Compiler Construction

(Week 3, Lecture 2)

Syntactic Analysis

```
int* foo(int i, int j))
{
 for(k=0; i j; )
  fi( i > j );
     return j;
}
```

Semantic Analysis

```
int* foo(int i, int j)
{
  for(k=0; i < j; j++ )
   if( i < j-2 )
    sum = sum+i
  return sum;
}
```

Parser

```
1. expr  → expr op expr
2.       | num
3.       | id
4. Op    → +
5.       | -
6.       | *
7.       | /
```

Parser

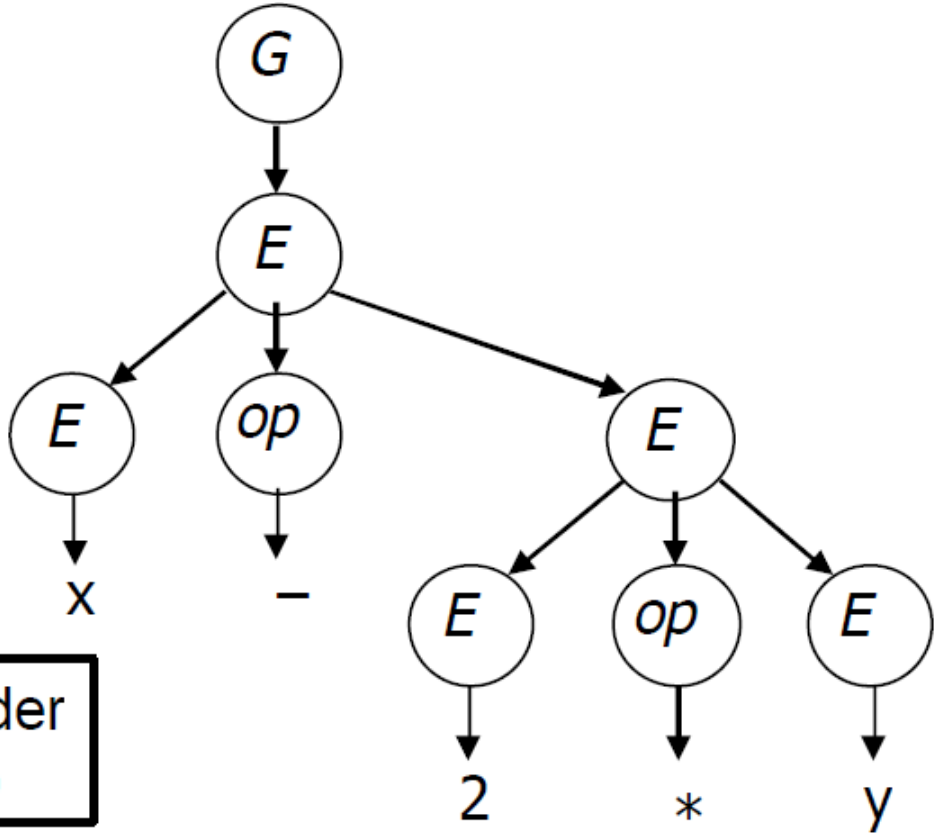
Rule	Sentential Form
-	expr
1	expr op expr
3	<id,x> op expr
5	<id,x> - expr
1	<id,x> - expr op expr
2	<id,x> - <num,2> op expr
6	<id,x> - <num,2> * expr
3	<id,x> - <num,2> * <id,y>

Parser

Rule	Sentential Form
-	expr
1	expr op expr
3	expr op <id,y>
6	expr * <id,y>
1	expr op expr * <id,y>
2	expr op <num,2> * <id,y>
5	expr - <num,2> * <id,y>
2	<id,x> - <num,2> * <id,y>

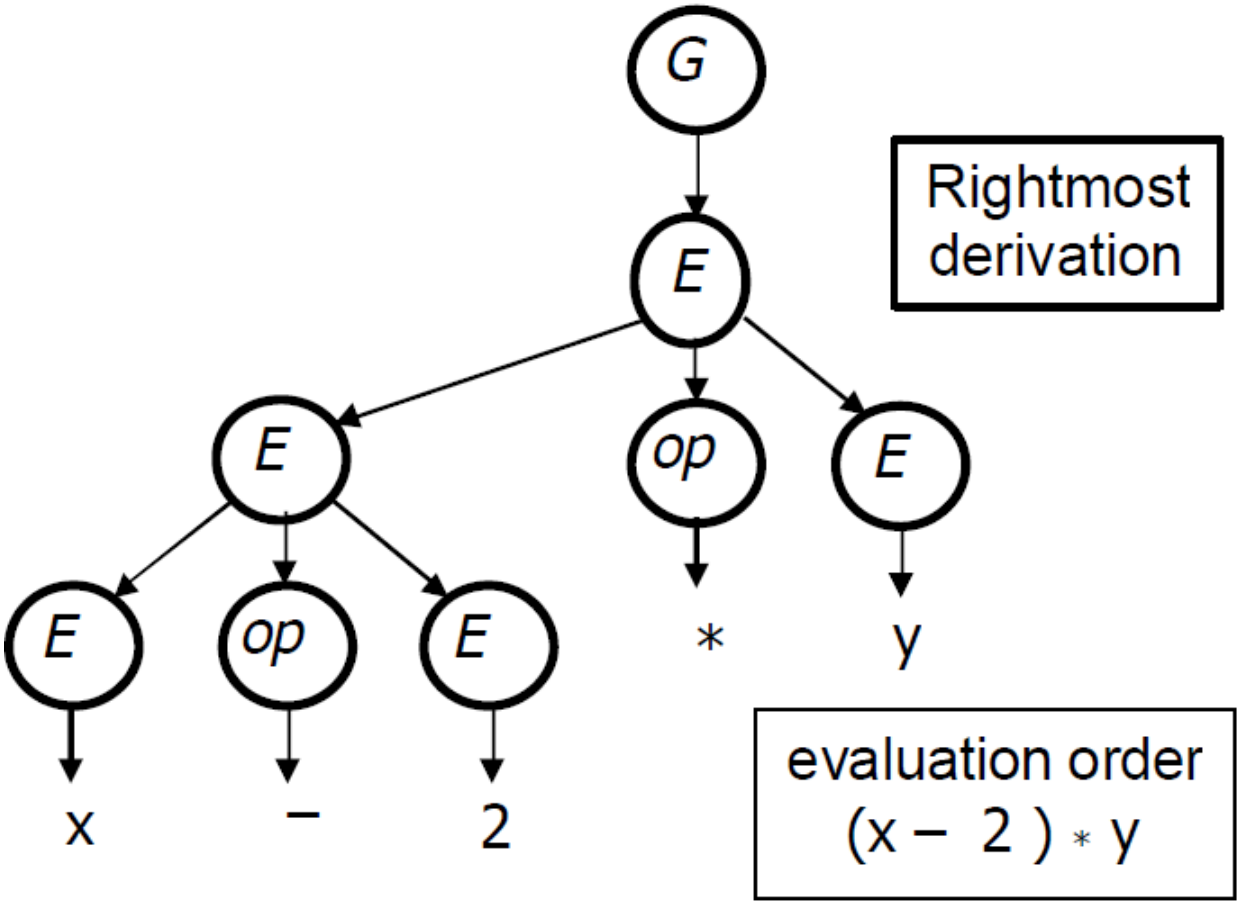
Parser

Leftmost derivation



evaluation order
x – (2 * y)

Parser


G
E
E
op
E
E
op
E
x
–
2
*
y
Rightmost derivation
evaluation order
(x – 2) * y

Precendence

```
1 goal   → expr
2 expr   → expr + term
3        | expr - term
4        | term
5 term   → term * factor
6        | term / factor
7        | factor
8 factor → number
9        | id
```

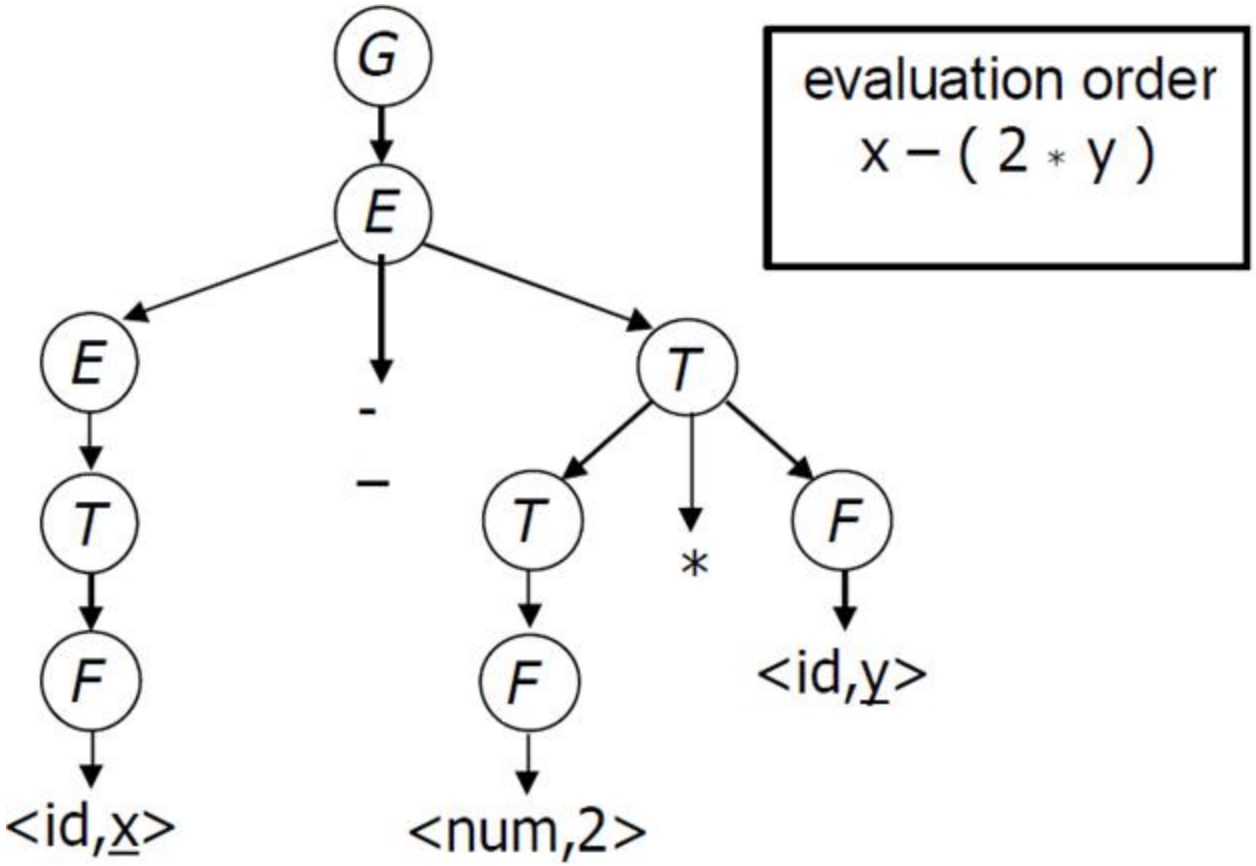
Level 2

Level 1

Parser

Rule	Sentential Form
-	goal
1	expr
3	expr - term
5	expr - term * factor
9	expr - term * <id,y>
7	expr - factor * <id,y>
8	expr - <num,2> * <id,y>
4	term - <num,2> * <id,y>
7	factor - <num,2> * <id,y>
9	<id,x> - <num,2> * <id,y>

Parser



evaluation order
x – (2 * y)

Ambiguity

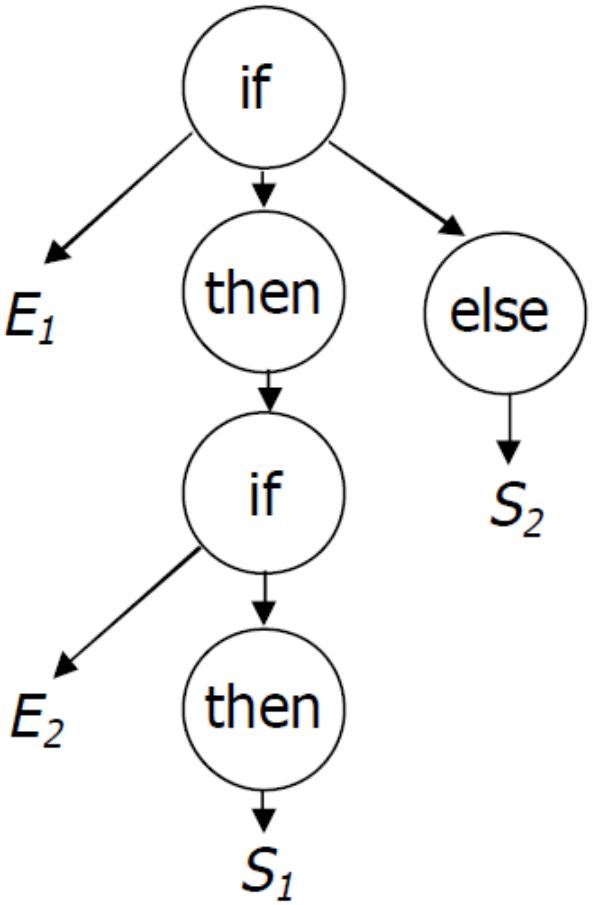
```
stmt → if expr then stmt
     | if expr then stmt else stmt
     | … other stmts …
```

Two possible derivations for

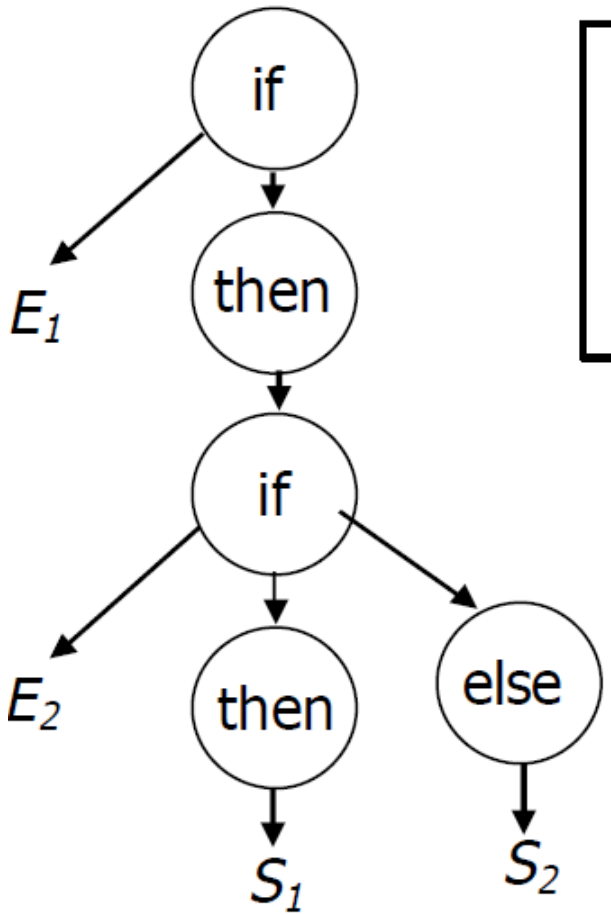
if E1 then if E2 then S else S2

Ambiguity

Production 1, then
Production 2:
if E_1 then
  if E_2 then S_1
else S_2



Ambiguity



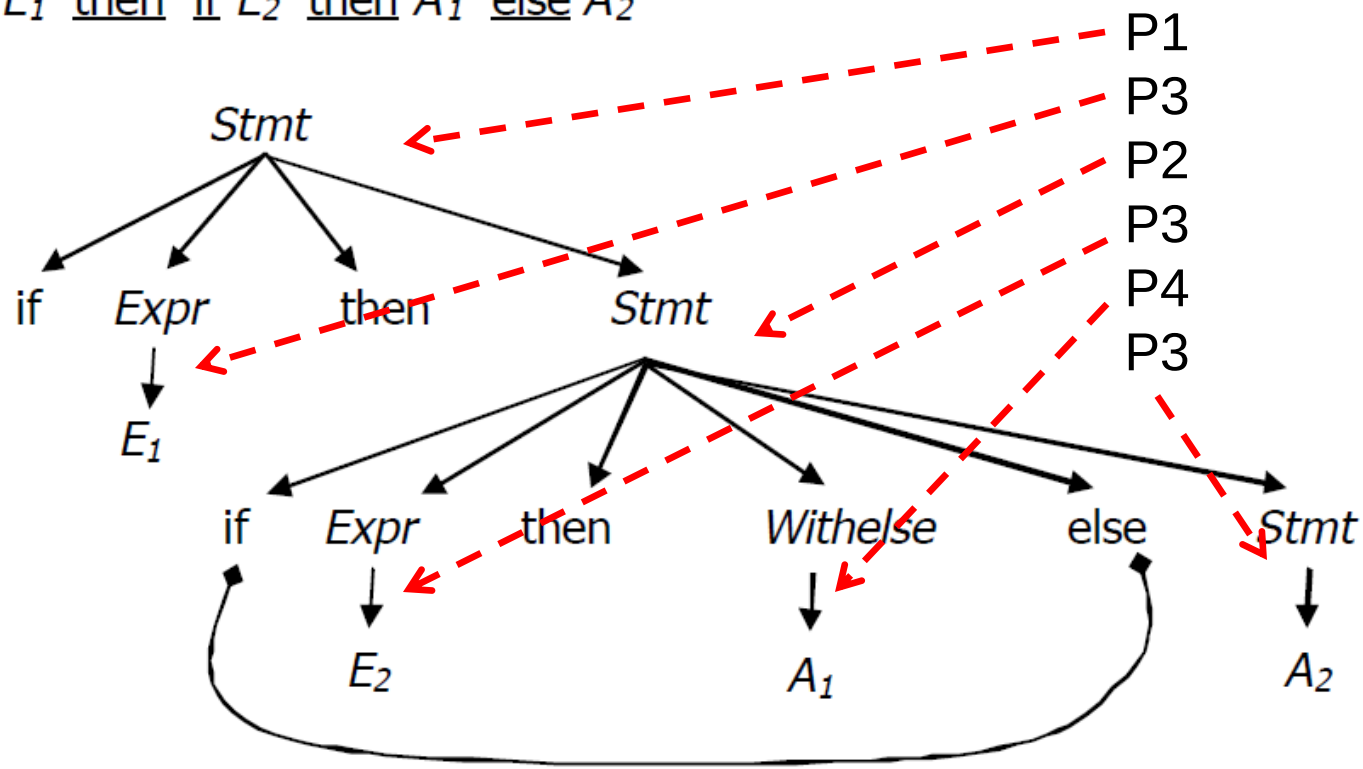
Production 2, then
Production 1:
if E_1 then
  if E_2 then S_1
  else S_2

Ambiguity

```
1 stmt      → if E then stmt
2           | if E then withelse else stmt
3           | … other stmt …
4 withelse  → if E then withelse else withelse
5           | … other stmt …
```

Ambiguity

<u>if</u> E_1 <u>then</u> <u>if</u> E_2 <u>then</u> A_1 <u>else</u> A_2



This binds the <u>else</u> controlling A_2 to inner <u>if</u>