Problem 1

1.a

$$V_{max,min}(s,d) =$$

$$\text{Utility}(s) \qquad \text{if isEnd} = \text{True}$$

$$\text{Eval}(s) \qquad \text{if } d = 0$$

$$\max_{a \in \text{Actions}(s)} V_{max,min}(\text{Succ}(s,a),d) \quad \text{if player}(s) = \text{agent}$$

or ghosts with
$$\text{index} \% n \neq n-1$$

$$\min_{a \in \text{Actions}(s)} V_{max,min}(\text{Succ}(s,a),d-1) \quad \text{if player}(s) = \text{last}$$

ghost

$$(\text{i.e. index} \% n == n-1)$$

Problem3.

3.(a)

$$V_{opt,\pi}(s,d) =$$

$\text{Utility}(s)$ if $\text{IsEnd}(s) == \text{True}$

$\text{Eval}(s)$ $d == 0$

$\max\limits_{a \in \text{Actions}(s)} V_{opt,\pi}(\text{Succ}(s,a), d\text{-}\emptyset)$ if $\text{Player}(s) == \sout{\text{lost}}$ Pacman

               $\sout{\text{ghost}}$

$\dfrac{1}{|\text{Actions}(s)|} \sum\limits_{a \in \text{Actions}(s)} \sout{\text{A}} V_{opt,\pi}(\text{Succ}(s,a), d)$ if $\text{player}(s) = \sout{\text{other}}$ ghoses

                                   except for the last one.

$\dfrac{1}{|\text{Actions}(s)|} \sum\limits_{a \in \text{Actions}(s)} V_{opt,\pi}(\text{Succ}(s,a), d\text{-}1)$ if $\text{player}(s)$

                                  $== \text{last ghose.}$

4-b:

I decided to look for the following features:

1. Reciprocal of distance to the closet ghost, which has a negative coefficient
2. Distance to the closet food, which has a negative coefficient
3. Distance to the closet scared ghost, which has a positive coefficient
4. Number of food left, which has a negative coefficient
5. Number of capsules left, which has a very large negative coefficient

In addition, we also have the following:

1. The Pacman 's location must not be within $7<=x<=12$ and $y>=5$, which is the spawn place of ghosts with no food
2. The score is multiplied by 4.5 every time