8. Tabela simbola

Zadatak 1.

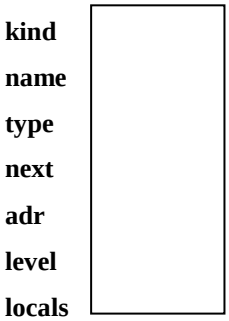
Prikazati izgled tabele simbola u karakterističnim tačkama za priloženi MikroJava program.

```
class P (** 1 **)

final int c = 15;
char r;
(** 2 **)
class Unutra {
  int u[];
}
(** 3 **)
Unutra k;

{ (** 4 **)
  int m1 (** 5 **) (int w, Unutra d) {
  (** 6 **)
       print(w);
       read(d.u[5]);
       return 0;
  } (** 7 **)

  void main ()(** 8 **)
  int a, b;    (** 9 **)
  {
       read(a);
       k = new Unutra;
       b = m1(a, k);
  } (** 10 **)
}
(** 11 **)
```

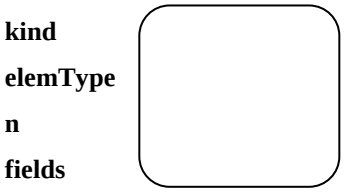
Rešenje:

Tabela simbola za jezik MikroJava će imati 3 vrste čvorova:

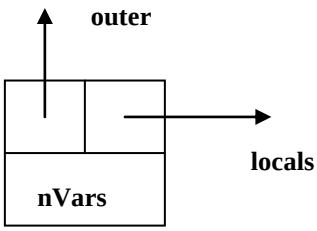
- Objektni čvorovi (Object nodes) čuvaju informacije o deklarisanim imenima.



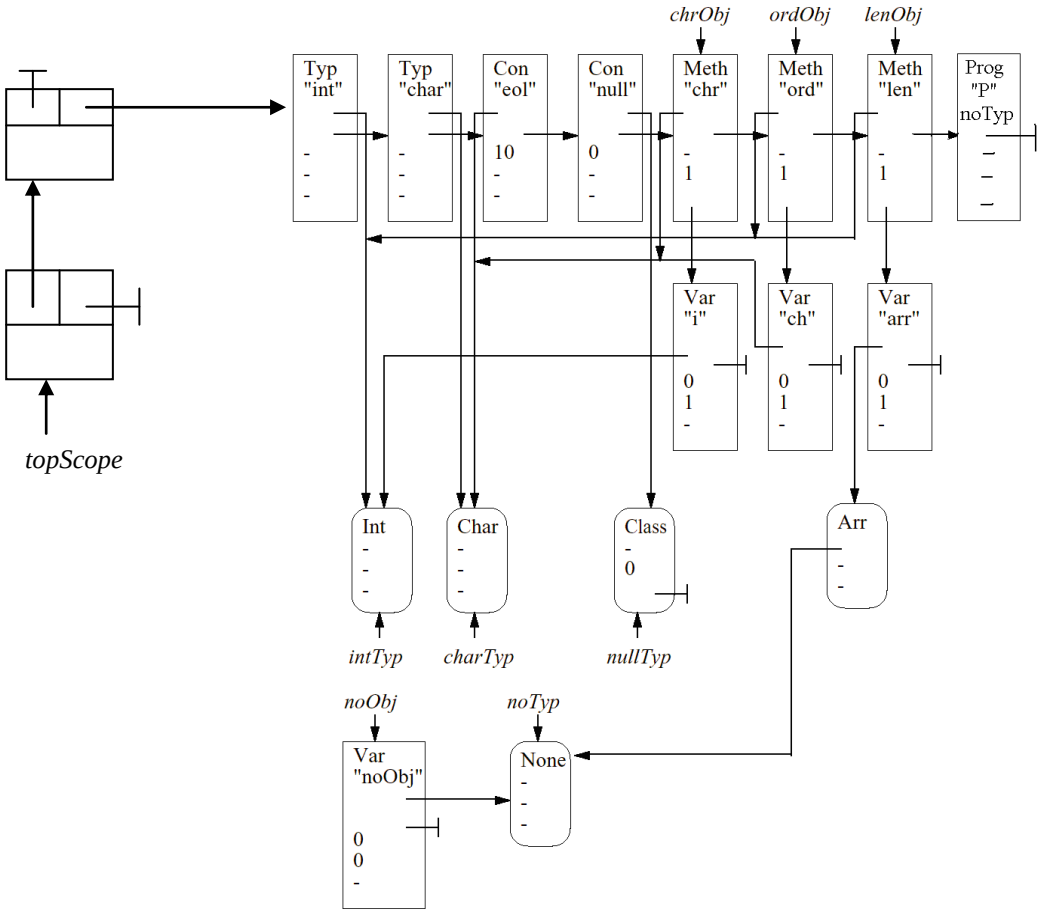
- Strukturni čvorovi (Structure nodes) čuvaju informacije o strukturama tipa.



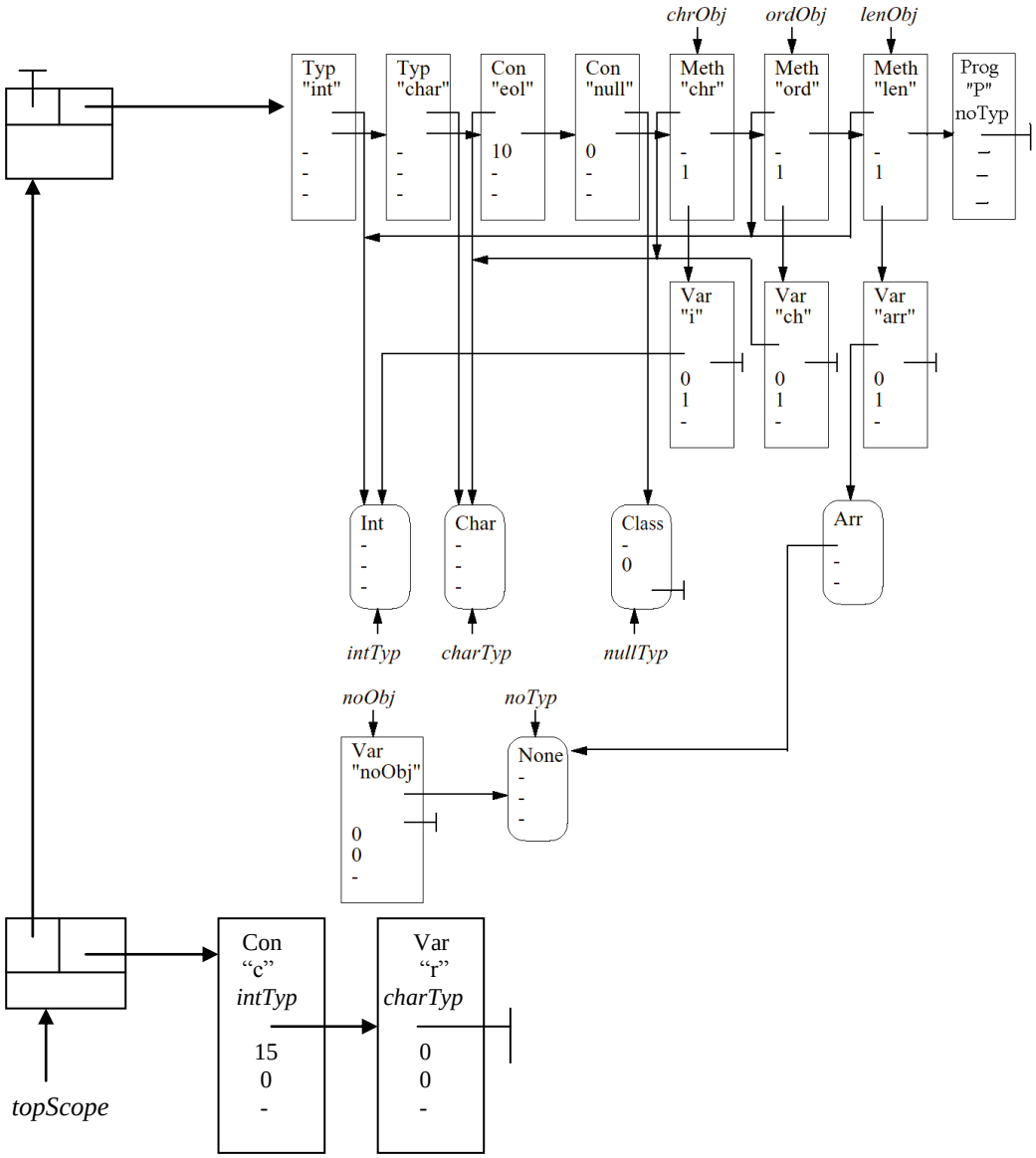
- Čvorovi opsega (Scope nodes) služe za manipulaciju opsezima važenja imena.



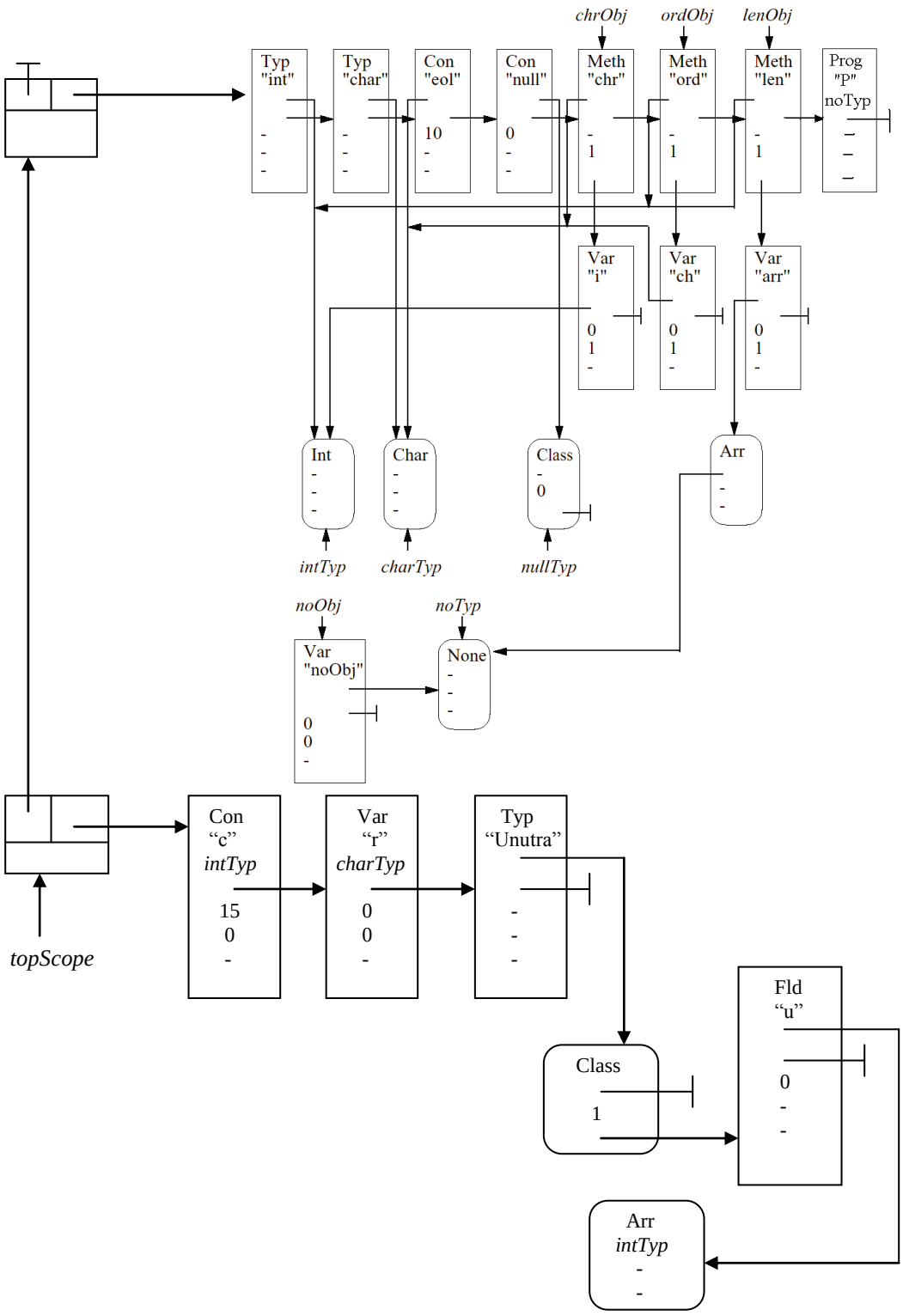
Tačka `(** 1 **)`


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
topScope
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None

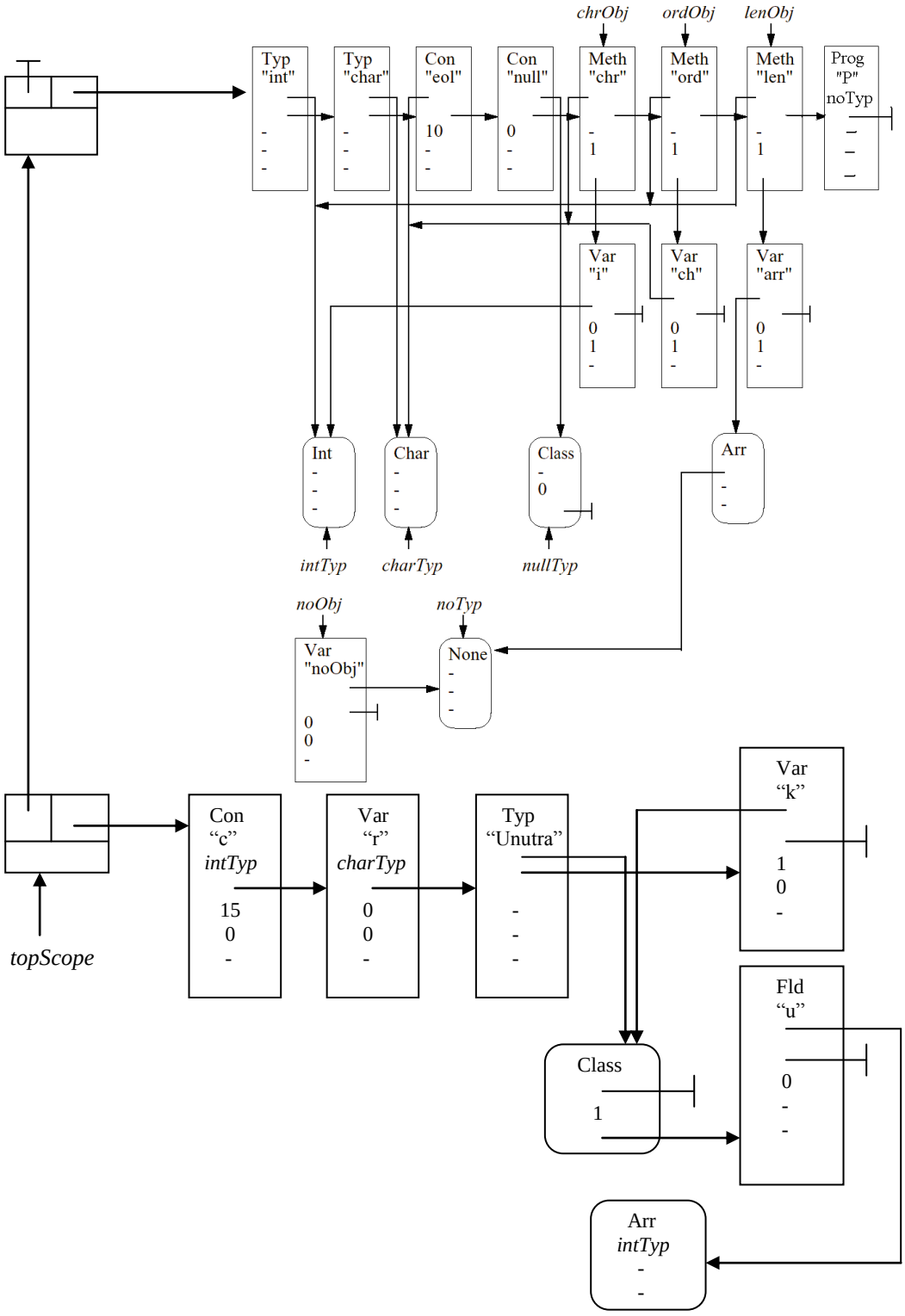
Tačka **(** 2 **)**


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
topScope
Con "c" intTyp
Var "r" charTyp

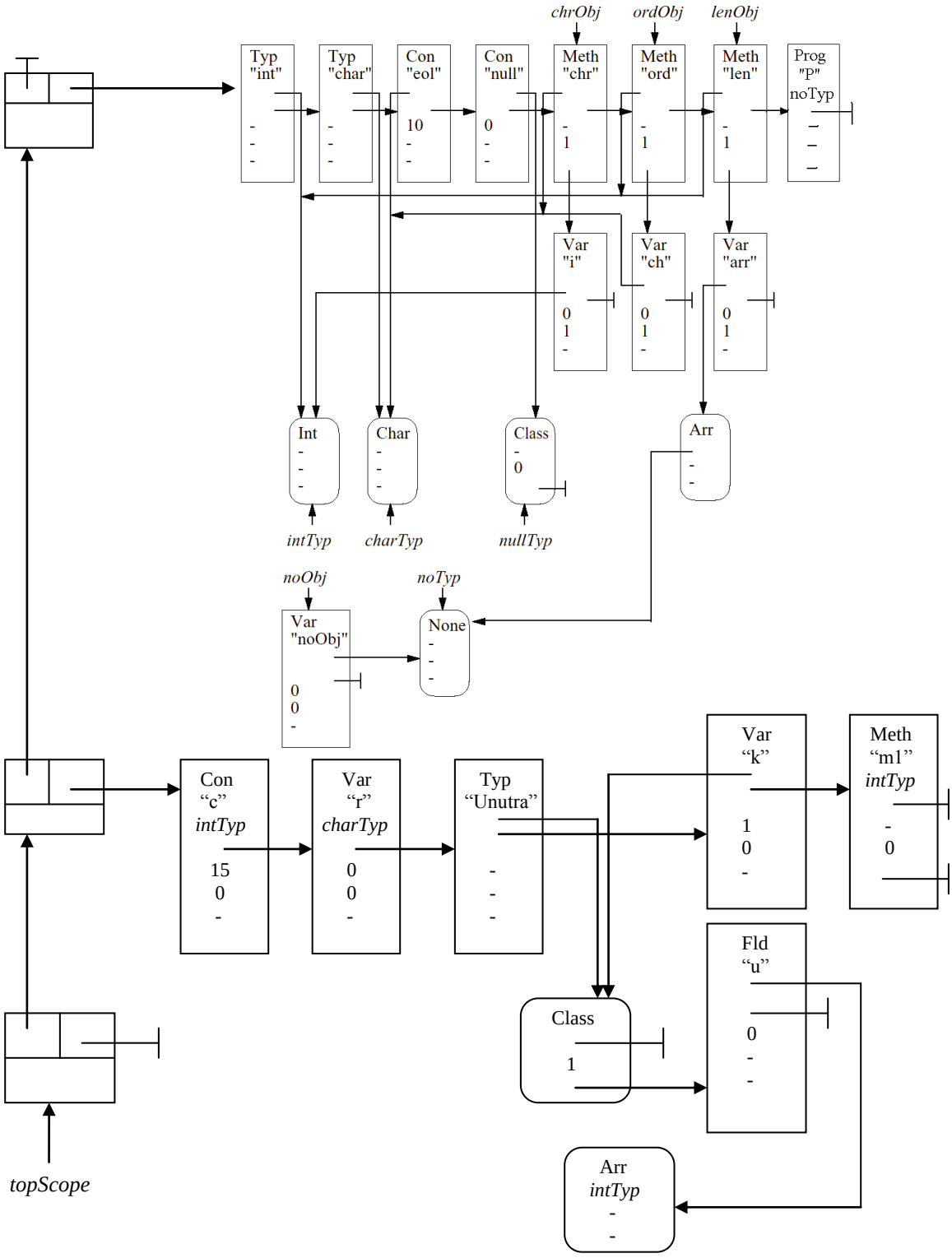
Tačka `(** 3 **)`


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
topScope
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Fld "u"
Class
Arr intTyp

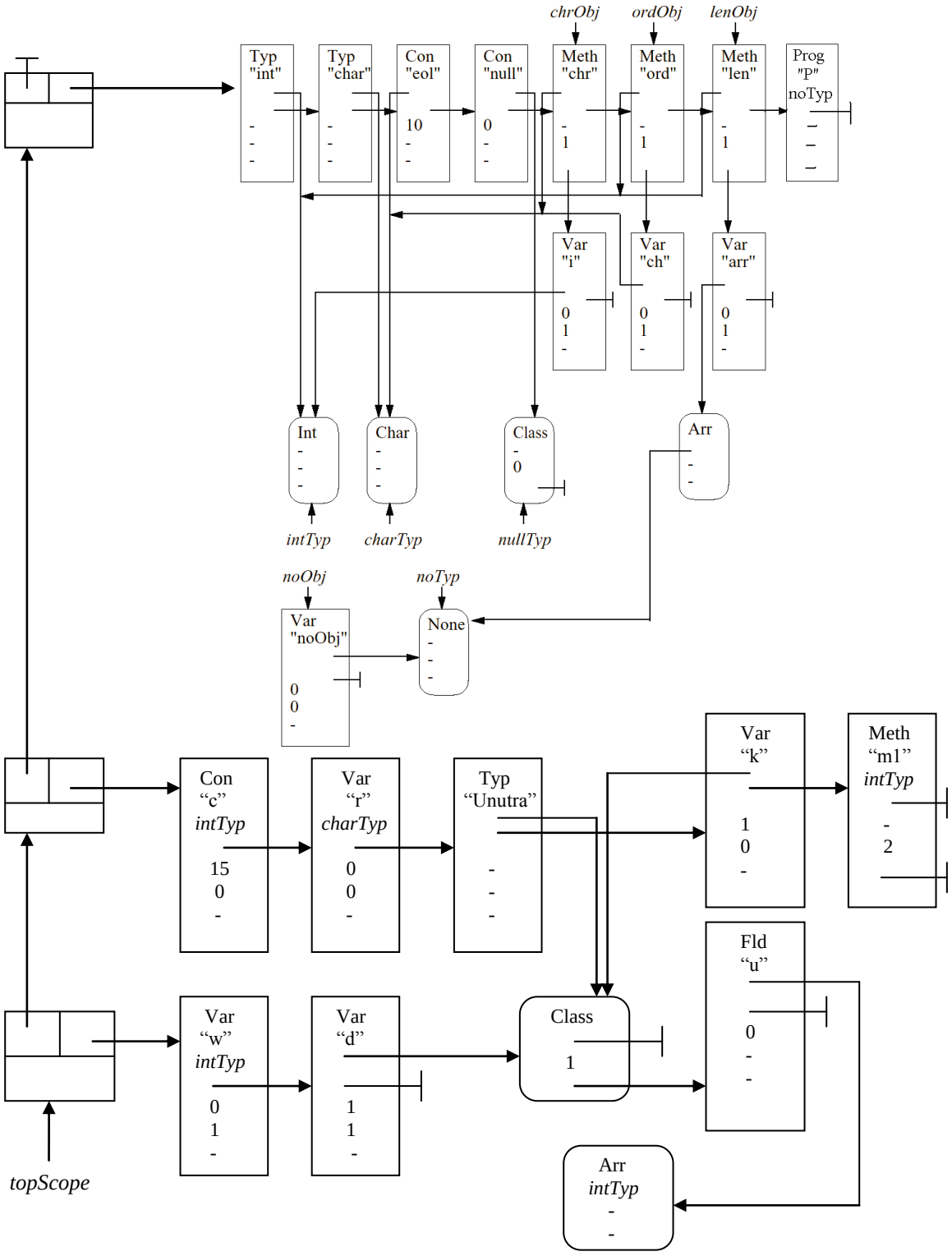
Tačka **(** 4 **)**


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
topScope
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Fld "u"
Class
Arr intTyp

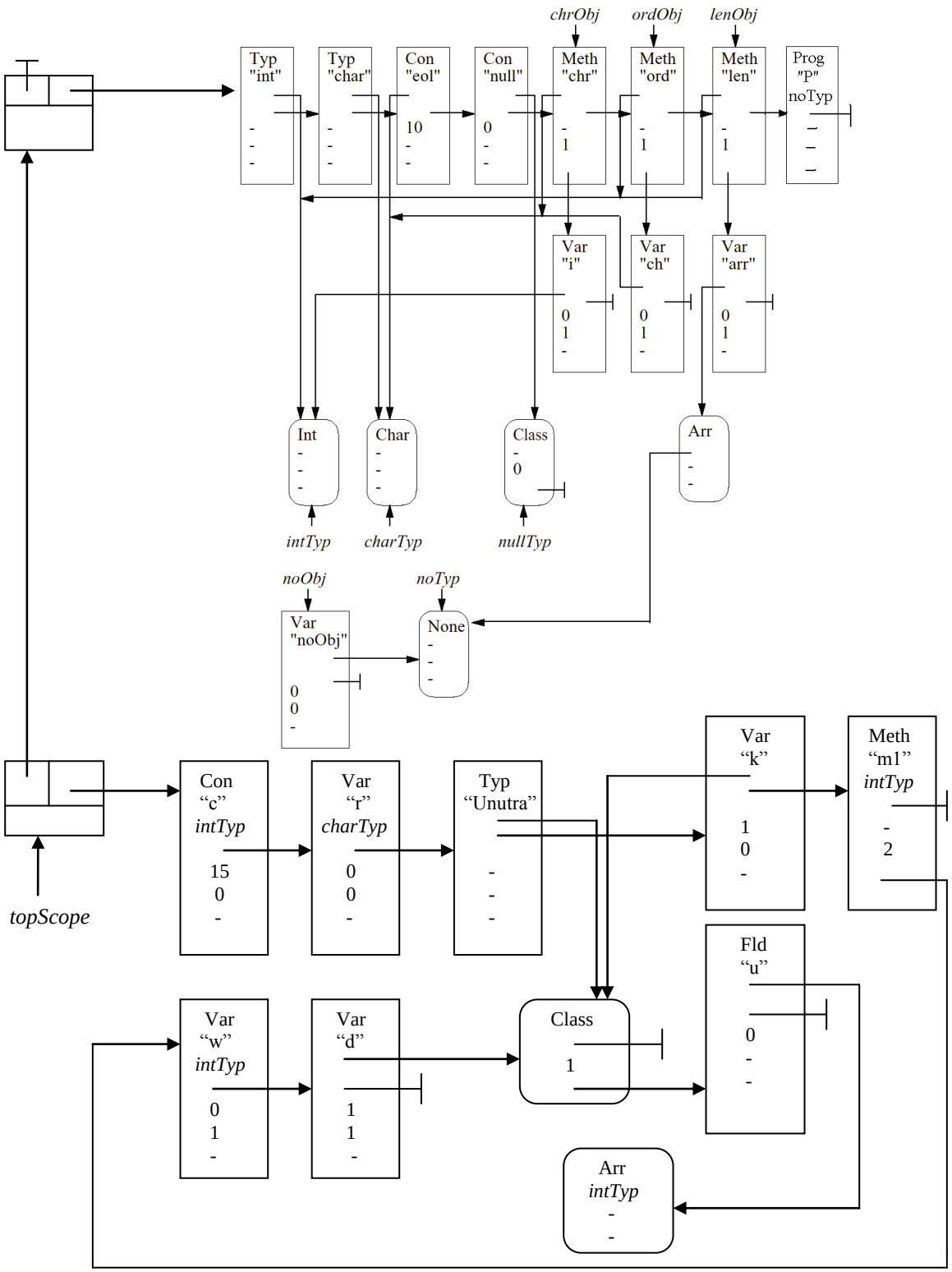
Tačka **(** 5 **)**


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Meth "m1" intTyp
Fld "u"
Class
Arr intTyp
topScope

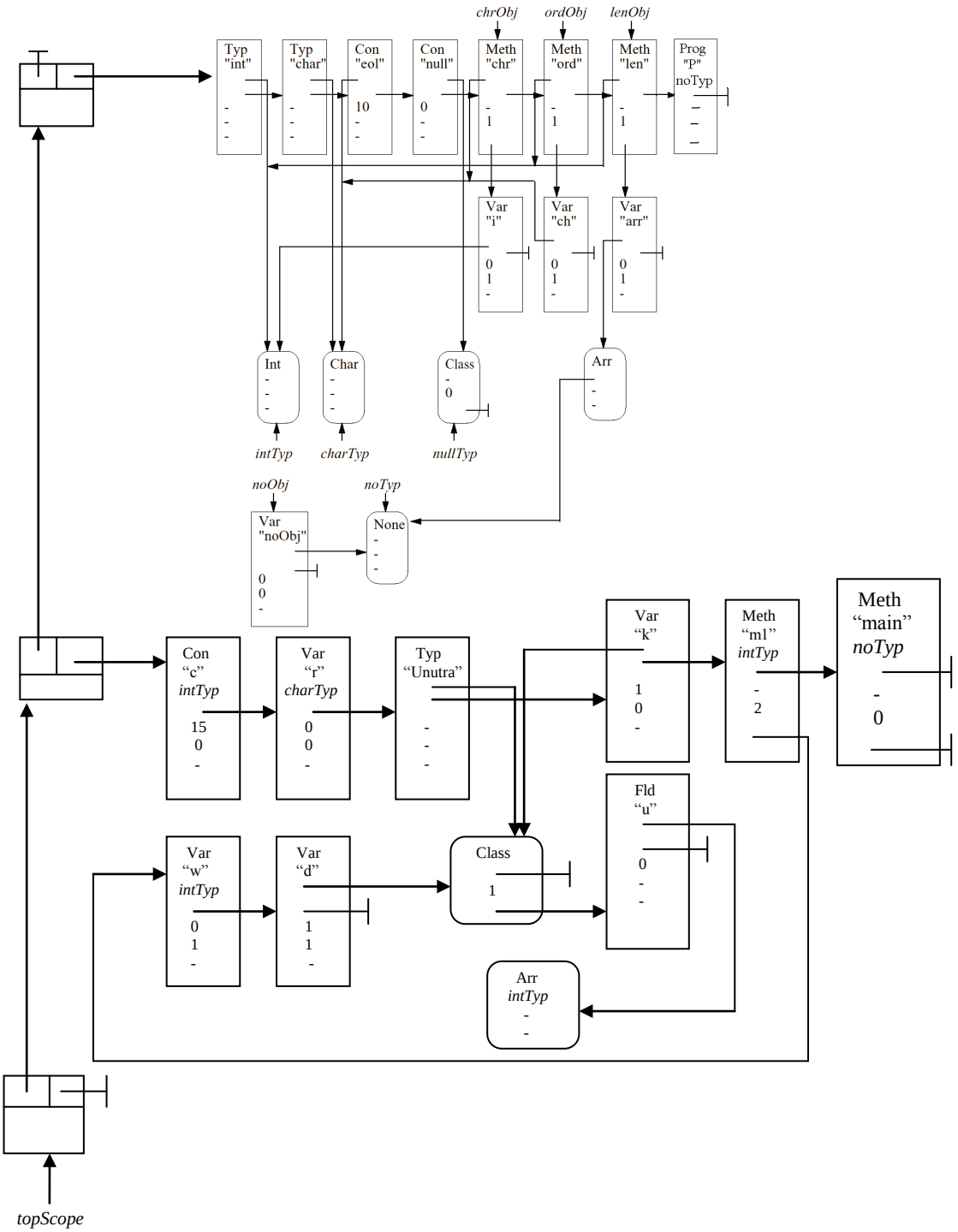
Tačka (** 6 **)


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
Con “c” intTyp
Var “r” charTyp
Typ “Unutra”
Var “k”
Meth “m1” intTyp
Fld “u”
Var “w” intTyp
Var “d”
Class
Arr intTyp
topScope

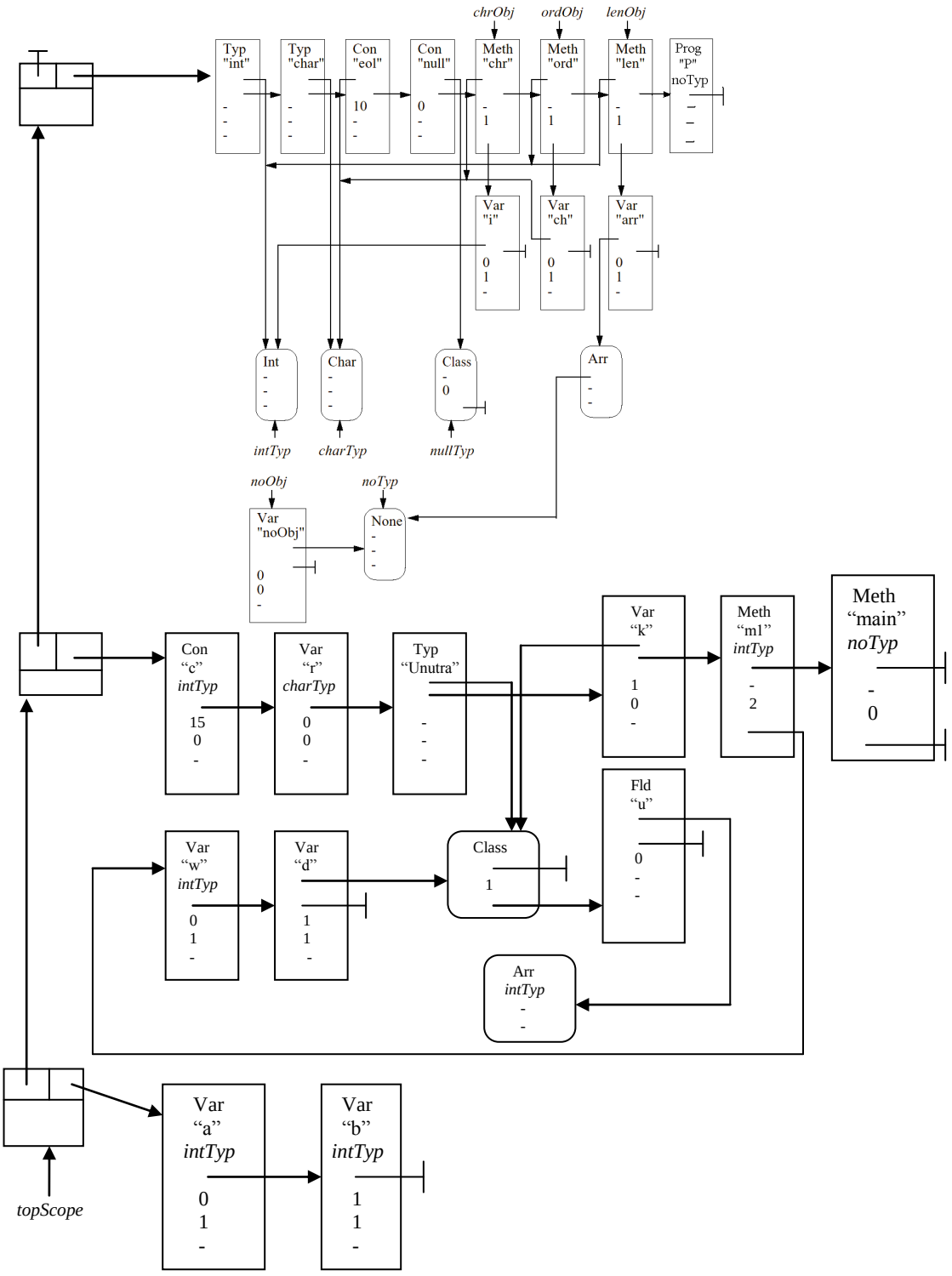
Tačka **(** 7 **)**


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
topScope
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Meth "m1" intTyp
Fld "u"
Var "w" intTyp
Var "d"
Class
Arr intTyp

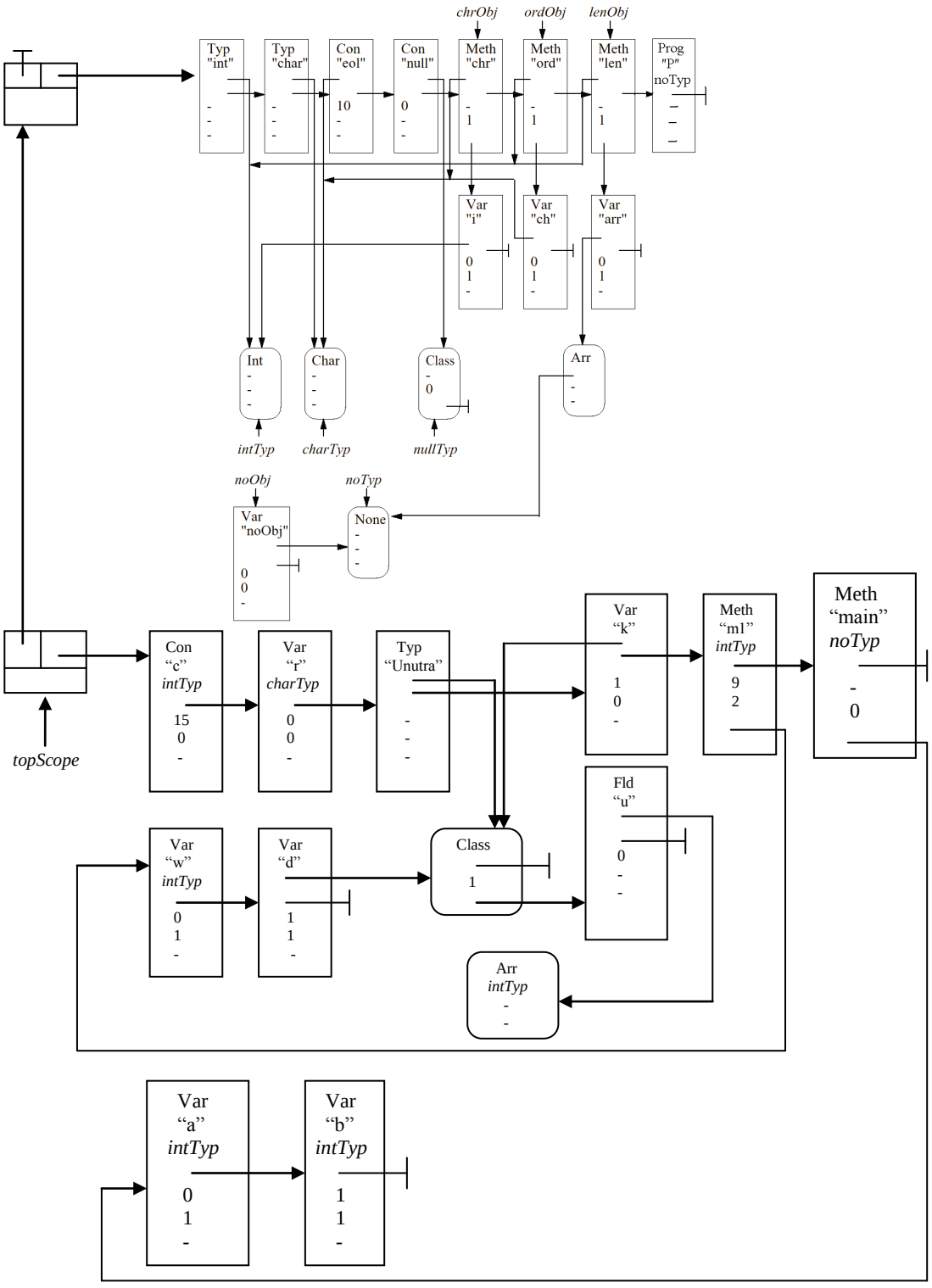
Tačka `(** 8 **)`


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Meth "m1" intTyp
Meth "main" noTyp
Var "w" intTyp
Var "d"
Class
Fld "u"
Arr intTyp
topScope

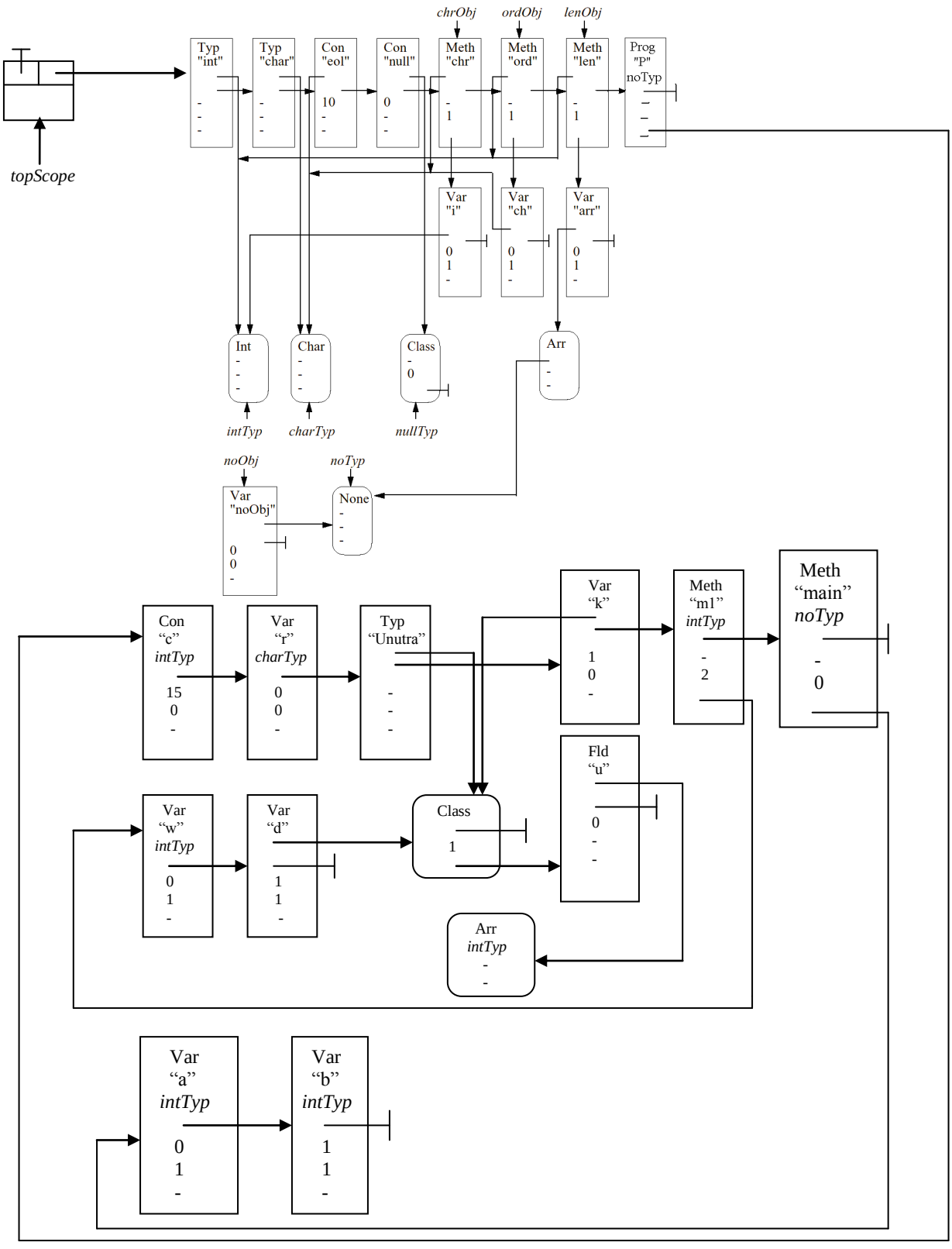
Tačka `(** 9 **)`


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Meth "m1" intTyp
Meth "main" noTyp
Var "w" intTyp
Var "d"
Class
Fld "u"
Arr intTyp
topScope
Var "a" intTyp
Var "b" intTyp

Tačka `(** 10 **)`


chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
topScope
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Meth "m1" intTyp
Meth "main" noTyp
Var "w" intTyp
Var "d"
Class
Fld "u"
Arr intTyp
Var "a" intTyp
Var "b" intTyp

Tačka `(** 11 **)`


topScope
chrObj
ordObj
lenObj
Typ "int"
Typ "char"
Con "eol"
Con "null"
Meth "chr"
Meth "ord"
Meth "len"
Prog "P" noTyp
Var "i"
Var "ch"
Var "arr"
Int
Char
Class
Arr
intTyp
charTyp
nullTyp
noObj
noTyp
Var "noObj"
None
Con "c" intTyp
Var "r" charTyp
Typ "Unutra"
Var "k"
Meth "m1" intTyp
Meth "main" noTyp
Fld "u"
Var "w" intTyp
Var "d"
Class
Arr intTyp
Var "a" intTyp
Var "b" intTyp

Zadatak 2.

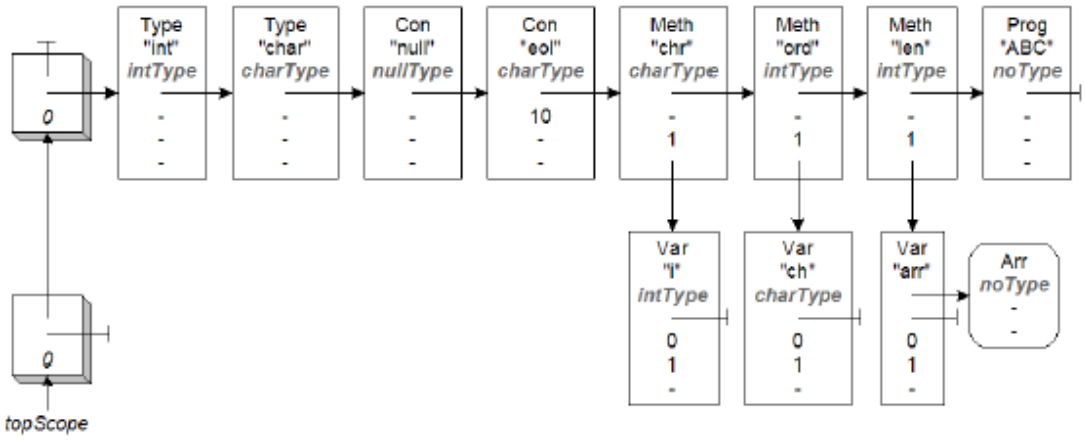
Prikazati izgled tabele simbola u karakterističnim tačkama za priloženi MikroJava program.

```
class ABC (** 1 **)

char c[];
int max;
char npp;

{
  int put (** 2 **)(int x)
  {
  (** 3 **)
       x++;
       print(x, 5);
       npp = 'C';
       return x;
  }(** 4 **)
}
(** 5 **)
```

Rešenje:

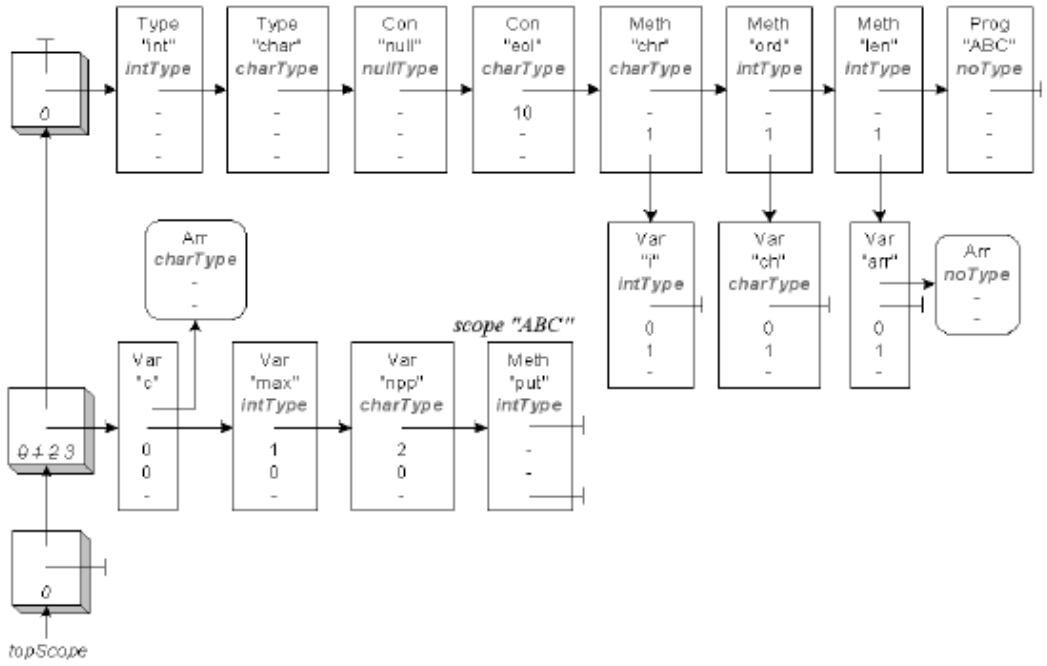
Tačka `(** 1 **)`

U glavnom opsegu se nalaze predefinisani simboli(“int”, “char”,…), a pošto se tačka 1 nalazi iza deklaracije glavne klase u tabeli simbola se nalazi i ime glavne klase tj. programa.



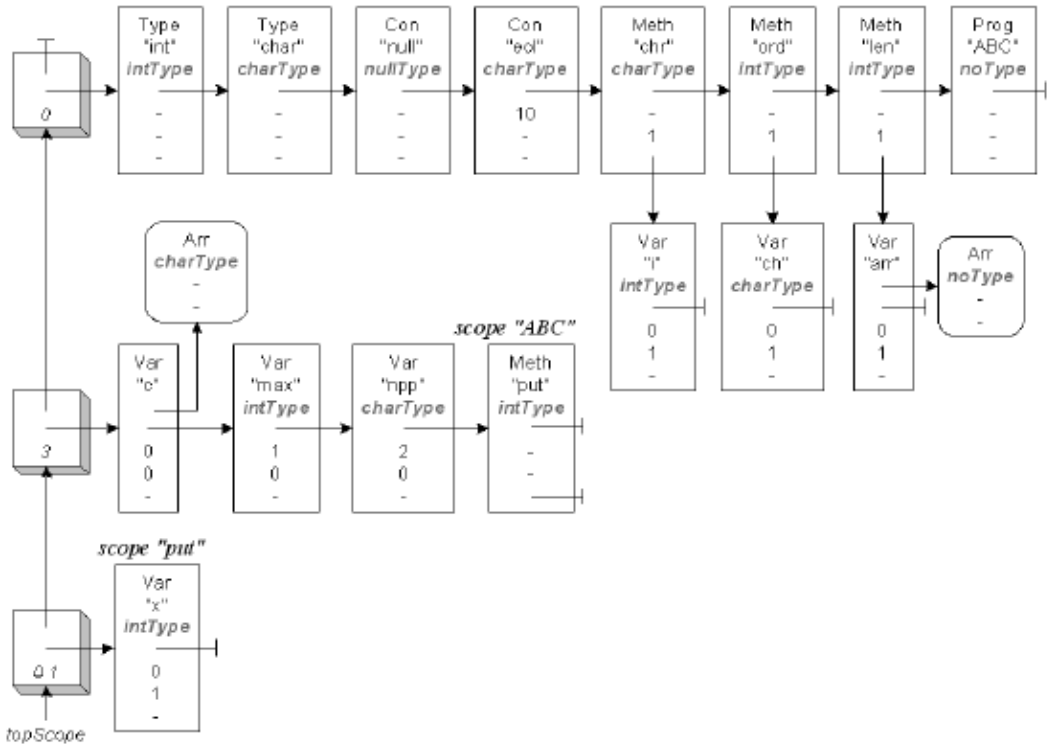
Tačka `(** 2 **)`

Obrađene su deklaracije globalnih promenljivih (niza karaktera `c`, celobrojne promenljive `max` i karaktera `npp`) i početak definicije metode `put`. Simboli se ubacuju u opseg koji pripada glavnoj klasi tj. u opseg “ABC”.



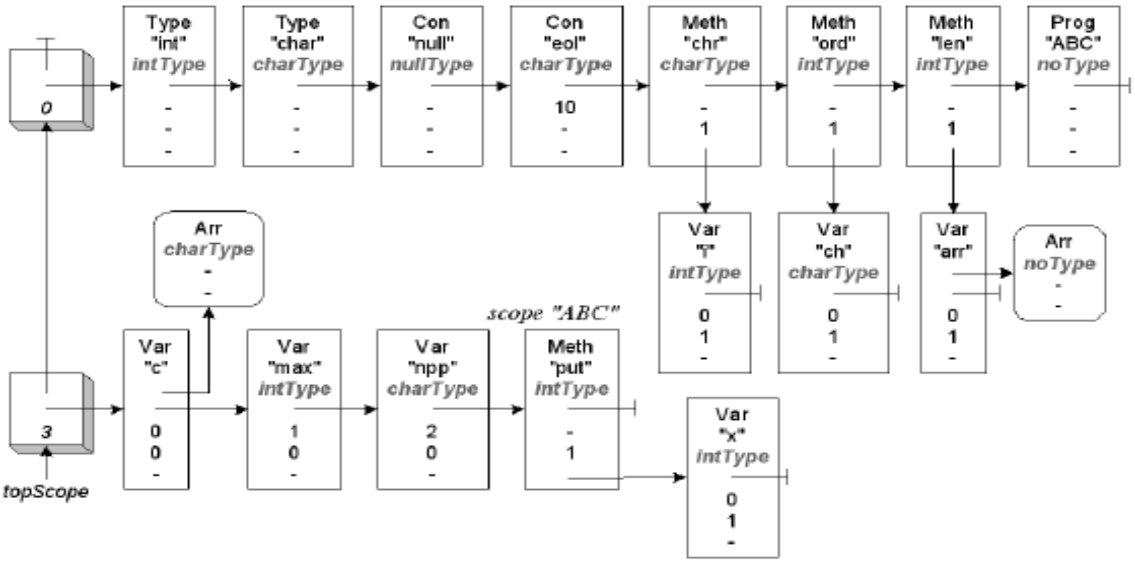
Tačka **(** 3 **)**

Obrađeni su argumenti metode `put` i simbol `x` je unet u tabelu simbola. Pošto je `x` vidljiv samo u metodi `put`, simbol `x` se stavlja u opseg koji pripada metodi `put`.



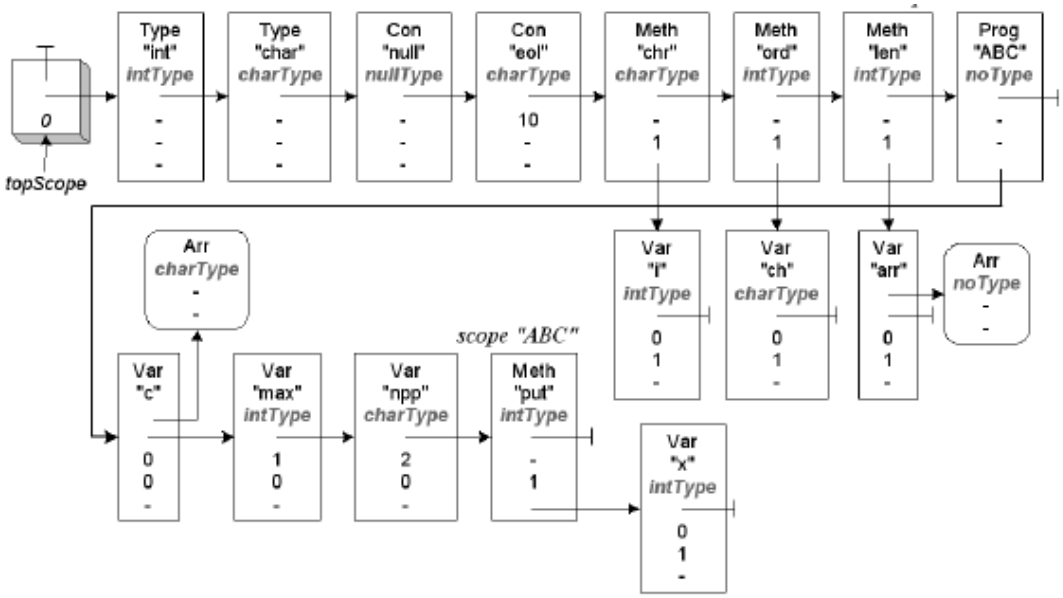
Tačka **(** 4 **)**

Parser je izašao iz opsega metode `put` i odgovarajući opseg je skinut sa steka.



Tačka `(** 5 **)`

Parser je završio sa radom, skinuo je poslednji opseg sa steka i dodelio ga Object čvoru glavne klase.



Zadatak 3

Prodiskutovati prednosti i mane organizovanja tabele simbola

a) kao jedinstvene tabele

b) uz postojanje posebne tabele za svaki opseg

ako se tabele realizuju uz upotrebu ili heš funkcije ili leksičkog stabla.

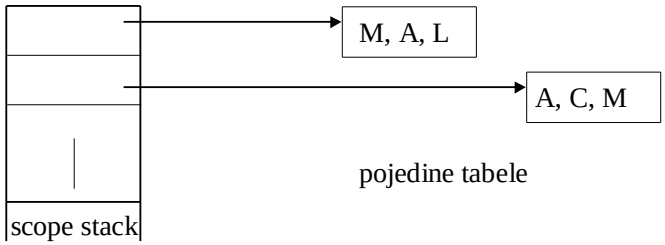
Rešenje:

Postoje 4 varijante: jedinstvena tabela - heš funkcija,
jedinstvena tabela - leksičko stablo,
lokalna tabela - heš funkcija,
lokalna tabela - leksičko stablo.

Razmotrićemo pretraživanje tabela (funkcija LookUp), otvaranje i zatvaranje leksičkog opsega funkcije OpenScope i CloseScope na primeru:

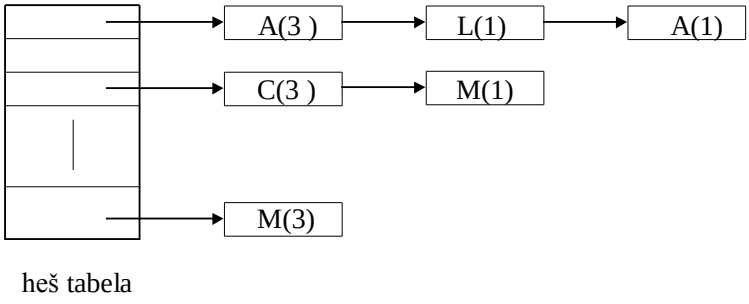
```
{ int H, A, L;
  …
  {float X, Y;
  …
  }
  {char A, C, M;
  …
  /* trenutna pozicija*/
  }
}
```

b) individualne tabele

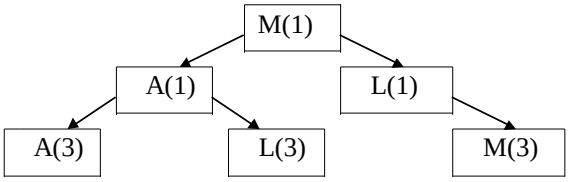


- pri otvaranju opsega na vrh steka ide tabela za taj opseg,
- pretraživanje: nelokalna imena ⇒ više tabela (mana),
- zatvaranje opsega ⇒ skine se tabela sa vrha steka,
- memorijski zahtevi: bolja realizacija sa stablima zbog fiksnog overheada heš tabela

a) jedinstvena tabela



- OpenScope: dodeli se opsegu jedinstven broj i čuva se uz ime (više memorije),
- LookUp: traži se dok se ne naleti na prvo A (efikasno),
- Insert: stavlja se na početak lanca kolizije
- CloseScope: izbrišu se imena sa početka svih lanaca (efikasno)



leksičko stablo

- OpenScope: kao gore,
- Insert: uvek se dodaju listovi, pa pri look up-u ne smemo se zadovoljiti prvim A nego treba ići do lista (neefikasno),
- CloseScope: mora se pretraživati celo stablo (neefikasno),
- rezime: pogodnije kombinacije heš - jedinstvena tabela i stablo - lokalne tabele.

Kod višeprolaznih prevodilaca gotovo isključivo se koriste lokalne tabele jer pri CloseScope ne smemo jednostavno uništiti informacije iz tabele (trebaju nam za druge prolaze).

Nasleđivanje i polimorfizam

Zadatak 4
Dat je sledeći program na programskom jeziku Mikrojava. Prikazati izgled tabele simbola u trenucima prevođenja koji su naznačeni u programu. Mikrojava podržava nasleđivanje klasa i polimorfizam.

```
class OOMJ (* T1 *)
      class TCalc (* T2 *) { // TaxCalculator
            double tax; // [0,1] interval (* T3 *)
            {
                  TCalc(double t) { tax = t; }
                  double calcPrice(double cost) { return cost*(1+tax); }
                  int check(double v) { return d>0; }
            } (* T4 *)
      }
      (* T5 *)
      class ATCalc (* T6 *) extends TCalc {
            // Tax with amortization
            double a;
            { (* T7 *)
                  ATCalc (int t, int a) { super(t); this.a = a; }
                  // @Overriden
                  double calcPrice(double c) { return (cost*a)*(1*tax); }
            } (* T8 *)
      } (* T9 *)
{
      void main()
            TCalc c1, c2;
            double cost; (* T10 *)
      {
            cost = 1000;
            c1 = new  TCalc(0.09);
            c2 = new ATCalc(0.18, 0.2);
            print(c1.calcPrice(cost));
            print(c2.calcPrice(cost));
      }
}
(* T11 *)
```

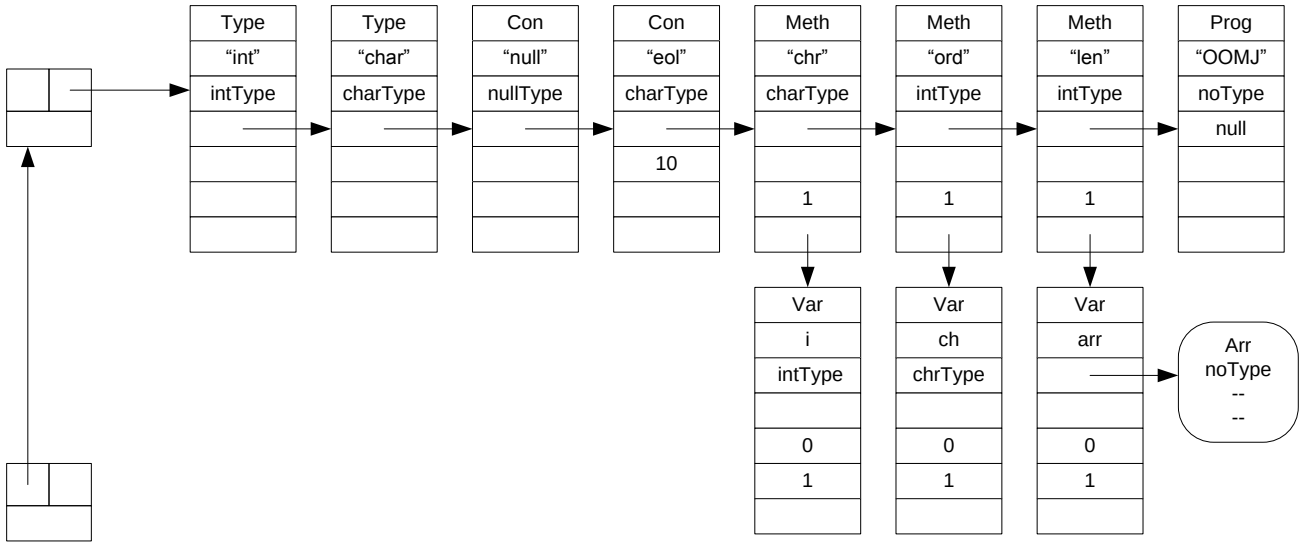


Figure 1 Izgled tabele simbola u tački T1.

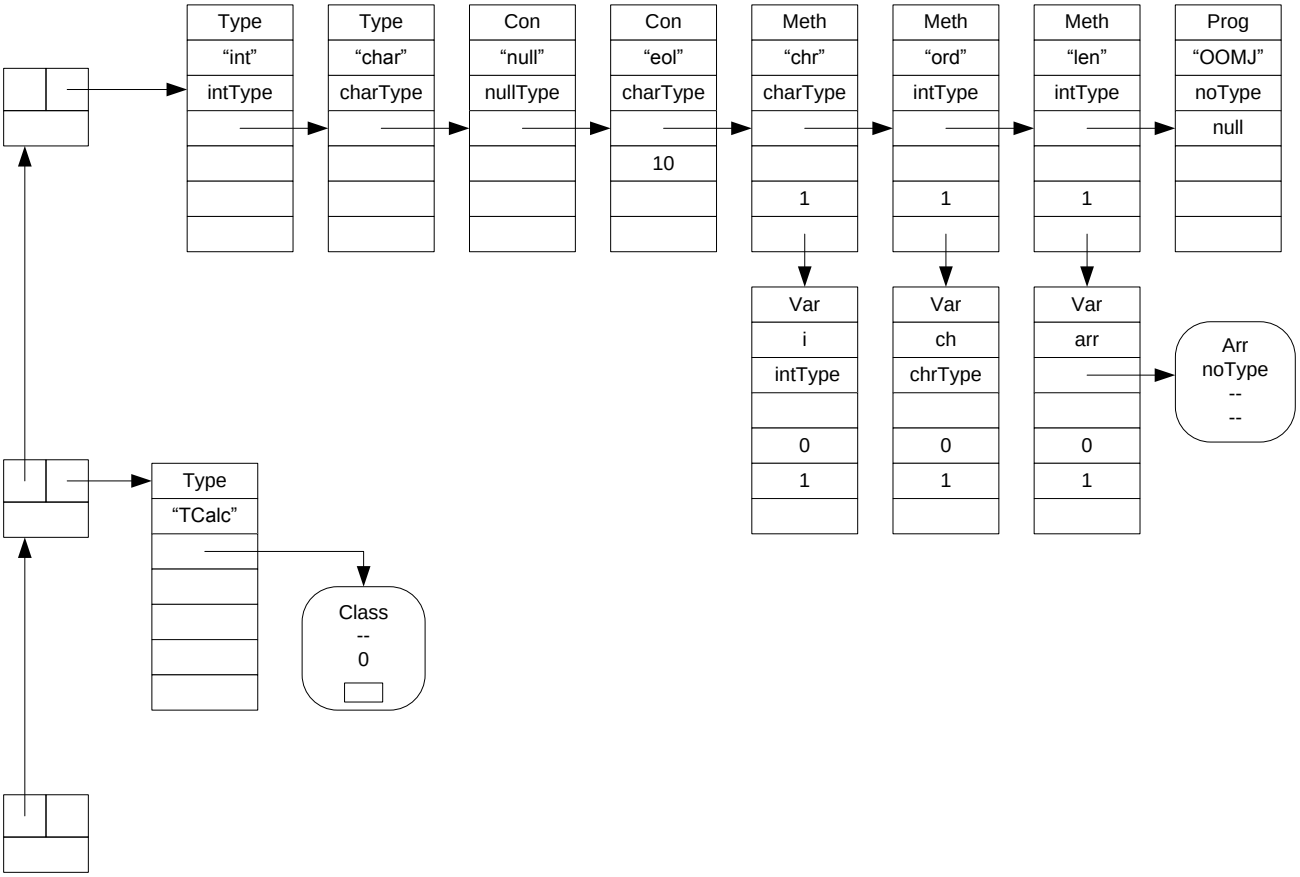


Figure 2 Izgled tabele simbola u tački T2.

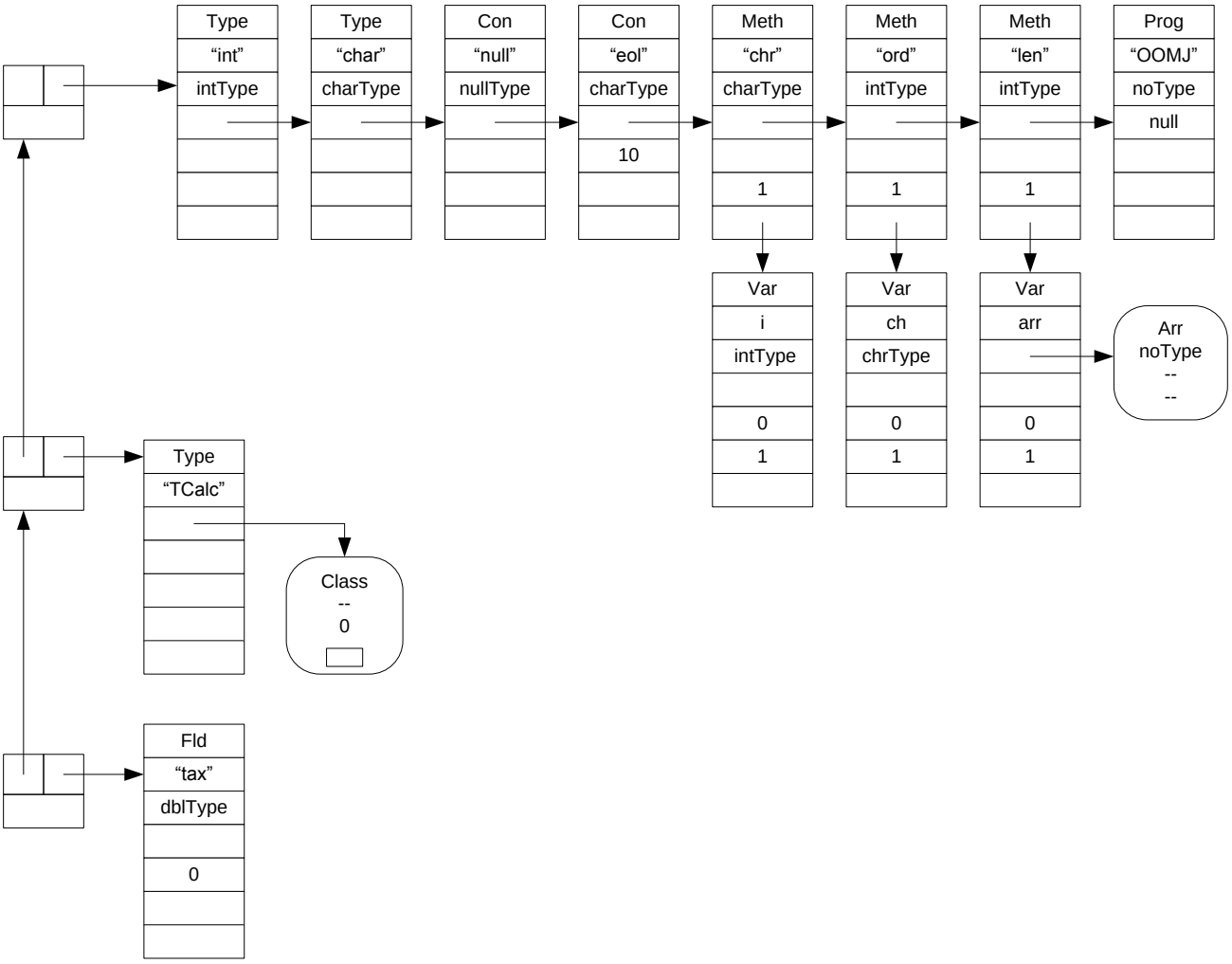


Figure 3 Izgled tabele simbola u trenutku T3.

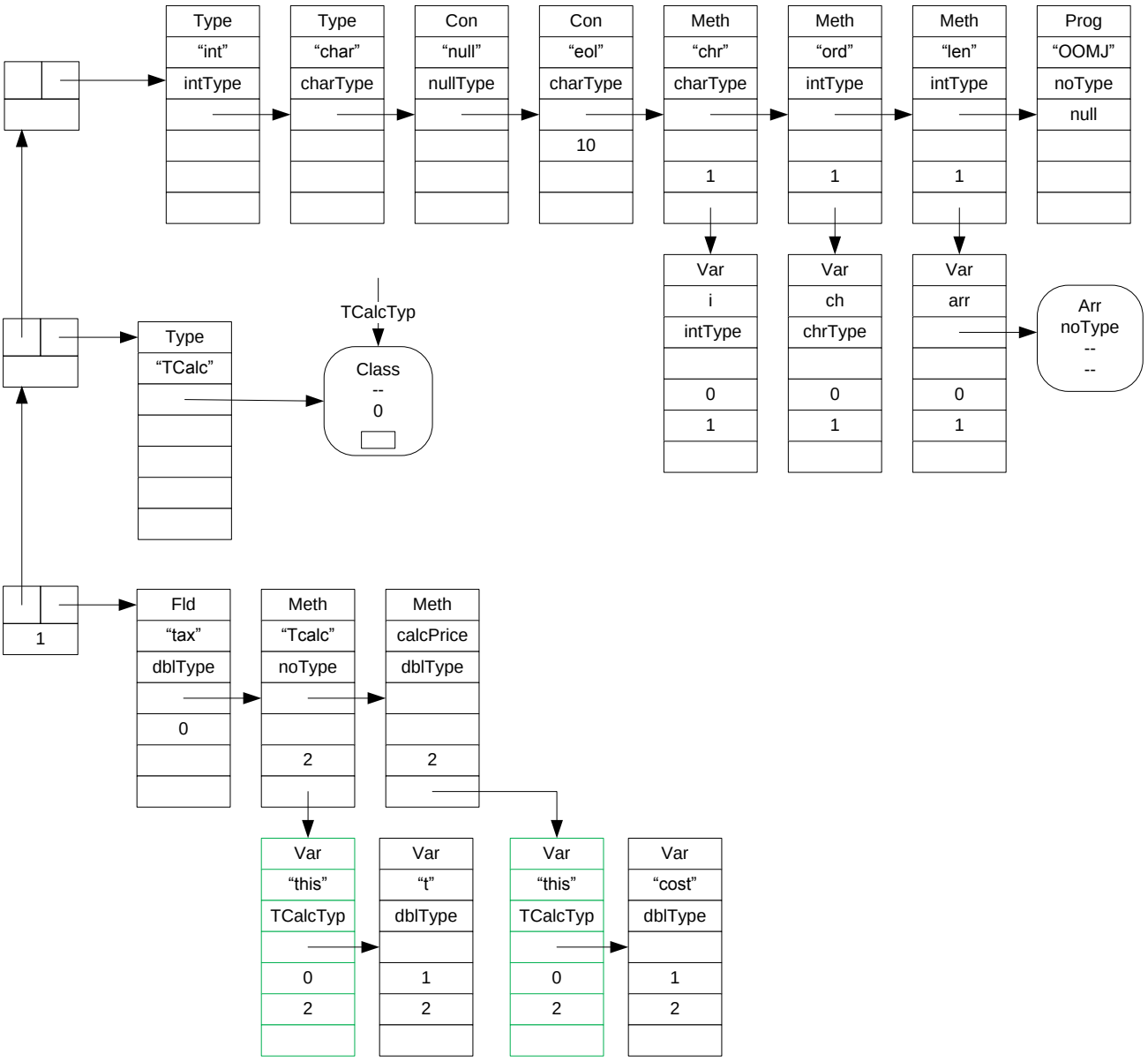


Figure 4 Izgled tabele simbola u tački T4.

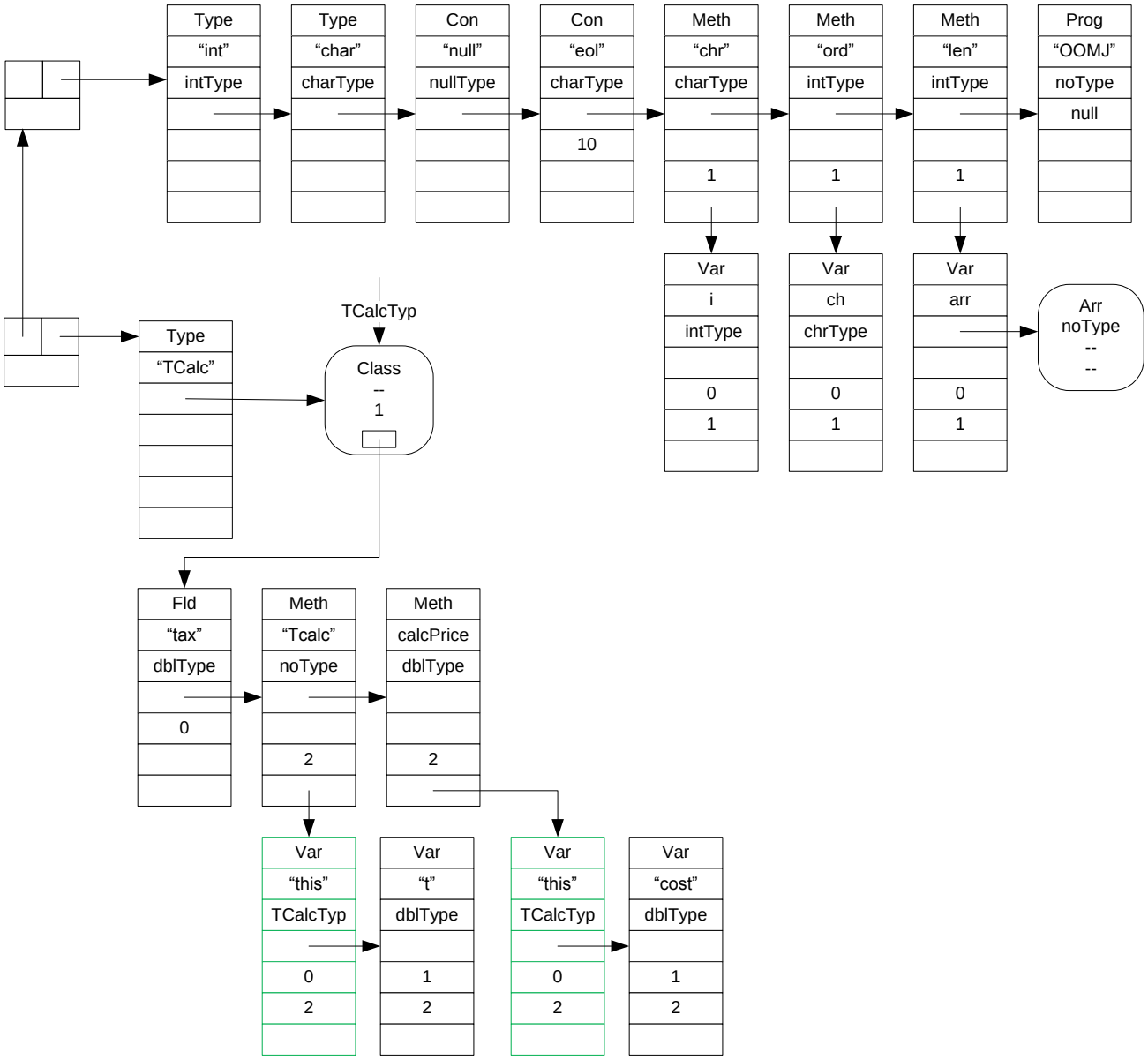


Figure 5 Izgled tabele simbola u tački T5.

Izgled tabele simbola

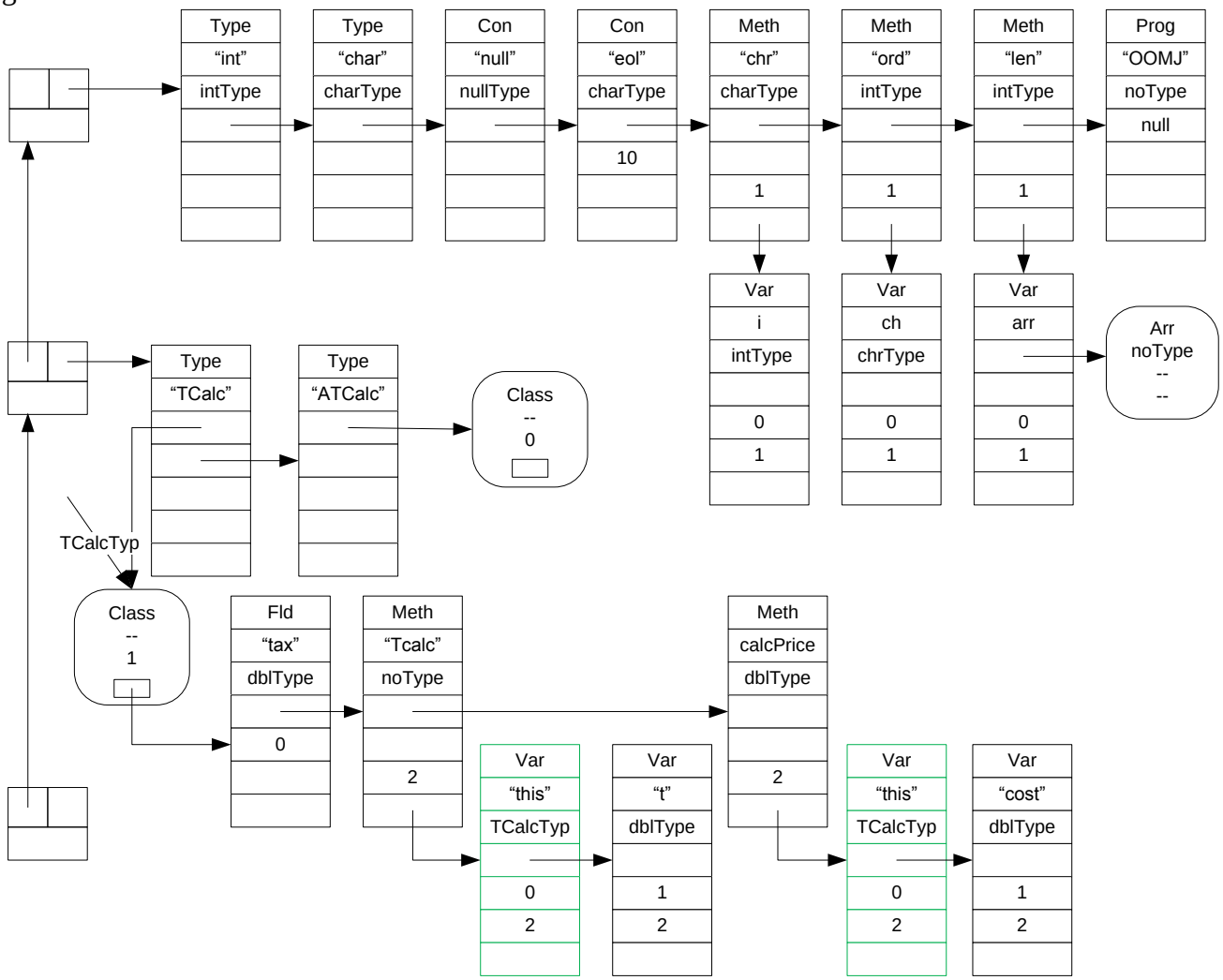


Figure 6 Izgled tabele simbola u tački T6.

Izgled tabele simbola:

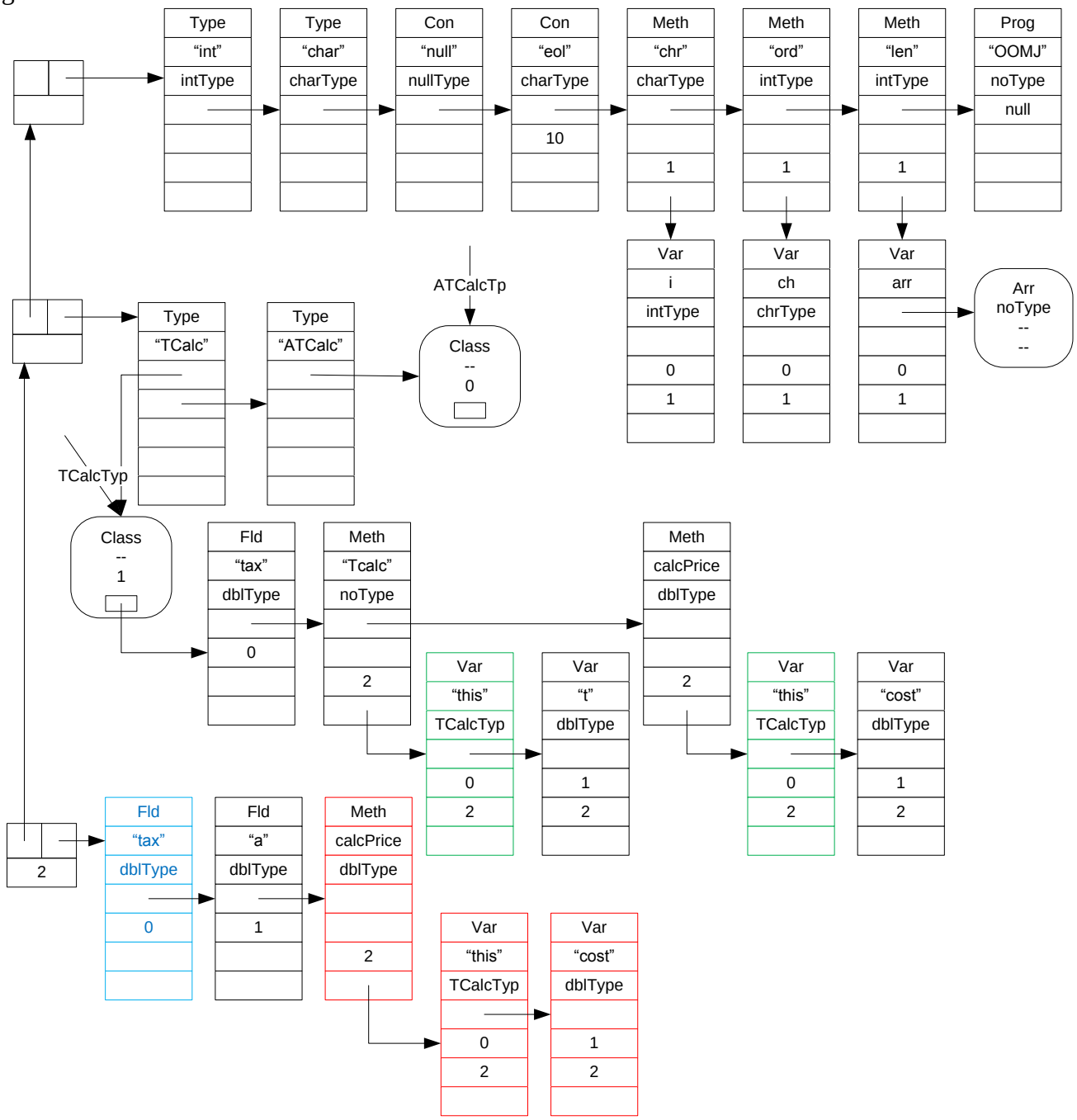


Figure 7 Izgled tabele simbola u tački T7.

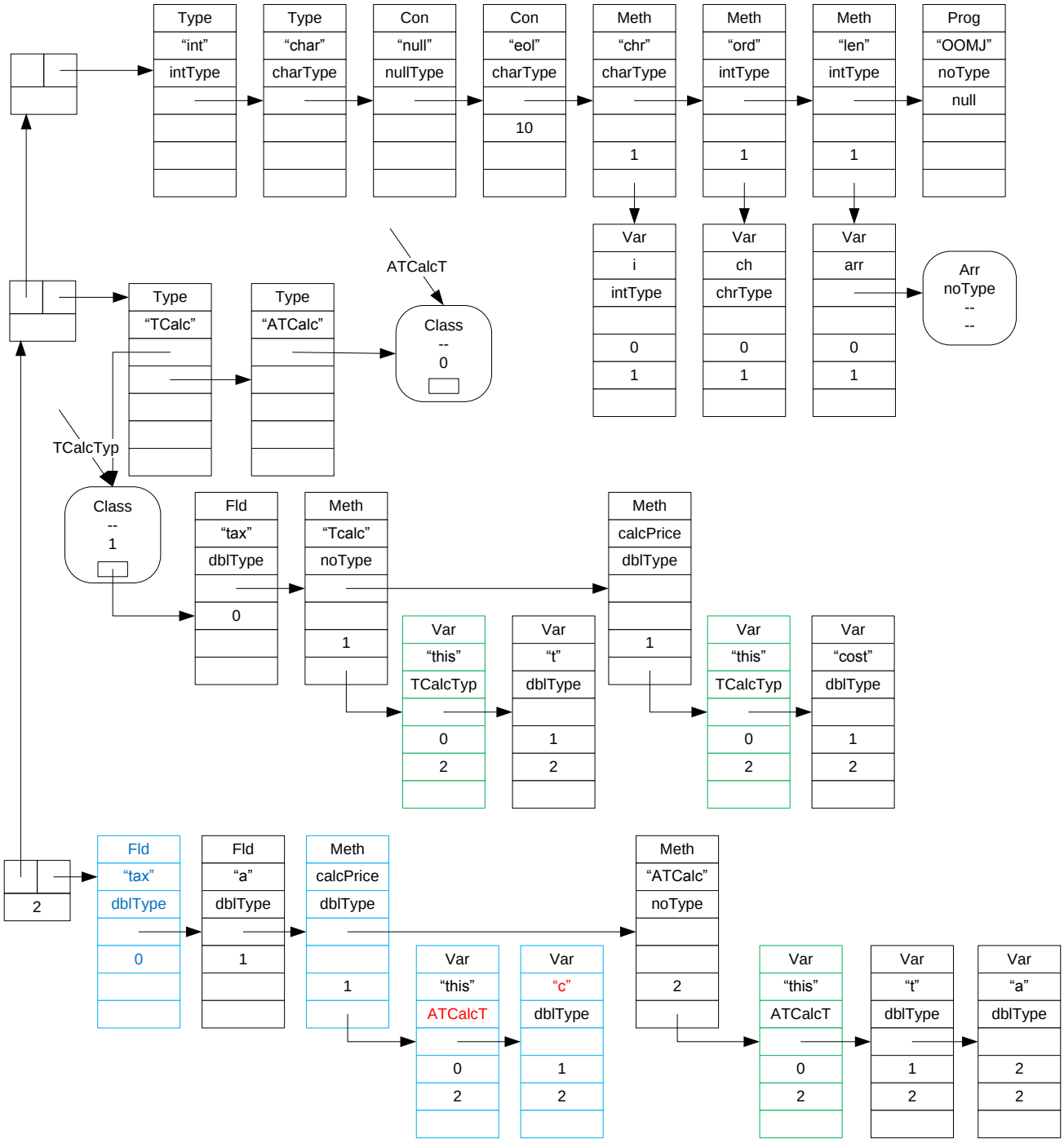


Figure 8 Izgled tabele simbola u tački T8.

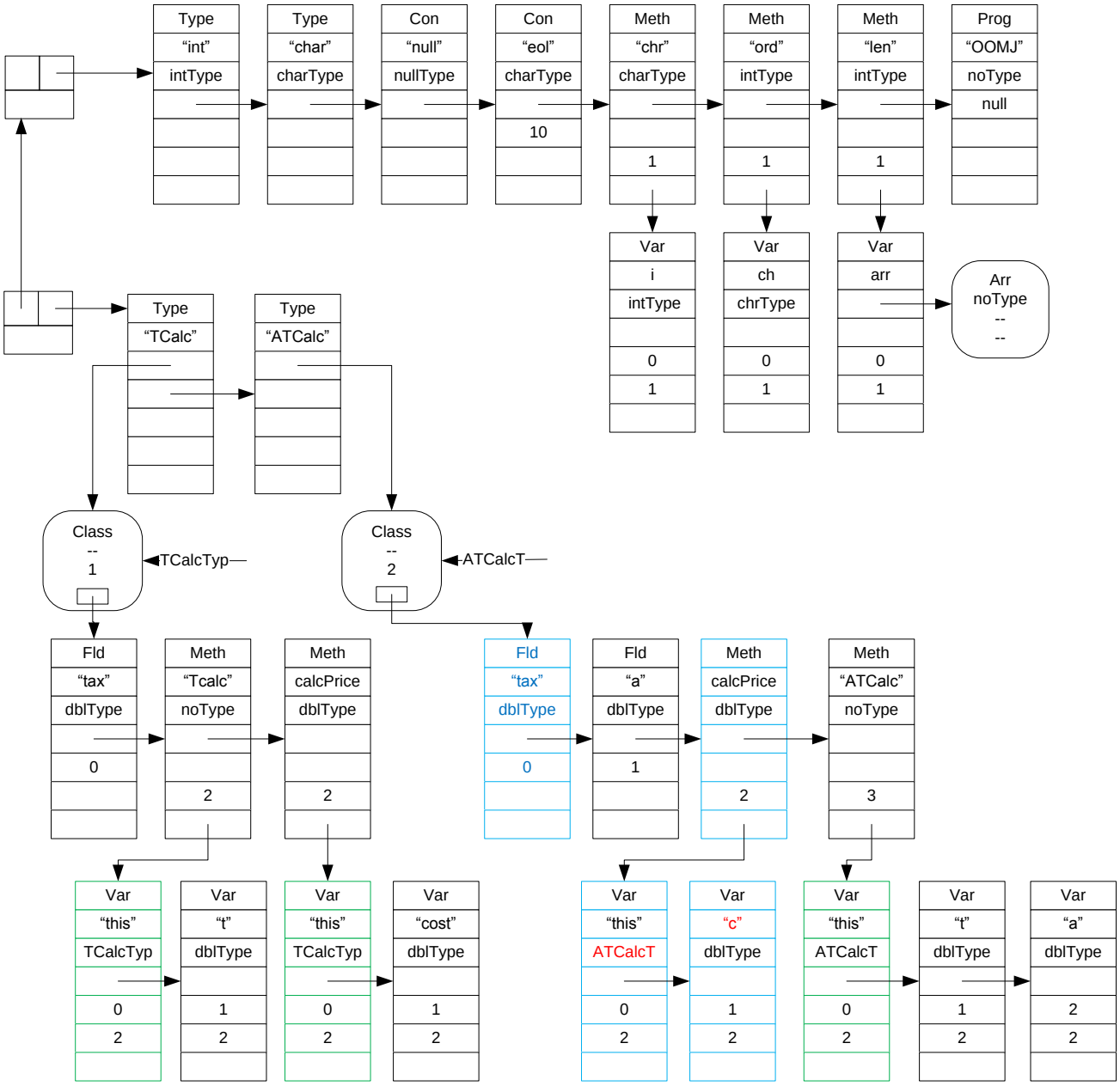


Figure 9 Izgled tabele simbola u tački T9.

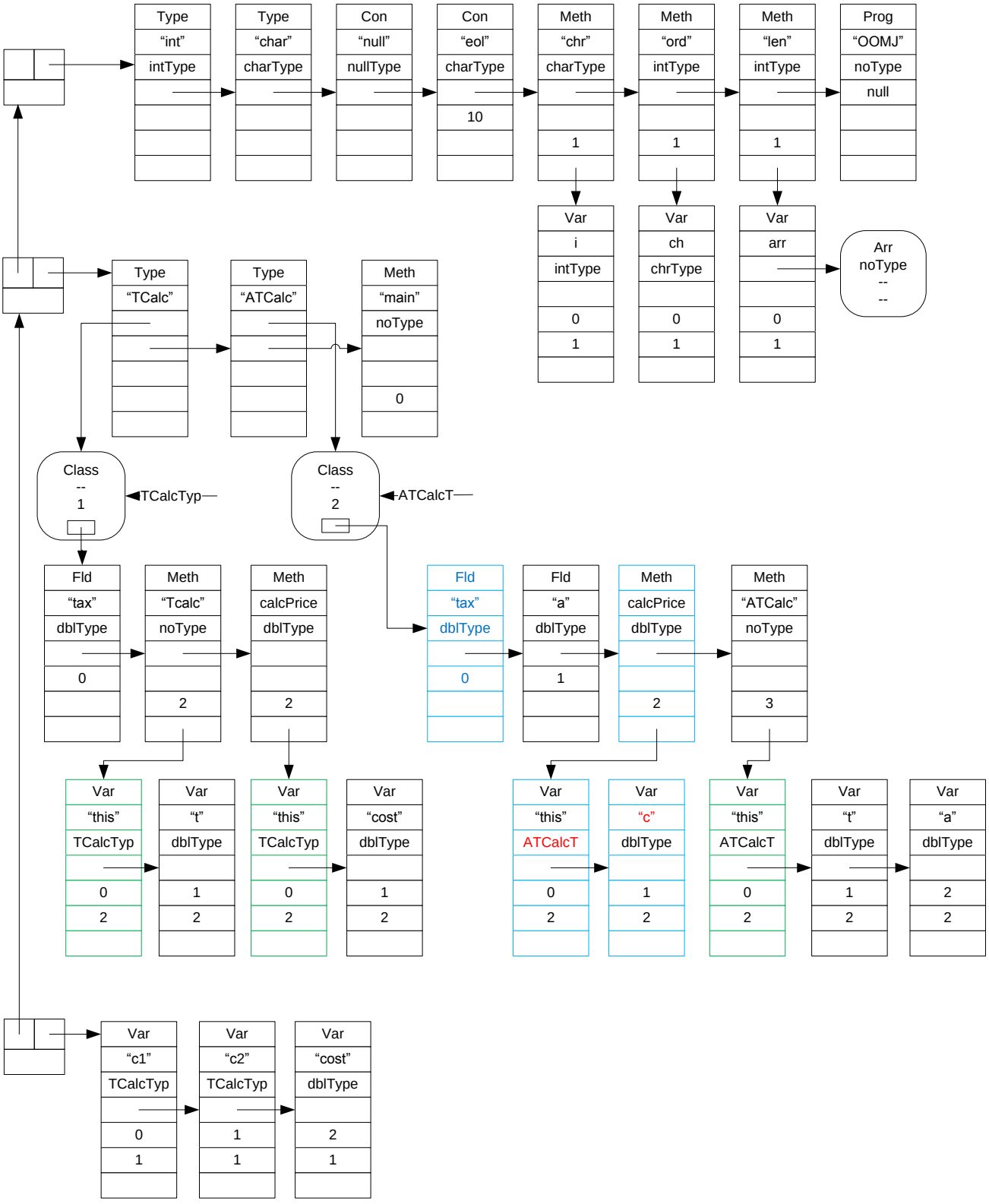


Figure 10 Izgled tabele simbola u tački T10.

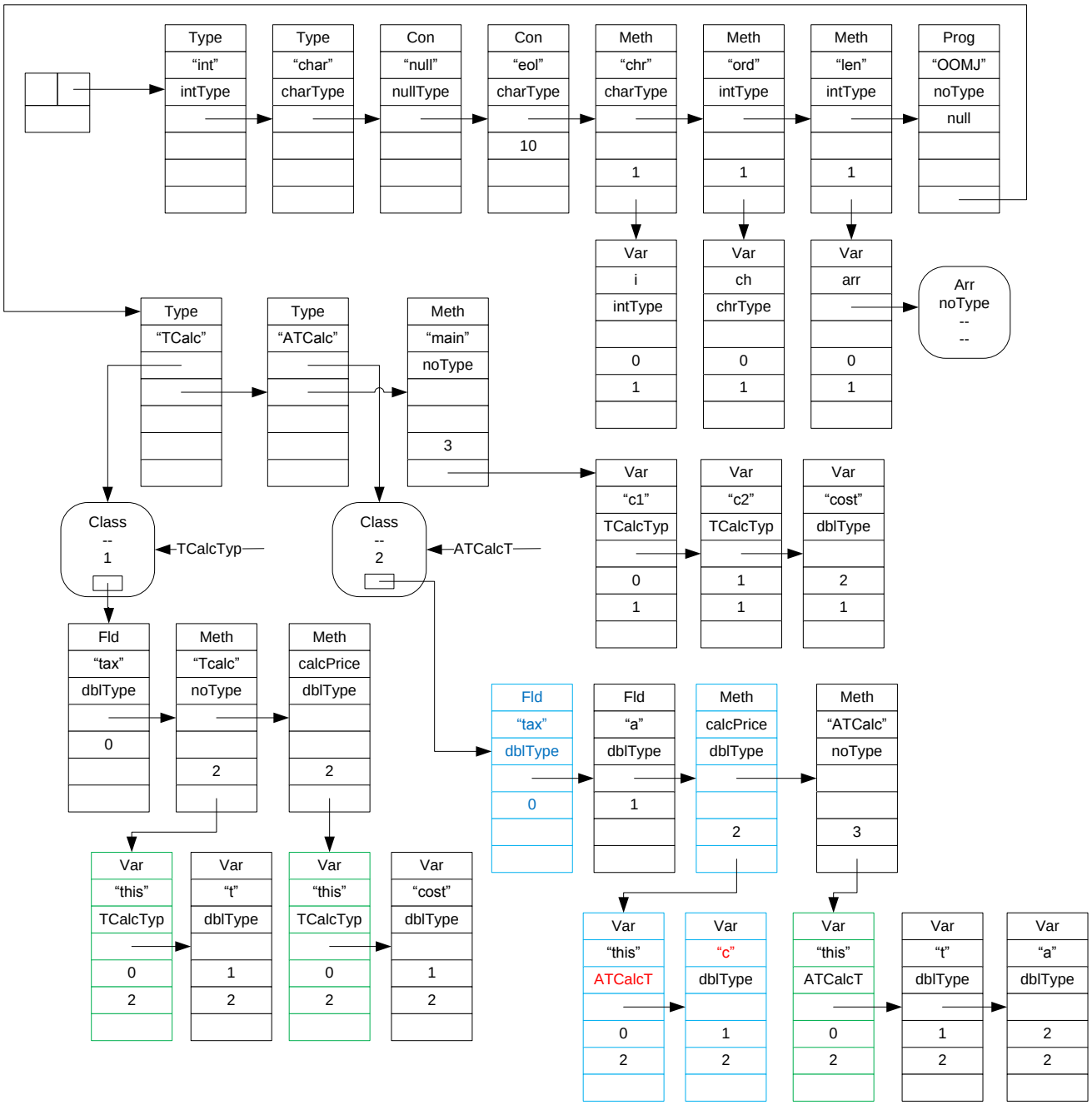


Figure 11 Izgled tabele simbola u tački T11.