Table S1. Top 100 cited articles in Artificial Intelligence and Machine learning in cancer research

SCR	Author	Title	PY	DT	TNC
1	Guyon I et al.	Gene selection for cancer classification using support vector Machines	2002	Article	5758
2	Esteva A et al.	Dermatologist-Level classification of skin cancer with Deep Neural Networks	2017	Article	3815
3	Khan J et al.	Classification and diagnostic prediction of cancers using Gene Expression Profiling and Artificial Neural Networks	2001	Article	2008
4	Furey TS et al.	Support vector machine classification and validation of cancer Tissue Samples Using microarray expression data	2000	Article	1809
5	Kourou K et al.	Machine learning applications in cancer prognosis and Prediction	2015	Review	960
6	Bejnordi BE et al.	Diagnostic assessment of deep learning algorithms for detection of lymph Node Metastases in women with breast cancer	2017	Article	791
7	Sirinukunwattana K et al.	Locality sensitive deep learning for detection and classification of Nucleiin routine colon cancer Histology images	2016	Article	542
8	Coudray N et al.	Classification and mutation prediction from Nonsmall cell lung cancer histopathology Images using Deep Learning	2018	Article	539
9	Cruz JA; Wishart DS	Applications of machine learning in cancer prediction and prognosis	2006	Review	510
10	Akay MF	Support vector Machines combined with feature selection for Breast Cancer Diagnosis	2009	Article	469
11	Statnikov A et al.	A comprehensive comparison of random forests and support vector machines for Microarray-based cancer classification	2008	Article	416
12	Ardila D et al.	End-to-End Lung cancer Screening with Three-Dimensional Deep Learning on low-Dose chest computed tomography	2019	Article	357
13	Wu Y et al.	Artificial Neural Networks in mammography: Application to decision Making in The diagnosis of breast cancer	1993	Article	351
14	Araujo T., et al.	Classification of breast cancer histology images using convolution Neural Networks	2017	Article	341
15	Timmerman D et al.	Logistic Regression Model to distinguish Between the benign and malignant Adnexal Mass Before surgery: A Multicenter study by the International Ovarian	2005	Article	324
16	Karabatak M; Ince MC	An Expert system for detection of breast cancer Based on Association Rules and Neural Network	2009	Article	320
17	Lisboa PJ; Taktak AFG	The use of Artificial Neural Networks in decision support In cancer: A Systematic Review	2006	Article	314
18	Xie B et al.	Mircancer: A Micro RNAome-cancer Association database constructed by Text Mining on Literature	2013	Article	297
19	Zheng B et al.	Breast cancer diagnosis based on feature extraction using a Hybrid of K-Means and support vector Machine Algorithms	2014	Article	296
20	Abbass HA	An evolutionary Artificial Neural Networks approach for breast cancer diagnosis	2002	Article	294

21	Wang Y et al.	Gene selection from Microarray data for cancer classification -A Machine learning approach	2005	Article	286
22	Langer DL et al.	Prostate cancer detection with Multi-Parametric MRI: Logistic Regression analysis of Quantitative T2, Diffusion-Weighted imaging, and Dynamic contrast	2009	Article	284
23	Albarqouni S et al.	Aggnet: Deep Learning from crowds for Mitosis detection in breast cancer histology images	2016	Article	271
24	Tan AC and Gilbert D	Ensemble machine learning on gene expression data for cancer classification.	2003	Article	262
25	Bi WL et al.	Artificial Intelligence in cancer imaging: Clinical challenges and Applications	2019	Review	259
26	Burke HB., et al.	Artificial Neural Networks improve the accuracy of cancer survival Prediction	1997	Article	259
27	Gniadecka M et al.	Melanoma Diagnosis by Raman spectroscopy and Neural Networks: Structure Alterations in Proteins and Lipids in Intact cancer tissue	2004	Article	256
28	Zhou ZH et al.	Lung Cancer Cell Identification Based on Artificial Neural Network Ensembles	2002	Article	251
29	Shen W et al.	Multi-Crop convolutional Neural Networks for Lung Nodule Malignancy Suspiciousness classification	2017	Article	250
30	Chen HL et al.	A support vector Machine Classifier with Rough Set-Based feature Selection for breast cancer Diagnosis	2011	Article	245
31	Polat K and Gne S	Breast cancer Diagnosis using Least Square support vector machine	2007	Article	243
32	Wei L et al.	A study on several Machine-Learning methods for classification of Malignant and Benign clustered Micro calcifications	2005	Article	243
33	Lee Y; LEE CK	Classification of multiple cancer types by Multicategory support vector Machines using Gene Expression data	2003	Article	234
34	Chaudhary K et al.	Deep Learning based Multi-OMICS integration robustly predicts survival IN Liver cancer	2018	Article	222
35	Menden MP et al.	Machine Learning prediction of cancer cell sensitivity to drugs Based on Genomic and Chemical properties	2013	Article	221
36	Dheeba J et al.	Computer-Aided detection of breast cancer on Mammograms: A Swarm Intelligence Optimized wavelet Neural Network Approach	2014	Article	216
37	Hirasawa T et al.	Application of Artificial Intelligence using a convolution neural network for detecting Gastric cancer in Endoscopic images	2018	Article	204
38	Rogers MA et al.	Proteomic profiling of urinary proteins in renal cancer by surface enhanced laser desorption ionization and neural-network analysis: identification of key issues affecting potential clinical utility	2003	Article	203
39	Kuruvilla J; Gunavathi K	Lung cancer classification using neural networks for CT images.	2014	Article	202
40	Acharya UR et al.	Thermograph based breast cancer Detection using texture features and support vector machine	2012	Article	197
41	Huang S et al.	Applications of support vector Machine (SVM) Learning in cancer genomics.	2018	Review	195
42	Zhang R; et al.	Multicategory classification using an extreme learning machine for microarray Gene expression cancer diagnosis.	2007	Article	195
43	Jerez JM et al.	Missing data imputation using statistical and machine learning methods in a real breast cancer problem	2010	Article	191

44	Parmar C et al.	Radiomic machine-Learning classifiers for prognostic Biomarkers of head and Neck cancer	2015	Article	188
45	Suzuki K et al.	Computer-Aided Diagnostic Scheme for distinction between benign and malignant Nodules in thoracic Low-Dose CT by use of Massive Training Artificial Ne	2005	Article	187
46	Bychkov D et al.	Deep learning based tissue analysis predicts outcome in Colorectal cancer	2018	Article	186
47	BAKER JA et al.	Breast cancer: Prediction with artificial neural network Based on Bi-Rads standardized Lexicon	1995	Article	185
48	Han Z et al.	Breast cancer Multi-Classification from Histopathological images with structured Deep Learning Model	2017	Article	181
49	Cawley GC; Talbot NLC	Gene selection in cancer classification using Sparse Logistic Regression with Bayesian Regularization	2006	Article	180
50	Cruz-Roa A et al.	Accurate and reproducible invasive breast cancer detection in whole-Slide Images: A Deep Learning Approach for Quantifying tumor Extent	2017	Article	179
51	Peng S et al.	Molecular classification of cancer types from Microarray data using the combination of genetic Algorithms and support vector machines	2003	Article	176
52	Han SS et al.	Classification of the Clinical Images for benign and malignant cutaneous Tumors using a Deep Learning Algorithm	2018	Article	175
53	Kather JN et al.	Deep learning can predict microsatellite Instability Directly from Histology in Gastrointestinal cancer	2019	Article	174
54	Wang H; Cruz-Roa A et al.	Mitosis detection in breast cancer pathology images by combining handcrafted and Convolutional Neural Network features	2014	Article	172
55	Sftoiu A et al.	Neural network analysis of dynamic sequences of EUS Elastography used for the differential Diagnosis of chronic pancreatitis and pancreatic cancer	2008	Article	169
56	Chen DR et al.	Diagnosis of breast tumors with sonographic texture Analysis using Wavelet Transform and Neural Networks	2002	Article	169
57	Valentin L et al.	Comparison of ‘‘Pattern ’recognition’ and logistic regression models for Discrimination between Benign and Malignant Pelvic Masses: A prospective cross	2001	Article	160
58	Jerez-Aragons JM et al.	A combined neural network and decision trees Model for Prognosis of Breast cancer Relapse	2003	Article	157
59	Djavan B et al.	Novel Artificial Neural Network for early Detection of Prostate cancer	2002	Article	157
60	Chougrad H et al.	Deep convolutional Neural Networks for Breast cancer Screening	2018	Article	150
61	Chu F; Wang L	Applications of Support vector Machines to cancer classification with Microarray data	2005	Article	150
62	Chou SM et al.	Mining the breast cancer pattern using Artificial Neural Networks and Multivariate Adaptive Regression Splines	2004	article	148
63	Ciompi F et al.	Towards Automatic Pulmonary Nodule Management in Lung cancer screening with Deep Learning	2017	Article	146
64	Hu Z et al.	Deep Learning for Image-Based cancer Detection and Diagnosis survey	2018	Article	145
65	Bottaci L et al.	Artificial Neural Networks applied to outcome Prediction for colorectal cancer Patients in Separate Institutions	1997	Article	144
66	Xiao Y et al.	A Deep Learning-Based Multi-Model Ensemble Method for cancer Prediction	2018	Article	143

67	Khan S et al.	A Novel Deep Learning Based Framework for the Detection and classification of Breast Cancer using Transfer Learning	2019	Article	142
68	Becker AS et al.	Deep Learning in Mammography Diagnostic Accuracy of a Multipurpose Image Analysis Software In The Detection of Breast Cancer	2017	Article	142
69	Floyd J et al.	Prediction of Breast cancer Malignancy Using an Artificial Neural Network	1994	Article	141
70	Wang J et al.	Discrimination of Breast Cancer with Microcal Cifications on Mammography by Deep Learning	2016	Article	138
71	Wolberg WH et al.	Machine Learning Techniques to Diagnose Breast cancer from Image-Processed Nuclear Features of Fine Needle Aspirates	1994	Article	136
72	Timmerman D et al.	Ovarian Cancer Prediction in Adnexal Masses Using Ultrasound-Based Logistic Regression Models: A temporal and external validation study by the Iota Gr	2010	Article	135
73	Horie Y et al.	Diagnostic outcomes of Esophageal cancer by Artificial Intelligence Using convolutional Neural Networks	2019	Article	134
74	Ongenaert M et al.	Pub meth: A Cancer Methylation Database Combining Text-Mining and Expert Annotation	2008	Article	131
75	Shen L et al.	Deep Learning to Improve Breast Cancer Detection on Screening Mammography	2019	Article	128
76	Steiner DF et al.	Impact of Deep Learning Assistance on the Histopathologic Review of Lymph Nodes for Metastatic Breast Cancer	2018	Article	128
77	Wang H et al.	A Support Vector Machine-Based Ensemble Algorithm for Breast Cancer Diagnosis	2018	Article	128
78	Azar AT; EL-SAID SA	Performance Analysis of Support vector Machines classifiers in Breast Cancer Mammography Recognition	2014	Article	128
79	Liu Y	Active Learning with support vector machine applied to gene Expression data for cancer Classification	2004	Article	126
80	Chen Yd et al.	Artificial neural networks analysis of surface-Enhanced Laser Desorption/Ionization Mass Spectra of serum Protein Pattern Distinguishes Colorectal Can	2004	Article	125
81	Nakamura K et al.	Computerized analysis of The likelihood of Malignancy in solitary pulmonary nodules with Use of Artificial Neural Networks	2000	Article	125
82	YALA A et al.	A Deep Learning Mammography-Based Model for Improved Breast cancer Risk Prediction	2019	Article	123
83	Timmerman D et al.	A Comparison of Methods for Preoperative Discrimination Between Malignant and Benign Adnexal Masses: The Development of a New Logistic Regression Mode	1999	Article	122
84	Liang M et al.	Integrative Data Analysis of Multi-Platform cancer Data with A Multimodal Deep Learning Approach	2015	Article	121
85	Kather JN et al.	Predicting survival from colorectal cancer histology slides using deep learning: a retrospective multicenter study	2019	Article	120
86	BhardWAJ A; Tiwari A	Breast cancer diagnosis using genetically optimized Neural network model	2015	Article	120
87	Ahmed FE	Artificial neural networks for diagnosis and survival Prediction in colon cancer	2005	review	120
88	Hosny A et al.	Deep learning for lung cancer prognostication: a retrospective multi-cohort radiomics study	2018	Article	119

89	Tailor A et al.	Sonographic prediction of malignancy in adnexal Masses using multivariate logistic regression analysis	1997	Article	119
90	Zhu F et al.	Biomedical text mining and its applications in cancer research	2013	Review	118
91	Marcano-Cedeo A et al.	WBCD breast cancer database classification applying artificial meta plasticity neural network	2011	Article	118
92	Stephan C et al.	Multicenter evaluation of an artificial neural network to Increase the prostate cancer detection rate and reduce unnecessary biopsies	2002	Article	118
93	Yokota T et al.	lymph node metastasis as a significant prognostic factor in gastric cancer: a multiple logistic regression analysis	2004	Article	117
94	Xu Y et al.	Artificial neural networks and gene filtering distinguish between global gene expression profiles of 'barrett's esophagus and esophageal cancer	2002	Article	115
95	Sun W et al.	Enhancing deep convolutional neural network scheme for breast cancer diagnosis with unlabeled data	2017	Article	113
96	Spasi I et al.	Text mining of cancer-related information: review of Current status and future directions	2014	Review	113
97	Chan HP et al.	Computerized classification of malignant and benign micro calcifications on mammograms: texture analysis using an artificial neural network	1997	Article	112
98	Huang CL et al.	Prediction model building and feature selection with support vector machines in breast cancer diagnosis	2008	Article	110
99	LustberG T et al.	Clinical evaluation of atlas and deep learning based automatic contouring for lung cancer	2018	Article	109
100	Rodrguez-Ruiz A et al.	Detection of breast cancer with mammography: Effect of an artificial intelligence support system	2019	Article	108

SCR: Standard Competition Ranking; TNC: Total Number of Citation, DT: Documents Type; PY: Year of Publications

Table S 2. Performance measures for Artificial Intelligence and Machine learning in Cancer and the themes of each subperiod

Subperiod	**Theme/To**	**Clust**	**CC**	**CD**	**Theme indicators words an occurrences of top**	**Thematic Evolution**

	pic	er	(R)	(R)	5 high frequency terms	themes
1993-2004						
	Article	1	175.01 (6)	509.12 (1)	Article (25), human (25), priority journal (25), artificial neural network (13), neural networks (13), diagnostic accuracy (11), breast cancer (8), breast neoplasms (7), and mammography (4).	Basic Theme
	Male	4	58.73 (1)	613.18 (2)	Male (7), Biological (4), colorectal cancer (3), tumor markers (3), mass spectrometry (2), Proteomics (2), colorectal neoplasms (2), computer program (2), learning systems (2), Protein (2), protein array analysis (2), protein determination (2), surface enhanced laser desorption ionization mass spectrometry (2).	Emerging Theme
	Humans	5	105.34 (3)	651.26 (3)	Humans (17), controlled study (10) , Prediction (6), Adenocarcinoma (3), human cell (4), gene expression (3), validation process (3), Cultured (2), lung neoplasms (2), squamous cell (2).	Emerging Theme
	Diagnosis	3	104.63 (2)	697.14 (4)	Diagnosis (7), Tumors (6), differential (4), neural networks(4), accuracy (3), forecasting (3), forecasting (2), cancer screening (2), and computer aided diagnosis (2).	Niche Theme
	Sensitivity and Specificity	6	139.92 (4)	1022.72 (5)	sensitivity and specificity (10),Algorithms (7), Algorithm (6),cancer classification (6),Classification (6), Carcinoma (4),gene expression profiling (4), comparative study (4),dna microarray (4), artificial intelligence (3).	Motor Theme
	Female	2	161.06 (5)	1063.36 (6)	Female (14), major clinical study (14), aged (8), adults (10), middle aged (7), prognosis (4), probability (4), p roc curve (5), 80 and over (4), predictive value of tests (4), and breast tumor (3).	Motor Theme
2005-2010						
	Humans	1	178.08 (3)	1492.30 (5)	humans (14),sensitivity and specificity (8), Diagnosis (8), priority journal (7), female (5), Adult (5), middle aged (5),Aged (4), prospective studies (4), logistic models (4), male (3).	Motor & Niche Theme
	Algorithms	2	224.93 (5)	1195.85 (4)	Algorithms (10), Methodology (8), artificial intelligence (7), Algorithm (6), neural networks (6), support vector machines (6), gene expression profiling (5), Automated (5), automated pattern recognition (5), computer-assisted (5).	Motor Theme
	Human	3	104.49 (2)	1108.83 (3)	Human (15), Article (15), Neoplasms (6),Neoplasm (4), Databases (3),gene expression regulation (2),Medline (2), DNA (2)Genetic (2),genetic database (2),Pubmed (2).	Emerging and Niche Theme

	Cancer Classification	4	210.51 (4)	890.84 (2)	Cancer classification (5), artificial neural network (5), Prognosis (4), Biological neural networks (computer) (4), tumor markers (4), Bioinformatics (3), breast cancer (3), controlled study (3), Machine (3).	Basic Theme
2011-2017						
	Human	1	173.71 (6)	645.54 (2)	Human (22), Humans (19), Article (14), Female (11), sensitivity and specificity (10), breast cancer (10), breast neoplasms (10), Pathology (9), breast tumor (9), computer-assisted (8).	Basic Theme
	Diseases	2	40.32 (2)	592.72 (1)	Diseases (12), Diagnosis (6), breast cancer diagnosis (5), classification accuracy (4), feature extraction (3), support vector machines (3), classification (of information) (2), confusion matrices (2), machine learning techniques (2), receiver operating characteristic curves (2).	Emerging Theme
	Machine learning	3	119.92 (5)	979.63 (4)	Machine learning (10),artificial neural network (10), neural networks (computer) (8), convolutional neural network (7), neural networks (7),deep learning (6),computer assisted diagnosis (5),Histopathology (4), image interpretation (4), Convolution (3).	Basic & Motor Theme
	Procedures	4	92.28 (4)	1361.04 (5)	Procedures (10), artificial intelligence (8), neoplasms (5), algorithms (5), learning systems (5), Neoplasm (4), Biology (3), Cancer (3), cancer research (3), Genetics (3), information processing (3).	Motor Theme
	Cancer classification	5	82.01 (3)	1619.39 (6)	Cancer classification (8), automation (2), classification (3), comparative study (3), learning algorithm (3), reproducibility (2), reproducibility of results (2).	Niche Theme
	Accuracy	6	37.18 (1)	826.19 (3)	Accuracy (2), biological organs(2), computerized tomography(2),lung neoplasms(2),lung nodule(2), models(2),theoretical(2),tomography(2),x-ray computed(2).	Emerging Theme
2018-2019						
	Article	1	216.74 (5)	1151.98 (5)	Article (13), computer-assisted (12), Pathology (12), Female (11), priority journal (11), retrospective study (8), Aged (7), middle aged (7), Male (6) , Adult (6), 80 and over (6).	Motor Theme
	Human	2	196.02 (3)	1066.10 (3)	Human (19), Humans (19), Algorithm (5), Genetics (5), Prediction (5), Algorithms (4), cancer classification (4), Neoplasm (3), cancer risk (3), Neoplasms (3).	Develoment & Prevance degree
	Procedures	3	177.57 (1)	1025.16 (2)	Artificial neural network (8), Prognosis (3), retrospective studies (6), gene expression (3), Hematoxylin (2), cohort analysis (3), Histopathology (3), Mortality (3), validation study (3), clinical trial (2).	Emerging Theme

Machine learning	4	178.80 (2)	1113.96 (4)	Machine learning (6), non small cell lung cancer (3), Carcinoma (4), cancer staging (4), risk assessment (3), lung neoplasms (3), lung tumor (3), non-small-cell lung (3), Tomography (3), x-ray computed (3).	Niche Theme
Deep learning	5	196.15 (4)	983.16 (1)	Deep learning (16), diagnostic imaging (10), Mammography (5), computer assisted diagnosis (9), Diagnosis (8), breast cancer (5), breast tumor (6), neural networks (computer) (6), Reproducibility (6), breast neoplasms (5),	Basic Theme

CC: CallonCentrality; CD: Callon Density ; R: Rank