Main examples of descent operators (convolution-of-projections maps) in the theory of Markov chains from Hopf algebras. This version: April 8, 2015. Curated by Amy Pang. Printer-friendly version, plus related summary tables, available at my website.

If you spot an error, or wish to add other maps to this list, please let me know.

Name of chain	Defining map	Eigenvalues β_λ	Eigenfunction formulae		References	
	(in all cases assume $\sum q_i = 1$)	($i(\lambda)$ denotes number of parts of size i in λ)	cocommutative	commutative	[DFP92]	[Pan15]
Hopf-square / Riffle-shuffle	$\frac{1}{2^n} m\Delta$	$2^{l(\lambda)-n}$	[Pan14, Th. 2.5.1.B]	[Pan14, Th. 2.5.1.A]		Sec. 1
Hopf-power /a-handed shuffle	$\frac{1}{a^n} m^{[a]}\Delta^{[a]}$	$a^{l(\lambda)-n}$	[Pan14, Th. 2.5.1.B]	[Pan14, Th. 2.5.1.A]		Sec. 1
biased Hopf-power / biased a-handed shuffle	$\sum q_1^{i_1} \dots q_a^{i_a} \operatorname{Proj}_{i_1} * \cdots * \operatorname{Proj}_{i_a}$	the power sum p_λ in the variables $q_1, \dots, q_a$				Ex. 3.2
ordered top-m-to-random	$\frac{1}{\binom{n}{m}} \operatorname{Proj}_m * \iota$	(doesn't simplify nicely)			Sec. 2, Sec. 6 Ex.1	Ex. 3.3
top-to-random (T2R)	$\frac{1}{n} \operatorname{Proj}_1 * \iota$	$\frac{1(\lambda)}{n}$	[Pan15, after Prop. 5.2]	forthcoming		Ex. 4.3
unordered top-m-to-random	$\frac{(n-m)!}{n!} \operatorname{Proj}_1^{*m} * \iota$	$\binom{1(\lambda)}{m}$			Sec. 6 Ex.2	Ex. 3.3
binomial top-to-random	$\sum_{m=0}^{n} \frac{1}{m!} q^m (1-q)^{n-m} \operatorname{Proj}_1^{*m} * \iota$	$(1-q)^{n-1(\lambda)}$			Sec. 2 Ex. 3	
top-or-bottom-to-random (ToB2R)	$\frac{1}{n} (q \operatorname{Proj}_1 * \iota + (1-q)\iota * \operatorname{Proj}_1)$	$\frac{1(\lambda)}{n}$	[Pan15, Th. 5.1]	forthcoming	Sec. 6 Ex.4	Ex. 3.4, Ex. 4.4
trinomial top-and-bottom-to-random	$\sum_{m_1+m_2+m_3=n} \frac{1}{m_1! m_3!} q_1^{m_1} q_2^{m_2} q_3^{m_3} \operatorname{Proj}_1^{*m_1} * \iota * \operatorname{Proj}_1^{*m_3}$	$q_2^{n-1(\lambda)}$			Sec. 6 Ex. 6	before Ex. 5.3
top-and-bottom-to-random (T+B2R)	$\frac{1}{n(n-1)} (\operatorname{Proj}_1 * \iota * \operatorname{Proj}_1)$	$\frac{1(\lambda)(1(\lambda)-1)}{n(n-1)}$	forthcoming		Sec. 6 Ex. 5	
top-m-and-bottom-m-to-random	$\frac{(n-2m)!}{n!} (\operatorname{Proj}_1^{*m} * \iota * \operatorname{Proj}_1^{*m})$	$\frac{1(\lambda)\dots(1(\lambda)-2m)}{n\dots(n-2m)}$	forthcoming		Sec. 6 Ex. 3	

References

[DFP92] P. Diaconis, J. A. Fill, and J. Pitman. Analysis of top to random shuffles. *Combin. Probab. Comput.*, 1(2):135–155, 1992.

[Pan14] C. Y. A. Pang. Hopf algebras and Markov chains. *ArXiv e-prints*, December 2014. A revised thesis.

[Pan15] C. Y. A. Pang. Card-shuffling via convolutions of projections on combinatorial Hopf algebras. In *27th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2015)*, Discrete Math. Theor. Comput. Sci. Proc., ??, pages ??–?? Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2015. available on Arxiv.