Summarizing Search Modeling Examples

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Tic Tac Toe – Set based Search Modeling

$R = \{1, \ldots, 3\}$

$M = \{X, O, B\}$

$F = \{ (i, j, m) \mid \forall\, i, j \in R, \forall\, m \in M \}$

$S = \{ F' \subseteq F \mid Covered(F') \wedge AllUnique(F') \wedge PlayOrderPreserved(F') \}$

$Covered(F) \leftrightarrow \forall i,j \in R\ \exists m \in M \mid (i, j, m) \in F$

$AllUnique(F) \leftrightarrow \forall i,j \in R\ \forall m,m' \in M \mid ((i,j,m) \in F \wedge (i,j,m') \in F) \rightarrow (m = m')$

$PlayOrderPreserved(F) \leftrightarrow 0 \leq (Count(X, F) – Count(O, F)) \leq 1$

$\quad Count(m, F) = | \{ (i, j, m) \in F, \forall i, j \in R \} |$

0-1 Knapsack Problem – Set based Search Modeling

Weights $W = \langle w_1, \ldots, w_n \rangle$

Values $V = \langle v_1, \ldots, v_n \rangle$

$F = \{ 1, \ldots, n \}$

$S = \{ F' \subseteq F \mid \sum_{\forall f \in F'} w_f \leq C \}$

$Ext = \{ A \rightarrow B \mid \forall s \in S \bullet A \subseteq s \mid ((s\text{-}A) \cup B) \in S \}$

0-1 Knapsack Problem (GA) – Set based Search Modeling

$I = \langle (w_1, v_1), \ldots, (w_n, v_n) \rangle$, C = capacity

$\quad$ where $w((w_i, v_i)) = w_i$ and $v((w_i, v_i)) = v_i$

$F = \{ \{ i_1, \ldots, i_m \} \mid (\sum_{j=1..m} w(i_j) \leq C) \}$

$S = \{ F' \subseteq 2^F \mid \sum_{\forall f \in F'} w_f \leq C \}$

$Ext = \{A \rightarrow B \mid \forall s \in S \bullet A \subseteq s \mid (s\text{-}A) \cup B \in S \wedge (Mutation(A,B) \vee Combination(A,B)\}$

$Mutation(A,B) \leftrightarrow A = \{ P \} \wedge B = \{ (P – K) \cup J \}$

$\quad$ where $K \subseteq P$, $J \subseteq I$ and $(K \cap J) = \emptyset$

$Combination(A,B) \leftrightarrow A = \{ P, Q \} \wedge B = \{ K \}$

where $K \subseteq (P \cup Q) \wedge (K \neq P) \wedge (K \neq Q) \wedge \min(|P|,|Q|) \leq |K| \leq \max(|P|, |Q|)$

Model Elimination Problem - And-Tree Search Modeling

C – the set of all clauses (our formal language)

$Prob_{\wedge,me} \subseteq 2^C$ (me stands for model elimination)

Solution Definition

$Erw_{\wedge,me}((pr, ?), (pr, yes))$

if $P, \neg P' \in pr$, where $\sigma = mgu(P,P')$

Branching Definition

$Erw_{\wedge,me}((pr \cup \{L_1 \vee \ldots \vee L_n\},?),$

$(pr \cup \{L_1 \vee \ldots \vee L_n\},?,(pr \cup \{L_1 \vee \ldots \vee L_n,L_1\}),\ldots,(pr \cup \{L_1 \vee \ldots \vee L_n,L_n\})))$

if for some i, $Erw_{\wedge,me}((pr \cup \{L_1 \vee \ldots \vee L_n,L_i\},?), (pr \cup \{L_1 \vee \ldots \vee L_n,L_i\},yes))$

Workers and Tasks Problem – Or-Tree Search Modeling

Let T be a set of tasks, and W a set of workers

Let $e: T \times W \rightarrow [0,1]$ be a function mapping tasks and workers onto efficiency ratings.

For a given sequence of tasks $S = \langle t_1, \ldots, t_n \rangle$, assign tasks to workers such that:

– the overall time to complete the sequence is minimized, and
– no worker is assigned to a task for which he has an efficiency rating of 0

$pr = \langle S = \langle t_1, \ldots, t_n \rangle, A = \langle (w_i, \langle t'_{1i}, \ldots, t'_{mi} \rangle) \mid w_i \in W, t'_{ij} \in T \rangle \rangle$

$f(pr) = min(\{ \sum_{i=1..mj} (e(t_{ij}, w_j))^{-1}) \mid (w_j, \langle t_{1j}, \ldots, t_{mj} \rangle \in A \})$

$Erw_{\vee,wt}((pr, ?), (pr, no)) \quad \leftrightarrow \exists (w_i, \langle t_{1i}, \ldots, t_{mi} \rangle) \in A, \exists j \in \{1 \ldots m_i\} \mid e(t_{ji}, w_i) = 0$

$Erw_{\vee,wt}((pr, ?), (pr, yes)) \quad \leftrightarrow \neg Erw_{\vee,wt}((pr, ?), (pr, no))$ and $|S| = 0$

* where $pr = \langle S, A \rangle$

$Altern(pr_0, pr_1, \ldots, pr_n) \leftrightarrow pr_0 = \langle S, A \rangle, pr_i = \langle S - s_0, Assign(A, w_i, s_0) \rangle \; \forall w_i \in W, \forall s_0 \in S$

$Assign(A, w, s) = A'$ s.t : if $(w, \langle t_1, \ldots, t_n \rangle) \in A$ then $(w, \langle t_1, \ldots, t_n, s \rangle) \in A'$

else $(w, \langle s \rangle) \in A'$