Optimization of a Roadway Network

ENCE 360

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Optimization of a Road Network

- Objective
- Proposed Road Network
- Description of Project
- Problems Encountered
- Applicable Course Concepts
- Future Improvements/ Expansions

Why Optimize?

- Optimization is an integral component of engineering systems, designs, and problems.
- Allows more complex problems/ situations to be modeled in an easier manner.

Objective

- Study a road network
  - Optimize time needed for all units who have entered network to leave
  - Network will be arbitrary
    - Extendable to other ideas and programs.

Objective Continued

- The network will have 5 nodes
  - 2 to 4 links emanating from each node.
- Two-directional flow will be accounted for
  - separate variables for capacity on each direction
- The network will have four sets of inflow and outflow pairs at roughly the cardinal directions.
  - North, South, East and West

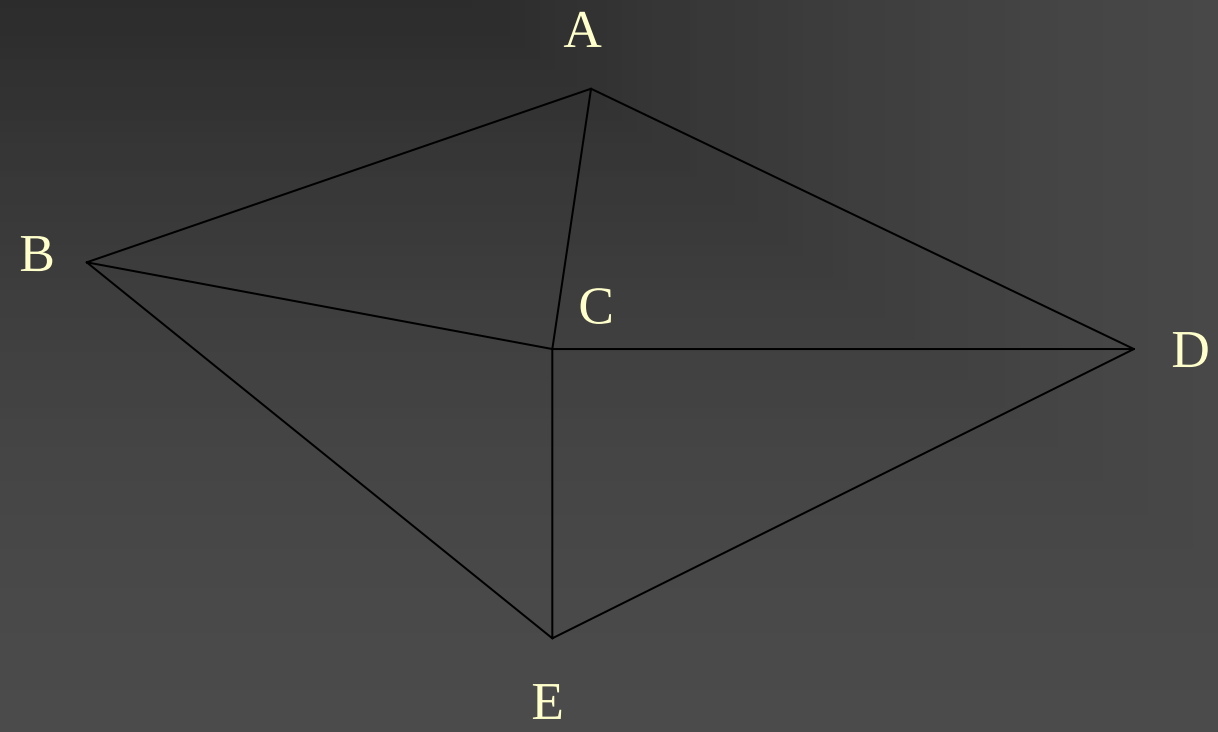
Objective Continued

- Each traffic flow will be tracked separately, and will have different amounts of traffic traveling between the points.
  - For example, the northern point may have 1000 cars entering, of which 250 will exist at the west point, 300 the east, and 450 at the south.

Objective Continued

- Tracking each set of inflow separately will ensure that the traffic will not optimize by filling the outflow at the northern point with the inflow from the northern point
  - does not represent typical drivers.
- Having multiple destinations for each origin is more realistic and similar to the real world.

Proposed Road Network



Description of Project

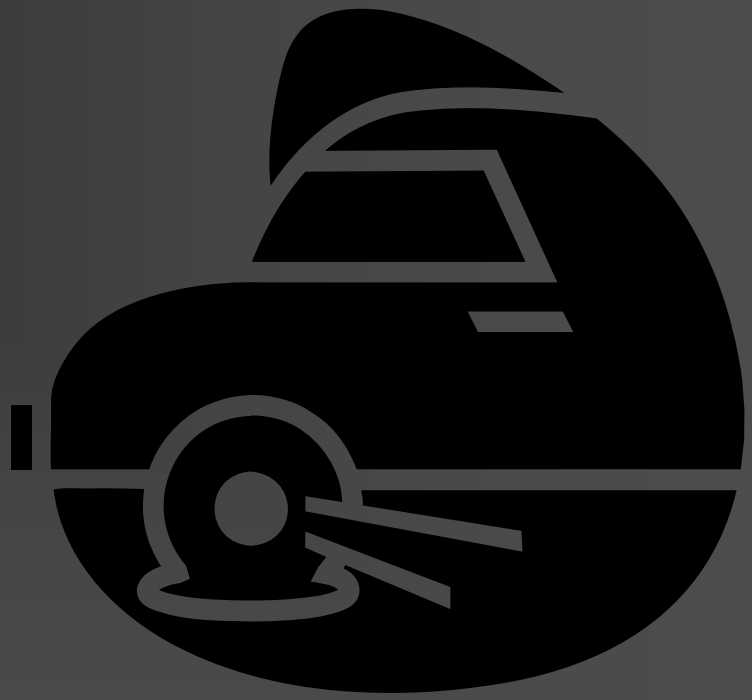
- Determined network (seen on previous slide)
- Calculated time through velocity and distance of roads on the network
- Calculated actual time
  - As the capacity of the road reaches full, it will take longer time for the driver to exit the road
  - Used equation $T_i = T_{0i}/[1-(V_i/C_i)]$

Description of Project Continued

- Decision variables were assigned
  - Volumes for each link on the road network
- Constraints
  - Each inflow at a node must equal its outflow
- Ultimate goal
  - Minimize travel time
  - Time = 204.060 hours
    - Note: Excel used branch and bound method to find travel time

Problems Encountered

- First time program was run there was no feasible answer.
  - Non-negativity
- Numbers were off since velocity and travel weren't on the same scale
- Inflow != Outflow
  - Had to set constraint



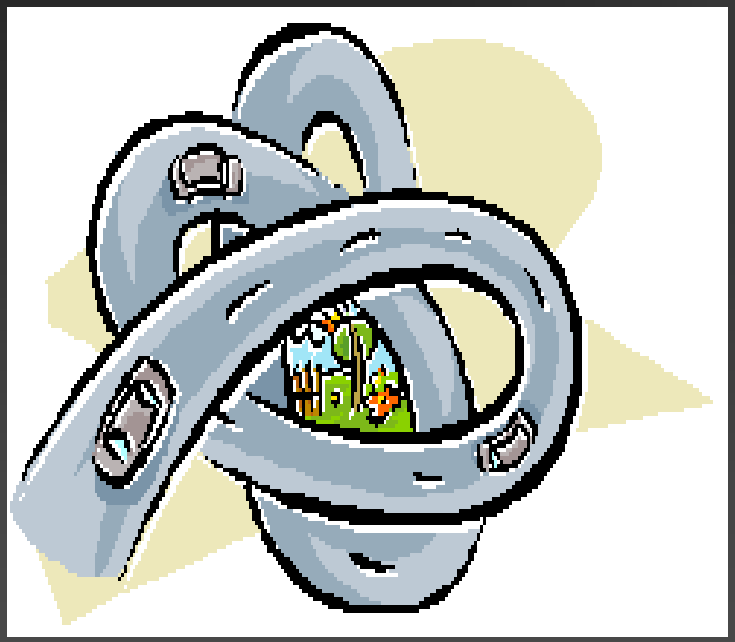
Applicable Course Concepts

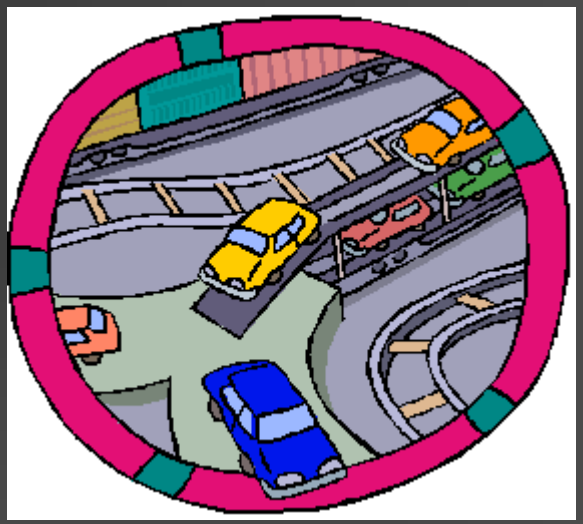
- Excel Programming
  - solver
  - easier to visualize
- Integer Constraints
- Concepts from transportation problems learned in class.

Future Improvements/Expansions

- Analysis on realistic problems
  - Increase capacity
  - Large influx of traffic on one area of network
- Enter in cost value
  - Find value of an hour for driver and use as a constraint to find travel time
- Extra roads added to the network

Questions ???





http://www.aatraffic.com/SIDRA/Simulation.htm