

# Welcome to 4003-380 Introduction to CS Theory

Joe Geigel

## Plan for this class

- Logistics
  - Syllabus & Ground Rules
  - Student Info Forms / Attendance
- What is this Course About
- ----- break -----
- Discrete Math Review

## Logistics

- First things first.
  - Class Web site
    - <http://www.cs.rit.edu/~jmg/cs380>
  - Syllabus (e-version of handout)
  - Schedule
  - Homework Assignments
  - Diary (including these slides)

## Logistics

- Textbooks
  - Required:
    - *Introduction to Languages and the Theory of Computation*, 3rd edition, by John C. Martin
  - Recommended:
    - *Theory of Computing: A Gentle Introduction* by Kinber & Smith
    - *Introduction to Automata Theory, Languages, and Computation* by Hopcroft, Motwani, & Ullman.

## Logistics

- Prerequisite:
  - 1016-265: Discrete Math
- Co-requisite
  - 1016-705: Discrete Math II
- These are important as the material in this class is mathematical in nature.

## Logistics

- About Me
  - Joe Geigel
  - Office: 10-A172
  - Office Hours: M 2-4 (and by appt)
  - <http://www.cs.rit.edu/~jmg>

## Logistics

- Grading:
  - Three basic course activities:
    - Homework 45%
    - Midterm Exam 25%
    - Final Exam 30%

## Logistics

- Homework
  - Homework will be assigned weekly.
  - Will have 1 week to complete each assn.
  - Due dates are definite!
    - no late homeworks!
    - Listed in HOMEWORK section of Web site
  - Group submission (max 2 people) ok
  - Each assignment carries equal weight
  - Lowest homework grade is dropped.

## Logistics

- Homework
  - Homework problem session
    - 2<sup>nd</sup> half of class on days when homework is not assigned.
    - Questions about current homework assignment.
    - Similar problems done on the board.

## Logistics

- Midterm Exam
  - Given Thursday, October 10
  - Covers Chapters 1 - 5
  - Closed book...1 page study guide
  - Review session: Tuesday, October 8
  - No make up exams

## Logistics

- Final Exam
  - Given during exam week
    - Exact date and time TBD
  - Cumulative
  - Closed book...1 page study guide
  - Review Session: last class (November 12)
  - No make up exams.
- Any questions so far?

## Logistics

- Schedule
  - Posted on SCHEDULE section of Web site
  - Subject to change, but indicates the best guess as to what will be covered when
  - Includes links to these slides (in PDF)
  - Slides should be available 1 day before the lecture.
- Diary
  - Running list of what was actually covered when
  - Includes links to these slides (in PDF)
  - Slides should be available 1 day before the lecture.

## Logistics

- CS Dept Policy of Academic Dishonesty
  - Included in hardcopy syllabus
  - Please read and understand.
- Speaking of student info forms
  - Any questions before I hand them out?

## Logistics

- A note about e-mail.
  - E-mail may be sent to entire class for late-breaking announcements.
  - E-mail address registered in the LDAP database will be used.
- PLEASE be sure that the e-mail listed is the one you actually read.

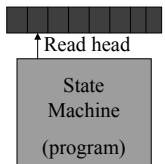
So what is this course all about?

## Theory of Computation

- The idea of a “computing machine” was debated long before the advent of the first computer.
  - Turing Machine (1936)
  - ENIAC (1946)
- Mathematical rather than physical machine.
  - Turing machine was invented as an approach at solving the following:
    - “Can there exist, at least in principle, a definite method by which all mathematical problems can be decided?”
- This course will present these mathematical models.

## Computation: Turing Machine

Input tape (input/memory)



- Tape that holds character string
- Tape head that reads and writes character
- Machine that changes state based on what is read in

## Computation: Turing Machine

- Running a Turing Machine
  - Encode your input and place on the input tape
  - Put state machine into the “start” state
  - Let the machine change states as it reads/writes characters to the tape
  - When machine “stops”, your answer will be left on the tape

## But why?

- Application areas
  - Computation
  - Language Processing
  - Mathematical Modeling

## Computation

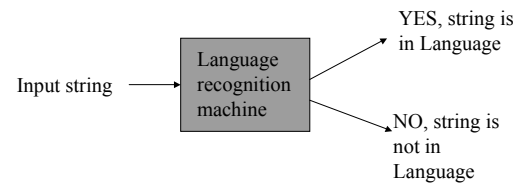
- Computation
  - Basic questions in computer science
    - **Computability**: What problems can and cannot be computed?
    - **Complexity**: If a problem can be solved using a “computing machine”, how long will it take ?
  - Approach
    - All this theory was developed before the advent of computers!
    - Develop a mathematical model for a “computer”
    - “Run” your problem using this model to test for computability and efficiency

## Computation: Turing Machine

- All this needs to be described using Mathematics!
- Getting from here to there
  - Will describe simpler “mathematical machines” that answer simpler problems.
  - One such problem: String recognition

## String Recognition problem

- Given a string and a definition of a language (set of strings), is the string a member of the language?



## Languages

- Three elements
  - Mechanism for defining/ generating a language
  - The language itself (set of strings)
  - A mathematical machine that can be used to test if a string is in the language.

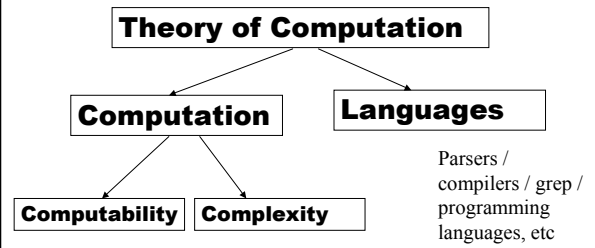
## Languages

- Will actually be looking at classes of languages:
  - Each class will have its own means for language generation
  - Each class will have its own machine model for string recognition
  - Languages and machines get more complex as we move forward in the course.

## Languages

- Practical Uses
  - Parsing / Compilers / Interpreters
  - grep
  - These mathematical models are used to parse programs written in modern computer languages

## So in short...



## But all this is to come....

- We'll start with the basics...
  - after the break
- Any questions?