Exam

- I will send the key shortly.
- I don't want to waste time going over the exam in class as not good use of everyone's time.
- High correlation between test questions and class activities/notes.
- Figure out the learning style that works for you
  - Work in smaller groups
  - Read book/notes before class
  - Study book/notes after class
  - Go to SI's each week
  - Come to office hours

Homework

- Next individual homework is posted – Due Friday MIDNIGHT. One goal – be able to follow written instructions.
- From now on, late assignments are docked.
- Some things cannot be turned in late. If we go over the answers in class, no late submission is possible.
- If you need to miss class, consult the webpage. Turn in the work to the grader of the assignment. Super* questions are required.
- Grading issues? - consult the webpage. Send email to the grader of that assignment WITHIN A WEEK!

Modeling

- Modeling: Extracting from the real world situation enough detail to solve the problem.
- Need to ignore details that do not affect the solution.
- Your understanding of the way computers solve problems will make you better users, administrators, or designers.
- Friend – horse trailers for transportation between various locations. Ask questions – user expected a “magic pill” – dump the data in and out comes the answer.
  - How many horses?
  - What can trailers hold?
  - What are needs? Regular schedule? Random events?
Operating Room Scheduling

1. Planning or Scheduling of the Patient
2. Administration of the Schedule

- Preparation of Active Schedules (anesthesia)
- Scheduling Request
- Step by Step Schedules
- Organization of Nursing and Anesthesiology
- Schedule (Administration Process)

Elements of a Schedule Planning Policy

- Scheduling Goals
- General Scheduling Definitions
  - Schedule Start time
  - Turnover – time between consecutive operations. (May administer anesthetic before previous operation ended.)
- Scheduling practices – preferences age, type, people.
- Balances the diverse needs of the four groups: surgeons, nursing, anesthesiology, administration
- First case start time
- "Closing" the schedule
- Information requirements when booking a patient for surgery

Key Components of Schedule Planning

- Coverage Plans Balanced with Surgical Demand
- Variable OR Room Access (set aside time to accommodate historical add-ons w/o disrupting elective schedule)
- Maintenance of Correct Materials Requirements (accurate preference cards)
- Accurate Case Duration Estimates
- Knowledgeable and Accessible Scheduler(s)
- Policies and Guidelines for Assigning and Re-Allocating Block Time
- Operating Room Committee as Governance/Oversight Body

Computer Science

Solve problems – measure results

- Design: What are goals? What are inputs? How do you want to interact with the system?
- Results: Turnover time between consecutive operations decreased from 65 to 52 min per operation (95% CI: 9; 17; P = 0.0001). Operating room occupancy increased from 4.28 to 5.27 h day⁻¹ (95% CI: 50; 68; P = 0.005). The surgeons began their work on the ward 35 min (95% CI: 30; 40) later than before the intervention and their overtime increased from 22:36 to 139:50 h.
- Conclusions: The time between surgical operations decreased significantly. Increased operating room efficiency owing to overlapping induction of anesthesia allows more intense scheduling of operations. Thus, physicians and nurses can be released to spend more time with their patients in the ward. Improving the efficiency of the operating room alone is insufficient to improve human resource management at all levels of a surgical clinic.
**Computer Model**

- A mathematical representation of the functioning of a system, presented in the form of a computer program.

**Modeling**

- The process of making and testing hypotheses about models and then revising designs or theories has its foundation in experimental sciences.
- Computer Scientists use modeling to analyze real-world problems in order to predict what might happen with some course of action.
- Examples
  - If we start anesthesia before previous ended, how much time would we save, what are increased demands on operating room, how do unscheduled events affect plan. Why better to let computer solve than just try it?
  - strategic planning in air traffic control
  - Journalism—women portrayed in newspaper articles
  - computational biology
  - Volleyball—skills affecting practicing strategy

**Model Classifications**

- **Probabilistic/Deterministic**
  - A probabilistic or stochastic model – random effects
    - Stochastic: non-deterministic, random, Greek “guess” or “aim”, involving chance.
  - Deterministic model – what happens depends on known sequences

- **Static/Dynamic**
  - Static model – does not consider time. A snapshot.
  - Dynamic model – changes with time
    - continuous model – time changes continuously
    - discrete model – time changes in incremental steps

**In Class Feb 9 Groupsize ≤2**

- Complete the CS-ILM exercise entitled “How many three letter words”.
- Logon via csilm.usu.edu. Enter as <guest>. (More instructions on webpage entitled Using CS-ILM.)
- Answer all green questions.
- Turn in paper/pencil answers at end of class.
- If turning this in via email, also do super* questions.
Homework Friday – Midnight

- Late assignments docked 10% a day (Sat/Sun count as one day)
- Need to conduct a survey and get results. Don’t wait until the last minute

“Take aways” from estimating 3 letter words

- **Acronyms** are abbreviations that are formed using the initial components in a phrase or name (as in HTML, CEO, VIP).
- We estimate when finding an actual answer is expensive or impossible. (We are supposing this is the case. Google doesn’t know the answer. We don’t have an electronic dictionary.)
- We make a small test case and generalize our result to the entire set of possibilities
- Idea of a proportion. If 3.8 out of 100 are words, then

\[
\frac{3.8}{100} = \frac{\text{Number}}{\text{AllStrings}}
\]

If we know “AllStrings”, we have one equation in one unknown and we can solve.

\[
3.8 = \frac{\text{Number}}{26 \times 26 \times 26}
\]

- Number = \((.038)\times17576 = 668\)
- Same idea of meal preparation for a crowd. I cook three pounds of potatoes for twelve people, how much should I prepare for 500?
- We need to be able to count the possibilities for AllStrings
- And rule: If I get choice 1 and choice 2 and choice 3, I multiply the number of possibilities
- Or rule: If I get choice 1 or choice 2 or choice 3, I add the number of possibilities.

Ryan has two shirts and three pair of pants. How many possible outfits does he have?

We can use a tree diagram to systematically list the various possibilities as shown below:
• How many ways can Alan, Ben, and Casie arrange themselves in a line?
• There are 5 numbers: 3, 4, 5, 6, and 7. Calculate how many different 3-digit odd numbers can be formed from those numbers without repetition of digits within an number?
• A standard deck of playing cards has 13 spades. How many ways can these 13 spades be arranged?
• There are 4 ways from Old Main to the Library. There are 3 ways from the Library to Class. How many possible ways are there to get from Old Main to Class?
• On holidays, Firehouse Pizza serves a dinner special consisting of a drink, an entree, and a dessert. Customers can choose from 5 drinks, 8 entrees, and 3 desserts. How many different meals can be created from the dinner special?
• There are three kinds of pies, two kinds of cake, and four kinds of ice cream. You can have either (a) pie (b) cake and ice cream. How many possible desserts can you have.

Experiment

Law of large numbers: is a theorem in probability that describes the long-term stability of the average of a random variable. As we increased our sample size (the number of words we generated), our confidence in our answer increased.

Allows "what if" questions.
- What if we had fewer letters, would our probability of getting a word increase? Depends on which letters, right? Perquacky or text twist
- What if we had longer words do we expect more or less?

Designing of experiments

We need to figure out how to design an experiment
We need to be able to extrapolate from the results of our experiment to "real life".
extrapolate: the process of constructing new data points outside a discrete set of known data points
Consider the problem of wanting an estimate of the area of a shape.
Why do I say estimate rather than actual value?
What are some of the things you could try?

In Class Feb 11 Groupsize ≤2

• Complete the CS-ILM exercise entitled “Estimating Area”.
• Logon via csilm.usu.edu. Enter as <guest>. (More instructions are on the webpage. The link is entitled Using CS-ILM.)
• Answer all green questions.
• Turn in paper/pencil answers at end of class.
• If turning the assignment in via email, also give well thought out answers to the super* questions.
Modeling

- We often use trees as a model for a problem.
- Consider the problem. I am having a dinner party at my house. There will be three kinds of pies (apple, lemon, peach), four kinds of cakes (chocolate, poppy seed, carrot cake, spice), and two kinds of ice cream (vanilla, rocky road). People may have both cake and ice cream. They may also have no dessert. How many spoons will I need if I invite 60 people?

We can use a tree to consider choices. Consider the first choice to be pie, cake or neither. Each leaf represents a different choice. Nodes represent states arcs represent decisions.

Be careful

- Make sure you don’t get the same result in two ways.
- As Tanisha tells us – nothing is nothing. (I feel a song coming on – “Nothing comes form nothing. Nothing ever could.”)
- You can’t distinguish between two ways of getting nothing. This is why we don’t allow someone who has picked “pie” to then choose “no pie”.

- So if we consider each “leaf” to be equally likely, we can say that there are 18 distinct results of the choices.
- Of those choices, 10 involve ice cream.
- Thus, we would guess that 10/18 people will need a spoon.
- If we have invited 60 people, then 60*10/18 = 33.33 spoons are needed.
Of course, we may think about it differently. The tree is a general purpose tool to help us think about the essence of the problem.

Learning styles

- We all learn differently
- Some like to hear instructions (auditory learners)
  - Auditory learners heard their mother, believed the information, and never touched a stove.
- Some like to read instructions or see a demo (visual learners)
  - Visual learners watched their brother touch the stove, and never touched it.
- Some are hands on learners (tactile/kinesthetic learners)
  - Kinesthetic learners touched the stove; but only once!

Something to be learned from each type. Kinesthetic is a reasonable way to learn software.

Trial and error

- If you get a bad answer, ask yourself, "Why?" and then backtrack.
- One was counting a grid cell as 250 instead of 2500 square pixels. When the estimate was way off, dismissed it as “the computer must be more accurate than I am”. The estimate was a tenth of what it should have been!!!!
- Spirit of “debugging” or “scientific method” says you must explain unexpected results and backtrack until you get it right.
Euler’s Königsberg’s (now Kaliningrad, Russia) Bridges Problem- 1736

The river Pregel divides the town of Königsberg into four separate land masses, A, B, C, and D. Seven bridges connect the various parts of town, and some of the town’s curious citizens wondered if it were possible to take a journey across all seven bridges without having to cross any bridge more than once. All who tried ended up in failure, including the Swiss mathematician, Leonhard Euler (1707-1783) (pronounced “oiler”), a notable genius of the eighteenth-century.

Laid foundations for modern day graph theory.

Modeling: Euler’s Königsberg’s (now Kaliningrad, Russia) Bridges Problem- 1736

- However, Euler did succeed in explaining why such a journey was impossible, not only for the Königsberg bridges, but whether such a journey was possible or not for any network of bridges anywhere.
- To start with, Euler pointed out that the choice of route inside each landmass is irrelevant. The only important feature of a route is the sequence of bridges crossed. Note the abstraction involved in his model.
- Euler reasoned that for such a journey to be possible that each land mass should have an even number of bridges connected to it, or if the journey would begin at one land mass and end at another, then exactly those two land masses could have an odd number of connecting bridges while all other land masses must have an even number of connecting bridges.

Model of problem: Abstract away details

Steps of modeling process

1. Analyze the problem. Understand fundamental questions
2. Formulate a model
   - Gather data about system behavior
   - Make simplifying assumptions. Factors not appreciable affects
   - Determine variables and units
     - independent variables upon which others depend
     - dependent variables
   - Establish relationships among variables
   - Determine equations and functions
3. Implement the model
4. Verify and interpret the model’s solution
5. Report
   - analysis of problem
   - model design
   - model solution
   - results and conclusions
InClass Jan 13 Groupsize ≤ 2

- Complete the CS-ILM exercise entitled “Graph Coloring”.
- Logon via csilm.usu.edu. Enter as <guest>. (More instructions are on the webpage. The link is entitled Using CS-ILM.)
- Answer all green questions.
- Turn in paper/pencil answers at end of class.
- If turning the assignment in via email, also give well thought out answers to the super* questions.

At your seats:

- For your major, (a) state a hypothesis that the computer could help you prove/disprove (b) design an experiment to test the hypothesis. (c) what details would be ignored?

  Every subject is interesting if you dig deeply enough.
  - What is the link between funding and wins (football)? We are seriously underfunded. We likely have an incredible record for the funding we receive.
  - What is the “home court” advantage? Is it real? 27%
  - In what ways is texting an addiction? Some psychiatrists are diagnosing obsessive texting as a mental illness.
  - How does outsourcing affect profits?
  - Do women make less than men because of bias or weaker training? Lily Ledbetter Law
  - When will financial bailouts work?

Example

- Manager of Smiths has a concern.
- They have introduced “self-serve” checkout, but there is some resistance to using the checkstands.
- Want to know how to allocate help personnel? Do I put more people are regular checkout lanes? Do I put more people helping the “self servers”?
- I could try a different arrangement every day and see what works, but I would like to do a computer experiment to “model” what would happen and make recommendations.
- Could make records of various facts and analyze cause and effect relationship.

Notation for queuing systems

A queue is just a “first come first serve” line

A/B/c/d

- A = the interarrival time distribution
- B = the service time distribution
- c = the number of servers
- d = the queue size limit

- Where A and B can be some statistical distribution
  - constant, random, Poisson, normal

omitted if infinite