Summary of Lecture #1

Probabilities
Monday, October 4, 2004
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Reading: Section 2.1 from the textbook

1. The concept of probability: random vs. deterministic

2. Random experiments and sample spaces
   - Toss a coin:
     - once
     - 3 times - record the outcome of every toss
     - 3 times - record the total # of heads
   - Drawing balls from an urn:
     - once
     - twice without replacement
   - Roll a die:
     - once
     - twice

3. Events
   - event = “# of Heads = 2”
   - event = “first draw is ball #2”

4. Calculation of simple probabilities

5. Set operations
   - $A \subseteq S$
   - $|A| = \{\text{size or # of outcomes in } A\} = \text{cardinality of } A$
   - $\emptyset = \text{empty set}: |\emptyset| = 0$
• Complement: $A^c = S - A$
• Intersection or AND: $A \cap B$
• Union or OR: $A \cup B$
• Venn diagrams
• Pairwise disjoint or mutually exclusive sets (when $A \cap B = \emptyset$):
  - If $A \cap B = \emptyset \Rightarrow |A \cup B| = |A| + |B|$
  - In general $|A \cup B| = |A| + |B| - |A \cap B|$
  - Often useful to write a complex event as a union of pairwise disjoint events,
    e.g. $A \cup B = (A \cap B^c) \cup (A \cap B) \cup (A^c \cap B)$
• De Morgan’s law: $(A \cup B)^c = (A^c \cap B^c)$, $(A \cap B)^c = (A^c \cup B^c)$