CS347 FS2007 Exam 2 Key

This is a closed-book closed-notes exam. The only items you are permitted to bring are writing implements, food and drink. Mark every sheet of paper you use with your name and the string “cs347fs2007 exam2”. If you are caught cheating, you will receive a zero grade for this exam. The max number of points per question is indicated in square brackets after each question. The sum of the max points is 52 (that includes 2 bonus points). You have 75 minutes to complete this exam. Good luck!

Questions 1-5 are about the following adversarial search tree. State evaluation heuristic values for the max player are provided in the form of numbers following the letter labels of the states (e.g., A19 indicates that the heuristic value of state A for the max player is 19). The order in which successors are generated is from left to right. Example: A generates first B, then C, and finally D.


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def DLM( ) ABDM( ), #define Max( ) ABMaxV( ), #define Min( ) ABMinV( )

call          open eval     value          α, β best action value
DLM(A,1,−∞,∞) B C D          B MinV(B,0,−∞,∞)=12 12, ∞  AB, 12
              C D           C MinV(C,0,12,∞)=5  12, ∞  AB, 12
              D D           D MinV(D,0,12,∞)=5  12, ∞  AB  12
DLM(A,2,−∞,∞) B C D          B MinV(B,1,−∞,∞)=11 11, ∞  AB, 11
              C D           C MinV(C,1,11,∞)=10 11, ∞  AB, 11
              D D           D MinV(D,1,11,∞)=5 (SSS,Prune) 11, ∞  AB  11
MinV(B,1,−∞,∞) E F           E MaxV(E,0,−∞,∞)=11 11, ∞  BE, 11
              F F           F MaxV(F,0,−∞,11)=12 11, ∞  BE, 11
MinV(C,1,11,∞) H G           H MaxV(H,0,11,∞)=10 (Prune) 11, ∞  CH, 10
DLM(A,3,−∞,∞) B C D          B MinV(B,2,−∞,∞)=13 13, ∞  AB, 13
              C D           C MinV(C,2,13,∞)=2  13, ∞  AB, 13
              D D           D MinV(D,2,13,∞)=16 16, ∞  AD  16
MinV(B,2,−∞,∞) E F           E MaxV(E,1,−∞,∞)=13 13, ∞  BE, 13
              F F           F MaxV(F,1,−∞,13)=14 13, ∞  BE, 13
MaxV(E,1,−∞,∞) J K           J MinV(J,0,−∞,∞)=13 13, ∞  EJ, 13
              K K           K MinV(K,0,13,∞)=10 13, ∞  EJ, 13
MaxV(F,1,−∞,13) L M N         L MinV(L,0,−∞,13)=14 (Prune) 13, ∞  FL, 14
MinV(C,2,13,∞) H G           H MaxV(H,1,13,∞)=2 (SSS,Prune) 13, ∞  CH, 2
MinV(D,2,13,∞) I I           I MaxV(I,1,13,∞)=16 13, ∞  DI, 16
MaxV(I,1,13,∞) S T U         S MinV(S,0,13,∞)=9  13, ∞  IS, 9
              T U           T MinV(T,0,13,∞)=16 13, ∞  IT, 16
              U U           U MinV(U,0,16,∞)=12 16, ∞  IT, 16
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2. Indicate for each depth iteration of ABIDM(A,3,−∞,∞) which nodes, if any, get pruned. [5]
   Depth 1: none
   Depth 2: G
   Depth 3: M,N,G,O,P,Q

3. What is the Principal Variant (PV) found by ABIDM(A,3,−∞,∞)? [3]
   A→D,D→I,I→T

4. Would IDM(A,3) have found the same PV? Explain your answer! [1]
   Yes, because backward pruning methods such as αβ-pruning do not effect the outcome of a search, only its efficiency.

5. Would adding a move ordering heuristic to ABIDM possibly have changed the PV found? Explain your answer! [1]
   No, because the outcome of minimax searches is not dependent on the order in which successors are generated.

6. Given two admissible heuristics $h_1$ and $h_2$.

   (a) What does it mean for $h_1$ to dominate $h_2$? [2]
   $h_1$ dominates $h_2$ iff $(\forall n)(h_1(n) > h_2(n))$

   (b) If $h_1$ dominates $h_2$, what is the implication for $A^*TS$ using $h_1$ versus $A^*TS$ using $h_2$? [2]
   If $h_1$ dominates $h_2$, then $A^*TS$ using $h_1$ will never expand more nodes than $A^*TS$ using $h_2$, except possibly for some nodes with $f(n) = C^*$

   (c) Are there any circumstances under which it would be beneficial to include in the max composite heuristic, two heuristics of which one is dominated by the other? Explain your answer! [3]
   No, because the max function will always select the dominant heuristic and the computational time required to compute the dominated heuristic is therefore always wasted.
7. What is the optimal move for player A in the top state? Illustrate your computation by copying the game tree onto your answer paper and writing the backed-up utility vectors by each state. [8]

The optimal move for player A is $A \rightarrow B$.

8. What is the PV? [2]
$A \rightarrow B, B \rightarrow C, C \rightarrow D$