**Machine Learning**

A Full-Semester Course (To be offered at JHU)

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| **Objective** | The objective of this course is to teach various machine learning algorithms with a few applications in mind, mostly covered via end-of-course projects. | |
| **General Links** | Subscribe to    My weekly newspaper on [Machine Learning and Data Science](https://paper.li/M_Ali_Yousuf/1575988418#/), (Updated every Monday, 10:00 AM EST)    My Twitter list, [Data Science](https://twitter.com/i/lists/1229642047377805312) (#Data, #DataScience, #DeepLearning, #MachineLearning, #Analytics #ArtificialIntelligence)    My Data Science Collection on YouTube, <https://tinyurl.com/DataScienceYouTube> | |
| **Book(s)** | [Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 1st Edition](https://www.amazon.com/Hands-Machine-Learning-Scikit-Learn-TensorFlow/dp/1491962291/ref=sr_1_1?ie=UTF8&qid=1524455970&sr=8-1&keywords=hands+on+machine+learning+with+scikit+learn+and+tensorflow)    Part I: The Fundamentals of Machine Learning  Chapter 1 The Machine Learning Landscape  Chapter 2 End-to-End Machine Learning Project  Chapter 3 Classification  Chapter 4 Training Models  Chapter 5 Support Vector Machines  Chapter 6 Decision Trees  Chapter 7 Ensemble Learning and Random Forests  Chapter 8 Dimensionality Reduction    Part II: Neural Networks and Deep Learning  Chapter 9 Up and Running with TensorFlow  Chapter 10 Introduction to Artificial Neural Networks  Chapter 11 Training Deep Neural Nets  Chapter 12 Distributing TensorFlow Across Devices and Servers  Chapter 13 Convolutional Neural Networks  Chapter 14 Recurrent Neural Networks  Chapter 15 Autoencoders  Chapter 16 Reinforcement Learning    See the book page: <http://shop.oreilly.com/product/0636920052289.do>    [Python Machine Learning 1st Edition by Wei-Ming Lee (Author)](https://smile.amazon.com/Python-Machine-Learning-Wei-Meng-Lee/dp/1119545633/ref=sr_1_4?crid=1YTB8BVFNYBTZ&dchild=1&keywords=python+machine+learning+Wei-meng&qid=1585771230&sprefix=Python+Machine%2Caps%2C137&sr=8-4)    Chapter 1 Introduction to Machine Learning  Chapter 2 Extending Python Using NumPy  Chapter 3 Manipulating Tabular Data Using Pandas  Chapter 4 Data Visualization Using matplotlib  Chapter 5 Getting Started with Scikit-learn for Machine Learning  Chapter 6 Supervised Learning-Linear Regression  Chapter 7 Supervised Learning-Classification Using Logistic Regression  Chapter 8 Supervised Learning-Classification Using Support Vector Machines  Chapter 9 Supervised Learning-Classification Using K-Nearest Neighbors (KNN)  Chapter 10 Unsupervised Learning-Clustering Using K-Means  Chapter 11 Using Azure Machine Learning Studio  Chapter 12 Deploying Machine Learning Models    Download full book sample code  <https://www.wiley.com/en-us/Python+Machine+Learning-p-9781119545637> | |
|  | **Core Material** | **Supplementary Material** |
| **Statistics (Review)** | A 7-hours course by Dr. Sarkar on [Statistics for Data Science](https://www.youtube.com/watch?v=Vfo5le26IhY&list=PLtIUKRnuBVlMpTtRD-NLW0m3Jwt0dDo2E&index=39&t=0s) |  |
| **Introduction** | Book (pdf): [Introduction to Machine Learning](https://alex.smola.org/drafts/thebook.pdf)    What are Neural Nets and how do they learn?    What is [Deep Learning](https://www.deeplearningbook.org/)? (Comprehensive online book from MIT press)    [What is MATLAB](https://www.mathworks.com/academia/highschool/courseware/introduction-to-matlab.html)?    [Introduction to Python](http://www.introtopython.org/) | From YouTube: [Machine Learning - Andrew Ng, Stanford University [FULL COURSE]](https://www.youtube.com/channel/UC5zx8Owijmv-bbhAK6Z9apg)    [What is Machine Learning?](https://www.coursera.org/learn/machine-learning/lecture/Ujm7v/what-is-machine-learning) (Online course at Coursera)    [Useful computational resources](https://maxkasy.github.io/home/computationlinks/)    [Fundamentals of Machine Learning](https://www.interactions.com/resources/technology/fundamentals-machine-learning/), a whitepaper published by Interactions Corporation. The resource defines machine learning, how it works and what kind of impact it has on our daily lives. It also discusses the future of machine learning, specifically anticipated challenges and the increasing importance of a human element in this intelligence. [Thanks to Billy Adams from Interactions.com for sharing this resource.]    Data Science Central, <https://www.datasciencecentral.com/> |
| **Python** | First you need a [Python](https://www.python.org/downloads/) compiler/IDE.    [Jupyter](http://jupyter.org/) - Online Python compiler    [Google Colab](https://colab.research.google.com/notebooks/intro.ipynb#recent=true) - Another online python compiler    [PyCharm](https://www.jetbrains.com/pycharm/) - A great IDE for Python    Then learn python, <http://learnpython.org/>. This is not the only resource and you can find many other online courses.    [SciPy](https://www.scipy.org/) (pronounced Sigh Pie) is a Python-based ecosystem of open-source software for mathematics, science, and engineering. It includes NumPy, Pandas, and Matplotlib    [NumPy](https://numpy.org/) is the fundamental package for scientific computing with Python.    [Matplotlib](https://matplotlib.org/)  Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python.    [SciKit-learn](http://scikit-learn.org/stable/) - Machine Learning in Python    [TensorFlow](https://www.tensorflow.org/) - An open source machine learning framework for everyone | From YouTube: [Python Tutorial for Beginners - Full Course in 11 Hours](https://www.youtube.com/watch?v=4F2m91eKmts&list=PLtIUKRnuBVlMpTtRD-NLW0m3Jwt0dDo2E&index=18&t=0s)    From YouTube: [Python for Data Science | Data Science with Python | Python for Data Analysis | 11 Hours Full Course](https://www.youtube.com/watch?v=edvg4eHi_Mw&list=PLtIUKRnuBVlMpTtRD-NLW0m3Jwt0dDo2E&index=44&t=0s)    Following webpage (shared by Kate Chapman / Aimee O'Driscoll) lists six courses which teach Python in the context of ethical hacking and are worth checking:    <https://www.comparitech.com/blog/information-security/hacking-python-courses-online/>. The website covers many other topics including [SQL](https://www.comparitech.com/?s=SQL).    There are many libraries for Machine Learning. Here is a short list (see <https://www.geeksforgeeks.org/best-python-libraries-for-machine-learning/> for details):    [PyTorch](https://pytorch.org/), is an open source machine learning framework that accelerates the path from research prototyping to production deployment.    [Keras](https://keras.io/) is a high-level neural networks API, written in Python and capable of running on top of TensorFlow, [CNTK](https://github.com/Microsoft/cntk), or [Theano](https://github.com/Theano/Theano).    [CNTK](https://www.microsoft.com/en-us/cognitive-toolkit/) - Microsoft Cognitive Toolkit, previously known as CNTK and sometimes styled as The Microsoft Cognitive Toolkit, is a deep learning framework developed by Microsoft Research.    [Theano](http://deeplearning.net/software/theano/) - Theano is a Python library that allows you to define, optimize, and evaluate mathematical expressions involving multi-dimensional arrays efficiently.    [Chainer](https://chainer.org/) from Japan - A Powerful, Flexible, and Intuitive Framework for Neural Networks |
| **R Programming** | The R Project for Statistical Computing, <https://www.r-project.org/>    R Studio Cloud (No download necessary)  <https://login.rstudio.cloud/>    R Studio, <https://www.rstudio.com/> | From YouTube:    Introduction to Data Science with R - Data Analysis by David Langer,  Part 1: <https://www.youtube.com/watch?v=32o0DnuRjfg>    Part 2: <https://www.youtube.com/watch?v=u6sahb7Hmog>    Free book: [R for Data Science](https://r4ds.had.co.nz/) by Garrett Grolemund and Hadley Wickham |
| **SQL** | SQL Server 2017 Express edition, <https://www.microsoft.com/en-us/sql-server/sql-server-editions-express>    <https://www.mysql.com/> | From YouTube: [SQL Tutorial - Full Database Course for Beginners](https://www.youtube.com/watch?v=HXV3zeQKqGY&list=PLtIUKRnuBVlMpTtRD-NLW0m3Jwt0dDo2E&index=47&t=0s)    <https://cloud.google.com/sql/> (Try it Free)    <https://free.caspio.com/> (Free)    <https://www.freesqldatabase.com/> (Free)    Introduction to SQL  <https://www.datacamp.com/courses/intro-to-sql-for-data-science?utm_medium=fb%2Cig-all&utm_source=fb_paid&utm_campaign=smartly_ppa&utm_id=5b1801cb8783d060f32ea35a> |
| **MATLAB** | If you are part of JHU, you can get MATLAB free.  If not, there is a free MATLAB Trial for Data Science, (It includes MATLAB and a full set of products for data science: Global Optimization Toolbox, Parallel Computing Toolbox, Curve Fitting Toolbox, Deep Learning Toolbox, Statistics and Machine Learning Toolbox, Optimization Toolbox, Database Toolbox, Text Analytics Toolbox and Symbolic Math Toolbox.)  <https://www.mathworks.com/campaigns/products/trials/targeted/dan.html>    MATLAB for Deep Learning, <https://www.mathworks.com/solutions/deep-learning.html?s_tid=hp_brand_deeplearning>    Data Analytics in MATLAB  <https://www.mathworks.com/products/data-analytics-whats-new.html>    and  <https://www.mathworks.com/videos/data-analytics-with-matlab-99066.html>    8 MATLAB Cheat Sheets for Data Science, <https://www.mathworks.com/campaigns/offers/data-science-cheat-sheets.confirmation.html?elqsid=1559494336562&potential_use=Education> | **Getting Started**courses called **Onramps**: These run entirely on the browser - no downloads needed - and allow students to earn certificates to share on their LinkedIn (for example),  Machine Learning - [https://www.mathworks.com/learn/tutorials/machine-learning-onramp.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Flearn%2Ftutorials%2Fmachine-learning-onramp.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425805225%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=OMupJCZBdvrIHwR1XW7DdzZH9c4OwSDFqakYHr%2BwfC0%3D&reserved=0)  Deep Learning - [https://www.mathworks.com/learn/tutorials/deep-learning-onramp.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Flearn%2Ftutorials%2Fdeep-learning-onramp.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425805225%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=iBTw2oy5uwyRbEHBKzkj0TympMyQZ5UUZ%2F2PIA2KiCg%3D&reserved=0)  Reinforcement Learning - [https://www.mathworks.com/learn/tutorials/reinforcement-learning-onramp.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Flearn%2Ftutorials%2Freinforcement-learning-onramp.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425815227%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=jykLNTPDEvZEduPJbS%2FI3DfNWewcRsOJmk%2BvDGdl%2Fqk%3D&reserved=0)  **Video series that provide high-level overviews on these topics:**  [https://www.mathworks.com/videos/series/introduction-to-machine-learning.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Fvideos%2Fseries%2Fintroduction-to-machine-learning.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425825217%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=hpz0cLjmG%2B7pIG4vnzpexPA7xbn6yMbEi8vBrtdIE%2F0%3D&reserved=0) (4 part video series on Machine Learning)  [https://www.mathworks.com/videos/series/applied-machine-learning.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Fvideos%2Fseries%2Fapplied-machine-learning.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425835213%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=PTxLMzvjzNfcU6NoRSn11WKqSArtLTFdcfBT8Q0h1k8%3D&reserved=0) (more practical perspectives)  [https://www.mathworks.com/videos/series/deep-learning-with-MATLAB.html#tutorials](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Fvideos%2Fseries%2Fdeep-learning-with-MATLAB.html%23tutorials&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425835213%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=gbZ0%2FWxdHJTOpl96Z7ZZLStXDDxb2qOMh8Mz3L5wb4k%3D&reserved=0) (video series focused on Deep Learning)  [https://www.mathworks.com/videos/series/deep-neural-networks.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Fvideos%2Fseries%2Fdeep-neural-networks.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425845217%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=97Mk47xh0wUYCXj7qxMxb3Ghqjeu346KvMtS9uwqKRE%3D&reserved=0) (video series)  [https://www.mathworks.com/videos/series/deep-learning-for-engineers.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mathworks.com%2Fvideos%2Fseries%2Fdeep-learning-for-engineers.html&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425855208%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=pqJMgbYZ%2F%2Bfkc0XUw%2Bh7ULZueBm6rWAmKuQp7zTLMYI%3D&reserved=0) (more practical perspectives)    **Specific Examples / Datasets:**    Data Sets for Deep Learning, including images: <https://www.mathworks.com/help/deeplearning/ug/data-sets-for-deep-learning.html>    Brain MRI Age classification interesting:  [matlab-deep-learning/Brain-MRI-Age-Classification-using-Deep-Learning: MATLAB example using deep learning to classify chronological age from brain MRI images (github.com)](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgithub.com%2Fmatlab-deep-learning%2FBrain-MRI-Age-Classification-using-Deep-Learning&data=04%7C01%7Cmali%40jhu.edu%7C2c8d0c436a254ff13d9008d906333e29%7C9fa4f438b1e6473b803f86f8aedf0dec%7C0%7C0%7C637547639425865204%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=lAOnxLZlt%2Bq2XCALPl%2FTu8Ke%2Fl6PwBR5HYbkfOXybNM%3D&reserved=0)    Semantic Segmentation of Multispectral Images Using Deep Learning,  <https://www.mathworks.com/help/releases/R2018a/images/multispectral-semantic-segmentation-using-deep-learning.html> |

**Additional Resources**

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| **Data Sources** | * Google Data Search, [https://datasetsearch.research.google.com](https://datasetsearch.research.google.com/)/ * Cancer Imaging Archive, <https://www.cancerimagingarchive.net/> * OpenNeuro for MRI, MEG, EEG, iEEG, ECoG, ASL, and PET data, <https://openneuro.org/> * UC Irvine Machine Learning Repository,  <https://archive.ics.uci.edu/ml/index.php> * Machine learning datasets, <https://www.datasetlist.com/> * ICPSR Sharing data to advance science, <https://www.icpsr.umich.edu/web/pages/> * Kaggle datasets, <https://www.kaggle.com/datasets> * The Social Science Data Archive at UCLA, <https://dataverse.harvard.edu/dataverse/ssda_ucla> * UN Data, <https://data.un.org/> * World Bank Data, <https://data.worldbank.org/> * Amazon AWS datasets, <https://registry.opendata.aws/> * The home of the U.S. Government's open data, <https://www.data.gov/> * ROPER for public opinion research at Cornell, <https://ropercenter.cornell.edu/> * Data and metadata for OECD countries and selected non-member economies, <https://stats.oecd.org/> * Links to various Poverty & Social Justice datasets, <https://elon.libguides.com/c.php?g=553597&p=5095797#s-lg-box-8785116> * Social Justice & Big Data Repository at Grand Valley State University, <https://www.gvsu.edu/bigdata/social-justice-big-data-repository-29.htm> |
| **Projects** | * Challenges: Here is an overview of all challenges that have been organized within the area of medical image analysis, <https://grand-challenge.org/challenges/> * Projects That Matter - Work That Matters - Data Science for Social Good, <https://www.solveforgood.org/> |
| **Julia Language** | [Julia](https://juliacomputing.com/domains/ml-and-ai.html) comes ready with Flux, a state-of-the-art framework for machine learning and AI.    From YouTube: [Intro to Julia for data science](https://www.youtube.com/watch?v=SLE0vz85Rqo&list=PLtIUKRnuBVlMpTtRD-NLW0m3Jwt0dDo2E&index=55&t=0s) |
| **Octave** | A MATLAB equivalent    Online version: <https://octave-online.net/>    Download: <https://www.gnu.org/software/octave/download> |
| **PROLOG** | A symbolic AI language, no longer fashionable but I have taught full-semester courses from 1998-2007    Online: <https://swish.swi-prolog.org/example/kb.pl> |
| **Online GPUs** | Google GPUs on rent <https://cloud.google.com/gpu/>    Cloud TPUs / Tensor Flow Research Cloud <https://www.tensorflow.org/tfrc/> |
| **Other sources of online courses** | (in alphabetical order)  Coursera, <https://www.coursera.org/>  Datacamp, <https://www.datacamp.com/>  DeepLearning.Ai, <https://www.deeplearning.ai/>  eduCBA, <https://www.educba.com/>  EdX, <https://www.edx.org/>  FAST <http://www.fast.ai/>  LinedIn Learning, <https://www.linkedin.com/learning/>  Udemy, <https://www.udemy.com/> |
| **Additional Books** | 100+ Free Data Science Books: <https://www.theinsaneapp.com/2020/12/free-data-science-books-pdf.html>    20 Free Online Books to Learn R and Data Science: <https://cmdlinetips.com/2018/01/free-online-resources-books-to-learn-r-and-data-science/>    From analyticsvidhya.com: [27 Amazing Data Science Books Every Data Scientist Should Read](https://www.analyticsvidhya.com/blog/2019/01/27-amazing-data-science-books-every-data-scientist-should-read/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+AnalyticsVidhya+%28Analytics+Vidhya%29)    From analyticsvidhya.com: [6 Open Source Data Science Projects to Make you Industry Ready!](https://www.analyticsvidhya.com/blog/2020/04/6-open-source-data-science-projects-industry-ready/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+AnalyticsVidhya+%28Analytics+Vidhya%29)    From Knuggets.com: [60+ Free Books on Big Data, Data Science, Data Mining, Machine Learning, Python, R, and more](https://www.kdnuggets.com/2015/09/free-data-science-books.html)    From DataScienceCentral.com: [50 Must-Read Free Books For Every Data Scientist in 2020](https://www.datasciencecentral.com/profiles/blogs/50-must-read-free-books-for-every-data-scientist-in-2020-1) |
| **Research** | Following sites have free access journal articles:    The 15 Most Popular Data Science and Machine Learning Articles on Analytics Vidhya in 2018  <https://www.analyticsvidhya.com/blog/2018/12/most-popular-articles-analytics-vidhya-2018/>    [Journal of Machine Learning Research](http://www.jmlr.org/)    [Arxiv.org](https://arxiv.org/)    Microsoft, <https://academic.microsoft.com/home>    Google Scholar,    Other journals and conferences on Neural Networks:    <https://www.omicsonline.org/artificial-neural-network-journals-conferences-list.php>    [44 Original Data Science and Machine Learning Articles](https://www.datasciencecentral.com/profiles/blogs/44-original-data-science-and-machine-learning-articles?fbclid=IwAR3l2ucvD_dnyennJ4Em0Jt3ZR9WfFiPMr0GKzEMSp9sCoGcdOJJA9tREkI) |
| **Related tools** | MongoDB, <https://www.mongodb.com/> to deploy fully managed cloud database in minutes. (Try free)  [Studio3T](https://studio3t.com/), Studio 3T is the professional GUI, IDE & client for MongoDB available for Windows, Mac, and Linux. There is a free course there, called MongoDB 101 which covers the basics in just two hours. (Thanks to Magda Matylla for pointing out the above link)  Microsoft Power BI for Data Analytics (Free), <https://powerbi.microsoft.com/>  Tableau, <https://www.tableau.com/>, changing the way you think about data  QLIK, <https://www.qlik.com/us>, Blaze trails daily - with the only end-to-end data management and analytics platform built to transform your entire business.  Hadoop, <https://hadoop.apache.org/>, open-source software for reliable, scalable, distributed computing  Periscope data, <https://www.periscopedata.com/> (Try free)  [GraphDB](http://graphdb.ontotext.com/) is an enterprise ready Semantic Graph Database, compliant with W3C Standards. Semantic graph databases (also called RDF triplestores) provide the core infrastructure for solutions where modelling agility, data integration, relationship exploration and cross-enterprise data publishing and consumption are important.  [PostgreSQL](https://www.postgresql.org/) is a powerful, open source object-relational database system  [CouchDB](https://couchdb.apache.org/) (NoSQL): Apache CouchDB(TM) lets you access your data where you need it. The Couch Replication Protocol is implemented in a variety of projects and products that span every imaginable computing environment from globally distributed server-clusters, over mobile phones to web browsers.  [Firebase](https://firebase.google.com/) (free cloud database by Google for use in apps). Firebase helps mobile and web app teams succeed.  [Redis](https://redis.io/) is an open source (BSD licensed), in-memory data structure store, used as a database, cache and message broker.  [Cassandra](https://cassandra.apache.org/) (big data storage). The Apache Cassandra database is the right choice when you need scalability and high availability without compromising performance.  [Snowflake](https://www.snowflake.com/) enables every organization to be data-driven  [Alteryx](https://www.alteryx.com/) With Alteryx Designer, the power to solve analytic and business challenges, big and small, is at your fingertips, no matter where you're working from.  [Machine Learning Open Source Software](http://www.jmlr.org/mloss/) |