgtgpeg qp"Rqy gt"Grgevtqpleu."Kpvgmki gpvEqpvtqn'cpf "Gpgti { "U{ ugo u"\*KRGKRGU:"4238.'r r 0 3670
- J46\_ U0Y grgdk' cpf "O 0' Dwtnc { "Y 3/4grk" õTgf " cpf " y j kg" dmqf " egm' ercuukhlecwqpp" wulpi Ct vkhlecn'P gwtcn'P gy qtm.ö"CKO U'Dkqpi 0"xqr07.'pq05.'r r 039; 63; 3.'423: 0
- J47\_ T0'D0J gi fg."M0'Rtcucf."J 0J gddct."cpf "D0'O 0'M0'Ukpi j ."õEqo rctkuqpp"qh'vtcf kkpqcn ko ci g'r tqeguulpi "cpf "f ggr "rgctplpi "cr r tqcej gu"ht"ercuukhlecwqpp"qh'y j kg"dmqf "egmu kp'r gtr j gtcn'dmqf "uo gct"ko ci gu.ö"Dkqe { dgtp0'Dkqo gf 0'Gpi 0"xqr05; . 'pq04.'r r 05: 46 5; 4.'423; 0
- J48\_ U0Ucj c."õC"eqo r t g j gpukxg"i wlf g"vq"Eqpxqmwkqppcn'P gwtcn'P gy qtm/ vj g"grk7"y c { .ö O gf kwo ." 39/F ge/423: 0' JQpikpg\_0' Cxckrcdng< j wr u-llqy ctf uf cvuelgpeg0eqo kc/ eqo r t g j gpukxg/i wlf g/vq/eqpxqmwkqppcn/pgwtcn'pgwy qtm/vj g/grk7/y c { /5df 4d3386c750 JCeeguuf <29/Cr t/4244\_0
- J49\_ O 0Zw."F 0'R0'Rcr ci gqti kqw."U0\ 0'cdk k"O 0'F cq."J 0\ j cq."cpf "I 0'G0'Mctpkf cnku."õC f ggr "eqpxqmwkqppcn'pgwtcn'pgwy qtm'ht"ercuukhlecwqpp"qh'tgf "dmqf "egmu"kp"ulemg"egm cpgo kc.ö"RNqU'Eqo r w0'Dkqr0"xqr035.'pq032.'r 0'g3227968.'42390
- J4: \_ O 0L00 cecy krg."X0X0S wlpqpgu."C0'Dcmf q."L0F 0'Et wj ."cpf "O 0'X0'Ec { c."õY j kg"dmqf egm'ercuukhlecwqpp" cpf "eqwvqpi " wulpi "eqpxqmwkqppcn'pgwtcn'pgwy qtmö"kp"423: "5tf Kpvtgpcvqppcn'Eqphgtgpeg"qp"Eqpvtqn'cpf "Tqdqleu"Gpi kpggtkpi "\*"KETTGT:"423: ."r r 0 47; 64850
- J4; \_ R0'Vky ctk"l0'S kcp."S 0'Nk"D0'Y cpi ."F 0I wr c."C0'Mj cppc."l0'l0'R0'E0'Tqf tki wgu."E0'X0 J wi q."õF gvgevwqpp"qh'uwdv{ r g"dmqf "egmu"wulpi "f ggr "rgctplpi .ö"Eqi p0'U{ u0'T gu0"xqr0 74.'r r 0325863266.'423: 0
- J52\_ [ 0'Y cpi "cpf "[ 0'Ecq."õJ wo cp'r gtr j gtcn'dmqf "rgwnqe { vg"ercuukhlecwqpp"o gj qf "dcugf qp"eqpxqmwkqppcn'pgwtcn'pgwy qtm'cpf "f cvc"cwí o gpwvqpp.ö"O gf 0'Rj { u0"xqr069.'pq03. r r 03646373.'42420



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Cr r gpf kz 'C''

CØ'Y ggm[ 'Tgr qt v

**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV''**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwf { 'y ggnipq0'3"
Uwf gpvP co g'( 'KF <Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xkuqt <F t0Vcp'Lqk'Ucp''	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuukhlec'vqp'Wukpi 'F ggr 'Ngctpkpi ''	

**30Y QTMFQPG**

]Rgcug'y tkg'y g'f g'cku'qh'y g'y qtnf qpg'kp'y g'rcuv'htvpi j v0"

- Tgxlgy kpi "qp'y g'eqf kpi 'f qpg'ht'H[ R'K
- Ugctej 'ht'r quukdr'ko r tqxgo gpw'l'pgz v'lvgr "q'vcng'ht't gugctej

**40Y QTMVQ'DG'FQPG**

- P qv'f qy p'qp'y j lej 'r cyj 'q'vcng'ht'htvj gt'o qf gnko r tqxgo gpv

**50RTQDNGO U'GPEQWPVGTGF**

- P q'r tqdrgo u'gpeqwpvgtgf

**60UGNH'GXCNWCVKQP'QH'VJ G'RTQI TGUU**

- P qv'dgkpi 'r tqf v'v'xg'gpqwi j 'q'dgi kp'y g'r tqlgew't'gugctej 'f wg'q'ugo guvgt dtgcn'u'ghgev



aaaaaaaaaaaaaaaaaaaaaaaaaaaa " "Uwr gt xkuqt u'uki pcwtg"



aaaaaaaaaaaaaaaaaaaaaaaaaaaa " "Uwf gpv u'uki pcwtg"

**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV"**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwf { 'y ggnipq0'4"
Uwf gpv'P co g'( 'K<Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuuklec'kqp"Wukpi 'F ggr 'Ngctp'kpi "	

<p><b>30Y QTMFQPG</b> ]Rgcug'y tkg'y g'f gcku'qh'y g'y qtnf qpg'lp'y g'rcuv'htv'kpi j x0"</p> <ul style="list-style-type: none"> <li>I gw'kpi 'o qtg'uwf { 'o cvgt'knu'uwej "cu'ct'v'engu."lqwt'pcnu."gve0'ht'ht'y gt'tgugctej</li> </ul>
<p><b>40Y QTMVQ'DG'F QPG</b></p> <ul style="list-style-type: none"> <li>Uwf { "qp'y g'T guP gwai'ctej kgewtg</li> <li>Dwkrf 'T guP g'htqo "uetcvej</li> </ul>
<p><b>50RTQDNGO U'GPEQWP VGTGF</b></p> <ul style="list-style-type: none"> <li>Gpeqwpvgtgf "uqo g'wphco k'kct'o gyj qf qm'kpi kgu'htqo "uwf { kpi 't'gugctej 'r cr gtu</li> </ul>
<p><b>60UGNH'GXCNWCVKQP 'QH'VJ G'RTQI TGUU</b></p> <ul style="list-style-type: none"> <li>P qv'dgkpi 'r tqce'v'xg'lp't'gugctej kpi 'ht'y g'r'tqlge'v'ur'cyj</li> </ul>



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"Uwr gt xkuqt'au'uki pcwtg"



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"Uwf gpv'au'uki pcwtg"

**HKP CN' [ GCT'RTQLGEV'Y GGMN' [ 'TGRQTV''**  
*(Project II)*

Vtlo guvgt.[ gct<Vtlo guvgt'5 [ gct'5"	Uwf { 'y ggnipq0'5"
Uwf gpv'P co g' ( 'Kf <Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuukhlec'kqp'Wukpi 'F ggr 'Ngctpkpi "	

**30Y QTMFQPG**

]Rgcug'y tkg'y g'f gcku'qh'y g'y qtnf'qpg'lp'y g'rcuv'htv'pki j x0"

- Uwf kcf 'j ch'qh'y g'T guP gv'u'o qf gn'ctej kgewtg

**40Y QTMVQ'DG'F QPG**

- Eqpv'pwg'uwf { kpi 'cpf 'tgugctej kpi 'kpv'T guP gv'o qf gnu
- F gek'kpi 'qp'y g'r quukdg'tgh'pgo gpv'u'ht'y g'o qf gn

**50RTQDNGO U'GPEQWP VGTGF**

- P q'r tqdngo u'gpeqwpvgtgf

**60UGNH'GXCNWCVKQP 'QH'VJ G'RTQI TGUU**

- Cdrq'v'wpf gtuv'pf 'y g'o cvgt'knu'i kxgp'y tqwi j 'eqpukv'gpv'u'gctej kpi 'cpf 'lqwkpi f qy p'pqv'gu



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 "Uwr gt xkuqt'au'uki pcwtg"




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 "Uwf gpv'u'uki pcwtg"

**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV''**  
(Project II)


Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwv { 'y ggnipq0'6"
Uwv gpv'P co g'( 'KF <Nky 'O wp'Mp.'3: CED26932"	
Uwv gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuukhlec'vqp'Wukpi 'F ggr 'Ngctpkpi "	

<p><b>30Y QTMFQPG</b> ]Rgcug'y tkg'yj g'f gcku'qh'yj g'y qtnf qpg'kp'yj g'rcuv'htvpi j x0"</p> <ul style="list-style-type: none"> <li>Hpkuj gf 'uwv { kpi 'yj g'T guP gv'cej kgewtg</li> </ul>
<p><b>40Y QTMVQ'DG'F QPG</b></p> <ul style="list-style-type: none"> <li>O qxg'qp'kpv'yj g'f guki p'r j cug'vq'f guki p'yj g'T guP gv'o qf gn</li> <li>I gwki 'f cvug'vcpf 'eqf gu'tgcf { 'hqt 'vgukpi 'r wtr qugu</li> </ul>
<p><b>50RTQDNGO U'GPEQWP VGTGF</b></p> <ul style="list-style-type: none"> <li>Wphco kkt'y kj 'yj g'eqf kpi 'rcpi wci g'qhr { yj qp'cpf 'Mgtcu'kdtct { '*f wg'vq'rcem'qh r tceveg+</li> </ul>
<p><b>60UGNHGXCNWCVKQP'QH'VJ G'RTQI TGUU</b></p> <ul style="list-style-type: none"> <li>Uj qwf 'dg'o qtg'eqpukv'gpv'kp'r tcevekpi 'eqf kpi 'cpf 'vcng'vko g'vq'tgcf 'eqf kpi f qewo gpv'vqp</li> </ul>



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\*\*\*\*\*Uwv gt xkuqt u'uki pcwtg"



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"Uwv gpv'u'uki pcwtg"

**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV"**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwf { 'y ggnipq0'7"
Uwf gpv'P co g'( 'Kf <Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xluqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuukhlec'vqp'Wukpi 'F ggr 'Ngctpki "	

**30Y QTMFQPG**

]Rgcug'y tkg'y g'f gcku'qh'y g'y qtnf qpg'lp'y g'rcuv'htvpi j x0"

- K gpv'khgf 'y g'o gyj qf 'vq'dwkrf 'y g'T guP gv'o qf gn
- T ghpki 'eqf gu

**40Y QTMVQ'DG'FQPG**

- Ectt{ 'qp'y kj 'y g'eqf kpi 'hqt'o qf grleqpustwvki 'cpf 'vckpki

**50RTQDNGO U'GPEQWP VGTGF**

- Vtqwdrg'lp'hkpf kpi 'uwkcdrg'tghgtgpegu'hqt'eqf kpi 'y g'f guki p'dmqemu

**60UGNH'GXCNWCVKQP'QH'VJ G'RTQI TGUU**

- Uj qwf 'ux{ 'r tq/cevkg'lp'eqo r ngvki 'y g'eqf kpi 'cumkpuvgcf 'qh'i gwki 'f kurtcevgf



aaaaaaaaaaaaaaaaaaaaaaaaaaaa " "Uwr gt xluqt au'uki pcwtg"



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**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV''**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwf { 'y ggnipq0'8"
Uwf gpv'P co g'( 'K<Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuuklecvkp"Wukpi 'F ggr 'Ngctpki "	

**30Y QTMFQPG''**

]Rgcug'y tkg'y g'f gcku'qh'y g'y qtnf qpg'lp'y g'rcuv'htvpi j x0"

- Hpkuj gf 'f gtxkpi 'y g'dwrf kpi 'dmemleqf gu'qh'T guP gv'
- Vguv'twp'qp'y g'vcklpi 'r j cug"

**40Y QTMVQ'DG'F QPG''**



- Uctv'y g'vcklpi 'r j cug'ht'y g'o qf gni"
- F ghp'y g'gzt gto gp'vetkgtk'ht'y g'o qf gni"

**50RTQDNGO U'GPEQWP VGTGF''**

- J cxkpi 'f hlewngu'lp'f gekf kpi 'y j lej 'etkgtk'vq'ej qqug'ht'gzt gto gpw"

**60UGNHGXCNWCVKQP'QH'VJ G'RTQI TGUU''**

- Eqwf 'o cpci g'vko g'y gml'ht'kpeqo kpi 'o kf vto u'o gcpy j kg'f qkpi 'tgugtej kpi 'ht' y g'r tqlgev'


  
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 "Uwr gt xkuqt u'iki pcwtg" " " " " " " " " " "Uwf gpv'u'iki pcwtg"

**HKP CN' [ GCT'RTQLGEV'Y GGMN' TGRQTV''**

*(Project II)*

Vtlo guvgt.[ gct<Vtlo guvgt'5 [ gct'5"	Uwf { 'y ggnipq0<9"
Uwf gpvP co g'( 'KF <Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xluqt <F t0Vcp'LqkUcp"	
Rt ql gev'Vlmg<Dmqf 'Egm'Ercuukhlec vqp'Wukpi 'F ggr 'Ngctpkpi ''	

**30Y QTMFQPG''**

]Rgcug'y tkg'yj g'f gcku'qh'yj g'y qtnf qpg'lp'yj g'rcuv'htvpi j x0"

- F gvto kpgf 'yj g'etkgtk'hq'gzr gtko gpvcvqp"
- Vtclpgf 'c'eqwr mg'qh'o qf gnu'y kj 'f khtgpv'eqphki wtcvqpu"

**40Y QTMVQ'DG'F QPG''**

- Crr gpf 'eqf kpi 'v'gzvcev'gzvte'kphqto cvkqp'cpf 'ko r tqxg'tgcf cdkrkv{ "
- Eqvkwpg'yj g'gzr gtko gpv'qh'yj g'o qf gn'

**50RTQDNGO U'GPEQWP VGTGF ''**

- Wpucdnr'kpvgtpgv'eqppgevqpu'y j lej 'j kpf gtgf 'r tqi tguu'qh'tcckpki "
- Nko kvgf 'I RW'wuci gu'htqo 'Eqrd'y j lej 'f grc{ 'r tqi tguu"

**60UGNH'GXCNWCVKQP 'QH'VJ G'RTQI TGUU''**

- J cf 'v'r tcevleg'r cvkpeg'cpf 'dg'cvwpvkvxg'v'yj g'eqf g'f wtkpi 'twpvko g'v'cxqkf " r tqi tguu'f grc{ u"

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 "Uwr gt xluqt au'uki pcwtg" " " " " " " " " " " "Uwf gpvau'uki pcwtg"  
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**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV''**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwf { 'y ggnipq0'! "
Uwf gpv'P co g'( 'K<Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt ql gev'Vlmg<Dmqf 'Egm'Ercuukhlec'vqp'Wukpi 'F ggr 'Ngctpkpi "	

**30Y QTMFQPG**

]Rgcug'y tkg'y g'f gcku'qh'y g'y qtnf qpg'lp'y g'rcuv'htvpi j x0"

- Eqo r ngv'\*3 l5+'g'zr g'ko gpvc'vqp'qp'y g'o qf gn

**40Y QTMVQ'DG'F QPG**

- Eqpv'pwg'y g'g'zr g'ko gpvc'vqp'qp'y g'o qf gn
- Uctv'q'tgh'pg'y g'tgr qtv'u'ctv'pi 'htqo 'Ej cr vgt'3"cpf'4

**50RTQDNGO U'GPEQWP VGTGF**

- Nko k'gf 'I RW'wuci gu'htqo 'Eqrd'y j lej 'f grc{ gf 'r tqi tguu

**60UGNH'GXCNWCVKQP 'QH'VJ G'RTQI TGUU**

- Cdrq'v'j' cpf ng'y g'f h'hw'ku'hc'egf "ch'gt'f k'uew'vqp'y kj 'uwr gtxkuqt



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"Uwr gtxkuqt'v'uki pcwtg"



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"Uwf gpv'v'uki pcwtg"

C/:

**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV''**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwv { 'y ggnipq0'; "
Uwv gpv'P co g'( 'KF <Nky 'O wp'Mp.'3: CED26932"	
Uwr gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuukhlec'vqp'Wukpi 'F ggr 'Ngctpkpi "	

**30Y QTMFQPG''**

]Rgcug'y tkg'y g'f gcku'qh'y g'y qtnf qpg'lp'y g'rcuv'htvpi j x0"

- Eqo r ngv'415+'g'zr g'ko gpvc'vqp'qp'y g'o qf gn'
- Tgh'pgf 'Ej cr vgt'3'cpf '4'qh'tgr qtv'

**40Y QTMVQ'DG'F QPG''**



- Eqpv'pwg'v'q'hp'kuj 'wr 'y g'zr g'ko gpvc'vqp'qh'y g'o qf gn'
- Uctv'q'y tkg'Ej cr vgt'5'cpf '6'qh'y g'tgr qtv'

**50RTQDNGO U'GPEQWP VGTGF''**

- Vlo g'o cpci go gpv'kuwgu'f wg'v'q'qj gt'cuuki po gpv'cpf 'o kf vgtu u'

**60UGNH'GXCNWCVIQP'QH'VJ G'RTQI TGU''**

- Uj qwf 'vcng'uqo g'v'ko g'qh'dghqtg'f kx'kpi 'lpv'q'y qtn'ci ckp'v'q'r t'gxgpv'qxgt/gzj cwukqp'cpf 'r tqf weg'dgwgt's wcrk'v' y qtn'



  
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 "Uwr gt xkuqt'v'uki pcwtg" " " " " " " " " " "Uwv gpv'v'uki pcwtg"
   
 " " " " " " " " " "

**HKP CN[ GCT'RTQLGEV'Y GGMN[ 'TGRQTV''**  
(Project II)

Vtlo guvgt.[ gct<Vtlo guvgt'5[ gct'5"	Uwff { 'y ggnipq0'32"
Uwff gpv'P co g'( 'KF <Nky 'O wp'Mkp.'3: CED26932"	
Uwr gt xkuqt <F t0'Vcp'Lqk'Ucp"	
Rt qlgev'Vlmg<Dmqf 'Egm'Ercuukhlec'vqp'Wukpi 'F ggr 'Ngctpkpi "	

**30Y QTMFQPG**

]Rgcug'y tkg'yj g'f gcku'qh'yj g'y qtnf qpg'lp'yj g'rcuv'htvpi j x0"

- Eqo r ngv'5 l5+'g zr gtko gpw'vqp'qp'yj g'o qf gn
- Eqo r ngvf 'Ej cr vgt'5'qh'yj g'tgr qtv

**40Y QTMVQ'DG'F QPG**

- Eqo r kq'cm'yj g'tguwmu'eqo r wgf 'hqt'tgr qtvkpi
- Eqo r ngv'Ej cr vgt'6'cpf '7'qh'yj g'tgr qtv

**50RTQDNGO U'GPEQWP VGTGF**

- Qxgty j gm kpi 'vcumi'cpf 'chcktu'v'j'j' cpf ng

**60UGNH'GXCNWCVIQP'QH'VJ G'RTQI TGUU**

- Uj qwf 'rgv'qh'uqo g'uvgeo 'd{ 'vcnkpi 'dtgcmi'lp'dgvy ggp'y qtmu'cpf 'cxqkf 'gzeguukxg qwkpi u'hqt'uo qqy gt'r tqi tguu'qh'yj g'r tqlgev



aaaaaaaaaaaaaaaaaaaaaaaaaaaa " "Uwr gt xkuqt u'uki pcwtg"



aaaaaaaaaaaaaaaaaaaaaaaaaaaa " "Uwff gpv'u'uki pcwtg"

# FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year:</b> Trimester 3 Year 3	<b>Study week no.:</b> 11
<b>Student Name &amp; ID:</b> Liaw Mun Kin, 18ACB04710	
<b>Supervisor:</b> Dr. Tan Joi San	
<b>Project Title:</b> Blood Cell Classification Using Deep Learning	

## 1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Completed (1/2) of Chapter 4 for report
- Documentation of the results

## 2. WORK TO BE DONE

- Finish up the report on Chapter 5
- Check on the formatting of the report

## 3. PROBLEMS ENCOUNTERED

- No problems encountered

## 4. SELF EVALUATION OF THE PROGRESS

- Capable of finishing up the project's report but with extra hours put in



Supervisor's signature



Student's signature

# FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year:</b> Trimester 3 Year 3	<b>Study week no.:</b> 12
<b>Student Name &amp; ID:</b> Liaw Mun Kin, 18ACB04710	
<b>Supervisor:</b> Dr. Tan Joi San	
<b>Project Title:</b> Blood Cell Classification Using Deep Learning	

## 1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Completed Chapter 4 and Chapter 5 of report
- Refined the format of the report according to guideline provided

## 2. WORK TO BE DONE

- Submit the report after getting supervisor's approval

## 3. PROBLEMS ENCOUNTERED

- No problems encountered

## 4. SELF EVALUATION OF THE PROGRESS

- Proud of the achievement done for the project and time was well spent for the entire week



Supervisor's signature



Student's signature

## A.2 POSTER



Universiti Tunku Abdul Rahman  
Faculty of Information and Communication Technology (FICT)

### BLOOD CELL CLASSIFICATION USING DEEP LEARNING

Done by: Liaw Mun Kin (18ACB04710)  
Supervisor: Dr Tan Joi San

#### Introduction

- Experts have been doing blood cell identification manually which is **time consuming and prone to mistakes**.
- Introduction of **AI technology** have created convenience for humans by automating daily tasks
- A **automated blood cell classification using deep learning method** was proposed in this project. A **pre-trained model, ResNet** was utilized due to its robustness to **classify White Blood Cells (WBCs)** into four subtypes (Eosinophils, Lymphocytes, Monocytes)

#### Objectives

- **To propose a method for classification of WBCs using ResNet models from scratch**
  - ResNet model was build from scratch to have better control over its layers.
- **To determine an efficient model for WBC diseases classification through hyperparameter tuning**
  - Learning rate was hypertuned for the ResNet model to achieve a robust model.

#### Methodology



#### Results

**Finalized ResNet-50 model** with batch size of 16, learning rate of 0.0009, 3 dense layers, use of global average pooling and dropping Neutrophils class achieved validation accuracy of **99%**

May 2022

# PLAGIARISM CHECK RESULT

## PLAGIARISM CHECK RESULT

FYP2\_turnitin

### ORIGINALITY REPORT

<b>13%</b>	<b>8%</b>	<b>11%</b>	<b>%</b>
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

### PRIMARY SOURCES

<b>1</b>	<a href="http://link.springer.com">link.springer.com</a> Internet Source	<b>1%</b>
<b>2</b>	A.I. Shahin, Yanhui Guo, K.M. Amin, Amr A. Sharawi. "White blood cells identification system based on convolutional deep neural learning networks", Computer Methods and Programs in Biomedicine, 2017 Publication	<b>&lt;1%</b>
<b>3</b>	Gaobo Liang, Huichao Hong, Weifang Xie, Lixin Zheng. "Combining Convolutional Neural Network With Recursive Neural Network for Blood Cell Image Classification", IEEE Access, 2018 Publication	<b>&lt;1%</b>
<b>4</b>	<a href="https://github.com">github.com</a> Internet Source	<b>&lt;1%</b>
<b>5</b>	<a href="http://www.mdpi.com">www.mdpi.com</a> Internet Source	<b>&lt;1%</b>
<b>6</b>	<a href="http://eprints.utar.edu.my">eprints.utar.edu.my</a> Internet Source	<b>&lt;1%</b>



\*\*\*\*\*HCE WNV [ 'QH'PHOTO CVKQP 'CPF 'EQO O WP'EC CVKQP '\*\*\*\*\*  
 \*\*\*\*\*VGEJ PQNQI [ " "

HwmlP co g*u+qh' Ecpf kf cvg*u"	"Nky 'O wp"Mlp"
Kf 'P wo dgt *u+' "	"3: CED26932" "
Rt qi tco o g'IEqwtug"	"Dcej grqt'qh'Ego r wgt'Uekpeg'*J qpqwtu+"
Vlwg'qh'Hpcrl[ gct'Rt qlgev'	"DNQQF 'EGNN'ENCUIKHEC VKQP "WUR I 'F GGR'NGCTP R I

Uo kctkw' "	Uwr gtxkuqt a'Ego o gpw" *Ego r wuqt { 'Hf'ct co gvgu'qh'qt ki lpcrk' " gzeggf 'vj g'iko kw'cr r tqxgf 'd' 'WCT+ "
Qxgtenlko kctkw' lpf gz < "35" " "	"P q'eqo o gpv"
Uo kctkw' d' 'lqwt eg" Kvgtpgv'Uqwt egu < " " " Rwdkcvkpu < "33" " " Uwf gpv'Rcr gt u < "2" " "	
" P wo dgt 'qh'lpf klf wcnlqwt egu'ikwgf " qh'o qtg'vj cp'5' "uko kctkw' < "2" " "	"P q'eqo o gpv"
<p>Rct co gvgu'qh'qt ki lpcrk' 'tgs wkt gf . 'cpf 'iko kw'cr r tqxgf 'd' 'WCT' 'ctg' 'eu'Hqmy u &lt; "          " *k' " Qxgtenlko kctkw' lpf gz 'ku'42' ' 'cpf 'dgnny . 'cpf "          *k' " O cvej lpi 'qh'lpf klf wcnlqwt egu'ikwgf 'b wu'dg'igu'vj cp'5' 'gcej . 'cpf "          *k' " O cvej lpi 'vgz w'lp 'eqvlpwqwu'dmenib wu'pqv'gzeggf ' ! 'y qtf u"          Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words. "</p>	

P qv < "Uwr gtxkuqt IEcpf kf cvg\*u+ 'kukt g' tgs wkt gf 'vq' r tqxkf g' uqhweqr { "qh'hwml'ugv'qh'vj g"  
 qtki lpcrk' 'tgr qtv'vq' Hcewml' l'pukwmg"

*Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.*

"  
"  
"

Uki pcwtg'qh'Uwr gtxkuqt"  
"  
P co g < "F t0Vcp'Iqk'Ucpaaaaaaa"  
"  
F cvg < " : 1; 4244aaaaaaaaaaaaa"

Uki pcwtg'qh'Eg/Uwr gtxkuqt"  
"  
P co g < "  
aaaaaaaaaaaaaaaaaaaaaaaaaaaaa"  
"  
F cvg < "  
aaaaaaaaaaaaaaaaaaaaaaaaaaaaa"





## UNIVERSITI TUNKU ABDUL RAHMAN

### FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

#### CHECKLIST FOR FYP2 THESIS SUBMISSION

Student ID	18ACB04710
Student Name	LIAW MUN KIN
Supervisor Name	DR TAN JOI SAN

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N/A	Front Plastic Cover (for hardcopy)
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✓	Table of Contents
✓	List of Figures (if applicable)
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N/A	List of Symbols (if applicable)
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✓	Bibliography (or References)
✓	All references in bibliography are cited in the thesis, especially in the chapter of literature review
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Date: 8/9/2022