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Scoping

Scoping in P.L.
begin int \(i := 1, j := 2\)
begin int \(i := 3\)
end
begin int \(i := 4, k := 5\)
end
end

Scoping in O.S.

```
\begin{verbatim}
  a \hline
   i \hline
     j \hline
       b
\end{verbatim}
```

```
\begin{verbatim}
i, j, a/i, b/i, b/k
i, ..i, ..j, ..b/i, ..b/k
i, k, ..i, ..j, ..a/i
\end{verbatim}
```

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DBPL is persistent, interactive: follow O.S., not P.L.

\begin{verbatim}
begin relation i(w, x); relation j(y, z)
i, j, a.i, b.i, b.k
begin a relation i(x, y)
i, up i, up j, up b.i, up b.k
end
begin b relation i(w, z), relation k(x, y)
i, j, up i, up j, up a.i
end
end
\end{verbatim}

Note resemblance to nested relations: a database is a scope, is a tuple (but only one).

Note \textit{ navigational } syntax.

This gives homogenous \textbf{multidatabases}. 

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It can be extended to **distributed databases** using Randell’s “UNIX United” (or “the Newcastle Connection”)
e.g., as implemented in AFS

- Each file hierarchy is a tree;
- file hierarchy for many machines is a forest;
- common root unites the forests into a tree.
- (The tree could start with the I.P. address levels.)
Partitioning in Distributed Databases

Fragmentation
\[ R = R_1 \text{ ujoin } (R_2 \text{ ijoin } R_3) \]

Distribution
\[ R_1 \text{ at sites 1, 2} \]
\[ R_2 \text{ at site 1} \]
\[ R_3 \text{ at site 2} \]

Working from site 1:

\[ R_1^1, R_2^1, \text{ up } 2.R_1^2, \text{ up } 2.R_3^2 \]

Working from site 2:

\[ \text{ up } 1.R_1^1, \text{ up } 1.R_2^1, R_1^1, R_3^2, \]
Now Query It

(the programmer controls locations)

\[ [B] \text{ where } A = 2 \text{ and } C = 1 \text{ in } R \]
\[ = [B] \text{ where } A = 2 \text{ and } C = 1 \text{ in } \]
\[ (R_1 \text{ ujoin } (R_2 \text{ ijoin } R_3)) \]
\[ = ([B] \text{ where } A = 2 \text{ and } C = 1 \text{ in } R_1) \text{ ujoin } \]
\[ (([B] \text{ where } A = 2 \text{ in } R_2) \text{ ijoin } \]
\[ [B] \text{ where } C = 1 \text{ in } R_3) \]
\[ = ([B] \text{ where } A = 2 \text{ and } C = 1 \text{ in } R_1^1) \text{ ujoin } \]
\[ (([B] \text{ where } A = 2 \text{ in } R_2^1) \text{ ijoin } \]
\[ \text{up } 2.[B] \text{ where } C = 1 \text{ in } R_3^2) \]
\[ = ([B] \text{ where } A = 2 \text{ and } C = 1 \text{ in } R_2^2) \text{ ujoin } \]
\[ ((\text{up } 1.[B] \text{ where } A = 2 \text{ in } R_1^1) \text{ ijoin } \]
\[ [B] \text{ where } C = 1 \text{ in } R_3^2) \]
Semijoins for efficiency

\[ S^1 \mathbin{ijoin} T^2 = \]
\[ \mathbin{up} 1. (S^1 \mathbin{ijoin up} 2. [Y] \mathbin{in} T^2) \mathbin{ijoin} T^2 \]

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