`fox-listings` — Listings language definition for COSYScript (COSY INFINITY)

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1 Introduction

The `fox-listings` package provides a language definition for the `listings` package to typeset source code in COSYScript, the programming language of COSY INFINITY, a beam dynamics code using high-order differential-algebraic (DA) transfer maps and methods, developed at Michigan State University. COSYScript is compiled and executed by the FOXY subsystem; source files use the `.fox` extension. This package uses the name `FOX` for the `listings` language identifier and style prefixes.

The package defines six keyword groups that can be independently styled, supports nested {...} comments and single-quoted string literals, and provides two ready-made styles.

2 Usage

Load the package after `listings`:

```
\usepackage{fox-listings}
```

The package automatically loads `listings` and `xcolor`.

2.1 Color style

```
\begin{lstlisting}[style=FOXcolor]
  ...
\end{lstlisting}
```

2.2 Monochrome style

```
\begin{lstlisting}[style=FOXmono]
  ...
\end{lstlisting}
```

2.3 Language only (custom style)

```
\begin{lstlisting}[language=FOX]
  ...
\end{lstlisting}
```

2.4 Inline code

```
\lstinline[language=FOX]{VARIABLE X 1 ;}
```

3 Keyword groups

Keywords are split into six groups so that each category can be styled independently. Groups 1–3 cover the general-purpose language (control flow, math, DA algebra), group 4 covers the beam-physics command set, group 5 covers the graphics subsystem, and group 6 covers built-in constants and global variables. The `FOXcolor` style assigns a distinct color to each group; the `FOXmono` style bolds groups 1, 2, and 6, and leaves the rest unstyled.

Group	Category	Examples
1	Control flow, declarations	PROCEDURE, IF, VARIABLE, WRITE
2	Intrinsic functions	SIN, SQRT, ABS, CONS, DA
3	Intrinsic procedures	DAINI, VELSET, CONFIG_SET
4	Beam physics	OV, MQ, CR, FR, ER
5	Graphics	GRMOVE, GRDRAW, GREPS, PP
6	Constants/globals	PI, CLIGHT, MAP, RAY

4 Examples

4.1 Color style (FOXcolor)

```
INCLUDE 'COSY' ;
VARIABLE X 1 ;
VARIABLE Y 1 ;

{Compute and display a value}
X := SIN(0.5) ;
Y := SQRT(X) + 1 ;
WRITE 6 'Result:' Y ;

PROCEDURE GREET A B ;
   VARIABLE C 1 ;
   C := A + B ;
   WRITE 6 'Sum =' C ;
ENDPROCEDURE ;

GREET 3 4 ;

OV 3 2 0 ;
UM ;
MQ 0.5 0.1 ;
CR ;
PP -10 10 -10 10 ;

END ;
```

4.2 Monochrome style (FOXmono)

```
INCLUDE 'COSY' ;
VARIABLE X 1 ;

PROCEDURE ORBIT_FIND ;
   VARIABLE TOL 1 ;
   TOL := 1E-10 ;
   FIT X := 0 ;
      UM ; MQ 0.5 0.1 ; CR ;
```

```
   ENDFIT 1E-12 100 1 1 ;
ENDPROCEDURE ;

ORBIT_FIND ;
WRITE 6 'Orbit:' X ;
END ;
```

4.3 DA computation with orbit fitting

```
INCLUDE 'COSY' ;

PROCEDURE RUN ;
   VARIABLE KE 1 ;  VARIABLE NUX 1 ;  VARIABLE NUY 1 ;
   OV 3 3 0 ;
   KE := 30 ;
   RPP KE ;

   {Find closed orbit by adjusting initial conditions}
   FIT MAP(1) := 0 ; MAP(3) := 0 ;
      UM ;
      DL 0.5 ; MQ 0.3 0.12 ; DL 0.5 ;
      MQ -0.25 0.12 ;
      CR ;
   ENDFIT 1E-12 100 1 1 ;

   {Extract tunes from the one-turn transfer map}
   NUX := ACOS(CONS(MAP(1) + MAP(2+NM1))/2) / (2*PI) ;
   NUY := ACOS(CONS(MAP(3) + MAP(4+NM1))/2) / (2*PI) ;
   WRITE 6 'Tunes: '&SF(NUX,'(F8.5)')&'  '&SF(NUY,'(F8.5)') ;
ENDPROCEDURE ;
RUN ; END ;
```

4.4 Including an external file

Use `\lstinputlisting` to typeset an external `.fox` source file:

```
\lstinputlisting[style=FOXcolor, caption={Simulation program},
  firstline=1, lastline=30]{EEFFAGsim.fox}
```

5 Known limitations

The `listings` package does not highlight in-code numbers for user-defined languages. Fortran-style `D`-exponent notation (e.g., `1.5D-3`) and standard decimal literals (`0.5`, `1E-3`) are rendered in the base style.

Because COSYScript is case-insensitive (`sensitive=false`), short keywords such as `OV`, `MQ`, and `CR` may highlight user variables that happen to share the same name. This is inherent to the `listings` tokenizer; avoiding these names for user variables is recommended.

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