CS581 Dynamic Programming Example

Game	Space required per table	Profit added per table			
		First Table	Second Table	Third Table	Fourth Table
Roulette	3	8	6	4	2
Craps	6	11	10	9	8
Poker	5	9	9	8	8
Blackjack	4	10	7	4	1

Given the above table, how many gaming tables should be installed for each game in order to maximize profits? Solve the problem with the dynamic programming "backward approach" as demonstrated in class. Let stage 1 correspond to the roulette decision, stage 2 to the craps decision, stage 3 to the poker decision, and stage 4 to the blackjack decision. Let s_i, the state variables, be the number of square yards available at stage i (note that $s_4 = 25$). Let d_i, the decision variables, be the number of gaming tables assigned at stage i. Let r_i^* and d_i^* be the best return (profit) and best decision, respectively, for stage i.

Solution:

Stage 1: Roulette

s_1/d_1	0	1	2	3	4	r_i^*	d_i^*
[0,2]	$0	-	-	-	-	$0	0
[3,5]	$0	$8	-	-	-	$8	1
[6,8]	$0	$8	$14	-	-	$14	2
[9, 11]	$0	$8	$14	$18	-	$18	3
[12, 25]	$0	$8	$14	$18	$20	$20	4

Stage 2: Craps

s_1/d_1	0	1	2	3	4	r_i^*	d_i^*
[0,2]	$0	-	-	-	-	$0	0
[3,5]	$8	-	-	-	-	$8	0
[6,8]	$14	$11	-	-	-	$14	0
[9,11]	$18	$19	-	-	-	$19	1
[12,14]	$20	$25	$21	-	-	$25	1
[15,17]	$20	$29	$29	-	-	$29	2
[18,20]	$20	$31	$35	$30	-	$35	2
[21,23]	$20	$31	$39	$38	-	$39	2
[24,25]	$20	$31	$41	$44	$38	$44	3

Stage 3: Poker

s_1/d_1	0	1	2	3	4	r_i^*	d_i^*
[0,2]	$0	-	-	-	-	$0	0
[3,4]	$8	-	-	-	-	$8	0
[5]	$8	$9	-	-	-	$9	1
[6,7]	$14	$9	-	-	-	$14	0
[8]	$14	$17	-	-	-	$17	1
[9]	$19	$17	-	-	-	$19	0
[10]	$19	$17	$18	-	-	$19	0
[11]	$19	$23	$18	-	-	$23	1
[12]	$25	$23	$18	-	-	$25	0
[13]	$25	$23	$26	-	-	$26	2
[14]	$25	$28	$26	-	-	$28	1
[15]	$29	$28	$26	$26	-	$29	0
[16]	$29	$28	$32	$26	-	$32	2
[17]	$29	$34	$32	$26	-	$34	1
[18]	$35	$34	$32	$34	-	$35	0
[19]	$35	$34	$37	$34	-	$37	2
[20]	$35	$38	$37	$34	$34	$38	1
[21]	$39	$38	$37	$40	$34	$40	3
[22]	$39	$38	$43	$40	$34	$43	2
[23]	$39	$44	$43	$40	$42	$44	1
[24]	$44	$44	$43	$45	$42	$45	3
[25]	$44	$44	$47	$45	$42	$47	2

Stage 4: Blackjack

s_1/d_1	0	1	2	3	4	r_i^*	d_i^*
[25]	$47	$50	$51	$47	$45	$51	2

The maximum profit that the gaming house can provide is $51, with the combination of tables being 2 Roulette, 1 Craps, 1 Poker, and 2 Blackjack.