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Exercise # 4

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COM 227

Step 1: Compute the value function of states A, B, D, E, F, H at $k = 1$

	$V_k(s)$	$V_{k+1}(s)$	$V_{k+2}(s)$
A	0	-1	-2
B	0	-1	-1.75
D	0	-1	-1.75
E	0	-1	-2
F	0	-1	-1.5
H	0	-1	-1.5

1.) $V_{k+1}(A) = \frac{1}{4}\left[(-1 + v(A)) + (-1 + v(B)) + (-1 + v(D)) + (-1 + v(A))\right]$
$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1+0) + (-1+0)\right]$
$= -1$

2.) $V_{k+1}(B) = \frac{1}{4}\left[(-1 + v(B)) + (-1 + v(E)) + (-1 + v(A)) + (-1 + v(c))\right]$
$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1+0) + (-1+0)\right]$
$= -1$

3.) $V_{k+1}(D) = \frac{1}{4}\left[(-1 + v(A)) + (-1 + v(G)) + (-1 + v(E)) + (-1 + v(D))\right]$
$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1+0) + (-1+0)\right]$
$= -1$

4.) $V_{k+1}(E) = \frac{1}{4}\left[(-1 + v(B)) + (-1 + v(H)) + (-1 + v(D)) + (-1 + v(F))\right]$
$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1+0) + (-1+0)\right]$
$= -1$

5.) $V_{k+1}(F) = \frac{1}{4}\left[(-1 + v(c)) + (-1 + v(1)) + (-1 + v(E)) + (-1 + v(F))\right]$
$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1+0) + (-1+0)\right]$
$= -1$

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6.) $V_{k+1}(H) = \frac{1}{4}\left[(-1+v(E)) + (-1+v(H)) + (-1+v(G)) + (-1+v(I))\right]$

$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1+0) + (-1+0)\right]$

$= -1$

7.)

-1	-1	0
-1	-1	-1
0	-1	0

8.) Step 2: Compute the action-value function and update the policy of state A at $k=1$

8.) $q_{k+1}(A, \text{Left}) = -1 + v(A)$

$= -1 + (-1)$

$= -2$

9.) $q_{k+1}(A, \text{Right}) = -1 + v(B)$

$= -1 + (-1)$

$= -2$

10.) $q_{k+1}(A, \text{Up}) = -1 + v(A)$

$= -1 + (-1)$

$= -2$

11.) $q_{k+1}(A, \text{Down}) = -1 + v(D)$

$= -1 + (-1)$

$= -2$

12.) $\pi_{k+1}(A) =$ ↕ Up, Down, Left, Right

B at $k=1$

13.) $q_{k+1}(B, \text{Left}) = -1 + v(A)$

$= -1 + (-1)$

$= -2$

14.) $q_{k+1}(B, \text{Right}) = -1 + v(C)$

$= -1 + (0)$

$= -1$

15.) $q_{k+1}(B, \text{Up}) = -1 + v(B)$

$= -1 + (-1)$

$= -2$

16.) $q_{k+1}(B, \text{Down}) = -1 + v(E)$

$= -1 + (-1)$

$= -2$

17.) $\pi_{k+1}(B) =$ → Right

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D at $k=1$

18.) $q_{k+1}(D, \text{Left}) = -1 + v(D)$
$= -1 + (-1)$
$= -2$

19.) $q_{k+1}(D, \text{Right}) = -1 + v(E)$
$= -1 + (-1)$
$= -2$

20.) $q_{k+1}(D, \text{Up}) = -1 + v(A)$
$= -1 + (-1)$
$= -2$

21.) $q_{k+1}(D, \text{Down}) = -1 + v(G)$
$= -1 + (0)$
$= -1$

22.) $\pi_{k+1}(D) =$ ↓ Down

E at $k=1$

23.) $q_{k+1}(E, \text{Left}) = -1 + v(D)$
$= -1 + (-1)$
$= -2$

24.) $q_{k+1}(E, \text{Right}) = -1 + v(F)$
$= -1 + (-1)$
$= -2$

25.) $q_{k+1}(E, \text{Up}) = -1 + v(B)$
$= -1 + (-1)$
$= -2$

26.) $q_{k+1}(E, \text{Down}) = -1 + v(H)$
$= -1 + (-1)$
$= -2$

27.) $\pi_{k+1}(E) =$ ↔↕ Up, down, Left, Right

F at $k=1$

28.) $q_{k+1}(F, \text{Left}) = -1 + v(E)$
$= -1 + (-1)$
$= -2$

29.) $q_{k+1}(F, \text{Right}) = -1 + v(F)$
$= -1 + (-1)$
$= -2$

30.) $q_{k+1}(F, \text{Up}) = -1 + v(C)$
$= -1 + (0)$
$= -1$

31.) $q_{k+1}(F, \text{Down}) = -1 + v(1)$
$= -1 + (0)$
$= -1$

32.) $\pi_{k+1}(F) =$ ↕ Up, Down

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39.)

$$V_{k+2}(A) = \frac{1}{4}\left[(-1+v(A)) + (-1+v(B)) + (-1+v(D)) + (-1+v(A))\right]$$
$$= \frac{1}{4}\left[(-1-1) + (-1-1) + (-1-1) + (-1-1)\right]$$
$$= -2$$

40.)

$$V_{k+2}(B) = \frac{1}{4}\left[(-1+v(B)) + (-1+v(E)) + (-1+v(A) + (-1+v(C))\right]$$
$$= \frac{1}{4}\left[(-1-1) + (-1-1) + (-1-1) + (-1+0)\right]$$
$$= -1.75$$

41.)

$$V_{k+2}(D) = \frac{1}{4}\left[(-1+v(A)) + (-1+v(G)) + (-1+v(E)) + (-1+v(D))\right]$$
$$= \frac{1}{4}\left[(-1-1) + (-1+0) + (-1-1) + (-1-1)\right]$$
$$= -1.75$$

42.)

$$V_{k+2}(E) = \frac{1}{4}\left[(-1+v(B)) + (-1+v(H)) + (-1+v(D)) + (-1+v(F))\right]$$
$$= \frac{1}{4}\left[(-1-1) + (-1-1) + (-1-1) + (-1-1)\right]$$
$$= -2$$

43.)

$$V_{k+2}(F) = \frac{1}{4}\left[(-1+v(C)) + (-1+v(I)) + (-1+v(E)) + (-1+v(F))\right]$$
$$= \frac{1}{4}\left[(-1+0) + (-1+0) + (-1-1) + (-1-1)\right]$$
$$= -1.5$$

44.)

$$V_{k+2}(H) = \frac{1}{4}\left[(-1+v(E)) + (-1+v(H)) + (-1+v(G)) + (-1+v(I))\right]$$
$$= \frac{1}{4}\left[(-1-1) + (-1-1) + (-1+0) + (-1+0)\right]$$
$$= -1.5$$

57.)

-2	-1.75	
-1.75	-2	-1.5
	-1.5	

95.)
A at $k+2$

1. $q_{k+2}(A, \text{Left}) = -1 + (-2)$
$= -3$

2. $q_{k+2}(A, \text{Right}) = -1 + v(B)$
$= -1 + (-1.75)$
$= -2.75$

3. $q_{k+2}(A, \text{Up}) = -1 + v(A)$
$= -1 + (-2)$
$= -3$

4. $q_{k+2}(A, \text{Down}) = -1 + v(D)$
$= -1 + (-1.75)$
$= -2.75$

5. $\pi_{k+2}(A) =$ → Right, Down

96.)
B at $k+2$

6.) $q_{k+2}(B, \text{Left}) = -1 + v(A)$
$= -1 + (-2)$
$= -3$

7. $q_{k+2}(B, \text{Right}) = -1 + v(C)$
$= -1 + (0)$
$= -1$

8. $q_{k+2}(B, \text{Up}) = -1 + v(B)$
$= -1 + (-1.75)$
$= -2.75$

9. $q_{k+2}(B, \text{Down}) = -1 + v(E)$
$= -1 + (-2)$
$= -3$

10. $\pi_{k+2}(B) =$ → Right

97.)
D at $k+2$

11.) $q_{k+2}(D, \text{Left}) = -1 + v(D)$
$= -1 + (-1.75)$
$= -2.75$

12. $q_{k+2}(D, \text{Right}) = -1 + v(E)$
$= -1 + (-2)$
$= -3$

13.) $q_{k+2}(D, \text{Up}) = -1 + v(A)$
$= -1 + (-2)$
$= -3$

14. $q_{k+2}(D, \text{Down}) = -1 + v(G)$
$= -1 + (0)$
$= -1$

15. $\pi_{k+2}(D) =$ ↓ Down

48.)

E at k+2

a.) $q_{k+2}(E, Left) = -1 + v(D)$
$= -1 + (-1.75)$
$= -2.75$

b. $q_{k+2}(E, Right) = -1 + v(F)$
$= -1 + (-1.5)$
$= -2.5$

c. $q_{k+2}(E, Up) = -1 + v(B)$
$= -1 + (-1.75)$
$= -2.75$

d. $q_{k+2}(E, Down) = -1 + v(H)$
$= -1 + (-1.5)$
$= -2.5$

e.) $\pi_{k+2} =$ ↓→

Right, Down

49.)

F at k+2

f.) $q_{k+2}(F, Up Left) = -1 + v(E)$
$= -1 + (-2)$
$= -3$

g.) $q_{k+2}(F, Right) = -1 + v(F)$
$= -1 + (-1.5)$
$= -2.5$

h. $q_{k+2}(F, Up) = -1 + v(C)$
$= -1 + (0)$
$= -1$

i.) $q_{k+2}(F, Reg Down) = -1 + v(I)$
$= -1 + (0)$
$= -1$

50.)

H. at k+2

j.) $q_{k+2}(H, Left) = -1 + v(G)$
$= -1 + (0)$
$= -1$

k. $q_{k+2}(H, Right) = -1 + v(I)$
$= -1 + (0)$
$= -1$

l. $q_{k+2}(H, Up) = -1 + v(E)$
$= -1 + (-2)$
$= -3$

m. $q_{k+2}(H, Down) = -1 + v(H)$
$= -1 + (-1.5)$
$= -2.5$

n. $\pi_{k+2}(H) =$ ←→

Left, Right

25.) $\pi_{k+2}(F) =$ ↕

Up Down

JK.