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

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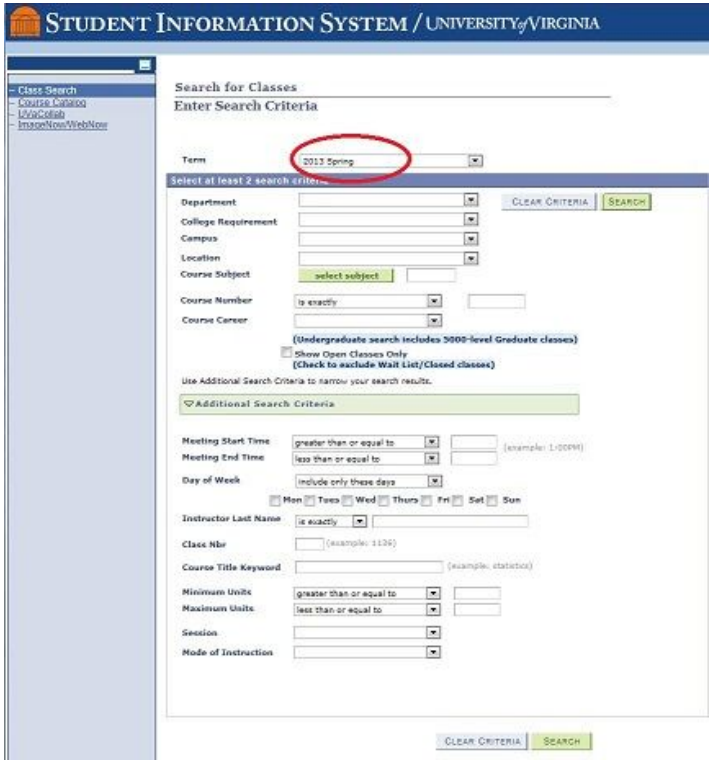
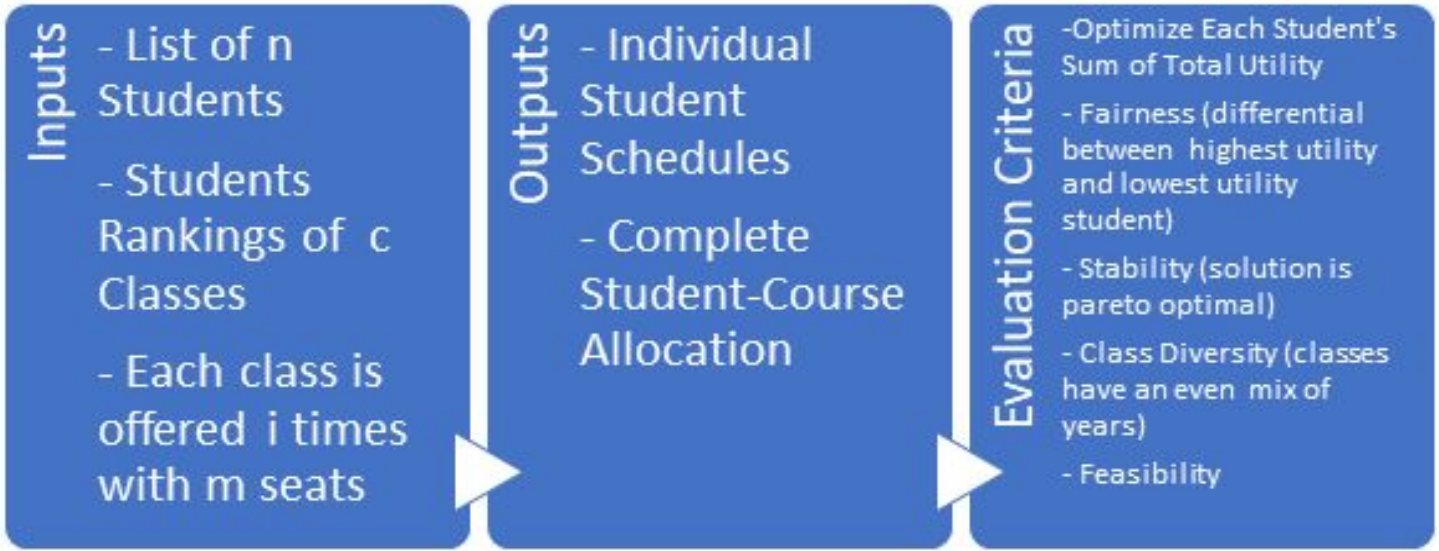
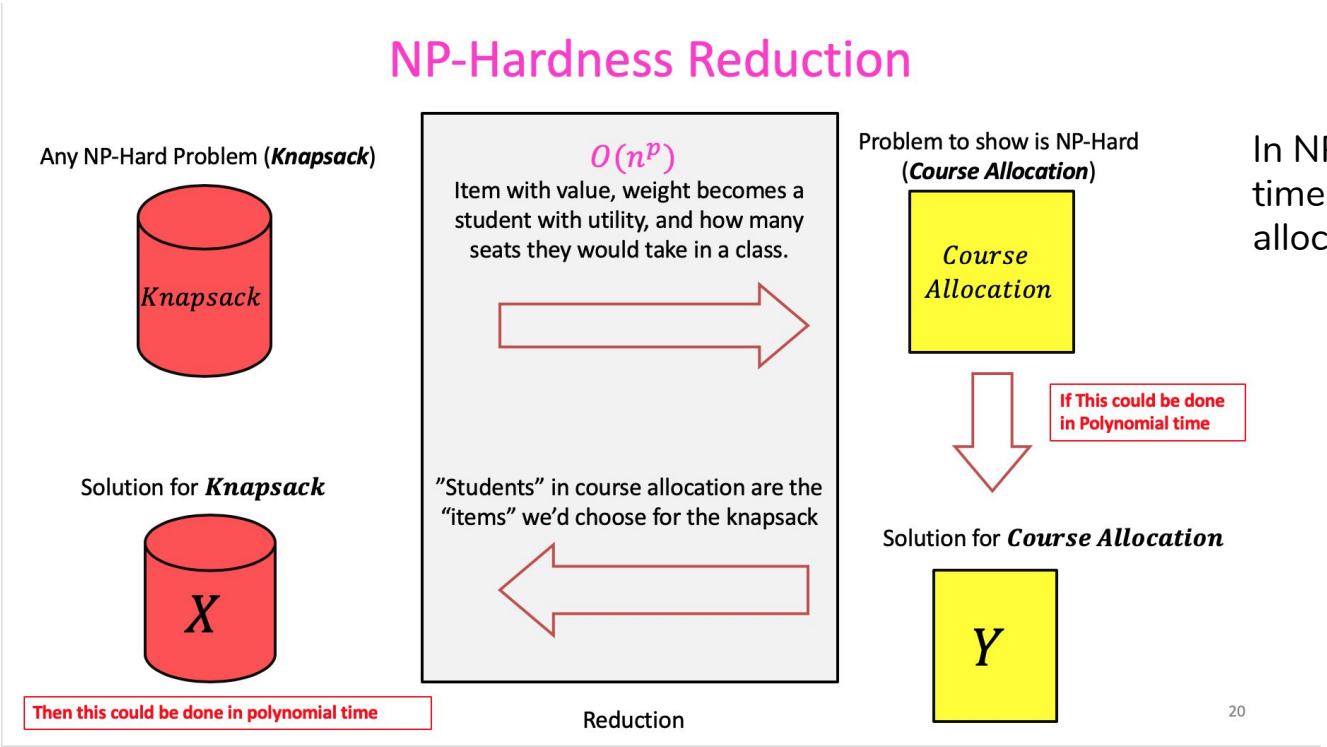
Our Existing Domain (What do you think of SIS?)



Our Model of the Problem



NP Completeness of the Course Allocation Problem



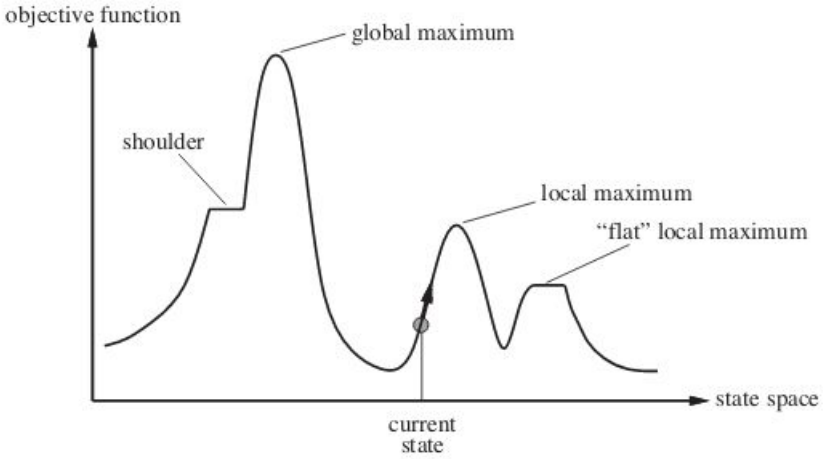
In NP: There exists a polynomial time verifier for a given course allocation

Data set

M11

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2	Observations	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	9	10		
4	2	1	10	2	3	8	4	6	9	5	7	1		
5	3	2	5	10	1	2	7	6	8	4	9	3		
6	4	3	2	8	6	1	7	4	9	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	10	4	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	5	8		
14	12	3	10	2	7	9	6	3	5	4	1	8		
15	13	4	4	1	7	8	10	5	9	2	3	6		
16	14	2	4	3	10	5	7	6	8	9	1	2		
17	15	2	1	3	7	6	5	10	4	2	9	8		

Greedy Algorithm + Hill Climbing



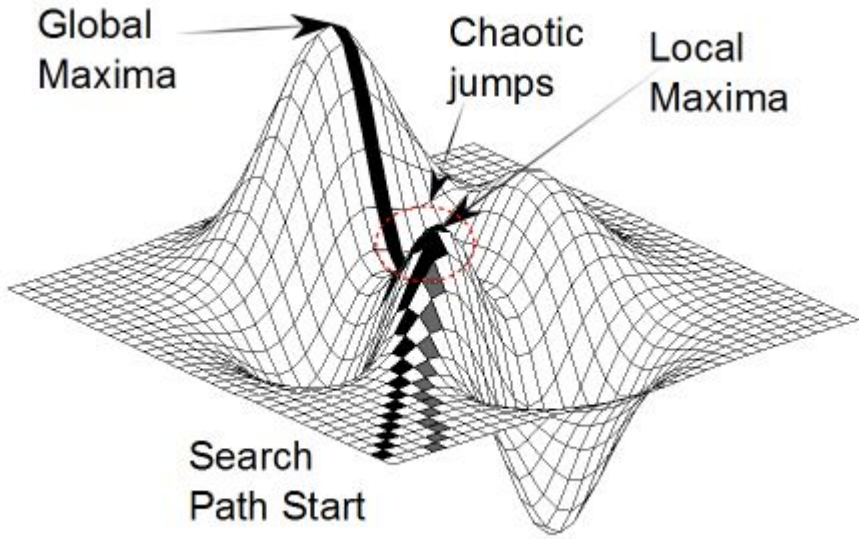

```
Student 0: 4,3 1,1 2,0
Student 1: 4,4 1,1 3,2
Student 2: 3,3 0,2 2,0
Student 3: 0,4
Student 4:
Student 5:
Student 6:
Student 7:
Student 8:
Student 9:
Total utility is: 35
```

```
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

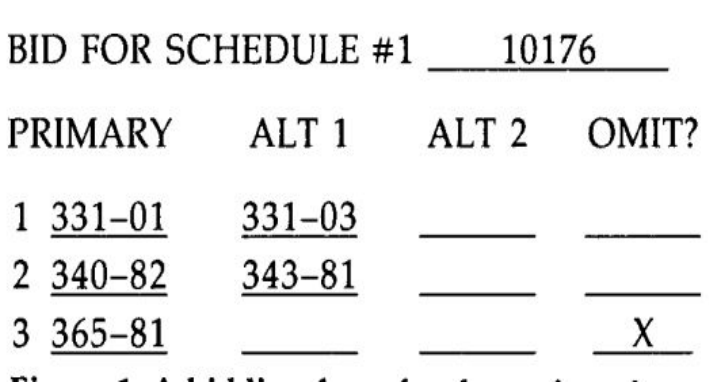
- Picks two random students to swap, then accepts it with a varying probability based off how much time/iterations have passed.

- Result: Allow us to escape local maxima where hill climbing would get stuck.



Other Implementations of Course Scheduling

UCHICAGO



BID FOR SCHEDULE #1 10176

	PRIMARY	ALT 1	ALT 2	OMIT?
1	331-01	331-03		
2	340-82	343-81		
3	365-81			X

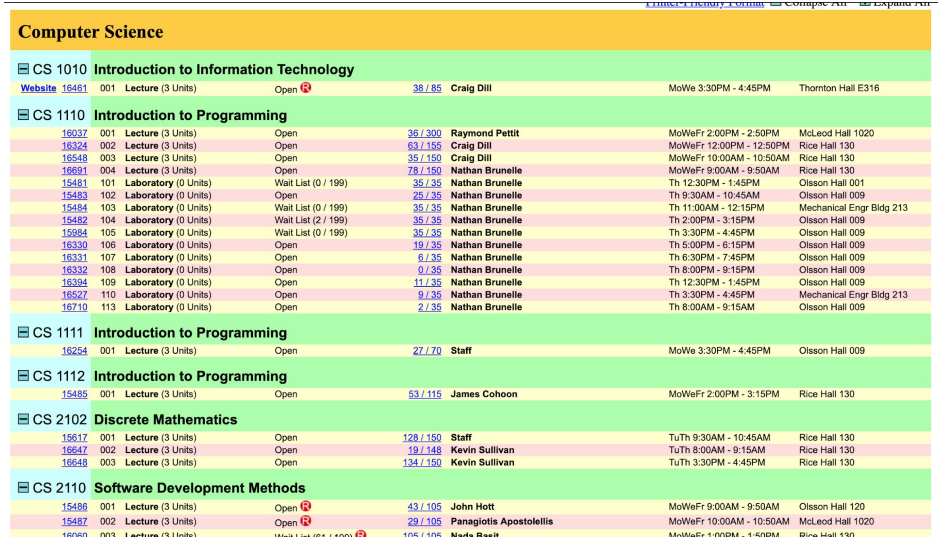
- 8000 bidding points + 2000 additional every time a course is completed
- Whoever bids most is placed first in queue
- Unsuccessful bid → no points taken away

WHARTON

Course	Title	Instructor	Day	Start	Stop	Prefs	Price	Sched
LGST813	LEG ASP ENTREPRENRSHP	FRANKLIN B	M	300 PM	600 PM	100	470	✓
LGST806-409	NEGOTIATIONS	NASH J	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	

- 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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Computer Science

⊟ CS 1010	**Introduction to Information Technology**						
Website 16461	001	**Lecture** (3 Units)	Open R	38 / 85	**Craig Dill**	MoWe 3:30PM - 4:45PM	Thornton Hall E316
⊟ CS 1110	**Introduction to Programming**						
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	35 / 150	**Craig Dill**	MoWeFr 10:00AM - 10:50AM	Rice Hall 130
16681	004	**Lecture** (3 Units)	Open	78 / 150	**Nathan Brunelle**	MoWeFr 9:00AM - 9:50AM	Rice Hall 130
15481	101	**Laboratory** (0 Units)	Wait List (0 / 199)	35 / 35	**Nathan Brunelle**	Th 12:30PM - 1:45PM	Olsson Hall 001
15483	102	**Laboratory** (0 Units)	Open	25 / 35	**Nathan Brunelle**	Th 9:30AM - 10:45AM	Olsson Hall 009
15484	103	**Laboratory** (0 Units)	Wait List (0 / 199)	35 / 35	**Nathan Brunelle**	Th 11:00AM - 12:15PM	Mechanical Engr Bldg 213
15482	104	**Laboratory** (0 Units)	Wait List (2 / 199)	35 / 35	**Nathan Brunelle**	Th 2:00PM - 3:15PM	Olsson Hall 009
15984	105	**Laboratory** (0 Units)	Wait List (0 / 199)	35 / 35	**Nathan Brunelle**	Th 3:30PM - 4:45PM	Olsson Hall 009
16330	106	**Laboratory** (0 Units)	Open	19 / 35	**Nathan Brunelle**	Th 5:00PM - 6:15PM	Olsson Hall 009
16331	107	**Laboratory** (0 Units)	Open	6 / 35	**Nathan Brunelle**	Th 6:30PM - 7:45PM	Olsson 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 1111	**Introduction to Programming**						
16254	001	**Lecture** (3 Units)	Open	27 / 70	**Staff**	MoWe 3:30PM - 4:45PM	Olsson Hall 009
⊟ CS 1112	**Introduction to Programming**						
15485	001	**Lecture** (3 Units)	Open	53 / 115	**James Cohoon**	MoWeFr 2:00PM - 3:15PM	Rice Hall 130
⊟ CS 2102	**Discrete 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
⊟ CS 2110	**Software Development Methods**						
15486	001	**Lecture** (3 Units)	Open R	43 / 105	**John Hott**	MoWeFr 9:00AM - 9:50AM	Olsson Hall 120
15487	002	**Lecture** (3 Units)	Open R	29 / 105	**Panagiotis Apostolellis**	MoWeFr 10:00AM - 10:50AM	McLeod Hall 1020
16060	003	**Lecture** (3 Units)	Wait List (64 / 199) R	105 / 105	**Nada Basit**	MoWeFr 1:00PM - 1:50PM	Rice Hall 130

ECHOLS
engaging curiosity for life

Conclusion

		Simulated Annealing	Greedy Algorithm
1	Fairness	✓	✗
2	Class Diversity	✓	✗
3	Stability	✓	✓
4	Feasibility	?	✓