CISC 1100: Structures of Computer Science
Review Topics
Final Exam

Arthur G. Werschulz

Fordham University
Department of Computer and Information Sciences

Summer, 2016

General info

- Date: Thursday 30 June, 1:00 p.m. to 3:00 p.m.
- 110 points' worth of questions, mainly on Chapters 4–7 and 9
- Graded on a 100-point basis
- Questions based on exercises on text (either assigned or unassigned)
- One double-sided $8\frac{1}{2} \times 11$-inch sheet of notes
- Unless told otherwise, complete all arithmetic operations. You do *not* need to convert fractions (such as $\frac{1234}{5678}$) into decimals.

Chapter 4: Relations

- Relation from X to Y: set of ordered pairs from $X \times Y$.
- Relation on X: relation from X to X
- Terminology
  - domain
  - codomain
  - rule or description
- Understand descriptions of relations:
  - a set of pairs
    - explicit listing
    - a rule: $\{(x, y) \in X \times Y : p(x, y)\}$ for some predicate $p : X \times Y \to \{\text{True}, \text{False}\}$
  - a graph
- Know whether a relation on some set satisfies the five properties:
  - reflexive
  - irreflexive
  - symmetric
  - antisymmetric
  - transitive

Chapter 5: Functions

- A function $f : X \to Y$ is a special kind of relation on $X \times Y$.
- Terminology
  - domain
  - codomain
  - range
  - rule or desciption
- Composite functions
- The identity function
- Properties of a function
  - injective
  - surjective
  - bijective
- Inverse functions
  - A function is invertible iff it is bijective
  - Finding the inverse of a simple function

Chapter 6: Counting

- Using a table
- Using a tree
- Elementary rules for counting
    - addition rule
    - multiplication rule
    - using the addition and multiplication rules together
- Permutations and combinations
    - computing permutations $P(n, r)$
    - computing combinations $C(n, r)$
    - computing permutations with repetitions
- Word problems
    - Kinds of problems include
        - license plates
        - phone numbers
        - dice
        - cards
        - lotteries
        - ... and so forth
    - Which rule(s) to apply?

Chapter 7: Probability

- Basic definition: $\text{Prob}(E) = |E|/|S|$ for "equally-likely" case
- Counting $|S|$, $|E|$
    - directly
    - using counting rules from Chapter 5
- Probability of complementary event

$$\text{Prob}(E') = 1 - \text{Prob}(E)$$

- Elementary rules
    - Independent and disjoint events
    - Addition rule for disjoint events

$$\text{Prob}(E_1 \cup E_2) = \text{Prob}(E_1) + \text{Prob}(E_2)$$

- Multiplication rule for independent events:

$$\text{Prob}(E_1 \cap E_2) = \text{Prob}(E_1) \cdot \text{Prob}(E_2)$$

Chapter 7: Probability (cont'd)

- General addition rule

$$\text{Prob}(E_1 \cup E_2) = \text{Prob}(E_1) + \text{Prob}(E_2) - \text{Prob}(E_1 \cap E_2)$$

- General rules
    - General addition rule

$$\text{Prob}(E_1 \cup E_2) = \text{Prob}(E_1) + \text{Prob}(E_2) - \text{Prob}(E_1 \cap E_2)$$

    - Conditional probabilty

$$\text{Prob}(E_1|E_2) = \frac{\text{Prob}(E_1 \cap E_2)}{\text{Prob}(E_2)}$$

    - General multiplication rule

$$\text{Prob}(E_1 \cap E_2) = \text{Prob}(E_1) \cdot \text{Prob}(E_2|E_1)$$
$$= \text{Prob}(E_2) \cdot \text{Prob}(E_1|E_2)$$

- Word problems (as before).

Chapter 7: Probability (cont'd)

- Bernoulli trials: if the probability of an event is p, then the probability of the event happening k times out of n trials is $C(n, k)p^k(1 - p)^{n-k}$.
- Expected value of an event with outcomes $O_1, O_2, \ldots, O_n$ is

$$\sum_{j=1}^{n} O_j \cdot \text{Prob}(O_j) =$$
$$O_1 \cdot \text{Prob}(O_1) + O_2 \cdot \text{Prob}(O_2) + \cdots + O_n \cdot \text{Prob}(O_n).$$

- Word problems
    - Kinds of problems include
        - lotteries
        - dice
        - cards
        - ... and so forth
    - Which rule to apply?

Chapter 9: Graphs

- Graph notation and terminology
  - Given the picture of a graph, list its vertices, edges (and weights, if applicable)
  - Graph vs. multigraph
  - Directed vs. undirected
  - Complete graphs
- Euler trails and circuits
  - Vocabulary: walks, trails, circuits, cycles. (For the latter, use the text's definition.)
  - When can we find Euler trails and circuits?

- Weighted graphs
- Minimum spanning trees
  - Definition of MST
  - Prim's algorithm for finding MST