strategies to overcoming challenges of BDA in health sector, 24–25
techniques, tools, and technologies in health sector, 20–21
Big Data to Knowledge (BD2K), 119, 127
Big Healthcare Data (BHD), 119
BMP180 Breakout, 102
Body mass index (BMI), 272
Boosting, 48–49
Bootstrap aggregation (see Bagging technique)
Botulinum toxin, 177
Breast cancer (BC), 190
related work on BC prediction, 190–192
Breastfeeding, 231
Brownian movement, 101
Business intelligence (BI), 153, 155
contribution, 154–155
data warehouse design, 160–161
dataset, 161–162
ETL process, 163
evolution, 156
in healthcare industry and benefits, 156–157
implementation, 167–170
literature survey, 157–159
problem identification, 159
vision, 154
workflow, 159
Business models of telehealth, 249–252
C4.5 decision tree algorithm technique, 275
Cadmium Sulfide (CdS), 143
Cancer (see also Breast cancer (BC)), 227
Carbohydrates, 226, 231
deficiency, 231
Carbon filter, 100
Carbs (see Carbohydrates)
CART techniques, 40
Cassandra, 84
Cells, 224–225
Central facial palsy, 174
Chi-square algorithm, 38
test, 210
Chip, 142
Chronic facial paralysis, 177
Chronic kidney disease (CKD), 276
Citizen-consumer, 57
City Block Distance (see Manhattan distance)
Classification algorithms
activation functions, 43
bagging, 49
boosting, 48–49
chi-square algorithm, 38
CNN and RNN, 47
combination methods, 49–50
cost function, 41–42
data mining in health care, 32–33
decision trees, 37–38
E-health, 52–53
ensemble learning, 47–48
gradient descent algorithm, 47
KNN, 33–34
linear activation function, 43
logistic regression, 40–41
model evaluation, 50–52
Naïve Bayes algorithm, 34–35
neural networks, 42–43
pruning, 39
random forest algorithm, 39–40
ROC curve, 52
sigmoid function, 41
SVM, 35–37
Clinical decision support (CDD), 116
Clinical trials, 80
Cloudera, 21
Cluster analysis, 20
Collaborative Assessment and Recommendation Engine (CARE), 131
Combination methods, 49–50
Committee-based learning, 48
Complex carbohydrates, 226
Computational fluid dynamics, 59
Computer-aided big healthcare data analytics *(see also Smart nursery with health monitoring system)*

- anatomy of big data, 123–126
- benefits of BHD analytics, 126–127
- BHD applications in real clinics, 127–131
- methods and technology progress in big data, 118–120
- motivation, 120–123

Conductivity sensor, 101

Confusion matrix, 51–52

Congestive heart failure (CHF), 47

Convolution, 235

Convolution(al) neural networks (CNNs), 47, 235–237

Coronary artery disease (CAD), 206

Correlation matrix, 154, 159, 167

Cosine distance, 34

Cost function, 41–42

CRDC tool, 10

Cross-facial re-innervation processes, 178

Data
- data-citizens, 57
- data-driven economy, 57
- as fuel of modern economy, 57–59
- mining, 20, 32–33, 66, 264
- quality, structure, and accessibility, 22
- set, 104

Data warehouse (DW), 154

DCM education tool, 210

Decision trees, 37–39, 158–159, 168, 272

Deep learning, 42, 234–238

Deming’s PDCA Cycle, 61

Descriptive analytics, 56, 67

DHT11 module, 143, 146

Diabetes *(see Diabetes mellitus (DM))*

- age group and gender distribution, 212
- experimental setup, 211
- future scope, applications, and limitations, 217–220
- insulin consumption, 213–220
- literature survey/previous findings, 209–211
- novelty in work, 216–217
- recommendations, 220
- study and analysis, 211

Diagnostic analytics, 56

Dietary fiber, 227

Digital disease surveillance, 80

Dimension table, 160

Disease level of patient, 176

District Level Household Survey (DLHS), 63

Doctor Insta, 252

Dynamic programming, 66

E-health, 13, 52–53

Education, 14

Electrocardiogram (ECG), 116

Electroencephalogram (EEG), 116

Electromyography (EMG), 116, 174

Electronic health records (EHR), 2, 6–7, 19, 76, 83, 116, 156, 248, 264

Electronic medical records (EMR), 19, 77–78, 116

Electronic patient records (EPRs), 118

Electronic wellbeing records (EWRs), 117

Emerging technological ecosystem, 66

Enhanced Multiclass Support Vector Machine (EMSVM), 191

Ensemble learning, 47–48

- model, 275

Entropy, 37

Error matrix *(see Confusion matrix)*

Euclidean distance, 33–34

European Union (EU), 59

Evidence-based decision-making, 22
Executive Information Systems (EIS), 156
Expression quantitative trait loci (EQTLs), 131
Extraction, transformation, and loading process (ETL process), 155, 163
eXtreme Gradient Boosting algorithm (XGBoost algorithm), 49
ExxonMobil Research and Engineering Company (EMRE), 58
F1 score, 52
Facial palsy, 173–175
comparative study of existing solution, 178–181
levels, 185
literature survey, 175–176
problem identification, 177
proposed solution, 181–183
pros and cons of solution, 183
Facial paralysis, initial surgery for, 177
Fact table, 160
Failure of heart (see Congestive heart failure (CHF))
False negative (FN), 51
False positive (FP), 51
Fat(s), 226
deficiency of, 231–232
fat-soluble vitamins, 226
Feature
ranking, 193
selection, 190
Filtering, 105
First-level learners, 50
Flaccid paralysis, 177
Flattening, 237
Food
choices, 223
dyes, 227
effect of weather, 228
role and value of nutrients, 224–227
security, 230
Forest optimization algorithm (FOA), 191
Fraud detection, 22
Frequency table, 37
G1 Dispensaries, 251
GDC tool, 9
GEneralizable Medical Information Analysis and Integration System (GEMINI), 129
Genetic algorithm (GA), 190
Genome Analysis ToolKit (GATK), 131
Genome-wide association study (GWAS), 131
Genomics, 78
Gestational diabetes, 204
Gini importance, 40
Gini index, 38
Global Pulse project, 119
Glocal Digital Dispensaries, 250–251
Glocal Healthcare Systems Private Limited, 250–251
Goodness of split criterion, 272
Government agencies, 13
Gradient boosting, 48
Gradient descent algorithm, 42, 47
Graph analytics, 21
Gross data product, 58
Gross domestic product (GDP), 121
Grove–Gas Sensor, 99–100
Hadoop, 21
Hadoop distributed file system (HDFS), 66, 84
Hamming distance, 33–34
Health Information Technology (HIT), 117, 248
Health Insurance Portability and Accountability Act legislation, 23
Health sector
BD definitions in, 18
BD needs in, 18–19
Health-threat detection, 22
Healthcare, 14, 139, 155
AI in, 207
analytics environment, 19
applications of BD in, 208
big data applications in, 4–15
data mining in, 32–33
IoT in, 208
ML in, 207
predictive analytics in, 10–11
technology in addressing
problem of integration, 208–209
Healthcare electronic record (HER), 116
Healthy diet with balanced nutrients, 223
HEPA filter, 100–101
High blood pressure, 227
HIT for Economical and Clinical
Health (HITECH), 117
Hold out method, 191
Hospitalization, 276
House Brackman grading system, 176
Hyperbolic tangent activation
function, 45
Hyperplanes, 36
ID3 algorithm, 158
IECM algorithm, 183
Image
acquisition, 182
conversion to arrays, 105
processing, 175
segmentation, 182–183
Information gain, 37–38
Information gain ratio (IGR), 191
Information technology (IT), 15, 125
Infrared sensor (IR sensor), 142, 144
Infrastructure Plus Program, 119
Instance-based KNN, 34
Institute for Health Technology
Transformation (IHTT), 117, 120
Insulin consumption, 213–216
Insurance, 14

Intensive care unit (ICU), 124
Intergovernmental Panel Climate
Change (IPCC), 95
International development, 13
Internet of Things (IoT), 14–15,
19–20, 57, 94, 208
Intrusion detection and security
system (IDS system), 141
future scope, 148–149
hardware assembly and
implementation, 144–147
literature review, 140–141
system architecture, 141–144
working, 148

Jaccard distance, 34
Jaql, 21

K-most similar data points, 34
\(k\)-Nearest Neighbours (KNN),
33–34, 233–234, 267,
269–270
Knowledge-based economy, 57

Lab testing, 78
Lazy learning KNN, 34
Leaky rectified linear unit activation
function (Leaky ReLU),
45–46
Learning
multiple classifier systems, 48
phase, 267
Light-dependent resistor (LDR), 141
module, 142–143, 146
sensor, 94, 97–98
Linear activation function, 43
Linear regression, 40–41, 272–273
Lipomics, 78
LitmusDx, 251
LM35 gadget, 101
Logistic regression, 40–41, 273–274

Machine learning (ML), 21, 32, 42,
66, 190, 207, 224, 233–234,
265
classifiers, 193–194
Macronutrients, 226
Magnetic resonance imaging (MRI), 116, 174
Mahalanobis distance, 34
Mahout, 21
Majority voting, 50
Malnutrition, 230–231
Mammography, 116
Man to machine interaction (M2M interaction), 120
Manhattan distance, 33–34
Manufacturing, 14
MapReduce, 21, 84
Margin in SVM, 36
Max pooling, 236–237
Meal classification and assessment of nutrients
autumn eats, 229–230
carbohydrates, 231
deep learning, 234–238
fat deficiency, 231–232
food security, 230
future scope, 239–240
life-threatening diseases caused by unhealthy food, 227
machine learning, 233–234
malnutrition, 230–231
mineral deficiency, 233
problem identification, 230
proposed solution, 238–239
protein deficiency, 232
role and value of nutrients in food, 224–227
spring eats, 229
summer eats, 228
vitamin deficiency, 232
effect of weather on food, 228
winter eats, 229
Mean decrease in impurity (MDI) (see Gini importance)
Medical Termination of Pregnancy (MTP), 64
Medicines, 231
history of, 244
Medongo, 251
Memory analytics, 66
Meta learner, 50
Metal oxide-semiconductor (MOS), 142
Microcontroller, 141–142
Micronutrients, 226
MiCS-2714 Gas Sensor, 100
Migraine, 204–205
Mineral(s), 227
deficiency, 233
Minkowski distance, 34
Model evaluation, 50–52
selection, 50
Moisture sensor, 94, 98
Morphological processing, 183
Mosaic plot, 159, 167
MQ2 Sensor, 99–100, 142, 145
MQ9 Sensor, 100
Multiple voxel pattern analysis (MVPA), 209
Multiway frequency analysis, 274
Mutation, 244
“My Kardio” framework, 256
Naïve Bayes (NB), 190, 194
algorithm, 34–35
classification modeling, 270–272
classifier, 34–35
National Family Health Survey (NFHS), 63
National Health Service (NHS), 127
National Institute of Health (NIH), 119
NCI tool, 10
Nerve transfer, 178
Neural networks, 21, 42–43
activation functions, 43
hyperbolic tangent activation function, 45
Leaky ReLU, 45–46
linear activation function, 43
ReLU function, 45
sigmoid activation function, 43
Softmax activation function, 46–47
Neurosynaptic communications, 249–250
Neurosynaptic Communications Private Ltd (NCPL), 249
Noise removal methods, 105
Non-essential nutrients, 227
Non-parametric KNN, 34
Non-suicidal trauma factor (NSSI), 209
Normal AC Filter, 101
Numeric predictions, 36
Nutrients, 223–224
role and value of nutrients in food, 224–227
Obesity, 205, 227
Object-oriented programs, 56
Omics, 78–79
Oozie, 21
Optical imaging, 116
Optimized delivery in telehealth care, 252
Osteoporosis, 227
Palsy, 173
Partial facial paralysis, 174
Patient
engagement, 8–9
health record, 116
patient-centric care, 22
predication, 3
Patient disease (Pdis), 161
Pattern recognition technique, 21
Peripheral facial palsy, 174
Personalized healthcare, 77
pH sensor, 94, 98
Photograph objects, 183
Photoresistor, 97–98
Photosynthesis, 96
PIG Latin, 84
PlantVillage, 104
Plurality voting, 50
PM 2.5 Sensor, 100
Population health, 22
Positron emission tomography (PET), 116
Potentiometric pH meter, 98
Power Grid Data, 4
PPD42NJ Particle Sensor Unit, 99
Precision, 51
Prediabetes, 204
Predictive analytics, 56, 67, 220
in health care, 10–11
Predictive big data analytics in healthcare (see also Big data analytics (BDA)), 76 advantages, 84–85
areas of application, 81–84
challenges, 86–88
claims data, 79–80
clinical data, 77–79
clinical research data, 80
data-related concerns, 87
infrastructural concerns, 86
IT infrastructure benefits, 84
managerial benefits, 85
operational benefits, 84–85
organization-related concerns, 88
organizational benefits, 85
patient–generated data, 80–81
security/privacy concerns, 87–88
sources of big data in healthcare, 77–81
strategic benefits, 85
Predictive healthcare, 77
Predictive modeling in health care data analytics, 264–266
applications, 274–277
disease diagnosis and treatment selection, 274–276
health care management, 276–277
reducing health care costs, 277
techniques for, 267–274
Prescription claims, 79–80
Prescriptive analytics, 56, 67
Preservatives, 227
Pressure sensor, 102
“Process of transformation”, 60
Protein(s), 226
  deficiency, 232
Proteomics, 78
Pruning, 39
PS2 Pollen Sensor, 99
Public health, 22

Radionuclide imaging, 116
Random decision forest, 193
Random forest (RF), 190–191, 193, 275
  algorithm, 39–40
  classifier, 40
  experimental results, 197–200
  machine learning classifiers, 193–194
  proposed methodology, 196–197
  statistical analysis, 194–196
Raspberry Pi, 141
Recall, 51–52
Receiver Operating Characteristics
curve (ROC curve), 52
Recommender system, 131
Rectified linear unit activation
  function (ReLU function), 45, 236
Recurrent Neural Networks (RNN),
  47, 237–238
Relay, 143–144
ReMeDi Nova, 250
ReMeDi Platform, 250
ReMeDi Solution, 249–250
Research and development
  professionals (R&D professionals), 56
Resizing images, 105
Right to Information Act (2005), 71
Risk-scoring, 79
Root mean square error (RMSE),
  191, 196
Root relative squared error (RRSE),
  191
Search Engine Data, 4
Second-level learner (see Weak learners)
  Security, 11, 139–140
  Semi-supervised learning, 193
Sensor(s), 140
  data, 19–20
Shannon’s entropy, 37
Sigmoid activation function, 43
Sigmoid function, 41
Simple averaging, 49
Simple carbohydrates, 226
Smart nursery with health monitoring
  system
  data acquiring and preprocessing,
  104–105
  data modeling, 105–106
  literature survey, 95–103
  methodology, 103–106
  results, 110–112
  solution, 106–110
Smartwatches (see Wristwatches)
Social media data, 80
Soft voting, 50
Softmax activation function, 46–47
Software for Flexible Integration of
  Annotation (SoFIA), 131
Soil pressure, 102
Spatial analysis, 21
Spring eats, 229
Sqoop, 21
Stacking, 50
Staffing levels, 5
Standard deviation (SD), 196
Statistical analysis, 194–196
Stress, 204
Sulfur dioxide, 96
Summer eats, 228
Supervised learning, 37, 193, 265
Support vector machines (SVM),
  35–37, 190, 192–194, 234,
  256, 267
  advantages and disadvantages,
  234
  Support vectors (SV), 234
Synkinesis, 177
  Tanimoto distance, 34
Telecardiology, 248
Index

Teledermatology, 248
Telehealth, 243, 246–247
  barriers to, 252–257
  business models, 249–252
  early civilization, 245
  evolution, 246
  history of medicine, 244
  methodology, 257
  modern history, 245–246
  optimized delivery in telehealth care, 252
  pre-historic ERA, 244–245
  process of evolution, 244
  results, 257–261
Telemedicine, 12–13, 77, 247–249
Telenephrology, 248
Teleneurology, 248
Teleobstetrics, 249
Teleoncology, 249
Teleophthalmology, 248
Telepathology, 249
Telepsychiatry, 248
Telerehabilitation, 249
Temperature sensor, 101
Tension-type headaches (TTH), 205, 215
Text mining, 66
  medical records, 11
Thermography, 116
Tin dioxide (SnO\textsubscript{2}), 142
True negative (TN), 51
True positive (TP), 51
Type 1 diabetes (T1D), 204, 204, 216
Ultrasonography (US), 116
Undernourishment, 231
Unsupervised learning, 193, 265
Valance, 125
Validity, 126
Value, 126
Variance, 196
Variety, 4, 18, 124
Velocity, 4, 18, 124
Veracity, 125
Visualization, 126
Vitamin(s), 226–227
  deficiency, 232
Volatility, 126
Volume, 4, 18, 123
Voting, 50
Vulnerability, 126
Water, 226
  water-soluble vitamins, 227
Weak learners, 48
Wearable sensors, 81
Weighted averaging, 50
Weighted voting, 50
Whole-genome association study (WGAS), 131
Winter eats, 229
Wireless sensor network (WSN), 141
Wisconsin Breast Cancer Data (WBCD), 190
World Health Organization (WHO), 122, 275
Wristwatches, 116
X-ray
  computed tomography, 116
  radiography, 116
YOLO Health, 251
Zookeeper, 21, 84