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METODE CNN UNTUK PENENTUAN EMOSI BERDASARKAN EKSPRESI WAJAH PADA VIDEO

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2020

PROGRAM STUDI INFORMATIKA

PROGRAM MAGISTER FAKULTAS SAINS DAN TEKNOLOGI

UIN SUNAN KALIJAGA YOGYAKARTA

METODE CNN UNTUK PENENTUAN EMOSI BERDASARKAN EKSPRESI WAJAH PADA VIDEO

TESIS

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UNIVERSITAS ISLAM NEGERI SUNAN KALIJAGA

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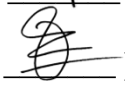
Penguji 2 : Dr. Agung Fatwanto, M.Kom. ()

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ABSTRAK

Emosi seseorang dapat ditunjukan melalui ekspresi wajah. Ekspresi wajah manusia dapat berubah-ubah secara dinamis tanpa disadari oleh orang tersebut. Penelitian ini melakukan penentuan emosi dengan melakukan pengenalan ekspresi wajah manusia di dalam sebuah video. Setiap perubahan ekspresi akan direkam dan dianalisis sehingga ditemukan emosi yang paling dominan. Metode dalam penelitian ini adalah dengan melakukan klasifikasi terhadap 6 ekspresi dasar wajah manusia ditambah ekspresi netral dengan *Convolutional Neural Network* (CNN). Data utama yang digunakan dalam penelitian ini adalah FER-2013. Pemerataan distribusi data dilakukan untuk meningkatkan kinerja model. Teknik regularisasi dan proses pelatihan menggunakan cross-validation diterapkan dalam pengembangan model CNN untuk mencegah terjadniya *overfitting*. Pemodelan tersebut menghasilkan model klasifikasi yang dapat diterapkan pada sebuah video. Model tersebut diuji menggunakan data yang terpisah dari data latih dan dievaluasi menggunakan *confusion matrix*. Sebagai hasil evaluasi, diperoleh akurasi 74.17%, rata-rata presisi 75.14%, dan rata-rata *recall* 74.18%. Penentuan emosi manusia dengan menghitung banyaknya ekspresi wajah yang muncul di dalam video pada rentang waktu tertentu. Emosi pada video didasarkan pada ekspresi wajah yang paling dominan pada video tersebut.

Kata kunci: Emosi, Ekspresi Wajah, CNN.

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DAFTAR SINGKATAN

AI	: Artificial Intelligent
ANN	: Artificial Neural Network
CNN	: Convolutional Neural Network
K-NN	: K-Nearest Neighbor
LBP	: Local Binary Pattern
LDA	: Linear Discriminant Analysis
MLP	: Multi Layer Peceptron
ReLU	: Rectified Linear Units
SVM	: Support Vector Macine
FER	: Facial Expression Recognition

DAFTAR ISTILAH

Akurasi	:	Ukuran seberapa dekat suatu hasil pengukuran dengan nilai yang benar atau diterima dari kuantitas besaran yang diukur.
Dropout	:	Pemutusan neuron (baik yang tersembunyi maupun yang terlihat) di dalam jaringan saraf.
Emosi	:	Suatu perasaan atau gejolak jiwa yang muncul di dalam diri seseorang sebagai akibat dari adanya rangsangan, baik dari dalam diri sendiri maupun dari luar.
Ekspresi	:	Pengungkapan ataupun suatu proses dalam mengutarakan maksud, perasaan, gagasan dan sebagainya.
Epoch	:	Suatu langkah yang dilakukan dalam pembelajaran pada jaringan syaraf.
Kernel	:	Sebuah jendela/matriks berukuran kecil yang digunakan dalam operasi konvolusi yang akan memeberikan efek seperti blurring, sharpening, embossing, dan sebagainya.
Kovariat	:	variabel bebas yang berkorelasi dengan variabel terikat.

Loss	:	Ukuran kuantitatif dari penyimpangan atau perbedaan antara output yang diprediksi dengan output.
Neuron	:	Satuan kerja utama dari sistem saraf yang berfungsi menghantarkan impuls listrik yang terbentuk akibat adanya suatu stimulus (rangsang).
Pooling	:	Lapisan yang mengurangi ukuran dimensi fitur dengan tujuan untuk mempercepat komputasi.
Presisi	:	Ukuran seberapa dekat serangkaian pengukuran satu sama lain.
Recall	:	Presentase total hasil yang relevan yang diklasifikasikan dengan tepat.
Regularisasi	:	Teknik yang digunakan untuk mengatur atau memperkecil perbedaan dari loss yang diperoleh dari proses pelatihan dengan data yang sudah pernah dilihat oleh model dan loss yang diperoleh dengan data baru.

BAB I

PENDAHULUAN

A. Latar Belakang Masalah

Emosi tidak dapat dipisahkan dalam kehidupan manusia. Perilaku manusia banyak dipengaruhi oleh emosinya. Emosi merupakan kekuatan pendorong yang hebat sepanjang rentang kehidupan manusia, mempengaruhi aspirasi, pikiran, dan tindakan seseorang (Jaisri and Joseph, 2013). Salah satu fungsi emosi adalah sebagai respon perlindungan diri agar manusia dapat beradaptasi dengan lingkungannya (Pratama, 2016). Sebagai contoh, bahagia merupakan emosi sebagai respon terhadap sesuatu yang menyenangkan dari lingkungannya. Sebaliknya, marah merupakan sebuah respon terhadap lingkungannya yang tidak menyenangkan.

Ekspresi wajah adalah salah satu cara, yang disebut komunikasi nonverbal, untuk mengungkapkan segala macam emosi baik yang negatif maupun yang positif (Prawitasari, 1995). Ekspresi wajah adalah perubahan wajah dalam menanggapi keadaan emosi, niat, atau komunikasi sosial seseorang (Tian, Kanade and Cohn, 2011). Seseorang dapat memiliki ekspresi wajah yang dapat dikontrol oleh dirinya sendiri secara sengaja, tetapi pada umumnya ekspresi wajah dapat timbul secara alami akibat perasaan atau emosi manusia tersebut. Ekspresi yang muncul secara tidak disengaja inilah yang dapat menggambarkan perasaan atau emosi pada saat itu. Ekspresi wajah sangat menarik untuk diteliti karena merupakan salah satu komunikasi non-verbal yang dapat digunakan untuk menyampaikan pesan sosial

dalam kehidupan manusia serta menggambarkan keadaan emosi seseorang. Wajah manusia dapat menggambarkan perasaan manusia saat itu. Mengenali ekspresi wajah merupakan cara penting untuk mengetahui apa yang dirasakan seseorang.

Seseorang terkadang ingin menyembunyikan perasaan atau emosinya, tetapi biasanya hal ini sangat sulit dilakukan karena wajah mereka biasanya akan menunjukan perasaan yang sebenarnya. Misalnya, seseorang ingin menyembunyikan perasaan bencinya terhadap orang lain, tetapi pada saat tertentu tanpa sengaja akan menunjukkan perasaannya tersebut di wajahnya, walaupun orang tersebut sangat pandai menyembunyikan perasaan tersebut. Sebaliknya, banyak orang yang salah membaca emosi sesorang karena hanya melihat sesaat saja padahal mereka sedang menyembunyikan perasaannya. Hal ini tentunya memerlukan pengamatan terus menerus terhadap perubahan ekspresi wajah seseorang. Namun hal ini tidak dapat dilakukan oleh manusia secara langsung karena pada saat tertentu akan mengalami kejenuhan yang mengakibatkan ketidaktelitian.

Penentuan emosi pada video melalui pengenalan ekspresi wajah merupakan salah satu cara untuk mengatasi permasalahan tersebut. Pengenalan ekspresi wajah merupakan pengembangan dari pengenalan wajah yang mampu mengidentifikasi wajah yang biasanya sulit untuk dilakukan. Banyak metode dan algoritma kecerdasan buatan dan pembelajaran mesin yang digunakan dalam pengenalan ekspresi wajah seperti K-NN (Arora, Anand and Tanwar, 2016) dan SVM (Vasanth and Nataraj, 2015). Kedua algoritma tersebut bekerja dengan melakukan klasifikasi terhadap input citra ke dalam beberapa kelas

ekspresi yang telah ditentukan. Dalam melakukan pengenalan wajah termasuk pengenalan ekspresi wajah, terdapat beberapa proses yang dilakukan seperti *face detection*, *face alignment*, *feature extraction*, dan *face mathcing* (Li and Jain, 2011). K-NN dan SVM biasanya hanya melakukan pencocokan wajah saja dan proses-proses sebelumnya biasanya dilakukan secara terpisah dengan mengandalkan kemampuan manusia dan dikombinasikan dengan beberapa metode pembelajaran mesin lainnya, seperti seperti *Principal Component Analysis (PCA)*, *Linear Discriminant Analysis (LDA)*. Kinerja sebuah model pengenalan wajah biasanya tergantung pada jenis algoritma yang dipilih, dan algoritma klasifikasi juga sangat tergantung dengan jenis metode ekstraksi fitur yang digunakan. Kondisi seperti ini tentunya sangat membutuhkan ketelitian dan kesesuaiann setiap metode yang digunakan pada masing-masing tahapan.

Seiring dengan semakin meningkatnya kemampuan perangkat komputer dalam melakukan pemrosesan, muncul teknologi baru yang mampu memperbaiki kekurangan-kekurangan yang dimiliki oleh pembelajaran mesin, termassuk K-NN dan SVM. Teknologi tersebut disebut dengan pembelajaran struktural mendalam (*deep structured learning*) atau dikenal dengan pembelajaran mendalam (*deep learning*). Pembelajaran mendalam memungkinkan model komputasi yang terdiri dari beberapa lapisan pemrosesan untuk mempelajari representasi data dengan berbagai tingkat abstraksi (Lecun, Bengio and Hinton, 2015). Salah satu algoritma pembelajaran mendalam yang digunakan dalam pengenalan wajah adalah *Convolutional Neural Network* (CNN). CNN memiliki kemampuan untuk mengekstraksi fitur secara otomatis. Hal ini tentunya dapat mengurangi beban

pemrograman dalam memilih algoritma ekstraksi fitur yang selama ini dilakukan pada pembelajaran mesin konvensional.

Permasalahan yang sering muncul dalam penggunaan CNN dalam klasifikasi citra tidak terlepas dari kualitas model yang dihasilkan itu sendiri. Peningkatan kualitas biasanya diselesaikan dengan penambahan jumlah dataset. Terkadang model yang dihasilkan dapat memprediksi suatu kelas dengan sangat akurat, tetapi kurang baik untuk kelas lain. Hal ini dapat terjadi karena tidak seimbangnya distribusi data latih pada saat pemodelan sehingga model seperti menghapal kelas-kelas tertentu saja. Permasalahan lainnya yang sering muncul dalam klasifikasi citra adalah terjadinya o*verfitting*, yaitu suatu kondisi dimana model dapat mengenali dengan baik data yang digunakan dalam proses pelatihan, tetapi kurang baik terhadap data yang belum pernah ditemui. Selain itu, apabila terdapat lapisan-lapisan yang sangat rumit dan mendalam tentunya akan mengakibatkan model yang dihasilkan akan sangat besar selain dalam proses pelatihannya juga memakan waktu yang cukup lama.

Untuk mengatasi permasalahan tersebut diperlukan arsitektur model CNN yang sederhana karena dalam proses pengenalan ekspresi wajah di dalam video harus dilakukan dengan cepat. Pemerataan distribusi data diperlukan agar model dapat mempelajari data dengan kelas yang seimbang, sehingga model tidak hanya menghapal kelas-kelas tertentu saja. Selanjutnya permasalan *overfitting* dapat dikurangi dengan regularisasi, yaitu dengan mengatur agar *loss* atau *error* yang diperoleh dari data yang pernah dilihat sebelumnya dengan *loss* atau *error* yang diperoleh dari data yang belum pernah dilihat sebelumnya. Selain itu, penerapan *cross-*

validation dilakukan pada saat proses pelatihan, sehingga setiap data dapat terlibat sebagai data latih dan data uji.

Dengan memanfaatkan teknologi pembelajaran mendalam terutama CNN, peneliti mencoba melakukan penentuan emosi pada video dengan melakukan pengenalan terhadap setiap perubahan ekspresi wajah pada setiap frame, dengan tujuan untuk mendapatkan ekspresi dominan pada rentang waktu tertentu, sehingga dapat menentukan emosi sebenarnya dari seseorang di dalam video tersebut.

B. Rumusan Masalah

Mengacu pada uraian latar belakang diatas, maka rumusan masalah dalam penelitian ini antara lain:

1. Bagaimana menentukan emosi pada video dengan CNN?
2. Bagaimana meyeimbangkan distribusi dataset yang digunakan untuk melakukan pelatihan model CNN?
3. Bagaimana mengurangi *overfitting* yang sering terjadi di dalam CNN?
4. Bagaimana kinerja model CNN yang dikembangkan dalam melakukan pengenalan ekspresi wajah?

C. Batasan Masalah

Untuk menghindari pembahasan yang meluas, maka peneliti hanya membatasi pembahasan permasalahan hanya pada penentuan emosi di dalam video dengan melakukan pengenalan ekspresi wajah pada setiap frame menggunakan model CNN, serta melakukan pemerataan dataset dan mengurangi *overfitting* dengan *regularisasi* dan *cross-validation* untuk mendapatkan model yang ringan dan sederhana.

D. Tujuan dan Manfaat Penelitian

Penelitian ini bertujuan untuk mengembangkan model CNN sederhana tetapi memiliki kinerja handal yang dapat digunakan untuk menentukan emosi di dalam sebuah video. Sedangkan kegunaan dari penelitian ini diharapkan mampu mambantu seseorang untuk mengetahui kecenderungan emosi orang lain.

BAB V

PENUTUP

A. Kesimpulan

Kesimpulan dari penelitian ini antara lain:

1. Emosi manusia dapat ditemukan dengan melakukan klasifikasi terhadap setiap perubahan ekspresi manusia pada setiap frame di dalam sebuah video dengan memanfaatkan teknologi pembelajaran mendalam (*deep learning*) khususnya *Convolution Neural Network* (CNN).
2. Pemerataan distribusi data dilakukan untuk meningkatkan kinerja model dengan melakukan flip dan rotasi pada citra di dalam kelas dengan jumlah anggota sedikit.
3. Overfitting dalam CNN dapat dikurangi dengan teknik regularisasi dan cross-validation pada saat pelatihan.
4. Model klasifikasi menggunakan Convolution Neural Network (CNN) menghasilkan akurasi sebesar 74%, rata-rata presisi 75,05%, dan rata-rata recall 74%.

B. Saran

Penentuan emosi pada video memerlukan pemrosesan yang cepat. Oleh karena itu, perlu dikembangkan lebih lanjut model yang sederhana tetapi memiliki kinerja yang baik. Selain itu, *noise* pada video sering mengganggu dalam proses penentuan emosi, sehingga perlu pemrosesan lebih lanjut untuk menghilangkan *noise* tersebut.

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LAMPIRAN I

SAMPEL DATA FER-2013

Emotion	*Pixels*	*Usage*
0	70 80 82 72 58 58 60 63 54 58 60 48 89 115 121 119 115 110 98 91 84 84 90 99 110 126 143 153 158 171 169 172 169 165 129 110 113 107 95 79 66 62 56 57 ...	Training
0	151 150 147 155 148 133 111 140 170 174 182 154 153 164 173 178 185 185 189 187 186 193 194 185 183 186 180 173 166 161 147 133 172 151 114 161 161 14 ...	Training
2	231 212 156 164 174 138 161 173 182 200 106 38 39 74 138 161 164 179 190 201 210 216 220 224 222 218 216 213 217 220 220 218 217 212 174 160 162 160 1 ...	Training
4	24 32 36 30 32 23 19 20 30 41 21 22 32 34 21 19 43 52 13 26 40 59 65 12 20 63 99 98 98 111 75 62 41 73 118 140 192 186 187 188 190 190 187 182 176 173 ...	Training
6	4 0 0 0 0 0 0 0 0 0 0 0 3 15 23 28 48 50 58 84 115 127 137 142 151 156 155 149 153 152 157 160 162 159 145 121 83 58 48 38 21 17 7 5 25 27 24 25 1 0 0 ...	Training
2	55 55 55 55 55 54 60 68 54 85 151 163 170 179 181 185 188 188 191 196 189 194 198 197 195 194 190 193 195 184 175 172 161 159 158 159 147 136 137 136 ...	Training
4	20 17 19 21 25 38 42 42 46 54 56 62 63 66 82 108 118 130 139 134 132 126 113 97 126 148 157 161 155 154 154 164 189 204 194 168 180 188 214 214 214 21 ...	Training
3	77 78 79 79 78 75 60 55 47 48 58 73 77 79 57 50 37 44 56 70 80 82 87 91 86 80 73 66 54 57 68 69 68 68 49 46 75 71 69 70 70 72 72 71 72 74 77 76 83 84 ...	Training
3	85 84 90 121 101 102 133 153 153 169 177 189 195 199 205 207 209 216 221 225 221 220 218 222 223 217 220 217 211 196 188 173 170 133 117 131 121 88 73 ...	Training
2	255 254 255 254 254 179 122 107 95 124 149 150 169 178 179 179 181 181 184 190 191 191 193 190 190 195 194 192 193 196 193 192 188 182 173 162 152 144 ...	Training
0	30 24 21 23 25 25 49 67 84 103 120 125 130 139 140 139 148 171 178 175 176 174 180 180 178 178 182 185 183 186 186 178 180 172 175 171 155 152 141 136 ...	Training
6	39 75 78 58 58 45 49 48 103 156 81 45 41 38 49 56 60 49 32 31 28 52 83 81 78 75 62 31 18 19 19 20 17 20 16 15 12 10 11 10 23 36 65 59 9 3 5 7 93 69 86 ...	Training
6	219 213 206 202 209 217 216 215 219 218 223 230 227 227 233 235 234 236 237 238 234 226 219 212 208 201 190 183 176 161 74 15 24 22 22 22 21 19 19 20 ...	Training

6	148 144 130 129 119 122 129 131 139 153 140 128 139 144 146 143 132 133 134 130 140 142 150 152 150 134 128 149 142 138 156 155 140 136 143 143 139 14 ...	Training
3	4 2 13 41 56 62 67 87 95 62 65 70 80 107 127 149 153 150 165 168 177 187 176 167 152 128 130 149 149 146 130 139 139 143 134 105 78 56 36 50 69 82 64 ...	Training
5	107 107 109 109 109 109 110 101 123 140 144 144 149 153 160 161 161 167 168 169 172 172 173 175 176 171 170 166 165 162 162 157 150 149 145 140 136 13 ...	Training
3	14 14 18 28 27 22 21 30 42 61 77 86 88 95 100 99 101 99 98 99 99 96 101 102 96 95 94 88 78 72 65 55 40 25 20 20 42 64 74 129 133 125 144 151 153 154 1 ...	Training
2	255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 25 ...	Training
6	134 124 167 180 197 194 203 210 204 203 209 204 206 211 211 216 219 224 228 230 230 226 222 220 217 217 210 207 213 210 199 191 190 188 177 172 148 14 ...	Training
4	219 192 179 148 208 254 192 98 121 103 145 185 83 58 114 227 225 220 203 202 168 154 157 164 182 211 164 94 122 155 176 238 240 242 192 87 43 39 60 85 ...	Training
4	1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 7 12 23 45 38 35 14 43 27 31 24 18 20 29 18 6 2 4 2 0 1 1 1 1 0 5 13 16 16 16 15 14 1 1 1 1 1 1 1 1 1 1 1 1 0 0 3 7 9 ...	Training
2	174 51 37 37 38 41 22 25 22 24 35 51 70 83 98 113 119 127 136 149 149 141 125 107 77 50 30 21 9 38 96 79 72 87 60 23 25 43 29 24 33 51 36 33 26 20 136 ...	Training
0	123 125 124 142 209 226 234 236 231 232 235 223 211 196 184 181 182 186 185 193 208 211 208 201 196 192 191 192 194 201 207 216 225 225 223 220 219 22 ...	Training
0	8 9 14 21 26 32 37 46 52 62 72 70 71 73 76 83 98 92 80 90 110 148 158 149 166 172 166 166 164 179 196 197 189 185 194 189 174 173 177 179 186 197 192 ...	Training
3	252 250 246 229 182 140 98 72 53 44 67 95 95 89 89 90 90 93 94 89 88 88 83 82 81 73 74 69 69 64 58 49 46 49 35 32 27 25 24 21 13 9 11 15 15 15 21 24 2 ...	Training
3	224 227 219 217 215 210 187 177 189 200 206 212 210 208 204 207 206 207 205 203 203 206 206 201 204 199 196 189 187 187 186 185 184 186 183 182 182 17 ...	Training
5	162 200 187 180 197 198 196 192 176 152 136 114 109 117 124 133 162 182 195 200 202 203 204 200 201 202 200 200 200 200 198 195 192 189 185 183 168 15 ...	Training
0	236 230 225 226 228 209 199 193 196 211 199 198 194 199 214 209 202 207 179 156 154 152 157 156 151 144 136 138 140 148 183 209 192 177 158 179 232 25 ...	Training
3	210 210 210 210 211 207 147 103 68 60 47 70 124 118 119 123 124 131 136 138 146 144 147 152 157 159 162 165 165 164 163 161 159 159 159 162 159 159 15 ...	Training

5	50 44 74 141 187 187 169 113 80 128 181 172 76 62 37 41 40 37 55 44 37 36 48 45 40 48 82 82 78 69 56 60 50 42 52 69 125 154 128 68 57 46 50 51 46 40 3 ...	Training
3	234 233 228 231 234 233 236 230 236 196 112 85 100 114 129 133 132 132 147 164 180 156 161 156 151 150 137 117 139 157 138 145 137 132 114 94 80 70 65 ...	Training
6	244 214 198 187 105 89 47 38 40 28 26 29 42 39 33 48 35 22 28 31 42 46 42 58 61 54 42 46 54 43 38 49 50 86 100 101 93 65 69 71 61 114 161 211 237 242 ...	Training
3	88 116 108 66 61 52 56 74 80 70 55 57 61 68 57 44 62 69 65 61 60 61 68 55 51 65 66 71 60 79 95 94 86 113 112 99 113 108 116 118 88 72 68 25 46 135 102 ...	Training
2	59 63 70 67 67 72 69 80 95 105 125 141 149 155 164 168 168 174 180 181 184 187 190 194 194 196 200 201 201 200 200 196 193 191 186 181 179 168 153 197 ...	Training
3	66 63 76 65 49 44 52 43 47 95 121 51 41 49 145 231 230 231 233 235 235 235 236 236 236 235 234 235 244 254 254 254 254 254 254 254 254 254 254 254 ...	Training
6	81 106 91 100 90 85 108 130 147 84 46 81 156 206 222 229 233 235 236 238 240 240 241 240 240 240 240 239 239 238 236 231 226 221 213 198 166 110 43 27 ...	Training
6	185 179 183 191 204 150 35 27 25 59 114 134 145 145 145 145 146 149 154 157 158 159 158 160 160 161 162 162 159 159 159 155 148 145 131 90 35 15 19 11 ...	Training
6	40 46 42 43 34 81 150 187 193 196 200 202 207 205 208 208 209 212 218 207 197 188 179 181 187 187 182 175 172 166 166 156 152 151 136 126 124 135 144 ...	Training
0	255 82 0 3 0 0 0 0 0 0 3 0 16 17 3 60 29 0 1 25 7 2 1 1 0 1 2 0 21 35 121 225 4 3 5 3 0 0 1 2 5 3 45 151 161 103 103 191 213 11 1 0 0 0 0 0 1 4 0 65 1 ...	Training
5	68 69 67 60 55 50 45 47 50 48 43 41 45 48 48 45 44 44 40 38 34 36 43 46 65 74 75 84 95 102 112 99 67 53 49 43 82 191 215 218 218 217 218 216 214 213 2 ...	Training
0	74 66 82 82 85 68 79 103 113 112 116 136 102 62 65 75 96 121 142 159 179 190 199 199 202 205 213 216 215 214 212 210 206 201 190 164 128 114 87 54 47 ...	Training
3	63 58 60 59 55 74 66 48 55 72 88 99 96 98 101 105 120 141 149 158 135 130 137 142 142 146 152 157 158 156 153 155 151 144 149 147 139 121 105 97 92 94 ...	Training
4	157 160 161 162 157 159 160 161 162 165 167 166 166 168 168 168 171 175 174 173 171 168 165 161 156 153 148 134 134 132 122 116 76 45 38 21 29 33 26 2 ...	Training
0	206 208 209 212 214 216 216 219 221 222 222 222 224 225 225 225 226 227 227 227 232 216 178 115 82 72 78 64 52 60 45 51 84 81 68 83 96 111 109 131 184 ...	Training
6	69 68 68 70 77 85 92 96 95 93 91 84 90 107 111 129 177 200 210 216 220 218 212 208 203 201 201 198 190 185 180 173 168 161 151 134 92 69 57 38 37 50 4 ...	Training

2	77 52 67 74 56 56 50 53 49 46 48 42 59 98 103 97 91 91 106 123 131 117 111 117 123 125 138 161 173 181 182 177 171 163 156 133 132 125 106 113 113 103 ...	Training
3	144 143 127 99 73 55 33 65 91 84 51 85 73 69 102 79 68 107 130 101 122 140 127 141 146 150 162 171 172 172 165 165 167 157 144 125 101 95 61 50 100 10 ...	Training
6	128 119 78 75 78 78 85 77 47 60 66 62 69 71 71 75 81 84 91 90 97 110 105 86 76 83 76 72 77 74 67 68 69 66 62 50 40 32 22 4 4 6 99 201 200 201 203 206 ...	Training
2	192 153 168 171 196 193 168 174 149 152 168 181 189 195 202 205 202 206 203 201 196 189 185 179 183 167 165 145 142 153 157 179 161 151 122 119 131 81 ...	Training
2	166 124 94 87 87 103 137 177 212 231 240 245 250 252 254 253 248 246 240 235 232 231 227 225 226 223 219 216 210 202 190 172 155 136 112 92 82 76 74 6 ...	Training
2	99 95 101 114 124 129 128 127 128 124 123 125 123 127 136 144 151 155 164 170 171 166 165 168 176 179 176 174 175 170 173 178 190 211 209 197 183 172 ...	Training
5	1 1 5 9 6 3 13 64 100 90 114 122 132 139 147 151 170 180 187 191 190 195 206 211 216 217 217 218 219 220 219 219 216 213 213 206 202 198 173 146 123 1 ...	Training
5	225 220 220 225 223 218 223 225 231 230 228 219 195 70 47 86 103 97 98 102 94 91 101 111 111 111 113 121 138 152 160 160 171 171 165 160 148 123 103 1 ...	Training
6	255 255 255 254 253 255 233 100 71 77 73 79 77 86 101 104 115 118 118 138 116 123 114 92 102 103 122 127 121 136 145 140 127 143 144 136 148 143 128 9 ...	Training
4	99 96 105 117 131 145 153 155 158 156 152 150 159 163 160 156 147 148 138 114 86 102 188 202 158 121 183 182 135 86 84 179 206 209 199 174 125 94 78 8 ...	Training
5	255 255 255 255 255 255 255 255 255 255 255 255 255 255 253 255 214 89 57 49 48 50 53 62 74 68 77 83 79 83 78 63 156 255 253 255 255 255 255 255 255 2 ...	Training
0	57 62 88 106 134 136 136 135 135 146 163 171 167 166 170 180 185 188 193 200 204 206 204 200 208 210 206 208 201 199 196 187 189 180 169 167 161 143 1 ...	Training
3	232 234 229 224 223 225 230 237 229 201 169 165 163 155 139 121 102 103 104 103 109 117 129 130 121 102 99 106 103 92 89 76 94 161 218 219 214 215 215 ...	Training
4	108 104 84 58 45 37 39 47 55 73 94 97 98 101 132 192 228 232 226 240 238 243 242 240 232 234 231 227 227 216 205 196 185 180 176 171 162 151 134 138 1 ...	Training
2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ...	Training
6	120 129 129 101 100 78 94 123 107 108 127 157 163 172 143 163 178 162 160 163 175 194 202 180 183 168 155 153 152 169 156 153 150 158 154 152 171 167 ...	Training

5	175 138 141 170 181 188 189 196 198 207 213 216 218 222 224 227 230 231 231 230 228 225 226 222 222 221 219 218 217 216 216 210 203 188 148 131 149 18 ...	Training
3	210 161 140 166 159 98 96 141 157 137 110 107 157 192 192 196 198 204 204 204 205 204 204 204 204 202 199 197 196 194 190 185 179 165 156 155 157 154 ...	Training
4	255 255 255 255 255 255 254 254 254 254 254 248 252 253 144 71 64 52 71 84 74 66 63 63 58 53 53 49 49 51 45 49 55 62 69 74 79 72 70 69 72 70 71 71 183 ...	Training
3	244 244 245 245 245 245 245 245 245 246 248 240 230 184 141 129 108 101 89 78 79 75 72 65 63 55 49 121 183 187 183 176 168 157 154 149 150 150 140 148 ...	Training
0	117 116 113 99 78 53 37 34 33 32 31 28 27 30 27 21 40 81 106 121 128 147 164 167 168 166 155 148 136 126 102 57 34 32 37 36 35 37 37 38 37 36 38 39 42 ...	Training
4	140 153 159 160 161 156 148 140 130 118 105 99 106 116 125 129 105 98 81 70 69 68 72 80 91 106 117 115 125 152 114 104 103 78 69 74 76 84 102 141 170 ...	Training
3	255 254 255 221 111 88 50 44 41 52 66 86 102 117 144 185 213 221 225 229 233 233 231 228 219 196 168 169 174 168 157 142 128 108 89 72 56 39 24 17 15 ...	Training
0	16 18 17 11 19 37 40 35 78 205 234 220 218 217 215 212 208 210 215 217 222 225 224 222 215 212 207 200 193 188 180 173 167 166 167 166 168 173 177 180 ...	Training
5	43 43 43 40 45 63 93 140 144 153 159 167 168 167 166 169 175 181 180 187 193 195 195 197 201 196 184 185 181 179 176 175 171 166 159 155 148 133 132 1 ...	Training
4	223 223 227 213 195 174 109 52 84 155 203 206 167 104 128 154 164 179 192 199 205 208 206 201 196 188 183 181 178 167 160 149 129 111 99 84 71 60 164 ...	Training
2	94 133 133 115 105 91 76 69 67 81 91 101 117 164 194 147 146 162 171 174 183 190 203 209 205 202 193 191 194 177 177 171 164 184 185 177 188 169 158 1 ...	Training
4	255 255 255 255 255 254 255 248 165 110 95 110 99 100 98 80 99 55 43 76 80 81 52 24 32 43 64 72 80 81 66 62 89 71 83 107 92 87 226 254 254 255 255 255 ...	Training
2	219 210 201 202 210 216 218 224 165 95 95 110 119 166 193 202 195 188 187 170 160 157 152 117 99 70 63 64 48 38 56 63 58 52 49 45 37 44 27 28 51 33 31 ...	Training
0	12 12 11 13 13 7 0 0 0 1 0 8 6 0 0 23 39 12 13 6 4 2 14 33 17 0 0 0 7 12 4 4 1 2 3 1 1 1 5 5 0 0 0 0 0 1 0 0 14 15 14 13 14 5 0 0 0 1 1 1 1 1 0 17 24 ...	Training
6	122 82 110 185 127 87 102 139 140 139 131 123 120 117 117 116 115 113 113 113 109 102 97 99 94 88 82 79 75 65 56 42 34 31 31 31 28 27 25 27 29 35 46 6 ...	Training
0	165 138 108 74 67 60 57 55 54 56 58 61 61 65 62 62 62 63 65 67 69 70 73 75 79 81 80 82 83 86 88 87 89 90 86 76 69 67 77 143 214 223 195 156 158 225 11 ...	Training

0	124 121 108 100 86 80 81 91 103 110 110 112 118 121 124 126 131 135 135 137 138 137 135 131 129 127 130 135 136 137 134 132 130 131 124 109 94 92 97 1 ...	Training
5	33 31 34 34 31 33 33 33 36 25 53 104 38 21 29 39 60 74 88 99 104 109 122 125 131 145 143 142 136 125 108 94 78 60 48 44 42 108 71 19 34 30 30 31 32 31 ...	Training
4	52 81 103 103 87 82 114 151 152 150 145 140 142 146 147 150 148 151 155 157 164 166 172 193 200 204 209 198 185 180 159 146 144 102 25 27 26 12 17 22 ...	Training
3	208 211 189 200 212 168 155 164 189 207 192 168 202 221 225 224 225 226 224 225 225 225 225 225 225 224 225 224 225 226 226 227 227 228 229 229 226 22 ...	Training
5	253 200 93 92 93 64 62 92 106 103 88 36 34 54 74 102 132 159 172 175 179 184 182 181 184 186 186 185 181 178 174 170 164 155 128 99 81 65 48 42 37 29 ...	Training
3	157 156 156 156 157 156 156 156 148 109 114 103 87 147 221 219 221 227 230 234 240 244 246 253 254 254 253 248 232 222 211 208 165 96 111 75 126 170 1 ...	Training
6	187 189 192 196 203 205 210 211 212 211 214 212 211 212 216 212 206 184 180 186 181 207 215 212 210 210 218 199 179 165 179 208 205 213 223 221 227 23 ...	Training
2	45 55 51 34 30 25 21 25 29 36 36 35 43 53 78 92 98 113 127 134 136 146 154 160 168 177 187 190 189 190 188 186 184 186 187 169 110 55 33 23 23 28 22 1 ...	Training
2	162 161 162 162 162 162 162 164 166 166 167 167 168 170 174 149 101 64 41 26 21 28 22 20 20 16 15 20 18 15 21 21 24 22 25 36 46 45 48 48 51 49 60 69 6 ...	Training
4	157 89 29 44 100 162 203 164 150 170 137 181 191 194 195 195 186 182 186 185 184 182 181 184 186 184 181 176 177 176 171 168 168 166 161 165 169 156 1 ...	Training
4	117 83 75 69 65 68 64 63 63 67 68 66 65 66 67 68 63 66 66 62 55 55 53 53 62 64 63 63 63 62 63 63 64 56 48 61 66 65 64 59 61 62 63 61 62 60 61 67 71 65 ...	Training
5	53 102 107 122 67 47 48 59 73 56 31 34 39 39 34 80 123 92 43 57 59 40 38 35 64 73 38 64 135 88 55 71 93 108 140 166 174 183 170 173 203 207 210 226 23 ...	Training
4	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ...	Training
0	239 232 251 142 16 0 41 97 46 43 51 77 86 94 94 95 106 105 105 106 107 111 108 102 101 99 97 85 87 87 84 76 75 72 65 64 62 66 64 63 66 59 50 33 21 23 ...	Training
0	255 255 254 253 250 146 91 64 53 72 68 62 64 74 85 63 61 54 51 68 55 44 50 35 30 42 50 56 43 64 69 63 56 59 64 78 105 112 141 151 172 233 255 253 253 ...	Training
6	74 58 23 70 110 97 87 78 72 69 66 62 58 56 58 57 55 49 40 34 27 27 24 18 19 23 24 28 49 61 43 29 42 69 83 70 63 103 130 128 137 116 102 102 175 225 17 ...	Training

0	186 181 178 178 163 84 48 20 18 19 33 86 106 109 113 118 119 120 123 126 131 131 130 132 136 108 100 99 77 78 57 45 44 58 89 54 49 60 55 44 42 61 58 6 ...	Training
6	255 254 254 249 187 183 172 179 182 159 148 147 160 176 184 182 184 183 164 157 180 191 178 175 174 161 155 167 149 161 167 173 173 161 153 151 136 14 ...	Training
2	70 81 103 97 81 37 20 19 21 19 15 19 17 15 17 20 20 21 26 26 30 43 43 31 22 18 17 16 16 16 15 12 12 12 10 12 14 10 11 16 13 9 12 19 22 20 21 23 78 102 ...	Training
2	91 37 22 39 39 32 31 21 34 49 50 50 55 54 49 61 73 80 84 85 85 86 85 83 83 82 83 84 84 82 74 59 51 67 54 76 53 71 81 74 69 69 64 84 90 89 89 89 63 21 ...	Training
3	15 16 19 22 20 20 20 24 31 50 71 69 78 112 137 154 166 173 181 190 194 196 200 201 203 205 206 210 210 212 213 211 200 172 156 107 72 82 69 58 127 209 ...	Training
4	124 109 86 65 48 35 25 21 23 32 43 59 81 93 102 99 160 243 249 245 245 242 240 240 240 241 237 234 235 234 230 231 229 228 228 222 219 219 217 212 205 ...	Training
3	111 106 107 112 89 69 61 59 57 62 83 85 77 81 99 117 124 119 134 157 166 134 123 120 110 104 115 99 97 88 73 58 37 35 30 36 37 29 22 14 0 2 71 112 109 ...	Training

LAMPIRAN II

PROSES PELATIHAN MODEL CNN

Training pada fold 1

```
Training on Fold:  1
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
73s 2ms/step - loss: 2.1041 - acc: 0.1578 - val_loss:
1.9504 - val_acc: 0.1751
Epoch 00001: val_loss improved from inf to 1.95039, saving
model to ./models/model_balancing3.h5

Epoch 2/50
72s 2ms/step - loss: 1.9551 - acc: 0.1648 - val_loss:
1.9431 - val_acc: 0.1603
Epoch 00002: val_loss improved from 1.95039 to 1.94306,
saving model to ./models/model_balancing3.h5

Epoch 3/50
73s 2ms/step - loss: 1.9393 - acc: 0.1716 - val_loss:
1.9548 - val_acc: 0.1794
Epoch 00003: val_loss did not improve from 1.94306

Epoch 4/50
74s 2ms/step - loss: 1.8781 - acc: 0.2194 - val_loss:
1.8296 - val_acc: 0.2456
Epoch 00004: val_loss improved from 1.94306 to 1.82963,
saving model to ./models/model_balancing3.h5
```

```
Epoch 5/50
75s 2ms/step - loss: 1.7732 - acc: 0.2811 - val_loss:
1.7274 - val_acc: 0.3266
Epoch 00005: val_loss improved from 1.82963 to 1.72741,
saving model to ./models/model_balancing3.h5

Epoch 6/50
77s 2ms/step - loss: 1.6502 - acc: 0.3548 - val_loss:
1.5062 - val_acc: 0.3988
Epoch 00006: val_loss improved from 1.72741 to 1.50619,
saving model to ./models/model_balancing3.h5

Epoch 7/50
78s 2ms/step - loss: 1.5475 - acc: 0.4028 - val_loss:
1.5063 - val_acc: 0.4396
Epoch 00007: val_loss did not improve from 1.50619

Epoch 8/50
79s 2ms/step - loss: 1.4627 - acc: 0.4451 - val_loss:
1.5877 - val_acc: 0.3776
Epoch 00008: val_loss did not improve from 1.50619

Epoch 9/50
79s 2ms/step - loss: 1.4050 - acc: 0.4733 - val_loss:
1.2913 - val_acc: 0.5178
Epoch 00009: val_loss improved from 1.50619 to 1.29126,
saving model to ./models/model_balancing3.h5

Epoch 10/50
80s 2ms/step - loss: 1.3430 - acc: 0.4985 - val_loss:
1.2608 - val_acc: 0.5283
Epoch 00010: val_loss improved from 1.29126 to 1.26085,
saving model to ./models/model_balancing3.h5
```

```
Epoch 11/50
77s 2ms/step - loss: 1.2938 - acc: 0.5136 - val_loss:
1.2424 - val_acc: 0.5229
Epoch 00011: val_loss improved from 1.26085 to 1.24235,
saving model to ./models/model_balancing3.h5

Epoch 12/50
77s 2ms/step - loss: 1.2564 - acc: 0.5316 - val_loss:
1.3140 - val_acc: 0.5006
Epoch 00012: val_loss did not improve from 1.24235

Epoch 13/50
76s 2ms/step - loss: 1.2143 - acc: 0.5445 - val_loss:
1.1446 - val_acc: 0.5737
Epoch 00013: val_loss improved from 1.24235 to 1.14456,
saving model to ./models/model_balancing3.h5

Epoch 14/50
77s 2ms/step - loss: 1.1759 - acc: 0.5677 - val_loss:
1.0897 - val_acc: 0.6003
Epoch 00014: val_loss improved from 1.14456 to 1.08965,
saving model to ./models/model_balancing3.h5

Epoch 15/50
76s 2ms/step - loss: 1.1454 - acc: 0.5792 - val_loss:
1.2017 - val_acc: 0.5328
Epoch 00015: val_loss did not improve from 1.08965

Epoch 16/50
76s 2ms/step - loss: 1.1120 - acc: 0.5921 - val_loss:
1.0843 - val_acc: 0.5879
Epoch 00016: val_loss improved from 1.08965 to 1.08429,
```

```
saving model to ./models/model_balancing3.h5

Epoch 17/50
77s 2ms/step - loss: 1.0774 - acc: 0.6097 - val_loss:
1.0284 - val_acc: 0.6264
Epoch 00017: val_loss improved from 1.08429 to 1.02839,
saving model to ./models/model_balancing3.h5

Epoch 18/50
77s 2ms/step - loss: 1.0455 - acc: 0.6251 - val_loss:
1.0266 - val_acc: 0.6153
Epoch 00018: val_loss improved from 1.02839 to 1.02655,
saving model to ./models/model_balancing3.h5

Epoch 19/50
77s 2ms/step - loss: 1.0051 - acc: 0.6352 - val_loss:
0.9927 - val_acc: 0.6402
Epoch 00019: val_loss improved from 1.02655 to 0.99271,
saving model to ./models/model_balancing3.h5

Epoch 20/50
76s 2ms/step - loss: 0.9784 - acc: 0.6478 - val_loss:
0.9502 - val_acc: 0.6507
Epoch 00020: val_loss improved from 0.99271 to 0.95022,
saving model to ./models/model_balancing3.h5

Epoch 21/50
77s 2ms/step - loss: 0.9515 - acc: 0.6623 - val_loss:
0.9467 - val_acc: 0.6633
Epoch 00021: val_loss improved from 0.95022 to 0.94668,
saving model to ./models/model_balancing3.h5

Epoch 22/50
```

```
77s 2ms/step - loss: 0.9260 - acc: 0.6722 - val_loss:
0.9659 - val_acc: 0.6464
Epoch 00022: val_loss did not improve from 0.94668

Epoch 23/50
77s 2ms/step - loss: 0.8943 - acc: 0.6829 - val_loss:
0.9173 - val_acc: 0.6740
Epoch 00023: val_loss improved from 0.94668 to 0.91727,
saving model to ./models/model_balancing3.h5

Epoch 24/50
77s 2ms/step - loss: 0.8672 - acc: 0.6926 - val_loss:
0.9045 - val_acc: 0.6820
Epoch 00024: val_loss improved from 0.91727 to 0.90445,
saving model to ./models/model_balancing3.h5

Epoch 25/50
77s 2ms/step - loss: 0.8496 - acc: 0.7003 - val_loss:
0.8838 - val_acc: 0.6802
Epoch 00025: val_loss improved from 0.90445 to 0.88377,
saving model to ./models/model_balancing3.h5

Epoch 26/50
79s 2ms/step - loss: 0.8235 - acc: 0.7109 - val_loss:
0.8578 - val_acc: 0.6959
Epoch 00026: val_loss improved from 0.88377 to 0.85784,
saving model to ./models/model_balancing3.h5

Epoch 27/50
80s 2ms/step - loss: 0.8064 - acc: 0.7196 - val_loss:
0.8564 - val_acc: 0.7066
Epoch 00027: val_loss improved from 0.85784 to 0.85639,
saving model to ./models/model_balancing3.h5
```

```
Epoch 28/50
80s 2ms/step - loss: 0.7823 - acc: 0.7258 - val_loss:
0.8364 - val_acc: 0.7117
Epoch 00028: val_loss improved from 0.85639 to 0.83642,
saving model to ./models/model_balancing3.h5

Epoch 29/50
80s 2ms/step - loss: 0.7588 - acc: 0.7370 - val_loss:
0.8543 - val_acc: 0.7079
Epoch 00029: val_loss did not improve from 0.83642

Epoch 30/50
80s 2ms/step - loss: 0.7424 - acc: 0.7401 - val_loss:
0.8605 - val_acc: 0.7070
Epoch 00030: val_loss did not improve from 0.83642

Epoch 31/50
80s 2ms/step - loss: 0.7205 - acc: 0.7528 - val_loss:
0.8470 - val_acc: 0.7156
Epoch 00031: val_loss did not improve from 0.83642

Epoch 32/50
81s 2ms/step - loss: 0.7054 - acc: 0.7548 - val_loss:
0.8235 - val_acc: 0.7285
Epoch 00032: val_loss improved from 0.83642 to 0.82349,
saving model to ./models/model_balancing3.h5

Epoch 33/50
80s 2ms/step - loss: 0.6786 - acc: 0.7655 - val_loss:
0.8860 - val_acc: 0.6970
Epoch 00033: val_loss did not improve from 0.82349
```

```
Epoch 34/50
80s 2ms/step - loss: 0.6740 - acc: 0.7680 - val_loss:
0.8794 - val_acc: 0.7195
Epoch 00034: val_loss did not improve from 0.82349

Epoch 35/50
77s 2ms/step - loss: 0.6546 - acc: 0.7752 - val_loss:
0.8218 - val_acc: 0.7293
Epoch 00035: val_loss improved from 0.82349 to 0.82181,
saving model to ./models/model_balancing3.h5

Epoch 36/50
77s 2ms/step - loss: 0.6334 - acc: 0.7839 - val_loss:
0.8249 - val_acc: 0.7272
Epoch 00036: val_loss did not improve from 0.82181

Epoch 37/50
77s 2ms/step - loss: 0.6228 - acc: 0.7871 - val_loss:
0.8100 - val_acc: 0.7379
Epoch 00037: val_loss improved from 0.82181 to 0.81000,
saving model to ./models/model_balancing3.h5

Epoch 38/50
77s 2ms/step - loss: 0.6053 - acc: 0.7920 - val_loss:
0.8137 - val_acc: 0.7415
Epoch 00038: val_loss did not improve from 0.81000

Epoch 39/50
77s 2ms/step - loss: 0.5887 - acc: 0.8029 - val_loss:
0.7987 - val_acc: 0.7400
Epoch 00039: val_loss improved from 0.81000 to 0.79871,
saving model to ./models/model_balancing3.h5
```

```
Epoch 40/50
77s 2ms/step - loss: 0.5745 - acc: 0.8049 - val_loss:
0.8394 - val_acc: 0.7321
Epoch 00040: val_loss did not improve from 0.79871

Epoch 41/50
77s 2ms/step - loss: 0.5750 - acc: 0.8082 - val_loss:
0.8035 - val_acc: 0.7417
Epoch 00041: val_loss did not improve from 0.79871

Epoch 42/50
77s 2ms/step - loss: 0.5526 - acc: 0.8127 - val_loss:
0.8242 - val_acc: 0.7458
Epoch 00042: val_loss did not improve from 0.79871

Epoch 43/50
77s 2ms/step - loss: 0.5466 - acc: 0.8192 - val_loss:
0.8730 - val_acc: 0.7345
Epoch 00043: val_loss did not improve from 0.79871

Epoch 44/50
77s 2ms/step - loss: 0.5408 - acc: 0.8177 - val_loss:
0.8336 - val_acc: 0.7458
Epoch 00044: val_loss did not improve from 0.79871

Epoch 00044: early stopping
4666/4666 [==============================] - 4s 873us/step
Val Score:  [0.8335539789297935, 0.7458208314707184]
```

Training pada Fold 2

```
Training on Fold:  2
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
76s 2ms/step - loss: 2.0959 - acc: 0.1622 - val_loss:
1.9435 - val_acc: 0.1742

Epoch 00001: val_loss did not improve from 0.79871
Epoch 2/50
77s 2ms/step - loss: 1.9493 - acc: 0.1754 - val_loss:
2.0547 - val_acc: 0.1509

Epoch 00002: val_loss did not improve from 0.79871
Epoch 3/50
77s 2ms/step - loss: 1.8746 - acc: 0.2238 - val_loss:
2.0029 - val_acc: 0.1742

Epoch 00003: val_loss did not improve from 0.79871
Epoch 4/50
77s 2ms/step - loss: 1.7445 - acc: 0.2975 - val_loss:
1.5987 - val_acc: 0.3541

Epoch 00004: val_loss did not improve from 0.79871
Epoch 5/50
77s 2ms/step - loss: 1.6274 - acc: 0.3736 - val_loss:
1.6279 - val_acc: 0.3733

Epoch 00005: val_loss did not improve from 0.79871
Epoch 6/50
77s 2ms/step - loss: 1.5144 - acc: 0.4273 - val_loss:
1.4255 - val_acc: 0.4565
```

```
Epoch 00006: val_loss did not improve from 0.79871
Epoch 7/50
77s 2ms/step - loss: 1.4429 - acc: 0.4635 - val_loss:
1.4264 - val_acc: 0.4492

Epoch 00007: val_loss did not improve from 0.79871
Epoch 8/50
77s 2ms/step - loss: 1.3843 - acc: 0.4836 - val_loss:
1.2299 - val_acc: 0.5339

Epoch 00008: val_loss did not improve from 0.79871
Epoch 9/50
77s 2ms/step - loss: 1.3310 - acc: 0.5060 - val_loss:
1.2445 - val_acc: 0.5279

Epoch 00009: val_loss did not improve from 0.79871
Epoch 10/50
77s 2ms/step - loss: 1.2847 - acc: 0.5258 - val_loss:
1.2440 - val_acc: 0.5347

Epoch 00010: val_loss did not improve from 0.79871
Epoch 11/50
79s 2ms/step - loss: 1.2400 - acc: 0.5410 - val_loss:
1.1546 - val_acc: 0.5671

Epoch 00011: val_loss did not improve from 0.79871
Epoch 12/50
79s 2ms/step - loss: 1.2017 - acc: 0.5614 - val_loss:
1.1360 - val_acc: 0.5819

Epoch 00012: val_loss did not improve from 0.79871
Epoch 13/50
```

```
79s 2ms/step - loss: 1.1766 - acc: 0.5742 - val_loss:
1.1002 - val_acc: 0.5883

Epoch 00013: val_loss did not improve from 0.79871
Epoch 14/50
79s 2ms/step - loss: 1.1246 - acc: 0.5907 - val_loss:
1.0974 - val_acc: 0.5928

Epoch 00014: val_loss did not improve from 0.79871
Epoch 15/50
79s 2ms/step - loss: 1.0935 - acc: 0.6041 - val_loss:
1.0519 - val_acc: 0.6125

Epoch 00015: val_loss did not improve from 0.79871
Epoch 16/50
80s 2ms/step - loss: 1.0639 - acc: 0.6170 - val_loss:
1.0575 - val_acc: 0.6057

Epoch 00016: val_loss did not improve from 0.79871
Epoch 17/50
78s 2ms/step - loss: 1.0322 - acc: 0.6295 - val_loss:
1.0635 - val_acc: 0.6097

Epoch 00017: val_loss did not improve from 0.79871
Epoch 18/50
77s 2ms/step - loss: 0.9975 - acc: 0.6423 - val_loss:
1.0384 - val_acc: 0.6222

Epoch 00018: val_loss did not improve from 0.79871
Epoch 19/50
77s 2ms/step - loss: 0.9614 - acc: 0.6581 - val_loss:
0.9942 - val_acc: 0.6462
```

```
Epoch 00019: val_loss did not improve from 0.79871
Epoch 20/50
77s 2ms/step - loss: 0.9327 - acc: 0.6667 - val_loss:
0.9594 - val_acc: 0.6567

Epoch 00020: val_loss did not improve from 0.79871
Epoch 21/50
77s 2ms/step - loss: 0.9054 - acc: 0.6790 - val_loss:
0.9148 - val_acc: 0.6710

Epoch 00021: val_loss did not improve from 0.79871
Epoch 22/50
77s 2ms/step - loss: 0.8920 - acc: 0.6843 - val_loss:
0.8586 - val_acc: 0.6920

Epoch 00022: val_loss did not improve from 0.79871
Epoch 23/50
77s 2ms/step - loss: 0.8528 - acc: 0.6995 - val_loss:
0.8767 - val_acc: 0.6922

Epoch 00023: val_loss did not improve from 0.79871
Epoch 24/50
77s 2ms/step - loss: 0.8312 - acc: 0.7082 - val_loss:
0.8735 - val_acc: 0.6918

Epoch 00024: val_loss did not improve from 0.79871
Epoch 25/50
77s 2ms/step - loss: 0.7971 - acc: 0.7190 - val_loss:
0.8521 - val_acc: 0.7036

Epoch 00025: val_loss did not improve from 0.79871
Epoch 26/50
77s 2ms/step - loss: 0.7880 - acc: 0.7230 - val_loss:
```

```
0.8494 - val_acc: 0.6972

Epoch 00026: val_loss did not improve from 0.79871
Epoch 27/50
77s 2ms/step - loss: 0.7650 - acc: 0.7315 - val_loss:
0.8219 - val_acc: 0.7203

Epoch 00027: val_loss did not improve from 0.79871
Epoch 28/50
77s 2ms/step - loss: 0.7463 - acc: 0.7433 - val_loss:
0.8297 - val_acc: 0.7132

Epoch 00028: val_loss did not improve from 0.79871
Epoch 29/50
77s 2ms/step - loss: 0.7162 - acc: 0.7518 - val_loss:
0.8357 - val_acc: 0.7156

Epoch 00029: val_loss did not improve from 0.79871
Epoch 30/50
77s 2ms/step - loss: 0.7017 - acc: 0.7583 - val_loss:
0.8008 - val_acc: 0.7248

Epoch 00030: val_loss did not improve from 0.79871
Epoch 31/50
77s 2ms/step - loss: 0.6785 - acc: 0.7661 - val_loss:
0.8001 - val_acc: 0.7340

Epoch 00031: val_loss did not improve from 0.79871
Epoch 32/50
77s 2ms/step - loss: 0.6583 - acc: 0.7757 - val_loss:
0.8213 - val_acc: 0.7334

Epoch 00032: val_loss did not improve from 0.79871
```

```
Epoch 33/50
77s 2ms/step - loss: 0.6488 - acc: 0.7772 - val_loss:
0.8303 - val_acc: 0.7274

Epoch 00033: val_loss did not improve from 0.79871
Epoch 34/50

77s 2ms/step - loss: 0.6344 - acc: 0.7851 - val_loss:
0.8712 - val_acc: 0.7117

Epoch 00034: val_loss did not improve from 0.79871
Epoch 35/50
77s 2ms/step - loss: 0.6112 - acc: 0.7913 - val_loss:
0.7884 - val_acc: 0.7501

Epoch 00035: val_loss improved from 0.79871 to 0.78839,
saving model to ./models/model_balancing3.h5
Epoch 36/50
76s 2ms/step - loss: 0.6045 - acc: 0.7954 - val_loss:
0.7884 - val_acc: 0.7495

Epoch 00036: val_loss improved from 0.78839 to 0.78839,
saving model to ./models/model_balancing3.h5
Epoch 37/50
77s 2ms/step - loss: 0.5955 - acc: 0.7987 - val_loss:
0.7886 - val_acc: 0.7471

Epoch 00037: val_loss did not improve from 0.78839
Epoch 38/50
77s 2ms/step - loss: 0.5722 - acc: 0.8036 - val_loss:
0.8123 - val_acc: 0.7531

Epoch 00038: val_loss did not improve from 0.78839
```

```
Epoch 39/50
77s 2ms/step - loss: 0.5603 - acc: 0.8098 - val_loss:
0.8161 - val_acc: 0.7469

Epoch 00039: val_loss did not improve from 0.78839
Epoch 40/50
77s 2ms/step - loss: 0.5492 - acc: 0.8131 - val_loss:
0.8368 - val_acc: 0.7454

Epoch 00040: val_loss did not improve from 0.78839
Epoch 41/50
77s 2ms/step - loss: 0.5334 - acc: 0.8218 - val_loss:
0.9622 - val_acc: 0.7034

Epoch 00041: val_loss did not improve from 0.78839
Epoch 00041: early stopping
4666/4666 [==============================] - 4s 795us/step
Val Score:  [0.9621703477055026, 0.7033861981049353]
============================================================
```

Training pada Fold 3


```
Training on Fold:  3
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
76s 2ms/step - loss: 2.1005 - acc: 0.1565 - val_loss:
1.9529 - val_acc: 0.1717

Epoch 00001: val_loss did not improve from 0.78839
Epoch 2/50
77s 2ms/step - loss: 1.9512 - acc: 0.1754 - val_loss:
```

```
1.9331 - val_acc: 0.2051

Epoch 00002: val_loss did not improve from 0.78839
Epoch 3/50
77s 2ms/step - loss: 1.9034 - acc: 0.2102 - val_loss:
1.9166 - val_acc: 0.1995

Epoch 00003: val_loss did not improve from 0.78839
Epoch 4/50
77s 2ms/step - loss: 1.8188 - acc: 0.2561 - val_loss:
1.7258 - val_acc: 0.3146

Epoch 00004: val_loss did not improve from 0.78839
Epoch 5/50
77s 2ms/step - loss: 1.6983 - acc: 0.3348 - val_loss:
1.6160 - val_acc: 0.3586

Epoch 00005: val_loss did not improve from 0.78839
Epoch 6/50
78s 2ms/step - loss: 1.6276 - acc: 0.3645 - val_loss:
1.5830 - val_acc: 0.3755

Epoch 00006: val_loss did not improve from 0.78839
Epoch 7/50
82s 2ms/step - loss: 1.5388 - acc: 0.4086 - val_loss:
1.5016 - val_acc: 0.4258

Epoch 00007: val_loss did not improve from 0.78839
Epoch 8/50
80s 2ms/step - loss: 1.4671 - acc: 0.4390 - val_loss:
1.3602 - val_acc: 0.4826

Epoch 00008: val_loss did not improve from 0.78839
```

```
Epoch 9/50
79s 2ms/step - loss: 1.4081 - acc: 0.4664 - val_loss:
1.3528 - val_acc: 0.4794

Epoch 00009: val_loss did not improve from 0.78839
Epoch 10/50
80s 2ms/step - loss: 1.3589 - acc: 0.4861 - val_loss:
1.2645 - val_acc: 0.5234

Epoch 00010: val_loss did not improve from 0.78839
Epoch 11/50
81s 2ms/step - loss: 1.3164 - acc: 0.5019 - val_loss:
1.2051 - val_acc: 0.5392

Epoch 00011: val_loss did not improve from 0.78839
Epoch 12/50
80s 2ms/step - loss: 1.2644 - acc: 0.5233 - val_loss:
1.2380 - val_acc: 0.5234

Epoch 00012: val_loss did not improve from 0.78839
Epoch 13/50
80s 2ms/step - loss: 1.2291 - acc: 0.5357 - val_loss:
1.3142 - val_acc: 0.4916

Epoch 00013: val_loss did not improve from 0.78839
Epoch 14/50
80s 2ms/step - loss: 1.1953 - acc: 0.5530 - val_loss:
1.1101 - val_acc: 0.5744

Epoch 00014: val_loss did not improve from 0.78839
Epoch 15/50
80s 2ms/step - loss: 1.1688 - acc: 0.5649 - val_loss:
1.1666 - val_acc: 0.5789
```

```
Epoch 00015: val_loss did not improve from 0.78839
Epoch 16/50
80s 2ms/step - loss: 1.1291 - acc: 0.5805 - val_loss:
1.1017 - val_acc: 0.5859

Epoch 00016: val_loss did not improve from 0.78839
Epoch 17/50
80s 2ms/step - loss: 1.0945 - acc: 0.5893 - val_loss:
1.0532 - val_acc: 0.5949

Epoch 00017: val_loss did not improve from 0.78839
Epoch 18/50
81s 2ms/step - loss: 1.0658 - acc: 0.6069 - val_loss:
1.1022 - val_acc: 0.5834

Epoch 00018: val_loss did not improve from 0.78839
Epoch 19/50
80s 2ms/step - loss: 1.0358 - acc: 0.6217 - val_loss:
1.0091 - val_acc: 0.6271

Epoch 00019: val_loss did not improve from 0.78839
Epoch 20/50
77s 2ms/step - loss: 1.0030 - acc: 0.6340 - val_loss:
0.9783 - val_acc: 0.6444

Epoch 00020: val_loss did not improve from 0.78839
Epoch 21/50
78s 2ms/step - loss: 0.9726 - acc: 0.6489 - val_loss:
0.9923 - val_acc: 0.6359

Epoch 00021: val_loss did not improve from 0.78839
Epoch 22/50
```

```
78s 2ms/step - loss: 0.9472 - acc: 0.6572 - val_loss:
1.0187 - val_acc: 0.6395

Epoch 00022: val_loss did not improve from 0.78839
Epoch 23/50
78s 2ms/step - loss: 0.9233 - acc: 0.6657 - val_loss:
0.9418 - val_acc: 0.6580

Epoch 00023: val_loss did not improve from 0.78839
Epoch 24/50
78s 2ms/step - loss: 0.9075 - acc: 0.6767 - val_loss:
0.9832 - val_acc: 0.6513

Epoch 00024: val_loss did not improve from 0.78839
Epoch 25/50
77s 2ms/step - loss: 0.8646 - acc: 0.6923 - val_loss:
0.9177 - val_acc: 0.6721

Epoch 00025: val_loss did not improve from 0.78839
Epoch 26/50
77s 2ms/step - loss: 0.8438 - acc: 0.6992 - val_loss:
1.0235 - val_acc: 0.6511

Epoch 00026: val_loss did not improve from 0.78839
Epoch 27/50
78s 2ms/step - loss: 0.8258 - acc: 0.7077 - val_loss:
0.9254 - val_acc: 0.6740

Epoch 00027: val_loss did not improve from 0.78839
Epoch 28/50
78s 2ms/step - loss: 0.8147 - acc: 0.7123 - val_loss:
0.8753 - val_acc: 0.7000
```

```
Epoch 00028: val_loss did not improve from 0.78839
Epoch 29/50
77s 2ms/step - loss: 0.7874 - acc: 0.7219 - val_loss:
0.9015 - val_acc: 0.6976

Epoch 00029: val_loss did not improve from 0.78839
Epoch 30/50
78s 2ms/step - loss: 0.7612 - acc: 0.7340 - val_loss:
0.9367 - val_acc: 0.6858

Epoch 00030: val_loss did not improve from 0.78839
Epoch 31/50
78s 2ms/step - loss: 0.7531 - acc: 0.7350 - val_loss:
0.8764 - val_acc: 0.7068

Epoch 00031: val_loss did not improve from 0.78839
Epoch 32/50
77s 2ms/step - loss: 0.7353 - acc: 0.7435 - val_loss:
0.8745 - val_acc: 0.7032

Epoch 00032: val_loss did not improve from 0.78839
Epoch 33/50
77s 2ms/step - loss: 0.7098 - acc: 0.7520 - val_loss:
0.8837 - val_acc: 0.7051

Epoch 00033: val_loss did not improve from 0.78839
Epoch 34/50

77s 2ms/step - loss: 0.6860 - acc: 0.7627 - val_loss:
0.9371 - val_acc: 0.6997

Epoch 00034: val_loss did not improve from 0.78839
Epoch 35/50
```

```
78s 2ms/step - loss: 0.6803 - acc: 0.7665 - val_loss:
0.8665 - val_acc: 0.7017

Epoch 00035: val_loss did not improve from 0.78839
Epoch 36/50
79s 2ms/step - loss: 0.6555 - acc: 0.7702 - val_loss:
0.9104 - val_acc: 0.6967

Epoch 00036: val_loss did not improve from 0.78839
Epoch 37/50
78s 2ms/step - loss: 0.6479 - acc: 0.7776 - val_loss:
0.8337 - val_acc: 0.7180

Epoch 00037: val_loss did not improve from 0.78839
Epoch 38/50
77s 2ms/step - loss: 0.6372 - acc: 0.7854 - val_loss:
0.8644 - val_acc: 0.7171

Epoch 00038: val_loss did not improve from 0.78839
Epoch 39/50
78s 2ms/step - loss: 0.6191 - acc: 0.7884 - val_loss:
0.8536 - val_acc: 0.7325

Epoch 00039: val_loss did not improve from 0.78839
Epoch 40/50
78s 2ms/step - loss: 0.6125 - acc: 0.7918 - val_loss:
0.9201 - val_acc: 0.7036

Epoch 00040: val_loss did not improve from 0.78839
Epoch 41/50
78s 2ms/step - loss: 0.5934 - acc: 0.7995 - val_loss:
0.8810 - val_acc: 0.7015
```

```
Epoch 00041: val_loss did not improve from 0.78839
Epoch 42/50
77s 2ms/step - loss: 0.5846 - acc: 0.8012 - val_loss:
0.8567 - val_acc: 0.7257

Epoch 00042: val_loss did not improve from 0.78839
Epoch 00042: early stopping
4666/4666 [==============================] - 4s 795us/step
Val Score:  [0.8566701732323602, 0.7256750965189944]
============================================================
```

Training pada Fold 4

```
Training on Fold:  4
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
76s 2ms/step - loss: 2.0904 - acc: 0.1578 - val_loss:
1.9547 - val_acc: 0.1655

Epoch 00001: val_loss did not improve from 0.78839
Epoch 2/50
77s 2ms/step - loss: 1.9498 - acc: 0.1743 - val_loss:
1.9460 - val_acc: 0.1567

Epoch 00002: val_loss did not improve from 0.78839
Epoch 3/50
78s 2ms/step - loss: 1.9301 - acc: 0.1847 - val_loss:
1.9415 - val_acc: 0.1702

Epoch 00003: val_loss did not improve from 0.78839
Epoch 4/50
```

```
78s 2ms/step - loss: 1.8698 - acc: 0.2178 - val_loss:
1.8144 - val_acc: 0.2542

Epoch 00004: val_loss did not improve from 0.78839
Epoch 5/50
77s 2ms/step - loss: 1.7730 - acc: 0.2860 - val_loss:
1.6598 - val_acc: 0.3455

Epoch 00005: val_loss did not improve from 0.78839
Epoch 6/50
77s 2ms/step - loss: 1.6353 - acc: 0.3641 - val_loss:
1.5030 - val_acc: 0.4235

Epoch 00006: val_loss did not improve from 0.78839
Epoch 7/50
78s 2ms/step - loss: 1.5356 - acc: 0.4110 - val_loss:
1.4658 - val_acc: 0.4361

Epoch 00007: val_loss did not improve from 0.78839
Epoch 8/50
77s 2ms/step - loss: 1.4516 - acc: 0.4521 - val_loss:
1.5473 - val_acc: 0.4093

Epoch 00008: val_loss did not improve from 0.78839
Epoch 9/50
77s 2ms/step - loss: 1.3956 - acc: 0.4779 - val_loss:
1.3087 - val_acc: 0.5159

Epoch 00009: val_loss did not improve from 0.78839
Epoch 10/50
77s 2ms/step - loss: 1.3432 - acc: 0.4987 - val_loss:
1.3125 - val_acc: 0.5092
```

```
Epoch 00010: val_loss did not improve from 0.78839
Epoch 11/50
78s 2ms/step - loss: 1.2967 - acc: 0.5150 - val_loss:
1.2146 - val_acc: 0.5424

Epoch 00011: val_loss did not improve from 0.78839
Epoch 12/50
79s 2ms/step - loss: 1.2602 - acc: 0.5298 - val_loss:
1.2356 - val_acc: 0.5446

Epoch 00012: val_loss did not improve from 0.78839
Epoch 13/50
80s 2ms/step - loss: 1.2215 - acc: 0.5467 - val_loss:
1.1080 - val_acc: 0.5802

Epoch 00013: val_loss did not improve from 0.78839
Epoch 14/50
80s 2ms/step - loss: 1.1851 - acc: 0.5631 - val_loss:
1.0889 - val_acc: 0.5913

Epoch 00014: val_loss did not improve from 0.78839
Epoch 15/50
80s 2ms/step - loss: 1.1536 - acc: 0.5787 - val_loss:
1.0796 - val_acc: 0.6050

Epoch 00015: val_loss did not improve from 0.78839
Epoch 16/50
80s 2ms/step - loss: 1.1205 - acc: 0.5942 - val_loss:
1.0653 - val_acc: 0.6007

Epoch 00016: val_loss did not improve from 0.78839
Epoch 17/50
79s 2ms/step - loss: 1.0937 - acc: 0.6042 - val_loss:
```

```
1.0330 - val_acc: 0.6264

Epoch 00017: val_loss did not improve from 0.78839
Epoch 18/50
81s 2ms/step - loss: 1.0651 - acc: 0.6182 - val_loss:
1.0705 - val_acc: 0.5919

Epoch 00018: val_loss did not improve from 0.78839
Epoch 19/50
80s 2ms/step - loss: 1.0303 - acc: 0.6266 - val_loss:
0.9960 - val_acc: 0.6432

Epoch 00019: val_loss did not improve from 0.78839
Epoch 20/50
78s 2ms/step - loss: 0.9947 - acc: 0.6451 - val_loss:
0.9956 - val_acc: 0.6382

Epoch 00020: val_loss did not improve from 0.78839
Epoch 21/50
79s 2ms/step - loss: 0.9813 - acc: 0.6513 - val_loss:
0.9517 - val_acc: 0.6571

Epoch 00021: val_loss did not improve from 0.78839
Epoch 22/50
77s 2ms/step - loss: 0.9459 - acc: 0.6646 - val_loss:
0.9112 - val_acc: 0.6757

Epoch 00022: val_loss did not improve from 0.78839
Epoch 23/50
77s 2ms/step - loss: 0.9040 - acc: 0.6825 - val_loss:
0.9310 - val_acc: 0.6691

Epoch 00023: val_loss did not improve from 0.78839
```

```
Epoch 24/50
77s 2ms/step - loss: 0.8932 - acc: 0.6842 - val_loss:
0.8961 - val_acc: 0.6880

Epoch 00024: val_loss did not improve from 0.78839
Epoch 25/50
77s 2ms/step - loss: 0.8598 - acc: 0.6987 - val_loss:
0.8796 - val_acc: 0.6918

Epoch 00025: val_loss did not improve from 0.78839
Epoch 26/50
77s 2ms/step - loss: 0.8491 - acc: 0.7042 - val_loss:
0.9146 - val_acc: 0.6813

Epoch 00026: val_loss did not improve from 0.78839
Epoch 27/50
79s 2ms/step - loss: 0.8220 - acc: 0.7120 - val_loss:
0.9065 - val_acc: 0.6927

Epoch 00027: val_loss did not improve from 0.78839
Epoch 28/50
80s 2ms/step - loss: 0.8065 - acc: 0.7184 - val_loss:
0.8610 - val_acc: 0.7023

Epoch 00028: val_loss did not improve from 0.78839
Epoch 29/50
80s 2ms/step - loss: 0.7854 - acc: 0.7295 - val_loss:
0.8277 - val_acc: 0.7165

Epoch 00029: val_loss did not improve from 0.78839
Epoch 30/50
80s 2ms/step - loss: 0.7529 - acc: 0.7393 - val_loss:
0.9163 - val_acc: 0.6974
```

```
Epoch 00030: val_loss did not improve from 0.78839
Epoch 31/50
79s 2ms/step - loss: 0.7426 - acc: 0.7437 - val_loss:
0.8410 - val_acc: 0.7186

Epoch 00031: val_loss did not improve from 0.78839
Epoch 32/50
78s 2ms/step - loss: 0.7196 - acc: 0.7558 - val_loss:
0.8126 - val_acc: 0.7255

Epoch 00032: val_loss did not improve from 0.78839
Epoch 33/50
77s 2ms/step - loss: 0.7098 - acc: 0.7567 - val_loss:
0.8090 - val_acc: 0.7282


Epoch 00033: val_loss did not improve from 0.78839
Epoch 34/50
77s 2ms/step - loss: 0.6935 - acc: 0.7586 - val_loss:
0.8034 - val_acc: 0.7338

Epoch 00034: val_loss did not improve from 0.78839
Epoch 35/50
77s 2ms/step - loss: 0.6664 - acc: 0.7703 - val_loss:
0.8253 - val_acc: 0.7332

Epoch 00035: val_loss did not improve from 0.78839
Epoch 36/50
77s 2ms/step - loss: 0.6700 - acc: 0.7724 - val_loss:
0.7834 - val_acc: 0.7349

Epoch 00036: val_loss improved from 0.78839 to 0.78338,
```

```
saving model to ./models/model_balancing3.h5
Epoch 37/50
77s 2ms/step - loss: 0.6463 - acc: 0.7815 - val_loss:
0.7625 - val_acc: 0.7458

Epoch 00037: val_loss improved from 0.78338 to 0.76249,
saving model to ./models/model_balancing3.h5
Epoch 38/50
77s 2ms/step - loss: 0.6367 - acc: 0.7833 - val_loss:
0.8267 - val_acc: 0.7379

Epoch 00038: val_loss did not improve from 0.76249
Epoch 39/50
77s 2ms/step - loss: 0.6346 - acc: 0.7888 - val_loss:
0.8557 - val_acc: 0.7364

Epoch 00039: val_loss did not improve from 0.76249
Epoch 40/50
77s 2ms/step - loss: 0.6147 - acc: 0.7934 - val_loss:
0.8050 - val_acc: 0.7447

Epoch 00040: val_loss did not improve from 0.76249
Epoch 41/50
78s 2ms/step - loss: 0.6063 - acc: 0.7970 - val_loss:
0.7995 - val_acc: 0.7495

Epoch 00041: val_loss did not improve from 0.76249
Epoch 42/50
83s 3ms/step - loss: 0.5924 - acc: 0.8012 - val_loss:
0.8160 - val_acc: 0.7439

Epoch 00042: val_loss did not improve from 0.76249
Epoch 00042: early stopping
```

```
4666/4666 [==============================] - 4s 809us/step
Val Score:  [0.8159873361910457, 0.7438919846203211]
============================================================
```

Training pada Fold 5

```
Training on Fold:  5
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
76s 2ms/step - loss: 2.0949 - acc: 0.1579 - val_loss:
1.9553 - val_acc: 0.1582

Epoch 00001: val_loss did not improve from 0.76249
Epoch 2/50
77s 2ms/step - loss: 1.9525 - acc: 0.1660 - val_loss:
1.9355 - val_acc: 0.1800

Epoch 00002: val_loss did not improve from 0.76249
Epoch 3/50
77s 2ms/step - loss: 1.9197 - acc: 0.1950 - val_loss:
1.9233 - val_acc: 0.1839

Epoch 00003: val_loss did not improve from 0.76249
Epoch 4/50
81s 2ms/step - loss: 1.8557 - acc: 0.2290 - val_loss:
1.8037 - val_acc: 0.2786

Epoch 00004: val_loss did not improve from 0.76249
Epoch 5/50
78s 2ms/step - loss: 1.7536 - acc: 0.2929 - val_loss:
1.6938 - val_acc: 0.2850
```

```
Epoch 00005: val_loss did not improve from 0.76249
Epoch 6/50
78s 2ms/step - loss: 1.6349 - acc: 0.3603 - val_loss:
1.5746 - val_acc: 0.3817

Epoch 00006: val_loss did not improve from 0.76249
Epoch 7/50
77s 2ms/step - loss: 1.5305 - acc: 0.4179 - val_loss:
1.4011 - val_acc: 0.4751

Epoch 00007: val_loss did not improve from 0.76249
Epoch 8/50
77s 2ms/step - loss: 1.4454 - acc: 0.4590 - val_loss:
1.3433 - val_acc: 0.5011

Epoch 00008: val_loss did not improve from 0.76249
Epoch 9/50
77s 2ms/step - loss: 1.3845 - acc: 0.4787 - val_loss:
1.3459 - val_acc: 0.4951

Epoch 00009: val_loss did not improve from 0.76249
Epoch 10/50
77s 2ms/step - loss: 1.3323 - acc: 0.4998 - val_loss:
1.2703 - val_acc: 0.5231

Epoch 00010: val_loss did not improve from 0.76249
Epoch 11/50
77s 2ms/step - loss: 1.2863 - acc: 0.5188 - val_loss:
1.2312 - val_acc: 0.5223

Epoch 00011: val_loss did not improve from 0.76249
Epoch 12/50
```

```
77s 2ms/step - loss: 1.2362 - acc: 0.5351 - val_loss:
1.1898 - val_acc: 0.5675

Epoch 00012: val_loss did not improve from 0.76249
Epoch 13/50
77s 2ms/step - loss: 1.2090 - acc: 0.5480 - val_loss:
1.1709 - val_acc: 0.5632

Epoch 00013: val_loss did not improve from 0.76249
Epoch 14/50
78s 2ms/step - loss: 1.1715 - acc: 0.5631 - val_loss:
1.1123 - val_acc: 0.5909

Epoch 00014: val_loss did not improve from 0.76249
Epoch 15/50
78s 2ms/step - loss: 1.1301 - acc: 0.5800 - val_loss:
1.1811 - val_acc: 0.5675

Epoch 00015: val_loss did not improve from 0.76249
Epoch 16/50
78s 2ms/step - loss: 1.1047 - acc: 0.5891 - val_loss:
1.0903 - val_acc: 0.5911

Epoch 00016: val_loss did not improve from 0.76249
Epoch 17/50
78s 2ms/step - loss: 1.0726 - acc: 0.6036 - val_loss:
1.0935 - val_acc: 0.6007

Epoch 00017: val_loss did not improve from 0.76249
Epoch 18/50
78s 2ms/step - loss: 1.0395 - acc: 0.6186 - val_loss:
1.0491 - val_acc: 0.5977
```

```
Epoch 00018: val_loss did not improve from 0.76249
Epoch 19/50
83s 3ms/step - loss: 1.0163 - acc: 0.6283 - val_loss:
1.0245 - val_acc: 0.6393

Epoch 00019: val_loss did not improve from 0.76249
Epoch 20/50
80s 2ms/step - loss: 0.9853 - acc: 0.6442 - val_loss:
1.0248 - val_acc: 0.6243

Epoch 00020: val_loss did not improve from 0.76249
Epoch 21/50
82s 3ms/step - loss: 0.9547 - acc: 0.6574 - val_loss:
0.9745 - val_acc: 0.6483

Epoch 00021: val_loss did not improve from 0.76249
Epoch 22/50
81s 2ms/step - loss: 0.9218 - acc: 0.6702 - val_loss:
1.0569 - val_acc: 0.6243

Epoch 00022: val_loss did not improve from 0.76249
Epoch 23/50
79s 2ms/step - loss: 0.9099 - acc: 0.6752 - val_loss:
0.9486 - val_acc: 0.6597

Epoch 00023: val_loss did not improve from 0.76249
Epoch 24/50
79s 2ms/step - loss: 0.8835 - acc: 0.6857 - val_loss:
0.9571 - val_acc: 0.6620

Epoch 00024: val_loss did not improve from 0.76249
Epoch 25/50
81s 2ms/step - loss: 0.8595 - acc: 0.6958 - val_loss:
```

```
0.9408 - val_acc: 0.6693

Epoch 00025: val_loss did not improve from 0.76249
Epoch 26/50
83s 3ms/step - loss: 0.8340 - acc: 0.7049 - val_loss:
0.9167 - val_acc: 0.6762

Epoch 00026: val_loss did not improve from 0.76249
Epoch 27/50
84s 3ms/step - loss: 0.8160 - acc: 0.7117 - val_loss:
0.9382 - val_acc: 0.6742

Epoch 00027: val_loss did not improve from 0.76249
Epoch 28/50
82s 3ms/step - loss: 0.7993 - acc: 0.7207 - val_loss:
0.8975 - val_acc: 0.6912

Epoch 00028: val_loss did not improve from 0.76249
Epoch 29/50
83s 3ms/step - loss: 0.7851 - acc: 0.7250 - val_loss:
0.9335 - val_acc: 0.6749

Epoch 00029: val_loss did not improve from 0.76249
Epoch 30/50
84s 3ms/step - loss: 0.7524 - acc: 0.7352 - val_loss:
0.9343 - val_acc: 0.6766

Epoch 00030: val_loss did not improve from 0.76249
Epoch 31/50
83s 3ms/step - loss: 0.7395 - acc: 0.7426 - val_loss:
0.8632 - val_acc: 0.7010

Epoch 00031: val_loss did not improve from 0.76249
```

```
Epoch 32/50
82s 3ms/step - loss: 0.7223 - acc: 0.7482 - val_loss:
0.8922 - val_acc: 0.6940


Epoch 00032: val_loss did not improve from 0.76249
Epoch 33/50
83s 3ms/step - loss: 0.6976 - acc: 0.7562 - val_loss:
0.8777 - val_acc: 0.7083

Epoch 00033: val_loss did not improve from 0.76249
Epoch 34/50
83s 3ms/step - loss: 0.6983 - acc: 0.7590 - val_loss:
0.8488 - val_acc: 0.7126

Epoch 00034: val_loss did not improve from 0.76249
Epoch 35/50
83s 3ms/step - loss: 0.6676 - acc: 0.7670 - val_loss:
0.8537 - val_acc: 0.7190

Epoch 00035: val_loss did not improve from 0.76249
Epoch 36/50
84s 3ms/step - loss: 0.6665 - acc: 0.7728 - val_loss:
0.9224 - val_acc: 0.6907

Epoch 00036: val_loss did not improve from 0.76249
Epoch 37/50
84s 3ms/step - loss: 0.6526 - acc: 0.7788 - val_loss:
0.8960 - val_acc: 0.7045

Epoch 00037: val_loss did not improve from 0.76249
Epoch 38/50
83s 3ms/step - loss: 0.6388 - acc: 0.7839 - val_loss:
```

```
0.8669 - val_acc: 0.7186

Epoch 00038: val_loss did not improve from 0.76249
Epoch 39/50
82s 3ms/step - loss: 0.6265 - acc: 0.7843 - val_loss:
0.8623 - val_acc: 0.7083

Epoch 00039: val_loss did not improve from 0.76249
Epoch 00039: early stopping
4666/4666 [==============================] - 4s 948us/step
Val Score:  [0.8622647177953348, 0.7083154735368973]
============================================================
```

Training pada Fold 6

```
Training on Fold:  6
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
84s 3ms/step - loss: 2.1052 - acc: 0.1594 - val_loss:
1.9525 - val_acc: 0.1586

Epoch 00001: val_loss did not improve from 0.76249
Epoch 2/50
82s 3ms/step - loss: 1.9481 - acc: 0.1732 - val_loss:
2.0090 - val_acc: 0.1682

Epoch 00002: val_loss did not improve from 0.76249
Epoch 3/50
82s 3ms/step - loss: 1.8907 - acc: 0.2150 - val_loss:
1.9257 - val_acc: 0.1858
```

```
Epoch 00003: val_loss did not improve from 0.76249
Epoch 4/50
81s 2ms/step - loss: 1.7913 - acc: 0.2813 - val_loss:
1.7123 - val_acc: 0.3024

Epoch 00004: val_loss did not improve from 0.76249
Epoch 5/50
81s 2ms/step - loss: 1.6452 - acc: 0.3686 - val_loss:
1.5036 - val_acc: 0.4076

Epoch 00005: val_loss did not improve from 0.76249
Epoch 6/50
83s 3ms/step - loss: 1.5295 - acc: 0.4169 - val_loss:
1.4293 - val_acc: 0.4475

Epoch 00006: val_loss did not improve from 0.76249
Epoch 7/50
81s 2ms/step - loss: 1.4494 - acc: 0.4593 - val_loss:
1.3911 - val_acc: 0.4709

Epoch 00007: val_loss did not improve from 0.76249
Epoch 8/50
81s 2ms/step - loss: 1.3860 - acc: 0.4828 - val_loss:
1.3642 - val_acc: 0.4788

Epoch 00008: val_loss did not improve from 0.76249
Epoch 9/50
80s 2ms/step - loss: 1.3388 - acc: 0.5044 - val_loss:
1.2981 - val_acc: 0.5075

Epoch 00009: val_loss did not improve from 0.76249
Epoch 10/50
```

```
82s 3ms/step - loss: 1.2957 - acc: 0.5164 - val_loss:
1.2077 - val_acc: 0.5360

Epoch 00010: val_loss did not improve from 0.76249
Epoch 11/50
84s 3ms/step - loss: 1.2492 - acc: 0.5356 - val_loss:
1.1987 - val_acc: 0.5403

Epoch 00011: val_loss did not improve from 0.76249
Epoch 12/50
85s 3ms/step - loss: 1.2064 - acc: 0.5565 - val_loss:
1.1561 - val_acc: 0.5647

Epoch 00012: val_loss did not improve from 0.76249
Epoch 13/50
82s 3ms/step - loss: 1.1793 - acc: 0.5685 - val_loss:
1.1788 - val_acc: 0.5547

Epoch 00013: val_loss did not improve from 0.76249
Epoch 14/50
83s 3ms/step - loss: 1.1329 - acc: 0.5855 - val_loss:
1.1247 - val_acc: 0.5767

Epoch 00014: val_loss did not improve from 0.76249
Epoch 15/50
84s 3ms/step - loss: 1.0901 - acc: 0.6037 - val_loss:
1.0803 - val_acc: 0.6009

Epoch 00015: val_loss did not improve from 0.76249
Epoch 16/50
82s 3ms/step - loss: 1.0600 - acc: 0.6178 - val_loss:
1.0324 - val_acc: 0.6222
```

```
Epoch 00016: val_loss did not improve from 0.76249
Epoch 17/50
78s 2ms/step - loss: 1.0350 - acc: 0.6278 - val_loss:
1.0304 - val_acc: 0.6099

Epoch 00017: val_loss did not improve from 0.76249
Epoch 18/50
77s 2ms/step - loss: 1.0007 - acc: 0.6449 - val_loss:
0.9748 - val_acc: 0.6397

Epoch 00018: val_loss did not improve from 0.76249
Epoch 19/50
77s 2ms/step - loss: 0.9749 - acc: 0.6562 - val_loss:
0.9691 - val_acc: 0.6507

Epoch 00019: val_loss did not improve from 0.76249
Epoch 20/50
77s 2ms/step - loss: 0.9329 - acc: 0.6695 - val_loss:
0.9438 - val_acc: 0.6601

Epoch 00020: val_loss did not improve from 0.76249
Epoch 21/50
77s 2ms/step - loss: 0.9177 - acc: 0.6752 - val_loss:
1.0128 - val_acc: 0.6429

Epoch 00021: val_loss did not improve from 0.76249
Epoch 22/50
77s 2ms/step - loss: 0.8895 - acc: 0.6888 - val_loss:
0.9405 - val_acc: 0.6562

Epoch 00022: val_loss did not improve from 0.76249
Epoch 23/50
77s 2ms/step - loss: 0.8681 - acc: 0.6950 - val_loss:
```

```
0.9381 - val_acc: 0.6633

Epoch 00023: val_loss did not improve from 0.76249
Epoch 24/50
77s 2ms/step - loss: 0.8340 - acc: 0.7083 - val_loss:
0.9114 - val_acc: 0.6766

Epoch 00024: val_loss did not improve from 0.76249
Epoch 25/50
77s 2ms/step - loss: 0.8083 - acc: 0.7190 - val_loss:
0.9095 - val_acc: 0.6800

Epoch 00025: val_loss did not improve from 0.76249
Epoch 26/50
77s 2ms/step - loss: 0.7869 - acc: 0.7269 - val_loss:
0.8657 - val_acc: 0.6997

Epoch 00026: val_loss did not improve from 0.76249
Epoch 27/50
77s 2ms/step - loss: 0.7661 - acc: 0.7343 - val_loss:
0.8945 - val_acc: 0.6942

Epoch 00027: val_loss did not improve from 0.76249
Epoch 28/50
77s 2ms/step - loss: 0.7478 - acc: 0.7423 - val_loss:
0.9001 - val_acc: 0.6976

Epoch 00028: val_loss did not improve from 0.76249
Epoch 29/50
77s 2ms/step - loss: 0.7339 - acc: 0.7477 - val_loss:
0.8714 - val_acc: 0.7023

Epoch 00029: val_loss did not improve from 0.76249
```

```
Epoch 30/50
77s 2ms/step - loss: 0.7222 - acc: 0.7546 - val_loss:
0.8833 - val_acc: 0.7062

Epoch 00030: val_loss did not improve from 0.76249
Epoch 31/50
77s 2ms/step - loss: 0.7019 - acc: 0.7580 - val_loss:
0.8350 - val_acc: 0.7229

Epoch 00031: val_loss did not improve from 0.76249
Epoch 32/50
77s 2ms/step - loss: 0.6773 - acc: 0.7693 - val_loss:
0.8799 - val_acc: 0.7032

Epoch 00032: val_loss did not improve from 0.76249
Epoch 33/50
77s 2ms/step - loss: 0.6652 - acc: 0.7751 - val_loss:
0.9172 - val_acc: 0.6995

Epoch 00033: val_loss did not improve from 0.76249
Epoch 34/50
77s 2ms/step - loss: 0.6531 - acc: 0.7785 - val_loss:
0.8227 - val_acc: 0.7366

Epoch 00034: val_loss did not improve from 0.76249
Epoch 35/50
77s 2ms/step - loss: 0.6223 - acc: 0.7874 - val_loss:
0.8646 - val_acc: 0.7165

Epoch 00035: val_loss did not improve from 0.76249
Epoch 36/50
77s 2ms/step - loss: 0.6326 - acc: 0.7875 - val_loss:
0.8792 - val_acc: 0.7075
```

```
Epoch 00036: val_loss did not improve from 0.76249
Epoch 37/50
77s 2ms/step - loss: 0.6102 - acc: 0.7957 - val_loss:
0.7968 - val_acc: 0.7415

Epoch 00037: val_loss did not improve from 0.76249
Epoch 38/50
77s 2ms/step - loss: 0.5893 - acc: 0.8041 - val_loss:
0.8271 - val_acc: 0.7405

Epoch 00038: val_loss did not improve from 0.76249
Epoch 39/50
77s 2ms/step - loss: 0.5749 - acc: 0.8075 - val_loss:
0.8314 - val_acc: 0.7351

Epoch 00039: val_loss did not improve from 0.76249
Epoch 40/50
77s 2ms/step - loss: 0.5637 - acc: 0.8094 - val_loss:
0.8134 - val_acc: 0.7430

Epoch 00040: val_loss did not improve from 0.76249
Epoch 41/50
77s 2ms/step - loss: 0.5517 - acc: 0.8145 - val_loss:
0.8416 - val_acc: 0.7285

Epoch 00041: val_loss did not improve from 0.76249
Epoch 42/50
77s 2ms/step - loss: 0.5484 - acc: 0.8187 - val_loss:
0.8938 - val_acc: 0.7233

Epoch 00042: val_loss did not improve from 0.76249
Epoch 00042: early stopping
```

```
4666/4666 [==============================] - 4s 828us/step
Val Score:  [0.8938290883786577, 0.7233176169045943]
============================================================
```

Training pada Fold 7

```
Training on Fold:  7
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
75s 2ms/step - loss: 2.0843 - acc: 0.1643 - val_loss:
1.9429 - val_acc: 0.1817

Epoch 00001: val_loss did not improve from 0.76249
Epoch 2/50
76s 2ms/step - loss: 1.9486 - acc: 0.1782 - val_loss:
1.9664 - val_acc: 0.1644

Epoch 00002: val_loss did not improve from 0.76249
Epoch 3/50
77s 2ms/step - loss: 1.9138 - acc: 0.1917 - val_loss:
2.0603 - val_acc: 0.1667

Epoch 00003: val_loss did not improve from 0.76249
Epoch 4/50
77s 2ms/step - loss: 1.8311 - acc: 0.2407 - val_loss:
1.8500 - val_acc: 0.2398

Epoch 00004: val_loss did not improve from 0.76249
Epoch 5/50
77s 2ms/step - loss: 1.7409 - acc: 0.3032 - val_loss:
1.9426 - val_acc: 0.2670
```

```
Epoch 00005: val_loss did not improve from 0.76249
Epoch 6/50
77s 2ms/step - loss: 1.6155 - acc: 0.3725 - val_loss:
1.5857 - val_acc: 0.3988

Epoch 00006: val_loss did not improve from 0.76249
Epoch 7/50
77s 2ms/step - loss: 1.5149 - acc: 0.4236 - val_loss:
1.4093 - val_acc: 0.4721

Epoch 00007: val_loss did not improve from 0.76249
Epoch 8/50
77s 2ms/step - loss: 1.4391 - acc: 0.4597 - val_loss:
1.3046 - val_acc: 0.5071

Epoch 00008: val_loss did not improve from 0.76249
Epoch 9/50
77s 2ms/step - loss: 1.3740 - acc: 0.4875 - val_loss:
1.2725 - val_acc: 0.5212

Epoch 00009: val_loss did not improve from 0.76249
Epoch 10/50
77s 2ms/step - loss: 1.3231 - acc: 0.5071 - val_loss:
1.2114 - val_acc: 0.5394

Epoch 00010: val_loss did not improve from 0.76249
Epoch 11/50
77s 2ms/step - loss: 1.2829 - acc: 0.5245 - val_loss:
1.1590 - val_acc: 0.5720

Epoch 00011: val_loss did not improve from 0.76249
Epoch 12/50
```

```
77s 2ms/step - loss: 1.2416 - acc: 0.5402 - val_loss:
1.1317 - val_acc: 0.5697

Epoch 00012: val_loss did not improve from 0.76249
Epoch 13/50
77s 2ms/step - loss: 1.2090 - acc: 0.5517 - val_loss:
1.1890 - val_acc: 0.5424

Epoch 00013: val_loss did not improve from 0.76249
Epoch 14/50
77s 2ms/step - loss: 1.1600 - acc: 0.5685 - val_loss:
1.0425 - val_acc: 0.6136

Epoch 00014: val_loss did not improve from 0.76249
Epoch 15/50
77s 2ms/step - loss: 1.1379 - acc: 0.5839 - val_loss:
1.0447 - val_acc: 0.6129

Epoch 00015: val_loss did not improve from 0.76249
Epoch 16/50
77s 2ms/step - loss: 1.1017 - acc: 0.5978 - val_loss:
1.0579 - val_acc: 0.6057

Epoch 00016: val_loss did not improve from 0.76249
Epoch 17/50
77s 2ms/step - loss: 1.0623 - acc: 0.6156 - val_loss:
0.9770 - val_acc: 0.6447

Epoch 00017: val_loss did not improve from 0.76249
Epoch 18/50
77s 2ms/step - loss: 1.0254 - acc: 0.6263 - val_loss:
1.0267 - val_acc: 0.6256
```

```
Epoch 00018: val_loss did not improve from 0.76249
Epoch 19/50
77s 2ms/step - loss: 1.0016 - acc: 0.6378 - val_loss:
0.9653 - val_acc: 0.6387

Epoch 00019: val_loss did not improve from 0.76249
Epoch 20/50
77s 2ms/step - loss: 0.9766 - acc: 0.6519 - val_loss:
0.9439 - val_acc: 0.6625

Epoch 00020: val_loss did not improve from 0.76249
Epoch 21/50
77s 2ms/step - loss: 0.9466 - acc: 0.6634 - val_loss:
0.9270 - val_acc: 0.6644

Epoch 00021: val_loss did not improve from 0.76249
Epoch 22/50
77s 2ms/step - loss: 0.9129 - acc: 0.6764 - val_loss:
0.9280 - val_acc: 0.6689

Epoch 00022: val_loss did not improve from 0.76249
Epoch 23/50
77s 2ms/step - loss: 0.8964 - acc: 0.6836 - val_loss:
0.8853 - val_acc: 0.6856

Epoch 00023: val_loss did not improve from 0.76249
Epoch 24/50
77s 2ms/step - loss: 0.8686 - acc: 0.6943 - val_loss:
0.8622 - val_acc: 0.6832

Epoch 00024: val_loss did not improve from 0.76249
Epoch 25/50
77s 2ms/step - loss: 0.8493 - acc: 0.7018 - val_loss:
```

```
0.8508 - val_acc: 0.7083

Epoch 00025: val_loss did not improve from 0.76249
Epoch 26/50
77s 2ms/step - loss: 0.8239 - acc: 0.7127 - val_loss:
0.8359 - val_acc: 0.7075

Epoch 00026: val_loss did not improve from 0.76249
Epoch 27/50
77s 2ms/step - loss: 0.8003 - acc: 0.7170 - val_loss:
0.8686 - val_acc: 0.6997

Epoch 00027: val_loss did not improve from 0.76249
Epoch 28/50
77s 2ms/step - loss: 0.7857 - acc: 0.7261 - val_loss:
0.8245 - val_acc: 0.7147

Epoch 00028: val_loss did not improve from 0.76249
Epoch 29/50
77s 2ms/step - loss: 0.7646 - acc: 0.7340 - val_loss:
0.8321 - val_acc: 0.7233

Epoch 00029: val_loss did not improve from 0.76249
Epoch 30/50
77s 2ms/step - loss: 0.7523 - acc: 0.7406 - val_loss:
0.8215 - val_acc: 0.7197

Epoch 00030: val_loss did not improve from 0.76249
Epoch 31/50
77s 2ms/step - loss: 0.7229 - acc: 0.7523 - val_loss:
0.8344 - val_acc: 0.7192

Epoch 00031: val_loss did not improve from 0.76249
```

```
Epoch 32/50
77s 2ms/step - loss: 0.7109 - acc: 0.7526 - val_loss:
0.8132 - val_acc: 0.7257

Epoch 00032: val_loss did not improve from 0.76249
Epoch 33/50
77s 2ms/step - loss: 0.6873 - acc: 0.7650 - val_loss:
0.7979 - val_acc: 0.7274

Epoch 00033: val_loss did not improve from 0.76249
Epoch 34/50
77s 2ms/step - loss: 0.6709 - acc: 0.7672 - val_loss:
0.7686 - val_acc: 0.7368


Epoch 00034: val_loss did not improve from 0.76249
Epoch 35/50
77s 2ms/step - loss: 0.6661 - acc: 0.7718 - val_loss:
0.7905 - val_acc: 0.7340

Epoch 00035: val_loss did not improve from 0.76249
Epoch 36/50
77s 2ms/step - loss: 0.6457 - acc: 0.7834 - val_loss:
0.8087 - val_acc: 0.7315

Epoch 00036: val_loss did not improve from 0.76249
Epoch 37/50
77s 2ms/step - loss: 0.6394 - acc: 0.7813 - val_loss:
0.7607 - val_acc: 0.7411

Epoch 00037: val_loss improved from 0.76249 to 0.76066,
saving model to ./models/model_balancing3.h5
Epoch 38/50
```

```
76s 2ms/step - loss: 0.6156 - acc: 0.7901 - val_loss:
0.7774 - val_acc: 0.7473

Epoch 00038: val_loss did not improve from 0.76066
Epoch 39/50
77s 2ms/step - loss: 0.6059 - acc: 0.7932 - val_loss:
0.7825 - val_acc: 0.7426

Epoch 00039: val_loss did not improve from 0.76066
Epoch 40/50
77s 2ms/step - loss: 0.5872 - acc: 0.8025 - val_loss:
0.7832 - val_acc: 0.7503

Epoch 00040: val_loss did not improve from 0.76066
Epoch 41/50
77s 2ms/step - loss: 0.5879 - acc: 0.8031 - val_loss:
0.8540 - val_acc: 0.7167

Epoch 00041: val_loss did not improve from 0.76066
Epoch 42/50
77s 2ms/step - loss: 0.5820 - acc: 0.8045 - val_loss:
0.7795 - val_acc: 0.7523

Epoch 00042: val_loss did not improve from 0.76066
Epoch 00042: early stopping
4666/4666 [==============================] - 4s 814us/step
Val Score:  [0.7794737613257348, 0.7522503215511418]
============================================================
```

Training pada Fold 8

```
Training on Fold:  8
(32657, 48, 48, 1)
Train on 32657 samples, validate on 4666 samples
Epoch 1/50
75s 2ms/step - loss: 2.1078 - acc: 0.1614 - val_loss:
1.9526 - val_acc: 0.1742

Epoch 00001: val_loss did not improve from 0.76066
Epoch 2/50
76s 2ms/step - loss: 1.9319 - acc: 0.1872 - val_loss:
1.8836 - val_acc: 0.2066

Epoch 00002: val_loss did not improve from 0.76066
Epoch 3/50
77s 2ms/step - loss: 1.8003 - acc: 0.2674 - val_loss:
1.7874 - val_acc: 0.2670

Epoch 00003: val_loss did not improve from 0.76066
Epoch 4/50
77s 2ms/step - loss: 1.6694 - acc: 0.3463 - val_loss:
1.5239 - val_acc: 0.4070

Epoch 00004: val_loss did not improve from 0.76066
Epoch 5/50
77s 2ms/step - loss: 1.5645 - acc: 0.4010 - val_loss:
1.8266 - val_acc: 0.3249

Epoch 00005: val_loss did not improve from 0.76066
Epoch 6/50
77s 2ms/step - loss: 1.4752 - acc: 0.4471 - val_loss:
1.3988 - val_acc: 0.4874
```

```
Epoch 00006: val_loss did not improve from 0.76066
Epoch 7/50
77s 2ms/step - loss: 1.3987 - acc: 0.4776 - val_loss:
1.3373 - val_acc: 0.4841

Epoch 00007: val_loss did not improve from 0.76066
Epoch 8/50
77s 2ms/step - loss: 1.3564 - acc: 0.4955 - val_loss:
1.3014 - val_acc: 0.5126

Epoch 00008: val_loss did not improve from 0.76066
Epoch 9/50
77s 2ms/step - loss: 1.3154 - acc: 0.5112 - val_loss:
1.2499 - val_acc: 0.5249

Epoch 00009: val_loss did not improve from 0.76066
Epoch 10/50
77s 2ms/step - loss: 1.2716 - acc: 0.5263 - val_loss:
1.1736 - val_acc: 0.5506

Epoch 00010: val_loss did not improve from 0.76066
Epoch 11/50
77s 2ms/step - loss: 1.2280 - acc: 0.5465 - val_loss:
1.1953 - val_acc: 0.5626

Epoch 00011: val_loss did not improve from 0.76066
Epoch 12/50
77s 2ms/step - loss: 1.1994 - acc: 0.5591 - val_loss:
1.1196 - val_acc: 0.5847

Epoch 00012: val_loss did not improve from 0.76066
Epoch 13/50
```

```
77s 2ms/step - loss: 1.1544 - acc: 0.5795 - val_loss:
1.1141 - val_acc: 0.5817

Epoch 00013: val_loss did not improve from 0.76066
Epoch 14/50
77s 2ms/step - loss: 1.1264 - acc: 0.5866 - val_loss:
1.1477 - val_acc: 0.5759

Epoch 00014: val_loss did not improve from 0.76066
Epoch 15/50
77s 2ms/step - loss: 1.0826 - acc: 0.6090 - val_loss:
1.0151 - val_acc: 0.6361

Epoch 00015: val_loss did not improve from 0.76066
Epoch 16/50
77s 2ms/step - loss: 1.0493 - acc: 0.6180 - val_loss:
1.0718 - val_acc: 0.6170

Epoch 00016: val_loss did not improve from 0.76066
Epoch 17/50
77s 2ms/step - loss: 1.0120 - acc: 0.6352 - val_loss:
1.0446 - val_acc: 0.6277

Epoch 00017: val_loss did not improve from 0.76066
Epoch 18/50
77s 2ms/step - loss: 0.9818 - acc: 0.6454 - val_loss:
0.9903 - val_acc: 0.6391

Epoch 00018: val_loss did not improve from 0.76066
Epoch 19/50
77s 2ms/step - loss: 0.9495 - acc: 0.6595 - val_loss:
0.9545 - val_acc: 0.6590
```

```
Epoch 00019: val_loss did not improve from 0.76066
Epoch 20/50
77s 2ms/step - loss: 0.9261 - acc: 0.6739 - val_loss:
0.9790 - val_acc: 0.6483

Epoch 00020: val_loss did not improve from 0.76066
Epoch 21/50
77s 2ms/step - loss: 0.8985 - acc: 0.6826 - val_loss:
0.8752 - val_acc: 0.6794

Epoch 00021: val_loss did not improve from 0.76066
Epoch 22/50
77s 2ms/step - loss: 0.8800 - acc: 0.6901 - val_loss:
0.8968 - val_acc: 0.6805

Epoch 00022: val_loss did not improve from 0.76066
Epoch 23/50
77s 2ms/step - loss: 0.8439 - acc: 0.7033 - val_loss:
0.8713 - val_acc: 0.6856

Epoch 00023: val_loss did not improve from 0.76066
Epoch 24/50
77s 2ms/step - loss: 0.8140 - acc: 0.7128 - val_loss:
0.8987 - val_acc: 0.6852

Epoch 00024: val_loss did not improve from 0.76066
Epoch 25/50
77s 2ms/step - loss: 0.7964 - acc: 0.7211 - val_loss:
0.8631 - val_acc: 0.7027

Epoch 00025: val_loss did not improve from 0.76066
Epoch 26/50
77s 2ms/step - loss: 0.7777 - acc: 0.7291 - val_loss:
```

```
0.8414 - val_acc: 0.7030

Epoch 00026: val_loss did not improve from 0.76066
Epoch 27/50
77s 2ms/step - loss: 0.7465 - acc: 0.7423 - val_loss:
0.8648 - val_acc: 0.6963

Epoch 00027: val_loss did not improve from 0.76066
Epoch 28/50
77s 2ms/step - loss: 0.7329 - acc: 0.7456 - val_loss:
0.8805 - val_acc: 0.6895

Epoch 00028: val_loss did not improve from 0.76066
Epoch 29/50
77s 2ms/step - loss: 0.7049 - acc: 0.7534 - val_loss:
0.8173 - val_acc: 0.7199

Epoch 00029: val_loss did not improve from 0.76066
Epoch 30/50
77s 2ms/step - loss: 0.6888 - acc: 0.7605 - val_loss:
0.8182 - val_acc: 0.7180

Epoch 00030: val_loss did not improve from 0.76066
Epoch 31/50
77s 2ms/step - loss: 0.6734 - acc: 0.7670 - val_loss:
0.7985 - val_acc: 0.7287

Epoch 00031: val_loss did not improve from 0.76066
Epoch 32/50
77s 2ms/step - loss: 0.6554 - acc: 0.7751 - val_loss:
0.8127 - val_acc: 0.7295

Epoch 00032: val_loss did not improve from 0.76066
```

```
Epoch 33/50
77s 2ms/step - loss: 0.6335 - acc: 0.7818 - val_loss:
0.7869 - val_acc: 0.7338

Epoch 00033: val_loss did not improve from 0.76066
Epoch 34/50

77s 2ms/step - loss: 0.6210 - acc: 0.7858 - val_loss:
0.8119 - val_acc: 0.7263

Epoch 00034: val_loss did not improve from 0.76066
Epoch 35/50
77s 2ms/step - loss: 0.6125 - acc: 0.7932 - val_loss:
0.8059 - val_acc: 0.7396

Epoch 00035: val_loss did not improve from 0.76066
Epoch 36/50
77s 2ms/step - loss: 0.5925 - acc: 0.7979 - val_loss:
0.7880 - val_acc: 0.7413

Epoch 00036: val_loss did not improve from 0.76066
Epoch 37/50
77s 2ms/step - loss: 0.5734 - acc: 0.8054 - val_loss:
0.7936 - val_acc: 0.7465

Epoch 00037: val_loss did not improve from 0.76066
Epoch 38/50
77s 2ms/step - loss: 0.5648 - acc: 0.8093 - val_loss:
0.8031 - val_acc: 0.7447

Epoch 00038: val_loss did not improve from 0.76066
Epoch 00038: early stopping
4666/4666 [==============================] - 4s 818us/step
```

```
Val Score:  [0.8031195291264906, 0.7447492497906478]
============================================================
```