

Ex C5/C6

- Ex C5
 - $\forall x \neg(x \bullet x)$
 - $\forall x \forall y ((x \bullet y) \rightarrow (y \bullet x))$
 - $\forall x \forall y \forall z (((x \bullet y) \wedge (y \bullet z)) \rightarrow \neg(x \bullet z))$
called **intransitive**
 - $\forall x \exists y \exists z (y \neq z \wedge (x \bullet y) \wedge (x \bullet z))$
– Smallest party?
- Ex C6
 - Solutions will be posted this afternoon

at least?
at most?
must/can have?
talking to self?

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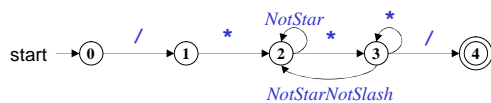
Java Comments (Comp A)

- A standard C-style comment, where all of the characters between `/*` and `*/` are ignored.
- A collection including `/**/`, `/* */`, `/*a*/`, `/*b*/`, etc.

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FSA



Cf. a standard C-style comment, where all of the characters between `/*` and `*/` are ignored.

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Regular Expression

`/* NotStar* *(*)* (NotStarNotSlash NotStar* *(*)*)* /`
where

- Σ = the set of acceptable characters
- $NotStar = \Sigma - \{*\}$
- $NotStarNotSlash = \Sigma - \{*, /\}$

A variant of regular expression used in Unix

`\ / \ * [^*]* [*]+ ([^\\/*] [^*]* [*]+)* \ /`

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Compiler Compiler

- Program to build compilers
- Most compilers contain a FSA to deal with string patterns, e.g., FP numbers, variable names, comments, etc.
- A compiler compiler will need some specification to build a FSA.

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FSA Transitions

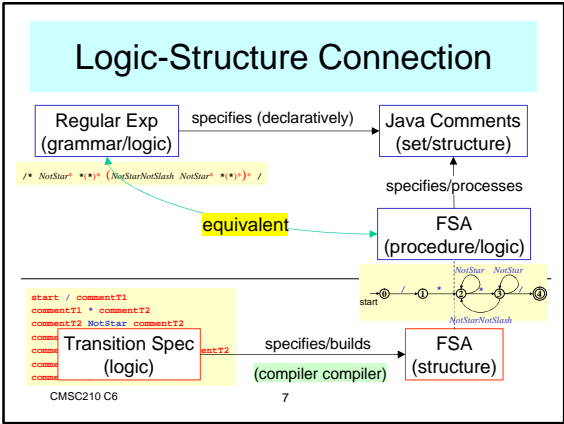
Transition spec: **State** \times **Input** \rightarrow **State**

- `start / commentT1`
- `commentT1 * commentT2`
- `commentT2 NotStar commentT2`
- `commentT2 * commentT3`
- `commentT3 NotStarNotSlash commentT2`
- `commentT3 * commentT3`
- `commentT3 / end`

Taken from a spec file actually used for constructing a mini Java compiler

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FSA Variations

- **Deterministic**
 - At most one transition for each pair of state and input
 - Transition \Rightarrow **Function**
- **Nondeterministic**
 - Possibly multiple transitions for each pair of state and input
 - Transition \Rightarrow **Relation**
- **Make deterministic for practical purposes**

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Poker Preview

Scenario

- In Las Vegas, playing poker with \$1M at stake
- Your hand: **Flush** (e.g., all \heartsuit)
- Your guess of an opponent's hand: **Full house** (e.g., $7\clubsuit, 7\heartsuit, 7\spadesuit, 8\clubsuit, 8\heartsuit$)
- Forgot which one is stronger, but (strategically) could not ask
- So, decided to compute which one is less likely (lower **probability**) ...

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Unit C6: Counting/Probability

Today

- Apply **probability** and **counting** ideas to analyze poker hands

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Probability

- One in 1,000,000 Probability?
- 10 winning tickets among 1,000,000
- Probability of an event =

$$\frac{\text{the number of possibilities for the event}}{\text{the number of all the possibilities}}$$

An event may involve multiple cases.

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Flush

- Deck of 52 cards
 - 13 numbers (A, 2, ..., 10, J, Q, K) for four suit ($\clubsuit, \heartsuit, \spadesuit, \diamondsuit$)
- A hand in poker (this type): 5 cards
- Number of different hands of Flush (F)
- Number of all possible hands (P)
- Probability = F / P

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Permutation

- The number of different **ordering** of r objects taken from n objects
 - Notation: $P(n, r)$
- Computation
$$P(n, r) = n \times (n - 1) \times \dots \times (n - r + 1) = n! / (n - r)!$$
- Example
 - Number of 3-letter words (from lower-case alphabet):
$$P(26, 3) = 26 \times 25 \times 24 = 15,600$$

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Combination

- The number of different **choices** of r objects taken from n objects
 - Notation: $C(n, r)$
- Computation
$$C(n, r) = P(n, r) / r! = n! / (r! (n - r)!)$$
- Example
 - Number of sets with cardinality 3 (from lower-case alphabet):
$$C(26, 3) = (26 \times 25 \times 24) / (3 \times 2 \times 1) = 2,600$$

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Group Exercise 1

- Explain how to compute the number of all possible hands consisting of 5 cards (from the standard deck of 52 cards).
 - No need to actually calculate. You can just give a formula.

How serious will you be if you may win or lose \$1M?

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Group Exercise 2

- A. Explain how to compute the number of Flush hands (from the standard deck of 52 cards).
 - A. No need to actually calculate. You can just give a formula.
- B. Explain how to compute the probability of Flush

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Probability Basics

- **Sample space**, Ω : Set of all possible outcomes
- **Event**: $A \subseteq \Omega$ why subset, not member?
- **Probability measure** (a function) on Ω : $Pr(A)$ has a real value and some other properties (next slide)

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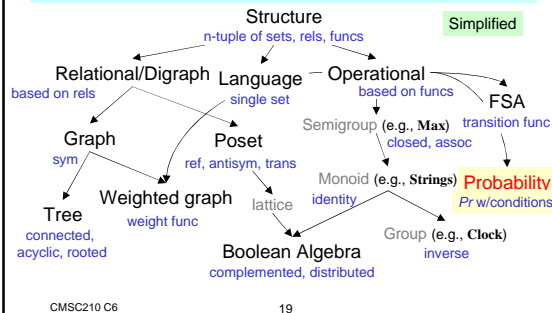
Probability as Structure

- Probability** = (Ω, Pr, \mathbf{R})
- Ω : Sample space (a non-empty set)
 - \mathbf{R} : set of real numbers
 - Pr : _____ (type)
 - **Probability** must satisfy the following conditions
 - $Pr(\Omega) = 1$
 - $A \subseteq \Omega \Rightarrow Pr(A) \geq 0$
 - $Pr(A \cup B) = Pr(A) + Pr(B)$ for disjoint A and B

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Organization of Structures



Multiplication Principle

- Suppose that two events occur *in sequence*, where the first event has n possibilities and the second, m . The number of possibilities for the sequence is $n \times m$.
- Examples
 - Choose 5 numbers, then choose a suit
 - Coin tossing single time vs. k times
 - Choice of 5 appetizers and 9 main dishes: 45

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Addition Principle

- Consider two *disjoint* sets of objects, where the first set has n elements and the second, m . The number of objects in the two set is $n + m$.
- Example
 - Consider 2 cats and 2 humans (and no hybrids). Then, there are 4 objects.
- Implication to probability: additive as well

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Section Summary

- Probability
 - As an operational structure with special conditions
- Counting
 - Permutation (order relevant)
 - Combination (order irrelevant)
- Principles
 - Additive: independent events
 - Multiplicative: sequential events

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Group Exercise 3

Rank the following hands

- Flush (e.g., $\spadesuit 2, \spadesuit 4, \spadesuit 5, \spadesuit 8, \spadesuit 9$)
- Four of kinds? cards (e.g., $\clubsuit 2, \heartsuit 2, \heartsuit 2, \heartsuit 2, \spadesuit 2$, another)
- Full house (e.g., $\clubsuit 2, \heartsuit 2, \heartsuit 2, \spadesuit 7, \spadesuit 7$)
- Straight (e.g., $\clubsuit 2, \heartsuit 3, \heartsuit 4, \spadesuit 5, \clubsuit 6$)

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No review/upgrade period

Module C Evaluation Workshop

- Fri., Nov. 14, class time (next class meeting)
- Review the relevant part of the syllabus and the on-line handbook
- Re-use your manila folder or large envelope
- Complete and bring "Take-Home Exercise Self-Evaluation Form" (distributed today) along with exercises
- Exercise C5 will be checked on Tue. Solutions available that day.
- Complete and bring "Module C Comprehensive Exercises" (available on-line)
- Group evaluation sessions (open book): 20 min \times 3
- "Comprehensive Exercise Self-Evaluation Forms" will be distributed that day (no need to print in advance) **New criteria; Preview on-line**
- Submit all materials at the end of the s **Note: critical analysis includes**
- Mini Project Phase 2 **due on Tue., Nov. positive aspects as well**

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