You may collaborate with other students on the homework but you must submit your own individually written solution, identify your collaborators, and acknowledge any external sources that you consult. Do no submit a solution that you cannot explain to me. All problems are related to maxflow/mincut.

PROBLEM 1 *April in Paris*

Lecture 27 will be in Paris! I'm sending all of you. Help me find the cheapest way to get all 135 of you there. Here are flights and available seats.

		Seats	Price ($)			Seats	Price ($)
CHO	ORD	14	114	CHO	IAD	74	64
CHO	LGA	13	89	CHO	ATL	24	72
CHO	CTL	44	90				
IAD	BRU	16	269	IAD	ZRH	78	536
IAD	CDG	15	555	IAD	MLA	13	480
ORD	LHR	61	309	ORD	CDG	23	390
ORD	FRA	61	412	ORD	BRU	115	332
LGA	JFK	230	37	JFK	CDG	37	693
JFK	LHR	56	528	JFK	FRA	20	412
CTL	LHR	53	528	CTL	FRA	28	412
CTL	CDG	34	593	ATL	CDG	19	607
ATL	LHR	23	466	ATL	ZRH	18	499
BRU	CDG	14	71	ZRH	CDG	335	53
LHR	CDG	211	35	FRA	CDG	412	57
MLA	CDG	111	34				

Express a linear program in standard form to solve this problem. [Extra credit: actually solve the LP and find out how much will it cost me.]

PROBLEM 2 *Andrew's Libraries*

> When a boy in Pittsburgh, striving with all his might to improve his prospects, [Andrew Carnegie] was permitted with some other youths to borrow books from the library of a gentleman named Colonel Anderson. Every Saturday afternoon the good-hearted Colonel was in attendance at his house to lend any of his four hundred books. Young Carnegie eagerly looked forward to those Saturday afternoons...The young telegraph messenger resolved in his buoyant enthusiasm that if ever wealth fell to his lot he would use it to establish free libraries, so that poor boys might have opportunities of reading the best books. [Excerpt from *Andrew Carnegie: the man and his work*, Alderson, 1909, p. 156]

Suppose it is Andrew's legacy to ensure that every town either has a library or is next to a town that has a library. Given a map of a country consisting of towns and roads between them, the *Library* problem is to decide whether k libraries can be placed in towns so as to satisfy Andrew's legacy. Show that the *Library* problem is NP-complete.