GENERATING STATE-BASED SYNTAX HIGHLIGHTERS FROM RASCAL'S CONTEXT-FREE GRAMMARS

By Edser Apperloo

university of groningen

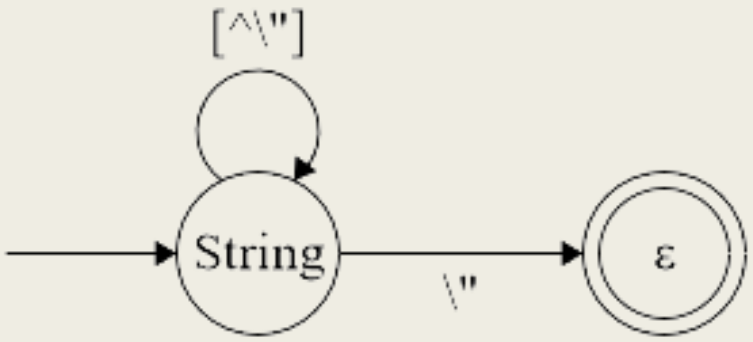
Supervisors:
Tijs van der Storm
&
Mircea Lungu

State-based syntax highlighters

- CFGs are too complex
- Similar to state machines
- Contexts
- Matches
- Scopes

State-based syntax highlighters

- Contexts -> States
- Matches -> Transitions
- Scopes -> Colouring




```
String:
  - meta_scope: string.quoted.double
  - match: '[^\"]'
  - match: \"
    pop: true
```

The designed algorithm in Rascal

- How to embed highlighter information?
- Simplify grammars
- Transform to strongly regular grammars
- To component machines
- Translation to a syntax highlighter

The original grammar

- Example sentences:
  - *“bbddbdb”*
  - *“bdbdbd”*

```
lexical A = (B | D)+;

lexical B
    = @Context="keyword.control.flow" "b"
    | @Context="null keyword.control.flow" D "b"
    ;

lexical D
    = @Context="storage.type" "d"
    | @Context="storage.type null" "d" B
    ;
```

- *@Context=“storage.type”*
- *@Context=“null storage.type”*

The plain version

- Rewritten regular tokens
- Reduce to (S,N,T,P)

```
start syntax S = A;

lexical A = B_D_ALT_PLUS;

lexical B_D_ALT_PLUS
  = B_D_ALT B_D_ALT_PLUS
  | B_D_ALT
  ;

syntax B_D_ALT
  = B
  | D
  ;

lexical B
  = @Context="keyword.control.flow" "b"
  | @Context="null keyword.control.flow" D "b"
  ;

lexical D
  = @Context="storage.type null" "d" B
  | @Context="storage.type" "d"
  ;
```

Strongly regular version

- Mohri and Nederhof
- Transforms any CFG into a strongly regular approximation

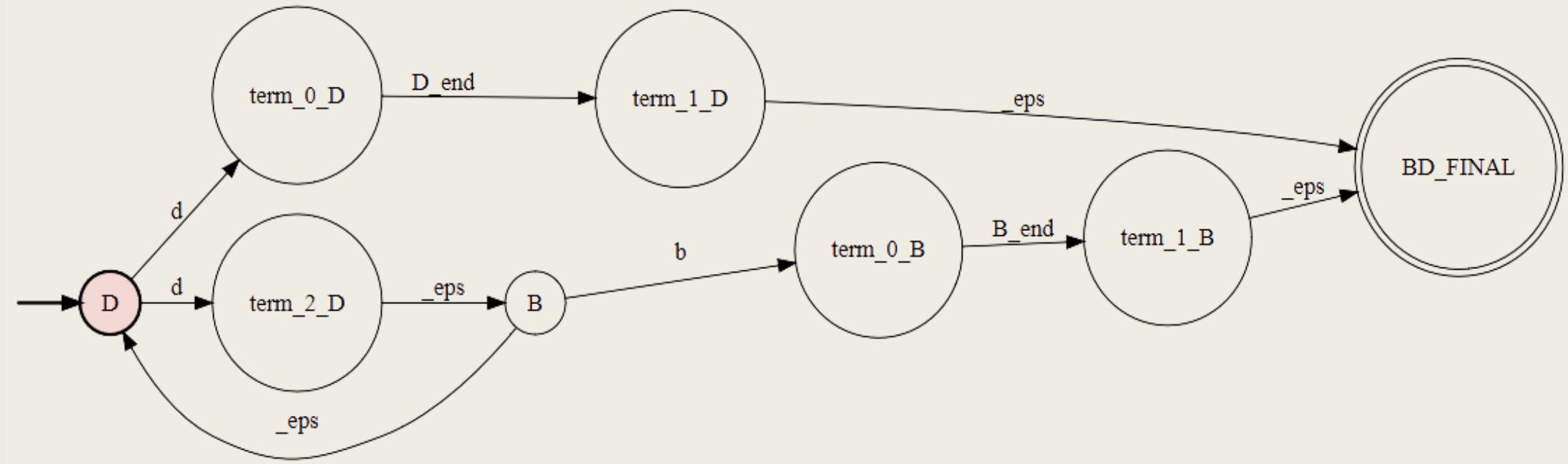
```
start syntax S = A;

lexical A = B_D_ALT_PLUS;

lexical B_D_ALT_PLUS
    = B_D_ALT B_D_ALT_PLUS
    | B_D_ALT
    ;

syntax B_D_ALT
  = B
  | D
  ;

lexical B
    = "b" B_end
    | D
    ;

lexical B_end
    = D_end
    |
    ;

lexical D
    = "d" D_end
    | "d" B
    ;

lexical D_end
    = "b" B_end
    |
    ;
```

```
start syntax S = A;

lexical A = B_D_ALT_PLUS;

lexical B_D_ALT_PLUS
    = B_D_ALT B_D_ALT_PLUS
    | B_D_ALT
    ;

syntax B_D_ALT
  = B
  | D
  ;
```

```
lexical B
    = "b" B_end
    | D
    ;

lexical B_end
    = D_end
    |
    ;

lexical D
    = "d" D_end
    | "d" B
    ;

lexical D_end
    = "b" B_end
    |
    ;
```

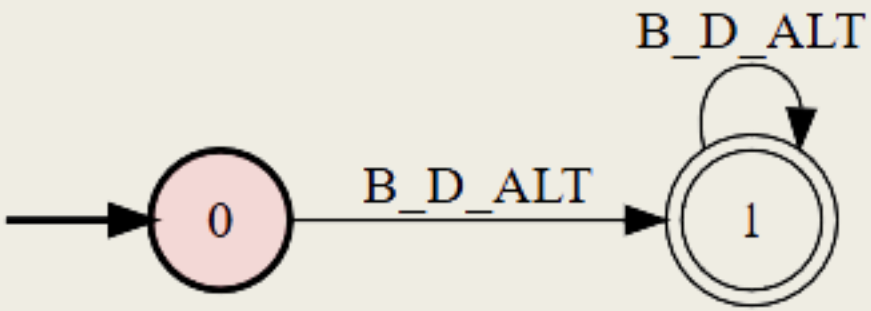
Component machines

- Compact representation
- NFA for “*lexical D*”



Mapping to Highlighter

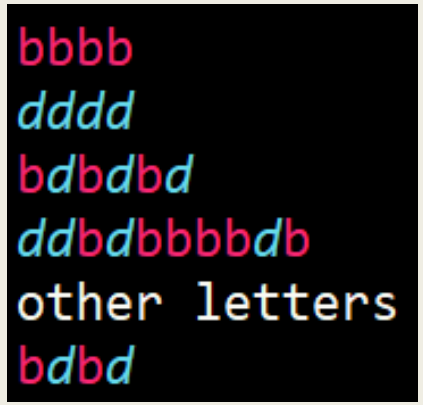
- Almost direct mapping




```
B_D_ALT_PLUS_0:
  - meta_scope: B_D_ALT_PLUS_0
  - match: '(?=(b|d))'
    set: [B_D_ALT_PLUS_1, B_D_ALT_0]


B_D_ALT_PLUS_1:
  - meta_scope: B_D_ALT_PLUS_1
  - match: '(?=(b|d))'
    set: [B_D_ALT_PLUS_1, B_D_ALT_0]
  - match: '(?!((?=(b|d))))'
    pop: true
```

Results & Evaluation

- Performance and resulting highlighter
  - *11 Contexts*
  - *~100 SLOC*



- Reasons for errors:
  - *End-of-line characters ($)*
  - *Parser like behavior*

Results & Evaluation

```
begin
    declare
        i2d : string, nat : natural,
        noHighlightingOnTheNextLine : nil-type
    ;

    %disfunctional multiline
    comment%
    %If is seen as identifier and therefore not highlighted%
    %Once it picks up on colouring the rest of the line colours quite okay%
    %If this was divided over multiple lies it would fal because of $-problem%

    if id then nat := 42 else nat := 24 fi; id := "some %% with comment token literal string";

    %%fails because the rule for line-comment is lower than multiline comment%
    %so its never matched and always opens a multiline comment%

    id := "should not be comment coloured which is good, but string coloured, which fails"
end
```

Conclusion

- Promising at first
- Severity of errors
- Wrong approach

- Future
  - *Retain less of the structure*