William Daniels

CSCI 4630

Linguistic Geometry

Homework #4 02/23/15

The grammar derivation of zones for this table looks like the following:

$u = (14, 39, 3), l = l_0 = 3$ Because $Q_1(u) = (ON(BISHOP) = 14) \wedge (MAP_{h5,BISHOP}(39) \leq 3\,leq3) \wedge ((ON(PAWN$

$$S(u, zero, zero)Q1 \rightarrow A(u, zero, zero)$$

$$A(u, zero, zero)Q2_{i=1} \rightarrow t(h_i^0(u), 4)A((0, 0, 0), g(h_1^0(u), zero), zero)$$

Computation of $h_i^0(u)(l = 3)$

$$\text{TRACKS}_{\text{BISHOP}} = \{\text{BISHOP}\}\text{X} \cup L\left[G_t^{(2)}(h5, h1, k, \text{BISHOP})\right]$$

The trajectory requested in the problem is the trajectory:

$$T_B = a(g3), a(f4), a(e5)$$

Thus TRACKS = $\{(\text{BISHOP}, t_B)\}$, the number of trajectories $b = 1$
and $h_1^0(u) = (BISHOP, t_B)t(BISHOP, t_B, 5)$ Computation of $g(h_1^0(u), zero)$

$$g(h_1^0(u), zero) = g(BISHOP, t_B, zero)$$

$$g_r\left(\text{BISHOP}, t_B, zero\right) = \left\{\frac{1, if\ \text{DIST}(rtextifBISHOP, t_B) < 2n}{0, \text{if DIST}\left(r, \text{BISHOP}, t_B\right) = 2n}\right\}$$

$$DIST(x, BISHOP, t_B) = k + 1$$

where k is the number of symbols of the trajectory t_B, whose parameter value is equal to x

$$DIST(g3, BISHOP, t_B) = 2$$

$$DIST(f4, BISHOP, t_B) = 3$$

$$DIST(e5, BISHOP, t_B) = 4$$

For the rest of x from $XDIST(x, BISHOP, T_B) = 2X64 = 128$ For $r \in \{e5, f4, g3\} = \{39, 30, 23\}g_r(BISHOP, t_B, zero) = 1$, for the rest of $rg_r = 0$

$$A(u, zero, zero) \rightarrow t(BISHOP, t_B, 4)$$

$$A((0, 0, 0), g(BISHOP, t_B, zero), zero)$$

$$TIME(z) = DIST(z, BISHOP, t_B)$$

$TIME(z)$ is equal to 128 for all $z \in X$ except $\{e5, f4, g3\}$, where $TIME(z)$ is equal to $4, 3, 2$ respectively

$$Q3((0, 0, 0)) = (0 \neq 64) \wedge (0 \neq 64)$$

$$t(BISHOP, t_1, 4)A((0,0,0), v, zero)Q3 \to t(BISHOP, t_1, 4)A(f((0,0,0), v), v, zero)$$

computation of f

$$u = (x, y, l) = (0,0,0) \text{ and } v_{y+1} = v_1 = 0 : f(u, v) = (1, y+1, TIME(y+1)Xv_{y+1}) = (1,1,0)$$

$Q3 \to t(BISHOP, t_B, 4)A((1,1,0), v, zero)NEXTTIME(z) = init(0,0,0), NEXTTIME(z)) = 2n = 128$ for all

try $4ju = (x, y, l) = (1,1,0)$, i.e. $, l = 0$ and $Q4 = F$ Try 3 $u = (x, y, l) = (1,1,0), v$ is in Table, and $w = zero$

$$Q3(1,1,0) = T$$

$$Q3 \to t(BISHOP, t_B, 4)A(f((1,1,0), v), v, zero).$$

computation of f
As far as $(l = 0) \wedge (y = 1)$ and $v_{y+1} = v_2 = 0, f(u, v) = (1, y+1, TIME(y+1)Xv_{y_1}) = (1,2,0)$

$$Q3 \to t(BISHOP, t_B, 4)A((1,2,0), v, zero)$$

$$NEXTTIME(z) = init((1,1,0), NEXTTIME(z))$$

$$NEXTTIME(z) = 128 \text{ for all } z \text{ from} X$$

Try $4jQ4(1,2,0) = F$ Try 3 $Q3(1,2,0) = T$ Try 4j $Q4(1,3,0) = F$ Loop continues until u changes either way:

$$l = TIME(y+1)Xv_{y+1} \neq 0$$

or

$$y = 128$$

In our case $v_{38+1} = 1(\neq 0)$ 38'th application of prouction 3 will result:

$$Q3 \to t(BISHOP, t_B, 5)A((1,37,4), v, zero)$$

because

$$u = (1,38,0))$$

$y+1$ corresponds to $h1, TIME(y+1)Xv_{y_1} = TIME(h1)X1 = 4$ Try 4j $Q4(1,39,4) = F$ Try 3 with $l > 0$ and $x \neq 64$

This means the beginning of a new loop which consists of multiple application of production 3 after failures of attemptes to apply one of productions $4j$

$$Q3 \to t(BISHOP, t_B, 4)A((2,39,4), v, zero)$$

$$Q3 \to t(BISHOP, t_B, 4)A((3,39,4), v, zero)$$

......

$$Q3 \to t(BISHOP, t_B, 4)A(50,38,4), v, zero)$$

With $u = (50,39,4)$ this loop will terminate because

$$Q4(50,39,4) = (ON(KING) = 50) \wedge (4 > 0) \wedge (\phi(BISHOP, KING) = 0) \wedge (MAP_{b7,KING}(e5) = 4) = T$$

which means that productions $4j$ are applicable. These productions will generate intercepting trajectories from $b7$ to $e5$

$$4j \to t(BISHOP, t_b, 4)t(h_j(50,39,4), TIME(39))A((50,39,4), v, g(h_j(50,39,4), zero))$$

$$4j \to t(BISHOP, t_B, 4)t(h_j(50, 39, 4), TIME(8))A((50, 39, 4), v, g(h_j(50, 39, 4), ero))$$

Computation of $h_j(50, 39, 4)$ We have to generate all the shortest trajectories from point $b7$ to $e5$ for the black KING. The length of these trajectories should be less or equal to 4

$$TRACKS_{KING} = \{KING\}\, X \cup L\left[G_t^{(2)}(b7, e5, k, KING)\right]$$

$$TRACKS = \{(KING, t_1), (KING, t_2)\}, m = 2$$

and

$$h_1(50, 39, 4) = (KING, t_1)$$

$$h_2(50, 39, 4) = (KING, t_2)$$

There are two such trajectories $t1, t2$ and they are generated by the grammar $G_t^{(2)}$ Taking into account that $TIME(39) = 4$ we have:

$$4_1 \to t(BISHOP, t_B, 4)t((KING, t_K), 4)A((50, 39, 4), v, g(KING, t_K, zero))$$

$$4_1 \to t(BISHOP, t_B, 4)t((KING, t_K), 4)A((50, 39, 4), v, g(KING, t_K, zero))$$

For all $r \in X$ the r-th component of functiong g is as follows:

$$g_r\,(\text{KING}, t_K, zero) = \left\{\frac{1, if\ \text{DIST}(rtextifKING, t_K) < 2n}{0, \text{if DIST}\,(r, \text{KING}, t_K) = 2n}\right\}$$

$$DIST(x, KING, t_K) = k + 1$$

where k is the number of symbols of the trajectory t_B, whose parameter value is equal to x

$$DIST(c6, KING, t_K) = 2$$

$$DIST(d5, KING, t_K) = 3$$

$$DIST(e5, KING, t_K) = 4$$

For the rest of x from $XDIST(x, KING, T_K) = 2X64 = 128$ For $r \in \{e5, d5, c6\} = \{39, 37, 43\} g_r(KING, t_K, zero)$ 1, for the rest of $rg_r = 0$ Computation of NEXTTIME

$$NEXTTIME(z) = ALPHA(z, (KING, t_K), 4 - 4 + 1)$$

From previous steps $NEXTTIME(x) = 128$ for all x from X

$$ALPHA(x, p_0, t_0, k) = \begin{cases} max & (NEXTTIME(x), k),\ if\ (DIST(x, p_0, t_0) \neq 2n) \\ & \wedge(NEXTTIME(x) \neq 2n); \\ k, & if\ DIST(x, p_0, t_0) \neq 2n) \\ & \wedge(NEXTTIME(x) = 2n); \\ NEXTTIME(x) & if\ DIST(x, p_0, t_0) = 2n). \end{cases}$$

Try 3 with $u = (50, 39, 4)$, i.e. with $l > 0$ and $x \neq 64$ New lop consists of multiple application of production 3 after failures of attemptes to apply one of productions $4j$

$$Q3 \to t(BISHOP, t_B, 4)t(KING, t_F, 4)A((50, 39, 4), v, w)$$

$$Q3 \to t(BISHOP, t_B, 4)t(KING, t_F, 4)A((51, 39, 4), v, w)$$

......

$$Q3 \rightarrow t(BISHOP, t_B, 4)t(KING, t_F, 4)A(64, 38, 4), v, w)$$

With $u = (64, 39, 4)$ this loop will terminate which means no other starting poitns are found. New loop begins. The grammar changes ending point of prospective trajectories

$$Q3 \rightarrow t(BISHOP, t_B, 4)t(KING, t_F, 4)A((50, 40, 0), v, w)$$

$$Q3 \rightarrow t(BISHOP, t_B, 4)t(KING, t_F, 4)A((50, 41, 0), v, w)$$

......

$$Q3 \rightarrow t(BISHOP, t_B, 4)t(KING, t_F, 4)A(50, 64, 0), v, w)$$

It is determined that there are no more valid ending points, and thus the loop terminates. Try 5: $Q5(w) = (w \neq 0) = T$

$$Q5 \rightarrow t(BISHOP, t_B, 4)t(KING, t_K, 4)A((0, 0, 0), w, zero)$$

$$TIME(Z) = NEXTTIME(z)$$

All the steps, 3 and 4j, which have been executed (or tried) for generating 1-st negation trajectroeis will be repeated for generated 2-nd negation, same as the 1-st, none will be generated. The next return to produciton 5 will happen with $w = zero$ (nothing is found) that means we move to production 6:

$$Q6 \rightarrow t(BISHOP, t_B, 4)t(King, t_K, 4)$$

And we are done. Whew.