Seminar: Search and Optimization
1. Organization, Seminar Schedule & Topics

Gabi Röger

Universität Basel

September 18, 2014

Constraint satisfaction problems

Topic of the Seminar

"Search and Optimization" is a very wide field.

This year, we concentrate on
constraint satisfaction and optimization problems

Example: Seating Arrangement for Wedding Party

Task: assign every guest (variable) a seat (value from its domain)

. . . but consider that . . .

- The bridal couple must sit at a table in the center.
- Parents must sit close to the bridal couple.
- There should be a man beside every woman.
- Sworn enemies must not sit at the same table.
- Everyone should have someone with similar interests or hobbies at the same table.

Such restrictions are called constraints.

Example: Sudoku

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9

Variables: cells

Domain of each variable: $\{1, 2, \ldots, 9\}$

Constraints:

- Within one block/row/column no number may be used twice.

Other examples

- Assigning time slots and classrooms to courses
- Coloring a map so that no neighbouring countries have the same color
- Resource allocation in manufacturing

Always:

- Variables that need to get assigned values from their domain
- Constraints that restrict the valid variable assignments
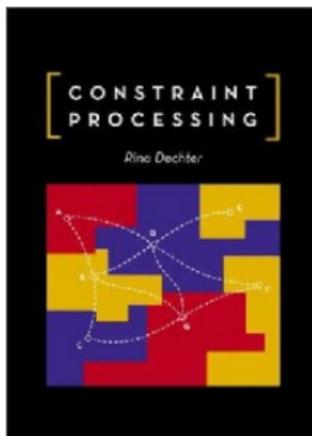
Main techniques

Search

Search for a solution by trying different values for each variable.

Inference

Reformulate the problem to make the search space smaller.

Book

Rina Dechter: Constraint Processing
Morgan Kaufmann, 2003

Available for free (from university network) at
http://proquest.tech.
safaribooksonline.de/9781558608900
(access limited to three readers at a time)

Constraint satisfaction problems
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Next steps
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Organizational matters

Target audience and prerequisites

Target audience

- MSc students of computer science and related subjects
- PhD students of computer science and related subjects

Prerequisites

- lecture "Foundations of AI (CS205)" or equivalent knowledge
- programming skills (only for the software project)

...or willingness to acquire these on the fly

Format

Seminar format

- 3 ECTS points for the seminar
- +3 ECTS points for the optional project extension
- evaluation: graded

Requirements

Requirements to pass

- Give a seminar presentation
  - 50–70 mins
  - submit slides to advisor three days in advance
- Write a seminar paper
  - 10–12 pages, LaTeX
  - due one week before presentation
- Read all presented material
  - prepare summary and questions
  - submit to advisor one day in advance
- Actively participate in discussions
- Participate regularly
  - be absent at most twice
  - notify us in advance if absent

Grading

Grading

- Give a seminar presentation (40%)
- Write a seminar paper (45%)
- Actively participate in discussions (15%)

These three aspects will be individually graded on a scale of
1.0-6.0, and the overall grade for the seminar will be determined as
a weighted average of the three components.

People

Organizers

Prof. Dr. Malte Helmert

- email: `malte.helmert@unibas.ch`
- office: Bernoullistrasse 16, room 305

Gabriele Röger

- email: `gabriele.roeger@unibas.ch`
- office: Bernoullistrasse 16, room 511

...

People

Organizers (ctd.)

Manuel Heusner

- email: `manuel.heusner@unibas.ch`
- office: Bernoullistrasse 16, room 404

Florian Pommerening

- email: `florian.pommerening@unibas.ch`
- office: Bernoullistrasse 16, room 404

...

People

Organizers (ctd.)

Silvan Sievers

- email: `silvan.sievers@unibas.ch`
- office: Bernoullistrasse 16, room 404

Salomé Simon

- email: `salome.simon@unibas.ch`
- office: Bernoullistrasse 16, room 404

Dr. Martin Wehrle

- email: `martin.wehrle@unibas.ch`
- office: Bernoullistrasse 16, room 510

People

Malte Helmert

Manuel Heusner
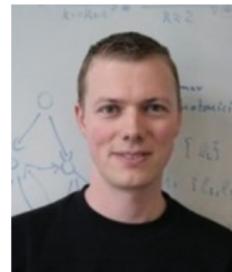

Florian Pommerening

Silvan Sievers

Salomé Simon

Martin Wehrle

Time & place

Seminar

- Time: Thursdays, 15:15-17:00
- Place: Bernoullistrasse 16, seminar room 205

Project

- free project work
- meetings by appointment

Internet

Seminar homepage

`http://informatik.unibas.ch/hs2014/`
`seminar-search-optimization/`

- description of seminar
- slides (to appear)
- additional materials (to appear)

Registration:

- `https://services.unibas.ch/`

Plagiarism

Plagiarism

- plagiarism: passing off someone else's work as your own
- consequence: failing the seminar
- if in doubt, ask us!

Learning goals

Learning goals

Seminar: dealing with scientific literature

- reading and understanding
- explaining and presenting
- comparing and discussing

Project: implementing efficient problem solvers

- practice in programming
- clean and efficient code ($\rightsquigarrow$ code reviews)
- evaluation of algorithms ($\rightsquigarrow$ scientific experiments)

Questions on organization

Questions?

Constraint satisfaction problems
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Seminar Schedule and Topics

Schedule

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Topic #1 (October 9)

Topic #1: Constraint Networks

- Basic concepts: constraint network, solution, . . .
- Properties of binary constraint networks
- Graph representations

Topic #2 (October 16)

Topic #2: Basic Inference Methods

- Arc consistency
- Path consistency
- More general consistency concepts

Topic #3 (October 23)

Topic #3: Look-Ahead Search

How can we find a solution for a constraint network?

Topic #4 (November 6)

Topic #4: Look-back Strategies

How can we learn from mistakes during the search?

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Topic #5 (November 13)

Topic #5: Directional Consistency

Is it possible to solve CSPs without search?

Topic #6 (November 20)

Topic #6: Stochastic Search

Feeling lucky? Finding solutions quickly (or possibly never)

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Topic #7 (November 27)

Topic #7: Tree Decomposition

Find all solutions for small subproblems.
Then extract overall solution quickly.

Topic #8 (December 4)

Topic #8: Exploiting special constraints

Different topics possible e. g. numeric constraints, boolean constraints, global constraints, temporal constraint networks

Topic #9/#10 (December 11 + 18)

Topic #9/#10: Constraint Optimization

Finding the best solution

Next steps

Assignment of Topics

- We will send you the link to a Doodle poll
- Number of the option = number of the topic in these slides
- Mark at least 2 topics with Yes
- Mark at least 3 topics positively: Yes or (Yes)
- until September 24 (next Wednesday)

Then:

- Paper assignment and supervisors announced September 25.