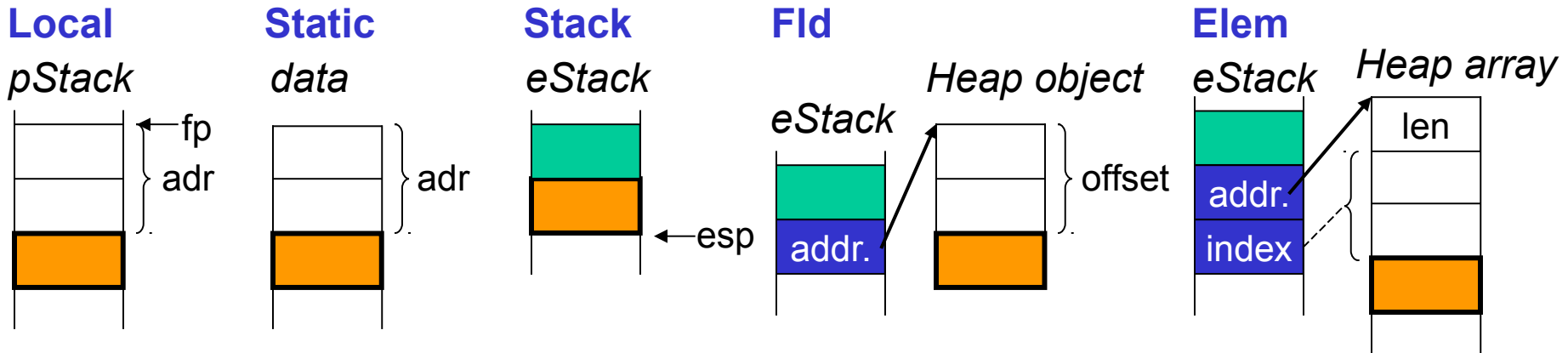


Klasse *Operand*



```
class Operand {  
    public enum Kind {  
        Con, Local, Static, Stack, Fld, Elem, Meth  
    }  
    public Kind kind;  
    public Struct type;  
    public int val;  
    public int adr;  
    public Obj obj;  
}
```

// Con: value
// Local, Static, Fld, Meth: address
// Meth: method object from the symbol table



Beispiel



Assignment = Designator "=" Expr .

Expr = Term { "+" Term } .

Term = Factor { "*" Factor } .

Factor = number | Designator.

Designator = ident ["." ident | "[" Expr "]"].

Designator erkennen



```
void Designator() {
    check(ident);

    if (sym == period) {
        scan();

        check(ident);

    } else if (sym == lbrack) {
        scan();

        Expr();

        check(rbrack);
    }
}
```

Operand erzeugen



```
Operand Designator() {  
    check(ident);  
    Operand x = new Operand(tab.find(t.str), this);  
    if (sym == period) {  
        scan();  
  
        check(ident);  
        Obj obj = tab.findField(t.str, x.type);  
        x.kind = Item.Kind.Fld; x.type = obj.type; x.adr = obj.adr  
    } else if (sym == lbrack) {  
        scan();  
  
        Operand y = Expr();  
  
        x.kind = Operand.Kind.Elem; x.type = x.type.elemType;  
        check(rbrack);  
    }  
    return x;  
}
```

Code erzeugen

```

Operand Designator() {
    check(ident);
    Operand x = new Operand(tab.find(t.str), this);
    if (sym == period) {
        scan();
        code.load(x);
        check(ident);
        Obj obj = tab.findField(t.str, x.type);
        x.kind = Operand.Kind.Fld; x.type = obj.type; x.adr = obj.adr
    } else if (sym == lbrack) {
        scan();
        code.load(x);
        Operand y = Expr();
        code.load(y);
        x.kind = Operand.Kind.Elem; x.type = x.type.elemType;
        check(rbrack);
    }
    return x;
}

```

Diagram illustrating the code generation process for the `Operand Designator()` method. The code is annotated with comments and arrows pointing to specific lines:

- The comment `x.type.kind == Struct.Kind.Class` points to the `code.load(x);` line within the `if (sym == period)` block.
- The comment `x.type.kind == Struct.Kind.Arr` points to the `code.load(x);` line within the `else if (sym == lbrack)` block.
- The comment `y.type == Tab.intType` points to the `code.load(y);` line within the `else if (sym == lbrack)` block.

Konstruktor *Operand(Obj)*



```
Operand(Obj o, Parser parser) {  
    type = o.type;  
    val = o.val;  
    adr = o.adr;  
    switch (o.kind) {  
        case Con:  
            kind = Kind.Con;  
            break;  
        case Var:  
            if (o.level == 0) { kind = Kind.Static; } else { kind =  
Kind.Local; }  
            break;  
        case Meth:  
            kind = Kind.Meth; obj = o;  
            break;  
        default:  
            parser.error(NO_OPERAND);  
    }  
}
```

Code.load()

```
void load(Operand x) {
    switch (x.kind) {
        case Con: loadConst(x.val); break;
        case Local:
            switch (x.adr) {
                case 0: put(OpCode.load_0); break;
                case 1: put(OpCode.load_1); break;
                case 2: put(OpCode.load_2); break;
                case 3: put(OpCode.load_3); break;
                default: put(OpCode.load); put(x.adr); break;
            }
            break;
        case Static: put(OpCode.getstatic); put2(x.adr); break;
        case Stack: break; // nothing to do (already loaded)
        case Fld: put(OpCode.getfield); put2(x.adr); break;
        case Elem:
            if (x.type == Tab.charType) { put(OpCode.baload); }
            else { put(OpCode.aload); }
            break;
        default: parser.error(NO_VAL);
    }
    x.kind = Operand.Kind.Stack;
}
```

Factor und Term

```

Operand Factor() {
    Operand x;
    if (sym == number) {
        x = new Operand(t.val);
        scan();
    } else {
        x = Designator();
    }
    return x;
}

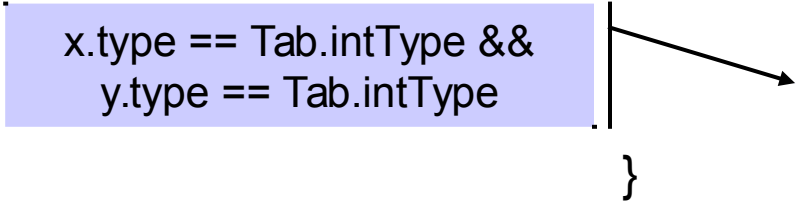
```

```

Operand Term() {
    Operand x = Factor();
    while (sym == times) {
        scan();
        code.load(x);
        Operand y = Factor();
        code.load(y);
        code.put(OpCode.mul);
    }
    return x;
}

```

x.type == Tab.intType &&
y.type == Tab.intType



Expr und Assignment

```
Operand Expr() {  
    Operand x = Term();  
    while (sym == plus) {  
        scan();  
        code.load(x);  
        Operand y = Term();  
        code.load(y);  
        code.put(OpCodes.add);  
    }  
    return x;  
}
```

x.type == Tab.intType &&
y.type == Tab.intType

```
void Assignment() {  
    Operand x = Designator();  
    check(assign);  
    Operand y = Expr();  
    code.assign(x, y);  
}
```

y.type.assignableTo(x.type)

Klasse *Code* – Hilfsmethode *assign*



```
void assign(Operand x, Operand y) {  
    load(y);  
    switch (x.kind) {  
    case Local:  
        switch (x.adr) {  
        case 0: put(OpCode.store_0); break;  
        case 1: put(OpCode.store_1); break;  
        case 2: put(OpCode.store_2); break;  
        case 3: put(OpCode.store_3); break;  
        default: put(OpCode.store); put(x.adr); break;  
        } break;  
        case Static: put(OpCode.putstatic); put2(x.adr); break;  
        case Fld: put(OpCode.putfield); put2(x.adr); break;  
        case Elem:  
            if (x.type == Tab.charType) { put(OpCode.bastore); }  
            else { put(OpCode.astore); }  
            break;  
        default: parser.error(NO_VAR);  
    }  
}
```

Klasse *Struct* – Hilfsmethoden



```
boolean isRefType() {  
    return kind == Kind.Class || kind == Kind.Arr;  
}
```

```
boolean equals(Struct other) {  
    if (kind == Kind.Arr) {  
        return other.kind == Kind.Arr && elemType.equals(other.elemType);  
    } else {  
        return this == other; // must be same type node  
    }  
}
```

Klasse *Struct* – Hilfsmethoden



```
boolean compatibleWith(Struct other) {  
    return this.equals(other) ||  
           (this == Tab.nullType && other.isRefType()) ||  
           (other == Tab.nullType && this.isRefType());  
}
```

```
boolean assignableTo(Struct dest) {  
    return this.equals(dest) ||  
           (this == Tab.nullType && dest.isRefType()) ||  
           (this.kind == Kind.Arr && dest.kind == Kind.Arr &&  
            dest.elemType == Tab.noType); // for function len()  
}
```

Beispiel: $b.x = \text{iarr}[5] + i * n$

Deklaration: program A

```
final int max = 12; // Konstante
char c; int i; // globale Variablen
class B { int x, y; // innere Klasse mit Feldern
{ void foo () int[] iarr; B b; int n; {...} }
```

