Finite Automata

What Are They?
An Example: Scoring in Tennis

What is a Finite Automaton?

◆ A formal system.

◆ Remembers only a finite amount of information.

◆ Information represented by its *state*.

◆ State changes in response to *inputs*.

◆ Rules that tell how the state changes in response to inputs are called *transitions*.

Informal Explanation

◆Finite automata are finite collections of states with transition rules that take you from one state to another.

◆Original application was sequential switching circuits, where the "state" was the settings of internal bits.

◆Today, several kinds of software can be modeled by FA.

Representing FA

◆Simplest representation is often a graph.

 ◆ Nodes = states.

 ◆ Arcs indicate state transitions.

 ◆ Labels on arcs tell what causes the transition.

Tennis

◆ Like ping-pong, except you are very tiny and stand on the table.

◆ *Match* = 3-5 sets.

◆ *Set* = 6 or more games.

Scoring a Game

◆One person serves throughout.

◆To win, you must score at least 4 points.

◆You also must win by at least 2 points.

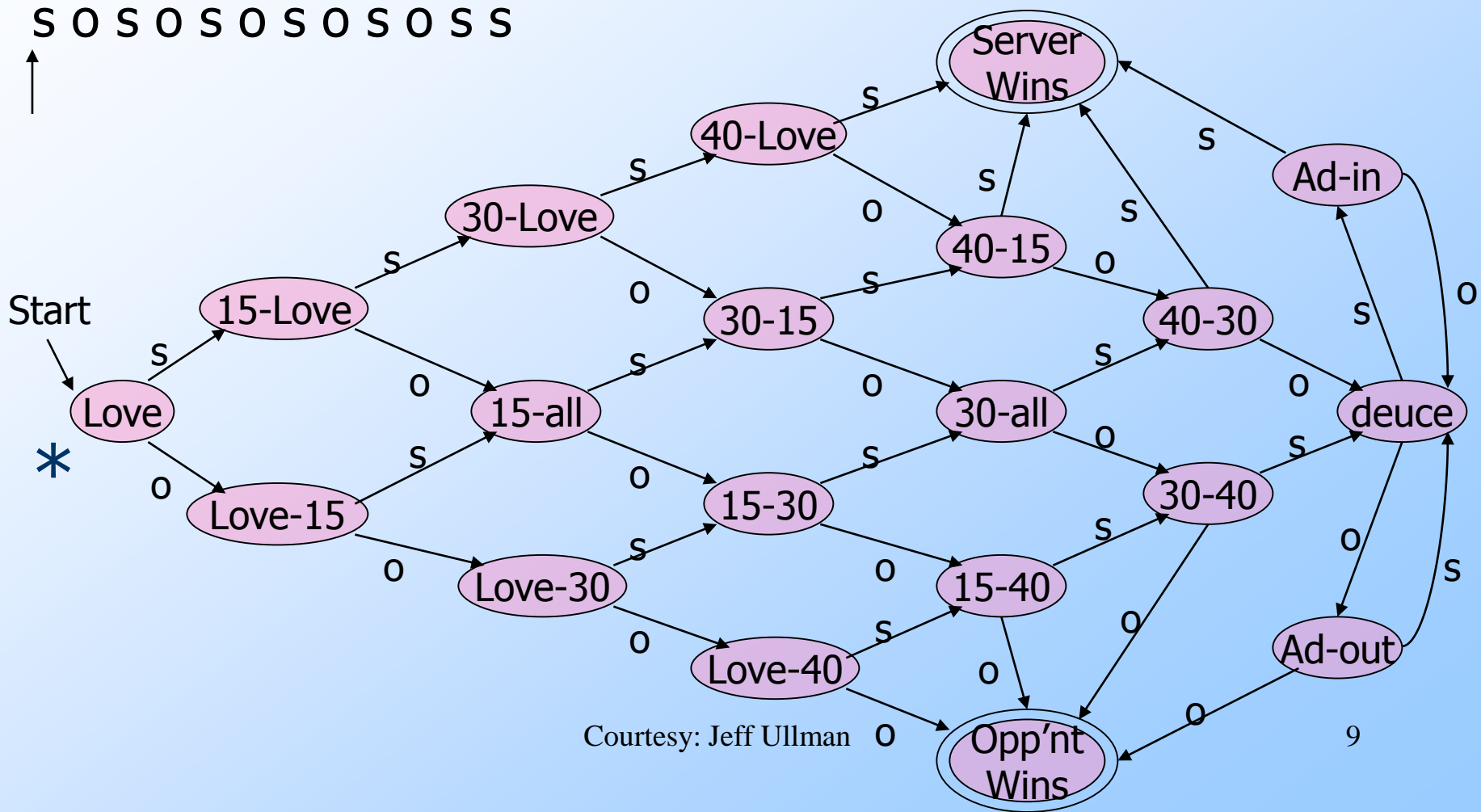◆Inputs are s = "server wins point" and o = "opponent wins point."

FA - Finite Automaton
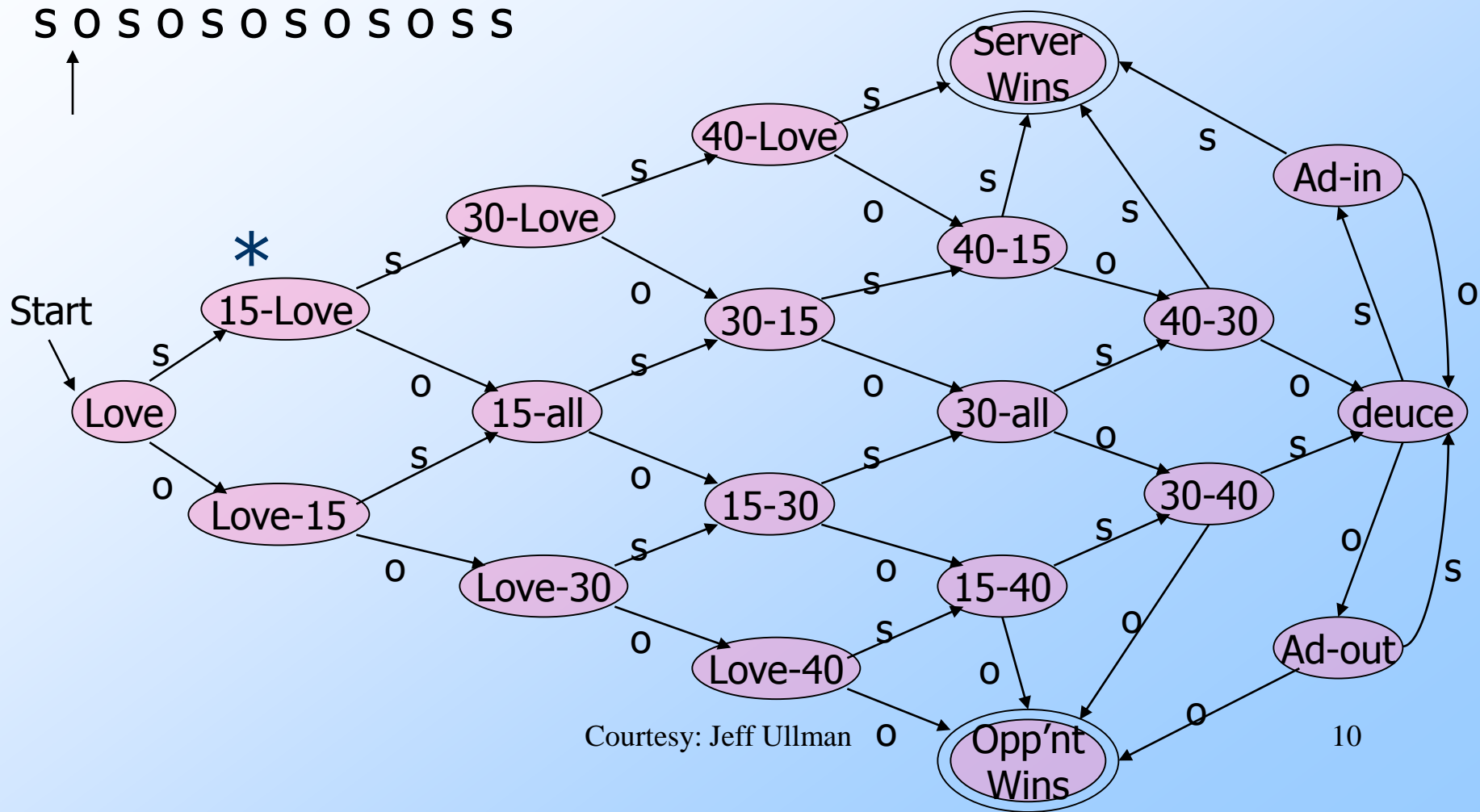# DFA - Deterministic FA

SOOSSOSS

SOOSO
SOSSOSO
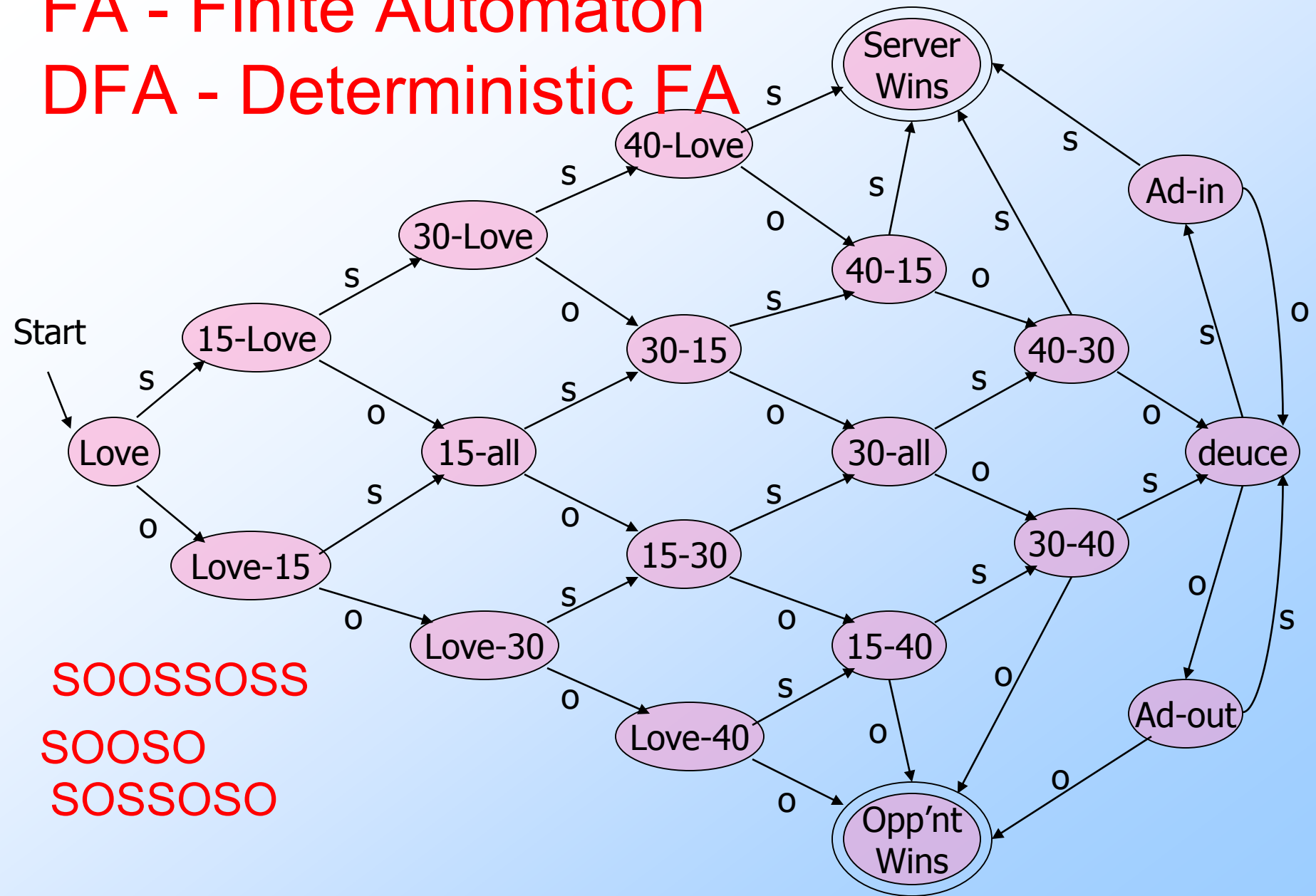
Acceptance of Inputs

◆Given a sequence of inputs (*input string*), start in the start state and follow the transition from each symbol in turn.

◆Input is *accepted* if you wind up in a final (accepting) state after all inputs have been read.
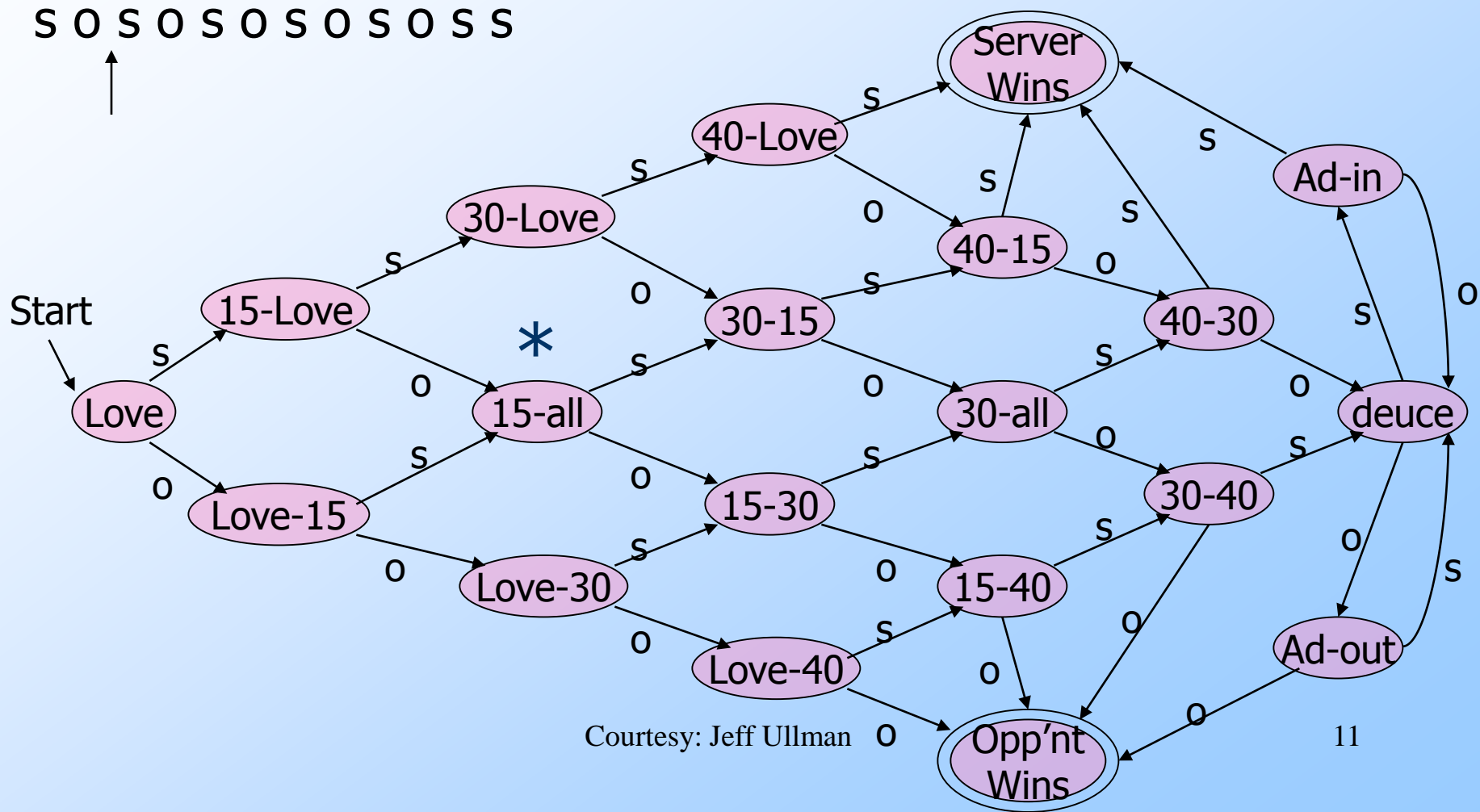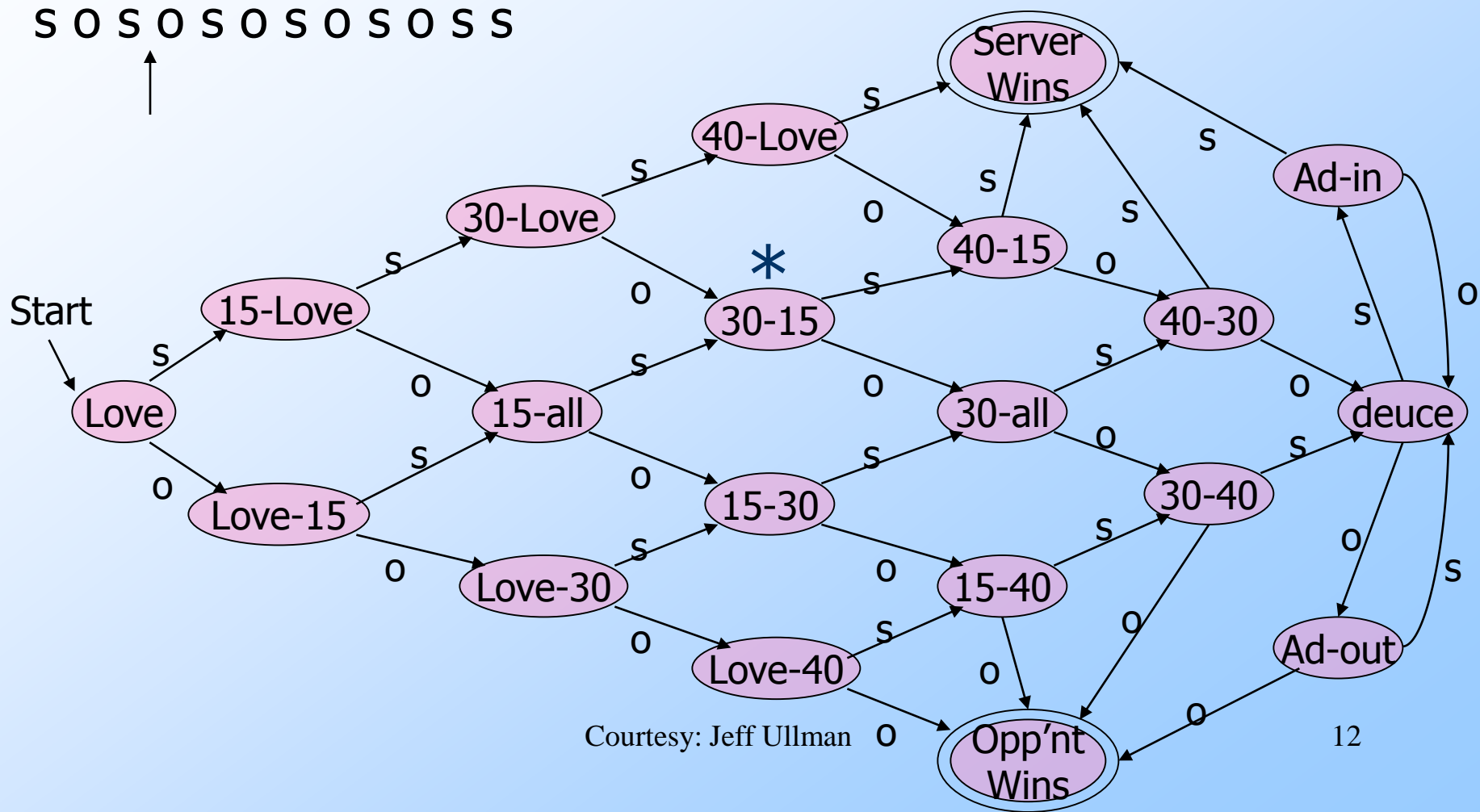
Example: Processing a String

Courtesy: Jeff Ullman

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Example: Processing a String
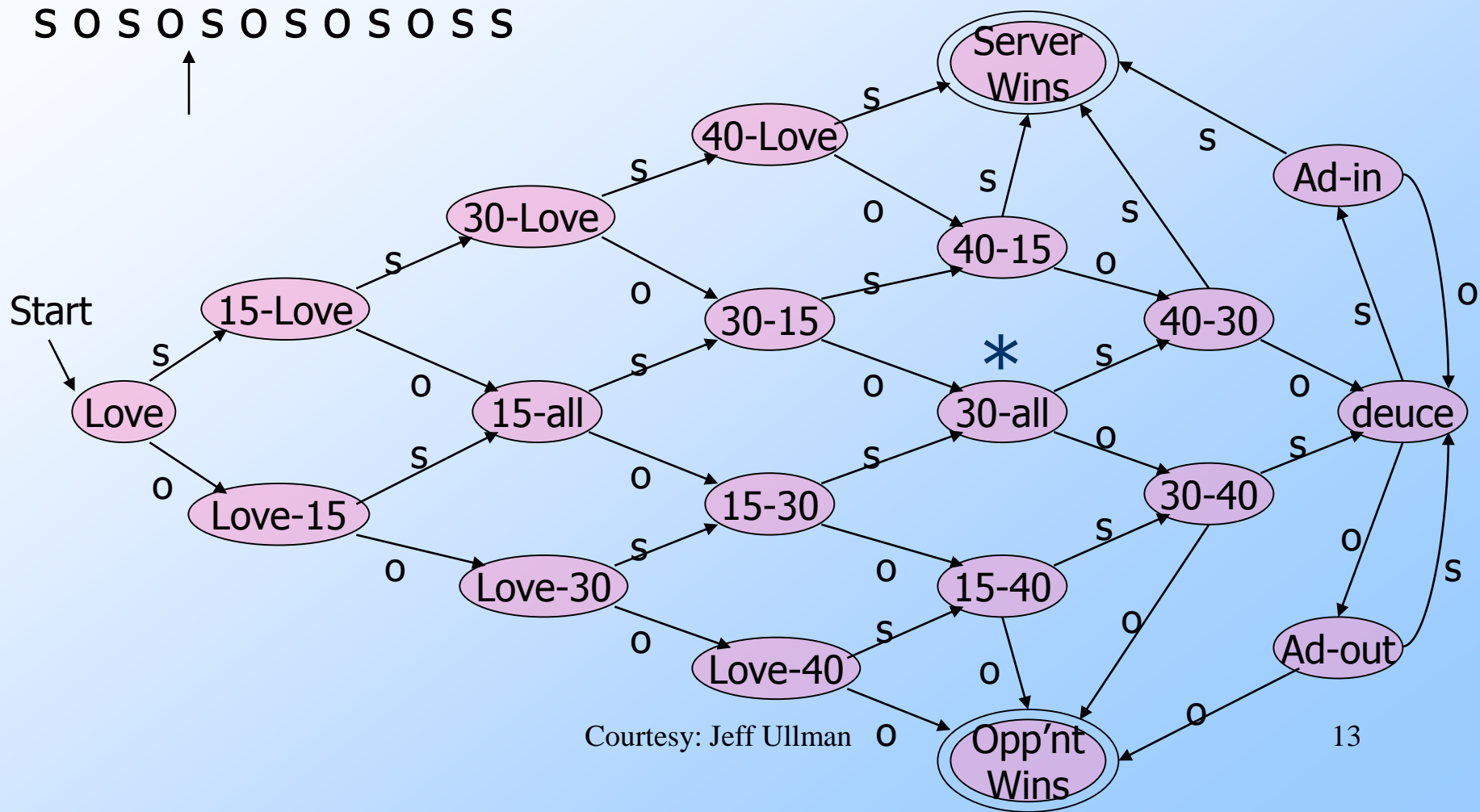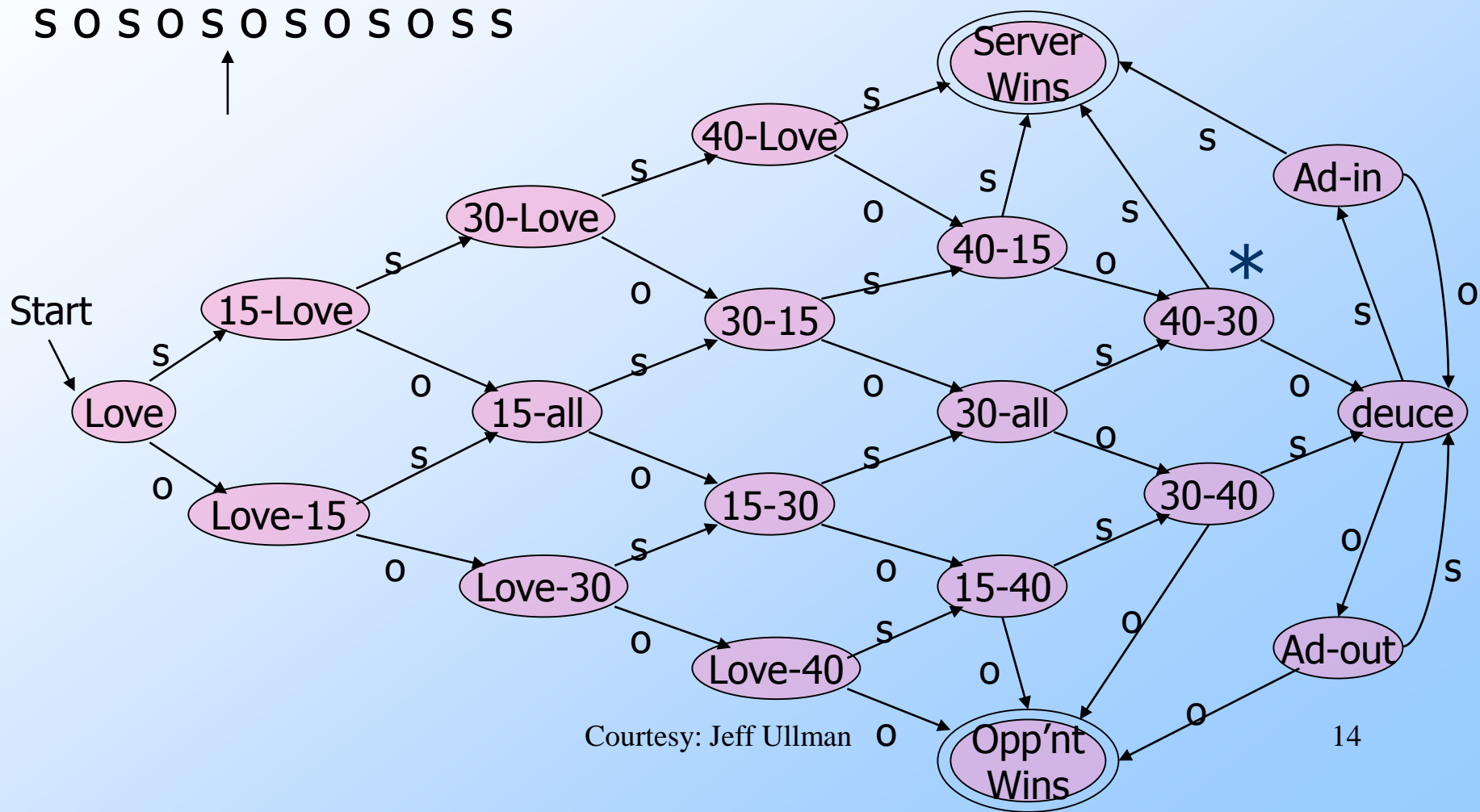
s o s o s o s o s o s s

Courtesy: Jeff Ullman

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Example: Processing a String

S O S O S O S O S O S S

Courtesy: Jeff Ullman

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Example: Processing a String

s o s o s o s o s o s o s s

Courtesy: Jeff Ullman

12

Example: Processing a String

s o s o s o s o s o s s

Courtesy: Jeff Ullman

13

Example: Processing a String

s o s o s o s o s o s s

Courtesy: Jeff Ullman

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Example: Processing a String

s o s o s o s o s o s s

Courtesy: Jeff Ullman

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Example: Processing a String
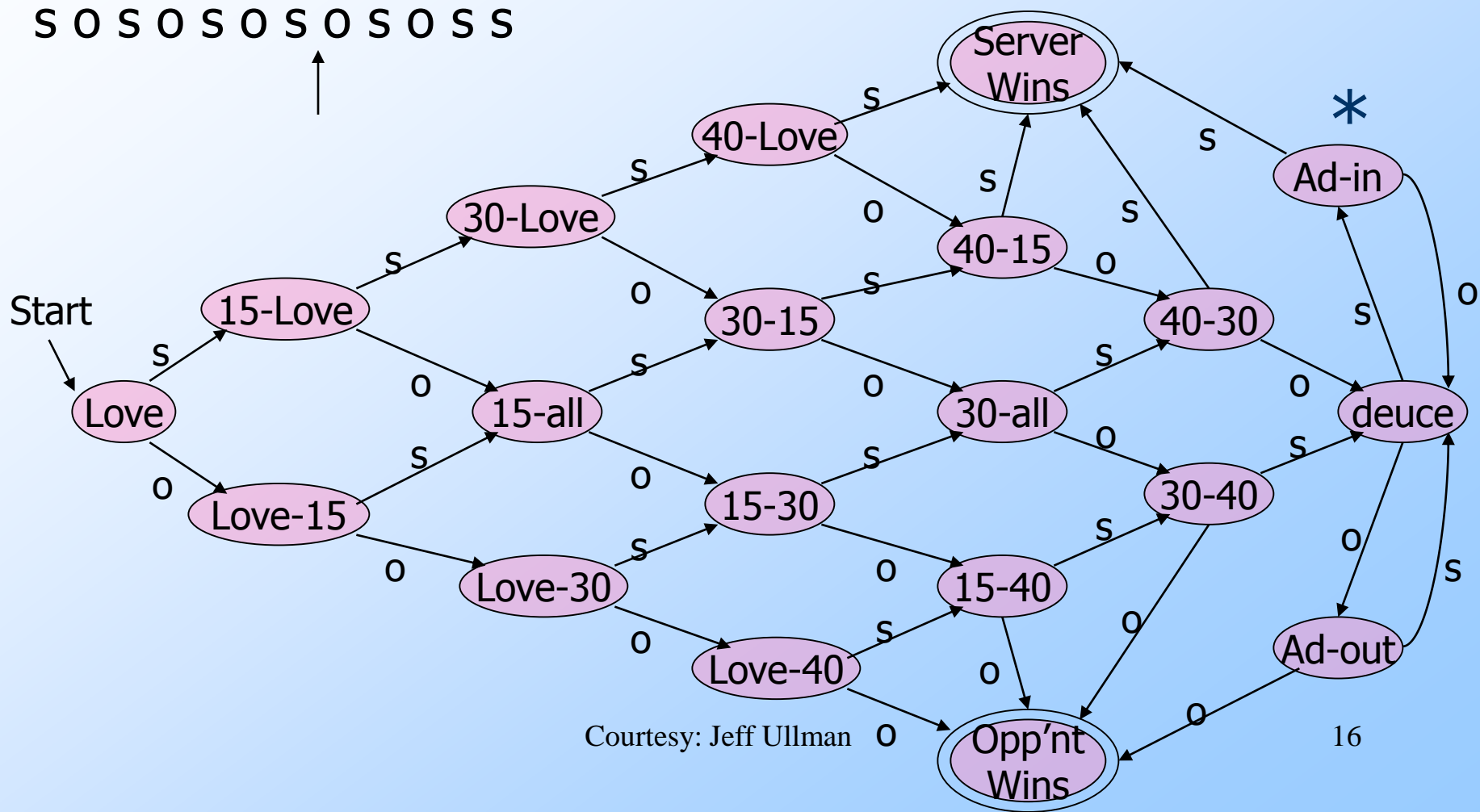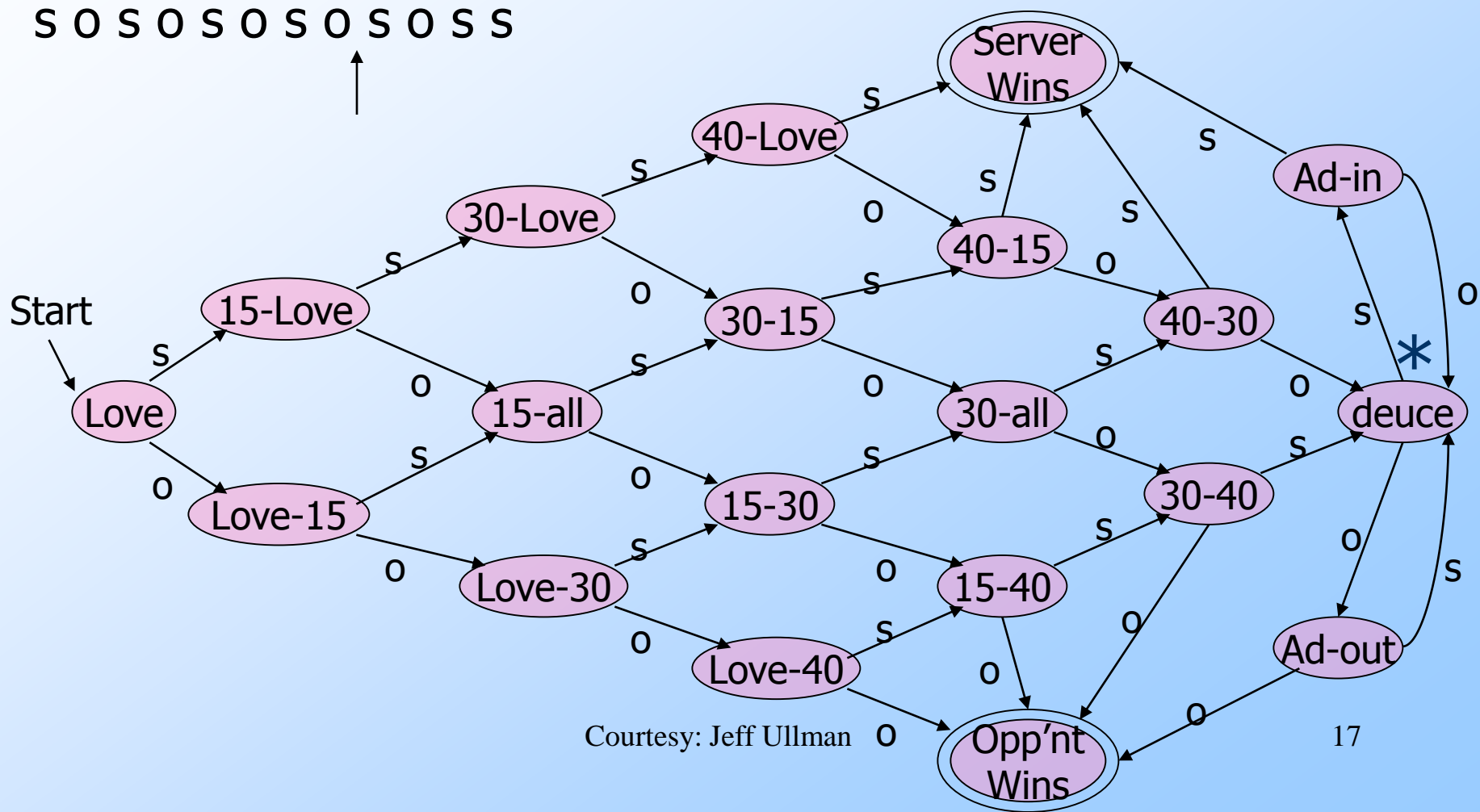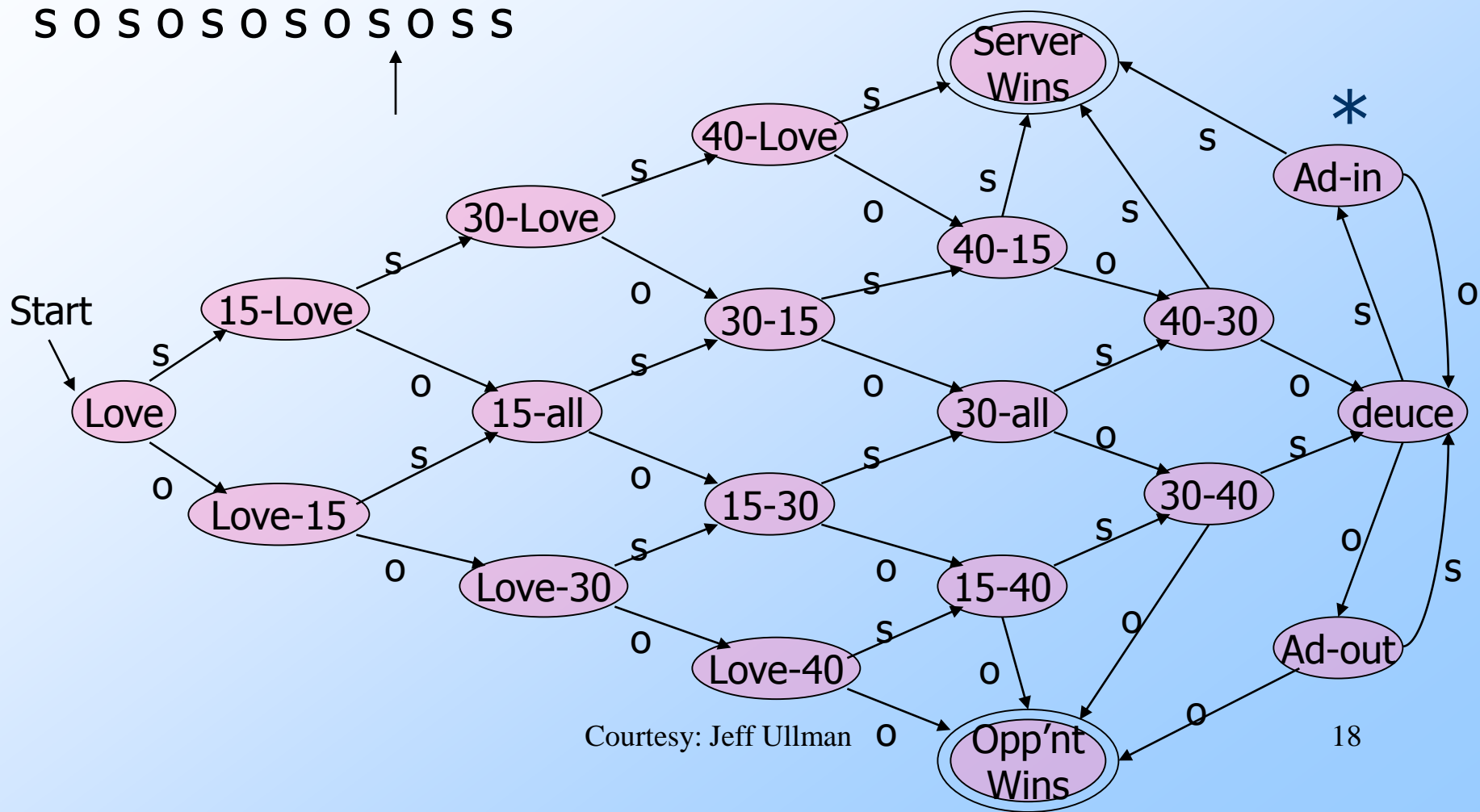
s o s o s o s o s o s s

Courtesy: Jeff Ullman

Example: Processing a String

Courtesy: Jeff Ullman

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Example: Processing a String

s o s o s o s o s o s o s s

Courtesy: Jeff Ullman

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Example: Processing a String

s o s o s o s o s o s o s s

Courtesy: Jeff Ullman

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Example: Processing a String

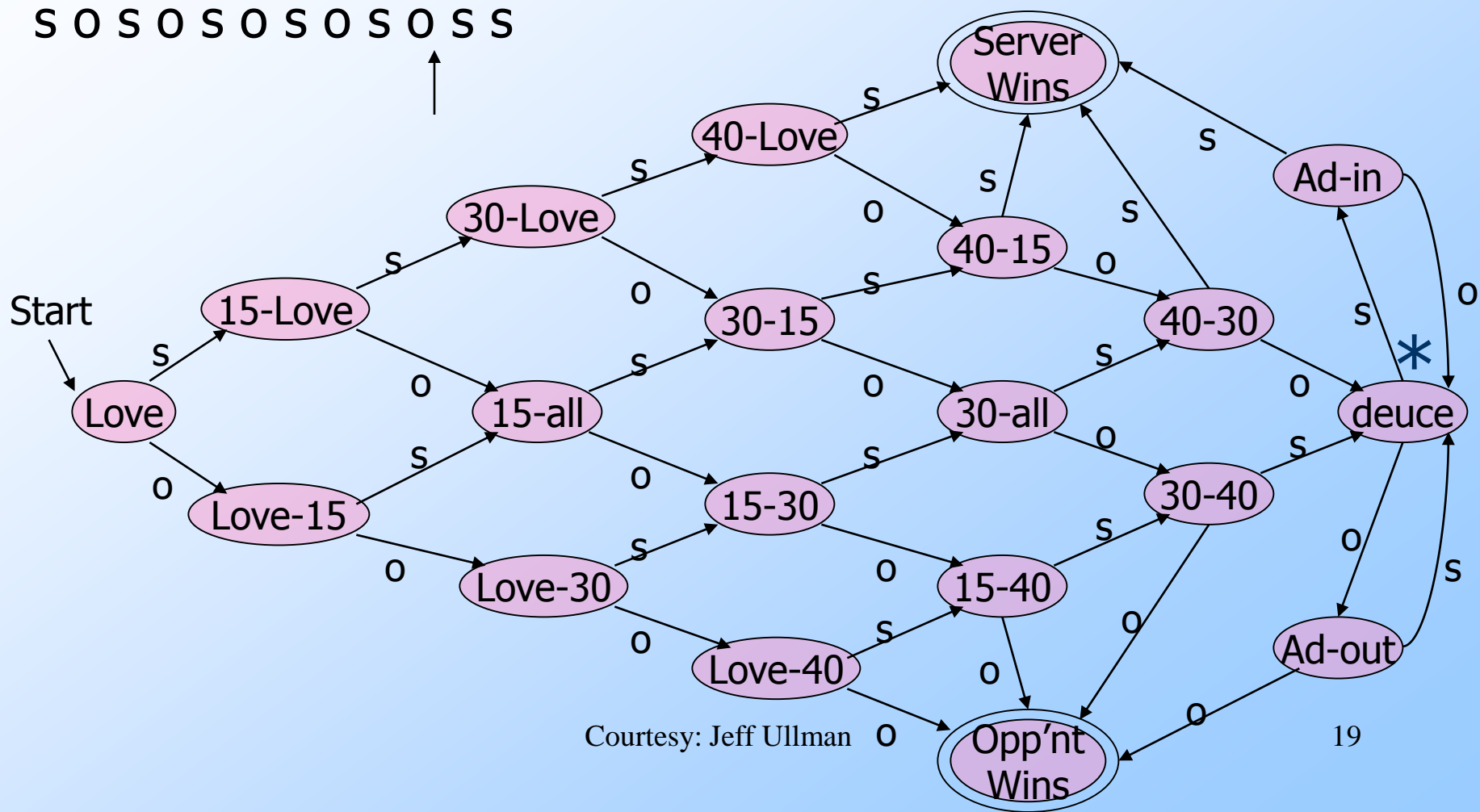

Courtesy: Jeff Ullman

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Example: Processing a String

S O S O S O S O S O S O S S

Courtesy: Jeff Ullman

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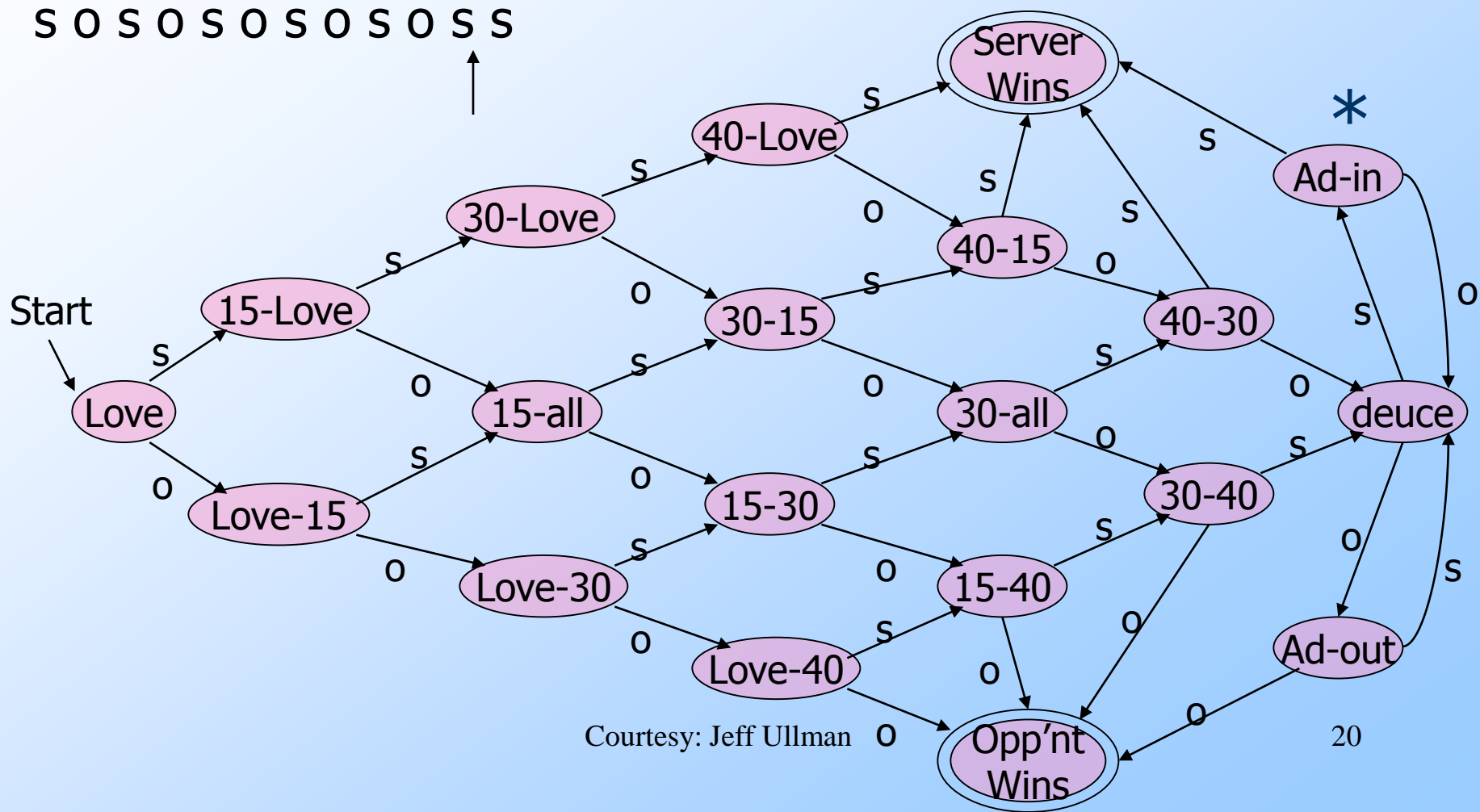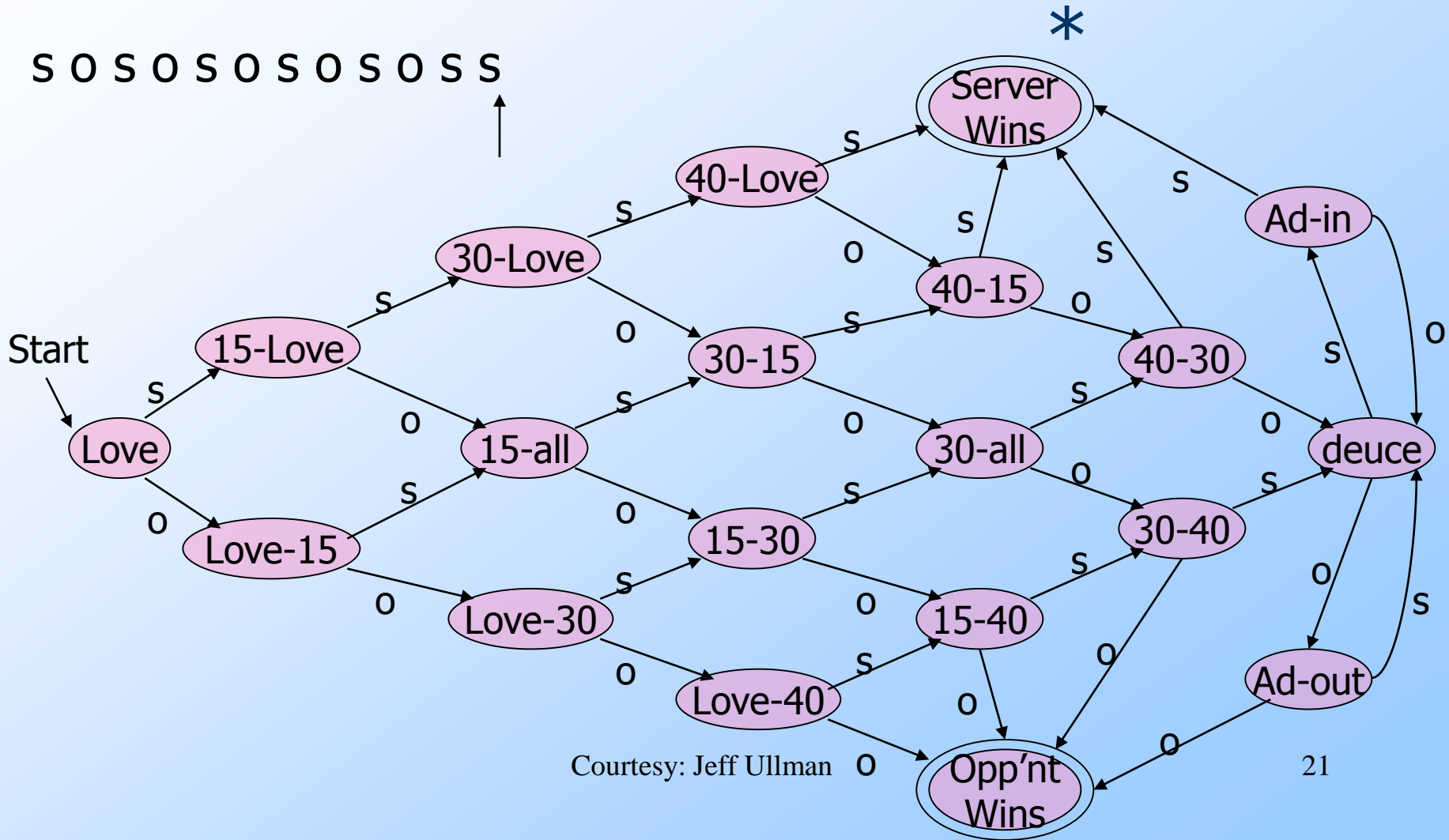
Example: Recognizing Strings Ending in "ing"
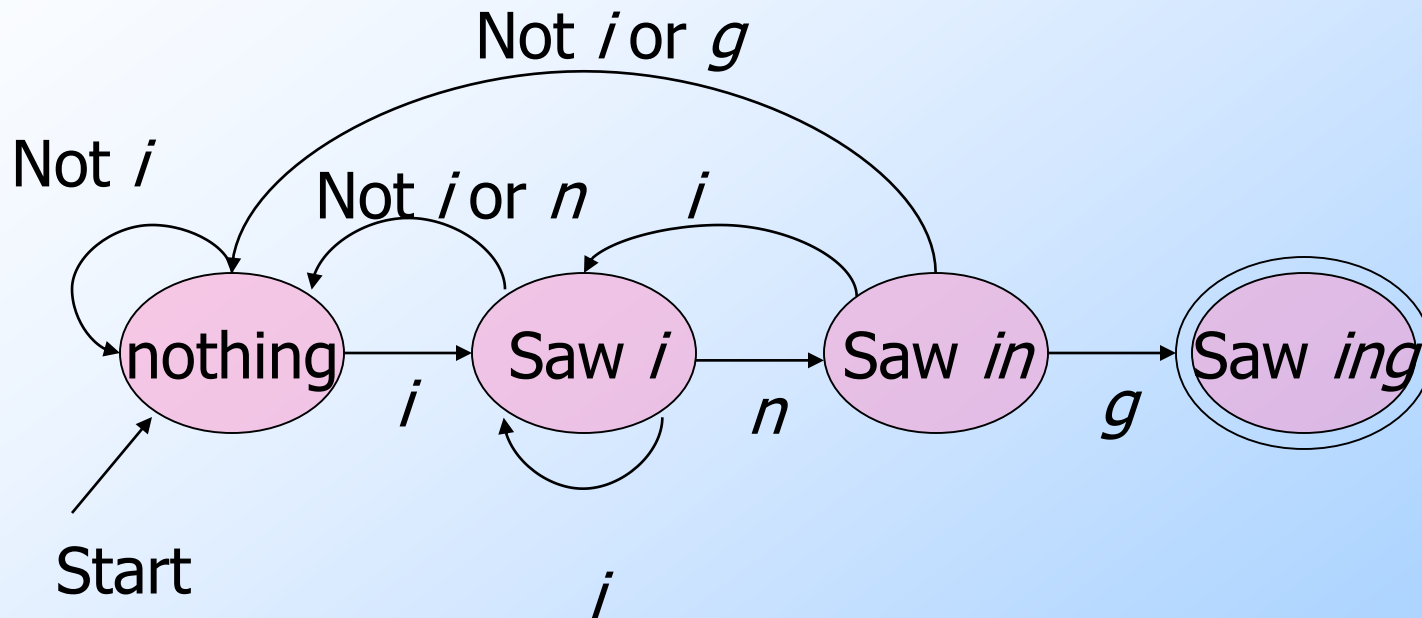
Automata to Code

◆ In C/C++, make a piece of code for each state. This code:

1. Reads the next input.
2. Decides on the next state.
3. Jumps to the beginning of the code for that state.

Example: Automata to Code

```
2: /* i seen */
   c = getNextInput();
   if (c == 'n') goto 3;
   else if (c == 'i') goto 2;
   else goto 1;
3: /* "in" seen */

   . . .
```

Language of an Automaton

◆ The set of strings accepted by an automaton A is the *language* of A.

◆ Denoted L(A).

◆ Different sets of final states -> different languages.

◆ Example: As designed, L(Tennis) = strings that determine the winner.