COMP4418, 2017 – Assignment 3

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1. Social Choice and Game Theory

(a)

the domination set of each alternative
a {b, d, f, g}
b {c, d, e, g}
c {a, d, e, f, g}
d {e, f, g}
e {a, f, g}
f {b, g}
g {}

- **the uncovered set:**

  Alternative in two steps:

  a {b, c, d, e, f, g} ✓
  b {a, c, d, e, f, g} ✓
  c {a, b, d, e, f, g} ✓
  d {a, b, e, f, g} ✗
  e {a, b, d, f, g} ✗
  f {b, c, d, e, g} ✗
  g {} ✗

  The uncovered set is **{a, b, c}**

- **the top cycle:**

  The top cycle is **{a, b, c, d, e, f}**

- **the set of Copeland winners:**

  the set of Copeland winners is **{c}**

- **the set of Banks winners:**

maximal acyclic subgraph length is 5
b ⇨ c ⇨ d ⇨ e ⇨ g
c ⇨ a ⇨ d ⇨ f ⇨ g
the set of Banks winners is **{b, c}**

- **the set of Condorcet winners:**

no alternative is satisfied, so the set of Condorcet winners is **{}**

(b)
Pure Nash equilibria
(A, E)
(B, D)

Mixed Nash equilibria
Player 1 plays A with p, plays B with 1 – p
$4p + 6(1 - p) = 5p + 4(1 - p)$
$4p + 6 - 6p = 5p + 4 - 4p$
$3p = 2$
$p = 2 / 3$

Player 2 plays D with q, plays E with 1 – q
$2q + 8(1 - q) = 6q + 4(1 - q)$
$2q + 8 - 8q = 6q + 4 - 4q$
$8q = 4$
$q = 1 / 2$

Mixed Nash equilibria
(A, B) = (2 / 3, 1 / 3)
(D, E) = (1 / 2, 1 / 2)

2. Decision Making

(a)

1. Blackjack: (D) POMDP
2. Candy Crush: (B) MDP
3. Chess: (E) None/Other
4. Minesweeper: (D) POMDP
5. Snakes and Ladders: (A) MP
6. Texas Hold ’em Poker: (E) None/Other

(b)
π(S1) = Stay
π(S2) = Stay
π(S3) = Stay or Leave

If the discount factor is very high, the value of state is hard to converge, so consider the value of state with state transition, I determine the S1 stay is positive, leave is negative or 0; S2 stay is 0, leave is negative; S3 both are negative.

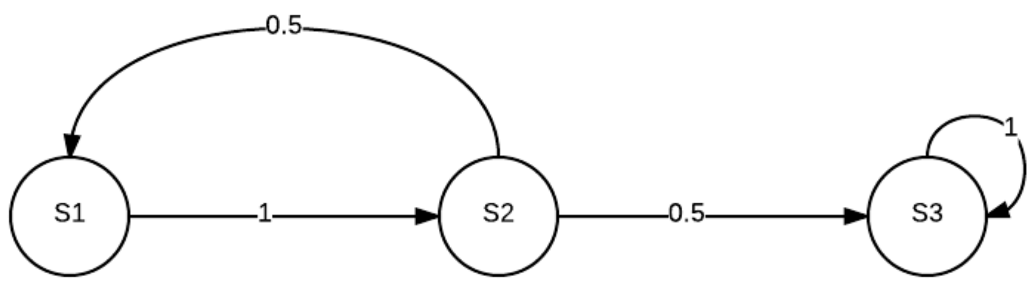
(c)
π(S1) = Stay
π(S2) = Leave
π(S3) = Stay or Leave

Since the discount factor is very low, the future part could be ignored, thus just chose the action whose associated reward is higher.

(d)

	V0(s)	V0(s, S)	V0(s, L)	V1(s)	V1(s, S)	V1(s, L)	V2(s)	V2(s, S)	V2(s, L)	V3(s)
s1	0	1	0	1	1.6	3	3	2.8	2.82	2.82
s2	0	0	5	5	3	4.7	4.7	7.82	4.94	7.82
s3	0	-2	-2	-2	-3.2	-3.2	-3.2	-3.92	-3.92	-3.92

(e)



(f)

Since agent uses π this could see as Markov process problem

when $i = 0$
$v_0(s1) = v_0(s2) = v_0(s3) = 0$

when $i > 0$
$v_i(s1)$
$= u(s1, L) + \delta P(s1, L, s2)v_i(s2)$
$= \delta v_i(s2)$

$v_i(s2)$
$= u(s2, L) + \delta(P(s2, L, s1)*v_{i-1}(s1)+P(s2, L, s3)*v_{i-1}(s3))$
$= 5 + \delta(0.5*v_i(s1) + 0.5*v_i(s3))$

$v_i(s3)$
$= u(s3, S) + \delta P(s3, S, s3)v_i(s3)$
$= -2 + \delta v_i(s3)$

According to
(1) $v_i(s1) = \delta v_i(s2)$
(2) $v_i(s2) = 5 + \delta(0.5*v_i(s1) + 0.5*v_i(s3))$
(3) $v_i(s3) = -2 + \delta v_i(s3)$

Get:
(1) $v_i(s1) = \frac{\delta(10-12\delta)}{(1-\delta)*(2-\delta^2)}$
(2) $v_i(s2) = \frac{10-12\delta}{(1-\delta)*(2-\delta^2)}$
(3) $v_i(s3) = \frac{-2}{1-\delta}$

When δ is very high like $\delta = 0.999$

Vi of all 3 states will be negative. This could support my intuition of question 2b since I determine when δ is very high, S1 leave action is negative, S2 leave action is negative, S3 Stay action is negative.

When δ is very low like $\delta = 0.001$

Vi of all 3 states will be close to their reward of action in π
$v_i(s1)$ close to 0
$v_i(s2)$ close to 5
$v_i(s3)$ close to -2

It supports my intuition of question 2c since vi is close to action associated reward, so the higher associated reward action will be the optimal policy.