

# Poster Diagrams

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## 1 Explanation

All tables should be properly labeled, except for the student preference chart. The title was cut off. It represents the preference rating each student gave. Blue is a class a student must take, red is a class teachers decide a student shouldn't take.

Each diagram is pretty large, so printing off each page should suffice in placing it on the poster board.

I also included the equations blown up in scale in case we want those on the board. Sections aren't meant to be used in the board, just a frame of reference.

## 2 Diagrams

Class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Student A	0	0	2	3	1	3	2	1	3	0	3	0	2	3	2
Student B	0	0	2	3	3	1	3	3	1	2	1	0	2	0	2
Student C	0	1	0	1	3	2	1	3	2	1	2	1	3	0	0
Student D	0	3	0	1	2	0	1	0	3	0	2	2	3	1	3
Student E	3	2	1	2	3	1	0	1	0	3	3	1	0	2	2
Student F	1	2	2	1	0	0	3	1	0	3	3	2	3	0	1
Student G	1	3	0	0	0	1	2	3	3	0	3	2	1	1	2
Student H	0	2	1	0	3	3	2	3	3	1	2	1	2	0	3
Student I	1	0	3	3	2	1	3	2	3	0	2	3	1	1	2
Student J	3	2	2	3	1	2	0	0	1	3	2	1	1	3	1
Student K	2	1	1	2	1	0	0	1	0	2	3	0	3	2	3
Student L	2	1	2	2	1	3	1	2	2	1	3	0	0	0	0
Student M	1	2	2	0	2	0	1	0	1	3	2	3	0	1	1
Student N	0	0	2	1	0	3	2	2	2	0	0	1	3	1	3
Student O	1	3	2	0	2	2	1	0	0	1	3	1	3	0	2
Student P	3	1	2	2	1	2	0	1	1	0	3	1	0	2	0
Student Q	2	0	1	3	2	2	2	1	2	0	3	3	1	1	3
Student R	2	0	2	2	0	1	2	3	3	3	1	2	1	0	3
Student S	3	2	0	3	3	0	3	2	1	2	1	1	3	0	1
Student T	2	1	3	2	1	0	2	2	0	3	3	0	1	2	1
Student U	1	3	0	2	0	1	3	2	2	0	2	3	1	0	0
Student V	1	3	0	1	0	3 <sup>2</sup>	3	0	2	1	2	2	1	0	2
Student W	0	3	0	0	2	1	3	2	1	2	1	1	2	3	1
Student X	0	2	2	3	2	0	1	3	0	3	3	1	0	1	3

Table 1: Student Preference

Class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Teacher a	0	0	10	0	0	0	4	0	0	10	0	0	0	10	0
Teacher b	10	10	0	0	7	0	0	0	0	0	10	0	0	0	0
Teacher c	0	0	0	0	9	0	10	0	10	0	0	10	0	0	0
Teacher d	0	0	0	10	0	0	0	10	0	6	0	0	0	0	10
Teacher e	0	0	0	0	10	10	0	0	0	0	0	0	10	4	0

Table 2: Teacher Eligibility, green represents the assigned class

Class	Include Student(s)	Exclude Student(s)
1	A, C	K
2		K, R
3	A, L	G
10	C	
13	C	
14	P	

Table 3: Overrides

Class	Timeslot	Teacher	Students
1	1	b	A,C,E,J,L,P,S,T
7	1	c	B,F,G,I,M,U,V,W
15	1	d	D,H,K,N,O,Q,R,X
8	2	d	B,C,G,H,L,R,S,X
12	2	c	D,F,I,M,O,Q,U,V
14	2	a	A,E,J,K,N,P,T,W
9	3	c	A,D,G,H,I,R,U,V
11	3	b	E,J,L,M,P,Q,T,X
13	3	e	B,C,F,K,N,O,S,W
4	4	d	B,D,I,J,Q,S,U,X
6	4	e	A,G,H,L,N,O,P,V
10	4	a	C,E,F,K,M,R,T,W
2	5	b	D,F,G,J,O,U,V,W
3	5	a	A,I,L,N,P,R,T,X
5	5	e	B,C,E,H,K,M,Q,S

Table 4: Class assignments

Student	Average Preference	Preference of Assigned Classes	Net Satisfaction
A	1.667	2.2	0.533
B	1.533	2.8	1.267
C	1.333	1.6	0.267
D	1.4	2.4	1.0
E	1.6	2.6	1.0
F	1.467	2.6	1.133
G	1.467	2.6	1.133
H	1.733	2.8	1.067
I	1.8	2.8	1.0
J	1.667	2.6	0.933
K	1.4	2.2	0.8
L	1.333	2.4	1.067
M	1.267	2.2	0.933
N	1.333	2.6	1.267
O	1.4	2.4	1.0
P	1.267	2.4	1.133
Q	1.733	2.2	0.467
R	1.667	2.8	1.133
S	1.667	2.6	0.933
T	1.533	2.6	1.067
U	1.333	2.6	1.267
V	1.4	2.0	0.6
W	1.467	2.4	0.933
X	1.6	3.0	1.4

Table 5: Student Satisfaction

### 3 Formulas

Let  $x$  represent student assignment into  $n$  classes.  $y$  represents instructor assignment into  $n$  classes.  $z$  represents time slots assignment of  $n$  classes. We set up the variables to be adjustable depending on the requirements in different circumstances.

$h \in \{1, 2, \dots, l\}$ , where  $l$  is the number of instructors

$i \in \{1, 2, \dots, m\}$ , where  $m$  is the number of students

$j \in \{1, 2, \dots, n\}$  where  $n$  is the number of classes

$t \in \{1, 2, \dots, s\}$  where  $s$  is the number of timeslots

$x_{ij} = 1$  if student  $i$  is assigned to class  $j$ , 0 otherwise

$y_{hj} = 1$  if instructor  $h$  is assigned to class  $j$ , 0 otherwise

$z_{tj} = 1$  if class  $j$  is assigned to timeslot  $t$ , 0 otherwise

$P = (p_{ij})$ , where  $p_{ij}$  represents preference rating of student  $i$  for class  $j$

$E = (e_{hj})$ , where  $e_{hj}$  represents eligibility rating of instructor  $h$  for class  $j$

$F = (f_{ij})$ , where  $f_{ij} = 1$  if student  $i$  is forced to take for class  $j$ , 0 otherwise

#### 3.1 Objective Function

$$\max \sum_{i=1}^m \sum_{j=1}^n x_{ij} p_{ij} + \sum_{h=1}^l \sum_{j=1}^n y_{hj} e_{hj}$$

### 3.2 Constraints

#### 3.2.1 Classes Taken

$$\forall i \in \{1, 2, \dots, m\}, \sum_{j=1}^n x_{ij} = 5$$

#### 3.2.2 Class Size

$$\forall j \in \{1, 2, \dots, n\}, \sum_{i=1}^m x_{ij} \leq 8$$

$$\forall j \in \{1, 2, \dots, n\}, \sum_{i=1}^m x_{ij} \geq 5$$

#### 3.2.3 Instructors Per Class

$$\forall j \in \{1, 2, \dots, n\}, \sum_{h=1}^l y_{hj} = 1$$

### 3.2.4 Instructor Eligibility

$$\forall j \in \{1, 2, \dots, n\}, \sum_{h=1}^l y_{hj} e_{hj} \geq 0$$

### 3.2.5 Overrides

Overrides constraints are calculated on a per student basis, reducing the number of constraints.

$$\begin{aligned} &\text{if } f_{ij} = 1, \text{ then } x_{ij} = 1 \\ &\text{if } f_{ij} = -1, \text{ then } x_{ij} = 0 \end{aligned}$$

### 3.2.6 Number of Classes Per Timeslot

$$\forall t \in \{1, 2, \dots, s\}, \sum_{j=1}^n z_{tj} = 3$$



### 3.2.7 Timeslots Per Class

$$\forall j \in \{1, 2, \dots, n\}, \sum_{t=1}^s z_{tj} = 1$$

### 3.2.8 Student Time Conflicts

Let:

$S_3$  = the set of all 3-size combinations of classes

$$c \in S_3, c = \{j_1, j_2, j_3\}$$

$$\forall c \in S_3, \forall i \in \{1, 2, \dots, m\} \sum_b^3 z_{tj_b} + x_{ij_b} < 4$$

$$\forall t \in \{1, 2, \dots, s\}$$

### 3.2.9 Instructor Time Conflicts

$$\forall c \in S_3, \forall h \in \{1, 2, \dots, l\} \sum_b^3 z_{tj_b} + y_{ij_b} < 4$$
$$\forall t \in \{1, 2, \dots, s\}$$