Optimizing Course Allocation for Students – "The Future of SIS"

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Our Existing Domain (What do you think of SIS?)

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Our Model of the Problem

Inputs - List of n Students

- Students Rankings of c Classes

- Each class is offered i times with m seats

- Individual Outputs Student **Schedules**

- Complete Student-Course Allocation

-Optimize Each Student's Ē Criteria Sum of Total Utility - Fairness (differential between highest utility and lowest utility Evaluation student) - Stability (solution is pareto optimal)

- Class Diversity (classes have an even mix of years)

- Feasibility

NP Completeness of the Course Allocation Problem

NP-Hardness Reduction



Data set

M1	•	I × 🗸	f_x											
	А	В	С	D	E	F	G	Н	1	J	К	L	М	N
1														
2	Observation	s Year	CS 2150	CS2102	CS 1110	CS 3330	CS 4102	CS 4774	CS 4330	CS 3102	CS 2110	CS 4630		
3	1	. 1	. 5	2	1	3	6		7	4 8	3 9	10		
4	2	1	. 10	2	3	8	4		5	9 5	5 7	1		
5	3	2	. 5	10	1	2	7	()	5	8 4	l 9	3		
6	4	. 3	2	8	6	1	7		1	9 5	5 10	3		
7	5	2	3	4	5	8	10		2	9 7	/ 1	6		
8	6	4	3	7	9	2	8		5	6 1	10	4		
9	7	1	. 8	5	2	6	7	1)	4 3	3 1	9		
10	8	1	. 6	2	8	9	1		3	7 4	10	5		
11	9	1	. 7	5	10	6	3		9	8 1	2	4		
12	10	2	2	4	9	8	10		3	6 1	7	5		
13	11	. 2	6	2	7	10	9		1	4 3	3 5	8		
14	12	. 3	10	2	7	9	6		3	5 4	l 1	8		
15	13	4	4	1	7	8	10		5	9 2	2 3	6		
16	14	. 2	4	3	10	5	7		5	8 9) 1	. 2		
17	15	7	1	2	7	6	5	1	1	4 5) q	8		

Greedy Algorithm + Hill Climbing



Student 0: 4,3 1,1 2,0
Student 1: 4,4 1,1 3,2
Student 2: 3,3 0,2 2,0
Student 3: 0,4
Student 4:
Student 5:
Student 6:
Student 7:
Student 8:
Student 0:
Student 9.
lotal utility is: 35
Student 0: 4,3
Student 1: 4,4
Student 2: 3,3
Student 3: 3,2 2,0
Student 4:
Student 5: 0,2
Student 6: 1,1 0,4
Student 7: 1,1
Student 8: 2,0
Student 9:
Stopped climbing after 11 iterations
Total utility is: 48

Simulated annealing - finding global optima among many local optima

- Picks two random students to swap, then accepts it with a varying probability based off how much time/iterations have passed.
- Result: Allow us to escape
 local maxima where hill
 climbing would get stuck.

Other Implementations of Course Scheduling

<u>UCHICAGO</u>

BI	D FOR SCH	IEDULE #1	1017	6
PF	RIMARY	ALT 1	ALT 2	OMIT?
1	<u>331–01</u>	<u>331–03</u>		
2	<u>340-82</u>	<u>343–81</u>		
3	365-81			<u> </u>
-				

W	ΉA	RT	ON

Course	Title	Instructor	Day	Start	Stop	Prefs	Price	Sched
LGST813	LEG ASP ENTREPRENRSHP	FRANKLIN B	м	300 PM	600 PM	100	470	~
LGST806-409	ST806-409 NEGOTIATIONS		R	300 PM	600 PM	91	4900	
LGST806-407	NEGOTIATIONS	MAGUIRE J	w	300 PM	600 PM	90	460	
MGMT691	NEGOTIATIONS	SAWYER T	TR	1030 AM	1200 PM	90	0	~
MKTG776	APPL PROB MODELS MKTG	GAUSS C	w	300 PM	600 PM	74	0	~
REAL721-405	REAL ESTATE INVESTMENTS	CHATEAU T	MW	130 PM	300 PM	71	0	
MKTG773	CUSTOMER BEHAVIOR	WALTON S	TR	1030 AM	1200 PM	65	1782	
REAL721-407	REAL ESTATE INVESTMENTS	MAHAL T	TR	130 PM	300 PM	62	0	~
FNCE750	VENT CAP & FNCE INNOVAT	SCHOLES M	MW	130 PM	300 PM	61	3220	~
MKTG778	STRATEGIC BRAND MGMT	KRAFT F	TR	130 PM	300 PM	49	0	

- 8000 bidding points + 2000 additional every time a course is completed
- Whoever bids most is placed first in queue
- Unsuccessful bid \rightarrow no points taken away

- Students assign each class a utility from 1-100
- Takes into account combinations of courses, both negative and positive

Real World Application Challenges

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Comp	pute	r Sc	eience						
CS 1	010	Intro	duction to Information	Technology					
Website	10401	001	Lecture (2 Lipite)		20 / 05	Croix Dill	MoWe 2:20DM 4:4EDM	Thornton Hall E216	
website	10401	001	Lecture (5 offics)	Open 🐨	307.03	Craig Din	WOWE 5.50PW = 4.45PW	Homon Hair ESTO	
	1110	Intro	duction to Programmi	na					
001	1110	mue	ouction to Programmi	ing					
	16037	001	Lecture (3 Units)	Open	36/300	Raymond Pettit	MoWeFr 2:00PM - 2:50PM	McLeod Hall 1020	
	16324	002	Lecture (3 Units)	Open	63 / 155	Craig Dill	MoWeFr 12:00PM - 12:50PM	Rice Hall 130	
	16548	003	Lecture (3 Units)	Open	357150	Craig Dill	Mowerr 10:00AM - 10:50AM	Rice Hall 130	
	10091	004	Lecture (3 Units)	Open	787 150	Nathan Brunelle	MOWEFT 9:00AM - 9:50AM	Rice Hall 130	
	15481	101	Laboratory (0 Units)	Wait List (07 199)	35/35	Nathan Brunelle	Th 12:30PM - 1:45PM	Olsson Hall 001	
	15403	102	Laboratory (0 Units)	Weit Liet (0 (100)	25/30	Nathan Brunelle	Th 9:30AM - 10:45AM	Mashaning Engr Bids 212	
	15409	103	Laboratory (0 Units)	Wait List (07 199)	25/25	Nathan Brunelle	Th 2:00PM 2:15PM	Oleson Hall 000	
	15084	104	Laboratory (0 Units)	Wait List (2 / 199)	35/35	Nathan Brunelle	Th 2:30PM - 4:45PM	Olsson Hall 009	
	16330	105	Laboratory (0 Units)	Open	10/35	Nathan Brunelle	Th 5:00PM - 6:15PM	Oleson Hall 009	
	16331	107	Laboratory (0 Units)	Open	6/35	Nathan Brunelle	Th 6:30PM - 7:45PM	Oleson Hall 009	
	16332	108	Laboratory (0 Units)	Open	0/35	Nathan Brunelle	Th 8:00PM - 9:15PM	Olsson Hall 009	
	16394	109	Laboratory (0 Units)	Open	11/35	Nathan Brunelle	Th 12:30PM - 1:45PM	Olsson Hall 009	
	16527	110	Laboratory (0 Units)	Open	9/35	Nathan Brunelle	Th 3:30PM - 4:45PM	Mechanical Engr Bldg 213	
	16710	113	Laboratory (0 Units)	Open	2/35	Nathan Brunelle	Th 8:00AM - 9:15AM	Olsson Hall 009	
🗏 CS 1	1111	Intro	duction to Programmi	ng					
	16254	001	Lecture (3 Units)	Open	27 / 70	Staff	MoWe 3:30PM - 4:45PM	Olsson Hall 009	
🗏 CS 1	1112	Intro	oduction to Programmi	ng					
	15485	001	Lecture (3 Units)	Open	53 / 115	James Cohoon	MoWeFr 2:00PM - 3:15PM	Rice Hall 130	
🗏 CS 2	2102	Disc	rete Mathematics						
	15617	001	Lecture (3 Units)	Open	128 / 150	Staff	TuTh 9:30AM - 10:45AM	Rice Hall 130	
	16647	002	Lecture (3 Units)	Open	19/148	Kevin Sullivan	TuTh 8:00AM - 9:15AM	Rice Hall 130	
	16648	003	Lecture (3 Units)	Open	134 / 150	Kevin Sullivan	TuTh 3:30PM - 4:45PM	Rice Hall 130	
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🗏 CS 2	2110	Soft	ware Development Met	hods					
	15486	001	Lecture (3 Units)	Open 😨	43 / 105	John Hott	MoWeFr 9:00AM - 9:50AM	Olsson Hall 120	
	15487	002	Lecture (3 Units)	Open 😮	29/105	Panagiotis Apostolellis	MoWeFr 10:00AM - 10:50AM	McLeod Hall 1020	
	16060	003	Lecture (3 Linite)	Mail 1	105/105	Nada Rasit	MoMeEr 1:00PM - 1:50PM	Rice Hall 130	

Conclusion

