course: CSC 135-01 - Computing Theory and Programming Languages

instructor: Ted Krovetz

related_notes: 2022-03-08

Conversion Algorithms: DFA, NFA, and FA

W10.2 | Tuesday, March 8, 2022 | 08:58 AM

Notes

- NFA is like DFA, but with additional features
  - λ in NFA you can feed in an empty/nothing string

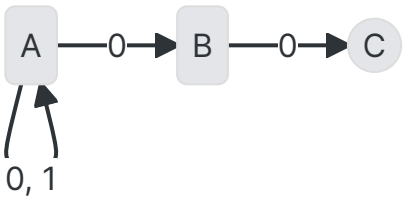
```
flowchart LR
        DFA <—> NFA <—> RE
```

NFA To DFA

- NFA are often simpler to design, but are equivalent to DFA
- NFA to DFA may mean O(n) → O(2n) time complexity

`Node C` is an accepting state

NFA



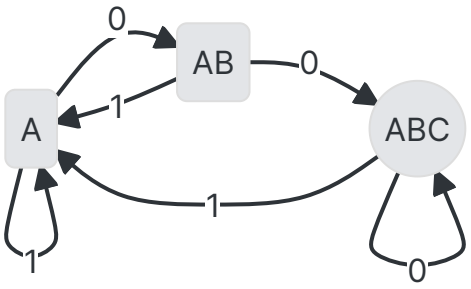
DFA

Idea: Each DFA tracks which NFA states the NFA could be in after consuming a sequence of characters

1. Label DFA start state with where NFA could be without consuming anything
2. Make DFA legal. Repeat:

1. Identify missing DFA arrow and determine which states NFA could be in if consuming that character
2. New arrow goes to state labeled with the states

3. Any DFA state listing NFA accept is accept



Regular Expressions (RE) to NFA

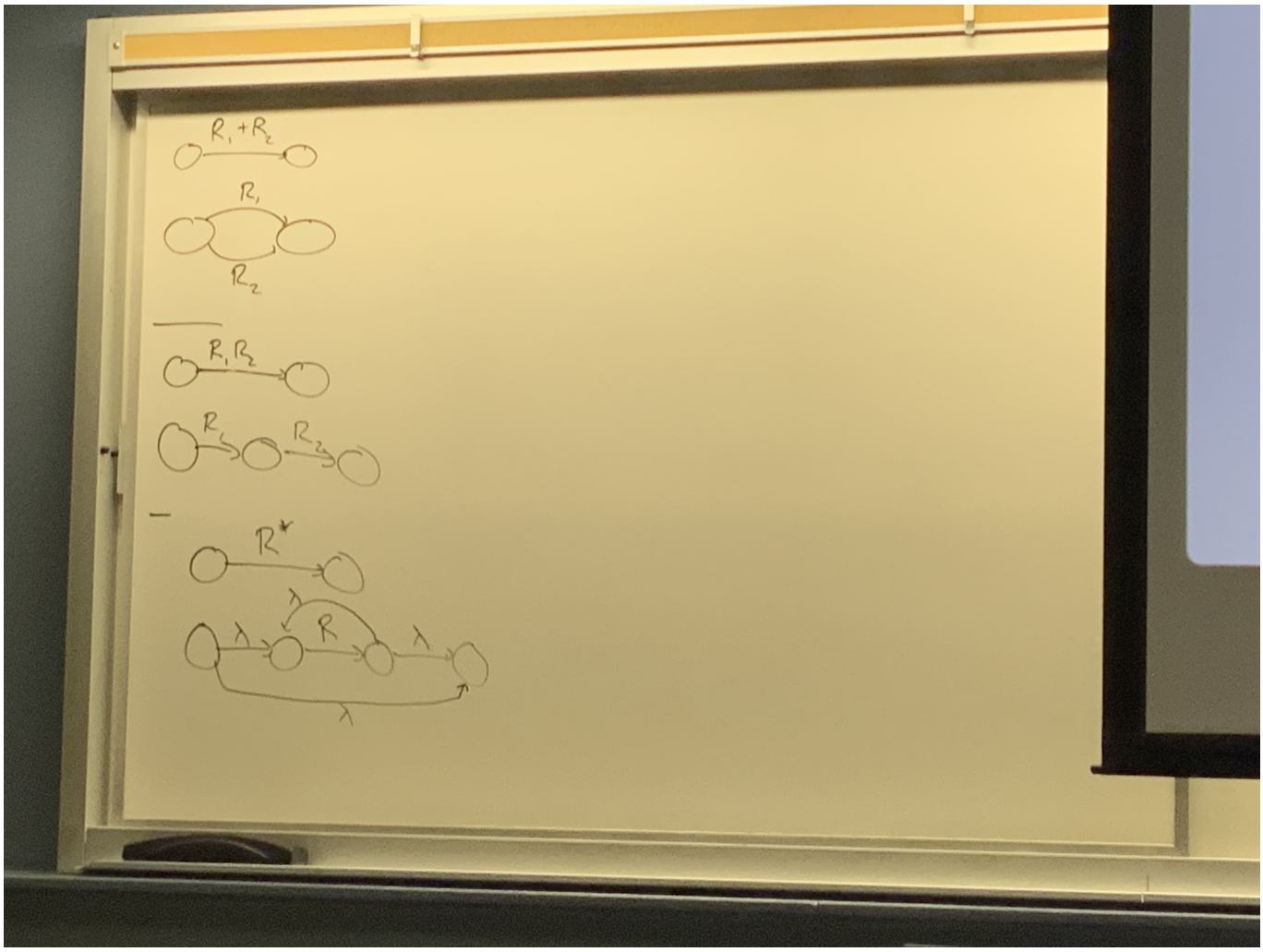
$(a + bb)^*$

Intermediate visualization device

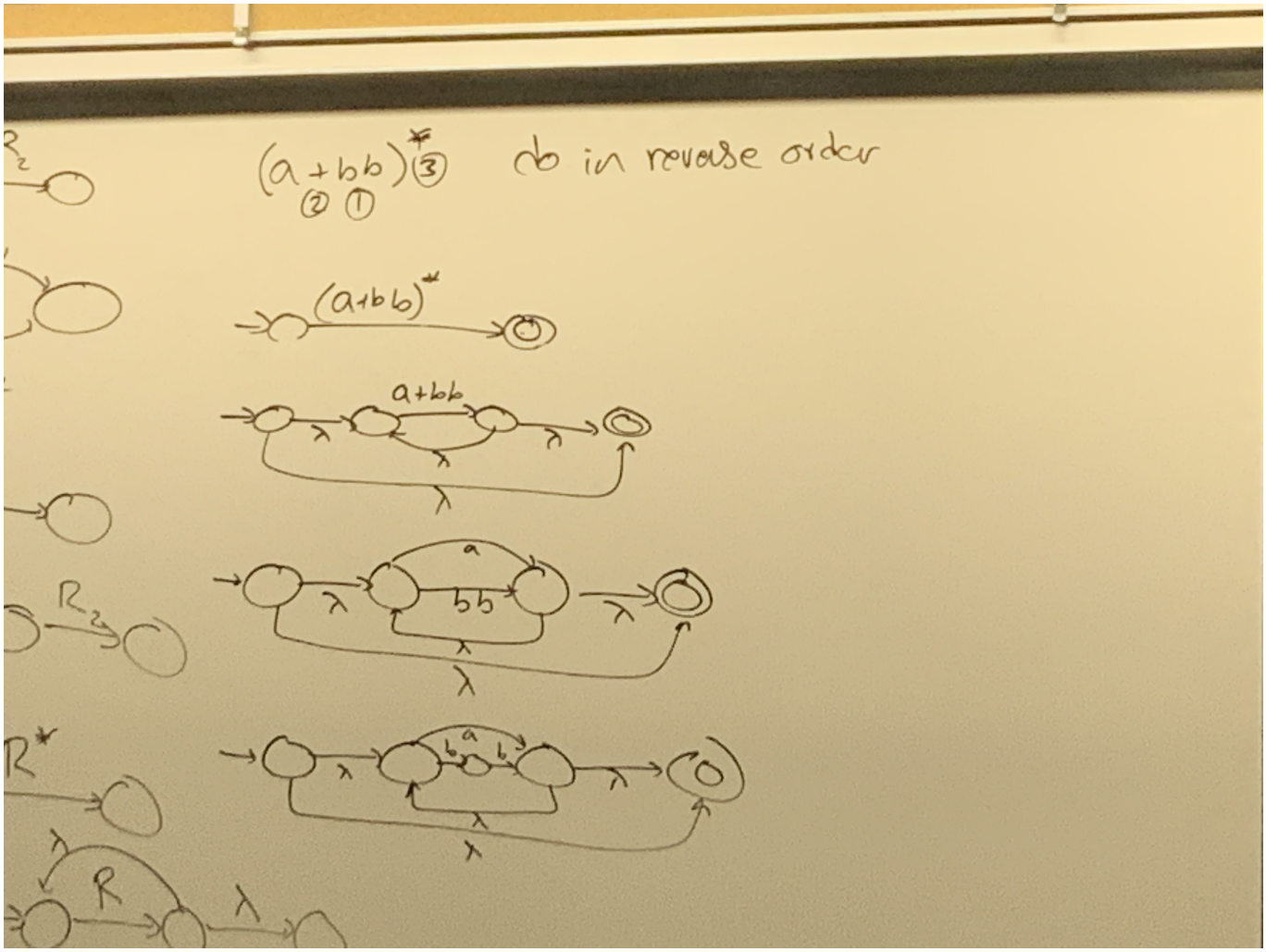
```
Error parsing Mermaid diagram!

Lexical error on line 2. Unrecognized text.
...hart LR      A( ) --> B[“(a+bb)^*”]  B --> C
----------------------^
```

The conversion



Example 02: $(a + bb)^*$



Step 01: bb

```
Error parsing Mermaid diagram!

Parse error on line 1:
Flowchart LR    [*] --
^
Expecting 'open_directive', 'NEWLINE', 'SPACE', 'GRAPH', got 'ALPHA'
```

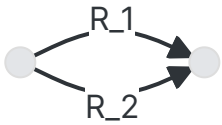
Step 02: $+$

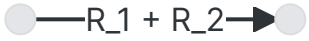
Step 03: $*$

NFA to RE

Note

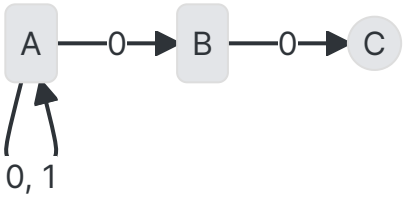
Replace parallel edges as needed



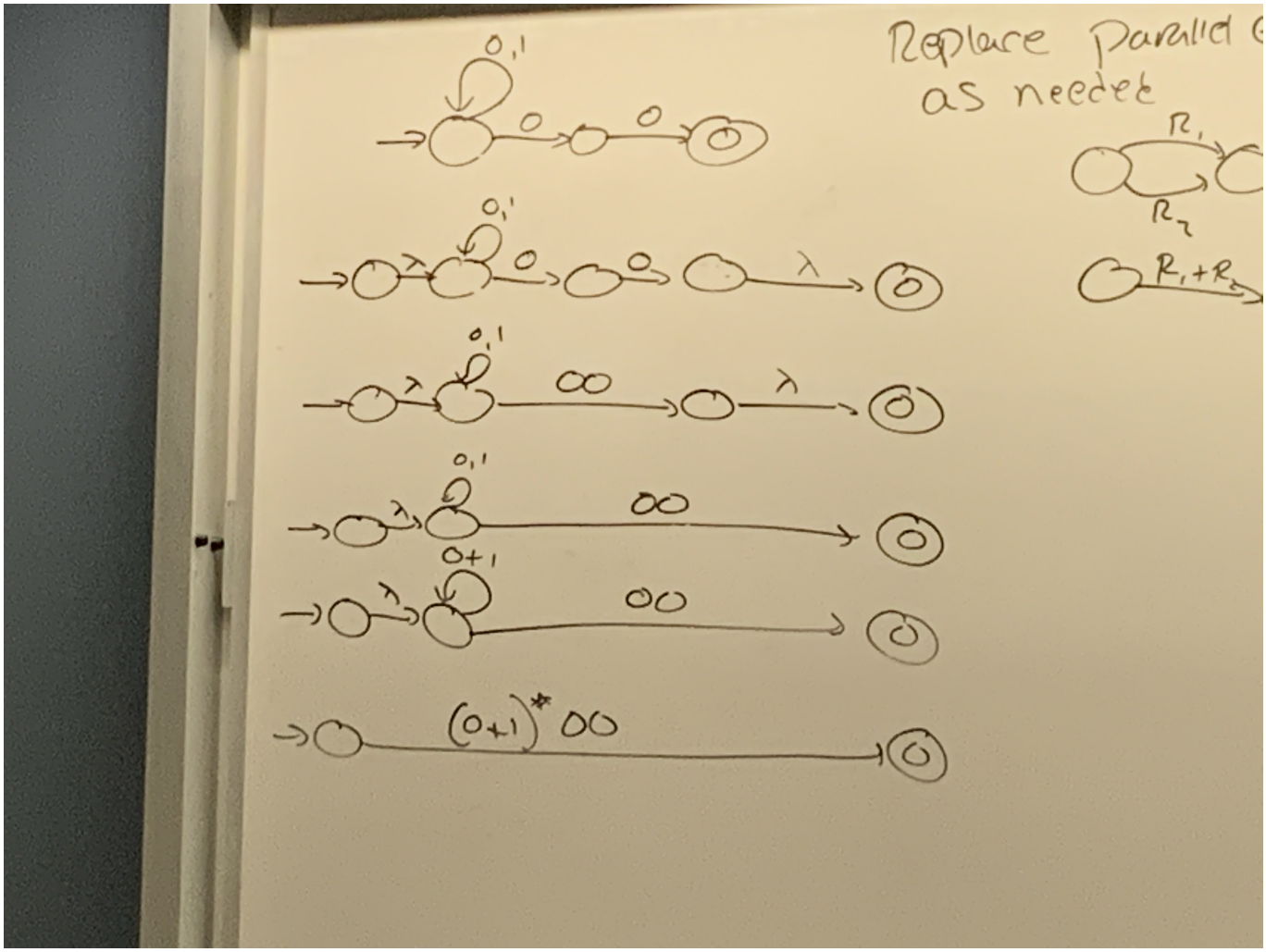


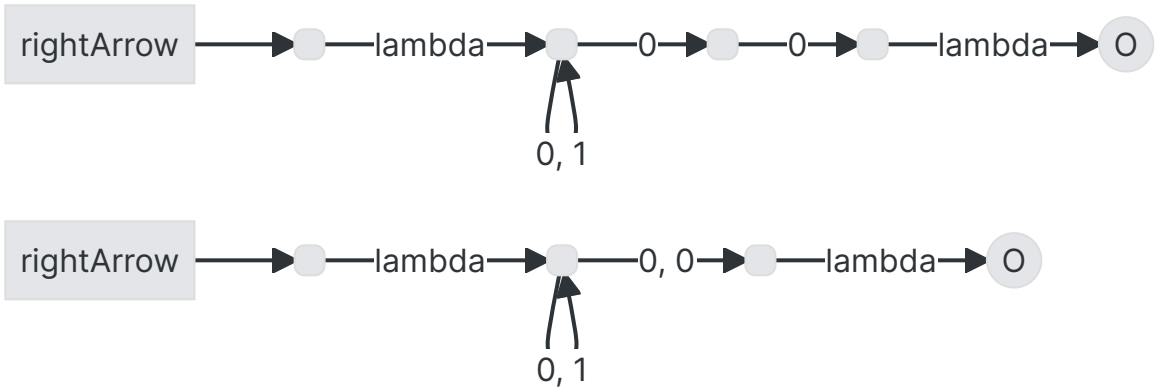
NFA to RE Conversion Example 01

NFA that accepts a pair of 1s and 0s



we want only one accept state





NFA to RE Conversion Example 02

Convert this NFA to RE