## CE 191: Introduction

- **Instructor, GSI**
- **One year from today...**
- **Main problems covered by this class**
- **Class format**
- **Your responsibility as a student**
- **Labs, lab submission, lab grading policy**
- **Course grade**
- **Why are you taking CE 191?**

## Instructor, GSI

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## One year from today

**You graduated from Berkeley, you just found your dream job in your dream field, in your dream city.**

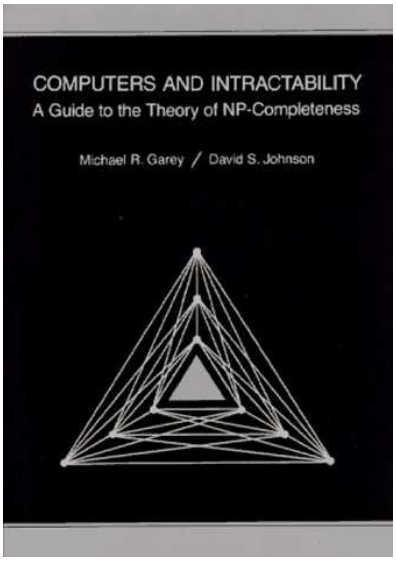
**One day, your boss calls you in his office, and asks you to solve a civil and environmental engineering problem.**

**You spend three weeks trying to find a solution. You find « some kind of a solution, but you are not sure ».**

**The week after, your boss calls you again.**

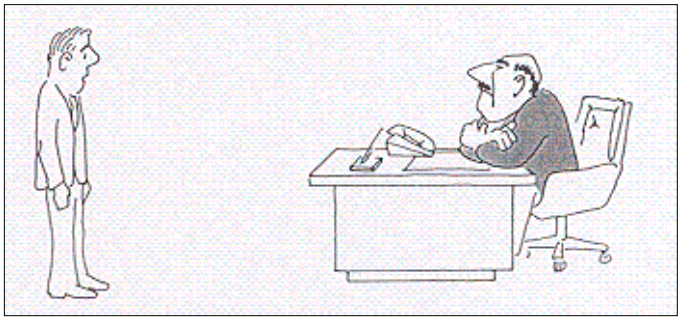
**What do you do?**

## One answer (Garey and Johnson)




**[Computers and intractability, Garey and Johnson, 1979]**

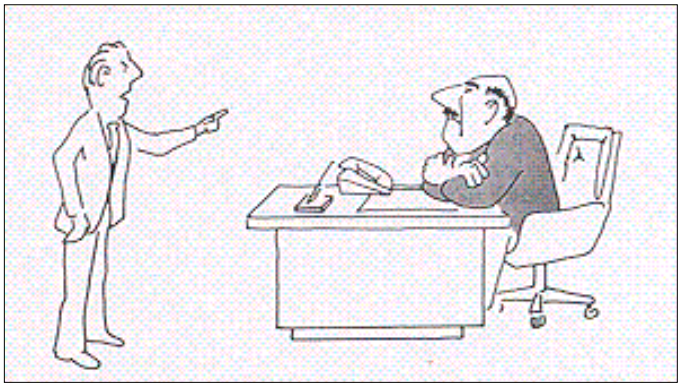
## Answer 1 (if you did not take CE 191)



I can't find an efficient algorithm, I guess I'm just too dumb

**[Computers and intractability, Garey and Johnson, 1979]**

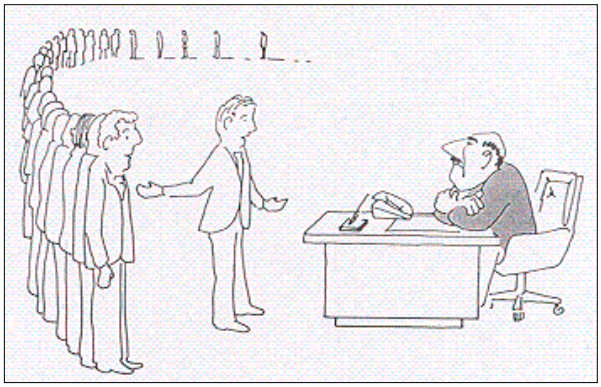
## Answer 2 (in your wildest dreams)



I can't find an efficient algorithm, because no such algorithm is possible

**[Computers and intractability, Garey and Johnson, 1979]**

## Answer 3 (after taking CE 191)



I can't find an efficient algorithm, but neither can all these famous people

[Computers and intractability, Garey and Johnson, 1979]

## Problem 1: feasability, uniqueness, optimality

**Your boss wants the cheapest solution:**

- Can you find a solution? → feasibility
- Can you find a cheaper solution? → optimality
- Can you find the cheapest solution? → uniqueness

- Can you find a cheap solution? → suboptimal
- How cheap is your solution? → degree of suboptimality

- Why can't you find a cheap solution? → hardness

## Problem 2: computational complexity

**Your boss gives you a huge data file**

**He does not care if your solution is cheap, as long as you can tell him how cheap it is**

**He wants your algorithm to find the solution of the problem in 5 minutes**

- Is your algorithm fast? → polynomial time
- Is your algorithm slow? → non polynomial time

## Problem 3: deterministic or not

**Your boss gives you a huge data file every day**

**She is happy if you can guarantee her that on average you will give her the optimal solution every other day in less than 5 minutes**

- Does you algorithm always converge? → deterministic/random
- Does it do well on average? → expected sense

## Problem 4: discrete / continuous

**Your boss wants to know how many trucks she needs to send to Sacramento next Friday.**

**Your boss wants to know how many pounds of sand she needs to send to Sacramento next Friday.**

**Which problem is easiest to solve for you?**

- Your algorithm says: 223276.25 pounds → continuous
- Your algorithm says: 25 trucks → discrete
- Your algorithm say: 24.6 trucks → LP-rounding?

## Problem 5: linear / nonlinear

**One of the people you supervise (from Stanford) tells you he just found the perfect model for your problem, it is very precise, but it involves the cosine of the square root of the quantity of fuel burned by your trucks.**

**The other person you supervise (from MIT) tells you she just found a not so precise model, but it is proportional to the quantity of fuel burned by your trucks plus a constant.**

**Which one should you put in your algorithm to give the best answer to your boss in a reasonable time?**

- Tractable models → linear/affine
- Harder models → nonlinear/nonconvex

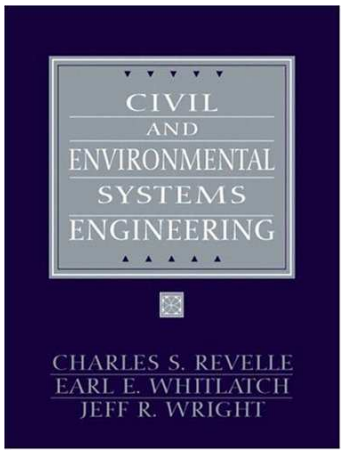
## CE 191: class format

- **Suggested book (mainly examples)**
  ***Civil and Environmental Systems Engineering*, C. Revelle, E. Whitlatch, R. Wright, Prentice Hall, 2004**

- **Format of the lectures: slides, examples on the board**

- **Slides are available online (class website)**

- **Slides will be distributed in class**




## CE 191: if you are experiencing difficulties

**You have many options**

- **Ask questions in class, interrupt**
- **See instructor after class**
- **See GSI during office hours**
- **See instructor during office hours**
- **Send us feedback using the webpage**
  **This is anonymous, we will check it every couple days.**
- **Send us an email**
  **If you send an email regarding the class, make sure to put CE191 in the subject, otherwise it might take us a few days to answer your email.**

## CE 191: your responsibility as a student

- **Check your email every working day**
- **Check the website every working day**
  **http://www.ce.berkeley.edu/~bayen/ce191www/**
- **Enroll in electronic submission site (address email provided on that site will be used to send announcements)**
- **Do Lab 0, how to submit a lab + Matlab review**
- **Submit your labs**
- **Come to the midterm and the final**
- **Tell us when the class is too fast / too slow**

- **Student Judicial Affairs**
- **Disabled student's program**

## CE 191: Labs

- **Class has five (5) Lab assignments**
- **GSI will help you to complete the labs**
- **Each lab will cover one of the five topics of the class**
  - **Linear Programming (LP)**
  - **Integer Programming (IP)**
  - **Mixed Integer Linear Programming (MILP)**
  - **Dynamic Programming (DP)**
  - **Non Linear Programming (NLP)**
- **The labs/examples will cover the main areas of interest of Civil and Environmental Engineering: tranportation, env. engineering, project managt., structures, geotech.**
- **We are investigating the possibility of scheduling a new lab**
- **Office hours might change to accomodate more people**

## CE 191: Lab submission

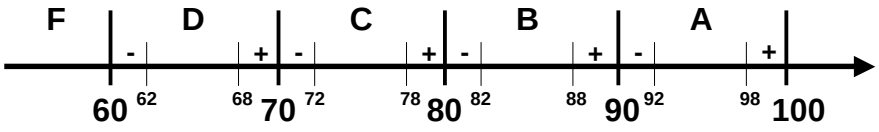
- **You need to submit your labs online.**
- **The system puts a time stamp on your submission.**
- **Every late day, one point is taken off from your grade (your grade is out of 10).**
- **Every day started is counted in full.**
- **You are given a total of two free late days, to spend on any lab(s).**
- **Submission follows clear rules:**

  **1) You need to submit your final report in pdf format (one document). System only keeps the last document submitted !!!**

  **2) You need to submit your source code as text files in a ZIP file. System only keeps the last document submitted and filters out files other than text inside ZIP file!!!**

## CE 191: Course grade

- **Straight scale:**




- **Breakdown of course grade:**
  - **Labs: 50% (5 labs, 10% each)**
  - **One midterm: 20%**
  - **Final: 50%**

## Why are you taking CE 191?

**Broader question: what is systems, why should you care?**

**One possible definition of systems:**

**Enabling algorithms, methods and technologies for monitoring, control and optimization.**

**In civil engineering, they might apply to**

- **large scale infrastructure**
- **transportation networks**
- **structures**
- **your application here…**

## Example of application of CE191

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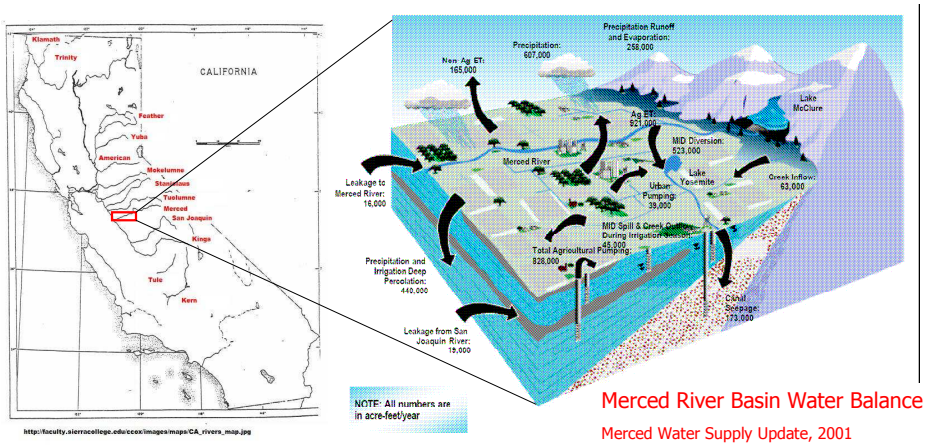
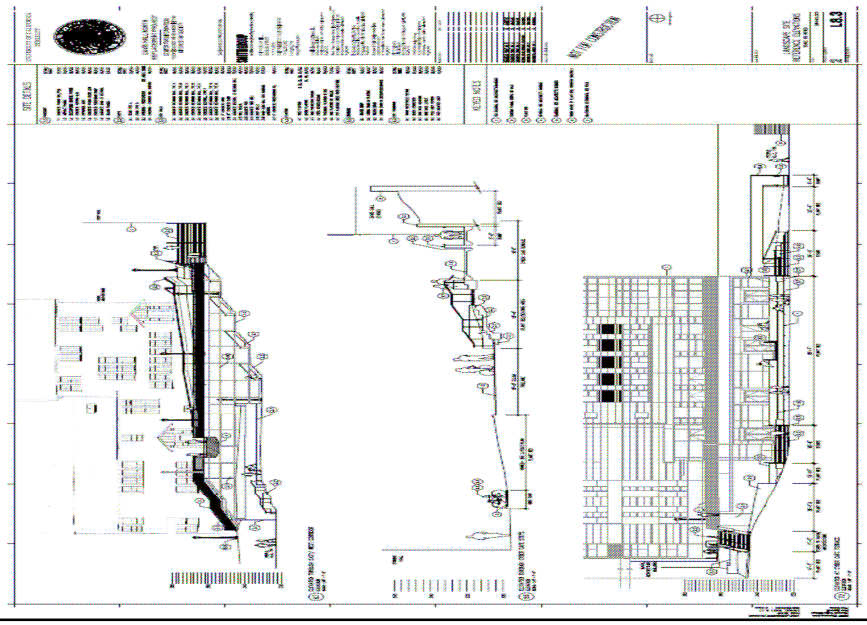



Merced River Basin Water Balance

Merced Water Supply Update, 2001

# Example of application of CE191



## Example of application of CE191