# Coming up on Exam 1

We have studied (weeks 1-5)

- agents and agent architectures
  - Thinking
    - Search
    - Propositional representations
    - Planning
      - With STRIPS operators
      - With propositional representations
    - Constraint reasoning
      - With propositional representations
    - Theorem proving
      - With propositional representations
  - Acting

All thinking activities are cast as search through a state-space using a given knowledge representation language for representing states

Acting can also be cast as search ("real-time search")

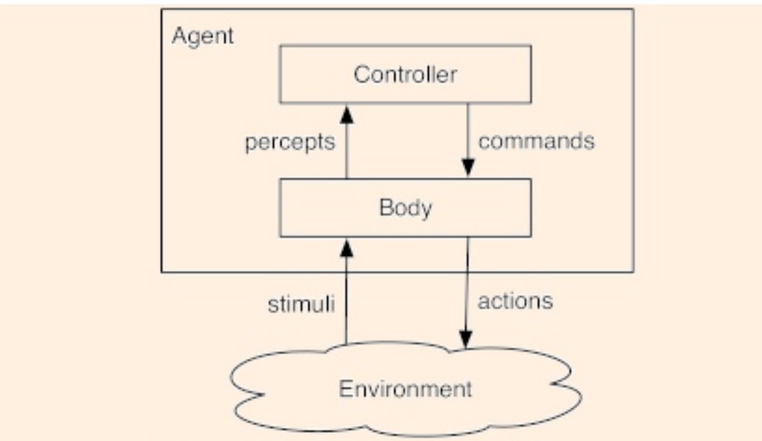
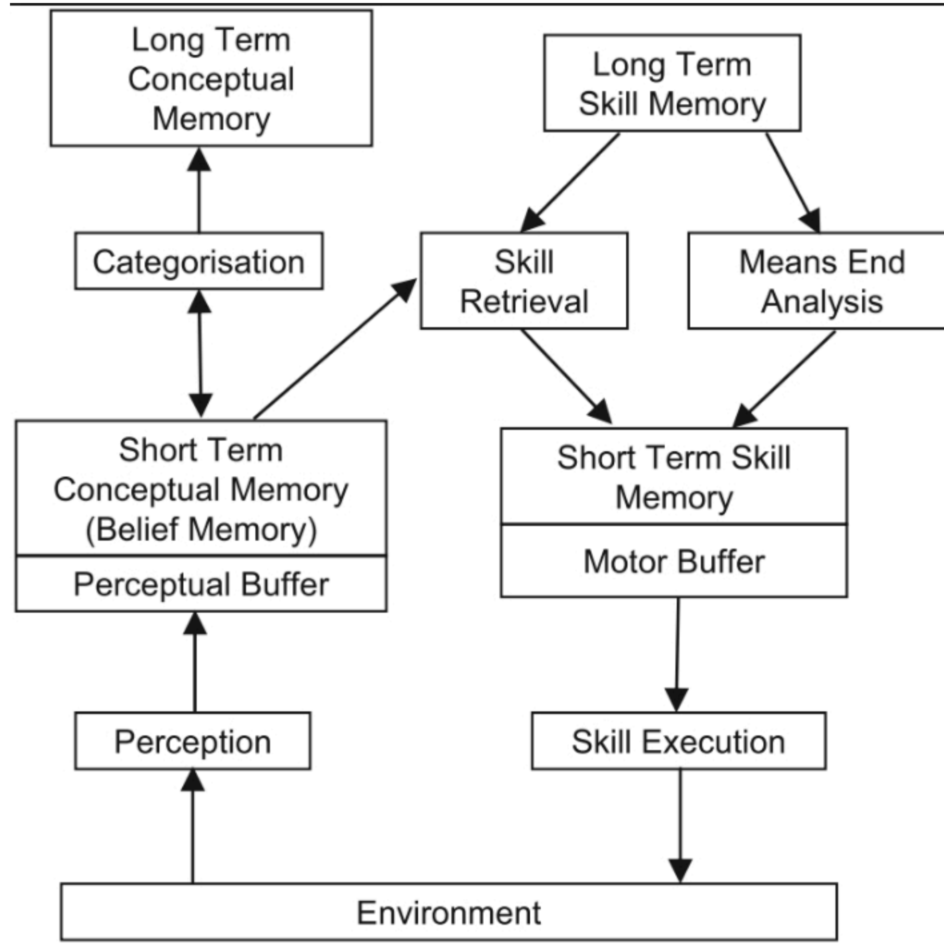



Figure 2.1: An agent system and its components

From Poole and Mackworth, 2nd Edition

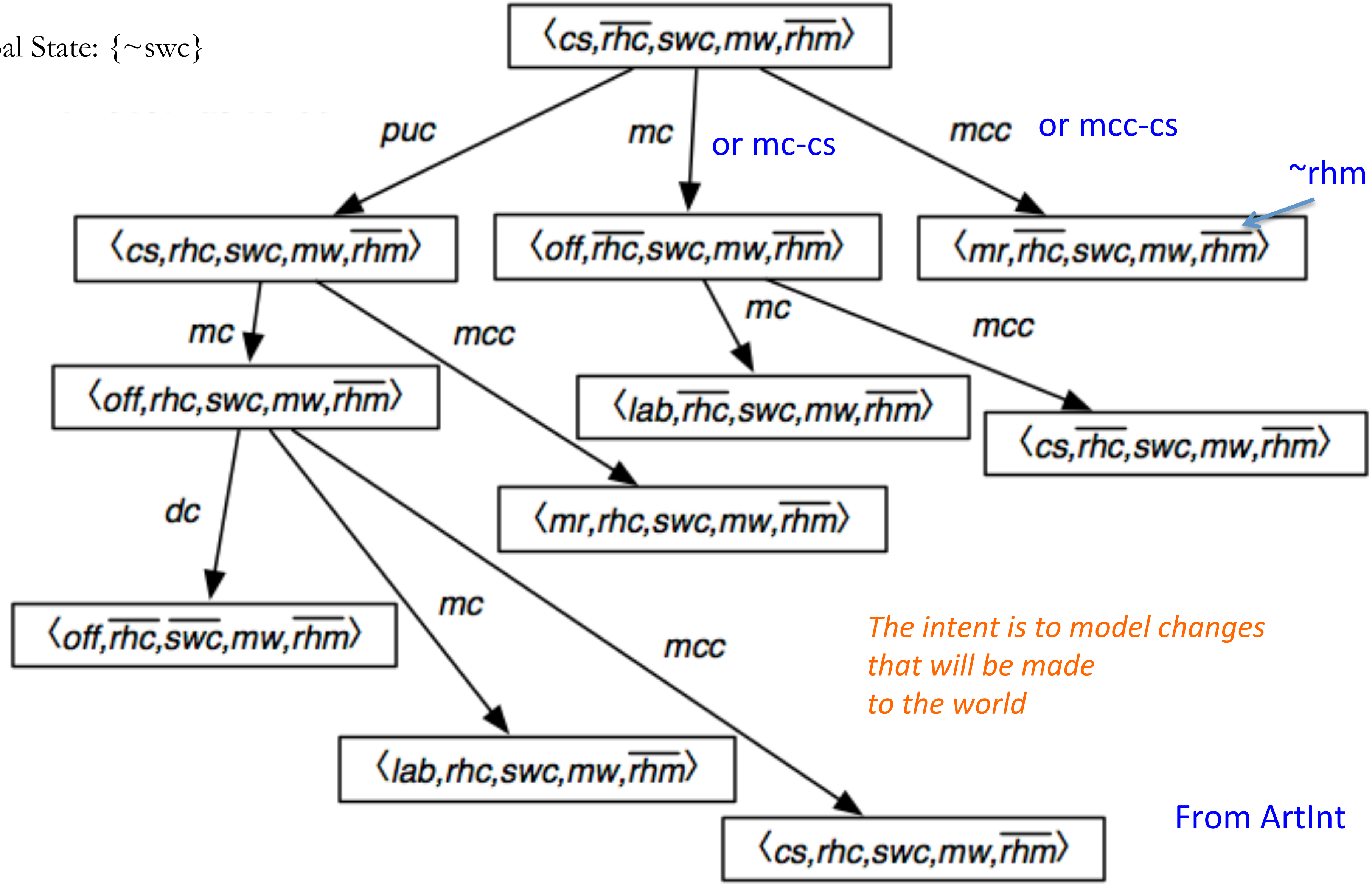



Icarus architecture (Langley et al; Image from Chong et al , adapted from Langley, 2004)

## Planning is done in anticipation of acting

Initial State: {cs, ~rhc, swc, mw, ~rhm}

Goal State: {~swc}




*The intent is to model changes that will be made to the world*

From ArtInt

Figure 6.2 Part of the search space for a state-space planner

## Planning is done in anticipation of acting

What have we not yet addressed in weeks 1-5? Lots, but here are a few

Planning to date has assumed certainty in effects of operators when those operators are executed in the real world

But uncertainty is rife

Addressing uncertainty requires

- Representing uncertainty (e.g., what is the probability that Rob will trip when executing an mc_cs into Sam's messy office?)
- Acting on uncertainty
  - Query for more information
  - Computing a probability distribution over outcomes and their utilities (and thus an expected utility of an action)
  - Replanning

## Planning is done in anticipation of acting

Propositional logic is a very limited representation scheme for the real world (though it is ubiquitous in areas such as machine learning, as well as the example of planning and theorem proving we have seen)

For example, four operators are needed to represent each of mc and mcc in STRIPS (e.g., mc_off, mc_mr, mc_lab, mc_cs)

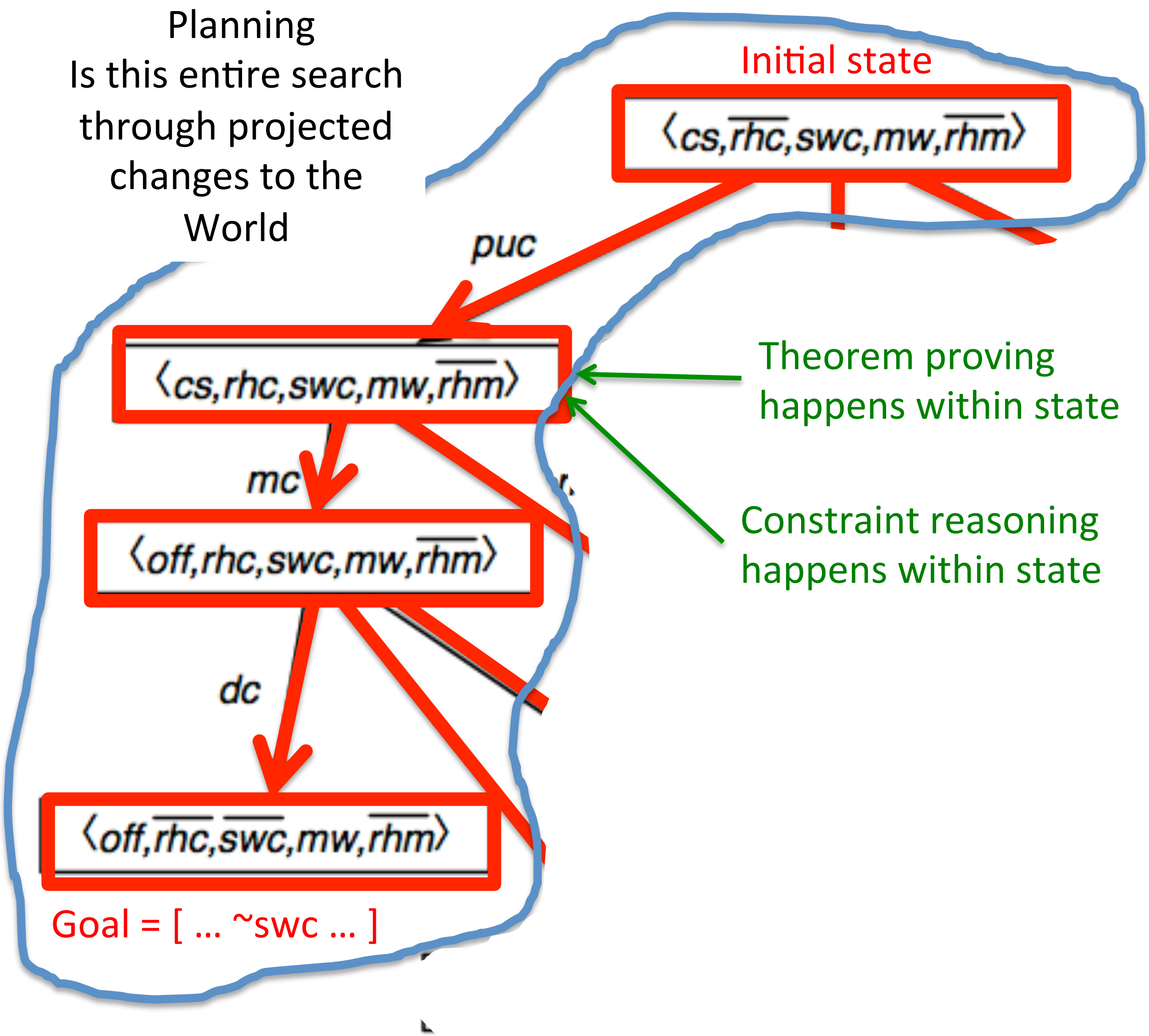
First-order representations enable one parameterized operator to replace many propositional operator (e.g., mc(?X), where ?X can be off, mr, lab, cs)

Greater inferential power can be used at each state in planning (e.g., theorem proving, constraint reasoning)

**Example 6.6.** *Consider representing the action mc to move clockwise. The effect of mc, where the robot ends up, depends on the robot's location before mc was carried out.*

*To represent this in the STRIPS representation, we can construct multiple actions that differ in what is true initially. For example, the action mc_cs (move clockwise from coffee shop) has a precondition* $\{RLoc = cs\}$ *and effect* $\{RLoc = off\}$*. The action mc_off (move clockwise from office) has a precondition* $\{RLoc = off\}$ *and effect* $\{RLoc = lab\}$*. STRIPS thus requires four move clockwise actions (one for each location) and four move counterclockwise actions.*

mc_cs: [cs] —> [off], or mc_cs: [cs] —> [off, ~cs], or mc_cs: [cs] —> [off]
with Rloc=off → RLoc≠~cs ∧ RLoc≠~lab ∧ ...)




Adapted from ArtInt

Figure 6.2 Part of the search space for a state-space planner

## Planning is done in anticipation of acting

Initial State: {cs, ~rhc, swc, mw, ~rhm}

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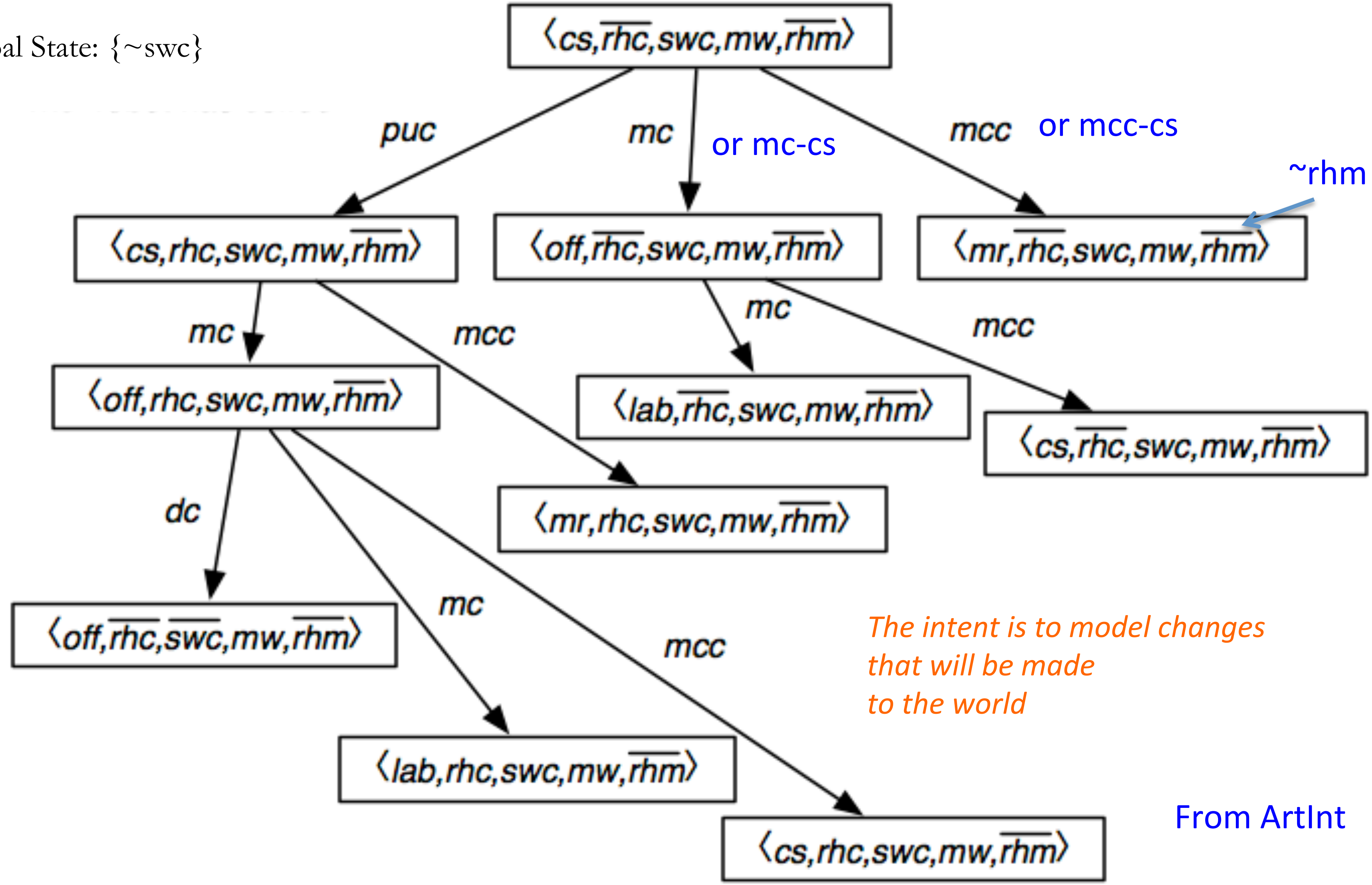


*The intent is to model changes that will be made to the world*

From ArtInt

Figure 6.2 Part of the search space for a state-space planner

## Schedule

This schedule includes a week by week summary of in-class activities; pre-class and post-class responsibilities; due dates of exercises, peer reviews, and projects.

Summary special dates (not counting weekly quizzes (due Tuesday mornings), forum posts (due Tuesday nights), or exercises (due Friday nights)

- Programming assignment 0 (due Wednesday September 12)
- Exam 1 (Thursday September 27, in class — no Zoom except one case)
- Programming assignment 1 (due Wednesday October 3)

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# WEEK 1

# Class meeting 7 (Thursday, September 13 ):

- Programming Assignment 1 on Search (Discussion slides) See exact specifications on Brightspace **(Due October 3)**
- Take Attendance
- Real world constraint and optimization scenarios (slides only)
- Key for A-w3 (in the final side of the presentation there is a reference to a typo in the text. This has been corrected in the online version of the book). (slides only, corrected)

Key for A-w4 posted soon

# To Do After Thursday, September 20 class:

- **Submit Assignment A-w5 by Saturday, September 22 at 11:59 pm** — est. 2 hours

## To Do before Tuesday, September 25 class:

- Watch Pre-class lecture on Adversarial Search in Games (slides only) (Sections 11.1 – 11.3 of ArtInt, optional reading)
- **Take online quiz Q-w6 by 8:00 am September 25**

## Class meeting (Tuesday, September 25 ):

- Othello Game Player and others (Go, Chess)

## To Do before Exam 1 on Thursday, September 27 class:

- **No Discussion Forum Post**
- Study for Exam 1 — est. 4 hours (assuming that you have stayed up on material)

## Class meeting (Thursday, September 27 ):

- **Exam 1** (covers all material studied in week's 1-5, excludes Adversarial Search)

## Exam 1 Study Outline

You are responsible for all material from weeks 1-5,

- with emphasis on
  - pre-recorded material, and
  - assigned exercises
    - including Quizzes and feedback, and
    - exercise keys
      - Key for A-w2 (slides only), which includes additional search material
      - Key for A-w3 (slides only, corrected)
      - Assignment A-w4 key, as well as
        - Sample partial solution 1 and solution 2 to textbook exercise 4.3c from chapter 4 on variable elimination for crossword puzzle
- with lesser emphasis (but not nil by any means) on
  - readings and
  - in-class lectures

# ARTIFICIAL INTELLIGENCE, MACHINE LEARNING, & ETHICS

Saturday, September 22

5-6:30 p.m.

Warren Great Room

WARREN COLLEGE