This is an example of a successfully approved 500-Level course proposal and syllabus. In this case, the faculty member provided two separate syllabi: One for undergraduates and one for graduate students. It can be done this way, or combined as one syllabus. In both cases, the typical problem is that the SLO's are not differentiated, nor are the evaluative criteria. Good examples of both follow.

NB: Form A from the Curriculum Guide and the signature pages are not included here for simplicity sake. Some faculty provide a page answering the questions from Form A, but do so on a separate page.

UNCG New Course Proposal

1. **Course Identification:**
   a. **Course prefix, number, title**
      CSC 550 Combinatorics on Words
   b. **New course**
      Yes
   c. **Department offering the course**
      Department of Computer Science
   d. **Contact person**
      Francine Blanchet-Sadri
2. **Rationale:**
   This course is intended as an elective for Computer Science graduate and Computer Science upper-level undergraduate students. The course, which is designed around algorithms, presents a treatment of the rapidly developing field of combinatorics on words and fills a gap in the current curriculum.
3. **Grading Method:**
   Letter grade
4. **Repeat for Credit:**
   The course cannot be repeated for credit.
5. **Credit:**
   3:3
6. **Prerequisites:**
   Permission of instructor
7. **Catalog Description:**
   An introduction to the problems and methods in algorithmic combinatorics on words. Problem areas include periodicity, primitivity, and borderedness.

8. **First Offering:**
   Fall 2007

9. **Frequency:**
   Each fall

10. **Consultations:**
    There are no similar courses on campus.

11. **Teacher Education Program:**
    This course will not satisfy requirements for any teacher education program.

12. **General Education Core or Marker designation:**
    No

13. **Syllabus:**
    See attached syllabus for undergraduates students and syllabus for graduate students.

Full instructor name and contact information are present.

Student learning outcomes are appropriate to the Undergraduate level, and are differentiated from the Graduate SLO's.

SYLLABUS FOR UNDERGRADUATE STUDENTS

COURSE NUMBER:
CSC 550

COURSE TITLE:
Combinatorics on Words

CREDITS:
3:3

PREREQUISITES/COREQUISITES:
Permission of instructor

FOR WHOM PLANNED:
This course is intended as an elective for Computer Science graduate and Computer Science upper-level undergraduate students.

INSTRUCTOR INFORMATION:
Instructor: Francine Blanchet-Sadri
Office: 391 Bryan Building
Office phone: 256–1125
E-Mail: blanchet@uncg.edu
Office hours: MWF 8:30am–9:00am, M 5:00pm–5:30pm, or by appointment

CATALOG DESCRIPTION:
An introduction to the problems and methods in algorithmic combinatorics on words. Problem areas include periodicity, primitivity, and borderedness.

STUDENT LEARNING OUTCOMES:
Upon successful completion of this course students will be able to

- Knowledge: Recognize the special partial words related to combinatorial results on words.
- Comprehension: Identify and discuss the main results of the current research on partial words and classify the proof cases according to their number of holes.
- Application: Use ideas and results whose main aim is to solve problems in combinatorics on words.

- Analysis: Analyze algorithms on words and test combinatorial properties of words.
- Synthesis: Design a World Wide Web server interface for automated use of the program related to the implementation of an algorithm on words.
- Evaluation: Select suitable combinatorial techniques for proving results in combinatorics on words and evaluate the significance of the results.

TEACHING METHODS AND ASSIGNMENTS FOR ACHIEVING LEARNING OUTCOMES:

Through lectures, the instructor will describe the basics of algorithmic combinatorics on words covering topics such as periodicity, primitivity and borderedness. The instructor will present background and computational ideas in a simple way. Students will be provided with the tools and techniques they need to prove combinatorial results on words.

Students will be expected to read the material prior to the week it is scheduled for lecture. Each topic contains many subtopics to help the students identify specific areas of in-class discussion. The instructor will facilitate class participation in order to check students' understanding.

To evaluate each student's work, there will be five assignments to assess students' learning, and one midterm exam that covers material presented by the instructor. In addition, each student will work in a team of two (or one) on a project. Each team is required to prepare a summary of their project using tools such as powerpoint slides and give a presentation in class at the end of the semester.

EVALUATION AND GRADING:

Evaluative criteria are appropriate to the Undergraduate Level, and are somewhat different from the Graduate Level. These criteria are clearly written so that students will know what they have to do to earn a A, A-, etc.

5 homework assignments, worth 10 points each.

1 midterm, worth 20 points.

Students taking CSC 550 will be divided in teams of two (or one). Each team is required to pick one project on which to focus for the remainder of the course. Suitable projects will be chosen by the instructor and the teams. A suitable project will be the implementation of an algorithm on words along with the design of a World Wide Web server interface for automated use of the program. Each team will give a 45-minute presentation of their project. The instructor will evaluate the project and the evaluation will consist of the presentation. The weight of the project is 30 points.

Grading scale:

A (93–100) A- (90–92)

B+ (87–89) B (83–86) B- (80–82)

C+ (77–79) C (73–76) C- (70–72)

D+ (67–69) D (63–66) D- (60–62)

F (0–59)

REQUIRED TEXTS/READINGS/REFERENCES:

F. Blanchet-Sadri, *Algorithmic Combinatorics on Words*, Lecture Notes ©2006.

References

[1] J.-P. Allouche and J. Shallit, *Automatic Sequences: Theory, Applications, Generalizations* (Cambridge University Press, Cambridge, 2003).

[2] F. Blanchet-Sadri and S. Duncan, Partial words and the critical factorization theorem, *Journal of Combinatorial Theory, Series A* **109** (2005) 221–245.

[3] S. Constantinescu and L. Ilie, Generalised Fine and Wilf's theorem for arbitrary number of periods, *Theoretical Computer Science* **339** (2005) 49–60.

[4] M. Crochemore and W. Rytter, *Jewels of Stringology* (World Scientific, NJ, 2003).

[5] P. Dömösi, S. Horváth and M. Ito, *Primitive Words and Context-Free Languages* (Masami Ito (eds.), 2006).

[6] D. Gusfield, *Algorithms on Strings, Trees, and Sequences* (Cambridge University Press, Cambridge, 1997). (This item,

which has been published more than five years ago, has become a classic and is still the best source for reference in the area of algorithms that operate on character strings and sequences. It covers a wide spectrum of string algorithms from classical computer science to modern molecular biology.)

[7] C.S. Iliopoulos, M. Mohamed, L. Mouchard, W.F. Smyth, K.G. Perdikuri, and A.K. Tsakalidis: String regularities with don't cares, Prague Stringology Conference (2002), *Nordic J. Comput.* **10** (2003) 40–51.

[8] M. Lothaire, *Algebraic Combinatorics on Words* (Cambridge University Press, Cambridge, 2002).

[9] M. Lothaire, *Applied Combinatorics on Words* (Cambridge University Press, Cambridge, 2005).

[10] E. Rivals and S. Rahmann, Combinatorics of periods in strings, *Journal of Combinatorial Theory Series A* **104** (2003) 95–113.

TOPICAL OUTLINE/CALENDAR:

Topical Outline is fairly explicit, so that students will know what they will be doing, and any faculty teaching this course in the future will have a guideline for where to start.

1 Preliminaries on Partial Words (Weeks 1–2)

- 1.1 Alphabets, letters, and words
- 1.2 Partial functions and partial words
- 1.3 Periodicity
- 1.4 Factorizations of partial words
- 1.5 Recursion and induction on partial words
- 1.6 Countainment and compatibility

2 Combinatorial Properties of Partial Words (Weeks 3–4)

- 2.1 Conjugacy
- 2.2 Commutativity

Assignment 1

3 Fine and Wilf's Theorem (Weeks 5–6)

- 3.1 The case of zero or one hole
- 3.2 The case of two or three holes
- 3.3 Special partial words
- 3.4 Graphs associated with partial words

3.5 The main result

Assignment 2

4 Critical Factorization Theorem (Weeks 7–8–9)

4.1 Orderings

4.2 The zero-hole case

4.3 The main result: First version

4.4 The main result: Second version

4.5 Tests

Assignment 3

Midterm

5 Guibas and Odlyzko's Theorem (Weeks 10–11)

5.1 The zero-hole case

5.2 The main result

5.3 The algorithm

Assignment 4

6 Primitive Partial Words (Weeks 12–13)

6.1 Testing primitivity on partial words

6.2 Existence of primitive partial words

7 Unbordered Partial Words (Week 14)

7.1 Concatenation of prefixes

7.2 Critical factorizations

Assignment 5

Project presentation (Week 15)

Academic Honor Code and the Attendance Policy are both included, as required by the Curriculum Guide.

ACADEMIC HONOR CODE:

Each student is required to sign the Academic Integrity Policy on all assignments and tests. A complete description of the Academic Integrity Policy can be found in the UNCG Undergraduate Bulletin.

ATTENDANCE POLICY:

Students are expected to attend all the lectures. If a student misses any of them, it is his/her responsibility to find out what went on during the lecture and to collect any material that was handed out.

Additional Requirements are included if needed.

FINAL EXAMINATION:

No final exam

ADDITIONAL REQUIREMENTS:

Absence Policy

No make-up test is given unless extenuating circumstances are proved.

Late Work Penalty

No late assignment will be accepted. Solutions will be distributed the day an assignment is due.

In this case, we have a separate syllabus for Graduate Students. While some faculty combine them, there must be clear differences in what is expected for Undergraduate students and Graduate students.

SYLLABUS FOR GRADUATE STUDENTS

COURSE NUMBER:
CSC 550

COURSE TITLE:
Combinatorics on Words

CREDITS:
3:3

PREREQUISITES/COREQUISITES:
Permission of instructor

FOR WHOM PLANNED:
This course is intended as an elective for Computer Science graduate and Computer Science upper-level undergraduate students.

INSTRUCTOR INFORMATION:
Instructor: Francine Blanchet-Sadri
Office: 391 Bryan Building
Office phone: 256–1125
E-Mail: blanchet@uncg.edu
Office hours: MWF 8:30am–9:00am, M 5:00pm–5:30pm, or by appointment

CATALOG DESCRIPTION:
An introduction to the problems and methods in algorithmic combinatorics on words. Problem areas include periodicity, primitivity, and borderedness.

STUDENT LEARNING OUTCOMES:
Upon successful completion of this course students will be able to

- Knowledge: Recognize the special partial words related to combinatorial results on words. Define basic concepts in combinatorics on words such as periods and borders in words, as well as critical factorizations.
- Comprehension: Identify and discuss the main results of the current research on partial words and classify the proof cases according to their number of holes. Study and discuss a recent topic on combinatorics of words to acquire some research methodology.

- Application: Use ideas and results whose main aim is to solve deep problems in combinatorics on words.
- Analysis: Analyze algorithms on words and test complex combinatorial properties of words such as periodicity and primitivity.
- Synthesis: Design a World Wide Web server interface for automated use of the program related to the implementation of an algorithm on words. Also formulate conjectures on some selected problems in combinatorics on words.
- Evaluation: Select suitable combinatorial techniques for proving results in combinatorics on words and evaluate the significance of the results.

TEACHING METHODS AND ASSIGNMENTS FOR ACHIEVING LEARNING OUTCOMES:

Through lectures, the instructor will describe the basics of algorithmic combinatorics on words covering topics such as periodicity, primitivity and borderedness. The instructor will present background and computational ideas in a simple way. Students will be provided with the tools and techniques they need to prove combinatorial results on words.

Students will be expected to read the material prior to the week it is scheduled for lecture. Each topic contains many subtopics to help the students identify specific areas of in-class discussion. The instructor will facilitate class participation in order to check students' understanding. Graduate students will also be expected to formulate conjectures on some selected problems in combinatorics on words to demonstrate deeper understanding.

To evaluate each student's work, there will be five assignments to assess students' learning, and one midterm exam that covers material presented by the instructor. Graduate students' work should exhibit maturity in discussing complex combinatorial properties of words such as the notion of critical factorizations. In addition, each student will work in a team of two (or one) on a project. Each team is required to prepare a summary of their project using tools such as powerpoint slides and give a presentation in class at the end of the semester.

Each graduate student is also expected to write a term paper on a topic of current research interest (related to combinatorics on words) he/she will select with the instructor. The topic will relate to a research publication in a scientific journal.

EVALUATION AND GRADING:

5 homework assignments, worth 10 points each.

1 midterm, worth 20 points.

Students taking CSC 550 will be divided in teams of two (or one). Each team is required to pick one project on which to focus for the remainder of the course. Suitable projects will be chosen by the instructor and the teams. A suitable project will be the implementation of an algorithm on words along with the design of a World Wide Web server interface for automated use of the program. Each team will give a 45-minute presentation of their project. The instructor will evaluate the project and the evaluation will consist of the presentation. The weight of the project is 30 points.

In addition to the above, a graduate student taking the course is required to write a term paper on a topic chosen by the instructor and the student. Suitable topics can be chosen from the bibliography of the required text. Other suitable topics can be chosen from journals (for instance *Journal of Algorithms*, *SIAM Journal on Computing*, and *Theoretical Computer Science*). The weight of the paper is 20 points, and the total (120 points) will be prorated to 100 points.

The additional assignment(s) for graduate students is (are) clear. A grading scale, following Graduate School guidelines, is present. The grading scale does not include a C- or D grades.

Grading scale:

A (93–100) A- (88–92)

B+ (83–87) B (78–82) B- (73–77)

C+ (68–72) C (63–67)

F (0–62)

REQUIRED TEXTS/READINGS/REFERENCES:

F. Blanchet-Sadri, *Algorithmic Combinatorics on Words*, Lecture Notes ©2006.

References

[1] J.-P. Allouche and J. Shallit, *Automatic Sequences: Theory, Applications, Generalizations* (Cambridge University Press, Cambridge, 2003).

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[10] E. Rivals and S. Rahmann, Combinatorics of periods in strings, *Journal of Combinatorial Theory Series A* **104** (2003) 95–113.

TOPICAL OUTLINE/CALENDAR:

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1.1 Alphabets, letters, and words

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2.1 Conjugacy

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Assignment 1

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3.1 The case of zero or one hole

3.2 The case of two or three holes

3.3 Special partial words

3.4 Graphs associated with partial words

3.5 The main result

Assignment 2

4 Critical Factorization Theorem (Weeks 7–8–9)

4.1 Orderings

4.2 The zero-hole case

4.3 The main result: First version

4.4 The main result: Second version

4.5 Tests

Assignment 3
Midterm

5 Guibas and Odlyzko's Theorem (Weeks 10–11)

5.1 The zero-hole case

5.2 The main result

5.3 The algorithm

Assignment 4

6 Primitive Partial Words (Weeks 12–13)

6.1 Testing primitivity on partial words

6.2 Existence of primitive partial words

7 Unbordered Partial Words (Week 14)

7.1 Concatenation of prefixes

7.2 Critical factorizations

Assignment 5

Project presentation (Week 15)

Term paper

ACADEMIC HONOR CODE:

Each student is required to sign the Academic Integrity Policy on all assignments and tests. A complete description of the Academic Integrity Policy can be found in the UNCG Undergraduate Bulletin/Graduate Bulletin.

ATTENDANCE POLICY:

Students are expected to attend all the lectures. If a student misses any of them, it is his/her responsibility to find out what went on during the lecture and to collect any material that was handed out.

FINAL EXAMINATION:

No final exam

ADDITIONAL REQUIREMENTS:

Absence Policy

No make-up test is given unless extenuating circumstances are proved.

Late Work Penalty

No late assignment will be accepted. Solutions will be distributed the day an assignment is due.

While it may be easier to follow Form A when the syllabi are provided separately, some faculty insert the syllabi in Item 13 (as in this case).

14. Differentiation of Requirements:

In addition to the above, a graduate student taking the course is required to write a term paper on a topic chosen by the instructor and the student. Suitable topics can be chosen from the bibliography of the required text. Other suitable topics can be chosen from journals (for instance *Journal of Algorithms*, *SIAM Journal on Computing*, and *Theoretical Computer Science*). The weight of the paper is 20 points, and the total (120 points) will be prorated to 100 points.

15. Student Contract/Agency Agreement:

This course is neither an Internship or Practicum course nor a service learning course.