Error-Recovery

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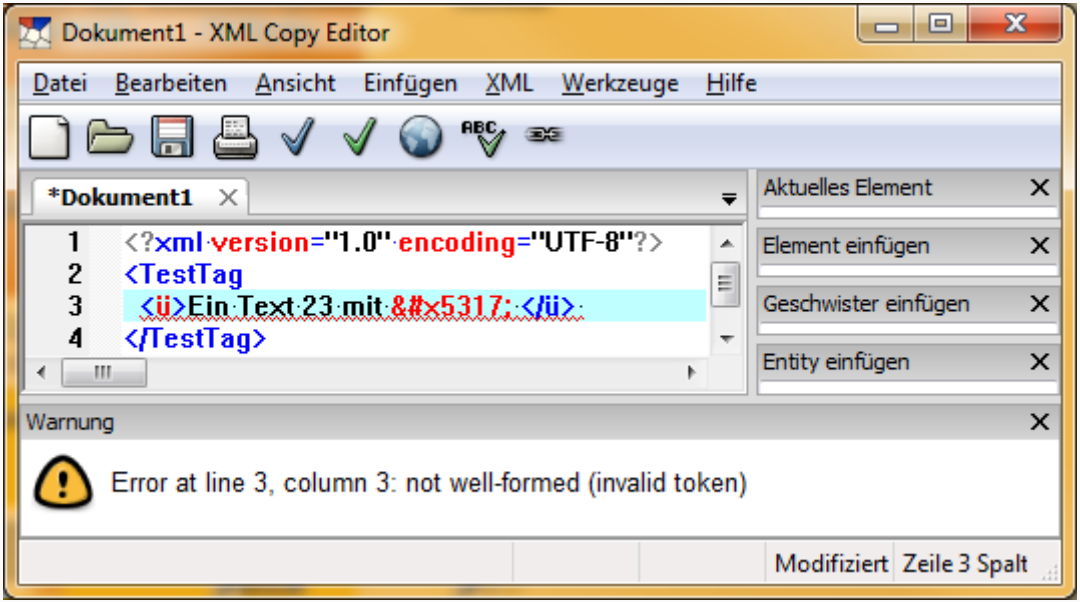
Fehler beim Parsen



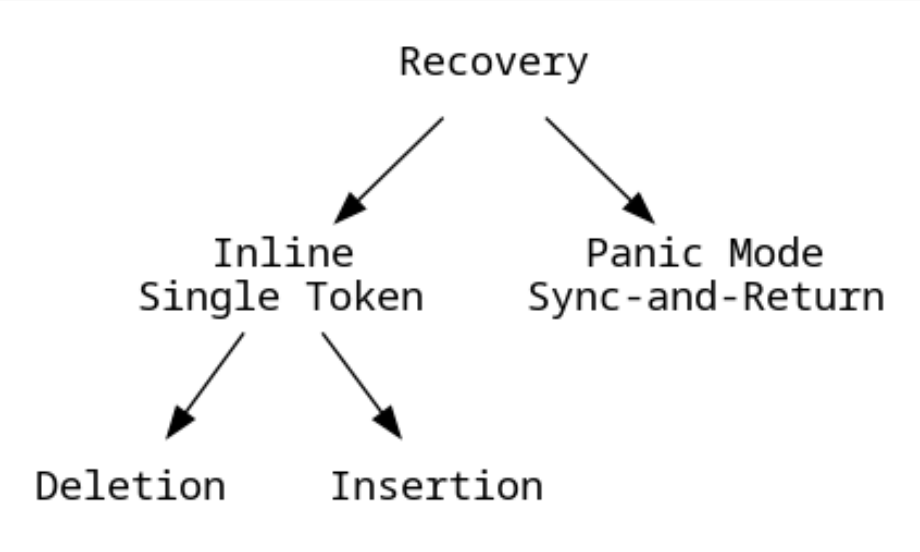
Typische Fehler beim Parsing

```
grammar VarDef;

alt   : stmt | stmt2 ;
stmt  : 'int' ID ';' ;
stmt2 : 'int' ID '=' ID ';'  ;
```

ANTLR4: VarDef.g4, Beispiele: VarDef.txt

Überblick Recovery bei Parser-Fehlern



Skizze: Generierte Parser-Regeln (ANTLR)

```
stmt  : 'int' ID ';' ;
```

```
def stmt():
    try: match("int"); match(ID); match(";")
    catch (RecognitionException re):
        _errHandler.reportError(self)              # let's report it
        _errHandler.recover(self)                  # Panic-Mode

def match(x):
    if lookahead == x: consume()
    else: _errHandler.recoverInline(self)          # Inline-Mode
}
```

Inline-Recovery bei Token-Mismatch (Skizze)

```
def recoverInline(parser):
    # SINGLE TOKEN DELETION
    if singleTokenDeletion(parser):
        return getMatchedSymbol(parser)

    # SINGLE TOKEN INSERTION
    if singleTokenInsertion(parser):
        return getMissingSymbol(parser)

    # that didn't work, throw a new exception
    throw new InputMismatchException(parser)
}
```

Panic Mode: Sync-and-Return (Skizze)

```
def rule():
    try: ... rule-body ...
    catch (RecognitionException re):
        _errHandler.reportError(self)       # let's report it
        _errHandler.recover(self)           # Panic-Mode
}
```

=> Entferne solange Token, bis aktuelles Token im "*Resynchronization Set*"

ANTLR: Einsatz des "*Resynchronization Set*"

```
stmt : 'if' expr ':' stmt           // Following Set für "expr": {':'}
     | 'while' '(' expr ')' stmt ;  // Following Set für "expr": {')'}
expr : term '+' INT ;               // Following Set für "term": {'+'}
```

- Eingabe: `if :`
- Aufruf-Stack nach Bearbeitung von `if`: `[stmt, expr, term]`
- **Resynchronization Set**: `{'+', ':'}`

Hinweis: *FOLLOW* $\neq$ *Following*

Panic Mode in Bison (Error Recovery)

```
stmt : 'int' ID ';'     { printf("%s\n", $2); }
     | error '\n'       { yyerror(); yyerrok; }
     ;
```

Fehlerproduktionen

```
stmt : 'int' ID ';'
     : 'int' ID              {notifyErrorListeners("Missing ';'");}
     : 'int' ID ';' ';'      {notifyErrorListeners("Too many ';'");}
     ;
```

```
stmt : 'int' ID ';'     { $$ = $2; }
     : 'int' ID         { yyerror("unterminated id");
                          $$ = $2; }
     ;
%%
void yyerror(char *s, ...) {
    va_list ap; va_start(ap, s);
    fprintf(stderr, "%d: error: ", yylineno);
    vfprintf(stderr, s, ap); fprintf(stderr, "\n");
}
```

Wrap-Up

- Fehler bei `match()`: *single token deletion* oder *single token insertion*
- Panic Mode: *sync-and-return* bis Token in *Resynchronization Set* (ANTLR4) oder `error`-Token shiftbar (Bison)
  - ANTLR4: Sonderbehandlung bei Start von Sub-Regeln und in Schleifen
  - ANTLR4: Fail-Save zur Vermeidung von Endlosschleifen
- Fehler-Alternativen in Grammatik einbauen

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