Python utility functions			Jupyter notebooks	
Data representing Data splitting Data sampling Data transforming	SVD SAR RLRMC NCF FM/FFM Wide&Deep xDeepFM DKN LightGBM	Ranking metrics Rating metrics Bitwise metrics	• Real-time recommendation with batch-mode model building pipeline • Real-time recommendation generation for personalization • Knowledge graph based recommendation	
Data preprocessing	Model selection	Model evaluating	Data preservation	Model / results deployment

CI/CD build pipeline

CPU	Spark	GPU	Globally distributed database	Kubernetes cluster
Docker container	Virtual machine			