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1. List Equality [20 marks]

a. (2 marks) $[X, Y \mid Z]$ and $[a, b, c \mid [d, e, Y]]$ can be made identical.

$[a, b, c \mid [d, e, Y]] = [a, b, c, d, e, Y] = [a, b \mid [c, d, e, Y]]$

$[X, Y \mid Z]$ and $[a, b \mid [c, d, e, Y]]$ match on:

$X = a$

$Y = b$

$Z = [c, d, e, b]$

b. (2 marks) $[q, [A \mid [r, s]], t]$ and $[q, [r, [r, s]] \mid B]$ cannot be made identical.

$[q, [A \mid [r, s]], t] = [q, [A, r, s] \mid [t]]$

$[q, [A, r, s] \mid [t]]$ does not match with $[q, [r, [r, s]] \mid B]$ because:

$q = q$

$A = r$

r cannot match with $[r, s]$

c. (2 marks) $[[Cow \mid [cat, dog]], bird, bug, chicken]$ and $[[ant, [cat, dog]] \mid Horse]$ cannot be made identical.

$[[Cow \mid [cat, dog]], bird, bug, chicken] = [[Cow, cat, dog], bird, bug, chicken]$

$[[Cow, cat, dog], bird, bug, chicken]$ does not match with $[[ant, [cat, dog]] \mid Horse]$ because:

$Cow = ant$

cat cannot match with $[cat, dog]$

d. (2 marks) $[1, A, 2 \mid [A, 3, 4]]$ and $[B \mid [2, C \mid [D \mid E]]]$ can be made identical.

$[1, A, 2 \mid [A, 3, 4]] = [1, A, 2, A, 3, 4] = [1, A, 2, A \mid [3, 4]]$

$[B \mid [2, C \mid [D \mid E]]] = [B \mid [2, C, D \mid E]] = [B, 2, C, D \mid E]$

$[1, A, 2, A \mid [3, 4]]$ and $[B, 2, C, D \mid E]$ match on:

$B = 1$

$A = 2$

$C = 2$

$D = 2$

$E = [3, 4]$

e. (3 marks) $[A \mid [A \mid [[A \mid [A]]]]]$ and $[b \mid C]$ can be made identical.

$[A \mid [A \mid [[A \mid [A]]]]] = [A \mid [A, [A, [A]]]]$

$[A \mid [A, [A, [A]]]]$ and $[b \mid C]$ match on:

$A = b$

$C = [A, [A, [A]]] = [b, [b, [b]]]$

f. (3 marks) $[X \mid [Y \mid [Z \mid [X]]]]$ and $[all, around, the, world, Y]$ cannot be made identical.

$[X \mid [Y \mid [Z \mid [X]]]] = [X \mid [Y \mid [Z, X]]] = [X \mid [Y, Z, X]] = [X, Y, Z, X]$

$[all, around, the, world, Y]$ does not match $[X, Y, Z, X]$ because:

$X = all$

$Y = around$

$Z = the$

$(X = world)$ failed

g. (3 marks) $[1, 2 \mid [X \mid [Y, Z \mid X]]]$ and $[Q \mid [R, S, [], [Y]]]$ can be made identical.

$[1, 2 \mid [X \mid [Y, Z \mid X]]] = [1, 2 \mid [X, Y, Z \mid X]] = [1, 2, X, Y, Z \mid X]$

$[Q \mid [R, S, [], [Y]]] = [Q, R, S, [], [Y]] = [Q, R, S, [], [Y] \mid []]$

$[1, 2, X, Y, Z \mid X]$ and $[Q, R, S, [], [Y] \mid []]$ match on:

$Q = 1$

$R = 2$

$S = X$

$Y = []$

$Z = [[Y]] = [[]]$

$X = []$

$S = X = []$

h. (3 marks) $[Lions, [[and], tigers], [and], bears, oh \mid [[my]]]$ and $[[I, have], [[A], Bad], Feeling \mid [About \mid This]]$ can be made identical.

$[Lions, [[and], tigers], [and], bears, oh \mid [[my]]] = [Lions, [[and], tigers], [and], bears, oh, [my]] = [Lions, [[and], tigers], [and], bears \mid [oh, [my]]]$

$[[I, have], [[A], Bad], Feeling \mid [About \mid This]] = [[I, have], [[A], Bad], Feeling, About \mid This]$

$[Lions, [[and], tigers], [and], bears \mid [oh, [my]]]$ and $[[I, have], [[A], Bad], Feeling, About \mid This]$ match on:

$Lions = [I, have]$

$I = I$

$A = and$

$Bad = tigers$

$Feeling = [and]$

$About = bears$

$This = [oh, [my]]$