Pure Math 945
Combinatorial Representation Theory

Class times and place: WF from 11:30-12:50 in MC 5403
Instructor: Ben Webster
Office: MC 5429
Office Hours: Wednesday 1–2PM, Friday 10–11AM
E-mail: ben.webster@uwaterloo.ca

Description
This course covers certain connections between representation theory and combinatorics. The first and most familiar example we’ll cover is the representation theory of symmetric groups following the approach of Vershik and Okounkov. This allows to understand the representations of all symmetric groups simultaneously, by studying the structure of induction and restriction functors. In particular, this gives a natural and simple explanation of the connection of symmetric groups to tableaux.

Then, we’ll discuss generalizations of this approach, to (affine) Hecke algebras, and then allow this to lead us to a much more recent topic in representation theory, Khovanov-Lauda-Rouquier algebras. These algebras are closely tied to the categorification of representations of Lie algebras, and we will develop their theory to consider topics like Lusztig’s canonical basis, and Broué’s conjecture in the context of symmetric groups.

Background
The main background expected is solid knowledge of basic group and ring theory. Familiarity with the representation theory of finite groups (as in PMATH 745) will be a big plus, as will a little knowledge of Lie algebras (for example, root systems), but concepts from these domains will be introduced when they are needed.

Texts
This class will have no official text; we’ll mostly read directly from the literature in addition to notes I’ll provide. Kleshchev’s book “Linear and Projective Representations of the Symmetric Groups” could be a useful adjunct.

Grades and assignments
The grade will be based on a final paper and class presentation.

Know your Rights and Responsibilities

• Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]
• Grievance: A student who believes that a decision affecting some aspect of his or her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the departments administrative assistant who will provide further assistance.

• Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

• Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals), www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

• Note for Students with Disabilities: AccessAbility Services, located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.