CKY Parsing Project: HASKELL LanGUAGE

CSCI-549 Automata

Project Assignment

Texas A&M University-Commerce Computer Science

Student Name: Chiho Kim

CWID: 50284532

Professor: Dr. Sang C. Suh

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1. SENTENCES

1.1. VALID SENTENCES

1. search day= 2 in published\_date

2. search authors = ”Steave”

3. find titles = “Automata”

4. find (==num\_of\_books)

5. filter (>=5) month\_of\_publication

6. find (==name\_of\_author)

7. length “Title\_of\_this\_book”

8. search (==year\_of\_publication)

9. filter (<=5) number\_of\_authors

10. (author, “Steaven”)

11. (month\_of\_publication, 7)

12. search authors = “Jobs”

13. month\_of\_publication = 12

14. filter (==1.0) version\_of\_book

15. length “Author\_of\_this\_book”

1.2. VALID SENTENCES

1. length “Author of this book

2. filter ( == 1.0

3. search authors = “ Jobs

2. LEXICONS

SF → find | length

DF → filter

TF → let, search

LO (Logical opeators) → == | < | > | <= | >=

DO (Definition operators) → =

ODQ (Opening double quotation mark) → “

CDQ (Opening double quotation mark) → ”

OP (Opening paranthesis) → (

CP (Closing paranthesis) → )

Comma → ,

Names → day | published\_date | authors | titles | num\_of\_books | month\_of\_publication | name\_of\_author | Title\_of\_this\_book | year\_of\_publication | number\_of\_authors | author | Steaven | Jobs | version\_of\_book | Author\_of\_this\_book

String → Automata | Steaven | Jobs | Author\_of\_this\_book | Title\_of\_this\_book

Lists → [“Steave”]Any → 2 | 5 | 7 | 12 | 1.0

3. CFG GRAMMA (*Used rules are highlighted*)

**Start → Pairs**

**Start → Any**

Nb (A number) → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

NZNb (A non-zero number) → 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

FP (Floating Point) → .

Negative → -

Number → Nb

Number → NZNb Nb

Integers → Number

Integers → Negative Number

Integers → OP Number CP

Integers → OP Negative Number CP

FPN (Floating Point Numbers) → Number FP Number

FPN → Negative Number FP Number

FPN → OP Number FP Number CP

FPN → OP Negative Number FP Number CP

Bool → False | True

Bools → OP Bool CP

Char (Character) → a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z | \_

SChar (Special Character)   
→ ` | ~ | ! | @ | # | $ | % | ^ | & | \* | ( | ) | + | = | \ | | | [ | ] | { | } | . | , | / | ? | ; | : | ‘ | “ | NUL | SPC | TAB

Character → Char

Character → Character Char

Characters → OQ Character CQ

Characters → OP OQ Character CQ CP

Names → Characters

Names → Names Number

Names → Names Characters

String → SChar

String → Nb

String → Char

String → String SChar

String → String Nb

String → String Char

**ODQ (Opening double quotation mark) → “**

**CDQ (Opening double quotation mark) → ”**

OQ (Opening quotation mark) → ‘

CQ (Opening quotation mark) → ’

**Strings → ODQ String CDQ**

Strings → OP ODQ String CDQ CP

OSB (Opening squared bracket) → [

CSB (Closing squared bracket) → ]

**OP (Opening paranthesis) → (**

**CP (Closing paranthesis) → )**

Comma → ,

**Any → Strings**

Any → Expressions

Any → List

Any → Names

Any → Integers

Any → FPN

Any → Characters

Any → Bools

**Any → FC**

Any → OP Any CP

**Pairs → OP Any Comma Any CP**

RO (Range operator) → ..

IO (Infix operator) → :

Elements → Any

Elements → Elements Comma Elements

Elements → Any IO Elements

Elements → OP Elements CP

List → OSB CSB

List → OSB Elements CSB

List → OSB Nb RO NZNb CSB

List → Any IO Any

Expression → Any AO Any

Expression → Any LO Any

Expression → Expression AO Any

Expression → Expression LO Any

Expression → Any AO Expression

Expression → Any LO Expression

Expressions → Expression

**VD (Variable Definition) → Names DO Any**

VD → LH DO Any

VD → PH DO Pairs

PH (Pairs with holes) → OP EH Comma EH CP

EH (Elements with holes) → Any

EH → Hole

EH → ^

EH → EH Comma EH

EH → Any IO OP EH CP

LH (List with holes) → OSB Elements CSB

LH → OSB Nb RO NZNb CSB

LH → Any IO Any

IEH (Infix expressions with holes) → Hole

IEH → Names

IEH → Hole IO IHE

IEH → Names IO IHE

IEH → LH IO IHE

IEH → Hole IO OP IHE CP

IHE → Names IO OP IHE CP

IHE → OP IHE CP

EH (An expression with holes) → OSB CSB

EH → Names IO Hole

EH → Hole IO Names

EH → Hole IO

EHs → OP EH IO Names CP

EHs → OP EH IO Names CP

FC (Function Call) → SF Any

**FC → DEF VD**

**FC → DF Criterion Any**

**FC → DEF VD InOp Any**

DT (Data types): Int, Char, Float, Bool

**SF (Single operand functions) → length | sort | fst | snd**

**DF (Double operand functions) → map | filter**

**TF (Triple operand functions) → let**

**InOp (in operator) → in**

**Criterion → OP LO Integers CP**

**Criterion → OP AO Integers CP**

AO (Arithmatic operators) → + | - | \* | /

**LO (Logical opeators) → == | < | > | <= | >=**

**DO (Definition operators) → =**

Hole (Hole variable) → \_

4. Chomsky Normal Form (CNF)

Start → B1 CP

Start → A1 CDQ

Start → TF VD

Start → TF  
Start → D1 Any  
Start → D2 Any

Start → SF Any

Start → SF Criterion

Strings → A1 CDQ  
A1 → ODQ String

Any → A1 CDQ  
Any → DEF VD  
Any → D1 Any

Any → D2 Any  
Pairs → B1 CP  
B1 → B2 Any

B2 → B3 Comma

B3 → OP Any

VD (Variable Definition) → C1 Any  
C1 → Names DO

FC → SF Any

FC → SF Criterion

FC → TF VD

FC → D1 Any

D1 → DF Criterion

FC → D2 Any  
D2 → D3 InOp

D3 → DEF VD

SF (Single operand functions) → find | length

DF (Double operand functions) → filter

TF (Triple operand functions) → search

InOp (in operator) → in

Criterion → E1 CP

E1 → E2 Integers

E2 → OP LO

Criterion → F1 CP  
F1 → F2 Integers

F3 → OP AO

5. CKY Parser Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1. | search | day | == | 2 | in | published\_date |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | TF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | Any, Names | X | Criterion | X | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | DO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | Any | X | X |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | InOp | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | Names |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2. | search | authors | == | " | Steave | " |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | TF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | Names | X | X | X | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | LO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | ODQ | X | X |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | String | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | CDQ |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |
|  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. | find | titles | = | " | Automata | " |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | SF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | Names | X | X | X | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | DO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | ODQ | A1 | Strings |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | String | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | CDQ |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 4. | find | ( | == | num\_of\_books | ) |
| 0 | 1 | 2 | 3 | 4 | 5 |
|  | SF | X | X | X | Start, FC |
|  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] |
|  |  | OP | X | X | Criterion |
|  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] |
|  |  |  | LO | X | X |
|  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] |
|  |  |  |  | Names | X |
|  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] |
|  |  |  |  |  | CP |
|  |  |  |  |  |  |
|  |  |  |  |  | [4,5] |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 5. | filter | ( | >= | 5 | ) | month\_of\_publication |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | DF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | OP | X | X | Criterion | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | LO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | Any | X | X |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | CP | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | Names |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 6. | find | ( | == | name\_of\_author | ) |
| 0 | 1 | 2 | 3 | 4 | 5 |
|  | SF | X | X | X | Start, FC |
|  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] |
|  |  | OP | X | X | Criterion |
|  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] |
|  |  |  | LO | X | X |
|  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] |
|  |  |  |  | Any | X |
|  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] |
|  |  |  |  |  | CP |
|  |  |  |  |  |  |
|  |  |  |  |  | [4,5] |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 7. | length | " | Title\_of\_this\_book | " |
| 0 | 1 | 2 | 3 | 4 |
|  | SF | X | X | Start, FC |
|  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] |
|  |  | ODQ | X | Any |
|  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] |
|  |  |  | Names | X |
|  |  |  |  |  |
|  |  |  | [2,3] | [2,4] |
|  |  |  |  | CDQ |
|  |  |  |  |  |
|  |  |  |  | [3,4] |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 8. | search | ( | == | year\_of\_publication | ) |
| 0 | 1 | 2 | 3 | 4 | 5 |
|  | SF | X | X | X | Start, FC |
|  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] |
|  |  | OP | X | X | Criterion |
|  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] |
|  |  |  | LO | X | X |
|  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] |
|  |  |  |  | Names | X |
|  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] |
|  |  |  |  |  | CP |
|  |  |  |  |  |  |
|  |  |  |  |  | [4,5] |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 9. | filter | ( | <= | 5 | ) | number\_of\_authors |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | DF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | OP | X | X | Criterion | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | LO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | Any | X | X |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | CP | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | Names |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 10. | ( | author | , | " | Steaven | " | ) |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | OP | B3 | B2 | X | X | B1 | Start, Pairs |
|  |  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] | [0,7] |
|  |  | Names | X | X | X | X | X |
|  |  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] | [1,7] |
|  |  |  | Comma | X | X | X | X |
|  |  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] | [2,7] |
|  |  |  |  | ODQ | X | Any, Strings | X |
|  |  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] | [3,7] |
|  |  |  |  |  | String | X | X |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] | [4,7] |
|  |  |  |  |  |  | CDQ | X |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] | [5,7] |
|  |  |  |  |  |  |  | CP |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | [6,7] |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 11. | ( | month\_of\_publication | , | 7 | ) |
| 0 | 1 | 2 | 3 | 4 | 5 |
|  | OP | B3 | B2 | B1 | Start, Pairs |
|  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] |
|  |  | Any, Names | X | X | X |
|  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] |
|  |  |  | Comma | X | X |
|  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] |
|  |  |  |  | Any | X |
|  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] |
|  |  |  |  |  | CP |
|  |  |  |  |  |  |
|  |  |  |  |  | [4,5] |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 12. | search | authors | = | " | Jobs | " |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | SF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | Any, Names | X | X | X | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | LO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | ODQ | X | X |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | InOp | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | CDQ |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |

|  |  |  |  |
| --- | --- | --- | --- |
| 13. | month\_of\_publication | = | 12 |
| 0 | 1 | 2 | 3 |
|  | VD | X | Start, Any |
|  |  |  |  |
|  | [0,1] | [0,2] | [0,3] |
|  |  | DO | X |
|  |  |  |  |
|  |  | [1,2] | [1,3] |
|  |  |  | Any, Names |
|  |  |  |  |
|  |  |  | [2,3] |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 14. | filter | ( | == | 1.0 | version\_of\_book | ) |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|  | SF | X | X | X | X | Start, FC |
|  |  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] | [0,6] |
|  |  | OP | X | X | X | X |
|  |  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] | [1,6] |
|  |  |  | LO | X | X | X |
|  |  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] | [2,6] |
|  |  |  |  | Any | X | X |
|  |  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] | [3,6] |
|  |  |  |  |  | Any, Names | X |
|  |  |  |  |  |  |  |
|  |  |  |  |  | [4,5] | [4,6] |
|  |  |  |  |  |  | CP |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  | [5,6] |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 15. | length | " | Author\_of\_this\_book | " |
| 0 | 1 | 2 | 3 | 4 |
|  | SF | X | X | Start, FC |
|  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] |
|  |  | ODQ | X | Any, Strings |
|  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] |
|  |  |  | String | X |
|  |  |  |  |  |
|  |  |  | [2,3] | [2,4] |
|  |  |  |  | CDQ |
|  |  |  |  |  |
|  |  |  |  | [3,4] |

6. INVALID SENTENCES

1. length “Author of this book

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | 1 | 2 | 3 |
|  | SF | X | X |
|  |  |  |  |
|  | [0,1] | [0,2] | [0,3] |
|  |  | ODQ | X |
|  |  |  |  |
|  |  | [1,2] | [1,3] |
|  |  |  | String |
|  |  |  |  |
|  |  |  | [2,3] |

2. filter ( == 1.0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 |
|  | SF | X | X | X |
|  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] |
|  |  | OP | X | X |
|  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] |
|  |  |  | LO | X |
|  |  |  |  |  |
|  |  |  | [2,3] | [2,4] |
|  |  |  |  | Any |
|  |  |  |  |  |
|  |  |  |  | [3,4] |

3. search authors = “ Jobs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 |
|  | SF | X | X | X | X |
|  |  |  |  |  |  |
|  | [0,1] | [0,2] | [0,3] | [0,4] | [0,5] |
|  |  | Any, Names | X | X | X |
|  |  |  |  |  |  |
|  |  | [1,2] | [1,3] | [1,4] | [1,5] |
|  |  |  | LO | X | X |
|  |  |  |  |  |  |
|  |  |  | [2,3] | [2,4] | [2,5] |
|  |  |  |  | ODQ | X |
|  |  |  |  |  |  |
|  |  |  |  | [3,4] | [3,5] |
|  |  |  |  |  | InOp |
|  |  |  |  |  |  |
|  |  |  |  |  | [4,5] |