# Written exam in Introduction to Artificial intelligence

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| Time | 8.30 – 13.30 | |
| Grade limits | U | 0 - 19 |
| | 3 | 20 - 26 |
| | 4 | 27 - 32 |
| | 5 | 33 - 40 |
| Admissible aids | None | |
| Responsible teacher | Roger Jonsson (will not visit the exam) | |

## Good luck!

Answers may be given in Swedish.

1. **History of AI (1+1+2p)**

   The course book describe the following four views of AI:
   "Systems that think like humans",
   "Systems that act like humans",
   "Systems that think rationally" and
   "Systems that act rationally".

   a) Which of the given views of AI is used through the course book (Russel and Norvig)?

      **Svar:** "Systems that act rationally"

   b) What other view is also a distinct research area?

      **Svar:** "Systems that think like humans" (= psykologi, neuroscience), och/eller "Systems that think rationally" (= logik)

   c) Why is the other two not interesting?

      **Svar:** "Systems that act like humans" anser man inte har något egenvärde. "Systems that think rationally" anses inte tillräckligt för att klassas som AI.

2. **Environments (2+2p)**

   The following descriptions are often used when describing environments:

   - Fully observable – partially observable
   - Deterministic – stochastic
   - Episodic – sequential
   - Static – dynamic
   - Discrete – continuous
   - Single agent – multi agent

   Describe the following environments with the above descriptions:

   a) AI chess player

      **Svar:** Fully observable, deterministic, episodic, static, discrete, multi agent

   b) Mobile lawn mover (automatically cutting grass in the garden)

**Svar:** Partially observable, stochastic, sequential, dynamic, continuous, single agent

## 3. Questions about searching (2+2+4p)

a) Which (one or many) of the above given descriptions of environments are required when using some sort of tree-search?

**Svar:** Deterministic, static and discrete

b) What are the differences between informed and uninformed search algorithms?

**Svar:** "Informed search algorithms"använder en heuristik eller signal för att rikta sökningen, den blir då i regel mycket effektivare.

c) Explain the terms "dominates" and "admissible" with respect to the A* algorithm.

**Svar:** En heuristik dominerar en annan om den är effektivare. En admissible heuristik överskattar aldrig den faktiska kostnaden.

## 4. First order logic (5+2+2p)

a) Make a model using first order logic of the game "Tic-Tac-Toe" (Swe: "Tre-i-rad"). The game consist of a a 3x3 squared board where each player place a piece in one unoccupied square until all squares are filled or one of the players have three pieces in a row.

**Svar:** (A = For-all, E = Exist)
Won(p) <=> E x,y Occupy(p,x,y) AND Occupy(p,x+1,y) AND Occupy(p,x+2,y)
Won(p) <=> E x,y Occupy(p,x,y) AND Occupy(p,x+1,y+1) AND Occupy(p,x+2,y+2)
Won(p) <=> E x,y Occupy(p,x,y) AND Occupy(p,x,y+1) AND Occupy(p,x,y+2)
Won(p) <=> E x,y Occupy(p,x,y) AND Occupy(p,x-1,y-1) AND Occupy(p,x-2,y-2)
Draw <=> (A p Not Won(p)) AND (E p A x,y Occupy(p,x,y))

b) Show with your model that if Kalle have a piece on (1,1) and (1,2), he is winning if it is his turn and the square (1,3) is free.

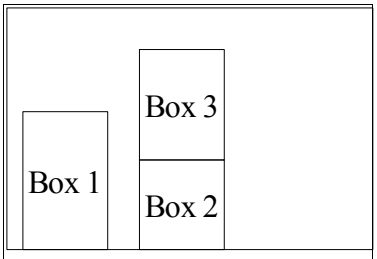
**Svar:** Fakta:
Occupy(Kalle,1,1)
Occupy(Kalle,1,2)
Lägger man till Occupy(Kalle,1,3) till databasen kan man härleda första meningen där p byts till Kalle, x till 1 och y till 1.

c) If you did not need to use logic for the AI-player, what kind of AI-technique would you use?
**Svar:** Alfa-Beta-pruning med t.ex. heuristiken vinst = 1, förlust = -1 och oavgjort = 0.

## 5. Planning (2+3p)

a) Write the STRIPS definitions for the "Blocks world" in picture 1. The possible actions are: grab and release. Only blocks that does not have any block on top are possible to grab.

**Svar:** (~ betyder Not)
Precondition: Free(b), ArmIsFree, At(b, pl)
Action: grab(b, pl)



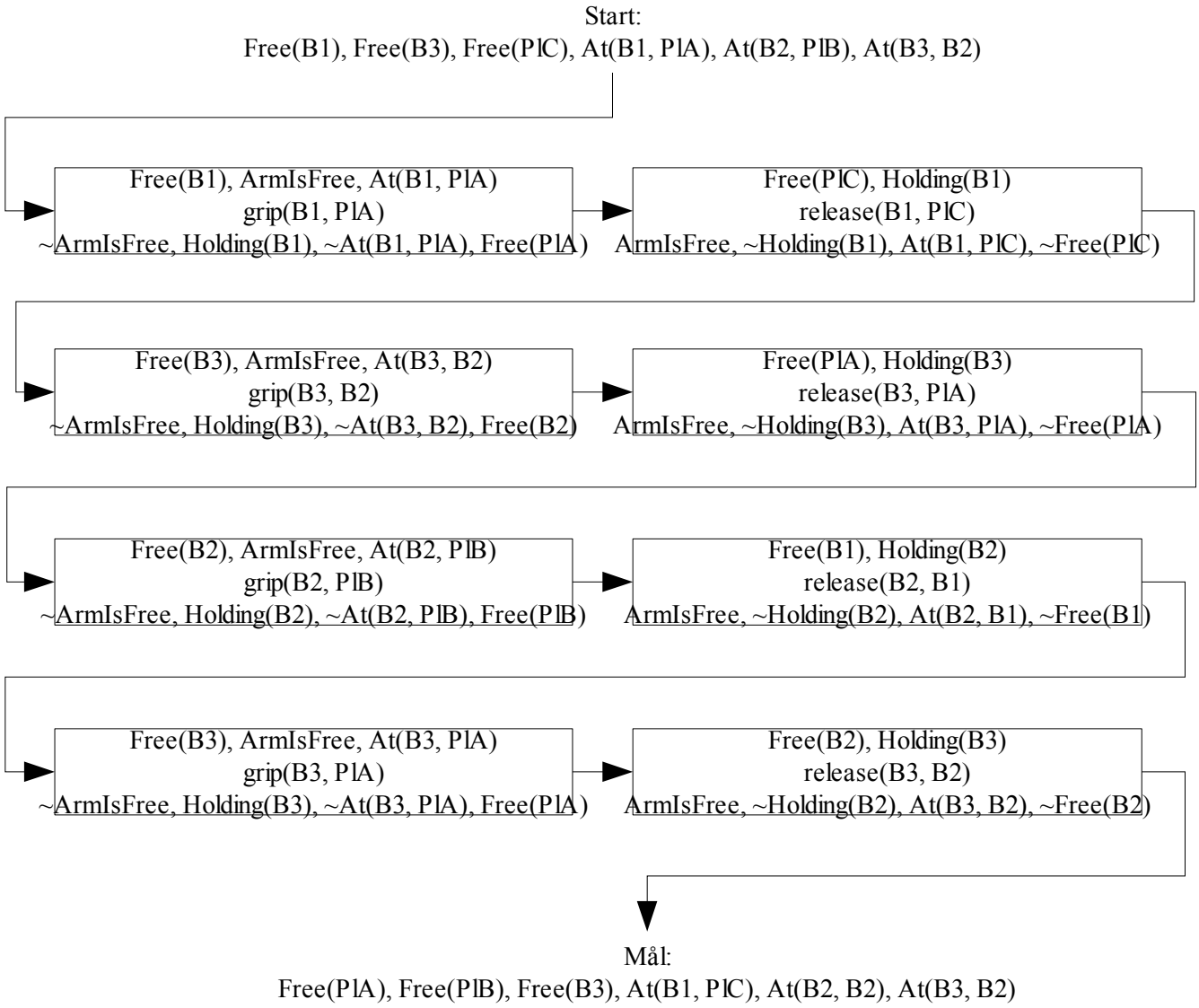
*Picture 1Blocks world*

Post-condition: ~ArmIsFree, Holding(b), ~At(b, pl), Free(pl)

Precondition: Free(pl), Holding(b)
Action: release(b, pl)
Post-condition: ArmIsFree, ~Holding(b), At(b, pl)

b) Illustrate the solution a POP-planner would give if picture 1 describes the starting condition and the goal would be to have all blocks on place C with Box 3 on top and Box 1 at the bottom.

**Svar:**




## 6. Intelligent search engine (10p)

Suppose a company would like to implement an intelligent search engine that learns what each employer most often looks for on the internal web-pages. Since it is the internal web, there are only so many pages (enumerable).

Illustrate with pictures and explaining text how a system that learns specific employers characteristics. The input is a set of words and output is a set of web-pages.

You need to name the algorithms you intend to use and explain how they will operate. Basically a high level description.

There is a Google-like search engine that you may use. This engine will report a set of web-pages that includes all words that is searched for, but the pages will not be ranked. The ranking is supposed to be done by your system.

**Svar:** Här måste varje presentation bedömmas för sig...