

## Left Recursion Removal Worksheet

Remove all Kleene \* notation. Do not use left recursion.

Use the replacement examples for numbers 2 and 15 to guide you in subsequent items. If you must add a non-terminal (e.g. #15), add a production for it.

Submit this to the Left Recursion dropbox on D2L by the due date.

1. `<program> --->`  
`program <ident> dec <dec part> begin <statement part> end.`

2. `<dec part> ---> <list var> : <type> [; <list var> : <type>]*`

Replace with: `<list var> : <type> | <list var> : <type> ; <dec part>`

Note the right recursion

3. `<list var> ---> <ident> [, <ident>]*`

5. `<type> ---> real | int`

6. `<statement part> ---> <statement> [; <statement>]*`

7. `<statement> ---> <input> | < output> | <assign>`

8. `<input> ---> Read ( <list var> )`

9. `<output> ---> Write ( < list var> )`

10. `<assign> ---> <ident> = <expression>`

11. `<expression> ---> <term> + <term> | <term> - <term>`

12. `<term> ---> <factor> * <factor> | <factor> / <factor>`

13. `<factor> ---> <namedigit> | ( <expression> )`

14. `<namedigit> ---> <ident> | <num>`

15. `<ident> ---> <letter> [<letter> | <digit>]*`

Replace with: `<letter> | <letter> <rest of ident>`

16. `<num> ---> <digit> [<digit>]*`