Linköping University

Automated Planning

Course Introduction

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About Us...

- Lecturer:
  - **Jonas Kvarnström** (jonas.kvarnstrom@liu.se)
  - Computer Science (C program) in Linköping 1992–1996
  - PhD in Linköping (automated planning)
  - Now assistant professor (*universitetslektor*)

- Lab Assistant:
  - **Mikael Nilsson** (mikael.a.nilsson@liu.se) – Ph.D. student in planning

About the Lectures...

Please interrupt!

*Questions and comments are welcome – start a **dialog**!*

Today's Lecture

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- **Today's lecture:**
  - **Introduction** to the **course**
    - Contents
    - Examination
    - Timetables
  - **Introduction** to the **topic**
    - Distinction: Planning vs. reacting
    - Distinction: Domain-specific vs. domain-independent
    - *Classical* planning – what is it, and where are the boundaries?

Introduction to the Course

Prerequisites

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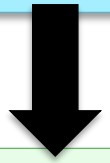
Prerequisites

Basic knowledge and understanding of
data structures and algorithms
as well as **logic and discrete mathematics**.

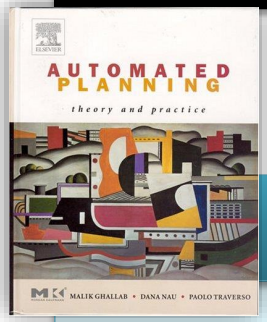
Knowledge and understanding of
basic artificial intelligence techniques and concepts,
including search, heuristics and the A* search algorithm.



➔ We will **introduce** planning concepts

➔ Then we will quickly go **much deeper**

Course Contents



Theory

How to **model** / **specify** planning problems, formally and practically?

How do **planning algorithms** work? Thinking forwards, backwards, in all directions; thinking differently, in unexpected ways

How do they relate to, and benefit from, different plan **structures**?

How can planners benefit from our own deeper **knowledge**? Thinking together…

How can we handle **uncertainty**?

How can we generate **paths** to follow?

Practice

Practical *experience* in **modeling** / **solving** planning problems using well-known planners

➔ Deeper understanding of **abilities** and **limitations**

Written Exam

Demos, hand-ins

Course Book

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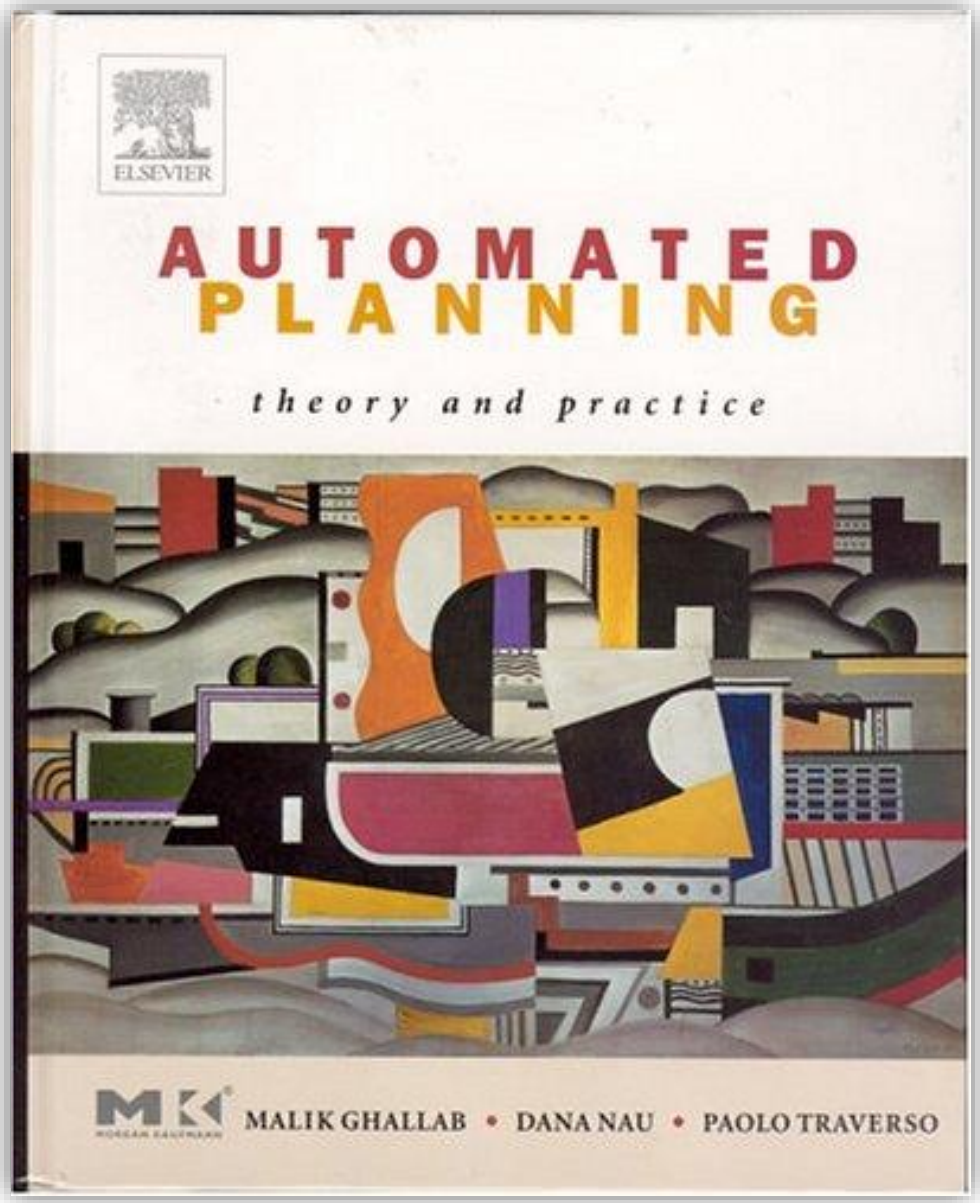
- Main course book
  - Reading instructions are on the web



Lectures vs. Course Book

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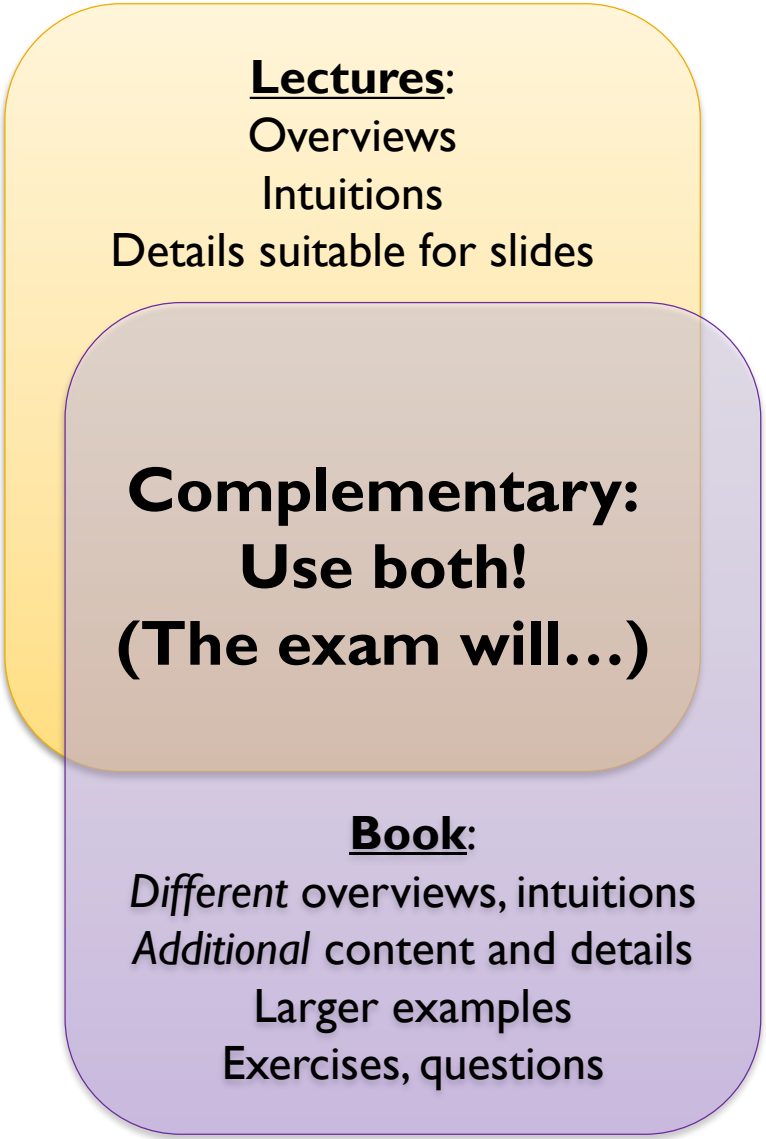
- Lectures vs. Course Book
  - Some overlap, but…



Labs

- Most planners are *research prototypes*
  - **Labs** based on state of the art systems
  - Dozens of planners are available
    - Some ”recommended”, others available as a bonus

Sequential satisficing
acoplan
acoplan2
arvand
brt
cbp
cbp2
cpt4
dae_yahsp
fd-autotune-1
fd-autotune-2
fdss-1
fdss-2
forkuniform
lama-2008
lama-2011
lamar
lprpgp
madagascar
madagascar-p
popf2
probe
randward
roamer
satplanlm-c
sharaabi
yahsp2
yahsp2-mt

Seq. sat. multi-core
acoplan
arvandherd
ayalsoplan
madagascar
madagascar-p
phsff
roamer-p
yahsp2-mt

Seq. optimizing
bjolp
cpt4
fd-autotune
fdss-1
fdss-2
forkinit
gamer
iforkinit
lmcut
lmfork
merge-and-shrink
selmax

Temporal satisficing
cpt4
dae_yahsp
lmtd
popf2
sharaabi
tlp-gp
yahsp2
yahsp2-mt

Older planners
IPP
FF

Specialized planners
SHOP2

Lab Overview

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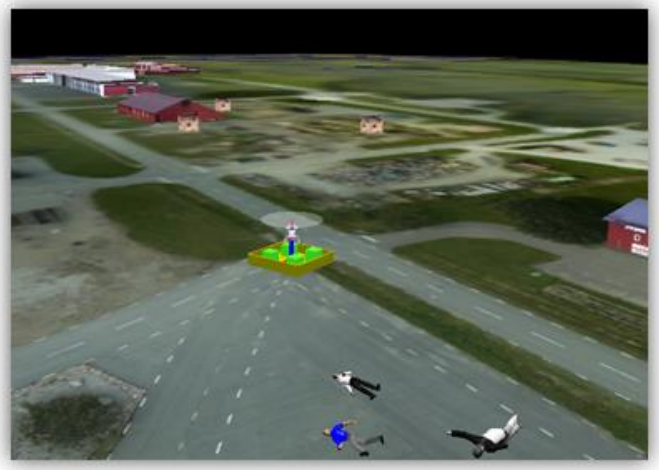
1. **Classical planning**
   - **Construct** a simple planning domain for emergency service assistance
   - **Investigate** properties of several planners



2. **Classical planning**
   - **Extensions** – learn more about modeling
   - Use action **costs** to model plan **quality**
   - Test *optimal* planners

3. **Planning for multiple agents**
   - Using sequential planners – what happens?
   - Using concurrent planners – what do you gain? How do you model?

Lab Overview (2)

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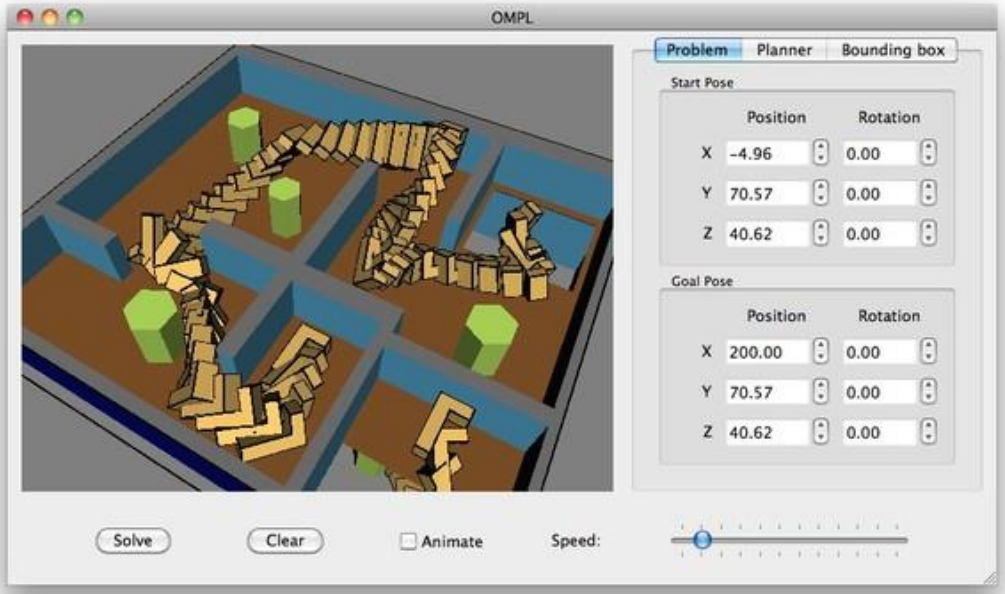
4. **Hierarchical Task Networks**
   - Defining *tasks to perform* instead of *goals to achieve*
   - Very different modeling task!

5. **Motion Planning with OMPL**
   - Test a variety of motion planning techniques using the Open Motion Planning Library



Labs

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- Work by yourselves or in pairs
  - Working in pairs ➔ must work **together**!
  - Register in WebReg (link on the course web page)

- If you have a problem:
  - First **try** to solve it yourselves
  - Then **ask us**! Without feedback **we can't help you**!

- **Lab assistant** available:
  - During **scheduled lab hours**
  - By **e-mail**, *during the course*
    (but don't expect immediate replies)

Labs (2)

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Plenty of work to do on your own – typical schedule:

45 minutes Work on your own	Work on your own (not scheduled)	45 minutes Work on your own	Work on your own (not scheduled)
1 hour Lab assistant present		1 hour Lab assistant present	

→ Larger number of labs
Fewer days to wait until you can ask for help

Schedule

- **Recommended timeline:**
  - **190405** – Lab 1 finished (Classical 1)
  - **190411** – Lab 2 finished (Classical 2)
  - **190507** – Lab 3 finished (Concurrent)
  - **190520** – Lab 4 finished (HTN)
  - **190523** – Lab 5 finished (OMPL)

  - **190524** – Final **hand-in / demo** session
    - Hand in earlier if you can – limited time during the final session

Additional Opportunities

General policy:
You can always take an **exam** at least three times per year

- For this course: **190605, 190822, 1910xx/11xx**

General policy: ***For all IDA courses having computer lab assignments***
there will be ***one deadline*** *during or at the end of the course.*
If you fail to make the deadline, you must ***retake the possibly new lab course***
the next time the course is given.

- For this course, three **bonus demo sessions**:
  - In the June 2019 (re-)exam period (date to be announced)
  - In the August 2019 re-exam period
  - In the October 2019 re-exam period

Strict Deadlines!

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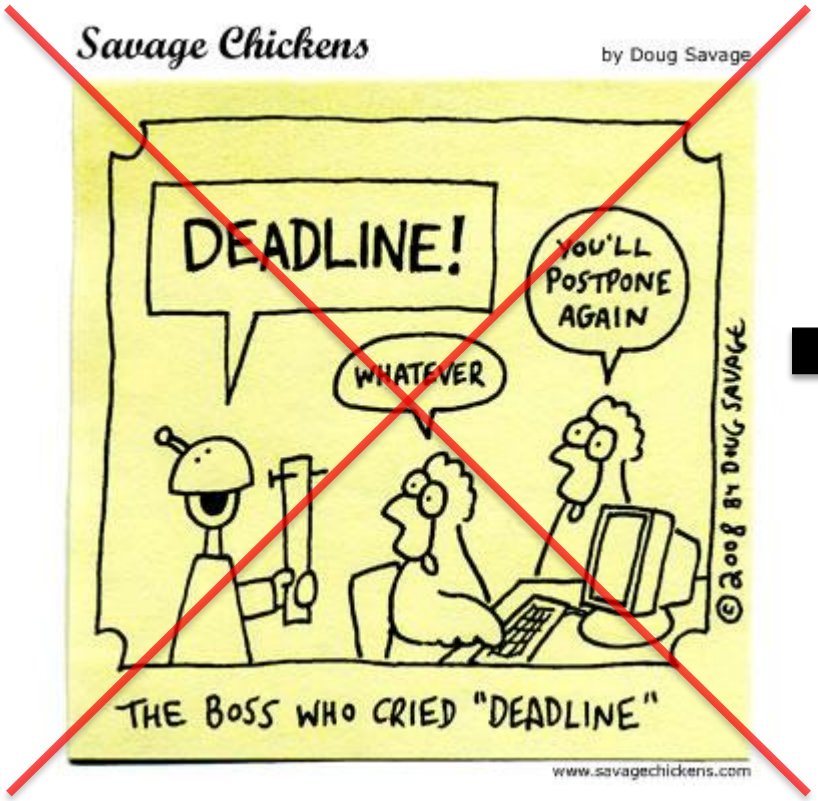

Strict Deadlines! 2

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Do you need money from CSN?

Finish in time, **study** for the exam!

You can only receive credits on the specified dates

Will you be leaving the country?

Study for the exam!

You can not take an exam without being here

TDDD48 Automated Planning

Questions?