МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ

«ОРЛОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИМЕНИ И.С. ТУРГЕНЕВА»

Кафедра программной инженерии

**Отчет по лабораторной работе**

по дисциплине «Теория языков программирования и методы трансляции»

на тему: «Синтаксический разбор снизу-вверх»

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Группа 61-ИВТ

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**ГРАММАТИКА**

1 SQL’ →SQL

2 SQL→ SELECT FROM WHERE

3 SQL→ SELECT FROM

4 SELECT→ select\_t FIELD\_LIST

5 FROM →from\_t id

6 WHERE→where\_t CONDITION\_LIST

7 FIELD\_LIST→FIELD\_LIST , id

8 FIELD\_LIST →id

9 CONDITION\_LIST→CONDITION\_LIST or\_t BOOLTERM

10 CONDITION\_LIST→ BOOLTERM

11 BOOLTERM → BOOLTERM and CONDITION

12 BOOLTERM → CONDITION

13 CONDITION → VALUE EOPR VALUE

14 EOPR→ <

15 EOPR→ >

16 EOPR → =

17 VALUE→ id

18 VALUE → num

Построим **каноническую совокупность множеств ситуаций** для данной грамматики:

I0 ={[SQL’ → \*SQL],[SQL → \*SELECT FROM WHERE], [SQL → \*SELECT FROM], [SELECT → \*select\_t FIELD\_LIST]};

**I1(SQL) = {[SQL’ → SQL\*]};**

I2(SELECT) = {[SQL → SELECT \* FROM], [SQL → SELECT \* FROM WHERE], [FROM → \*from\_t id]};

I3(from\_t) = {[FROM → from\_t \* id]};

**I4 (id) = {[FROM → from\_t id\*]};**

I5 (FROM) = {**[SELECT → SELECT FROM\*],** [SQL → SELECT FROM \* WHERE], [WHERE → \*where\_t CONDITION\_LIST};

I6 (select\_t) = {[SELECT → select\_t \* FIELD\_LIST], [FIELD\_LIST → \*FIELD\_LIST , id], [FIELD\_LIST→ \*id]};

**I7 (id) = {[FIELD\_LIST → id\*]};**

I8 (FIELD\_LIST) = {**[SELECT → select\_t FIELD\_LIST\*],** [FIELD\_LIST → FIELD\_LIST \* , id]};

I9 (,) = {[FIELD\_LIST → FIELD\_LIST , \* id]};

**I10 (id) = {[FIELD\_LIST → FIELD\_LIST , id\*]};**

**I11 (WHERE)= {[SQL → SELECT FROM WHERE\*]};**

I12 (where\_t)= {[WHERE → where\_t \* CONDITION\_LIST], [CONDITION\_LIST → \*CONDITION\_LIST or\_t BOOLTERM], [CONDITION\_LIST → \*BOOLTERM], [BOOLTERM → \*BOOLTERM and\_t CONDITION], [BOOLTERM → \*CONDITION], [CONDITION → \*VALUE EOPR VALUE], [VALUE → \*id], [VALUE → \*num]};

**I13(id) = {[VALUE → id\*]};**

**I14(id) = {[VALUE → num\*]};**

**I15(CONDITION) = {[BOOLTERM → CONDITION\*]};**

I16 (VALUE) = {[CONDITION → VALUE \*EOPR VALUE], [EOPR → \*<], [EOPR → \*>], [EOPR → \*=]};

**I17 (<) = {[EOPR → <\*]};**

**I18 (>) = {[EOPR → >\*]};**

**I19 (=) = {[EOPR → =\*]};**

I20 (EORP) = {[CONDITION → VALUE EOPR \*VALUE], [VALUER → \*id], [VALUER → \*num]};

**I21 (VALUE) = [CONDITION → VALUE EOPR VALUE\*]};**

I22 (CONDITION\_LIST) = {**[WHERE → where\_t CONDITION\_LIST\*]**, [CONDITION\_LIST → CONDITION\_LIST \*or\_t BOOLTERM]};

I23 (BOOLTERM) = {**[CONDITION\_LIST → BOOLTERM\*],** [BOOLTERM → BOOLTERM \*and\_t CONDITION]};

I24 (and\_t) = {[BOOLTERM → BOOLTERM and\_t \*CONDITION], [CONDITION → \*VALUE EOPR VALUE], [VALUER → \*id], [VALUER → \*num]};

**I25 (CONDITION) = {[BOOLTERM → BOOLTERM and\_t CONDITION\*]};**

I26 (or\_t) = {[CONDITION\_LIST → CONDITION\_LIST or\_t \*BOOLTERM], [BOOLTERM → \*BOOLTERM and\_t CONDITION], [BOOLTERM → \*CONDITION], [CONDITION → \*VALUE EOPR VALUE], [VALUER → \*id], [VALUER → \*num]};

I27 (BOOLTERM) = {**[CONDITION\_LIST → CONDITION\_LIST or\_t BOOLTERM\*],** [BOOLTERM → BOOLTERM \*and\_t CONDITION]};

Таким образом, результирующая каноническая совокупность выглядит следующим образом:

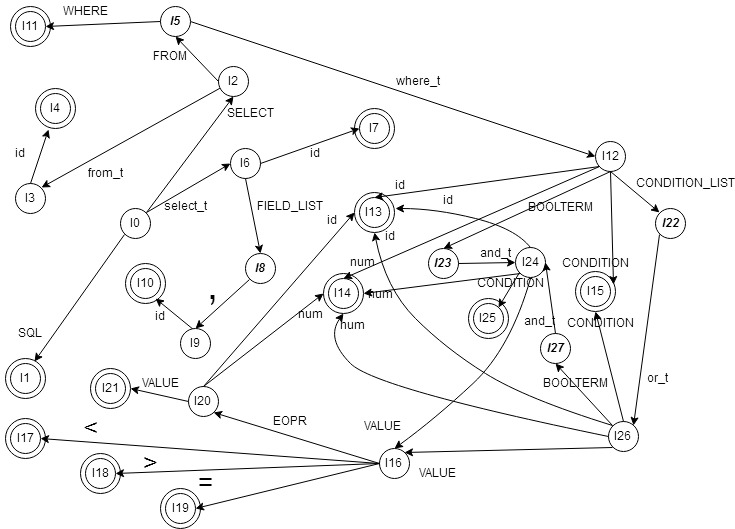


Рисунок 1 - Каноническая совокупность множеств ситуаций

Далее необходимо построить таблицы **Action** и **Goto,** и множество **FOLLOW**.

|  |  |
| --- | --- |
| **Нетерминал** | **Множество FOLLOW** |
| SQL’ | {eof} |
| SQL | {eof} |
| SELECT | {from\_t} |
| FROM | {where\_t, eof} |
| WHERE | {eof} |
| FIELD\_LIST | {‘,’, from\_t} |
| CONDITION\_LIST | {or\_t, eof} |
| BOOLTERM | {or\_t, and\_t, eof} |
| CONDITION | {or\_t, and\_t, eof} |
| EOPR | {id, num} |
| VALUE | {<, >, =, or\_t, and\_t, eof} |

Таблица 1 – Множество FOLLOW

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Состояние | select | from | where | , | or | and | id | num | < | > | = | eof |
| S0 | Shift 6 | - | - | - | - | - | - | - | - | - | - | - |
| S1 | - | - | - | - | - | - | - | - | - | - | - | Accept |
| S2 | - | Shift 3 | - | - | - | - | - | - | - | - | - | - |
| S3 | - | - | - | - | - | - | Shift 4 | - | - | - | - | - |
| S4 | - | - | Reduce 5 | - | - | - | - | - | - | - | - | Reduce 5 |
| S5 | - | Reduce 3 | Shift 12 | - | - | - | - | - | - | - | - | Reduce 3 |
| S6 | - | - | - | - | - | - | Shift 7 | - | - | - | - | - |
| S7 | - | Reduce 8 | - | Reduce 8 | - | - | - | - | - | - | - | - |
| S8 | - | Reduce 4 | - | Shift 9 | - | - | - | - | - | - | - | - |
| S9 | - | - | - | - | - | - | Shift 10 | - | - | - | - | - |
| S10 | - | Reduce 7 | - | Reduce 7 | - | - | - | - | - | - | - | - |
| S11 | - | - | - | - | - | - | - | - | - | - | - | Reduce 2 |
| S12 | - | - | - | - | - | - | Shift 13 | Shift 14 | - | - | - | - |
| S13 | - | - | - | - | Reduce 17 | Reduce 17 | - | - | Reduce 17 | Reduce 17 | Reduce 17 | Reduce 17 |
| S14 | - | - | - | - | Reduce 18 | Reduce 18 | - | - | Reduce 18 | Reduce 18 | Reduce 18 | Reduce 18 |
| S15 | - | - | - | - | Reduce 12 | Reduce 12 | - | - | - | - | - | Reduce 12 |
| S16 | - | - | - | - | - | - | - | - | Shift 17 | Shift 18 | Shift 19 | - |
| S17 | - | - | - | - | - | - | Reduce 14 | Reduce 14 | - | - | - | - |
| S18 | - | - | - | - | - | - | Reduce 15 | Reduce 15 | - | - | - | - |
| S19 | - | - | - | - | - | - | Reduce 16 | Reduce 16 | - | - | - | - |
| S20 | - | - | - | - | - | - | Shift 13 | Shift 14 | - | - | - | - |
| S21 | - | - | - | - | Reduce 13 | Reduce 13 | - | - | - | - | - | Reduce 13 |
| S22 | - | - | - | - | Shift 26 | - | - | - | - | - | - | Reduce 6 |
| S23 | - | - | - | - | Reduce 10 | Shift 24 | - | - | - | - | - | Reduce 10 |
| S24 | - | - | - | - | - | - | Shift 13 | Shift 14 | - | - | - | - |
| S25 | - | - | - | - | Reduce 11 | Reduce 11 | - | - | - | - | - | Reduce 11 |
| S26 | - | - | - | - | - | - | Shift 13 | Shift 14 | - | - | - | - |
| S27 | - | - | - | - | Reduce 9 | Shift 24 | - | - | - | - | - | Reduce 9 |

Таблица 2 – Таблица Action

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Состояние | SQL | SELECT | FROM | WHERE | FIELD\_LIST | CONDITION\_LIST | BOOLTERM | CONDITION | EOPR | VALUE |
| S0 | S1 | S2 | - | - | - | - | - | - | - | - |
| S1 | - | - | - | - | - | - | - | - | - | - |
| S2 | - | - | S5 | - | - | - | - | - | - | - |
| S3 | - | - | - | - | - | - | - | - | - | - |
| S4 | - | - | - | - | - | - | - | - | - | - |
| S5 | - | - | - | S11 | - | - | - | - | - | - |
| S6 | - | - | - | - | S8 | - | - | - | - | - |
| S7 | - | - | - | - | - | - | - | - | - | - |
| S8 | - | - | - | - | - | - | - | - | - | - |
| S9 | - | - | - | - | - | - | - | - | - | - |
| S10 | - | - | - | - | - | - | - | - | - | - |
| S11 | - | - | - | - | - | - | - | - | - | - |
| S12 | - | - | - | - | - | S22 | S23 | S15 | - | - |
| S13 | - | - | - | - | - | - | - | - | - | - |
| S14 | - | - | - | - | - | - | - | - | - | - |
| S15 | - | - | - | - | - | - | - | - | - | - |
| S16 | - | - | - | - | - | - | - | - | S20 | - |
| S17 | - | - | - | - | - | - | - | - | - | - |
| S18 | - | - | - | - | - | - | - | - | - | - |
| S19 | - | - | - | - | - | - | - | - | - | - |
| S20 | - | - | - | - | - | - | - | - | - | S21 |
| S21 | - | - | - | - | - | - | - | - | - | - |
| S22 | - | - | - | - | - | - | - | - | - | - |
| S23 | - | - | - | - | - | - | - | - | - | - |
| S24 | - | - | - | - | - | - | - | S25 | - | S16 |
| S25 | - | - | - | - | - | - | - | - | - | - |
| S26 | - | - | - | - | - | - | S27 | S15 | - | S16 |
| S27 | - | - | - | - | - | - | - | - | - | - |

Таблица 3 – Таблица Goto

**Листинг программы**

type

action\_in\_cell = (Shift, Reduce, Accept, Error);

state = (S0,S1,S2,S3,S4,S5,S6,S7,S8,S9,S10,S11,S12,S13,S14,S15,

S16,S17,S18,S19,S20,S21,S22,S23,S24,S25,S26,S27,S\_er);

symb = (SQL1,SQL,SELECT,FROM,WHERE,FIELD\_LIST,CONDITION\_LIST,

BOOLTERM,CONDITION,EOPR,VALUE,select\_term,from\_term,where\_term,comma,or\_term,

and\_term,id\_t,num\_t,less\_term,more\_term,equal\_term,eof);

gramm\_type = record

noterm: symb;

basic\_length: integer;

end;

stack\_type = record

stack\_state: state;

stack\_symb: symb;

end;

const

gramm: array[1..18] of gramm\_type =(

(noterm: SQL1; basic\_length:1),

(noterm: SQL; basic\_length: 3),

(noterm: SQL; basic\_length: 2),

(noterm: SELECT; basic\_length: 2),

(noterm: FROM; basic\_length: 2),

(noterm: WHERE; basic\_length: 2),

(noterm: FIELD\_LIST; basic\_length: 3),

(noterm: FIELD\_LIST; basic\_length: 1),

(noterm: CONDITION\_LIST; basic\_length: 3),

(noterm: CONDITION\_LIST; basic\_length: 1),

(noterm: BOOLTERM; basic\_length: 3),

(noterm: BOOLTERM; basic\_length: 1),

(noterm: CONDITION; basic\_length: 3),

(noterm: EOPR; basic\_length: 1),

(noterm: EOPR; basic\_length: 1),

(noterm: EOPR; basic\_length: 1),

(noterm: VALUE; basic\_length: 1),

(noterm: VALUE; basic\_length: 1));

action\_: array[S0..S27, select\_term..eof] of string =

(

('shift 6','er','er','er','er','er','er','er','er','er','er','er'), //0

('er','er','er','er','er','er','er','er','er','er','er','accept'), //1

('er','shift 3','er','er','er','er','er','er','er','er','er','er'), //2

('er','er','er','er','er','er','shift 4','er','er','er','er','er'), //3

('er','er','reduce 5','er','er','er','er','er','er','er','er','reduce 5'), //4

('er','reduce 3','shift 12','er','er','er','er','er','er','er','er','reduce 3'), //5

('er','er','er','er','er','er','shift 7','er','er','er','er','er'), //6

('er','reduce 8','er','reduce 8','er','er','er','er','er','er','er','er'), //7

('er','reduce 4','er','shift 9','er','er','er','er','er','er','er','er'), //8

('er','er','er','er','er','er','shift 10','er','er','er','er','er'), //9

('er','reduce 7','er','reduce 7','er','er','er','er','er','er','er','er'), //10

('er','er','er','er','er','er','er','er','er','er','er','reduce 2'), //11

('er','er','er','er','er','er','shift 13','shift 14','er','er','er','er'), //12

('er','er','er','er','reduce 17','reduce 17','er','er','reduce 17','reduce 17','reduce 17','reduce 17'),//13

('er','er','er','er','reduce 18','reduce 18','er','er','reduce 18','reduce 18','reduce 18','reduce 18'),//14

('er','er','er','er','reduce 12','reduce 12','er','er','er','er','er','reduce 12'), //15

('er','er','er','er','er','er','er','er','shift 17','shift 18','shift 19','er'), //16

('er','er','er','er','er','er','reduce 14','reduce 14','er','er','er','er'), //17

('er','er','er','er','er','er','reduce 15','reduce 15','er','er','er','er'), //18

('er','er','er','er','er','er','reduce 16','reduce 16','er','er','er','er'), //19

('er','er','er','er','er','er','reduce 13','shift 14','er','er','er','er'), //20

('er','er','er','er','reduce 13','reduce 13','er','er','er','er','er','reduce 13'), //21

('er','er','er','er','shift 26','er','er','er','er','er','er','reduce 6'), //22

('er','er','er','er','reduce 10','shift 24','er','er','er','er','er','reduce 10'), //23

('er','er','er','er','er','er','shift 13','shift 14','er','er','er','er'), //24

('er','er','er','er','reduce 11','reduce 11','er','er','er','er','er','reduce 11'), //25

('er','er','er','er','er','er','shift 13','shift 14','er','er','er','er'), //26

('er','er','er','er','reduce 9','shift 24','er','er','er','er','er','reduce 9') //27

);

goto\_: array[S0..S27, SQL..VALUE] of state =

(

(S1,S2,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //0

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //1

(S\_er,S\_er,S5,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //2

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //3

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //4

(S\_er,S\_er,S\_er,S11,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //5

(S\_er,S\_er,S\_er,S\_er,S8,S\_er,S\_er,S\_er,S\_er,S\_er), //6

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //7

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //8

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //9

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //10

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //11

(S\_er,S\_er,S\_er,S\_er,S\_er,S22,S23,S15,S\_er,S\_er), //12

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //13

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //14

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //15

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //16

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S20,S\_er), //17

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //18

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //19

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S21), //20

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //21

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //22

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //23

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S25,S\_er,S16), //24

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er), //25

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S27,S15,S\_er,S16), //26

(S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er,S\_er) //27

);

procedure TForm1.Parse;

var i,length: integer;

er\_flag: boolean;

cur\_prod: gramm\_type;

cur\_state: state;

action\_type: action\_in\_cell;

action\_value: string;

begin

er\_flag:=false;

push(S0,eof);

token:=lextosymb(yylex);

repeat

actionProd(action\_[stack[p\_s].stack\_state, token], action\_type, action\_value);

if action\_type = shift then

begin

push(strtostate(action\_value),token);

token:=lextosymb(yylex);

end

else if action\_type = reduce then

begin

for i:=0 to gramm[strtoint(action\_value)].basic\_length-1 do pop();

push(goto\_[stack[p\_s].stack\_state,gramm[strtoint(action\_value)].noterm],

gramm[strtoint(action\_value)].noterm);

end

else if (strtostate(action\_value) = S\_er) or (action\_type = error) then

begin

showmessage('Неудача!');

er\_flag:=true;

break;

end;

until action\_type = accept;

if not er\_flag then showmessage('Успех');

end;

procedure TForm1.push(value\_state: state; value\_symb: symb);

var t:symb;

begin

p\_s:=p\_s+1;

stack[p\_s].stack\_state:=value\_state;

stack[p\_s].stack\_symb:=value\_symb;

end;

procedure TForm1.actionProd(cell: string; var aType: action\_in\_cell;

var aValue: string);

begin

if cell = 'accept' then aType:=Accept

else

case Copy(cell, 1, Pos(' ',cell)-1) of

'shift':begin

aType:=Shift;

end;

'reduce':begin

aType:=Reduce;

end;

else aType:=Error;

end;

if cell <> 'er'

then aValue:=Copy(cell, Pos(' ',cell)+1, Length(cell)-Pos(' ',cell))

else aValue:=cell;

end;

procedure TForm1.pop;

begin

p\_s:=p\_s-1;

end;