Name, Binding and Scope

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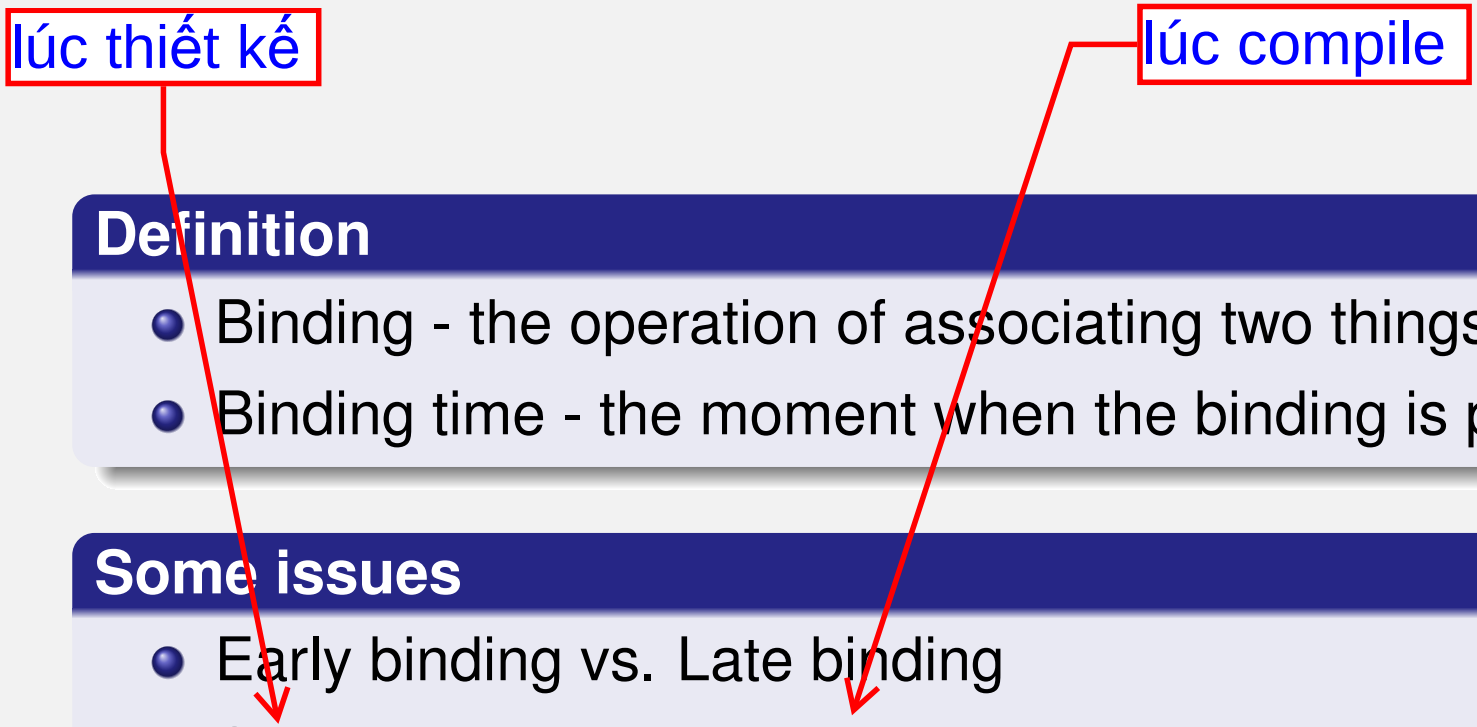
Name

- Name - character string used to represent something else.
  - identifiers,
  - operators (+, &, *).
- Use symbol instead of **address** to refer an entity.
- Abstraction

Binding



Definition

- Binding - the operation of associating two things.
- Binding time - the moment when the binding is performed.

Some issues

- Early binding vs. Late binding
- Static binding vs. Dynamic binding
- Polymorphism - A name is bound to more than one entity.
- Alias - Many names are bound to one entity.

Binding Time

- Language design time
- Language implementation time
- Programming time
- Compilation time
- Linking time
- Load time
- Runtime

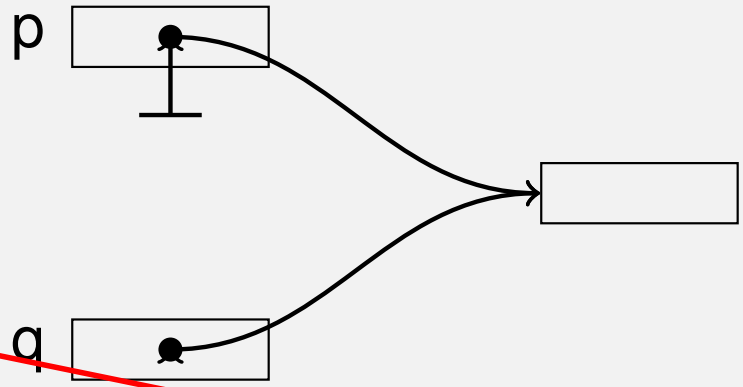
Object Lifetime

- *Object* - any entity in the program.
- *Object lifetime* - the period between the object creation and destruction.
- *Binding lifetime*
- *Dangling reference*

```
p = new int;
q = p;
delete p;
*q;
```

- *Leak memory - Garbage*

```
p = new int;
p = null;
```



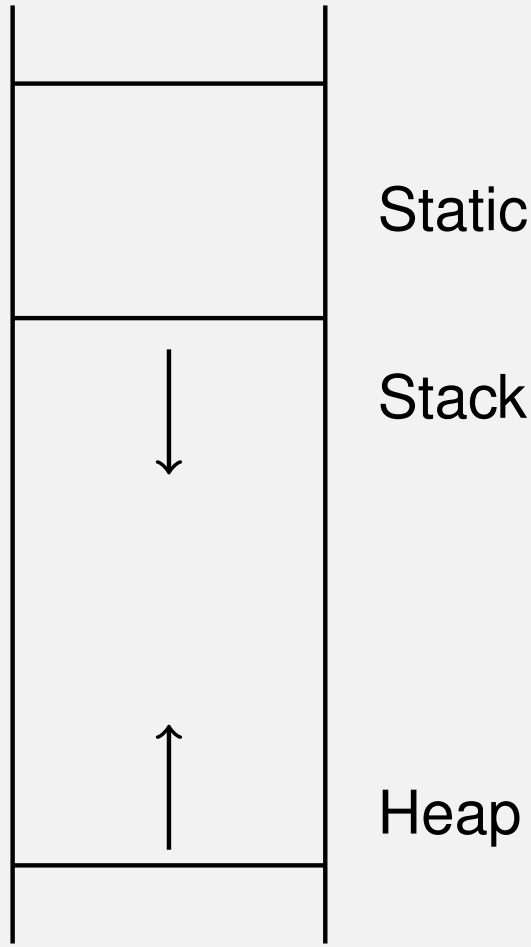
kết hợp alias và delete

do dùng null mà chưa delete

dòng truy xuất mới bắt đầu bị lỗi

Object Allocation

- Static
- Stack Dynamic
- Explicit Heap Dynamic
- Implicit Heap Dynamic



Blocks

Definition

A block is a textual region, which can contain declarations to that region

Example,

```
procedure foo()
var x:integer;
begin
    x := 1;
end;
```

```
{
    int x;
    x = 1;
}
```

Scope

Definition

Scope of a binding is the textual region of the program in which the binding is effective.

Static vs. Dynamic

- Static scope, or lexical scope, is determined during compilation
  - Current binding - in the block most closely surround
  - Global scope
  - Local static scope
- Dynamic scope is determined at runtime.
  - Current binding - the most recently execution but not destroyed

Staic Scope Rules for Blocks

- A reference to an identifier is always bound to **its most local declaration**
- A declaration is **invisible** outside the block in which it appears
- Declarations in enclosing blocks are **visible** in **inner blocks**, unless they have been **re-declared**
- Blocks may be named and its name declaration is considered as a **local declaration of outer** block.

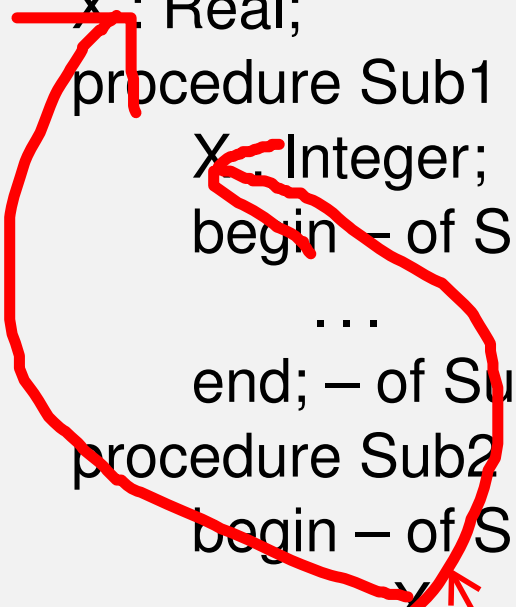
Example on Static scope

```
var A, B, C: real; //1
procedure Sub1 (A: real); //2
        var D: real;
        procedure Sub2 (C: real);
                var D: real;
                begin
                        ... C:= C+B; ...
                end;
        begin
                ... Sub2(B); ...
        end;
begin
        ... Sub1(A); ...
end.
```

Variable	Scope
A:real //1	Main
B:real //1	Main, Sub1, Sub2
C:real //1	Main, Sub1
A:real //2	Sub1, Sub2
...	

Example on Dynamic Scope

```
procedure Big is
    X : Real;
    procedure Sub1 is
        X : Integer;
        begin – of Sub1
            ...
        end; – of Sub1
    procedure Sub2 is
        begin – of Sub2
            ... X ...
        end; – of Sub2
begin – of Big
    ...
end; – of Big
```



X in Sub2 ?
Calling chain:
Big $\rightarrow$ Sub1 $\rightarrow$ Sub2
X $\Rightarrow$ X:Integer in Sub1
Calling chain:
Big $\rightarrow$ Sub2
X $\Rightarrow$ X:Real in Big

trong dynamic
=> phải chạy mới bik

Referencing Environment

- The referencing environment of a **statement** is the collection of all names that are visible to the statement
- In a static-scoped language, it is the local names plus all of the visible names in all of the enclosing scopes
- In a dynamic-scoped language, the referencing environment is the local bindings plus all visible bindings in all active subprograms

Example on Static-scoped Language

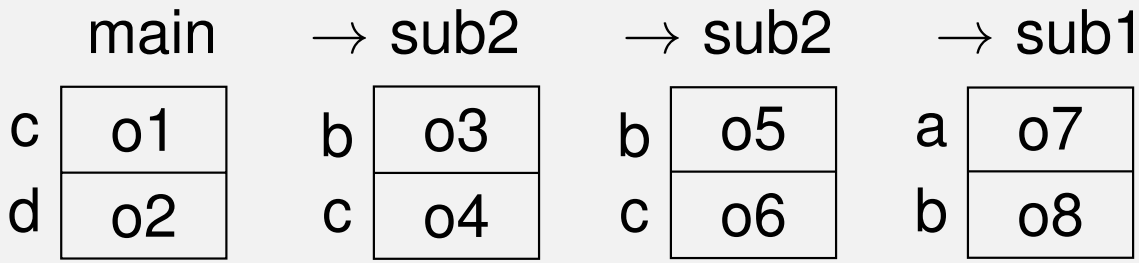
```
var A, B, C: real; //1
procedure Sub1 (A: real); //2
        var D: real;
        procedure Sub2 (C: real);
                var D: real;
                begin
                        ... C:= C+B; ...
                end;
        begin
                ... Sub2(B); ...
        end;
begin
        ... Sub1(A); ...
end.
```

Function	Referencing Environment
Main	A, B, C, Sub1
Sub1	A, B, C, D, Sub1, Sub2
Sub2	A, B, C, D, Sub1, Sub2

ngược lại với bảng scope => A,B,C,Sub1 có scope là Main

Example on Dynamic-scoped Language

```
void sub1() {
        int a, b;
        ...
} /* end of sub1 */
void sub2() {
        int b, c;
        ...
        sub1;
} /* end of sub2 */
void main() {
        int c, d;
        ...
        sub2();
} /* end of main */
```



Frame	Referencing Environment
main	c → o1, d → o2
sub2	b → o3, c → o4, d → o2
sub2	b → o5, c → o6, d → o2
sub1	a → o7, b → o8, c → o6, d → o2

Summary [1]

- Name
- Binding
- Scope
- Referencing Environment

References I


, Maurizio Gabbrielli and Simone Martini, Programming Languages: Principles and Paradigms, Chapter 4, Springer, 2010.