COMP424 Assignment 2

Sample Solutions

1

tldr answers are in bold

1. $\mathbf{2^{25} - 1}$
2. **7**
3. Yes, the tiles on the far-right $(\mathbf{11}, \mathbf{3})$ and the far-left $(\mathbf{1}, \mathbf{3})$
4. We have some way to get to G in strictly less than $60min/5min = 12$ steps and because each of the 4 friends should take a different portal we should have 2 classes of conformant plans. Either:
   (a) $(\Rightarrow \mathbf{N})^{\mathbf{2}} \Rightarrow \mathbf{E} \Rightarrow \mathbf{S} \Rightarrow \mathbf{E} \Rightarrow \mathbf{S}(\Rightarrow \mathbf{E})^{\mathbf{3}}(\Rightarrow \mathbf{S})^{\mathbf{2}}$ or
   (b) $\Rightarrow \mathbf{N} \Rightarrow \mathbf{E} \Rightarrow \mathbf{N}(\Rightarrow \mathbf{E})^{\mathbf{2}} \Rightarrow \mathbf{S} \Rightarrow \mathbf{E}(\Rightarrow \mathbf{S})^{\mathbf{2}}$
   (c) You can also swap E with W in each of i and ii

2

For the following sub-questions students may choose to include the final state (where the board is completely filled) as well.

1. See figure 1; the **3x3 grids**
2. See figure 1; the **orange boxes** on top the nodes (grids)

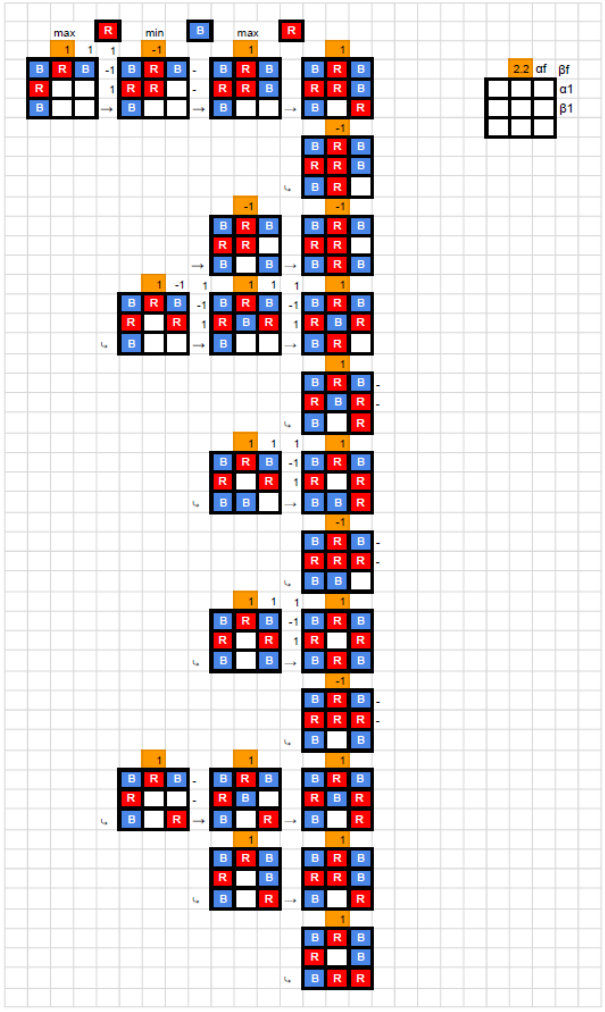

Figure 1: All the states of the game omitting the symmetrically equivalent ones are shown in the 3x3 grids. Children of a node are shown using the right arrow $\longrightarrow$ and the down-right arrow $\hookrightarrow$. Highlighted in orange are minimax values for question 2.2. The initial and final alpha-beta values are shown on the right and top-right respectively of each grid. -/- alpha-beta values denote pruned nodes

3. a See figure 2. αf is final alpha value, $\beta 1$ is final beta value . $\alpha 1$ and βf are the initial values . The final value of the nodes are the same as the min-max (orange) values.

   b i. if they use -1/+1 and omit final nodes **15**

   ii. if they don't omit final nodes **24**

c No. If they go down the branch where it leads to definite win they can prune more (shown in Fig.1 as bottom branch) .

i. if they use -1/+1 and omit final nodes **17**

ii. if they don't omit final nodes **27**

3

1. (a) **3**
   (b) $2^5 - 1 = \mathbf{31}$
   (c) $1 + 2^2 = \mathbf{5}$
   (d) **0**
   (e) $2^6 = \mathbf{64}$
2. (a) valid
   (b) satisfiable
   (c) valid
   (d) valid
   (e) unsatisfiable

4

1. Constants : K = Dustey, Elody, Michael, and William, S = eggo, pudding, 3-m
   Variables: x, y
   Sentence by sentence from the question
   $\forall x \in K.\ Bought(x, eggo) \ \vee \ Bought(x, pudding) \ \vee \ Bought(x, \text{3-m})$
   $\forall x \in K.\ Bought(x, pudding) \ \Rightarrow \ \neg Bought(x, eggo)$
   $\forall x \in K.\ Bought(x, \text{3-m}) \ \Rightarrow \ Bought(x, pudding)$
   $\forall y \in S.\ Bought(Elody, y) \ \leftrightarrow \ \neg Bought(Michael, y)$
   $Bought(Michael, \text{3-m}) \ \wedge \ Bought(Dustey, \text{3-m})$
2. i $Bought(x, eggo) \ \vee \ Bought(x, pudding) \ \vee \ Bought(x, \text{3-m})$
   ii $\neg Bought(x, pudding) \ \vee \ \neg Bought(x, eggo)$
   iii $\neg Bought(x, \text{3-m}) \ \vee \ Bought(x, pudding)$
   iv $Bought(Elody, y) \ \vee \ Bought(Michael, y)$
   v $\neg Bought(Elody, y) \ \vee \ \neg Bought(Michael, y)$
   vi $Bought(Michael, \text{3-m})$
   vii $Bought(Dustey, \text{3-m})$

3. Query in FOL
   $\alpha = \exists x. \neg Bought(x, pudding) \ \wedge \neg Bought(x, \text{3-m}) \ \wedge \ Bought(x, eggo)$

   We will show that $KB \wedge \neg\alpha$ is unsatisfiable.

   $\neg\alpha = Bounght(x, pudding) \vee Bought(x, \text{3-m}) \vee \neg Bought(x, eggo)$

   I use i and vi and $\sigma = \{x/Michael\}$
   $Bought(Michael, pudding)$

   II use I and ii
   $\neg\ Bought(Michael, eggo)$

   III use II and iv and $\sigma = \{y/eggo\}$
   $Bought(Elody, eggo)$

   IV use $\neg\alpha$ and III $\sigma = \{x/Elody\}$
   $Bought(Elody, pudding) \vee Bought(Elody, \text{3-m})$

   a Proof for $Bought(Elody, pudding)$ is unsatisfiable
   Use I and iv and $\sigma = \{y/pudding\}$

   b Proof for $Bought(Elody, \text{3-m})$ is unsatisfiable
   use vi and iv and $\sigma = \{y/\text{3-m}\}$

   V both branches of IV is unsatisfiable therefore $KB \wedge \neg\alpha$ is unsatisfiable

And yes, the references you see in the assignment are referring to Stranger Things.