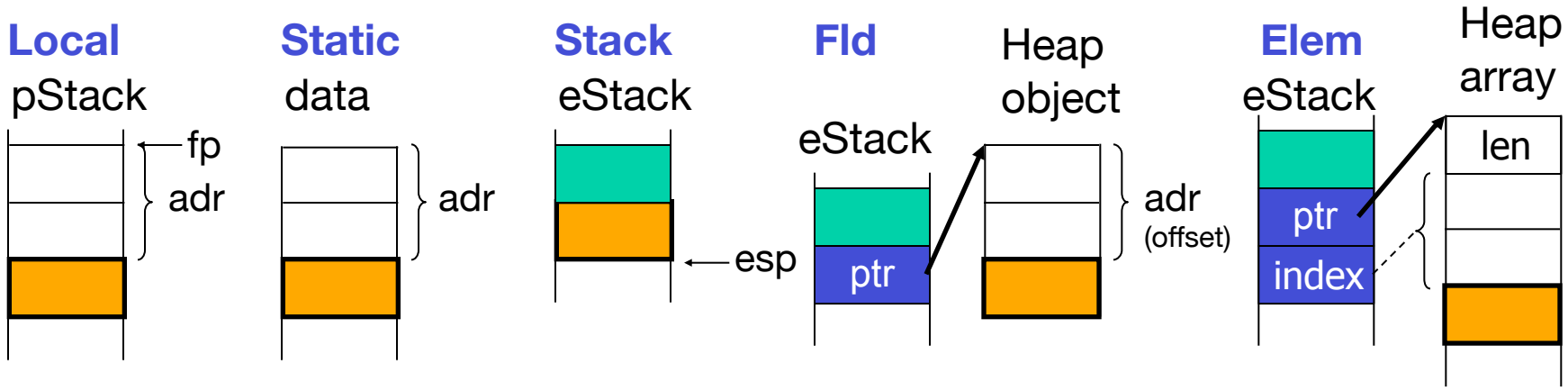
Klasse Operand

```
class Operand {
    public enum Kind {
        Con, Local, Static, Stack, Fld, Elem, Meth
    }
    public Kind kind;
    public Struct type;
    public int val;          // Con: value
    public int adr;          // Local, Static, Fld, Meth: address
    public Obj obj;          // 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 = Item.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;
}
```

x.type.kind == Struct.Kind.Class

x.type.kind == Struct.Kind.Arr

y.type == Tab.intType

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(la.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(OpCode.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 = 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;   {...}    }
```