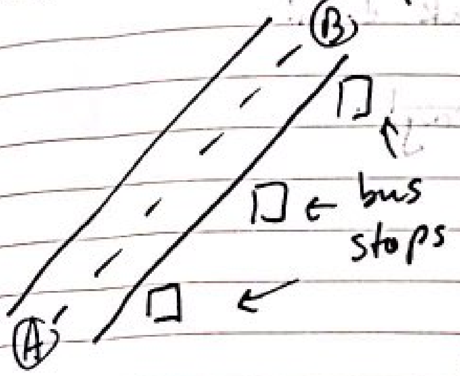
22/07/14

Traffic

"you are not stuck in traffic
you are traffic"

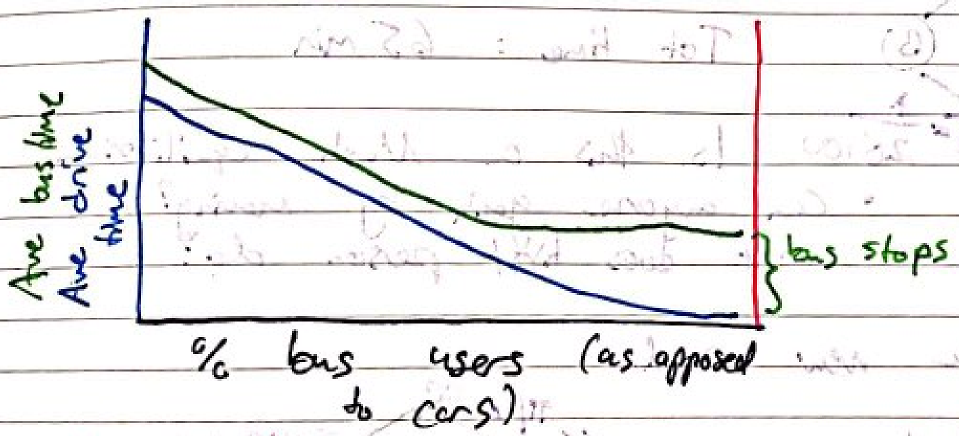
Bus motivation problem:

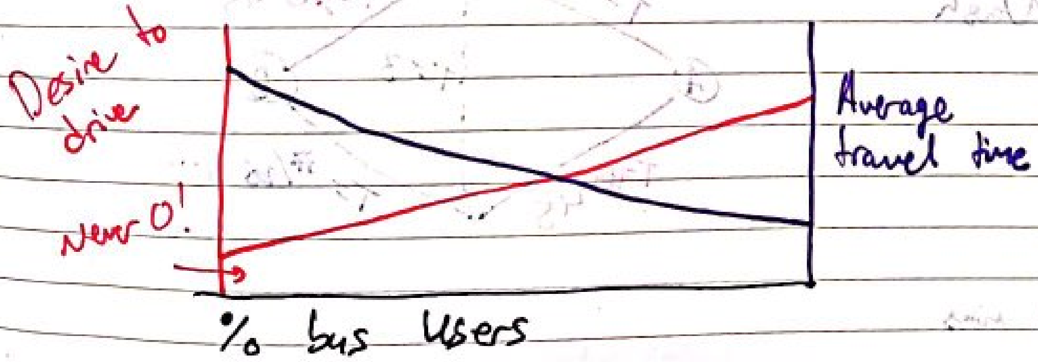


Q: How many people will use the bus?

Assumptions:
- Only cars & buses
- Bus stops at every stop
- No intersections
- People are rational

Objective: get from A to B as fast as possible.





Conclusions:
- Always prefer driving
- The more drivers, the worse everyone is
- In real life, there are limitations.

BAN CARS

How do we quantify this? How do we know this actually happens?

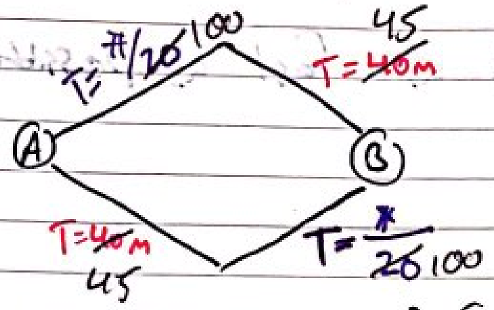
Discussion questions:

- How do we fix this?
- Where do other transit options come in?
- Where does this argument break down?

~~We need a formalism .... Game theory!~~

Example 2: Braess' Paradox

Consider:



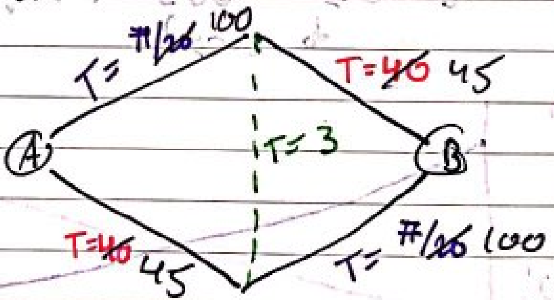
N = ~~1000~~ 4000 people

Tot time : 65 min

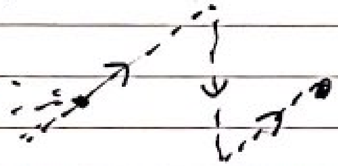
Is this a Nash equilibrium?

- Can anyone gain by moving?
- What does first person do?

The city builds a new road:



What is the Nash equilibrium?



Tot time : 83 mins

We need some formalism

Congestion games:

- A set E of congestible elements
- n players
- A finite set of strategies S_i where if $P \in S_i$ then $P \subseteq E$
- for each $e \in E$, and set of strategies $(P_1, \_, P_n)$, a load $x_e = \#\{i : e \in P_i\}$
- A delay function $d : \mathbb{N} \times E \to \mathbb{R}$
  $d_e : \mathbb{N} \to \mathbb{R}$
- Assume d_e is positive, monotonic increasing

$\Big\{$ eg: hospitals
roads
services
lanes in a street
...

Each player experiences delay ~~$d(i) = \sum_{e \in P_i} d_e(x_e$~~$)$

$$\text{Delay of } i = \sum_{\underbrace{e \in P_i}_{\text{sum over resources } i \text{ uses}}} \overset{\text{delay of that resource}}{d_e}(\underset{\text{at } x_e \text{ (congestion}}{x_e})$$

Q: Does there exist a Nash equilibrium? How do we find it?