//These models **contain** Agent Can Hit Enemy Operation

//Message for explaining the mathematical forms for functions

•x_1: the difference of health points of agent and enemy
•x_2: the difference of x-coordinate distance of agent and enemy
•x_3: the difference of x-coordinate relative speed of agent and enemy
•x_4: enemy is attacking (Boolean factor, by depending the action the enemy is using)
•x_5: agent can hit enemy (Boolean factor, by depending the attack/guard type of the actions)
•x_6: agent is in corner (Boolean factor, by depending the x-coordinate of the agent)

Aggressive model:

Most learned same loss functions(34 times in 500,loss=76.2308):

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- $f_{MoveForward} = 4 * \frac{1-2*x_5}{2}$
- $f_{Punch} = 2 * Min\left(-x_1, \frac{e^{x_1}}{2}, -\ln(x_1+1), -\frac{1}{1+e^{-(x_1-0.5)}}, \frac{1}{1+e^{-(x_1-0.5)}}, -x_2, -x_3, -\ln(x_3+1), \ln(x_3+1), \frac{2*x_4-1}{2}, \frac{1-2*x_4}{2}, \frac{2*x_6-1}{2}, \frac{1-2*x_6}{2}\right)$

Training

76 loss, 6691 Training data:

action	Loss=0	Loss=1
Action0	2765/100.0%	0
Action1	3850/98.1%	76/1.9%
In all	**6615/98.9%**	**76/1.1%**

Testing

20 loss, 1672 testing data

action	Loss=0	Loss=1
Action0	691/100.0%	0
Action1	961/98.0%	20/2.0%
In all	**1652/98.8%**	**20/1.2%**

Defensive model:

Most learned same loss functions(3 times in 500,loss=1372.4):

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- $f_{MoveBack} = 0.25 * \left(\frac{e^{x_1}}{2} - x_2 - \ln(x_2 + 1) - x_3 - \frac{e^{x_3}}{2} + \frac{1}{1+e^{-(x_3-0.5)}} + \frac{2*x_6-1}{2}\right)$
- $f_{Guard} = 2 * \frac{1}{14} * \left(x_1 + \frac{e^{x_2}}{2} - x_3 + \ln(x_3 + 1) - \frac{1}{1+e^{-(x_3-0.5)}} + \frac{1-2*x_6}{2}\right)$

Training

1372 loss, 7710 Training data:

action	Loss=0	Loss=1
Action0	2757/75.2%	911/24.8%
Action1	3581/88.6%	461/11.4%
In all	**6338/82.2%**	**1372/17.8%**

Testing

348 loss, 1929 testing data

action	Loss=0	Loss=1
Action0	685/74.6%	233/25.4%
Action1	896/88.6%	115/11.4%
In all	**1581/82.0%**	**348/18.0%**

Hybrid(Defensive->Aggressive) model:

Most learned same loss functions(2 times in 500,loss=2846.38):

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10111001010100000001111100010110000001010110000001111000101001000100110000000100100001101000010001000000011010000000010100011101010111011111100101011000000010
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$$f_{MoveForward} = 2 * \left(-x_1 - \ln(x_1 + 1) + \frac{1}{1 + e^{-(x_1 - 0.5)}} + x_2 + \frac{e^{x_2}}{2} + \frac{e^{x_3}}{2} + \frac{1 - 2 * x_5}{2} + \frac{1 - 2 * x_6}{2}\right)$$

$$f_{Punch} = 4 * \left(-x_1 + x_3 + \frac{e^{x_3}}{2} - \frac{1}{1 + e^{-(x_3 - 0.5)}} + \frac{2 * x_5 - 1}{2} + \frac{1 - 2 * x_6}{2}\right)$$

$$f_{MoveBack} = 4 * \left(-\frac{e^{x_1}}{2} + \frac{1}{1 + e^{-(x_1 - 0.5)}} - x_2 - \frac{e^{x_2}}{2} + \frac{1}{1 + e^{-(x_2 - 0.5)}} + \frac{e^{x_3}}{2} + \frac{1 - 2 * x_5}{2} + \frac{2 * x_6 - 1}{2}\right)$$

$$f_{Guard} = 2 * \left(x_1 + \ln(x_1 + 1) + x_2 + \frac{e^{x_2}}{2} + \ln(x_2 + 1) + x_3 - \frac{1}{1 + e^{-(x_3 - 0.5)}} + \frac{1 - 2 * x_4}{2} + \frac{1 - 2 * x_5}{2} + \frac{1 - 2 * x_6}{2}\right)$$

Training

2846 loss, 7266 Training data:

Action	Loss=0	Loss=1	Loss=2	Loss=3
Move forward	406/30.5%	825/62.0%	101/7.6%	0
Punch	1245/92.3%	75/5.6%	27/2.0%	2/0.1%
Move back	2753/85.0%	168/5.2%	52/1.6%	265/8.2%
Guard	909/67.5%	259/19.2%	179/13.3%	0
In all	**5313/73.1%**	**1327/18.3%**	**359/4.9%**	**267/3.7%**

Testing

705 loss, 1817 Testing data:

Action	Loss=0	Loss=1	Loss=2	Loss=3
Move forward	99/29.8%	215/64.8%	19/5.7%	0
Punch	312/92.6%	19/5.6%	4/1.2%	2/0.6%
Move back	687/84.8%	42/5.2%	12/1.5%	69/8.5%
Guard	225/66.8%	78/23.1%	34/10.1%	0
In all	**1323/72.8%**	**354/19.5%**	**69/3.8%**	**71/3.9%**

Wrong outputs of Hybrid(Defensive->Aggressive) model in testing data

Action	Move forward	Punch	Move back	Guard
Move forward		0	141	93
Punch	0		15	10
Move back	16	0		107
Guard	24	0	88	

Blue part: the hybrid model chooses the "correct" behavior pattern(aggressive behavior), but finally choose "wrong" action in the corresponding pattern.

Red part: the hybrid model chooses the "correct" behavior pattern(defensive behavior), but get "wrong" action finally.

Yellow part: the model get wrong the behavior pattern choices