Problem 1)

let rec cst\_to\_ast t = match t with

| E1(t1, token, t2) -> (match token with

| Minus -> Sub(cst\_to\_ast t1, cst\_to\_ast t2))

| E2(t) -> cst\_to\_ast(t)

| T1(tok) -> (match tok with

| Ident(str) -> Id(str))

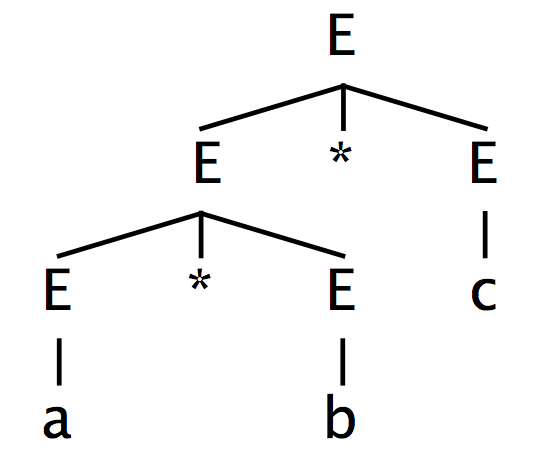
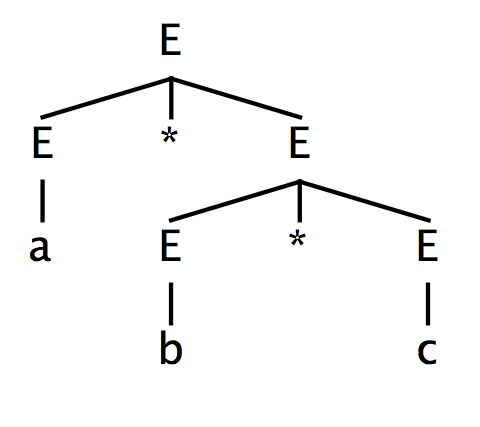
| T2(tree, token1, token2) -> (match (token1, token2) with

| (Star, Ident(str2)) -> Times(cst\_to\_ast tree, Id(str2)))

Problem 2)

A)

1) 2)

B)

Shift-reduce Parse for Tree 1

|  |  |  |
| --- | --- | --- |
| Action | Stack | Input |
| Shift |  | a\*b\*c |
| Reduce E->id | a | \*b\*c |
| Shift | E | \*b\*c |
| Shift | E\* | b\*c |
| Reduce E->id | E\*b | \*c |
| Reduce E->E\*E | E\*E | \*c |
| Shift | E | \*c |
| Shift | E\* | c |
| Reduce E->id | E\*c | eof |
| Reduce E->E\*E | E\*E | eof |
| Accept | E | eof |

Shift-reduce Parse for Tree 2

|  |  |  |
| --- | --- | --- |
| Action | Stack | Input |
| Shift |  | a\*b\*c |
| Reduce E->id | a | \*b\*c |
| Shift | E | \*b\*c |
| Shift | E\* | b\*c |
| Reduce E->id | E\*b | \*c |
| Shift | E\*E | \*c |
| Shift | E\*E\* | c |
| Reduce E->id | E\*E\*c | eof |
| Reduce E->E\*E | E\*E\*E | eof |
| Reduce E->E\*E | E\*E | eof |
| Accept | E | eof |

C)

I ) The first parse tree is correct

II ) The first shift reduce parse is correct since it takes the right step at Step 6 of reducing

D)

%left Minus

%left Star

Problem 3)

Extended grammar will be:

E -> T=E | T

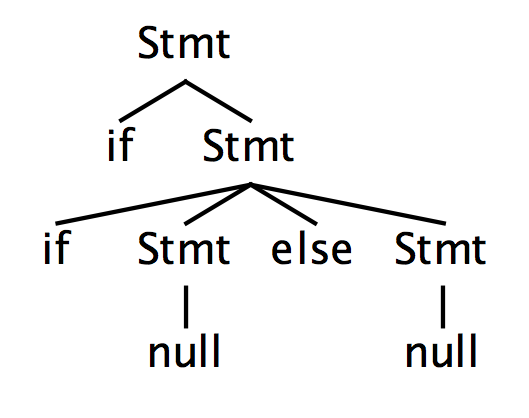
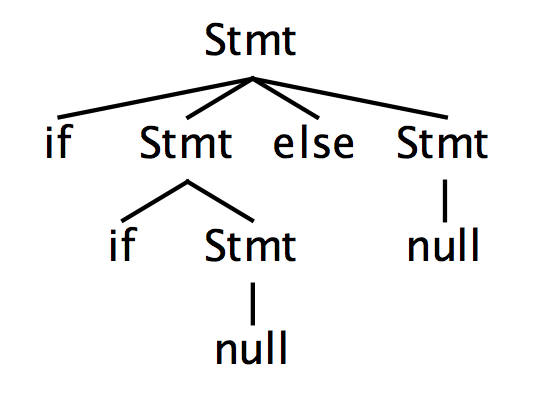
T -> T==P | P

P -> P-O | O

O -> O\*id | id

Problem 4)

A) The Correct Parse Tree Incorrect Parse Tree

B)

Correct Shift Reduce Parse

|  |  |  |
| --- | --- | --- |
| Action | Stack | Input |
| Shift |  | if if null else null |
| Shift | if | if null else null |
| Shift | if if | null else null |
| Reduce Stmt->null | if if null | else null |
| Shift | if if Stmt | else null |
| Shift | if if Stmt else | null |
| Reduce Stmt->null | if if Stmt else null | eof |
| Reduce Stmt-> if Stmt else Stmt | if if Stmt else Stmt | eof |
| Reduce Stmt-> if Stmt | if Stmt | eof |
| Accept | Stmt | eof |

Incorrect Shift Reduce Parse

|  |  |  |
| --- | --- | --- |
| Action | Stack | Input |
| Shift |  | if if null else null |
| Shift | if | if null else null |
| Shift | if if | null else null |
| Reduce Stmt->null | if if null | else null |
| Reduce Stmt->if Stmt | if if Stmt | else null |
| Shift | if Stmt | else null |
| Shift | if Stmt else | null |
| Reduce Stmt->null | if Stmt else null | eof |
| Reduce Stmt->if Stmt else Stmt | if Stmt else Stmt | eof |
| Accept | Stmt | eof |

C)

%right if

%nonassoc else

since else has a greater precedence than if.