

OpenKernel library

www.openkernel.org

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Library overview

- ▶ A general open-source kernel library
- **Kernels**
 - Standard kernels:
linear, polynomial, Gaussian and sigmoid
 - Sequence kernels:
 n -gram, gappy n -gram, mismatch and arbitrary rational kernels
- **Learning kernel tools**
 - ▶ one-stage and two-stage methods
- **Implementation**
 - works with LIBSVM
 - uses the OpenFst library (<http://www.openfst.org>)

Rational Kernels

[Cortes et al., 2003]

- A sequence kernel K is a **rational kernel** if there exists a transducer U over the real semiring s.t.

$$K(x, y) = U(x, y)$$

- ▶ If $U = T \circ T^{-1}$, then K is positive definite symmetric (PDS).

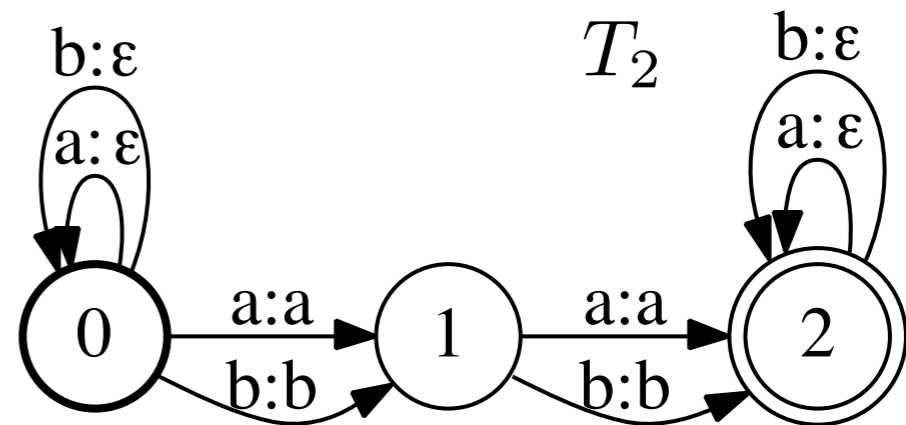
- ▶ Commonly used sequence kernels are rational

- **Example: n -gram kernel**

$$K_n(x, y) = \sum_{|z|=n} c_x(z) c_y(z)$$

$$T_n(x, z) = c_x(z) \quad \text{and}$$

$$K_n(x, y) = (T_n \circ T_n^{-1})(x, y)$$



with $c_x(z)$ is the number of occurrences of z in x

Learning Kernel Tools

- ▶ Tools for using training data to automatically combine multiple kernels
- One-stage algorithms
 - L1-regularized linear combinations [Lanckriet et al., 2004]
 - L2-regularized linear combinations [Cortes et al., UAI 2009]
 - L2-regularized quadratic combinations [Cortes et al., NIPS 2009]
- Two-stage algorithms
 - ▶ Alignment-based methods [Cortes et al., ICML 2010]
 - Simple alignments
 - More general alignments by solving a QP (next release)

Future plans

- **New algorithms**
 - Kernel PCA
 - Structured prediction
 - Online algorithms
- **Other efficient solvers**
 - ▶ To benefit from new optimization techniques
- **Automata-based solution**
 - ▶ Useful for sequence kernels [Allauzen et al., CIAA 2010]
- **Low rank approximation**
 - Nyström method [Williams and Seeger, NIPS 2000; Drineas and Mahoney, JMLR 2005]
 - Ensemble Nyström [Kumar et al., NIPS 2009]