Intelligent Systems – Final Exam (Block 1)
ETSINF, Universitat Politècnica de València
January 20th, 2015 (2 points)

Surname(s):
Name:
Group: A B C D E F Flip RE1 RE2

1) Given the LHS of the rule:

```
(defrule R1
        (list $? ?x $? ?y)
        (test (< ?x ?y))
=>
```

, and the fact: (list 1 3 2 1 3 6), how many instances of the rule will be inserted in the Agenda?

A. 0
B. 1
C. 5
D. More than 5

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2) Given three search methods: M1 applies a uniform-cost search, M2 is an A* algorithm and M3 applies a greedy search, which assertion is INCORRECT?

A. M1 and M2 will find the optimal-cost solution
B. There is guarantee that M3 will find the solution more rapidly than M1 and M2
C. There is no guarantee that M3 will find the optimal-cost solution
D. M1 will expand more nodes than M2

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3) Given the evaluation functions $f1(n)=g(n)+h1(n)$ and $f2(n)=g(n)+h2(n)$, such that $h1(n)$ is admissible and $h2(n)$ is not, mark the CORRECT answer:

A. Both functions guarantee they will find the optimal-cost solution
B. There is guarantee that $f2(n)$ will generate fewer nodes than $f1(n)$
C. Only in the case that h1(n) is a consistent heuristic function, $f1(n)$ will generate fewer nodes than $f2(n)$
D. There exists some node n for which it holds $h2(n)>h^*(n)$

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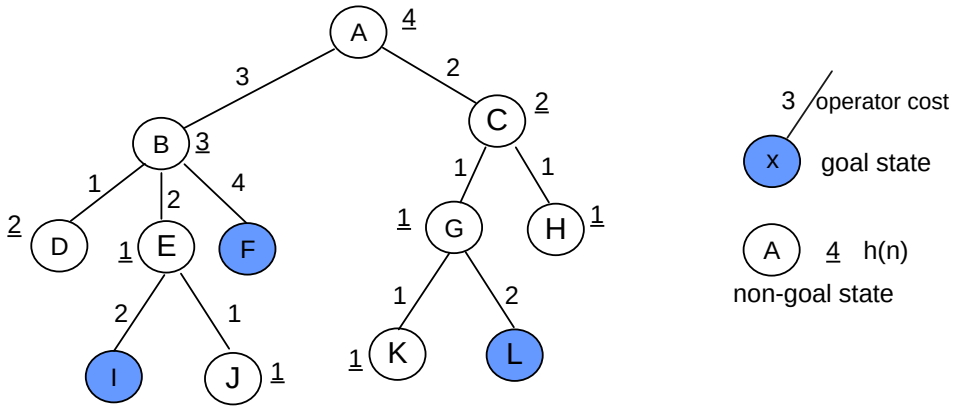
4) Given the state space of the figure and assuming a breadth-first search (expanding the leftmost node first), which assertion is TRUE?



A. The algorithm returns node I
B. The algorithm generates 8 nodes
C. The algorithm expands 4 nodes
D. None of the above

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5) Given again the state space of question 4 and assuming now a search algorithm of type A ($f(n)=g(n)+h(n)$), which assertion is FALSE?

A. $h(n)$ is admissible
B. The algorithm returns the node L
C. The algorithm expands 3 nodes
D. The algorithm generates 7 nodes

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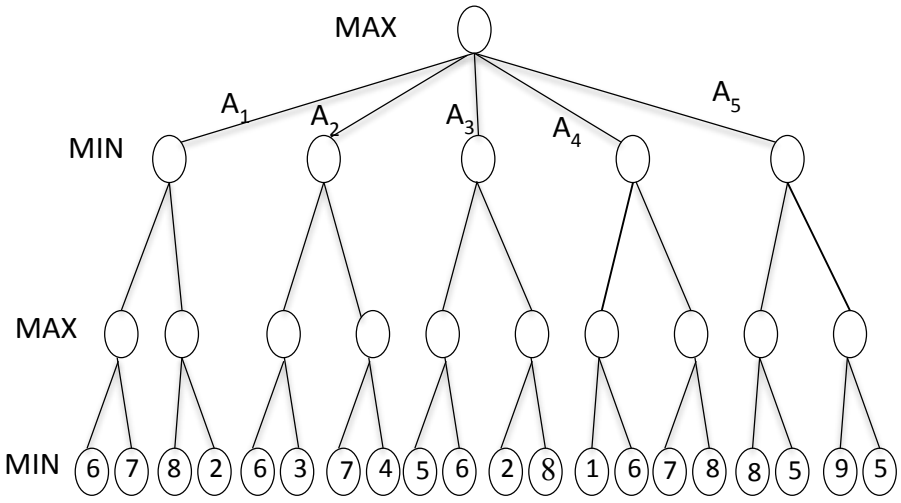
6) If we apply and α-β algorithm for the game tree of the figure, which is the best move for MAX?



A. Either branch A1 or A4
B. Branch A4
C. Branch A5
D. Either branch A1 or A2

Intelligent Systems – Final Exam (Block 1)
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January 20th, 2016 (3 points)

We have three storehouses (A, B and C) in a city location, each having a set of packages to be transported to any of the other two stores. Hence, store A may have packages for B and/or C; store B may have packages for store A and/or C; and store C may have packages whose destination is store A and/or B. The problem goal is to deliver all packages to their destination store.

For the package transportation, there is only one truck available which can keep 10 packages at most. The truck cam move between any pair of storehouses. When the truck is at store X, packages located at store X and whose destination is a store other than X can be loaded into the truck. Likewise, when the truck is at store X, only the packages whose final destination is X can be unloaded from the truck.

Example of initial situation:

- There are 7 packages in store A: 4 of them go to B and 3 go to C.
- There are 10 packages in store B: 7 of them go to A and 3 go to C.
- There are 6 packages in store C: 3 for A and 3 for B.
- The truck is initially in store A and it is empty.

Given the following pattern to represent the dynamic information of the problem;

(transport [store ?cit [destin ?dest ?num]^m]^m truck ?loc [?dest_pack ?num_pack]^m total ?tot)

, where:

?cit, ?loc $\in$ {A,B,C}
?dest $\in$ {A,B,C} such that ?dest $\neq$?cit ;; destination
?num $\in$ INTEGER ;; number of packages to destination, even when the number is 0

?tot $\in$ INTEGER ;; overall number of packages in the truck

?dest_pack $\in$ {A,B,C} ;; destination (only if there are packages for such destination)
?num_pack $\in$ INTEGER such that ?num_pack $\neq$ 0 ;; number of packages to destination (only if it is not 0)

NOTE 1: If the truck is not carrying packages for store X then the label [X 0] does not appear in the fact

NOTE 2: Given a store X, we only represent the packages to be moved to another store (we do not represent the packages of X)

NOTE 3: If necessary, you can add a static fact in any of the following questions.

a) (0.5 points) Write the initial fact base that represents the information described above.

```
(transport store A destin B 4 destin C 3 store B destin A 7 destin C 3 store C destin A 3 destin B 3 truck A total 0)
```

b) (1 point) Write a single rule that loads into the truck all the packages in store X that go to a destination Y. Assume the truck does not have a priori packages for Y. The restriction about the max capacity of the truck must be satisfied

```
(defrule load
   (transport $?x1 store ?alm $?y1 destin ?dest ?num $?y2 truck ?alm $?z total ?total)
    (test (> ?num 0))
    (test (not (member store $?y1)))
    (test (<= (+ ?total ?num) 10))
 =>
   (assert (transport $?x1 store ?alm $?y1 destin ?dest 0 $?y2 truck ?alm ?dest ?num $?z total (+ ?total ?num))))
```

c) (0.8 points) Write a single rule that displays a message for each destination for which the truck is not carrying packages. You must show a message like: “The truck has not packages for destination XXXX “, for each destination that satisfies this condition.

We generate the static fact (destinations A B C)

```
(defrule display
   (transport $?x truck ?loc $?z total ?tot)
   (destinations $? ?d $?)
   (test (not (member ?d $?z)))
 =>
   (printout t "The truck has not packages for destination " ?d crlf))
```

d) (0.7 points) Write a single rule that unloads from the truck in store X the packages whose destination is X. The rule must be valid for any destination and the new resulting fact must not contain the label of the destination nor the number of packages; that is, once the packages are unloaded at X, the label [X 0] of the truck must not appear in the new fact.

```
(defrule unload
   (transport $?x truck ?loc $?y ?loc ?elem2 $?z total ?tot)
 =>
   (assert (transport $?x truck ?loc $?y $?z total (- ?tot ?elem2))))
```